Passive RFID, a new technology for dense and long-term monitoring of unstable structures.

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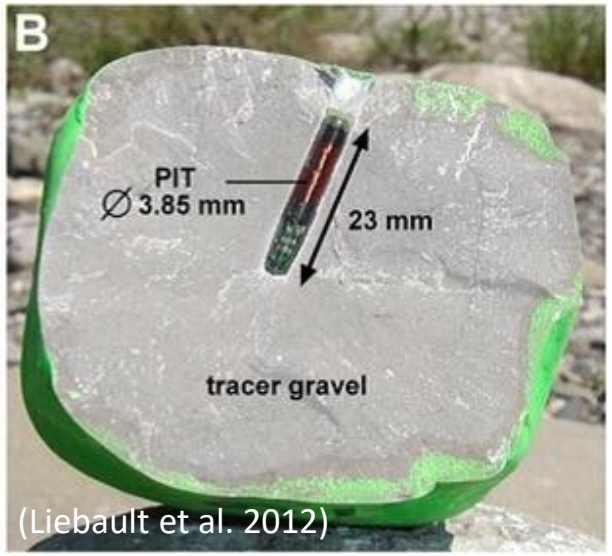

River bedloading

Landslide displacement

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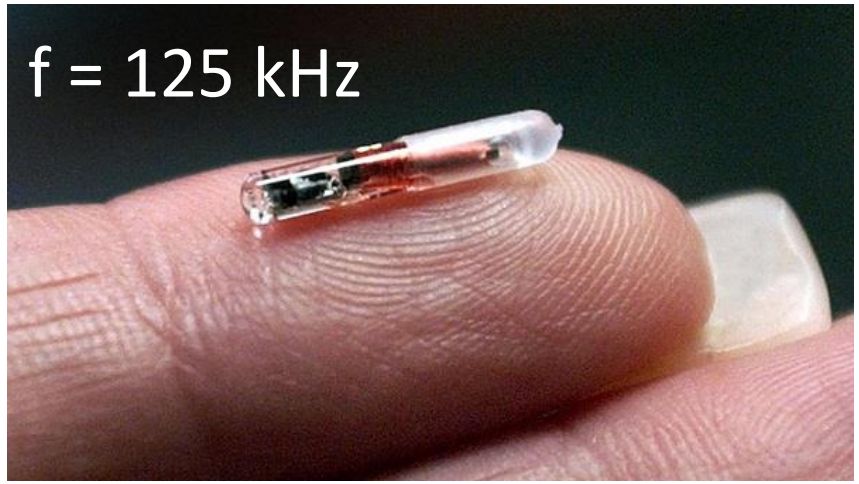
Passive RFID technologies in earth science today

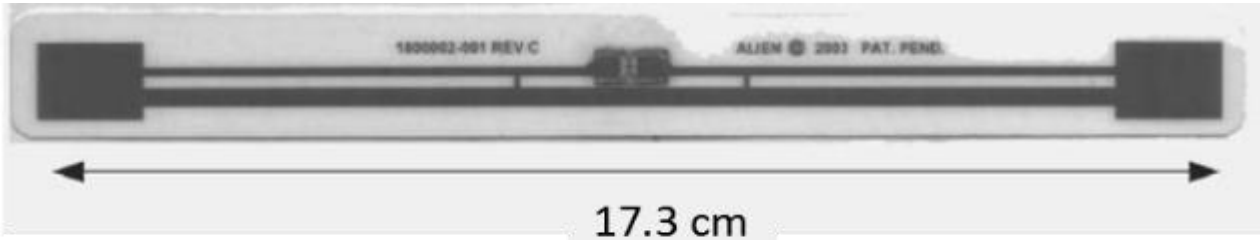


Near-field magnetic coupling
Tag-reader distance < 0.5 m

Typical applications : contactless payment, personal identification, animal identification

Used to monitor riverine bedload

f=866 MHz



Far-field backscattering
Tag-reader distance 0 to > 10 m

Typical applications : traking goods for logistics, transportation and retail

Used to monitor landslide displacements

Why passive RFID tags to monitor the earth surface ?

=> Deploy hundreds of low-cost wireless sensors for years

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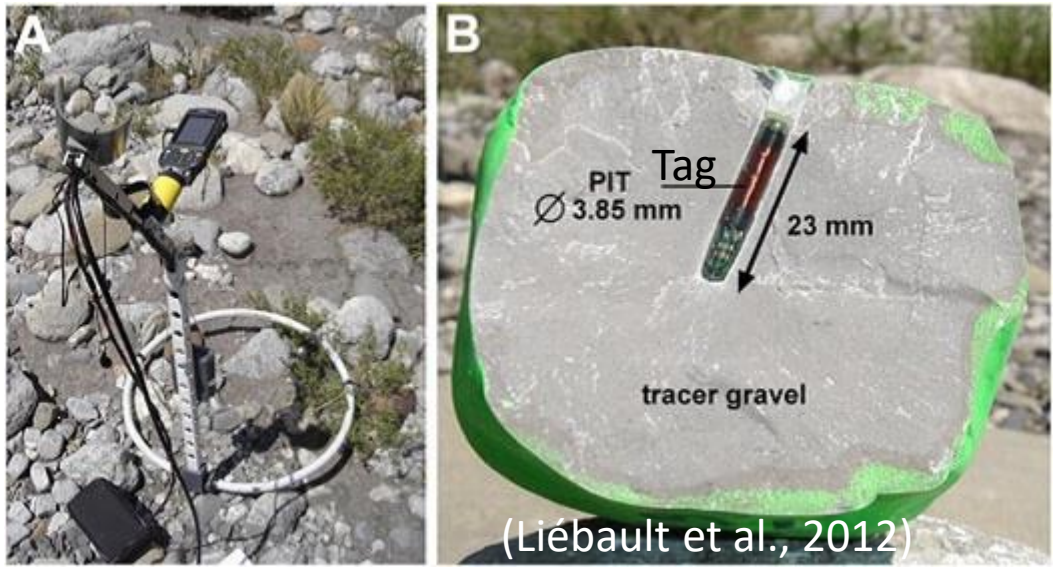
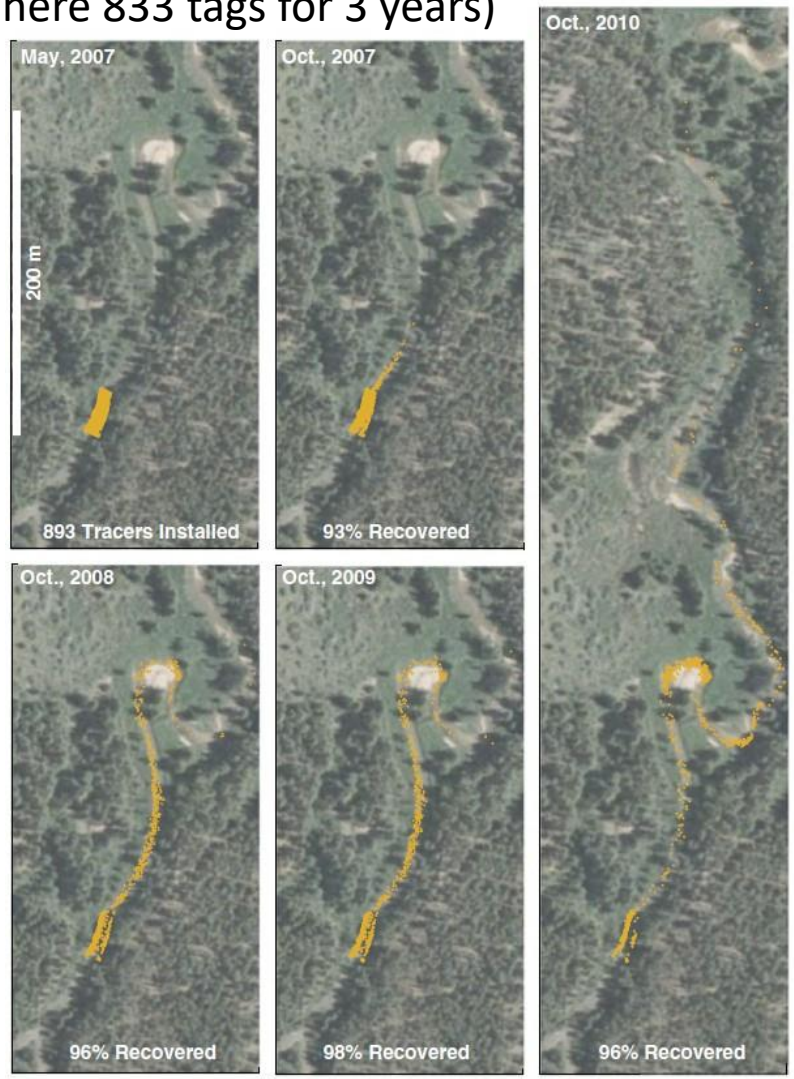
Bedload monitoring (125kHz tags)

Tags inserted in pebbles and manually tracked with a mobile reader



(Liébault et al., 2012)

Monitors the riverine bedload of hundreds of pebbles during years (here 833 tags for 3 years)



(Bradley and Tucker, 2012)

Mature method, used in 50+ studies. Advantages :

- High recovery rate (vs. paint)
- Identification (vs. magnetic & radioactive tracers)
- Small, cheap, and no battery (vs. radio emiters)

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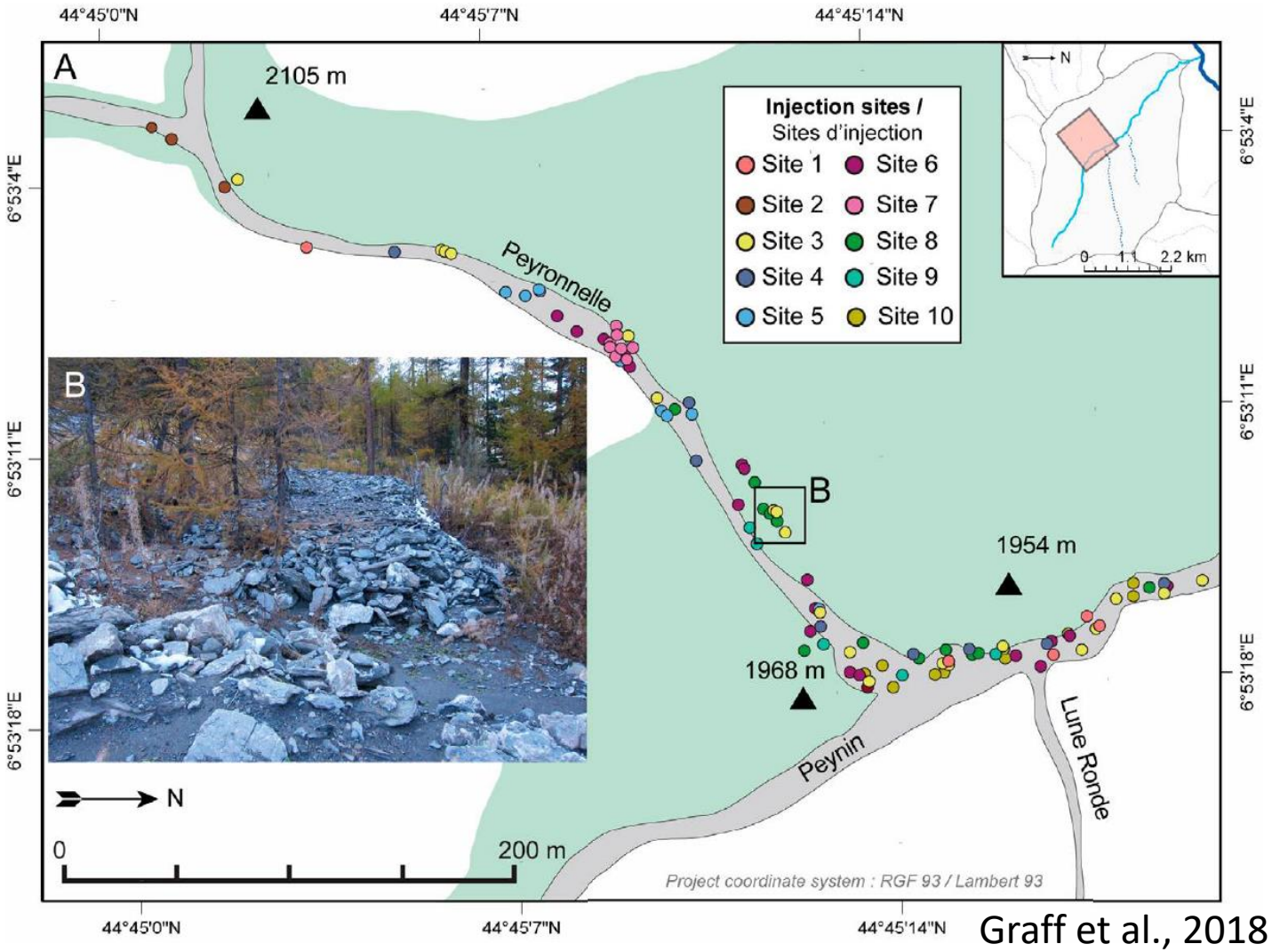
Application to debris flow study (125 kHz tags)

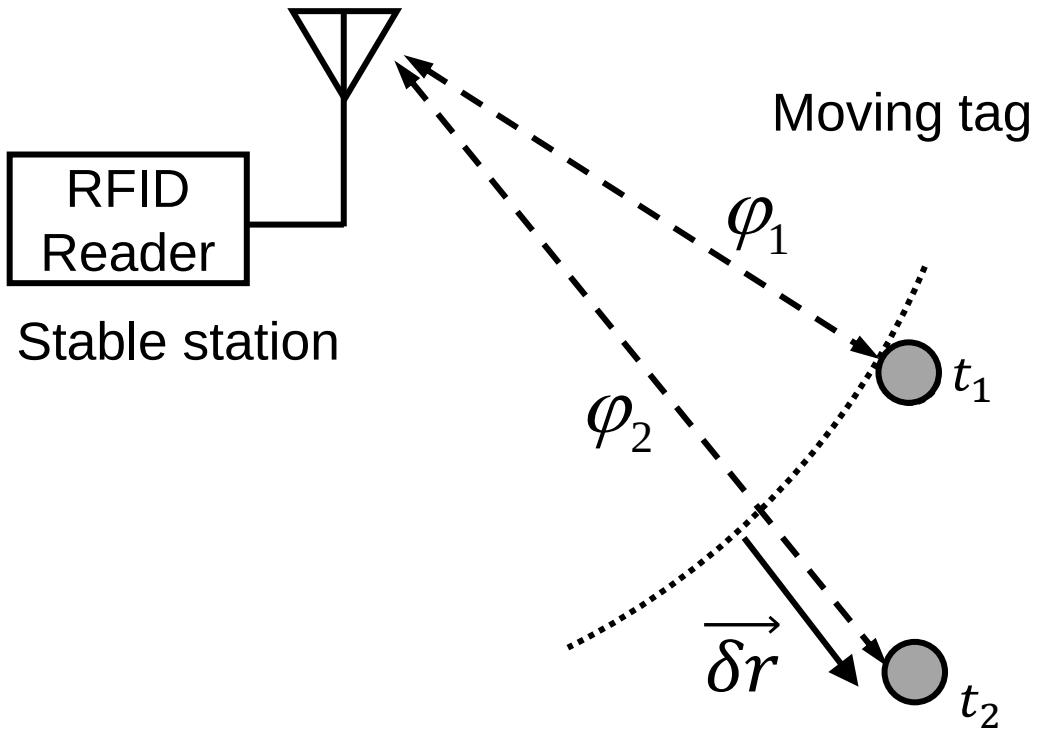


Graff et al., 2018

(A) Position of tracked pebbles after being moved by (B) a debris flow in 2015. Each color represent a position where pebbles were initially inserted.

Accurate displacement monitoring using the phase difference (868 MHz tags)

Tags displacement measured by phase variations, with 868 MHz tags

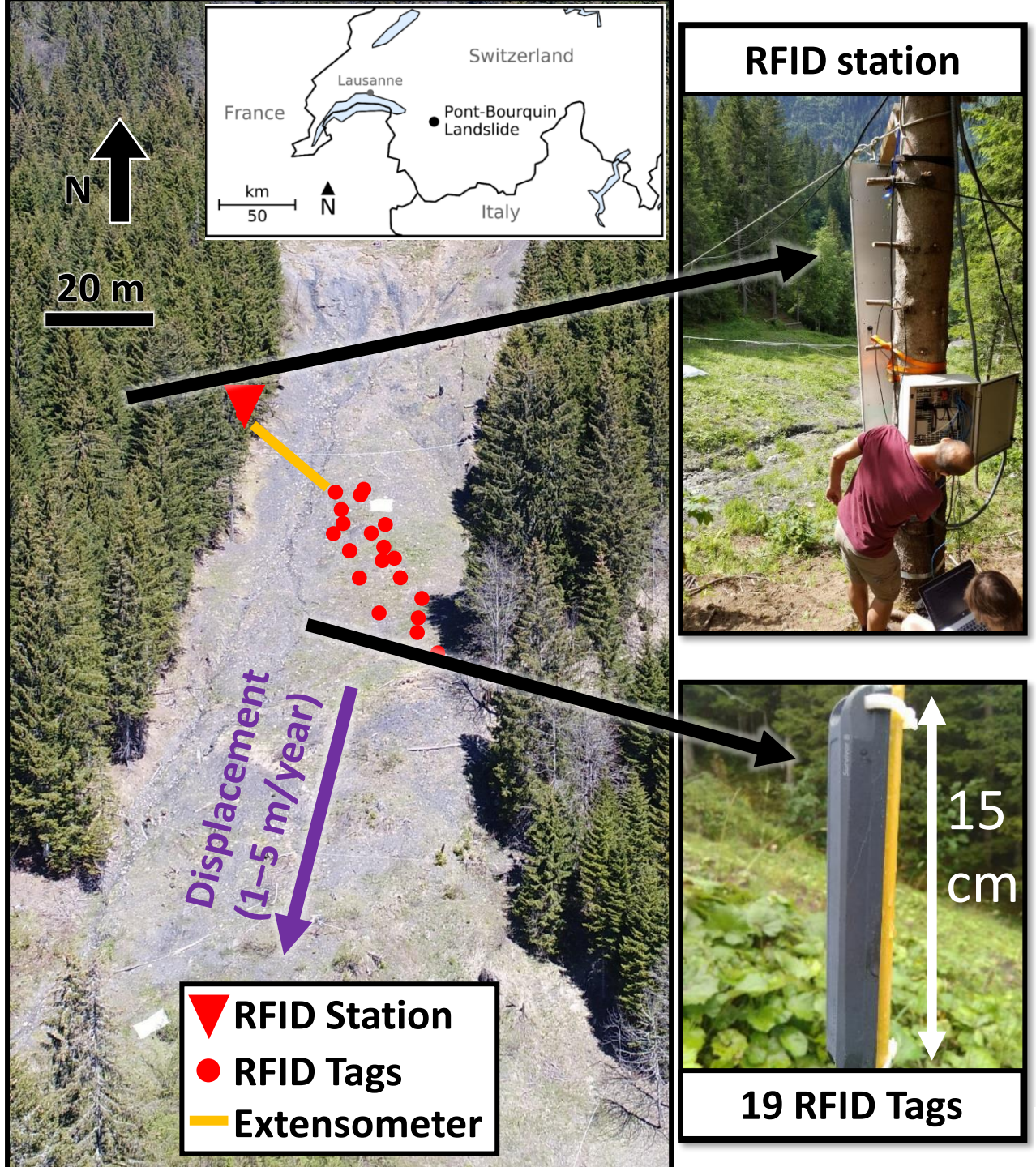


Phase ⇔ Displacement

$$\varphi_2 - \varphi_1 = -\frac{4\pi}{\lambda}\delta r$$

Nikitin et al., 2000

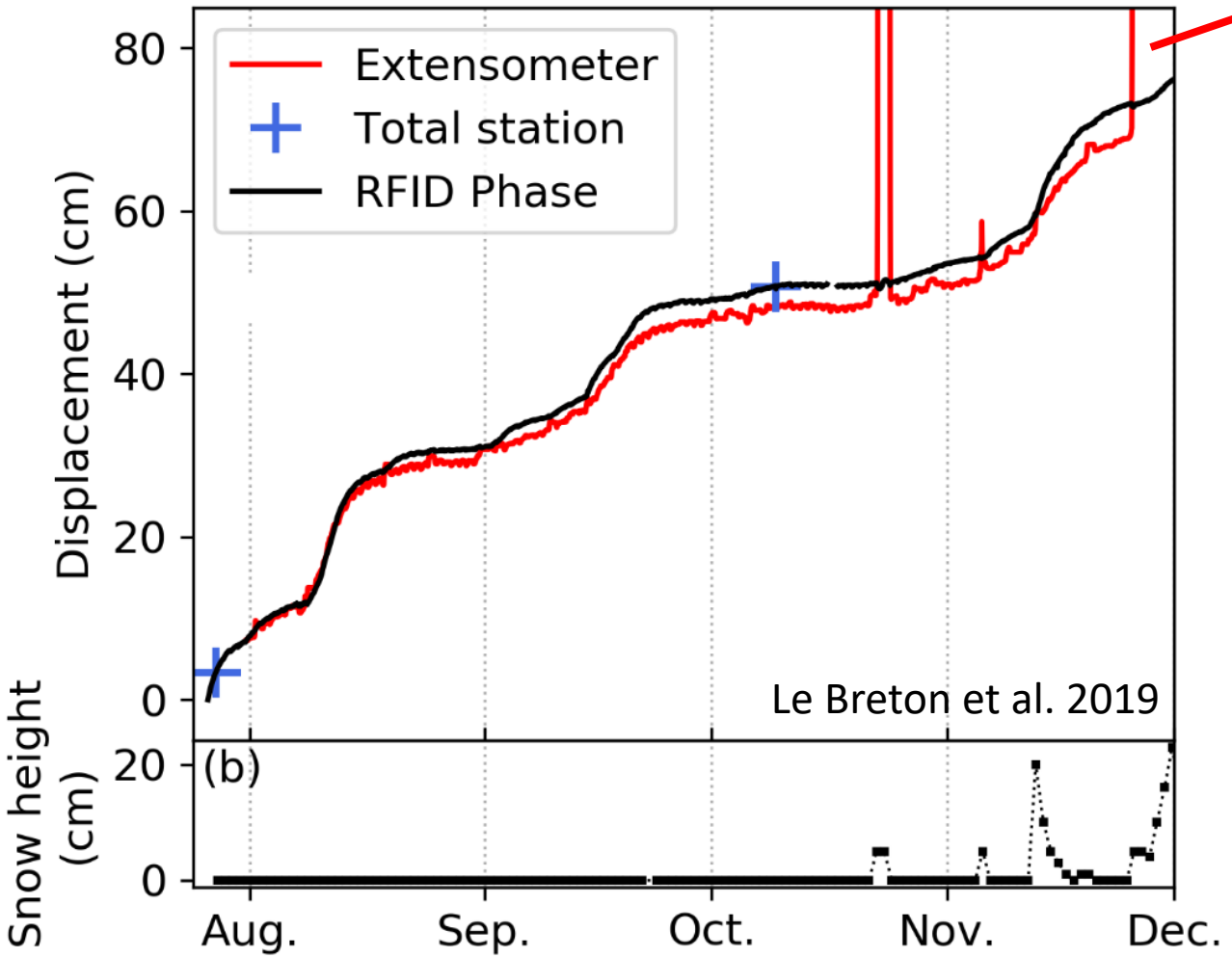
Application of RFID phase-based ranging on a landslide (Pont-Bourquin)

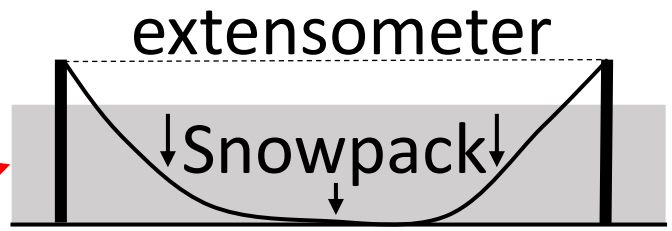


Le Breton et al., 2019

Does it work ?

20-m long extensometer and tag-reader distance here :





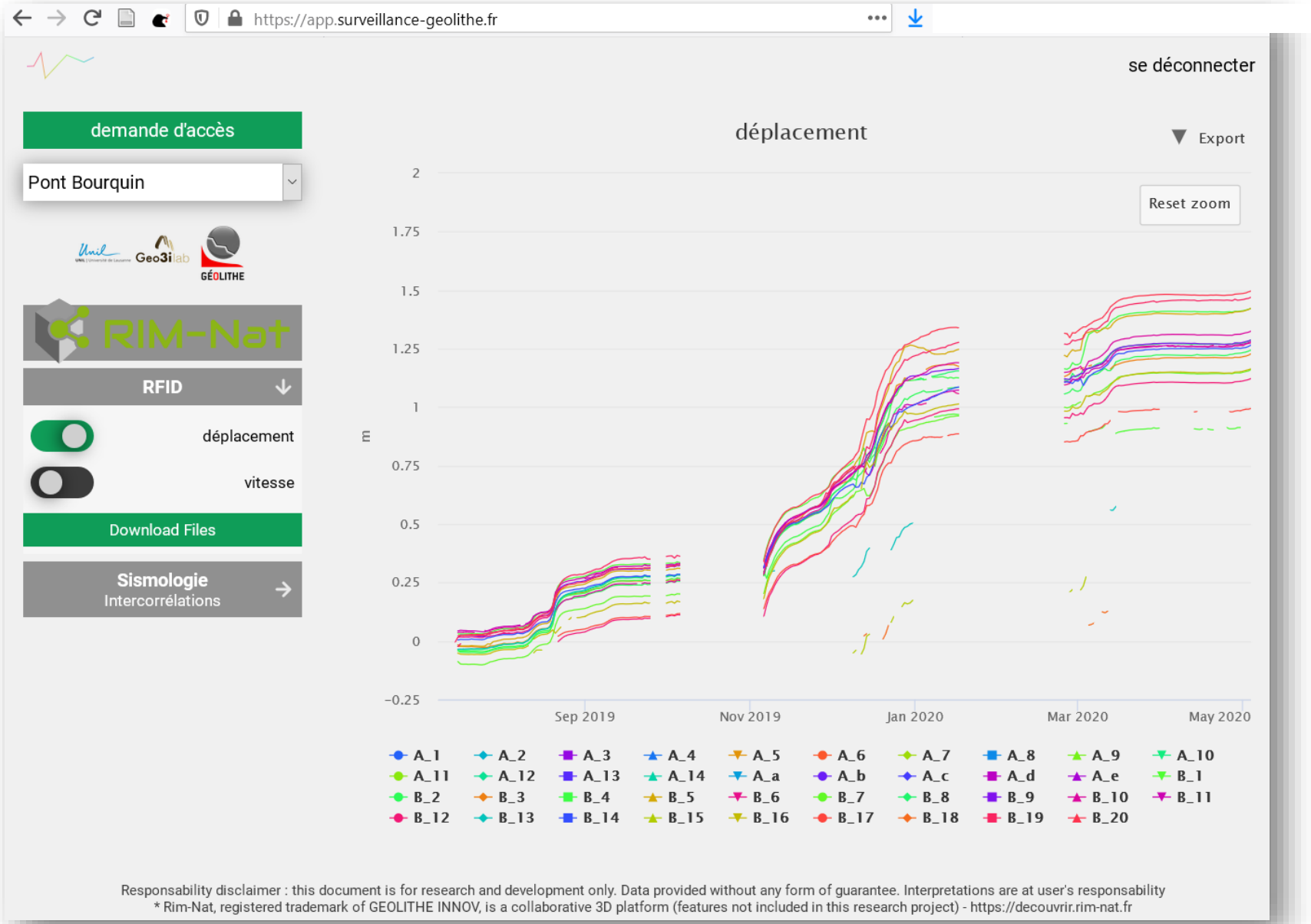
RFID technique

Validated

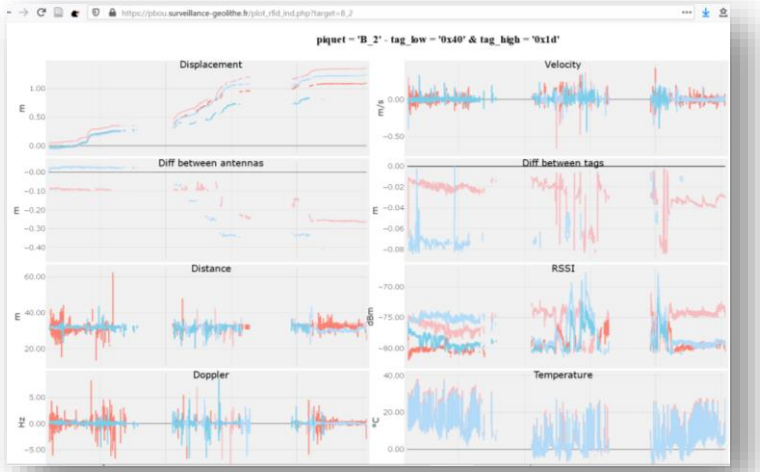
+

More stable than wire extensometer under rain and snow

Cloud software for processing and vizualization



In-depth data for each tag :



Available today :

- Automatic RFID processing
- Interactive vizualization
- Detailed data for each tag
- Sms/email alert on threshold

Operational on 3 landslides :

- Pont-Bourquin
- Harmalière
- Valloire

Ask me for a demo access

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Passive radio-frequency identification ranging, a dense and weather-robust technique for landslide displacement monitoring

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ABSTRACT

Ground deformation monitoring at a local scale requires accuracy, along with dense spatio-temporal resolution. Radio-Frequency Identification (RFID) technology is proposed as an alternative to classical geodetic methods for monitoring displacements of a landslide. Passive RFID tags allow for a very dense resolution, both in time and space, at the scale of a 100-m-long surface. By deploying 19 passive RFID tags on a landslide for 5 months, this study validates the technique by comparison with laser total station and wire extensometer data. The accuracy of the RFID technique was 1 cm during normal weather and up to 8 cm during snow events. The results demonstrate that RFID tag tracking can monitor landslide displacements with multiple sensors at low cost, providing dense spatio-temporal data. This technique could potentially be used for other applications such as monitoring volcanic activity, buildings, unstable rocks or snow cover.

For details on the method and perspectives

Le Breton, M., Baillet, L., Larose, E., Rey, E., Benech, P., Jongmans, D., Guyoton, F., Jaboyedoff, M., 2019. Passive radio-frequency identification ranging, a dense and weather-robust technique for landslide displacement monitoring. Engineering Geology 250, 1–10. https://doi.org/10.1016/j.enggeo.2018.12.027