

First steps in the development of an EUREF Velocity Model

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Deformation in Europe



Deformation in Europe



GNSS stations in Europe

More stations in Europe, i.e. in the south and east can be included!

EUREF Permanent Network, *dense* EPN to be used as "backbone".



Possibly useful permanent GNSS stations But for geodynamics, stability and reliable metadata on equipment etc. are issues.



EUREF working group on deformation models (1)

The dual purposes of the working group (WG):

- First, there are pure scientific interests in improving the knowledge of surface deformations in Eurasia and adjacent areas
- Second, a reliable velocity model will potentially be a valuable tool for management and use of national realizations of the ETRS89
 GNSS-based station velocity (and time series) solutions:
- Is not the topic for this WG!
- Will build on results and products from the EUREF EPN Reference Frame Coordinator (Ambrus Kenyeres, FOMI) as "backbone" for velocity model(s).
- Managers of GNSS networks are invited to submit weekly (daily) SINEXsolutions to be included in the combined products. Contact to EUREF/Ambrus!

Objectives of the WG:

- 1. Evaluation of available GNSS-derived velocity fields
- 2.Inventory and evaluation of available crustal deformation models for Europe or selected parts of it
- 3.Consideration of a deformation model in maintenance and use of national realizations of the ETRS89

Note the common interest with EPOS and the WG4 (GNSS and other geodetic...)

EUREF working group on deformation models (2)

About models of crustal deformations:

Preferred are geophysical meaningful models which explain the observed deformations. Second option are models based on reliable interpolation (e.g. collocation/kriging) of observed deformations (based on dense GNSS stations). Specific areas of interest:

- Mediterranean area
- Fennoscandia
- Iceland Greenland

 ...but of course there are many more geophysically interesting areas!
Not trivial to include earthquake events into a spatial (ex. gridded) model of crustal deformations

First steps

- Inventory of performed and published work on deformations in Europe and adjacent areas; includes observation analysis and modelling
- Evaluation of GNSS velocity field
- Evaluation of performance of models

WG status

- Collected more than 60 published local/regional velocity fields
- Most peer-reviewed publications since early 90s included
 - Reanalysed BIFROST/SWEPOS will be included once available (September 2013)
 - Still missing: Germany (SAPOS)
- Currently analysis of reports and conference proceedings
- Any other material (i.e. datasets with sufficient information) is much appreciated
- Evaluation of velocity fields from geophysical models
- Tests with combining/merging of such data and check of residuals

Test with model data and EPN

- Eurasian frame
- Backbone: EPN

Method used in this test: The "velrot" program from GAMIT/GLOBK was applied to merge EPN with model results.



Interpolation of residuals

Principle: A residual at one point is valid for its surrounding area, and residuals at adjacent points are "similar".

- Is this the situation? How can we test that?









Image of the differential residuals in horizontal component



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Image of the differential residuals in vertical component





GPS determined uplift rate in Fennoscandia



BIFROST (2010) observation

BIFROST Project (Baseline Inferences for Fennoscandian Rebound, Sea-level, and Tectonics) uses GPS to measure crustal deformation in Fennoscandia

(Steffen and Wu 2011)

Data from Lidberg et al. (2010)

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Image of the differential residuals in vertical component





Image of the differential residuals in vertical component with PGR signal added



Milne 120p55



LANTMÄTERIET

Image of the differential residuals in vertical component



Image of the differential residuals in vertical component, PGR signal at EPN/BIFROST stations removed



Image of the differential residuals in vertical component corrected for PGR using the model (more stations added)



Image of the differential residuals in vertical component corrected for PGR using the model





Modelled velocities for Eastern Mediterranean



Image of the differential residuals in horizontal component



Image of the differential residuals in horizontal component including McClusky et al. (2000) data





Image of the differential residuals in horizontal component removing signal determined by McClusky et al. (2000) with model results from Fischer (2006)



Image of the differential residuals in horizontal component



Image of the differential residuals in horizontal component including the model results from Fischer (2006)





Conclusions

- The EPN alone are not enough to get the complete picture of crustal deformations within the geographical scope of EUREF
- Managers of GNSS networks are invited to submit weekly (daily) SINEXsolutions to be included in combined products. Contact to EUREF / Ambrus Kenyeres !
- "WG on deformation models" are aiming for a high resolution velocity field model for Europe and adjacent areas, together with uncertainty estimates. The model should preferably be geophysical meaningful.
- First steps are an inventory of published work, and some tests by merging observed and/or modelled velocity field data sets.

We invite all colleagues to participate and contribute to this work!



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Thank you for your attention!