



LAUREA MAGISTRALE  
IN FISICA

# La fisica del sistema Terra

Fabio Romanelli

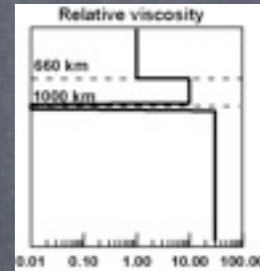
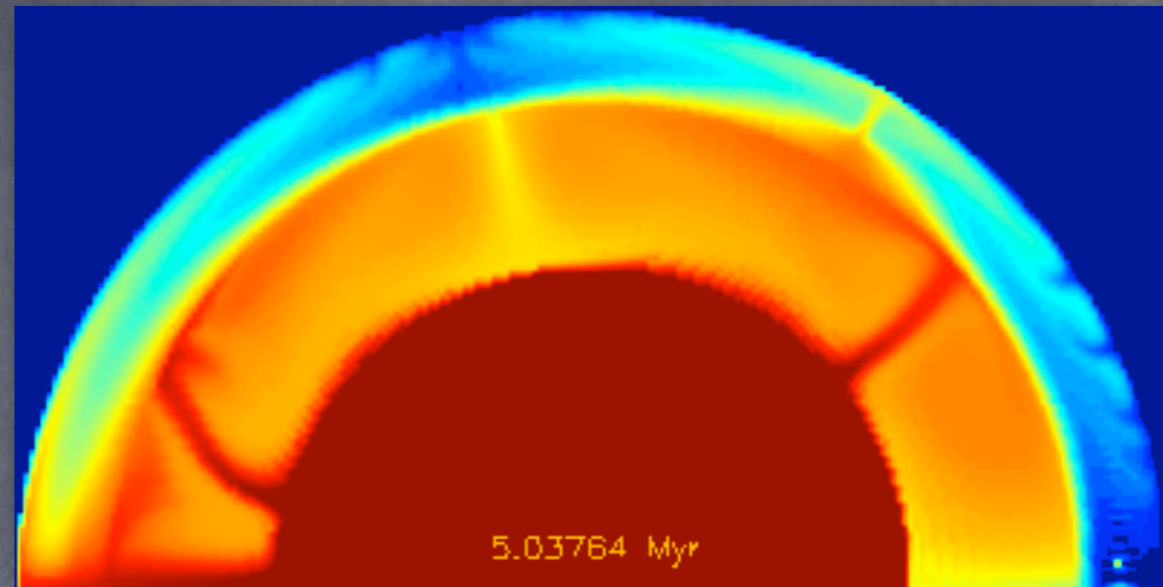
Dipartimento di Matematica e Geoscienze  
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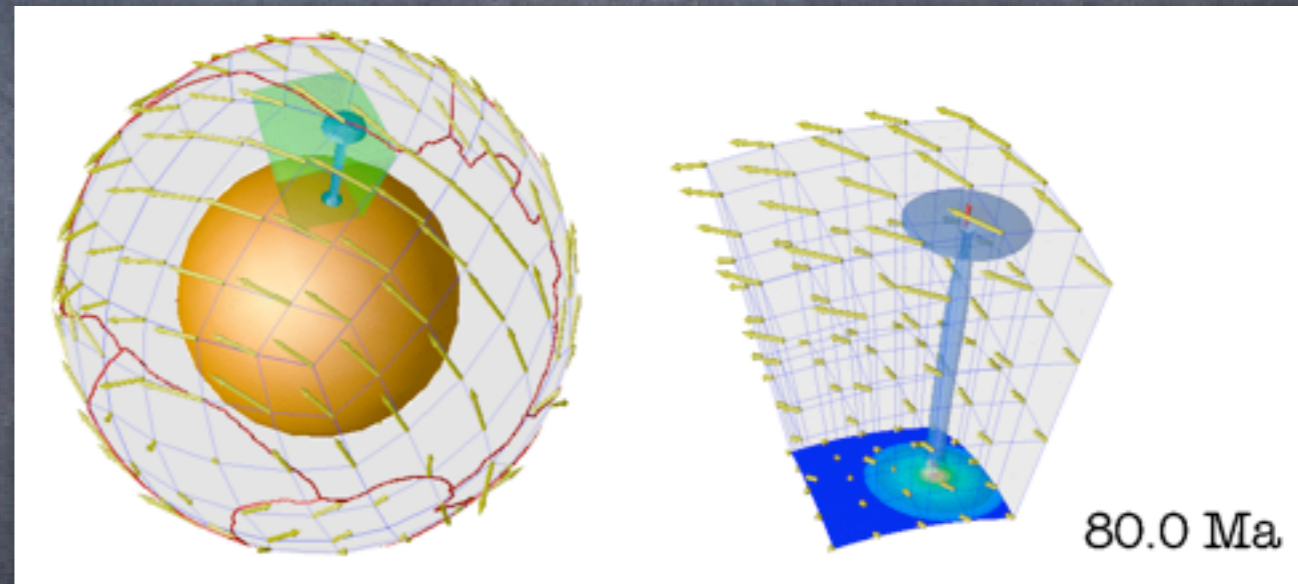
# Geodinamica



Da Namazu....

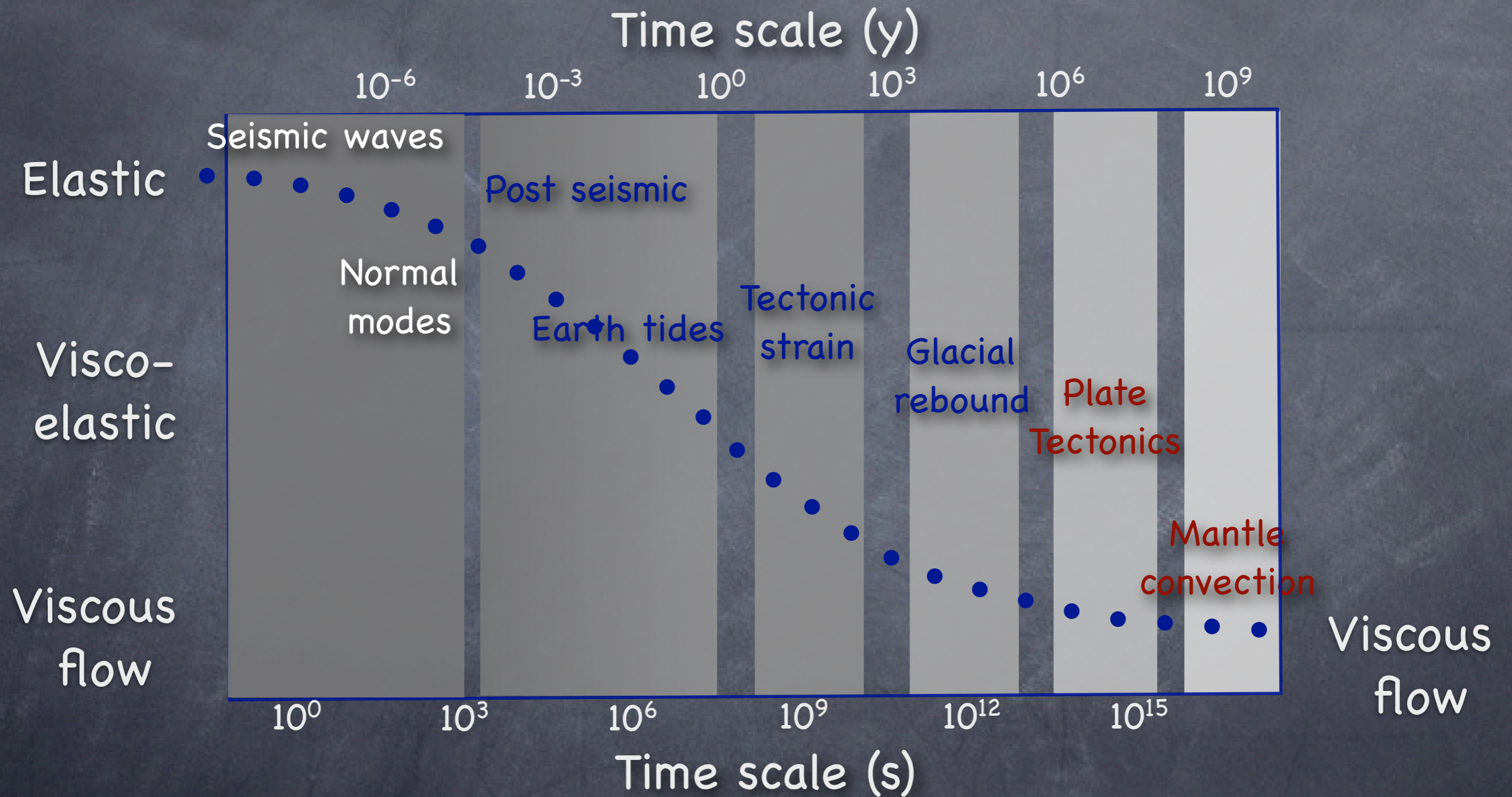


Convezione termo-chimica  
<http://geo.mff.cuni.cz/~cizkova/Anim/animace.htm>



alla fluido-dinamica complessa!

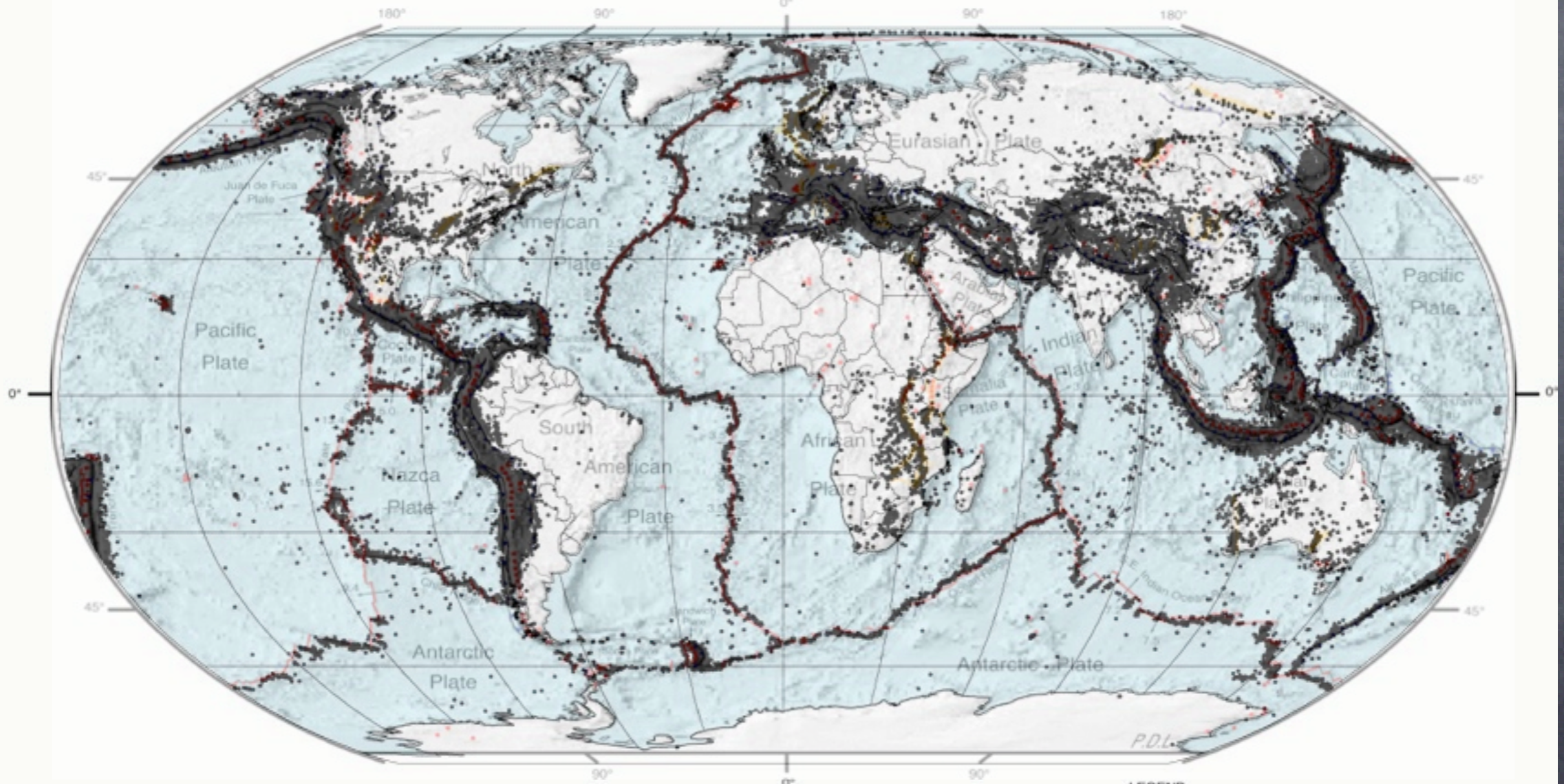
# Spettro delle deformazioni della Terra





# Principali placche tettoniche

358,214 Events, 1963 - 1998



**DIGITAL TECTONIC ACTIVITY MAP OF THE EARTH**  
Tectonism and Volcanism of the Last One Million Years

**DTAM**

NASA/Goddard Space Flight Center  
Greenbelt, Maryland 20771

Robinson Projection  
October 1998

**LEGEND**

- Actively-spreading ridges and transform faults
- Total spreading rate, cm/year, NUVEL-1 model (DeMets et al., Geophys. J. International, 101, 425, 1990)
- Major active fault or fault zone; dashed where nature, location, or activity uncertain
- Normal fault or rift; hachures on downthrown side
- Reverse fault (overthrust, subduction zones); generalized; bars on upthrown side
- Volcanic centers active within the last one million years; generalized. Minor basaltic centers and seamounts omitted.

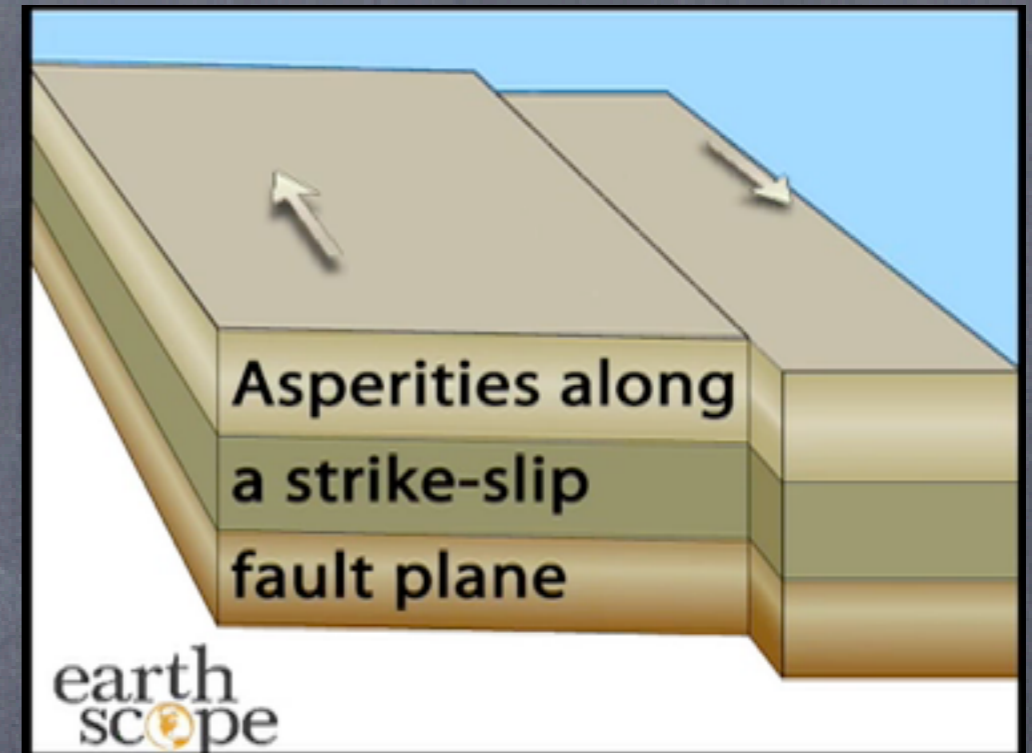
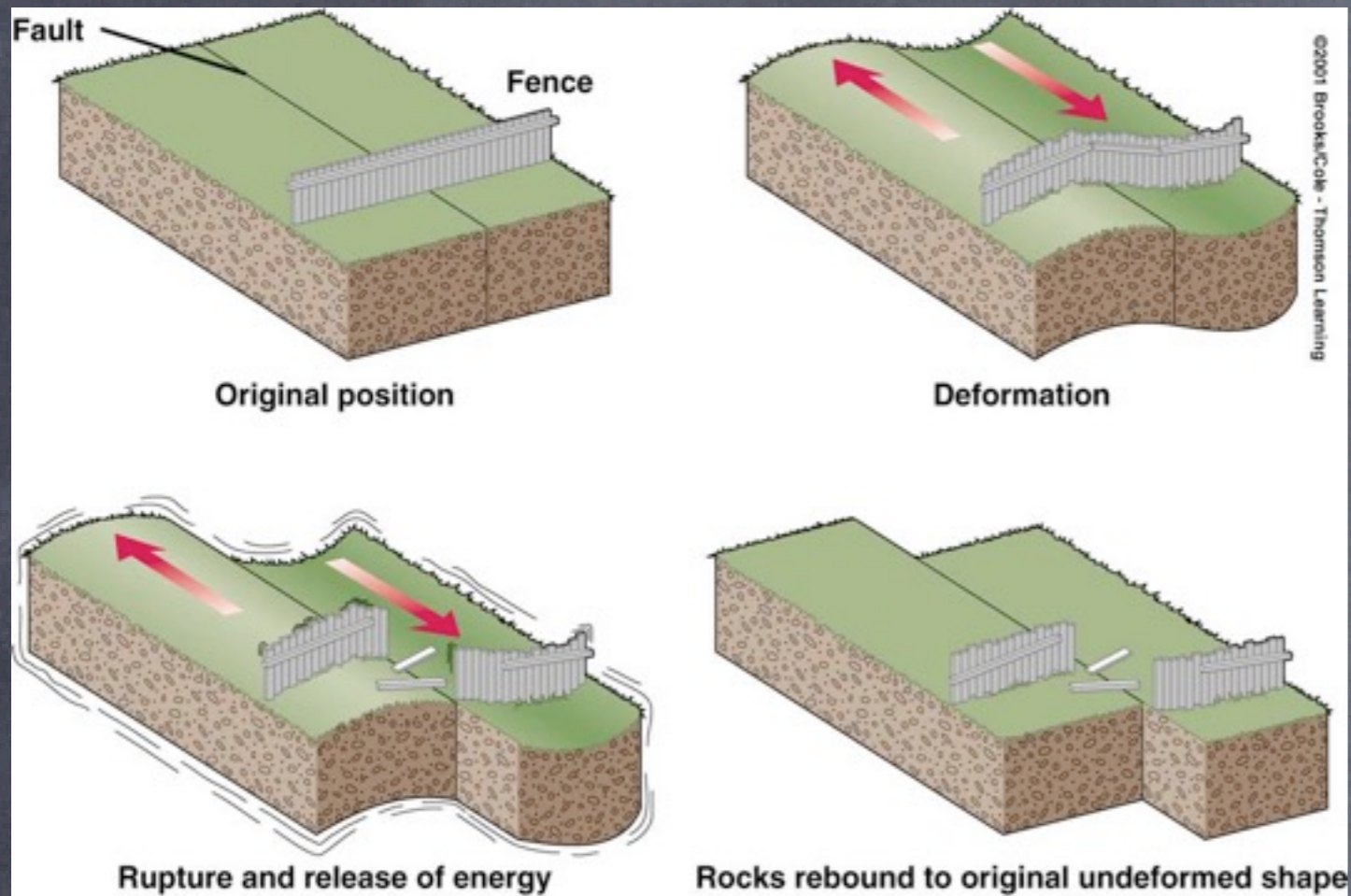
G221.001

Isacks, Bryan; Oliver, Jack; Sykes, Lynn R. (1968).

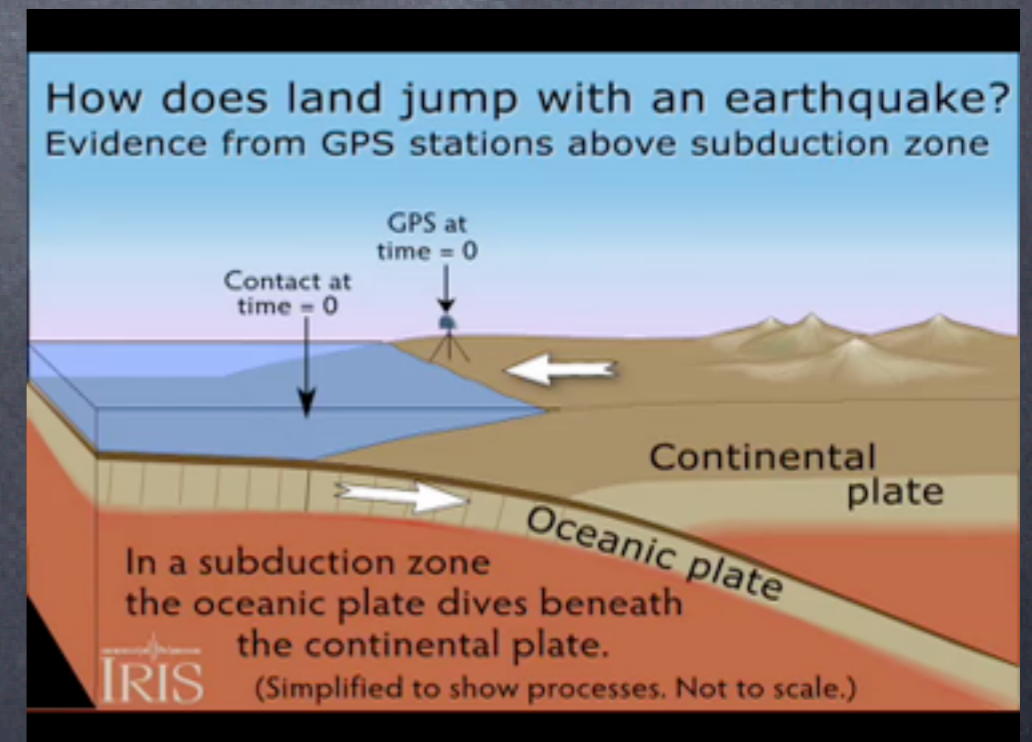
"Seismology and the New Global Tectonics". Journal of Geophysical Research 73 (18)



# Teoria del rimbalzo elastico



- A causa della frizione i blocchi non scorrono liberamente ma si deformano
- Quando gli sforzi sul piano di faglia superano la frizione il processo di rottura inizia.
- L'energia elastica immagazzinata dal sistema viene rilasciata in gran parte come onde sismiche che si irradiano dalla faglia.

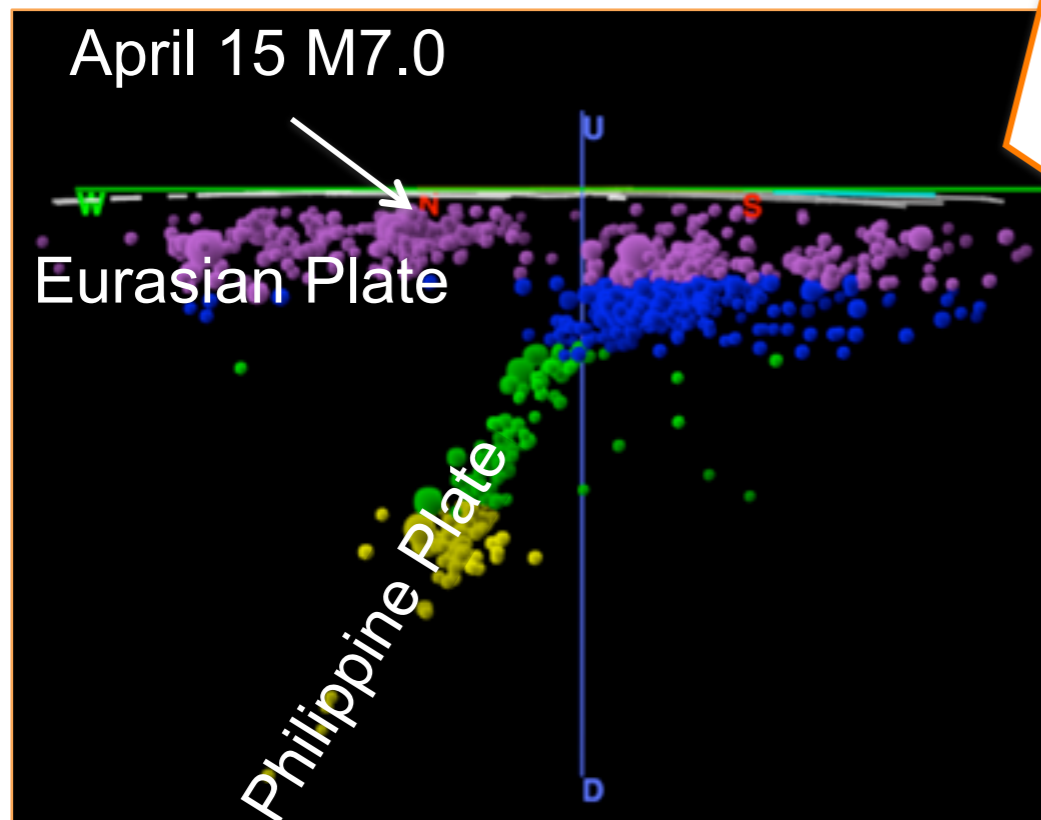
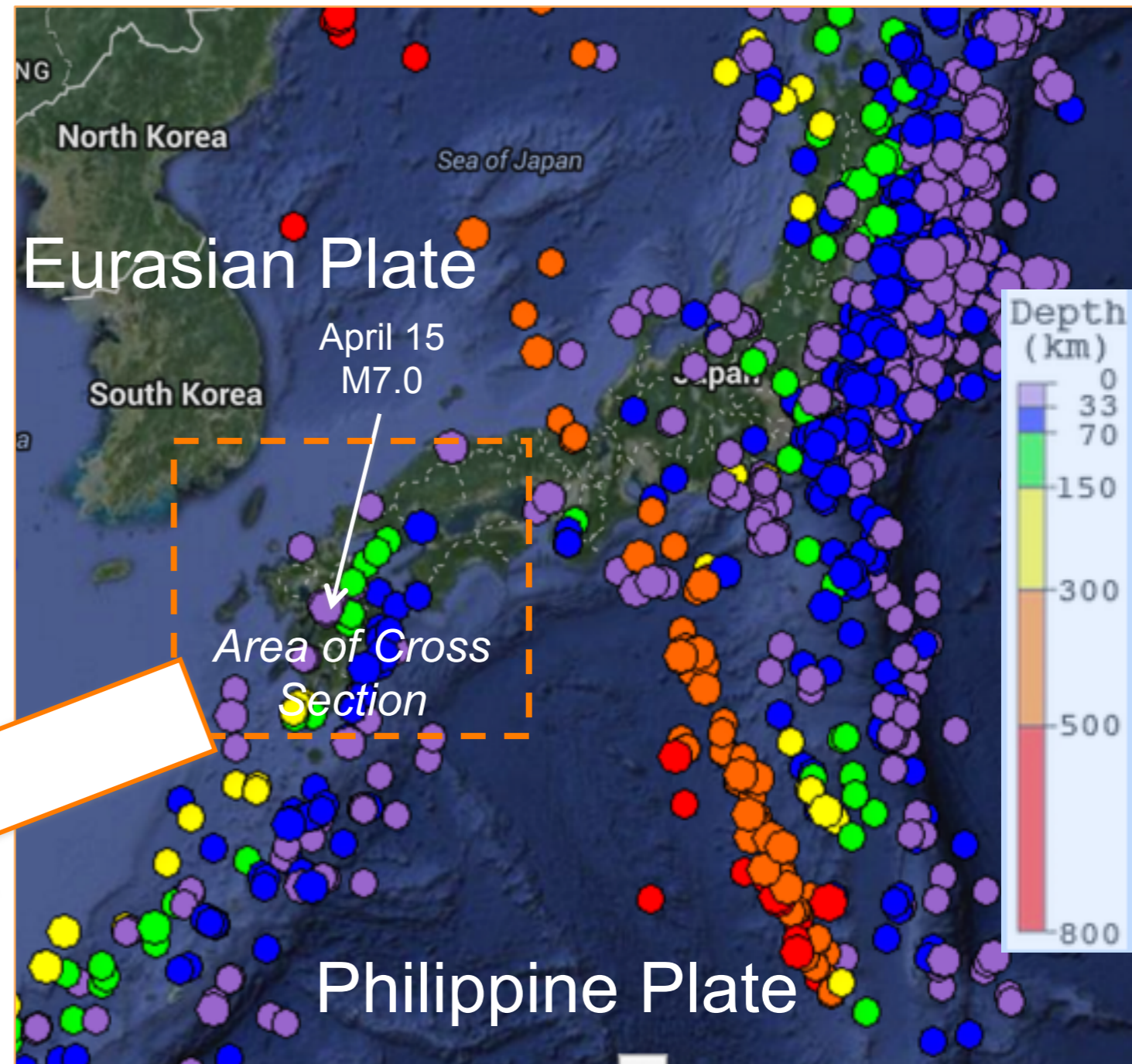




# Magnitude 7.0 KYUSHU, JAPAN

## Earthquake and Historic Seismicity

The epicenter of the April 15 M 7.0 earthquake is shown on the regional seismicity map at right. The cross section below, shows the Philippine Plate subducting below the Eurasian Plate. The April 15 earthquake occurred on a crustal fault within the Eurasian Plate.



Map generated using IRIS Interactive Earthquake Browser



# Magnitude 7.0 KYUSHU, JAPAN

The plate tectonic map below shows rates of motion between the Pacific, Philippine, and Eurasian plates. In the region of Kyushu Island, the Philippine Plate subducts beneath the Eurasian Plate at a rate of about 5 cm/yr.

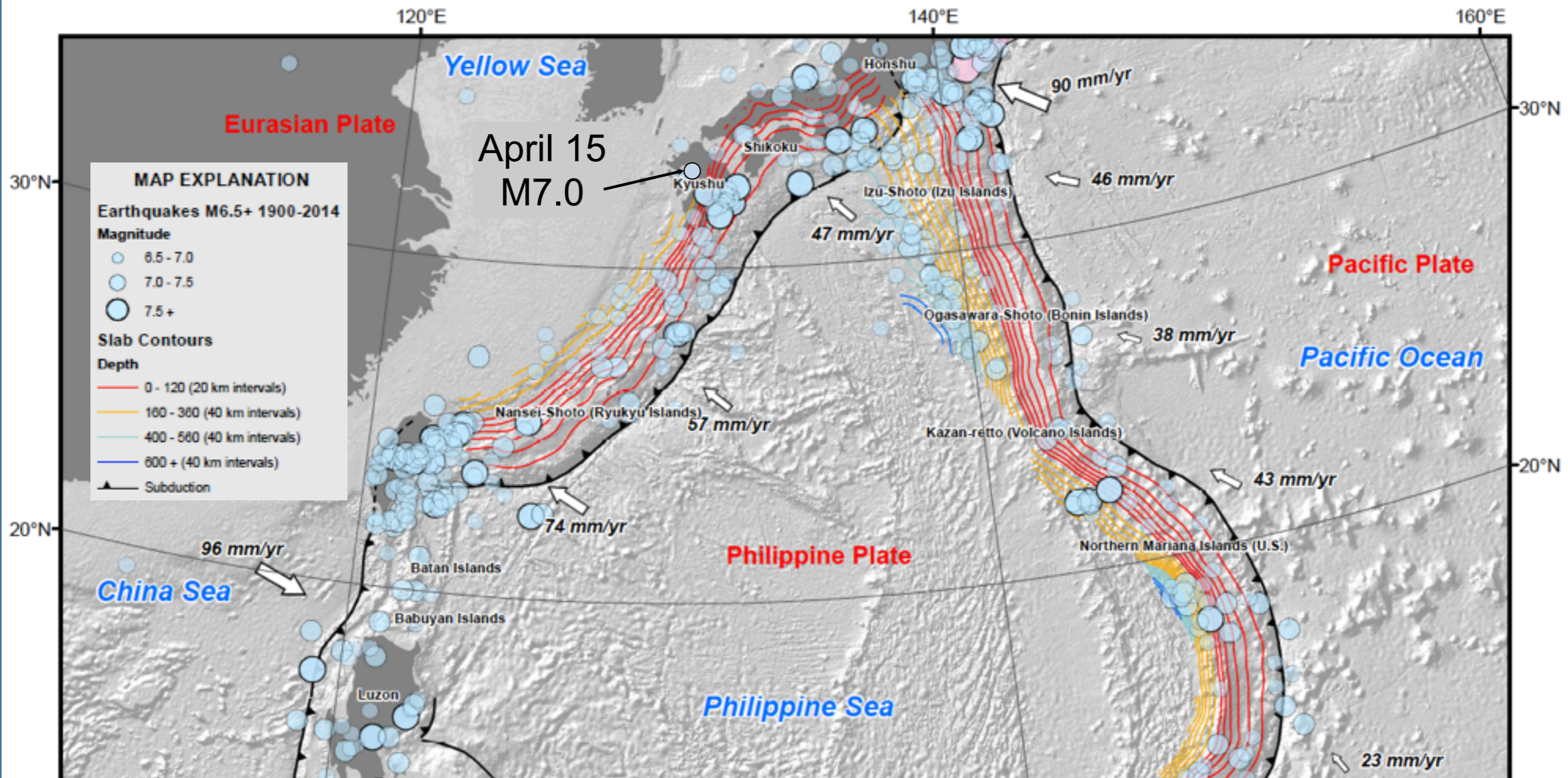


Image courtesy of the US Geological Survey

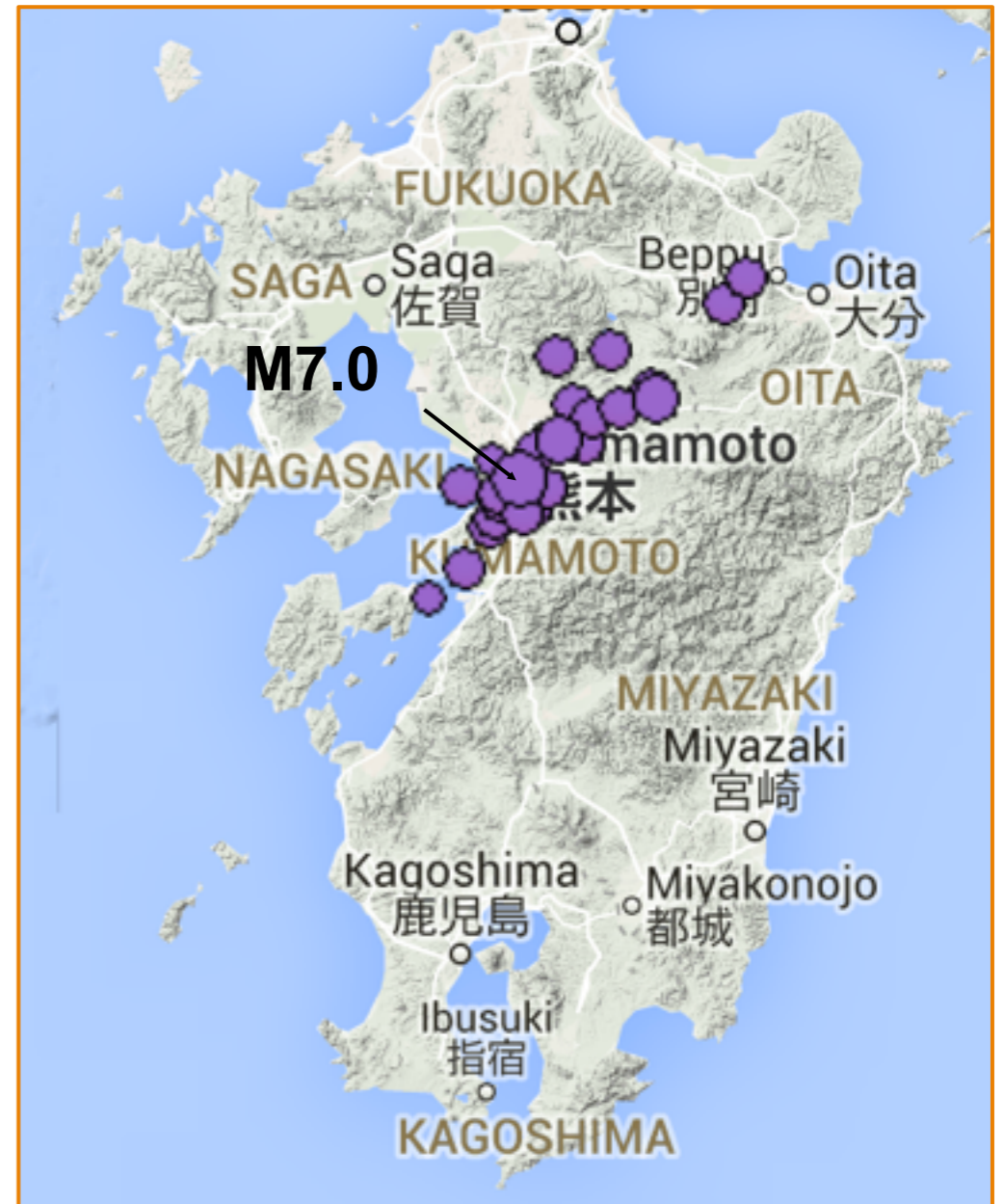


# Magnitude 7.0 KYUSHU, JAPAN

## April 14 Foreshocks



## M 7.0 & April 15 – 16 Aftershocks



Maps generated using IRIS Interactive Earthquake Browser

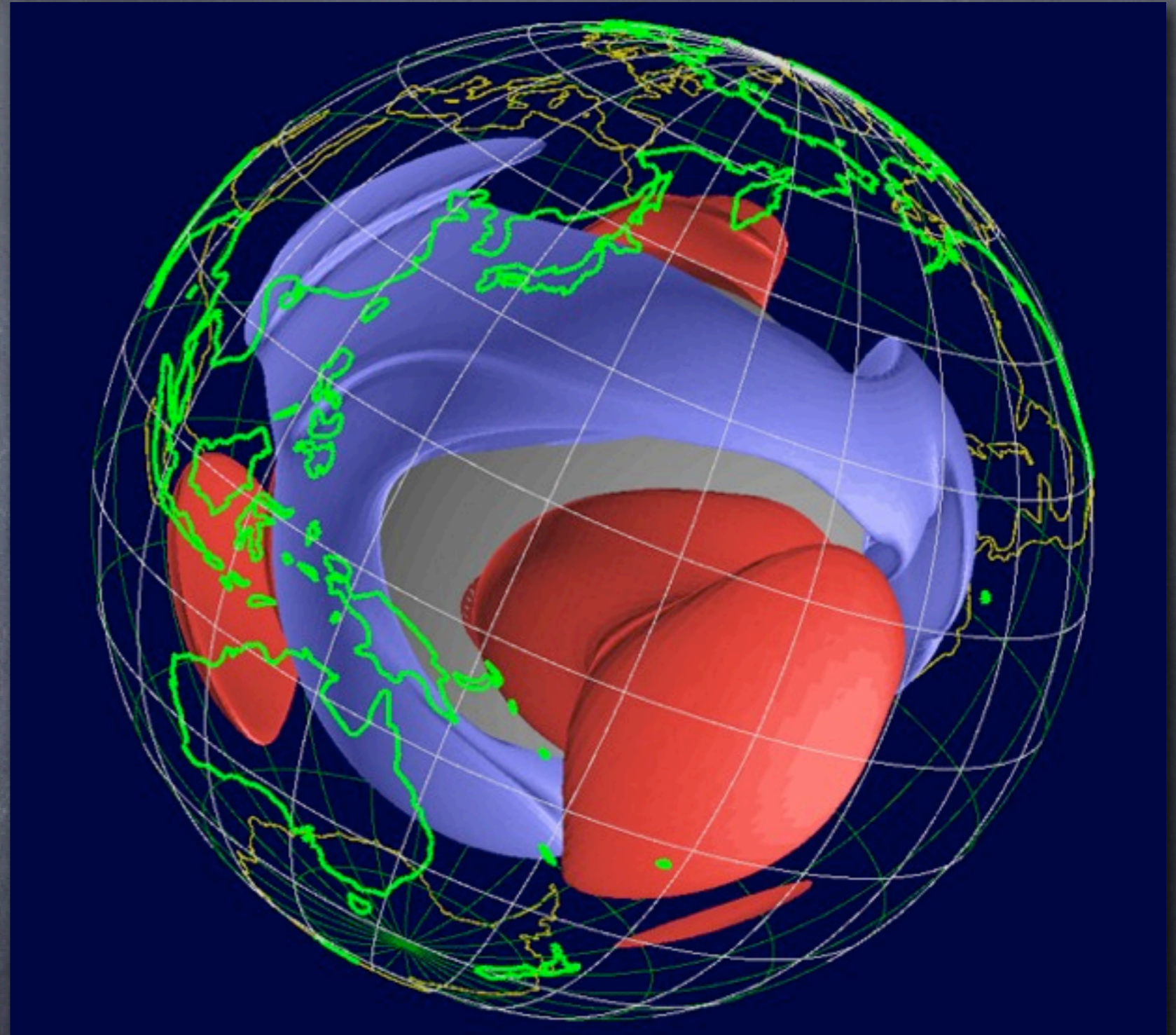
On April 14, eighteen earthquakes occurred near Kumamoto, including a magnitude 6.2 event that killed 9 people. In retrospect, the April 14 events are recognized as foreshocks to the April 15 magnitude 7.0 earthquake (main shock). In the 25 hours following the M7.0 earthquake, 25 aftershocks occurred with magnitudes up to 5.7.



# Tomografia 3D

La tomografia sismica può fornire immagini 2D o 3D della struttura dell'interno della Terra, sia a partire dall'analisi della sismicità che utilizzando sorgenti artificiali (sismologia a sorgente controllata), metodo impiegato anche nella geofisica di esplorazione per la prospezione di depositi petroliferi.

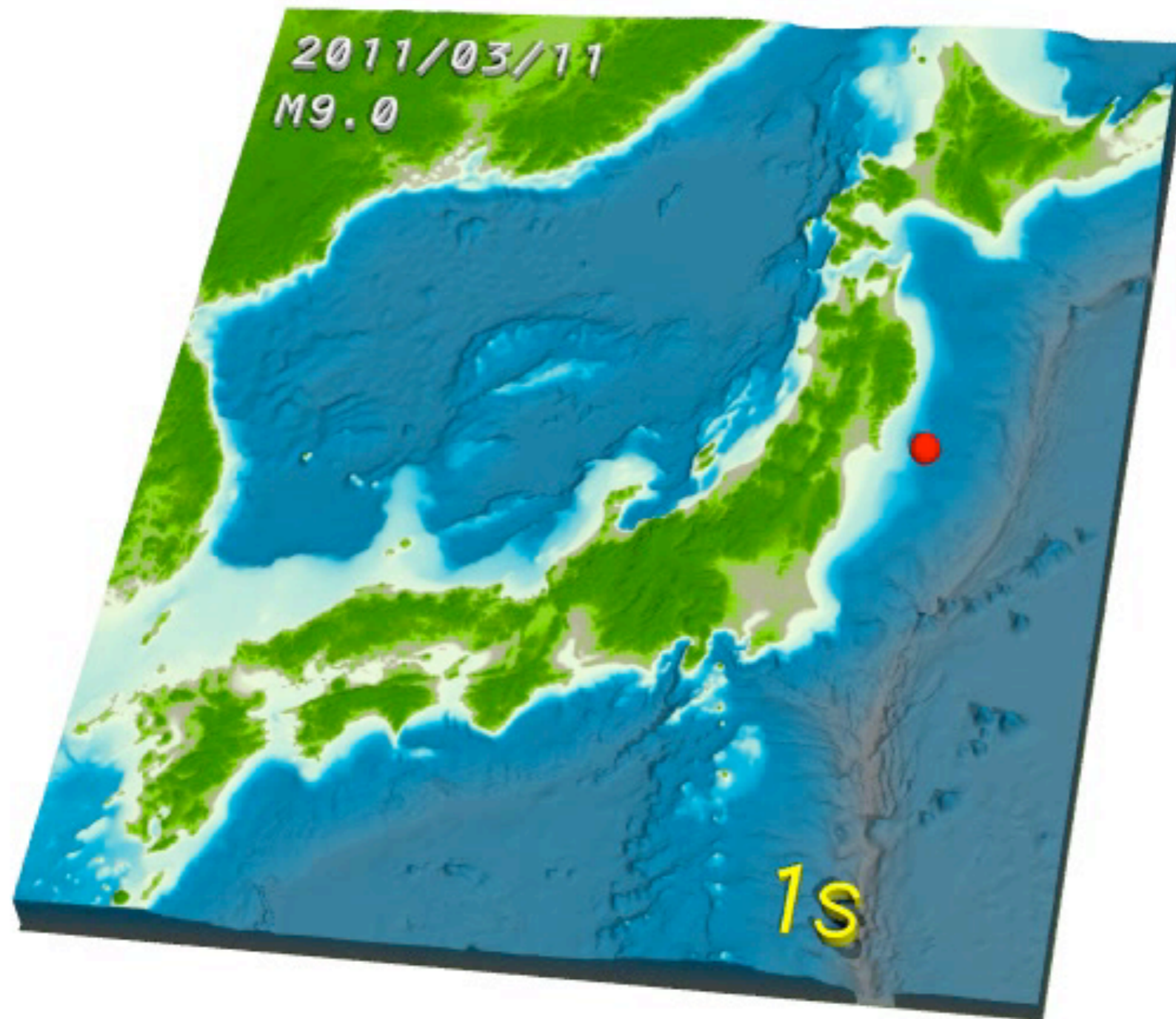
**Probabilmente il compito odierno più importante della sismologia globale è quello di determinare ad alta risoluzione la struttura 3D a grande scala della Terra.**



<http://www.seismology.harvard.edu/projects/geomap/geomap.html>



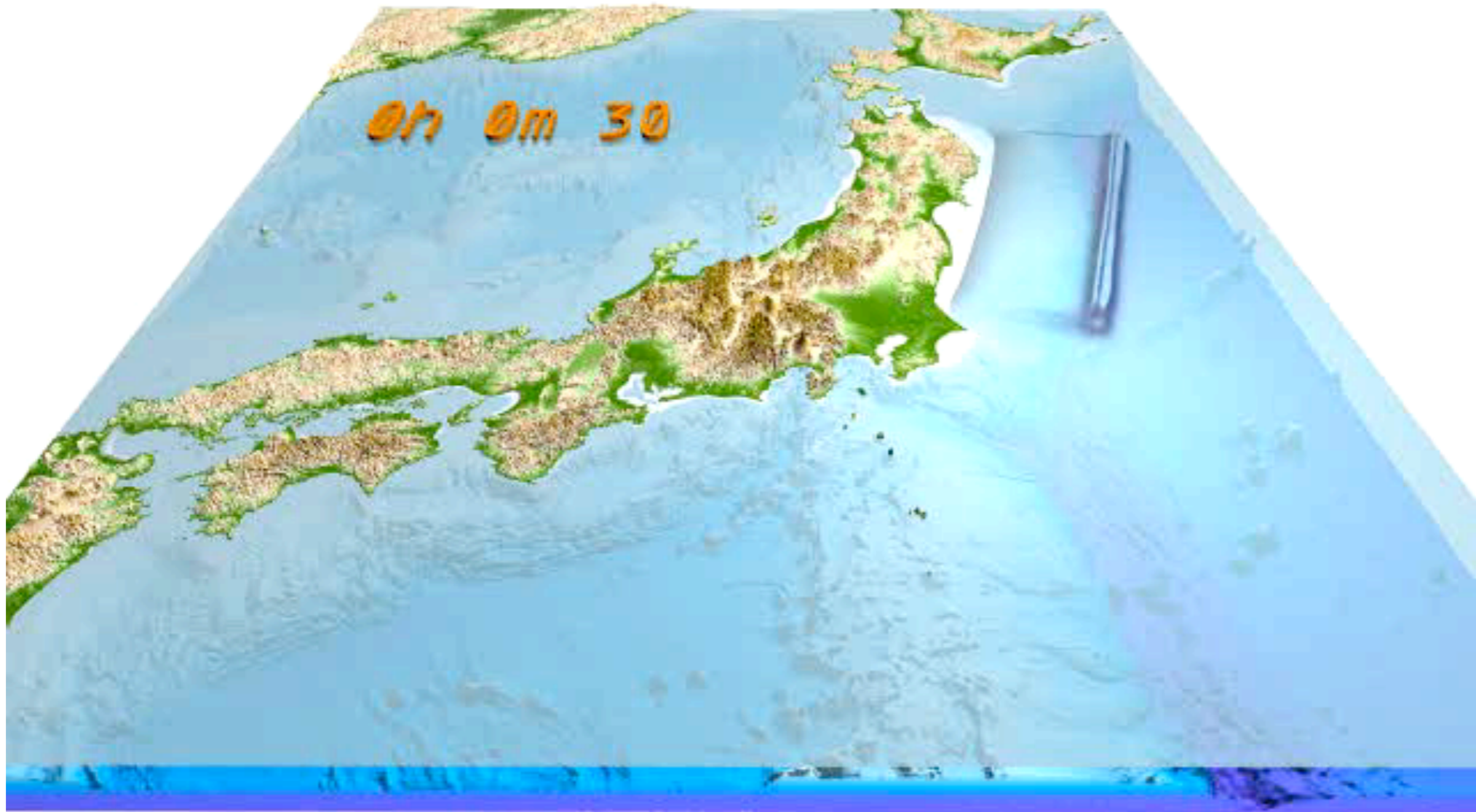
# Ground motion animation: time scales...



Courtesy of Takashi Furumura



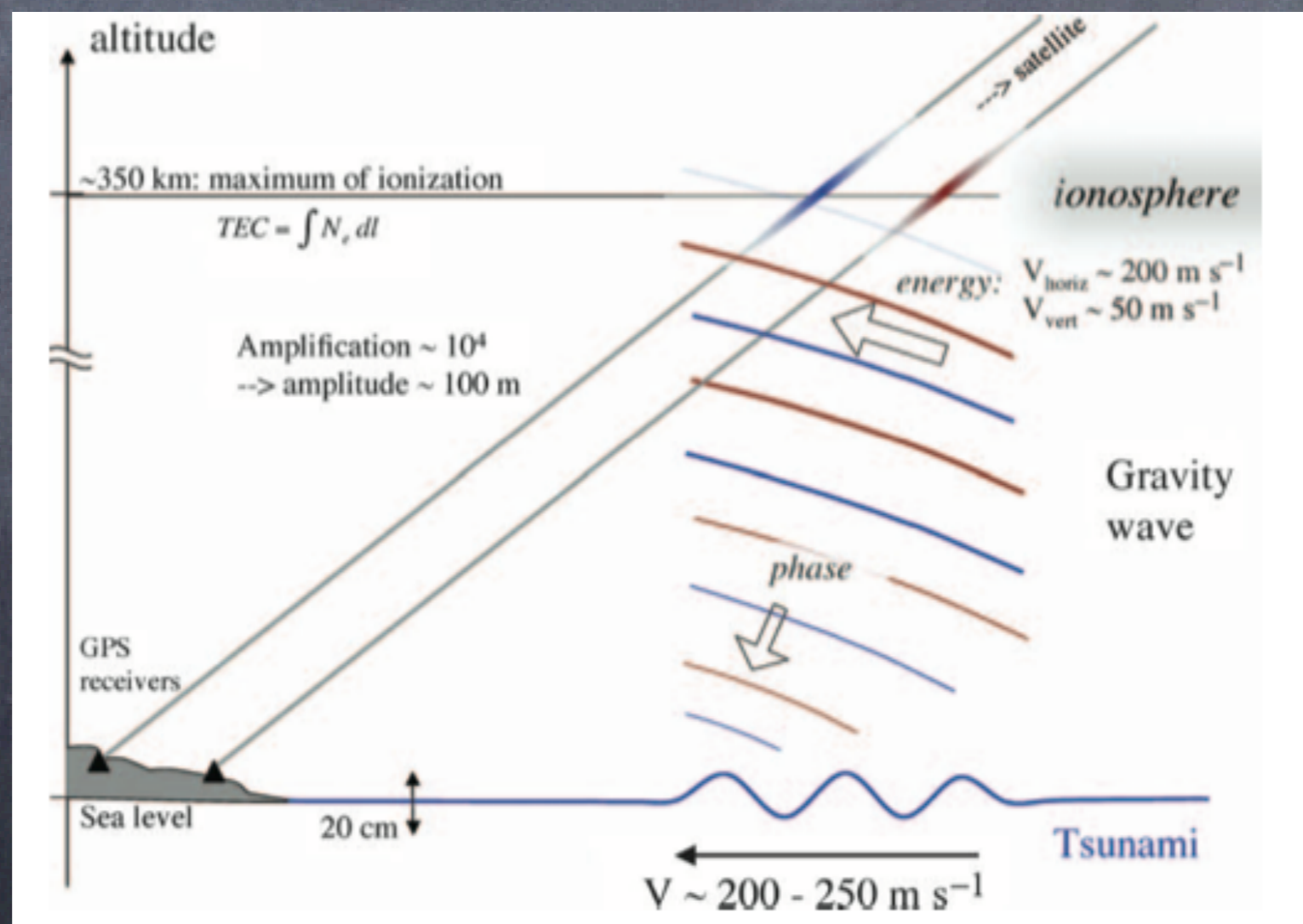
# Tsunami animation: time scales...





# Traccia dello Tsunami nella ionosfera

- Tramite l'accoppiamento dinamico con l'atmosfera, vengono generate onde acustiche-gravità
- Traveling Ionospheric Disturbances (TID) possono essere rivelate e seguite da reti GPS ad alta densità

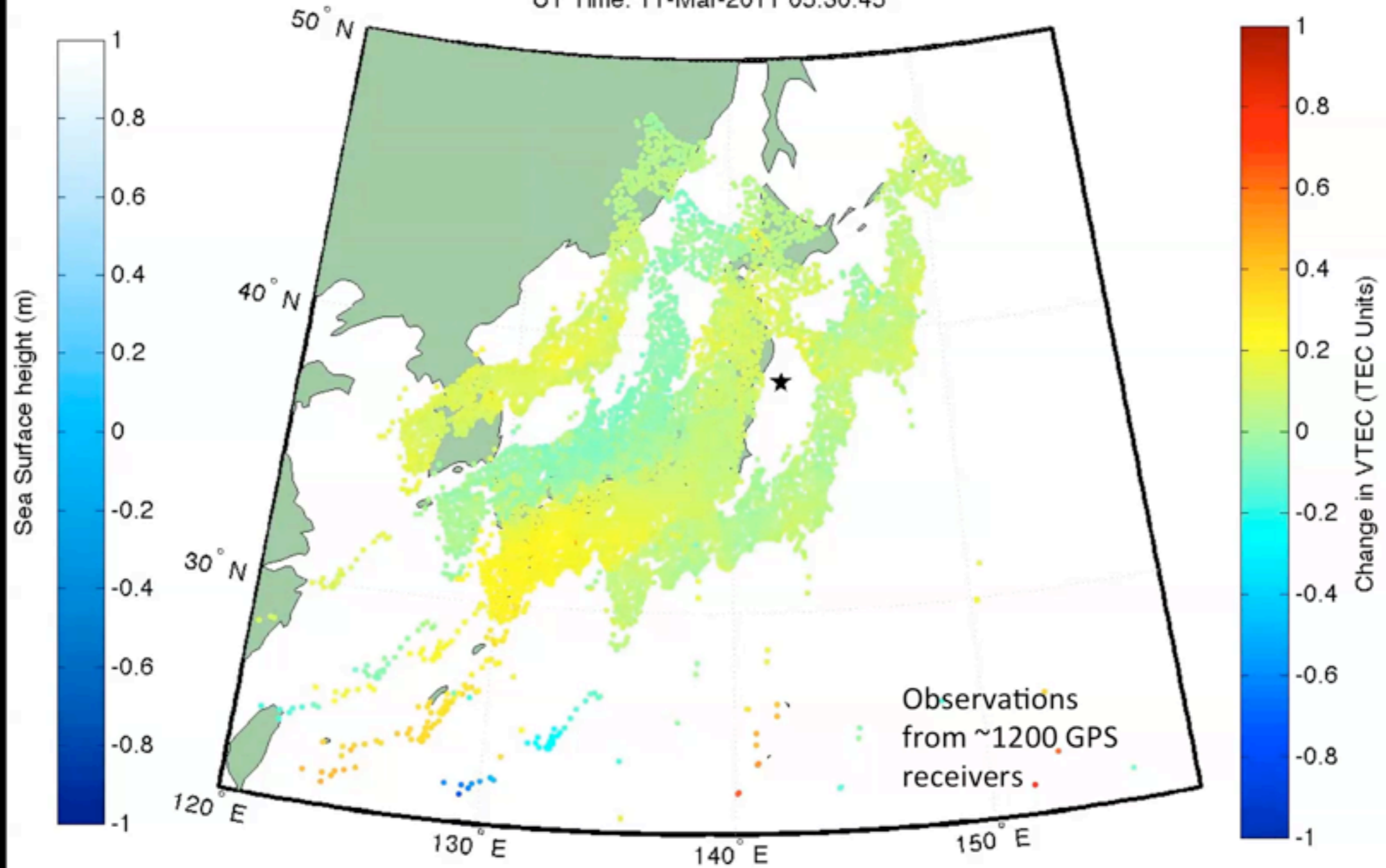




# Tsunami signature in the ionosphere

Tohoku Tsunami Seen in Ionosphere Using GPS  
Compared with JPL's Song Tsunami Model

UT Time: 11-Mar-2011 05:30:45





# Percorso...

Fisica Terrestre, dell'Ambiente e Interdisciplinare – Insegnamenti							
I ANNO							
I Semestre	SSD	TAF	CFU	II Semestre	SSD	TAF	CFU
Teoria dei campi I	FIS/02	B	6	Affine C: Fisica dell'Atmosfera	FIS/06	C	6
Fisica della Materia Condensata I	FIS/03	B	6	Laboratorio di Fisica Computazionale	FIS/01	B	6
Simmetrie e interazioni fondamentali	FIS/04	B	6	Cosmologia I	FIS/05	B	6
Affine A: Metodi di potenziale	GEO/10	C	6	Sismologia	GEO/10	B	6
Affine B: Fluidodinamica geofisica	GEO/12	C	6	Insegnamento a scelta A (es. Oceanografia)		D	6
Totale crediti del I anno							60
II ANNO sarà attuato nell'a.a. 2017/2018							
I Semestre	SSD	TAF	CFU	II Semestre	SSD	TAF	CFU
Rischio sismico e vulcanico	FIS/07	B	6	Tesi		E	30
Insegnamento a scelta B		D	6				
Abilità informatiche e telematiche		F	3				
Tirocinio		F	5				
Tesi		E	10				
Totale crediti del II anno							60