Poster #XY0427

Recent deformation at Campi Flegrei Caldera (Italy) detected by DInSAR and leveling techniques

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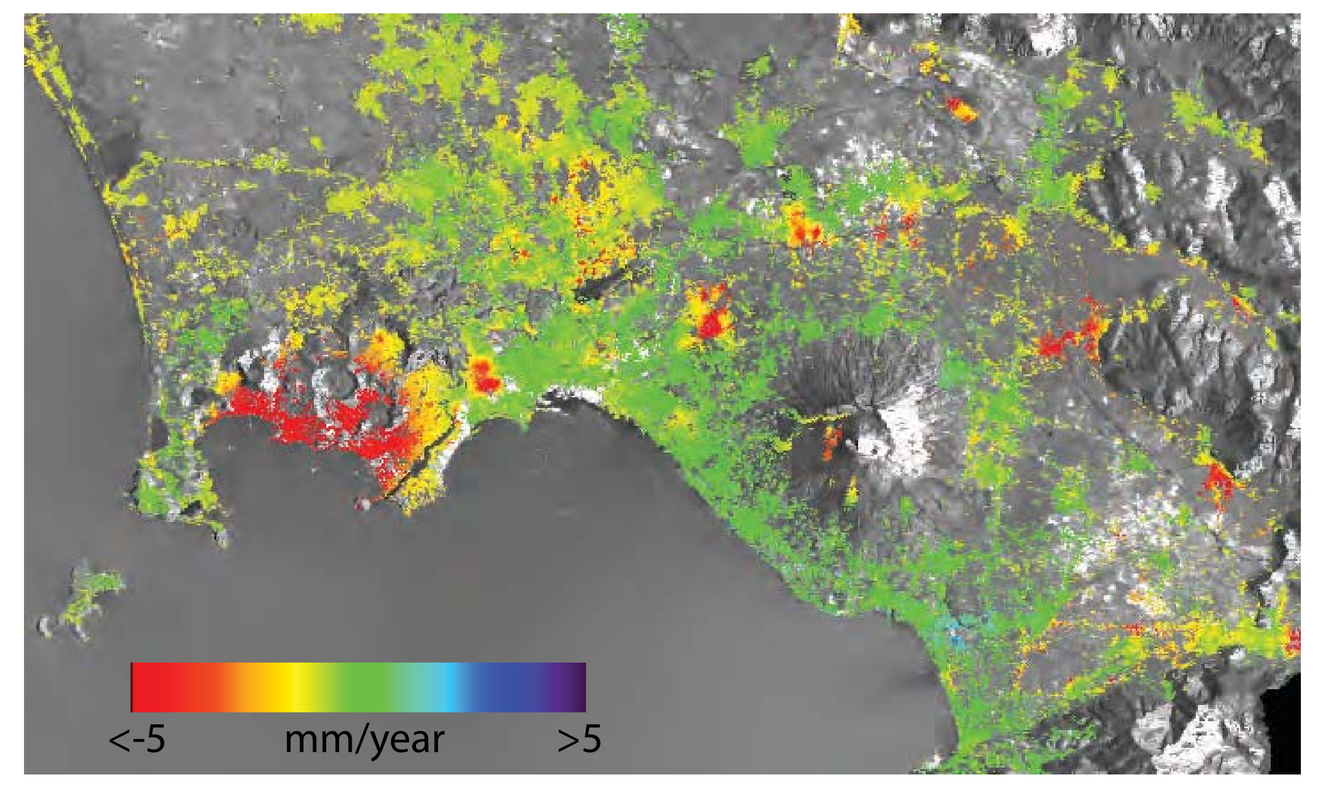
Summary

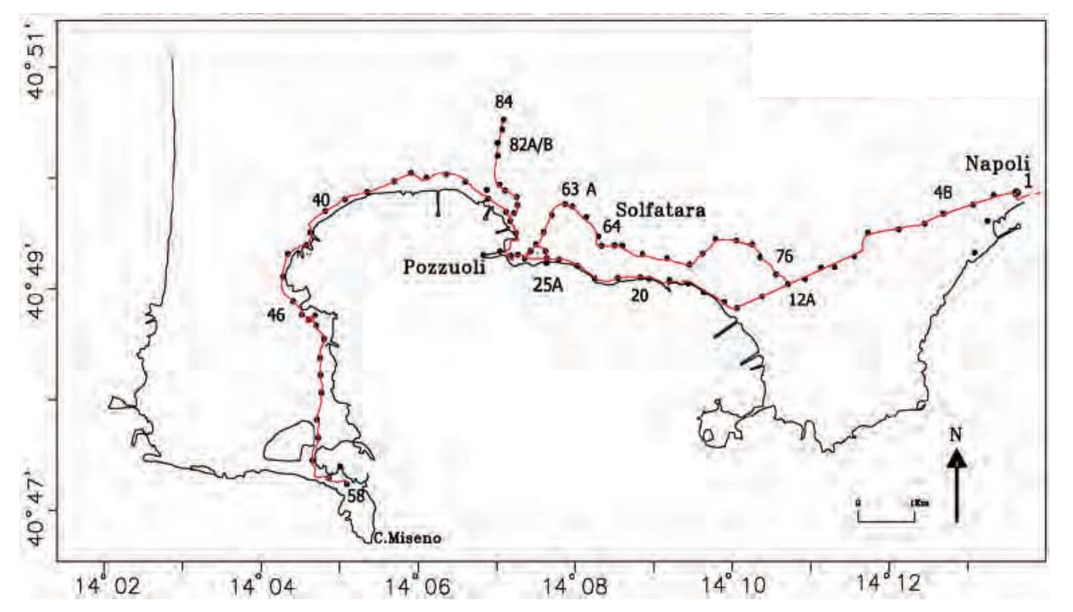
The Campi Flegrei Caldera experienced rapid ground deformation during 1970-72 and 1982-84 (a total amount of 3.5 m in the city of Pozzuoli). A new, consistent, uplift event is now going on since November 2004. In this paper we show velocity maps computed, following the SBAS approach, using ENVISAT ASAR data acquired from both ascending and descending orbits and leveling data from the OV/INGV network. Both DInSAR and leveling data evidence a nice radial pattern with a maximum uplift near the city of Pozzuoli. We model the observed deformation by the following sources: 1) point-source sphere (*Mogi, 1958*), 2) finite volume spheroid (*Yang et al., 1988*) and 3) point-source moment tensor (*Davis, 1986*). We perform a direct search in the parameters space followed by a Bayesian statistical analysis. The inversions retrieve sources located below Pozzuoli at about 3 km depth with volume variation of 1,3-2,6 10^6 m^3.

Ground deformation at Campi Flegrei

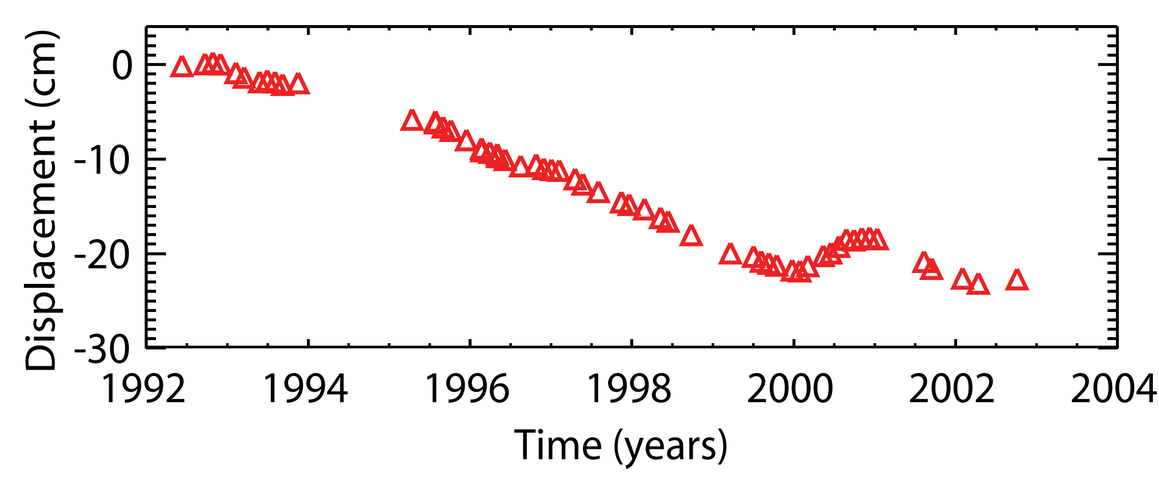
Leveling and DInSAR before 2004

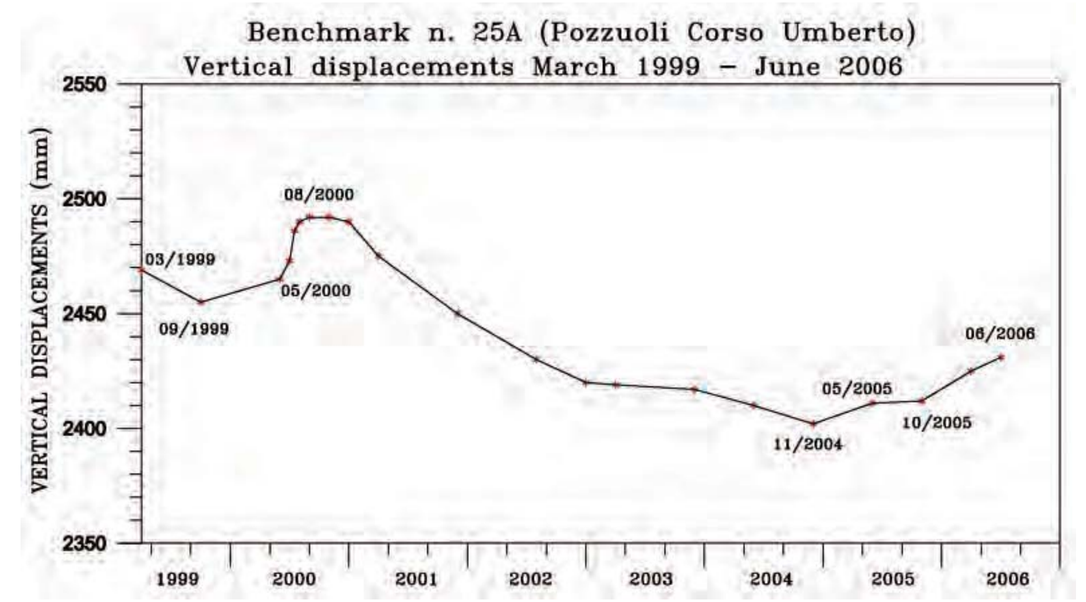
After two unrest phenomena during 1970-72 and 1982-84 (in both cases maximum uplift of 1.7 m) the Campi flegrei caldera is undergoing a subsidence phase, with some short uplift events recorded in 1989, 1994, 2000.





Left: Mean deformation velocity map computed for the descending ERS data of the Napoli bay during 1992-2002. Right: The INGV leveling network, with 350 benchmarks covering a total length of 135 km.

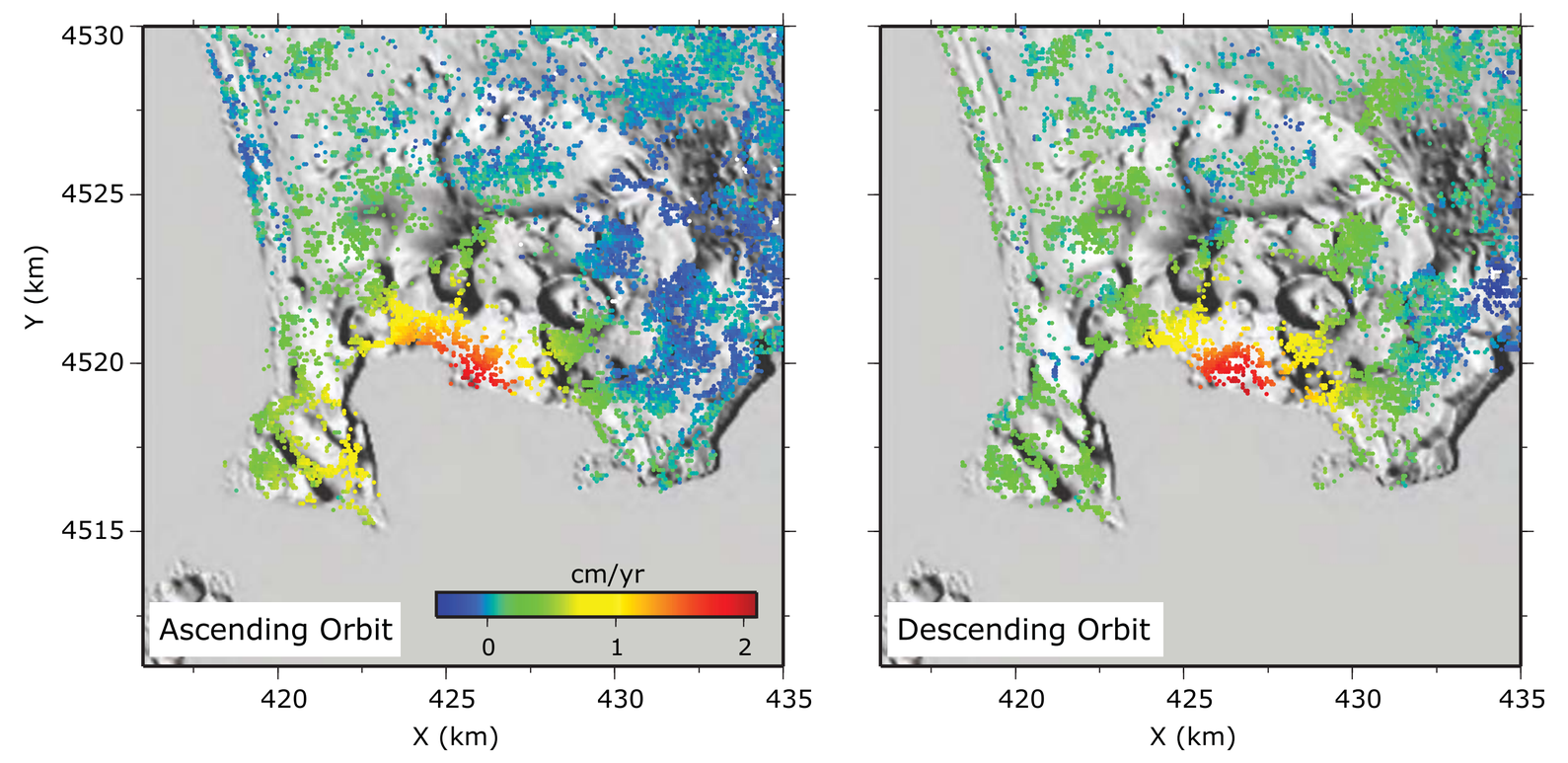


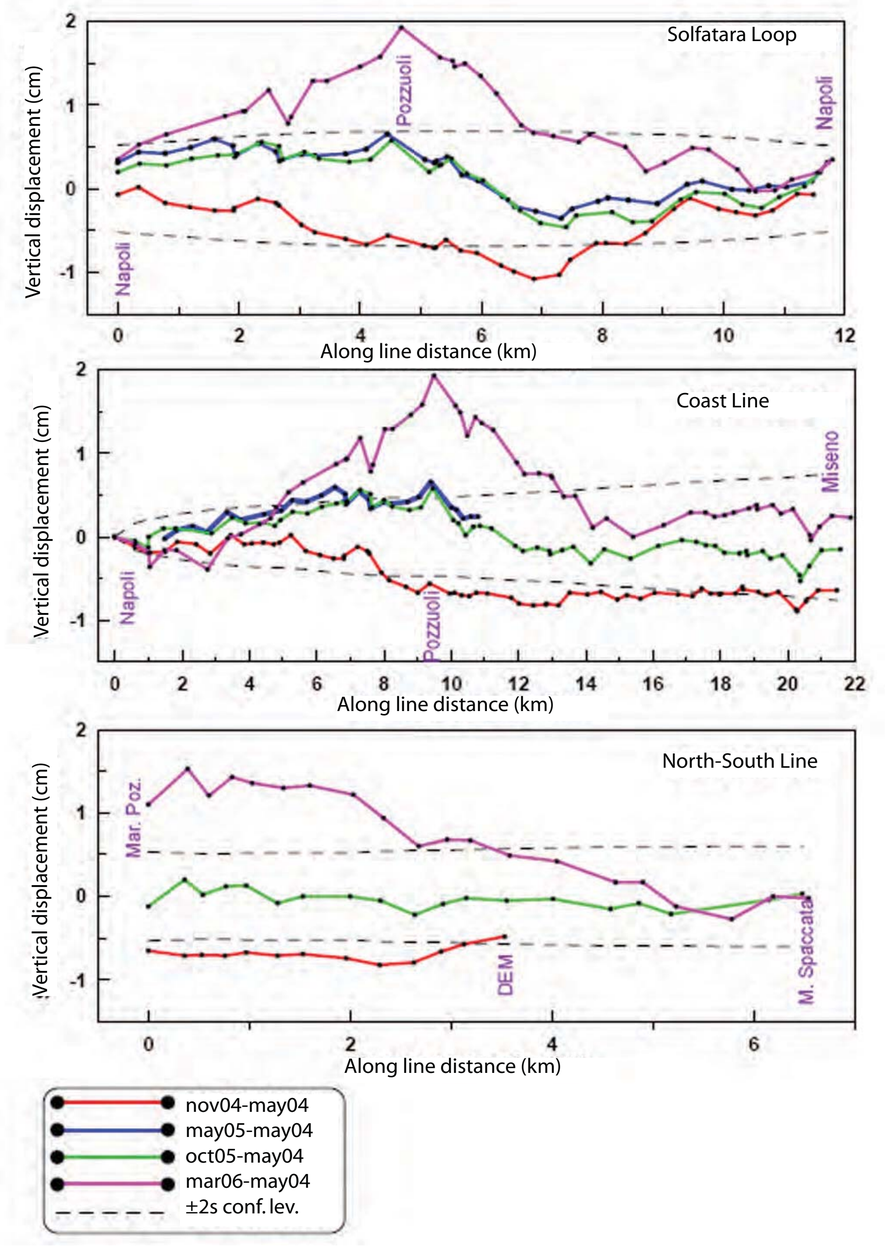


Temporal evolution of uplift detected by DInSAR (left) and leveling (right) at the benchmark 25A, located within the maximum deformation area on the coast line near Pozzuoli.

From November 2004 to December 2006

All the available ENVISAT ASAR data acquired from both ascending/descending orbits during 2002-2006 are used to generate mean deformation velocity maps and time series with spatial resolution of 90 m. Maps are computed following the SBAS approach (*Berardino et al, 2002*).

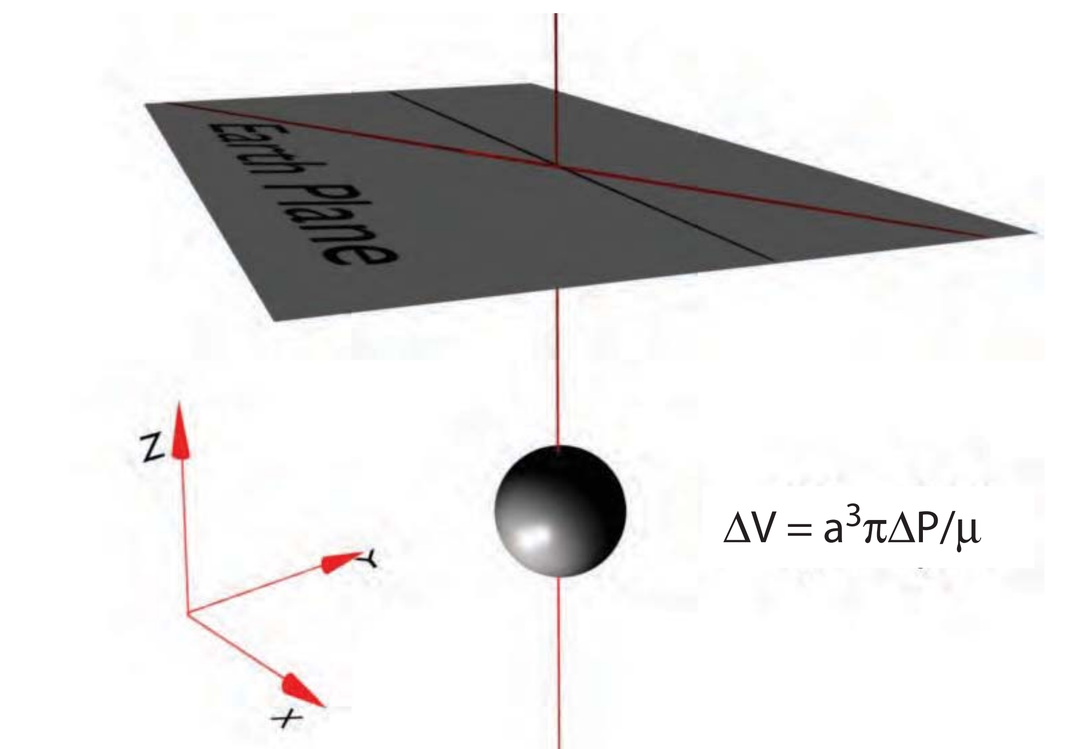




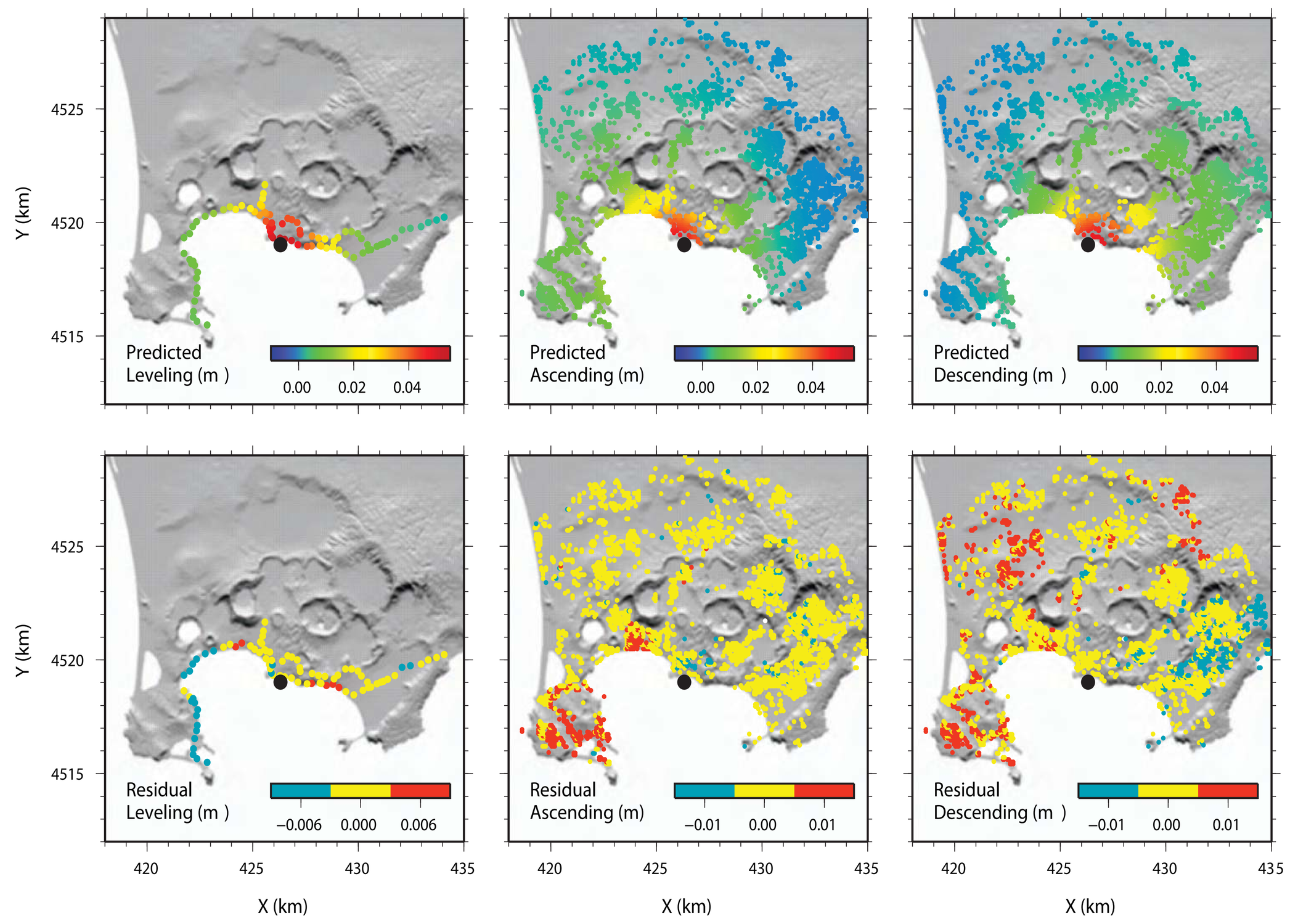
Positive quote variations detected from November 2004 to march 2006 along 3 leveling lines at Campi Flegrei. The total uplift until December 2006 is 0.55 m, observed at benchmark 25A.

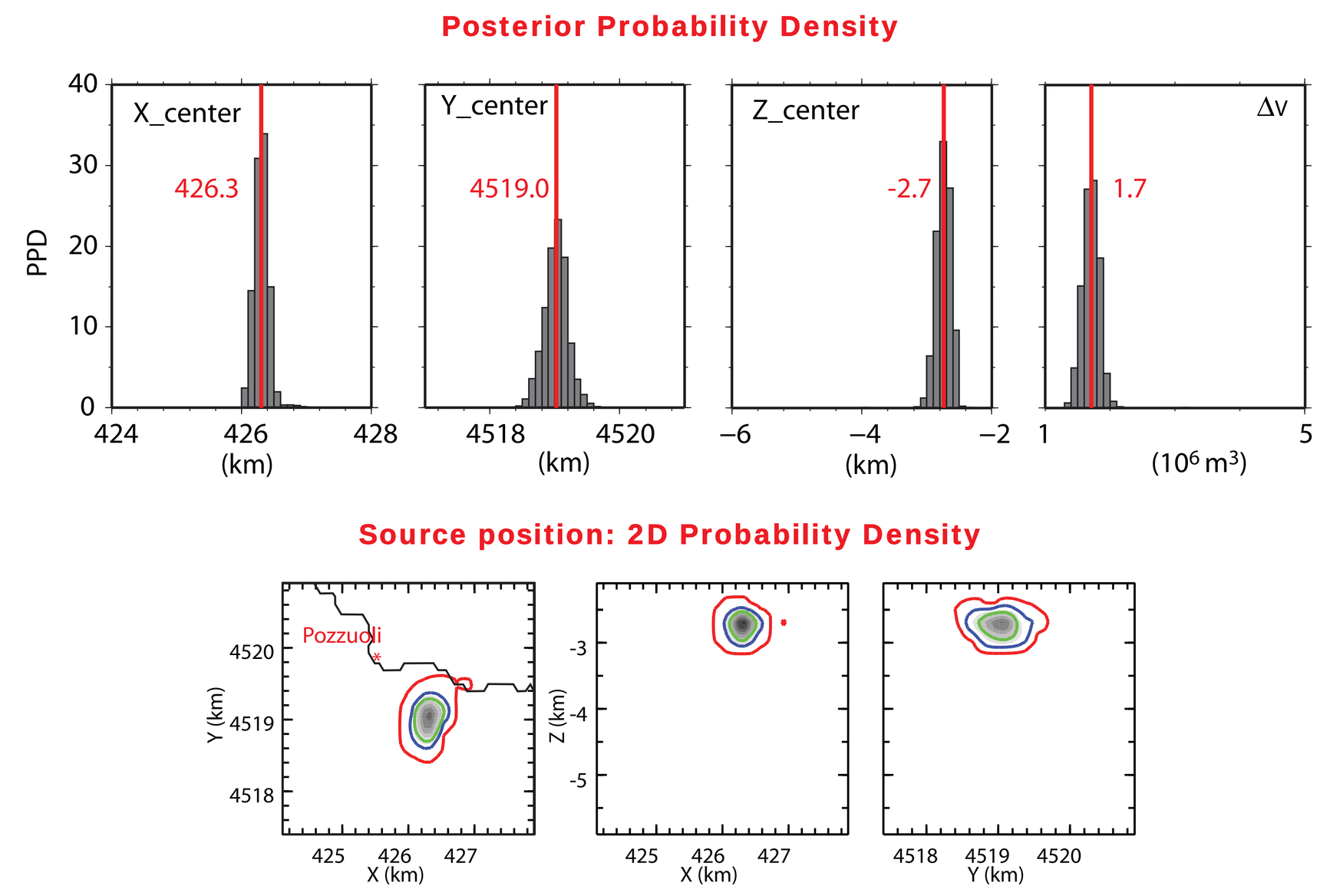
Forward Model | Model Predictions | Inversion Results

Sphere

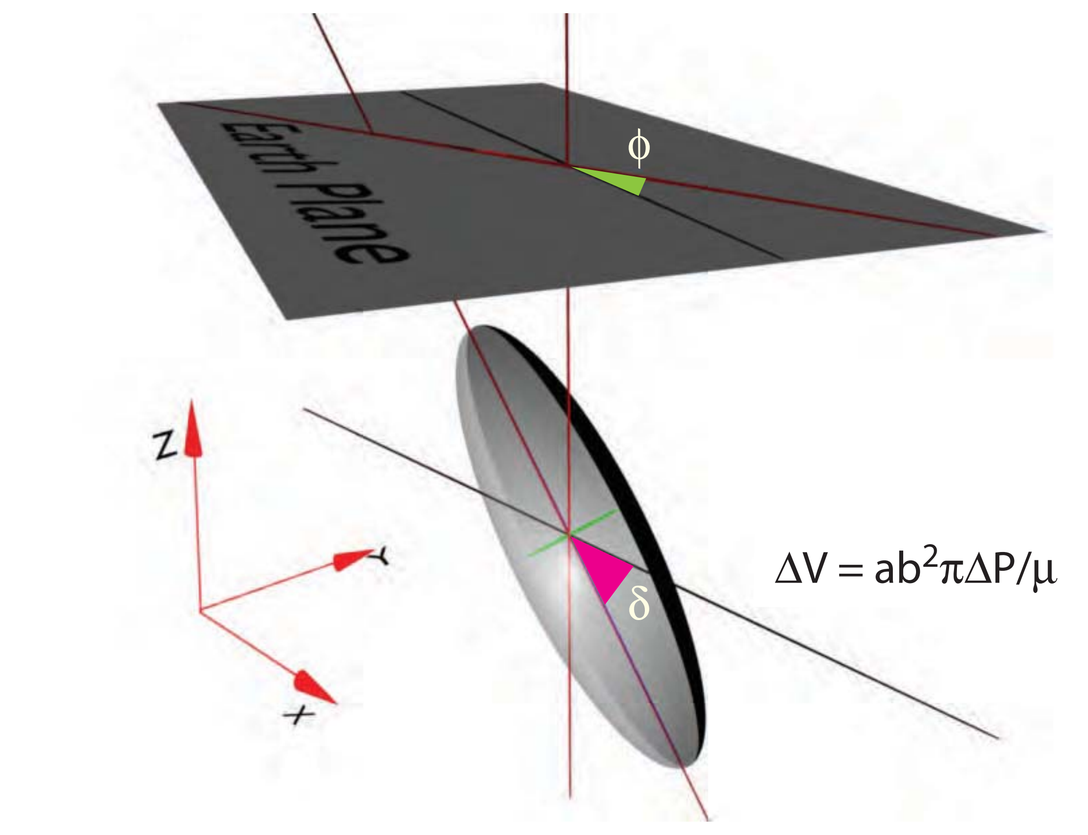


Parameters:
- X_center, Y_center, Z_center
- volume variation ΔV

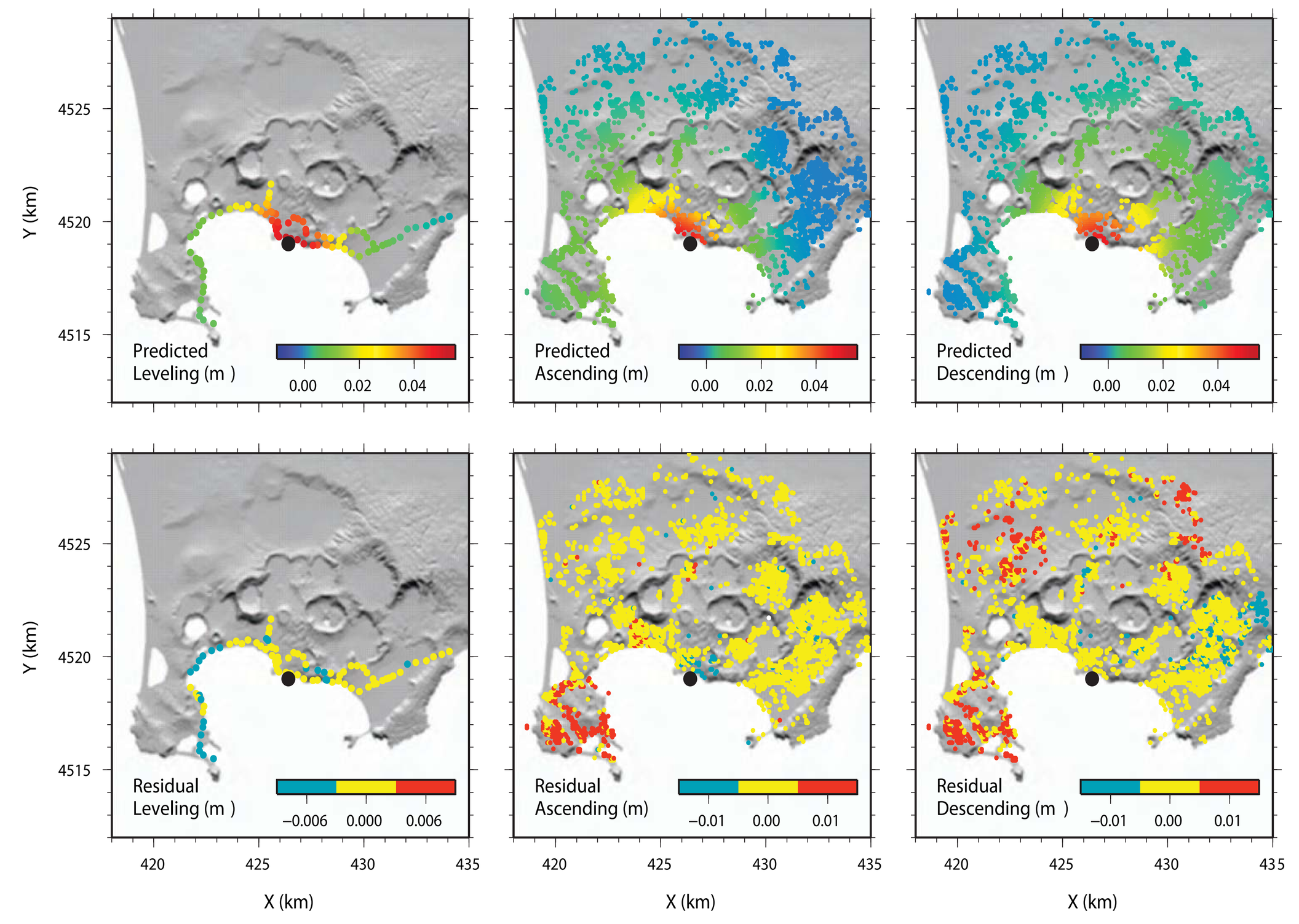


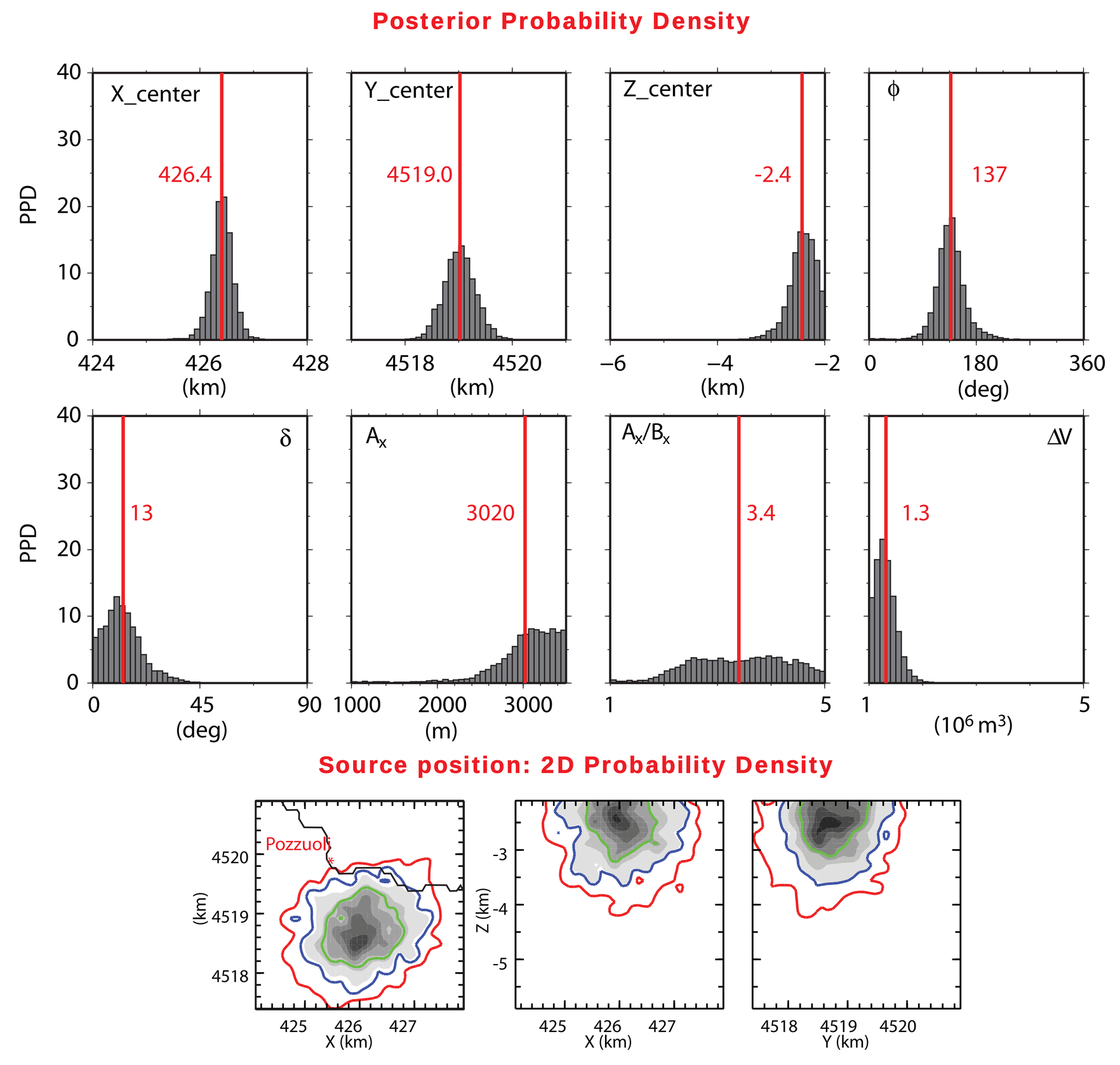


Spheroid

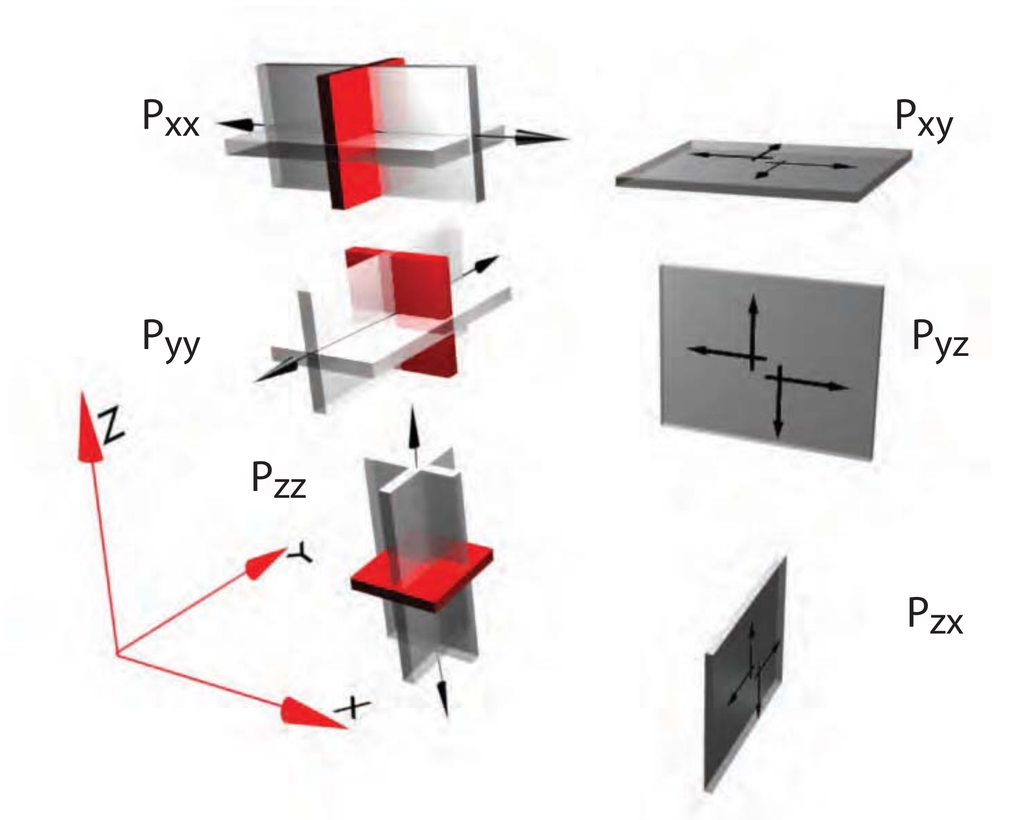


Parameters:
- X_center, Y_center, Z_center
- volume variation ΔV
- orientation ϕ, δ
- semi-major axis Ax
- axes ratio Ax/Bx

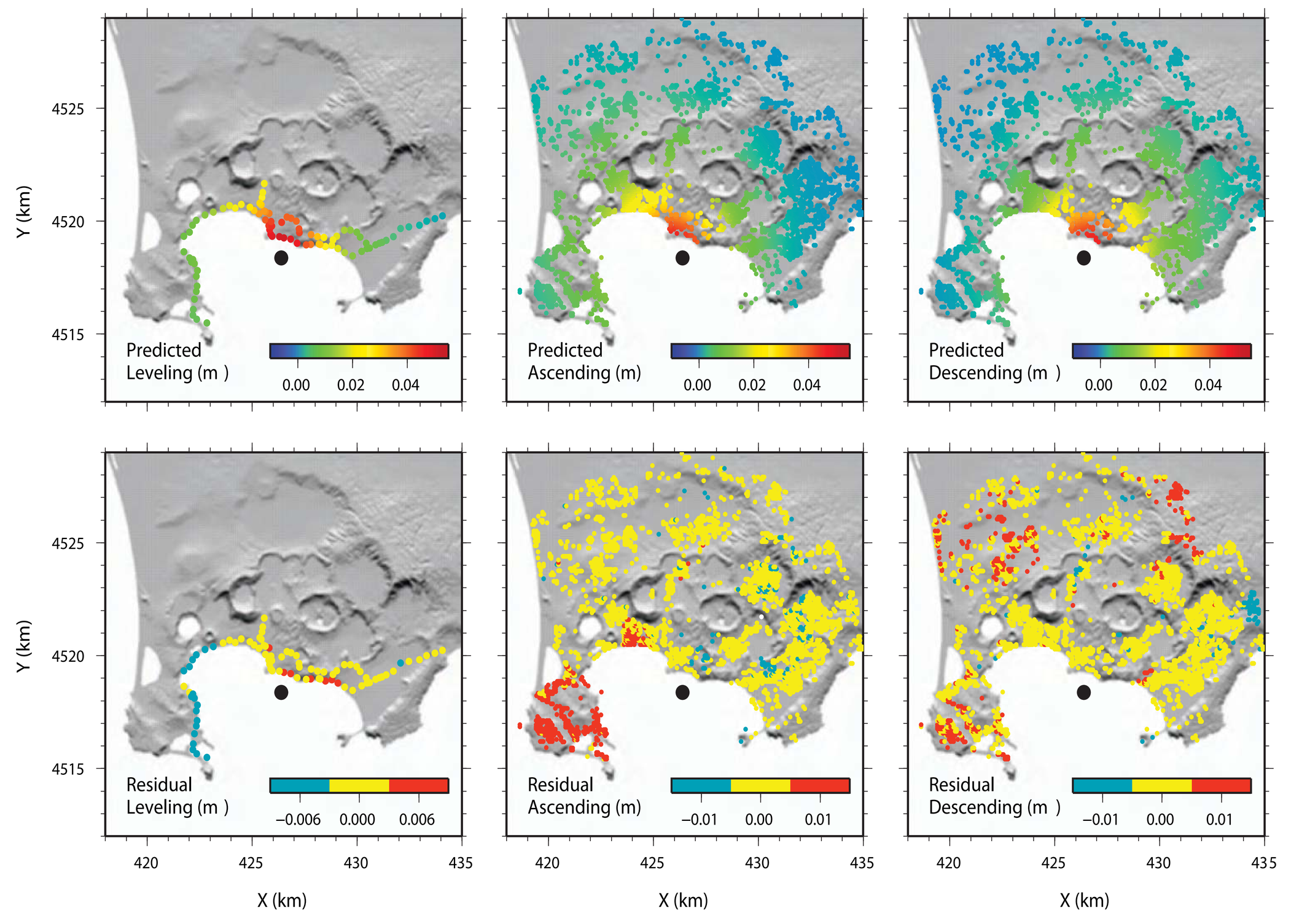


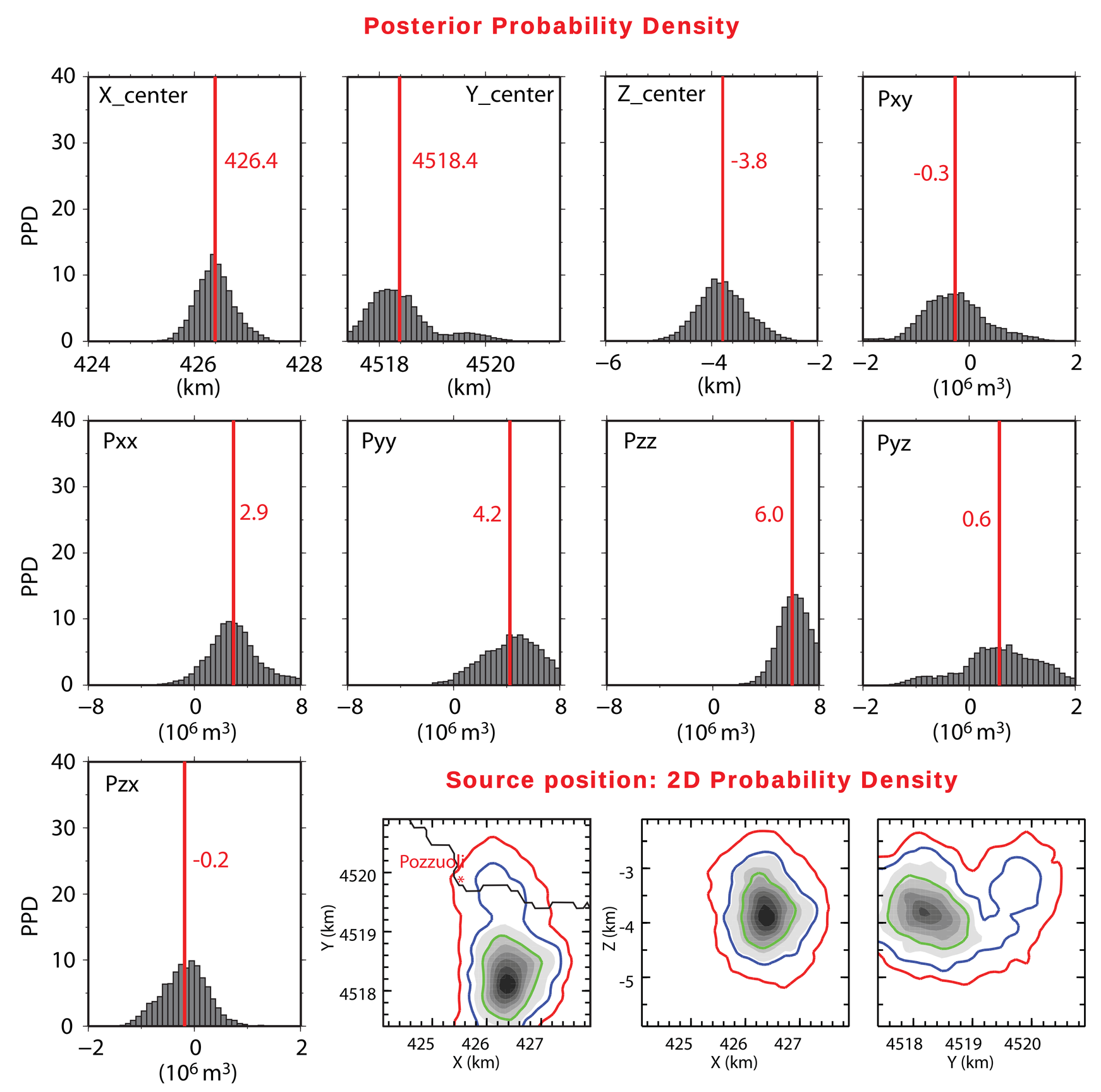


Moment Tensor

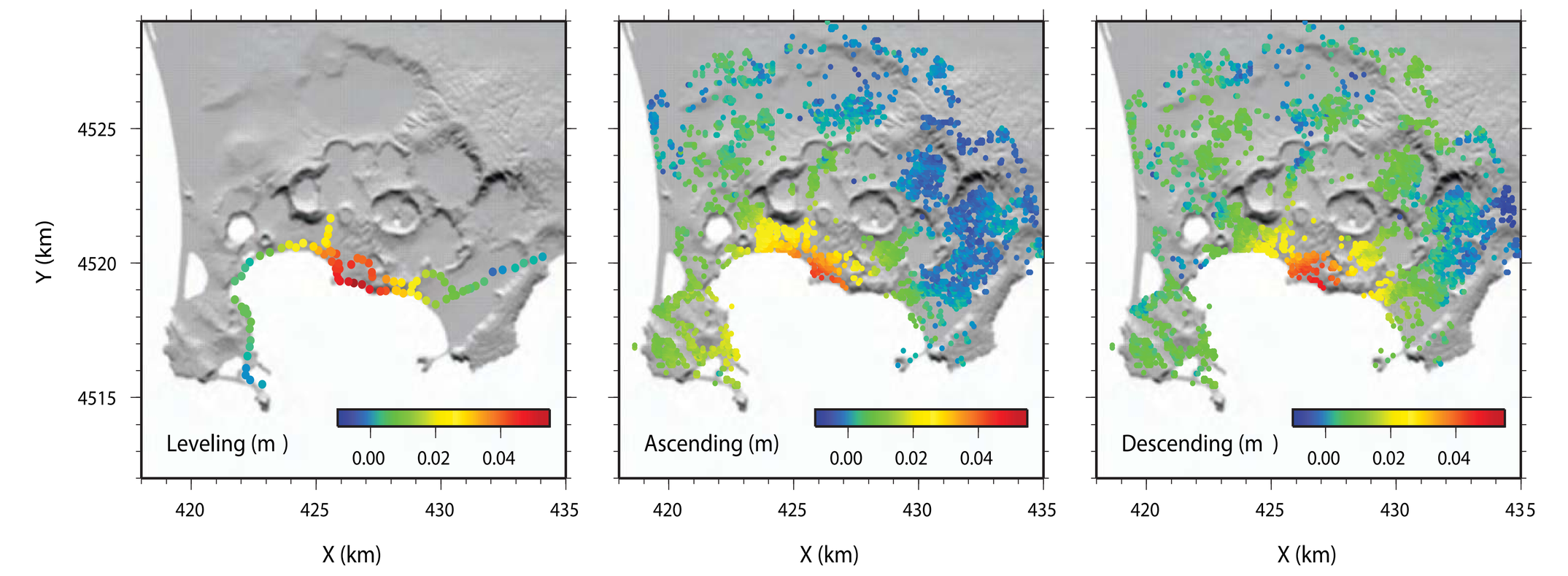


Parameters:
- X_center, Y_center, Z_center
- moment tensor Pij





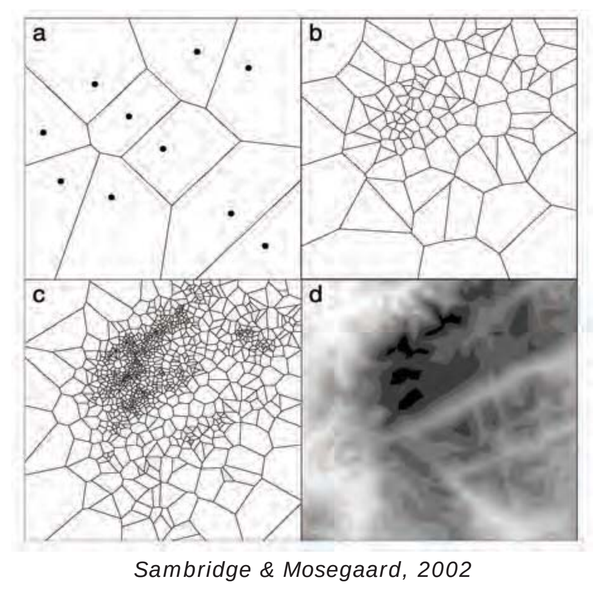
Inverted Dataset



From November 2004 to December 2006:
- 86 leveling measurements.
- 5540 ascending + descending SBAS points (a subset of the SBAS DInSAR deformation rates dataset is extracted by a radial selection and converted to displacement).

Inversion method

- Model performance is evaluated by the average of the χ^2 misfit functions computed for each independent dataset.
- The neighborhood algorithm (*Sambridge, 1999*) is used to search good fitting regions in the parameters space.
- The ensemble of the sampled models is used to evaluate the posterior probability density functions for each parameter.
- All the inversion procedure is implemented in a web-based user-friendly interface called DOiT.



Let's DOiT !!!

See poster XY0422 for details about DOiT

Inferred sources comparison

	X_center (m)	Y_center (m)	Z_center (m)	ΔV ($10^6 m^3$)
SPHERE	426310	4519020	-2750	1,7
SPHEROID	426410	4519020	-2420	1,3
M. TENSOR	426390	4518380	-3790	2,6

- X_center and Y_center parameters are retrieved within 100 m x 600 m, respectively, for all the model sources.
- Moment tensor model requires a deeper source and a larger volume variation with respect to both sphere and spheroid.

Preliminary findings

- All the forward models considered (sphere, spheroid, moment tensor) show a very good fit to the observed data.
- The source position is well constrained at about 3 km depth, below Pozzuoli.
- The estimated volume variations range from 1,3 to 2,6 10^6 m^3.
- The spherical source, characterized by the lowest number of parameters and more peaked PPDs, is the preferred model to interpret the experimental data.