EUREF Symposium 2025

Universidade da Beira Interior
June 25-26, 2025 – COVILHÃ, PORTUGAL

Extending the ETRS89 lifetime: case study for Spain

J. Zurutuza (EUREF ETRS89 WG)

Agenda

1. The INSPIRE Directive
2. ETRS89 (focused on the Iberian Peninsula)
3. Computed New Euler Pole
4. Conclusions

The INSPIRE Directive

As of April 25th 2007, the **INSPIRE** (Infraestructure for Spatial InfoRmation in Europe) **Directive** was published in the Official Journal of the European Union (Directive 2007/2/EC of the European Parliament and of the Council of March 14th 2007)

One of the most relevant implications of the INSPIRE Directive is that **ETRS89** (European Terrestrial Reference System) or any of its **ETRF** (European Terrestrial Reference Frame) realizations – **ITRS** (International Terrestrial Reference System) or any of its ITRF (International Terrestrial Reference Frame) in areas outside the scope of the ETRS89 – is adopted as the **horizontal reference frame to refer the coordinates**.

“The EPN was The primary purpose of the EPN is to provide access to the European Terrestrial Reference System 89 (ETRS89) which is the standard precise GNSS coordinate system throughout Europe. Supported by EuroGeographics and endorsed by the INSPIRE…” (epncb website).

As a consequence, most European countries adopted ETRF realizations as their national reference frame.

The INSPIRE Directive

The **advantage** of using ETRS89/ETRF **coordinates** (fixed to the stable EURASIA plate and aligned to the ITRS at epoch 1989.0), is mainly their small variations over time.

This makes them very suitable for legal and practical issues.

However, in certain areas, such as the Eurasia south-western borders, Italy, Greece,…, the ETRS89 departs from the EURASIA plate and the coordinates may change rapidly over time.

In modern GNSS networks, the access to the ERS89 is done through **Permanent GNSS** Stations, and some thresholds are imposed to the reference coordinates when **no velocities are provided** as a part of the National Realization deliverables.

For example, the coordinates should not vary more than 10 mm over a certain period of time. If they do, the coordinates must me updated.

ETRS89 (focused on the Iberian Peninsula)

The ETRF2000 adapts quite well to the measured values, very especially at the North.

We notice a clockwise rotation of all the stations from 40 deg. N to the South related to the rest of the Iberian Peninsula. This study is focused mainly on Andalusia (around 87,597 square kilometers) and could applied to small countries.

This intraplate rotation (above 4 mm/year southern Spain), implies that the ETRF2000 coordinates must be updated every 3 years to keep the coordinates within +/- 1 cm respect the initial reference epoch.

We do not find this in the Northern stations.

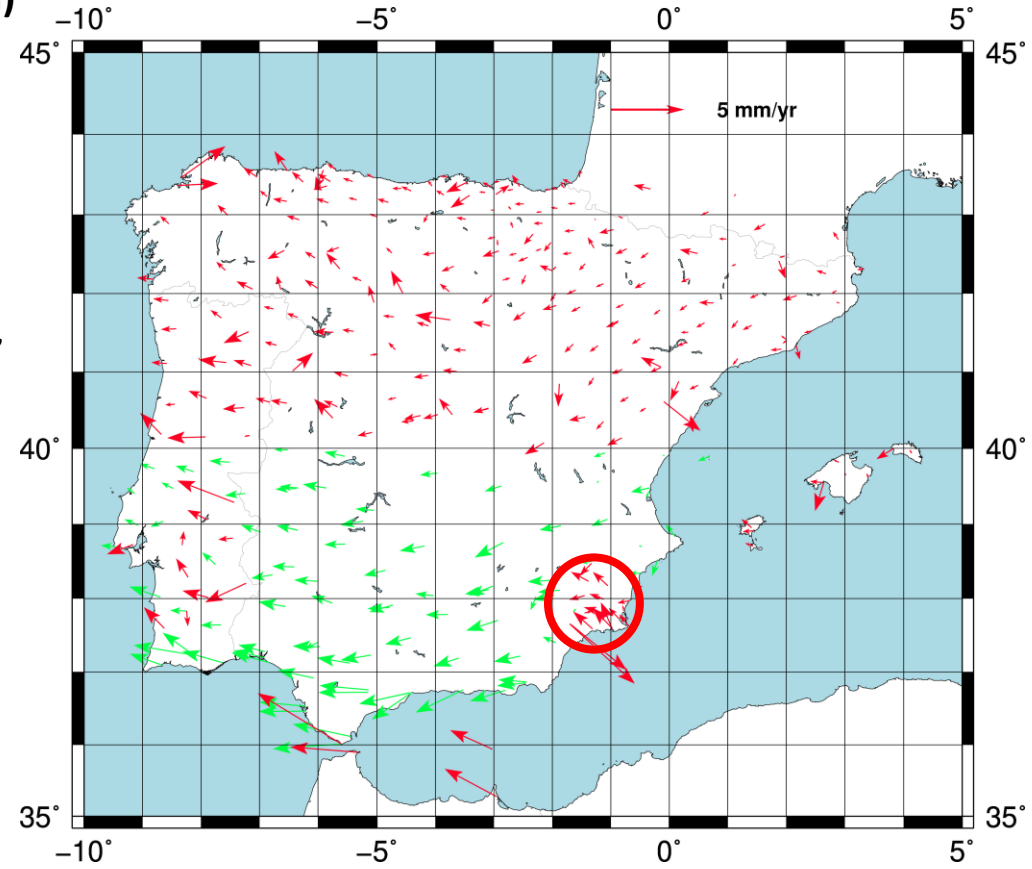
In this presentation, a case study is presented in order to improve the ETRF2000 lifetime by adding an additional Euler Pole rotation model.

ETRS89 (focused on the Iberian Peninsula)

The Northern stations show no patterns

Souther sites (latitude < 40 deg) show a rotation.

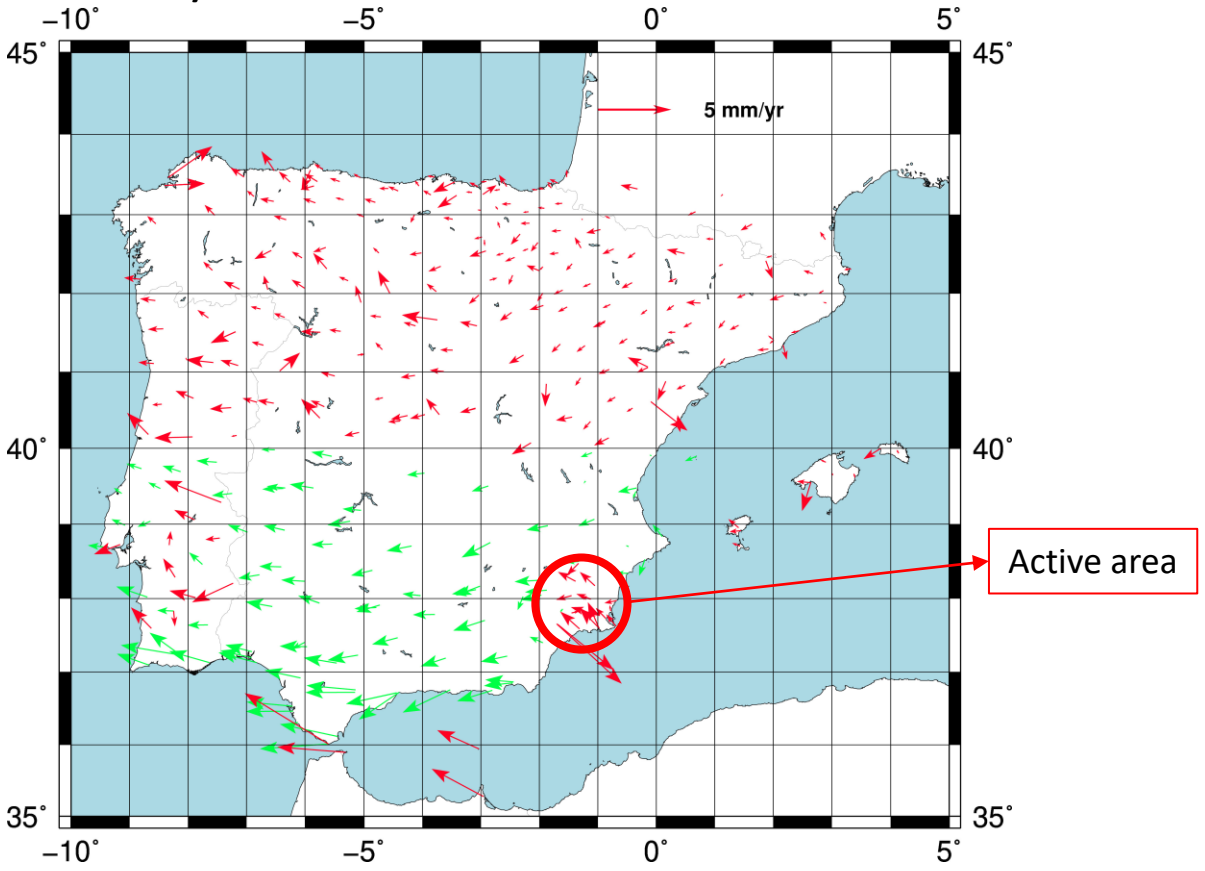
We compute a new Euler Pole to “correct” the coordinates with these computed velocities (Euler Pole+rate related to this new Pole).



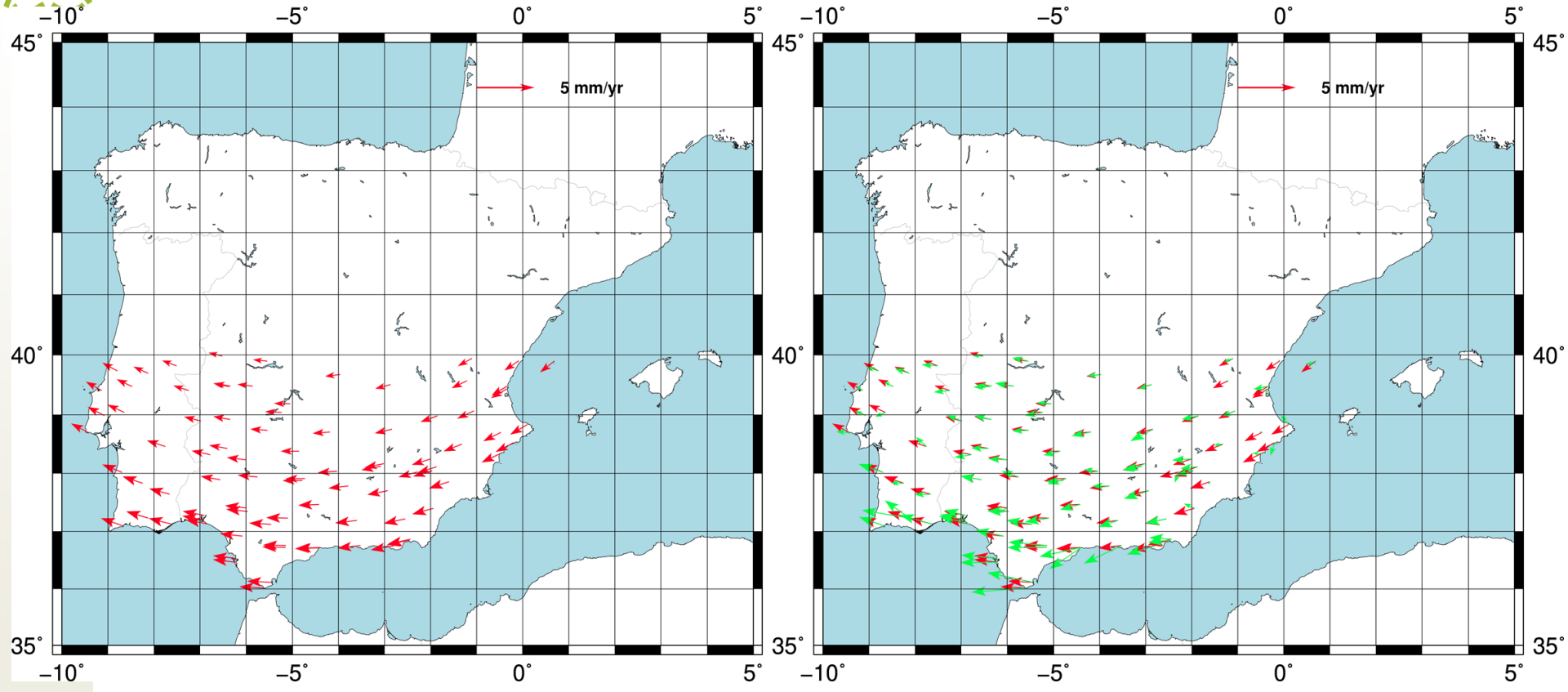
ETRS89 (focused on the Iberian Peninsula)

ETRF2000 Computed Velocities (+3 years of data, repro3 solutions)

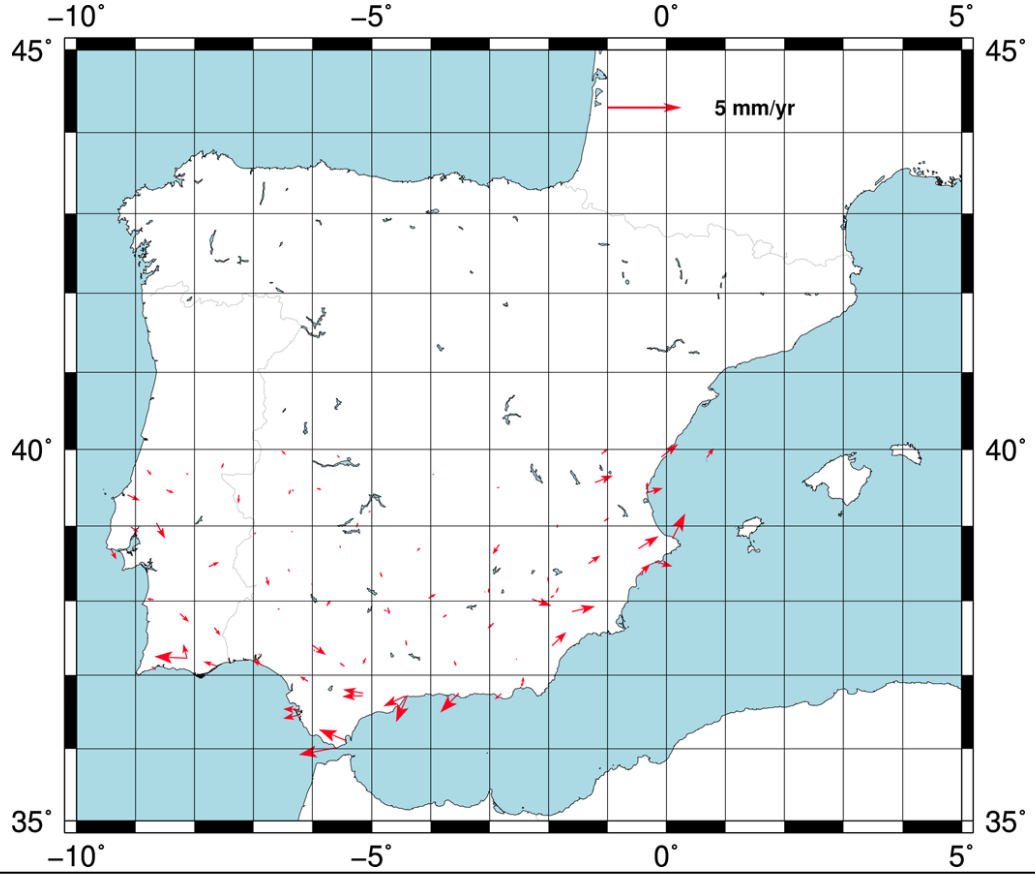
GREEN: used velocities



Computed New Euler Pole (Euler Pole related velocities vs Measured velocities)



Computed New Euler Pole (Euler Pole related velocities vs Measured velocities) residuals



Computed New Euler Pole

If we correct the coordinates using these predicted velocicites, the lifetime of the coordinates can be extended:

	min (mm/yr)	max (mm/yr)	mean (mm/yr)	rms (mm/yr)
pred_e	-2.16	-1.20	-1.63	1.65
pred_n	-0.97	0.80	-0.02	0.46
Measured_Ve	-4.67	-0.11	-1.61	1.85
Measured_Vn	-1.85	1.53	-0.03	0.52
Residual_ve	-2.51	1.55	0.02	**0.74**
Residual_vn	-1.77	1.68	-0.01	**0.50**

Considering the mean residuals (EP vs Measured velocity differences), we can project the solutions up to 13 to 14 years to reach the 10 mm coordinate variation (V East).

Conclusions

The presented exercise can be applied to different areas using the EPND velocities.

Its implementation is very straightforward and very easy to be implemented: we only nee the EP coordinates and the rate

These kind of modelizations can be very useful for densification solutions (or PPP solutions), where we do not have long time span solutions. In these cases we can have cETRF2000 coordinates.

The computed coordinates are not ETRF2000 anymore! They should be called **c**ETRF2000 (Corrected ETRF2000) or any name to make this clear.

Thank you for your attention

Questions/suggestions/comments/want to take part?

At the EUREF2025 (anytime/any place), or
jzurutuza@gmail.com