Joint Analysis of InSAR and Geodetic Time Series from a Principal Component Analysis-Based Inversion Method

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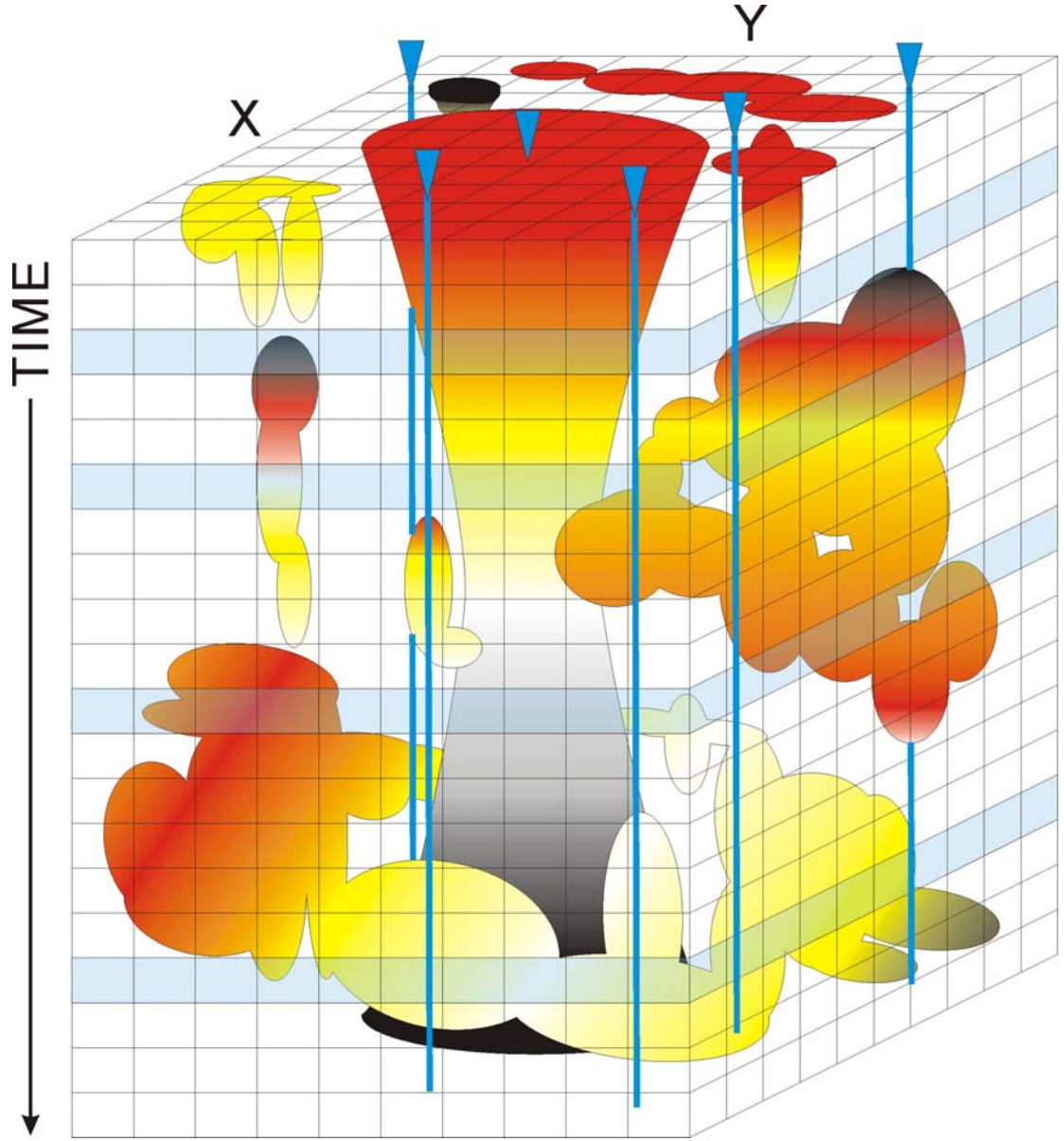
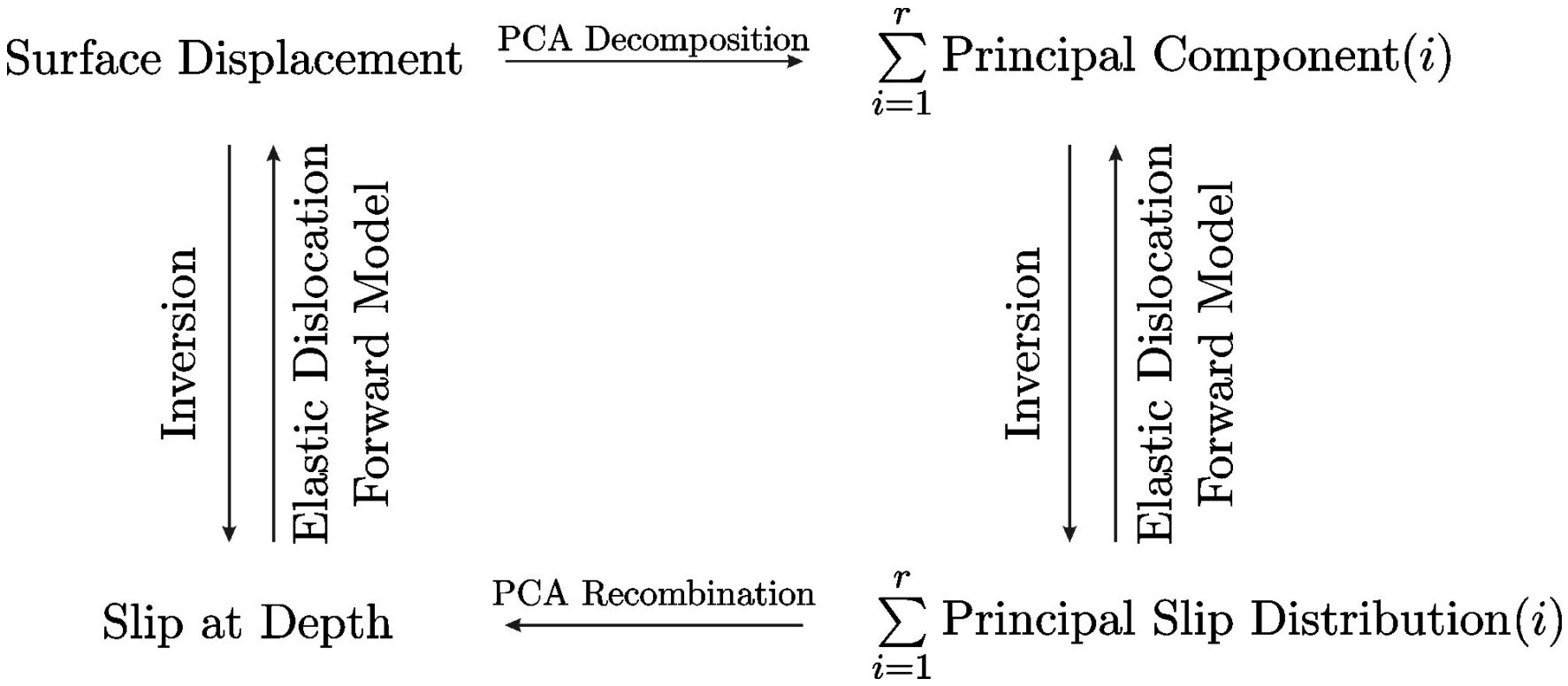
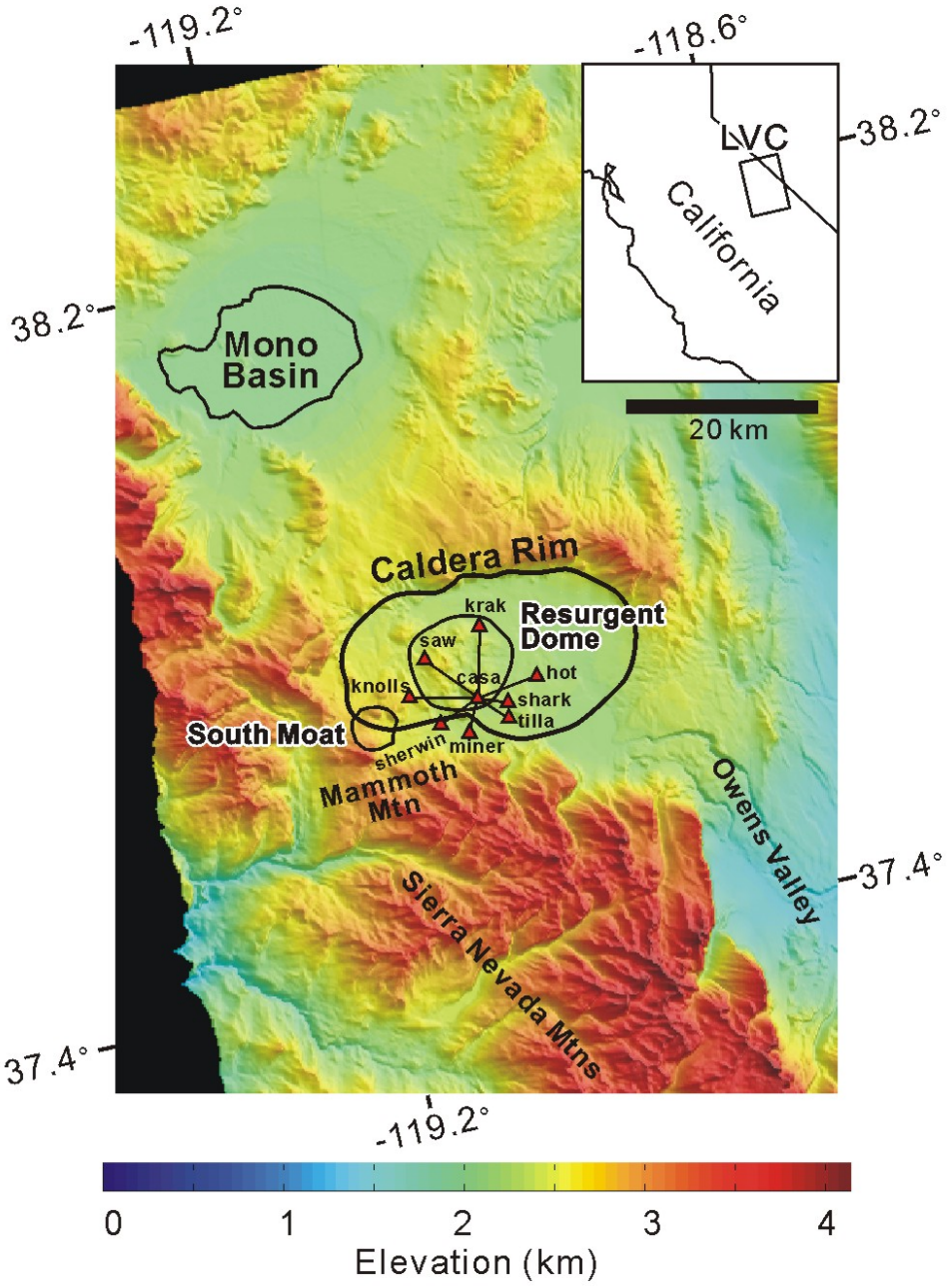
Q: How do we join InSAR and geodetic time series?



Principal Component Analysis-based Inversion Method (PCAIM)



[Kositsky and Avouac, 2009]



Long Valley Caldara 1997-1998 Inflation Episode

- **multiple inflation events since 1980's**
- **~10 cm uplift near the resurgent dome during 1997-98 episode**
- **8 EDM time series**

[Langbein, 2003]

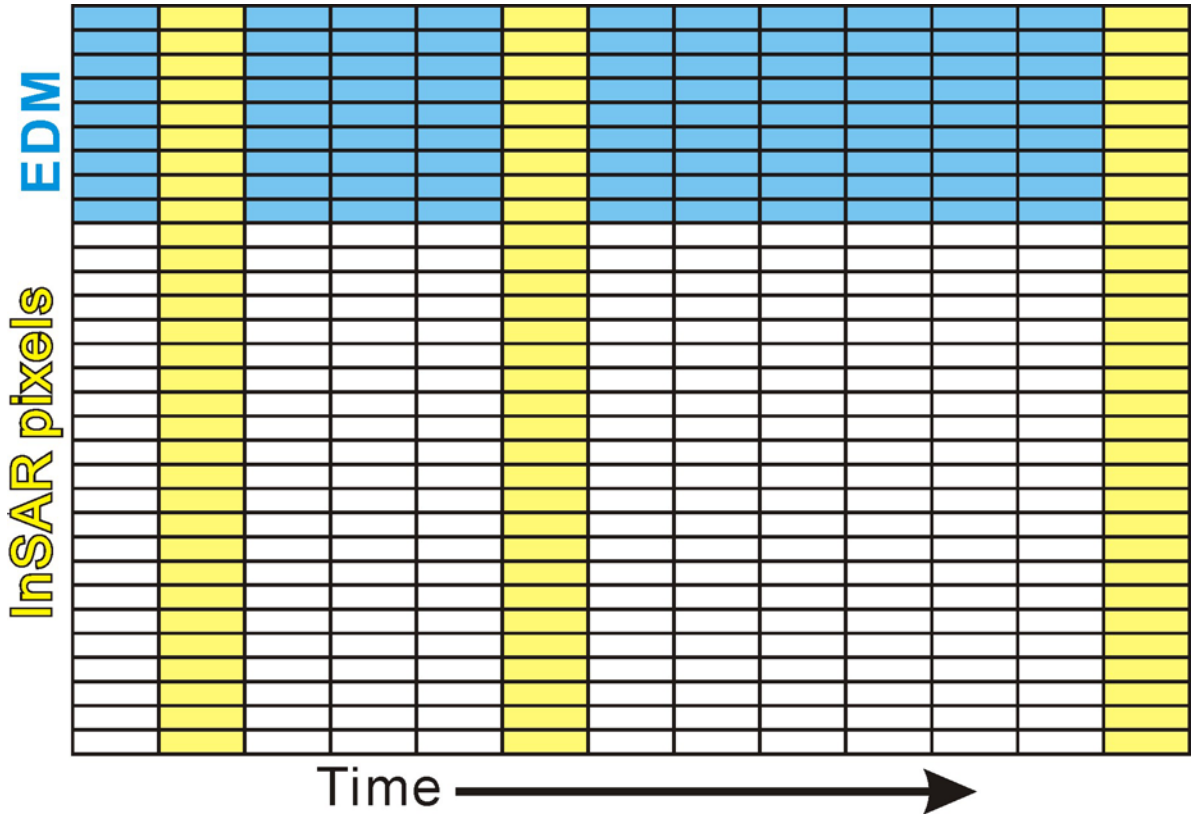
- **24 ERS scene and 65 interferograms**

PCAIM Nonlinear Solver

- **Sparse matrix → weighting matrix and nonlinear solver**

[Srebro and Jaakkola, 2003]

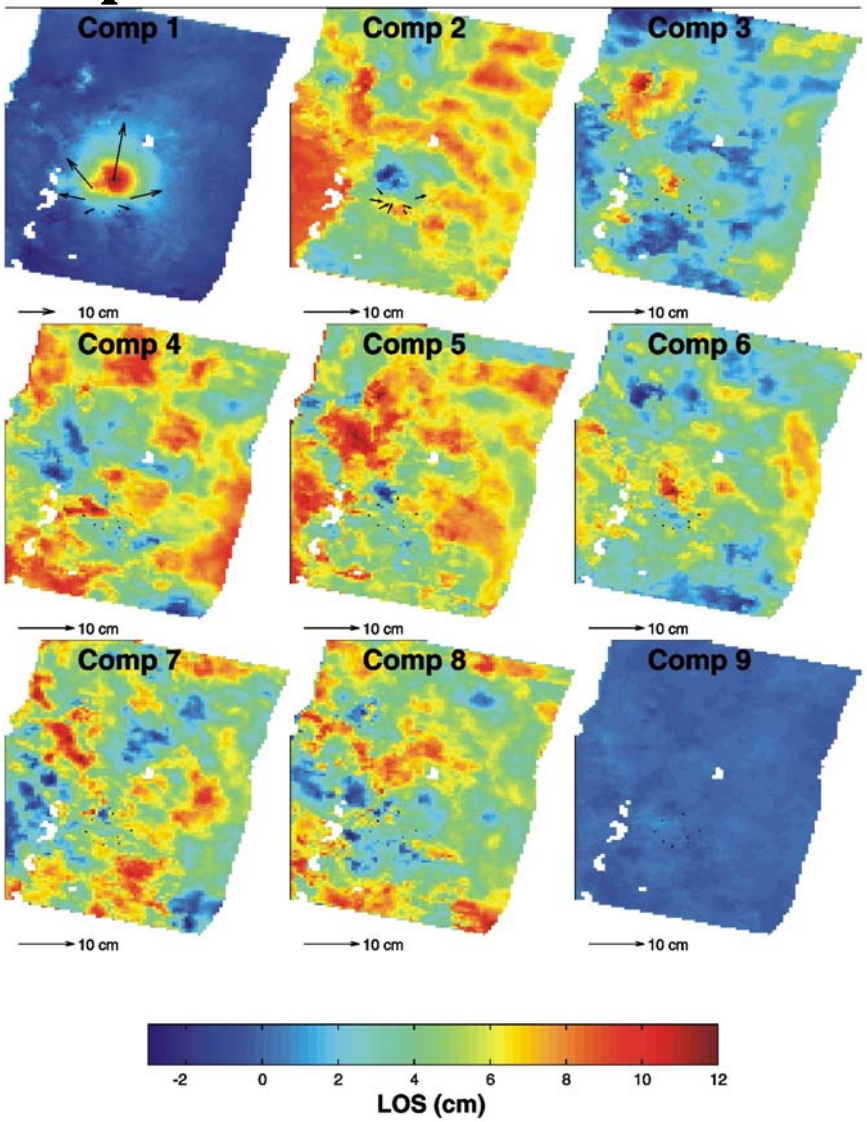
- **Iterative decomposition to maintain temporal continuity of the signals**

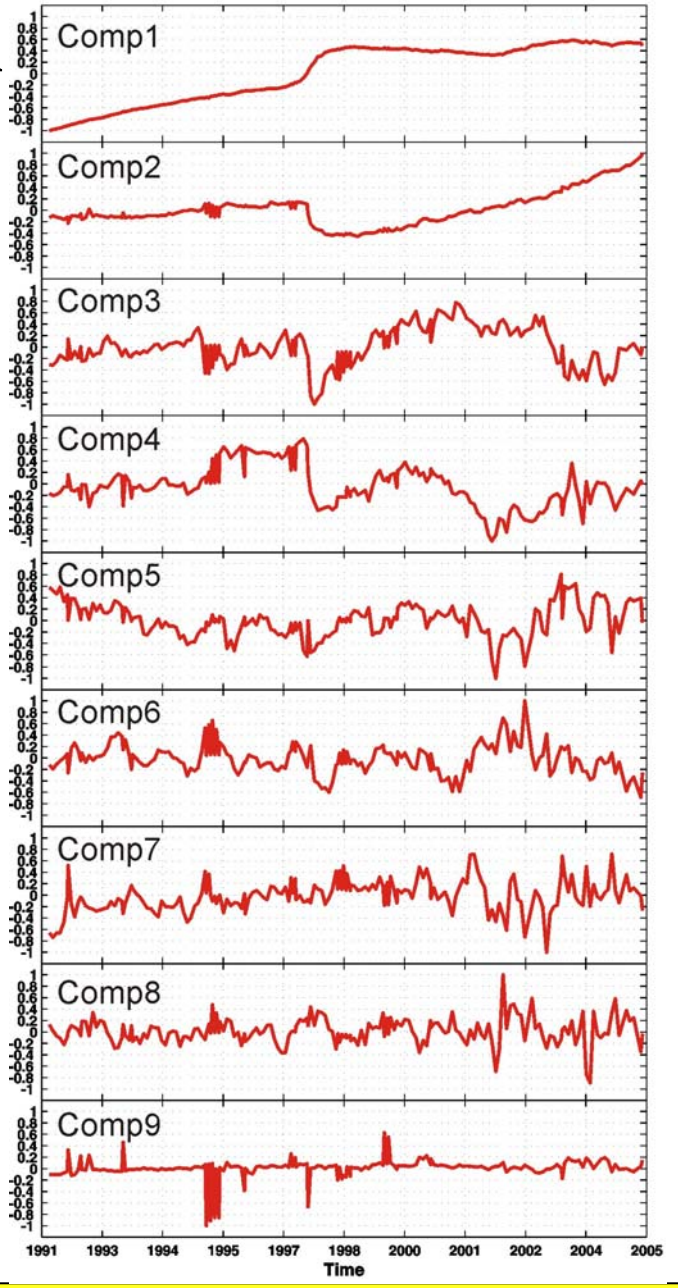


PCA Decomposition

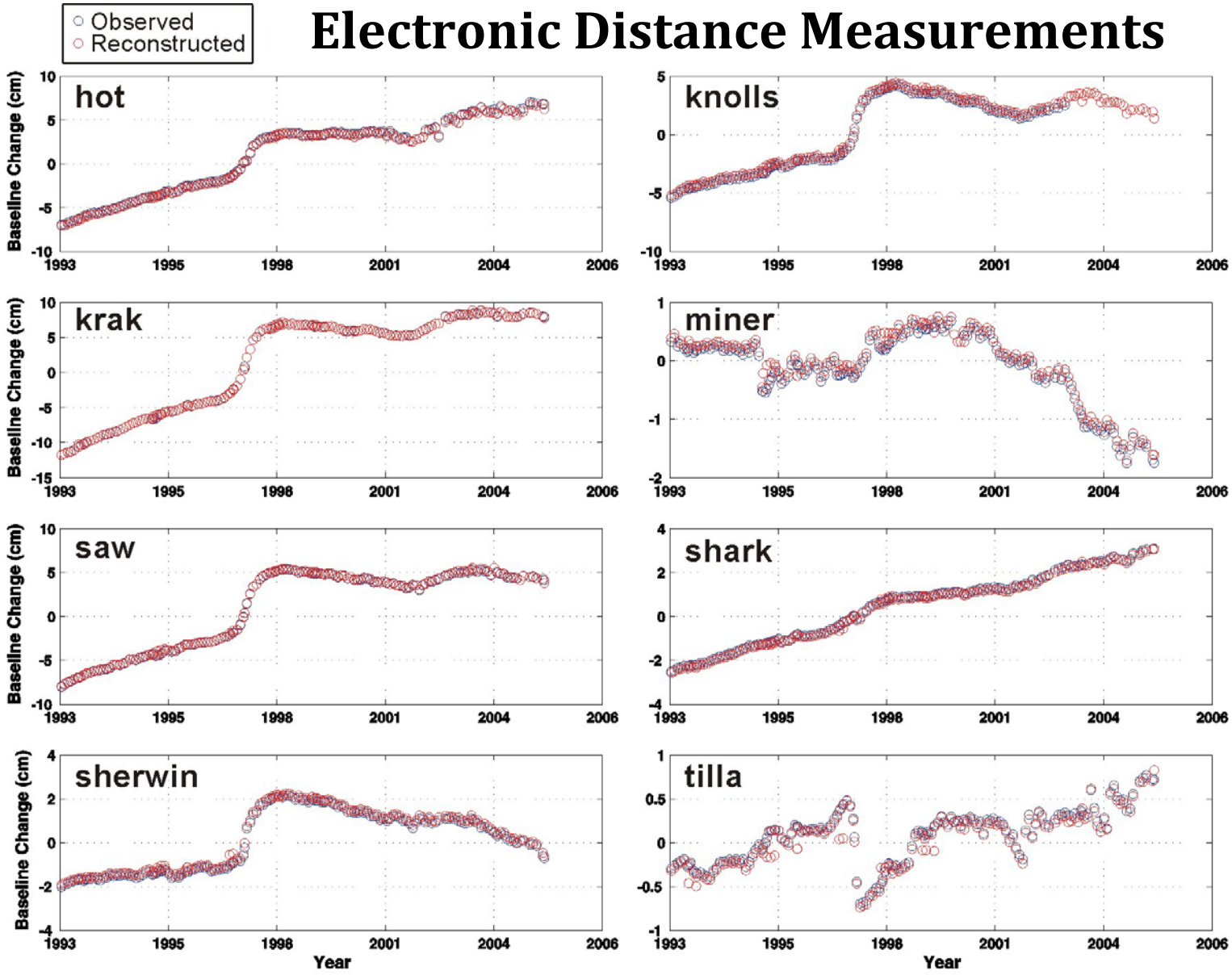
► Time function

▼ Spatial function

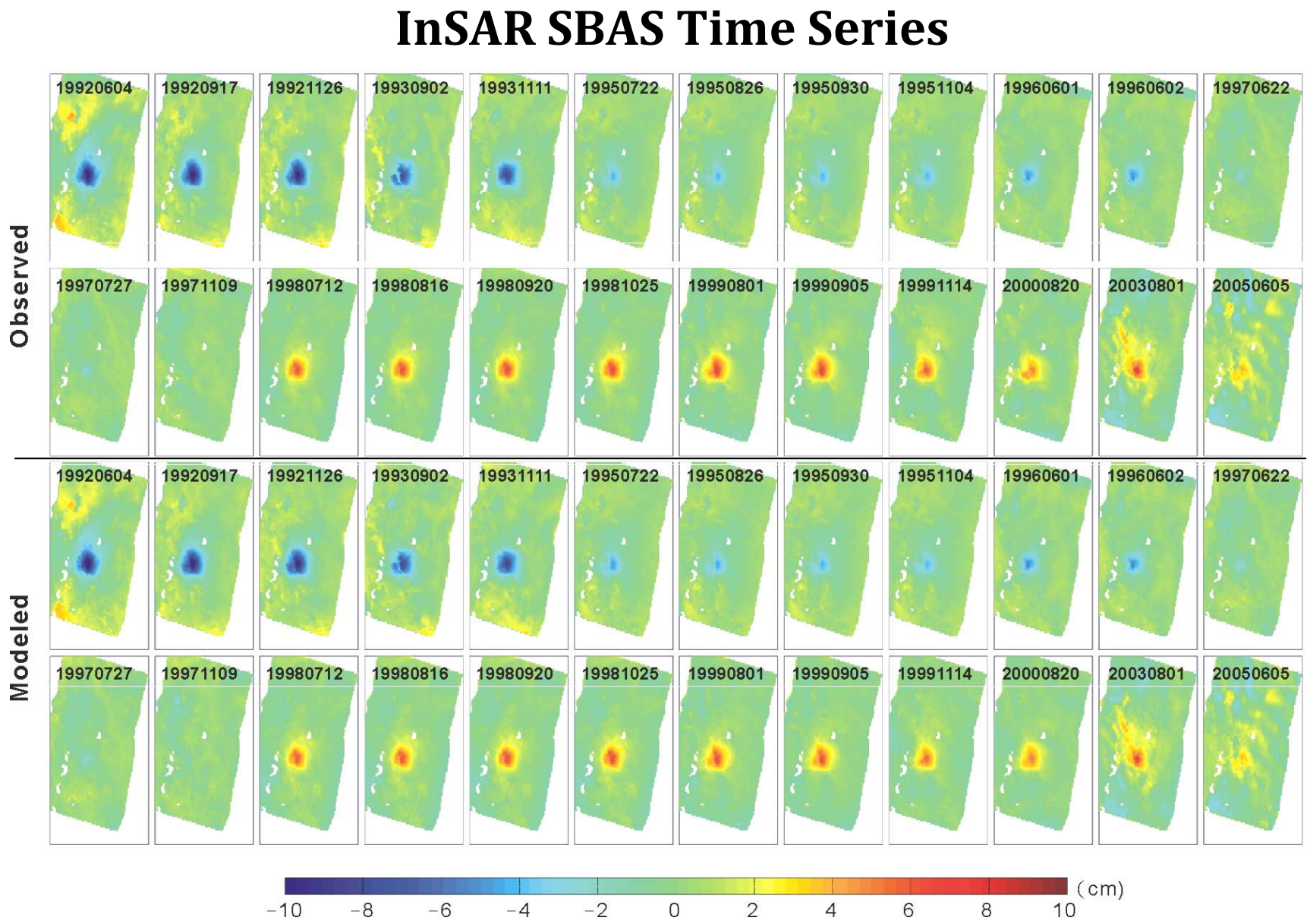




PCA Reconstruction (4 components)

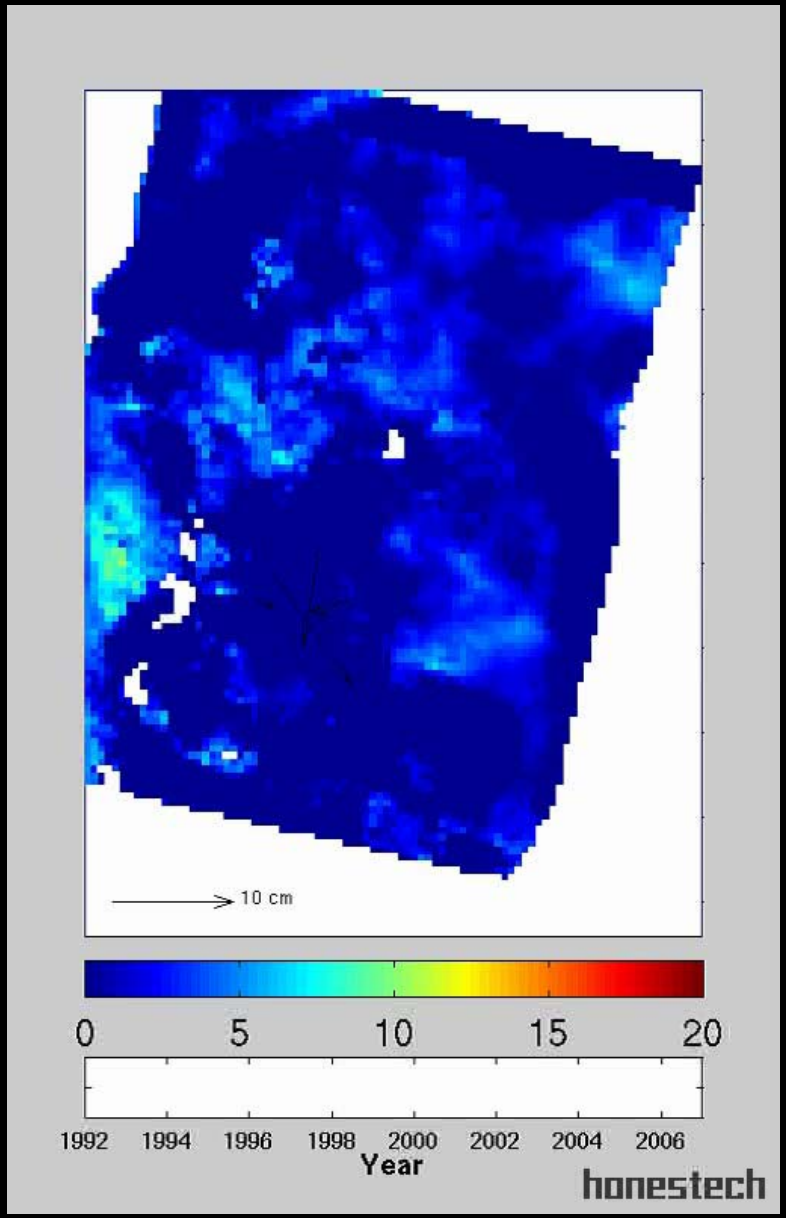


PCA Reconstruction (4 components)

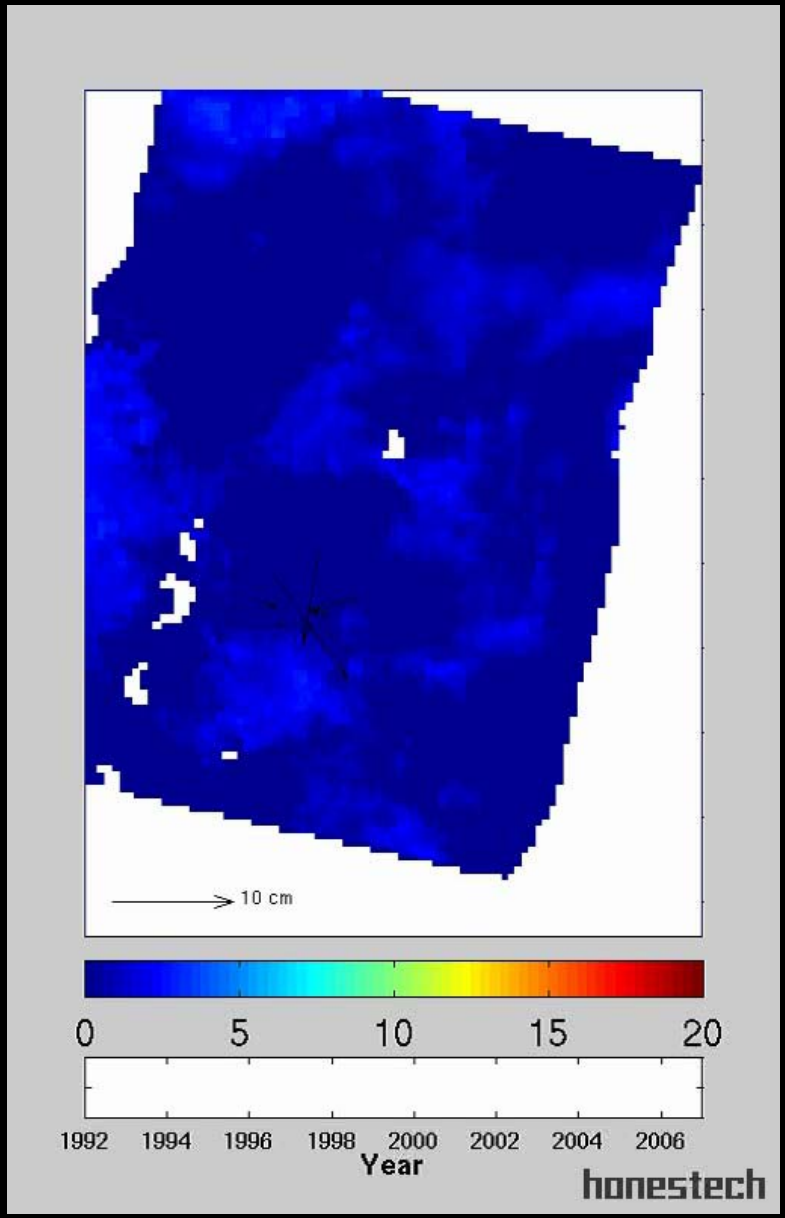


Displacement Field

9 Components



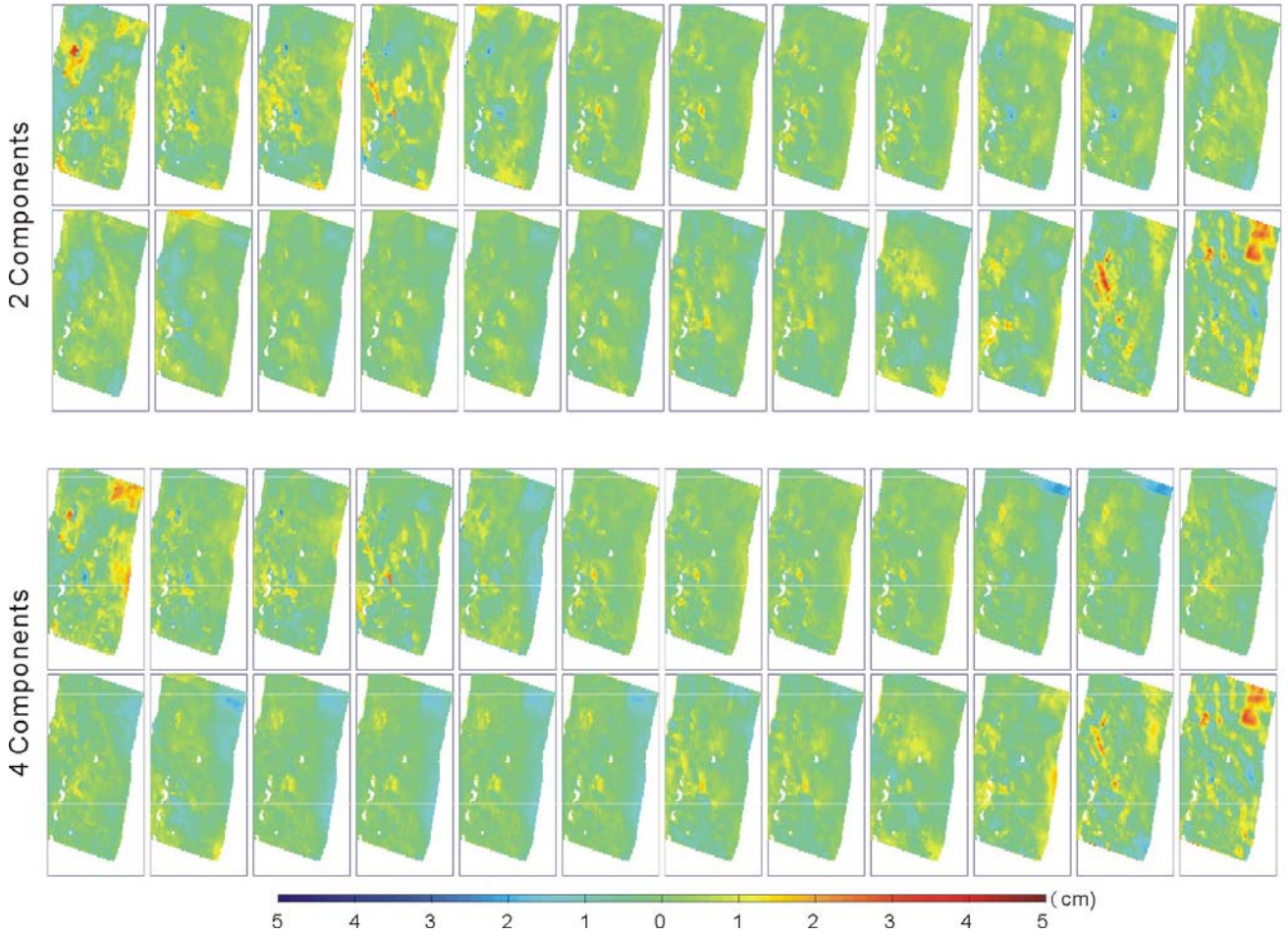
4 Components



PCA Joint Inversion

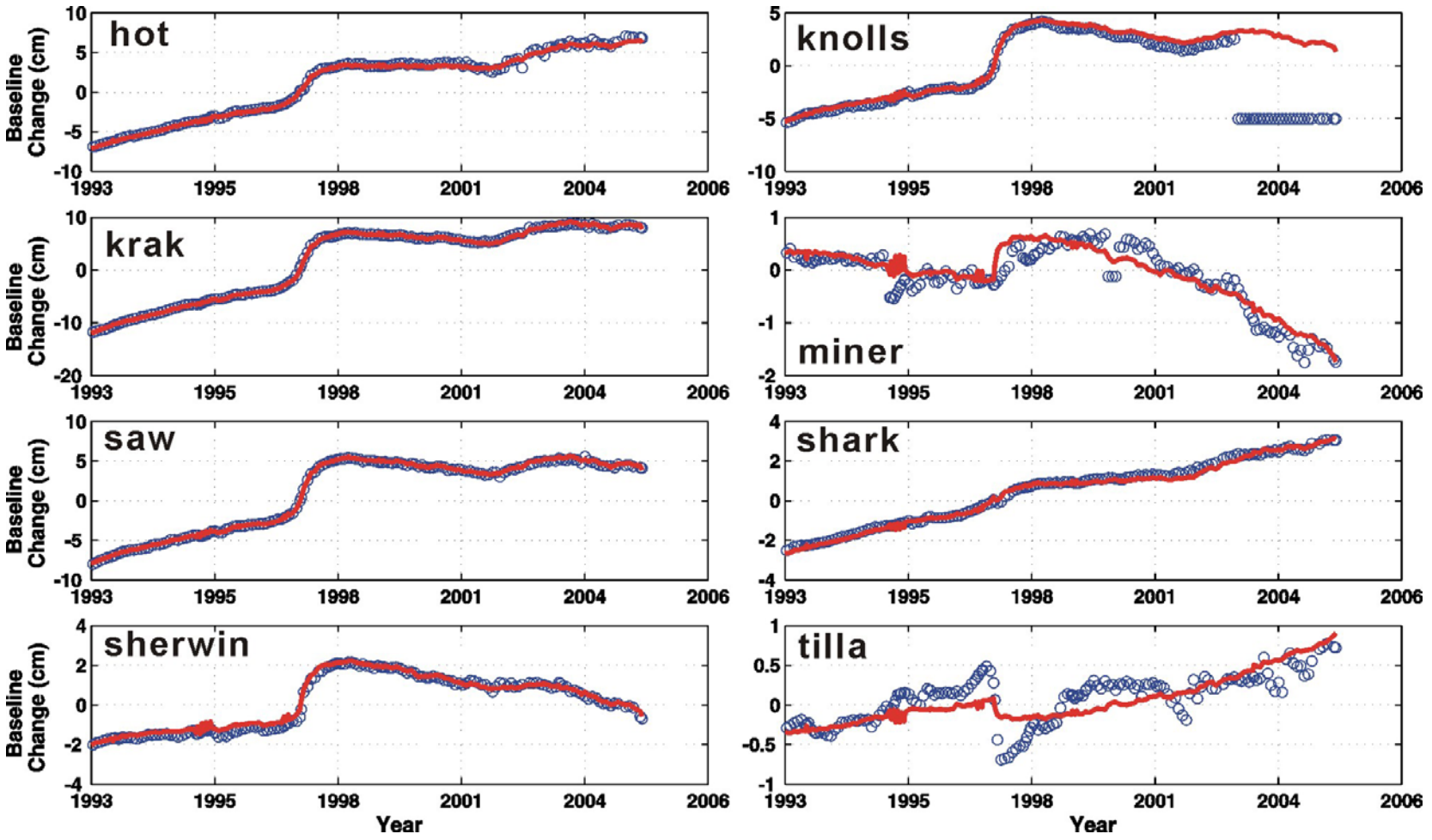
- **Gridded Mogi Model** [Masterlark and Lu, 2004]
- **Apply Laplacian operator and cross validation**

Residuals between inversion result and observed data



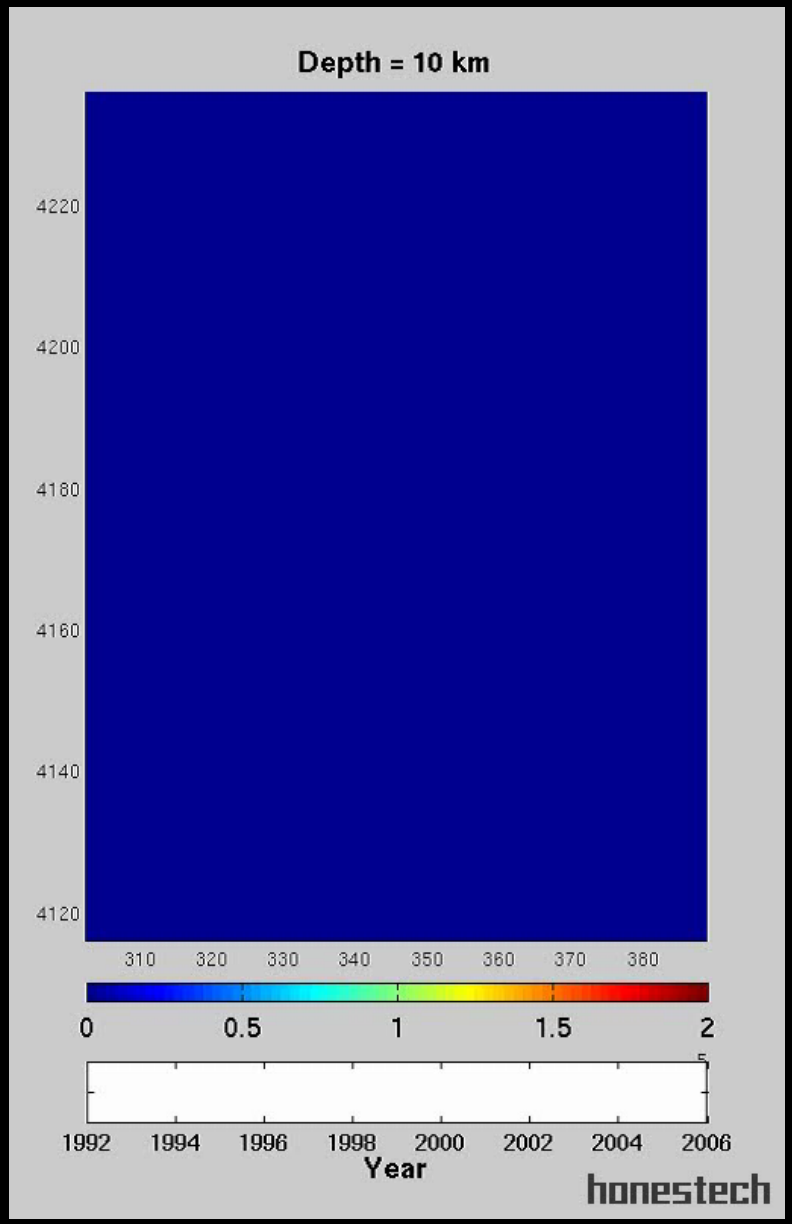
PCA Joint Inversion

2 Components

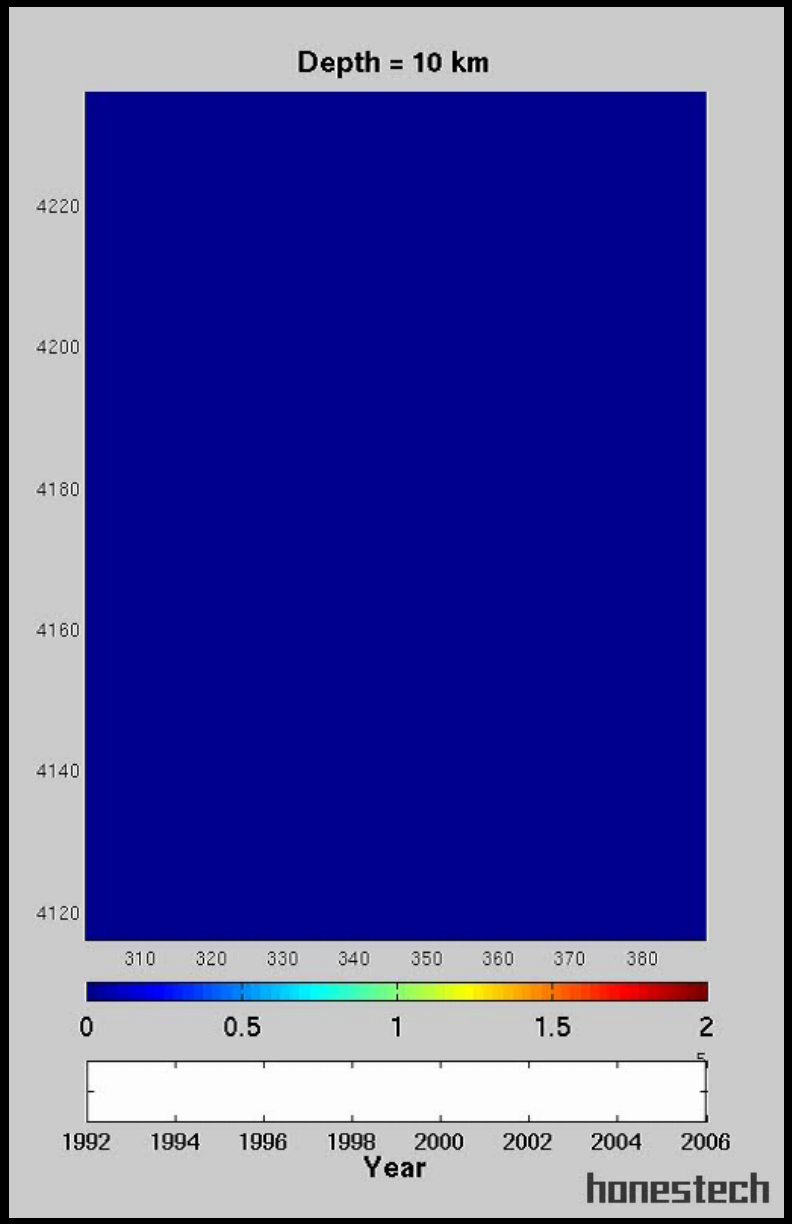


Source Mapping

4 Components



2 Components



PCA Joint Inversion -- Discussion

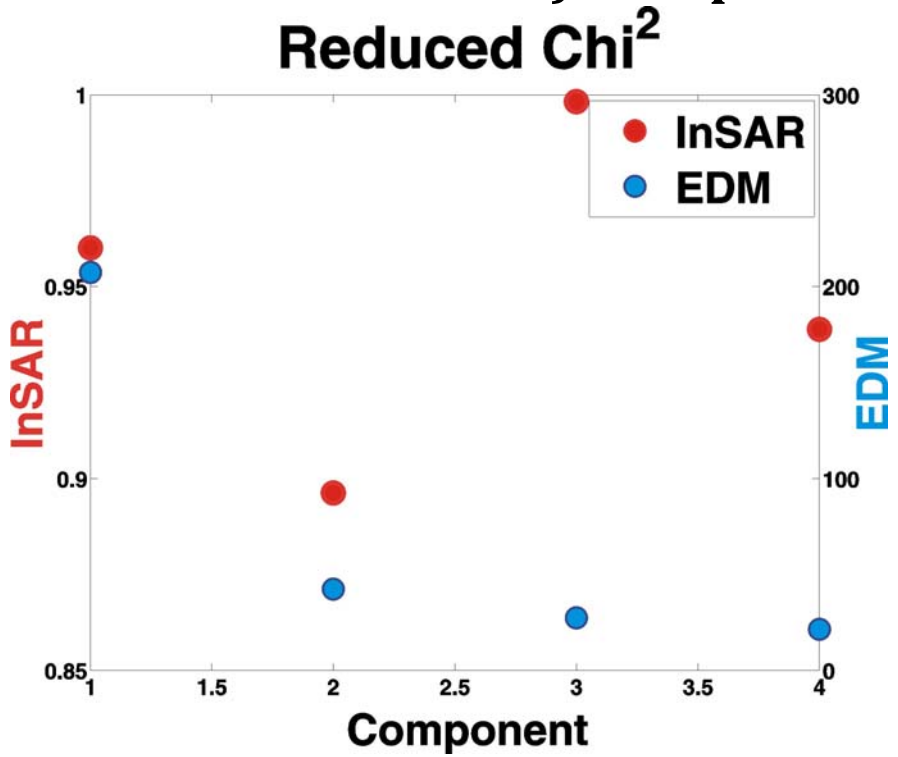
- We can get better source mapping in time and in space through combining InSAR and EDM

- Some (local) tectonic signals are mixed with noises in higher components

- We may need another source (such as South Moat Fault) to improve the fitting to EDM data

- Noises such as atmospheric signals in InSAR data can be filtered out into higher components

- Atmospheric correction will improve joint inversion by reducing the magnitude of noises



Summary

- **PCAIM can produce a detail mapping of the source both in time and in space when combining InSAR and other time series data**

- **PCA decomposition may filter the unwanted atmospheric signals from InSAR data, but some local low-amplitude signals can also be excluded**