3D Deformation in time of the ETRF2000 grid

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Outline

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2. Input data
3. Deformation grid generation procedure
4. Results
5. Conclusions (future plans)

3D Deformation in time of the ETRF2000 grid

The objective of this work is to show how a dense 3D velocity field can be used to analyze the deformation, from the local to the regional level, of an original undistorted reference grid.

The data can be also used to go back in time and to extrapolate positions.

The original grid is expressed in ETRF2000 and EPN A and B class sites, as well as densification solutions (CEGRN+Italy) have been used.

Adding new solutions to the “deforming” grid is a straightforward process, so new solutions are welcome!

Input Data: quality assessment

The data (POS+VEL) quality is summarized as follows:

- EPN A class sites: provided by EPN
- CEGRN: former network validated by TWG in 2015. Enlarged Network follows the same adjustment criteria (see CEGRN talk).
- UPA Italian Densification: data submitted regularly to EPN Densification.
- ARA Densification: data submitted regularly to EPN Densification.

Method:

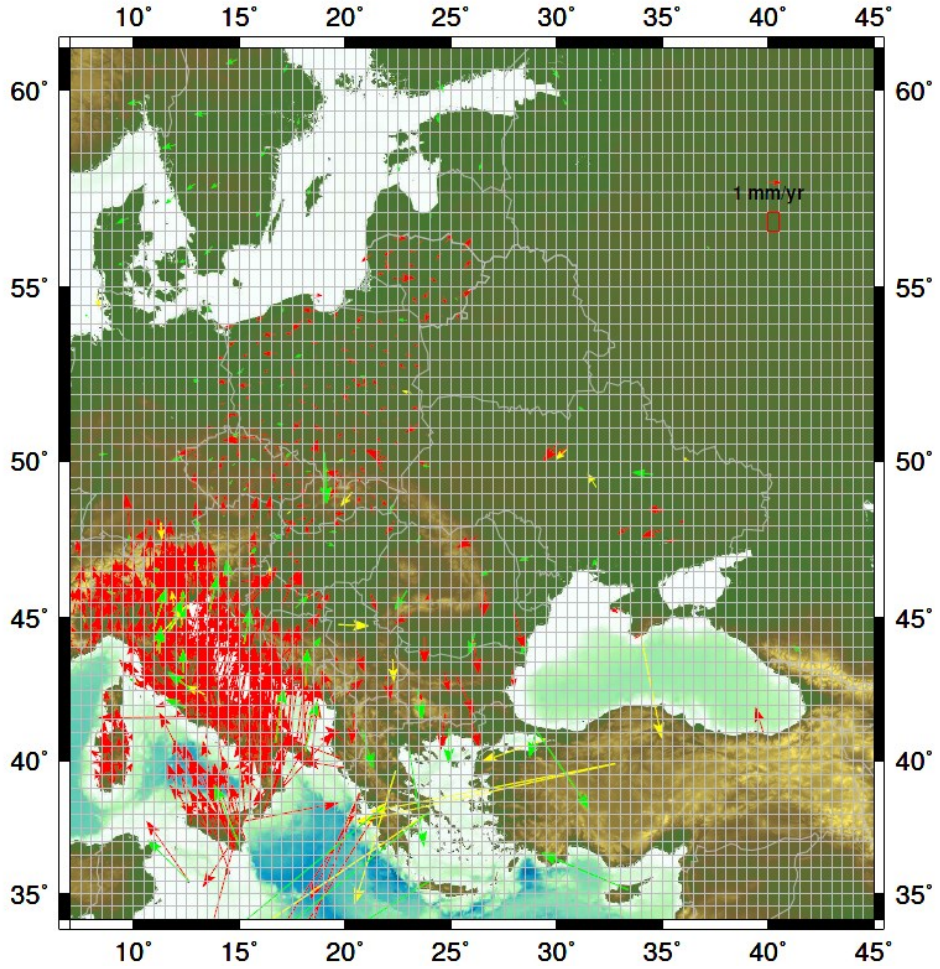
Horizontal: generate yearly grids with grid nodes displaced by the value of the horizontal velocity interpolated at the grid. Stack and make animated .GIF

Vertical: generate yearly level curves with vertical displaced by the interpolated vertical velocity. Stack and make animated .GIF

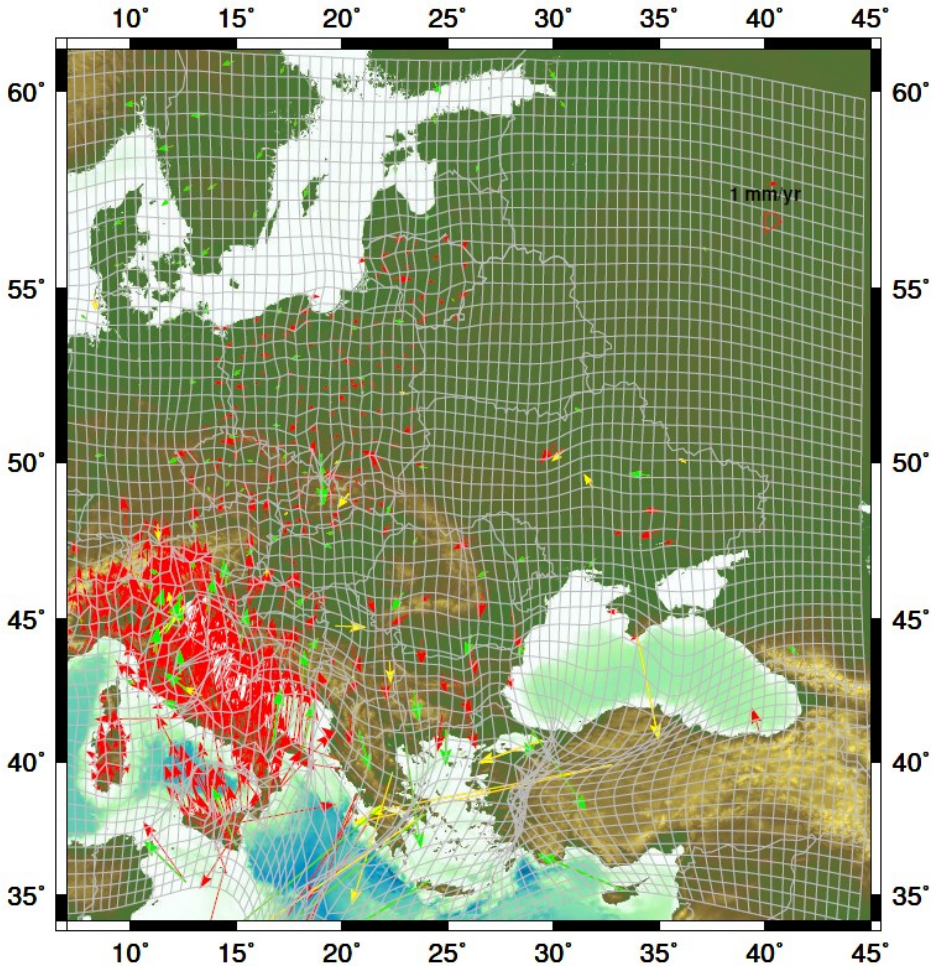
Warning: Densification is very uneven across Europe. Consequently the grid spacing is over or undersized, depending on region. **We show the method**, but we have to wait for a full densification (see E. Brockmann/M. Lidberg WGs) for final results.

Results (Horizontal deformations)

Years since ETRF realization 00

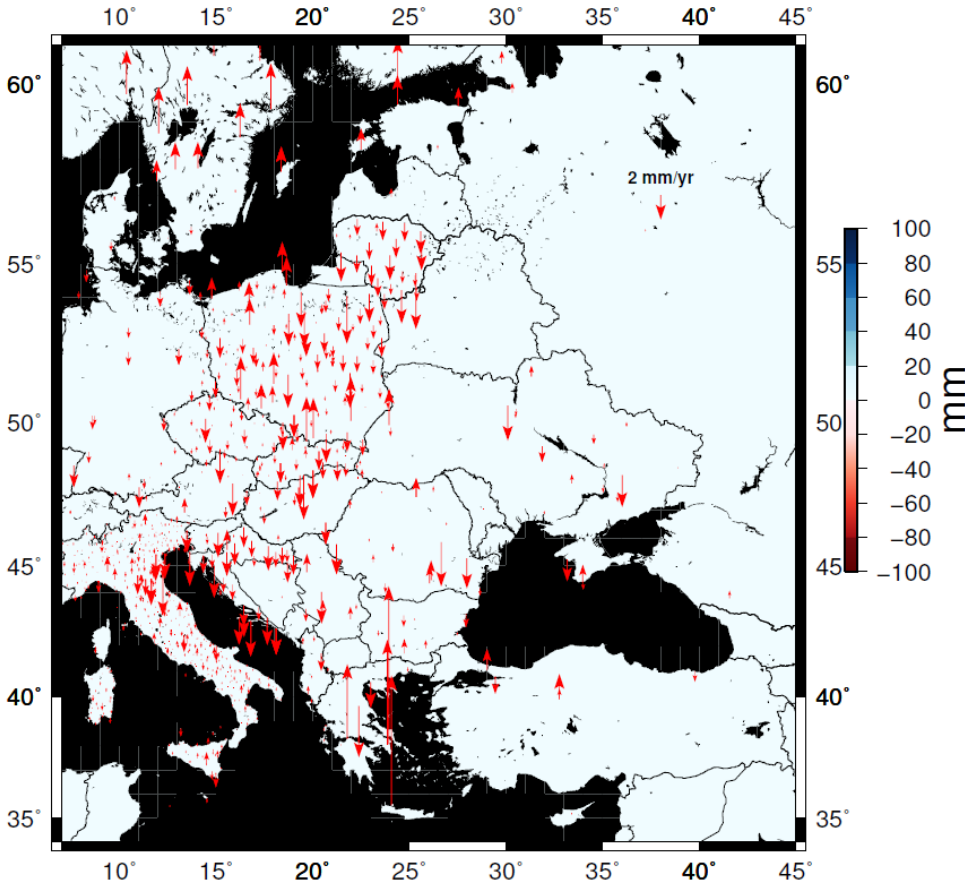


Years since ETRF realization 30

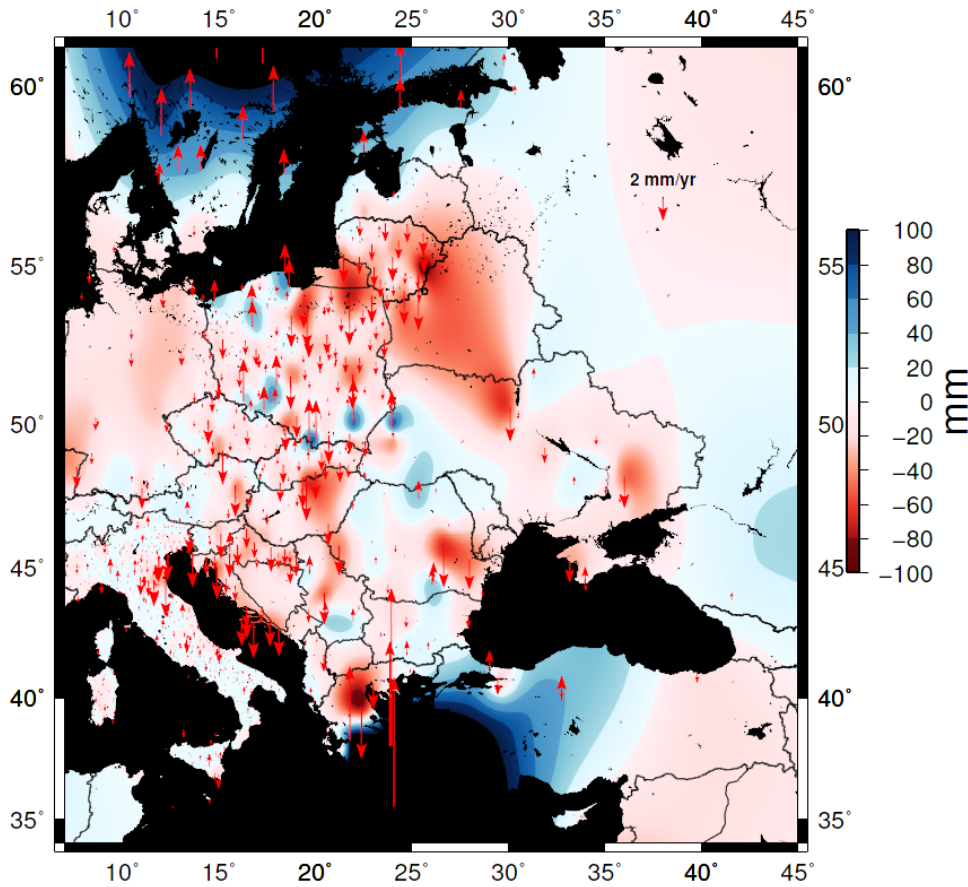


Results (vertical rates)

Years since ETRF realization 00

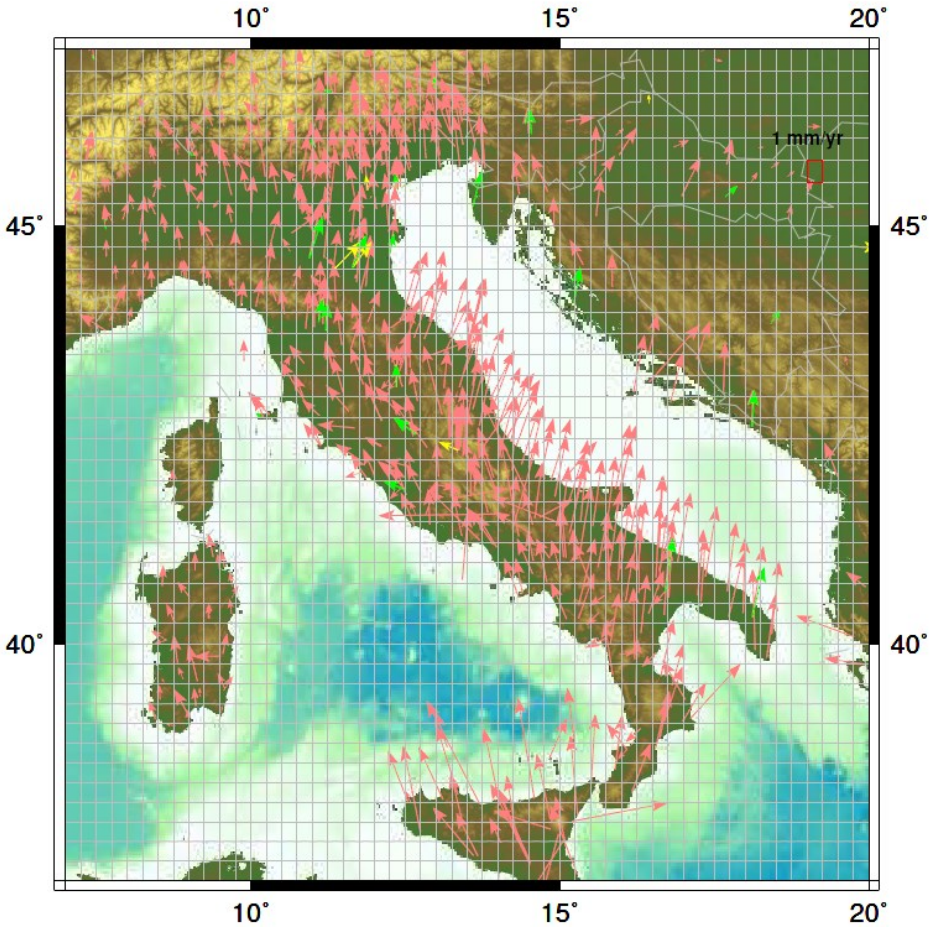


Years since ETRF realization 20

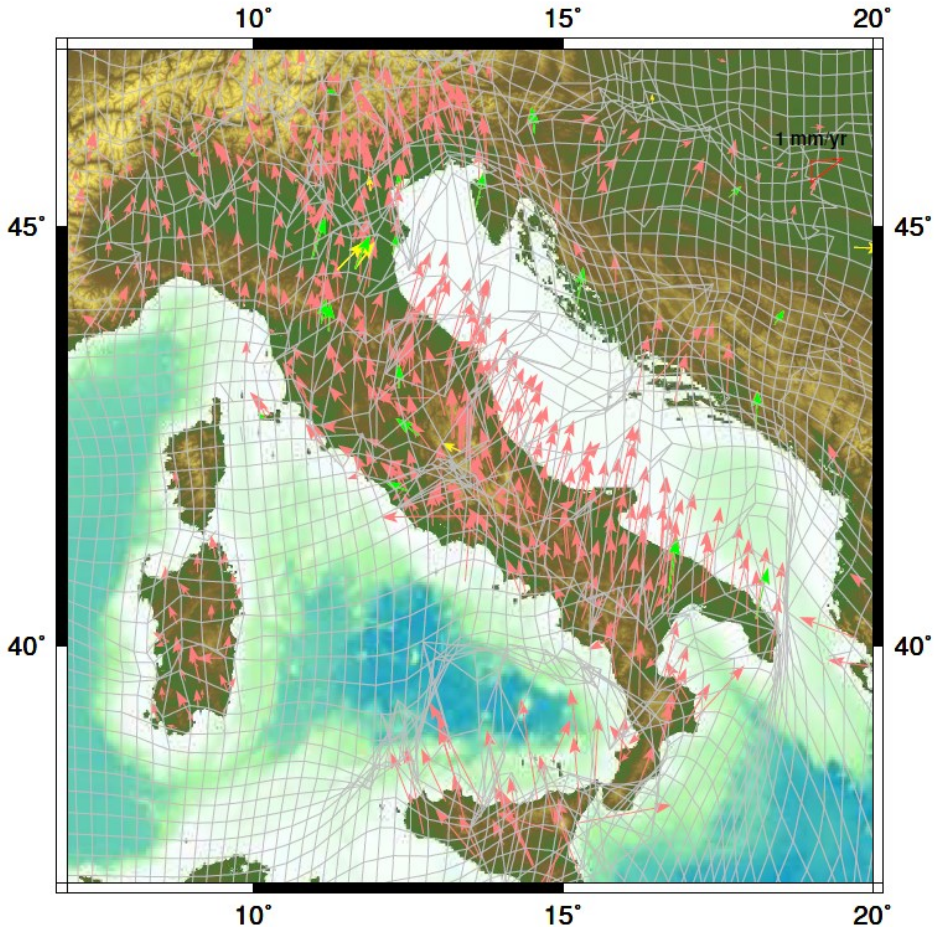


Results (Horizontal deformations):ITA

Years since ETRF realization 00

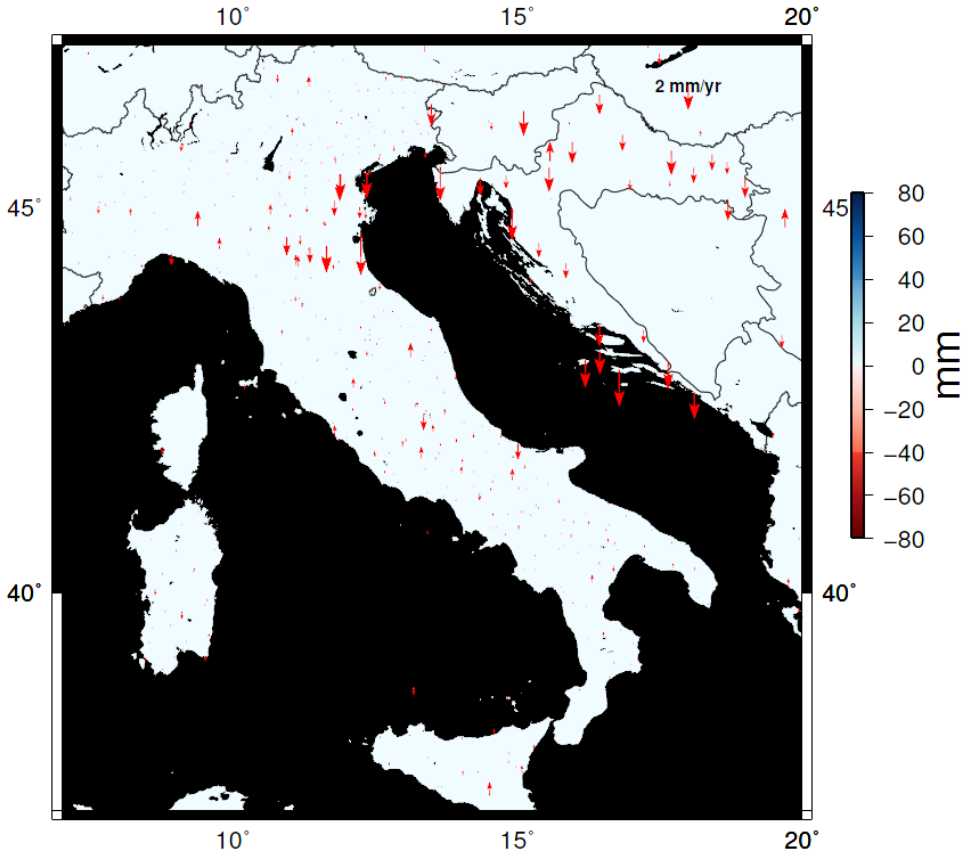


Years since ETRF realization 30

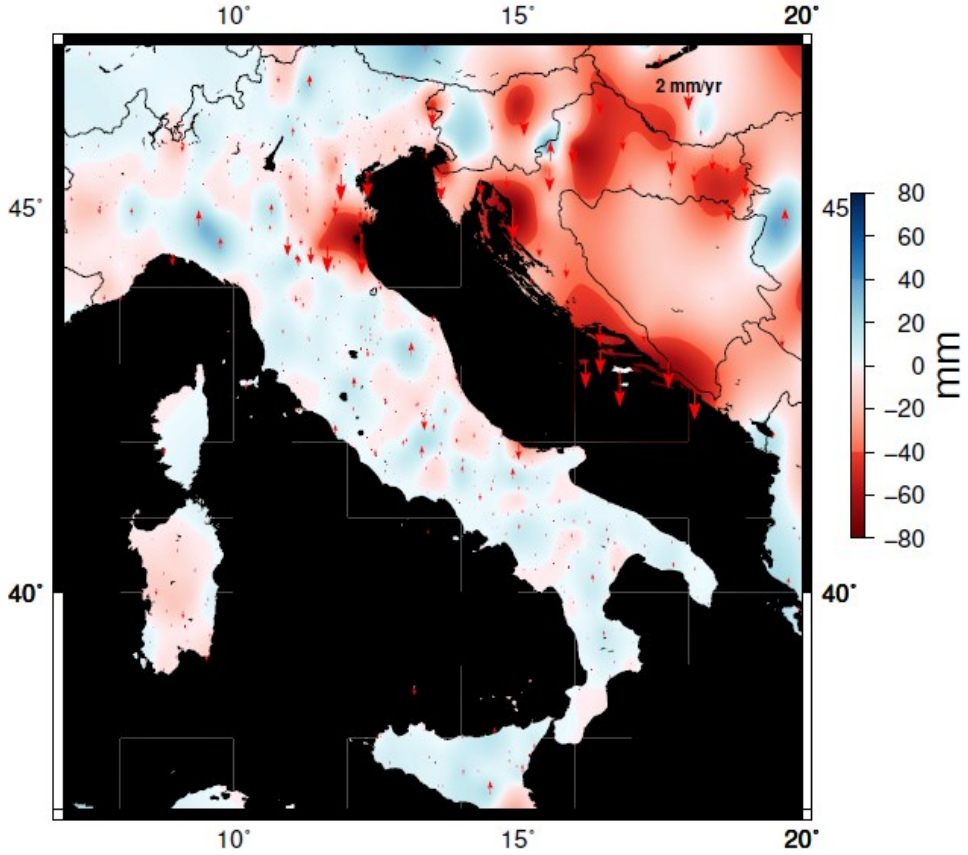


Results (Vertical deformations):ITA

Years since ETRF realization 00



Years since ETRF realization 30



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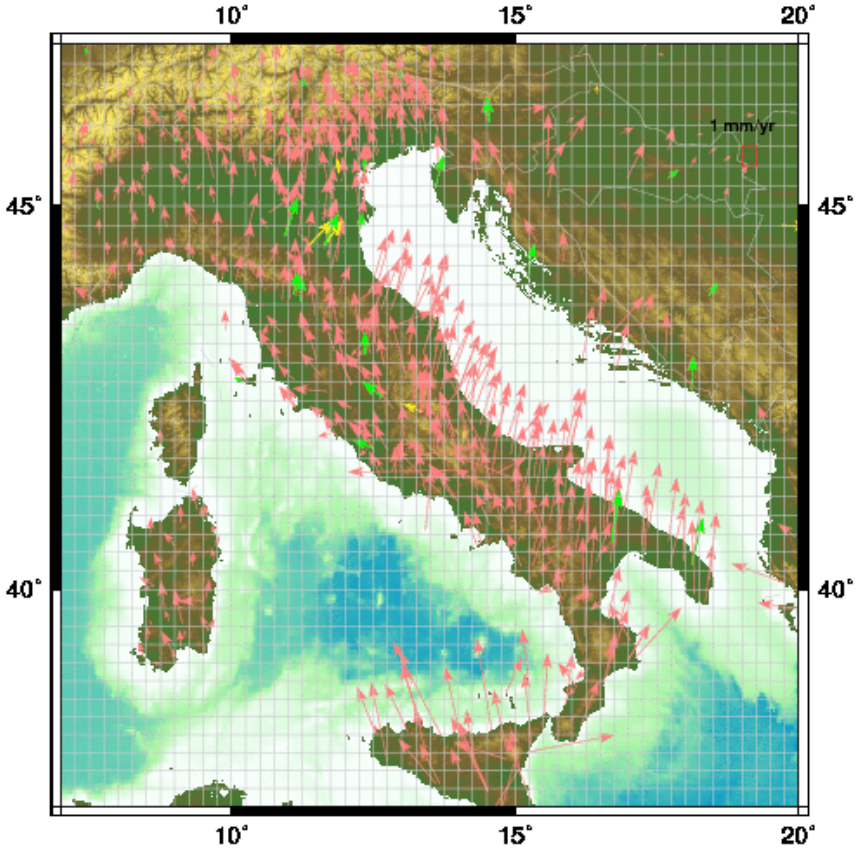
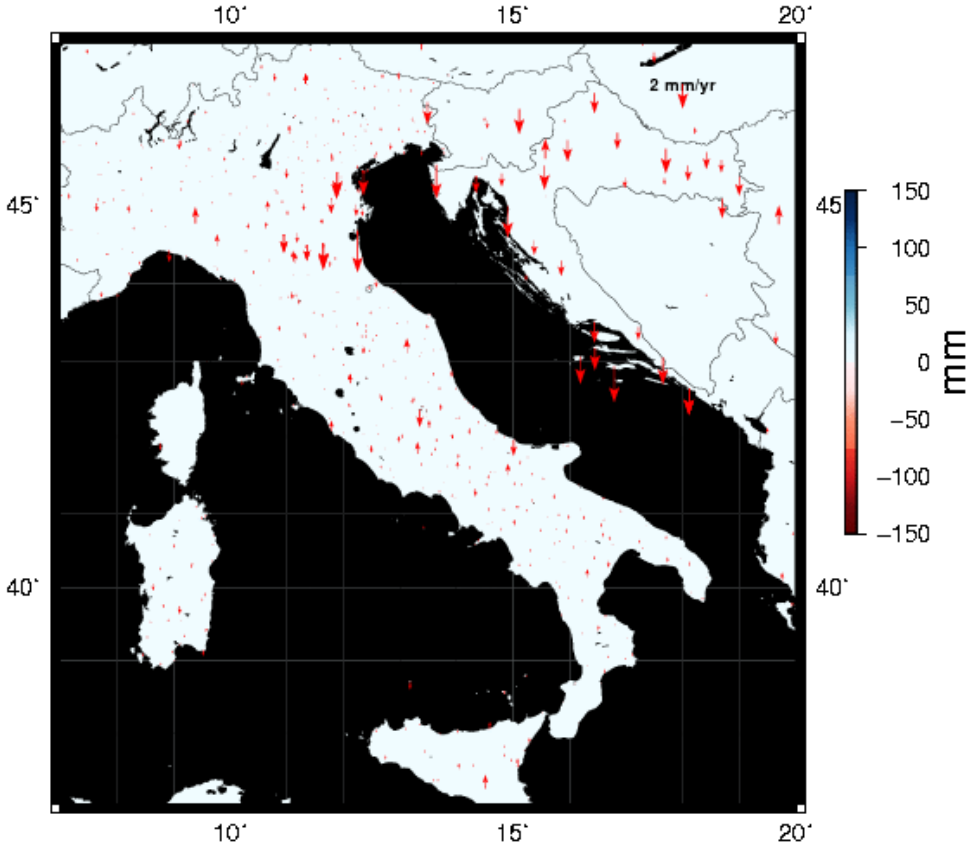
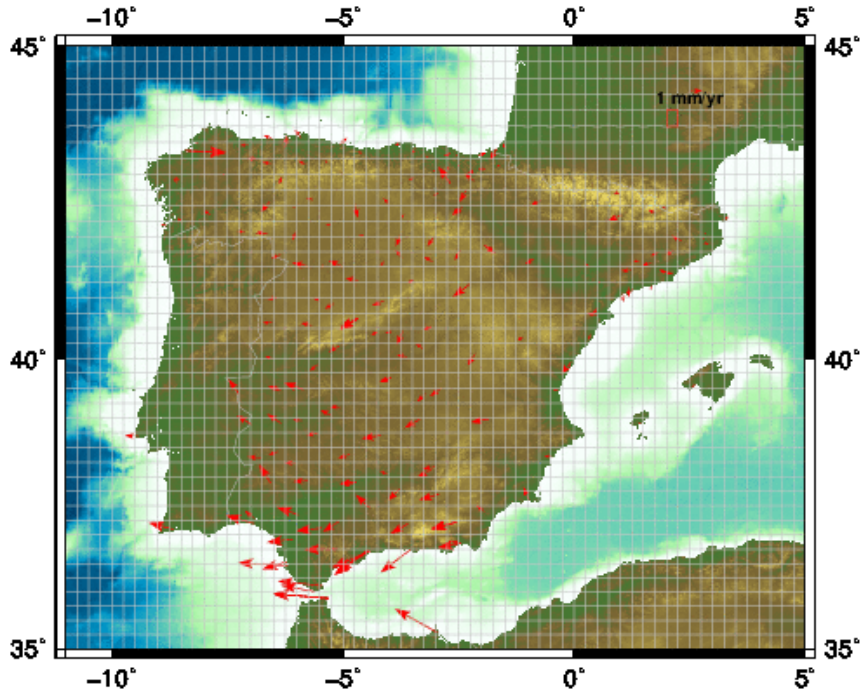
Years since ETRF realization 0(



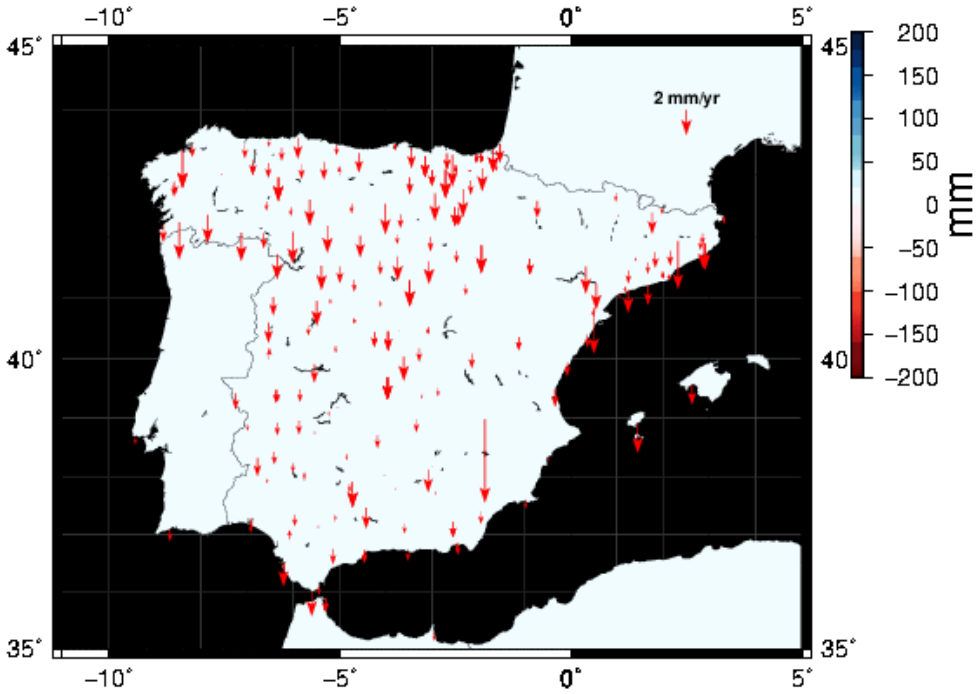
Years since ETRF realization 00



Years since ETRF realization 00



Years since ETRF realization 00



Conclusions/Future plans

- The presented grids are very easily augmented with any additional data (simple ASCII files).
- Areas where deformation relative to undistorted grid (== ETRF2000 realization at epoch) exceeds a threshold (e.g. 3 cm) can be highlighted and visualized (extension of original work by Lidberg and Caporali on the 'validity time of a regional ETRF2000 realization') →very important to NMAs
- For Geokinematic applications we provide a prototype map at a (potentially) European scale of the horizontal shear field and vertical up/down lift → very important for Earth Scientists (EPOS, CEGRN, Wegener and similar projects)
- Possible extension consists in including DInSAR vertical data in the database and grids
- The results support quantitatively the conceptual research on a 'Dynamic Reference Frame' (see M.Poutanen talk) and show that the classical concept of 'straight leg' frame and 7/14 parameter Helmert transformation should evolve into a concept which takes into account that there exists no '.. Stable part of Europe..' at the level of accuracy currently allowed by GNSS technology.

Thank you for your attention