Ground deformation in Thessaly, Central Greece, between 1992 and 2000 by means of ERS multi-temporal InSAR

S. Atzori\(^{(1)}\), C. Tolomei\(^{(1)}\), S. Salvi\(^{(1)}\), A. Ganas\(^{(2)}\), S. Stramondo\(^{(1)}\) and L. Colini\(^{(1)}\)

\(^{(1)}\) *Istituto Nazionale di Geofisica e Vulcanologia – Roma - Italy*

\(^{(2)}\) *National Observatory of Athens – Athens - Greece*
The Thessaly (Greece) Region – An Overview
The Thessaly Geology

- Thessaly region is characterised by a considerable neo-tectonic activity
- Known active faults are normal and WNW-trending, indicating a NNE extension
The interferometric processing (1)

We used the SBAS (Small Baseline Subset) algorithm, developed at IREA-CNR, to detect the temporal displacement evolution over the investigated area.

- 47 ERS descending images spanning from 1992 to 2002 and 23 ascending, spanning from 1995 to 2000, were combined to produce about 150 interferograms, through which we retrieved the mean velocity field and the time series for the whole region.
- The 80 m SRTM Digital Elevation Model has been used to remove topography and to geocode all the output products.
- Maximum spatial baseline set to 200 m.
- Maximum temporal baseline set to 1500 days.
- Area investigated 80 x 60 Km
The interferometric processing (2)

Multi-temporal coherence maps

Descending orbit

Ascending orbit
Mean Velocity Fields

- The black diamond represents the starting point for the spatial/temporal unwrapping.
- In the descending orbit, the solution doesn’t propagate to Larissa town.
The Up velocity field over the mountains

Legend

Up Component

Velocity (mm/yr)

-4 -3
-3 -2
-2 -1
-1 0
0 -1
1 -2
2 -4

Major City

Tyrnavos Fault
Larissa Fault

28 Nov 2 Dec • ESA-ESRIN • Rome - Italy
The East velocity field over the mountains

1989-97 East velocities [mm/y] for the Central Greece Network (Clarke et al. 1998).
Subsidence in the Larissa plain

• Strong subsidence, up to 30 mm/yr, is observed over the Larissa urban area

• Strong lateral gradients (up to 1 cm/yr per km) are probably due to concentrated pumping and compartmentalized acquifers
Subsidence and over-pumping of the water table
General trend and seasonal fluctuations
Final considerations - 1

• A good deformation signal was retrieved using the SBAS technique on the ERS archive data set

• Two of the four available GPS data agree with the general trend

• The low frequency component of the Up velocity field shows a 3-4 mm/yr relative uplift of the mountains west of the Larissa basin compared with the eastern range

• The negative Up velocity gradient around the Larissa plain suggests that the tectonic processes responsible for the basin formation are still ongoing

• High frequency variations of the Up velocity occur across some active faults
Final considerations - 2

- A considerable E-W extension (6÷8 mm/yr) is also present on the western mountains while the eastern sector is showing contraction.

- In the Larissa plain a strong subsidence (up to 3 cm/yr) is observed, due to over-pumping for field irrigation.

- The time series show a periodic component likely due to seasonal water table fluctuations.

- Strong lateral variations of the velocity field suggest a strong structural control over the aquifer, possibly due to sealed fault surfaces.