A solid foundation for earth sciences: EUDAT interviews Massimo Cocco of EPOS

Massimo Cocco is a Director of Research at the National Institute of Geophysics and Volcanology, Department of Seismology and Tectonophysics, Rome. His research interests are focused on the physics of earthquakes and faults. More specifically, his work deals with earthquake dynamics and fault interaction, seismicity patterns and fault frictional properties. He is interested in both theoretical studies and observational research. He has interests in all aspects of the mechanics of earthquakes and faulting from observations of natural faults through geophysical and geological measurements to experimental faults at the laboratory scale. His expertise also covers the management of seismic networks and monitoring research infrastructures. Massimo is presently coordinating the preparatory phase of a European project named EPOS: European Plate Observing System.

Good morning, Massimo. First of all, would you please explain what EPOS is - it stands for the European Plate Observing System, doesn't it? But what exactly is plate observing - I guess you don't mean you spend a lot of time in restaurants watching the crockery?

The European Plate Observing System (EPOS) is a long-term plan to facilitate the integrated use of data, models and facilities from distributed national research infrastructures for solid Earth science in Europe.

By providing an integrated solid Earth Sciences research infrastructure, giving researchers better access to a wider range of Earth Science data and tools for working with that data, EPOS will help the Earth science community to provide answers to important societal questions concerning geo-hazards and those geodynamic phenomena (including geo-resources) relevant to the environment and human welfare. For example, providing earlier warning on earthquakes or predicting sea level changes sufficiently in advance that preventative measures can be taken.

Well, it certainly sounds like EPOS is supporting research that is really useful. Now, you mentioned that EPOS is the integrated solid Earth Sciences research infrastructure in Europe - what does that mean in practical terms?

EPOS represents a scientific vision and approach in which innovative multidisciplinary and cross-disciplinary research is made possible by integrating research infrastructures belonging to solid Earth science observation and related Earth system modelling. This is all done with the final goal of a better understanding of the active processes on Earth: those controlling earthquakes, volcanic eruptions, unrest episodes and tsunamis, as well as those driving tectonics and Earth surface dynamics.

EPOS aims to build an efficient and comprehensive research platform for the Earth sciences in Europe relying on new e-science opportunities through the construction of a distributed e-infrastructure (EPOS Core Services).

And what does it actually mean to be a research infrastructure? What is the EPOS infrastructure aiming to provide and do?

According to the Horizon2020 Work Programme, research infrastructures are “facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. Where relevant, they may be used beyond research, e.g. for education or public services. They include: major scientific equipment (or sets of instruments); knowledge-based resources such as collections, archives or scientific data; e-infrastructures, such as data and computing systems and communication networks; and any other infrastructure of a unique nature essential to achieve excellence in research and innovation. Such infrastructures may be 'single-sited', ‘virtual’ or 'distributed'.

EUDAT receives funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 654065.
EPOS is, indeed, all these. EPOS actually integrates more than 250 national research infrastructures for solid Earth science in Europe with the mission of enabling seamless access to pan-European data and services. EPOS will develop a holistic, sustainable, multidisciplinary research platform that provides co-ordinated access to harmonized and quality-controlled data from diverse Earth science disciplines, together with tools for their use in analysis and modelling.

By accomplishing its mission, EPOS will make cross-disciplinary research easier and promote the development of new research concepts and tools, as well as empowering researchers to address the origin and nature of geo-hazards and geo-resources – thereby safeguarding our environment and the welfare of our societies.

EPOS is a tool to make integrated use of data, data products, software and services (including laboratories) provided by different research infrastructures operating in the solid Earth science domain. Hence EPOS is not only a portal to domain-specific (thematic) datasets for download: EPOS is this, and much more.

The ambition of EPOS is to overcome the general difficulty researchers face when using a wide diversity of data and data products to do their research, by providing a simple, “one-stop shop” tool. If a researcher tries to find or work with some data they end up having to deal with a lot of complex aspects:

- **complexity of offerings**: data, data products, software, services (e.g. facilities including computing) that can be provided by institutions, national centres, or Thematic Services to the EPOS system;
- **complexity of users**: users role will be dynamic (the user can also be a data provider, a data consumer, a service provider/manager etc.) and associated to different authorities and responsibilities; a user can have personalized preferences (e.g. mobile, laptop);
- **complexity of usage**: including issues as data ownership and Intellectual Properties (data, software, publications), permissions of use (data, software, facilities including computing), conditions of use (licence, acknowledgement, citation, payment and constraints on further actions); and
- **complexity of requests**: a request can be considered as a function of user, data, software, or facilities with constraints which are – in the real world – very complex.

The integrated EPOS environment will deal with all of this in place of the researchers, which will make it much easier for researchers to perform various actions. EPOS is not going to be providing yet another tool to browse and download data! EPOS is more than data download, data mining, and data discovery. Our goal with EPOS is to provide an integrated environment where the user can browse, preview and/or select data, and then simply download the desired data or perform processing and modelling directly online.

This means that researchers are not going to have to deal with all the complex issues mentioned previously, and that the EPOS system is not just a duplication of already existing services (which mainly deal with data browsing and downloading).

**Wow! That sounds brilliant! What kinds of data services are actually needed in the Earth Sciences for the purposes of data sharing and so forth?**

The main goal of the EPOS e-Infrastructure, whose main “centralised” components are the INTEGRATED CORE SERVICES (ICS), is to integrate data (data discovery and download), processing and visualization services. To reach this ambitious goal the following modules are envisaged:

- AAAI,
- data identification and retrieval,
- a system to move data to processing centres or code to data centres, and
- HPC and HTC processing.

Note that we do not intend to reinvent the wheel, so some of these services might be outsourced or run by other EUDAT receives funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 654065.
Massimo, what kind of institutions, departments or computer centres are involved in EPOS and how are they all linked together?

EPOS integrates more than 138 diverse institutions (universities, research institutions, and organizations) covering the whole gamut of solid Earth science research from seismology to volcanology, and from geology to geodesy, including experimental facilities. One can get an idea of the number and typology of them from RIDE. EPOS is also linked to international initiatives as ORFEUS/EIDA, EUREF, EPHER, and institutional nodes which deal with seismological and GPS data and which are now included in the EPOS demonstrator.

Most of these institutions are cooperating at a national level by creating consortia or similar entities. Many of them are beneficiaries of the EPOS PP grant agreement. All institutions are cooperating at a scientific level by participating in the various EPOS thematic services. Importantly, EPOS is going to create a legal subject (ERIC) that will link all the participating partners.

So EPOS consists of an impressive number of different groups and centres working together as a single research community focussing on earth sciences, and you are all working together to establish the necessary hardware, software and personnel so that earth sciences data can easily be shared between researchers in different places across Europe. I understand that in order to help achieve those aims, EPOS has joined EUDAT. How will being part of EUDAT help EPOS to attain its goals?

EPOS is very interested in the developments of EUDAT since it is designing and building its own e-infrastructure. EPOS ultimately aims to provide all researchers with basic e-science services relevant to solid Earth science, and to exploit the “core services” provided by EUDAT to build a robust e-infrastructure that uses state-of-the-art technologies for tasks as diverse as data staging and data replication, the implementation of AAI procedures and adoption of metadata and persistent identifiers. The adoption of EUDAT’s IT solutions is important for EPOS as it will ensure optimum standardization across the participating sub-communities within the solid Earth sciences. EUDAT can provide IT solutions that would be difficult for the solid Earth sciences community to provide on its own.

Now, I’ve heard that EPOS is approved by the European Strategy Forum on Research Infrastructures (ESFRI) - what does that mean in practical terms?

ESFRI, the European Strategy Forum on Research Infrastructures, is a strategic instrument created in 2002 by the Member States and the European Commission to develop the scientific integration of Europe and to strengthen its international outreach. ESFRI gives national authorities the opportunity to explore common and integrated activities for the best development and use of Research Infrastructures of pan-European relevance.

In 2004, the Competitiveness Council mandated ESFRI to develop a strategic roadmap for research infrastructures in Europe. The ESFRI roadmap is an ongoing process. First published in 2006, with 35 projects, it was updated in 2008 (when EPOS was included) bringing the number of RIs of pan-European relevance to 44. The latest update focusing on projects dealing with energy, food and biology was published in December 2010. Having identified 48 projects of new research infrastructures (or major upgrades on existing ones) so far, ESFRI will focus more on their implementation for the next few years. The next update of the roadmap will be carried out in 2015.

In its conclusions of 26th May 2014, the Council acknowledges the work done by ESFRI to identify three priority projects (EPOS is one of those three) which are mature enough to be under implementation in 2015-2016 and whose timely implementation is considered essential to extend the frontiers of knowledge in the fields concerned.

The Commission also defined how these priority projects will be supported in the framework of Horizon 2020 to
develop new world-class research infrastructures. The first support action will be implemented under the call INFRADEV-3-2015. A total budget of about 90 million € will be allocated to this action.

You can see that EPOS has been more than approved by ESFRI! EPOS has been prioritised for implementation which, in practical terms, means that EPOS can apply for the INFRADEV-3-2015a call to be funded with 15-20 million € for its implementation phase.

Thanks Massimo! That all sound great and we’ll be looking forward to the implementation of EPOS in the near future!