The European Near Fault Observatories and the EPOS IP project: a long and exciting journey for a young and ambitious community

Lauro Chiaraluce
TABOO - NFO | INGV, Italy

Gaetano Festa
IRPINIA - NFO | Unina, Italy

Becoming one of the Solid Earth Science thematic communities in EPOS has been a real challenge for young groups so far entirely devoted to research activity with almost no experience in service creation and provision. But we are proud that we have made it!

Crustal faults are complex natural systems whose mechanical properties evolve with time. Thus, the understanding of the multi-scale physical-chemical processes responsible for earthquakes and faulting requires considering phenomena at the boundaries between different research fields. This is the investigation philosophy (we called road of integration - https://www.epos-ip.org/near-fault-observatories-europe-road-integration...) we pursue through our Near Fault Observatories (NFO), consisting of advanced research infrastructures based on local and dense networks of multi-parametric sensors continuously recording high resolution near fault data related to Earth instability processes over a broad time interval.

At the end of the EPOS-IP project we are able to provide virtual access to such valuable data and derived high quality scientific products through newly implemented services relying on a pan European network of federated in-situ observatories.

The NFO-TCS in EPOS consists today of seven NFOs, operating on different tectonic regimes and different areas of Europe. They include the South Iceland Seismic Zone, the Marmara Sea (Turkey) and the Corinth rift (Greece) at plate boundaries, the Alto Tiberina and Irpinia faults in the Italian Apennine mountain range, the Valais region in the Alps (Switzerland), and the Vrancea fault in the Carpathian Mountains (Romania). These observatories monitor all kinds of faulting mechanisms, high to low angle faults, experiencing shallow and deep earthquakes, fast and slow strain rate accumulation. All the fault zones can generate large earthquakes (M>6) posing substantial to great earthquake hazards. Two of the zones, Marmara Sea and Corinth, are under ocean causing additional tsunami hazard and steep slopes and sediment-filled valleys in the Valais give rise to hazards from landslides and
liquefaction. The active volcanoes flanking the South Iceland Seismic zones also bring the added dimension of volcano-tectonic interaction and natural geothermal activity.

Thus, the focus of the Observatories varies responding to specific scientific objectives and consequently the typology of produced data is distinctive. This TCS makes a large set of data and scientific products available now through both a community service named FRIDGE (NFO Federated Specific Data Gateway) containing NFO Specific Data and services pertaining to other communities (e.g. ORFEUS for seismic data and GLASS for GNSS ones) for raw data, thus befitting from community-shared approaches for Standard Data.

NFO Specific Data are data collected in situ through small-scale and specific monitoring networks (e.g. electro-magneto telluric, geochemical, gravity, strain-tilt-meter and other multidisciplinary data including borehole data) not having yet a proper reference community and/or not having a well-developed and described format and metadata. They include as time series derived from geochemical data (like Carbon dioxide and Radon) and high resolution scientific products (like VP/VS time series). The Specific Data are now available on FRIDGE, that is the community portal hosting web-service making these data findable and available bridging the NFO databases with a main federator.

This virtual initiative will soon be complemented with the availability of physical access to the NFO facilitating state of art scientific exchanges and international field experiments. NFO have in fact the expertise in non-conventional instrumentations (e.g. extensometers, strainmeters, fluids flux measurements) at surface and within boreholes. This educational environment also represents a big opportunity for implementing and customizing new high resolution and possibly cheaper instruments implementing the competitiveness of EU small and medium enterprises (SME) in the technological market.

Thanks to a big interoperability effort between our IT community and the EPOS ICS group, all the NFO data will be also available on the EPOS portal together with the data of the other TCS.

The NFOs are ideal environments to test new codes for near/real time analysis of different kind of data that one day will definitively help the decision makers to ground their actions. In this framework, we are developing the NFO Testing Centre for Early Warning & Source Characterization (acronym: CREW). CREW is a testing facility designated to compare methodologies and software for real-time monitoring of faulting processes. Today, CREW is operational in real-time mode for Earthquake Early Warning (EEW); it receives the data in real-time mode and, when an earthquake occurs the systems provide alerts, analyze and compare results and publish the statistics about software performances.
NFO can be seen as the incubators of the next generation monitoring systems when less expensive technology will allow the communities the deployment of a very large number of multisensor stations at local scale. In the meantime, by collecting and making accessible in standardized formats high resolution and integrated data banks originated at the different NFOs, the diverse stakeholder’s community will have the opportunity to look with a comprehensive multidisciplinary approach at the deformation, faulting and earthquake generation processes. That is why FRIDGE already hosts simple visualization tools, representing a first prototype of a great scientific opportunity of generating new expertise on multidisciplinary data integration, creating tools for next generation multidisciplinary combined routine data analysis.

The NFO community is now facing the signature process of the Consortium Agreement (CA), the common agreement opening a new phase in terms of governance architecture, community coordination and organization. The Consortium will be composed by a Consortium Board (CB), an Executive and Service Committee (ExC and SeC) and the Advisory Board (AB). The CB will be the decision-making body and will replace the interim board. The CB is composed by one representative from each Party; the community agreed to have one vote per NFO, but as many Parties per NFO as required by the NFO governance structure. The ExC will manage daily activities of the NFO -TCS, supervise the execution and implementation of the Work Program and of CB decisions. ExC will also manage progress reports from NFO- TCS committees and propose a Work program each year based on the recommendations within the reports. The SC will monitor the Services performance and eventually plan their implementation. The AB will support the community building, advise the CB on the development of the Work Program, provide user perspective on the services, advise on future development, and suggest priorities to further extend the services. The signatory phase will be finalized within the next couple of months, this means that early 2020 we will start defining the new strategic directions of the community including future common projects and the implementation of new services.

Ultimately, at the end of the EPOS-IP project, we are also working to enlarge the community. Few weeks ago, we had a plenary meeting to discuss the outcome of the project and that was the opportunity to host colleagues representing research infrastructure interested in joining the group. The meeting was held in Postojna (Slovenia) and there we had a series of communications introducing new potential NFOs: Postojna Caves Observatory in Slovenia, North-Eastern Italy Thrust Faults Observatory and West Bohemia Observatory, a joint Czech and German effort. The possibility to embrace these new, diverse and complementary sites would really mean making a big cultural and scientific step forward. However, their inclusion will also allow for a partial change in the leading team that have been
working so hard in the last five years. This expansion would boost the community, introducing new skills and data availability, all strategic actions for a better future of the NFO people.

*NFO Virtual Laboratory Concept - Virtual access to a dissemination and exploitation platform for online engagement and knowledge-sharing initiatives dealing with multidisciplinary high-level products and services describing the anatomy of active faults and the basic causative physical processes generating earthquakes. Storing and making available all the existing geo-referenced information related to the monitored areas is a fundamental activity for the learning sector at all levels upon which building educational experiences for both the students and population.