EGU General Assembly 2020

Online | 4–8 May 2020

Monitoring of levee breaching through remote sensing and artificial intelligence

Rosa Di Maio, Eleonora Vitagliano, and Rosanna Salone

Department of Earth Sciences, Environment and Resources, University of Naples Federico II, Naples, Italy

Corresponding author: eleonora.vitagliano@unina.it

Friday, 8 May 2020

EGU2020-3324

Outline

- Aim of the proposed study
- Methodology
- Involved physical mechanisms
- Machine learning and time series trends
- Final remarks

Aim of the proposed study

The proposed study aims to monitor the fluvial levee breaching.

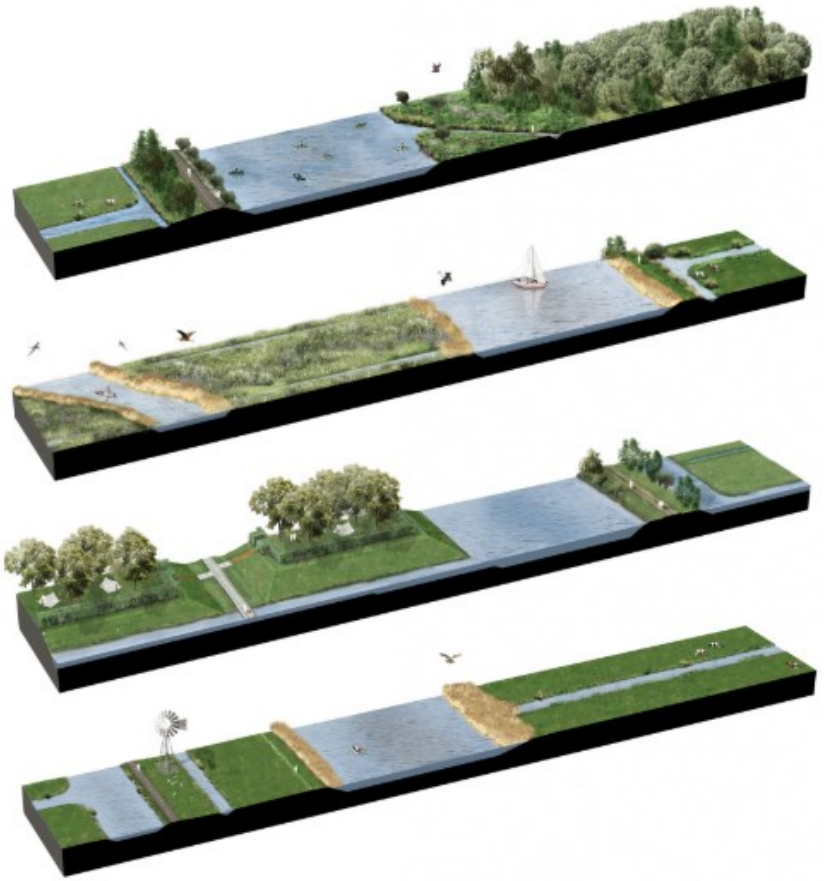
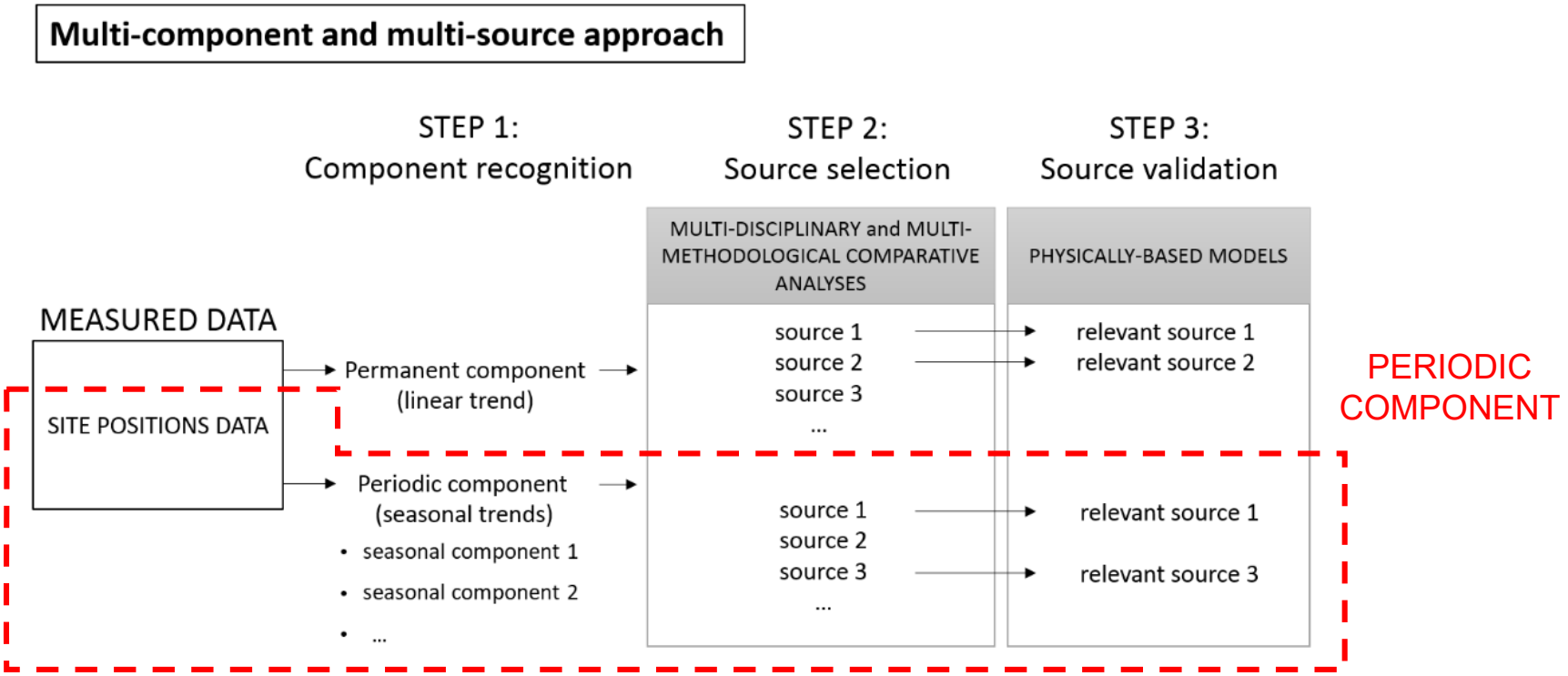


Image from Archiprix website (www.archiprix.nl/national/)

This task is accomplished first through multi-methodological comparative analyses applied to geodetic, hydrological and soil-properties series, then through mapping of river zones prone to failure.

Methodology

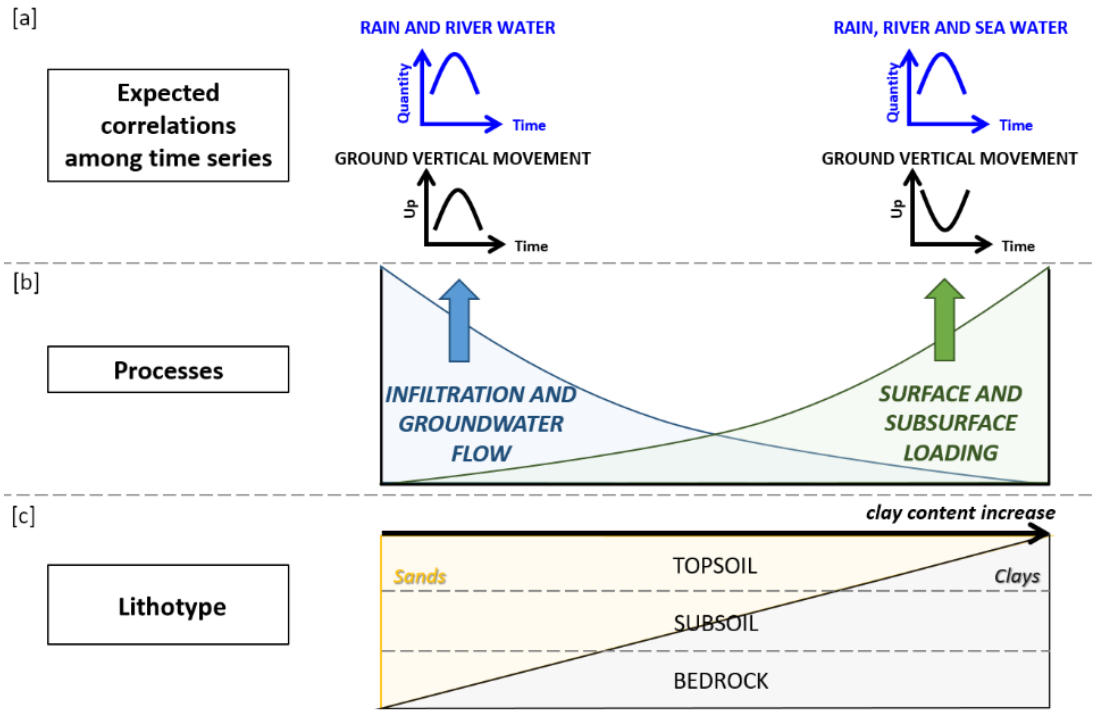
We investigate the periodic components of land movement (levee and riverbank levels) by applying a wider methodological approach already used for evaluating land subsidence



Vitagliano, E.; Riccardi, U.; Piegari, E.; Boy, J.P.; Di Maio, R. Multi-component and multi-source approach for studying land subsidence in deltas. Remote Sens. 2020, 12(9), 1465

Involved physical mechanisms

To estimate the periodic movement of ground level, we consider the correlation/anti-correlation expected from comparing geodetic time series and hydro-meteorological patterns



The occurrence of the water pressure- and mass-dependent processes is mainly driven by the lithological composition of soil (topsoil and subsoil) and shallow layers of sedimentary coverage (bedrock).

Figure shows a simplified lithological sketch of subsurface layers (c) with the associated physical processes (b) and the ideal ground level rebound in response to the increase and decrease of water supply (a).

Vitagliano, E.; Riccardi, U.; Piegari, E.; Boy, J.P.; Di Maio, R. Multi-component and multi-source approach for studying land subsidence in deltas. Remote Sens. 2020, 12(9), 1465

Machine learning and time series trend

We combine Machine Learning (ML) methods to extract information from spatial big data. In particular:

Relevant areas (e.g. riverbank) are selected from large geo-referential datasets (input phase)

The time series trends are compared point by point also making use of standard statistic methods and wavelet techniques (calculation phase)

Correlation indexes are extracted to build hazard maps (output phase)

Final remarks

- ✓ We propose a levee monitoring study based on possible relationships between physical mechanisms causing ground level motion and their effects, which are exhibited by geodetic time series and hydrological or soil-property patterns. When the correlation among these parameters is high, alert is activated
- ✓ The theoretical framework of the study is almost completed, while its application in a test area is currently pending
- ✓ Potentially, this study may led to the implementation of a large-scale and fast alert system: it is “large-scale”, because, based on satellite data, it is able to monitor large spatial areas; it is “fast” because it uses ML techniques applied to Earth’s surface observations. Due to these peculiarities, the study can be used for driving the localization of weak river portions prone to failure, where focusing detailed geotechnical and geophysical surveys.