



ASSESSING INFRASTRUCTURE FROM SPACE

Giorgia Giardina



**Los Angeles**



**New York**



**London**



**Paris**



**Doha**

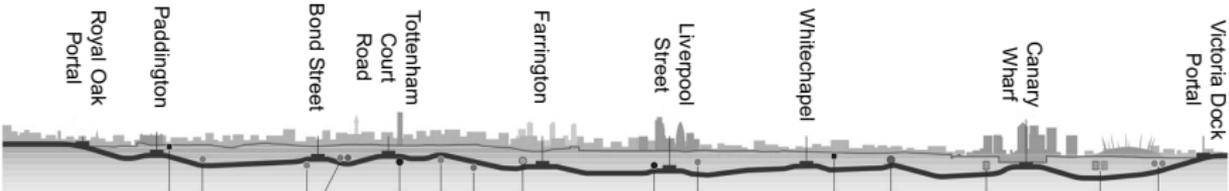


**San Paulo**



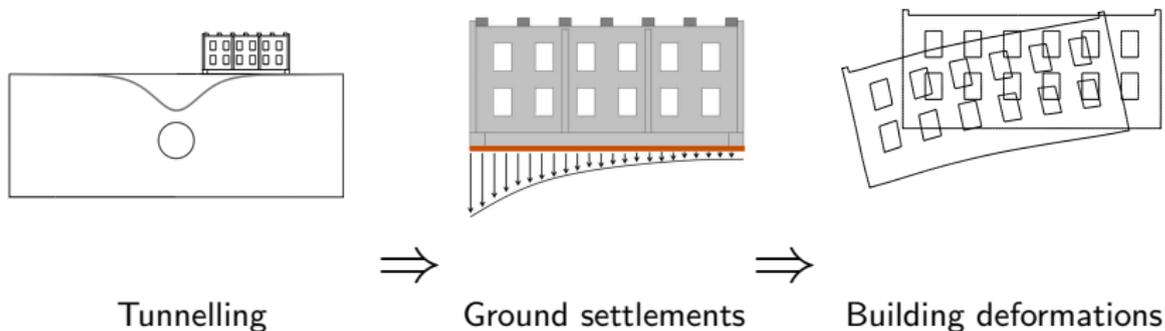
**Sidney**

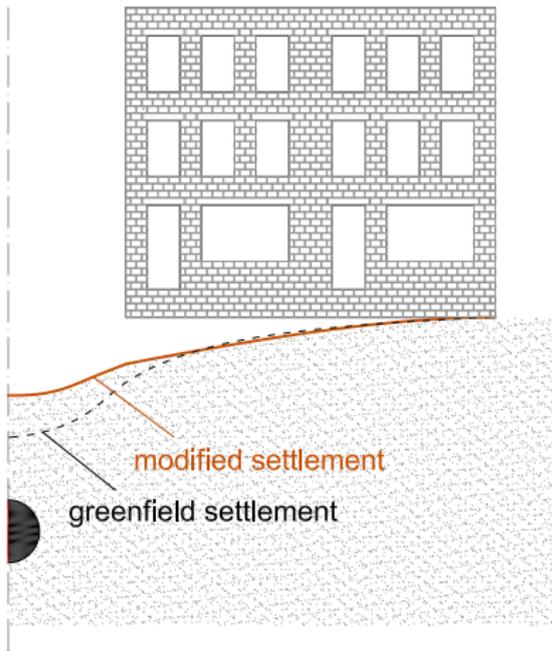




## Motivation

- ▶ Reducing the negative **impact of underground excavations** to existing structures
- ▶ Improving methods for the assessment of tunnelling-induced **damage to masonry buildings**





## Aim

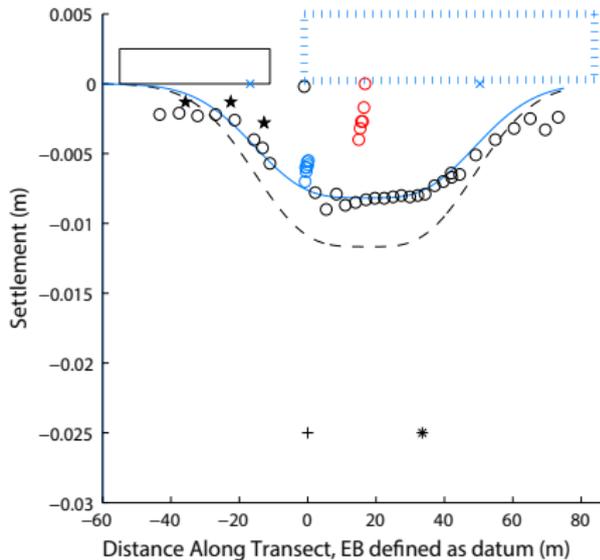
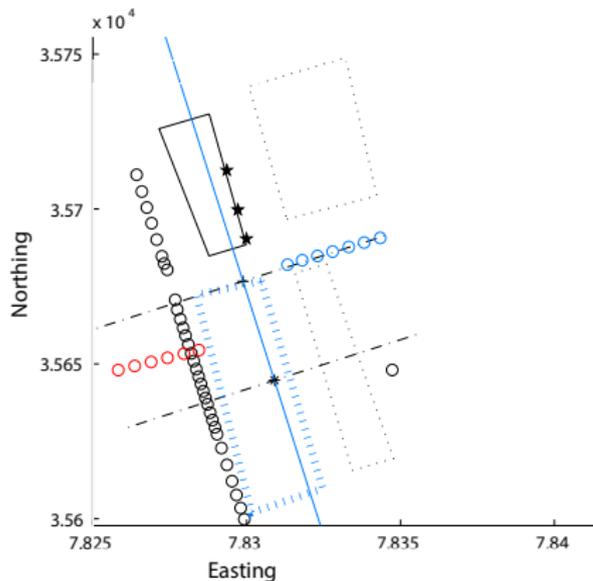
Evaluating the **soil-structure interaction effect** on the tunnelling-induced structural damage

# Ground-based field data

## Example



# Ground-based field data



## Reference

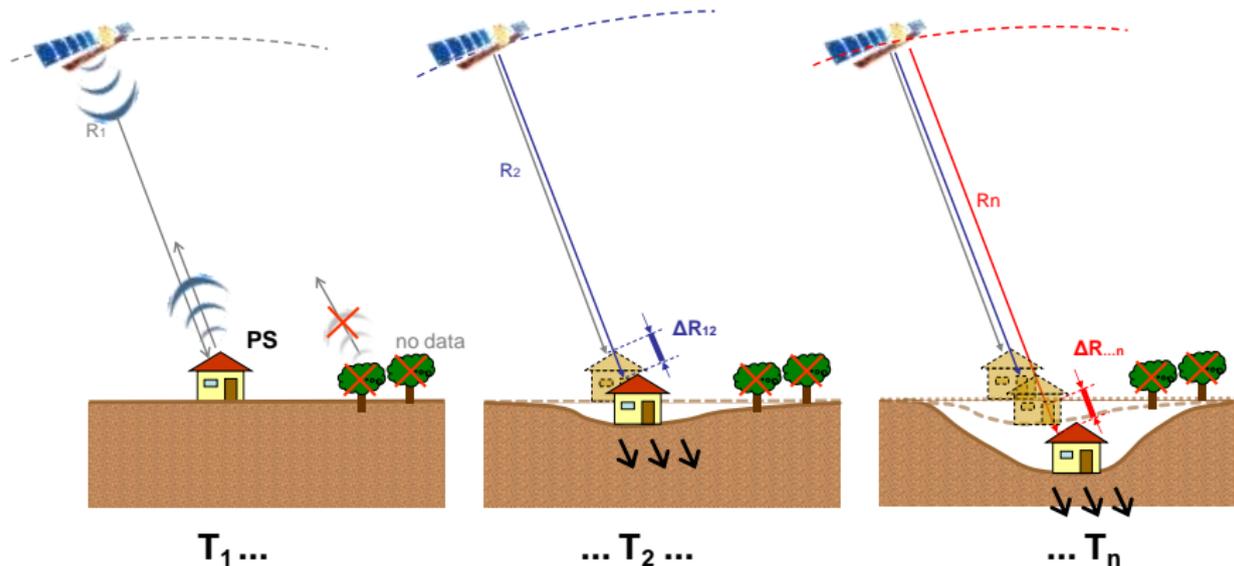
DeJong, MJ, Giardina, G, Chalmers, B, Lazarus, D, Ashworth, D and Mair, RJ, 2019, The impact of tunnelling on loadbearing masonry buildings on shallow foundations, *ICE Proceedings: Civil Engineering*, 172(5), 402-416

# Ground-based field data

## Conclusions

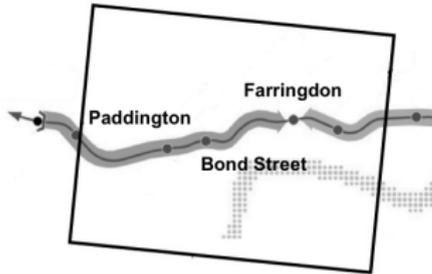
- ▶ Some evidence that the building stiffness influence the tunnelling-induced settlement profile
- ▶ Limited number of monitoring points for each structure
- ▶ Difficult evaluation of soil-structure interaction

# Synthetic Aperture Radar Interferometry (InSAR)

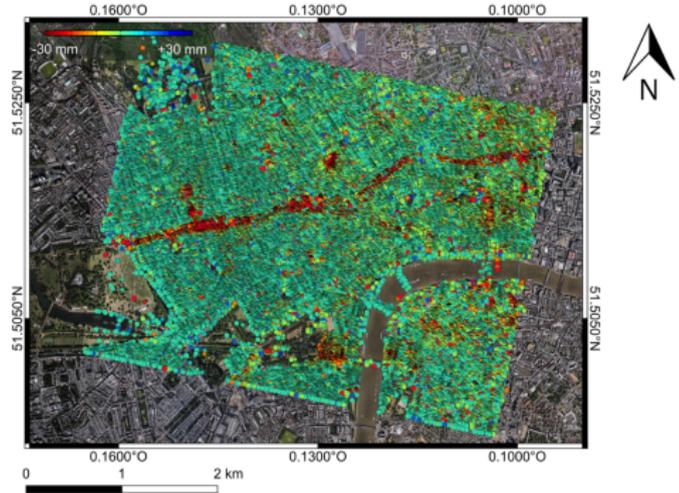


Giannico et al. (2012)

# Crossrail tunnels, London



Crossrail route

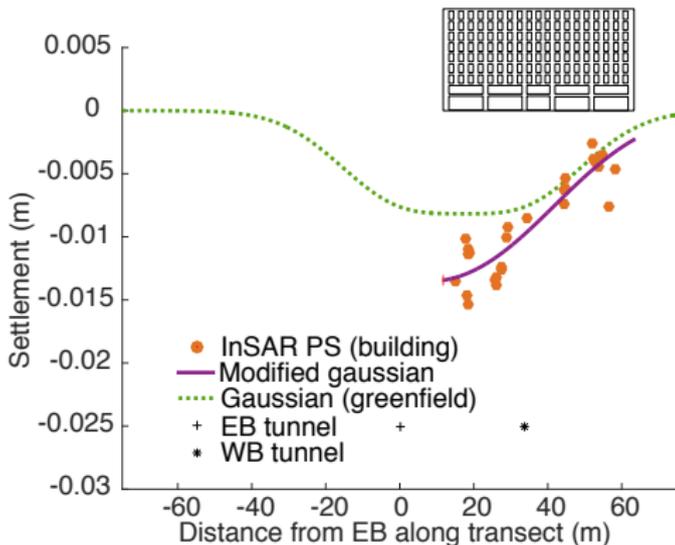


Displacement map

## Reference

Giardina, G, Milillo, P, DeJong, MJ, Perissin, D and Milillo, G 2018, Evaluation of InSAR monitoring data for post-tunnelling settlement damage assessment, *Structural Control and Health Monitoring*, 26(2), e2285

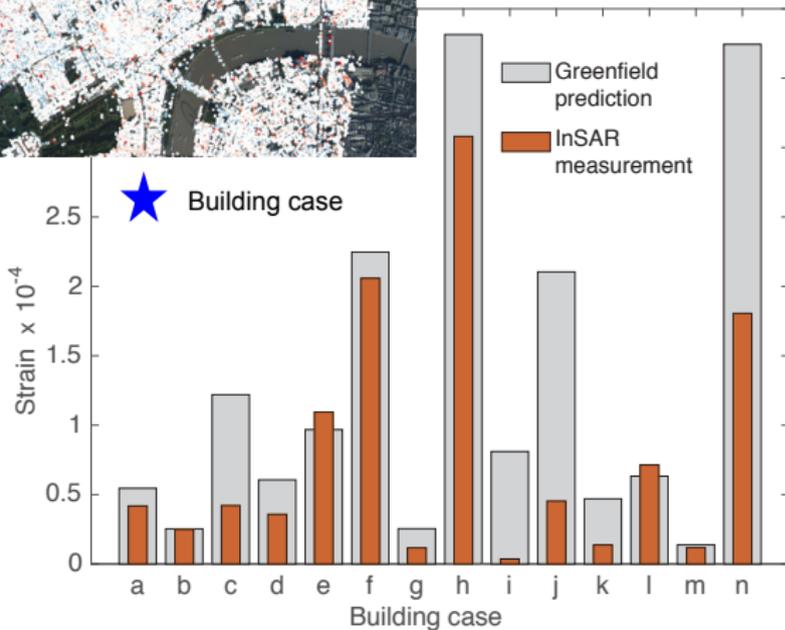
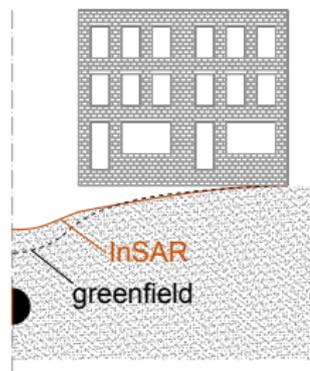
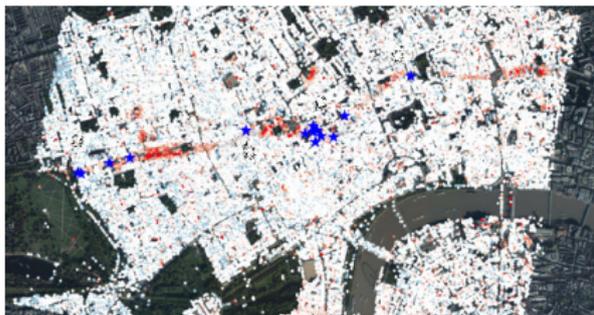
# Satellite-based field data



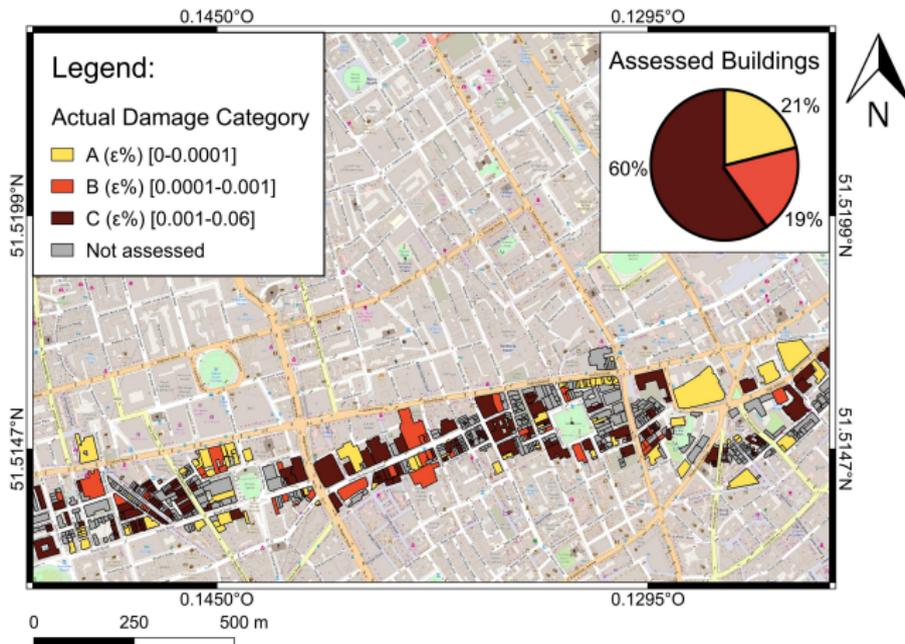
## Reference

Giardina, G, Milillo, P, DeJong, MJ, Perissin, D and Milillo, G 2019, Evaluation of InSAR monitoring data for post-tunnelling settlement damage assessment, *Structural Control and Health Monitoring*, 26(2), e2285

# Satellite-based field data



# Satellite-based damage assessment



## Reference

Macchiarulo, V, Giardina, G, Milillo, P, DeJong, MJ, Perissin, D and Milillo, G 2019, Settlement-induced damage assessment using MT-InSAR data for the Crossrail study in London, ICSIC Proceedings

# Conclusions

## Satellite monitoring

1. Extensive and relatively inexpensive field data
2. High resolution and spatially dense InSAR measurements of differential settlements
3. Can capture the typical settlement trough generated by tunnelling
4. Can be used to assess tunnelling-induced deformations to structures
5. Offers unprecedented insight into the soil-structure interaction mechanism

Further information:

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