

# Monitoring Land Subsidence in Ho Chi Minh City Using Radar Interferometry Techniques

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## ABSTRACT

The level of the ground water has been constantly lowering and the urbanization has been rapidly developing during the last decades due to the strong groundwater extraction which has led to the subsidence of some areas in the Ho Chi Minh City (HCMC). Land deformation at the rate of few centimetres per year can be measured at the heavy ground water pumping stations.

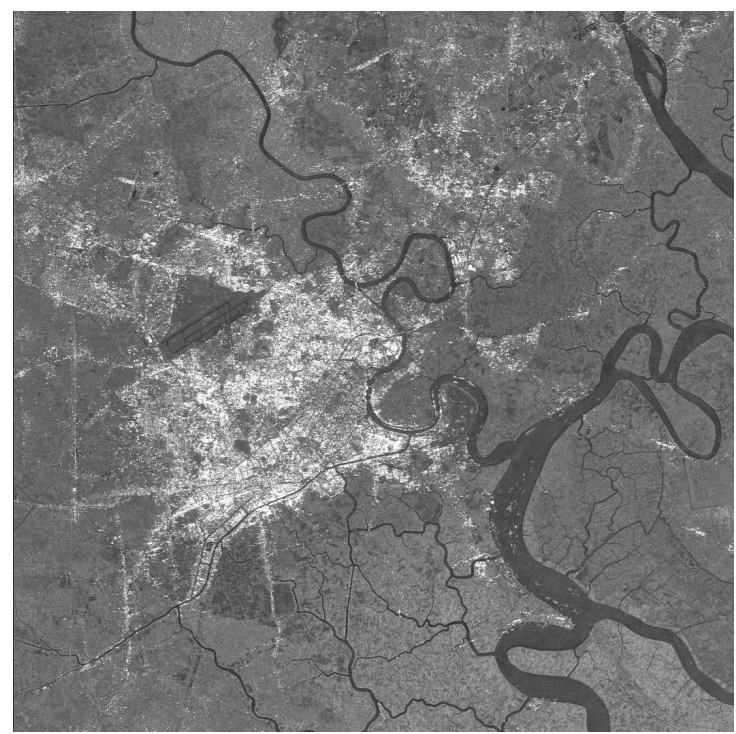
This poster demonstrates the effectiveness of radar interferometry to detect the deformations in HCMC. The goal is to employ this powerful new technique to measure the land subsidence phenomenon in HCMC using ERS SAR SLC scenes acquired over HCMC.

## INTRODUCTION

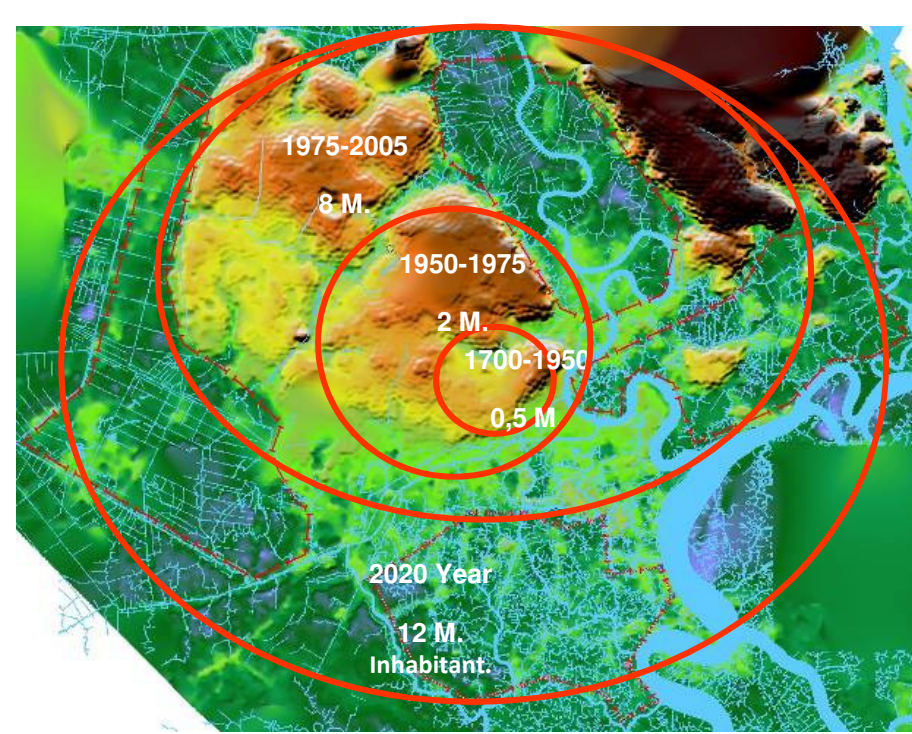
- Subsidence in Ho Chi Minh City is a long term problem



- Conventional methods : precise levelling and GPS – they are costly and time consuming
- Radar Interferometry – Permanent Scatterer InSAR - economical, fast, provides information on a large area



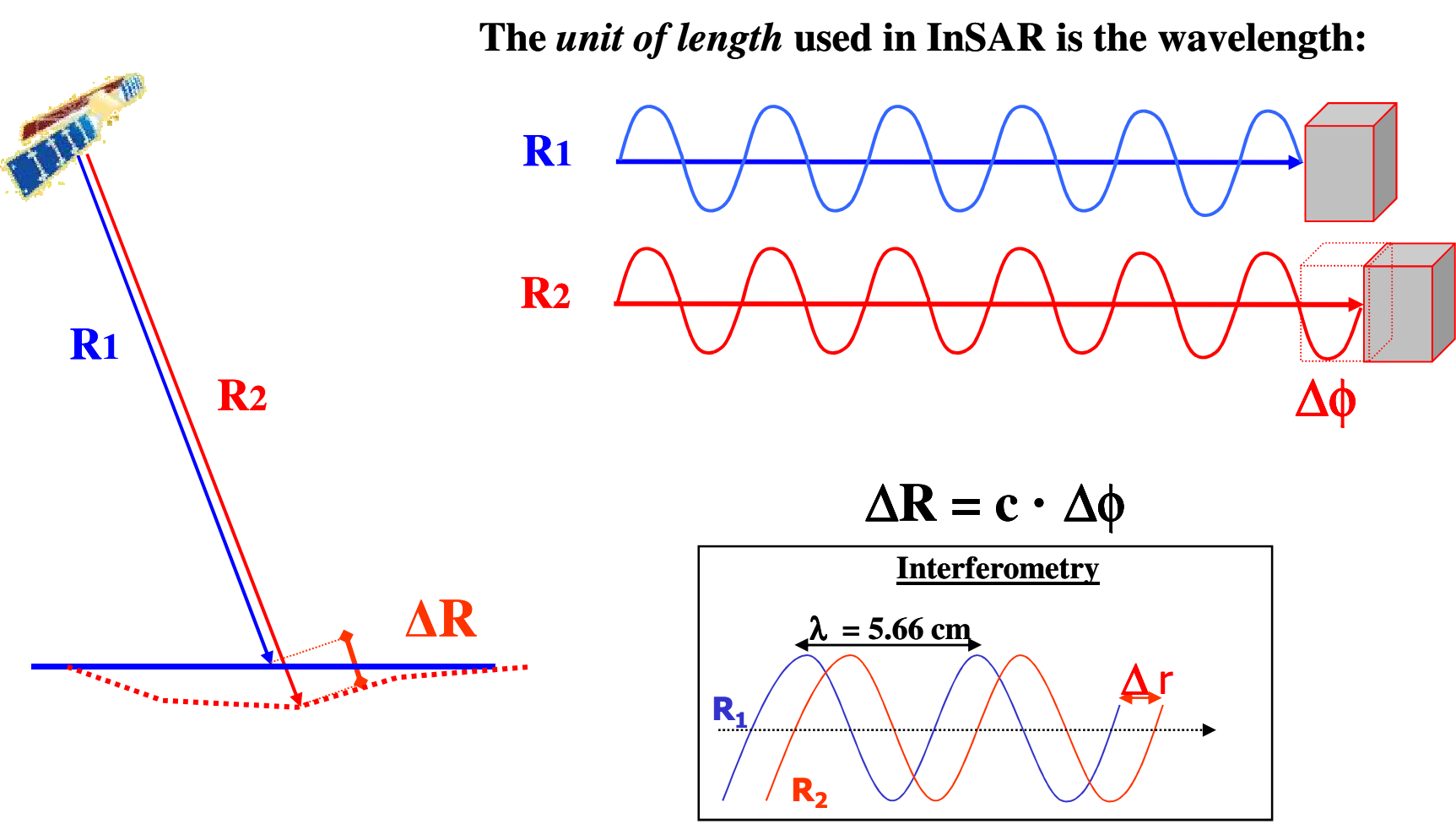
Average backscatter intensity



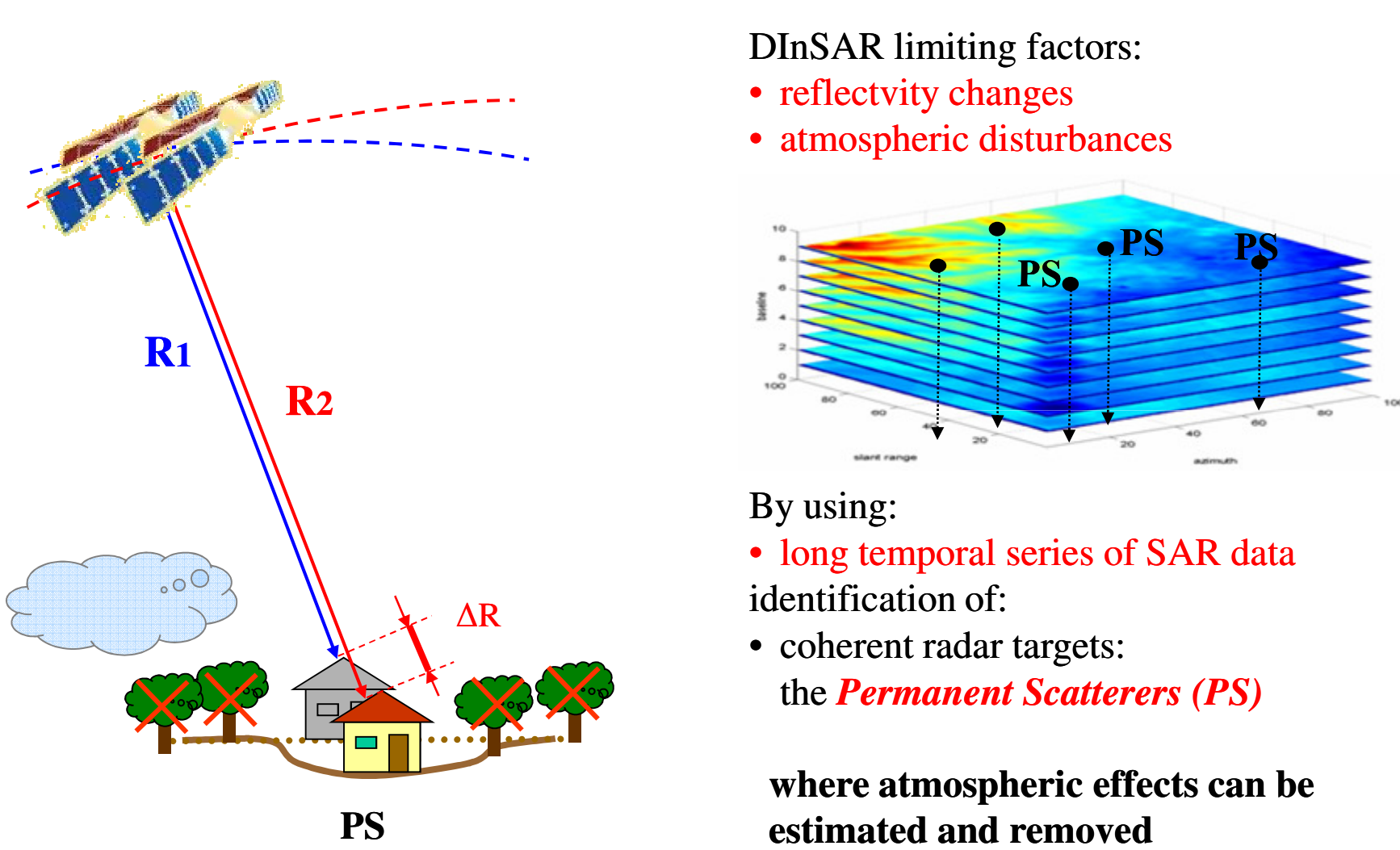
Urbanized direction and population

## METHODS

### The Interferometric Concept



### The PS Technique



Observed interferometric phase is the sum of many terms

$$\phi_{insar} = \phi_{def} + \phi_{topo} + \phi_{atm} + \phi_{orbit} + \phi_{noise}$$

↑  
PS pixels have low noise

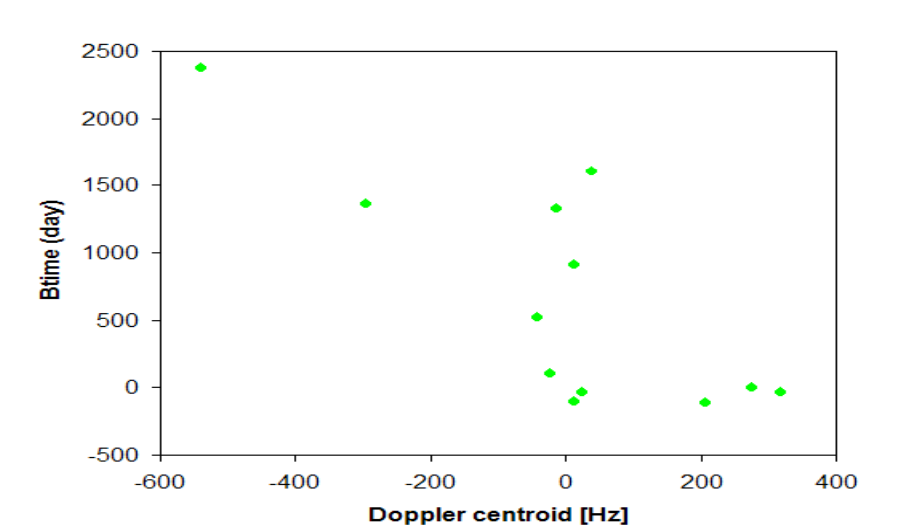
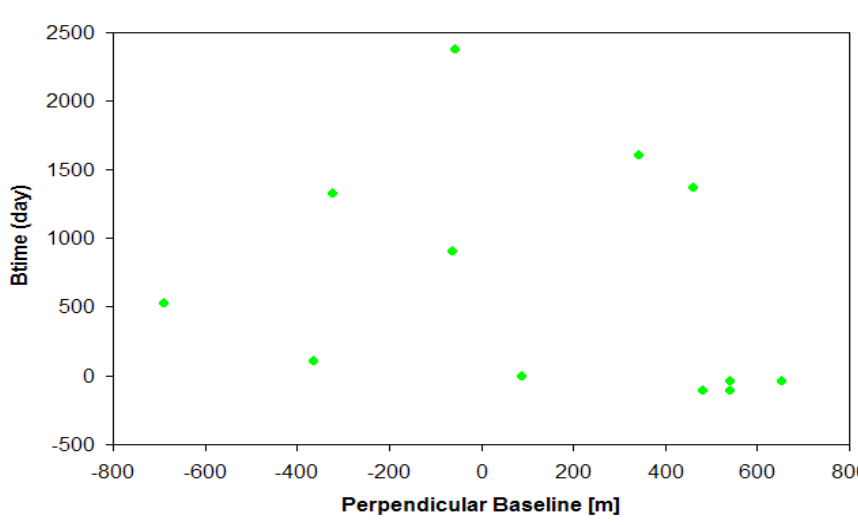
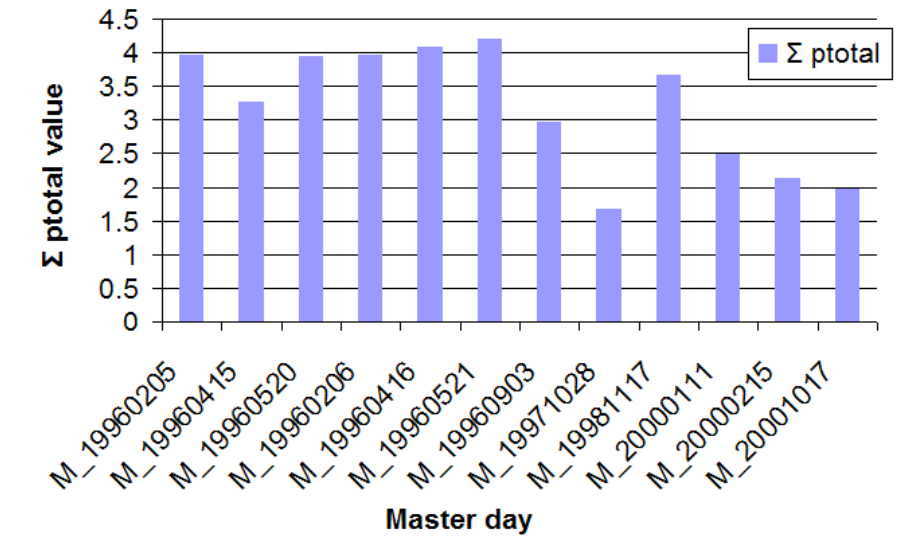
## RESULTS

### Data ERS-1 & 2

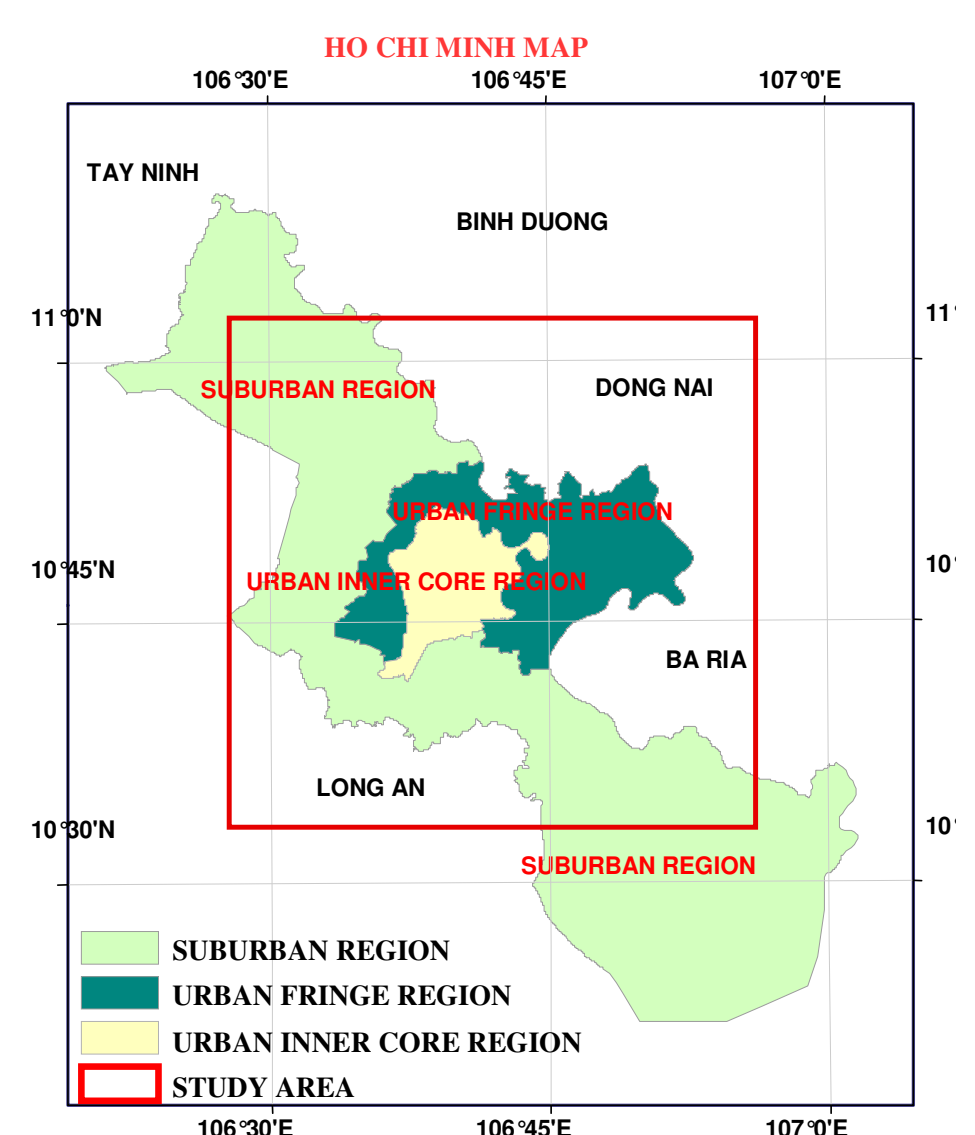
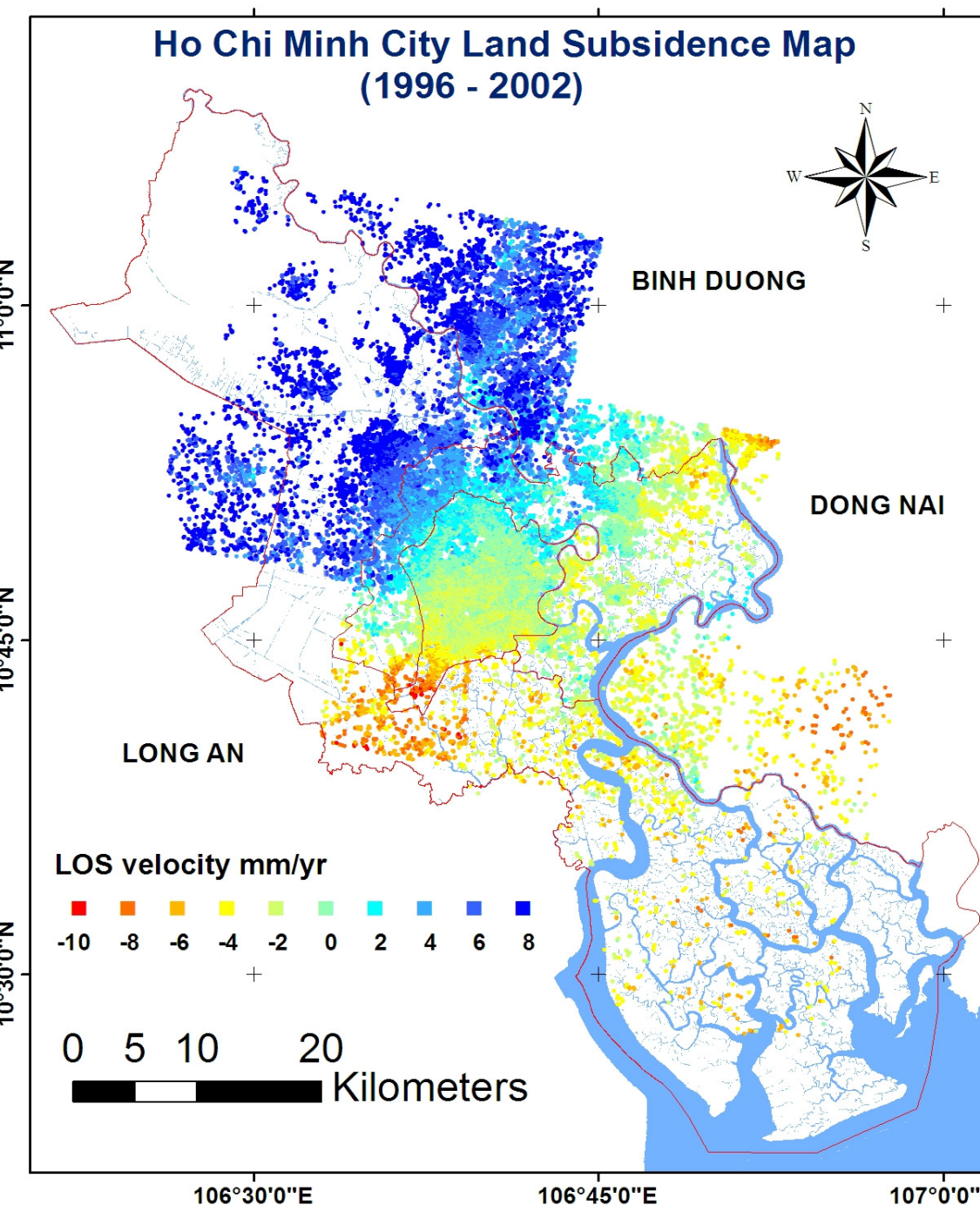
Total correlation, ptotal

$$\rho_{total} = \rho_{temporal} \rho_{spatial} \rho_{doppler} \rho_{thermal}$$

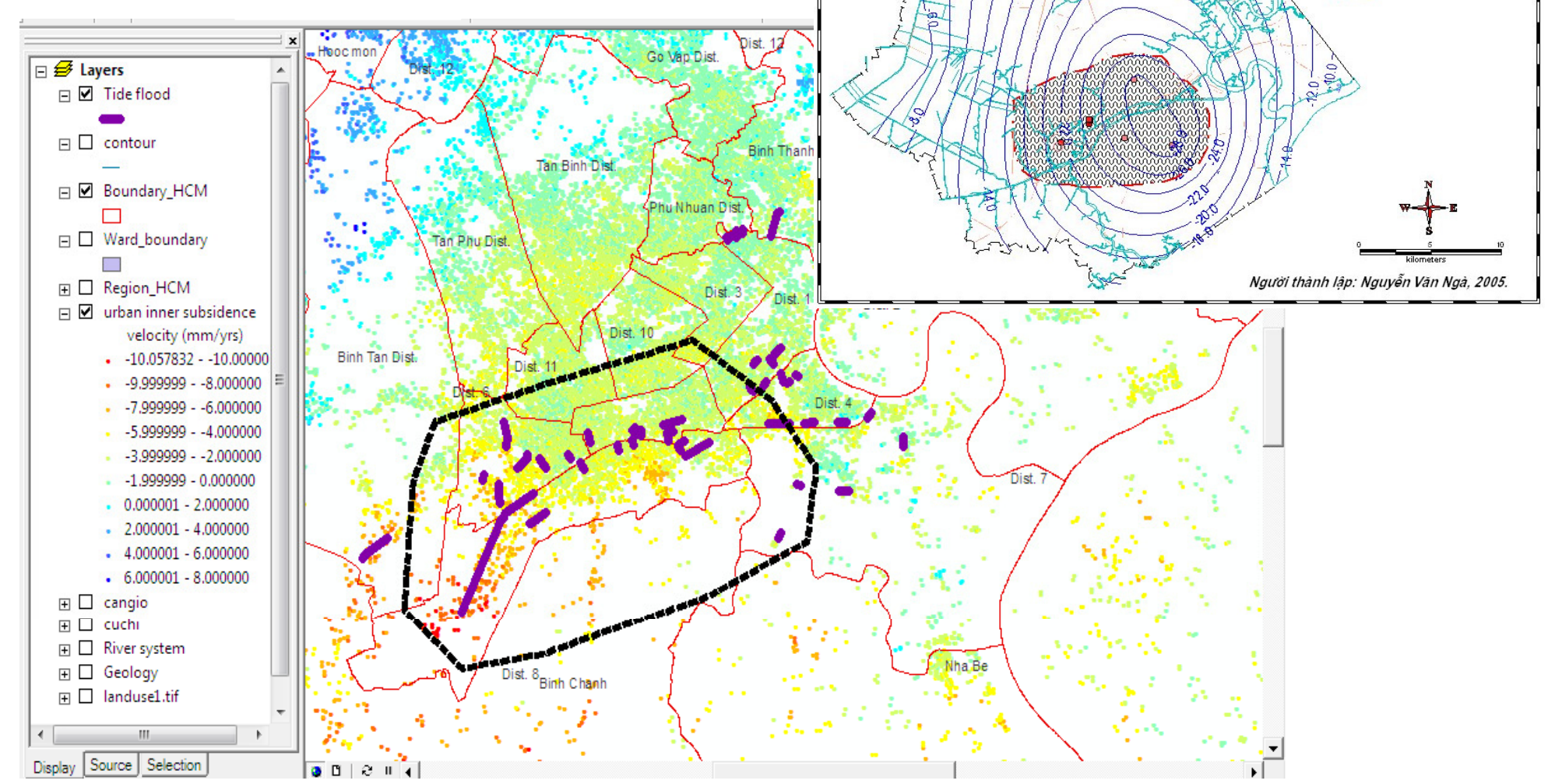
$\rho$  denotes correlation



### Subsidence trend



### Interpretation



We see that the some Southwest subsidence areas coincide. The most reliable information is in the zone were the PS are concentrated. Moreover, looking at the position of the “subsidence zones”, most of tide flood sites lie at these areas of the city (as expected).

## CONCLUSIONS

- The capability of using PS techniques to map land subsidence phenomenon in Ho Chi Minh City.
- Progressing urbanization and a rising population cause more exploitation of underground-water and more large structures to be built. This is effecting HCMC surface causing significant ground deformation.

## BIBLIOGRAPHY

- Ferretti, A., C. Prati, and F. Rocca, (2000). Nonlinear subsidence rate estimation using permanent scatterers in differential SAR interferometry, IEEE Trans. Geosci. Remote Sens., 38(5), 2202–2212.
- Hooper, A., P. Segall, and H. Zebker, (2007). Persistent scatterer interferometric synthetic aperture radar for crustal deformation analysis, with application to Volcáno Alcedo, Galápagos, Journal of Geophysical Research, Vol. 112, B07407, doi:10.1029/2006JB004763.
- Le Van Trung and Ho Tong Minh Dinh. Monitoring Land Deformation Using Permanent Scatterer InSAR Techniques – Case Study: Ho Chi Minh City. 7th FIG Regional Conference, Hanoi, Vietnam, October 2009.