

Experiences and Activities on Interdisciplinary Research and Disaster Science in Japan

Dr. Erick Mas

Profesor Asociado

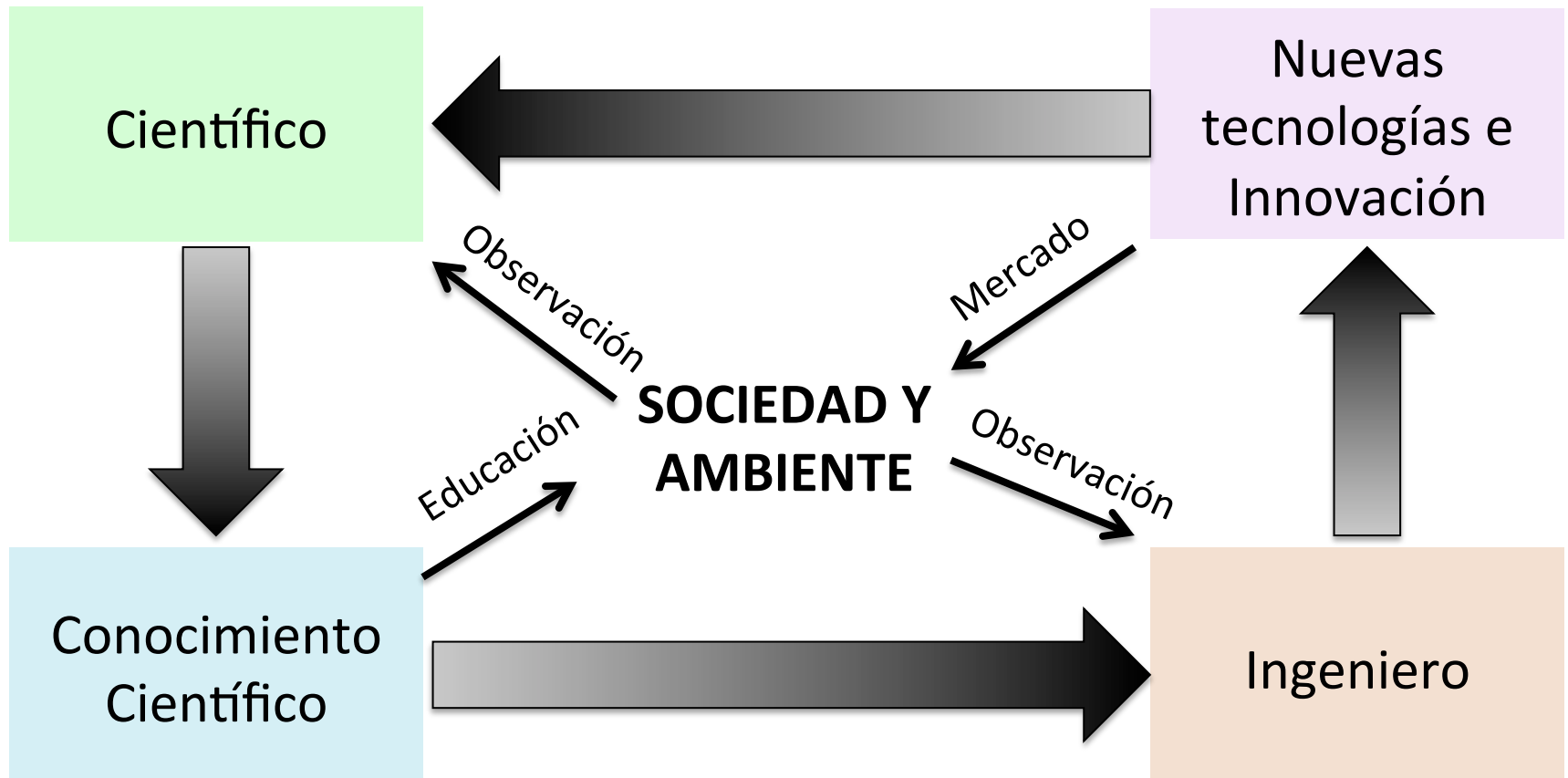
*International Research Institute
of Disaster Science (IRIDeS)*

Tohoku University

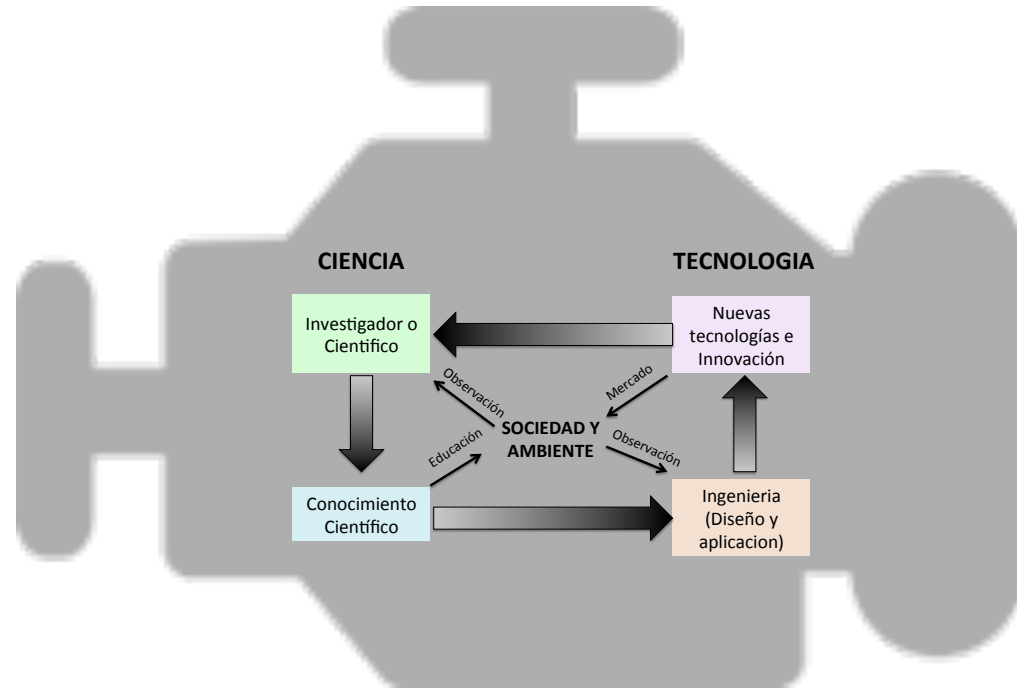
ENCUENTRO DE CIENCIA Y TECNOLOGÍA PARA EL DESARROLLO PERUANO

CIENCIA

TECNOLOGÍA

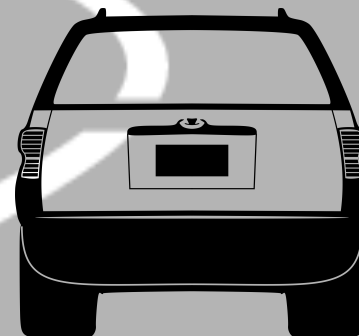
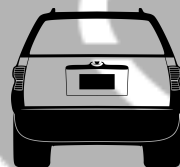


*El desarrollo de ciencia y tecnología
es el motor que impulsa
la economía*



*El impulso de la
economía lleva al
desarrollo nacional*

*El desarrollo sostenible
debe generar
BIENESTAR SOCIAL*



- **1999-2004** > Bachiller en Ingeniería Civil, UNI
- **2005-2009** > Defensa Civil, Gobierno Regional del Callao (GRC)
- **2006-2009** > Maestría en Gestión de Riesgo de Desastres, UNI
- **2009-2012** > PhD en Ingeniería de Tsunami, Universidad de Tohoku
- **2012-2016** > Profesor Asistente en IRIDeS
- **2016-** > Profesor Asociado en IRIDeS y adjunto a la Facultad de Ingeniería Civil

Miembro del sub-comité de Tsunami de la Sociedad Japonesa de Ingenieros Civiles (JSCE) (50 miembros a nivel nacional, 2 extranjeros)

Idiomas: Español, Inglés y Japonés

Lecciones aprendidas

- Aprende todo lo que puedas, después el tiempo se reduce y las ganas de aprender aumentan
- Encuentra un o varios Mentor(es) en tu área



Lecciones aprendidas

- **Infórmate, percibe tu entorno y la situación mundial → (Identificar Necesidades Sociales)**
- **Aprende a trabajar en equipo**



Multi-disciplinario



Trans-disciplinario



Inter-disciplinario

- **2009-2012** > PhD en Ingeniería de Tsunami,
Universidad de Tohoku



2011 Terremoto de Tohoku

2011年の日本の地震
Japan earthquakes 2011

発生地点・規模・時刻分布図
Visualization map

2011年1月1日00:00 ~ 2012年1月1日00:00
2011-01-01 00:00 / 2012-01-01 00:00 JST

International Research Institute of Disaster Science(IRIDS)

Major Research Issues

Reconstruction of disaster prevention and reduction technologies based on reality of the 2011 off the Pacific coast of Tohoku earthquake and tsunami disaster

Construction of "Disaster area supportology" in the event of a disaster

Advancement of anti-hazard performance and upgrading for multiple-fail-safe in urban areas as disaster recovery projects

Research on mechanism of mega earthquake and tsunami generation and developing of next-generation of early detection technology of tsunamis

Establishment of disaster medical relief service system of responding appropriately to wide area massive disaster

Rehabilitation regional and urban and creating disaster digital archive pass for the next generation

Hazard and Risk
Evaluation

Disaster Information
Management and
Public Collaboration

Human and Social
Response

Disaster Medical
Science

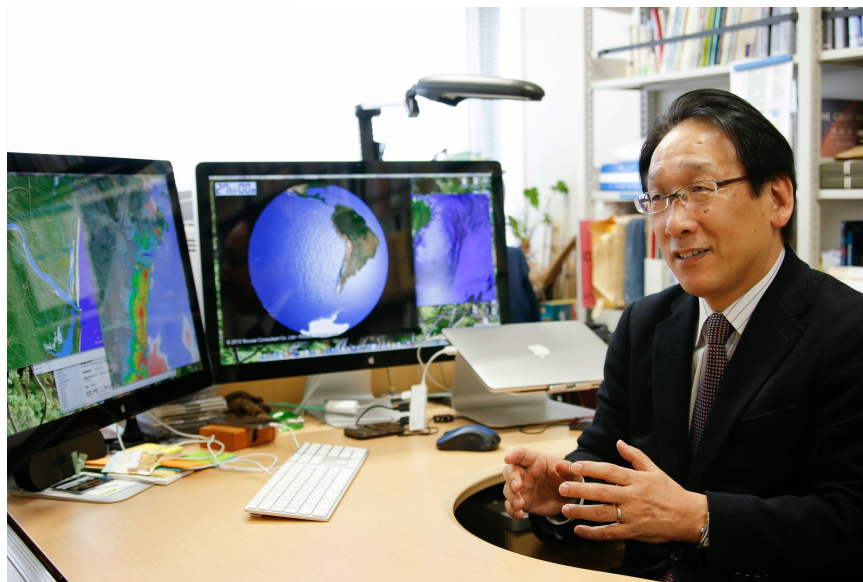
Regional and Urban
Reconstruction

Disaster Science

Research institute in
Japan and overseas

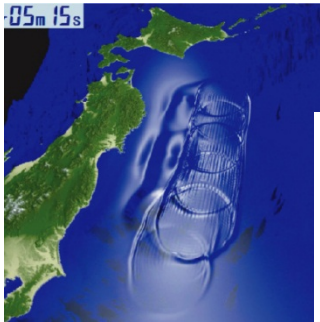
Private companies

Affected local
governments



Hazard and Risk Evaluation Research Division

Reconstruction of disaster prevention and reduction technologies based on reality of the 2011 off the Pacific coast of Tohoku earthquake and tsunami disaster



Research Fields

- Earthquake Engineering
- Tsunami Engineering
- Disaster Potential Study
- Remote Sensing and Geoinformatics for Disaster Management
- Science and technology for low-frequency Risk Evaluation
- Technology for Optimum Mitigation
- Technology for global Disaster Risk

Human and Social Response Research Division

Construction of “Disaster area supportology” in the event of a disaster



Research Fields

- Disaster-Related Cognitive Science
- Affected Area Supportology
- Preservation of Historical Materials
- Social Systems for Disaster Mitigation
- Disaster Legislation
- Japanese Disaster Culture
- Comparative Mitigation Society

Regional and Urban Reconstruction Research Division

Advancement of anti-hazard performance and upgrading for multiple-fail-safe in urban areas as disaster recovery projects

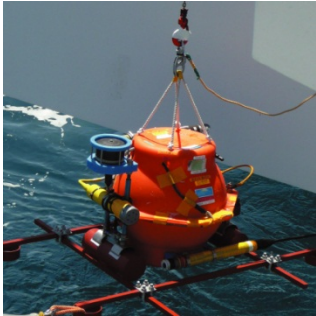


Research Fields

- Technology for Urban Resuscitation
- Radiational Decontamination Science
- Regional Safety Engineering
- Disaster Robotics
- International Strategy for Disaster Mitigation

Disaster Science Research Division

Research on mechanism of mega earthquake and tsunami generation and developing of next-generation of early detection technology of tsunamis



Research Fields

- Marine Geodesy Research
- Seismic Hazard Research
- Volcanic Hazard Research
- Geologic Hazard Research
- Atmospheric and Oceanic Disaster Research
- Space Environment Disaster Research
- Natural Disaster Research

Disaster Medical Science Research Division

Establishment of disaster medical relief service system of responding appropriately to wide area massive disaster



Research Fields

- International Cooperation for Disaster Medicine
- Disaster-related Infectious Disease
- Radiation Disaster Medicine
- Disaster Psychiatry
- Disaster Obstetrics and Gynecology
- Disaster-related Public Health
- Disaster Medical Informatics

Disaster Information Management and Public Collaboration Division

Rehabilitation regional and urban and creating disaster digital archive pass for the next generation



Research Field

- Disaster Digital Archive
- Disaster Reconstruction design & Management
- International and Regional Cooperation Office

Endowed Research Division

Research Field

- Earthquake induced Tsunami Risk Evaluation (Tokyo Marine)

Comparison of IRIDeS and other disaster research institutes

Research area		Tohoku Univ. IRIDeS	Univ. of Tokyo E Institute	Kyoto Univ. D Institute	Niigata Univ. R Institute	Fukushima Univ. S Institute	D Institute
Hazard and Risk Evaluation Disaster Science	Earthquake, Tsunami	Hazard and Risk Natural Disaster Science	研究所全体 (4部門, 4研究センター, 3マネジメントセンター)	地震・火山研究グループ 大気・水研究グループ	環境変動科学部門 複合災害科学部門 地域安全科学部門		地震・火山研究ユニット 兵庫県耐震工学研究センター
	Volcanic						
	Wind and Rain						
	Snow Storm						
Human & Social Response		Human and Social Response		総合防災研究グループ	地域安全科学部門	研究所全体 (11研究会)	災害リスク研究ユニット
Regional & Urban Reconstruction	Regional safety	Regional and Urban Reconstruction					
	Radiation Decontamination						
	Robotics						
Medical Relief		Disaster Medical Science			地域安全科学部門		
Public Cooperation		Information management		総合防災研究グループ		研究所全体 (11研究会)	災害リスク研究ユニット
International Cooperation		all over IRIDeS	研究所全体	研究所全体			

- * マルチハザードの自然災害に対応, かつ低頻度・広域巨大災害に主眼
(東日本大震災, 東海・東南海・南海地震災害等の地震・津波に起因する災害研究に注力)
- * 人間・社会, 地域・都市再生, 災害医療, 復興・社会連携については, それぞれに特化した部門を設置

Acerca del Laboratorio de Sensores Remotos y Geoinformatica para la Mitigacion de Desastres



~minutes



~hours



~days



~weeks



Critical problems since the aftermath

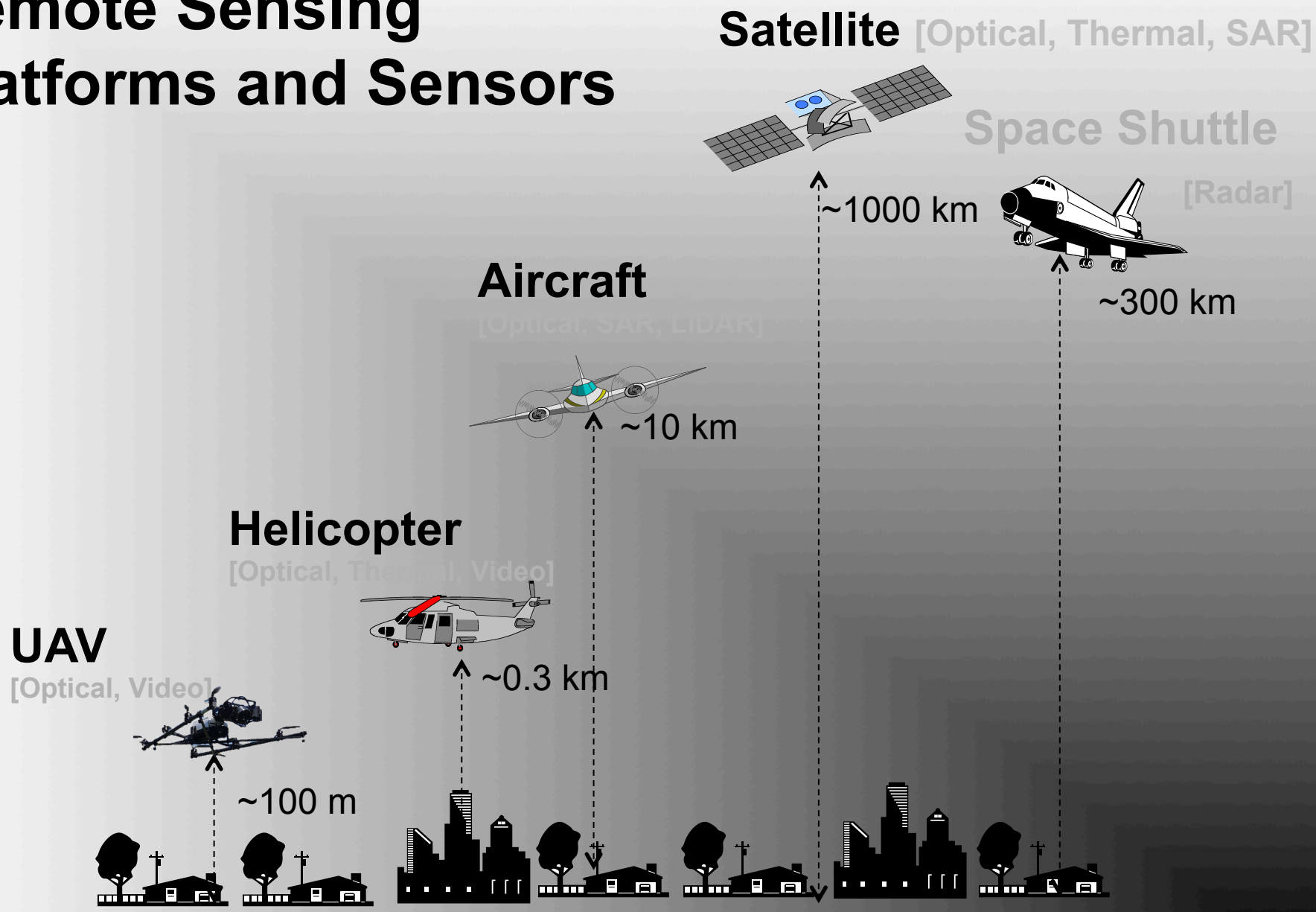
- ❖ How **extensive** was the impact (area)?
- ❖ How **many people** are exposed, killed, and injured ?
- ❖ How **many structures/infrastructures** are damaged ?
- ❖ How extensive **disaster relief** activities should be deployed ?
- ❖ How **much amount of debris** need to be removed ?
- ❖ How **much economic losses** are ?
- ❖ How **much progress** does reconstruction process have?
- ❖ ...

Acerca del Laboratorio de Sensores Remotos y Geoinformatica para la Mitigacion de Desastres

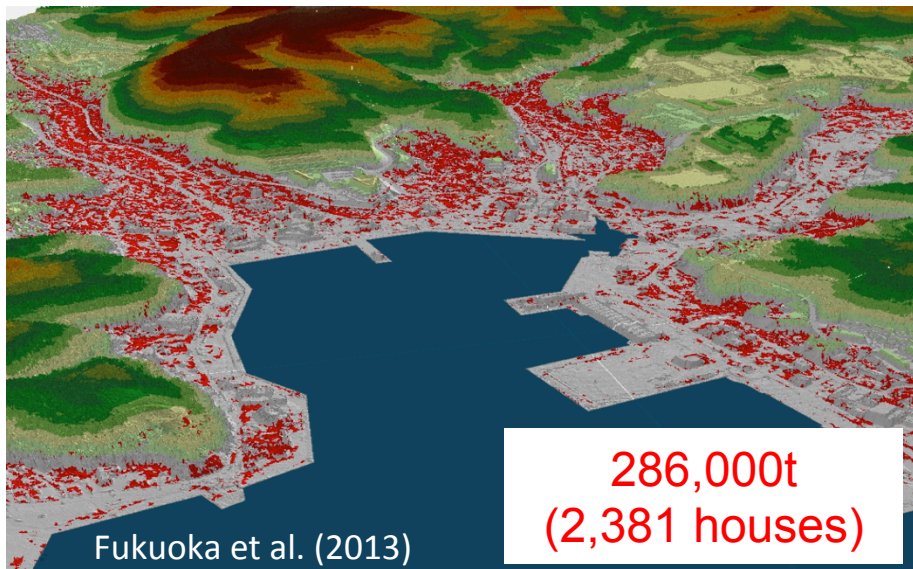
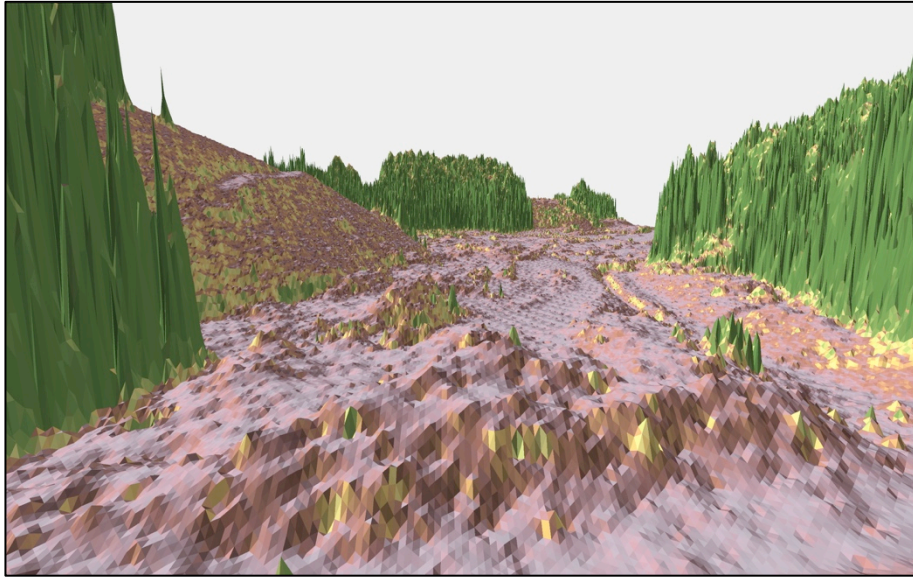
In the Laboratory of **Re**mote Sensing and **Geo**informatics for **D**isaster Management (ReGiD) we **develop technology for damage estimation** and rapid response support after disasters.

We **enhance simulation techniques** (earthquake, tsunami, evacuation) and remote sensing technology (satellite image, UAV, ICT) to grasp within large areas the possible impacts to buildings and people from a disaster.

Remote Sensing Platforms and Sensors



Tsunami Debris Mapping using LiDAR (Light Detection and Ranging)



Tsunami Damage Detection using PALSAR

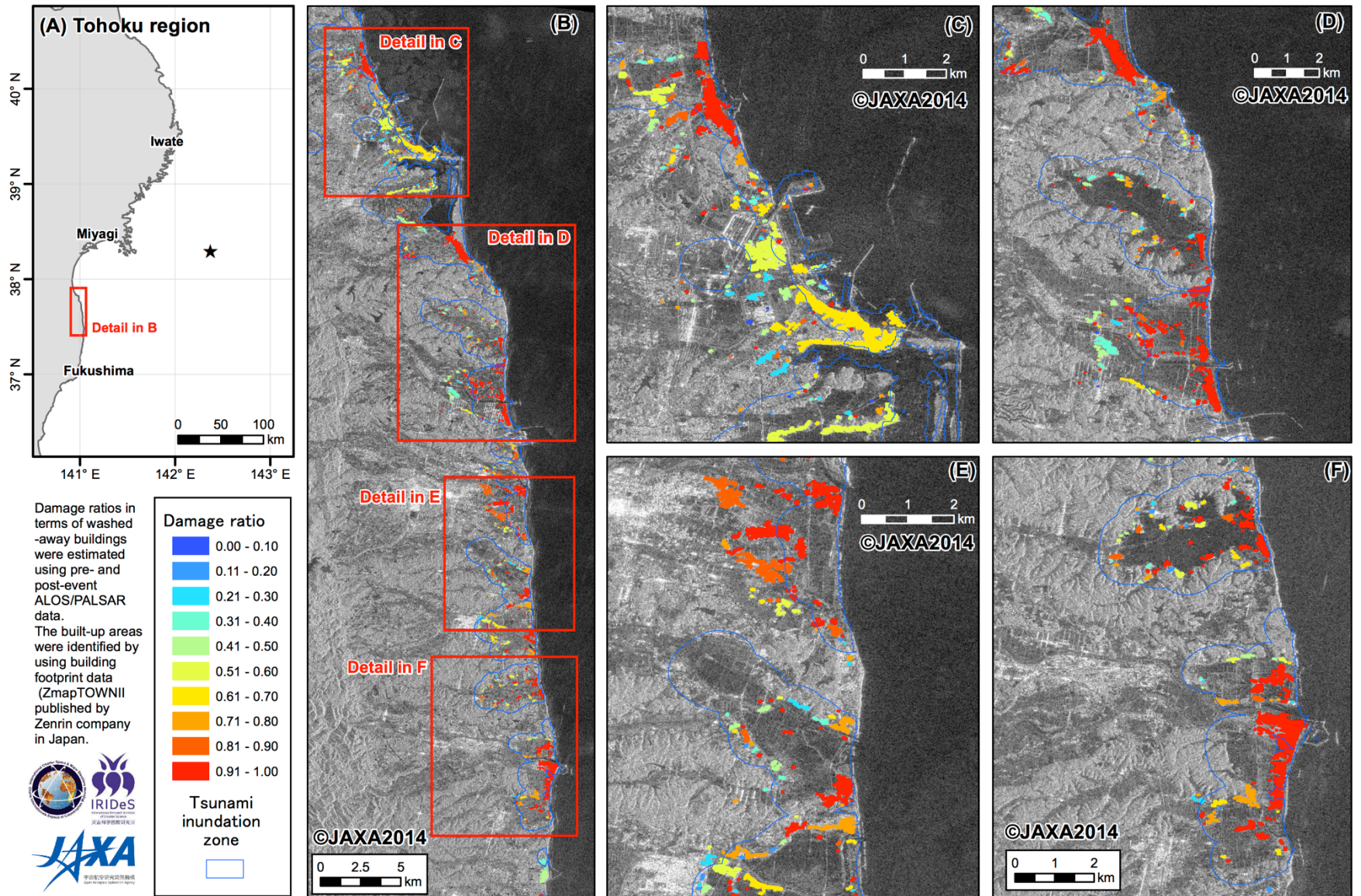
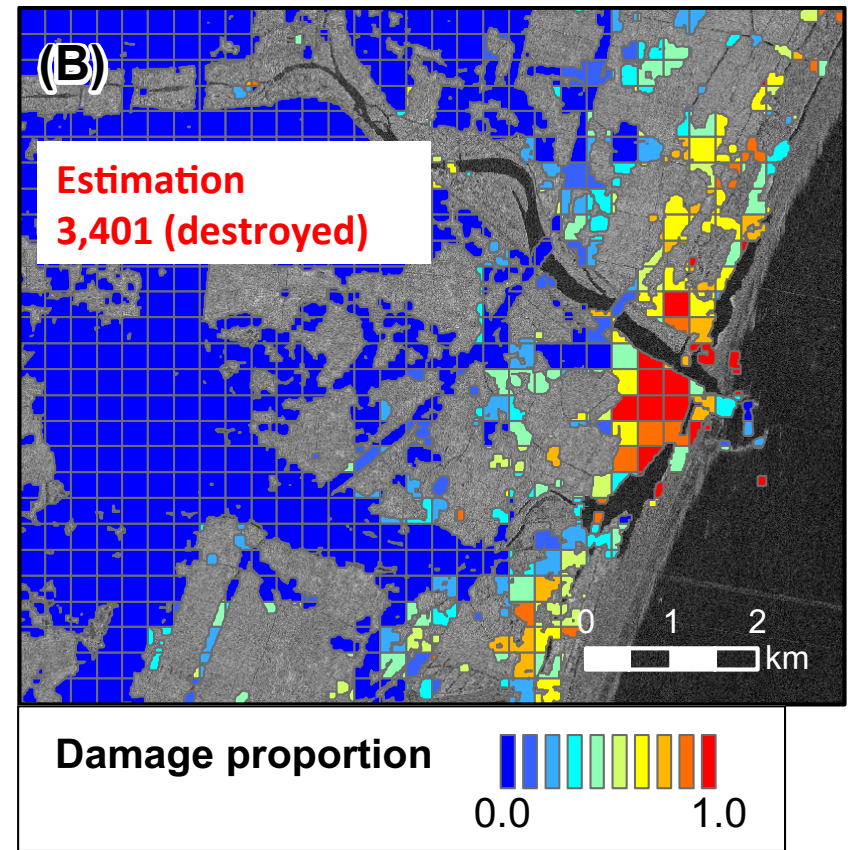
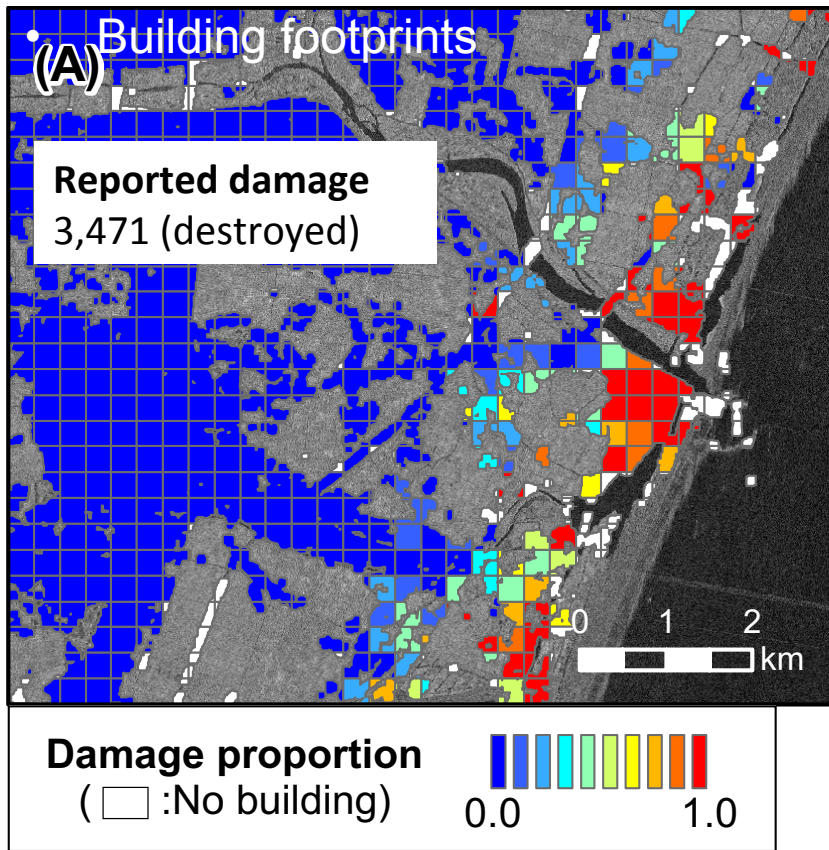


Image : ALOS/PALSAR

Towards Quantitative Estimation of Structural Damage using SAR data

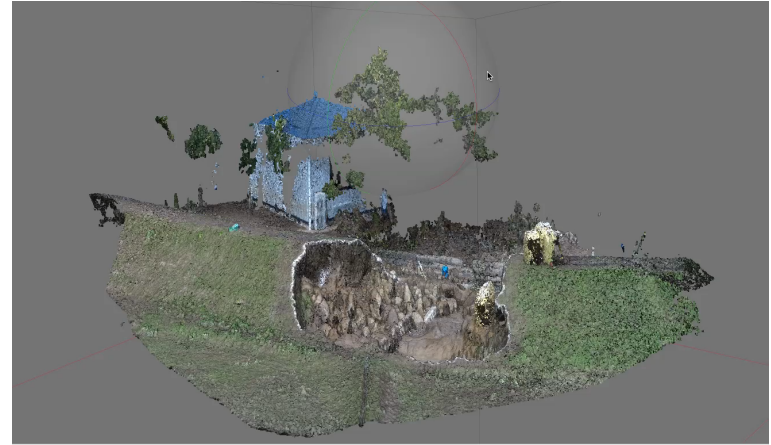


UAV applications

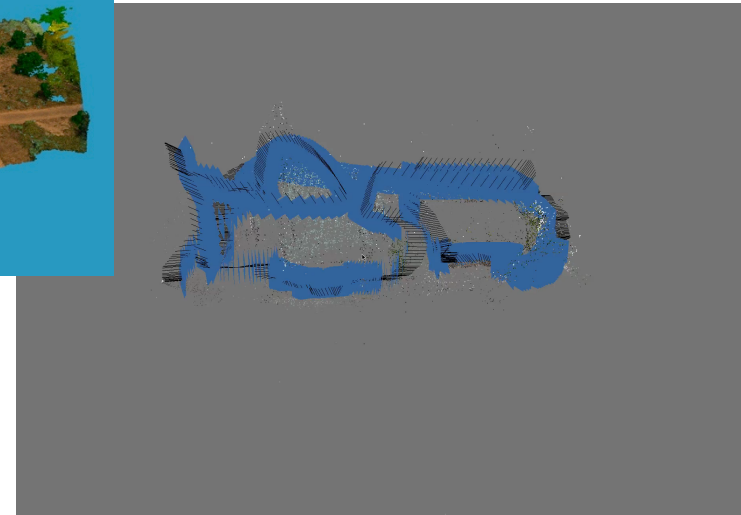
Searching survivors using UAV



Damage field survey using UAV technology

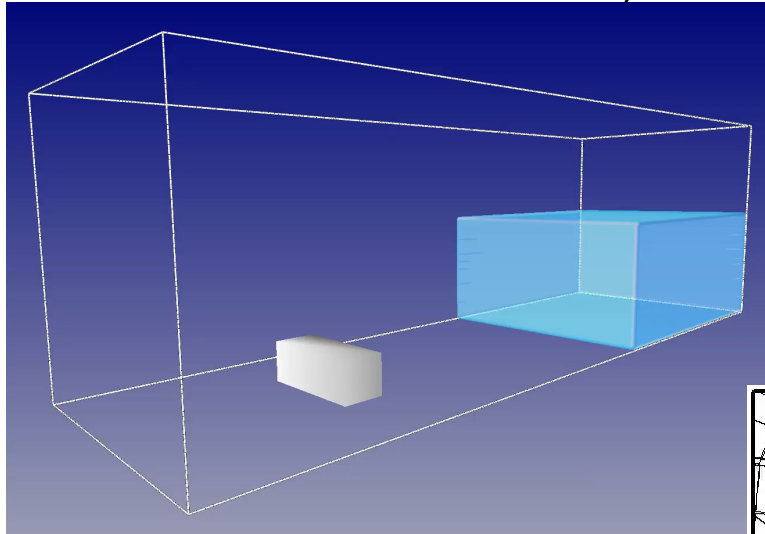


Building 3D model for damage survey with UAV



Enhancing Lattice Boltzmann method
for 3D tsunami simulation

Sato, 2016

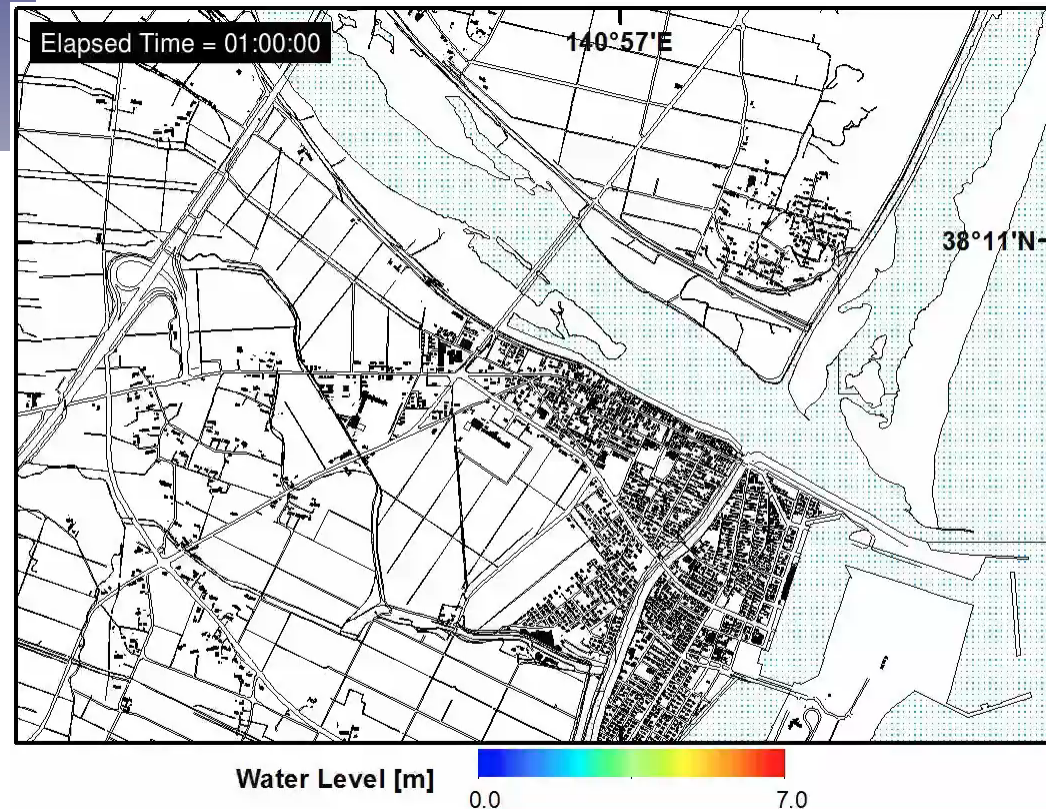
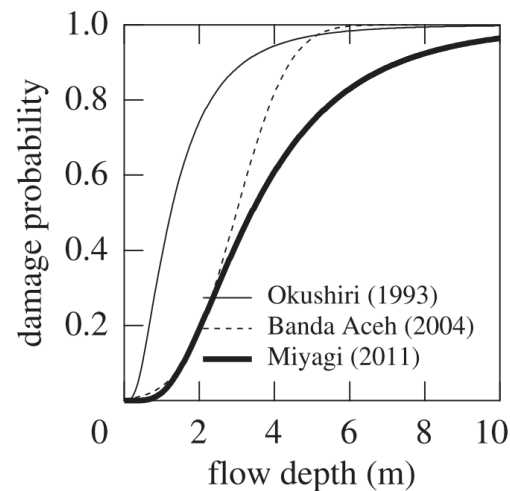


Tsunami Simulation

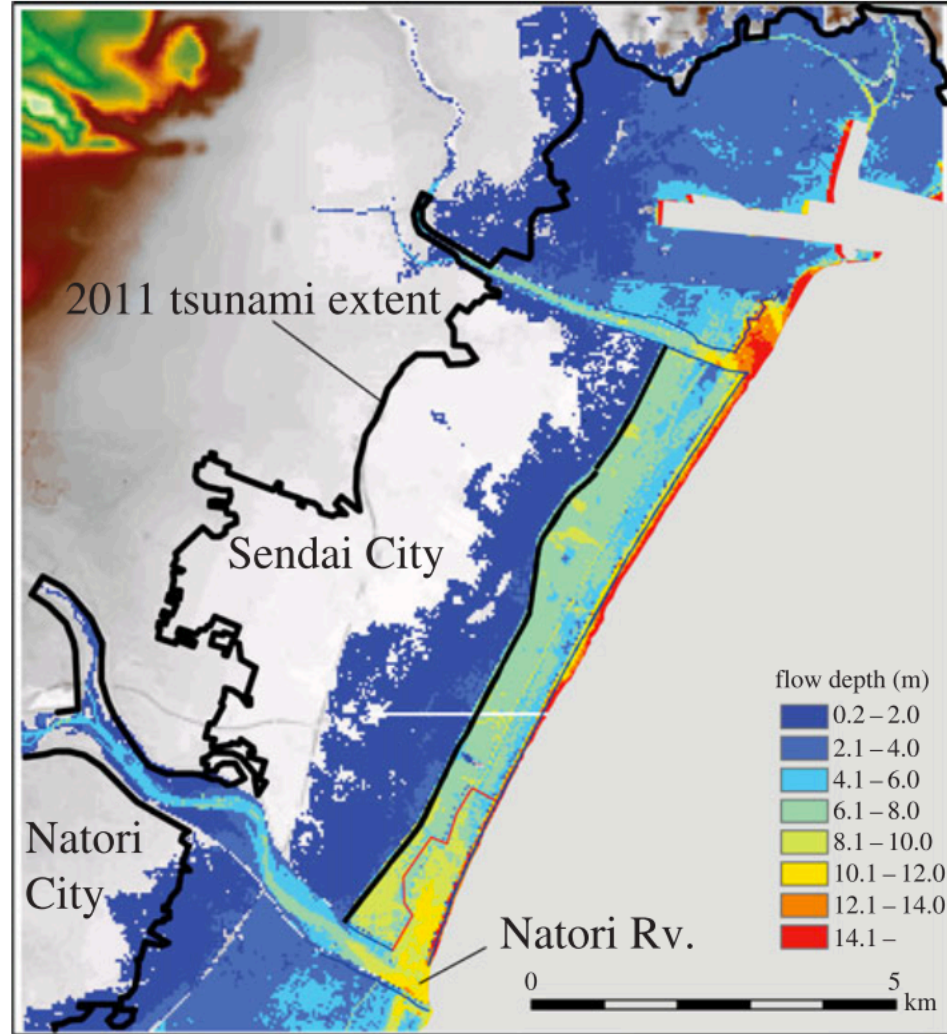
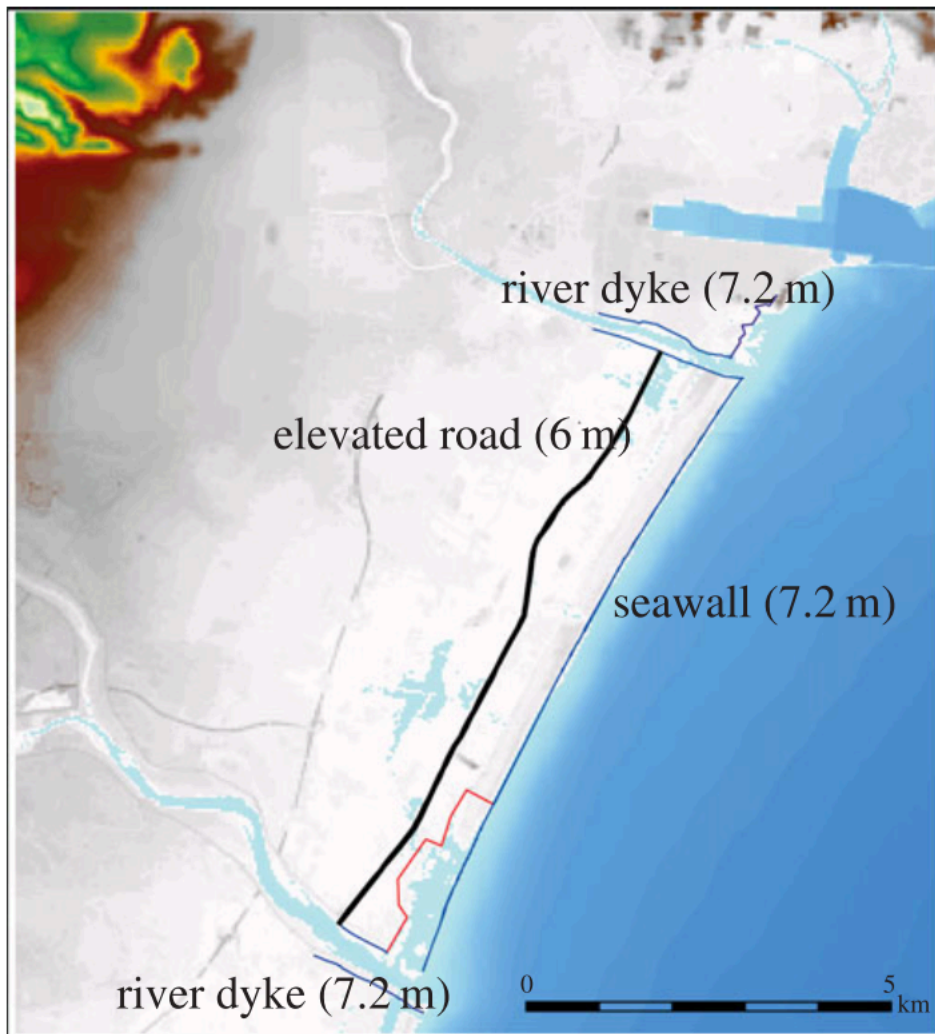
Integration of tsunami fragility
curves and tsunami simulation
for damage estimation

Hayashi, 2016

Developing tsunami fragility curves



Tsunami Simulation

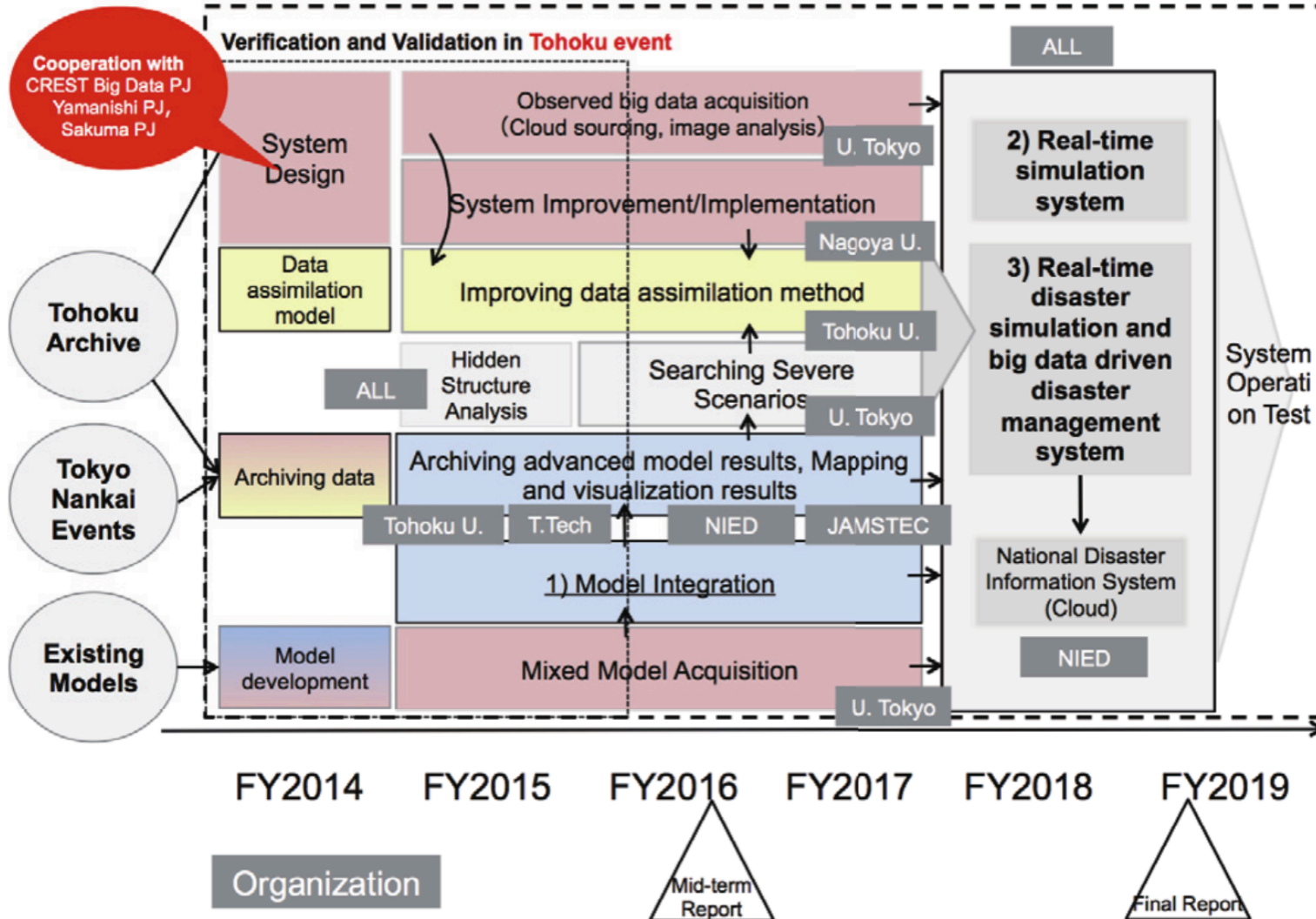


Proyecto CREST (Big Data)

Tsunami Simulation



Application to Tokyo and Nankai Events

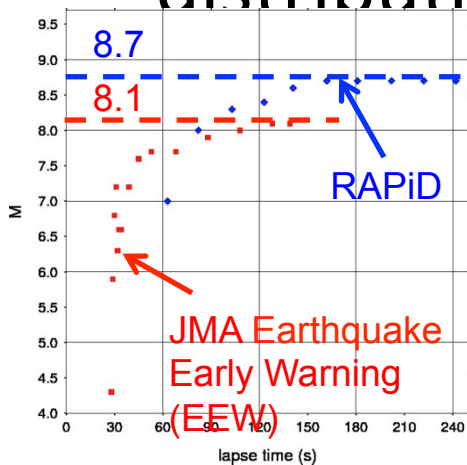


Proyecto CREST (Big Data)

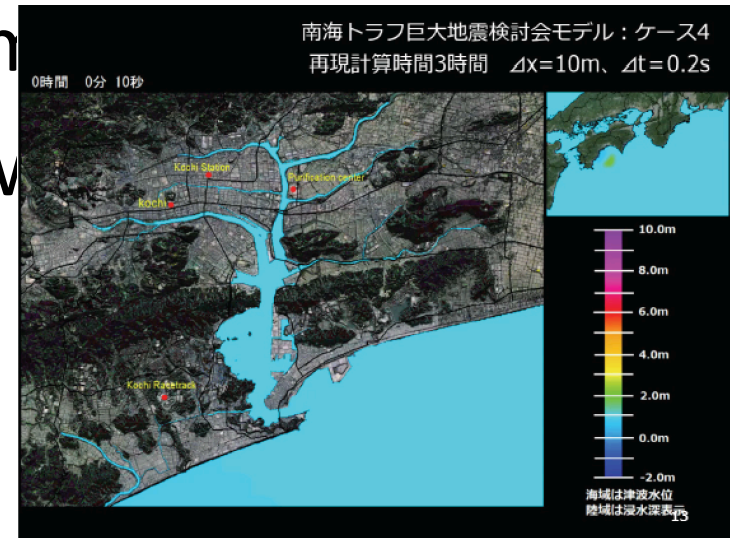
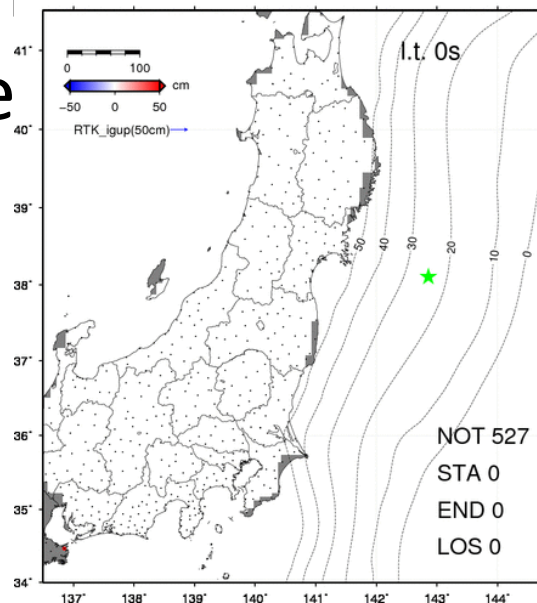
Tsunami Simulation



- Real time forecast of worse scenario of tsunami using Gaussian probability distribution and super com



Ing. lat. dep. fen. wid. str. dip. rak. slp. opn.



Ohta et al, 2012
Koshimura, 2016

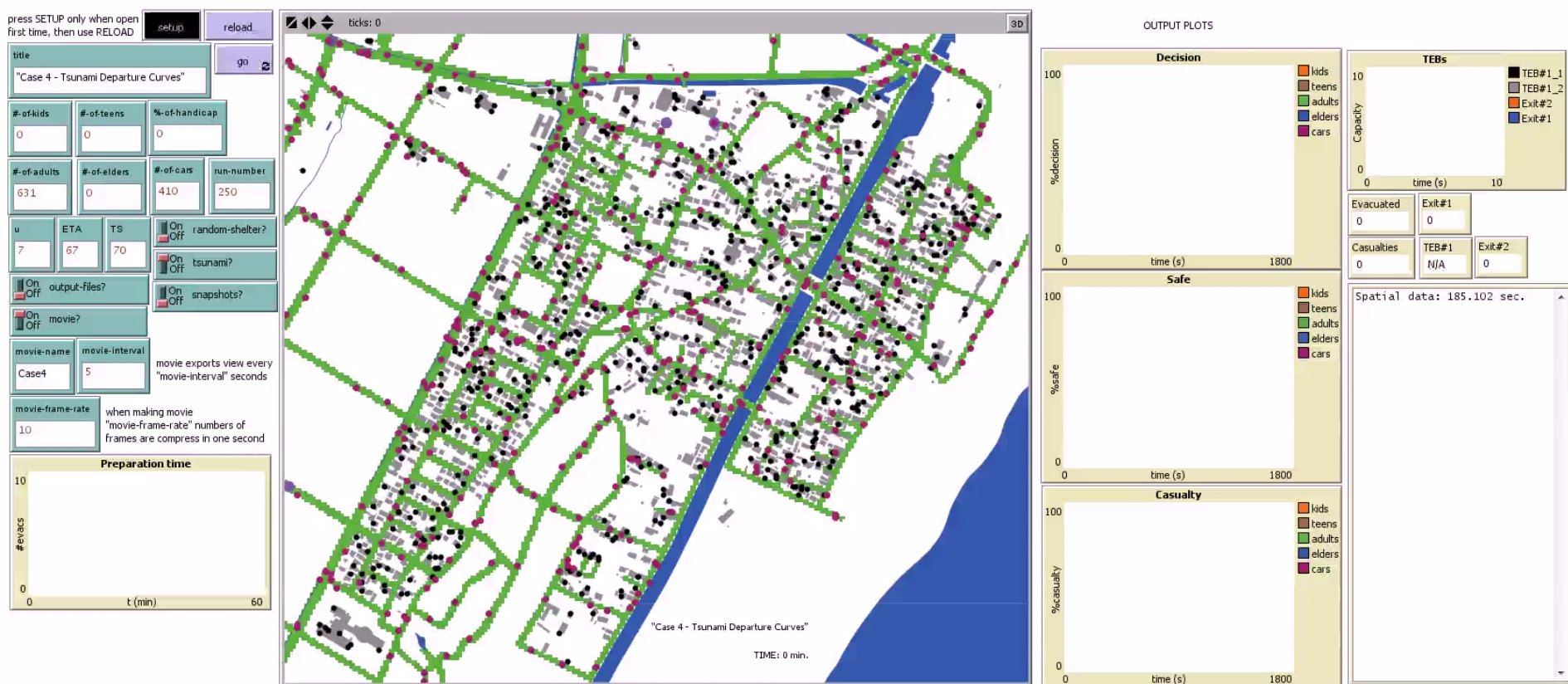
10-10-10 challenge

- Tsunami source (<10min)
- Tsunami simulation (<10min)
- 10m grid

Agent-based modeling

- Tsunami Inundation and Evacuation Simulation

Mas, 2016



Agent-based modeling

- UAV swarm planning tool
- Disaster support logistic optimization

Search And Rescue Planner (SARP)

1. Setup the environment (Disaster Area)

X0	Y0	DXY
494692.32	4224193.43	5

Import terrain Draw Area Close Area

2. Edit waypoints for route planning

Add Erase Wstart Wend

Show 0 0

3. Add units for the mission

Add Units Show

4. Plan Mission (Press Button to calculate)

Plan

5. Execute the Mission (see units walk the calculated path)

Execute

To start a new mission in the same environment press REFRESH and start from step 2. Or to start a different mission go back to Step 1.

On Off save-log?

Refresh

ticks: 1523 3D



^ UTM coordinates (X0,Y0) of image at resolution DXY

(marker 9): [494806.32 4224211.93]
(marker 10): [494832.82 4224200.43]
(marker 11): [494893.82 4224259.43]
(marker 12): [494931.82 4224353.43]
(marker 13): [494757.32 4224441.43]
(marker 14): [494696.82 4224421.43]
(waypoint 15): [494760.32 4224383.43]
(waypoint 16): [494811.82 4224406.93]
(waypoint 17): [494876.32 4224371.43]
(waypoint 18): [494823.82 4224367.43]
(waypoint 19): [494879.32 4224300.43]
(waypoint 20): [494845.82 4224248.43]
(waypoint 21): [494813.82 4224300.43]

These are the waypoints created so far:

Waypoint 15 at [494760.32 4224383.43]
Waypoint 16 at [494811.82 4224406.93]
Waypoint 17 at [494876.32 4224371.43]
Waypoint 18 at [494823.82 4224367.43]
Waypoint 19 at [494879.32 4224300.43]
Waypoint 20 at [494845.82 4224248.43]
Waypoint 21 at [494813.82 4224300.43]

=====

(uav 22): [494725.32 4224345.93]
(uav 23): [494773.82 4224258.43]

These are the units created so far:

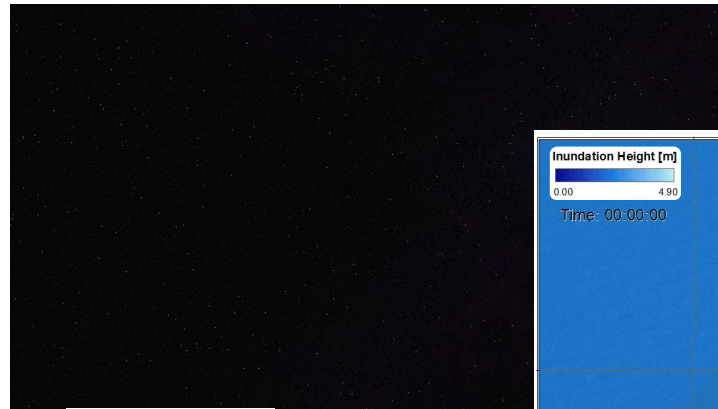
UAV 22 at [494725.32 4224345.93]
UAV 23 at [494773.82 4224258.43]

Calculating mission...

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International Collaboration

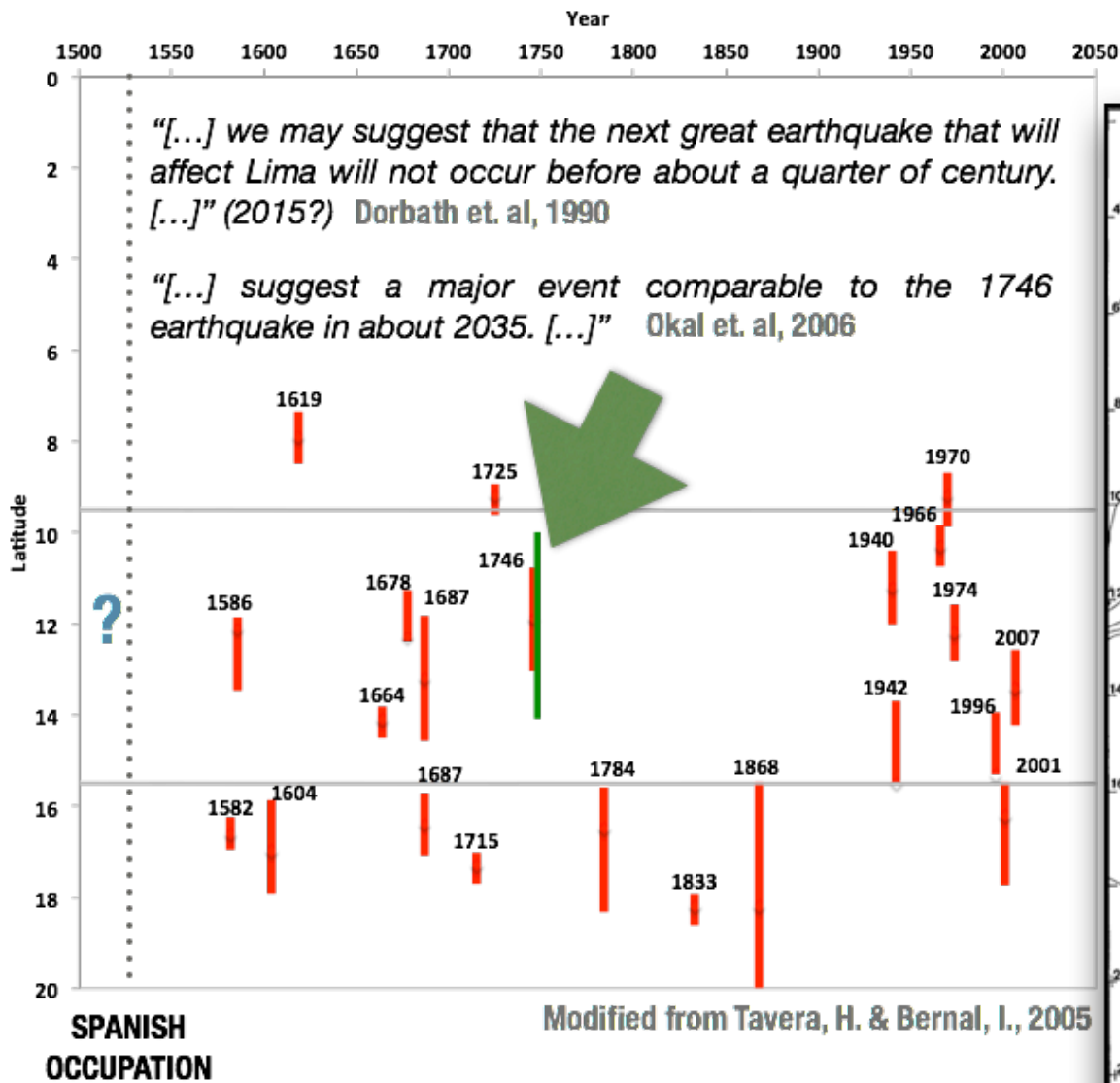
- Interdisciplinary projects: **SATREPS** Peru, Chile, Ecuador, Colombia and Mexico
- Collaboration on Tsunami simulation (NOAA)
- Collaboration on Remote Sensing Technologies (DLR, UN-SPIDER, Waterloo Univ.)
- Collaboration on Urban simulation: SICORP project on socio-economic ABM modeling (Israel)



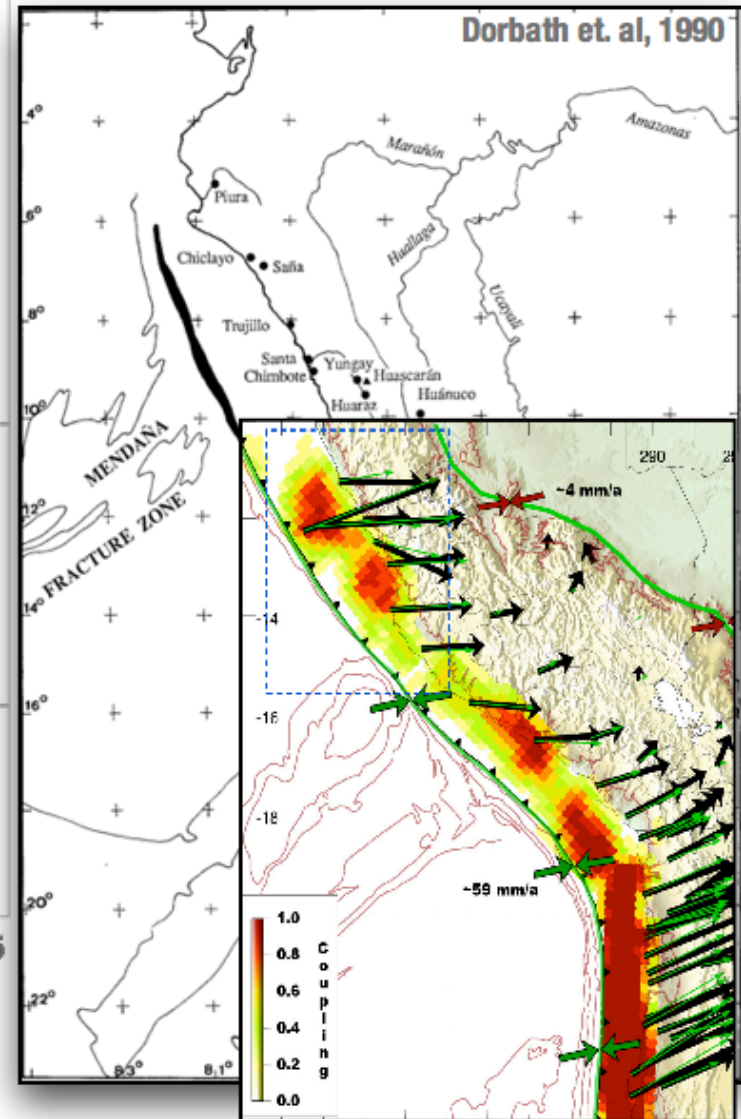
By HUJI



By Luisa Urrea



2015 ~ 2035 ?



Gracias por su atencion

