

PROCEEDINGS
OF
International Memorial Symposium
“Protecting Lives from Earthquake and Tsunami Disasters”

国際記念シンポジウム
「命を守る地震津波防災の実現に向けて」
報告書



June 27 2012
Tokyo

Building Research Institute (BRI)

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Phone: +81-29-864-2151 Fax: +81-29-864-2989

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国際記念シンポジウム「命を守る地震津波防災の実現に向けて」

International Memorial Symposium "Protecting Lives from Earthquake and Tsunami Disasters"

2012年6月27日（水）10:00～17:00 於：政策研究大学院大学 想海楼ホール

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はじめに

スマトラ沖地震津波や東日本大震災など巨大震災が世界各地で頻発しています。独立行政法人建築研究所と政策研究大学院大学は、地震・津波防災に関する研究成果や技術を国際的に普及することを目的とした共同事業を行っており、同じ趣旨を持つユネスコ建築・住宅地震防災国際プラットフォーム(IPRED)と連携して、国際記念シンポジウム「命を守る地震津波防災の実現に向けて」を、2012年6月27日に政策研究大学院大学想海楼ホールで開催しました。

午前中に、地震学者で前京都大学総長の尾池先生、ユネスコのルーバン自然災害ユニット部長が基調講演を行い、午後に震災の最新の教訓と今後の展望についての講演と、命を守る地震防災国際協力についてIPRED参加国の代表者等を交えて議論を行いました。なお50年の歴史を持つ建築研究所の国際地震工学研修は、当初ユネスコとの共同事業であり、2007年に国土交通省の支援により日本を含む10ヶ国でIPREDが活動を始めた際、同研究所国際地震工学センターがそのCOEと位置づけられたことが、本国際記念シンポジウムに結びつきました。

シンポジウムの前日の26日にはIPRED第5回年次会合が行われ、大地震・津波が発生した際の国際的なバックアップ体制の構築などについて議論が行われました。また、シンポジウム後の28-29日には、東日本大震災による被災地を訪れ、被害状況や復旧・復興の状況を視察しました。地震や津波から命を守るための地震学と地震工学の研究を深め、それぞれの国の実情にあった防災政策を構築できるよう情報交流を進め、よりよい解決策を探る場として、今回の国際記念シンポジウムがお役に立てたなら幸いです。

本報告書は2012年6月27日の国際記念シンポジウムの内容と成果をとりまとめたものであり、地震津波防災関係者の参考になれば、幸甚に存じます。なお、プレゼンテーション・スライドは講演者のご厚意により掲載させていただき、また講演内容の要約は編集者の責任で行いました。

独立行政法人建築研究所国際地震工学センター長
安藤 尚一

Preface

Super earthquake disasters such as Sumatra off-coast earthquake and tsunami, the Great East Japan earthquake, frequently occurred all over the world. Building Research Institute (BRI) and National Graduate Institute for Policy Studies (GRIPS) are carrying out joint projects in order to internationally disseminate research outcomes and technologies. Both institutes held a memorial international symposium entitled “Protecting Lives from Earthquake and Tsunami Disasters” on June 27, 2012 at Sokairo Hall of GRIPS collaborated with UNESCO International Platform for Reducing Earthquake Disasters (IPRED) that has same purpose.

Dr. Oike, seismologist and former President of Kyoto University and Dr. Rouhban, Director of Unit for Natural Disasters of UNESCO delivered keynote lectures in the morning. A panel discussion on global cooperation for protecting lives was held with representatives of IPRED etc., following lectures on latest lessons and future prospects in the afternoon. It is remarkable that training at International Institute of Seismology and Earthquake Engineering (IISEE) of BRI initiated as a joint program with UNESCO at the beginning, fifty years ago. This memorial international symposium also commemorates the UNESCO IPRED that was established in 2007 and supported by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). IISEE is playing a role of COE of IPRED that has 10 member countries including Japan.

One day before this symposium June 26, IPRED held its 5th Annual Meeting to discuss international back-up system against large earthquakes and tsunamis and others. The member countries also visited affected areas of the Great East Japan Earthquake to observe damages, recovery and reconstruction after the symposium during June 28-29.

It is our great pleasure if this memorial international symposium can be of any help as an opportunity to proceed researches in seismology and earthquake engineering for protecting lives from earthquake and tsunami, to promote information exchange for establishing disaster management policies in each country that suit respective real conditions, and to seek better solutions.

This report summarizes contents and outcomes of the memorial international symposium on June 27, 2012 as a reference for earthquake and tsunami disaster mitigation.

Shoichi Ando, Director of IISEE/BRI

I . 国際記念シンポジウム

「命を守る地震津波防災の実現に向けて」（日本語版）

1. 国際記念シンポジウムの概要

(1) 実施概要

スマトラ沖地震津波や東日本大震災など巨大震災が世界で頻発するなか、ユネスコの建築・住宅地震防災国際プラットフォーム(IPRED)の活動を推進するため、建築研究所国際地震工学センターと政策研究大学院大学が協力し、国際シンポジウムを開催した。本シンポジウムでは、世界各国の第一人者から、地震津波防災の展望を伺い、国際協力を通じて命を守る方策を探った。

※ユネスコの協力で開始された国際地震工学研修の記念行事も兼ねた。

タイトル	国際記念シンポジウム「命を守る地震津波防災の実現に向けて」
日時	2012年6月27日(水) 午前10時から午後5時まで
場所	政策研究大学院大学 1階 想海楼ホール
参加費	無料(要申込み)
使用言語	英語および日本語(同時通訳あり)
当日参加者	約150名(講演者等含む)
主催	ユネスコ、(独)建築研究所、政策研究大学院大学
後援	国土交通省、外務省、JICA、読売新聞社



受付(想海楼ホール入口)



会場(想海楼ホール)

国際記念シンポジウム

「命を守る地震津波防災の実現に向けて」

International Memorial Symposium "Protecting Lives from Earthquake and Tsunami Disasters"

日時：2012年6月27日 [水]

午前10時から午後5時まで

会場：政策研究大学院大学

1階 想海楼ホール

(港区六本木7-22-1)

使用言語：英語および日本語（同時通訳あり）

スマトラ沖地震津波や東日本大震災など巨大震災が世界で頻発するなか、ユネスコの建築・住宅地震防災国際プラットフォーム (IPRED) の活動を推進するため、建築研究所国際地震工学センターと政策研究大学院大学が協力し、国際シンポジウムを開催します。世界各国の第一人者から、地震津波防災の展望を伺い、国際協力を通じて命を守る方策を探ります。
※ユネスコの協力で開始された国際地震工学研修の記念行事も兼ねます。

主催：ユネスコ (UNESCO)、独立行政法人建築研究所 (BRI)、政策研究大学院大学 (GRIPS)
後援：国土交通省、日本ユネスコ国内委員会、外務省、JICA、読売新聞社 (予定)



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【お申し込み先・お問い合わせ先】

政策研究大学院大学 岡崎研究室 (担当：黄) E-mail: phd09009@grips.ac.jp FAX: 03-6439-6010

<http://www.grips.ac.jp/jp/about/access.html>

国際記念シンポジウム

「命を守る地震津波防災の実現に向けて」

International Memorial Symposium "Protecting Lives from Earthquake and Tsunami Disasters"

プログラム — 2012年6月27日 [水]

10:00 開会

- 主催者挨拶
坂本 雄三 (独) 建築研究所理事長
恒川 恵市 政策研究大学院大学副学長
- 来賓挨拶
井上 俊之 国土交通省大臣官房審議官



10:20 基調講演1 「地震学の未来」

尾池 和夫 (財) 国際高等研究所所長・前京都大学総長

11:10 基調講演2 「地震津波防災におけるユネスコの役割と戦略」

バダウィ・ルーバン ユネスコ科学部門自然災害ユニット部長

=====《 12:00 - 13:15 昼 食 》=====

13:15 「命を守る—震災の教訓と今後の展望」(各 25 分)

- 「2015年以後の視点 - 災害軽減の実績と今後の課題」
サルパノ・プリセーニョ IRDR 科学委員会委員長・前国連国際防災戦略事務局長
- 「都市の新たな脅威としての長周期地震動」
額田 一起 東京大学地震研究所教授
- 「インドネシアにおける耐震建築基準の普及戦略」
アニータ・フィルマンティ インドネシア人間居住研究所 (RIHS) 所長
- 「津波避難ビルの構造設計法」
福山 洋 (独) 建築研究所構造研究グループ長
- 「地震工学分野の調査研究協力—ヨーロッパの SAFECAST プロジェクト」
ファルク・カラドアン トルコ・イスタンブール工科大学 (ITU) 教授・前学長

=====《 15:20 - 15:40 休 憩 》=====

15:40 パネルディスカッション：「命を守る地震防災国際協力」(75 分)

- モデレータ
ユネスコ バダウィ・ルーバン ユネスコ科学部門自然災害ユニット部長
- パネリスト
チリ ラウル・アルバレス チリ カトリカ大学教授
エジプト サラ・ムハンマド エジプト国立天文地球物理研究所部長
ペルー カルロス・サバラ 日本・ペルー地震防災センター (CISMID) 所長
ルーマニア ラドゥ・バカロヌ ルーマニア 国立ブカレスト工科大学 (UTCB) 副学長
日本 岡崎 健二 政策研究大学院大学教授

16:55 閉会

- 閉会挨拶
西山 功 (独) 建築研究所理事

使用言語：英語および日本語 (同時通訳あり)

主催：ユネスコ (UNESCO)、独立行政法人建築研究所 (BRI)、政策研究大学院大学 (GRIPS)

(2) 当日プログラム

内 容	時 間
(1) 開会	10:00-
1) 主催者挨拶 ①坂本 雄三 (独) 建築研究所理事長 ②恒川 恵市 政策研究大学院大学副学長	10:00-10:10
2) 来賓挨拶 井上 俊之 国土交通省大臣官房審議官	10:10-10:20
(2) 基調講演	10:20-
1) 基調講演Ⅰ「地震学の未来」 尾池 和夫 (財) 国際高等研究所所長・前京都大学総長	10:20-11:10
2) 基調講演Ⅱ「地震津波防災における役割と戦略」 バダウィ・ルーバン ユネスコ科学部門自然災害ユニット部長	11:10-12:00
昼 食	12:00-13:15
(3) 講演「命を守る—震災の教訓と今後の展望」	13:15-
1) 「2015 年以後の視点—災害軽減の実績と今後の課題」 サルバノ・ブリセーニョ IRDR 科学委員会委員長・前国連国際防災戦略事務局長	13:15-13:45
2) 「都市の新たな脅威としての長周期地震動」 瀧 一起 東京大学地震研究所教授	13:40-14:15
3) 「津波避難ビルの構造設計法」 福山 洋 (独) 建築研究所構造研究グループ長	14:15-14:45
4) 「地震工学分野の調査研究協力—ヨーロッパの SAFECAST プロジェクト」 ファルク・カラドアン トルコ・イスタンブール工科大学教授・前学長	14:45-15:15
5) Q & A 討論	15:15-15:20
休 憩	15:20-15:40
(4) パネルディスカッション：「命を守る地震防災国際協力」	15:40-
1) ユネスコ：バダウィ・ルーバン ユネスコ科学部門自然災害ユニット部長	15:40-15:45
2) チリ：ラウル・アルバレス チリ・カトリカ大学教授	15:45-15:55
3) エジプト：サラ・ムハンマド エジプト国立天文地球物理研究所部長	15:55-16:05
4) ペルー：カルロス・サバラ 日本・ペルー地震防災センター所長	16:05-16:15
5) ルーマニア：ラドゥ・バカロヌ ルーマニア・国立ブカレスト工科大学副学長	16:15-16:25
6) 日本：岡崎 健二 政策研究大学院大学教授	16:25-16:35
7) Q & A 討論	16:35-16:55
(5) 閉会	16:55-
1) 閉会挨拶 西山 功 (独) 建築研究所理事	16:55-17:00

2. 各プログラムの概要

(1) 開会

1) 主催者挨拶

① 坂本 雄三 (独) 建築研究所理事長

(独) 建築研究所は、今からちょうど 50 年前の 1962 年に国際地震工学部(現在の国際地震工学センター: IISEE) を立ち上げ、当初、ユネスコと日本の共同事業として運営されていた国際地震工学研修事業を引き継いだ。これまでに 97 か国、1,539 名の研修生がコースを修了し、現在はその大半が行政、調査研究および教育機関で中心的役割を担っている。また、2006 年からは政策研究大学院大学と連携し、修士号を授与できることになった。

2007 年からは、国土交通省の支援を受けてユネスコとの共同プログラムを再始動させ、建築・住宅地震防災国際プラットフォーム (IPRED) を構築、活動をしている。また、JICA との連携のもと、9 か国およびそれらの国の地震防災関連機関とのネットワークを築いている。そのような経緯があり、本シンポジウムは、それらの機関の代表と著名な講演者が集結しており、意見交換や専門知識のやりとりをする希少かつ貴重な機会にもなっている。

建築研究所では、本シンポジウムでの貴重な提言を踏まえ、研修事業を含めた国際貢献活動のより一層の充実を図っていくつもりである。



② 恒川 恵市 政策研究大学院大学副学長

シンポジウム開催の直接の動機は 2011 年の東日本大震災と津波であるが、同じように一瞬にして何百、何千もの命が失われる災害が近年たびたび起きている。本シンポジウムのテーマは将来の地震・津波災害から命を守るための国際協力を深める方法を探究することである。

政策研究大学院大学は災害対策に関する研究・教育に携わってきており、2005 年から (独) 建築研究所、(独) 土木研究所と JICA の協力のもと、防災政策に関する一年間の修士課程プログラムを実施している。毎年、途上国から 40 名前後の研修生が履修している。また、2011 年の大災害を受けて復興に向けた二つの政策提案を行っており、調査研究プロジェクトへの参加、およびレクチャー、セミナー、シンポジウムの開催を行っている。今年 4 月からは、日本人学生のための一年間の修士課程を開講している。



2) 来賓挨拶

① 井上 俊之 国土交通省大臣官房審議官

東日本大震災は津波被害が中心であります。過去の日本は色々な地震災害に見舞われたわけですが、代表的なものとしては、約90年前の関東大震災、18年ほど前になるかと思いますが阪神・淡路大震災、そして、今回の東日本大震災、比較すると、人的被害については非常に顕著な差が出ている。地震の揺れは同じだが、その揺れの結果、地域が見舞われた被害の差によるのだと思う。関東大震災は、今と時代が違い、ほとんどの家屋が木造で、非常に火災に弱いということで、死者・行方不明者10万6千人に及んでおりますが、9割近の方が火災で亡くなっている。これに対して阪神・淡路大震災は死者6千4百人、8割近くが家屋の倒壊による。13%くらい。東日本震災では約1万9千人の死者・行方不明者がありますが、その9割が津波被害によって亡くなっている。同じ地震といっても、それがどこの地域で起こるか、いつ起こるかにより被害の範囲も様々である。従って、地震防災も多様かたちで行われなければならない。



また、安全性は弱い方ほど守られなければならないが、実際には高齢者において多くの死者が出ており、最も弱い立場の人々を守るための対策の強化が求められている。

2011年の東日本大震災では建物倒壊による犠牲者は比較的少なく、1981年の建築基準法改正による構造基準の強化が一因だろうと思う。それ以外の部分では、教訓的な震災被害が見られた。ひとつは長周期震動の問題で、被害地域からはるかに離れた地域でも被害があった。また、津波に対する建物の耐性については対策の余地がある。

その他にも、埋立地等の液状化、エレベータ等の設備機器の変形の問題、また、非構造部材が激しい揺れに対して非常に脆弱だということで、ホールの天井が破損する等の被害が何千箇所も発生したこと、このような新たな教訓についても、しっかりとした対策が必要となる。

本シンポジウムでは、各国の皆さまから貴重な助言をいただき、今後の地震防災により一層の尽力をしていきたい。また、本シンポジウムが、各国の地震防災対策の相互理解と進展につながることを願っている。

(2) 基調講演

1) 基調講演 I 「地震学の未来」

尾池 和夫 (財)国際高等研究所 所長・前京都大学総長

東アジアには長い地震の歴史がある。最も古い地震の記録は紀元前 1831 年に遡って中国（山東省）の地震であり、以降約 3 千年の地震の記録がある。日本では 1,500 年の記録があり、800 年代に大きな活動期があったと記録されている。東アジアの地震と地震学の歴史に関する詳しい歴史をたどると、300 年から 600 年の間隔で世界のどこかで極めて大規模な地震が発生している。東アジアは今地震活動が活発化する周期に入っており、太平洋地域を取り巻く環境においては、国際協力が非常に重要になる。また、昨年の東北地方太平洋沖地震は、日本の 800 年代の活動期が再認識されることとなった。



地震の記録を残すことが定着して以来、日本には長年にわたり地震に関する記録があり、江戸時代には、現在の気象庁のデータと同様に余震の解析ができるほどの良好なデータも保存されている。近代的な地震学が始まったのは 1880 年に横浜で中規模な地震が発生した際に日本地震学会が設立されたことに始まる。また、地球内部構造の研究が始まったのも日本の地震がきっかけになってのことである。その後、1960 年代までは歴史資料の統計的分析による地震学が中心となっていたが、1960 年代中頃から断層運動による地震発生モデルが示され、1970 年頃にはプレートテクトニクスができた。その頃から私は「地震は連動する」という考えを持っていたため、東日本大震災の発生状況はよく理解できた。

地震学の未来を展望するにあたり、2011 年の東日本大震災および津波を契機に対策の必要性の高まった数々の課題が山積している。見解が分かれる極端な地震将来予測、効果的に活用できていない早期警報システム、シミュレーションに用いるスーパーコンピューターの許容量の限界、地震の予想外の連鎖反応、津波による福島原子力発電所の破壊的な影響、避難手順の効果的な教育、土地構造の変化の監視、前震群の物理的メカニズムに対するより深い理解の必要性がある。怖いものは怖い、安全なものは安全と知らせることも地震学の広報活動の役目でもある。

地球を見る（知る）絶好のフィールドとして「ジオパーク」があげられる。ジオパークは、2004 年にユネスコの支援で始まり日本でも 2008 年から指定が始まり、現在 20 か所が指定されている。今後は、公園としてのジオパークを災害学習等、様々な意味で活用していただきたい。日本の人口予測は減少傾向と予測されており、今後 100 年間で 100 年前（明治時代後半）の水準に戻ると言われている。今後は人口の変化や環境の変化を含めて色々な事を考えていく必要があるのではないかと。

2) 基調講演Ⅱ「地震津波防災における役割と戦略」

バダウィ・ルーバン ユネスコ科学部門自然災害ユニット部長

ユネスコの役割には、知識、教育、科学、文化の普及推進と、教育システムの不足、文化的発展の乏しさ、水資源の不足などに直面している政府への問題解決の支援がある。世界的に見て自然災害の増加傾向がみられる、それは危険要素が増えているからではなく、そうした災害に対するぜい弱さが拡大していることによるものである。また、先進国においてそれに関連した死者数が減少している一方で貧しい国々では多大な犠牲が出ており、よって国連はそれらの貧しい国々が対策を向上させられるよう支援すべきである。また、これらの災害は当該地方を超えた連鎖反応を引き起こすこともある。国際社会は災害における救助、復旧、復興には積極的に関わるものの、予防や備えに対する投資はほとんど行われず、悪しき「災害循環」に陥っている。脆弱さを改善する施策には、より優れたリスク評価、予防、そして緊急対応が含まれる。

ユネスコは国際的・地域の拠点および津波警報システムの立ち上げを支援している。同時に、国単位の支援も行っている。例えば2010年のハイチ地震後には、教育、沿岸部の警報システムの復旧、地震に強い建築に向けた職人の訓練など、災害復興の様々な側面においてハイチ政府と協働した。さらにユネスコは、九か国が参加する建築・住宅地震防災国際プラットフォーム（IPRED）、地中海地方を中心とした拡大地中海地域地震防災プロジェクト（RELEMR）、南アジアの南アジア地域地震防災プロジェクト（RELSAR）、国際的活動として国際斜面災害研究機構（ICL）と国際火山噴火早期警報システム、中央アメリカでの災害予防プログラム DIPECHO への参加など、数々のプログラムに参加している。

ユネスコの教育部門は学校環境における安全性向上、教材の開発、災害軽減に関する土地固有の知識の活用に携わっている。文化部門は世界遺産や世界ジオパークのうちいくつかを災害軽減活動実施のパイロットエリアとして利用している。社会科学部門は、災害における倫理・人権の問題を担当している。



(3) 講演「命を守る—震災の教訓と今後の展望」

1) 「2015 年以後の視点—災害軽減の実績と今後の課題」

サルパノ・ブリセーニョ IRDR 科学委員会委員長・前国連国際防災戦略事務局長

自然災害の増加傾向は自然現象や危険要素(ハザード)の増加に起因するのではなく、社会の脆弱性に原因がある。これまでも災害対策への備えは重視されてきた。しかし、災害の主要因となっている脆弱性に対策を講じるなどのリスク軽減に重点的に取り組むことの必要性は切迫したものとなっている。ここでいう脆弱性には建て方や立地の悪い建物、エコシステムと天然資源の枯渇、危機意識・リスク・ガバナンス機関・説明責任の欠如が含まれている。しかも大学は未だに統合的・全体的というよりは、分断したアプローチで。それぞれの分野の専門家を育成している。



これらの問題点が「災害軽減 (DRR)」というテーマへとつながり、2000 年の国連国際防災戦略 (UNISDR) が生まれた。国連国際防災戦略UNISDRとは持続可能な開発の一環として災害軽減への意識を高めることで災害に強いコミュニティの構築を目指すための理念的枠組みであり、それにより自然ハザードおよびそれに関連した技術的・環境的災害による人、社会、経済、環境の損失を減らすことを目標としている。

国連国際防災戦略UNISDRは国際防災の 10 年 (1990-1999) を継承するものとして打ち出された。2005 年には兵庫行動枠組み (HFA) が世界防災会議において国連加盟 168 国によって採択された。兵庫行動枠組みは自然ハザードに対してより安全な世界を実現するための 10 年計画である。現在、国連国際防災戦略UNISDR では 2015 年に第三回世界防災会議を開催する準備を進めており、その際に兵庫行動枠組みの後継となる体制の採択を予定している。兵庫行動枠組みではリスク・ガバナンスの仕組みの土台が築かれたが、それを発展させるにあたっての各政府の取り組みはごく初期段階にとどまっており、政策としての優先順位を高める必要がある。ガバナンスには、説明責任、透明性、並びに参加型アプローチが組み込まれる必要がある。災害軽減はまた、気候変動に適応していく過程においてのみならず、すべての部門が適応を図っていく以前の最初の一步として認識されなければならない。なお、災害軽減はミレニアム開発目標 (MDG) の次の段階における必須要件でもある。環境政策には、欠くことのできないエコシステムの一部として災害軽減を正式に認めることが求められる。更に、すべての建物の安全性に対するより強い意識が必要であり、これはより高いレベルの主導によってのみ実現する。

学問の世界は、その細分化された専門家教育によって問題の根源となっているため、防災重点研究 (IRDR) プログラムが開始され、科学界が研究や教育においてリスク理解への統合的アプローチを更に開発することが目標とされている。

2) 「都市の新たな脅威としての長周期地震動」

瀬戸 一起 東京大学地震研究所教授

近年の大規模建造物の急激な増加に伴い長周期地震動（LPGM）が大きな課題となつてきており、これは同時に免震建造物にも影響を及ぼす可能性がある。大規模な海溝型地震および中規模から大規模な地殻地震は伝播効果を通じて遠く離れた堆積盆地に遠方震源の長周期地震動を発生させることがあり、他方、断層付近の長周期地震動の大半は震源の破壊指向性によって発生する。遠方を震源とする長周期地震動には断層付近の長周期地震動に比べ長時間持続する表面波が含まれている。短周期地震動とは異なり、長周期地震動は数値シミュレーションによるみ予測できる。



日本政府の地震調査研究推進本部は、地下構造モデル検討分科会を設立した。多くの機関が国内様々な地の速度構造モデルを構築しており、地下構造モデル検討分科会ではそれらのモデルをアップデートして長周期地震動のハザードマップを作成する三か年プロジェクトを開始した。ハザードマップ作成は数値シミュレーションによって行われている。アップデートされたモデルは日本全体の速度構造モデルに組み込まれていく。速度構造モデルは震源モデル以上に長周期地震動のハザードマップの正確性を左右する。速度構造モデルを構成する三つの部分は、それぞれ「表土層」「深部堆積層」「地震基盤以深の地殻構」と呼ばれる。表土層は他の二つに比べ長周期地震動への影響が小さいため、工学的基盤より下にある残りの二層に焦点を当てる。付加体の利用が長周期地震動の速度構造モデル構築に大変重要であることがわかっている。最終的な差分アルゴリズムに向けた数値シミュレーションには速度構造モデルの地形図を平面化する必要があるが、その際は「押しつぶし（squashing）」手法（海面上の地形特性を海面下に押し付ける）が「ブルドーザー（bulldozing）」手法よりも優れていることが明らかとなった。

これまでに3広域の一時モデルが開発された。そのうち東海地震と東南海地震のモデルの試行を行い、シミュレーション結果を1944年の東南海地震で記録されたデータと比較した結果、良好な結果が示された。この結果は公表され、NHK「MEGAQUAKE」（第三回）の番組内で取り上げられた。

3) 「津波避難ビルの構造設計法」

福山 洋 (独) 建築研究所構造研究グループ長

2011年の東日本大震災と津波で、陸前高田市は15メートルの津波に襲われた。多くの木造建造物が流出したが、ほとんどのRC造建築物は構造的な損傷を受けなかった。とはいえ、深刻な損傷を受けたRC造建築物もあった。最初の事例は、津波荷重が建物の水平方向の抵抗力を上回ったことによる二階建て建物の完全な崩壊。二つ目はピロティ構造のような二階建て建築物の一階部分が、破壊されたケース。三つ目は、大きな浮力が原因で建物が転倒したケース。



このようなケースで転倒に対する抵抗力を上げるためには、杭基礎の活用が有効である。天井下の空気溜まりは浮力を増大させるため、構造設計において考慮に入れる必要がある。四つ目の事例は、余震や第二波に抵抗するために重要な耐力壁や柱が破壊されたケース。五つ目は非常に強い津波の流れにより建造物のコーナー部の洗掘が起これ建物に傾斜したケース。六つ目は滑動で、これは杭基礎の活用により防ぐことができる。七つ目は漂流物の衝突による耐力壁の破壊と漂流物の建物内侵入。

鉄骨造建築物の被害に目を転じると、露出型柱脚および柱頭接合部の破壊がわりと多く、上部構造の流出につながった。その他には、外装材がほぼ無傷にも関わらず津波荷重と浮力により転倒したものがあつた。鉄骨造建築物の多くは、外装材、内装材ともすべて失い骨組みだけが残っている。また大きな残留変形が見られた。

これら事例をもとに、(独) 建築研究所は、内閣府において2005年に定められた津波避難ビルに係る構造設計法を検証した。津波からの避難が可能な高台がない場合、とりわけ沿岸部では、迅速な避難のために津波避難ビルが人命を守る。ここでは遮蔽物の有無や、海からの距離による津波波圧とへの影響を検証した。津波避難ビルの構造設計が目指すのは、倒壊しない、転倒しない、滑動しないということである。これを満たす構造設計要件は、津波波圧から算定される各層せん断力と浮力により導き出される。(独) 建築研究所は、ここで提案した構造設計法が、津波災害から生命を守る津波避難ビルの建設を後押しすることを強く願っている。

4) 「地震工学分野の調査研究協カ―ヨーロッパの SAFECAST プロジェクト」

ファルク・カラドアン トルコ・イスタンブール工科大学教授・前学長

構造工学や研究テーマには協力と相補的研究が重要である。トルコはヨーロッパにおける三つの継続的な協調型プロジェクトに参加した。ECOLEADER と PRECAST EC8 にはプレキャストコンクリート構造の靱性を計り原位置コンクリート構造と比べる目的があった。その成果として、プレキャスト骨組および建物は原位置工法によるものと遜色ない靱性を示すことが確認された。ただし調査結果から明らかになったのは床組の変形性、特に床・デッキと垂直柱の接合部の実際の設計について、完全に把握できておらず、そのためにプレキャスト建築構造の設計に必要な数量的検討を正しく行うことが難しかった。



SAFECAST プロジェクトは今述べた二つのプロジェクトから生まれたもので、RTD 提供者とイタリア、スペイン、ポルトガル、トルコ、ギリシャの中小企業連合の共同事業体である。このプロジェクトの目的は、接合部、変形性、プレキャストと原位置要素の相互作用を中心にプレキャスト補強鉄筋入り構造の地震時の挙動に関する知識の格差を埋めることである。さらに、信頼できる数値的ツールを開発し、地震地域において接合材の特性を活かしたプレキャスト構造を設計する新たな基準を体系化することもプロジェクトの目標である。接合材、ジョイント、部分組立材について一連の単純、反復、並びに振動台による実験が行われた。大規模な仮動的実験が、一階建ておよび多層型の構造体について行われた。適切な数値的モデルを検証する前に数値的シミュレーションが行われた。

SAFECAST は 2012 年 3 月に完了し、「地震作用のもとでのプレキャスト構造の接合部の設計指針 (Design Guidelines for Connections of Precast Structures under Seismic Actions)」として発表された。まとめると、その成果が示すのは、地域の協力の重要性和、協調型プロジェクトのためには予算の増加が必要だということである。また、地元のニーズを満たすべく地方の行政体および住民が関与していかなければならない。

5 年前のユネスコでの発足時の会合で、世界中に十分な実験機関、訓練施設、そして訓練を受けた人材がおり、現地や個別の取り組みをつなぎあわせることでそれら相互の協力を強めていく時期に来ているという話があった。カラドアン氏は建築・住宅地震防災国際プラットフォーム (IPRED) が既存の協調型プロジェクトをコーディネートするような機関になっていくことはできないだろうか。

5) Q & A 討論

質問: 「津波避難ビルの構造設計法」の研究では、なぜ海岸線から 500 メートルを安全圏に設定したのか? 浸水深度や波圧の設定にあたっては、土地の地形や高さを考慮に入れる必要はなかったのか? 極めて低い土地については津波が起きた際の避難にあたってはどれくらいの建物高さを安全とみなすべきなのか?

回答: 地形については研究の範疇外であり、限られたデータに基づき、海岸線から 500 メートルを安全な距離だと判断した。決定的なデータを持っているわけではないが、これからも設計法の改善を続けていくつもりでいる。私たちが提唱するのは、浸水した階高より少なくとも二階分高い建物高さにすることと、その際に各階に床が設けられなければならないということ。



(4) パネルディスカッション：「命を守る地震防災国際協力」

パネルディスカッションのモデレーターであるユネスコ：バダウィ・ルーバン氏が、「地震の危険性と自然ハザードは地理的・政治的・地政学的境界とは関係なく存在する」と述べた後、各国パネリストの発表およびQ&A討論が行われた。

1) ユネスコ：バダウィ・ルーバン ユネスコ科学部門自然災害ユニット部長

過去 50 年間にわたる地震学と地震軽減は国際協力のもとで進展し、今後もこの協力なしに発展することは不可能である。国際協力は別々の国に所在する機関や団体の各々の活動のおかげで成り立っている。よって本パネルディスカッションは国際協力における個々の経験から得られた教訓、またそうした協力関係を将来的に強化していく方法に光を当てたい。



2) チリ：ラウル・アルバレス チリ・カトリカ大学教授

2010年にチリで起きたマグニチュード8.8の地震は、災害に対する備えや事後対処に関する多くの問題点を明らかにするものだった。政府部門間の協力は欠如、筆頭責任機関は災害の状況に圧倒され、管理職層は不十分な技術的能力と権限と予算しか持ち合わせていなかった。危機対応と管理の欠如、知識の首都への集中、政府機関の建物には破壊されてしまったものもあり、調整の基地が失われた。略奪や破壊行為に対する政治権力の対応が遅れた。国民が危機管理計画について教育されていなかった。建物が危険な場所に、不適切な建築資材や地震のない国から入った構造方法で建てられていた。早期津波警報がなかった。移動式コミュニケーションの甚だしい断絶。まともな、きちんと維持管理されたモニタリング設備が欠如し、モニタリングデータは科学界が使える形になっていなかった。地震後の建物を独自に評価する手法がなく、データ解析が複雑になった。被害を査定するボランティアも不足していた。



こうした問題を解決するには改善措置が必要である。チリ内務省緊急事態局 (ONEMI) を根本から組み立て直し、十分な予算措置と政治権力に対抗する権限を与え、職員に技術的な訓練を積み、強力な研究分野を開発する必要がある。国内全体に早期警報網を築き、一般人にも国内外の科学界にもデータを提供しなくてはならない。通信網はその継続稼働を守るために、強化しなければならない。国レベルで集まったボランティアのネットワークを調整し、構造の簡易検査を必ず実施しなくてはならない。十分な予算が与えられなければならない。学校のカリキュラムには自然災害についての教育が盛り込まれ、一般市民を対象に危機管理教育が行われなければならない。

最後に、日本とユネスコに向けて、うまくいっている国の制度、運用、モニタリングの経験を共有すること、リスク管理、手法、緊急時の人の行動などについての技術者や専門家の人材交流を図ること、危険のある地域に必要なだけのまとまった人材を集めて知識を国全体に広めていくことを提案したい。

3) エジプト：サラ・ムハンマド エジプト国立天文地球物理研究所部長

国立天文地球物理研究所 (NRIAG) の地震情報センター (EIC) は継続的にエジプト内外の地震の兆候を監視・分析しており、支援の要請があればただちに行動に移ることができる。また、意識向上活動、教育、地域の人材への訓練を通じ、災害を減らすことを目指している。

緊急時においては、支援の要請や提供に関するコミュニケーション・ハブとなることができ、近隣諸国に対する支援を行うことができる。また、支援の要請と提供をマッチングさせ、支援ギャップの把握、解決法の模索、可能であれば共通資源の蓄積の促進を行い、エジプトからの支援を調整することができる。このメカニズムは大規模地震を受けて迅速な国際支援を求めるとの参加国でも活用することができる。

現状ではほとんどの資源が災害後の活動に配分されており、これは災害前に備える場合に比べ、少ない命しか救えない。



4) ペルー：カルロス・サバラ 日本・ペルー地震防災センター所長

ペルーにおける現地調査を実施する際の問題点は、災害後の緊急用資金の活用が難しいことである。官僚政治により資金の拠出が遅れるうえに上限が 2000US\$ に制限され、それでは二日しかもたない。

ペルーでの災害対策にはその他にも障害がある。すなわち、行政が災害リスクに敏感でない、ハザード、マイクロゾーニング、リスク分析が行われている都市もあるが都市の行政当局が都市計画にこれらのデータを使わない、国立監視・防止・減災センター (National Center for Assessment, Prevention and Disaster Risk Reduction) が災害対策を地方自治体に伝達・教授することに積極的でない。

災害対策を実施するにあたっての今後の課題は、市民の間に災害対策の文化を行き渡らせること、防災と救援に関わる官民の間の合意形成をすること、国家・地域・地方それぞれのレベルで危険についての情報が自動的に伝達されるシステムの開発、国家防災システム (SINAGERD) を中央集権的でなく地域・地方政府に権限を与える形で強化する。国家計画を作成する際、災害対策に対する包括的アプローチには住民の参加が必要である。減災計画は各政府機関または省庁ごとに作成されな



なければならない。持続可能な開発のためには行政当局及び決定権のある職員の能力向上が求められる。意志決定者と行政当局の無関心の解消が最も優先されるべき課題であり、彼らの能力を高めることが必要である。

日本とユネスコが地震対策に関して今後国際協力できるものとしては、傷つきやすい歴史的建造物や学校の保護を支援することが挙げられる。ペルーは SATREPS プログラムのもと日本と協力型プロジェクトを行っており、そのなかにはいくつかの研究課題、たとえば強震動と地震工学、津波、被害の査定、建物、減災計画がある。

5) ルーマニア：ラドゥ・バカロヌ ルーマニア・国立ブカレスト工科大学副学長

ルーマニアでは地震リスクがブランチャ震源から直接及ぶものであるということが大変良く知られている。100年に2~3度発生する中規模地震で、特にブカレストの建物ストックに影響が大きい。最も破壊的な地震は1977年に発生したもので、1,600人以上が死亡したのだが、うち1,500人はブカレストでの死者だった。ブカレストには未だに全く耐震設計を施さない多層型ビルが沢山ある。ルーマニアの国家的減災プログラムでは、地震リスク I の建物を補強すること、建物耐震基準の改善、並びに地震観測の改善が目標とされている。



国際協力の側面からは、ルーマニアでは複数のプロジェクトが実行されている。最も重要だったのは国内の建物や構造物の地震リスクを減らす JICA のプロジェクトだった。このプロジェクトを通じ、ルーマニアは多くの構造・土壌実験施設を受け取り、新たな地震ネットワークが取り入れられた。ところが、2010年に突然、ルーマニア政府は地震防災センター（NCSRR）の解体を決定。施設は BRI に移動させられ、スタッフは大学に残ることとなった。これは大いなる後退だった。その他の国際協調プロジェクトは、ドイツ、EU、歴史建物の地震からの保護（PROHITECH）そして世界銀行との間で行われている。

地震対策の障害となっているのは、政府支援の弱さ、国民の意識の低さ、社会的問題による居住用建物の改修の困難さ、国際資金の改修プログラムが公共建物に重点化されていることなどである。

6) 日本：岡崎 健二 政策研究大学院大学教授

国際社会がより多く減災への関与を表明しているにもかかわらず、災害の数は増加している。災害による被害を減らすための技術や知識の取り入れ方に問題があった。同時に、人命を失うことへの無関心もあった。人命の経済的価値については災害の経済コストを計算する際に考慮されていない。住民の命を守ることが政府の最優先課題であるべきなのに、そのために最大限の努力をしているようには見えない。

国際的な取り組みの傾向は未だに応答型に集中しており、それによって災害によって失われた命を回復することはできない。もし彼らが生き延びたなら、復興はもっと簡単に、もっと費用をかけずに行えることだろう。

更に、資金提供国も、これ以上長く応答型の資金提供をすることには耐えられないと考えている。よって生命を守るためには災害が起こる前により多くの資源が費やされなければならない。

2011年の東日本大震災と津波による最も大きな教訓は、何千人もの人が、もし迅速に避難していたら死なずに済んだかもしれないということである。被害を受けた地域の人々は大きな地震の後に津波が襲うことも知っていたし避難の方法も知っていた、しかも津波が迫っているという正しい早期警報も届いていた、それでも多くの人々がすぐには避難しなかった。

1995年の阪神淡路大震災での最大の教訓は、何千という人が、ぜい弱な自分たちの家を改修していれば命を失わずに済んだかもしれないということである。日本には厳しい建築基準があり、改修のための技術もあれば資金援助も受けられる。にもかかわらず、人々には改修しない様々な理由がある。根本的な理由としては、人間がリスクテイカー（リスクを選ぶ）だということである。だから彼らは改修にお金をかけず、近い将来には大地震は来ないだろうというほうに賭ける。

災害に合う前に人々の行動を促す施策には、教育、訓練、意識向上、地域単位の災害管理、安全なコミュニティのための政策策定と制度化が挙げられる。

災害による人命の損失を減らすための国際協力として、災害を見越して行動するための国際的取組、減災のための適切な政策を立てられて地域の人々とリスクコミュニケーションできるスキルを持った専門家をもっと育成すること、コミュニティ主体の災害管理を促す資金・技術的支援、住民や地方自治体が災害への対策を取るような動機づけについて更に研究すること、そして災害リスク管理に向けた分野横断的な学際的アプローチなどを提案する。



7) Q & A 討論

ファルク・カラドアン氏： 岡崎氏に質問です。今回のようなシンポジウムの成果を政府に確実に伝達するためにはどうしたらよいか？

ポール・グランディ氏（オーストラリア）： 特に岡崎氏の発言に感銘を受けた。来たる災害から身を守るために、耐性を高めるために資金を使うのではなく、災害後に莫大な資金投入をしなくてはならないという枷から抜け出すことの難しさが提示されていたからです。我々は災害軽減について、トータルで分野横断的なアプローチができる学術機関を持っていないように思います。そこが欠如していることと近年多くの地で持続可能性を掲げる機関が急速に立ち上がっていることの間には平行関係があります。自然災害は非持続的であり、一方で持続可能性の問題として議

論されていることは、明確な分野横断的アプローチを必要とする災害という側面に対して何一つ貢献していません。

岡崎氏：日本は、国および地方自治体がリスクと課題解決の方法について関心が高いです。しかし途上国の多くではこのようなわけにはいかないかもしれません。そのため私は、災害軽減に取り組んだ地方自治体はより多くの補助金を受け取り、国からアドバイスや活動を受けてはどうかと提案したのです。同時に、地方の住民が災害軽減の重要性に高い意識を持っていれば、地方の政治家が地元住民の興味関心に沿って行動するはずですよ。

ルーバン氏：たびたび取り上げられた視点としては、国内において異なる分野同士の協力を増やす必要があるということと、科学者、専門家、政策立案者の間により多くの対話が必要だということです。それと同時に大衆の意識向上という課題も挙げられていましたし、災害の予想と予防が最終的に成果を上げられるよう促す方法を探る必要があるということです。ユネスコには多くの提案が寄せられましたので、そうした提案に耳を傾け、今後活かしていくため最大限の努力をしていくのがユネスコの使命です。

バカロヌ氏：カラドアン氏への回答として、一例をあげたいと思います。1977年に開始されたアメリカ国家地震災害軽減プログラム（US National Earthquake Hazard Reduction Program）は1960年代にフランク・プレス教授が起案したものです。新しい大統領がホワイトハウスに入る際、フランク・プレスは新大統領の科学顧問でした。その一か月後、このプログラムは進行していました。というわけでたまにはこういういいことが起こるということです。

ムハンマド氏：カラドアン氏への回答として、我が国の場合は外務省に海外と地元のパートナーの協力を促してもらう必要があります。時には異なる国と協力してプロジェクトを進めるうえでの問題が生じることもあります。エジプトでは、新しい体制のなかでこの問題にうまく取り組んでいけることを期待しています。

サバラ氏：持続可能性についてのコメントがありましたが、ペルーでは昨年法律が変わり、すべての都市開発計画に災害軽減の要素が含まれなければならなくなりました。そのため現在、地方の政治家たちは、災害管理プロジェクトを立ち上げることが法律上求められています。この法律に従うよう政治家に圧力がかかることもあるのです。

（5）閉会

1）閉会挨拶

西山 功 （独）建築研究所理事

災害管理は世界・国・地方・コミュニティレベルで継続的に取り組むべき課題であり、本シンポジウムはそういった必要性について改めて思い起こさせてくれた。取り組むべき課題は山ほどあり、研究活動を活発化させなければならない。海外へ帰国されるゲストのみなさんは自国の環境に対して今回の成果や教訓を活かされることと思う。



II . International Memorial Symposium

“Protecting Lives from Earthquake and Tsunami Disasters”

1. Outline - International Memorial Symposium

(1) Outline

Objective : Since devastated super disasters frequently occurred such as the 2004 Indian Ocean Tsunami and the Great East Japan Earthquake, in order to promote activity of the International Platform for Reducing Earthquake Disasters (IPRED) by UNESCO, International Institute of Seismology and Earthquake Engineering (IISEE) of BRI and GRIPS co-host an international symposium. Top class experts from all over the world provide message for future to protect lives through global cooperation. (It will be also held as a memorial event of IISEE initiated by UNESCO.)

Title	International Memorial Symposium “Protecting Lives from Earthquake and Tsunami Disasters”
Date and Time	Wed, June 27, 2012, 10:00-17:00
Venue	Sokairo Hall of National Graduate Institute for Policy Studies (GRIPS)
Fee	Admission Free (Pre-registration required)
language	Japanese - English (Simultaneous translation service)
attendance	About 150 people
Organizer	UNESCO , Building Research Institute (BRI), GRIPS
Supporter	Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Ministry of Foreign Affairs (MOFA), JICA, The Yomiuri Shimbun



International Memorial Symposium “Protecting Lives from Earthquake and Tsunami Disasters”

Date and Time : Wed, **June 27, 2012, 10:00-17:00**

Venue : Sokairo Hall of National Graduate Institute for Policy Studies (GRIPS)
[7-22-1 Roppongi, Minato-ku, Tokyo]

Simultaneous translation service (Japanese/English)

Objective : Since devastated super disasters frequently occurred such as the 2004 Indian Ocean Tsunami and the Great East Japan Earthquake, in order to promote activity of the International Platform for Reducing Earthquake Disasters (IPRED) by UNESCO, International Institute of Seismology and Earthquake Engineering (IISEE) of BRI and GRIPS co-host an international symposium. Top class experts from all over the world provide message for future to protect lives through global cooperation. (It will be also held as a memorial event of IISEE initiated by UNESCO.)

Organized by :
UNESCO , Building Research Institute (BRI), GRIPS
Supported by :
Ministry of Land, Infrastructure, Transport and Tourism (MLIT),
Japanese National Commission for UNESCO,
Ministry of Foreign Affairs (MOFA), JICA, The Yomiuri Shimbun

Organizers :

- UNESCO
- International Institute of Seismology and Earthquake Engineering (IISEE) of BRI
- GRIPS

IPRED member country :

- Japan
- Romania
- Peru
- Turkey
- Chile
- Kazakhstan
- Egypt
- El Salvador
- Indonesia
- Mexico



- From exit no. 7 at Roppongi station on the Toei Oedo Line: 5 minutes walk
- From exit no. 4A at Roppongi station on the Tokyo Metro Hibiya Line: 10 minutes walk
- From exit no. 5 at Nogizaka station on the Tokyo Metro Chiyoda Line: 6 minutes walk

-- How to register

Please send your "Name", "Contact information", and "Affiliation" by E-mail or Fax.

- Without registration, you may not be able to participate in the symposium when seats are full.

Admission Free
(Pre-registration required)

-- Registration/ Inquiry

Attn: to Mr. Huang, Okazaki-lab, GRIPS

E-mail: phd09009@grips.ac.jp

<http://www.grips.ac.jp/en/about/access.html>

Fax: +81-3-6439-6010

International Memorial Symposium “Protecting Lives from Earthquake and Tsunami Disasters”

Program ----- Wed, June 27, 2012

10:00 >>> Opening Ceremony

-- Opening and Welcome Remarks

Yuzo Sakamoto, Chief Executive, BRI

Keiichi Tsunekawa, Vice President, GRIPS

-- Guest Speech

Toshiyuki Inoue, Deputy Director-General, Housing Bureau, MLIT

Keynote Lecture 1



Kazuo Oike

Keynote Lecture 2



Badaoui Rouhban

10:20 >>> Keynote Lecture 1 “Future of Seismology”

Kazuo Oike, Director, International Institute for Advanced Studies/ Former President of Kyoto University

11:10 >>> Keynote Lecture 2 “UNESCO’s roles and strategies for reducing earthquake and tsunami disasters”

Badaoui Rouhban, Director, Unit for Natural Disasters, Natural Sciences Sector, UNESCO

===== [12:00 - 13:15 Lunch] =====

13:15 >>> Lectures “Protecting Lives: Lessons learned and Future prospects” [25 min. each]

--“Views for the post-2015: achievements and challenges in the field of disaster risk reduction”

Sálvano Briceño, Chair, Science Committee, Integrated Research on Disaster Risk/ Former Director of UN International Strategy for Disaster Reduction

--“Long-Period Ground Motion as a New Urban Threat”

Kazuki Koketsu, Professor, Earthquake Research Institute, University of Tokyo

-- “Dissemination strategy of the standard on earthquake engineering design to support a better earthquake disaster mitigation in Indonesia”

Anita Firmanti, Director of Research Institute for Human Settlement (RIHS), Indonesia

--“Structural Design Requirement on the Tsunami Evacuation Buildings”

Hiroshi Fukuyama, Director, Department of Structural Engineering, BRI

--“The importance of collaboration for complementary research in the field of earthquake engineering-An example SAFECAST project in Europe”

Faruk Karadoğan, Professor & Former Rector, Istanbul Technical University (ITU), Turkey

===== [15:20 - 15:40 Break] =====

15:40 >>> Panel Discussion “International Cooperation on Earthquake Disaster Management to Protect Lives” [75 min.]

--Moderator:

[UNESCO] Badaoui Rouhban, Director, Unit for Natural Disasters, Natural Sciences Sector, UNESCO

--Panelists:

[Chile] Raul Alvarez, Professor, Universidad Catolica de Chile

[Egypt] Salah Mahmoud, Head, Department of Geodynamics, National Research Institute of Astronomy and Geophysics (NRIAG)

[Peru] Carlos Zavala, Director, Japan-Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID)

[Romania] Radu Vacareanu, Vice-Rector, Technical University of Civil Engineering of Bucharest (UTCB)

[Japan] Kenji Okazaki, Professor of GRIPS

16:55 >>> Closing Remarks

--Closing Remarks

Isao Nishiyama, Deputy Chief Executive, BRI

Simultaneous translation service (Japanese / English)

Organized by : UNESCO, International Institute of Seismology and Earthquake Engineering (IISEE) of BRI, GRIPS

(2) Program

Contents	Time
(1) Opening Ceremony	10:00-
1) Opening and Welcome Remarks Yuzo Sakamoto, Chief Executive, BRI Keiichi Tsunekawa, Vice President, GRIPS	10:00- 10:10
2) Guest Speech Toshiyuki Inoue, Deputy Director-General of the Housing Bureau of MLIT	10:10- 10:20
(2) Keynote Lecture	10:20-
1) Keynote Lecture 1 "Future of Seismology" Kazuo Oike, Director of the International Institute for Advanced Studies (IIAS) and Former President of Kyoto University	10:20- 11:10
2) Keynote Lecture 2 "UNESCO's Roles and Strategies for Reducing Earthquake and Tsunami Disasters" Badaoui Rouhban, Director of the Unit for Natural Disasters, Natural Sciences Sector at UNESCO	11:10- 12:00
Lunch 12:00-13:15	
(3) Lectures "Protecting Lives: Lessons learned and Future prospects"	13:15-
1) "Views for Post-2015: Achievements and Challenges in the Field of Disaster Risk Reduction" Sálvano Briceño, Chair of the Science Committee, Integrated Research on Disaster Risk and Former Director of UN International Strategy for Disaster Reduction	13:15- 13:45
2) "Long-Period Ground Motion as a New Urban Threat" Kazuki Koketsu, Professor at the Earthquake Research Institute of the University of Tokyo	13:40- 14:15
3) "Structural Design Requirement on the Tsunami Evacuation Buildings" Hiroshi Fukuyama, Director of the Department of Structural Engineering at BRI	14:15- 14:45
4) "The Importance of Collaboration for Complementary Research in the Field of Earthquake Engineering—An Example SAFECAST Project in Europe" Faruk Karadoğan, Professor and former Rector of Istanbul Technical University (ITU)	14:45- 15:15
5) Question and Answer Session	15:15- 15:20
Break 15:20-15:40	
(4) Panel Discussion "International Cooperation on Earthquake Disaster Management to Protect Lives"	15:40-
1) UNESCO Badaoui Rouhban, Director of the Unit for Natural Disasters, Natural Sciences Sector at UNESCO	15:40- 15:45
2) Chile Raul Alvarez, Professor at the Universidad Catolica de Chile	15:45- 15:55
3) Egypt Salah Mahmoud, Head of the Department of Geodynamics at the National Research Institute of Astronomy and Geophysics (NRIAG)	15:55- 16:05
4) Peru Carlos Zavala, Director of the Japan-Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID)	16:05- 16:15
5) Romania Radu Vacareanu, Vice-Rector of the Technical University of Civil Engineering of Bucharest (UTCB)	16:15- 16:25
6) Japan Kenji Okazaki, Professor at GRIPS	16:25- 16:35
7) Question and Answer Session	16:35- 16:55
(5) Closing ceremony	16:55-
1) Closing Remarks Isao Nishiyama, Deputy Chief Executive of BRI	16:55- 17:00

2. Summary - Protecting Lives from Earthquake and Tsunami Disasters

(1) Opening Ceremony

1) Opening and Welcome Remarks

Mr. Yuzo Sakamoto, Chief Executive of the Building Research Institute (BRI)

welcomed the symposium participants. He noted that in 1962 BRI set up the Department of International Earthquake Engineering Studies, and took over the International Training Program for Earthquake Engineering, jointly organized by UNESCO and Japan. To date, 1,539 trainees from 97 countries have completed the course, and most now have pivotal roles in government,

research and educational institutions. Additionally, since 2006 the master degree has been conferred to those trainees who have successfully completed the course, in collaboration with the National Graduate Institute for Policy Studies (GRIPS).

From 2007, with support from the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), BRI restarted a collaborative partnership with UNESCO, and launched the International Platform for Reducing Earthquake Disasters (IPRED). Going forward, BRI in collaboration with the Japan International Cooperation Agency (JICA) have established a network of nine countries and their organizations engaged in earthquake disaster management. Representatives from all of these organizations as well as famous lecturers have gathered for this symposium, offering a rare and precious opportunity to exchange views and expertise.



Mr. Keiichi Tsunekawa, Vice President of GRIPS

thanked the participants for attending the symposium. He remarked that while the immediate motive for the symposium was the Great East Japan Earthquake and Tsunami of 2011, there have been a series of such disasters in recent years, in which tens or hundreds of thousands of lives were lost in an instant. The theme of the symposium is investigating how to deepen international cooperation to protect lives from earthquake and tsunami disasters in the future.



GRIPS has been engaged in research and education on disaster management, offering a one-year masters program on disaster management policy in 2005, in cooperation with BRI, the Public Works Research Institute (PWRI) and JICA. Each year the program is offered to

around 40 students from developing countries. GRIPS also published two policy proposals for reconstruction after the 2011 disaster, and is engaged in research projects and organizing lectures, seminars and symposiums. This April, GRIPS has started a one-year masters program for Japanese students.

2) Guest Speech

Mr. Toshiyuki Inoue, Deputy Director-General of the Housing Bureau of MLIT

expressed his gratitude to the participants and organizers of the symposium. He noted that Japan has experienced a number of devastating earthquakes, with differing primary causes of loss of life, through fire, collapsing buildings, and tsunami. The extent of damage also differs depending on factors such as the time of day that the earthquake takes place. There



should therefore be diverse countermeasures for dealing with earthquakes. Additionally, a disproportionate number of elderly people lost their lives in these earthquakes, showing that better measures must be taken to protect the most vulnerable.

In the Japan earthquake of 2011 there were a relatively low number of casualties from building collapse, due to improvements in structural standards introduced in 1981. However there are lessons to be learned including damage to buildings due to the long period of ground shaking, and how resistant buildings are to tsunami. Countermeasures must also be put in place against the liquefaction of reclaimed land and the destruction of elevators and escalators and non-structural building materials.

(2) Keynote Lecture

1) Keynote Lecture 1 "Future of Seismology"

Mr. Kazuo Oike, Director of the International Institute for Advanced Studies (IIAS) and Former President of Kyoto University began his keynote by noting that East Asia has a long history of earthquakes, with the oldest recorded earthquake dating back to 1831 BC in the Shandong province of China. Mr. Oike went on to detail the history of earthquakes and seismology in East Asia, based on which he suggested that every 300 to 600 years a very large earthquake



occurs somewhere in the world. East Asia is now in an era of high seismological activity. Given that, international cooperation is very important in and around the Pacific region.

In Japan, good records and analysis of earthquakes have been kept for many years. It has been predicted that western Japan enters an active period every 100 years, alternating with quiet periods. Modern seismology in Japan dates back to 1880, when the Seismological Society was founded and the Japanese government hired foreign scholars to investigate an earthquake in Yokohama.

Looking at the future of seismology, Mr. Oike highlighted a number of issues to be tackled following the Great East Japan Earthquake and Tsunami of 2011, including: controversial extreme predictions being made for future earthquakes; ineffective use of the early warning system; limited supercomputing capacity for simulation; the unexpected chain-reaction of multiple earthquakes; the destructive impact of the tsunami on the Fukushima nuclear power plants; effective education of evacuation procedures; monitoring changes to land structure; and the need for greater understanding of the physical mechanism of precursor earthquakes.

2) Keynote Lecture 2 "UNESCO's Roles and Strategies for Reducing Earthquake and Tsunami Disasters"

Mr. Badaoui Rouhban, Director of the Unit for Natural Disasters, Natural Sciences Sector at UNESCO

began by explaining that UNESCO has the role of promoting knowledge, education, science and culture, as well as assisting governments in finding solutions to the problems they face including lack of education systems, poor cultural development and lack of water resources. Globally there is a trend of increase in natural disasters, not because the



hazards are increasing but because the vulnerability to those disasters is increasing. And while there is a decrease in related deaths in developed countries, poor countries are paying the highest toll, and so the United Nations should help these poorer countries to be better prepared. Such disasters can also have knock-on effects beyond the local region. While the international community actively responds to disasters in providing relief, rehabilitation and reconstruction, there is little investment in mitigation and preparedness, leading to a vicious "disaster cycle." Measures to reduce vulnerability include better risk assessment, prevention, preparedness and emergency response.

UNESCO assists with the establishment of international and regional centers as well as tsunami warning systems. UNESCO also assists at the national level, such as working with the Haitian government following the 2010 Haiti Earthquake in various aspects of disaster recovery, including education, rehabilitation of the coastal warning system, and training of masons for earthquake-resistant construction. UNESCO also works through a number of programs including: IPRED with nine member countries; RELEMR in the extended Mediterranean region; RELSAR in the South Asia Region; ICL and IMEWS internationally; and DIPECHO in Central America.

UNESCO's education sector is involved in the promotion of school safety, the development of educational materials and the use of indigenous knowledge for disaster reduction. UNESCO's culture sector uses some UNESCO World Heritage Sites and Geoparks as pilot areas for implementing activities for disaster reduction. Finally, ethics and human rights aspects of disasters are handled by UNESCO's social science sector.

(3) Lectures "Protecting Lives: Lessons learned and Future prospects"

1) Views for Post-2015: Achievements and Challenges in the Field of Disaster Risk Reduction

Mr. Sálvano Briceño, Chair of the Science Committee, Integrated Research on Disaster Risk and Former Director of UN International Strategy for Disaster Reduction

reiterated that the trend of increasing natural disasters is not due to the increase in natural phenomena and hazards but due to the increase in vulnerability of society. Traditionally, societies have been focused on preparing for response to disaster. However, there is an urgent need to focus on risk



reduction, i.e. addressing the vulnerabilities that are the main causes of disaster. These vulnerabilities include poorly constructed and located buildings, ecosystem and natural resource depletion, lack of risk awareness and risk governance institutions and accountability. Then, universities are still training professionals of different disciplines in a fragmented manner rather than with integrated and holistic approaches.

These problems led to the creation of the topic of “disaster risk reduction” (DRR) and the launch in 2000 of the United Nations International Strategy for Disaster Reduction (ISDR). ISDR is a conceptual framework aimed at building disaster-resilient communities by increasing awareness of disaster reduction’s importance as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters.

ISDR was launched as a successor to the International Decade on Natural Disaster Reduction (IDNDR) from 1990 to 1999. In 2005 the Hyogo Framework for Action (HFA) was adopted by 168 Member States of the United Nations at the World Disaster Reduction Conference. The HFA is a 10-year plan to make the world safer from natural hazards. ISDR is now preparing for the third World Disaster Reduction Conference in 2015 where a post-Hyogo regime will be adopted. The HFA set up the basis for risk-governance mechanisms; however, governments are still in the early stages of developing them and there is a need to strengthen them as a policy priority. That governance needs to include accountability, transparency and participatory approaches. DRR also needs to be recognized not only in the climate change adaptation process but also as the first step before adaptation can take place in all other sectors. DRR is also an essential requirement in the next phase of the Millennium Development Goals (MDG). Environmental policies need to include formal recognition of DRR as an essential ecosystem service. There is also a need for greater awareness of the importance of safety in all buildings, which can only be achieved through greater high-level leadership.

Because the academic world is at the origin of the problem through the fragmentation of education of professional disciplines, the Integrated Research on Disaster Risk program was launched aiming to have the scientific community develop more integrated approaches to

understanding risk in research and in education.

2) Long-Period Ground Motion as a New Urban Threat

Mr. Kazuki Koketsu, Professor at the Earthquake Research Institute of the University of Tokyo explained that long-period ground motion (LPGM) has become an important issue due to the recent rapid increase in number of large-scale structures, and it can also affect base-isolated buildings. Large subduction-zone earthquakes and moderate to large crustal earthquakes can generate far-source LPGM in distant sedimentary basins through path effects,



while near-fault LPGM is mostly generated through the source effects of rupture directivity. Far-source LPGM consists primarily of surface waves with a longer duration than that of near-fault LPGM. Unlike short-period ground motion, LPGM can only be predicted through numerical simulation.

The Japanese government's Headquarters for Earthquake Research Promotion (HERP) set up the Section for Subsurface Velocity Structures (SSVS). Numerous institutions constructed velocity structure models across Japan, and SVSS has begun a three-year project to update those models for LPGM hazard maps. These maps are being created through numerical simulation. The updated models will be combined into a Japan integrated velocity structure model. Velocity structure models control the accuracy of LPGM hazard maps more than source models. A velocity structure consists of three parts, called the "surface soil layers," the "deep sedimentary layers" and "crustal structure deeper than the seismic basement." Surface soil layers do not affect LPGM as much as the other two parts, so the focus is on the two parts that are lower than the engineering bedrock. The use of accretionary wedges has been shown to be very important in developing a velocity structure model for LPGM. For the final difference algorithm, numerical simulation requires the velocity structure topography to be flattened, and the "squashing" method—pushing topographical features from above sea level to below sea level—has been shown to be superior to "bulldozing" or removing those features. To date, three wide-area 1st grade models have been developed. The performance of the model for Tokai and Tonankai earthquakes was tested by comparing simulations against data recorded for the 1944 Tonankai earthquake, and showed a good agreement. The results have been published and have been incorporated into the third edition of a television program *MegaQuake* by NHK.

3) Structural Design Requirement on the Tsunami Evacuation Buildings

Mr. Hiroshi Fukuyama, Director of the Department of Structural Engineering at BRI

explained that his lecture would first cover the categorization of damage to buildings caused by tsunami, and would then consider structural design requirements for tsunami evacuation buildings. In the Great East Japan Earthquake and Tsunami of 2011, the city of Rikuzentakata was hit by tsunami waves 15 meters high. Most of the wooden structures were washed away,



while most reinforced concrete (RC) buildings remained structurally intact. That said, several RC buildings suffered severe damage. The first example is the total collapse of a two-story structure when the tsunami load exceeded the horizontal resistance capacity of the building. Second, the first story of a two-story structure collapsed when tsunami pressure on the second story propagated to the first story. Third, a building overturned due to a high buoyancy and insufficient building weight. In cases such as this, pile foundations can be used to increase resistance to overturning; however, even some buildings with pile foundations overturned. Accumulated air pockets under floor slabs increase buoyancy, which should be considered in structural design. The fourth example is the deformation of walls through failure of shear walls and columns to resist aftershocks and secondary tsunami. Fifth is tilting due to scouring at the corner of a building by strong whirling streams of the tsunami. Sixth is sliding, which can be avoided by utilizing pile foundations. Seventh is impact by debris causing shear wall failures and debris entering buildings.

Turning to damage to steel buildings, failure of exposed column bases and column top connections was quite frequent, resulting in upper structures being washed away. In other cases, although the exterior finishing survived almost intact, tsunami load and buoyancy caused overturning. Most steel buildings entirely lost the exterior and interior finishing, with only the skeleton remaining. However there was a large residual deflection.

Based on these examples, BRI's Department of Structural Engineering reviewed 2005 structural design requirements for tsunami evacuation buildings. Where no high ground is available for tsunami evacuation, tsunami evacuation buildings should be constructed on the highest ground for quick evacuation, particularly in coastal areas. The study reviewed the influence on resistance of building height, defense, and distance from the sea. The targets for the structural design of tsunami evacuation buildings are to not collapse, overturn or slide. Structural design to meet those targets is based on calculations incorporating tsunami pressure and load, story shear force and buoyancy. BRI strongly hopes that the proposed structural design method will accelerate the construction of tsunami evacuation buildings for protecting lives from tsunami disasters.

4) The Importance of Collaboration for Complementary Research in the Field of Earthquake Engineering—An Example SAFECAST Project in Europe

Mr. Faruk Karadoğan, Professor and former Rector of Istanbul Technical University (ITU) told participants that he would provide some background information in order to then be able to pose a question.

Collaboration and complimentary research is important in structural engineering and research topics. Turkey has engaged in three successive collaborative projects in Europe. The first two, ECOLEADER and PRECAST



EC8 aimed to quantify the ductility capacity of precast concrete structures compared to cast-in-situ concrete structures. The outcome confirmed that precast frames and buildings can exhibit ductile behavior comparable to cast-in-situ structures. However, it was clear from the findings that the deformability of the floor system, and in particular the actual design of the connections between the floor/deck system and the vertical columns, was not fully understood and therefore difficult to model correctly for the numerical studies used in design of precast buildings structures.

The SAFECAST project emerged from these two projects, as a consortium of RTD providers and SME associations from Italy, Spain, Portugal, Turkey and Greece. The project aimed to fill the gap in knowledge of seismic behavior of precast pre-stressed structures, with specific reference to connections, deformability and interaction between precast and cast-in-situ elements. Further, the project aimed to develop reliable numerical tools, and to codify new criteria for the design of precast structures in seismic regions exploiting the properties of connection devices. A series of monotonic, cyclic and shaking-table tests were carried out on connection devices, joints and subassemblies. Large-scale pseudo-dynamic testing was carried out on single-story and multi-story frames. Numerical simulation was employed to verify adequate numerical models.

SAFECAST was completed in March 2012 with the publication of the *Design Guidelines for Connections of Precast Structures under Seismic Actions*. In conclusion, the outcome demonstrates the importance of regional cooperation, as well as the need for increased budgets for cooperative projects. Local administrative bodies and peoples should be engaged to satisfy the local needs.

Five years previously, at the UNESCO kick-off meeting, it had been said that there are sufficient laboratories, training centers and trained students around the world, and it was time to increase the cooperation of these institutions by linking local and individual efforts together. Mr. Karadoğan concluded by asking whether IPRED can be improved to be an organization that can coordinate predefined collaborative projects.

5) Question and Answer Session

Question for Mr. Fukuyama: In your study, why did you determine that a distance of 500 meters from the coastline is considered safe? When determining inundation depth and pressure, is it not necessary to also take into account the topographical shape and height of the ground? In cases of very low ground, what building height should be considered safe for refuge in case of tsunami?



Mr. Fukuyama: Topographical conditions were outside of the scope of our study. Based on limited data we considered 500 meters from the coastline to be a safe distance; however, we do not have definitive data. Going forward we will continue to improve our design methods. We recommend a building height of at least two stories above the inundated stories, and those stories must have flooring.

(4) Panel Discussion "International Cooperation on Earthquake Disaster Management to Protect Lives"

1) UNESCO

Mr. Rouhban, acting as moderator, opened the panel discussion by remarking that earthquake risk and natural hazards do not recognize geographical, political or geopolitical boundaries. The study of seismology and earthquake risk mitigation over the past five decades has gained from international cooperation, and without this cooperation it is not possible to advance in the future. International cooperation benefits from the individual input of institutions and entities located in different countries. The panel discussion should therefore illuminate lessons drawn from individual experiences in international cooperation, and how to improve this cooperation in the future.



2) Chile

Mr. Raul Alvarez, Professor at the Universidad Catolica de Chile stated that the 2010 magnitude 8.8 Chile earthquake highlighted many problems with disaster preparedness and response. There was a lack of coordination between different government departments. The primary responsible institution was overwhelmed by the circumstances of the event. Management personnel had insufficient technical competence, autonomy and budget. There was a lack of crisis coordination and management. Knowledge was concentrated in the capital. Some government buildings were destroyed leaving no base for coordination. Political power's response to looting and vandalism was delayed. The population was not educated on a crisis management plan. Buildings had been constructed in vulnerable areas, and inappropriate building materials had been used as well as structural solutions from non-seismic countries. There was no early tsunami warning. Mobile communications were severely crippled. There was a lack of proper and properly maintained monitoring equipment, and monitoring data was not readily available to the scientific community. There was no unique methodology to evaluate structures following the earthquake, complicating data interpretation. And there was a lack of volunteers to assess damage. Improvements need to be implemented in order to address these issues. The National Office



of Emergency of the Interior Ministry (ONEMI) needs to be completely restructured, provided with sufficient budget, empowered against political power, members technically trained, and a strong research area developed. An early warning network should be created nationwide, with data provided to civilians and to the local and international scientific community. Communication networks should be reinforced to ensure continuous operation. A quick inspection of structures must be implemented, with a coordinated volunteer network at the country level. Sufficient budget must be provided. School curriculums should incorporate natural disaster education, and crisis management education should be provided to the general population.

Mr. Alvarez concluded with some suggestions for Japan and UNESCO: to share positive experiences in institutional issues, management and monitoring of successful countries; to exchange technical personnel and experts in risk management, methodologies, studies of human behavior in emergencies, etc; and to help create a critical mass of experts in each area of risk, to permeate this knowledge throughout the country.

3) Egypt

Mr. Salah Mahmoud, Head of the Department of Geodynamics at the National Research Institute of Astronomy and Geophysics (NRIAG) outlined NRIAG's roles for international cooperation and earthquake disaster management. NRIAG's Earthquake and Information Centre (EIC) continuously monitors and analyzes earthquake signals in and around Egypt and is able to spring into action immediately when it receives a call for assistance. NRIAG also aims to mitigate disasters through awareness-raising media, education, and training for regional colleagues.



During emergencies, NRIAG may act as a communication hub for requests and offers of assistance, and can offer assistance to affected neighboring countries. NRIAG can also coordinate the provision of Egyptian assistance by matching offers to needs, identifying gaps in assistance and searching for solutions, as well as facilitating the pooling of common resources where possible. This mechanism can be activated by any participating state seeking prompt international assistance following a major earthquake disaster.

Currently most resource is allocated to post-disaster efforts, which can save relatively few lives in comparison to pre-disaster preparation.

4) Peru

Mr. Carlos Zavala, Director of the Japan-Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID) talked about the problems in execution of field surveys in Peru. Accessing emergency funds following a disaster is difficult as bureaucracy delays the issuing of the funds, and the funding is limited to US\$2,000 which is only sufficient for two days.

There are also several impediments to earthquake disaster management in

Peru: the government offices are not sensible with disaster risk; there are cities where hazard, microzonification and risk analysis have been developed but city authorities do not use this data for city planning; and the National Center for Assessment, Prevention and Disaster Risk Reduction is not aggressive in considering alliances or teaching local authorities about disaster management policies.

The main future challenges for implementation of disaster risk management are: achieving a culture of disaster risk management in the population; building consensus and commitments between public and private institutions involved in disaster prevention and relief; developing a system to automatically disseminate information on potential risks at local, regional and national levels; and strengthening SINAGERD in a decentralized manner to empower regional and local governments. The integrated approach to disaster management should include the participation of the population. A risk reduction plan should be developed for each government agency or ministry in order to produce a national plan. Sustainable development demands an improvement in capacities of authorities and officers with power of decision. The indifference of decision makers and authorities is one of the primary issues, and their capacity needs to be improved.

Japan and UNESCO can further international cooperation on earthquake disaster management through assistance to protect vulnerable historical buildings and schools. Peru has a cooperative project with Japan under the SATREPS program, which encompasses several research topics: strong motion and geotechnical; tsunami; damage assessment; building; and disaster mitigation planning.



5) Romania

Mr. Radu Vacareanu, Vice-Rector of the Technical University of Civil Engineering of Bucharest (UTCB) noted

that in Romania the source of seismic risk is very well known, coming directly from the Vrancea subcrustal source. It is an intermediate earthquake occurring two to three times per century, and affects particularly the building stock in Bucharest. The most destructive event occurred in 1977 when more than 1,600 people died, of which 1,500 died in Bucharest. Bucharest still has many high-rise buildings that do not incorporate any seismic design. National programs for seismic risk mitigation in Romania aim to strengthen seismic risk class I buildings, upgrade the code for seismic design of buildings, and improve seismic instrumentation.

In terms of international cooperation, there have been several projects in Romania. Most important was a JICA project to reduce seismic risk for buildings and structures in Romania. Through this project, Romania received a lot of structural and soil testing equipment and new seismic networks were installed. However rather suddenly in 2010 the Romanian authorities decided to dismantle the National Center for Seismic Risk Reduction (NCSRR) and move the equipment to the BRI, while the staff remaining at the university, which has been a significant setback. Other international collaborations include projects with Germany, with the European Union, with Earthquake Protection of Historical Buildings (PROHITECH), and with the World Bank.

Impediments in earthquake disaster management include weak political support, low public awareness, the difficulty in retrofitting residential buildings due to social issues, and the focus of international financing bodies of retrofitting programs on public buildings and structures.



6) Japan

Mr. Kenji Okazaki, Professor at GRIPS commented that even as more international communities express their commitment to disaster reduction, the number of disasters has been increasing. There has been a failure to apply technologies and knowledge to reduce the impact of disasters. There has also been an indifference to the loss of human life. The economic value of human lives is not accounted for in the calculation of



the economic cost of disasters. Although protecting the lives of citizens should be the highest priority of government, it does not seem that they are making every effort to achieve that.

The trend of international activity is still focused on response, which cannot recover lives lost in disasters. If people were to survive, reconstruction would be much easier and less costly. Additionally, donor countries are now thinking that they can no longer afford to fund response efforts any longer. More resources must therefore be mobilized for protecting lives before disasters hit.

The most important lesson of the Great East Japan Earthquake and Tsunami of 2011 is that thousands of people would not have been killed if they had evacuated promptly. Although people in the region knew well that a tsunami would strike after a strong earthquake, and knew how to evacuate, and there was good early warning of an impending tsunami, many people did not evacuate promptly.

The most important lesson learned from the 1995 Hanshin-Awaji earthquake is that thousands of people would not have been killed if they had retrofitted their vulnerable houses. Japan has strong building codes and techniques for retrofitting are available as is financial assistance. Despite that, people have many reasons not to retrofit their houses. The basic reason is that people are risk takers; they do not invest in the retrofitting, gambling on the chance that a large earthquake would not occur in the near future.

Measures to convince people to take action before a disaster hits can include education, training, awareness raising, community-based disaster management, and policy development and institutionalization for safer communities.

Recommendations for international cooperation to reduce the loss of life due to disasters include: an international commitment to promoting proactive efforts; fostering more experts who can develop appropriate policies for disaster reduction and have good skills for risk communication with local people; financial and technical assistance to promote community-based disaster management; more research to investigate how to motivate people and local governments to take actions against disaster; and establishing a multi-disciplinary academic approach for disaster risk management.

7) Question and Answer Session

Mr. Faruk Karadoğan: Mr. Okazaki, how can we ensure that our message and the outcome of symposiums such as this one are communicated to governments?

Mr. Paul Grundy, Australia: I was particularly impressed with Mr. Okazaki's comments because it raises the problem of how to get out of the bind of spending all of our money after a disaster strikes rather than on building resilience to survive further disasters. We do not seem to have any academic institutions that have a totally multidisciplinary approach to DRR. There is a parallel between that lack and the recent burgeoning of sustainability institutes in many places. Natural disasters are unsustainable, yet none of the sustainability arguments are being brought to bear on our need for a coherent multidisciplinary approach to disasters.

Mr. Okazaki: In Japan the national and local governments are aware of the risk and how to tackle the challenges. However this may not be the case in many developing countries. That is why I propose that local governments who make DRR efforts may receive more subsidies and advice and activities from the national government. Also, if local people are very aware of

the importance of DRR then local politicians should act on the interests of the local people.

Mr. Rouhban: A point that has been made very frequently is that within a country we need to have more cooperation among different disciplines, as well as better dialogue between scientists, specialists and policymakers. The public awareness issue has also been raised, and we need to find incentives to ensure that the anticipation and prevention of disasters pays off in the final analysis. Also many recommendations went to UNESCO, and it is for UNESCO to listen to these recommendations and make the best possible use of them in the future.

Mr. Vacereanu: Responding to Mr. Karadoğan's question, I would like to give an example. The US National Earthquake Hazard Reduction Program launched in 1977 was in fact drafted in the 1960s by Professor Frank Press. When a new president came to the White House, Frank Press was the scientific advisor to the new president. One month later, the program was on its way. So, sometimes good things do happen.

Mr. Mahmoud: Responding to Mr. Karadoğan, we need the ministry of foreign affairs to facilitate cooperation between international and local partners. Sometimes we face problems cooperating on projects with different countries. In Egypt with the new regime we hope that this problem will be addressed.

Mr. Zavala: On the comment about sustainability, in Peru the law changed last year to require every urban development plans to include a DRR component. So politicians in local and regional governments are now required by law to produce disaster management projects, and pressure can therefore be applied to politicians to apply this law.

(5) Closing ceremony

1) Closing Remarks

Mr. Isao Nishiyama, Deputy Chief Executive of BRI expressed his gratitude to all participants for their contributions to the symposium. He thanked GRIPS for providing the venue and UNESCO for their sponsorship. Disaster management is a task that should be undertaken continuously at the global, national, local and community levels, and this symposium has been a reminder of that necessity. There are many tasks to be undertaken and research activities must be accelerated. Those guests returning overseas will be able to apply outcomes and lessons to their own environments.



Ⅲ. 現地視察 (Field trip)

東北被災地の現地視察

6月28日(木) - 6月29日(金)

6月28日(木)	現地視察(仙台市～女川～石巻市)
8:00	IH ホテルから出発
8:56	東京駅から仙台へ (はやて19号)
10:37	仙台駅に到着
10:50	仙台駅から出発
11:10-12:30	東北地方整備局
12:30-13:30	バス内で昼食 (コンビニ弁当)
14:00-15:00	女川町 病院周辺視察
	女川町から出発
15:30-17:00	石巻市に到着
	石巻日和山公園 (被災地視察)
17:30	石巻グランドホテルに到着
18:00	夕食
6月29日(金)	現地視察(南三陸町～気仙沼市)
7:00	ホテルで朝食
8:00	ホテルから出発
9:00-10:00	南三陸町に到着
	南三陸町の視察
	気仙沼市へ移動
11:00-12:30	気仙沼に到着
	市内視察 (市役所の説明と意見交換)
12:30-13:30	昼食後一関に出発
15:30	一関駅に到着
15:54	一関駅から東京へ (やまびこ62号)
18:28	東京駅に到着

東日本大震災 気仙沼市の状況（平成24年5月）

1 被災状況等

- ・発生 : 平成23年3月11日(金) 14時46分ごろ
 - ・震源 : 北緯38.1度, 東経142.9度, 深さ24km
 - ・マグニチュード : 9.0
 - ・各地の震度 : [赤岩] 6弱 [笹が陣] 5強 [本吉町] 5強
 - ・津波高 : 最大20m超
 - ・浸水面積 : 市域全体 18.65km² (市域面積の5.6%)
都市計画区域 9.60km² (区域面積の20.5%)
 - ・焼失面積 : 2.48km² (市域面積の0.7%)
 - ・地盤沈下 : 最大 マイナ74cm
 - ・死者数 : 1,034人 [身元不明者数: 53人] (平成24年5月17日現在※)
 - ・行方不明者数 : 市内288人, その他0人, 計288人 (平成24年5月17日現在※)
- ※気仙沼警察署発表
- ・住家被災棟数 : 15,661棟 (平成24年4月30日現在)
 - ・被災世帯数 : 9,500世帯 (平成23年4月27日現在・推計)
 - ・避難所数 : 最大 105箇所 (平成23年3月20日)
 - ・避難者数 : 最大20,086人 (平成23年3月17日)
 - ・応急仮設住宅 : 計93団地 3,503戸

2 気仙沼市震災復興計画

- ・策定 : 平成23年10月7日
- ・副題 : 「海と生きる」
- ・震災復興会議 : 平成23年6月19日設置 (学識経験者7人, 市総合計画審議会委員6人)
同年9月30日までに会議を6回開催
- ・震災復興市民委員会 : 平成23年6月21日設置 (市内在住・出身者11人)
同年9月24日までに会議を12回開催 (以後翌年2月21日までに会議を4回開催)
「気仙沼市の震災復旧・復興に向けた提言」
「気仙沼市震災復興市民委員会プロジェクト」
「気仙沼ものがたり2021」

3 国の動き

- 平成23年12月7日 東日本大震災復興特別区域法成立
- 12月9日 復興庁設置法成立
- 12月16日 復興庁設置法施行
- 12月26日 東日本大震災復興特別区域法施行
- 平成24年1月6日 復興特別区域基本方針閣議決定
- 2月10日 復興庁宮城復興局気仙沼支所開設

参加者リスト

氏名	国	所属
Raul Alvarez Medel	Chile	チリ・カトリカ大学教授
Salah Mahmoud	Egypt	エジプト国立天文地球物理研究所部長
Edgar Armando Peña Figueroa	El Salvador	エルサルバドル大学教授
Sutadji Yuwasdiki	Indonesia	インドネシア人間居住研究所（RIHS）構造研究室長
Tanatkan Abakanov	Kazhakstan	カザフスタン地震学研究所所長
Carlos Zavala	Peru	日本・ペルー地震防災センター（CISMID）所長
Radu Vacareanu	Romania	ルーマニア・国立ブカレスト工科大学（UTCB）副学長
Faruk Karadogan	Turkey	トルコ・イスタンブール工科大学（ITU）教授・前学長
石山 雄二	Japan	北海道大学名誉教授
勝見 康生	UNESCO	ユネスコ自然災害ユニット専門家（SC/DIS）
Jair Torres	UNESCO	ユネスココンサルタント（SC/DIS）
古川 信雄	日本	独立行政法人建築研究所研究専門役
長谷川 知弘	日本	国土交通省住宅局建築指導課
安藤 尚一	日本	独立行政法人建築研究所国際地震工学センター長
犬飼 瑞郎	日本	独立行政法人建築研究所国際地震工学センター上席研究員
岡崎 建二	日本	政策研究大学院大学教授

The Schedule of Field Trip in Tohoku Area (6/28~6/29)

6/28 (Thu)	Itinerary
8:00	Depart from Hotel
8:56	Depart from Tokyo Station for Sendai
10:37	Arrive at Sendai Station
10:50	Depart from Sendai Station
11:10-12:30	The Sendai Government Office Building
12:30-13:30	Lunch (box lunch in the bus)
14:00-15:00	Visit Onagawa Town
	Visit Onagawa Hospital area
15:30-17:00	Arrive at Ishinomaki City
	Visit the damaged area
17:30	Arrive at Ishinomaki Grand Hotel
18:00	Dinner
6/29 (Fri)	
7:00	Breakfast at Hotel
8:00	Depart from Hotel
9:00-10:00	Arrive at Minamisanriku Town
	Visit Minamisanriku Town
	Depart for Kesenuma City
11:00-12:30	Arrive at Kesenuma City
	Visit Kesenuma City Office
12:30-13:30	Lunch (near Kesenuma port)
	Depart for Ichinoseki Station
15:30	Arrive at Ichinoseki Station
15:54	Depart for Tokyo
18:28	Arrive at Tokyo

Situation of Kesennuma City: Great East Japan Earthquake (H24.5 2012.5)

1 Situation of Damage etc.

Occurrence	: March 11, 2011 (Friday) approx. 14:46
Seismic center	: Lat. 38.1° N, Long.142.9 ° E, Depth 24km
Magnitude	: 9.0
Seismic intensity	: (Akaiwa) 6 lower, (Sasagajin) 5 upper, (Motoyoshi-cho) 5 upper
Tsunami height	: more than 20 m (max.)
Inundated area	: Whole City area 18.65k m ² (5.6% of whole city area) Urban Planning area 9.60k m ² (20.5% of Urban Planning area)
Burnt area	: 2.48k m ² (0.7% of whole city area)
Land Subsidence	: 74cm subsided (max.)
Number of deaths	: 1,034 persons (unidentified: 53 persons) as of May 17, 2012*
Number of missing	: within city 288 persons, others 0 person, total 288 persons as of May 17, 2012* (*reported by Kesennuma Police Station)
Damaged houses	: 15,661 buildings (as of April 30, 2012)
Damaged households	: 9,500 households (estimated as of April 27, 2011)
Evacuation places	: max. 105 places (March 20, 2011)
Number of Evacuees	: max. 20,086 (March 17, 2011)
Temporary houses	: in total 93 complexes, 3,503 units

2 Kesennuma City Disaster Recovery Plan

Establishment	: October 7, 2011
Sub-title	: “Living with the Sea”
Disaster Recovery Council	: set June 19, 2011 (7 academic, 6 City General Planning Committee), 6 council meetings were held by Sept. 30, 2011.
Disaster Recovery Civil Committee	: set June 21, 2011 (11 current/former residents) 12 meetings by Sept. 24, 2011 (by Feb. 21, 2012, 4 times more)

3 National Level Actions

Dec. 7, 2011	Approval of Act on Great East Japan Earthquake Special Recovery Area
Dec. 9, 2011	Approval of Act on Establishment of Recovery Agency
Dec.16, 2011	Enforcement of Act on Establishment of Recovery Agency
Dec.26, 2011	Enforcement of Act on Great East Japan Eq. Special Recovery Area
Jan. 6, 2012	Decision of Cabinet Meeting on Special Recovery Area Basic Policy
Feb.10, 2012	Open of Kesennuma Branch Office of Miyagi Recovery Bureau, Recovery Agency

List of Participants

Name	Country	affiliation
Raul Alvarez Medel	Chile	Professor, Universidad Catolica de Chile
Salah Mahmoud	Egypt	Head, Department of Geodynamics, National Research Institute of Astronomy and Geophysics (NRIAG)
Edgar Armando Peña Figueroa	El Salvador	Professor, Universidad de El Salvador
Sutadji Yuwasdiki	Indonesia	Head, Laboratory of Structure and Building Construction, Research Institute of Human Settlements (RIHS)
Tanatkan Abakanov	Kazhakstan	Director, Institute of Seismology
Carlos Zavala	Peru	Director, Japan-Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID)
Radu Vacareanu	Romania	Vice-Rector, Technical University of Civil Engineering (UTCB)
Faruk Karadogan	Turkey	Professor & Former Rector, Istanbul Technical University (ITU)
Yuji Ishiyama	Japan	Professor Emeritus, Hokkaido University
Badaoui Rouhban	UNESCO	Director, Unit for Natural Disasters, Natural Sciences Sector, UNESCO
Yasuo Katsumi	UNESCO	Programme Specialist, Unit for Natural Disasters, Natural Sciences Sector, UNESCO
Jair Torres	UNESCO	Consultant, Unit for Natural Disasters, Natural Sciences Sector, UNESCO
Nobuo Hurukawa	Japan	Research Coordinator of Building Technology, Building Research Institute (BRI)
Tomohiro Hasegawa	Japan	Director for International Building Analysis, Building Guidance Division, Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
Shoichi Ando	Japan	Director, International Institute of Seismology and Earthquake Engineering (IISEE), Building Research Institute (BRI)
Mizuo Inukai	Japan	Chief Research Engineer, International Institute of Seismology and Earthquake Engineering (IISEE), Building Research Institute (BRI)
Kenji Okazaki	Japan	Professor, National Graduate Institute for Policy Studies (GRIPS)

June 28-29, 2012 IPRED Tohoku Field Visit

Photos by International Institute of Seismology and Earthquake Engineering (IISEE), Building Research Institute (BRI), Tsukuba, JAPAN, as the COE of International Platforms for Reducing Earthquake Disaster (IPRED), UNESCO



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IV. 参考資料：発表資料 (Reference: Presentation Materials)

発表資料リスト (Table of Presentations)

◆ 基調講演 Keynote Lecture	
基調講演Ⅰ「地震学の未来」 尾池 和夫 (財) 国際高等研究所所長・前京都大学総長 Keynote Lecture 1 "Future of Seismology" Kazuo Oike, Director of the International Institute for Advanced Studies (IIAS) and Former President of Kyoto University	50
基調講演Ⅱ「地震津波防災における役割と戦略」 バダウイ・ルーバン ユネスコ科学部門自然災害ユニット部長 Keynote Lecture 2 "UNESCO's Roles and Strategies for Reducing Earthquake and Tsunami Disasters" Badaoui Rouhban, Director of the Unit for Natural Disasters, Natural Sciences Sector at UNESCO	72
◆ 講演「命を守る—震災の教訓と今後の展望」 Lectures "Protecting Lives: Lessons learned and Future prospects"	
「2015 年以後の視点—災害軽減の実績と今後の課題」 サルバノ・ブリセーニョ IRDR 科学委員会委員長・前国連国際防災戦略事務局長 "Views for Post-2015: Achievements and Challenges in the Field of Disaster Risk Reduction" Sálvano Briceño, Chair of the Science Committee, Integrated Research on Disaster Risk and Former Director of UN International Strategy for Disaster Reduction	84
「都市の新たな脅威としての長周期地震動」 瀧 一起 東京大学地震研究所教授 "Long-Period Ground Motion as a New Urban Threat" Kazuki Koketsu, Professor at the Earthquake Research Institute of the University of Tokyo	89
「津波避難ビルの構造設計法」 福山 洋 (独) 建築研究所構造研究グループ長 "Structural Design Requirement on the Tsunami Evacuation Buildings" Hiroshi Fukuyama, Director of the Department of Structural Engineering at BRI	93
「地震工学分野の調査研究協力—ヨーロッパの SAFECAST プロジェクト」 ファルク・カラドアン トルコ・イスタンブール工科大学教授・前学長 "The Importance of Collaboration for Complementary Research in the Field of Earthquake Engineering—An Example SAFECAST Project in Europe" Faruk Karadoğan, Professor and former Rector of Istanbul Technical University (ITU)	101
◆ パネルディスカッション：「命を守る地震防災国際協力」 Panel Discussion "International Cooperation on Earthquake Disaster Management to Protect Lives"	
チリ：ラウル・アルバレス チリ・カトリカ大学教授 Chile Raul Alvarez, Professor at the Universidad Catolica de Chile	110
エジプト：サラ・ムハンマド エジプト国立天文地球物理研究所部長 Egypt Salah Mahmoud, Head of the Department of Geodynamics at the National Research Institute of Astronomy and Geophysics (NRIAG)	113
ペルー：カルロス・サバラ 日本・ペルー地震防災センター所長 Peru Carlos Zavala, Director of the Japan-Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID)	116
ルーマニア：ラドゥ・バカロヌ ルーマニア・国立ブカレスト工科大学副学長 Romania Radu Vacareanu, Vice-Rector of the Technical University of Civil Engineering of Bucharest (UTCB)	122
日本：岡崎 健二 政策研究大学院大学教授 Japan Kenji Okazaki, Professor at GRIPS	134

UNESCO BRI GRIPS 国際記念シンポジウム
 「命を守る地震津波防災の実現に向けて」
 International Memorial Symposium on June 27, 2012
 “Protecting Lives from Earthquake and Tsunami Disasters”

地震学の未来
 Future of seismology

2012年6月27日(水曜日)
 政策研究大学院大学 想海楼ホール
 財団法人国際高等研究所所長
 Director, International Institute for Advanced Studies

尾池和夫 Kazuo OIKE

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地震学の未来の予測ではなく、未来への期待
 Not to forecast the future but to Look forward to future of seismology

東アジアの地震と地震学の歴史
 History of earthquake and seismology in East Asia

歴史からの地震活動の長期予測
 Long term prediction of earthquakes from historical data

東日本の巨大地震に学ぶ
 Learn from the 2011 M9.0 earthquake and tsunami

観測と調査
 Observation and survey

理論と計算
 Theory and simulation

連携と普及
 Cooperation and outreach

地球を学ぶ
 Learn from the Earth

2

東アジアの地震と地震学
 History of earthquake and seismology in East Asia

- 歴史地震: 古文書、記念碑などから
- 先史地震: 遺跡、地質調査などから有史以前の地震
- 古地震: 近代の地震観測開始以前の地震
- 地震考古学
- 東アジアで最古の地震記録: 夏、BC1831年、泰山付近(『竹書紀年』)
- Oldest earthquake record in the East Asia

3

東アジアの地震と地震学
 History of earthquake and seismology in East Asia

Historical records in China

- 中国の最古の地震記録: Oldest record in China
 夏、BC1831年、泰山付近(『竹書紀年』)
- BC193年、BC186年: 肅省の地震 (NOAAの地震年表)
- AD132 張衡(AD. 78~ 139)の地動儀
 Oldest seismometer in the world
 AD138年: 甘肅省で発生した隴西地震
 (震央距離700km)を洛陽で感知した。
- 最大規模の地震: 1556年華県の地震
 largest disaster in the world
- 1668年山東省、郟城地震

4

東アジアの地震と地震学
 History of earthquake and seismology in East Asia

- 朝鮮半島の最古の地震記録
 Oldest earthquake record in Korea
 『三国史記』、AD2年、27年、34年、37年、89年
 京畿道広州で大地震、家屋倒壊および液状化
 史上最大規模:
 Largest earthquake in Korea
 1681年、江原道、襄陽郡・三陟の地震

5

東アジアの地震と地震学
 History of earthquake and seismology in East Asia

- 日本の最古の地震: AD416年(『日本書紀』)
 Oldest earthquake record in Japan
 599年、最初の被害地震の記録 first disaster
 679年、震源域が筑紫と判明
 684年、白鳳地震、最古の巨大地震
 oldest large scale earthquake
 地震活動期 貞観の時代
 old large activity in Japan
 (『日本三代実録』) 869年貞観地震、陸奥

6

国際協力の重要性 Importance of international cooperation

- 宝永地震の津波: 济州島、上海に被害
- 安政東海地震の津波: サンフランシスコの驗潮所
- ペルー地震: 1471年に巨大地震の記録
- チリ地震: 1520年から記録に登場
- 1730年チリ: 津波が陸前に到達し田畑を損じた(『東藩史稿』)
- カスケード、スマトラ、南海トラフ、千島海溝、日本海溝: 300 - 600年程度の間隔で巨大地震

Many kinds of historical records of large tsunamis

7

張衡(AD. 78-139)の地動儀(西暦132年) oldest seismometer

AD138年: 甘肅省で発生した隴西地震(震央距離700km)を洛陽で感知した。

Kazuo Oike 2001

8

Oldest Japanese earthquake catalogue By Sugawara Michizane

Kazuo Oike 2000

9

800年代のM7以上の地震 M₇≥7.0 in 800s

- 818年(弘仁9年7月)、M7.5以上、関東諸国の地震
- 827年8月11日(天長4年7月12日)、M6.5~7.0、京都の地震
- 830年2月3日(天長7年1月3日)、M7.0~7.5、出羽の地震
- 841年(承和8年)、M6.5以上、信濃の地震
- 841年(承和8年)、M7.0程度、伊豆の地震、丹那断層の活
- 850年(嘉祥3年)、M7程度、出羽の地震
- 868年8月3日(貞観10年7月8日)、M7.0以上、播磨、山崎断層の活動
- 869年7月13日(貞観11年5月26日)、M8.3、三陸沿岸、巨大地震
- 878年11月1日(元慶2年9月29日)、M7.4、関東諸国の地震
- 880年(元慶4年)、M7.0程度、出雲の地震
- 887年8月26日(仁和3年7月30日)、M8.0~8.5、五畿・七道、南海トラフ

10

火山活動は Volcanic activities in 800's

800年代の火山活動を列挙すると、磐梯山806年、浅間山887年、白山835、859年、900年頃、富士山800-01年の爆発・溶岩流出など、826年、864-66年の爆発・「青木ヶ原」溶岩流など、870年、伊豆新島886年、神津島838年、鶴見岳867年、阿蘇山864年、867年、雲仙岳860年、霧島山837、843、857、858年、開聞岳874、885年がある。

これらの中で、富士山の貞観の大噴火が知られている。

864年6月から866年にかけて噴火活動があり、青木ヶ原溶岩を形成した。
major eruption of Mt.Fuji from 864 to 866

『日本三代実録』の記録では、「富士郡正三位浅間大神大火、其勢甚熾、燒山方一二許里。光炎高二十許丈、大有声如雷、地震三度…」などとある。

また、日において「駿河国富士大山、忽有暴火、燒碎崗巒、草木焦殺。土鏢石流、埋八代郡本栖并剗両水海。水熱如湯、魚龍皆死。百姓居宅、与海共埋、或有宅無人、其数難記。両海以东、亦有水海、名曰河口海…」と、その様子がくわしく記録されている。

このような活動で、今の青木ヶ原樹海ができた。

11

SEISMIC INTENSITY OF THE MAIN AND AFTER-SHOCKS OF 1830 EARTHQUAKE IN KYOTO(京都) REGION

Kazuo Oike 2000

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地震学と地球内部構造研究の歴史

- John Milne joined James Alfred Ewing and Thomas Lomar Gray and others in founding the Seismological Society in 1880.

A distant earthquake is recorded instrumentally for the first time. The recording is made in Potsdam, Germany of a Japanese earthquake.

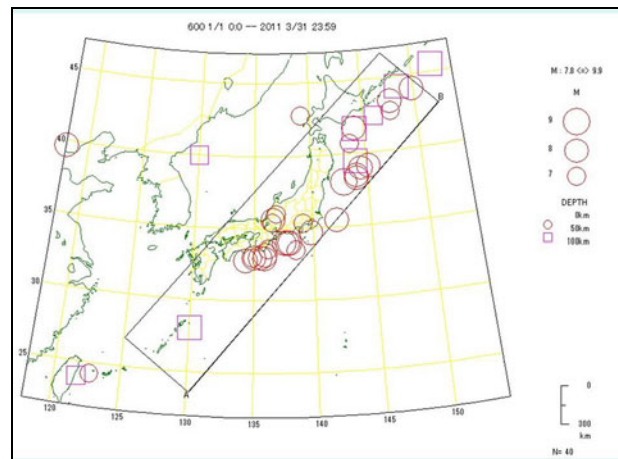
1889:

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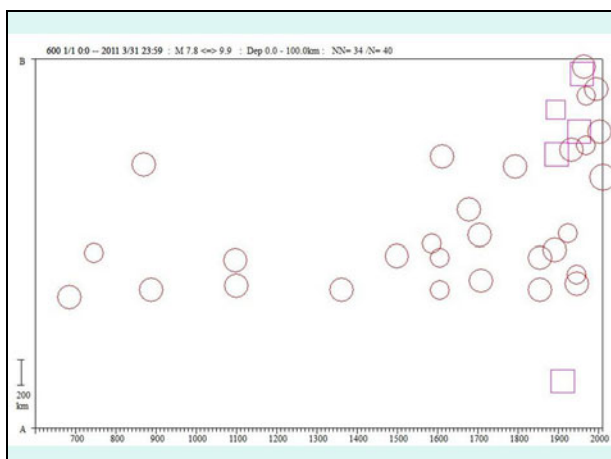
日本の地震と地震防災の歴史

- 1960年頃 地震の統計学 歴史資料から地震の発生の統計的性質
- 1961年 災害対策基本法
- 1962年 建築研究所に国際地震工学会設置
- 1969年 地震予知連絡 国土地理院長の私的諮問機関として発足し、1970年に観測強化地域・特定観測地域を指定
- 1970年頃 地震発生の物理学 プレートテクトニクスの考えが定着し、震源断層モデルの物理学が進んだ。
- 1978年 大規模地震対策特別措置法
- 1980年 地震学は定量的アプローチ 活断層とプレート境界の物理学
- 1990年 貞観津波の津波堆積物調査
- 1995年 地震防災対策特別措置法 地震調査研究推進本部 観測網の整備と長期予測体制 GPS 強震計 計測震度
- 2000年 フィリピン地震 雲仙の活動
- 2001年 中央防災会議 (会長:内閣総理大臣)
- 2002年 東南海・南海地震に係る地震防災対策の推進に関する特別措置法
- 2004年 日本海溝・千島海溝周辺海溝型地震に係る地震防災対策の推進に関する特別措置法
- 2004年12月 インド洋の津波
- 2007年 緊急地震速報実用化 7月新潟県中越沖地震
- 2008年 敷地南部でO.P.+15.7m という想定波高
- 2011年 巨大地震と津波の発生

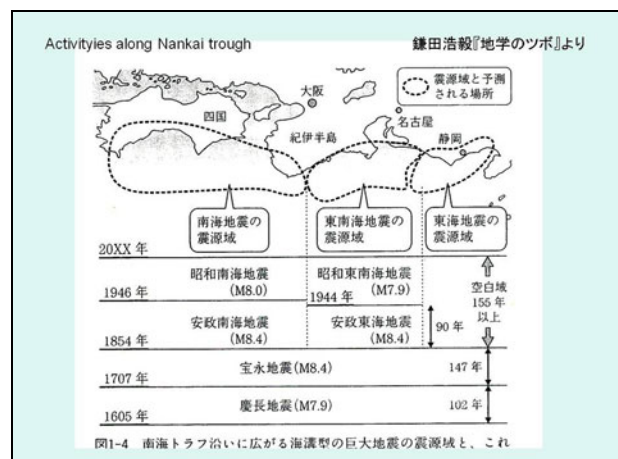
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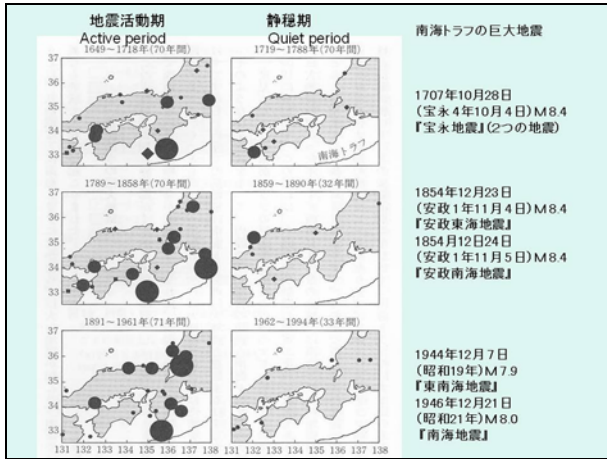
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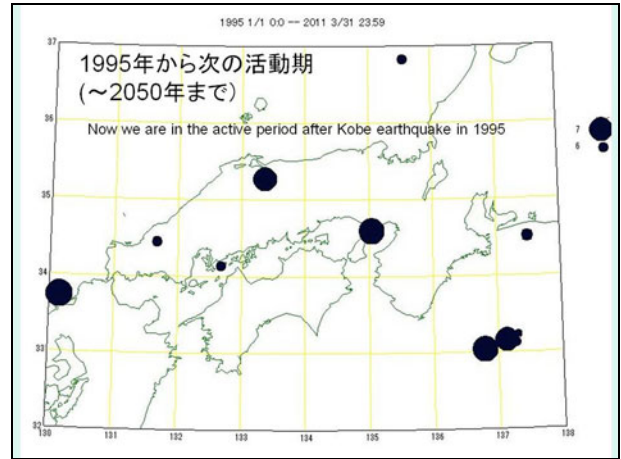
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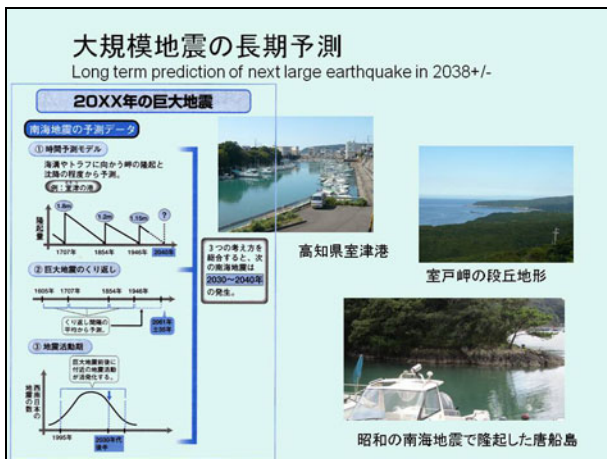
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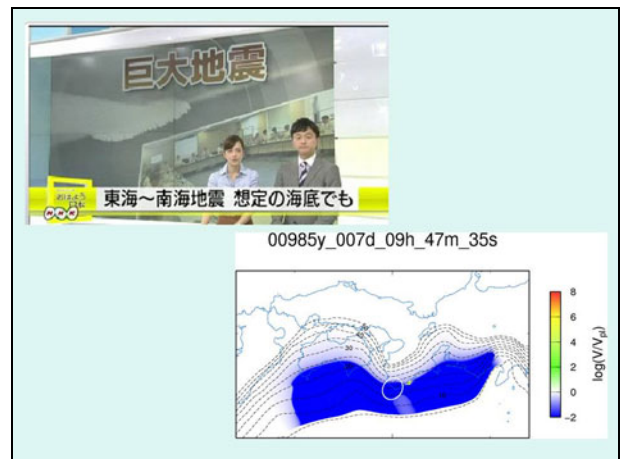
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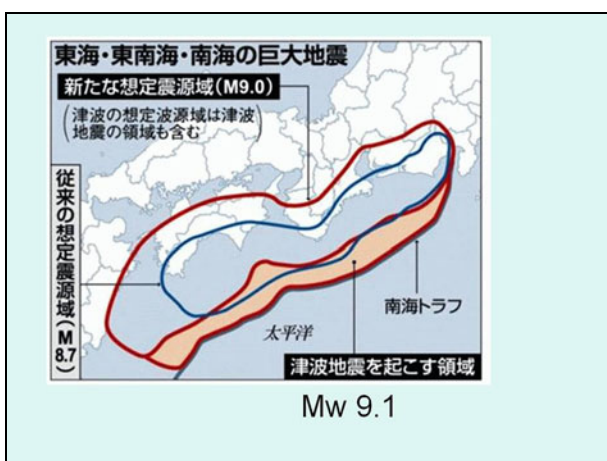
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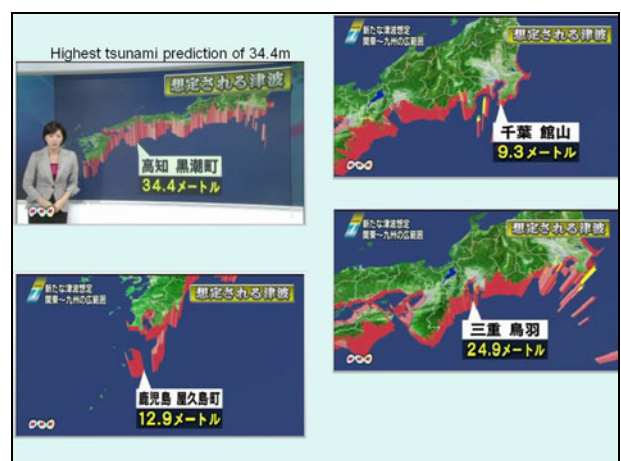
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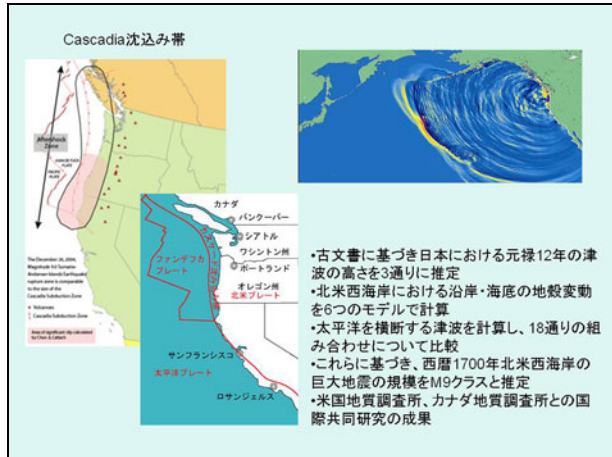


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理科年表より M8.8以上

1700年 1月 26日	M9	USA(Oregon/Washington)	Cascadia沈込み帯
1716年 2月 6日	M8.8	Peru	Torata
1868年 8月 13日	Mw8.8 M8.5	Chile/Peru	死2万5千 (別)死2千/11500/4万
1906年 1月 31日	M8.8	Ecuador/Colombia	死1千
1952年 11月 4日	Mw9.0 M9	Russia[Kamchatka EQ]	死多数
1957年 3月 9日	Mw9.1 M9.1	USA:Andreanof Is. (Aleutian Is.)	死0
1960年 5月 22日	Mw9.5	Chile:[Chilean EQ]	死5700
1964年 3月 27日	Mw9.2	USA:[Alaska EQ]	死131
2004年 12月 26日	Mw9.0	Indonesia:Sumatra	大津波 死283100以上
2010年 2月 27日	Mw8.8	Chile:Bio-Bio沖	日本に津波 死521以上
2011年 3月 11日	Mw9.0	東北日本	太平洋沖地震

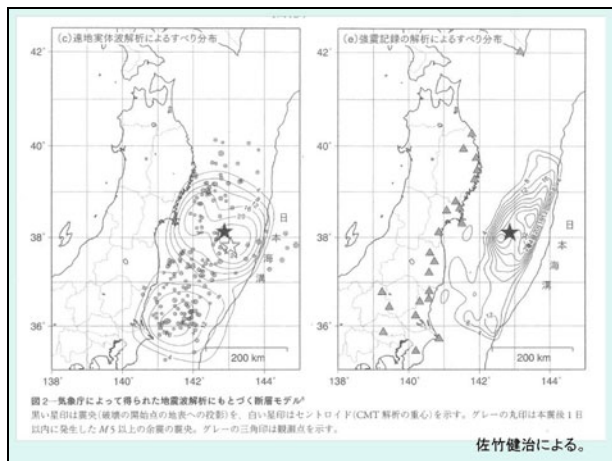
31



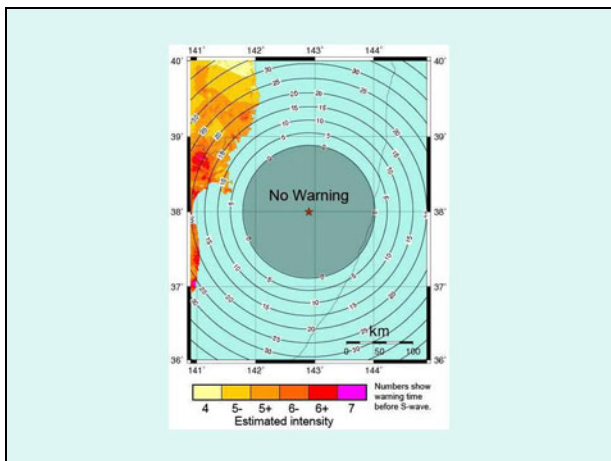
32



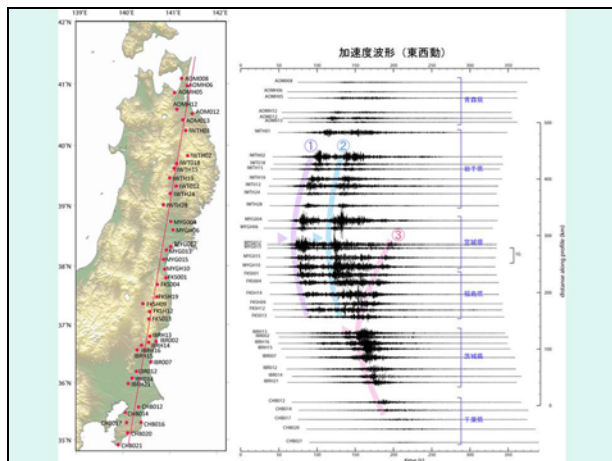
33



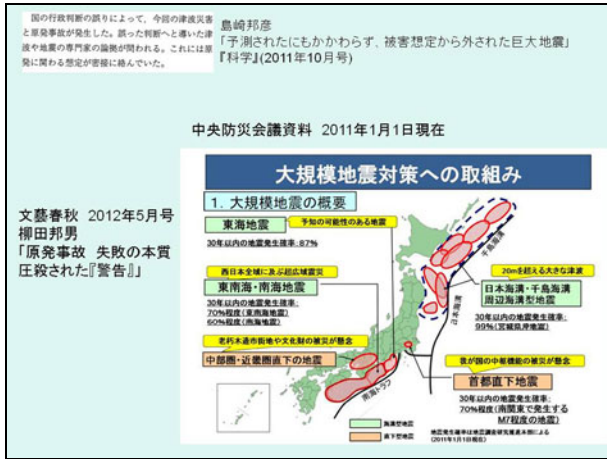
34



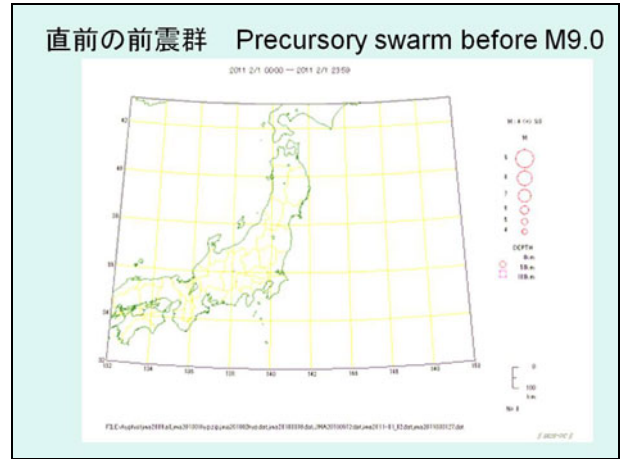
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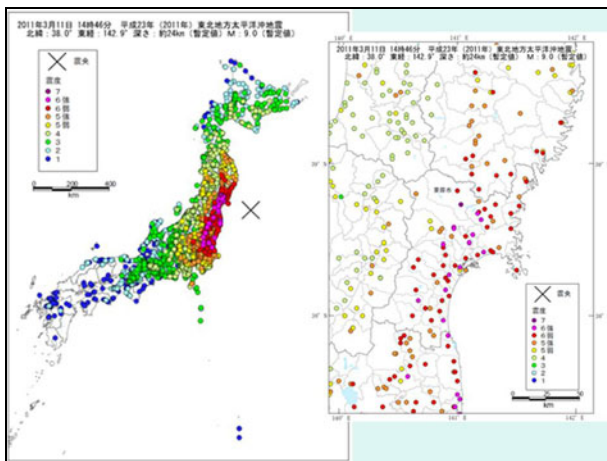
36



43



44



45

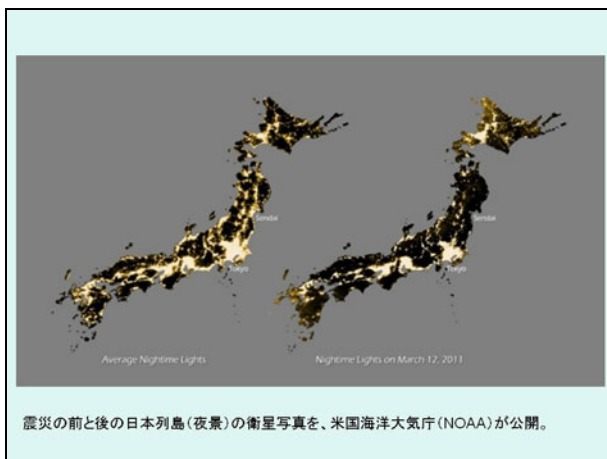
最大加速度上位10観測点

観測点名	最大加速度	計測震度※
1 K-NET築館(MYG004)	2933gal	6.6
2 K-NET塩竈(MYG012)	2019gal	6.0
3 K-NET日立(IBR003)	1845gal	6.4
4 K-NET仙台(MYG013)	1808gal	6.3
5 K-NET銚田(IBR013)	1762gal	6.4
6 KiK-net西郷(FKSH10)	1335gal	6.0
7 KiK-net芳賀(TCGH16)	1305gal	6.5
8 K-NET茂木(TCG014)	1291gal	6.3
9 KiK-net岩瀬(IBRH11)	1224gal	6.2
10 KiK-net山元(MYGH10)	1137gal	6.0

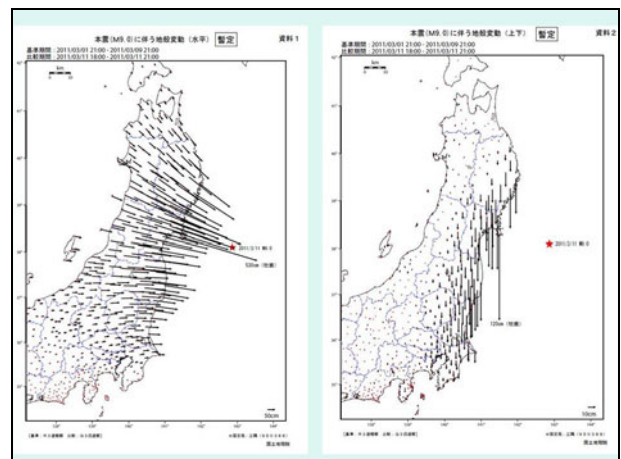
※気象庁告示に基づき計算

3月13日現在のデータ確認済み観測点: K-NET276点, KiK-net112点

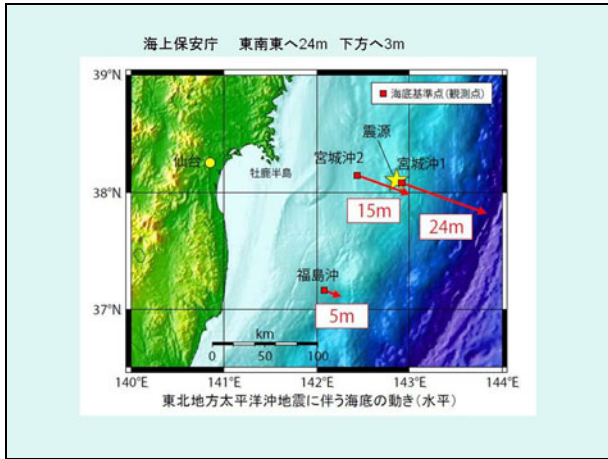
46



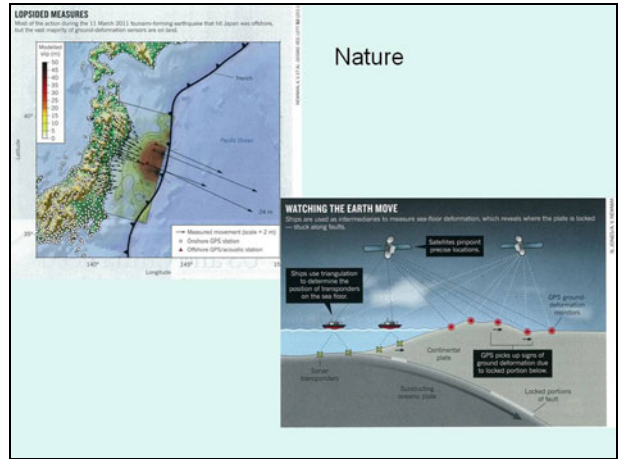
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48



49



50

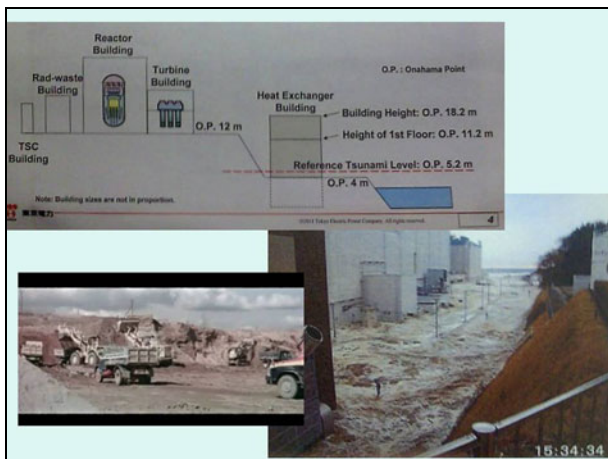


地盤の液状化

51



52



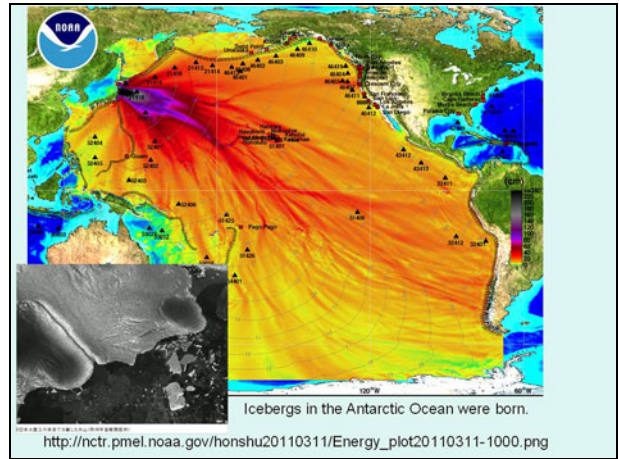
53



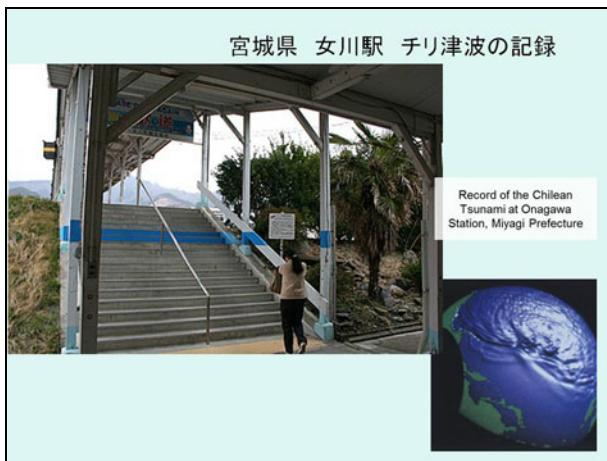
54



61



62



63



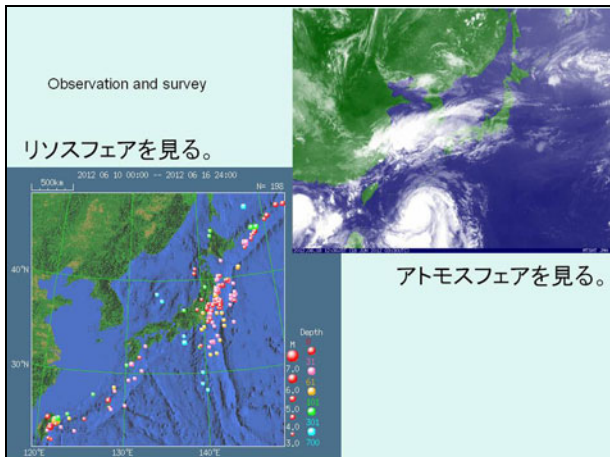
64



65



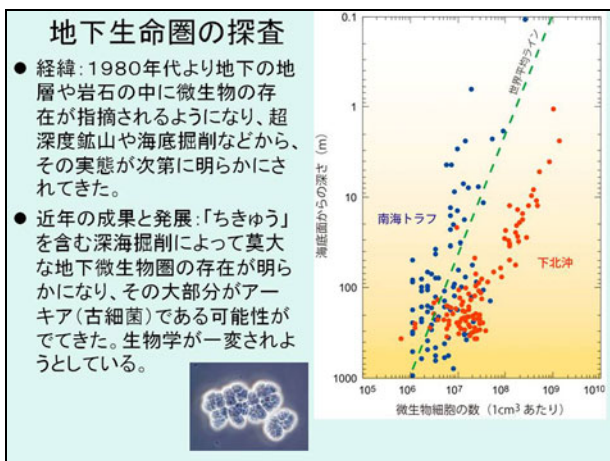
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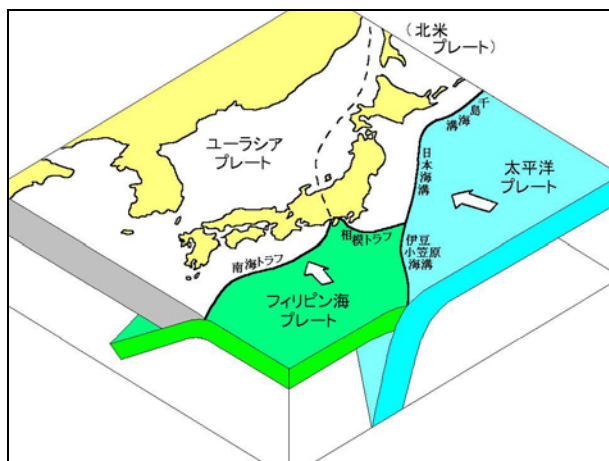
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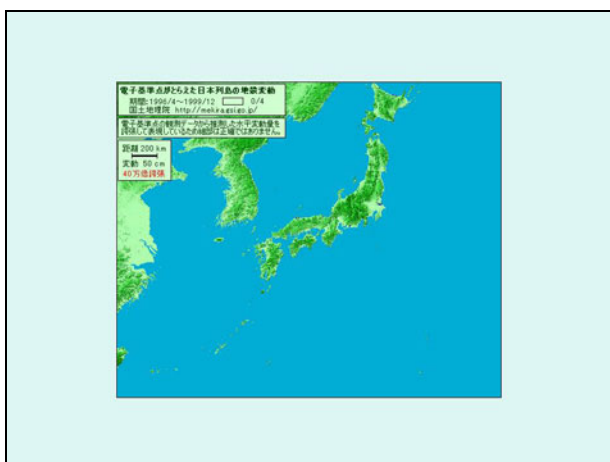
68



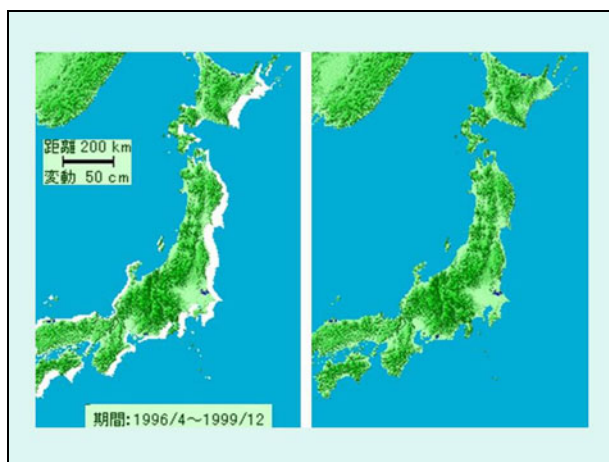
69



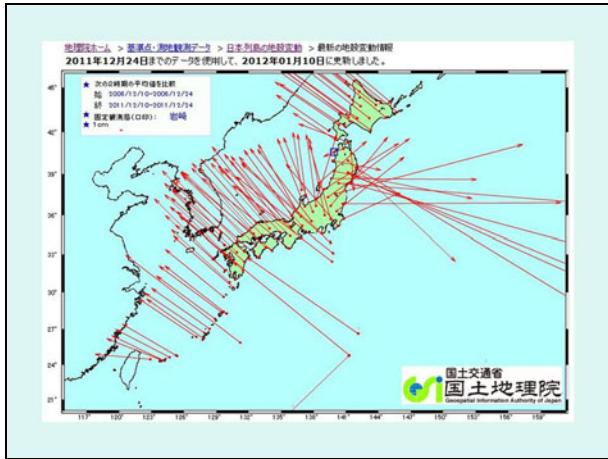
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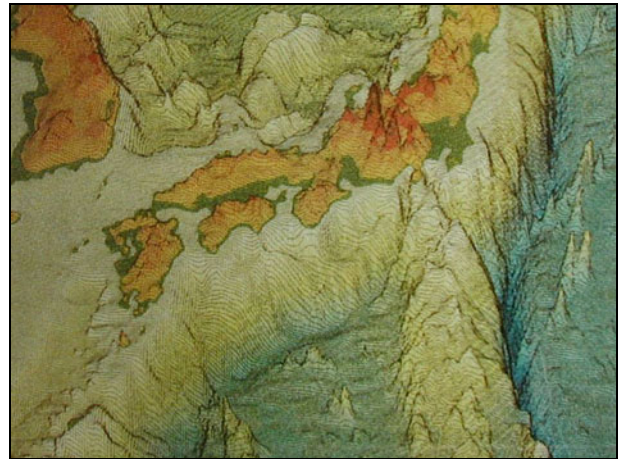
71



72



73



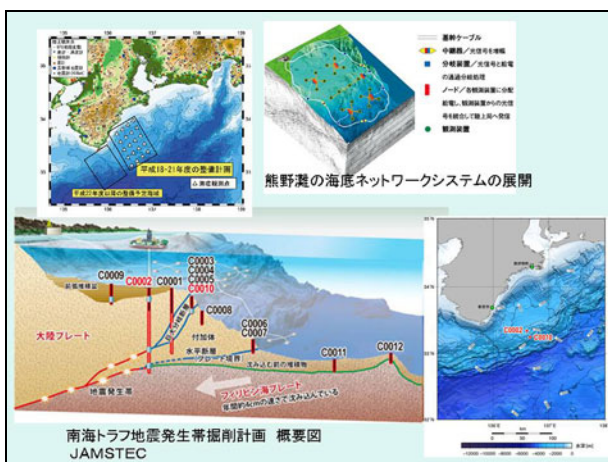
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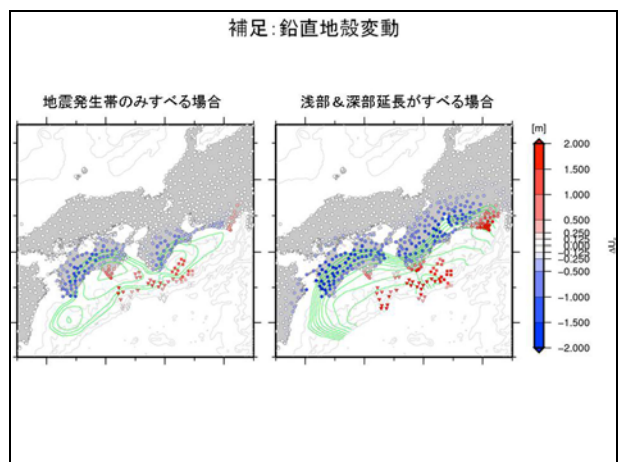
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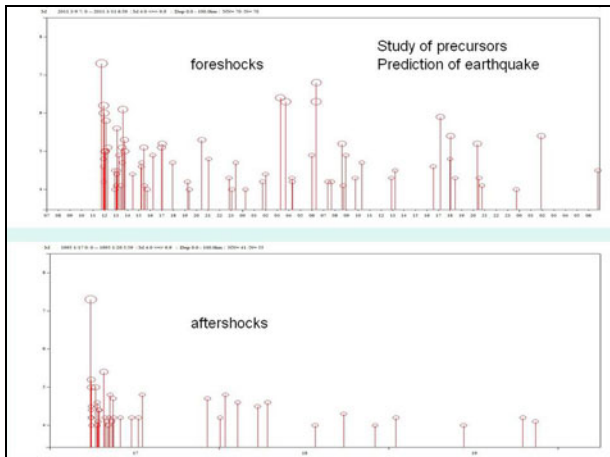
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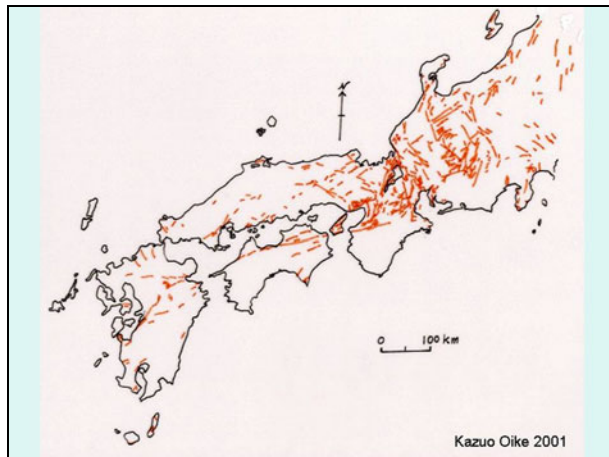
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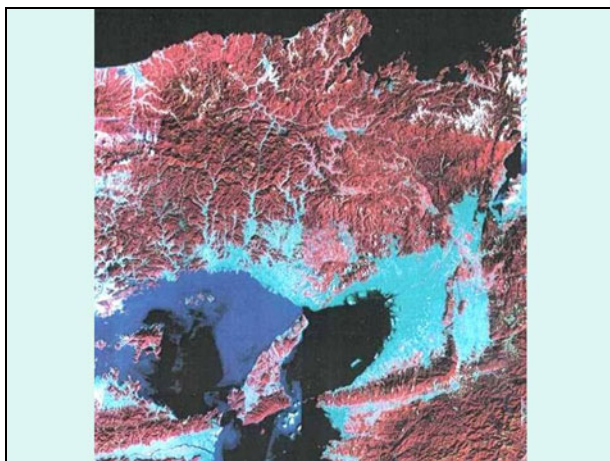
78



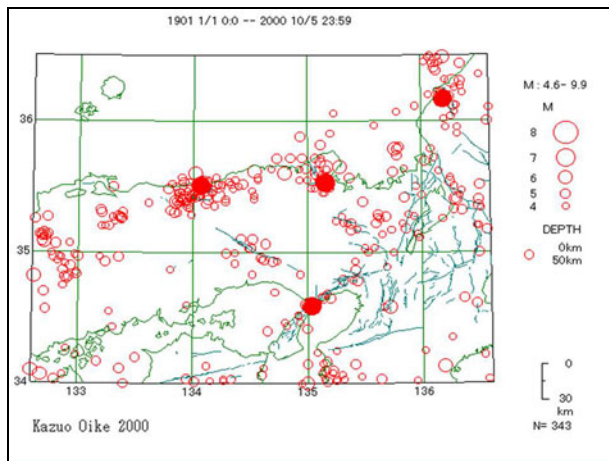
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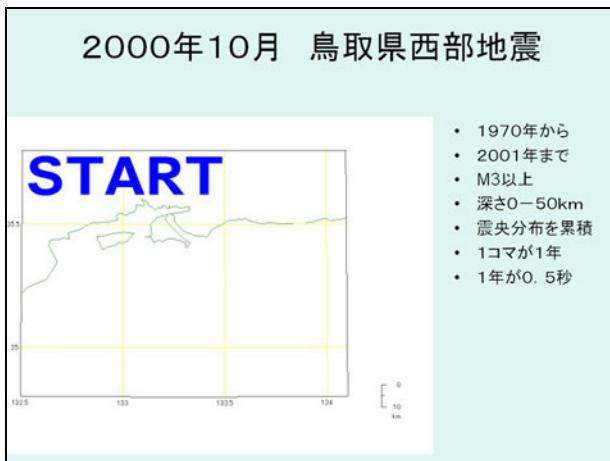
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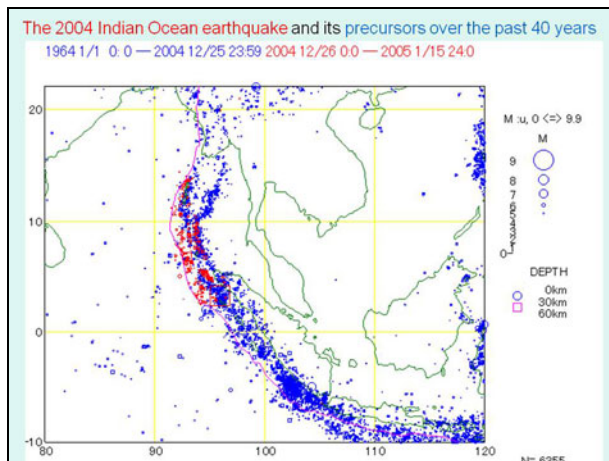
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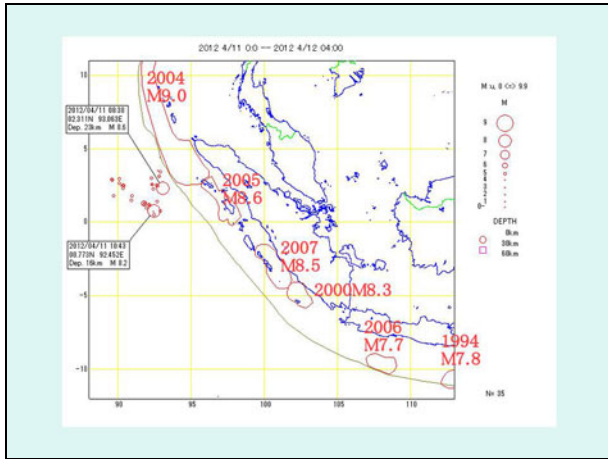
82



83



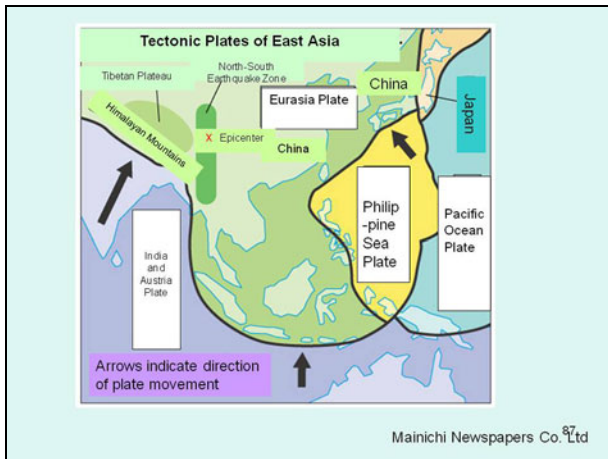
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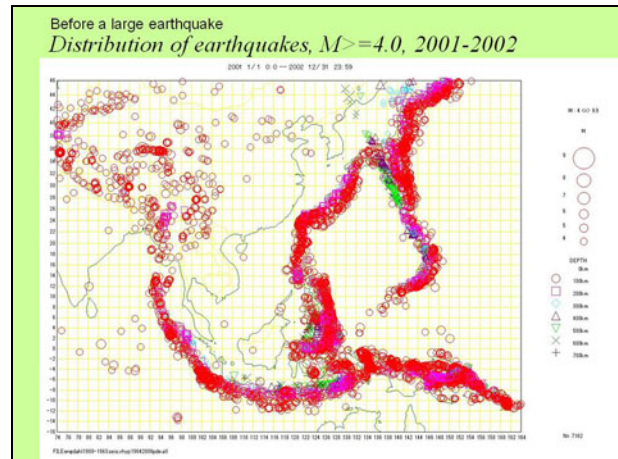
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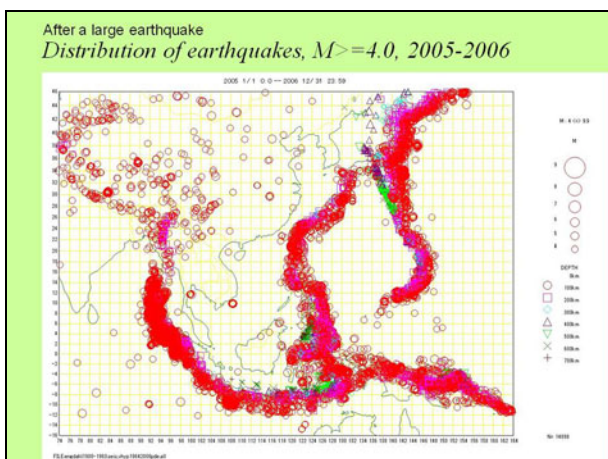
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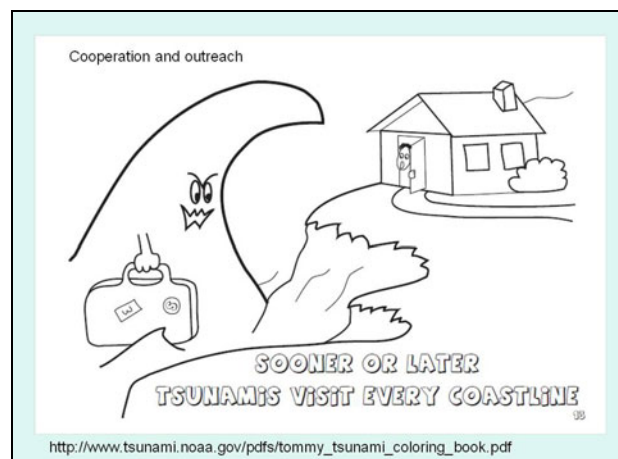
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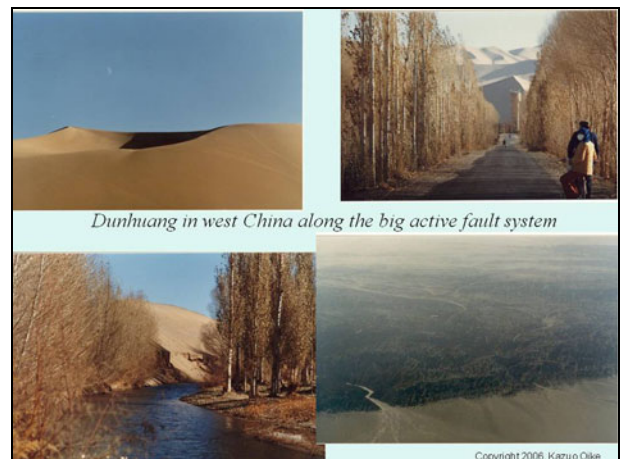
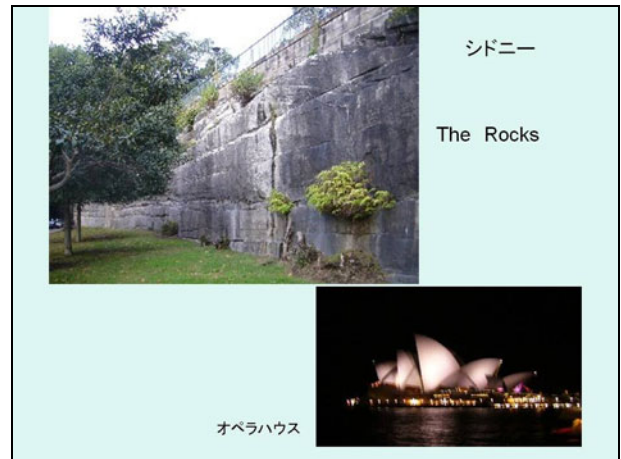
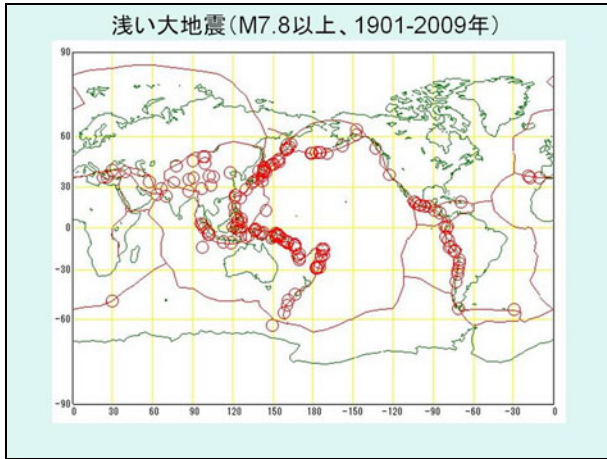
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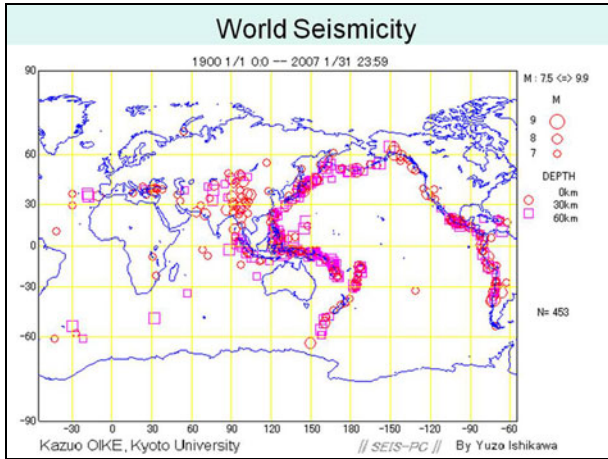


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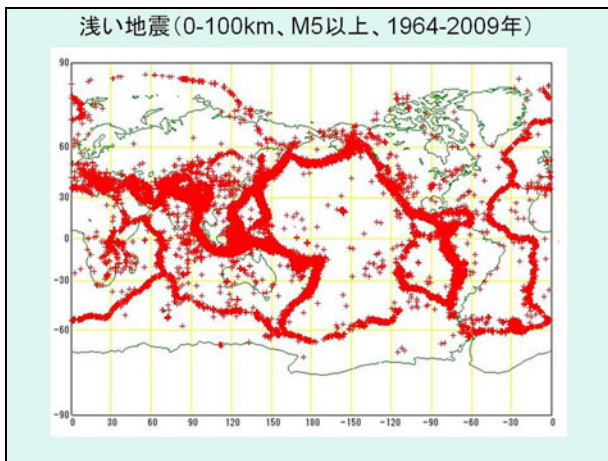


97

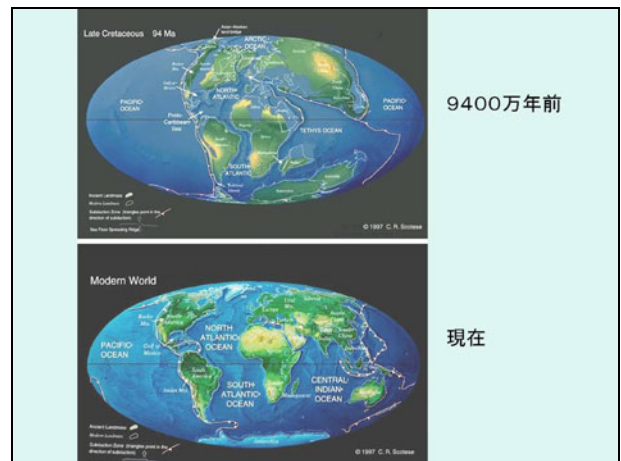
Two worlds: a new scientific dichotomic perception of the world

Sydney
Luzon
Moving
Almost Still
Stockholm
Tokushima

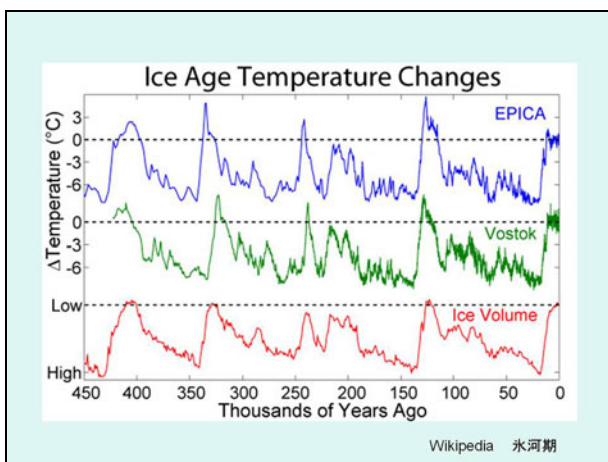
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The deformation belt and the stable continental region

- The Stable continental region and the deformation belt have **different subsurface structures**
- Plates are constantly in motion away from Antarctica
- **The Pacific Rim region** is a plate convergence regions
- Earthquake prediction was first successfully achieved in China (Zhang Hong, 132 A.D.)
- The motion of active faults give rise to **land basin cities**
- Earthquakes and eruptions form **islands** with diverse terrain
- Focusing on the distribution of small earthquakes is important for **prediction**

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The 2008 Sichuan Earthquake
media coverage the day
after the earthquake

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IISEE Newsletter No. 81 June 21, 2012
国際地震工学センター ニュースレター 第81号 2012年6月22日発行

[1] 第4期の中国耐震建築研修が開始されました

第4期の中国耐震建築研修が6月5日に建築研究所においてスタートしました。中国国内の各地域から選抜された18名の構造技術者が参加しています。この研修は、2008年の四川大震災のあとに開始されたJICAプロジェクト”中国耐震建築人材育成プロジェクト”の一環として計画されています。耐震設計、診断、補強の講義に加えて、東日本大震災の被災地の視察旅行も計画されています。

齊藤 大樹(博士)
国際地震工学センター上席研究員

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Blessings of the moving ground
e.g. the culture of water

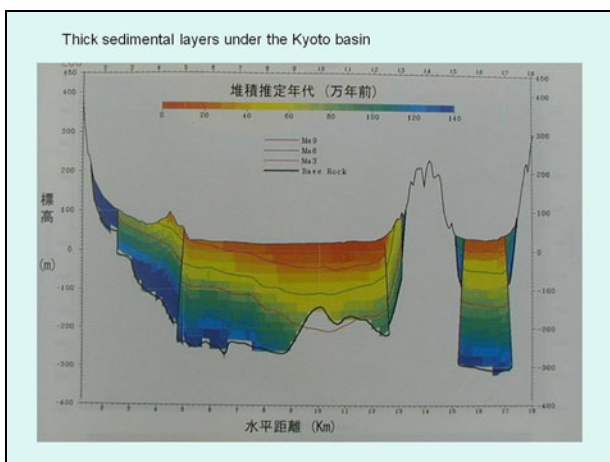
Waseda-Kyoto joint venture *White Nile Beer*
Archeology + Bioscience + Kyoto Well Water

Tea Ceremony Tofu Traditional Dyeing

105



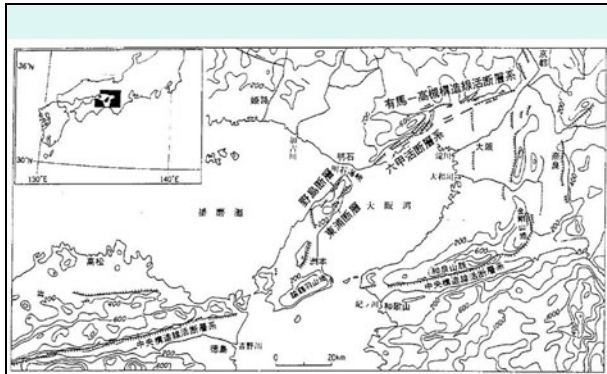
106



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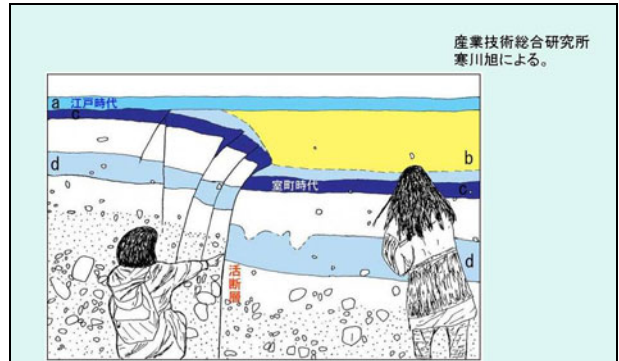


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第1図 近畿西部～四国北東部の活断層分布
Fig. 1 Active fault distribution in the western Kinki to northeast Shikoku region.

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産業技術総合研究所
寒川旭による。

真上断層のトレンチ調査。a: 近世の耕作土の床土、b: 断層活動の後で運んだ盛土、
c: 鎌倉～室町時代の耕作土、d: 奈良～平安時代の耕作土

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地質調査所「有馬－高槻構造線活断層系のトレンチ調査」

川西地区、箕面地区、茨木地区でトレンチ調査を実施した。

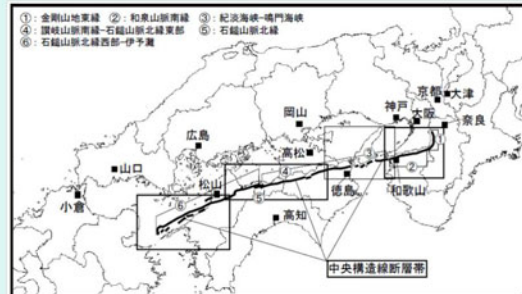
川西地区: 花屋敷低地帯南縁断層の最新活動時期は安土桃山時代～江戸時代初頭

箕面地区: 坊島断層の最新活動時期は室町時代～江戸時代

茨木地区: 安威断層の最新活動時期は鎌倉時代～江戸時代、真上断層の最新活動時期は鎌倉～室町時代以降

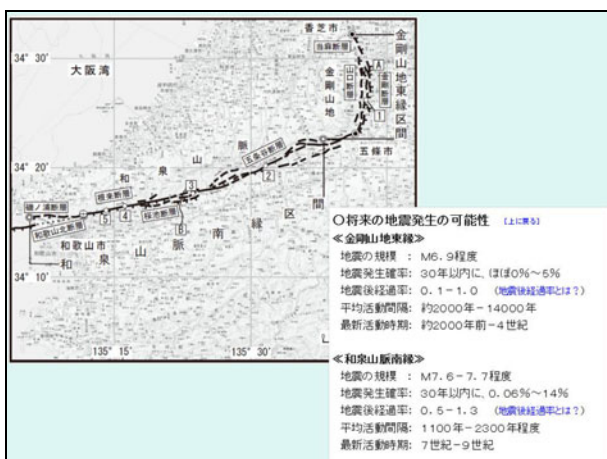
有馬－高槻構造線活断層の最新活動は1596年慶長伏見地震に対応する。先行する活動は約2800年前の縄文時代晩期に生じた。

平成8年1月10日 地震調査研究推進本部 地震調査委員会

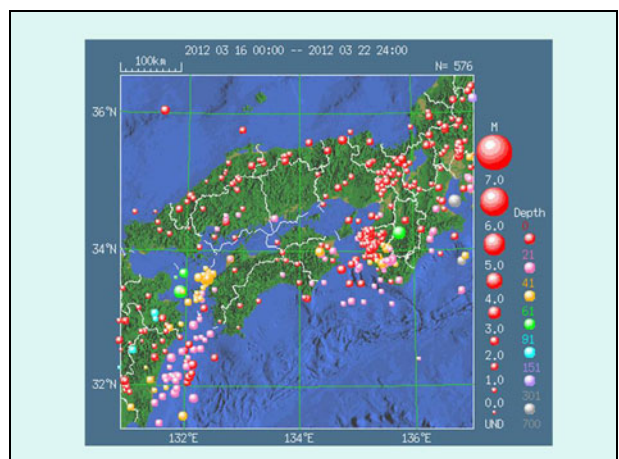


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Muroto geopark 室戸ジオパーク

南瓜咲き室戸の雨の湯の如し
大峯あきら

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Itoigawa geopark 糸魚川ジオパーク

爽やかやフォッサマグナの地に嬉し
秋出水翡翠流るる噂など
保坂季泉
五十嵐三千枝

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asahi.com: ジオパークツアー好評 首都圏から「大人の修学旅行」-マイ
ワン岩手 mynews.asahi.com

【いわてジオパーク】の認定地も目下予約が、観光旅行など観光客の増加に伴ってツアーも人気です。ジオパークの魅力を伝えるため、観光客の増加に伴ってツアーも人気です。ジオパークの魅力を伝えるため、観光客の増加に伴ってツアーも人気です。

東日本大震災の記憶を
後世に伝えるために

11.25 三陸ジオパーク 被災地巡検
震災復興シンポジウム

シンポジウム講演者
尾池和夫氏

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大地の遺産とそれらの持続可能な発展

第5回ジオパーク国際ユネスコ会議
5th International UNESCO Conference on Geoparks

GEOPARKS 2012
2012年(平成24年)
5月12日(土)~15日(火)
鳥取県鳥取市ジオパーク

第5回ジオパーク国際ユネスコ会議
5th International UNESCO Conference on Geoparks

6/21 プレイベント「シンポジウム」
『鳥取県ジオパークと観光振興のゆくえ』開催
会場： 津山ふるさと会館
内容： 【基調講演】 深見勉 (鳥取大学大学院水産・環境科学総合研究科教授) 演題「ジオパークに学ぶおもしろい地域のつくりと歩み」
【パネルディスカッション】
『鳥取のふるさとづくり〜鳥取県ジオパークを盛り上げよう』
※詳細は、こちらをご覧ください。

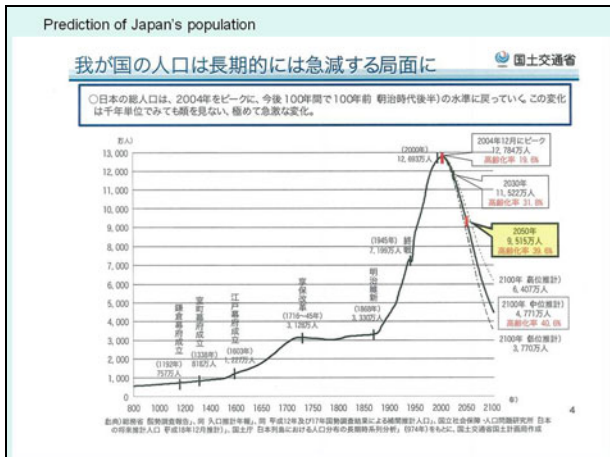
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ありがとうございます。
Thank you very much.
谢谢
감사합니다
ขอบคุณ มาก ครับ
Спасибо

尾池和夫『日本列島の巨大地震』
岩波科学ライブラリー
2011年10月26日

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基調講演Ⅱ「地震津波防災における役割と戦略」

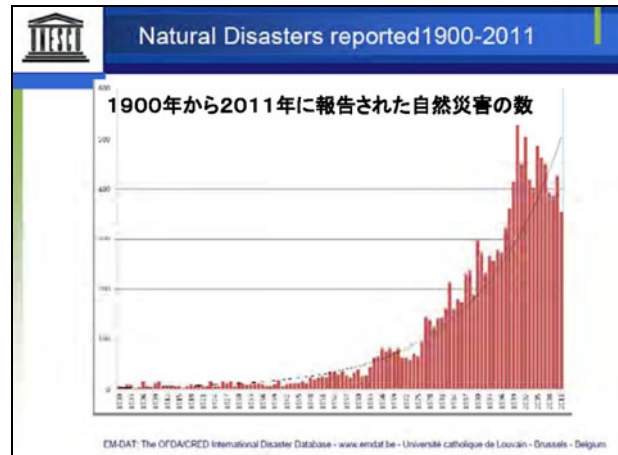
バダウィ・ルーバン ユネスコ科学部門自然災害ユニット部長

Keynote Lecture 2 “UNESCO’s roles and strategies for reducing earthquake and tsunami disasters”

Badaoui Rouhban, Director, Unit for Natural Disasters, Natural Sciences Sector, UNESCO



1

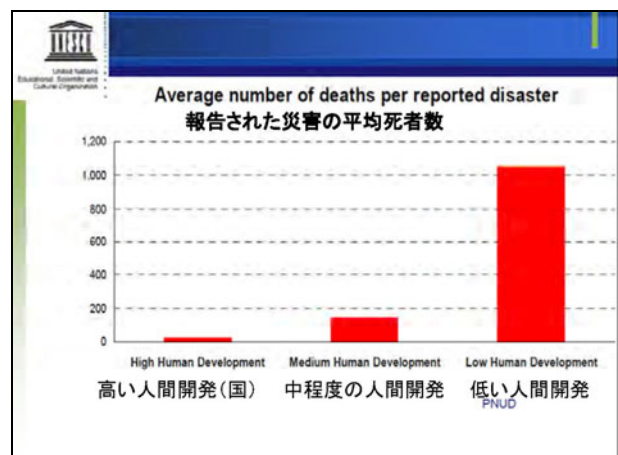


2

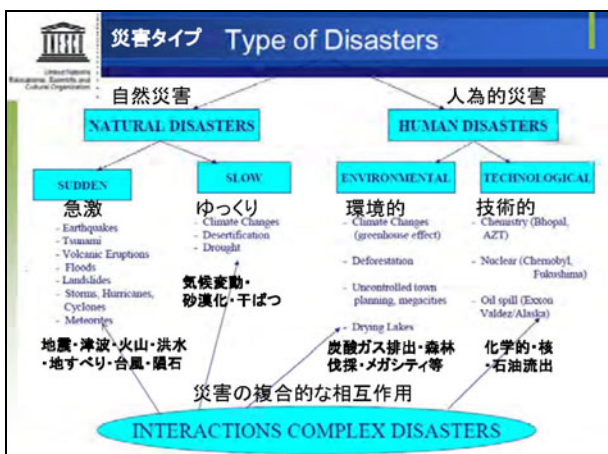
10 Major Disasters (fatalities) in the last 30 years
最近30年間の10大災害 (死者数)

Iran	Earthquake	1990	35,000
Bangladesh	Cycl/flood	1991	140,000
Venezuela	Flood	1999	30,000
Iran	Earthquake	2003	27,000
Indonesia, others	Eg/tsunami	2004	over 280,000
Pakistan	Earthquake	2005	over 80,000
Myanmar	Cycl/flood	2008	over 130,000
China	Earthquake	2008	90,000
Haiti	Earthquake	2010	over 200,000
Armenia	Earthquake	1988	25,000

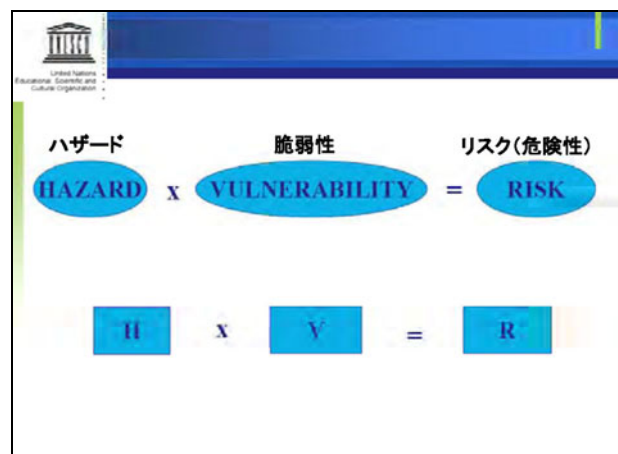
3



4



5



6



7



8

United Nations system engaged in DRR
防災に関わる国連のシステム

International Strategy for Disaster Reduction (ISDR)

UNESCO

UNICEF

UN-HABITAT

United Nations Human Settlements Programme

World Meteorological Organization

INPECC

WORLD BANK

World Health Organization

UNEP

9

兵庫行動枠組 (HFA)
Hyogo Framework for Action

Five Priority Areas 5つの優先分野

- Governance. ガバナンス
- Risk identification, assessment, monitoring and early warning. リスク評価・早期警報
- Knowledge management and education. 研究・教育
- Reducing underlying risk factors. リスク低減
- Preparedness for effective response and recovery. 救援・復興の備え

10

UNESCO ユネスコ

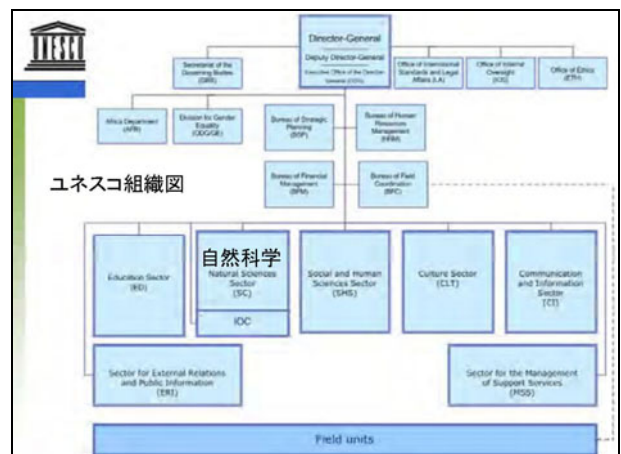
United Nations Educational Scientific Cultural Organization

国際連合 教育科学文化機関

(natural, social, human sciences)

(culture, communication, information, WHC)

11



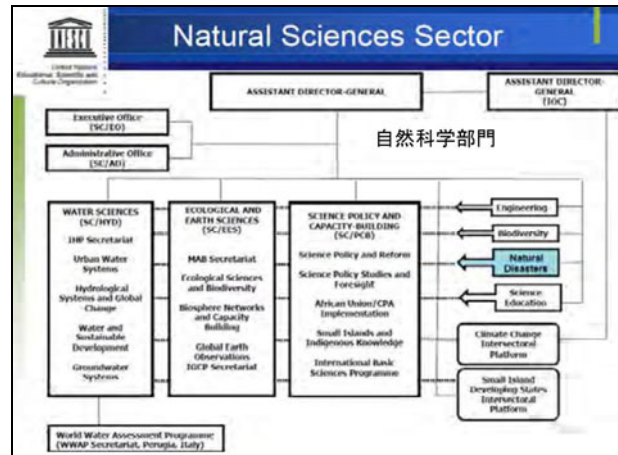
12

防災のためのユネスコの活動
UNESCO's Actions for Disaster Reduction

Long-term Goals
長期目標

- ❖ Observation and early warning networks of natural hazards
- ❖ Hazard risk mapping ハザードマップ
- ❖ Disaster-resistant building codes 耐震建築基準
- ❖ Education for disaster reduction 防災教育
- ❖ Help make schools safer 安全な学校を支援
- ❖ Promotion of public awareness through communication
- ❖ Protection of cultural monuments and sites
- ❖ Social dimensions and ethics of disasters

13



14

UNESCO Scientific Programmes

ユネスコ科学プログラム

- ❖ **Natural Sciences 自然科学**
 - International Hydrological Programme (IHP)
 - Man and the Biosphere Programme (MAB)
 - International Engineering Initiative
 - International Geosciences Programme (IGCP)
 - Intergovernmental Oceanographic Commission (IOC)
- ❖ **Social and Human Sciences 社会・人間科学**
 - Management of Social Transformations (MOST) Programme

15

Establishment of international and regional centres
国際的・地域的センターの設立

- Japan,
- Peru,
- Iran,
- FYR Macedonia,
- Netherlands
- ...

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18

数分でどこに最初の津波が来るか

United Nations Educational, Scientific and Cultural Organization

Where the First Wave Arrives in Minutes
Indonesian Lessons on Surviving Tsunamis near Their Sources インドネシアの津波の教訓




19

Pakistan Flood Risk Management パキスタンの洪水管理

United Nations Educational, Scientific and Cultural Organization



❖ International Flood Initiative
国際的な洪水対策

© UN Photo/Evan Schneider
A view of heavy flooding caused by monsoon rains in Punjab Province, near the city of Multan, Pakistan



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Pakistan Flood Risk Management パキスタンの洪水管理

United Nations Educational, Scientific and Cultural Organization

- ❖ Integrated flood and watershed management
- ❖ Groundwater resources for emergency situations
- ❖ Glaciers Melt, landslides and ground instability geohazards in flood affected areas
- ❖ Education and capacity building as a cross-cutting issue

21

International Flood Initiative 国際的な洪水対策

United Nations Educational, Scientific and Cultural Organization

International Centre for Water Hazard and Risk Management (ICHARM)
Tsukuba, Japan
水災害・リスクマネジメント国際センター (ICHARM) つくば(土研)

Global Center of Excellence for Water Hazard and Risk Management
ICHARM
International Centre for Water Hazard and Risk Management under the auspices of UNESCO




22

UNESCO-IHE ユネスコ水教育研究所 (IHE)

United Nations Educational, Scientific and Cultural Organization



- Flood resilience
- Floating buildings
- Redesigning urban areas
- Flood warning
- Developing flexible, appropriate software tools for real-time flood prediction
- Examining the effect of climate on flood prediction tools
- Using SMS messaging to deliver flood warning by location

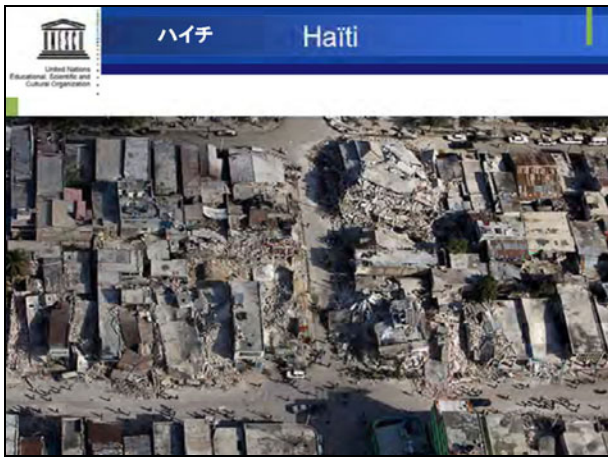
23

DROUGHT HORN OF AFRICA

United Nations Educational, Scientific and Cultural Organization

- Operational Regional Drought early warning system
- A Regional Groundwater Resources Database
- A critical mass of scientists
- A set of drought response policies for managing groundwater in emergency situations

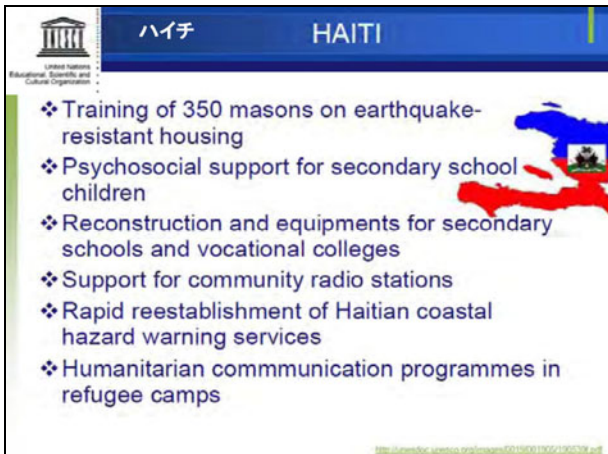
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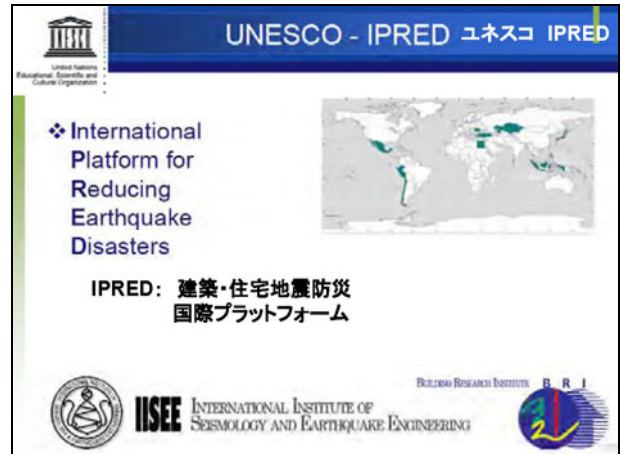
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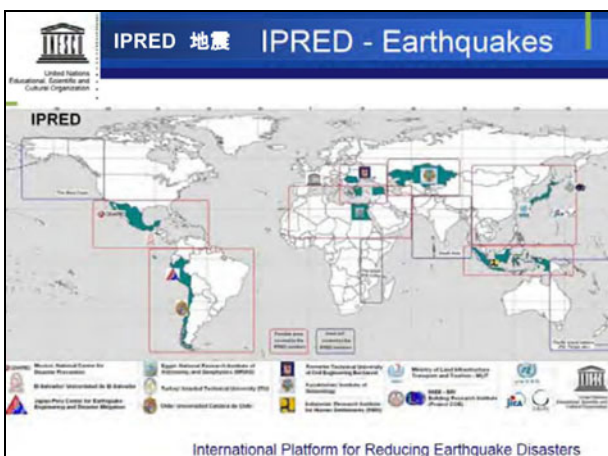
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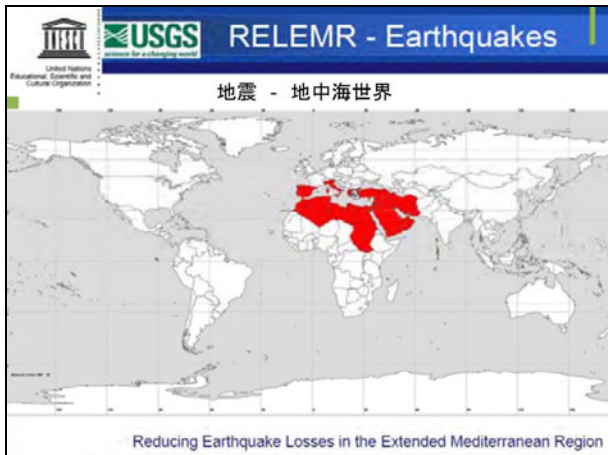
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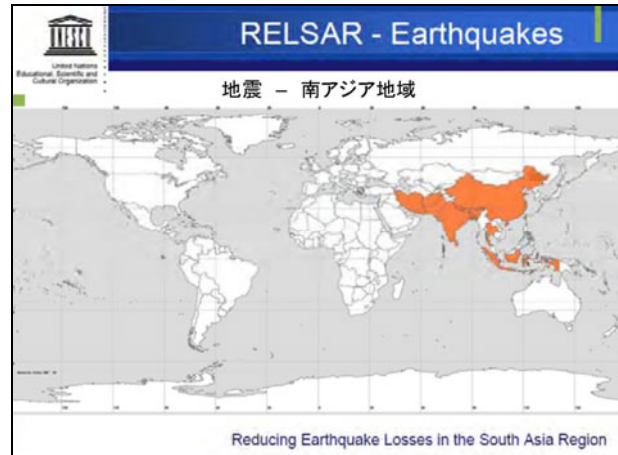
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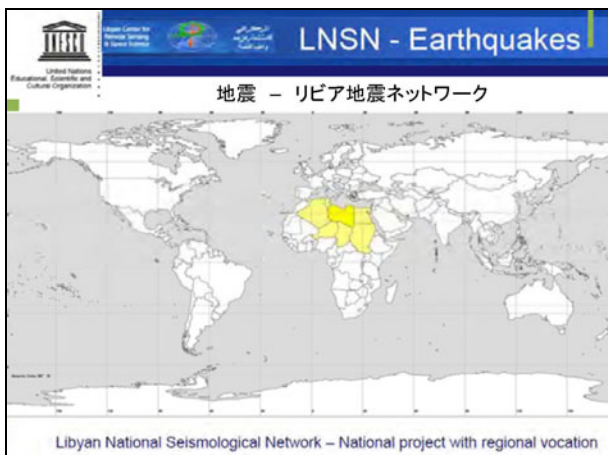
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建築基準 グローバル タスクフォース
❖ Global Taskforce on Building Codes

34



35

カトマンズとニューデリー事務所の業務

- ❖ Establishment of Earthquake Monitoring Stations in Nepal
- ❖ Preparedness for Flood Risk Reduction through Mapping and Assessing Risk and Management Options and Building Capacity in Lal Bakaiya Watershed, Nepal
- ❖ Improving Human Security through Better Understanding of Flood Mechanism in the Himalayas: A Pilot Project for Flash Flood Management in the lesser Himalayas of South Asia



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ICL 地すべり ICL - Landslides

国際斜面災害研究機構
International Consortium on Landslides

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International Consortium on Landslides (ICL) ICL 国際斜面災害研究機構

Kyoto University

38

IMEWS - Volcanoes

IMEWS 国際火山噴火早期警戒制度 (火山)

Volcanoes - International Monitoring Early Warning System

39

DIPECHOプロジェクト: 中米総合防災警報システム

DIPECHO Project: Strengthening Early Warning Systems in Central America from a multi-threat perspective

DIPECHO: 欧州連合人道局 災害準備体制

40

DIPECHOプロジェクト(中米)の内容

- ❖ Inventory and diagnostic of EWS in Central America.
- ❖ Study of EWS legal frameworks and procedures.
- ❖ Validation of the "Manual on EWS Regional Flood" (produced by the OAS).
- ❖ Guidelines for the design and sustainability of EWS to Landslides / Mudslides
- ❖ Development of educational materials on EWS for the Ministries of Education.
- ❖ Incorporation of EWS in the formal school curriculum of each country.
- ❖ Awareness workshops and training aimed at authorities and officials from the ministries of education in the subject EWS.
- ❖ Support national efforts to commemorate the International Day for Disaster Reduction

41

Safe School Strategy 安全な学校戦略

School collapse or damages

被災した学校の数

- Tangshan, China 1976 (>2,000)
- Spitak, Armenia 1988 (>1,000)
- Ardakul, Iran 1997 (110)
- Bingol, Turkey 2003 (84)
- Ahmedabad, India 2003 (>25)
- Kashmir, Pakistan 2005
- Sichuan, China 2008 (>6,500 Classrooms)
- Haiti 2010 (>5,000 schools)

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School Safety 学校の安全性




学校の災害管理
School Disaster Management

防災教育
Disaster Prevention Education

安全な学校施設
Safe School Facilities

1. Baseline study on school safety activities worldwide
2. Methodology for assessing school safety
3. School safety index
4. Guidelines for strengthening school safety
5. Implementation of school safety measures, e.g.: (soft → emergency plans) (hard → retrofitting)

- ❖ Multi-sectoral (ED, SC, SHS, CLT, CI)
- ❖ UN Interagency (UNISDR, Unicef, WB, etc)
- ❖ DRR Community (Plan, Save the Children, INEE)

TPKE

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UNESCO - Indigenous ユネスコ 在来の知恵




Indigenous Knowledge
在来(伝統)の知恵



ESD-DRR
防災教育 - 減災

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DIPECHOプロジェクト: 津波学習と備え(南米)



DIPECHO Project: Learning and Preparedness for Tsunamis



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ユネスコ プロジェクト: 津波学習
チリ・コロンビア・エクアドル・ペルー




❖ Learning and

Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura

Fortalecimiento del Sistema Regional de Alerta ante Tsunami en Chile, Colombia, Ecuador y Perú

46

Education Package "Earthquake Preparedness Programme for School"
UNESCO Office, Jakarta

教育パッケージ 学校の地震対策プログラム (ジャカルタ)

Reinforce the school community group in disaster preparedness

1. Development Kit for Teachers
2. Learning Materials for Teachers
3. Worksheet for Students



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Asia-Pacific Cultural Centre for UNESCO (ACCU)
ユネスコ アジア(太平洋)文化センター (ACCU) 日本

Programmes and materials in Disaster Reduction and Preparedness



減災と備えのためのプログラムと教材



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UNESCO
Educational, Scientific and Cultural Organization

減災 活動 DRR Activities サブサハラアフリカ
Sub-Saharan Africa



49

UNESCO
Educational, Scientific and Cultural Organization

Support for the study of geo hazards within the framework of the geosciences Initiatives African Region

- ❖ to improve the awareness and the understanding of, and the preparedness for geohazards
- ❖ to be included and specifically addressed in the study of Earth science in the Africa universities.

地球科学研究の枠組みでのハザード研究支援(アフリカ地域)



50

UNESCO
Educational, Scientific and Cultural Organization

Hyogo framework for action
兵庫行動枠組 2005-2015

優先行動3: 防災文化を構築するため、知識、技術、教育を活用する

Priority No 3:
Knowledge, innovation and education - Building a culture of resilient communities

“the integration of disaster risk reduction as an intrinsic element of the UN Decade of Education for Sustainable Development”,

51

UNESCO
Educational, Scientific and Cultural Organization

DRR integration into curricula
教育カリキュラムへの防災の取込み

1. A comprehensive mapping that captures key national experiences and good practices with regards to integration of DRR in school curriculum
2. A guidance for governments, ministries and partner agencies and organizations to effectively integrate DRR in curricula. It will draw from previous experiences and further DRR agenda through curriculum enhancement.



unicef

TPKE

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Educational, Scientific and Cultural Organization

教育の最低基準: 備え、救援、復興

Minimum Standards for Education: Preparedness, Response, Recovery.



Notes d'orientation pour La construction d'écoles plus sûres

Organisation des Nations Unies pour l'éducation, la science et la culture

UNESCO

INEE

THE WORLD BANK

Dispositif mondial de résilience des établissements et de recouvrement (IDRR)

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UNESCO
Educational, Scientific and Cultural Organization

ユネスコ バンコク アジア太平洋地域教育局
UNESCO Bangkok
Asia and Pacific Regional Bureau for Education



54

Education for Natural Disaster Preparedness in the Context of ESD
UNESCO Bangkok 防災教育ESD

- ❖ Take stock of ongoing ENDP activities at the country level
- ❖ Conduct situational analyses in the following proposed countries to identify and address gaps and needs:

China	Japan	中国 日本
India	Indonesia	インド インドネシア
Philippines	Sri Lanka	フィリピン スリランカ
Thailand	Vanuatu	タイ バヌアツ

1. Development of an ENDP materials website
2. Regional Workshop on Education for Disaster Risk Reduction for Sustainable Development
3. Curriculum recommendations

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防災教育教材 (教師用マニュアル)

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防災教育用教材

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Web-Tools ウェブ・ツール

58

Culture Sector 文化部門

- ❖ World Heritage 世界遺産

Protecting, safeguarding and managing the tangible and intangible heritage

59

The World Heritage Convention 世界遺産条約

The World Heritage Convention:

- unique international legal instrument for the protection of both cultural and natural Heritage
- international cooperation in favour of the promotion of peace and recognition of cultural diversity

60

Strategy for reducing risks at World Heritage Properties 世界遺産 防災戦略

- ❖ Purposes: 目的: 世界遺産の保護を強化する
- ❖ Strengthen the protection of World Heritage
- ❖ Contribute to sustainable development
 - integrate concern for heritage into national disaster reduction policies
 - incorporate concern for disaster risk reduction within management plans and systems for World Heritage properties in their territories.

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Heritage 世界遺産 緊急事態で作られた概念

A concept created by an emergency:

1910 : The first dam is built in Aswan

The Nubian monuments are threatened by the water of the lake created by the dam.

1960 : The construction of the high dam of Aswan is accomplished

"The Nubian monuments will disappear under the water unless..."



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8 March 1960 1960年3月8日 ユネスコが活動を開始

UNESCO launches an international campaign...

UNESCO requests international technical and financial assistance in order to save the Nubian monuments.

A group of experts, coming from different countries, is asked to prepare an action plan in order to safeguard all the Nubian heritage.

- the contribution of 50 countries
- an amount of around US\$ 80 millions
- the acceleration of the excavations

The temples of Abu Simbel and Philae are "saved".



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UNESCO's response to

Natural disaster

自然災害へのユネスコの責任

To protect cultural heritage

文化遺産の保護

ペルー・マチュピチュの斜面崩壊 Landslides, Machu Pichu, Peru

International Programme on Landslides supported by UNESCO



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BAM, IRAN イラン バム



Copyright: Richard Langenbach

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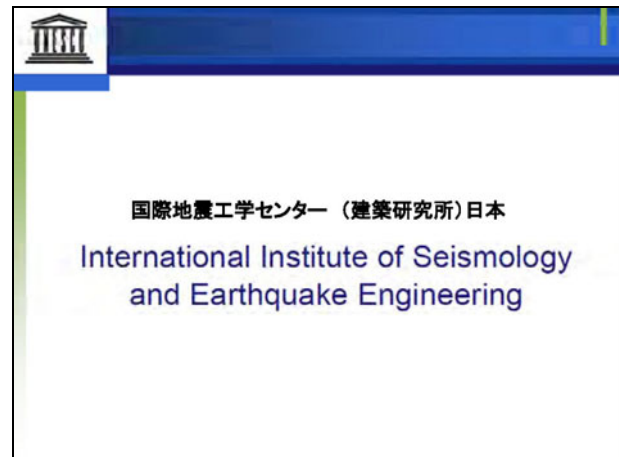
2003年 バム地震後



66



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講演「2015 年以後の視点—災害軽減の実績と今後の課題」

サルバノ・ブリセーニョ IRDR 科学委員会委員長・前国連国際防災戦略事務局長

"Views for the post-2015: achievements and challenges in the field of disaster risk reduction"
 Sálvano Briceño, Chair, Science Committee, Integrated Research on Disaster Risk/ Former Director of UN International Strategy for Disaster Reduction

防災と自然災害に強い社会構築のための国際活動の成果と課題

Achievements and Challenges in International Activities for Disaster Risk Reduction and Building Resilience to Natural Hazards

International Memorial Symposium on "Protecting Lives from Earthquake and Tsunami Disasters" BRI/GRIPS/UNESCO, Sokairo-Hall of GRIPS, Tokyo, 27 June 2012

サルバノ・ブリセーニョ IRDR/ICSU 科学委員会委員長 前UNISDR事務局長 (2001-2011)

Sálvano Briceño Chair, Science Committee, Integrated Research on Disaster Risk (IRDR/ICSU) Former Director UNISDR (2001-2011)

www.irdrinternational.org www.preventionweb.net www.unisdr.org

1

全体構成 Overview

I Global data and trends on "natural" disasters, understanding key concepts
 「自然」災害の世界データと傾向、主な概念の理解

II Key international instruments: UN International Strategy for Disaster Reduction and its Hyogo Framework for Action (2005-2015), and Integrated Research on Disaster Risk
 主な国際的しくみ: 国連国際防災戦略の兵庫行動枠組(2005-2015)と防災重点研究

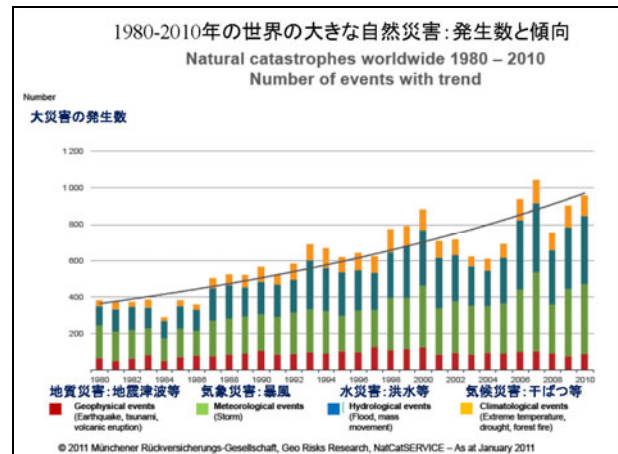
III Climate change, a main disaster reduction issue
 気候変動、重要な防災の課題

2

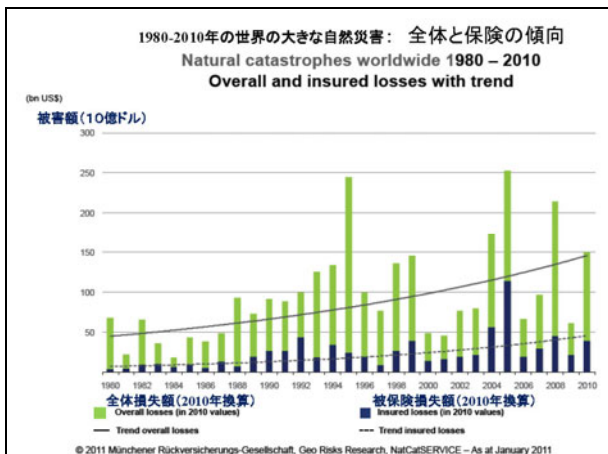
「自然」災害の世界データと傾向、主な概念の理解

I Global data and trends on "natural" disasters, understanding key concepts

3



4



5

世界の大きな自然災害 1980-2010: 全体損失額の上位10災害
 Significant natural catastrophes worldwide 1980 – 2010
 10 costliest natural catastrophes ordered by overall losses

期間 Period	災害 Event	影響地域 Affected Area	全体損失 保険損失分		死者数 Fatalities
			Overall losses 百万米ドル US\$ m, original values	Insured losses	
25-30.8.2005	Hurricane Katrina カトリナ	USA: LA, New Orleans, Shreve, MS, Biloxi, Paragale, Wetland, Gulfport	125,000	62,200	1,300
17.1.1995	阪神・淡路 地震	Japan: Hyogo, Kobe, Osaka, Kyoto	100,000	3,000	6,400
12.5.2008	四川地震 地震	China: Sichuan, Mianyang, Beichuan, Wenchuan, Shidang, Chengde, Guangyuan, Ngawa, Yibai	85,000	300	84,000
17.1.1994	ノースリッジ 地震	USA: Northridge, Los Angeles, San Fernando Valley, Ventura, Orange	44,000	15,300	80
6-14.9.2008	Hurricane Ili イレー	USA: Cuba, Haiti, Dominican Republic, Turks and Caicos Islands, Bahamas	38,300	18,500	170
May-September 1996	中国水害 洪水	China: Jiangxi, Jiangsu, Anhui, Henan, Hunan, Sichuan, Shaanxi, Shanxi, Gansu, Hubei, Guangdong, Guangxi, Yunnan, Inner Mongolia, Tibet, Xinjiang, Ningxia, Qinghai, Shaanxi, Shanxi, Gansu, Hubei, Guangdong, Guangxi, Yunnan, Inner Mongolia, Tibet, Xinjiang, Ningxia, Qinghai	30,700	1,000	4,200
27.2.2010	チリ地震 地震	Chile: Bio Bio, Concepción, Talcahuano, Coronel, Dichato, Chillán, Cerro Maipo, Talca, Curicó	30,000	8,000	520
23.10.2004	東日本 地震	Japan: Hiroshu, Niigata, Ojya, Tokyo, Nagasaki, Yamaguchi	28,000	760	50
23-27.8.1992	中越地震 地震	USA: FL, Homestead, LA, Bahamas	26,500	17,000	60
27.6-13.8.1996	中国水害 洪水	China: Guizhou, Hebei, Guizhou, Zhejiang, Sichuan, Hunan, Anhui, Jiangxi, Hubei, Guangxi, Jiangsu	24,000	445	3,050

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世界の大きな自然災害 1980-2010: 被保険損失額の上位10災害
Significant natural catastrophes worldwide 1980 - 2010
10 costliest natural catastrophes ordered by insured losses

期間 Period	災害 Event	影響地域 Affected Area	全体損失 被保険分 Overall losses Insured losses 百万米ドル US\$ m. original values		死者数 Fatalities
25-30.8.2005	ハリケーン カトリナ	USA: LA, New Orleans, Slidell, MS, Biloxi, Pascagoula, Waveland, Gulfport	125,000	62,200	1,300
9-14.9.2008	ハリケーン イク	USA, Cuba, Haiti, Dominican Republic, Turks and Caicos Islands, Bahamas	38,300	18,500	170
23-27.8.1992	ハリケーン アンドリュー	USA: FL, Homestead, LA, Bahamas	26,500	17,000	60
17.1.1994	地震 プレズリッジ	USA: Northridge, Los Angeles, San Fernando Valley, Ventura, Orange	44,000	15,300	60
7-21.9.2004	ハリケーン ナン	USA, Trinidad and Tobago, Venezuela, Colombia, Mexico	23,000	13,800	130
19-24.10.2005	ハリケーン ウィラ	USA, Bahamas, Cuba, Haiti, Jamaica, Mexico	22,000	12,500	40
20-24.9.2005	ハリケーン リタ	USA: LA, Lake Charles, Holly Beach, Cameron, New Orleans, MS, TX, Houston	16,000	12,100	10
27.2.2010	地震 チリ地震	Chile: Bio Bio, Concepción, Talcahuano, Coronel, Dichato, Chiloé, Del Maipo, Talca, Curico	30,000	8,000	500
11-14.8.2004	ハリケーン チャーリー	USA, Cuba, Jamaica, Cayman Islands	16,000	8,000	40
26-28.9.1991	台風 1991台風	Japan: Miyazhi, Hokkaido, Hakata	10,000	7,000	60

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世界の大きな自然災害 1980-2010: 死者数の上位10災害
Significant natural catastrophes worldwide 1980 - 2010
10 deadliest events

期間 Period	災害 Event	影響地域 Affected Area	全体損失 被保険分 Overall losses Insured losses 百万米ドル US\$ m. original values		死者数 Fatalities
12.1.2010	地震 ハイチ地震	Haiti: Port-au-Prince, Petionville	8,000	200	222,570
26.12.2004	地震 インド洋津波	Sri Lanka, Indonesia, Thailand, India, Bangladesh, Myanmar, Maldives, Malaysia	10,000	1,000	220,000
24.5.2008	地震 グアルギス	Myanmar: Aungmyethay, Yangon, Bugeyat, Inawthady, Bago, Yamé, Mon, Lapulla, Wang Kyi	4,000		140,000
29-30.4.1991	津波 バングラ1991	Bangladesh: Bay of Bengal, Cox's Bazar, Chittagong, Bole, Noakhali districts, esp. Kutubdia	3,000		139,000
8.10.2005	地震 カシミール地震	Pakistan, India, Afghanistan	5,200		86,000
12.5.2008	地震 四川地震	China: Sichuan, Mianyang, Beichuan, Wenchuan, Shifang, Chengde, Guanguan, Ngawa, Yalan	85,000		84,000
July-August 2003	洪水 欧州熱波	France, Germany, Italy, Portugal, Romania, Spain, United Kingdom	13,800		70,000
July-Sept. 2010	洪水 ロシア熱波	Russia	2,000		56,000
21.6.1990	地震 イラン地震	Iran: Caspian Sea, Gilan Province, Manjil, Rudbar, Zanjan, Sefid, Qazvin	7,100		40,000
8-19.12.1999	洪水 南米水害	Venezuela, Vargas, La Guaira Punta de Mulas, Miranda, Nueva Esparta, Yacuyacu, Kolumbien	3,200		30,000

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8

災害リスク軽減(防災)とは何か?
What is Disaster Risk Reduction (DRR)?

方法と手段からなる概念的枠組み

- A conceptual framework consisting of ways and means:
 - 脆弱性を減らし能力を増やす災害リスクの最小化
 - To minimize disaster risks (hence, loss of lives, livelihoods and property) by reducing the degree of vulnerability and increasing resilience capacity
 - To avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of natural hazards with a sustainable development approach

持続可能な開発アプローチで危険要因を避けるか制限すること

Natural hazard + Exposure x Vulnerability - Capacity = Disaster Risk

自然(危険)要因+影響範囲 x 脆弱性-(対応)能力 = 災害リスク

9

世界の傾向 — 災害は自然(現象)ではない
Global Trends - Disasters are NOT natural

自然または人為的な危険要因(ハザード)、気候変動など
Greater exposure to natural and human-induced hazards, climate change and variability

社会経済的: 貧困、無計画な成長、リスク認識欠如など
Socio-economic: poverty & unsustainable development styles, unplanned urban growth and migrations, lack of risk awareness & risk governance institutions & accountability...

物理的: 不十分な土地利用、危険地域の住宅建設など
Physical: insufficient land use planning, housing & critical infrastructure in hazard prone areas, little safety awareness...

生態系悪化と自然資源の枯渇 (マングローブ、湿地など)
Ecosystem & natural resource depletion (coastal-coral reefs, mangroves..., mountains, watersheds, wetlands, forests...)

脆弱性
HAZARDS + EXTREME EVENTS
VULNERABILITY

10



11

これまでの災害に対する認識とアプローチ
Traditional perceptions and approaches on disasters... priorities have been and still are...

人々のあきらめ

- Public fatalistic perception: « natural » disasters = acts of god = focus on preparedness for response, not understanding disasters as a human creation through wrong or incomplete development, not focused on building resilience and reducing human and social vulnerability, as it has happened in health and accidents prevention, among other hazards
- Governance & policy processes focused on preparing for the emergency and the short-term: 短期・緊急対応が政策の中心
 - EMERGENCY MANAGEMENT: disaster management & humanitarian action: politically sensitive, « CNN syndrome » with DRR still a small complementary/secondary function
 - SECTORIAL AND SHORT-TERM development with policy integration, long-term sustainable development vision and holistic approach still mainly theoretical
- Fragmented knowledge transmission in academic institutions: NATURAL SCIENCES, ECONOMICS & QUANTITATIVE ANALYSIS and not enough social sciences, psychology, anthropology, sociology, communications, management and leadership, ethics, governance, « new economics »... or knowledge-based and applied research (DRIP syndrome)

学術の世界での断片的な知識の伝達

12

2つの主要文書

Two key documents

自然のハザード、自然でない災害(人災) 世界銀行
Natural Hazards, Unnatural Disasters – The Economics of Effective Prevention by World Bank and ISDR system

様々な防災政策・対策のコスト便益分析、防災に関する幅広い影響など

- Evaluates economic arguments related to DRR, through a cost-benefit analysis of different DRR policies and measures
- Influences the broader thinking related to disaster risk, awareness of the potential to reduce the costs of disasters, and guidance on the implementation of disaster risk-reducing interventions
- The study was issued in Nov 2010 and is available at: <http://www.efdr.org/efdr/nhud-home>

2011 世界災害リスク軽減評価報告書
2011 Global Assessment Report on Disaster Risk Reduction by ISDR system partners

2011年5月の第3回グローバルプラットフォームで発表、新しいアプローチを含む

- Report was launched at the 3rd session of the Global Platform for DRR, Geneva, 8-13 May 2011
- It contains new approaches, mainly requesting for radical reform of institutional mechanisms for managing risk among other
- Available at www.preventionweb.net and www.unisdr.org

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**主な国際的しくみ： 国連国際防災戦略の
兵庫行動枠組(2005-2015)と防災重点研究**

II Key international instruments: UN International Strategy for Disaster Reduction and its Hyogo Framework for Action (2005-2015), and Integrated Research on Disaster Risk

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減災 — 進行中の事項

Disaster Reduction – An Agenda in Progress

国際防災の十年

1989: IDNDR 1990-1999 – promotion of disaster reduction, scientific development
 1994: 1st WCDR - Yokohama Strategy and Plan of Action – Mid-term review IDNDR, first disaster reduction policy guidance
 1998: UNDP inherits DRR function from DHA (former OCHA) for supporting capacity development on DRR at national level
 2000: International Strategy for Disaster Reduction (ISDR) – for increased public awareness, link to sustainable development, enlarged coordination at int'l and regional levels, networking and partnerships ISDR secretariat, UN Trust Fund
 2002: Johannesburg Plan of Implementation- WSSD Includes a new section on "An integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management..."
 2005: 2nd WCDR - Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters
 2007: 1st session Global Platform for Disaster Risk Reduction (GP2007)
 Monitor HFA progress, facilitate further actions and partnerships, take stock, identify gaps and obstacles and share lessons and good practices
 2009: 2nd session Global Platform for DRR (GP2009) Monitor HFA progress, identify gaps and priorities
 2010: Mid-term review of the HFA and links with CC Adaptation COP-16, MDGs 2010 review and 2012 Sustainable Development Rio Summit
 2011: 3rd session Global Platform for DRR (GP2011, Geneva, 8-13 May 2011) Monitor HFA progress, identify gaps and priorities; 4th session, Geneva, 19-23 May 2013...

第3回グローバルプラットフォーム、第4回は2013年5月19日-23日

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減災のための国際戦略

International Strategy for Disaster Reduction

国際防災の10年IDNDR1990-1999を継承する国連総会決議A/54/219により開始
Launched in 2000 by UN General Assembly Resolution A/54/219 as successor of the International Decade on Natural Disaster Reduction – IDNDR, 1990-1999:

The ISDR aims at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters.

事務局長



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第2回世界防災会議WCDR 2005年1月神戸にて

World Conference on Disaster Reduction

2nd WCDR, Kobe, Hyogo, Japan, 18-22 January 2005

兵庫行動枠組 2005-2015 (HFA) : 災害に強い国・コミュニティの構築
 Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters (HFA)

✓ 3 Strategic goals	3つの戦略目標
✓ 5 Priorities for action	5つの優先行動
✓ Implementation and follow-up	実行とフォローアップ

期待される成果
Expected outcome:

今後10年間でWCDRは、コミュニティや国の災害損失の基本的な削減を目指す。
 The WCDR resolved to pursue the following expected outcome for the next 10 years: *the substantial reduction of disaster losses, in lives & in the social, economic & environmental assets of communities & countries.* The realization of this outcome will require the full commitment & involvement of all actors concerned, including governments, regional & international organizations, civil society including volunteers, the private sector & the scientific community.

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兵庫行動枠組 2005-2015 (つづき)

Hyogo Framework for Action 2005-2015 (continued)

3つの戦略目標
3 strategic goals:

持続可能な開発の取組みに減災の観点より効果的に取り入れる
 - The integration of disaster risk reduction into sustainable development policies & planning

全てのレベル、特にコミュニティレベルで防災体制を整備し、能力を向上する
 - The development & strengthening of institutions, mechanisms & capacities to build resilience to hazards

緊急対応や復旧・復興段階において、リスク軽減の手法を体系的に取り入れる
 - The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response & recovery programmes

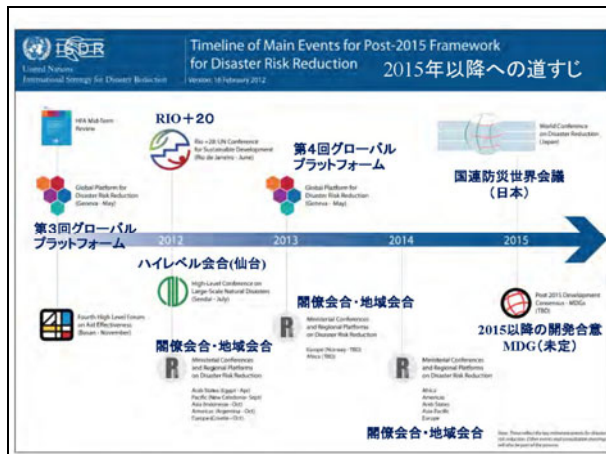
<http://www.hemri21.jp/21buumeiseminar/handout/b-f081219matsusaka.pdf> 訳文

18

兵庫行動枠組 2005-2015 (つづき)
Hyogo Framework for Action 2005-2015 (continued)
 5つの優先行動
Five priorities for action:

- 1. Governance:** ensure that disaster risk reduction is a national and local priority with strong institutional basis for implementation
 防災を国、地方の優先課題に位置づけ、実行のための強力な制度基盤を確保する
- 2. Risk identification:** identify, assess and monitor disaster risks and enhance early warning
 災害リスクを特定、評価、観測し、早期警報を向上する
- 3. Knowledge:** use knowledge, innovation and education to build a culture of safety and resilience at all levels
 すべてのレベルで防災文化を構築するため、知識、技術、教育を活用する
- 4. Reducing the underlying risk factors** in various sectors (environment, health, construction, private sector etc.)
 潜在的なリスク要因を軽減する
- 5. Strengthen disaster preparedness for effective response**
 効果的な応急対応のための事前準備を強化する

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減災 — 進行中の事項 (つづき)
Disaster Reduction – An Agenda in Progress, cont...
 次なる挑戦 2015年とそれ以降
Next challenges, to 2015 & beyond...

- より強力なリスク・ガバナンスの仕組み
- Stronger risk governance institutions**, including integration of DRR into various sectors: issue management; team building; stronger local implementation with greater participation, decentralization, transparency and accountability at all levels...
- DRR recognized as urgent first step for CC adaptation** in successor agreement to Kyoto Protocol (Doha 2012...), urgency to start planning for future relocations due to sea-level rise, glacier melting and water pressures...
- Hazard risk as essential requirement in MDGs and future SDGs (UNCSD, Rio+20) & development planning & sectors (land-use, urban & sectorial planning)**
 防災を気候変動適応の緊急な第一段階と認識すること
 危険要因をミレニアム開発目標や将来の持続可能な開発目標の基本要素事項とすること

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減災 — 進行中の事項 (つづき)
Disaster Reduction – An Agenda in Progress, cont...

- 危険要因の削減を基本的な生態系サービスと認識
- Hazard risk reduction recognized as essential ecosystem service** by environmental policies & legislation
- Greater awareness-raising programmes for wider public understanding of risk & vulnerability, in particular of **building safety for homes, schools, offices...**; 住宅、学校事務所の建築安全性
- Greater leadership by high-level authorities** in public & private sectors & civil society to ensure a paradigm shift; risk knowledge, a regular feature in educational programmes at all levels, same as health or traffic prevention... 上級機関の指導性の発揮
- Enhanced **ethical perspective of disasters & risk reduction** as part of sustainable development (6 sustainability principles), including rights-based approach, accountability & transparency for disaster losses & impacts, participation, decentralisation... 防災の倫理的展望
- Urgency in building resilience in those countries whose **economy & trading capacity** are dependent on exports that are especially affected by recurrent natural hazards such as tropical storms, floods or drought
 輸出経済や貿易に依存する国の特に洪水などへの緊急な備え

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ICSU/ISSC/ISDR災害リスク計画の重点研究: 主な質問と反応
The Integrated Research on Disaster Risk programme of ICSU/ISSC/ISDR
Key questions and a response:

- Why, despite advances in the natural and social science of hazards and disasters, do losses continue to increase?
 The IRDR Science Plan: addressing the challenge of natural and human-induced environmental hazards with an integrated approach to research on disaster risk through: an international, multidisciplinary (natural, health, engineering and social sciences, including socio-economic analysis) collaborative research programme. To be found at: www.irdrinternational.org/
- To what extent is the world-wide growth in disaster losses a symptom and indicator of unsustainable development?
 科学の進歩にも関わらず、なぜ被害は増え続けるのか
 どの程度世界の災害被害額は持続可能でない開発の現象であり、またその指標となるのか

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災害調査の論点
Forensic Disaster Investigations – FORIN & IRDR Legacy

- Probe further into complex and underlying causes of growing disaster loss
- Fundamental cause of disasters
- Trace out and assign causal explanation of losses
- Intervening conditions that increased or reduce losses
- Series of case studies
- Common template and methodology as a standard for research on disaster risk
- 世界のハザード対策や実行能力の向上
 An enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts.
- 事後対応・復興から事前予防・強化・減災へ
 Societies to shift focus from response-recovery towards prevention-mitigation, building resilience and reducing risks, learning from experience and avoiding past mistakes.

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気候変動、重要な防災の課題



**III
Climate change, a main disaster reduction issue**

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**気候変動と災害リスク
Climate change and disaster risks**

より激しい事象は既に証拠がある(IPCC評価)

1. Evidence of more extreme events already found (IPCC Assessments) – temperatures rising, loss of glaciers and polar ice, droughts, heavy rainfall, heat and cold waves, stronger tropical cyclones, floods...
2. 海面上昇に対し、人口集中デルタや開発途上島嶼国(SIDS)が最も危険である
Populated deltas as well as small island developing states (SIDS) are most at risk to sea-level rise
3. 3通りの影響 i)より激しい事象、ii)新しい場所での事象、iii)新しい事象 がある
Impacts in 3 ways: (i) more extreme events (increased frequency and intensity) in same areas (ii) more extreme events in new areas, not prepared for them and (iii) new impacts from sea level and temperature rise, glacier melting and greater stresses on ecosystems and water
4. 災害リスクの増加は、基本的に開発の実施に伴い生じる
Increasing disaster risk is primarily due to development practices

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**災害リスク軽減のための気候政策
Climate policy to reduce disaster risks**

2007年COP13のバリ行動計画に防災が含まれる

1. UNFCCC COP 13 2007 Bali Action Plan proposed "risk management and risk reduction strategies, including risk sharing and transfer mechanisms"... and ... "disaster reduction strategies and means to address loss and damage in developing countries"...
2. 2010年COP16で気候変動対策と防災の合意を確認(合意は前年のCOP15)した
UNFCCC Ad-hoc Working Group on Long-term Cooperative Action agreed on DRR & HFA for CC adaptation at 2009 COP 15 Copenhagen, confirmed at 2010 COP 16 Cancun Adaptation Framework and Durban 2011...
3. 防災は国家の開発計画や気候変動適応計画で有効である
Disaster risk reduction & CC adaptation have the most leverage when placed at the centre of national development planning, DRR still to be integrated in national CC adaptation plans (NAPAs & other), & in criteria for all adaptation funding
4. IPCC 2012 気候変動適応を進めるための極端事象と災害のリスク管理特別報告(SREX)
IPCC 2012 Special Report on Managing the Risk of Extreme Events & Disasters to advance CC Adaptation (SREX), available at <<http://ipcc-wg2.gov/SREX/>>

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- **Climate change and disaster risk are intertwined issues** 気候変動と災害は結合
- **Important opportunity to achieve reductions in disaster risk** 災害軽減の重要な機会
- **HFA as an important available tool for adaptation to climate change and other hazards (earthquakes, etc.)** 気候地震等に有効 HFA
- **ISDR, IRDR, GFDRR, GNDR in place, more partnerships to take actions and work together** 関係組織はより多く連携

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**結論としてのいくつかの反省
Some reflections as conclusions**

- Need to avoid using « natural » disasters and use instead 'natural hazards' and 'disasters' or preferably, 'disasters caused by vulnerability to natural hazards' or 'disasters triggered by natural hazards'... 「自然」災害と言わず「自然ハザード」や「災害」を使う
- Need to promote and develop a policy focus on risk reduction and management (prevention, mitigation, preparedness) as essential requirement for SD, also of interest to private sector for ensuring business continuity, not only as CSR 減災に焦点をあてる
- Use comparisons with health prevention policies for advocacy and policy-making 運動の提唱や政策決定で、健康予防政策を比較参考にする
- A main common objective of DRR and CCA policies is to advocate for the urgent need to reduce risk and vulnerability to current climate variability as a first step or basis for adaptation to the longer-term effects of CC... 防災と気候変動適応政策は共通目的がある

29

ありがとうございます
THANK YOU

www.irdrinternational.org
www.preventionweb.net
www.unisdr.org
www.globalquakemodel.org

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講演「都市の新たな脅威としての長周期地震動」 瀬戸 一 東京大学地震研究所教授
 "Long-Period Ground Motion as a New Urban Threat" Kazuki Koketsu, Professor, Earthquake Research Institute, University of Tokyo

2012/06/27 Kenken symposium



Long-Period Ground Motion as a New Urban Threat

都市の新たな脅威としての長周期地震動

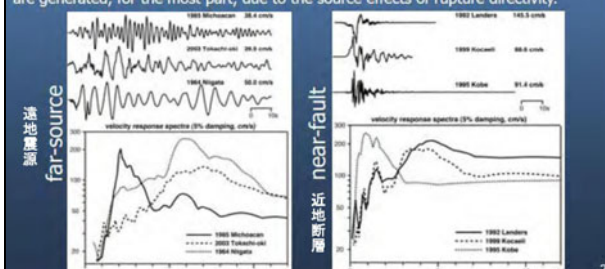
Kazuki Koketsu 瀬戸 一

Earthquake Research Institute, University of Tokyo 東京大学地震研究所

1

Background in the world (1) 世界の背景 (1)

Long-period ground motion becomes an important issue because of recent rapid increase of large-scale structures such as high-rise buildings, oil storage tanks, and long-span bridges. They can also affect long-period structures such as base-isolated buildings. Large subduction-zone earthquakes and moderate to large crustal earthquakes can generate far-source long-period ground motions in distant sedimentary basins with the help of path effects. Near-fault long-period ground motions are generated, for the most part, due to the source effects of rupture directivity.



遠地地震動 (far-source) 近地断層 (near-fault)

2

Background in the world (2) 世界の背景 (2)

Far-source ones mostly consist of surface waves with longer duration than that of near-fault ones. They can even be damaging in some circumstances; the worst example occurred in Mexico City due to the 1985 Michoacan earthquake. Further examples were provided by recent large events such as the 2003 Tokachi-oki, Japan, earthquake. In addition, long-period ground motions can be predicted only by numerical simulations, differently from short-period ground motions.



メキシコ 1985 Michoacan earthquake 十勝沖 2003 Tokachi-oki earthquake

3

Situation in Singapore シンガポールの状況



Singapore in the 1960's in the 1980's

(Pan & Sun, 1995)

シンガポールではスマトラの巨大地震が、1980年代以降超高層ビル内で感じられる。Large and shallow Sumatran earthquakes were felt by Singaporeans in high-rise buildings only in the 1980's or later. Its severity can be such that panic is produced. (Pan, 1995)

4

Expansion to newly industrializing countries 新興工業国への拡大




高い順200位以内で300m以上ビルがある国
 高い順200位以内ビルの国
 300m以上のビルのある国

(from Wikipedia)

5

Shaking table tests for the effects of long-period ground motion on people in a high-rise building 長周期地震動の高層建築居住者への影響に関する振動台実験

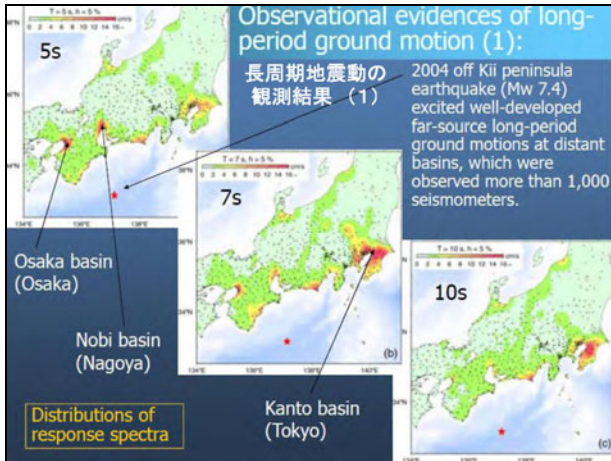


全 景

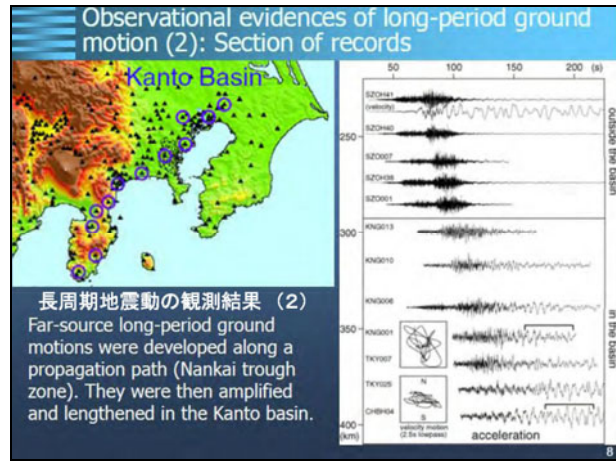
TGR-15-08-411722

We think that the building itself should be all right but people inside are greatly affected by long-period ground motions.
 建物そのものは大丈夫だが、内部の人間は長周期地震動で大きな影響を受けるであろう。

6



7



8

Background in Japan 日本背景

- The Headquarters for Earthquake Research Promotion (HERP) of the Japanese government set up 'Section for Subsurface Velocity Structures (SVSS)' (chair: K. Koketsu) under 'Subcommittee for Evaluation of Strong Ground Motion' of 'Earthquake Research Committee.' 地震調査研究推進本部 地下構造モデル検討分科会 (総編主査)
- National Research Institute for Earth Science and Disaster Prevention (NIED) and many other institutions constructed velocity structure models all over Japan. SVSS has started a 3-year project (PI: K. Koketsu), where those models are being updated for long-period ground motion hazard maps.
- The long-period ground motion hazard maps are being made by numerical simulation with the updated velocity structure models. The updated models will be combined into a Japan integrated velocity structure model at the end of the 3-year project.

長周期地震動のハザードマップは新しい速度構造モデルによる数値計算で作成中。

9

Features (1) 特徴 (1)

- Velocity structure models control the accuracy of long-period ground motion hazard map more than source models.
- A velocity structure consists of three parts called 'surface soil layers,' 'deep sedimentary layers,' and 'crustal structure deeper than the seismic basement.'
- Surface soil layers do not affect long-period ground motion so much as the other two parts, so we are concentrated into the two parts lower than the engineering bedrock.

10

Features (2) 特徴 (2)

- It was required to establish a standard modeling procedure for the lower parts of velocity structures in Japan, in order to keep their quality up.
- Models with which ground motions can be simulated well is more preferable than models with which geological entities can be recovered well.
- S-wave velocity structures are more important than P-wave velocity structures, because the main parts of long-period ground motions consist of S-waves and surface waves.
- Actual records of ground motions from small to moderate earthquakes are used as data, because they should work for models with which long-period ground motions can be simulated well.
- In the prediction of long-period ground motions from a large subduction-zone earthquake, the structures of the lower crust, upper mantle, and subducting plates are also necessary.

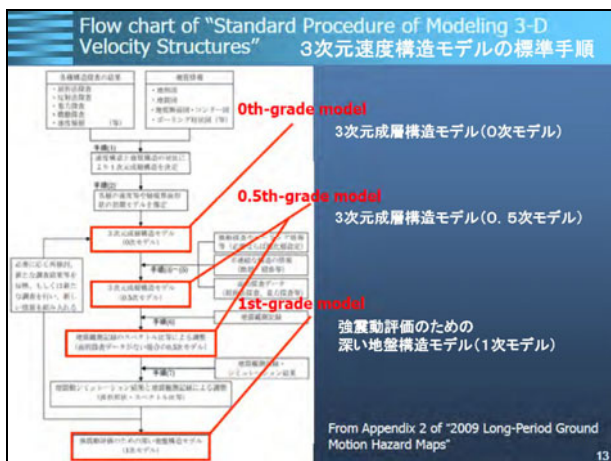
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Standard Procedure of Modeling 3-D Velocity Structures (1) (Koketsu et al., *Tectonophysics*, 2009) 3D速度構造モデル

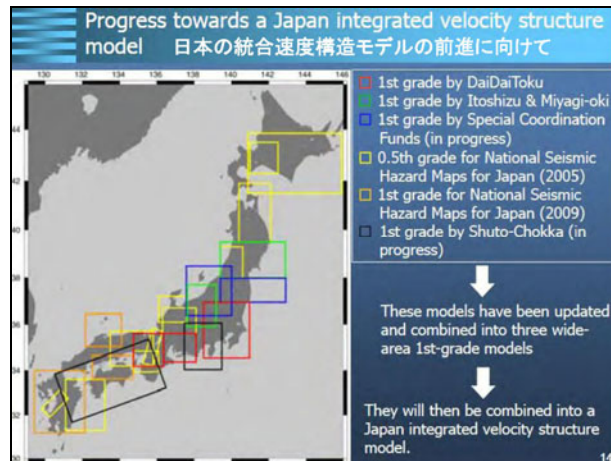
- Step 1: Assume an initial layered model consisting of seismic basement and sedimentary layers from comprehensive overview of geological information, borehole data, and exploration results.
- Step 2: Assign P-wave velocities to the basement and layers based on the results of refraction and reflection surveys, and borehole logging. Assign S-wave velocities based on the results of borehole logging, microtremor surveys, spectral-ratio analyses of seismograms, and empirical relationships between P- and S-wave velocities.
- Step 3: Obtain the velocity structure right under engineering bedrock from the results of microtremor surveys referring to the results of borehole logging, since among 2-D or 3-D surveys only microtremor surveys are sensitive to shallow velocity distributions and the shapes of shallow interfaces.
- Step 4: Compile data and information on faults and folds. Convert time sections from seismic reflection surveys and borehole logging into depth sections using the P- and S-wave velocities in Step 2.
- Step 5: Determine the shapes of interfaces between the layers and basement by inversions of geophysical-survey data (e.g., refraction traveltimes and gravity anomalies). In case of insufficient data, forward modeling is carried out. The depths of faults and folds in Step 4 are introduced into the inversions as constraints, or additional data to the forward modeling.
- Step 6: Calibrate the P- and S-wave velocities in Step 2 and the interface shapes in Step 5 by inversion or forward modeling of spectral features of observed seismograms such as dominant periods of HV (horizontal/vertical) spectral ratios.
- Step 7: Adjust the velocities and interface shapes using inversion or forward modeling of time history waveforms of observed seismograms.

- 0th-grade model = Initial model after Steps 1 to 2
- 0.5th-grade model = Intermediate model after Steps 3 to 5
- 1st-grade model = Final model after Steps 6 to 7

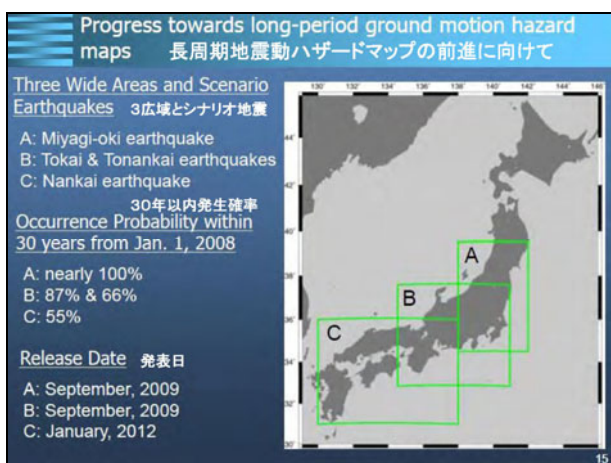
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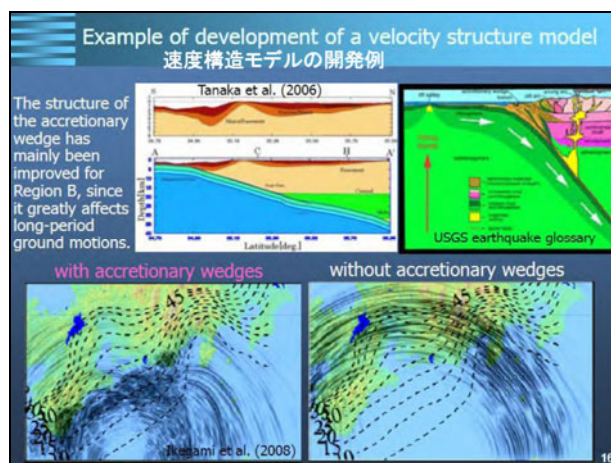
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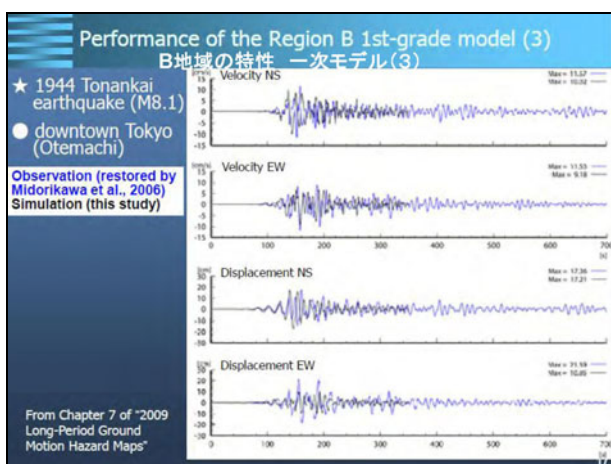
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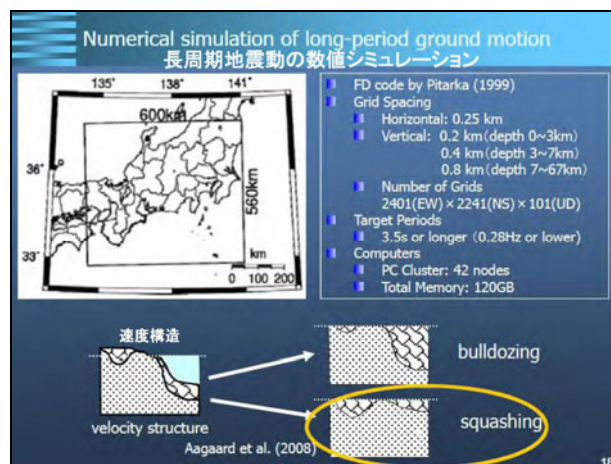
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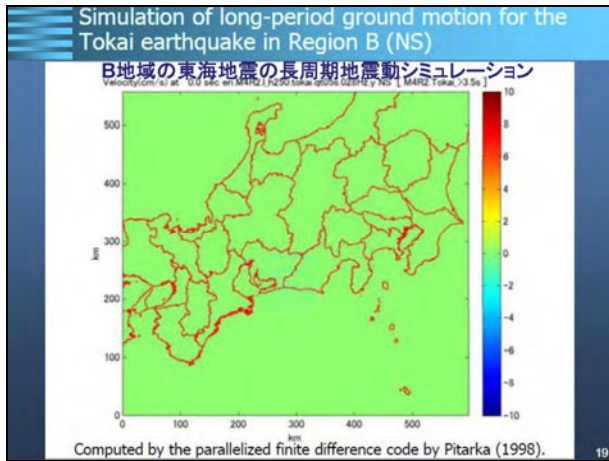
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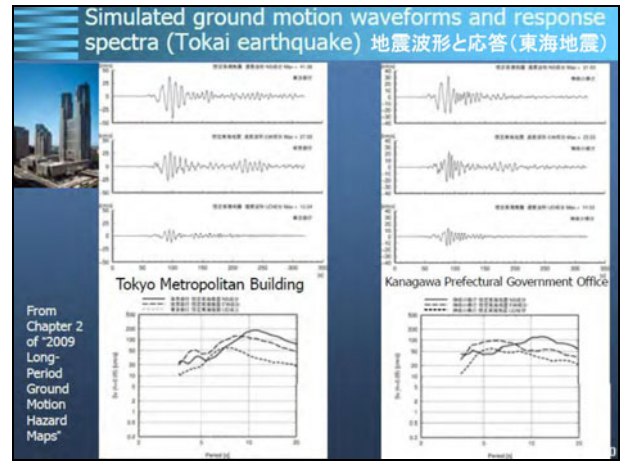
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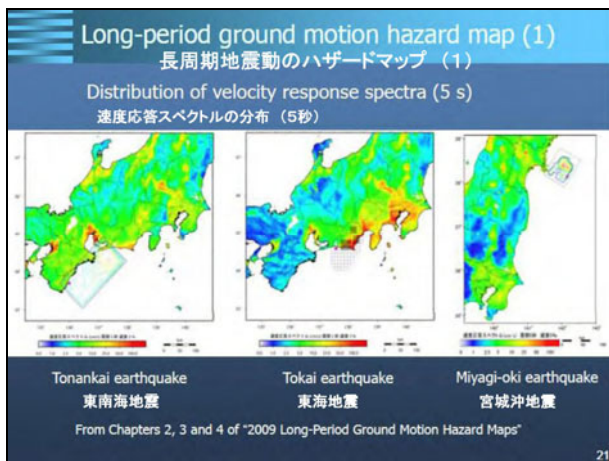
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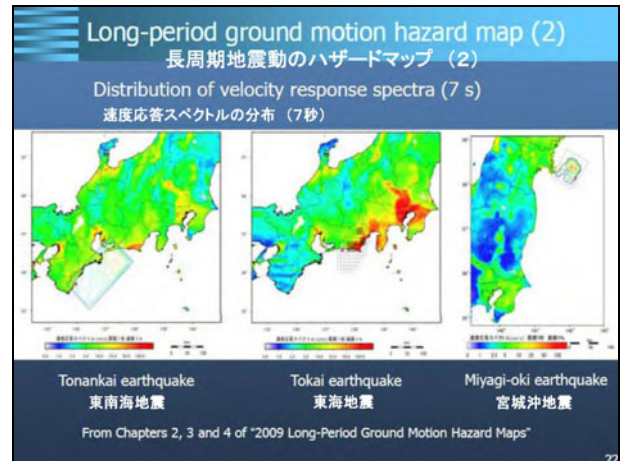
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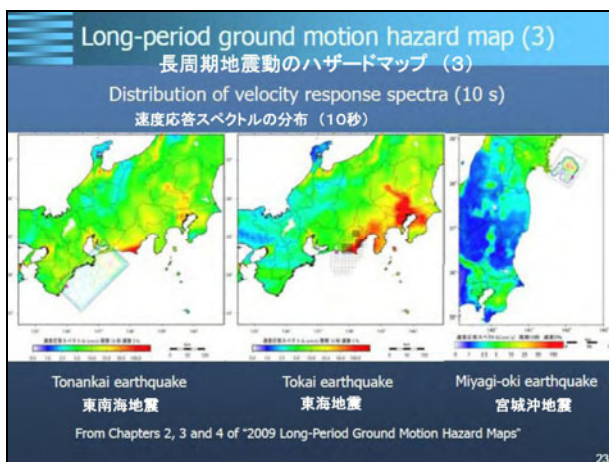
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21



22



23

Report, press release, and TV program 報告書、記者発表とテレビ番組

Report in Japanese 報告書
http://www.tohin.go.jp/main/chosusai/09_choshuki/choshuki2009.pdf

Press Release in Japanese 日本語記者発表
http://www.tohin.go.jp/main/chosusai/09_choshuki/choshuki2009_kohyo090917.pdf

TV program in Japanese 日本語TV番組
http://www.nhk.or.jp/megaquake/p_highlight.html/

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講演「津波避難ビルの構造設計法」 福山 洋 (独) 建築研究所構造研究グループ長
 "Structural Design Requirement on the Tsunami Evacuation Buildings" Hiroshi Fukuyama, Director,
 Department of Structural Engineering, BRI

**Structural Design Requirement
 on the Tsunami Evacuation Buildings**
 (津波避難ビルの構造設計法)

Hiroshi FUKUYAMA
 Director, Dept. of Structural Engineering
 Building Research Institute

独立行政法人 建築研究所
 構造研究グループ長 福山 洋

1

1

Contents (本日の内容)

**1) Categorization of the damage to buildings
 caused by tsunami**
 (津波による被害パターン分類)

**2) Structural design requirement on the tsunami
 evacuation buildings**
 (津波避難ビルの構造設計法)

2

2

Damage to RC buildings
 (鉄筋コンクリート造建築物の被害)

3

3

**Most of the RC buildings were survived
 without any structural damage**
 (多くのRC造建築物は構造的にほぼ無被害で残存した)



Ikuze (Ishikawa City)
 (越前高田市)

... However, severe damage were observed in a part of RC Buildings
 (... ただし、一部のRC造建築物には大きな被害も見られた)

4

4

(1) Total collapse (倒壊)



5

5

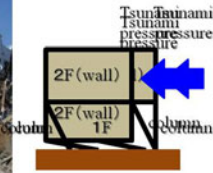
(2) Collapse of 1st story (1階の崩壊)



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(2) Collapse of 1st story (1階の崩壊)



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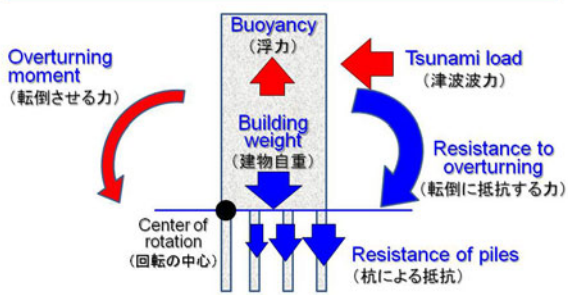
(3) Overturning (転倒)



The building overturned with climbing over the fence
 → Huge buoyancy happened
 (この塀を乗り越えて転倒した → 大きな浮力が作用した)

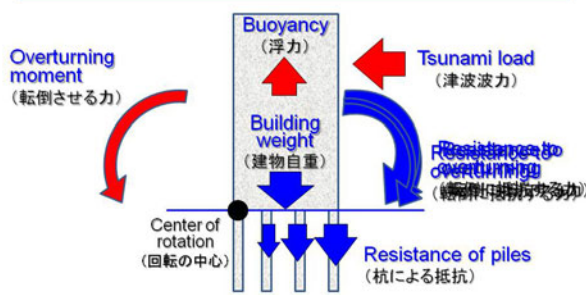
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Mechanism of overturning (転倒のメカニズム)



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Mechanism of overturning (転倒のメカニズム)



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(3) Overturning (転倒)



Overturning of RC buildings with pile foundation was observed
 → Overturning moment due to tsunami load was larger than the resistance to overturning by building weight and pile contribution
 (杭基礎の建築物でも転倒したのが見られた
 → 自重と杭による抵抗よりも、津波荷重により転倒させる力の方が大きかった)

11

Accumulated air under floor slab Influence to buoyancy (浮力に影響する天井下の空気溜まり)



It should be considered in the structural design (構造設計で考慮が必要)

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(4) Failure of walls (壁の破壊)



Shear walls and columns should not be failed to resist to later tsunami and aftershocks.
構造耐力上主要な部分である耐力壁や柱は、第2波、第3波の津波や、余震に抵抗するため破壊させてはならない



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(5) Scouring (洗掘)



Scouring happened at the corner of the building due to strong whirl stream of tsunami (非常に強い津波の流れが建築物のコーナー部で渦となり洗掘を起こす)

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(5) Scouring & Tilting (洗掘・傾斜)

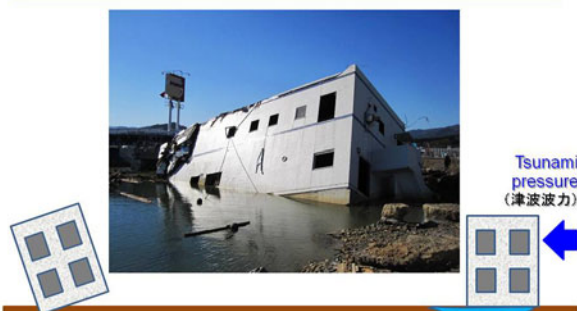


A building with mat foundation tilted due to scouring (洗掘により直接基礎の建築物が傾斜した例)

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(6) Sliding (滑動)



Pile foundation is effective to prevent sliding (滑動防止には杭基礎が有効)

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(7) Debris impact (漂流物の衝突)



Large trees rushed into the building (開口部からの大木の突入)



Failure of shear wall (構造耐力上主要な部分である耐力壁の破壊)

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Damage to steel buildings

(鉄骨造建築物の被害)

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(1) Failure of exposed column base
(露出型柱脚の破壊)



Rupture of anchor bolt, base-plate or welding part between column and base-plate
(アンカーボルト、ベースプレート、もしくは柱とベースプレートとの溶接部の破断)

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(2) Failure of column top connection
(柱頭接合部の破壊)



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(3) Overturning (転倒)



Exterior finishing was survived. Then large tsunami load and buoyancy happened.
(外装材がほとんど残存したため、大きな波力と浮力が作用したと推測される)

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(4) Washed away of interior & exterior finishing
(内外装材の破壊・流出)
(5) Large residual deflection (大きな残留変形)



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Study on the structural design requirement on the tsunami evacuation buildings

(津波避難ビルの構造設計法に関する検討)



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Importance of tsunami evacuation buildings
(津波避難ビルの位置付け)

- Evacuation to a high ground is a basic principle when tsunamis occur (津波の際には高台避難が原則)
- If there is no high ground to evacuate to, a tsunami evacuation building will protect human lives instead of high ground (高台が近くに無い海岸地域では、津波避難ビルが高台に代わって人命を守る)
- Tsunami evacuation building should be prepared for quick evacuation in coastal area (海岸地域での迅速な避難のために、津波避難ビルの整備が必要)



Proposal of the structural design method for tsunami evacuation buildings (津波避難ビルの構造設計法の提案)

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Background (背景)

General principles for the measures against

- Tokai E.Q. (May, 2003) (東海地震対策大綱)
- Tonankai, Nankai E.Q. (Dec, 2003) (東南海・南海地震対策大綱) by the Central Disaster Prevention Council (中央防災会議)

2004 Study on tsunami evacuation buildings (BCJ)
(津波避難ビルに関する調査検討 ((財)日本建築センター))

2004.12.26 Indian Ocean earthquake and tsunami
(スマトラ島沖地震津波(インド洋大津波))

2005.6 The Guidelines concerning the tsunami evacuation buildings etc, by Cabinet Office of Japanese Government
(津波避難ビル等に係るガイドライン(内閣府))
(巻末資料② 構造的要件の基本的な考え方)

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Objective (目的)

Review the structural design method of the 2005 Guidelines (Japanese cabinet office) based on the observed damage (内閣府「ガイドライン」に示された構造設計法を被害の実態に基づき検証)

Tsunami pressure = $3 \times h$
(津波波圧 = 設計用浸水深の3倍の高さの静水圧)

New proposal based on the impulse of stream (流勢に応じた新たな提案)

$Tsunami\ pressure = 3 \times h$
 (津波波圧 = 設計用浸水深の3倍の高さの静水圧)

$Tsunami\ pressure$ (津波波圧)

$Inundation\ depth$ (設計用浸水深)

h : Design inundation depth (m) (設計用浸水深)
 ρ : Specific gravity of water (t/m^3) (水の単位体積質量)
 g : Acceleration of gravity (m/s^2) (重力加速度)

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Analyzed structures (検討対象構造物の例)

 Collapsed Building (崩壊した建築物)	 Survived Building (残存した建築物)	 Collapsed CB wall (崩壊したブロック塀)	 Survived RC fence (残存したRC塀)
 Collapsed RC bridge (崩壊したRC鉄道橋)	 Collapsed CB column (崩壊したブロック柱)	 Overturned stone monument (転倒した石碑)	 Overturned seawall (転倒した防潮堤)

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Analysis based on the field survey (現地調査に基づく検討)

- 1) Set the height of tsunami pressure at ah , and calculate tsunami load
(津波波圧の高さを浸水深 h の a 倍とおき、波力を算定)
- 2) Calculate lateral capacity of structures
(構造物の水平耐力を算定)
- 3) Calculate a , when lateral capacity = tsunami load
(水平耐力 = 波力となる a を逆算)

$Tsunami\ load = a^2 \rho g h^2 / 2$

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Relationship between a and damage pattern (aと被害程度の関係)

1.0
 a

With defense
(遮蔽効果有り)

Damaged and no-damaged structures were classified at $a = 1.0$
($a = 1.0$ 程度で被害/無被害構造物が区分される)

1.5
 a

W/O defense
(遮蔽効果無し)

Damaged and no-damaged structures were classified at $a = 1.5$
($a = 1.5$ 程度で被害/無被害構造物が区分される)

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Influence of defense (遮蔽物の影響)

Tsunami direction
(津波来襲方向)

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Influence of defense & distance from the sea (遮蔽物の影響、海岸からの距離の影響)

Influence of defense (遮蔽物の影響)

1 : 1.5 ← Results of field investigation (調査結果より)	
with defense (遮蔽物あり) $a = 2$	w/o defense (遮蔽物なし) $a = 3$

(Stream is reduced) ←

Refer to previous guidelines & test results (既往のガイドラインや実験結果等を参照)

Influence of distance from the sea (海岸からの距離の影響)

When distance $\geq 500m$, stream is reduced. Then $a = 1.5$
(海岸から500m以上離れると流勢がさらに弱まるので $a = 1.5$)

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Structural design requirement on the tsunami evacuation buildings (津波避難ビルの構造設計法)

Design target (設計目標)

- 1) Not to collapse (倒壊しないこと)
- 2) Not to overturn (転倒しないこと)
- 3) Not to slide (滑動しないこと)

The walls and columns, for the tsunami contact side shouldn't be destroyed by the wave pressure (外側にある壁や柱は、津波波圧に対して破壊しないことを確認)

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Design flow (設計の流れ)

- 1 Calculate tsunami pressure (津波波圧の算定)
- 2 Calculate tsunami load (津波波力の算定)
- 3 Calculate story shear force (各層せん断力の算定)
- 4 Calculate buoyancy (浮力の算定)
 - a) Buoyancy for design of superstructure (上部構造の設計に用いる浮力)
 - b) Buoyancy for design of foundation (基礎の設計に用いる浮力)
- 5 Design of exterior elements (耐圧部材の設計)
- 6 Design for debris impact (津波流物に対する検討)
- 7 Design for scouring (洗掘に対する検討)
- 8 Design for collapse prevention (倒壊の検討)
- 9 Design for overturning prevention (転倒の検討)
- 10 Design for sliding prevention (滑動の検討)
- 11 Design of foundation beam (基礎梁の設計)

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① Calculate tsunami pressure (津波波圧の算定)

Tsunami pressure is obtained as static water pressure distribution with height of design inundation depth multiplied by coefficient a
(津波波圧は設計用浸水深の a 倍の静水圧で算定される)

a : Coefficient (浸水係数)
 h : Design inundation depth (m) (設計用浸水深)
 ρ : Specific gravity of water (t/m^3) (水の単位体積質量)
 g : Acceleration of gravity (m/s^2) (重力加速度)

Distance from sea or river (海岸や河川等からの距離)	with defense (遮蔽物あり)	w/o defense (遮蔽物無し)
	a	a
$\geq 500m$	1.5	2
$< 500m$	2	3

Regardless of distance (距離によらず)

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$a=1.5$ $a=2.0$ $a=3.0$ ← Tsunami direction 津波来襲方向

Defense (遮蔽物) Sea

$a=1.5$ $a=2.0$ ← Tsunami direction 津波来襲方向

Defense (遮蔽物) Sea

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Calculate ② tsunami load & ③ story shear force (津波波力および層せん断力の計算)


Tsunami load can be reduced due to ratio of openings (津波波力は開口率に応じて低減できる)

Lower limit is 0.7 (波力は無開口の7割を下限とする)

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④ Calculate buoyancy (浮力の算定)

Buoyancy influences to design of collapse prevention, overturning prevention and sliding prevention, should be calculated
 (倒壊防止、転倒防止、滑動防止の設計に直接関係する浮力を計算する)




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⑤ Design of exterior elements (耐圧部材の設計)

Tsunami load \leq Ultimate capacity of columns and walls
 (津波波圧により生じる力 \leq 部材終局強度)

Failure of columns and walls should be prevented
 (柱と耐力壁が波力によって破壊しないことを確認)



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⑥ Design for debris impact (漂流物に対する検討)

Preventing failure of walls and columns is not easy
 (漂流物によっては柱・壁部材の破壊を防止するのは困難)



Axial capacity of each story should be kept even after the failure of exterior column or wall due to debris impact
 (外部に面する柱等が漂流物により破壊しても、その軸力支持能力を喪失しない(他の柱等で支持できることを確認する))

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⑦ Design for scouring (洗掘に対する検討)

Pile foundation is recommended to prevent tilting of superstructures due to scouring
 (洗掘に対して上部構造が傾斜しないよう杭基礎を推奨する)



Mat foundation (直接基礎) Pile (杭基礎)

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⑧ Design for collapse prevention (倒壊防止の検討)

Story shear capacity $>$ Story shear force
 (各階の水平耐力 $>$ 津波による各階に生じる力)



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⑨ Design for overturning prevention (転倒防止の検討)

Axial capacity of piles $>$ Axial force of piles
 (杭の極限支持力 or 極限引抜抵抗力 $>$ 杭の軸方向力)



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⑩ Design for sliding prevention (滑動の検討)

Lateral capacity of piles > Lateral force of piles
(杭の水平耐力 > 杭に作用する津波荷重)



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Base shear required for tsunami evacuation buildings (津波避難ビルに要求される強度)

(In case of RC residential buildings: RC集合住宅の場合)

Cs: Base shear coefficient in short direction (1階の層せん断力係数)

	Inundation depth (浸水深)		
	5m	10m	15m
$\alpha = 3.0$	$C_B = 0.97$	$C_B = 2.83$	$C_B = 4.56$
$\alpha = 2.0$	$C_B = 0.38$	$C_B = 1.44$	$C_B = 2.42$
$\alpha = 1.5$	$C_B = 0.3$	$C_B = 0.78$	$C_B = 1.36$

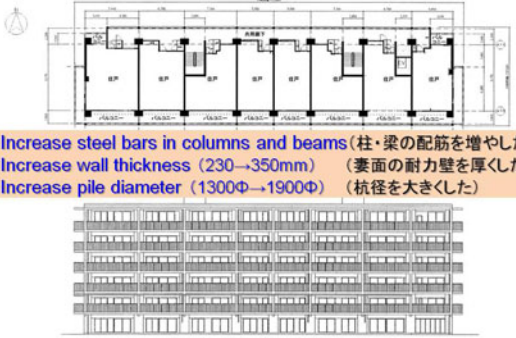
○: Strength due to seismic design is larger than strength due to tsunami design (except piles and foundations) (杭と基礎を除き、要求強度は耐震設計の方が津波設計を上回る)
 □: Meeting demand is available by increase of strength (need special consideration for piles and foundations) (設計要求の充足は可能、ただし、杭と基礎は特別な検討を要する)
 △: Require special consideration for increase of strength of super-structure, piles and foundations (上部構造、杭、基礎の強度を大きく高めるための特別な工夫を要する)

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Design example (設計例)

Inundation depth (浸水深) = 10m, $\alpha = 2.0$



- Increase steel bars in columns and beams (柱・梁の配筋を増やした)
- Increase wall thickness (230→350mm) (妻面の耐力壁を厚くした)
- Increase pile diameter (1300Φ→1900Φ) (杭径を大きくした)

South elevation (南側立面図)

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Design of tsunami evacuation building (津波避難ビルの設計)



Design tsunami force is capable of over seismic force in case inundation depth is larger than 10m (浸水深が10mを超えると、設計用地震力よりも津波力の方が大きくなることもある)

↓

High capacity buildings required (耐震設計より強い建築物が必要)

- ✓ thicker wall, much steel (壁を厚く、柱・梁の配筋を多く)
- ✓ bigger, longer piles (杭を太く、長く)

→ available with conventional techniques (従来技術で対応可)

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Conclusion (まとめ)

It is highly expected the proposed structural design method accelerate construction of tsunami evacuation buildings for protecting lives from tsunami disasters.
(提案した構造設計法が津波避難ビルの建設を促進し、命を守る津波防災に資することが大いに期待される)

BRI will continue the technical support for recover of the disaster area as quick as possible.
(建築研究所は、被災地の一日も早い復興のために、さらなる技術支援を続けていく予定)

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Thank you for your attention
(ご静聴有り難うございました)

BRI, Japan
建築研究所

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講演「地震工学分野の調査研究協力—ヨーロッパの SAFECAST プロジェクト」

ファルク・カラドアン トルコ・イスタンブール工科大学教授・前学長

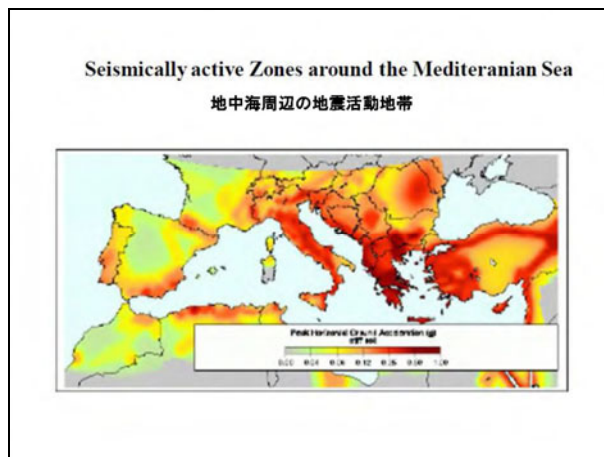
"The importance of collaboration for complementary research in the field of earthquake engineering-An example SAFECAST project in Europe" Faruk Karadoğan, Professor & Former Rector, Istanbul Technical University (ITU), Turkey

International Memorial Symposium
27 th of June 2012 Wednesday
at GRIPS

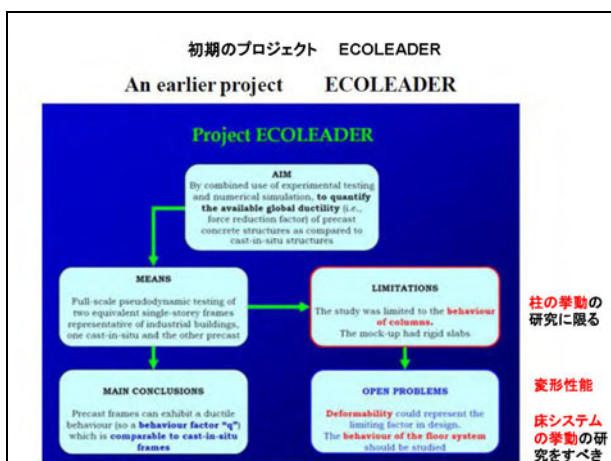
地震工学分野のさらなる研究協力の重要性
The importance of collaboration for
complementary research in the field of
earthquake engineering
An example : SAFECAST project in Europe
ヨーロッパにおけるSAFECASTプロジェクトを例にして

イスタンブール工科大学
ファルク・カラドアン
Faruk Karadogan

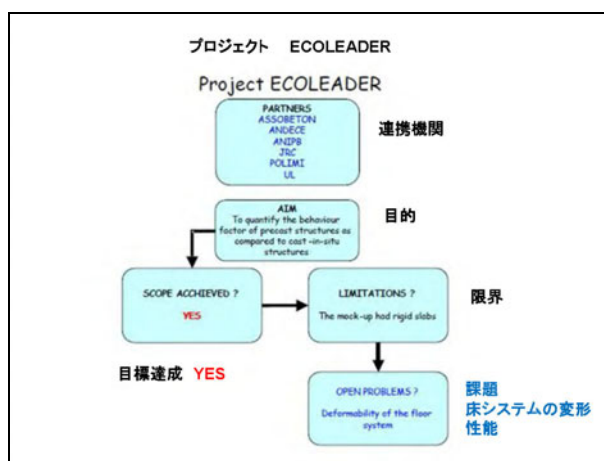
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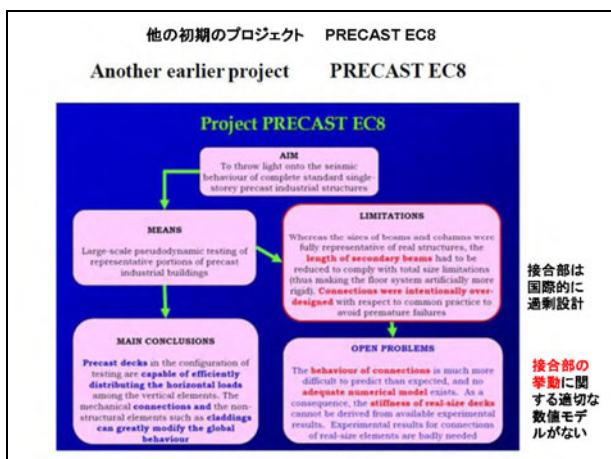
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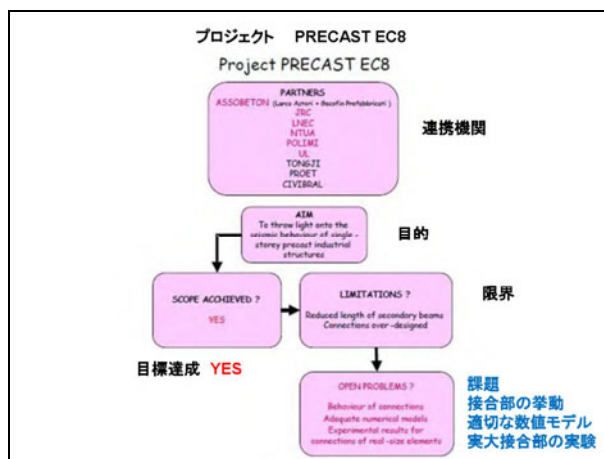
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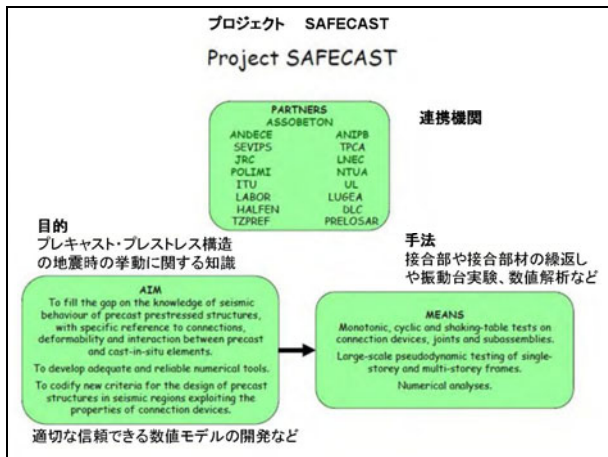
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7

PERFORMANCE OF INNOVATIVE MECHANICAL
CONNECTIONS IN PRECAST BUILDING STRUCTURES
UNDER SEISMIC CONDITIONS

プレキャスト建築構造における新型接合方法の耐震性能

- Grant agreement no. 218417 資金協定 218417
- Research for SME associations SME組合のための研究
- Project start date: 1st March 2009 Duration: 36 months
- Coordinator: Dr. Antonella COLOMBO, ASSOBETON (AXB), Italy

プロジェクト期間 2009年3月1日から 36ヶ月間
コーディネーター アントネラ・コロンボ博士 イタリア

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プレキャスト構造の耐震性能
Seismic performance of precast structures

SAFECAST – the Consortium

SME-AGs: ASSOBETON, ANDECE, ANIPB, SEVIPS, TPCA
Role: to fix priorities and needs

RTD-Performers: JRC, POLIMI, NTUA, ITU, LNEC, UL, LABOR
Role: to carry out research

Others: DLC, PRELOSAR, LUGEA, HALFEN
Role: to guarantee constant feedback on the results and their applicability

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関係(受益)機関 Beneficiary name	略称 Beneficiary short name	国名 Country
(coordinator) ASSOBETON - National Italian Association of Precast Concrete Producers	AXB	Italy
Asociación Nacional de Prefabricados y Derivados del Cemento	ANDECE	Spain
National Portuguese Association of Precast Concrete Producers	ANIPB	Portugal
SEVIPS - Greek National association of precast concreteproducers	SEVIPS	Greece
Turkish Precast Concrete Association	TPCA	Turkey
Joint Research Centre – Elsa Laboratory	JRC	Belgium
Politecnico di Milano	POLIMI	Italy
National Technical University of Athens	NTUA	Greece
Istanbul Technical University	ITU	Turkey
Laboratorio Nacional de	LNEC	Portugal
University of Ljubljana	UL	Slovenia
Labor srl	LABOR	Italy
DLC srl	DLC	Italy
Truzzi Prefabbricati	TZPREF	Italy
PRELOSAR SL – Losas Riojanas SL	PRELOSAR	Spain
LU.GE.A Progetti Costruzione Gestione Spa	LUGEA	Italy
HALFEN GmbH	HALFEN	Germany

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Project PRECAST EC8 プロジェクト PRECAST EC8

AIM 目的
To throw light onto the seismic behaviour of complete standard single-storey precast industrial structures

MEANS 手法
Large-scale pseudodynamic testing of representative portions of precast industrial buildings

MAIN CONCLUSIONS 主な結論
Precast decks in the configuration of testing are capable of efficiently distributing the horizontal loads among the vertical elements. The mechanical connections and the nonstructural elements such as claddings can greatly modify the global behaviour

LIMITATIONS 限界
Whereas the sizes of beams and columns were fully representative of real structures, the length of secondary beams had to be reduced to comply with total size limitations (thus making the floor system artificially more rigid). Connections were intentionally over-designed with respect to common practice to avoid premature failures

OPEN PROBLEMS 課題
The behaviour of connections is much more difficult to predict than expected, and no adequate numerical model exists. As a consequence, the stiffness of real size decks cannot be derived from available experimental results. Experimental results for connections of real-size elements are badly needed

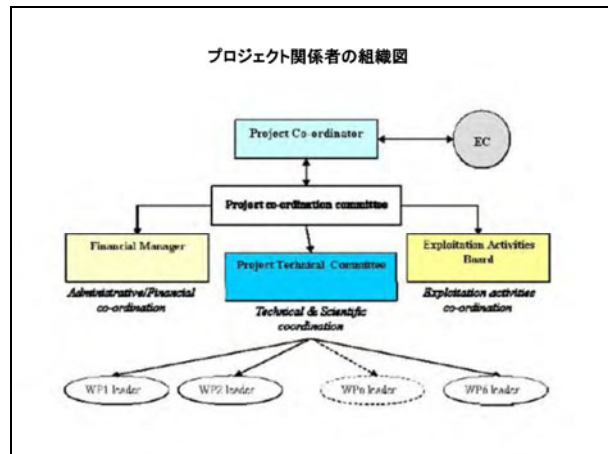
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作業項目	名称	活動種別	
Work package No	Work package title	Type of activity	
WP 1	Literature survey and identification of needs	RTD	1 文献調査、需要把握
WP 2	Experimental activity on new and existing connections	RTD	2 実験的活動
WP 3	Development of analytical models	RTD	3 分析モデルの開発
WP 4	Experimental assessment on real structures	RTD	4 実大構造実験評価
WP 5	Numerical model validation	RTD	5 数値モデルの評価
WP 6	Derivation of design rules	RTD	6 設計基準の誘導
WP 7	Training and dissemination	OTH	7 研修と普及
WP 8	Management	MNGT	8 マネージメント

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SAFECAST に関する追加情報
More about SAFECAST

Seismic performance of precast structures

Connection typologies:
Wet, Dry, Emulative, Non emulative

- 1) adjacent floor or roof elements
- 2) floor or roof panels and supporting beams
- 3) columns and beams
- 4) segments of columns or columns and foundations
- 5) cladding panels and structural elements

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接合部
Connections

1. Floor - Floor
床-床
2. Floor - Beam
床-はり
3. Beam - Column
はり-柱
4. Column - Foundation
柱-基礎
5. Cladding - Frame
外装材-構造体
6. Cladding - Cladding
外装材-外装材
7. Cladding - Foundation
外装材-基礎

16

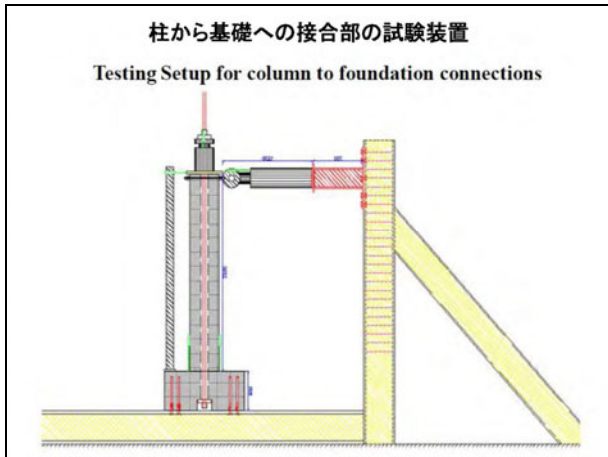
柱から基礎への接合部 POLIMU
Column to Foundation Connections
POLIMU

- Pocket Foundation ポケット基礎
- Protruding bars 外伸(突出)鉄筋
 - Separated protruding bars 分離した外伸鉄筋
- Bolted Sockets ソケットボルト
 - Weakened Bolted Sockets 柔軟ソケットボルト
 - Inverted Bolted Sockets 逆ソケットボルト
- Bolted Flanges フランジボルト
- Couplers カブラー(結合器)

17

POLIMU
柱から基礎への接合部

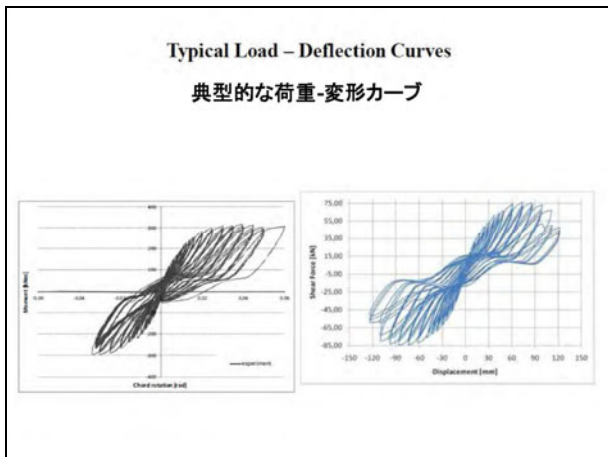
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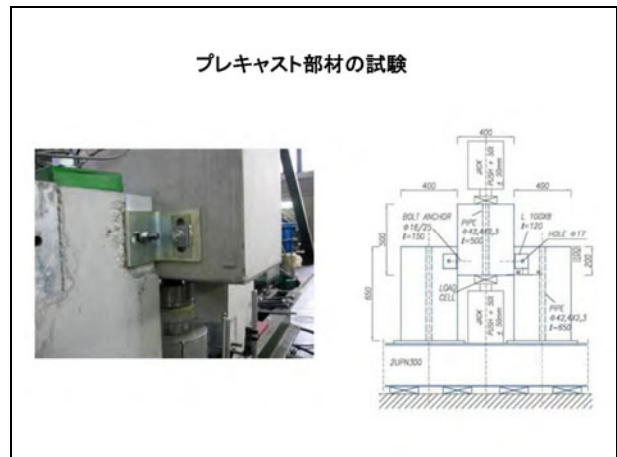
19



20



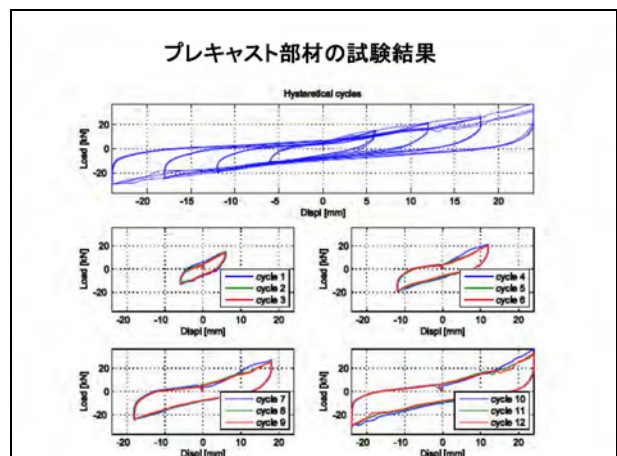
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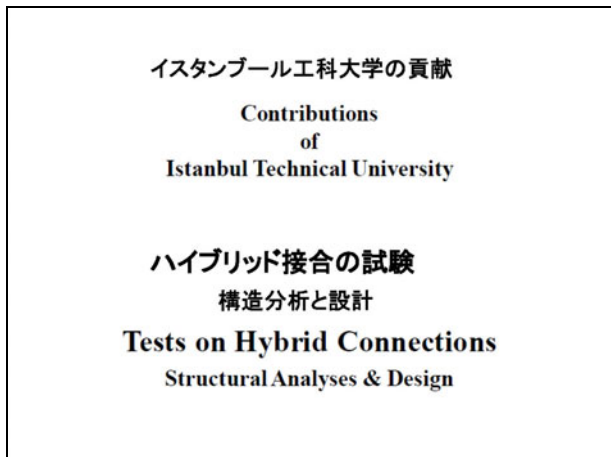
22



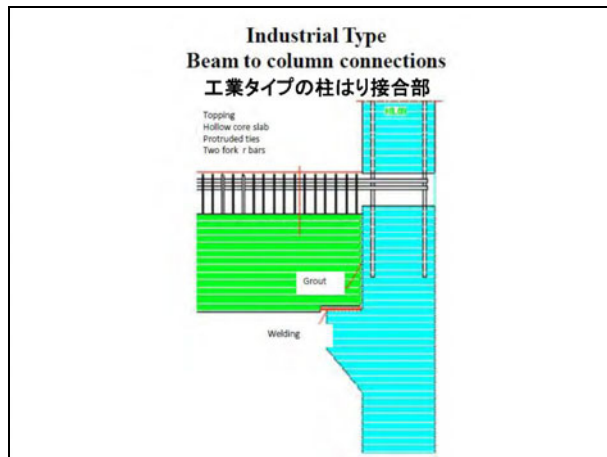
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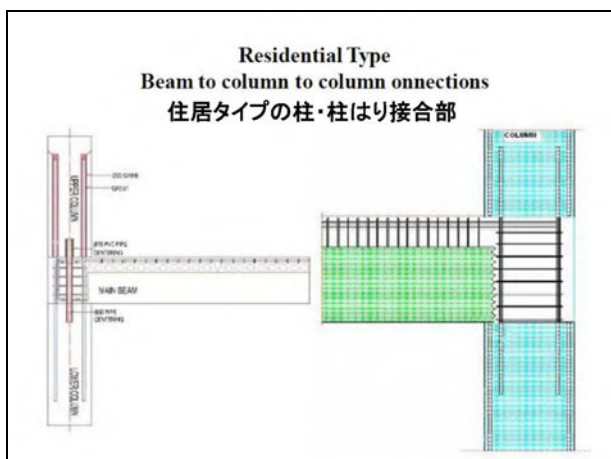
24



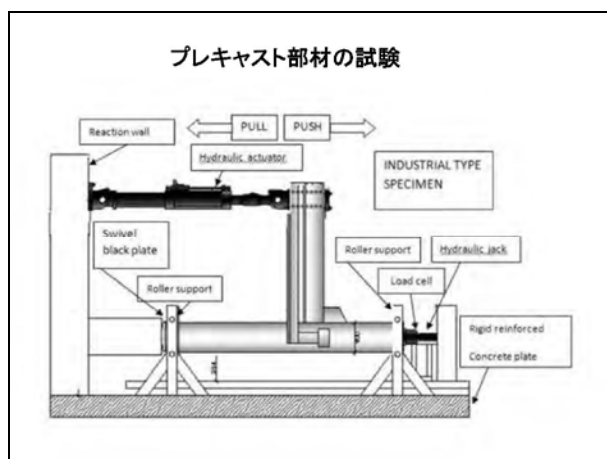
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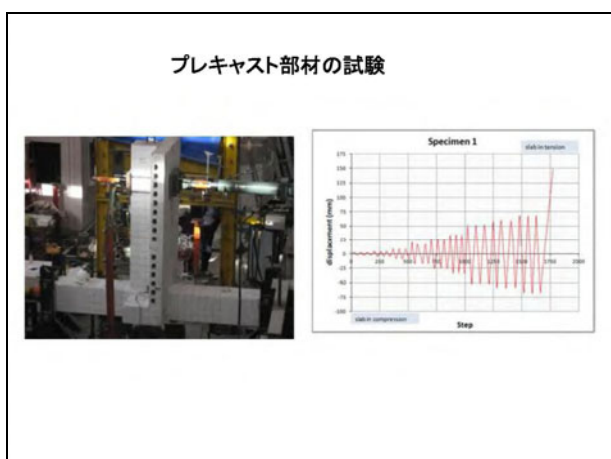
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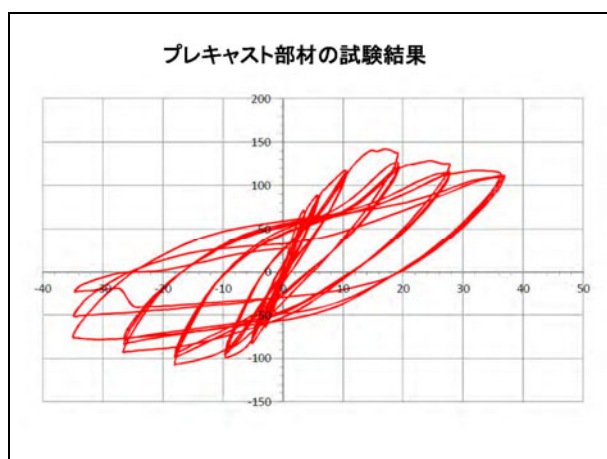
27



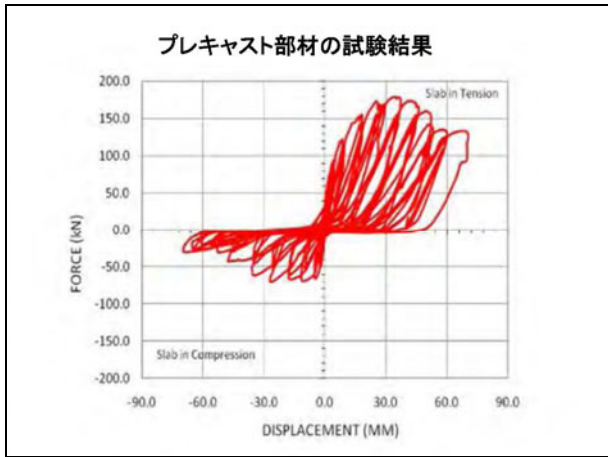
28



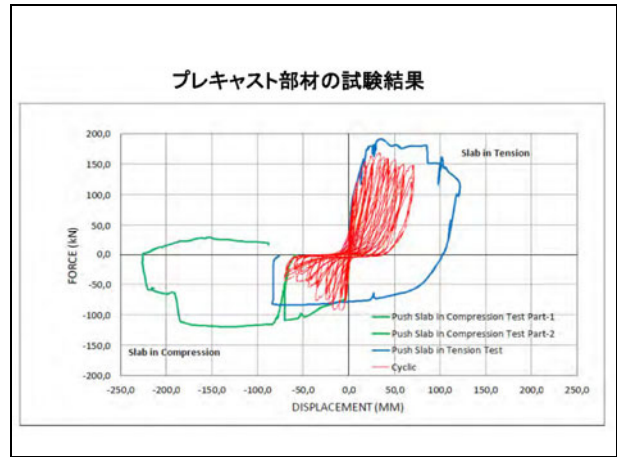
29



30



31



32

観察された柱はり接合部の一般的特徴
 The observed general characteristics of beam to column connections

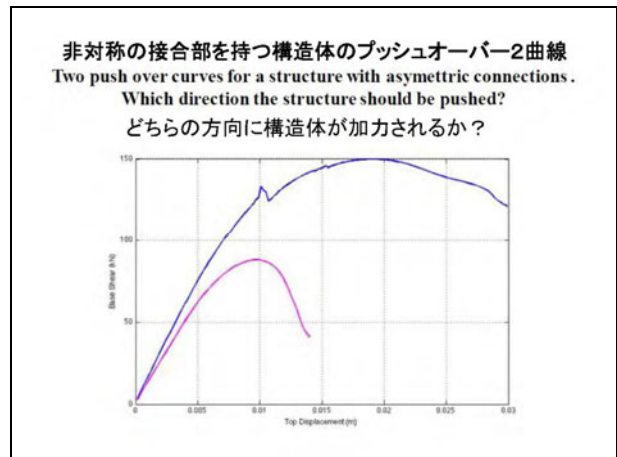
They are not symmetric
 Strength degradation
 Stiffness degradation
 Heavy pinching for Residential Types

対称的でない
 強度低下
 剛性低下
 住居タイプにおける
 激しいピンチング

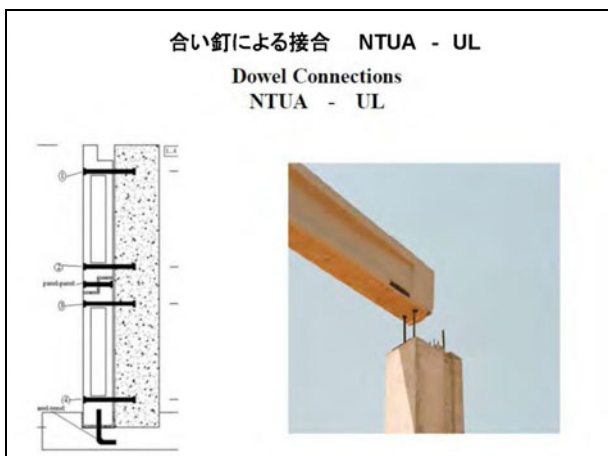
Important differences between Monotonic and Cyclic P-D Diagrams

単純・繰返しの
 重要な差異
 P-D図

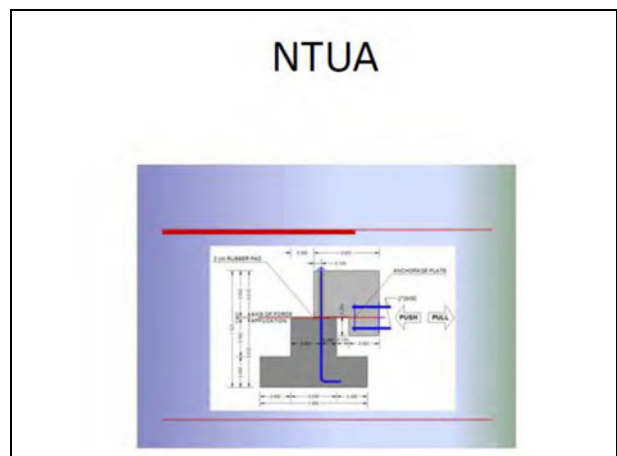
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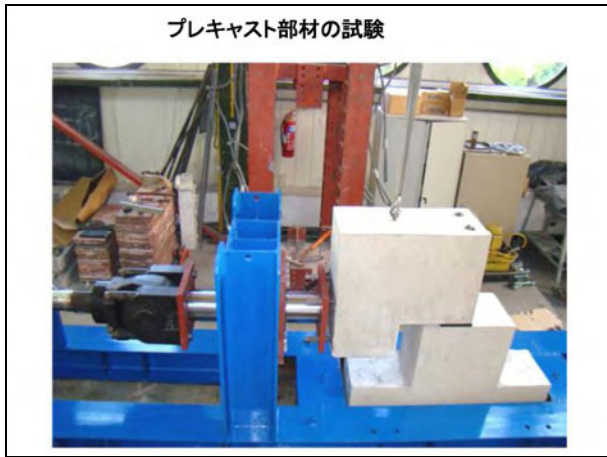
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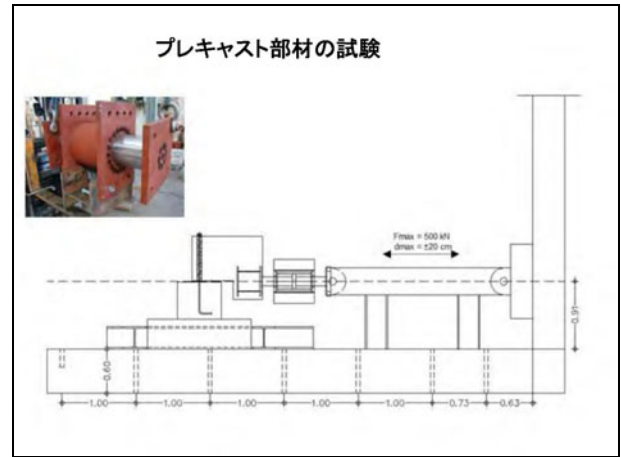
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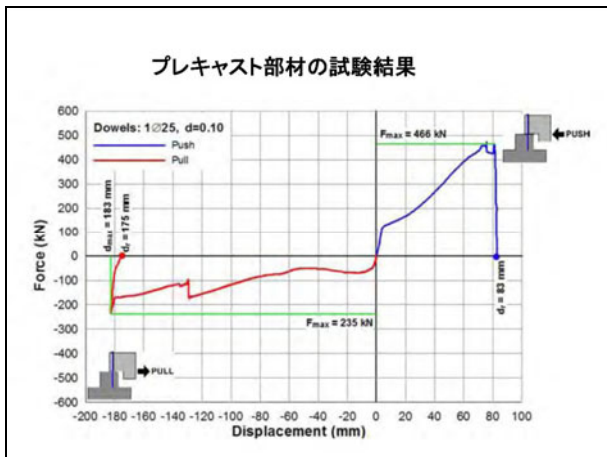
36



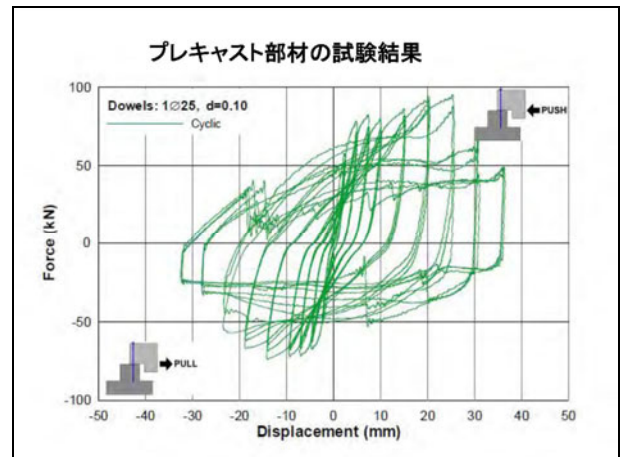
37



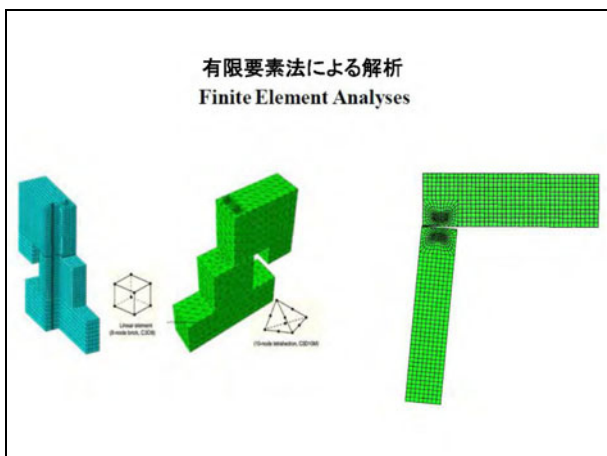
38



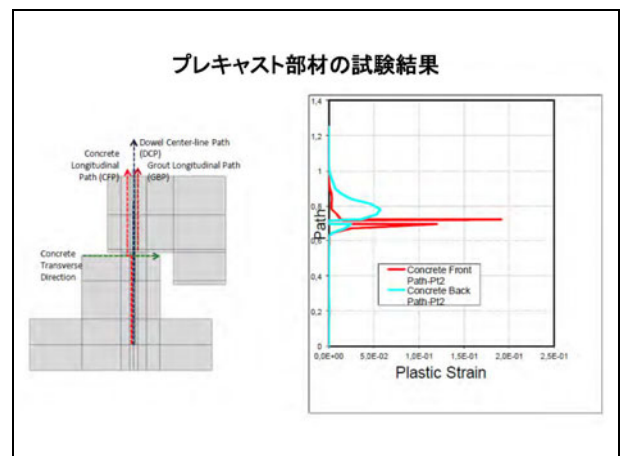
39



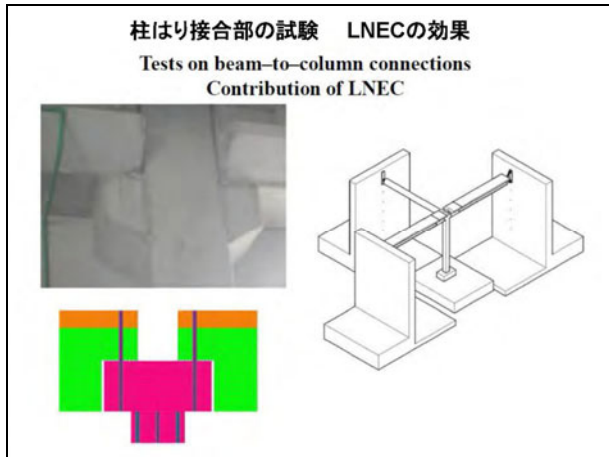
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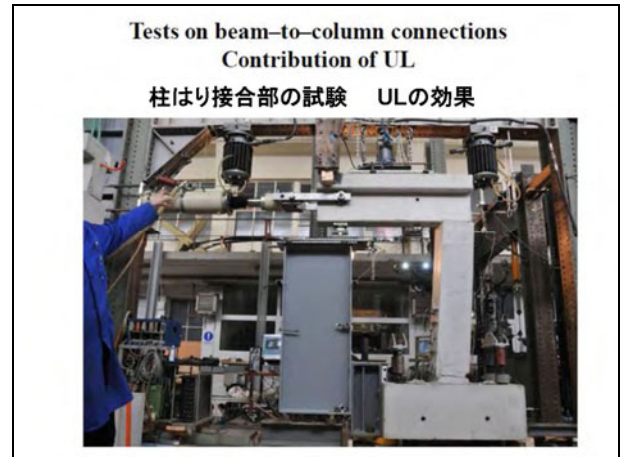
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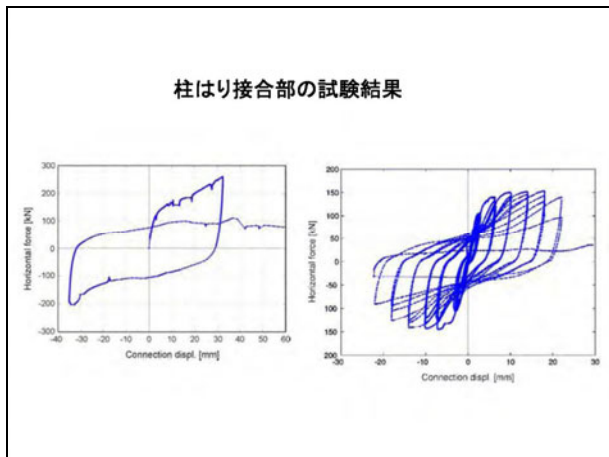
42



43



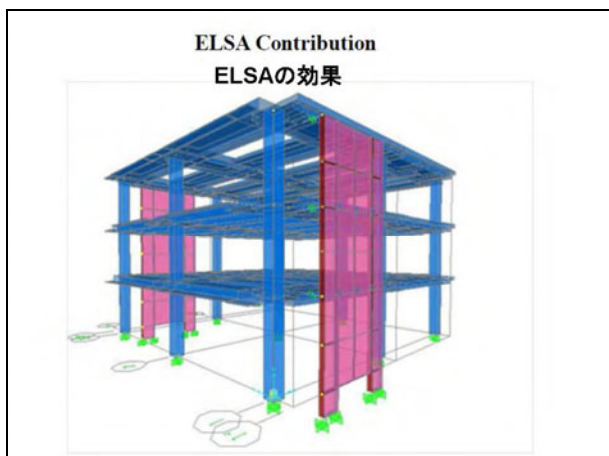
44



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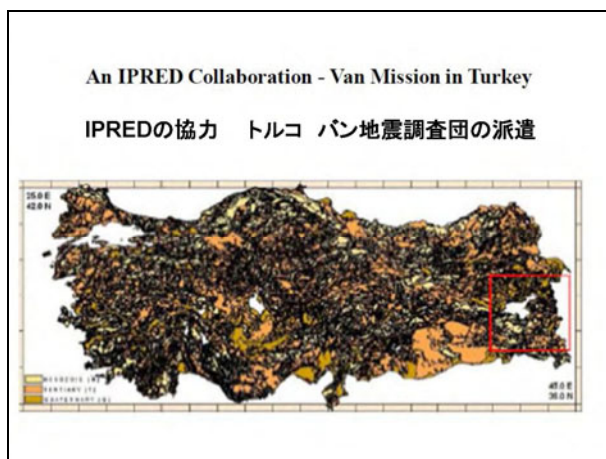
49



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51



52

Conclusions
まとめ

- Regional cooperations should have priorities and have to be encouraged
- Budget of the cooperative works should be increased
- Local administrative bodies and the people should be a part of the problems to satisfy the local needs
- Can IPRED be improved to such an organisation to coordinate the predefined collaborative works ?

- 地域協力は優先的に促進されるべき
- 協力活動の予算額は増加させるべき
- 地域団体と住民は地域の課題を体現
- IPREDは協力活動の調整役となるか？

53

チリ：ラウル・アルバレス チリ・カトリカ大学教授
 [Chile] Raul Alvarez, Professor, Universidad Catolica de Chile

Pontificia Universidad Católica de Chile
 カトリカ大学、チリ

地震防災の国際協力
 International Cooperation on
 Earthquake Disaster Management
 to Protect Lives

ラウル・アルバレス・モデル カトリカ大学、チリ
 Raúl Alvarez Medel, Pontificia Universidad Católica de Chile.

Credits for Photos and Information: Faculty, Students, WWWeb, Onemi, Other Universities, own.

UNESCO – IPRED5 Workshop
 ユネスコIPRED第5回会合、東京、2012
 27 June 2012, Tokyo, Japan

Structural and Geotechnical Engineering

1

Chile, un país con múltiples amenazas
 様々な脅威のある国 チリ

Seismic / Earthquakes
 Volcanic Eruptions / 火山
 Tidal waves / Tsunamis
 Flood / 洪水
 drought / 干ばつ

2

Geographic Location チリの位置

Placa Euroasiática, Placa Norteamericana, Placa Filipina, Placa Juan de Fuca, Placa del Caribe, Placa de Nazca, Placa Sudamericana, Placa Africana, Placa Australiana, Placa Antártica, Placa Escandinava, Placa de Cocos, Placa Arábica, Placa Hindú.

3

Geological Location チリの位置

Placa Andesofora, Límite de Placas convergentes, Límite de Placas divergentes, Límite de Placas Transformantes, Límite de Placas convergentes, Zona de Rift Continental, 太平洋, 南米大陸, Límite de Placas convergentes, Corteza Oceánica, Subducción de la placa, Corteza Continental.

4

Footprint historic earthquake in Chile
 チリにおける地震の歴史

Earthquakes

About 90 earthquakes since 1570 1570年以降約90の地震

200 earthquakes per day (between perceptible and imperceptible) 体感しない地震を入ると一日200地震

Greater magnitude earthquake recorded in the world 世界最大のマグニチュードを記録

5

Footprint historic earthquake in Chile
 チリにおける地震の歴史

Earthquake, Santiago 1647
 1647年サンチャゴ地震

Earthquake, Valparaiso 1907
 1907年バルパライソ地震

6

7

8

9

10

11

12



Experiences of the last earthquake 最近の地震の経験

Equipment 設備機器

- Lack of proper equipment, in order to have a monitoring of the country (accelerographs, seismographs, equipment at sea), considering the vast extension of the country. 監視機器の不足
- Lack of maintenance of existing instruments, for lack of funds and lack of qualified personnel, especially outside of Santiago. メンテ・人材の不足
- Data from the few devices that work are not accesibles the scientific community, so you have the information months or years of delay.
研究者に情報が届かず、数ヶ月数年遅れて情報が得られる

13



Implement Improvements 改善の実施

Government and Institutions 政府及び関係機関

- Completely restructure the ONEMI, giving emphasis in management. Change its organic law. Major institutional change. 政府機関の機構改革
- Provide it with sufficient budget. 予算の充実
- Empower them against the conjunctural political power. 政治への抗力
- Professionalize their members and provide them with professional training in seismology, volcanology, tsunami experts, engineers, seismic, etc. 政府機関要員への地震、火山、津波の専門的な訓練
- Develop a strong research area in all subjects listed above. 全ての課題でしっかりした研究分野を開発

14



Implement Improvements 改善の実施

Government and Institutions 政府及び関係機関

- Create an early warning network nationwide, with sufficient resources to operate and maintain, with appropriate staff in evaluating the information obtained. 人材と予算付きで早期警報ネットワークを構築
- Knowledge permeate the province. 地方へ知識普及
- Share this information with local and international scientific community. 地域・国際間で科学情報を共有
- Ensuring the continuous operation of the communication network at the country level, citizen. 全国、市民レベルで情報ネットワークを持続運営

15



Implement Improvements 改善の実施

Government and Institutions 政府及び関係機関

- Implement a quick inspection of structures and create and coordinate a volunteer at the country level for implementing disaster. 早期被災判定体制
- It seems obvious, but provide the necessary budget to function and operate as indicated in the course of time. 当然だが、時系列で必要な予算
- In schools the curriculum incorporate the issues of natural disasters. 学校での自然災害に関する教育
- Crisis management education to the population. 市民への危機管理教育

16




Tips to Japan and UNESCO 日本とユネスコへの示唆

- Share positive experiences in institutional issues, management and monitoring of successful countries. 成功国の制度、実施など積極的な経験の共有
- Exchange of technical personnel and experts in risk management, methodologies, studies of human behavior in emergencies, etc. 専門家の交流
- Help create a critical mass of experts in each area of risk, to permeate this knowledge throughout the country. 全国への知識普及のための最低必要な専門教育支援

17



End of Presentation 発表は以上です



Thanks ありがとう

18

エジプト：サラ・ムハンマド エジプト国立天文地球物理研究所部長

[Egypt] Salah Mahmoud, Head, Department of Geodynamics, National Research Institute of Astronomy and Geophysics (NRIAG)

United Nations Educational, Scientific and Cultural Organization

命を守る地震防災国際協力
エジプトの役割

Egypt Role for International Cooperation on Earthquake Disaster Management to Protect Lives

サラ・ムハンマド
エジプト国立天文・地球物理研究所
Salah Mahmoud
salahm@nriag.sci.eg; www.nriag.sci.eg
National Research Institute of Astronomy and Geophysics (NRIAG)
Helwan, Cairo, EGYPT

1

NRIAG's Roles for International Cooperation and Earthquake disaster Management
国際協力と地震防災における研究所の役割

- ▶ The operational heart of the Mechanism is the Earthquake and Information Centre (EIC) based at the National Research Institute of Astronomy and Geophysics (NRIAG). EIC is working 24/7 and can spring into action immediately when it receives a call for assistance. 研究所(NRIAG)の地震情報センター(EIC)が中心
- ▶ The EIC monitoring the earthquake signals in and around Egypt through the National Earthquake Network. 国家地震ネットワークを通じてEICは全エジプトの情報を監視
- ▶ NRIAG provides Training courses for Young Seismologists from Africa, Arab and Middle East. NRIAGはアフリカ、アラブ、中東の若い地震学者を研修している

2

NRIAG Earthquake and Information Centre
国立天文・地球物理研究所(NRIAG)の地震情報センター

3

The main objectives of this network is:
このネットワークの主な目的は：

- ▶ Monitoring local and regional activity including artificial events. モニター(監視活動)
- ▶ Assessment of seismic hazard. 地震ハザードの評価
- ▶ Estimating the expected future earthquake effects. 将来予測
- ▶ Continuous assessment of strategic buildings, high dam and archeological sites, etc. 建築、ダム、遺跡の継続評価

4

The main objectives of this network is:
このネットワークの主な目的は -

- ▶ Isoseismal map 地震地図
- ▶ Information on Geology 地質情報
- ▶ Seismic Zones 地震地域区分
- ▶ hazard Map ハザードマップ
- ▶ GPS Crustal deformation GPS地殻変動監視

5

During emergencies NRIAG plays two important roles:
危機時に研究所の果たす2つの重要な役割

- ▶ **Communications:** NRIAG may acts as a focal point for the exchange of requests and offers of assistance. This helps cut down on the participating states' administrative burden in liaising with the affected country. 情報拠点
- ▶ **Example Case:** NRIAG offers help during Izmit earthquake (Turkey) 1999 and dispatched a team. 例:トルコ1999年地震の支援提供と調査団派遣

6

- ▶ **Coordination:** The EIC facilitates the provision of Egyptian assistance through the Mechanism . This takes place by matching offers to needs, identifying gaps in assistance and searching for solutions, and facilitating the pooling of common resources where possible.

調整：地震情報センターは、メカニズムを通じてエジプトの支援を提供する。可能な限り、ニーズへの対応、支援ギャップの把握、解決の模索、共通資源の蓄積を促進

7

メカニズムの活性化

Activation of the Mechanism

8

Inside the Egypt

エジプト国内で

- ▶ The Mechanism can be activated by any participating state seeking prompt international assistance following a major earthquake disaster. 大震災後の緊急国際支援を求める参加国がしくみを活用
- ▶ As soon as a request for assistance is received, it can be viewed by all Provinces via the Center of Supporting and Decision Makers (CSDM). The national contact points then assess their available resources and inform the CSDM whether or not they are in a position to help.

支援要請があり次第、支援決定センター(CSDM)を通じてすべての州に連絡される。コンタクトポイントでそれぞれの資源を確認し、支援が可能か返事をする

9

Outside Egypt

エジプト国外で

- ▶ As the use of the Mechanism is not restricted to interventions within Egypt, any country affected by a disaster can also make an appeal for assistance through the Ministry of foreign Affairs (MFA). Following a formal request for assistance from other country, different procedures are applied for the activation of the Mechanism. In such cases, the MFA needs to consult the Presidency Council to determine the course of action to take. In this case the Council plays the lead role in coordinating the Egyptian response.

このメカニズムはエジプト国内だけでなく、どの被災国も、外務省を通じて要請が可能

10

支援の急派

Dispatching assistance

- ▶ Arrangements for the dispatch of the accepted assistance (delivery, transport, customs, etc.) are made directly between the offering and requesting states. If required, the EIC may play a facilitating role. Any intervention teams or assistance sent from the UNESCO to a disaster area will work closely with the national authorities of the affected country.

受諾した支援の急派(配送、輸送、税関など)は当事者間で直接行う。必要ならEICも支援する。ユネスコが被災地に派遣するチームや支援は、被災国の関係機関と緊密に作業をする事になる。

11

12

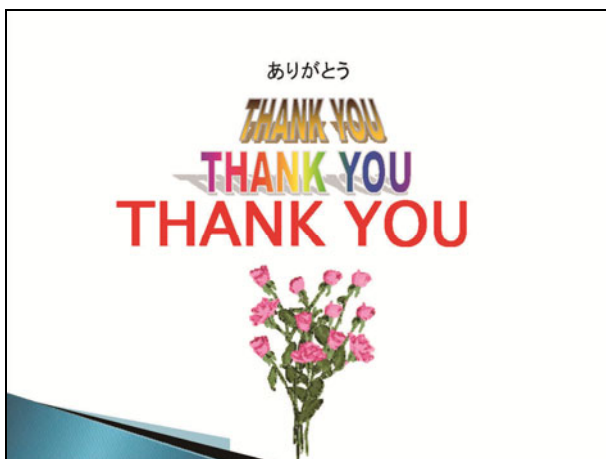
Resource allocation for disaster management 防災における資源の配分		
	Resource allocation 資源配分	Lives that could be saved 人命救助
Post-disaster 災害後		
Pre-disaster 災害前		

13

▶ To facilitate the technical co-ordination of Egyptian civil protection assistance a small team of experts (Seismology & earthquake Engineering) can be dispatched on site by NRIAG. This team will ensure effective liaison with local authorities and any other relevant actors so as to integrate Egyptian civil protection assistance into the overall relief effort and facilitate the work of Egyptian teams on the ground.

エジプト市民保護支援の技術的調整を進めるため、(地震学・耐震工学) 専門家をNRIAGが現地に派遣。このチームは地元機関や諸活動団体と有効に連絡し、救援活動全体を強化するとともに、諸活動を支援する。

14



15

ペルー：カルロス・サバラ 日本・ペルー地震防災センター所長

[Peru] Carlos Zavala, Director, Japan-Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID)

UNESCO-IPRED International Memorial Symposium on "Protecting Lives from Earthquake and Tsunami Disasters" and the 5th session of IPRED in Tokyo, Japan, 26-29 June 2012

現地調査の遂行における問題とSATREPSプロジェクトの進捗

PROBLEMS IN THE EXECUTION OF FIELD SURVEY AND ADVANCE ON SATREPS PROJECT

Dr. Carlos ZAVALA
CISMID – FIC – UNI
Universidad Nacional de Ingeniería

カルロス・サバラ
日本・ペルー地震防災センター(CISMID)
ペルー国立工科大学 土木学部

1

災害の前(準備)
BEFORE THE DISASTER

ペルーのチーム
The Peruvian TEAM

□ GEOTECHNICAL GROUP 土質グループのメンバー

- Dr. Zenon Aguilar
- Msc. Fernando Lazares
- Eng. David Luna
- Eng. Luis Chang
- Dr. Diana Calderon
- Eng. Silvia Alarcon
- Eng. Selene Quispe
- Eng. Rocio Uriarte
- Eng. Ramiro Piedra

Advisor: Dr. Jorge Alva

2

BEFORE THE DISASTER
災害の前(準備)
The Peruvian TEAM
ペルーのチーム

□ BUILDING GROUP

- Dr. Carlos Zavala
- Dr. Miguel Estrada
- Msc. Ricardo Proaño
- Msc. Jenny Taira
- Msc. Lourdes Cardenas
- Eng. Luis Lavado
- Eng. Cesar Fajardo
- BCE. Luis Moya
- BCE. Lucio Estacio
- BCE. Erika Flores
- BCE. Jorge Morales

建築グループのメンバー

3

災害の後
AFTER THE DISASTER: チーム間の連携
Establishment communication between teams

GEOTECHNICAL TEAM
土質チーム

BUILDING TEAM
建築チーム

Team meeting to study the possibility to dispatch immediately with Researchers own funds. If there is not possibility we must wait for Emergency found of UNI

4

災害の後
AFTER THE DISASTER

UNI – National University of Engineering
国立工科大学

Faculty of Civil Engineering
土木学部

CISMID

緊急時: 5日間 2千ドル 日本・ペルー地震防災センター 現地: 3日間

TIME FOR ACTIVATION OF THE EMERGENCY ECONOMIC FOUND: 5 days (There are bureaucracy items delay the Generation of the found US\$ 2000 maximum amount)

DURATION OF FOUND ON FIELD: 3 days

5

緊急時の活動費用の問題点
PROBLEMS FOR THE GENERATION OF THE EMERGENCY FOUND

- Ministry of Economy had a protocol even in emergency cases
- Priorization of the found must be submitted
- Approval of the Priorization must be submitted for certification
- Certification of the found by Ministry of Economy will allow the use of the found
- After Certification is approve the found money will be allowable
- Found could not be more than US\$ 2000 from and are taken from CISMID funds
- Teams can survive only 2 days with this money.

一経済省は緊急時でも儀礼的だった
一優先順位が高いことを示さなければならない
一保証のために優先順位の承認を提出する必要がある
一経済省による費用の保証によって活動費用が使用できる
一CISMIDの費用から使い、2千ドルを超えてはならない
一この費用でチームは2日間しか現地にいられない

6

ペルーにおける地震防災の障害は何か？

WHAT ARE THE IMPEDIMENTS TO EARTHQUAKE DISASTER MANAGEMENT IN PERU?

- Government Officers of Ministry of Economy, Majors of City Office and also City Planners are not sensible with disaster risk.
- There are cities where Hazard, Microzonification and Risk Analysis has been developed. Authorities of City office don't use it on the planning of the city. Studies are on a shelf or in a drawer very hide.
- CENEPRD (brand new government agency) should be more aggressive and active consider alliance and teach the local authorities about the disaster management policies.

一経済省、市役所、都市計画者は災害リスクに敏感でない
 一ハザードやリスク分析はしてあっても市役所で棚に眠っている
 一国は地方政府にもっと働きかけるべきである

Dr. Carlos Zavala - czavala@uni.edu.pe

7

国家防災システム

National System on Disaster Management - SINAGERD

Components of the disaster management	National and International Policies for the development	Process for the implementation of disaster management
Prospective Management	-Education -Health	-Estimation of the risk
Corrective Management	-Science & Technology -Planning for development	-Prevention and reduction of the risk
Reactive Management	-Citizens security -Environmental -Public investment -Control & monitoring	-Preparation Response and rehabilitation -Reconstruction

Source: CENEPRD
 防災の要素 開発の国家・国際政策 防災の実施プロセス

Dr. Carlos Zavala - czavala@uni.edu.pe

8

計画とリスク管理のための技術的なツール

Technical Tolls for planning and management the risk (Source: CENEPRD)

RISK REDUCTION PLAN BY SECTOR FOR EXAMPLE: EDUCATION
部門のリスク低減計画：教育

RISK REDUCTION PLAN BY SECTOR FOR EXAMPLE: HOUSING AND CONSTRUCTION
部門のリスク低減計画：住宅建築

RISK REDUCTION PLAN FOR DRAIN SYSTEMS AND WATER SUPPLY
水関係のリスク低減計画

RISK REDUCTION PLAN OF TRANSPORTATION SYSTEM AND HIGHWAYS AND BRIDGES
交通部門のリスク低減計画

NATIONAL PLAN OF RISK REDUCTION
リスク低減の国家計画

Dr. Carlos Zavala - czavala@uni.edu.pe

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ペルーにおける(防災の)主な将来の課題

MAIN CHALLENGES FOR FUTURE IMPLEMENTATION OF MANAGEMENT AND CORRECTIVE IN PERU? (SOURCE: CENEPRD)

- Achieving a culture of disaster risk management in the population located in urban and rural areas nationwide.
- 防災の文化を都市・地方を問わず構築する
 - Articulate a consistent manner between the public and private institutions involved in the processes of prevention and relief, to ensure consensus and commitments necessary to enable the formulation, implementation, monitoring and evaluation of policies, plans, programs and investment projects.
- 政策・投資の実施・評価のため官民で防災への合意形成に努める
 - Achieve a system of automated information about potential risks at local, regional and national levels, enabling the formulation of plans and investment projects reducing the vulnerability of the population and heritage.
- 市民や遺跡を守る計画や事業のためリスク情報システムを構築する
 - Strengthen the SINAGERD integrally from a decentralized perspective to empower regional and local governments under the leadership CENEPRD
- 国家防災システム(SINAGERD)を地方分権の視点で強化する

Dr. Carlos Zavala - czavala@uni.edu.pe

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防災の総合的なアプローチとは何か？

WHAT WOULD BE THE INTEGRATED APPROACH TO DISASTER MANAGEMENT?

- Integrated approach to disaster management should include the participation of the population, because if technical tools are development, people should know about the risk they are expose.
- 総合的な防災には市民がリスクを知るよう、住民の参加が不可欠
- Risk Reduction plan should be developed for each governmental agency or ministry to produce a national plan. Disaster reduction plan of each sector with the knowledge of the population, will judge the authorities, and monitoring can be effective.
- 各政府機関が防災計画を作る。部門毎の計画は市民、専門家参画と監視が有効
- Sustainable Development demands the improve of the capacities of the authorities and also officers with power of decision
- 持続可能な開発には、決断の出来る機関と担当者能力改善が必要

Dr. Carlos Zavala - czavala@uni.edu.pe

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地震防災国際協力のため日本とUNESCOがすべきことは？

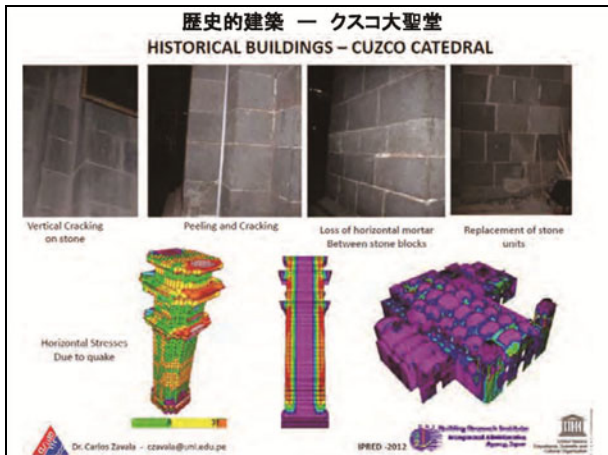
WHAT DO YOU SUGGEST JAPAN AND UNESCO TO DO FOR THE FURTHER INTERNATIONAL COOPERATION ON EARTHQUAKE DISASTER MANAGEMENT?

HISTORICAL BUILDINGS UNDER RISK - NON BUDGET TO KEEP OUR HERITAGE

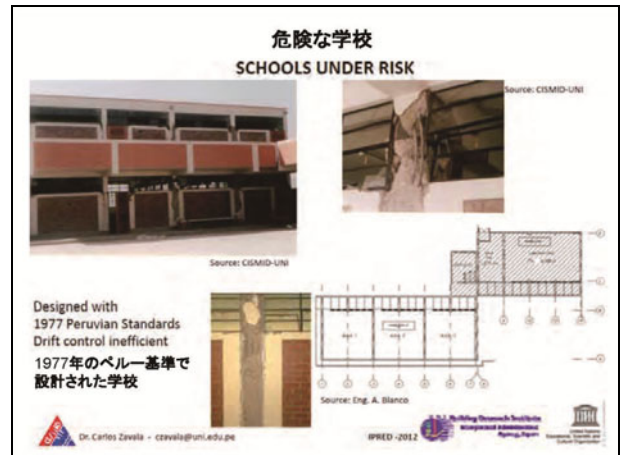
リスクにさらされている歴史的建築 - その遺産を守る予算がない

Dr. Carlos Zavala - czavala@uni.edu.pe

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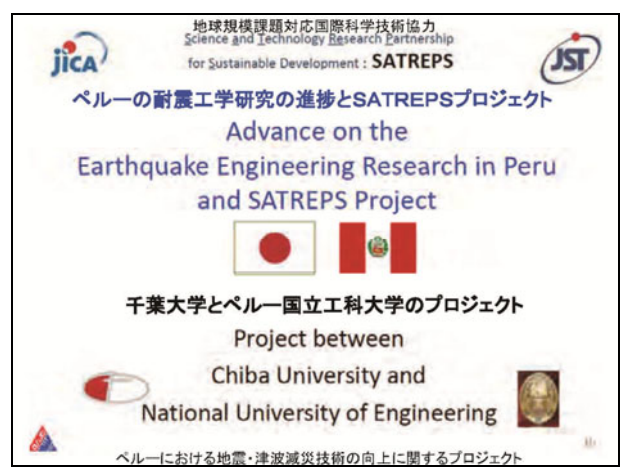
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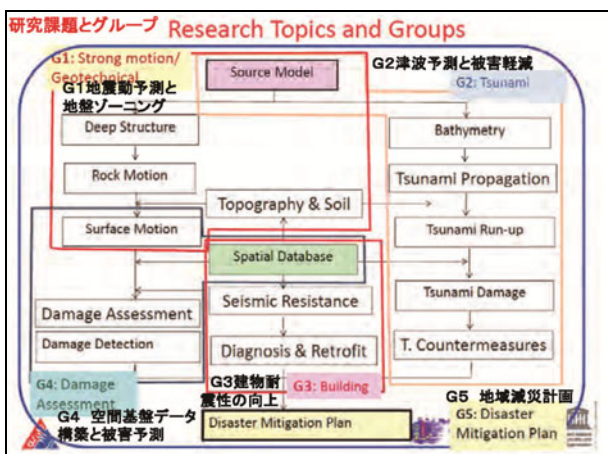
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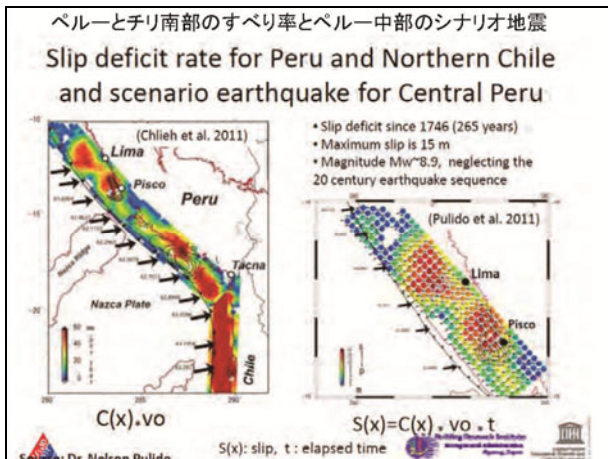
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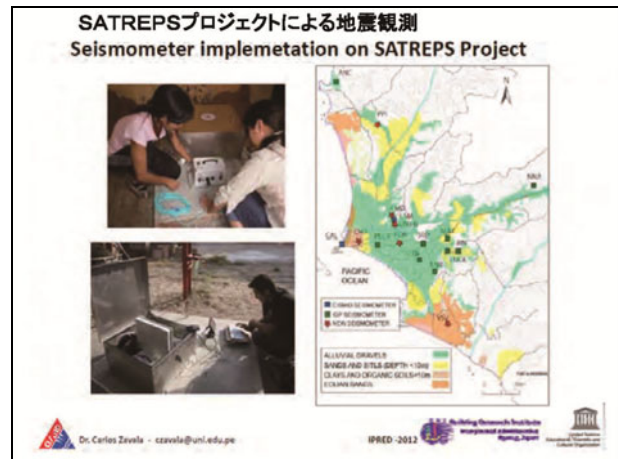
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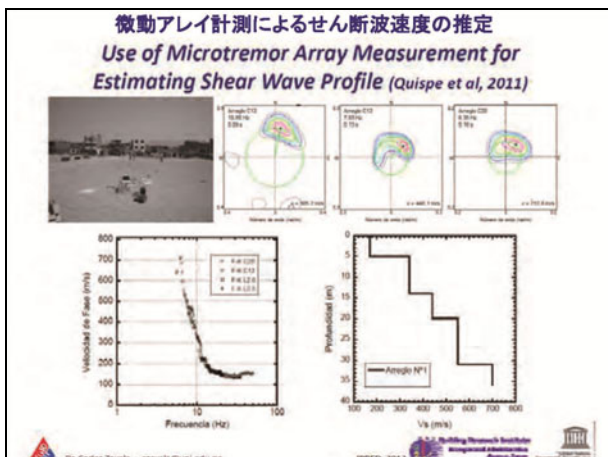
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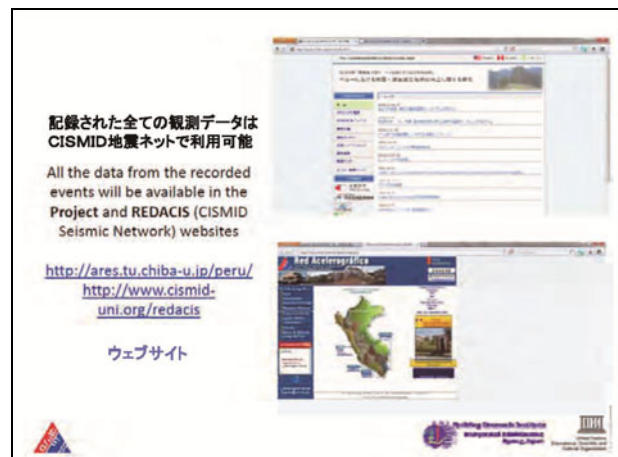
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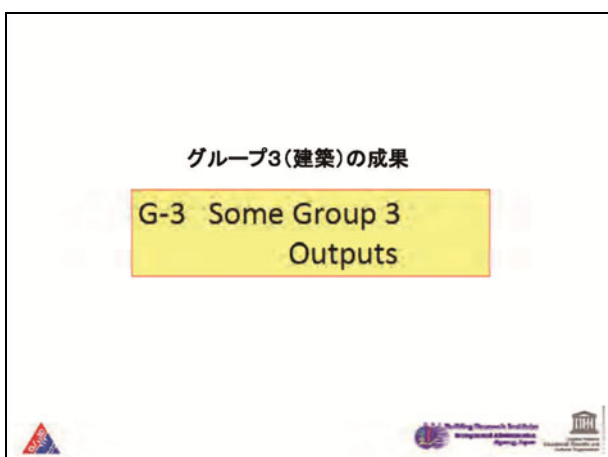
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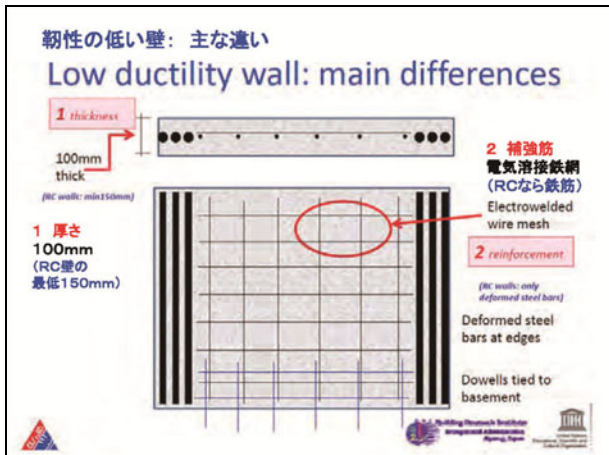
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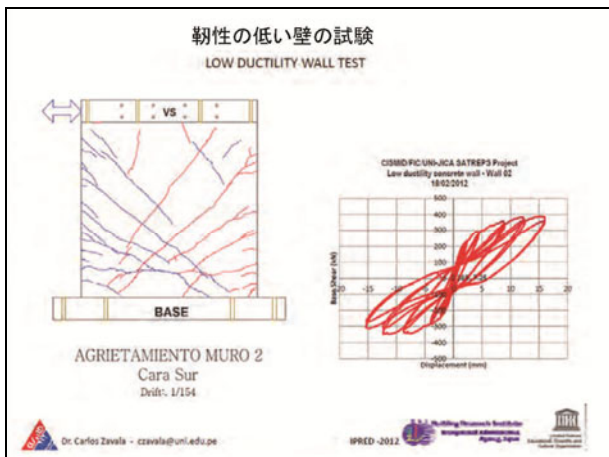
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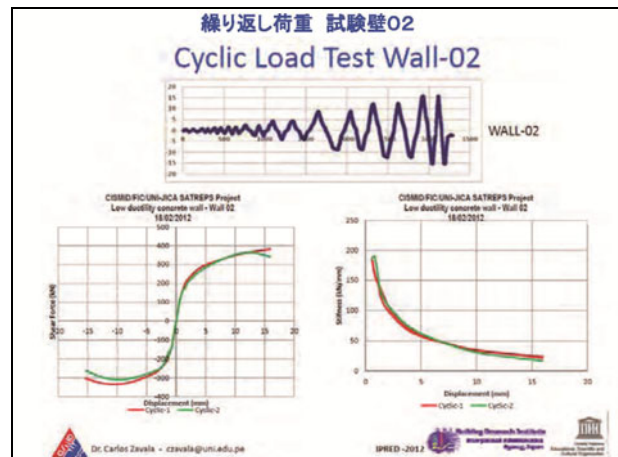
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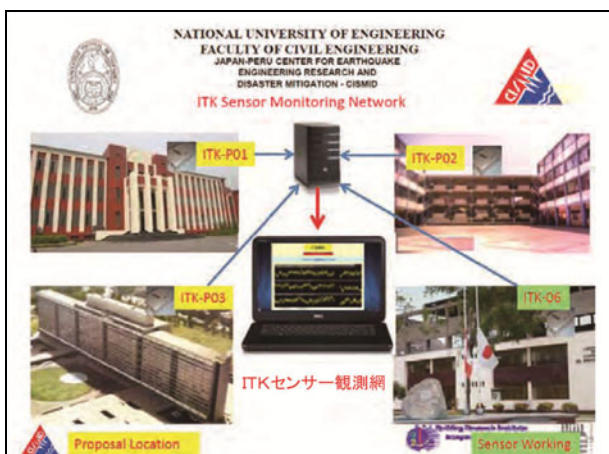
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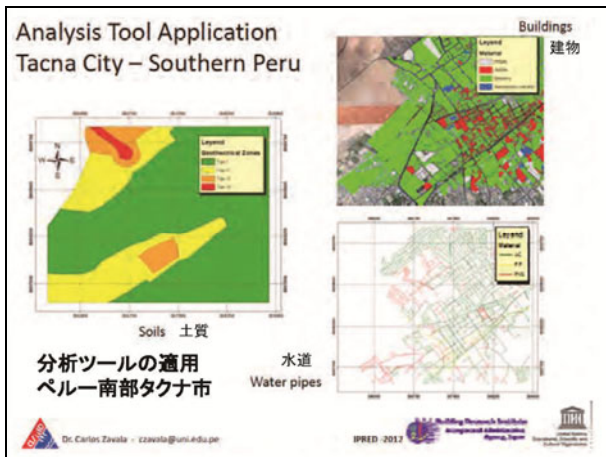


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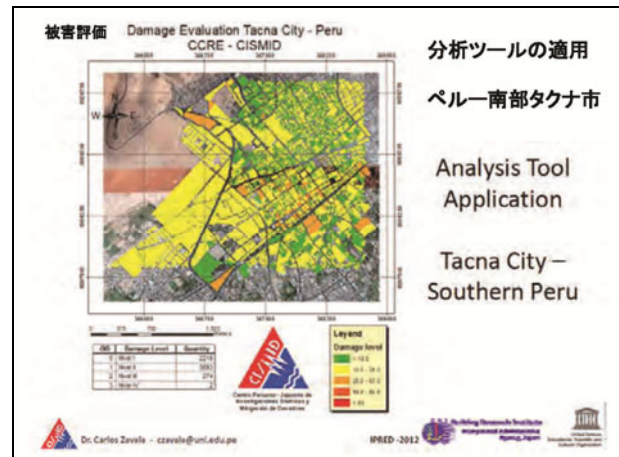
G4 (地理空間情報) グループの成果
G-4 Some Group 4
Outputs

Dr. Carlos Zaveala - czaveala@uni.edu.pe
 IPRED -2012

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まとめ
CONCLUSIONS

- The introduction for the implementation of a Filed survey in Peru has been treated 現地調査実施
- Peruvian disaster management scope was presented. ペルーの防災計画の紹介
- Indiference of decision makers and authorities is one of the main problems. Improval of the capacities of the authorithies is needed. 責任者の無関心が大問題 関係者の能力改善が必要

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ルーマニア：ラドゥ・バカロヌ ルーマニア・国立ブカレスト工科大学副学長
 [Romania] Radu Vacareanu, Vice-Rector, Technical University of Civil Engineering of Bucharest (UTCB)

International Memorial Symposium
 "Protecting Lives from Earthquake and Tsunami Disasters"
 Tokyo, Japan, June 27, 2012

ブランチャ地震群のための防災国際協力
International Cooperation on Earthquake Disaster Management for Vrancea Seismic Events

R. バカレアヌ ほか ブカレスト工科大学
 R. Vacareanu, D. Lungu, A. Aldea, C. Arion
 Technical University of Civil Engineering, Bucharest

1

同じ震源からの地震に何度も襲われる都市は世界でも例がない
 "Nowhere else in the world is a center of population so exposed to earthquakes originating repeatedly from the same source"

C. リヒター 1977年3月 ルーマニア政府宛の書翰
 Charles Richter, 15 March 1977, Letter to the Romanian government

World Map of Natural Hazards prepared by the Munich Re, 1998 indicates for Bucharest: "Large city with Mexico-city effect"
 自然災害の世界地図でブカレストは「メキシコ市効果(沼地の埋め立て)のある大都市」

"The unusual nature of the ground motion and the extent and distribution of the structural damage have important bearing on earthquake engineering efforts in the United States."
 Jennings & Blume, NRC & EERI Report
 通常と異なる地震動特性と構造被害の分布は米国における地震工学上、重要な意義を持つ
 ジェニングほか EERI報告書

2



3

1000 yr catalogue of Vrancea earthquakes
 ブランチャ地震群のカタログ

Major historical events and major earthquakes in the XX century

Event	Epicentral intensity I _s	Focus depth, km	Moment magnitude M _w	Obs
1502, October 26	~9			
1829, November 20	~8		7.9	Largest Vrancea event ever occurred
1836, June 23	~8			
1940, November 10	9	150	7.7	Largest seismic losses ever experienced
1977, March 4	8.9	109	7.5	
1986, August 30	7.8	133	7.2	

地震 震央の震度 震源深さ モーメントマグニチュード 備考

19世紀と20世紀の主な地震

4

Nov. 10, 1940 earthquake 1940年11月10日の地震
 $M_{GR} = 7.4$; $M_w = 7.7$

- At least 350 deaths in Romania
 死者はルーマニア全体で350名以上
- Collapse of Carlton Building in Bucharest
 - 11 storey, h = 47 m
 - RC frame
 - 130 death
 ブカレストのカールトンビルの被害
- Important damage in Chisinau, R. of Moldova

5

March 4, 1977 earthquake 1977年3月4日の地震
 $M_w = 7.7$; $h = 109$ km
 死者1,578名(うち、ブカレスト市で1,424名)
 負傷者11,221名

Killed 1,578 people (1424 in Bucharest)
Injured 11,221 people (7598 in Bucharest)

- Destroyed or seriously damaged 33,000 housing units and caused lesser damage to 182,000 other dwellings
- Destroyed 11 hospitals and damaged 448 others hospitals, etc.

世界銀行による経済的被害
 The World Bank estimation of losses (Report 16.P-2240-RO, 1978):

- Total losses in Romania : 2.05 billion USD (100%)
- Construction losses : 1.42 (70%)
- Building and housing losses : 1.02 (50%)

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1977年地震による教訓 International lessons unlearned from the 1977 earthquake

- 耐震設計法がつけられる以前の全ての建物の診断をするべきである。
 "A systematic evaluation should be made of **all buildings in Bucharest erected prior to the adoption of earthquake design requirements and a hazard abatement plan should be developed.**"
 From: "Observation on the behaviour of buildings in the Romanian earthquake of March 4, 1977" by G. Fattal, E. Simu and Ch. Cliver. Edited as the NBS Special Publication 490, US Dept of Commerce, National Bureau of Standards, Sept 1977.
- 仮補強の方法を至急、開発すべきである。
 "Tentative provisions for **consolidation solutions** would preferably be developed **urgently**."
 From: "The Romanian earthquake. Survey report by Survey group of experts and specialists dispatched by the Government of Japan (K. Nakano). Edited by JICA, Japan International Cooperation Agency, June 1977.
- 地震リスクが低い評価のブカレスト市で最も被害が大きかった。
 "Bucharest had been microzoned as part of UNESCO Balkan Project, with microzones denoting three levels of risk. **The worst destruction occurred in lowest-risk microzone.**"
 From: "Earthquake in Romania March 4 1977. An Engineering Report" by G. Berg, B. Bull, M. Sozen, Ch. Rognin. Edited by National Academy Press, Washington, D.C. 1980

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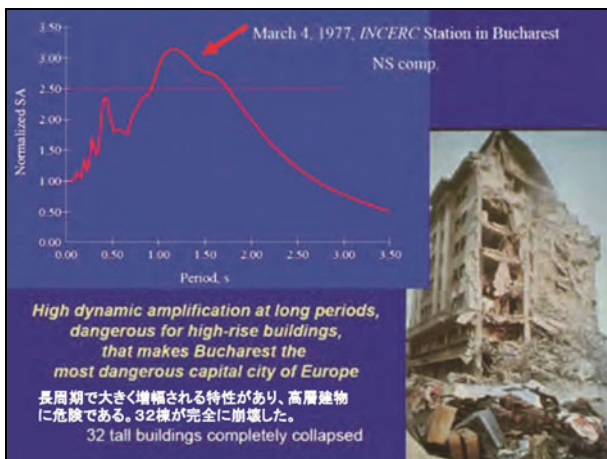
日本の協力でINCERCに設置された強震計で、ルーマニアで最初の記録が取られた。

March 4, 1977
seismic station INCERC
Bucharest

Station	Comp.	PGA cm/s ²	IE
INCERC	NS	194.9	1.40%
O	Z	105.8	1.20%
	EW	162.3	0.89%

First strong ground motion recorded in Romania

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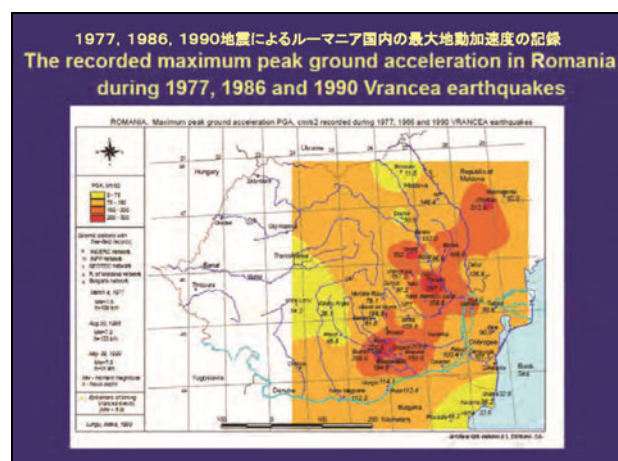
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世界銀行のレポート
World Bank report

避けうる損失: 人命と財産を救うハザード・リスク管理
"Preventable Losses: Saving Lives and Property through Hazard Risk Management"

Strategic Framework for reducing the Social and Economic Impact of Earthquake, Flood and Landslide Hazards in the Europe and Central Asia Region

July, May 2014

- **Romania is regarded as one the most seismically active countries in Europe** ルーマニアはヨーロッパで最も地震活動が活発な国の一つである。
- **Bucharest is one of the 10 most vulnerable cities in the world.** ブカレストは世界で最も脆弱な10都市の一つである。

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ルーマニアに対する推奨
Recommendations for Romania:

- Upgrade the legal framework for hazard specific management; 災害に対する法的基準の整備
- Review the existing buildings code for the retrofitting of vulnerable buildings. 耐震基準の見直しと脆弱建物の補強
- Conduct a comprehensive public awareness campaign for the earthquake risk; 地震リスクに対する市民の意識向上
- Invest in hazard mitigation activities in order to reduce the risks caused by earthquakes; 地震災害軽減への投資
- Develop financing strategy for catastrophic events. 甚大な災害に対する経済的戦略の開発

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National programs for seismic risk mitigation in Romania
ルーマニア国の地震防災プログラム

Objectives 目的

- Strengthening of "seismic risk class I" buildings. Legislation + Construction work
地震リスクIの建物の補強
- Upgrading of the code for seismic design of buildings and structures
耐震基準の改善
- Seismic instrumentation
地震観測

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Central Bucharest: 129 buildings built prior to 1945 and listed as having seismic risk class 1 in case of a strong earthquake, Mw27.5
ブカレスト中心部における地震リスクIの建物分布

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Strengthening of 9 storey residential building in central Bucharest 9階建て集合住宅の補強

June 2012, after ~ 15 yr of actions:

26 buildings are fully retrofitted out of which 11 were seismic risk class I
26棟が補強済み(そのうち11棟はクラスI)

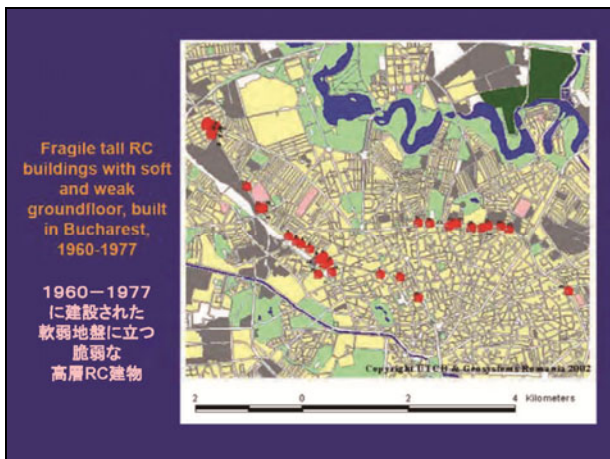
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ブカレストの集合住宅の補強
Strengthening of residential buildings in Bucharest

Category	No. of buildings	No. of apartments	Total floor area, m ²
1	26	716	79648
2	111	3189	395738
3	263	2668	366228
4	299	10732	946944
5	69	1590	182622
6	6	86	12530
7	1658	5037	753706
8	147	1522	92122
TOTAL	2579	25540	2829538

1. Retrofitted buildings
2. Seismic risk class I buildings that represent public danger
3. Seismic risk class I buildings
4. Seismic risk class II buildings
5. Seismic risk class III buildings
6. Seismic risk class IV buildings
7. Buildings seismically evaluated according to P100-92
8. Buildings seismically evaluated but not ranked within a seismic risk class.

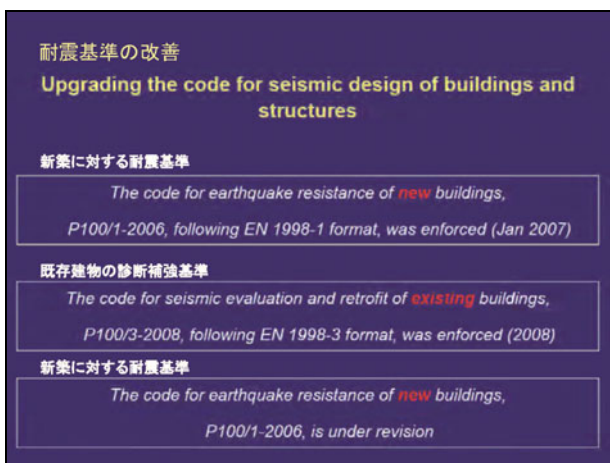
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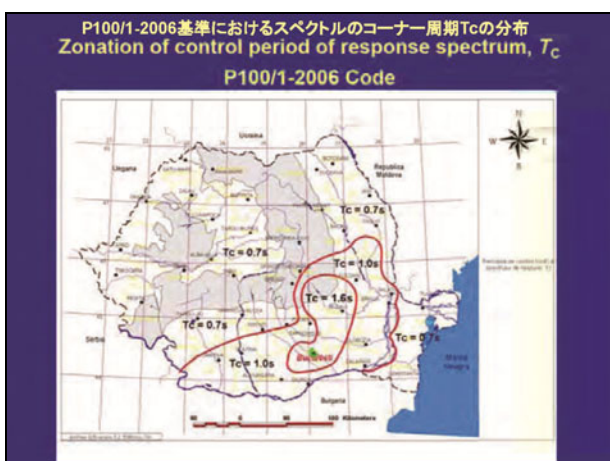
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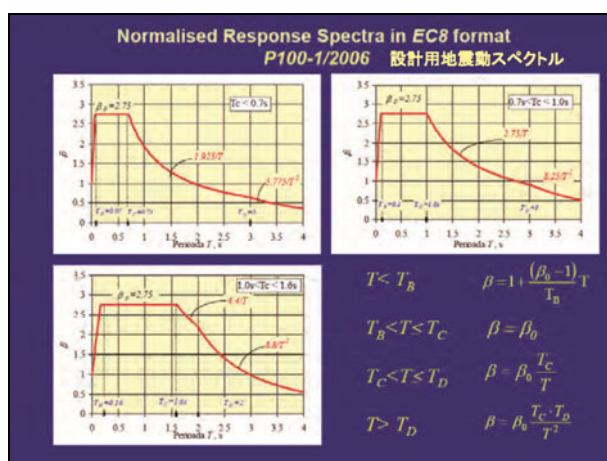
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地震災害軽減の国際プロジェクト
2. International projects for seismic risk mitigation in Romania

- JICA Project - Reduction of seismic risk for buildings and structures in Romania
- CRC 461 Project - Vrancea Earthquakes. Tectonics, Hazard and Risk Mitigation
- RISK-UE - An advanced approach to earthquake risk scenarios with applications to different European town
- PROHITECH - Earthquake Protection of Historical Buildings by Reversible Mixed Technologies
- World Bank Hazard and risk mitigation in Romania - Component B: Earthquake Risk Reduction
- NATO Project- Harmonization of Seismic Hazard Risk and Reduction in Countries Influenced by Vrancea Earthquakes

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JICA PROJECT - Reduction of seismic risk for buildings and structures in Romania
日本・ルーマニアの外交100周年に、JICAプロジェクトがスタートした。
Project signed in 2002, when 100 years of diplomatic relations between Japan and Romania were celebrated

Partnership of 3 institutions:
ルーマニア公共事業省MDLPLの下の3つの研究機関が協力
NCSRR, National Center for Seismic Risk Reduction
UTCB, Technical University of Civil Engineering Bucharest
INCERC, National Institute for Building Research, Bucharest
under the authority of:
MDLPL, Ministry of Development, Public Works and Housing

Project duration: 5.5 yr

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プロジェクト費用
Total cost of the project
7 mil. USD – Donation from JICA

機材供与
Equipment cost 3 mil. USD:
- Soil testing laboratory
- Structure testing laboratory
- Seismic instrumentation network in Bucharest and Romania (free field, borehole, buildings)

研修・専門家派遣
29 Romanian young students/engineer trained in Japan
46 Japanese short term and long term experts in Romania

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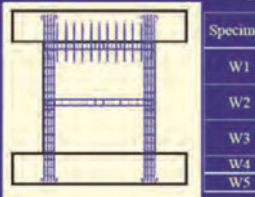
Structural testing equipment - Reaction frame
日本が供与した構造実験施設




- ✓ Maximum weight of tested specimens - 7t
- ✓ Maximum dimensions of the tested specimens - 2.5m by 3 m
- ✓ Reaction frame 9.7m x 7.6m

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JICA Project – structural testing
JICAプロジェクトによる構造実験

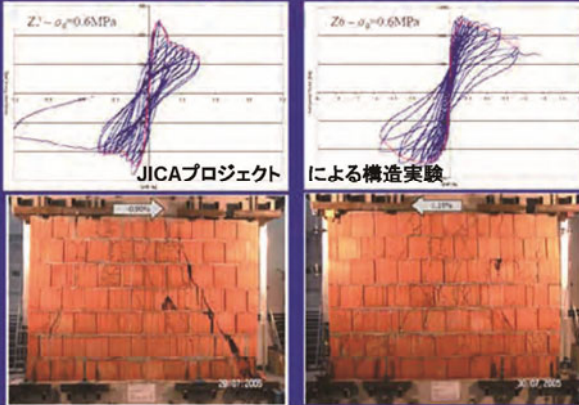


Specimen	σ_0	Armare "grinda"	Armare "stalp"	Armare mima	Mod de cedare
W1	0.13	da	sporita	-	Forța taietoare
W2	0.26	da	sporita	-	Forța taietoare
W3	0.13	-	sporita	-	Forța taietoare
W4	0.13	da	normala	-	Incovoiere
W5	0.13	da	normala	da	Incovoiere



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JICA Project – structural testing



JICAプロジェクトによる構造実験

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Equipments for soil investigation
Triaxial testing equipment 3軸土質試験機

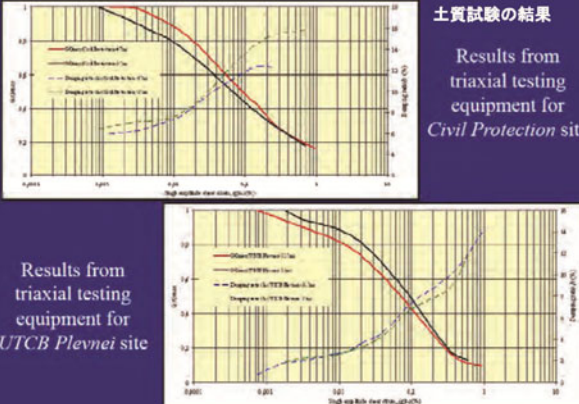


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JICA Project – soil investigation

土質試験の結果

Results from triaxial testing equipment for Civil Protection site



Results from triaxial testing equipment for UTCB Plevnei site

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PS logging, downhole method results
PS検層による地盤調査



Address	Site	$V_{s,30}$	T_p	$V_{s,30}$	T_p
140	INCERC	271	0.449	301	0.677
69	SIPITAL	246	0.495	279	0.731
110	VALONI	285	0.427	309	0.660
79	UTCB	310	0.393	325	0.627
66	INSTALATI	289	0.421	317	0.643
68	PIRC	294	0.414	308	0.662
51	PRONIA	224	0.544	264	0.772



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JICAプロジェクト 地震観測ネットワーク
JICA Project – seismic network

✓ *ETNA-Kinematics* and *Geosig* accelerometers (3 channels) - placed in free field outside Bucharest

✓ *ALTUS K2-Kinematics* and *Geosig* accelerometers (12 channels) – installed in boreholes and buildings inside Bucharest

Seismic network

<p>Free field outside Bucharest</p> <p><i>ETNA & Geo</i></p> <p>8 sites</p> <p>6 - JICA</p> <p>2 - MTCT</p> <p style="text-align: center;">地表</p>	<p>Borehole Bucharest</p> <p><i>K2&Geo</i></p> <p>8 sites</p> <p>7 - JICA</p> <p>1 - MTCT</p> <p style="text-align: center;">地中</p>	<p>Building Bucharest</p> <p><i>K2&Geo</i></p> <p>5 sites</p> <p>4 - JICA</p> <p>1 - MTCT</p> <p style="text-align: center;">建物内</p>
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典型的なRC構造の共同住宅



Typical RC frame structure residential Buildings

1 - after 1977 (11 storeys)

2 - before 1977 (7 storeys)

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National Romanian Television. RC frame structure built before 1977 earthquake (14 storeys)

国営ルーマニアテレビ
1977年地震以前のRC構造14階



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ソシエテジェネラル銀行本部
2002年のRC造 19階

BRD - Societate Generale bank headquarters

RC structure, 2002


19 storeys



27 October, 2004 seismic event
2004年10月27日の強震記録

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JICA Project for Seismic Risk Reduction in Romania
 JICAプロジェクトによるルーマニアの防災セミナー・シンポジウムの報告書



Earthquake Hazard and Countermeasures for Existing Fragile Buildings

Contributions from JICA International Seminar on Seismic Risk Reduction, Bucharest, November 19-20, 2007



ISSAR 2007

Proceedings

International Symposium on Seismic Risk Reduction

The JICA Technical Cooperation Project in Romania

November 2007, Bucharest, 26-27 April 2007

International Symposium on Seismic Risk Reduction – The JICA Technical Cooperation Project, Bucharest, April 26-27, 2007

JICA International Seminar, Bucharest, Nov. 23-24, 2000

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JICA Project for Seismic Risk Reduction in Romania

JICAプロジェクトが終了後、2010年8月にルーマニア政府は地震防災センターを解体し、機材をINCERCに移した。センター・スタッフの多くは大学(UTCB)に戻った。

Even the *NCSRR* was created for building a capacity to last even after the termination of *JICA* Project in Romania, in August 2010 the Romanian authorities decided to dismantle the *Center* and to relocate the equipments to the former partner, *INCERC*. The whole staff of *NCSRR* from *UTCB* (almost 90% of the staff of *NCSRR*) stayed with the University.

It is like a computer with the software (highly trained engineers) in one place and the hardware (equipment) in some other place – not operational.

これはコンピュータで例えれば、ソフト(人材)とハード(機材)を別の場所に分けたことになり、機能しない。

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ドイツ・カールスルーエ大学との共同研究
CRC 461, Collaborative Research Center - Strong Earthquakes: A Challenge for Geosciences and Civil Engineering

University of Karlsruhe, Germany

1996年から2007年まで
 Starting Date: 1996
 Ending Date: 2007

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Future Extension of seismic cooperation ?

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参加者
Participants

- Collaborative Research Center (CRC) 461: "Strong Earthquakes: A Challenge for Geosciences and Civil Engineering", University of Karlsruhe, Germany

and

- Romanian Group for Strong Vrancea Earthquakes (RGVE)
 - INFP, National Institute for Earth Physics
 - UTCB, Technical University of Civil Engineering
 - INCERC, National Institute for Building Research
 - University of Bucharest, Faculty of Geology and Geophysics
 - GEOTEC, Institute for Geotechnical and Geophysical Studies and others

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Project planning プロジェクト計画

- A 1: Deep Seismic Sounding of the Vrancea Zone
- A 6: Stress Field and Geodynamics
- A 7: Strong Ground Motion Assessment
- B 1: Three-Dimensional Plate Kinematics in Romania
- B 3: Seismogenic Potential of the Vrancea Subduction Zone - Quantification of Source- and Site-Effects from Strong Earthquakes
- B 4: Non-Linear Wave Phenomena in Fine and Soft Soils
- B 6: Geotechnical and Seismic Microzoning of Bucharest
- B 7: Hydrogeology and Site Effects by Earthquakes in Bucharest
- C 2: Methods for the Retrofitting of Damaged Buildings
- C 3: Disaster Management - Models and Simulation
- C 5: Image Analysis in Geosciences and Civil Engineering
- C 6: Knowledge Representation for Disasters with a Technical Information System
- C 7: Novel Rescue and Restoration Technologies
- C 9: Vulnerability Analysis of Existing Structures
- Z 1: Central Geographical Information System (GIS)
- Z 2: SFB Management

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ルーマニアUTCB大学とドイツKarlsruhe大学では、地震計をブカレスト市内に密に配置することにした。

The contribution of engineers from RC departments in both UTCB & Univ. of Karlsruhe to the CRC461 seismic instrumentation project in Romania was focusing on conversion of the original pattern of CRC461 instrumentation initially planned outside Bucharest into finally dense seismic instrumentation inside Bucharest.

That new pattern of the CRC461 network in Bucharest was the basis for the future microzonation studies as well as for dynamic characterization of site conditions in the capital city of Romania.

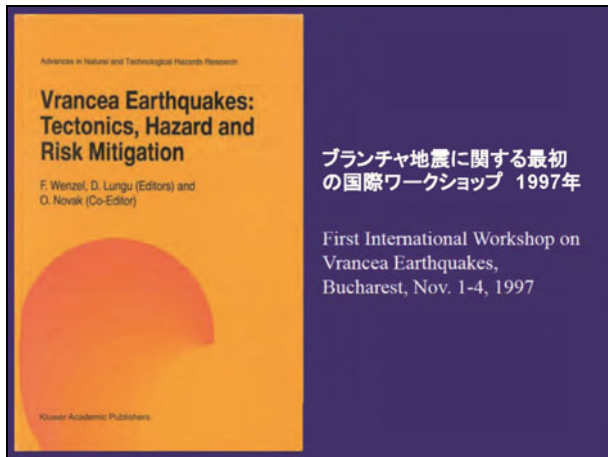
CRC361地震観測ネットワークは、首都ブカレストの将来の地震マイクロゾーニング研究の基礎となる。

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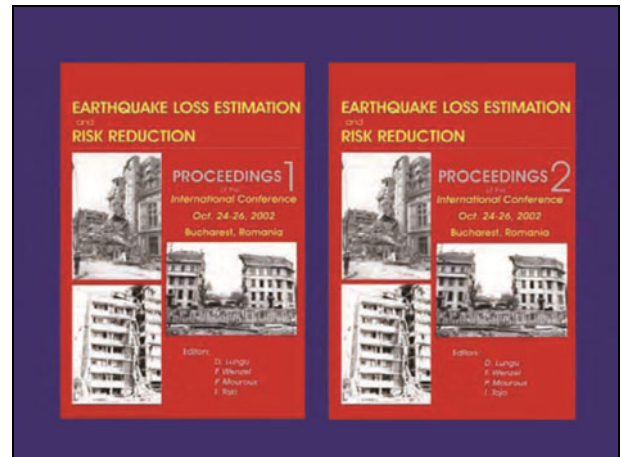
Test building at INCERC site and ALGA rubber bearings-HDRB 250x164-S

免震装置

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RISK-UE - An advanced approach to earthquake risk scenarios with applications to different European towns

RISK-UE ヨーロッパの異なる都市の地震リスクシナリオ研究

Contract n° EVK4-CT-2000-00014 with European Commission, Research Directorate General

2001年から2004年まで計2,477,643ユーロ

Amount: 2 477 643 €

Funding: EC : 66 %

participants: 34 %

Starting Date: 2001

Ending Date: 2004

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RISK U.E. Project

An advanced approach to earthquake risk scenarios with applications to different European towns

RISK-UEプロジェクト
ヨーロッパの異なる都市の地震リスクシナリオ研究

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**Project planning
プロジェクト計画**

WP 1: Evaluation of European distinctive features

WP 2: Earthquake hazard assessment

WP 3: Urban system analysis

WP 4: Vulnerability assessment of current buildings

WP 5: Vulnerability assessment of historical and monumental buildings

WP 6: Vulnerability assessment of lifelines and essential structures

WP 7: Earthquake risk scenarios

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**参加機関
Participants**

Name Participants	Responsible persons
Bureau de Recherches Géologiques et Minières, BRGM, France	P. Meunier, Project Co-ordinator
Géologie tectonique environnement et risques, France	C. Martin
Politecnico di Milano, POLIMI, Italy	E. Faccioli
University of Genoa, UNIGE, Italy	S. Lagetonsine
Technical University of Civil Engineering, UTCB, Romania	D. Lungu
Institut Cartogràfic de Catalunya, ICC, Spain	A. Roca
Aristotle University of Thessaloniki, AUTH, Greece	K. Pitilakis
Institute of Earthquake Engineering and Engineering Seismology, IZIS, FYROM Macedonia	Z. Mihinevic
Central Laboratory for Seismic Mechanics and Earthquake Engineering, CLSMEE, Bulgaria	M. Kostov

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Workpackage 1 of RISK-UE
 European distinctive features, inventory database and typology

Objective 1 - Distinctive features of European towns
 目的1: ヨーロッパ諸都市の特徴

- Town identity
- Population characteristics
- Urbanised area and elements at risk
- Impact of past earthquakes on elements at risk
- Strong motion data in the city and seismic hazard
- Geological, geophysical and geotechnical information
- Evolution of earthquake resistant design codes
- Earthquake risk management efforts

References

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Objective 2 - Europe inventory database and typology
 目的2: ヨーロッパ諸都市の建物情報の整理
 Classification of buildings occupancy

Code	Occupancy category	Importance & exposure category		
		1	2	3
B	GENERAL BUILDING STOCK			
B1	Residential			
1.1	Single family dwelling (house)			x
1.2	Multi family dwelling (apartment bldg.)			x
1.3	Low-rise (1-2)		x	
1.4	Mid-rise (3-7)		x	
1.5	High-rise (8+)	x		
1.6	Institutional dormitory	x		
B2	Commercial			
2.1	Supermarkets, Malls	x		
2.2	Offices	x		
2.3	Services	x		
2.4	Hotels, Motels	x		
2.5	Restaurants, Bars	x		
2.6	Parking	x		
2.7	Warehouse	x		
B3	Cultural			
3.1	Museums	x		x
3.2	Theaters, Casinos	x		x
3.3	Public event buildings	x		x
3.4	Stadiums	x		x

1) Buildings with capacity greater than 150 people
 2) Buildings with capacity greater than 300 people or where more than 300 people congregate in one area

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Building typology matrix, BTM 建物タイプ

Label	Building type description	Height description		Code level			
		Class	No. of stories	N	L	M	H
BC	Reinforced concrete structures:						
BC1	Concrete moment frames	Low-rise	1-3	h ≤ 9			
		Mid-rise	4-7	9 < h ≤ 21			
		High-rise	8+	h > 21			
BC2	Concrete shear walls	Low-rise	1-3	h ≤ 9			
		Mid-rise	4-7	9 < h ≤ 21			
		High-rise	8+	h > 21			
BC3	Concrete frames with unreinforced masonry infill walls	Low-rise	1-3	h ≤ 9			
		Mid-rise	4-7	9 < h ≤ 21			
		High-rise	8+	h > 21			
BC4	Regularly infilled frames	Low-rise	1-3	h ≤ 9			
		Mid-rise	4-7	9 < h ≤ 21			
		High-rise	8+	h > 21			
BC5	Irregularly frames (i.e., irregular structural system, irregular infills, soft/weak story)	Low-rise	1-3	h ≤ 9			
		Mid-rise	4-7	9 < h ≤ 21			
		High-rise	8+	h > 21			
BC6	RC Dual systems (RC frames and walls)	Low-rise	1-3	h ≤ 9			
BC7	Precast Concrete Tilt-Up Walls	Low-rise	1-3	h ≤ 9			
		Mid-rise	4-7	9 < h ≤ 21			
		High-rise	8+	h > 21			
BC8	Precast Concrete Frames with Concrete shear walls	Low-rise	1-3	h ≤ 9			
		Mid-rise	4-7	9 < h ≤ 21			
		High-rise	8+	h > 21			

*Code level
 N - no code;
 L - low-code (designed with unique arbitrary base shear seismic coefficient);
 M - moderate-code;
 H - high-code (code comparable with Eurocode 8)

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Population density in the 7 towns
 7都市の人口密度

Town	Population density (persons/km²)
Barcelona	15,000
Bitola	12,000
Bucharest	11,000
Catania	6,000
Nice	5,000
Sofia	4,500
Thessaloniki	22,000

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Number of housing units for 7 towns
 7都市の住宅数

Town	Number of housing units
Barcelona	700,000
Bitola	100,000
Bucharest	780,000
Catania	180,000
Nice	220,000
Sofia	480,000
Thessaloniki	400,000

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ヨーロッパの建物ストックの脆弱性とタイプ
 Vulnerability and typology of European buildings stock

Building stock age in the 7 towns versus Seismic codes inter-benchmark periods
 7都市の建物の耐震設計の時期とその分布

Town	Seismic codes inter-benchmark periods		
	Pre-code	Low-code	Moderate code
Barcelona	79%	21%	--
Bitola	45%	29%	25%
Bucharest	30%	30%	40%
Catania	92%	--	8%
Nice		75%	25%
Sofia	Data not available		
Thessaloniki	20%	50%	30%

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PROHITECH
歴史建物の地震からの保護に関わるプロジェクト
PROHITECH - Earthquake Protection of Historical Buildings by Reversible Mixed Technologies

Contract n° INCO – CT-2004 – 509119 with European Commission, Research Directorate General

2004年から2007年まで計2,400,000ユーロ
 Amount: 2 400 000€
 Funding: EC: 88 %, participants : 12 %
 Starting Date: 2004
 Ending Date: 2007

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プロジェクト計画
Project planning

- WP 1: Overview of existing techniques
- WP 2: Damage assessment
- WP 3: Risk Analysis
- WP 4: Intervention strategies
- WP 5: Innovative materials and techniques
- WP 6: Reversible mixed technologies
- WP 7: Experimental analysis
- WP 8: Numerical analyses
- WP 9: Calculation models
- WP 10: Validation of innovative solutions and procedures
- WP 11: Study cases
- WP 12: Design guidelines

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参加機関
Participants

Part.	Entity Name	Country	Lead/Co-ordinator
1	UNIVERSITY OF NAPLES FEDERICO II - ENGINEERING	Italy	F. Mammi
2	UNIVERSITY OF NAPLES FEDERICO II - ARCHITECTURE	Italy	F. Lamberti
3	UNIVERSITY OF GREECE	Greece	P.P. Ioannidis
4	UNIVERSITY "BIL. CIBELAND METEOROLOG" IN SOFIA	Bulgaria	G. Gerasimov
5	NATIONAL TECHNICAL UNIVERSITY OF ATHENS	Greece	T. Tassos
6	UNIVERSITY OF NAPLES FEDERICO II - ARCHITECTURE	Italy	F. Lamberti
7	INSTITUTO TECNICO TECNICO OLSANO	Romania	T. Galati
8	TECH. POLYTECHNIC - UNIVERSITY OF BRESLAU	Poland	P. Dolez
9	TECHNICAL UNIVERSITY OF CIVIL ENGINEERING - BUCHAREST	Romania	P. Dorca
10	UNIVERSITY OF BELGRADE	Serbia	P. Pec
11	MAŠINSKI UNIVERZITET	Croatia	P. Bitor
12	TECHNICAL SCHOOL INSTITUTE OF TECHNOLOGICAL BAHU	Romania	A. V. Eufrosina
13	ENGINEERING CENTER FOR ARCHITECTURE AND ENVIRONMENT HEAD - FACULTY OF ENGINEERING - CARU UNIVERSITY	Romania	M. G. Galati
14	NATIONAL SCIENTIFIC AND TECHNICAL RESEARCH CENTER	Romania	A. Iordan
15	SECOND UNIVERSITY OF NAPLES	Italy	A. Marotta
16	FACULTE DE GENIE CIVIL UNIVERSITE DES SCIENCES ET DE LA TECHNOLOGIE (USTHB) ALGERIA	Algeria	M. Chammak
17	UNIVERSITY OF CRISTOPHESCU	Italy	D. De Mottis

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世界銀行によるプロジェクト
World Bank Project in Romania

Component A: **防災マネジメントの強化**
Strengthening of disaster management capacity

Component B: **地震リスクの軽減**
Earthquake Risk Reduction - 71.2 million US\$

Subcomponents: 補強、検査、設計法の改善、補強のための研修
 -Strengthening of high priority buildings and lifelines
 -Design & supervision
 -Building code review and study of code enforcement
 -Professional training in cost effective retrofitting

Components C, D&E: **洪水、公害対策**
Flood, Pollution & Project Management

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Distribution of buildings with occupancy
対象建物の分布 (左:ブカレスト、右:他都市)

Bucharest

Hospitals 40%
Emergency facilities 30%
Educational 18%
Public 12%

Other cities

Emergency facilities 39%
Educational 11%
Hospitals 20%
Public 4%
Communication 2%

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Distribution of number of buildings to be retrofitted
補強が必要な建物の比率

Distribution of cost for buildings to be retrofitted
補強に必要なコストの比率

Number of buildings

Bucharest 38%
Other cities 62%

Cost

Bucharest 67%
Other cities 33%

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Conclusions
結論

Impediments in Earthquake Disaster Management
地震災害マネジメントの障害

1. Weak political support – results pay off later 弱い政治サポート
2. Low public awareness – time between earthquakes longer than the vivid memories of the public – as consequences:
 - Disaster relief – OK 低い防災意識
 - Preparedness – low 結果として、地震前の準備よりも地震後の対応に関心 hard process because
3. Retrofitting of residential buildings of social issues: multiple owners, lack of awareness, poverty, juridical issues on property 集合住宅の補強の難しさ 区分所有、低い防災意識
4. International financing bodies of retrofitting programs – focus on public buildings and structures 国際資金は公共建物の補強に重点がある(民間の集合住宅の補強がおろそかになる)

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Conclusions

Further actions 将来の課題 建物の地震後の診断マニュアル

1. Prepare and endorse a manual for post-earthquake investigation to be used within IPRED missions; manual shall include very clear rules and very precise criteria for making the decision on the damage state of the buildings
2. The post-earthquake investigation information on the damage on buildings, structures and lifelines shall be valuable in two directions: 建物の地震後の診断の重要性
 - lessons learnt on the vulnerability of different building typologies and/or construction techniques and details; this information shall be used to improve the seismic design regulations; 耐震基準の改善において重要
 - statistical information for different building typologies and different seismic demands; this information might be used for both seismic design regulations and for fragility/vulnerability and risk analysis.

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International Memorial Symposium
 "Protecting Lives from Earthquake and Tsunami Disasters"
 27 June 2012, GRIPS, Tokyo

自然災害による人命損失を減らす国際協力
 International cooperation to reduce the loss
 of lives due to natural disasters

政策研究大学院大学教授 岡崎健二
 Kenji Okazaki
 Professor
 National Graduate Institute for Policy Studies (GRIPS)
 Tokyo, Japan



1

国際社会が防災の関与を表明すればするほど、災害でより多くの人々が亡くなる。
 The more international communities express their commitment
 for disaster reduction, the more people are killed by disasters

最近30年間の死者数の多い災害 上位10
 10 most deadly disasters in the last 30 years


Nation	Disaster	Year	Death
Armenia	Earthquake	1988	25,000
Iran	Earthquake	1990	35,000
Bangladesh	Cycl./flood	1991	140,000
Venezuela	Flood	1999	30,000
Iran	Earthquake	2003	27,000
Indonesia, others	Eq./tsunami	2004	280,000
Pakistan	Earthquake	2005	80,000
Myanmar	Cycl./flood	2008	130,000
China	Earthquake	2008	90,000
Haiti	Earthquake	2010	230,000

国連などの国際的活動
 UN and international activities

UN/IDNDR: 1990 -1999
 1994: Yokohama Principles
 横浜戦略

UN/ISDR: 2000 -
 2005: Hyogo Framework
 for Action 2005-2015
 兵庫行動枠組

- Deadly disasters occur in developing countries (10/10)
- Deadly disasters occur mostly in Asia (7/10)
- Deadly disasters are mostly caused by earthquakes (7/10)
- Deadly disasters have been increasing (6 in 2000's)



2

災害による人命の損失は、いかに軽いのか
 Human lives lost by disasters: how cheap?

「一人の死者は悲劇だが、百万人の死者は統計である。」(スターリン)
 • "One death is a tragedy. A million of deaths are statistics."
 (Stalin)


Thousands of tragedies behind thousands of deaths.

人命の経済的価値は、災害による経済被害額に含まれていない。
 • Economic value of human lives are not included in the
 economic loss due to disasters

Economic loss of 3.11 Great East Japan Earthquake: Total 17
 trillion yen (Value of lost human lives: zero)

「市民の生命を守る」ことは政府の最高の優先事項である。
 • "To protect the lives of citizens" is the highest priority of the
 governments.

Are governments making every effort to protect people's lives
 from disasters?



3

防災に関する国際活動
 International activities for disaster management

- Most international resources focus on
 response (rescue and recovery) activities
- Urgent and humanitarian
- Covered by mass media because
 such activities are dramatic



However:

- Relief activities cannot recover the lost lives.
 Thousands of people are instantly killed in disasters.
- If people survive, recovery and reconstruction would be much easier
 and less costly.
- Donor countries cannot fund for response any more after repeating
 super disasters recently

More focus on protecting lives before disasters hit !!
 災害が起こる前の人命保護に、より焦点を当てるべきである。



4

Inappropriate resource allocation for disaster
 risk management
 災害リスク管理における不適当な資源の配分

- Post-disaster > Pre-disaster
 災害後 > 災害前
- Engineered > Non-engineered
 工学的 > ノンエンジニアド(在来的)
- Hardware (infrastructure and modern technologies)
 > Software (human power/education)
 ハード(インフラや近代技術) > ソフト(人間の力や教育)




5

The most important lesson of 2011 Great
 East Japan Earthquake Disaster
 東日本大震災による最も重要な教訓

"Thousands of people would not have been killed if they would have
 evacuated promptly"

「適切な避難がなされていれば、何千人の人たちの命が救われたはずである」

- People in this region knew the tsunami would strike after a strong
 earthquake. 繰り返される津波
 Repeated Tsunamis – Meiji Sanriku Tsunami (1896), Showa Sanriku
 Tsunami (1933), Chile Earthquake Tsunami (1960), etc.
- Most people in this region knew "Tsunami Tendenko" (in case of
 tsunami, you should evacuate promptly by yourself without taking
 care of other family members) 地域は皆「津波でんでんこ」を知っていた。
- Tsunami warning was issued 3 minutes after the earthquake. People
 had approx. half an hour or more before the tsunami stroke.
- Municipalities instructed people to evacuate promptly.
 Yet, they had many reasons not to evacuate promptly
 適切に避難できない多くの理由があった。



6

The most important lesson of 1955
 Hanshin-Awaji Earthquake Disaster
 阪神・淡路大震災による最も重要な教訓
 “Thousands of people would not have been killed if they would have retrofitted their vulnerable houses”
 「脆弱な住宅の改修がされていれば、何千人の人たちの命が救われたはずである」

- Most of the victims were killed by collapse of their houses
- Currently, most of Japanese citizens know that vulnerable houses may collapse and kill the residents in earthquakes.
- Japan has severe building codes.
- Techniques for retrofitting are available.
- Financial assistances for retrofitting are available.

Yet, people have many reasons not to retrofit their vulnerable house. **それでもなお、脆弱な住宅を改修しない様々な理由がある。**

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People are risk-takers in disaster risk management
 災害リスク管理において人々はリスクの方を選ぶ

- People are risk-seekers when the choice involves loss (Prospect theory, Kahneman & Tversky).
 Question : Choose between: **質問: AとBのどちらを選ぶ**
 A. Sure loss of \$3,000 **A 3000ドルを確実に失う**
 B. 80% chance of losing \$4,000 and 20% chance of losing nothing.
結果: 92%がBを選択 **B 4000ドルを失う確率80%で20%は無損失**
- Future uncertain loss is psychologically much discounted.
- Investment (retrofitting) for safety would be waste if a large earthquake would not occur soon.
 - Life expectancy of a house: approx. 30 years (Japan)
 - Remaining life expectancy of an investor: 20-50 years
 - Return period of a big earthquake: hundreds or more years

It is rational for people not to take actions to avoid future disaster risk. 人々が将来の損失を避ける行動をしないのは合理的である。

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How can we convince people to take actions before a disaster hits
 災害がくる前に人々に行動を起こさせるにはどうしたらよいか

- Education, training, and awareness raising
 教育、研修訓練と意識啓発
- Community-based disaster management
 コミュニティ(地域社会)主体の防災
- Policy development and institutionalization for safer communities
 安全な地域社会のための政策策定と制度化

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Disaster education can play an important role
 防災教育は重要な役割を果たす

- Capacity building and awareness raising **能力構築と意識啓発**
 - Local people, particularly children, should understand better their disaster risk and take appropriate actions to reduce the impact of disasters
- Technology and policy development **技術と政策の開発**
 - Experts should develop affordable and applicable technologies, and develop policies for disaster reduction, reflecting the local conditions.
- Risk communication **リスクコミュニケーション**
 - Experts should be able to communicate with local people with trust in laymen's language with professional knowledge.

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政策研究大学院大学による防災専門教育
 Education for Disaster Management Professionals by GRIPS

Master's degree programs on "Disaster Management"
 English program since 2005 「災害管理」修士号のプログラム

- Conducted jointly with BRI (Building Research Institute), PWRI (Public Works Research Institute), and JICA
- 3 courses: Seismology/Earthquake Engineering, Tsunami, Water-related disasters **開発途上の技術官や研究者**
- Target Groups: Technical officials, or researchers in developing countries
- Course Duration: 1 year (October–September)
- Approx. 50 students in 2012-2013

Japanese program since 2012

- Target groups: national and local government officials
- Course Duration: 1 year (April–March)

Accepting application for 2013 entrance!!



GRIPS Roppongi campus

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コミュニティ主体の防災 (CBDM)
 Community Based Disaster Management (CBDM)

- Local people are potential victims and assume responsibility in managing the risk
- Disasters reflect local conditions, of which local people are well ware **地域の人は災害のリスクとその避け方をよく知ることができる。**
- Local people can better understand disaster risk and how to avoid such risks through risk communication
- Participatory decision making process leads to ownership of risk and actions **参加型の決定プロセスは、リスクと行動を自らのものとする。**



RADIUS project by IDNDR



Shake table demonstration by UNCRD

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- Recommendation for international cooperation to reduce the loss of lives due to disasters
災害による人命損失を減らす国際協力のための提言
- International commitment to promote proactive efforts 国際支援
International communities (International organizations such as UN and UNESCO and donor countries like Japan) should assist more explicitly those countries which are making proactive efforts.
 - Fostering more experts who can develop appropriate policies for disaster reduction and have good skills for risk communication with local people 適切な防災対策を講じられるより多くの専門家の育成
 - Financial and technical assistance to promote community-based disaster management コミュニティ防災のための財政的・技術的な支援
 - More researches to investigate how to motivate people and local governments to take actions against disaster 防災対策・政策研究推進
 - Establishing multi-disciplinary academic approach for disaster risk management, incorporating economics, politics, sociology, psychology, engineering, etc. 経済・政治・社会・心理・技術の学際的アプローチ
- K.Okazaki 15

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ありがとうございます
Thank you !

Kenji Okazaki
Professor 政策研究大学院大学 岡崎健二 教授
National Graduate Institute for Policy Studies (GRIPS)
7-22-1 Roppongi, Minato-ku, Tokyo, 106-8677 Japan
Email: okazakik@grips.ac.jp
Web: http://www.grips.ac.jp

K.Okazaki 16

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