Second Meeting: 2-3 April 2014:
Host: Institut de Physique du Globe de Paris (IPGP)
1 rue Jussieu, 75005 Paris

Meeting record

Introduction & Welcome *(John Ludden, ESE and NERC-BGS)*

1. **Reaffirmation of the overarching aim: Creating a forum and a voice for earth sciences (ES) in Europe** (see detail of the breakout discussion)

2. **Presentation of the first output (draft document) "Earth Science for Europe"**

In general the participants agreed that this document had achieved the objective of providing a high-level vision for ESE. Further comments were requested and agreement to publish logos etc. Objective to have a digital version for EGU Vienna 2014.

3. **Infrastructure proposals – ESFRI and the EU list for Earth Sciences**

This group input to EC's consultation on ***Possible topics for future activities for integrating and opening national research infrastructures*** in October 2012.
http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=consultation
Of 7 proposed topics, 6 from the solid ES community were approved and some of these have already translated into topics for starting communities under the H2020 Research Infrastructures call:
INTEGRATING AND OPENING RESEARCH INFRASTRUCTURES OF EUROPEAN INTEREST
H2020-INFRAIA-2014-2015
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/calls/h2020-infraia-2014-2015.html

The state of preparedness and ongoing activities (short maximum 10 minute presentations from: EPOS, EMSO, EGDI, ECORD, Research Drilling, Crustal fluids, Geochemistry, etc

It was agreed that a letter should be written to the EC to indicate the ES community's appreciation and intention to respond to the calls. **ACTION: Chair**

4. **Workshop on an Ultimate Earth Model/Project**

Inspired by the success and general objectives of the **Human Brain Project**
https://www.humanbrainproject.eu/en_GB

In this second meeting the focus was primarily on the science challenges that can be addressed in global earth sciences models. Our aim is for our community take a globally leading position in an "**Earth Model/Project**" possibly broadly based on the "Our focus is specifically the solid Earth and its interactions with its envelopes. An "**Ultimate Earth**" was proposed **(see Annex 1).**

5. ***Breakout discussions***

Wrap up and next steps

I. The Ultimate Earth; task force to be appointed (writing team separate meeting)
II. EarthScienceEurope: its role and future governance
III. Ongoing actions and reports

Breakout Group reports

Group A
Key questions posed:

1. **Mission, goals and role of EarthScienceEurope – do we need it?**
2. **"The Ultimate Earth"**
   What is it? Should it be a goal/virtual target? A key integrating factor? The driver to understand resource formation and the processes controlling natural hazards?

Group 1
Raporteur 1: Massimo Cocco

1 - Mission & Goals of ESE

- *To coordinate the activities and initiatives to strengthen, to unite and integrate the ES community.*
- *Capacity building for solid ES in Europe.*

The group believes that the Mission and Goals should be emphasized when disseminating the Brochure later this year and further circulating the subsequent Roadmap text in 2015.

2 - An overarching program for ESE
The group believes that "our genome project" can be summarized as: "Living on a dynamic Earth"
ESE should not be seen as a new big project to be funded, it should foster cooperation between existing and future projects and by providing a multi/inter-disciplinary perspective for ES and scientific vision for the future and

3 - Stakeholders
The Group believes that it is important to identify the key stakeholders for ESE and to this task proposes:

- *Scientists/academia (including young researchers and students - training and education)*
- *Funding agencies (including governmental agencies)*
- *Private sector (including SMEs and industry).*

4 - Key Pillars
Two key pillars defining ESE were identified:

- *Science Drivers (questions/challenges)*
- *Data & Research Infrastructures, (enablers of research)*

As Science Drivers we propose several key challenging scientific questions (see below).
ESE should promote and support coordination and collaborations between existing (e.g. EPOS, OneGeology, ECORD, ICDP, IODP, CCS, EMSO, ...) and future RI and programmes.

The group believes that a new document more science driven entering more in detail on the key scientific challenges should be produced in one year.

5 - Present Landscape
The group believes that it would be useful to map the involved initiatives, projects, programmes. We also propose formal commitment (such as a Letter of Intent) to corroborate the support to ESE and declare a commitment to contribute to its capacity building.
We foresee the need to implement the Earth Science Roadmap through a Strategic Document.

Raporteur 2: Wim Spakman
Big questions: Habitability of a changing planet
Human society is impacting on the habitability of its natural environment. We change Earth's surface in a pace faster than that of natural processes. We utilize the subsurface for public infrastructure and rapidly exhaust the known mineral and energy resources that have been stored for millions of years in Earth's interior. These activities are often at risk from natural occurrence of solid-Earth disasters and may even create new risk of triggering earthquakes or massive landslides. The need for a sustainable

supply of energy and for a wide range of, meanwhile scarce, raw materials defines global societal urgencies. Steering the future habitability of our changing planet demands for novel energy solutions, novel resource exploration strategies, and novel assessment of the multiple risks posed by the active (sub)surface. These targets are all part of the many big questions of modern Earth Science, e.g.,

1. What processes of the Earth's interior lead to the formation and preservation of georesources? How can we learn from that to develop exploration strategies for new finds of commodities, hydrocarbons, and accessible geothermal energy in the uncharted deeper crust?
2. What is the dynamic state of Earth's surface? How do processes at depth couple with surface processes in shaping Earth's surface topography at present and in the geological past? How can we determine the interaction between human-induced and natural processes that ultimately affects surface stability?
3. How do Earth processes couple across large temporal and spatial scales and eventually culminate in the sudden release of stress during an earthquake? How can we quantitatively integrate geological, geochemical, seismological, geodetic, and experimental laboratory observations in the local studies of fault processes and earthquake physics, or of volcanic activity?
4. Addressing such questions unavoidably requires deep research into the workings of our planet in past and present, i.e., of research addressing grand questions like:
    - How does our planet's interior work and how did Earth evolve from its early formation until its present-day complexity?
    - Why is Earth so different from other planets?
    - How and where did life begin?
5. Humans have the ability to change the Earth's surface increasingly rapidly. We need to understand the forcing and feedback effects. To "define Earth's fitness".

Where does European Earth Science stand?

Since the great discovery of plate tectonics, only half a century ago, Earth Science has greatly expanded and matured into many subfields. High-level research into our planet's dynamic evolution and its present-day state now integrates the geological past with present-day deep structure and active processes. This underpins the research ambitions for reaching the targets of assessing habitability risks of an active planet and of providing a sustainable future supply of geo-resources and –energy. Reaching these big targets is dependent on acquiring the necessary observations and on the availability of state-of-the-art European research infrastructure.

Modern gravity and geodetic satellite missions provide crucial data on the active planet, but no satellite can look into the Earth and map the processes underpinning surface change or map the deeply hidden, yet to be discovered, resources. Therefore, Earth Science predominantly depends on labour-intensive observation at the Earth's surface comprising, e.g., seismological observation, deep crustal drilling, geological observation, or detailed observation of surface change. This is supported by a vast range of laboratory experiments on materials and natural rock samples that contain crucial information on Earth's evolution, on geological processes, and on material behaviour in the deep Earth as well as in actively deforming fault regions or in hydrocarbon reservoirs. Earth observation is fundamental for seismological imaging to map the internal structure and composition, for geodetic modelling to map the deformation of the active surface, for geological modelling to reconstruct the evolution of the crust and surface, and for laboratory and numerical modelling to simulate the key Earth processes driving planetary change from global to local (reservoir; deposits; active faults; subsurface infrastructure) scales.

The modern big questions we address are intertwined and no single sub-field of Earth Science can solely provide the answers. Their resolution strongly demands for developing multidisciplinary research efforts involving scientific expertise and investments from all across Europe. This is stimulated by the Earth Science Europe initiative that builds on our current accomplishments in European collaboration and will crucially depend on the European-wide sharing of research- and data infrastructures that is now being constructed into EPOS and which involves European universities, research institutes, and national Geosurveys.

Group B
Raporteur: Anselm Smolka
Key issues raised by group

- Visibility: The ES Community need a body to represent them in Europe, to do this ESE will need a mandate from the community itself, and must include all sub-disciplines.
- Organisation: We need overarching RI, cf. EPOS for a wider breadth of disciplines. Need a clear vision and common target. An integrating project such as the Human Brain? **The Ultimate Earth?**
- Strategy: Must show clear societal impact.

Discussion and next steps
Key issues raised

- Project proposals must remain bottom up, not top down from this group. Although ESE "plan or vision" could endorse the proposals/add weight
- Must ensure clear representation of the whole ES community
- Form? Board/ Forum, issue : bureaucracy
- Issues – clarify position to community, and relationship to projects and RIs.
- Must seek to gain recognition and credibility
- Solid earth first. We need to self-organise before we can interact with other communities e.g. Atmospheric scientists, Biologists etc.
- Who do we include – projects/programmes/RIs (list to be populated)
- Aim – to promote ES in Europe and the value of ES to Europe.
- Seek sponsors? ESF? At present ESE is self-funding activity.

Meeting Conclusions and way forward

Issues: must ensure that ESE is fully representative of the ES community (invitees groups listed Annex 2, gap analysis is essential)

EC communication
A 2 page communication to the EC to be compiled, to thank them for the opportunity to respond to the Consultation on Research Infrastructures and topics for integrating activities indicating the community's intention to respond to the current Horizon 2020 Infrastructures call: H2020-INFRAIA-2014-2015 and updating them on progress with ESE.

Brochure – launch by end of month, approved. Comments requested by COP 7 April, critical for May 2014. Met with overarching approval. **Action: All**

Follow up
A more detailed science document (or Roadmap[1]) by May 2015

Next meeting: Autumn 2014.
"Defining the Roadmap*" venue tbc.

Organisation ESE
John Ludden (Remains Chair ESE: 2014-15)
Writing Team: Sean Willet, Wim Spakman, Massimo Cocco, Anselm Smolka, Gilbert Camoin.
Coordinator: Vicky Hards

Our community MISSION:

[1] ***Roadmap: a plan or guide for future actions to achieve/reach a goal.***

To make new discoveries and inspiration to better understand the history and internal dynamics of our planet, and to provide society with data, knowledge better manage and live more wisely on our planet.

Our aim
To establish an Earth Science Forum or Board, an umbrella to represent the whole ES community, recognised by both the ES community and the EC. The relationships between this and individual ES initiatives need to be fully transparent.

Our strategy: To self-organise as a forum to represent [solid] earth science and scientists in Europe on the world stage, and to prepare a road map* and to work with other likeminded communities.

Vicky Hards
ESE Coordinator
08 April 2014

Annex 1

The Ultimate Earth seminar

The key questions:

- How can earth science data contribute to earth system models in terms of the solid earth component underpinning these models and can we in Europe lead on this thinking?
- How do we as a European community contribute to global models? Global strain models, global sedimentation, global volcano models, deep Earth models, palaeoclimate etc.?
  Clearly this must integrate data from many sources, but it could be the definitive global model for the solid components in the Earth that no one has taken leadership of to date and may be a defining step.
- How can we engage with private sector sponsors and the EC to underpin this sort of knowhow?
- What should be the form and role of this group? Do we need EarthScienceEurope?

Global Earth Models - presentations

Initial discussion of the concept and how Europe might contribute, followed by ..
Individual presentations by invited speakers

1. Global Earthquake Model & Global Volcano Model *(Anslem Smolka)*
2. Global strain rate model *(Richard Walters, Leeds University)*
3. OneGeology Global *(Marko Komac)*
4. Global stratigraphic models and industrial applications *(Andrew Davies, Neftex)*
5. Global seismic tomography *(Jean-Paul Montagner, IPGP)*
6. Global plate tectonics and geodynamics *(Carmen Gaina, CEED, University of Oslo)*
7. Global metallogeny, and georesources *(John Ludden)*
8. Paradigm shift in the orientation of geosciences R&D programs: the RGF example *(Patrick Landais, BRGM*)
9. A new ECORD in a new IODP *(Gilbert Camoin, CEREGE)*

Presentations can be found at www.earthscienceeurope.org

Annex 2

The ESE Community – invited groups 2014[2]

ERC Grantees - scientists

ESFRI
ESA
JRC
EGU European Geosciences Union: Scientific Divisions and Division Presidents
EAG
Science Europe
EGS - Expert Group Chairs
EFG - European Federation of Geologists

Projects/programmes
EMSO: the European Multidisciplinary Seafloor Observatory
The Deep Carbon Observatory
EDGI
GEM
GMES
GEO/ GEO European Projects
IODP
ECORD (the European Consortium of Ocean Reseach Drilling)
ICDP The International Continental Scientific Drilling Program
The Deep-Sea and Sub-Seafloor Frontiers project (DS3 F)
TOPO-EUROPE
EPOS
TOPO-IBERIA Research Initiative
AlpArray

Research Council Delegates - representative of national funding agencies across Europe

Earth Science National Labs
- ICTJA Institut de Ciències de la Terra Jaume Almera
- Utrecht University
- Polish Institute of Geophysics
- TNO
- INGV
- CNRS
- GFZ

Helmholtz centres
ETH, Zurich
Institute of Geophysics, Acad. Sci., Prague

Industry
EAGE European Association of Geoscientists and Engineers section leads
ETP Sustainable Mineral resources (SMR)
EUROMINES
Total
SHELL
BP
Willis Global Analytics

[2] Representatives off all these associations/bodies/groups were invited. Participation in this meeint was obviously more restricted.

VATTENFALL
Anglo American
Nordic Mining
Eureau (European Water)
AREVA
ANDRA
Neftex