



Up to date geodetic velocity field of the Belledonne region (Western Alps, France)

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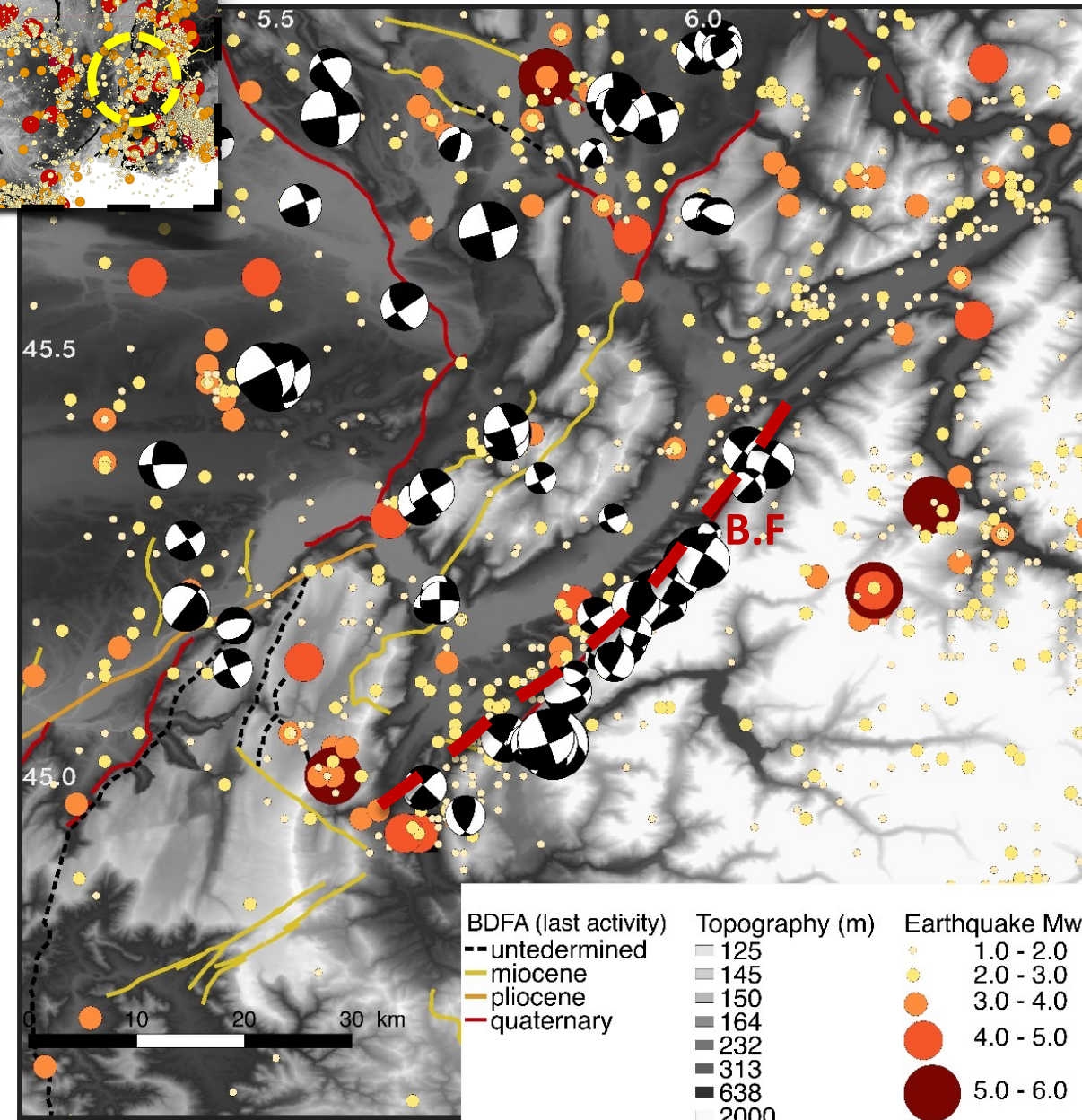
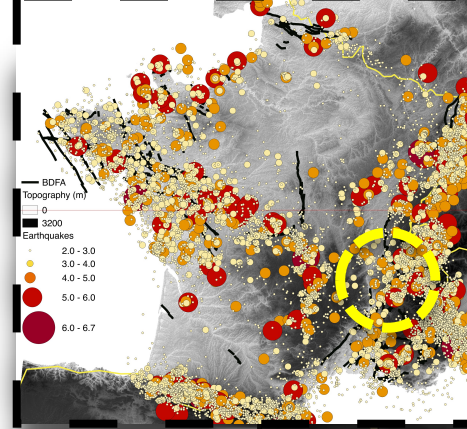
- **Belledonne region**

- Transfer area between inner part of the western Alps and its surrounding basin (the Rhone Valley) that have 2 different deformation modes: extensional (inner Alps) and compressional-strike slip (Rhone Valley)
- Presents a lot of social and industrial issues (densely populated)
- However, behaves as one of the most seismic area in France with a seismicity mostly concentrated on NE-SW Belledonne Fault (B.F)

- **Belledonne Fault (B.F)**

- Dextral strike-slip kinematics well known thanks to the dense French Alps seismic network
- Some geometrical parameters still need better constraints (e.g. its connexion with its neighbour faults)

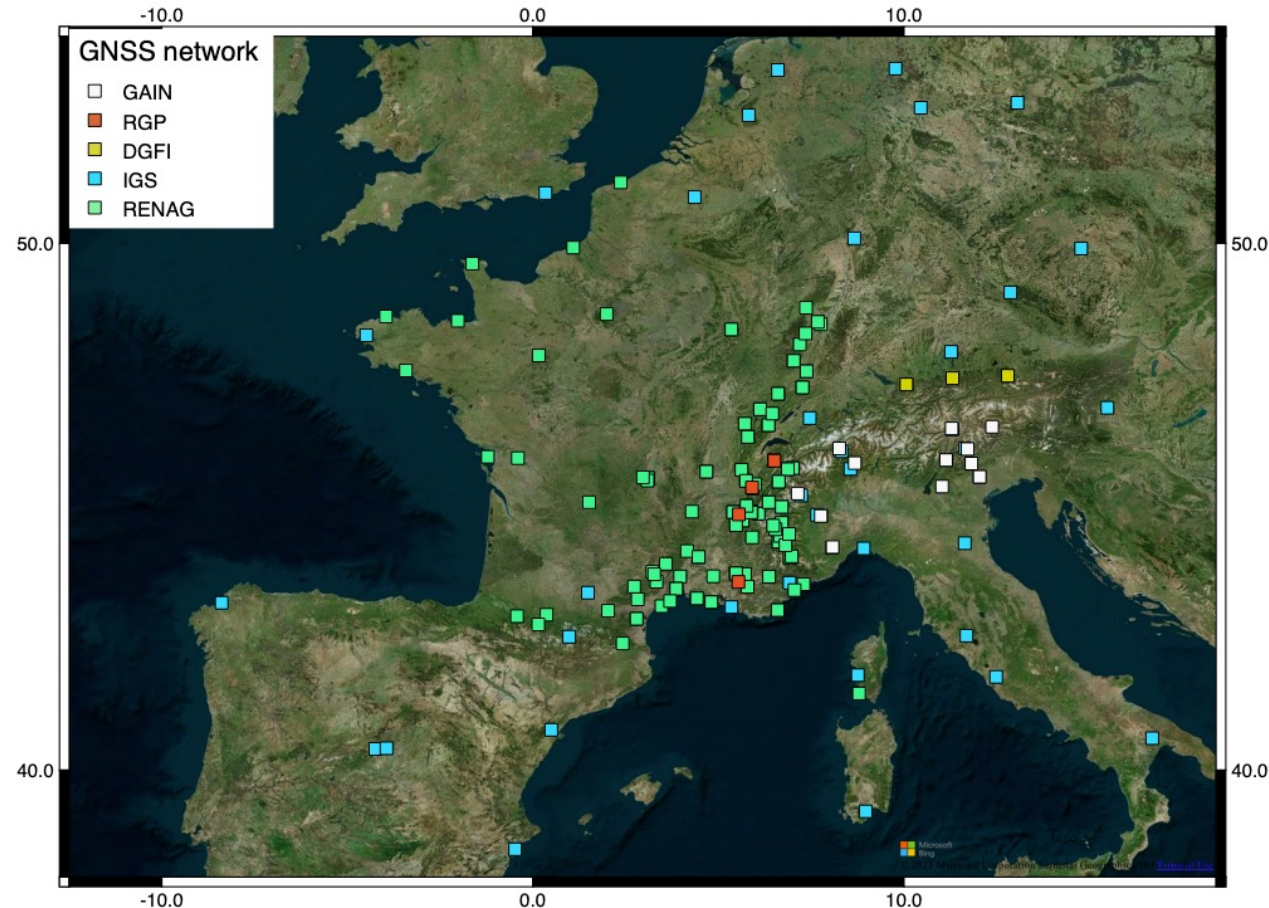
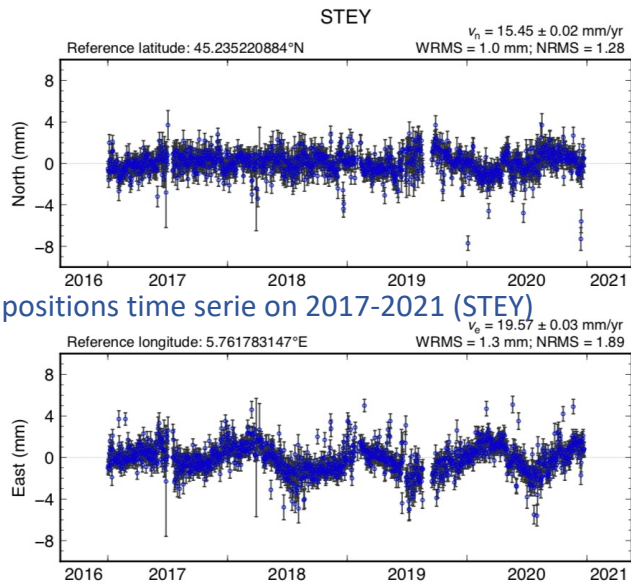
—> How can up-to-date long term GPS velocity fields contribute to better knowledge of the current regional deformation ?





Approach

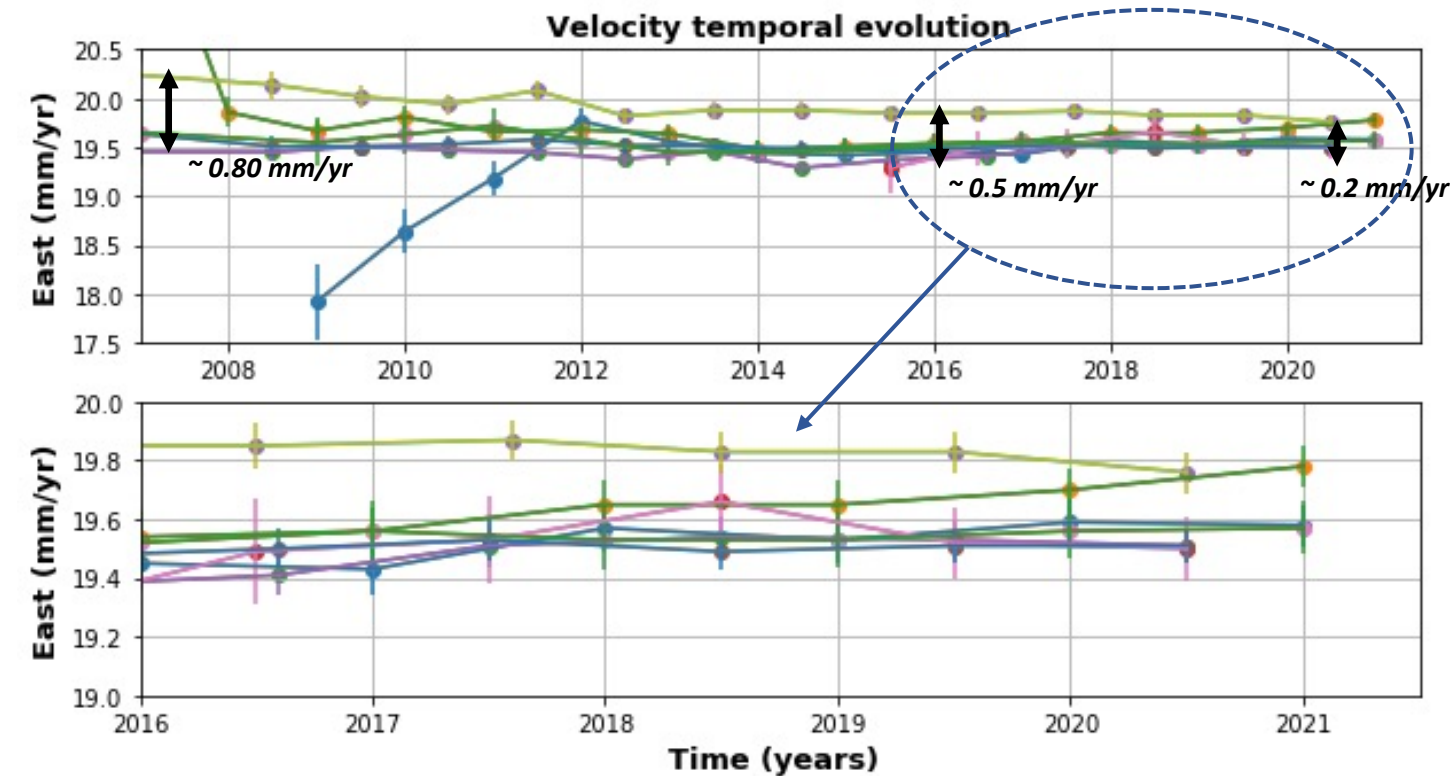
- **Available data**
- ~ 200 stations provided from different European networks (IGS, RENAG, RGP, GAIN, DGFI)
- Recordings over a period of 23 years (1998-2020)



- **Processing with GAMIT/GLOBK software (Herring et al. 2015)**
- Daily positions computed for each station over 1998-2020 interval using double-difference processing
- Velocity field estimation with the Kalman filter (GLOBK) with respect to the fixed stable European plate to obtain the residual motions in the Belledonne Region.

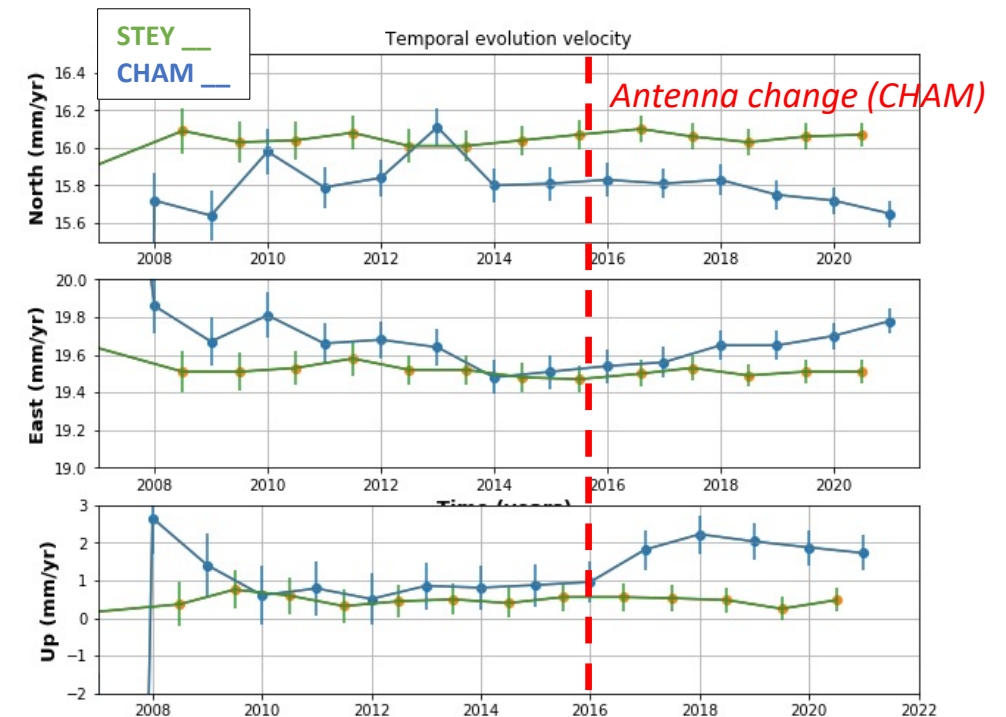


Velocity convergence through time



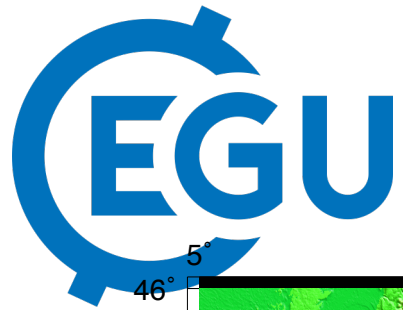
➔ Ongoing convergence of velocity with increasing recording time

- 1998 – 2009 ~ ± 0.40 mm/yr velocity oscillation
- 1998 – 2016 ~ ± 0.25 mm/yr velocity oscillation
- 1998 – 2020 ~ ± 0.10 mm/yr velocity oscillation

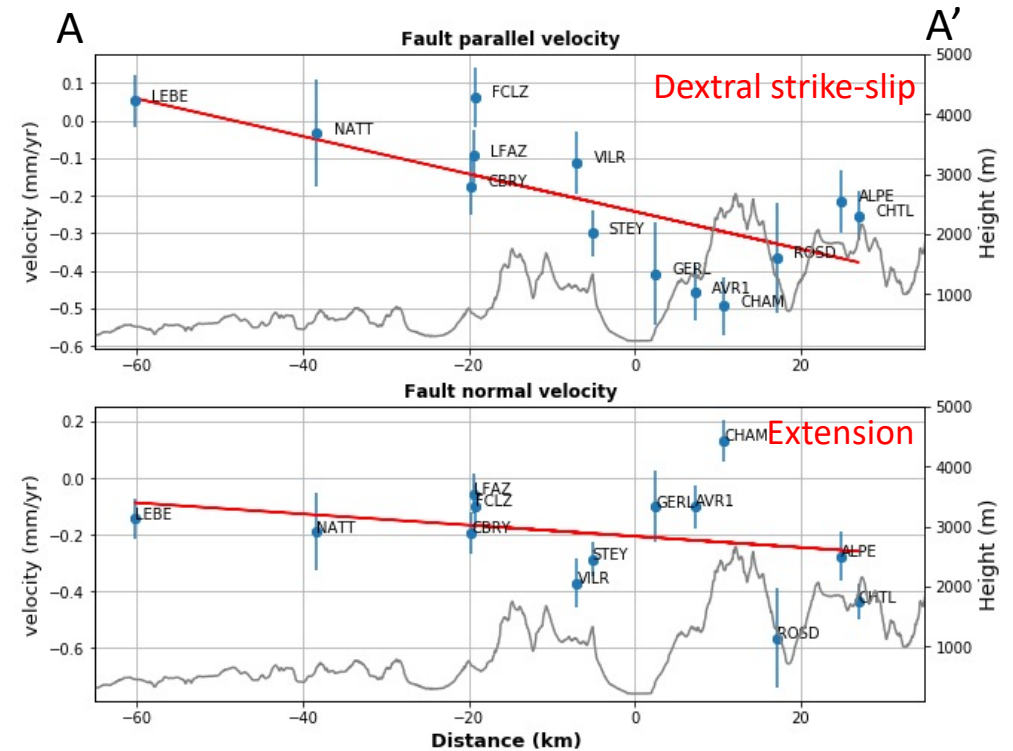
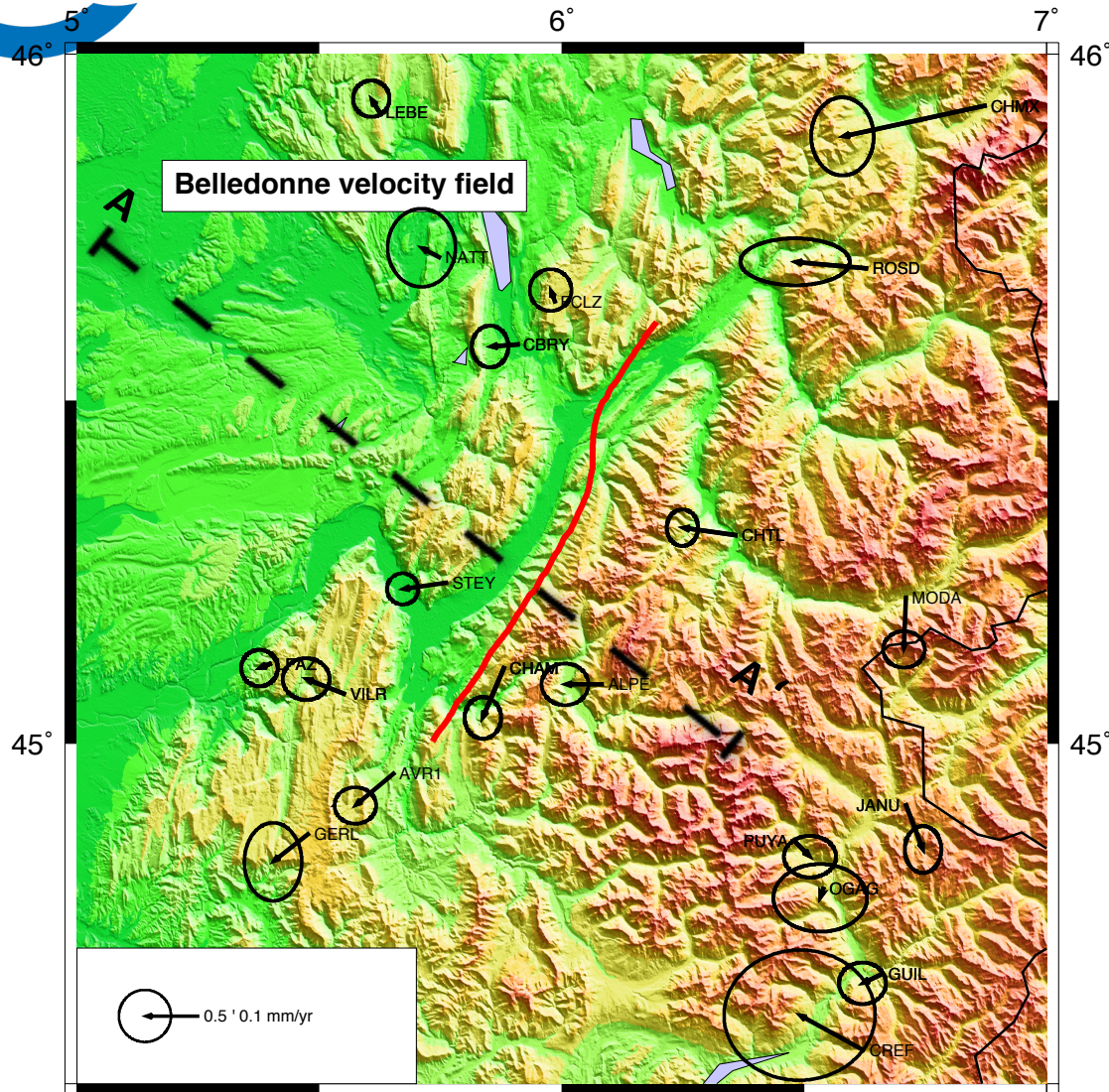


➔ Major Belledonne stations

- **STEY** site (no big changes on installation) seems start to converge toward fix value (± 0.1 mm/yr for horizontal component)
- **CHAM** started to converge until 2015, change on antenna site... must wait again ...



Belledonne Fault dextral strike slip kinematics



—> **Geodetic deformation pattern consistent with the dextral strike slip observed by instrumental seismicity** on the Belledonne region.

~0.4 mm/yr of dextral strike-slip across B.F over 80km distance

~0.2 mm/yr of extension across B.F over 80km distance

Noisy velocities SE of the fault, maybe due to secondary faults in the inner Alps



After 23 years of recording

- Velocities are **on the way of convergence** (from ± 0.35 mm/yr in 2007 to 0.2 mm/yr in 2021)
- **BUT** in low deformed areas as Belledonne region ± 0.20 mm/yr of uncertainty still remains high to estimate robust fault slip rates using individual GPS velocities
- **Nevertheless**, we **highlight a dextral strike slip motion** (~ 0.40 mm/yr across B.F over 80km distance) exploiting redundant information on velocity profiles. This motion is furthermore **consistent with seismicity**, an often difficult result to reveal in low deformed zones. More detailed analysis on fault slip rate will also allows to **improve seismic hazard** in Belledonne Region.
- **5 more years of recordings and minimizing equipment changes** will help **velocities to converge**

Ongoing works

- *Estimation of geodetic slip rate along the Belledonne fault exploiting redundancy between station velocities by using block models*
- *Vertical analysis to confirm and precise the local amplitude of Alpine uplift.*
- *Correct for some heterogeneities in the models used in the analysis between older and recent years of recording*
 - *improve convergence and further reduce velocity uncertainties*