

How can geophysical methods help fluvial levee investigation?

The floods resulting from levee failures can lead to human loss especially in densely populated areas.

For instance, the breaching of the levees in New Orleans in August 2005 and in Vendée in February 2010. Both of these two disasters had their origin in major meteorological events such as Hurricane Katrina and Xynthia storm. Hurricane Katrina caused damage of US\$100-200 billion and a regional death count of about 1600. The storm Xynthia has been one of the most deadly on the French territory since several decades, with 53 deaths.

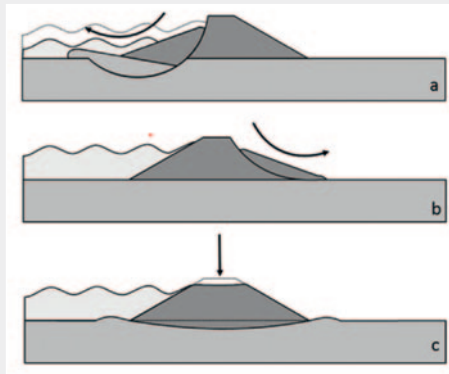
Electrical Resistivity Tomography (ERT) is a non-invasive geophysical often interpreted in a complementary way with geotechnical data according to the physical property of the levee.

The most suitable survey layout is 2D lines placed along the levee, rarely in 3D configuration. The system can be set-up permanently as Hojat et al. 2020 described.

An increase of the water content within the levee, decreases the recorded resistivity. Cracks can be decipher at a centimetric scale with a dedicated survey set-up. Metallic pipes appear with very low value of resistivity.

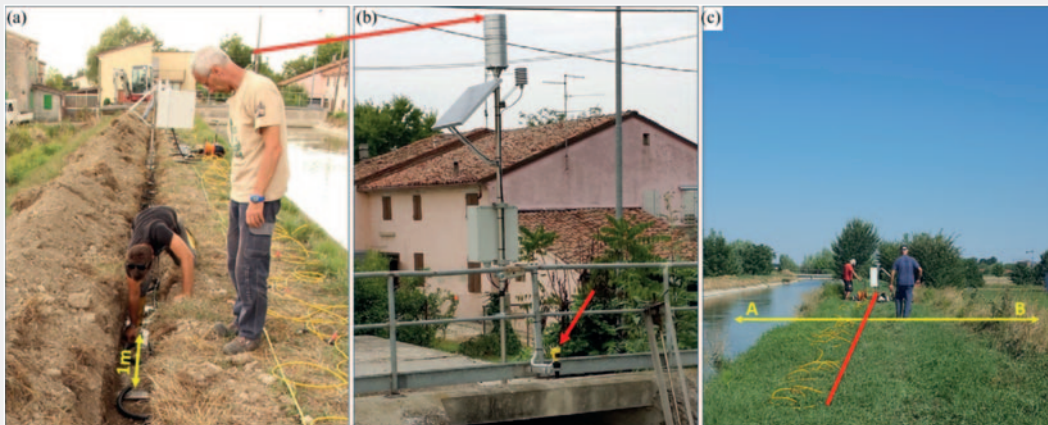
Levees monitoring can be performed using the self-potential passive method which consists in recording electrical potential variations underground over time. The self-potential method is mainly used for the detection of water and flow velocities. leakage within the levees.

The Induced Polarization method records the chargeability of the medium which is apt to decrease when the water content increases. Interfaces between distinct materials are detectable if the chargeability contrast is enough. The method has been shown to be useful for root detection in dykes embankments (Mary et al. 2016).



Various processes associated to the slope instability mechanism:

- a) Deep rotational sliding of a levee*
- b) Shallow rotational sliding of the landside of a levee*
- c) Settlement of a levee on a soft soil foundation (Sharp et al., 2013)*



- a) the customized ERT system being installed along the levee in San Giacomo (Italy)*
- b) A weather station was installed close to the ERT profile*
- c) 2D profile section in red*

SYSCAL PRO, SYSCAL PRO SWITCH 48/72/96/120 SYSCAL PRO and SYSCAL PRO SWITCH are all well adapted to Electrical surveys (ERT, SP and IP) dedicated to evaluate levees integrity.

Derived from T. Dezert et al. 2019, 2019. Hojat et al 2020, Sharp et al. 2013, Mary et al. 2016