## Complex Use Case for GUI

By a complex user story we are talking about Research Scientist (RS) who is searching for multiple types of data and want to visualize them together, compare similar data types, do its own analysis (do programming) and save the results for later use. Download either the whole dataset or just parts of it. A presentation of results/conclusions should be also part of the system.

At the same time we want to activate all the architecture elements in this complex use case.

## Example

**Event:** A strong earthquake hit southern Italy near the Vesuvius volcano. As a scientist I want to get different datasets, display them and compare. I want to select subset of data that shows some specific trend and perform analysis on that subset. After that I want to use the results in another context and prepare figures for publication or web presentation.

**Initial hypothesis:** There may be relations between large EQs affecting the local stress conditions and magma chamber underneath the volcano. Changes in stress can trigger volcanic activity.

**Aims:** Investigate possible relations between different data types, analyse such relations (statistical significance). Verify or reject the initial hypothesis and possibly come with new suggestions/conclusions.

### A. Discovery / search for relevant trends / correlations

#### 1. Get overview - show me: (visual / spatio-temporal relations in maps)

1.1 Historical seismicity in that area (map within a bounding box) - earthquake catalogue (interactive map; filtering of events)

EXAMPLES: <http://www.emsc-csem.org/Earthquake/?filter=yes>

<https://earthquake.usgs.gov/earthquakes/search/>

WEBSERVICE: <http://www.seismicportal.eu/fdsn-wsevent.html>

1.2 Mapped faults + geology (map, WMS)

EXAMPLE: <http://geo.ngu.no/kart/berggrunn/> (exists as WMS as well)

1.3 Previous volcanic activity (interactive map)

EXAMPLE: <http://icelandicvolcanoes.is/>

1.4 GNSS velocity field (map)

1.5 Plot those datasets (maps) together or in different pairs

* + - seismicity and distribution of lava flows
    - seismicity and faults
    - GNSS velocity map and faults

 including various subsets of data (e.g. specific volcanic eruption in a given time and space and the associated seismicity in the same space and time window).

1.6 Save selected search results into my workspace

#### 2. Investigate possible indicators of geodynamic activity (map and graphic visualisation of parametric data)

2.1 Show positions of all measuring stations in map (interactive map) - those can be GPS/GNSS stations, seismic stations, monitored boreholes, dilatometers in field, water level gauges, etc.

 2.2 Allow filtering for specific data types as mentioned above (using faceted search) (add selected stations to a basket/workspace for later processing)

    2.2.1 In-situ stress measurements (time series)

    2.2.2 Water level in surrounding boreholes (time series)

    2.2.3 Real time GPS/GNSS (time series)

    2.2.4 Amount of CO2 production in boreholes near volcano (time series)

2.2.5 Compare all time series in time-aligned plots and save figure.

2.3 Plot various combinations of subsets of data and do an agnostic data discovery, e.g. "Does CO2 production correlates with seismicity?" (this analysis can involve ICS-D for visualization and trend analysis)

2.4 Add selected datasets to my workspace

#### 3. Download data or their subsets

3.1 Make a request (e.g. specify time window for waveform extraction)

3.2 The user will get response from the system on execution time for preparation of data

3.2 Confirm and download

### B. Analysis

Using the selected subsets of data from various resources

#### 4. Analyse the earthquake

4.1 Plot waveforms and check automatic phase onsets (process online; data download, catalogue record download)

 EXAMPLE: <https://quakelink.gempa.de/gaps/>

4.2 Do corrections of phase onsets (plot waveforms)

4.3 Relocate earthquake (using different velocity models - 1D, 3D), magnitude estimate

4.3 MT inversion

4.3.1 Compare MT solution with historical MTs of EQs in that area

4.4 Do processing in any software (domestic or external) - ICS-D (HPC)

4.5 Analyse static stress transfer -> see if additional stress in magma chamber is significant (?)

#### 5. Analyse co-seismic processes

5.1 Show InSAR images (map)

5.2 Show static displacement from GNSS after the earthquake (map)

5.3 Slip inversion - ICS-D (CES, modelling)

Compare, save figure.

### C. Results and presentation of output from analysis for decisions

#### 6. Interactive check points for validation of the hypothesis (i.e. summarize results from points 2, 4 and 5)

6.1 From point 2: "Is there any statistically significant correlation between any observations?"

6.2 From point 4:

6.2.1 "Is the volumetric (or non-DC) part of the moment tensor significant? Can it be related to magma intrusion?"

6.2.2 "Could be the additional stress caused by EQ in magma chamber significant?"

6.3 From point 5:

6.3.1 "Does the InSAR data show any movement (inflation/subsidence)?"

6.3.2 "Does the static displacement from GNSS data show any movement (inflation/subsidence)?"

6.3.3 "What is the slip distribution along the fault plane?"

### D. Display and download results / conclusions / interpretations

#### 7. Presenting the results for various end users (using specific web templates)

* for my own research publication
* for another research group
* for external use by different stake holders (e.g. public / governmental / emergency services / industry)