Inverting Geodetic Time-Series With a Principal Component Analysis-Based Inversion Method (PCAIM)


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INTRODUCTION

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References:

RESULTS AND DISCUSSION

CONCLUSIONS

Acknowledgements:

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Located in Southeast Asia, the Sunda subduction zone lies at the interface between the Sunda lithospheric plate and the Australian plate. Over the last 200,000 years, there have been at least five giant earthquakes, including the December 26, 2004 Sumatra-Andaman earthquake which caused a tsunami that killed over 240,000 people. The need to understand how the interplay of slip is changing near the coast is important for understanding how the next subduction earthquake to occur near the Sunda subduction zone is likely to be.

Modeling surface displacements to constrain the slip distribution is still a very challenging problem. Understanding how the Earth's surface helps us uncover clues about the slip patterns.

Before a large earthquake, the surface shows a gradual increase in strain, which becomes more localized in the ENIF version and farther down-dip. This implies the range of time after which the slip occurs.

Figures 7-9 show the results from the PCAIM and ENIF (Hsu, 2006) inversions of the year 2000 InSAR data. These results were obtained from the inversion of each principal component. The ENIF model produced slip models comparable to those obtained from standard inversion techniques with less computational complexity. We can compare an analysis derived from the PCAIM inversion with some data on the 2000 InSAR Earthquake, with another solution obtained from the Extended Network Inversion Filter (ENIF). We introduce several extensions of the algorithm to allow statistically rigorous integration of multiple data sources (e.g., both GPS and InSAR time-series) over multiple time scales. PCAIM can be generalized to any linear inversion scheme.