



**Special thanks:** Peter Moczo, Josef Kristek,  
Greta Küppers, Celine Hadzioannou, Gerhard  
Pratt, Michael Afanasiev, Stefan Mauerberger

**Welcome to the 3rd QUEST  
Research and Training Workshop!  
Tatranska Lomnica May 20-26, 2012**

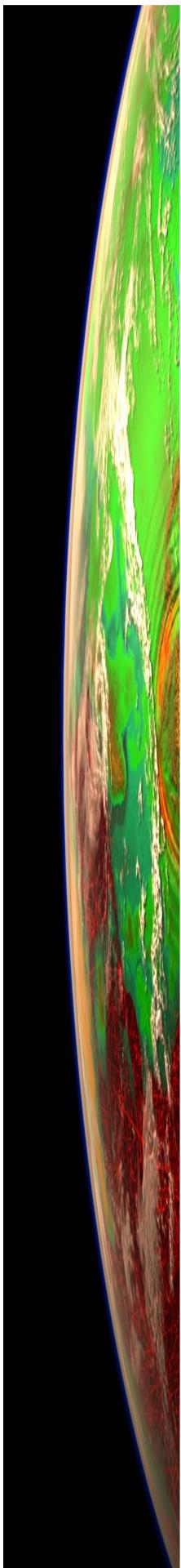
**QUantitative estimation of Earth's seismic sources and STructure**

# Initial Training Network – QUEST

## *fact sheet*



- 5 partners (2 industrial)
- 20 associated partners (EU, US, AU, JP, etc.)
- 8 PhD positions (3 years)
- 8 postdoc positions (1-2 years)
- Budget 5 MEuro
- 4-year project runs until end of 2013
- 6 scientific work packages
- Builds on SPICE project ([www.spice-rtn.org](http://www.spice-rtn.org))





## Related relevant EU-project projects

**NERA (2010)**  
Seismology & Earthq Eng.  
**ETHZ + ORFEUS/KNMI**  
**(D. Giardini; T. van Eck)**



**SHARE(2009)**  
Hazard/Risk  
**ETHZ (D. Giardini)**

**VERCE (2011)**  
IT & computational  
seismology  
**IPGP (J-P Vilotte)**  
ORFEUS/KNMI  
EMSC,...

**EPOS PP (2010)**  
**INGV (M. Cocco)**

**REACT (2011)**  
Rapid Response  
**GFZ (J. Zschau)**, EMSC,

**QUEST (2009)**  
(Training network)  
Computational Seismology  
**LMU (H. Igel)**

**COOPEUS (2012)**  
EU-US collaboration  
**Marum (C. Waldmann)**  
EPOS(ORFEUS/INGV)  
EarthScope

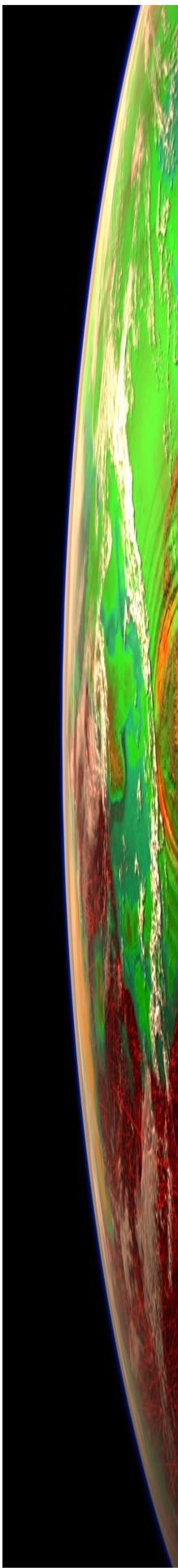
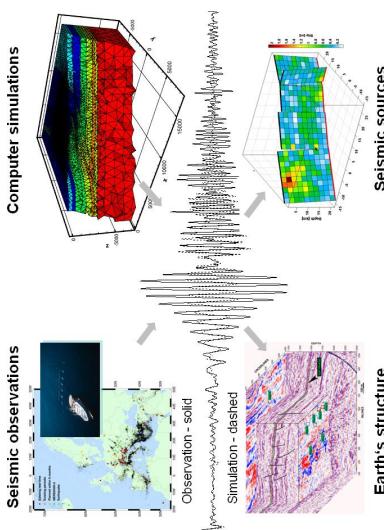
**EUDAT (2011)**  
ESFRI, IT computational  
Seismology/geophysics  
**CSC Finland (K. Koski)**  
EPOS (INGV)

**ENVRI (2011)**  
**ESFRI, IT standards**  
**UvA/LifeWatch (W. Los)**  
EPOS (ORFEUS/KNMI)

# QUEST - S&T Objectives

(in the contract ...)

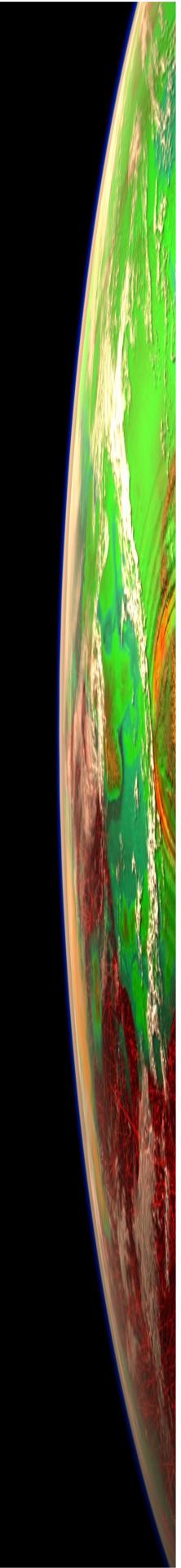
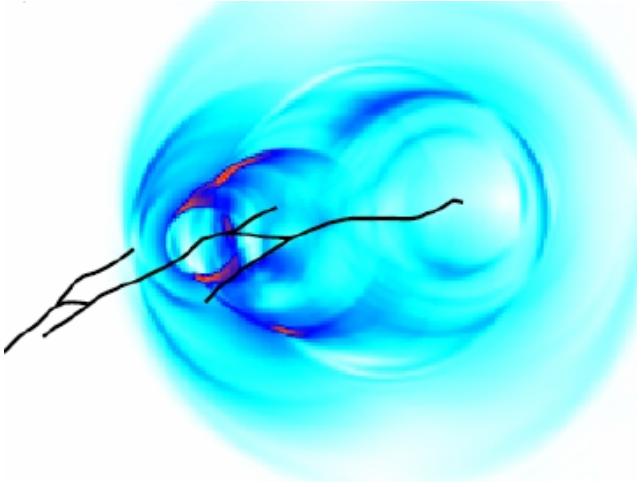
- ↳ Develop strategies to incorporate complete 3-D modelling into the tomographic imaging of Earth's structure and seismic sources on all scales (WP2, WP3, WP4)
- ↳ **Link Earth Science with High-Performance Computing experts** and make use of the European supercomputer infrastructure for seismic tomography (WP2, WP3)
- ↳ **Demonstrate the imaging power of full waveform inversion** through applications on a reservoir scale, volcanoes, active seismic faults, and planets (WP6, WP7)
- ↳ **Develop and apply novel approaches using passive imaging** that make use of virtual sources, investigate and broaden their domains of application on all scales (WP4, WP5, WP6)
- ↳ **Disseminate the developed methodologies and standards to the user community** through an open-source software repository and web-interfaced benchmark facilities (WP1)



# WP2 Forward Modeling

(**Leaders:** CUB, Bratislava + OGS Trieste)

- ❖ Research into all aspects of simulating seismic wave propagation and earthquake rupture
- ❖ Investigation of new mathematical approaches to wave simulation (e.g., homogenization)
- ❖ Providing a code library with benchmarking facilities (extension of SPICE library and benchmarking)



# WP3 High-Performance Computing (IPG Paris, LMU Munich)

Access to HPC training in  
Europa (see links on www)

Parallelization of  
computational tools



Seeking further funding for e-  
infrastructure in computational  
seismology (-> VERCE)

Science

- HPC
- HPC Training
- Jobs
- Events
- Library
- Mailing Lists
- Contact
- Shop

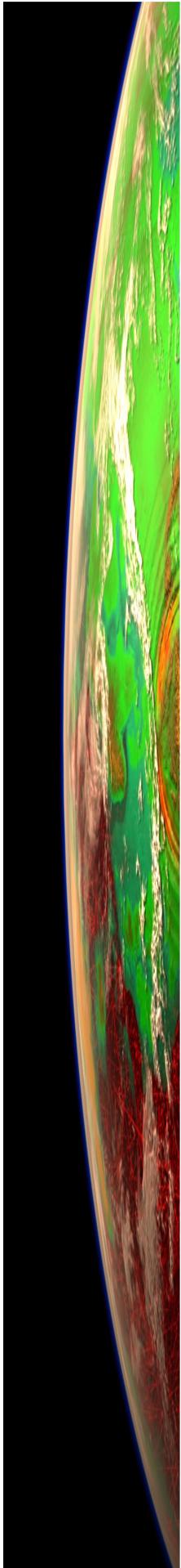
High Performance Computing in Europe

- <http://www.prace-project.eu/>
- <http://www.deisa.eu/>
- <http://www.hpc-europa.org/>

HPC Facilities in Europe

- Rechenzentrum Garching of the Max Planck Society, Germany
- Leibniz Computing Centre of the Bavarian Academy of Sciences and Humani
- High Performance Computing Center Stuttgart, Germany
- Barcelona Supercomputing Center, Spain
- European Centre for Medium-Range Weather Forecasts
- SARA Computing and Networking Services, The Netherlands
- Finnish Information Technology Centre for Science, Finland
- Edinburgh Parallel Computing Centre, UK
- Consorzio Interuniversitario, Italy
- Institut du Développement et des Ressources en Informatique Scientifique,
- CEA Computing Complex, Bures-sur-Yvette, France
- Joint Supercomputer Center of the Russian Academy of Sciences, MOSCOW,
- Swiss National Supercomputing Centre, Manno, Switzerland
- The Royal Institute of Technologies - Center for Parallel Computers, Stockholm

HPC Projects and Workshops (Europe & International)



# WP4 Inversion

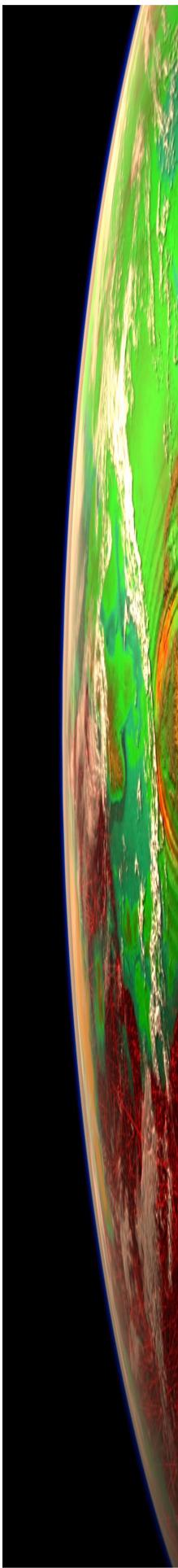
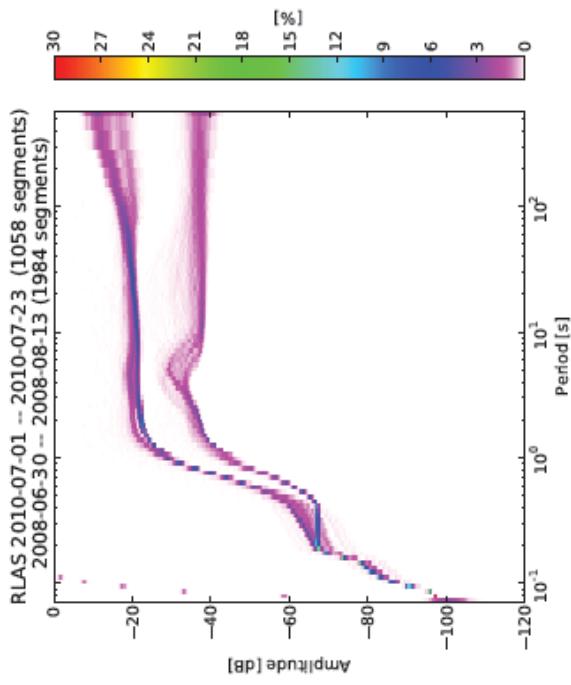
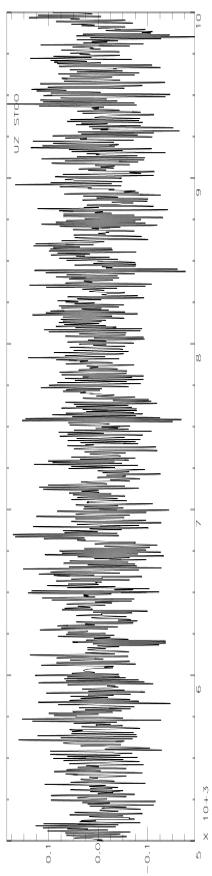
(Utrecht, ETH Zurich)

Advancing inverse  
methodologies

Exploring new observables  
(e.g. strain, rotations)

Extending passive imaging  
methodologies (noise  
analysis)

Improving waveform inversion  
work flows



# WP5 Industrial Applications

(Schlumberger Cambridge Research, Spectraseis Zurich)

- ❖ Application of full waveform inversion on industrial problems
- ❖ Passive imaging methods applied to industrial problems
- ❖ Wave simulations in complex reservoir situations

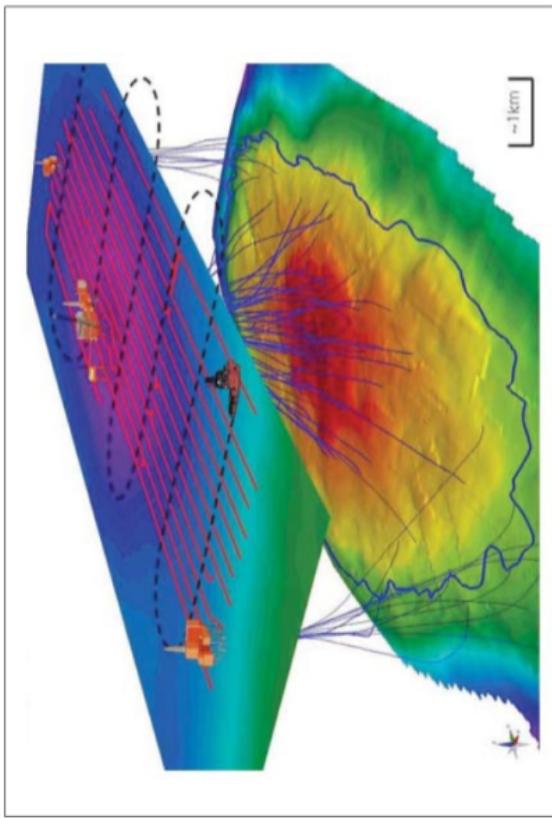
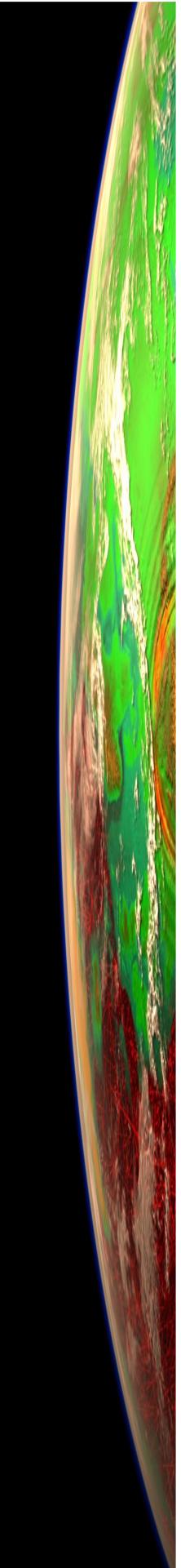


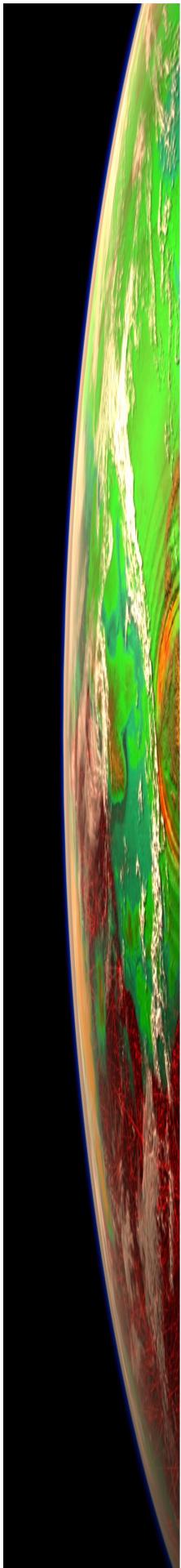
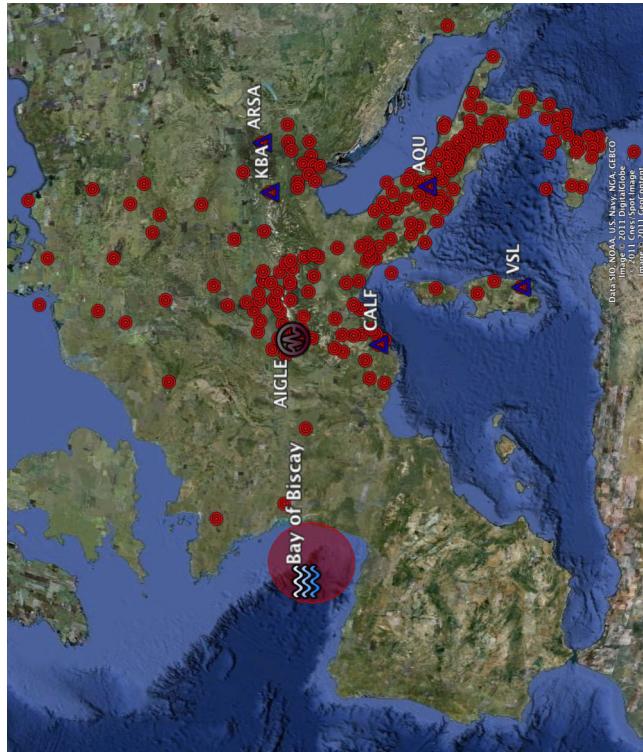
Figure 1. Overview of Valhall Field showing the layout of the geophone array at the sea floor (red lines), the top of the reservoir, the outline of the field (dark blue line), and the wells (thin blue lines).



# WP6 Tomography and Geodynamics

UEA, ETH Zurich

- ❖ Regional applications of tomography using real data
- ❖ Applications of tomographic structures for geodynamic issues

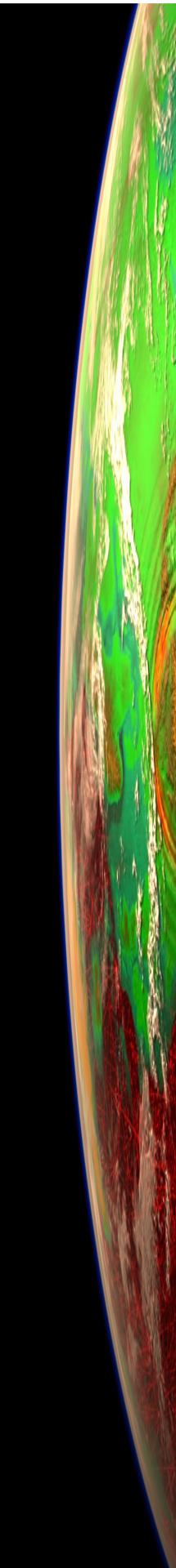
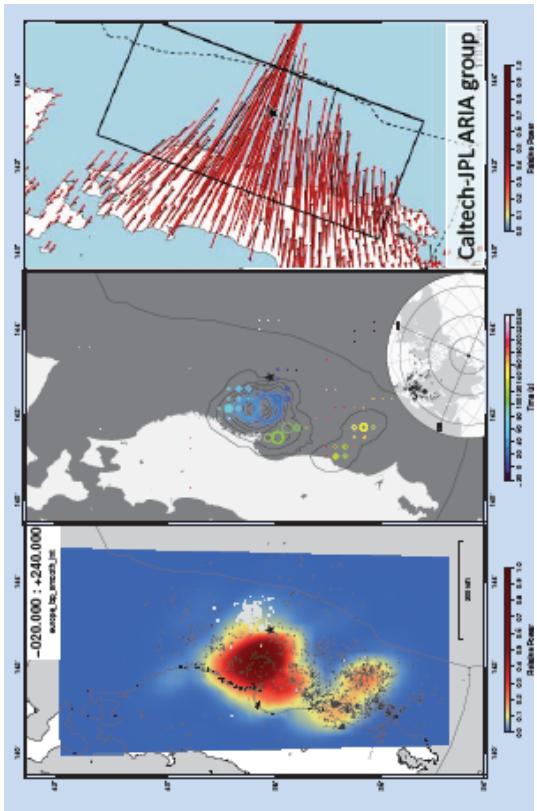


# WP7 Earthquake source (ETH, Oxford)

Understanding earthquake  
source processes

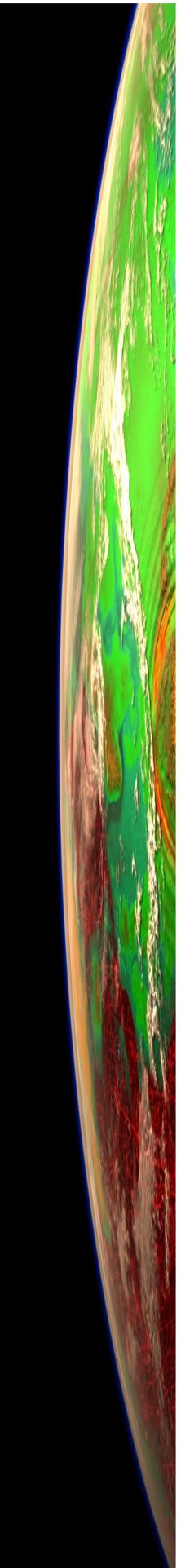
Inversion of waveforms for  
earthquake parameters

Simulating dynamic rupture on  
complex faults



# QUEST **Training** activities

- ❖ Annual 5-6 day research and training workshops
- ❖ Special sessions at international conferences (e.g., EGU, AGU)
- ❖ Additional training activities co-sponsored by QUEST
- ❖ Additional workshops on specific topics (e.g., uncertainties, ObsPy, tomographic model comparison, homogenization), coop. with CIG



# Workshop I – Sardinia 2010

- ↳ 110 participants (23 countries) in Capo Caccia
- ↳ Participants from US, Taiwan, Canada, etc
- ↳ **Tutorial on all QUEST aspects (processing, modelling, inversion)**
- ↳ Special training on GPU programming
- ↳ „What does it take to get a PhD“
- ↳ Software training 3-D wave propagation
- ↳ Programme and all presentations online
- ↳ QUEST movie (G. Nolet)



# Workshop II – Iceland 2011

- ↳ 110 participants (28 countries, 5 continents)
- ↳ Participants from US, Saudi Arabia, Russia, Taiwan, Australia
- ↳ Focus on **data analysis, probabilistic inversion, earthquake sources, and the geophysics of Iceland**
- ↳ Group practicals on various methods (prize awarded)
- ↳ „How to write proposals“
- ↳ Geophysical excursion (volcanoes and faults, geothermal fields)
- ↳ Dense programme with „Midnight Specials“



## Workshop III - Programme 2012 in a nutshell

**(Main topics:** Seismic tomography in all aspects, kernels, full waveform inversion (freq. vs. time domain), source problems

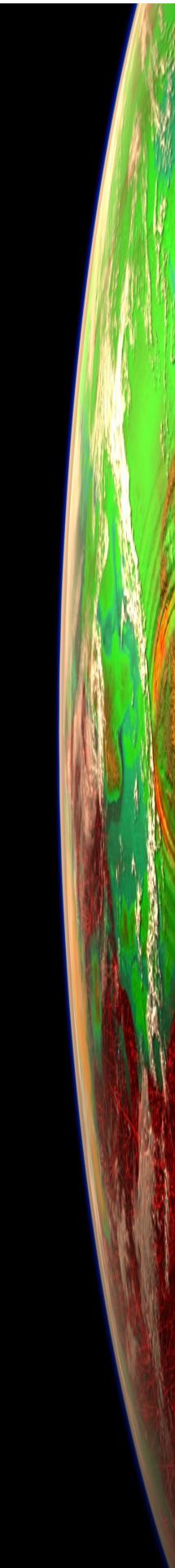
**Mon+Tue:** Presentations of the QUEST research

projects (self-organized), pub quiz

**Wed:** Poster session (part 1) and free afternoon

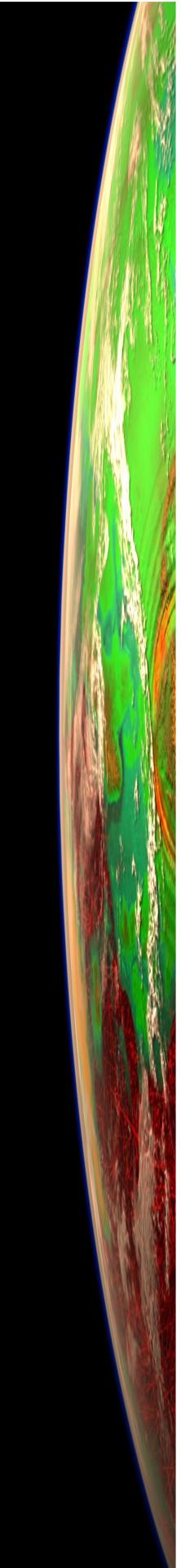
**Thu:** Kernels, full waveform inversion, practical, correlations, poster session (part 2)

**Fri:** New tomographic models, global and regional scale, e-infrastructure, football, conference dinner



# Highlights

- ↳ Prof. Montagner (lead scientist IPG) Gutenberg Medal 2010
- ↳ Prof. Campillo (lead scientist UJF) Gutenberg Medal 2012
- ↳ ERC Grants of partners and assoc. partners:
  - ↳ Prof. Campillo (UJF Grenoble)
  - ↳ Prof. Nolet (University of Nice, associated)
  - ↳ Prof. Romanowicz (Berkeley, also IPG, associated)
- ↳ Dr. Andreas Fichtner (WP leader) publishes book on waveform modelling and inversion (Springer)
- ↳ Dr. Andreas Fichtner receives Aki Young Scientist Award of the American Geophysical Union, 2011 (Prof. Prieto was winner of Aki Award 2010)
- ↳ Reid Awards by SSA (Romanowicz, Archuleta)

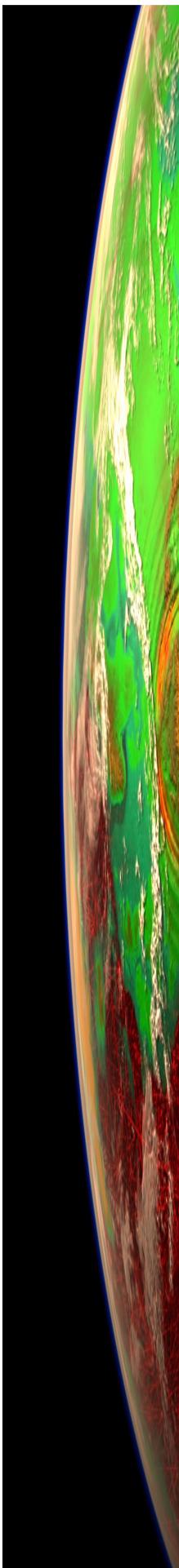
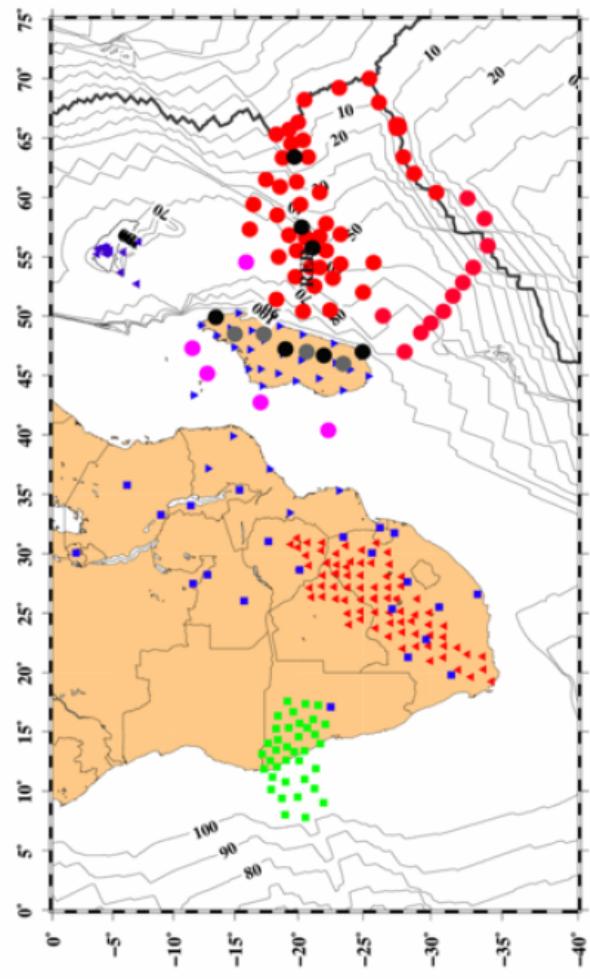


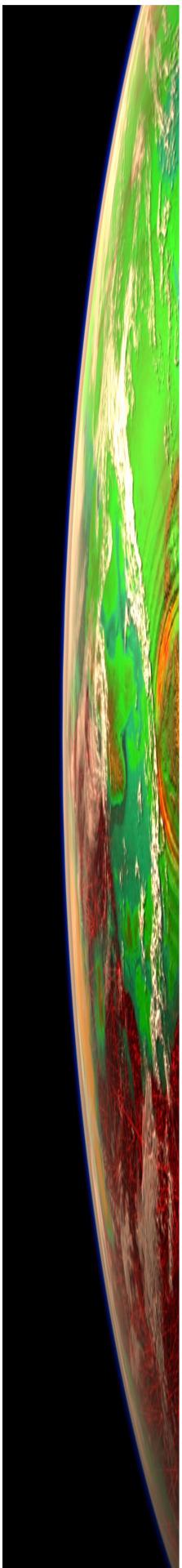
# Highlights

- RHUM project initiated by Dr. Sigloch (LMU), Dr. Barruol (Montpellier), Prof. Montagner (IPG), Dr. Stutzmann (IPG), Prof. Nolet (Nice)

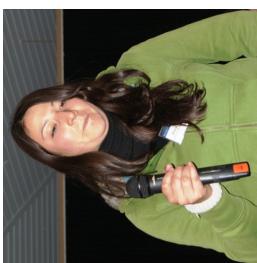
► RHUM: Réunion Hotspot Upper Mantle

► OBS Deployment in October 2012



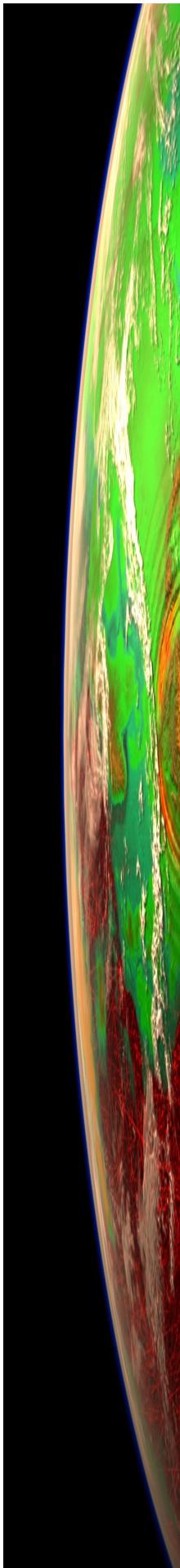


Lots of highlights when we see the  
project presentations of all  
researchers!



## Goals (personal – overall)

- ❖ Get feedback on your projects
- ❖ Find out everything about other people's projects
- ❖ Get inspired from projects of different nature
- ❖ Learn new methodologies (practicals)
- ❖ Improve your soft skills
- ❖ Think about, discuss, or discover big unsolved problems
- ❖ Find a new job
- ❖ Meeting someone you always wanted to meet
- ❖ Plan, schedule your next steps (with new colleagues?)



I wish you all an exciting, fruitful, inspiring workshop!  
Appreciate this special country, its people, culture, history, and  
nature!

Thank you!

