Geodesy in EPOS
- a status report

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Outline for this presentation

- Comprehensive background on EPOS was given in previous presentation. Therefore not repeated here!
- Background to Geodesy in EPOS
  (EPOS WG4 – GNSS data and other geodetic data)
- What to include and what to leave out in the geodesy component?
- Status of WG4 achievements May 2013…
- Relation between EPOS WG4 and EUREF
  – is it competing or complementary? (*complementary of course!*)
- Summary

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Background to geodesy in EPOS

WG4 – "GNSS Data and Other Geodetic Data" is the Working Group of the EPOS project in charge of defining and preparing the integration of the existing Pan-European Geodetic Infrastructures that will support the European Geosciences. It is open to the entire geodetic community. In fact, WG4 also includes members from countries that formally are not part of the current phase of EPOS.

What to include and what to leave out in the geodesy component?

There has been discussions within the EPOS WG4 on which observations to be included or not:

- GNSS data is obvious, but is only permanent installations of interest, or will also campaign data be considered?
- Other parts of EPOS have asked WG4 to include sea level data. However, there are other international structures for that (like PSMSL)
- Other parts of EPOS has also asked for the static gravity field! So far, it is not considered in WG4.
- Within the WG it has been discussed on repeated absolute gravity (AG) and superconducting gravity (SG),

Conclusion:

Focus on cGNSS (continuous GNSS) as a start!

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RIs, TS and CS

- Installations that collect and provide observations are denoted "research infrastructure" (***RI***), in EPOS terminology

- "Thematic Services" (***TS***) provide community oriented services (added value to data related to one specific scientific discipline, WG 1 -7)

- EPOS Integrated "Core Services" (***CS***) build on products from Thematic Services, and provide integrated products from several scientific disciplines

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Table 1. Scientific application of GNSS data for the EPOS community

Application	Data need	Existing projects	EPOS added value
Tectonics	30s, daily	EUREF, CEGRN, ...	Dense velocity field
GNSS-seismology	1Hz, sub-hourly>=1Hz, real-time (GNSS seismometer)		>1Hz real-time processing, Collocation with seismometers
GIA	30s, daily		Densification
Sea-level change	30s, daily	IGS TIGA, EUREF	Collocation with tide gauges,
Loadings	30s, daily (global) 1Hz, sub-hourly (storm surge) >=1Hz, real-time (storm surge)		Densification
Early warning systems	>=1Hz, real-time	TRANSFER,	>1Hz real-time processing

From draft version of EPOS WG4 thematic and core service document

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Table 2. Scientific application of GNSS data for other communities

Application	Data need	Existing projects	EPOS added value
Reference frame	30s, daily	EUREF	National level
Meteorology	30s, hourly (forecasting) 1Hz, sub-hourly (now-casting) >=1Hz, real-time (now-casting)	E-GVAP, COST	Unique access to a common dataset, additional collocations with met sensors, ...
Climate change	30s, daily		Data density, homogeneity in long-term processing, collocations
Space weather	30s, hourly (forecasting) 1Hz, sub-hourly (scintillations) >=1Hz, real-time (scintillations)		Densification

Move to Table 1?

From draft version of EPOS WG4 thematic and core service document

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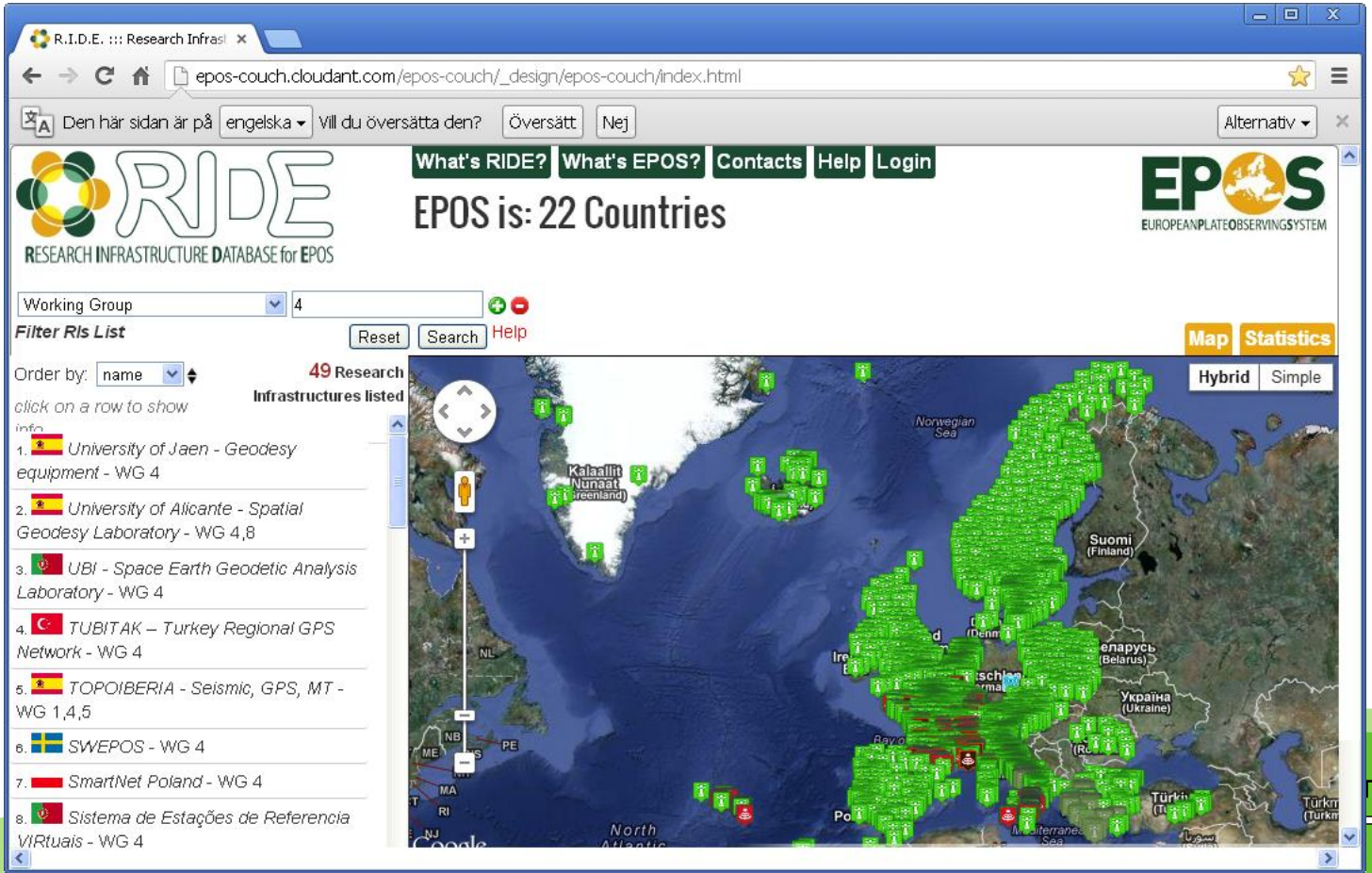
RIDE - Research Infrastructure Database for EPOS

(database with information on research infrastructures)

Some 1500 cGNSS stations, managed by some 50 research infrastructures (RI), potentially available for EPOS

- You may have contributed to this by answering a call some years ago !



EPOS Board of Service Providers (all thematic & integrated service Board members)

EPOS Geodetic Products & Services (EGPS)

Governance and coordination by Board of Service representatives, 4-6 members

GNSS DATA DISSEMINATION

RINEX and RTX (stream) data from Permanent Stations

Structure: Distributed (GSAC?)
1 EPOS Data Gateway
~6-10 nodes, including EPN Data Centers.

Products (indicative list)
RINEX and RTK data from Permanent Stations:
- GNSS daily (30s), delay of max 1-2 days
- GNSS daily (30s), full history, archived
- GNSS hourly (30s)
- GNSS sub-hourly (1Hz)
- GNSS real-time (>=1Hz)

Services
- GNSS Data (seamless and redundant access)
- Station information (metadata, site characteristics, ...)

GNSS DATA PRESERVATION

RAW and RINEX data from Permanent (and Campaign) Stations

Structure: Distributed
~2-3 nodes, including EPOS Data Gateway.
(EUDAT initiative?)

Products (indicative list)
Historical RAW and RINEX data at different observation rates (in particular for >=1Hz).
Metadata for all archived data.

Services
- Preservation of historical data and metadata (including commercial networks)
- Data redundancy and synchronization
- Original format and conversion to common format (RINEX x.x)

GNSS DATA MONITORING

Data QC Summaries, Graphical Outputs and Feedback

Structure: Distributed
~2-3 nodes, including EPOS Data Gateway

Products (indicative list)
Results of data and metadata control (without processing)
- Availability/redundancy monitoring
- Latency monitoring
- Data quantity and quality monitoring
- Metadata monitoring

Services
- Feedback to data providers
- Support for analysis

EPOS Volcanology

EPOS Geology

... Other EPOS Communities

Still preliminary

e-Geodesy & common services

Geodetic services for visualisation, discovery and access to portal
expert groups, standards

EPOS Integrated Services

Visualisation tool / discovery & access portal
high performance and high end computing (may absorb E-Seismology)
expert groups, standards

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GNSS DATA ANALYSIS

Station Processing for Position Estimations

Structure: Distributed
~3-5 nodes, including EPOS Data Gateway.

Products (indicative list)
Real-time to post-processing position solutions:
- Enhanced data quality control
- Long-term performance monitoring
- Monitoring visualizations

Derived Velocity Fields
- Secular Motions
- Other periodical and no-periodical signals.

Services
- Web-services for online GNSS data processing
- Additional feedback for data providers and data users
- Repository of existing products:
  - position time series,
  - velocity fields.

SUPPORT and GOVERNANCE INFRASTRUCTURE

Support to GNSS activities for Solid Earth research

Structure: Centralized
~1 node (EPOS-GNSS Center)

Products (indicative list)
- Quality Control including rapid analysis.
- Coordination.
- Diffusion of best practices.

Services
- Support to Research projects
- Support to installation of Permanent stations
- Realization of Scientific and Technical Courses

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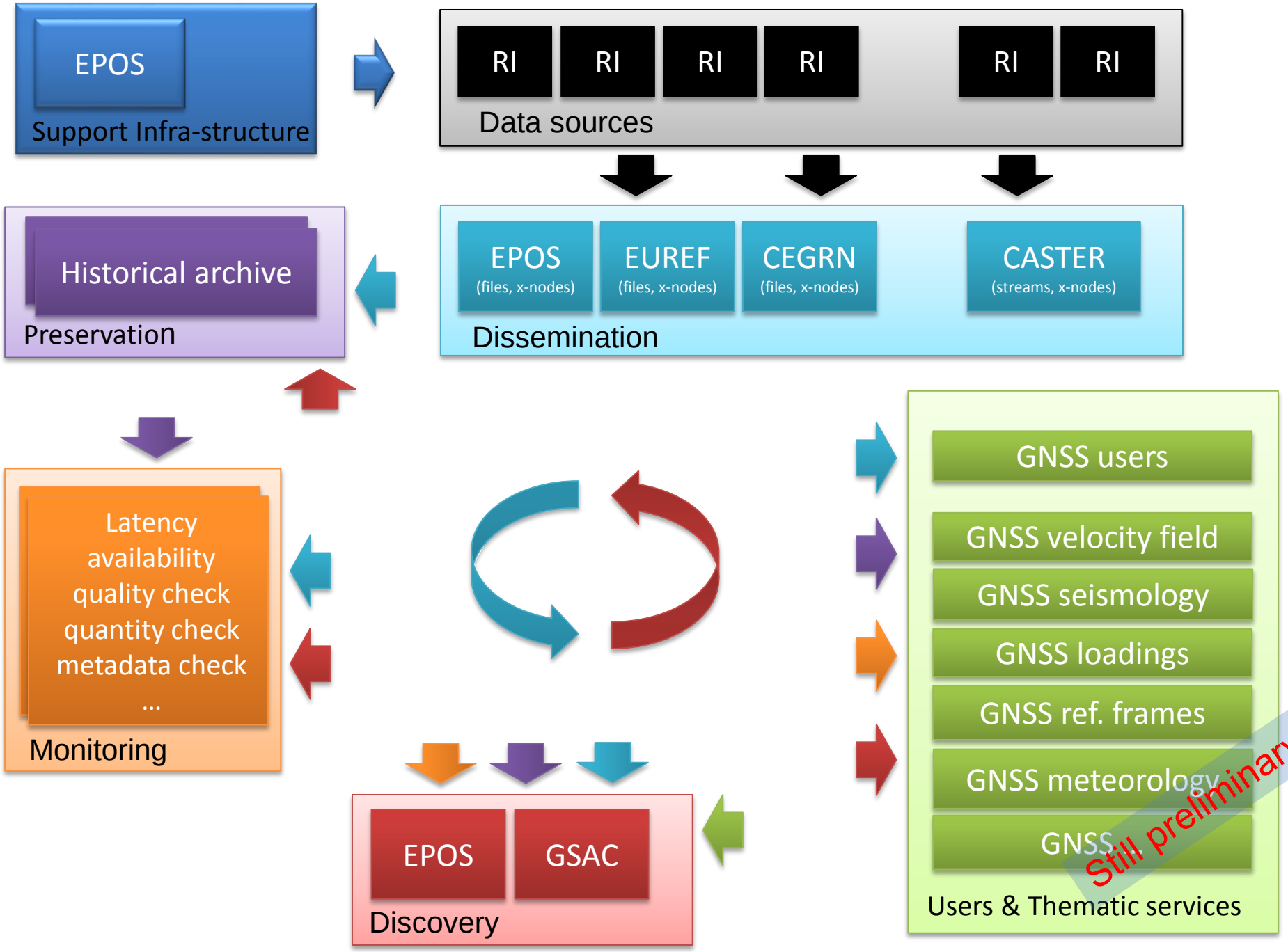
EPOS
Support Infra-structure
RI
RI
RI
RI
RI
RI
Data sources
Historical archive
Preservation
EPOS
(files, x-nodes)
EUREF
(files, x-nodes)
CEGRN
(files, x-nodes)
CASTER
(streams, x-nodes)
Dissemination
Latency
availability
quality check
quantity check
metadata check
...
Monitoring
EPOS
GSAC
Discovery
GNSS users
GNSS velocity field
GNSS seismology
GNSS loadings
GNSS ref. frames
GNSS meteorology
GNSS...
Users & Thematic services
Still preliminary

Benefits of EPOS (compared to current situation) (1)

- Formal organization of EPOS will be through "European research Infrastructure Consortium, ERIC".

  Usually countries are members, and *RIs* and *services* are included into EPOS through the contribution from each country

- When included in EPOS, there is a firm commitment from your country for long term support (and financing!) for your contribution!

  So try to be included in EPOS!

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Benefits of EPOS (compared to current situation) (2)

- EPOS WG4 consider EUREF EPN to be the backbone for geodetic GNSS in Europe!
- And EPN strive for best performance and highest possible quality
  - And therefore don't include stations with limitations in performance
- EPOS strive to collect, preserve, and utilize all observations that potentially may contribute to scientific progress
  - Therefore much more stations and raw (RINEX) data are welcomed and asked for
- Data preservation and archiving is important in the EPOS WG4 component

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Benefits of EPOS (compared to current situation) (3)

- The ambition is that EPOS will facilitate improved, extended and new products compared to current situation, e.g. (personal ideas from the presenter…)
  - GNSS seismometers based on GNSS real time streams?!
  - Position time series in well defined reference frame from 4000 cGNSS stations in Europe?!

    …With 1s temporal resolution to facilitate detailed studies of earth quake events???
  - European post processing service for geosciences applications – for easy and accurate access to ETRS89
  - And hopefully much more that we are not aware of today!

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Relation between EPOS WG4 and EUREF EPN (1) *- is it competing or complementary?*

- EUREF EPN is the backbone – while EPOS facilitate an organizational context of the extension
- EUREF EPN densification activity are aiming for a dense field of station velocities by including national/regional SINEX solutions to be merged by the EPN weekly combinations (for position time series and velocities) – while EPOS supply data preservation and archiving facilities for raw (RINEX) data

  (to compute and provide SINEX solutions from RINEX within EPOS has not yet been discussed)
- Ideally, EPOS will facilitate that more stations will be included in the development of the dense field of station velocities

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Relation between EPOS WG4 and EUREF EPN (2) *- is it competing or complementary?*

Organizational differences between EPN & EPOS not sorted out, but:

- Ideally, current RIs and organizational bodies contributing to EPN, should be included in the different national contributions to EPOS!
- And when needed (e.g. demand for increased capacity due to the additional number of stations etc.) complementary contributions of services may be developed.

- Probably there will be a need for a Central Bureau, Data Centers, analysis centers, "product providers" etc. booth within EPN and EPOS WG4.

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Summary

- Within EPOS WG4 there are fairly well established ideas on what the GNSS community should deliver to other geoscience disciplines
- And the (preliminary?) structure for the services has been discussed and documented (slide 9 – 11)
- However, much work are still needed regarding the implementation of the proposed structure
- And there are many open issues on how to deal with the organizational structure between EPOS and EUREF
- (and there are also other existing organizations not mentioned in this presentation)

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