D9.4 Report on Use Cases, Requirements, Metadata and Interoperability of WP 9

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1. Introduction

Near Fault Observatories (NFOs) are advanced multidisciplinary research infrastructures, based on multi-parametric networks, that monitor the chemical and physical processes in and around active faults matching the largest possible data and information related with earthquake generation (*https://epos-ip.org/near-fault-observatories-europe-road-integration-why-do-we-need-nfos*).

These networks usually complement regional infrastructures (a typical station configuration in an NFO has a spacing of 10km to a maximum of 60 km) with high-density distributions of seismic, geodetic, geochemical and geophysical sensors surrounding the geological structures where large earthquakes are expected in the future. NFOs have also related acquisition centers and laboratories where learning best practices in diverse sensor design and installation, in multi-disciplinary data analysis, and in advanced methods for real-time data processing.

The NFO-TCS (WP9) presently coordinates the effort in terms of data, data products and services generation, standardization, implementation and usability as well as community building. Seven European Near Fault Observatories (NFOs) are included so far in the EPOS initiative: the Alto Tiberina (TABOO) and the Irpinia Near Fault Observatory (both in Italy), the Corinth Rift (CRL, Greece), the Valais (Switzerland), the Vrancea (Romania), the South Iceland Seismic Zone (SISZ; Iceland) and the Marmara (Turkey) Observatories.

Three of the NFOs operate near plate boundary systems at South Iceland Seismic Zone, the Marmara Sea and the Corinth Rift. Two of them, Marmara Sea and Corinth, include offshore seismic sources that pose an additional tsunami hazard. While CRL and Marmara manage and coordinate international networks (Table 1), others are organized as national networks. Table 1 lists the names of the NFOs and their reference persons, to contact. The inventory is given in Table 2.

Each NFO provides raw data, coming form their multidisciplinary dense networks and high-level scientific data products. Data are classified as standard and specific. Standard data (e.g. seismological and geodetic) are data having well known format and metadata as well as defined or under implementation their own services for data discovery and distribution (e.g. EIDA): these services are also ready to be shared using in-place or easy-to-develop solutions. While NFO specific data (e.g. geochemical data) need definition, format and metadata and the establishment of new services for discovery and dissemination. The organization chart (Figure 1) shows the data and service providers contributing to this TCS, providing a variety of DDSSs.

This deliverable reports the status of TCS-ICS integration of TCS WP9 and prepared by the contributions of all seven NFOs within WP9 (Table 1). 46 DDSS (Data, Data Product, Service and Software) elements have been proposed. All elements are related with continuous acquisition and archives of long time-series of multidisciplinary data and data products. To generate a distributed database of multidisciplinary and high resolution data and data products which are accessible through a common TCS gateway (FRIDGE), metadata sets of DDSS elements and required services are also defined in the new services of TCS WP9 or addressed to other well-defined thematic WP(s).

Finally, we described one internal and one cross-disciplinary use case, to demonstrate the availability of data and data extraction procedures, using common gateway FRIDGE. Now, these use cases demonstrated in TCS-ICS meeting, Prague (2017).

RI Name	Location	Contact Person	DDSS provider(s)
TABOO	Italy	L. Chiaraluce	INGV
IRPINIA	Italy	G. Festa	UNINA
CRL	Greece	P. Bernard	CNRS
MARSITE	Turkey	S. Ergintav	KOERI
VALAIS	Switzerland	J. Clinton	ETH
SISZ	Iceland	K. Vogfjord	IMO
VRANCEA	Romania	A. Marmureanu	INFP

Table 1. NFOs across Europe in WP9, contact people and associated DDSS main providers. For CRL, DDSS are provided both by French (CNRS) and Greek (NOA and Greek Universities) Institutions. DDSS of MarSite are provided by KOERI (Boğaziçi University, Turkey), French (CNRS), Kocaeli University (KU, Turkey), Istanbul University (IU, Turkey), TUBITAK (Turkey), INGV (Italy) and GFZ (Germany).

Table 2. NFO Inventory

NFO	Seism. SP/BB	Seism. Accel.	OBS	Tide guage	GPS	Strain/ Tilt meters	Borehole water level/Pore pressure	Geo Chemical	Magnet/ EM	Deep drill	Meteo *	Infra sound
SISZ	17/1	1[1)]			11	5						
MARMARA	4/115	14	16	2	40	3	1	23	3* Ocean bottm	1		
TABOO	13/13	6[1)]			10	4[2)]		5				
CRL	12/(9+7[4])	7[1)] +14		1	9	2	1					
IRPINIA	8/8	15+16[1)]			1							
VRANCEA	21/22	28[1)]+7[1)+4)]			6			1	2			6[4)]
VALAIS	4/11	1[4)]+29[1)]					1	1	1			

[1)] Some of them co-located with seismic station
[2)] Planned installation
[3)] With OBS's
[4)] Array
* Each NFO has meteo stations co-located with other instruemnts, that will be soon

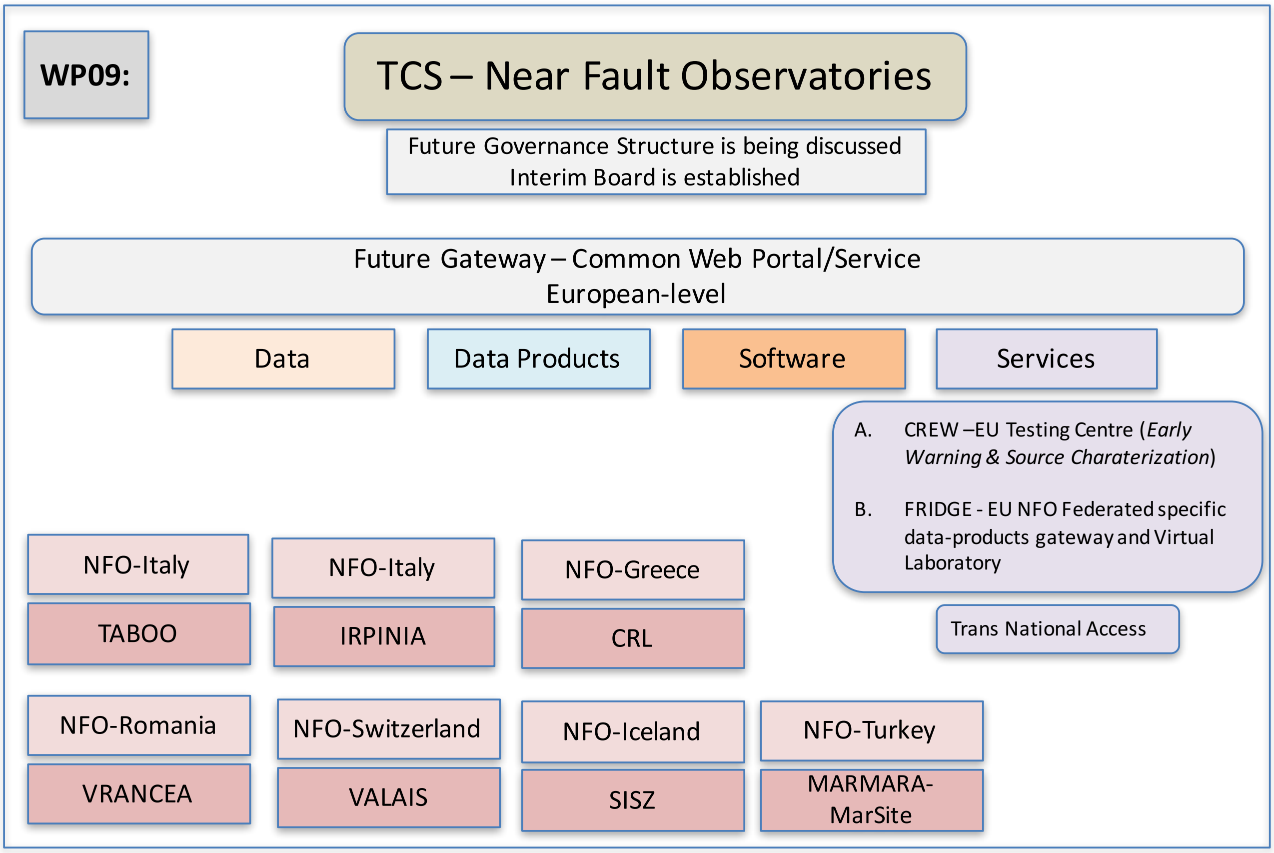

Figure 1. NFO - TCS organization

2. Priority List of DDSS

2.1 Definition of High and Non-High Priority groups

The DDSS Master Table of the WP9 has been reviewed with WP6-7 in Bucharest (Romania), June 2016 and in Naples (Italy), November 2016 meetings. Then it's been divided into two groups, based on their priorities. High priority group contains 30 DDSS elements: 12 are Data elements, 15 are Data Product elements and 3 are Services. 12 DDSS are Seismological Data or Data products; 5 DDSS are Geodetic Data or Data products, 4 DDSS are Geochemical Data, 1 DDSS is Strain Data, indicating the effective multidisciplinary within each NFO (Figure 2). Non-high group contains 20 DDSS elements from different disciplines (Figure 3). Almost all data and data products concern more than one NFO depending on the specific National or International RIs. Each DDSS linked to the corresponding harmonization group. Most of the elements from Seismology, Geodesy and

Satellite are or will be exposed through the existing services from the authoritative WP (e.g. EIDA: WP08). Specific data, high-level data and data-products that will be produced by the NFO(s), will be exposed through the NFO-TCS data gateway.

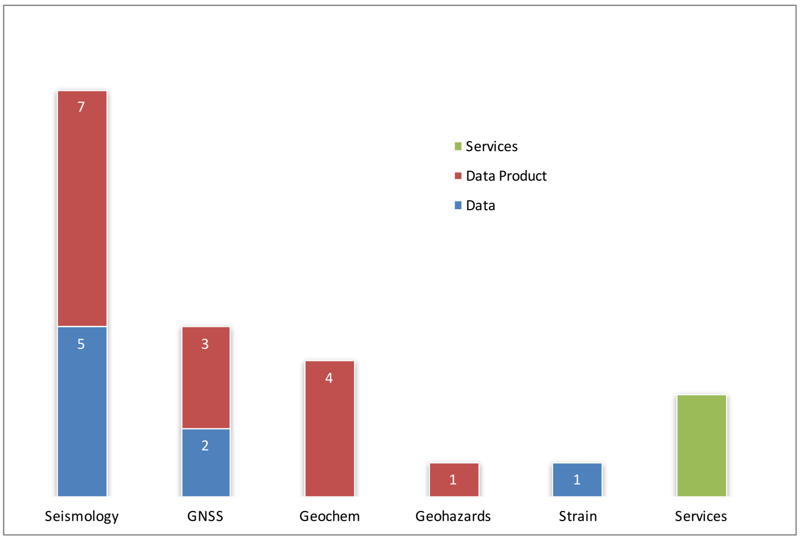

Figure 2. The multidisciplinary character of WP09 in high priority group.

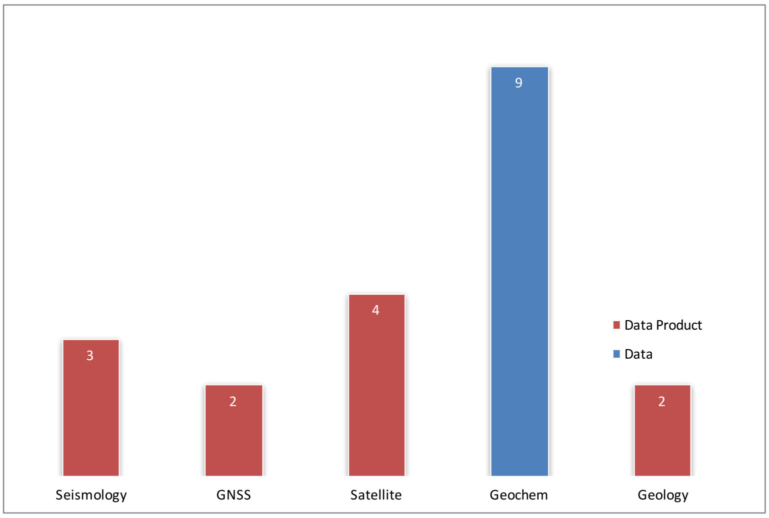

Figure 3. The multidisciplinary character of WP09 in non-high priority group

2.2 AAAI type of DDSS elements

According to the NFO-TCS meeting in Bucharest, the WP9 will offer open access to data and data products. Embargoed data will be opened only after the embargo period ended and will be distributed as non–embargoed data. Hence, we do not plan different rights, conditions and licenses for access to EPOS legal entities, non-commercial entities and others. However, authorization is required, mainly, to assure traceability.

2.3 Harmonization of DDSS list within EPOS

The harmonization of the available formats and metadata of data and data products was the first task in different WP(s). Then, following the multidisciplinary nature of NFO(s), WP9 contributed to the 12 Harmonization Groups (HG). The following list shows the contact persons in each HG(s):

- Seismology (HG-01/03): Raffaele Di Stefano
- Geology and 3D/4D structural Models (HG-05/10): Yaman Özakın
- Geodetic and Satellite (HG-02/03): Semih Ergintav
- Geohazards (HG-07): John Clinton
- Geo-chemical data and Meteo parameters (HG-09/15): Antonio Caracausi
- Borehole data (HG-12): Pascal Bernard
- Episodes and Geo-resources (HG-06/08): Lauro Chiaraluce

The feedback from HG(s) was not well organized, until ICS-TCS meeting in Prague (2017). At the date of this report, only, HG-03 finalized the harmonization activities and defined the common metadata structures. In the IC-TCS meeting, many discussions have been realized between WP(s) and HG(s) and we got important feedbacks from HG-09 and HG-02. Then, we reconstructed (renamed, concatenated moved to non-HIG list and deleted) some DDSS element, related with HG(s) discussions, in High priority list.

After the discussion in ICS-TCS meeting, priorities of the satellite data changed from high to non-high. The main idea is to modify the GEP (main service for the satellite WP) as a specific service for the NFO community. This has important advantages. In addition to the advantages about data discovery and automatic processing of satellite data in GEP, end-user can also run additional analysis on the data in GEP. The only drawback is that, as stated by WP12, this needs effort and time and hence is postponed to M24.

Of course, the visibility for the NFOs wil be increased by GEP. For the seismological data, NFO-TCS has been used the virtual network definaiton under the EIDA structure. Similar efforts run for the other thematic standart data sets (e.g GLASS). ICS awares about these acvitities ,related with the visibility of NFOs infrastructure. Now, as a general solution, the WP6&7 prepare a tool to map the granularity of database.

2.4 New services

Another effort was to identify the metadata standards of NFO specific data and data products and to create a service for them. For this purpose, FRIDGE (EU NFO Federated specific data and products gateway and Virtual Laboratory), as an NFO service, is currently under construction. This will be the common gateway to all NFOs in order to discover and download NFO specific data and high level data products. It will also host simple visualization tools for multidisciplinary data. The IT team is currently creating common dB standards for NFO specific data and data products, taking adventage of available data structures in the NFOs, e.g. the geochemical database schema used by TABOO and QuakeML, which is used in all NFOs. The IT team introduced and demonstrated a proof-of-concept of two new web services related with Vp/Vs ratio and Radon time series. Details are given in the Use Case section.

CREW (EU Testing Center for Early Warning & Source Characterization) is also defined as another EU level service. It is a testing facility, built on real-time and offline high-resolution data, aimed at fostering the development of next generation methodologies and software for real-time monitoring of faulting processes.

The TCS has also planned to propose a Transnational Access (TNA) at the NFOs. NFO-TCS offer opportunities for free-of-charge TNA for selected research groups (candidate NFOs) and companies (to develop/test new sensors) within a multidisciplinary platform.

2.5 The current DDSS list of NFO-TCS

The current DDSS priority list for the NFO-TCS is organized and contains the information about the current state of the metadata standards, data formats, service names, DDSS categories in ICS, the names of the related Harmonization Groups and the one to one link between the single DDSS element and the Institutions as data supplier.

In the DDSS list, there are two international Observatories, which DDSS provision is supplied by national institutions on behalf of institutions from other EU countries. For these observatories, a coordination for DDSS provision at European level is required:

- Marmara Observatory born as an international initiative inheriting the effort and part of the facilities build during the EU MARSITE Supersite project. After the end of the project, this international initiative is still active and all attempts are made to sustain the established infrastructure by EU MarSite consortium, until relevant calls would be available in the framework of Horizon-2020, expected in 2018. The institutions, contributing to the DDSS list in MarSite international initiative, coordinated by KOERI, are KOERI (Seismology/ Geodesy/ Satellite), İstanbul

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University (TR, Seismology), Kocaeli University (TR, Seismology/ Geochemical), İstanbul Technical University (TR, Geology/ Geochemical), Ifremer (FR, Seismology/ Geodesy/ Geochemical), BRGM (FR, Seismology/ Satellite), CNRS (FR, Seismology), GFZ (DE, Seismology/ Geochemical), INGV (IT, Seismology/ Geochemical/ Satellite), CNR (IT, Satellite), AMRA (IT, Seismology).

• Service Provider of Corinth Rift Laboratory (CRL) DDSS provision is CNRS (France), that is defining a LoI with NOA, as DDSS supplier. NOA gathers DDSS from all Greek Universities (University of Athens NKUA, University of Patras, University of Thessaloniki) though a national Consortium, while Charles University of Prague (Czech Republic) is linked to the University of Patras though a LoI.

The summarized version of the DDSS Master Table of the NFO-TCS (WP9) is given in Annex-1.

3. TCS roadmap

To organize the final list of high-priority DDSS elements that are the ones to be implemented during the first 24 months of the EPOS-IP project, we decided to work on the standardization and the provision of the DDSS elements, determined to have a HIGH degree of priority (Figure 1). Afterwards, we will focus on the implementation of the DDSS elements having Medium and Low priorities to increase the number of the DDSSs (Figure 2).

As can be seen in Figure 3, non-high list mainly consists of data products, since they are complex elements and need collaborative studies with other WP(s) in HG(s).

Most of the elements of Seismology, Geodesy and Satellite are well defined within existing formats and services in authoritative WP(s), with the inputs of HG(s). We push the HG(s) to estimate the roadmaps and timelines in our DDSS list. Until now, using the feedbacks, we simplified our roadmap and moved the risky elements to the non-high DDSS list.

To eliminate any irrecoverable mistakes, we decided to define some formats independently. For example, WP08 has no products for earthquake catalog in our list. If they will not define any formats for this DDSS element in the next few months, we will create one to make the target deadline of WP9 in M24.

The following list includes main milestones on the roadmap:

- The high-priorty DDSS elements will be ready for validation process (M24)
- Operational phase of FRIDGE and CREW will be started (M24 –M48)
- Preparation for the non-high DDSS elements (>M24)

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Now, the roadmap is currently under study by our internal IT working group in order to derive a timeline, based on the validation phase.

4. Data Management Plan (DMP)

Generally, at the TCS level, we are working to propose a DMP demonstrating and supporting our long-term sustainability plan overtaking also the planned EPOS services operational phase. Now, individual DDSS elements discuss their own DMP, focusing on the following topics:

- Data storage and maintenance responsibility
- Data curation responsibility
- Data management and governance structure
- Financial commitment securing the operational costs

The DMP (Data Management Plan) for each DDSS is still in the discussion level. The complexities related to the variety of legal entities, operating the National Research Infrastructures (NRIs) behind the declared service providers are expected to be managed at NFO level. TCS service providers will furnish LoI and MoU, formalizing the permit of distributing data and data products through EPOS services, on behalf of the owners.

The first decisions, related with the governance and financial model, are given in the following deliverables of M24:

- D9.1 Legal and Governance Framework for TCS Implementation of WP 9
- D9.2 financial work and sustainability for TCS implementation of WP 9

5. Use cases

Using the advantages of multi-disciplinary data sets, we can utilize many simple use cases. Table 3 includes general categories of these examples.

First, we organized an IT meeting (Rome, 2017) and focused Vp/VS and Radon time series. Then, the IT group of WP9 prepared all relevant API/web services. Hence, the two web services are ready to be used (as a part of FRIDGE), when called either by the user or by the ICS.

Generally, to create these use cases, we solved complex problems that are related with

- the scientific concept
- the query building
- the common DB structure
- the query performance
- the input parameters standard definitions and defaults
- the output (data and metadata) format standard

After this exercise, IT group of WP9 produced the following products:

1. a text document (API description) organized into sections describing
   - the concept
   - the input parameters and related standards priorities and defaults
   - the DB query itself
   - the payload (output) with related standards (this last part is in progress and almost finished)
2. a "portable" package including
   - the working server
   - the needed DBs (with example data)
   - the API (in python)

The minimum purpose of the “portable” package is to demonstrate the two-working web-services at any place. As a first example, our IT group used it in TCS section of ICS-TCS meeting (Prague, 2017).

Table 3 Example Use Cases,

	Use Cases
Time Series	X Chemical Component in time Geodetic Displacement (all comp) Number of earthquakes per day b-value in time Vp/Vs, Vp, Vs, Attenuation in time at site Heat Flux in time
Maps with surfaces	X Chemical component distribution Map Layers from 3D models (Vp, Vs, Vp/Vs, Poisson ecc) Faults surfaces Geo Layers top and bottom surfaces Seismological Discontinuity surfaces Heat Flux Vertical Sections through 3D models
Positional maps	Interactive Maps of selected sites position Interactive Maps of selected earthquakes position Space-Time earthquakes distribution
Histograms and Dispersion	Selected earthquakes parameters errors distribution Selected earthquakes' depth distribution depth errors vs Origin-time errors Dromocronas (Distance vs P and S Traveltime)
VLAB	Vp/Vs, Vp, Vs, Neqks/Day, CO2 flux, Radon Flux, Geodetic Displacements ALL at site

In the following part, we specified one internal and one cross-disciplinary use case in detail.

Specific Use Case

Use case name/topic: *Selecting and viewing earthquakes' distribution in maps and vertical sections*
Use case domain This use case is *related to one single discipline: seismology. The goal is to allow the user to select earthquakes locations from the specific NFO-DB based on some spatial-temporal-quality criteria and to plot the distribution in a geographic map and along a vertical section which extremes are interactively selected on the map. The aim is to help understanding the fault system geometry and spatial-temporal trend of the seismicity pattern.*

Use case description: *As a seismologist, I want to observe the spatial and temporal distribution of earthquakes sources in the fault system volume in different 2D views. I want to be able to chose* • *the type of locations to use for plots (1D or 3D obtained with different location codes)* • *the quality of such locations (rms, gap, h_err, v_err, nP, nS and so on)* • *the time window* • *the volume (geographic area + depth range)* • *the magnitude range* • *the magnitude threshold to use different symbol and show focal mechanisms if available* *I also want to use a color palette to identify the time range of plotted locations* *As soon as the map is ready, I also want to be able to draw an oriented rectangle on the interactive map to produce a vertical section with locations, as wide as the rectangle short side and as long the rectangle long side and as deep as the deepest earthquake.*
Actors involved in the use case • *User Seismologist* • Seismology researcher
Priority: *High*
Pre-conditions: *User must have logged in*

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Flow of events – user view
 	
The following steps are need to answer the question:
1. *seismologist user chooses*
    a. *the specific NFO [the use case is focused on just one NFO]*
    b. *a lapse of time*
    c. *a geographic region inside the NFO area (or the whole)*
2. *seismologist user chooses*
    a. *criteria to select earthquakes' locations by*
        i. *type of location*
        ii. *quality of location*
        iii. *magnitude range*
    b. *magnitude threshold to show strongest earthquakes with different symbol and eventually attribute a focal mechanism if available*
    c. *weather to use a color palette for time*
    d. *symbols to use for earthquakes beyond magnitude threshold*
3. *seismologist user produces a geographical map with gray shaded topography, seismic stations distribution, earthquakes' locations plotted as dots colored as a function of time and strongest earthquakes plotted with the same color code but with different symbol and focal mechanism associated if available*
4. *as soon as the map is ready the seismologist user*
    a. *draws an oriented rectangle on the map*
    b. *obtains a new Distance/Depth (XY Cartesian) plot with all the locations included within the rectangle from depth 0km to the deepest earthquake (scaled plot) with the same color and symbol code as the map and focal mechanisms if available.*
5. *The locations, magnitudes, focal mechanisms, related locations' quality parameters are restituted to the user in a quakeML catalog with all metadata included.*

System workflow - system view 1. *The user interface receives the input parameters for query_locations* 2. *It activates one tasks (query_locations) connecting to the specific NFO database* 3. *The task connects to the database and performs a query typically combining information from locations, quality, magnitudes, and focal mechanism tables* 4. *The task a temporary VIEW (see mySQL) in the DB storing the results from the combined query (one line per location)* 5. *The data contained in the VIEW are also stored in a downloadable quakeML catalog file* 6. *A listening service takes data from the view and produces the interactive map* 7. *The interactive map allows to draw the rectangle based on which extremes a sub_task is activated selecting earthquakes from the view based on polygonal in/out function and locations are plotted in a vertical section* 8. *A button to reset the vertical section plot and redraw the rectangle is made available*
Post-conditions *The View is kept in the DB until the user session is active or until the session timeout is passed*
Extension Points If the use case has extension points, list them here. *No extension points.*

« Used » Use Cases If the Use Case uses other Use Cases, list them here. *No other use cases.*
Other Requirements This can include non-functional requirements related to the Use Case. *Privacy legislation, response time of the system*
(to be filled in by WP7) Class diagram and sequence diagram

Cross-disciplinary Use Case

Use case name/topic: *Viewing and comparing Vp/Vs ratio to Radon concentration in time*
Use case domain This use case is *Cross-disciplinary. The goal is the comparison of two "entities" related to seismological (Vp/Vs time series) and geochemical (Rn concentration time series) disciplines. The scientific reason for this is looking for changes (in space and time) related to the deformation process (e.g. fracturing and/or fluid migration processes) occurring during the pre- co- or post-seismic phase.*
Use case description: *As a seismologist, I want to observe and compare the spatial and temporal behavior of P- and S-wave velocity ratio (referable to the rock volume elastic parameters) with the temporal and spatial pattern in Rn concentration in a defined rock volume (referable to on-going deformation processes), looking for statistically coherent change points, thus possibly ascribable to the same undergoing physical process such as for example the earthquake preparatory phase.*
Actors involved in the use case • *User Seismologist* • *Geochemistry researcher* • Seismology researcher
Priority: *Medium*
Pre-conditions: *User must have logged in*

Flow of events – user view
 	
The following steps are need to answer the question:
6. *seismologist user chooses*
  a. *the specific NFO [the use case is focused on just one NFO]*
  b. *a lapse of time*
7. *seismologist user chooses*
  a. *one specific seismic station*
  b. *criteria to select seismic rays by earthquakes quality and takeoff angle*
  c. *criteria to generate a moving mean (boundary and default criteria are suggested by the Seismology researcher*s group)
  d. *a magnitude threshold to show strongest earthquakes on top of the two time series*
8. *seismologist user chooses*
  a. *one specific site from suggested neighboring Radon sites active in the same period or part of it, based on the step 2*
  b. *criteria to correct for meteorological data and to produce a moving mean (boundary and default criteria are suggested by the Geochemistry researcher*s group)
9. *seismologist user produces a combined X (time) Y (Vp/Vs ratio) and Y' (Rn concentration) dispersion plot with symbols and strokes*
Alternative sequences and needed steps (user view)
1. *seismologist user may go for step 3 (Geochemistry) before step 2 (Seismology). Step 1 is forced to be the beginning.*

System workflow - system view
9. *The user interface receives the input parameters for query_VpVs and query Radon*
10. *It activates two tasks, one per CPU, connecting to the specific NFO database*
11. *Each task connects to the database and searches, for the chosen recording site, records that match to the required criteria: SQL queries might be complex or simple queries, depending on the DB structure, operating on the basic tables containing*
  a. *Vp/Vs: P arrival times (and related quality parameters), S arrival times (and related quality parameters), earthquakes locations, quality of earthquakes locations, takeoff angles, back-azimuth angles*
  b. *Radon concentration: Rn counts, site correction parameters, meteorological site parameters*
12. *Each task restitutes a file on disk in a standardized format for time series (to be defined)*
13. *A listening service takes the files as soon as they are ready and produces an interactive plot where only scales, symbols and colors can be changed*
14. *A button to "Change criteria" sending to the selection page from step 2 is made available (see post-conditions)*

Post-conditions *The request is kept in memory to be reloaded as default in step 6 of the System workflow*
Extension Points If the use case has extension points, list them here. *No extension points.*

« Used » Use Cases If the Use Case uses other Use Cases, list them here. *No other use cases.*
Other Requirements This can include non-functional requirements related to the Use Case. *Privacy legislation, response time of the system*
(to be filled in by WP7) Class diagram and sequence diagram

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Annex 1 – The Summarized Version of DDSS Descriptions

DDSS Name	Service ID	Implem. Success at M24	Status	SISZ	MARMAA	TABOO	CRL	IRPINIA	VRANCEA	VALAIS
Seismology Data										
Vel. Seismic Waveforms Cont.	EIDA	HIGH	IMPLEMENTED		✔	✔	✔	✔	✔	✔
Acc. Seismic Waveforms Cont.	EIDA	HIGH	IMPLEMENTED		✔	✔	✔	✔	✔	✔
OBS Waveforms	EIDA	HIGH	IMPLEMENTED		✔		✔			
Infrasound Waveforms	EIDA	HIGH	IMPLEMENTED				✔		✔	
Strainmeter (water level, pressure)	EIDA	HIGH	UNDER IMPLEMENTATION				✔		✔	
Seismic Station Information	EIDA	HIGH	IMPLEMENTED		✔	✔	✔	✔	✔	✔
Seismology Data Products										
Earthquake Catalog	FRIDGE	HIGH	UNDER IMPLEMENTATION	✔	✔	✔	✔	✔	✔	✔
EQ parameters (location, mag, phases, moment tensor)	FRIDGE	HIGH	WP 08		✔	✔	✔	✔	✔	✔
Focal mech.	FRIDGE	HIGH	WP 08		✔	✔	✔	✔		✔
Vp/Vs (Time Series)	FRIDGE	HIGH	IMPLEMENTED			✔				
b-value (Time Series)	TBD	TBD	WP 08			✔		✔	✔	
Network detection (Space/Time)	TBD	TBD	WP 08			✔		✔	✔	
Repeaters and multiplets catalogue	FRIDGE	LOW	WP 08			✔	✔	✔		
Seismic Velocity and Attenuation Models (1D, 2D, 3D, 4D)	FRIDGE	HIGH	UNDER IMPLEMENTATION		✔	✔		✔		✔
Site Characterisation	TBD	HIGH	WP 08			✔	✔			✔
Historical Eq Catalog	NOT CLEAR (AHEAD?)	HIGH	WP08		✔	✔	✔		✔	✔

DDSS Name	Service ID	Implem. Success at M24	Status	SISZ	MARMAA	TABOO	CRL	IRPINIA	VRANCEA	VALAIS
GNSS Data										
GNSS Daily Data (30/15/1 second)	GLASS	HIGH	PROTOTYPE (WP 10)		✔	✔	✔		✔	
GNSS Site and Station information	GLASS	HIGH	DEVEL. (WP 10)		✔	✔	✔		✔	
GNSS Data Products										
GNSS daily-solutions (PPP,DD)	GLASS	HIGH	FINALIZING PROTO. (WP 10)		✔	✔	✔		✔	
GNSS coordinate time-series (PPP,DD)	GLASS	HIGH	FINALIZING PROTO. (WP 10)		✔	✔	✔		✔	
GNSS velocity fields (PPP,DD)	GLASS	HIGH	FINALIZING PROTO. (WP 10)		✔	✔			✔	
GNSS Real-Time Data (high-rate)	WP10	LOW	NOT PLANNED (WP 10)				✔		✔	
Sattelite Data Products										
InSAR LOS Displacement Time series	ESA-GEP	HIGH	IMPLEMENTED		✔	✔				
Strain rate time series	FRIDGE	HIGH	DEVEL. (TABOO, WP 10)			✔				
InSAR mean LOS velocity	ESA-GEP	HIGH	IMPLEMENTED		✔	✔				
Wrapped Differential Interferograms (Phase and Amplitude)	ESA-GEP	HIGH	IMPLEMENTED		✔	✔	✔			
Unwrapped Differential Interferograms (Phase and Amplitude)	ESA-GEP	HIGH	IMPLEMENTED		✔	✔	✔			

DDSS Name	Service ID	Implem. Success at M24	Status	SISZ	MARMAA	TABOO	CRL	IRPINIA	VRANCEA	VALAIS
Geochem Data										
Total gas pressure in well water	WP 11	MEDIUM	UNDER IMPLEMENTATION			✔				✔
Ground water temperature	WP 11	MEDIUM	UNDER IMPLEMENTATION		✔	✔			✔	✔
Multiple band Fluoresence	WP 12	MEDIUM	UNDER IMPLEMENTATION							✔
Radon Counts	WP 11	HIGH	UNDER IMPLEMENTATION		✔	✔			✔	✔
Meteo parameters	WP 12	HIGH	UNDER IMPLEMENTATION		✔	✔	✔		✔	
Local Temperature in Radon sites	Wp 12	HIGH	UNDER IMPLEMENTATION			✔			✔	
Spring or well water chemistry	WP 11	MEDIUM	UNDER IMPLEMENTATION		✔	✔				✔
Gas chemistry near the fault	WP 12	MEDIUM	UNDER IMPLEMENTATION		✔	✔				
CO2 soil flux measurements	WP 12	HIGH	UNDER IMPLEMENTATION			✔			✔	
Ground water level	WP 11	MEDIUM	UNDER IMPLEMENTATION			✔				
Ions (+/-) (VRANCEA)	WP 11	MEDIUM	UNDER IMPLEMENTATION						✔	
Geochem Data Products										
CH4 methane concentration	WP 11	MEDIUM	UNDER IMPLEMENTATION							✔
Water chemistry	WP 11	MEDIUM	UNDER IMPLEMENTATION		✔					✔
Geohazards Geology										
Fault Inventories (Ground Deformations (inventories, hazard maps))	WP 15	HIGH	IMPLEMENTED		✔		✔	✔		
Seismogenic Fault	WP 08	MEDIUM	UNDER IMPLEMENTATION		✔		✔	✔		
Geological Maps	WP 15	MEDIUM	IMPLEMENTED		✔		✔			

DDSS Name	Service ID	Implem. Success at M24	Status	SISZ	MARMAA	TABOO	CRL	IRPINIA	VRANCEA	VALAIS
Services										
CREW - EU Testing Center Early Warning & Source Characterization	Univ. of Naples	HIGH	UNDER IMPLEMENTATION		✔		✔	✔		
FRIDGE - EU NFO Federated specific data-products gateway and Virtual Laboratory	INGV	HIGH	UNDER IMPLEMENTATION	✔	✔	✔	✔	✔	✔	✔
Trans National Access	UNINA	LOW	UNDER IMPLEMENTATION	✔	✔	✔	✔	✔	✔	✔