Planning DSO contribution to EUREF densification project.

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DSO Recent Activity

Dionysos Satellite Observatory (DSO) and Higher Geodesy Laboratory of the National Technical University of Athens, have developed an automated processing scheme to accommodate the routine analysis of all available continuous GNSS stations in Greece.
This daily analysis process, is implemented for the last two years, yielding results which help us further understand the complicated tectonic setting of Greece and nearby regions.
Important results, include:

- the recent volcanic activity in *Santorini* (e.g. [2]),
- the 2014 *Kefallonia* earthquakes (e.g. [4], [3])

SEISMO Project

In the framework of the SEISMO[1] Project, platform has been upgraded, to include:

- more GNSS stations, divided into sub-networks,
- manipulation, archiving & dissemination of GNSS data files,
- new processing capabilities (e.g. GPS+GLONASS processing),
- automatic archiving and publishing of results (via a dedicated web-site),
- integration with `GSAC` ([5]) and `MySQL` databases,
- new results and products

The platform was in practice re-designed & re-implemented.

[1] South Aegean Geodynamic And Tsunami Monitoring Platform

Status

Motivation

Via our contribution to EUREF and interaction with its community, we hope to:

- expand & modernize our research activity,
- contribute to the GNSS community,
- take part in ongoing/future projects,
- expand our knowlegdbase,
- improve our academic services (NTUA is a University)

Densification Network Selection

To contribute to the Densification we have to establish a credible dataset (network). This has proven to be rather challenging !

Currently we process whatever we can get our hands on ...
Problems:

- Inhomogenous dataset (`RINEX`, raw files, etc).
- Various maintainers, different mentalities.
- Different aquisition methods/rates.
- Hardly any log files.
- Wide variety of equipment (not always included in `atx` files).

COMET/NTUA Network

Network installed/maintained by COMET[1] & NTUA.

established along the Aegean Arc

homogenous (geodetic type) equipment

credible time-span (early 2004 - late 2011)

data aquisition stoped at late 2011

equipment is old & GPS-only

needs repairing

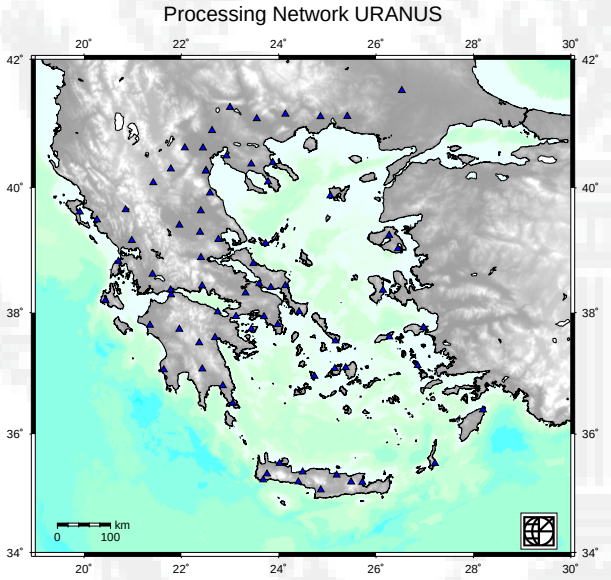


Figure: Flowchart of the processing scheme.

Can be used for EUREF densification "as is".

[1] Center for Observation and Modeling of Earthquakes, http://comet.nerc.ac.uk/

NOA/GEIN and others

Network maintained by GEIN/NOA[1]. Sites established by various institutes (NTUA, UNAVCO, MIT).

covers (sparsely) all of Greece

credible time-span (newest stations at 2012)

inconsistent providers (for some stations)

no log files

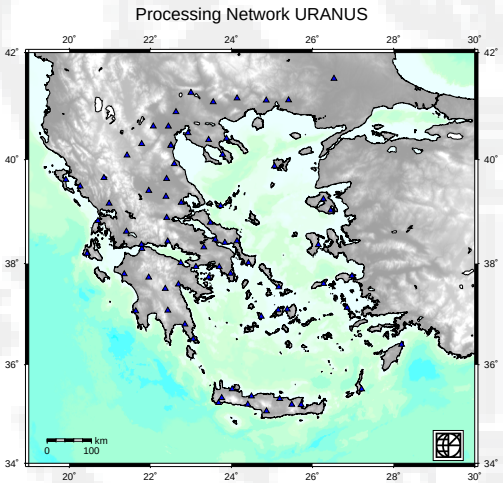


Figure: Flowchart of the processing scheme.

Unusable sites: atal, stef, ?? (no calibration).

[1]National Observatory of Athens
http://www.gein.noa.gr/services/GPS/noa_gps.html

Tree-Company / URANUS

Network installed/maintained by `Tree-Company`[1].

dense network, covers all of Greece

homogenous (geodetic type) equipment

limited time-span (late 2013 onwards)

no log files

comercial usage oriented

$\sim$ 2 years of data lost !

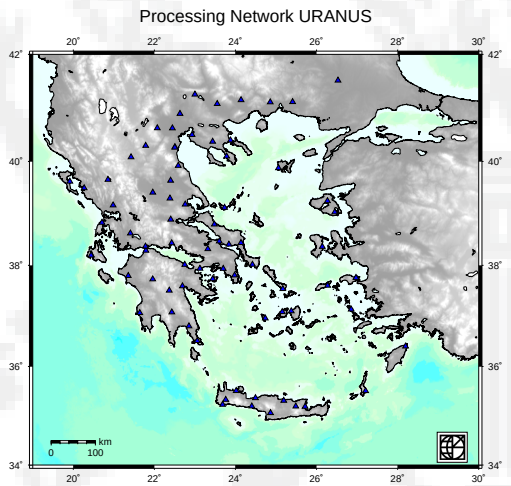


Figure: Flowchart of the processing scheme.

Can nonly use ones with time-span $>$ 2 years ($\sim$??).

[1] URANUS network `http://www.uranus.gr/`

HEPOS

Network installed/maintained by HEPOS[1] (Greek Cadastre Service).

dense network, covers all of Greece

homogenous (geodetic type) equipment

credible time-span (late 2007 onwards)

limited access (∼5 stations)!!

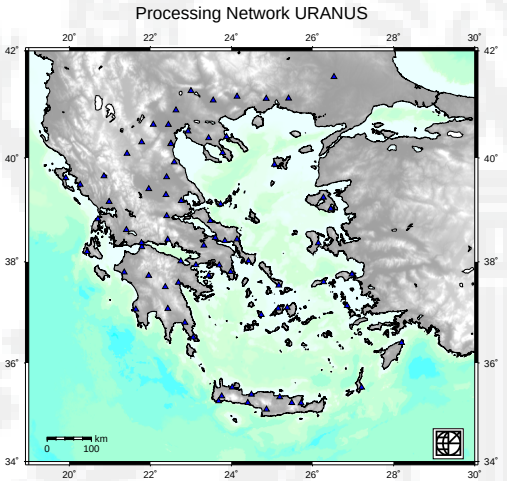


Figure: Flowchart of the processing scheme.

Can only use somewhere between 5 and 10 sites for a time-span of ∼ 4 years.

[1] http://www.hepos.gr/

Localised Networks

Network installed/maintained by CRLab[1].

- credible time-span
- only covers the Corinth Rift
- inconsistent providers
- no log files & equipment changes

Santorini Network.

- localized
- limited time-span

[1] Rift Laboratory http://webobs.crlab.eu/

Densification Network

The network to be used for the Densification, will look something like this ...

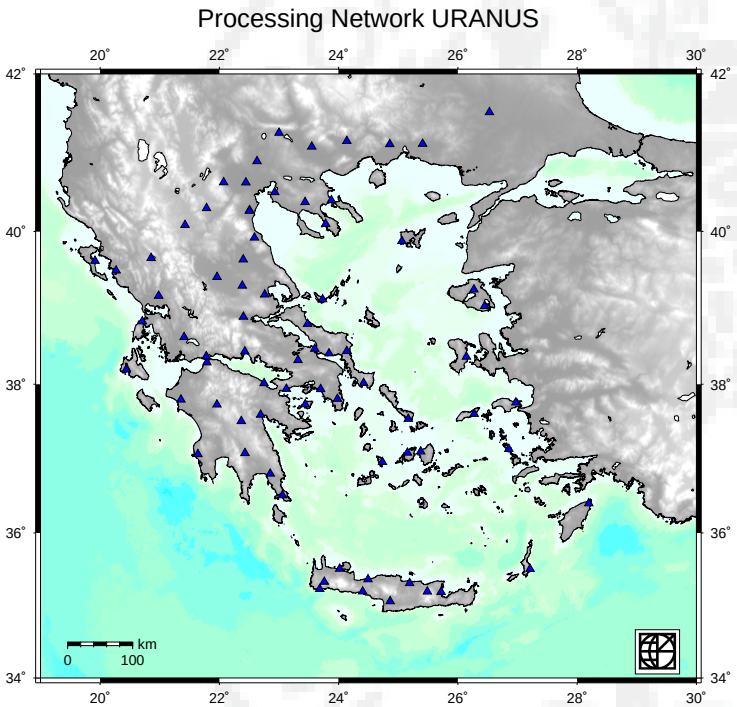


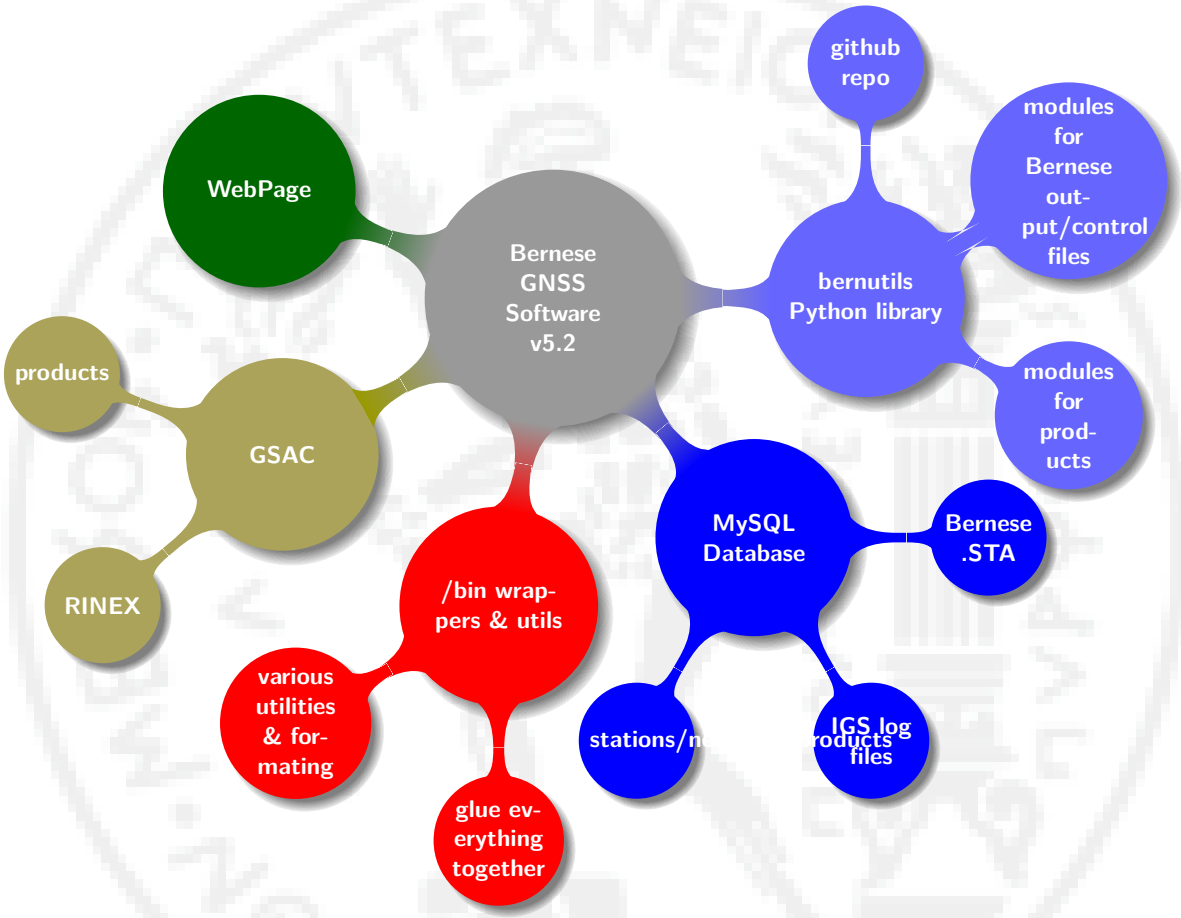
Figure: Flowchart of the processing scheme.

The Scheme

The core tool/software is `Bernese GNSS Software v5.2`[?].

Integration with

- `MySQL` database,
- `Python` library
- `GSAC`
- wrappers (`shell`)



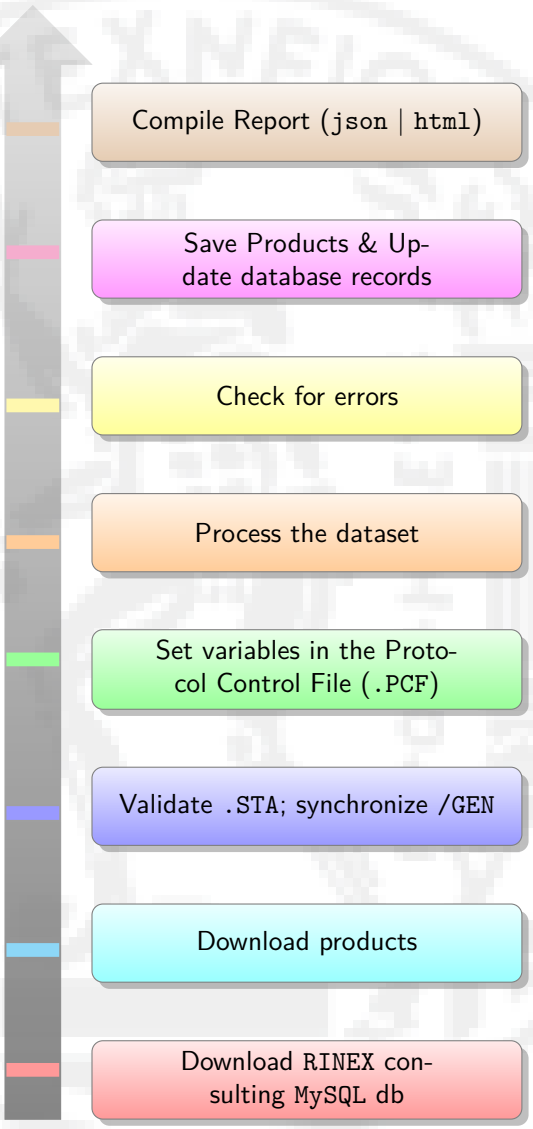
Outlook

Processing is consistent with EUREFF standards (Guidelines for Analysis Centres).

- ✓ `SINEX` with required info/blocks,
- ✓ Reference frame `IGb08`,
- ✓ `IERS` Conventions 2010,
- ✓ `IGS/CODE` products,
- ✓ ocean loading corrections (`FES2004`),
- ✓ atmospheric tidal loading corrections,
- ✓ 3° elevation cut-off angle; elevation dependent weighting,
- ✓ `GMF` and/or `VMF1`; `Chen-Herring` gradient parameter,
- ✓ amiguities fixed (length-dependent algorithm),
- ✓ use `GLONASS` obs (when available)

Workflow

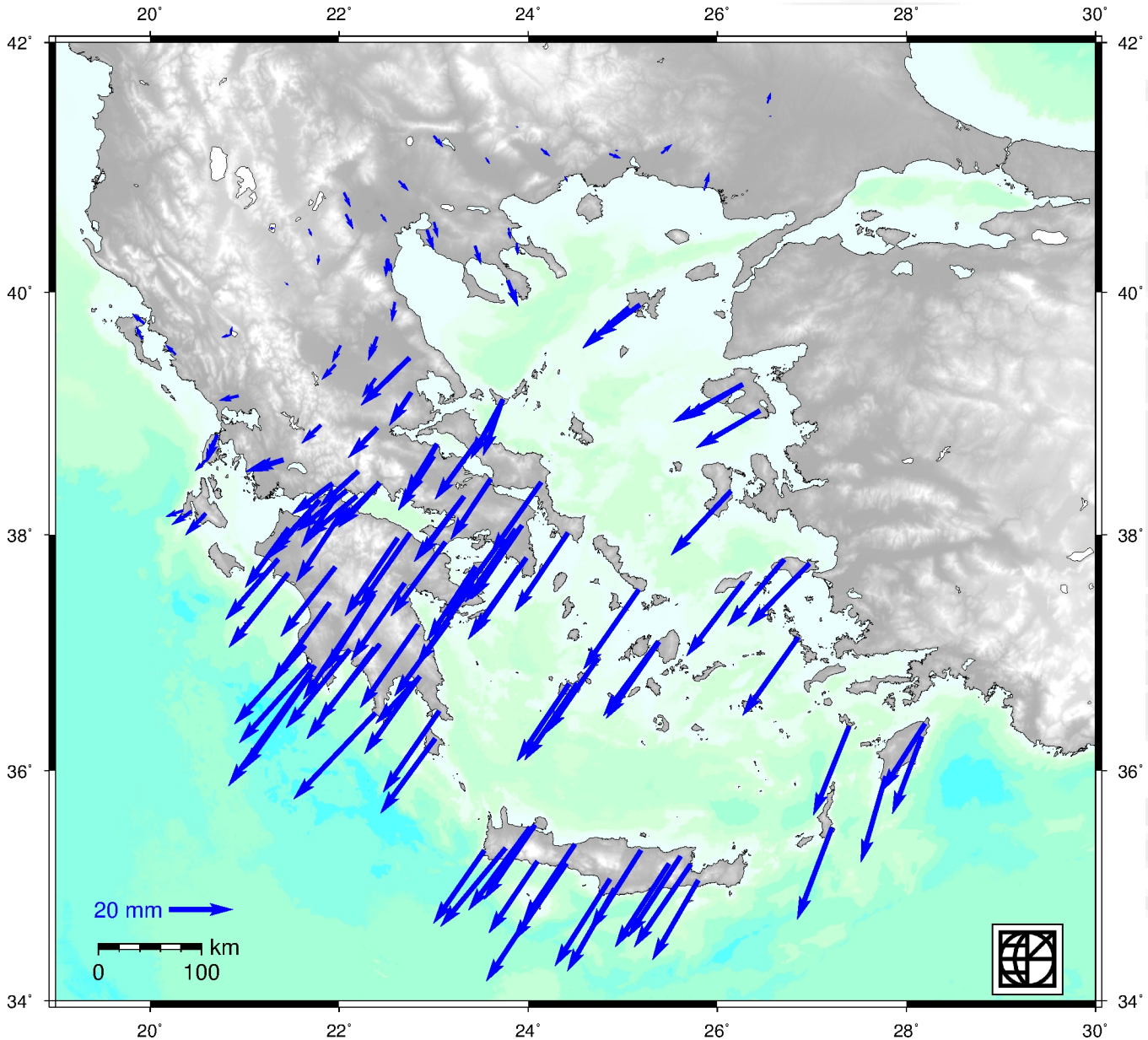
```
$>ddproces.sh --year=
--doy= --session=
--bern-loadgps=
--campaign=
--satellite-system=
--solution-id=
--save-dir=
--analysis-center=
--use-ntua-products=
--append-suffix=
--elevation-angle=
--update= --pcv=
--apply-exclude-list
```



Results & Output

JSON output

Velocity Field



Web Resources

Visit, Browse, Interact, Comment

Dionysos Satellite Observatory
http://dionysos.survey.ntua.gr/

GSAC repository http://dionysos.survey.ntua.gr/dsoportal/_datacenter/gsacrepos.html

Ftp site http://dionysos.survey.ntua.gr/dsoportal/_datacenter/ftpdata.html

Kefallonia earthquake http://dionysos.survey.ntua.gr/dsoportal/_projects/supersites/cephalonia/

Ionospheric Remote Sensing http://dionysos.survey.ntua.gr/dsoportal/_projects/IonoRemSens/

Thank you very much for your attention !

References I

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Bernese GPS Software Version 5.0
Astronomical Institute, University of Bern, 2007.

Papoutsis I., Papanikolaou X., Floyd M., Ji K. H., Kontoes C., Paradissis D., Zacharis V.
Mapping inflation at Santorini volcano, Greece, using GPS and InSAR
Geophysical Research Letters, 40(2):267-272, 2013

Sakkas V., Lagios E.
Fault modelling of the early-2014 $\sim$ M6 Earthquakes in Cephalonia Island (W. Greece) based on GPS measurements
Tectonophysics, Volumes 644–645,184-196, 2015, Pages 184-196

References II

Merryman Boncori J.P., Papoutsis I., Pezzo G., Tolomei C., Atzori S., Ganas A., Karastathis V., Salvi S., Kontoes C., Antonioli A.

The February 2014 Cephalonia Earthquake (Greece): 3D Deformation Field and Source Modeling from Multiple SAR Techniques

Seismological Research Letters, Vol.86(1), 2015

UNAVCO

GSAC – Geodetic Seamless Archive Centers: Open-source Software for Geodesy Data Repositories

available at `https://www.unavco.org/software/data-management/gsac/gsac.html`

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IGb08: an update on IGS08
IGSMAIL [6663] http://igscb.jpl.nasa.gov/pipermail/igsmail/2012/007853.html, 2012

Boehm J., B. Werl, and H. Schuh (2006)
Troposphere mapping functions for GPS and very long baseline interferometry from European Centre for Medium-Range Weather Forecasts operational analysis data
Journal of Geophysical Research, vol. 111, B02406, 2006