

Project A03-01

The outline of seismic-geoelectromagnetic observation of the core and mantle

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“Interaction and Coevolution of the Core and Mantle
~Toward Integrated Deep Earth Science~”

Kick-off symposium, Aug.7-8, 2015

Project Team Members



PI:
Satoru Tanaka (JAMSTEC)

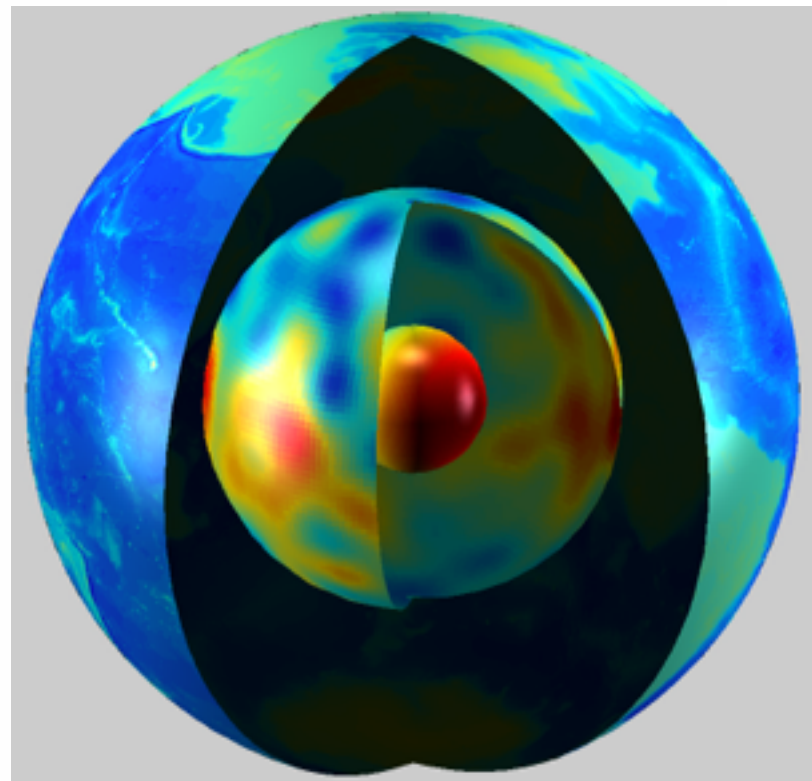
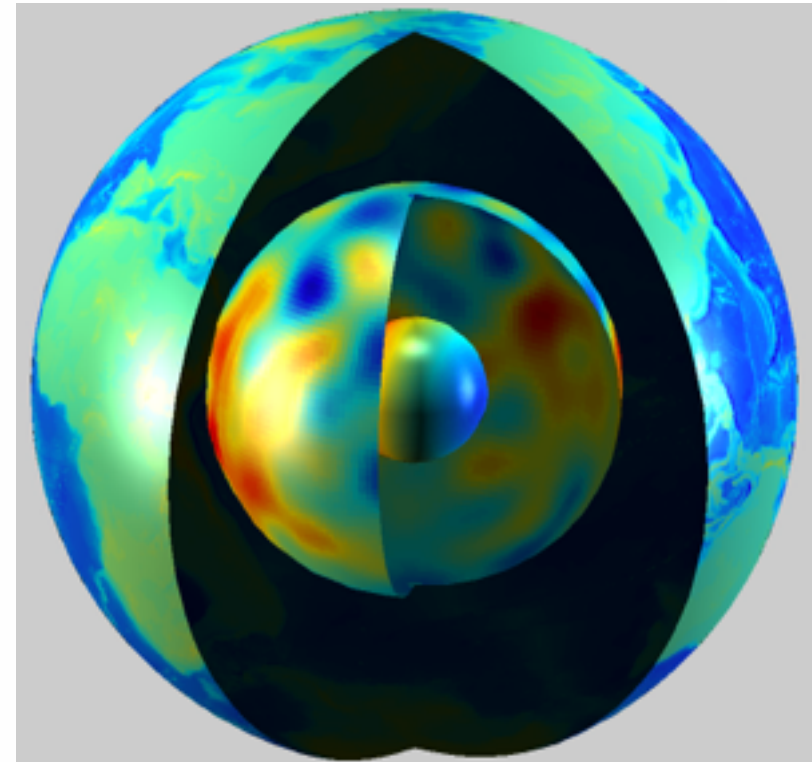
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Kenji Kawai (U.Tokyo)

George Helffrich (TiTech)
Christine Houser (TiTech)
Satoshi Kaneshima (Kyushu U.)
Toshiki Ohtaki (AIST)

Collaborator
Daisuke Suetsugu (JAMSTEC)

Introduction

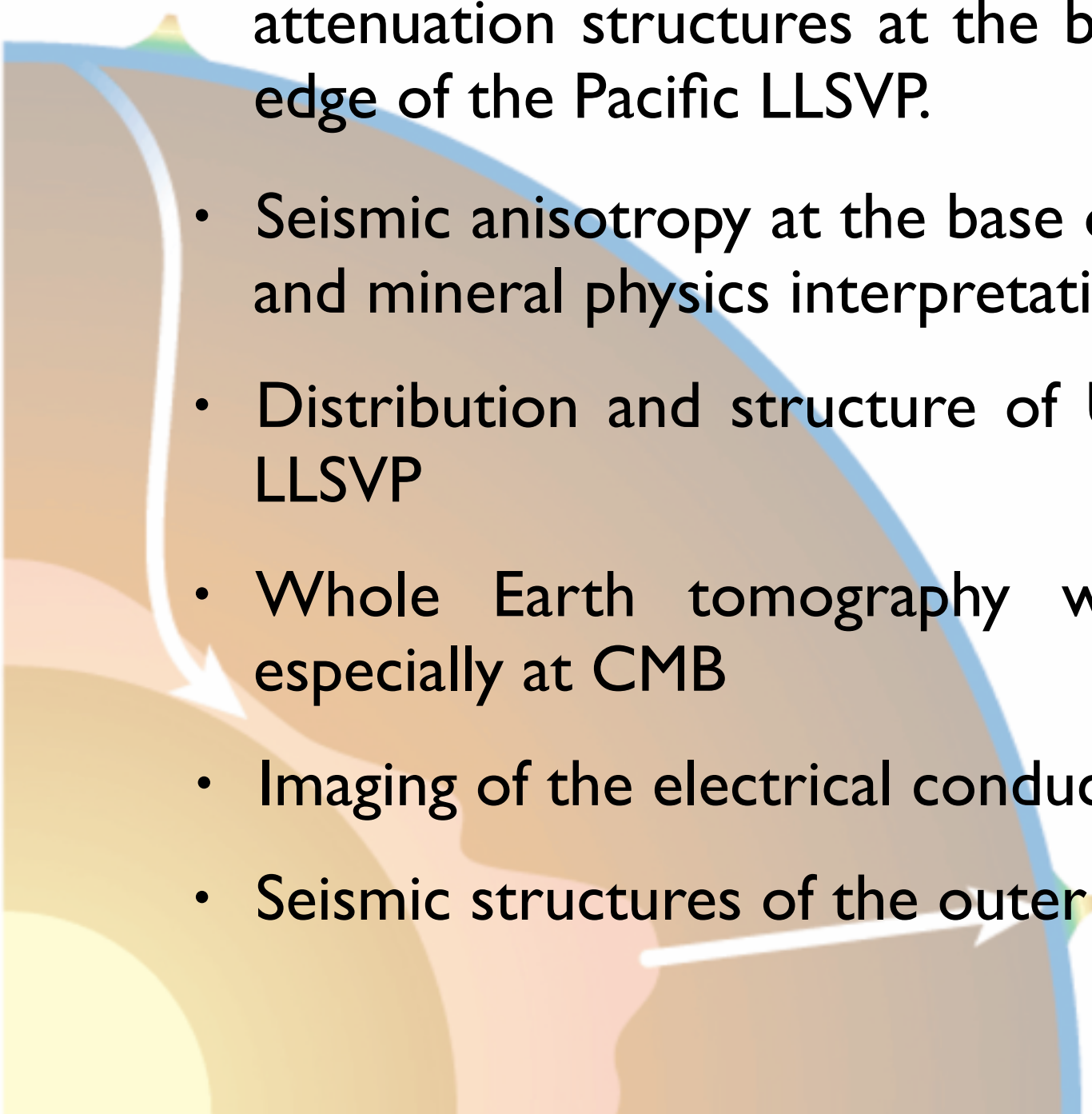
- Anomalous structures at the margin of LLSVP
- Hemispherical inner core
- Velocity gradient at the top and the bottom of the outer core
- Attenuation anomaly in the inner core



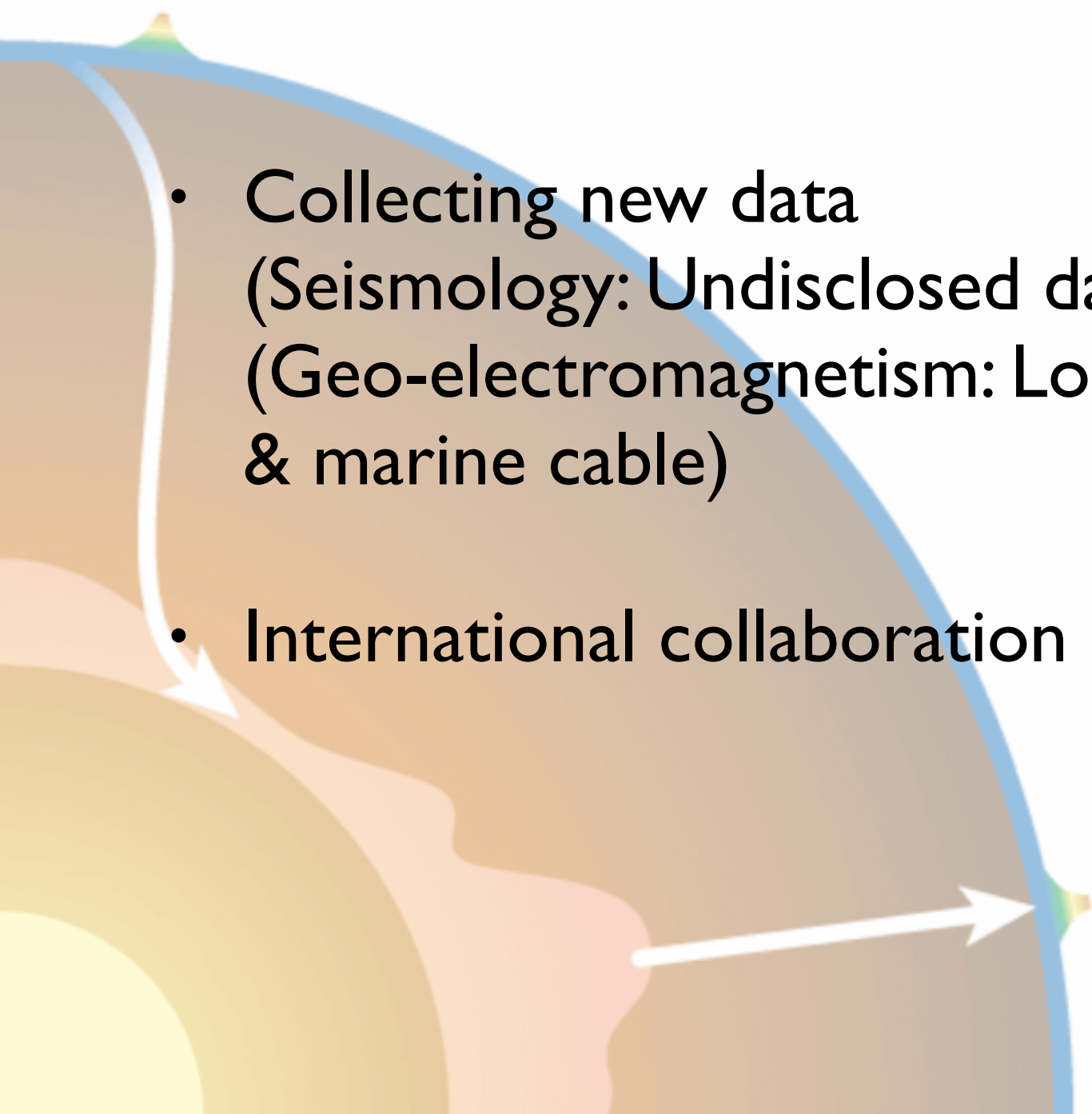
Objective

- Seismological and geo-electromagnetic studies on the deep structure of the Earth have contributed to construct a static image of the Earth's interior.
- However, there have been a few contributions to understand dynamic behavior of materials in the deep Earth.
- In this project, we would like to contribute to an integrated understanding of the Earth's deep interior based on a new viewpoint, co-evolution of the core and mantle, by geophysical observations.

Target & approach

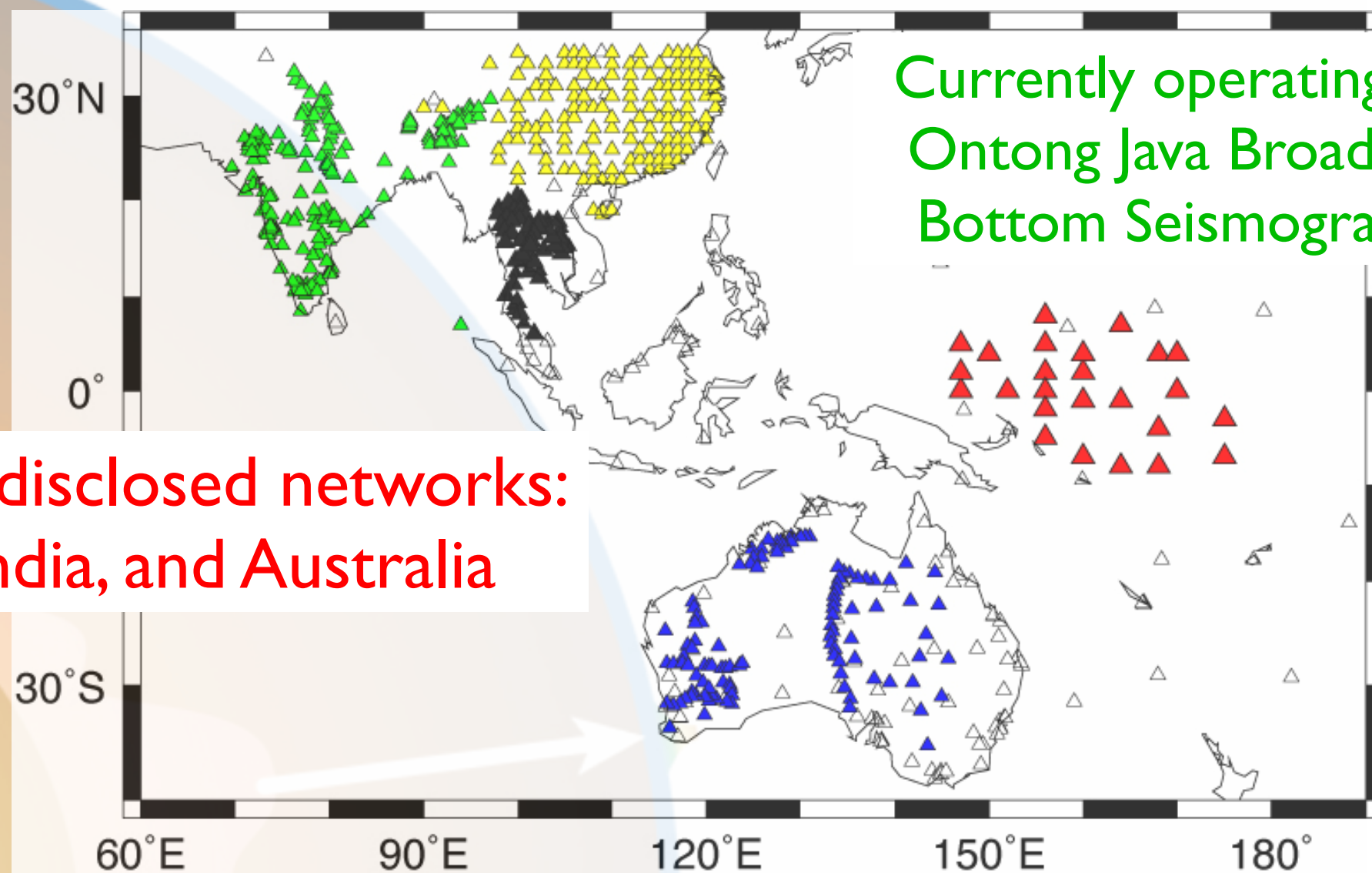
- Imaging of exact seismic discontinuities, anisotropy, and attenuation structures at the base of mantle near the western edge of the Pacific LLSVP.
 - Seismic anisotropy at the base of mantle by waveform inversion and mineral physics interpretation
 - Distribution and structure of ULVZs at CMB in and far from LLSVP
 - Whole Earth tomography with improving the resolution especially at CMB
 - Imaging of the electrical conductivity anomaly at the CMB.
 - Seismic structures of the outer and inner cores
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Method

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- Collecting new data
(Seismology: Undisclosed data & new observation)
(Geo-electromagnetism: Long term data by Satellite obs. & marine cable)
 - International collaboration

Method: Seismology

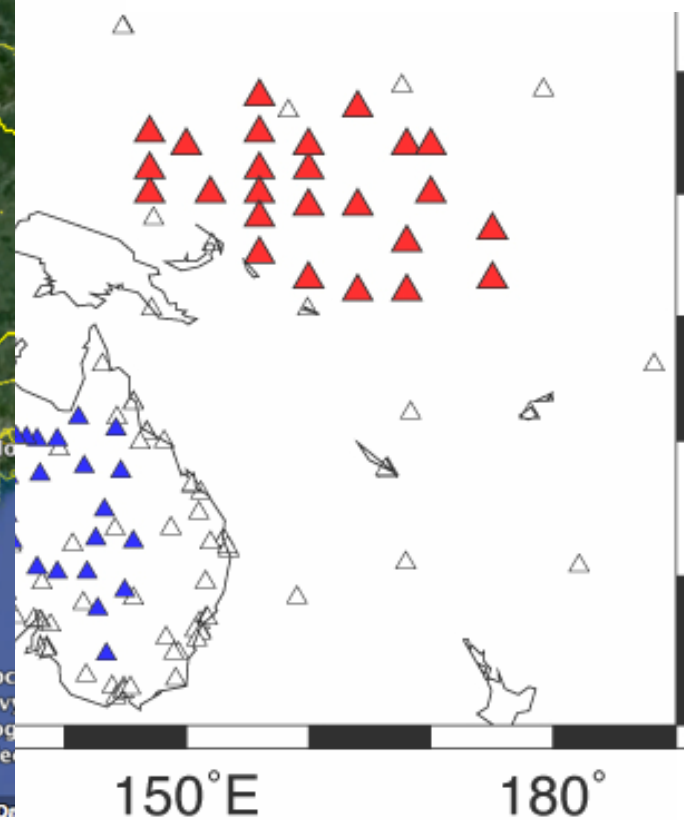
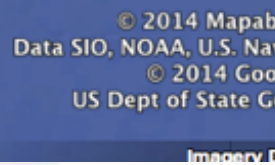
- A virtual huge seismic network: UNited seismic network for Deep Earth Research (UNDER)



Currently operating networks:
Ontong Java Broadband Ocean
Bottom Seismograph network

Existing & disclosed networks:
China, India, and Australia

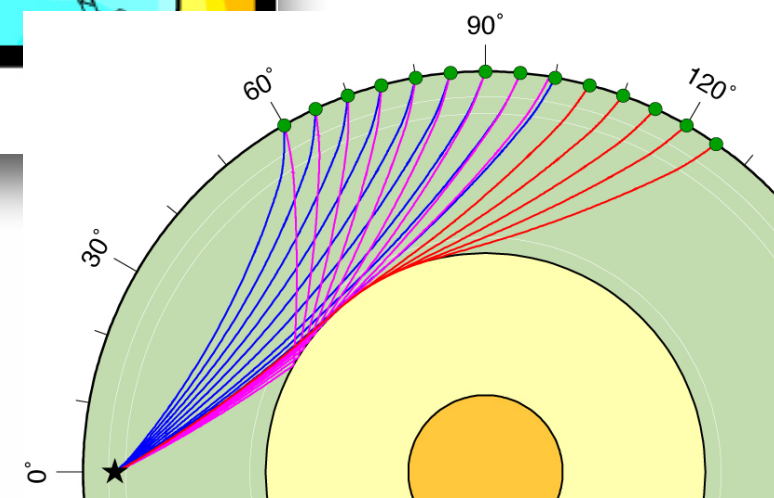
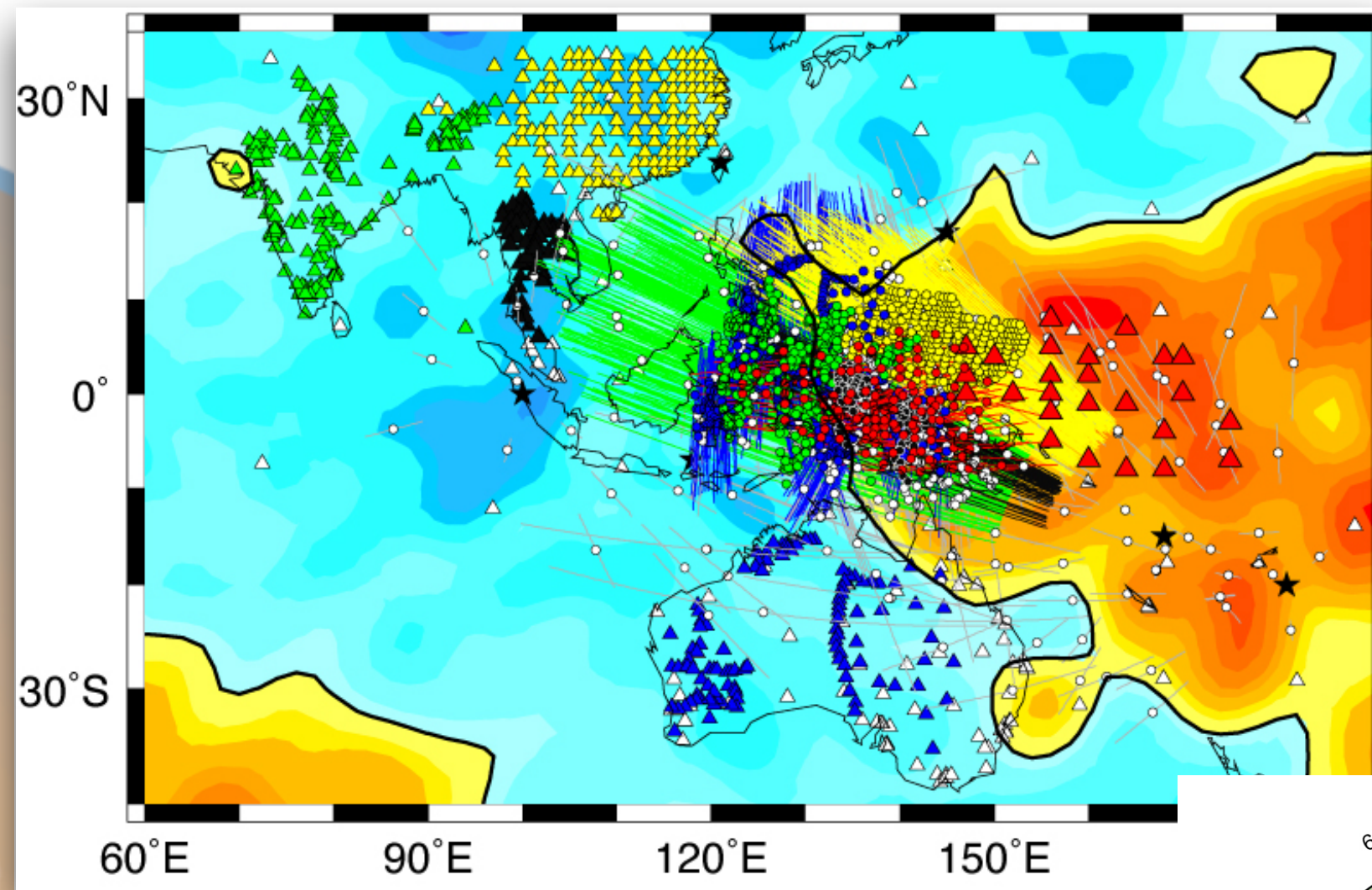
- 30°N
0°
30°S
6



150°E

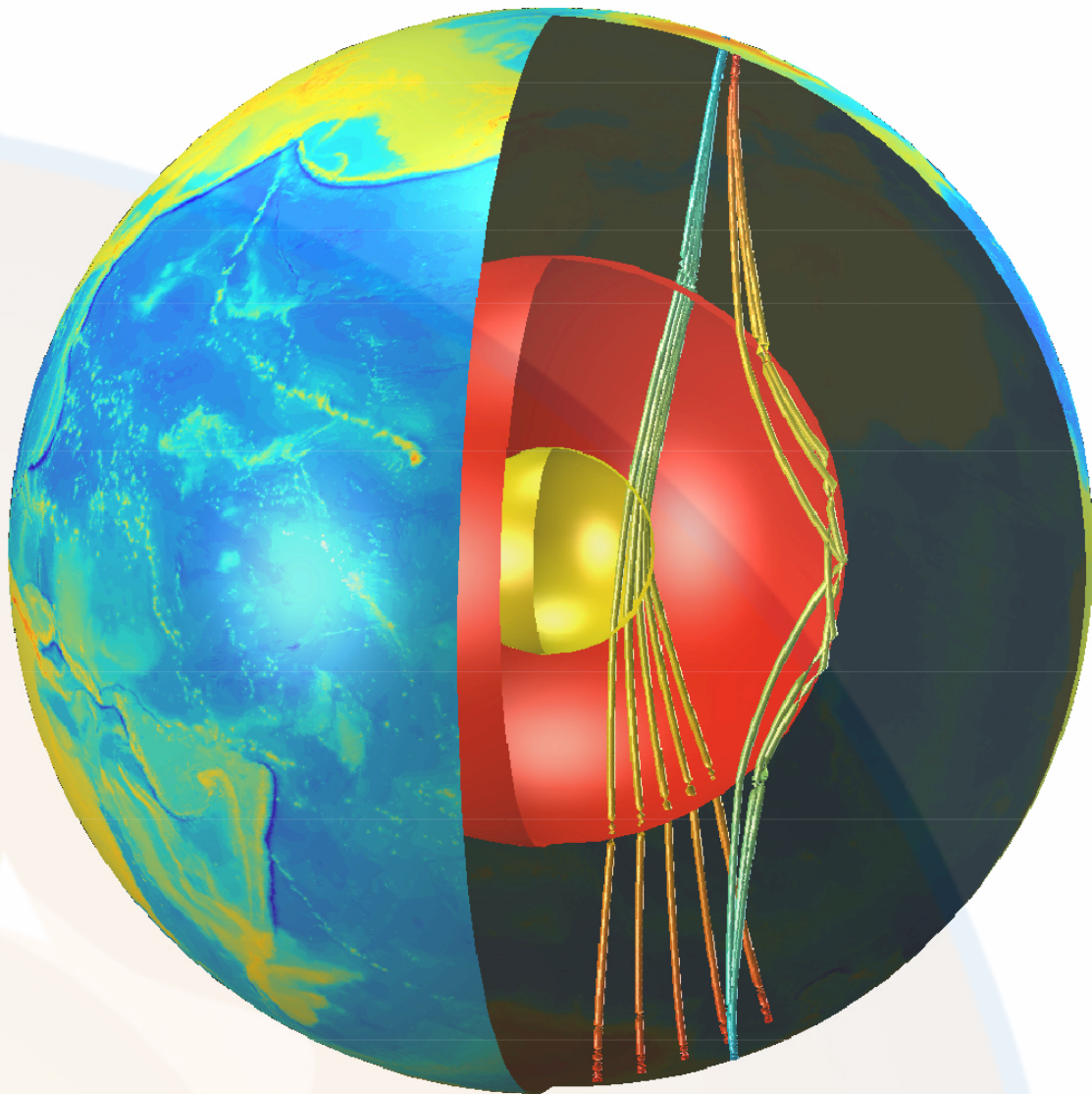
 180°

Method: Seismology

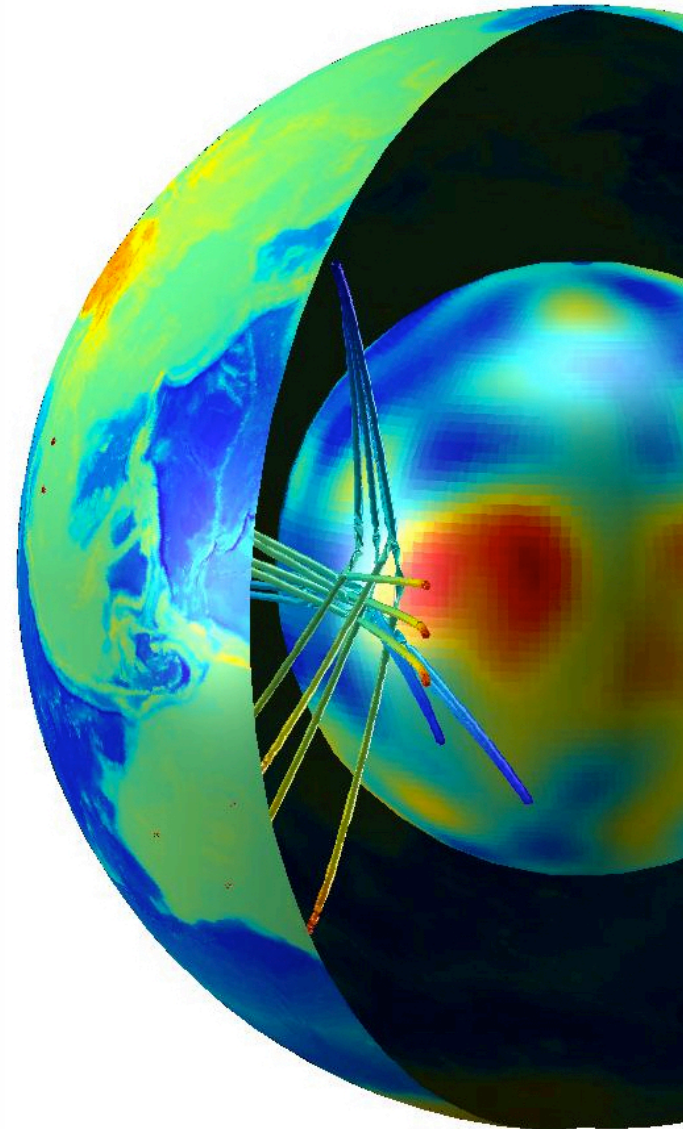


Method: Seismology

Outer and inner cores

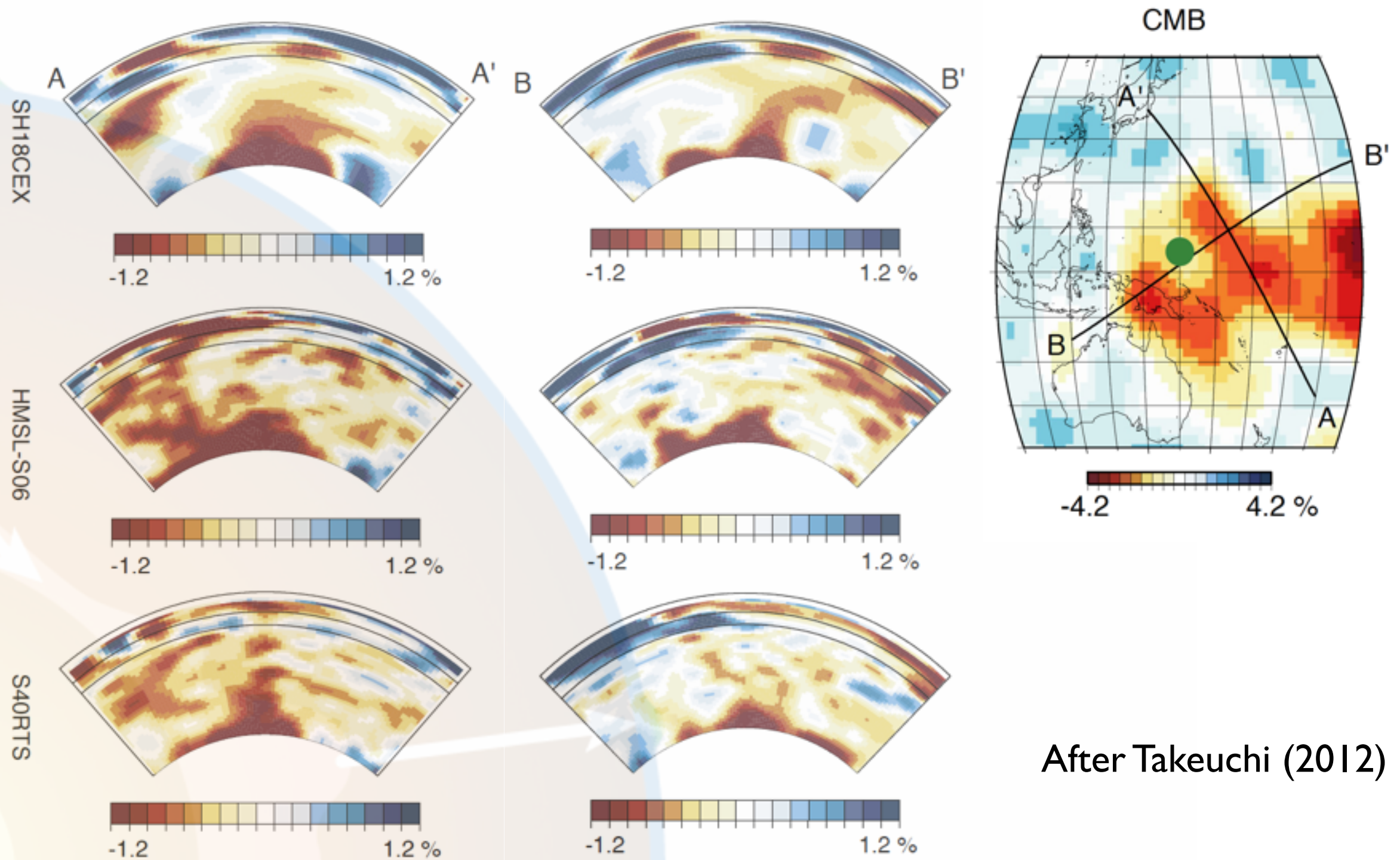


Mantle: LLSVP and its margin



Detailed talks will be given by Kawai, Houser, and Helffrich

Improvement of global tomography

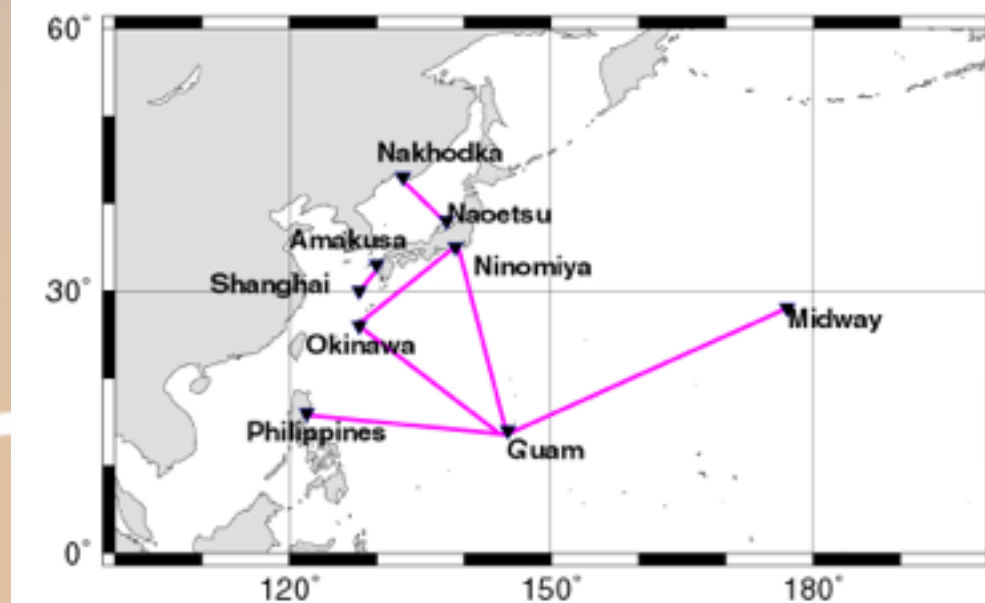
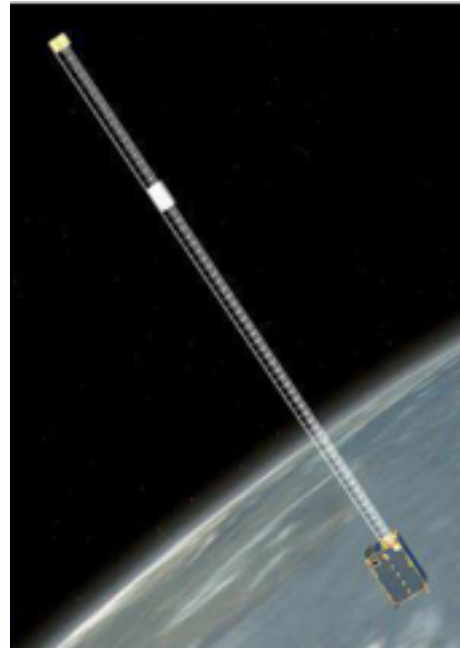
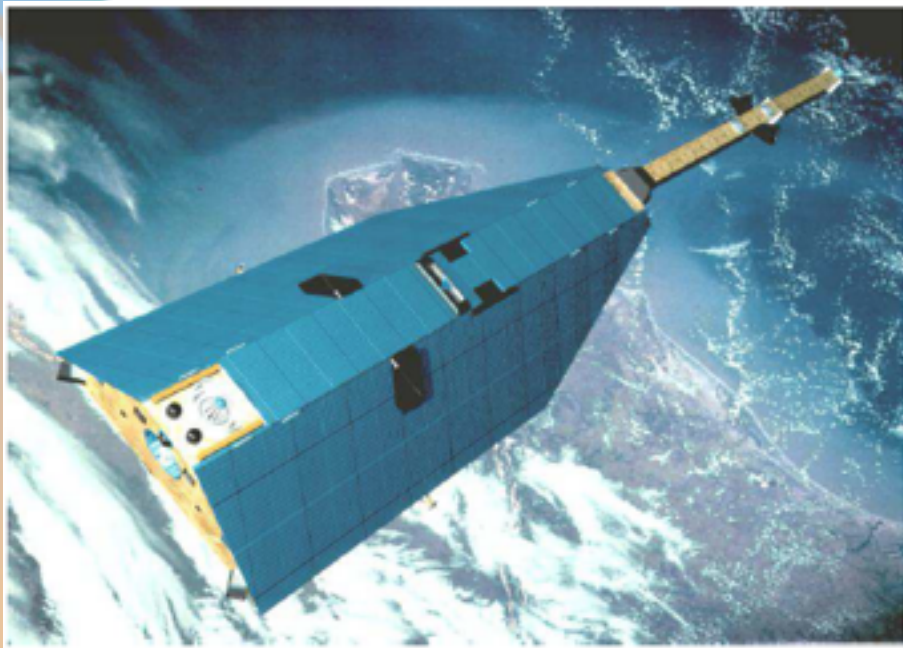


After Takeuchi (2012)

Method:

Geo-electromagnetism

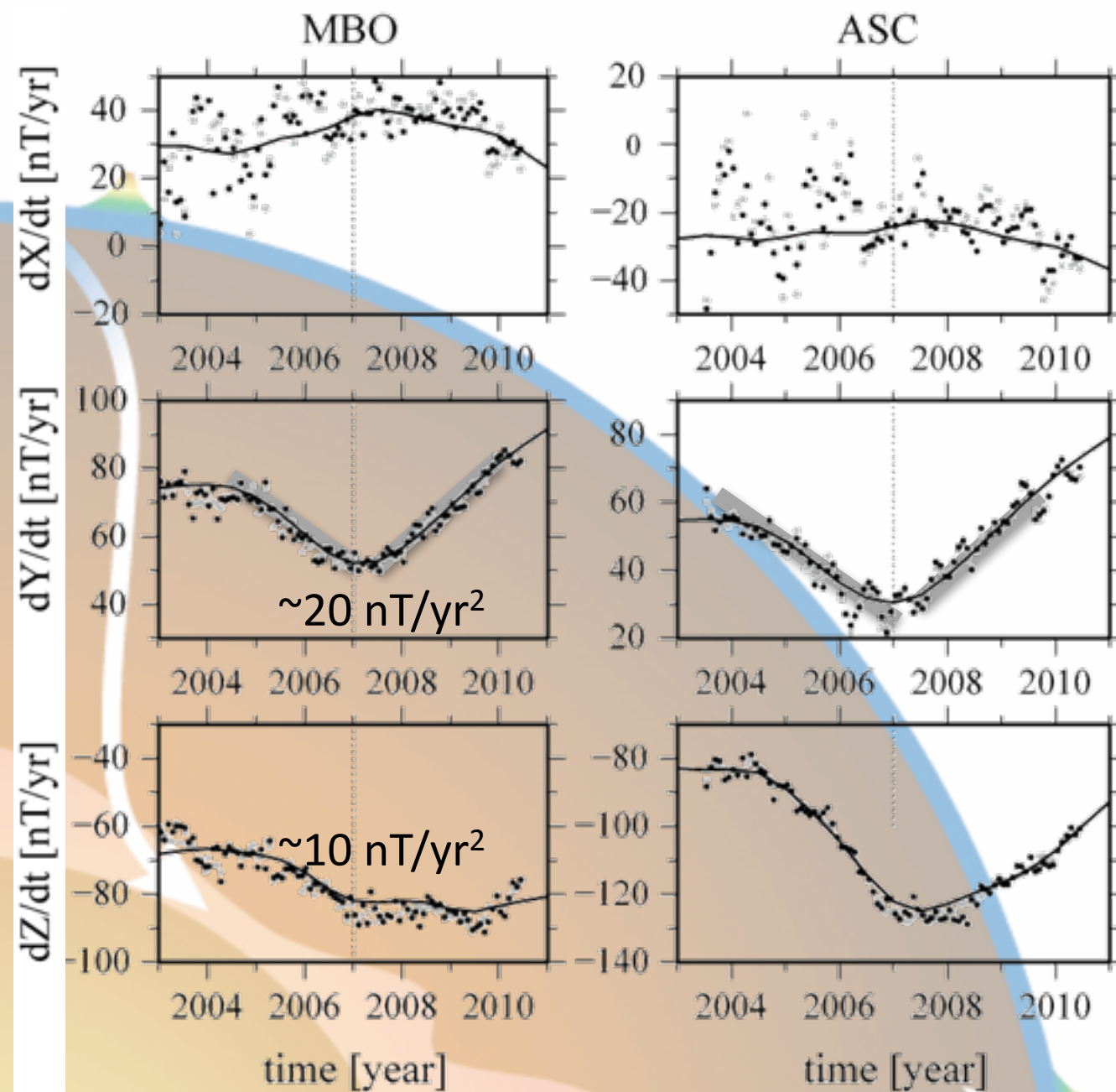
- Analysis and modeling of Geomagnetic Jerk by satellite data



In the future
Submarine Cable Voltage

Local geomagnetic jerk around 2007.0

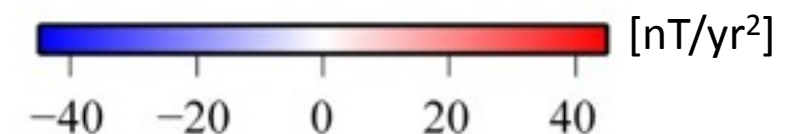
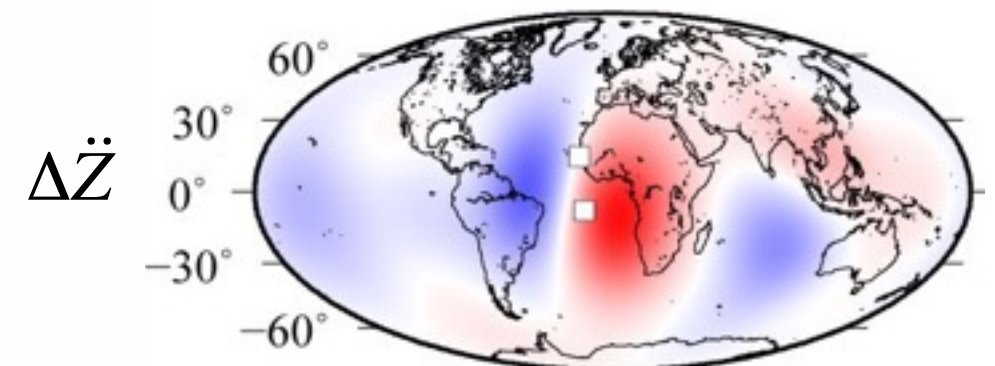
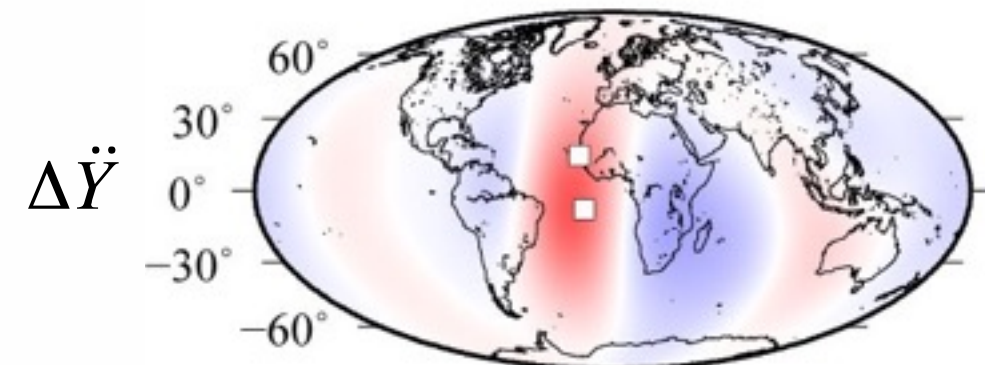
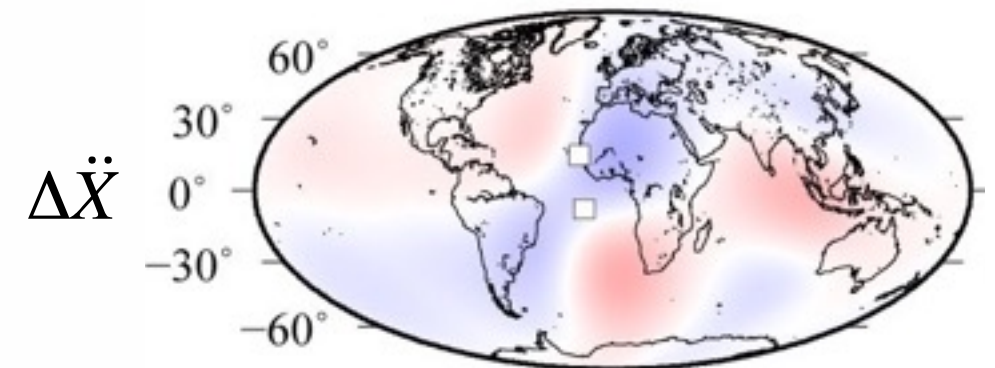
Observatory data



Jerk amplitude at 2007

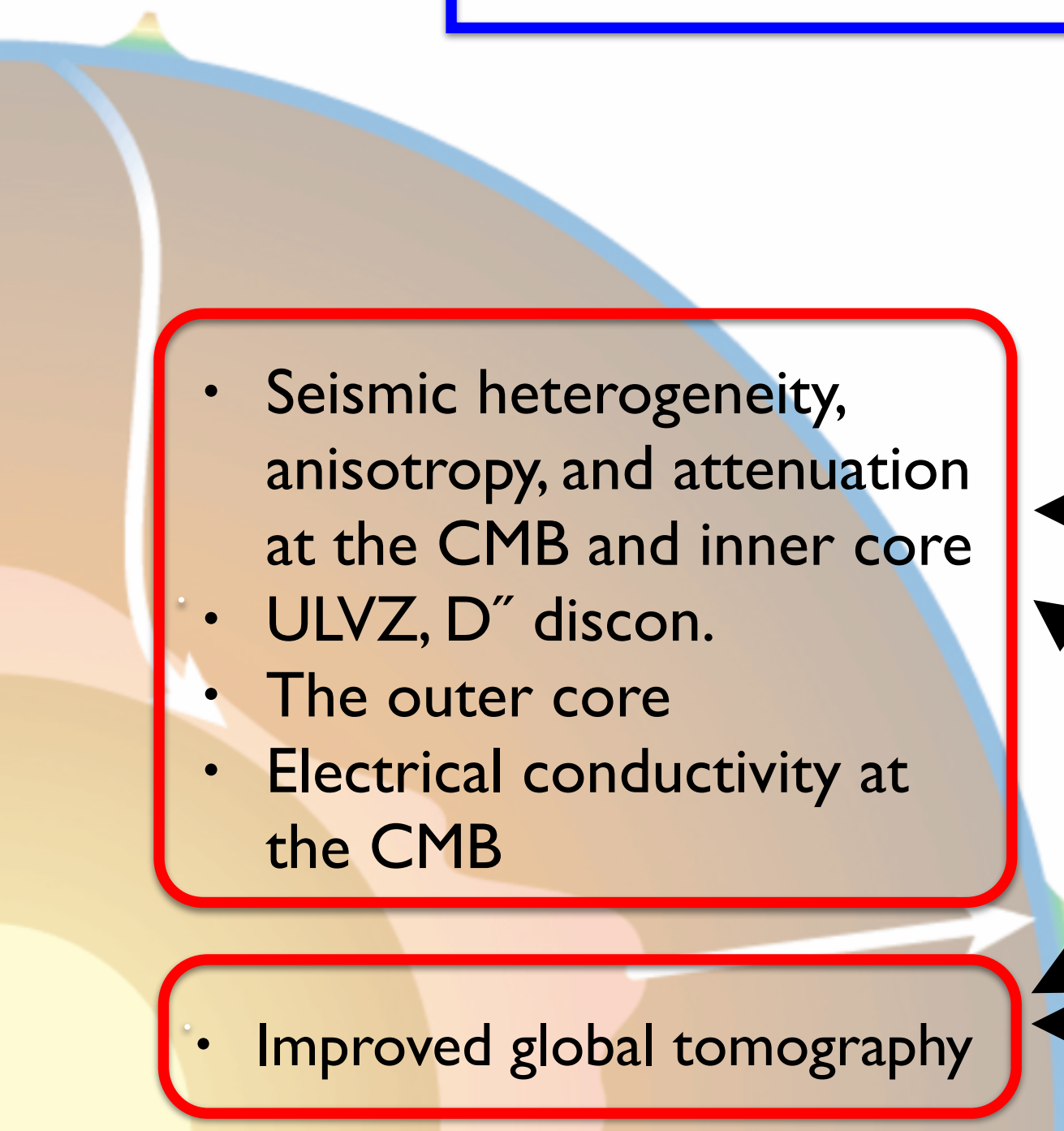
CHAOS-4 model (Olsen et al. 2011)

$$\Delta \ddot{A}_{t=2007} = \ddot{A}_{t=2008.5} - \ddot{A}_{t=2005.5}$$



Expected results and collaboration with the other research projects

Integrated Deep Earth Science

- 
- A stylized cross-section of the Earth's interior, showing the crust, mantle, and core. The layers are color-coded: brown for the crust, light blue for the upper mantle, dark blue for the lower mantle, and yellow for the core. A large black arrow points upwards from the core region towards the 'Integrated Deep Earth Science' box.
- Seismic heterogeneity, anisotropy, and attenuation at the CMB and inner core
 - ULVZ, D'' discon.
 - The outer core
 - Electrical conductivity at the CMB

- Improved global tomography

Dynamics research (A01-1)
Element partitioning (A02-2)

Numerical simulation (A04)

Neutrino obs. (A03-2)