



UNIONE EUROPEA
Fondo Europeo di Sviluppo Regionale



Mitigazione dei rischi naturali per la sicurezza e la mobilità nelle aree montane del Mezzogiorno

Università della Basilicata

Monitoraggio di frane lente da terra e da satellite: casi di studio di Costa della Gaveta (Potenza) e Bosco Santa Domenica (Calciano)

Roberto Vassallo, Jacopo De Rosa, Caterina Di Maio (Unibas)

Gianluca Cutrera, Roberto Murtas (Rete Ferroviaria Italiana)

G.V. Pandiscia, F. Trillo (e-GEOS)

B. Lacovara (Geocart)

22-23 Giugno 2023



UNIONE EUROPEA
Fondo Europeo di Sviluppo Regionale



*Ministero dell'Università
e della Ricerca*



Estratto da: Secondo convegno annuale del progetto MITIGO - 22-23 Giugno 2023 - Sommari degli interventi e presentazioni

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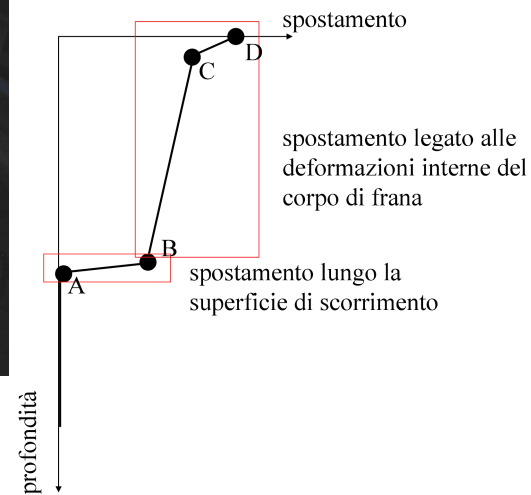
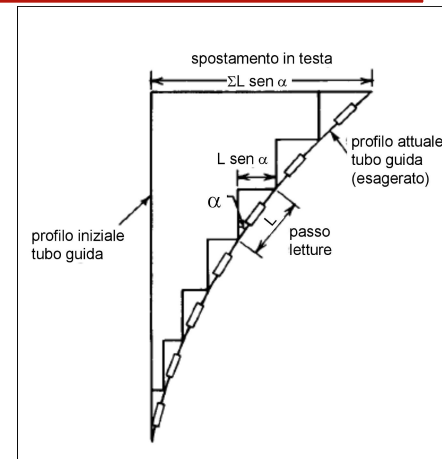
Editrice Universosud – Potenza

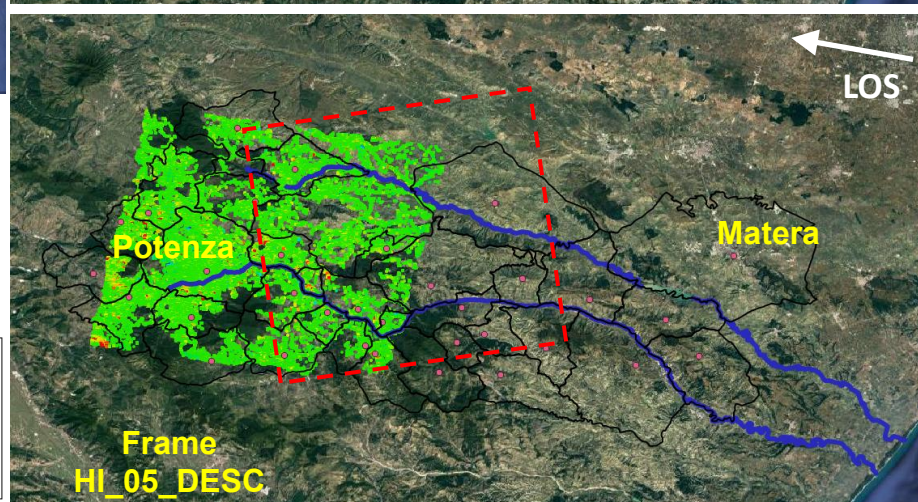
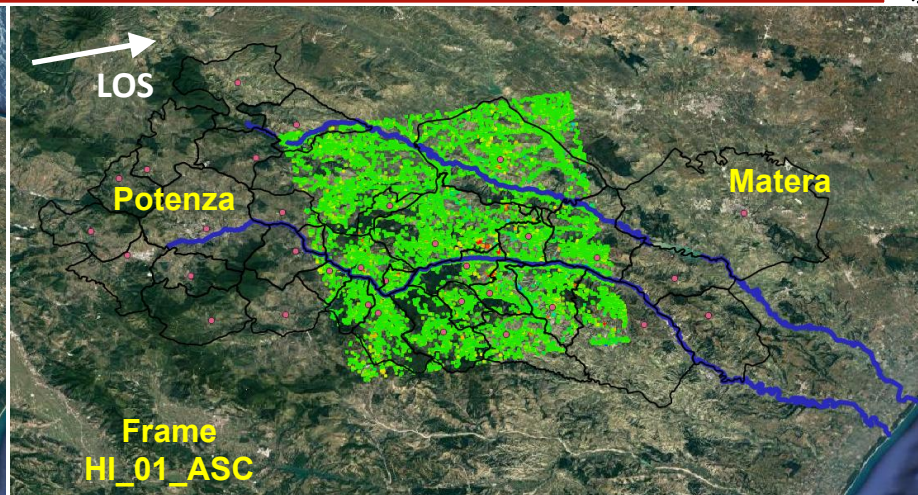
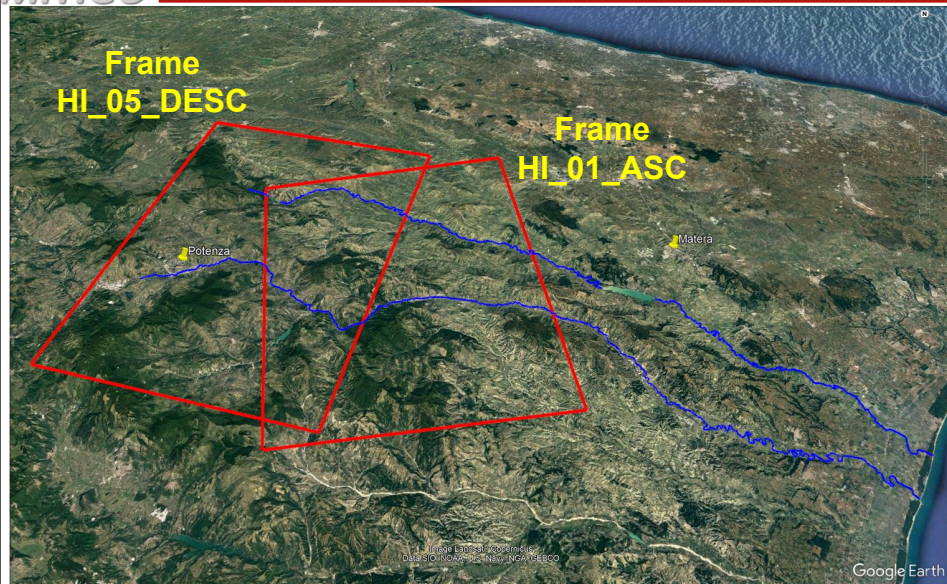
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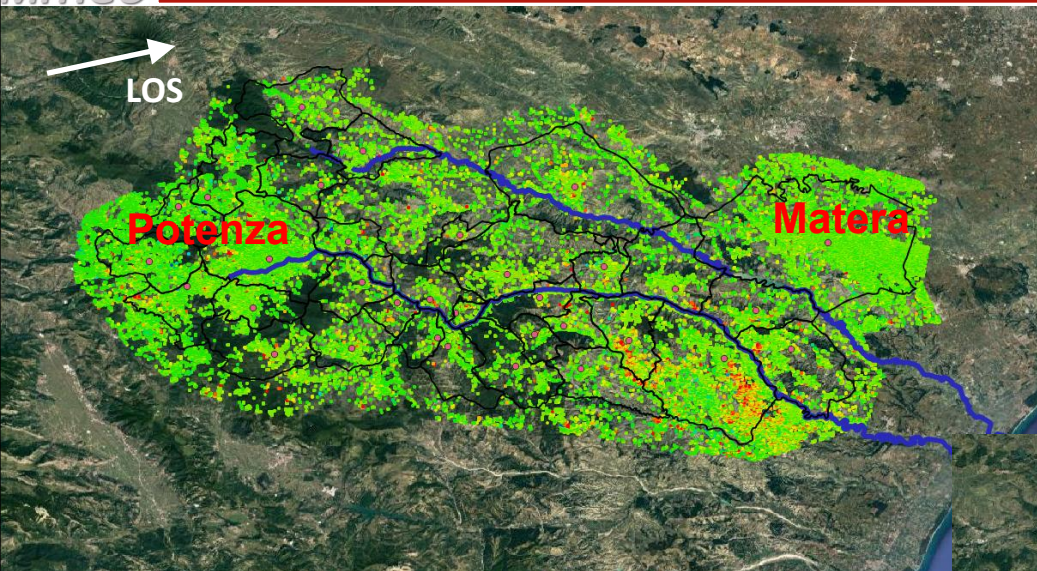




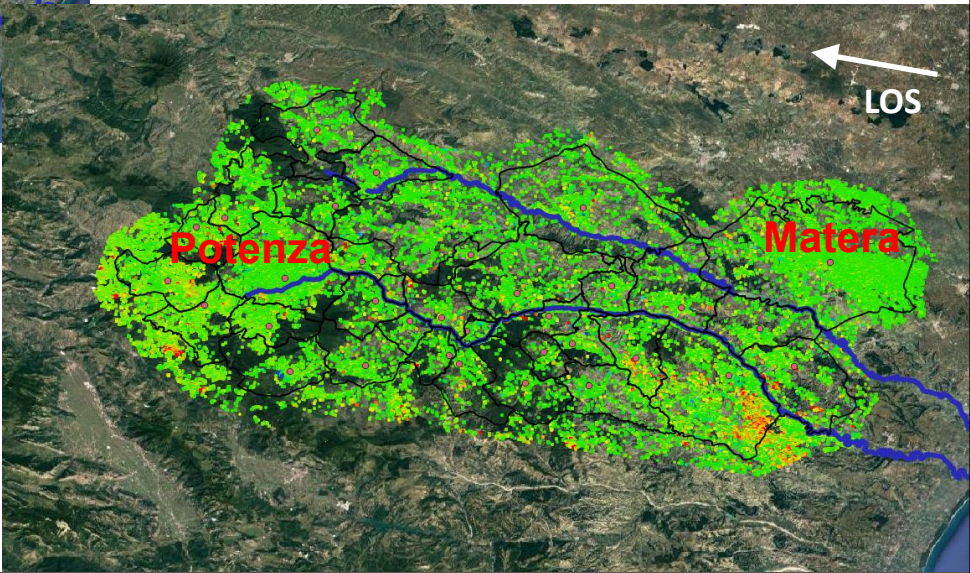
circa 36 x 47 km

CSK (2011-2021)

V_{LOS} (mm/anno)		
● < -9	● -3 + -1	● < +5 + +7
● -9 + -7	● -1 + +1	● +7 + +9
● -7 + -5	● +1 + +3	● > +9
● -5 + -3	● +3 + +5	



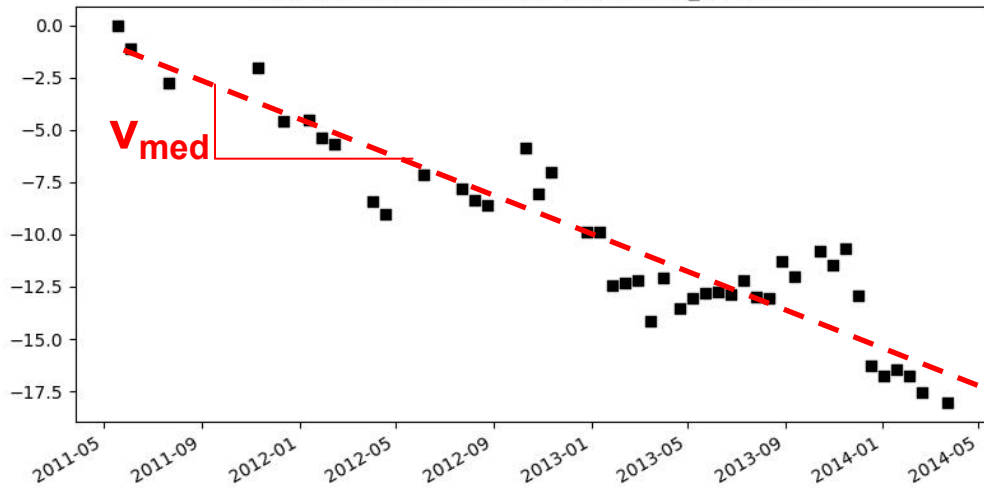
scala regionale ↔ scala del pendio



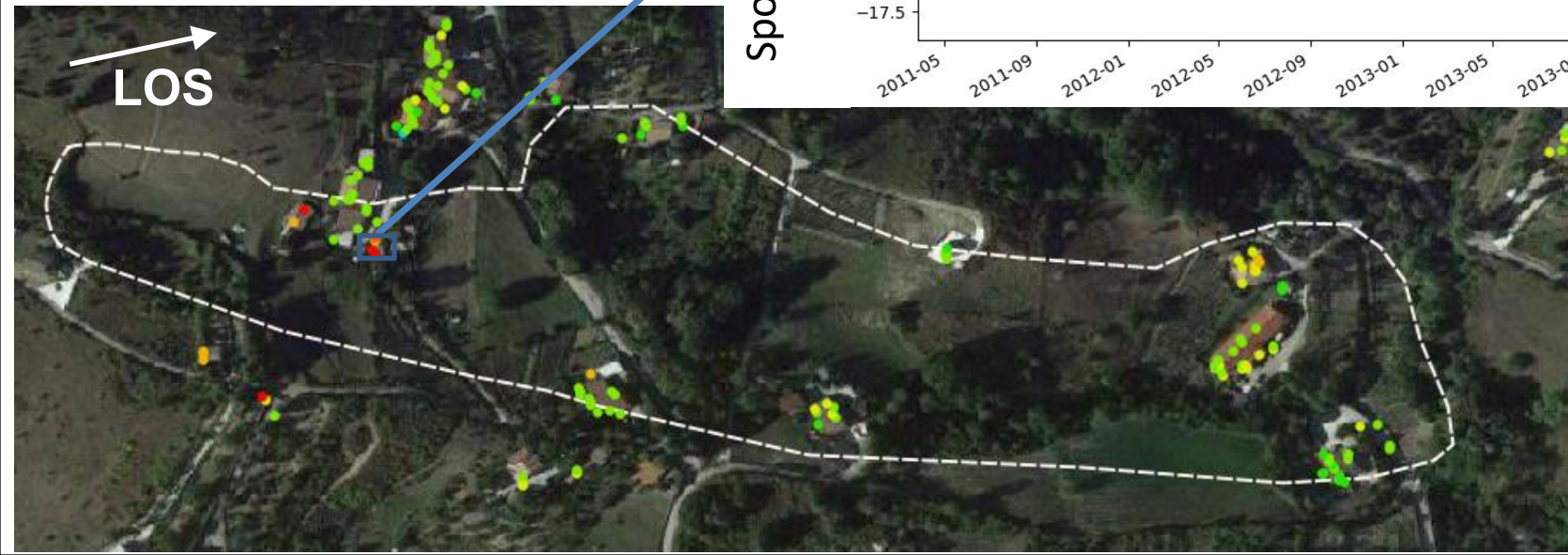
v_{Los} (mm/anno)		
● < -9	● -3 + -1	● < +5 + +7
● -9 + -7	● -1 + +1	● +7 + +9
● -7 + -5	● +1 + +3	● > +9
● -5 + -3	● +3 + +5	

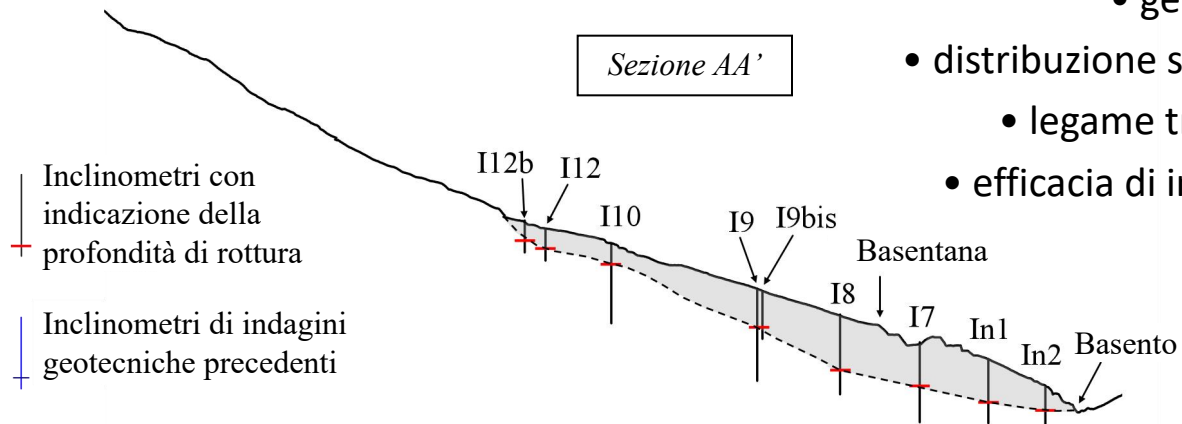
PS: 61jA1002jq coher.: 0.81 vel.: -5.26 v_stdev.: 1.0

Spostamenti lungo la
LOS (mm)

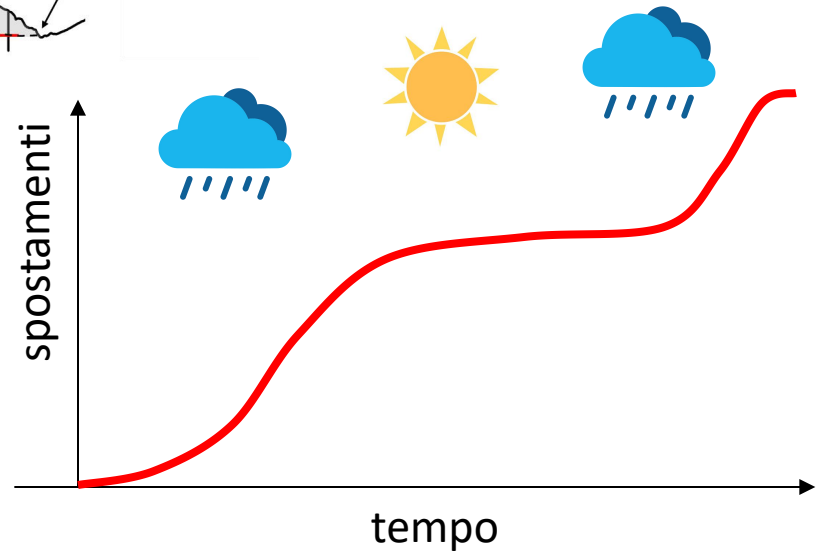
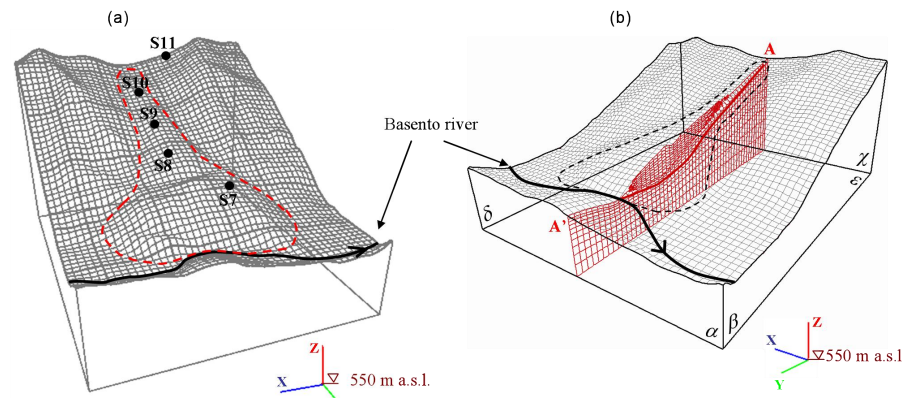


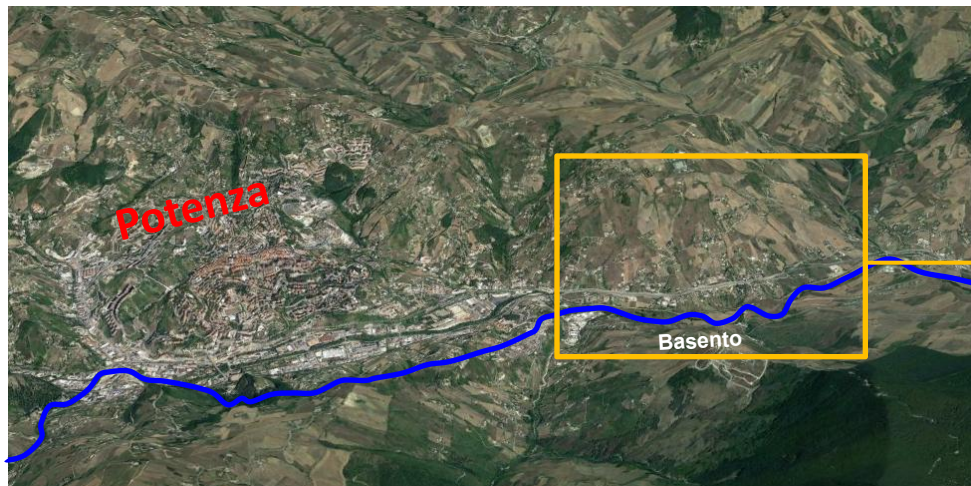
LOS





- geometria del corpo di frana
- distribuzione spaziale e temporale degli spostamenti
 - legame tra gli spostamenti e le loro cause
 - efficacia di interventi di mitigazione già esistenti

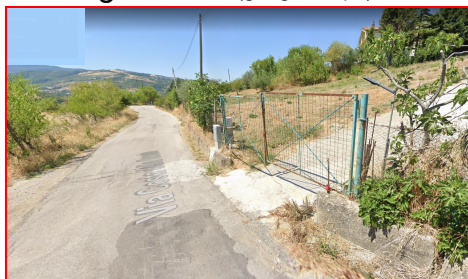




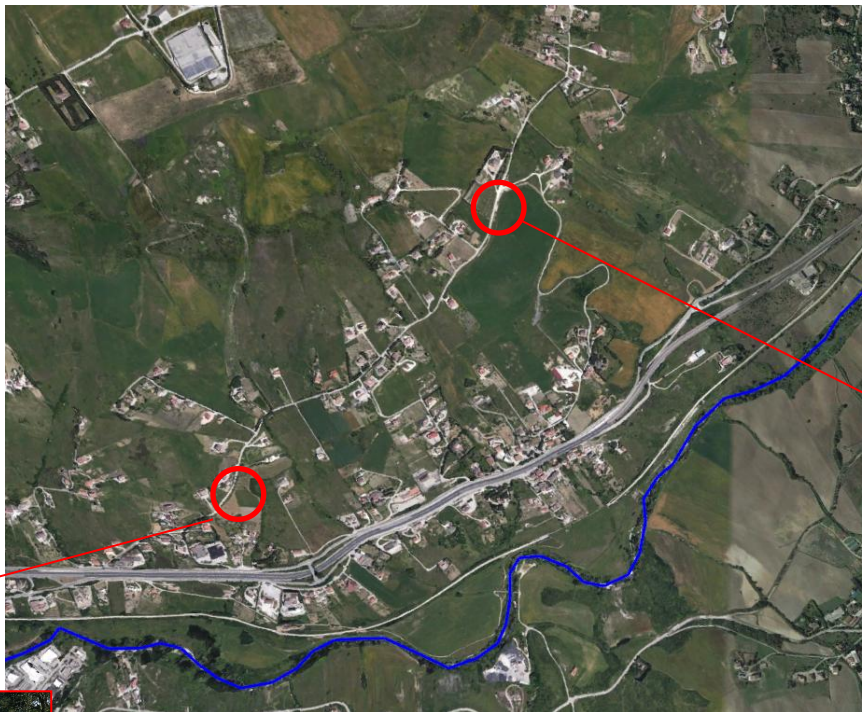
Piano stralcio per la Difesa dal Rischio Idrogeologico

* *Argille Varicolori: successione argillosa-marnosa-calcareo del Cretaceo-Miocene costituita da un'alternanza irregolare di argille, argille marnose e marne argillose, con diffusa presenza di frammenti lapidei.*

luglio 2022 (google maps)



tra il 1° e il 6 giugno 2023



2011



mar 2022

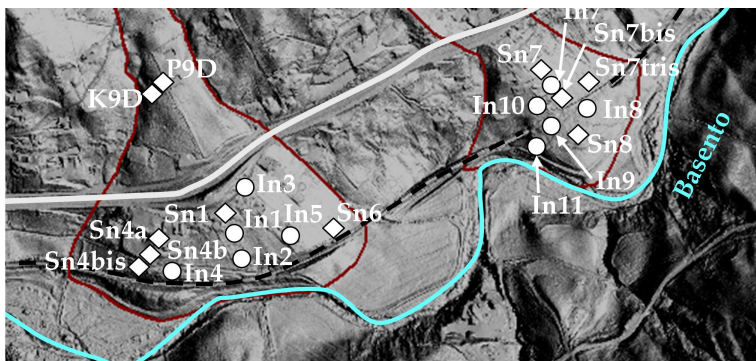
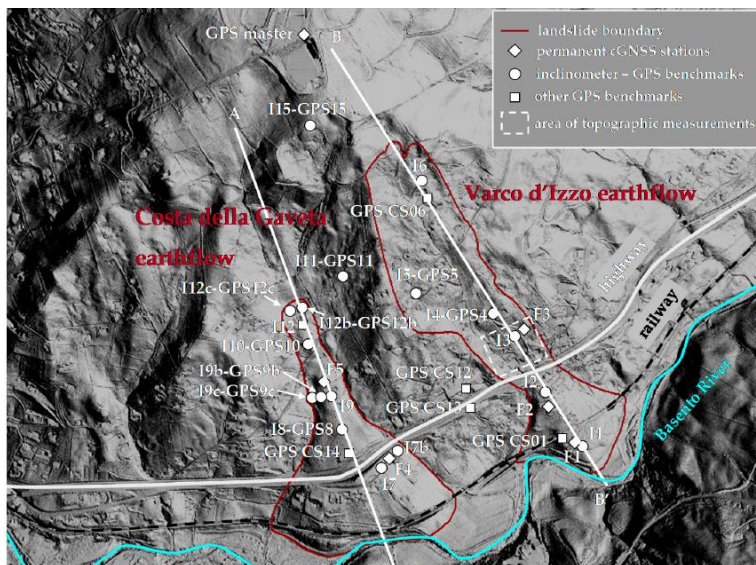


3 gg fa



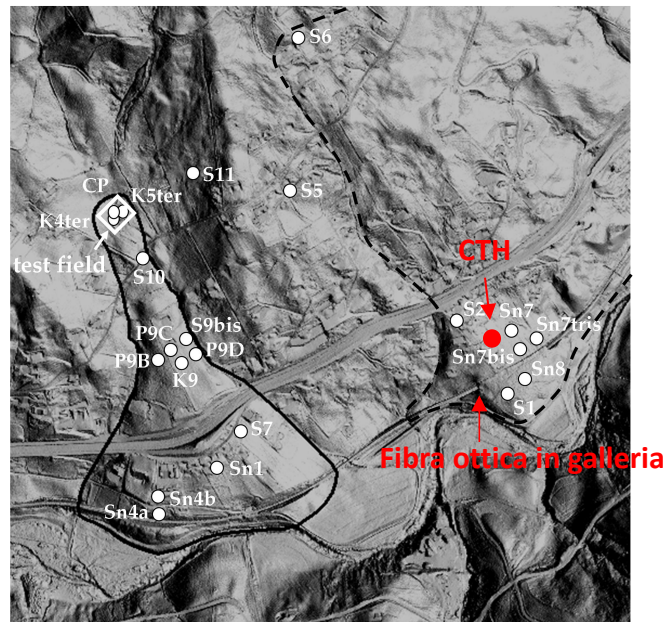
3 gg fa

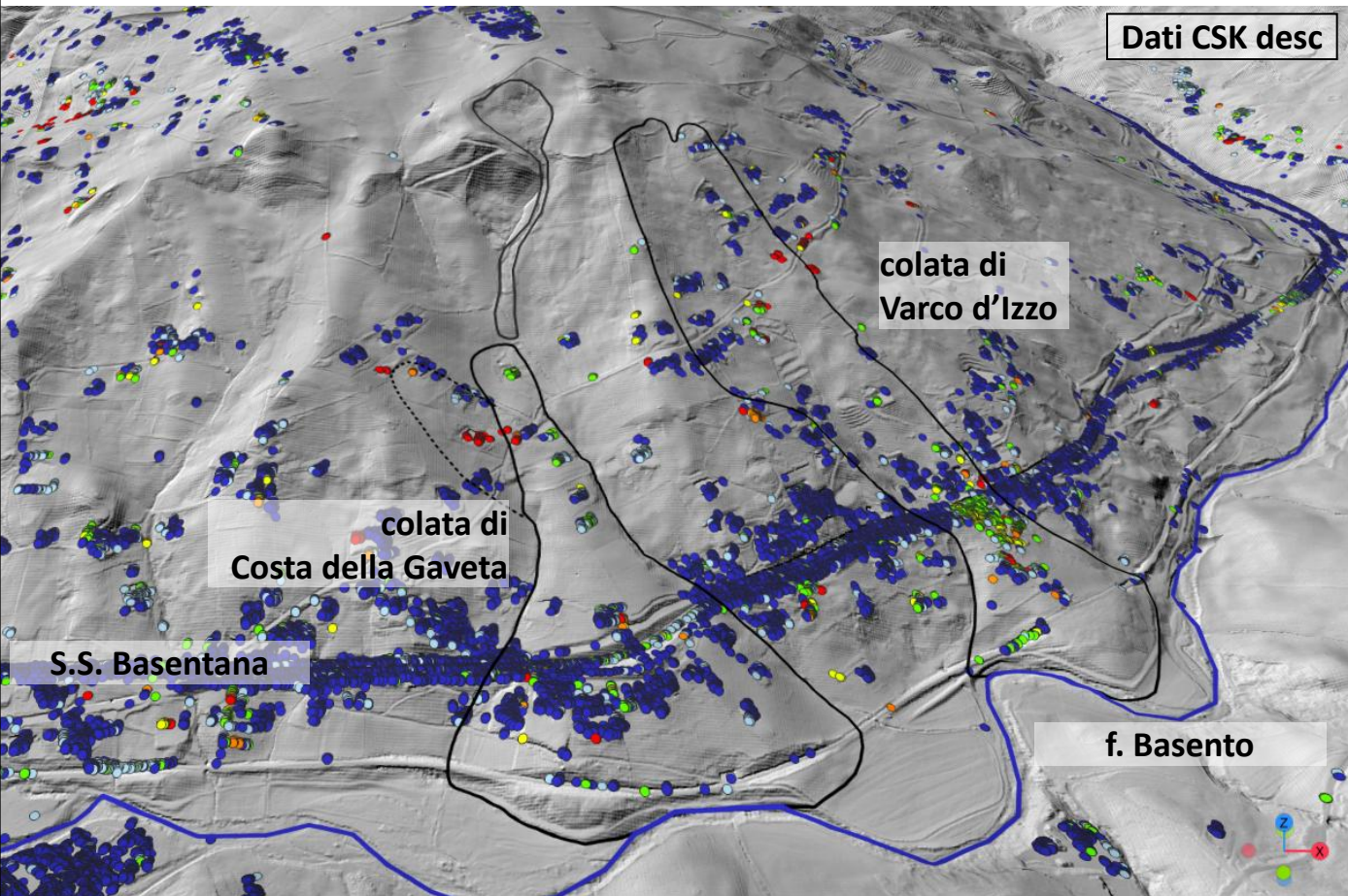
Ubicazione degli strumenti di misura degli spostamenti superficiali e profondi (inclinometri, antenne GPS, colonnine topografiche, dati satellitari)



Ulteriori installazioni del 2018 a cura di RFI

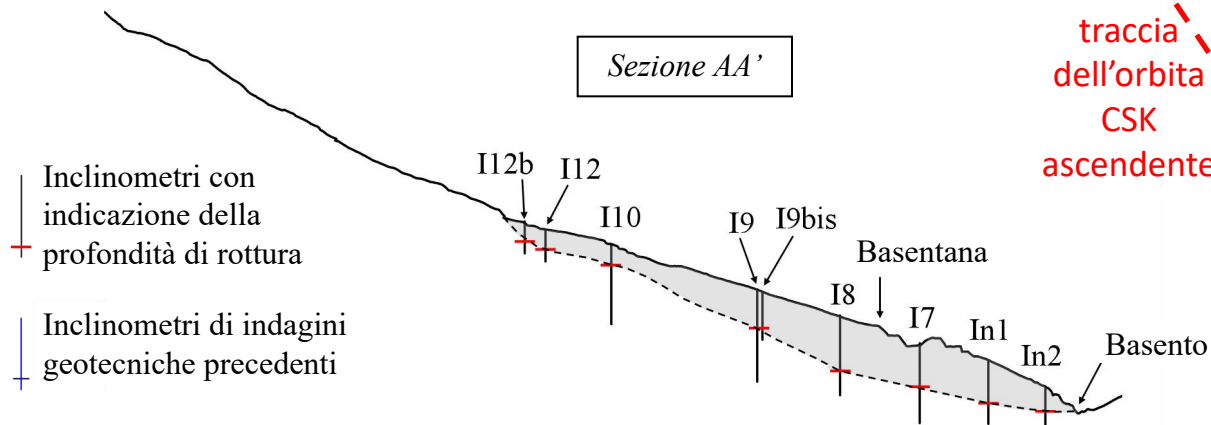
Ubicazione degli strumenti di misura di pressioni totali, pressioni dell'acqua di porosità, deformazioni infrastrutture



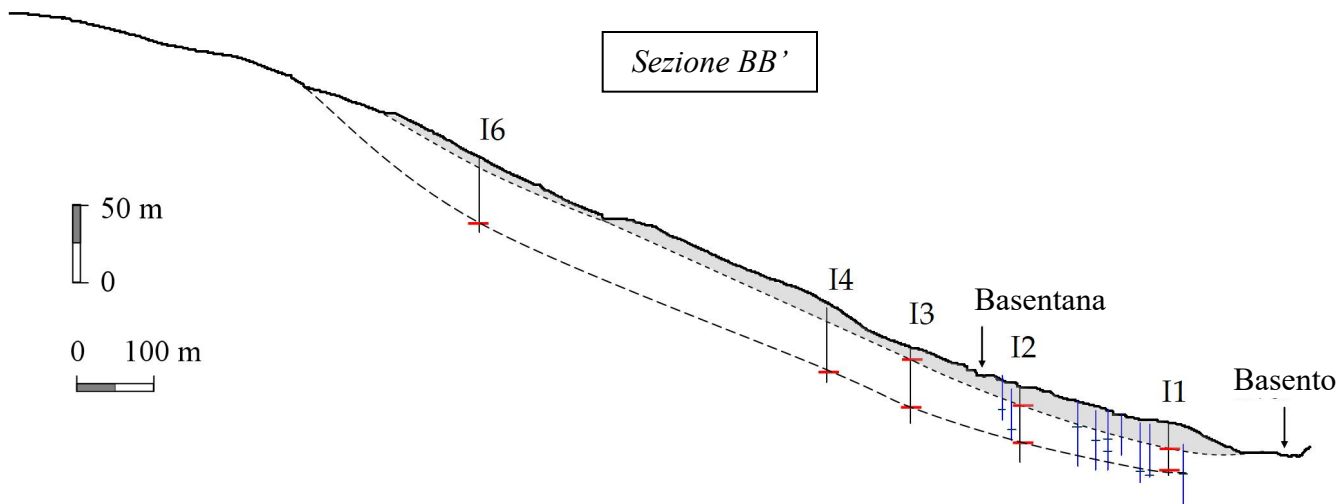
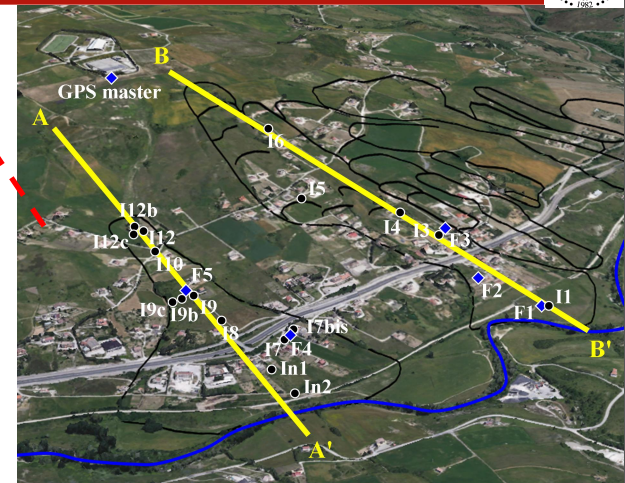


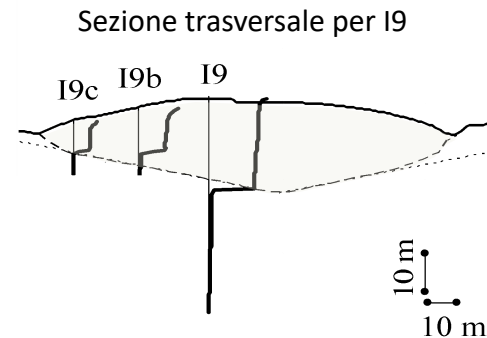
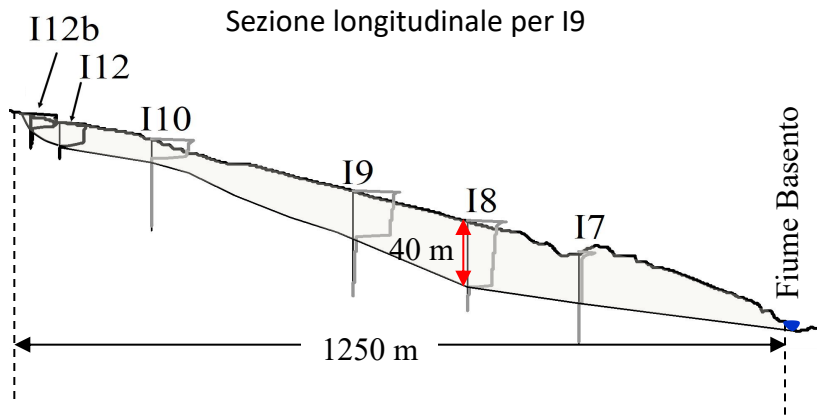
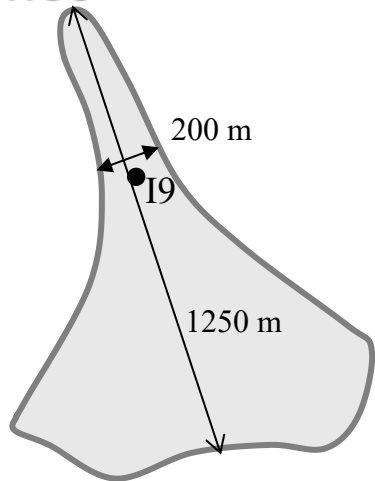
Antenne GPS fisse e mobili



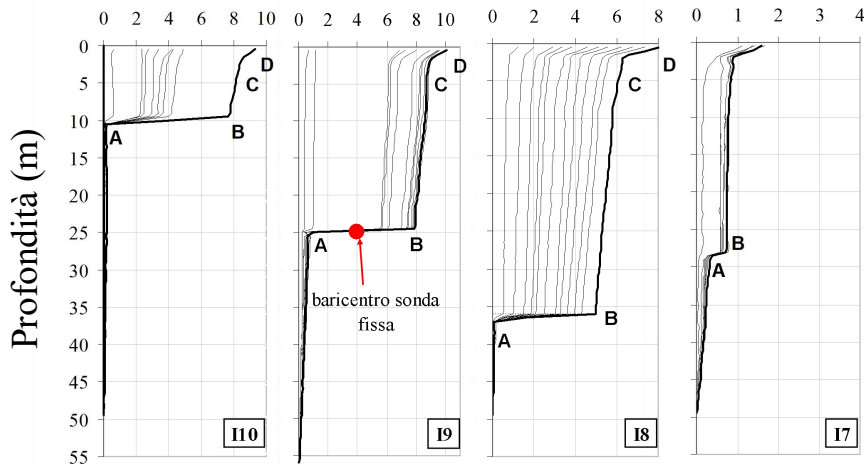


traccia
dell'orbita
CSK
ascendente

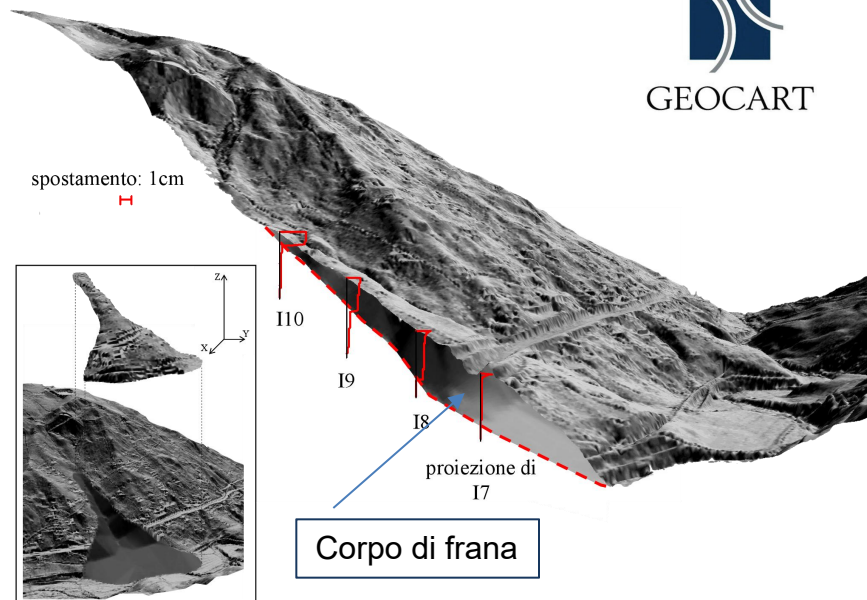
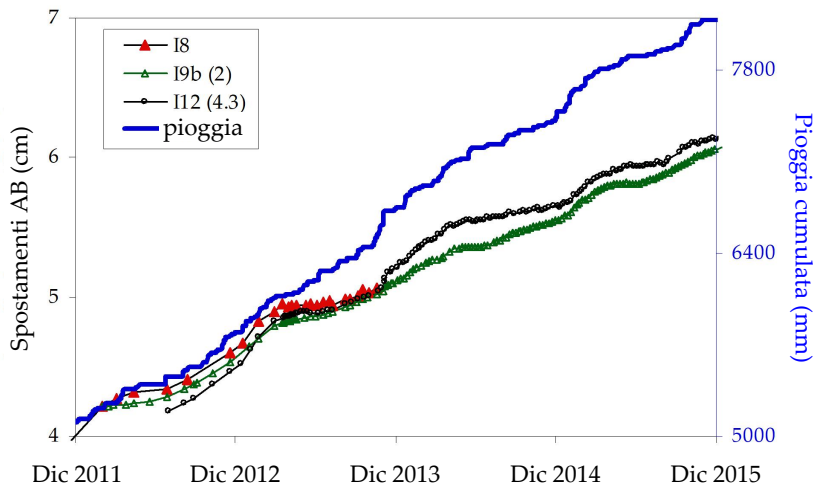
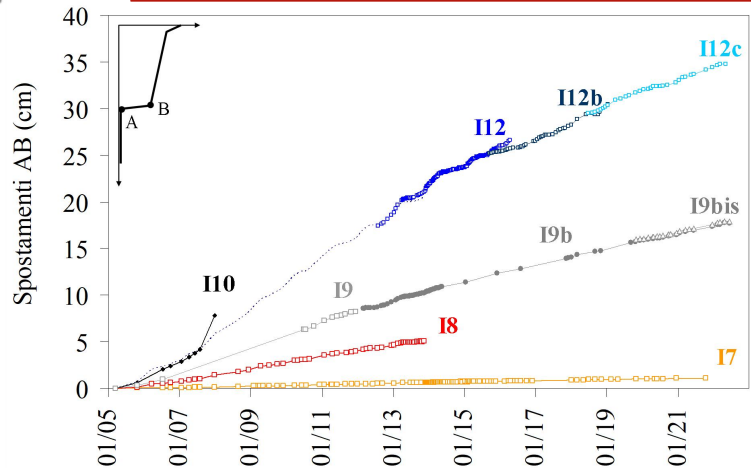




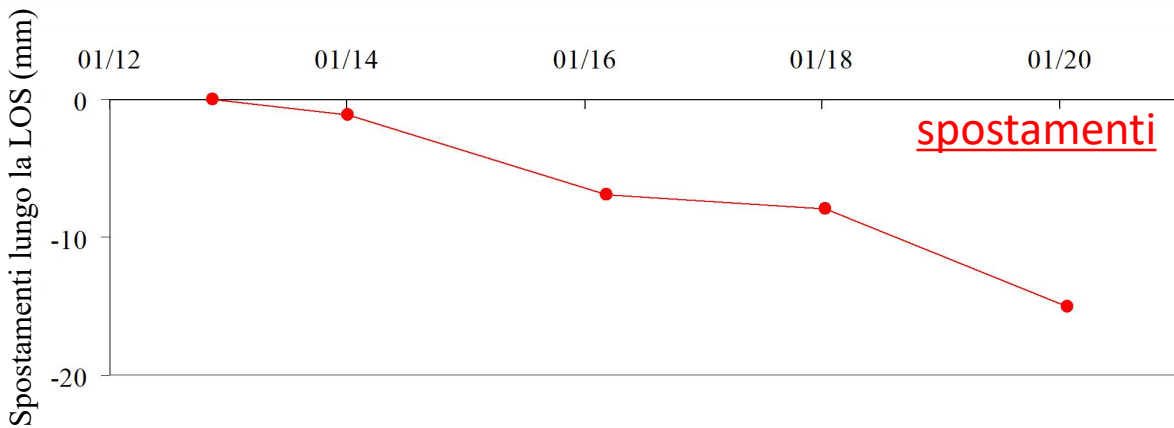
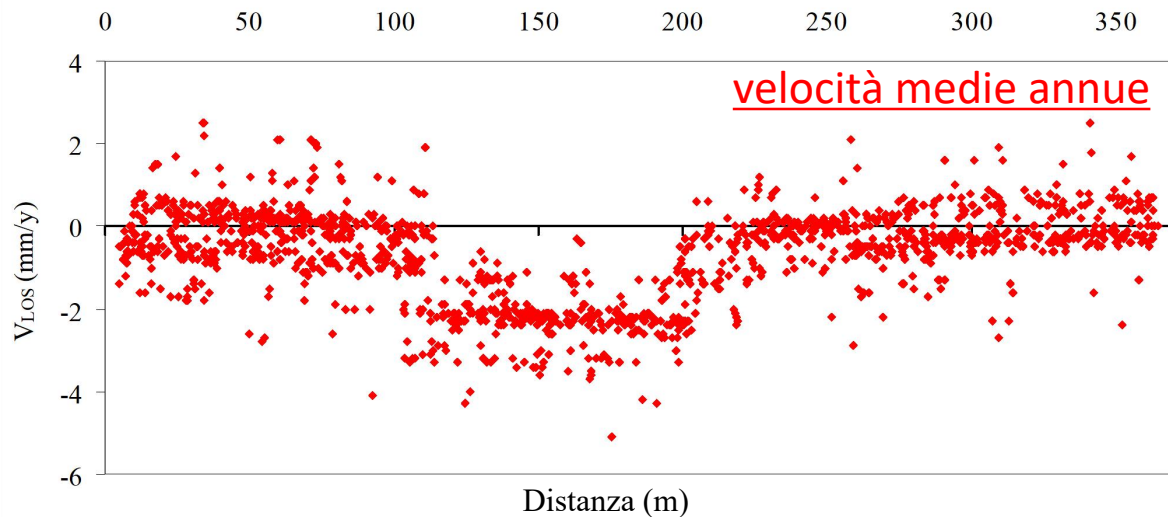
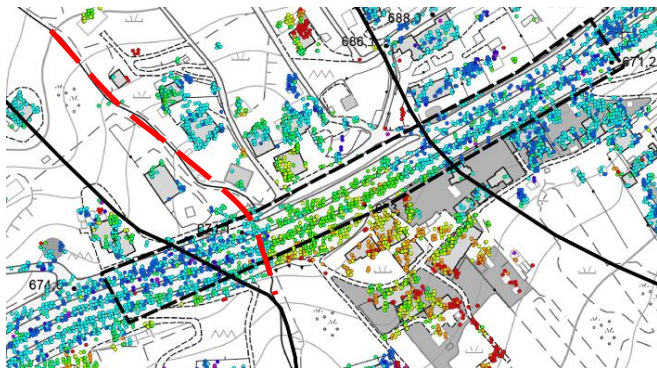
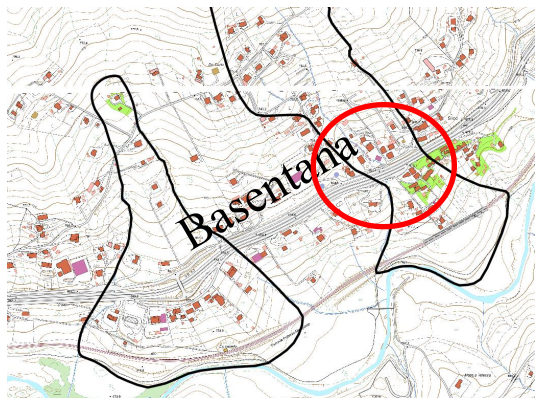
Spostamenti cumulati (cm)

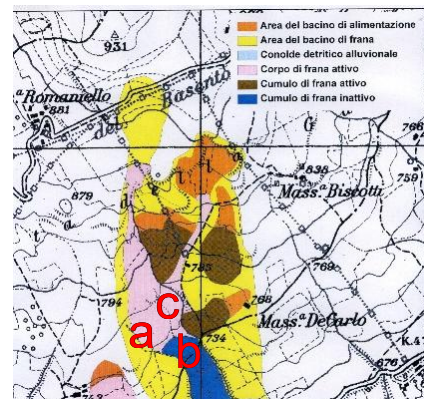
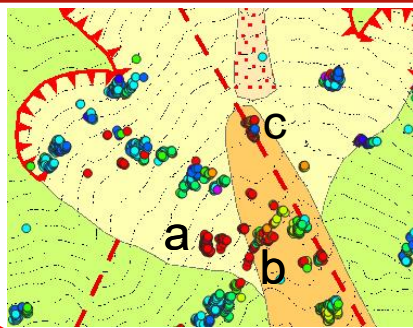
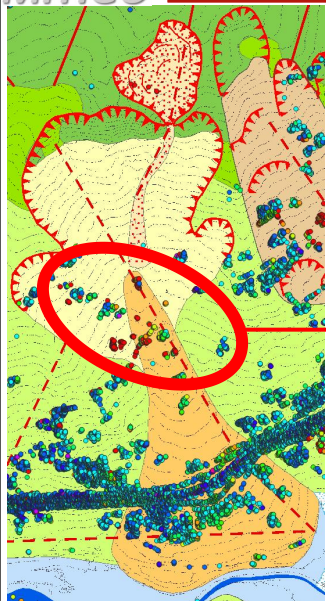


- 1) scorrimento lungo una sottile banda di taglio
- 2) deformazioni interne più marcate nei primi metri di profondità
- 3) velocità di spostamento sostanzialmente uniformi nelle sezioni trasversali
- 4) meccanismo a portata di terra costante

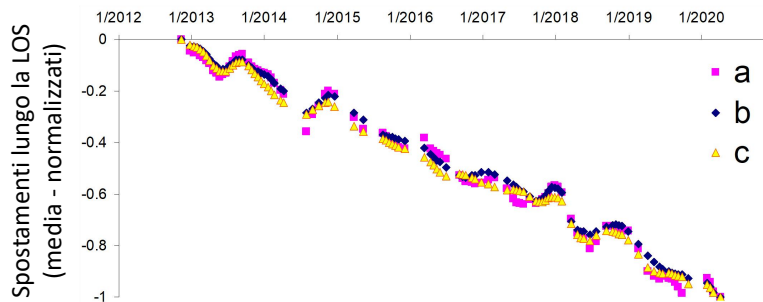
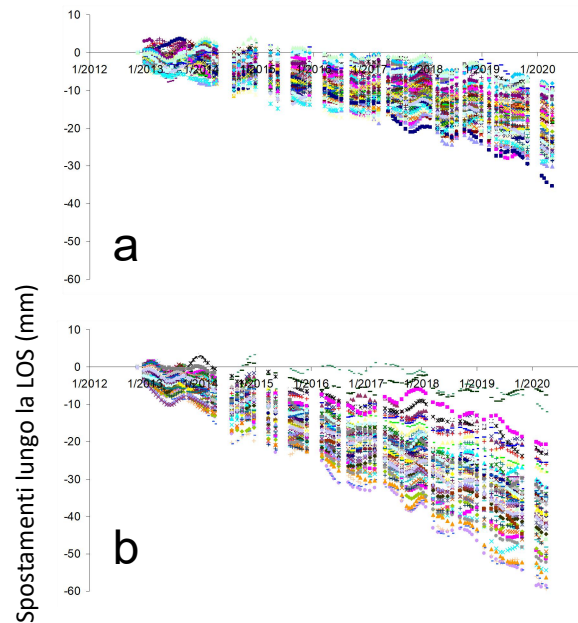


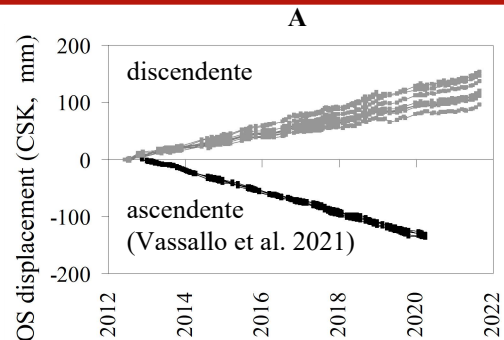
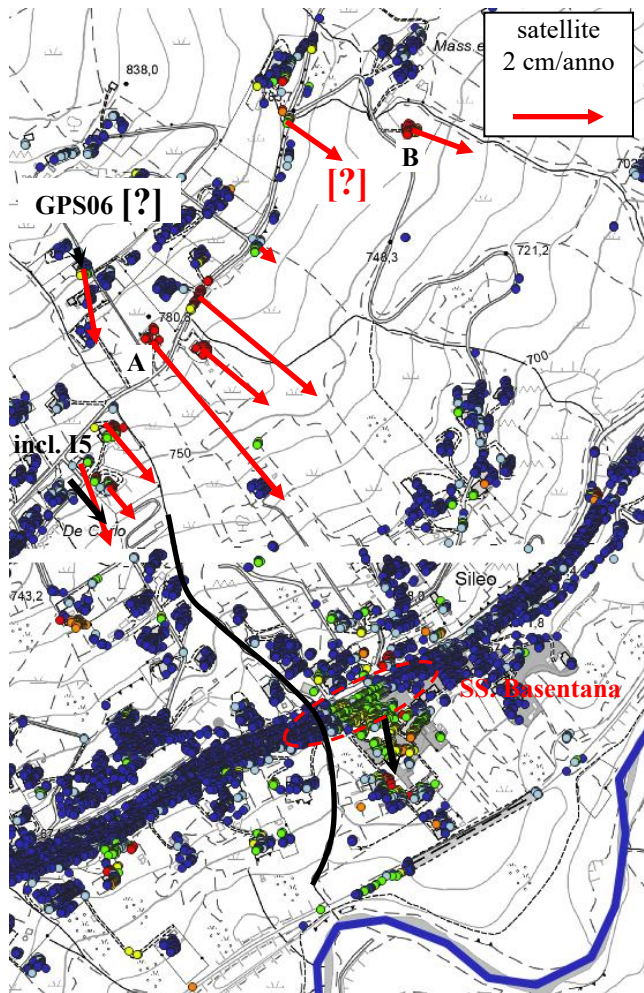
- 5) velocità medie annue sostanzialmente costanti
- 6) variazioni stagionali di velocità
- 7) marcata correlazione tra velocità e piogge



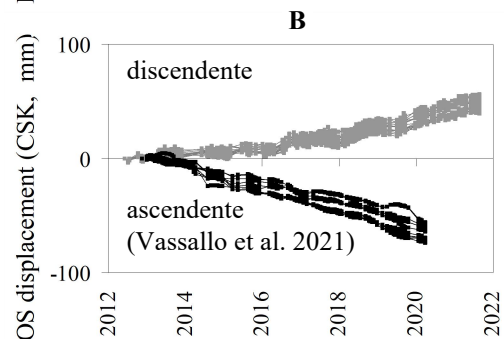


S. Di Nocera (com. pers.)

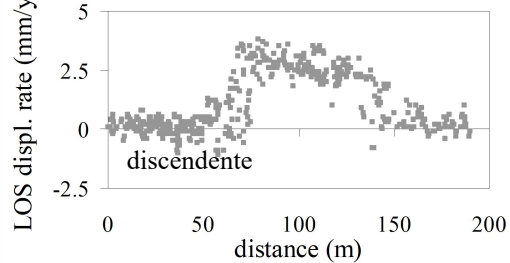


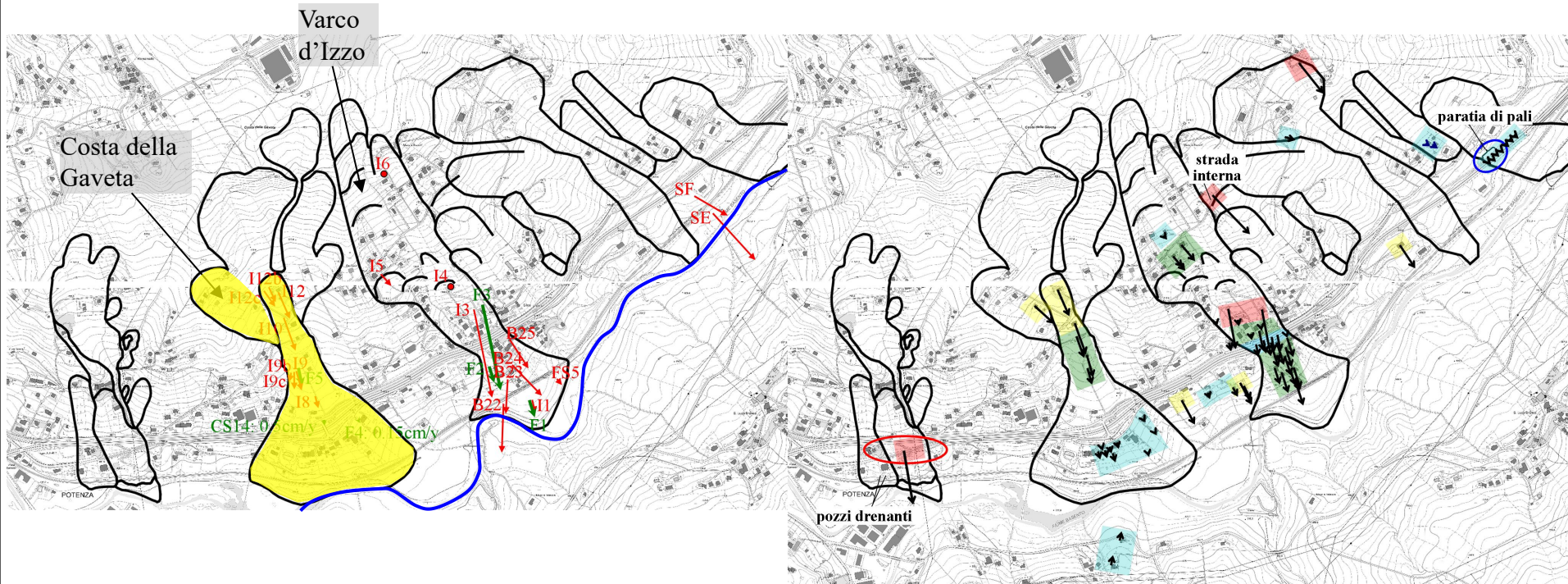


Dati COSMO SkyMed
passaggi orbitali ascendente +
discendente



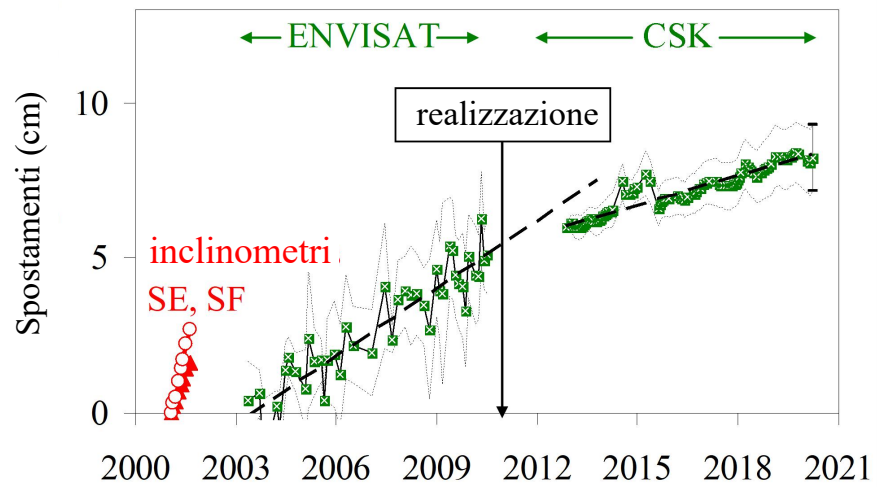
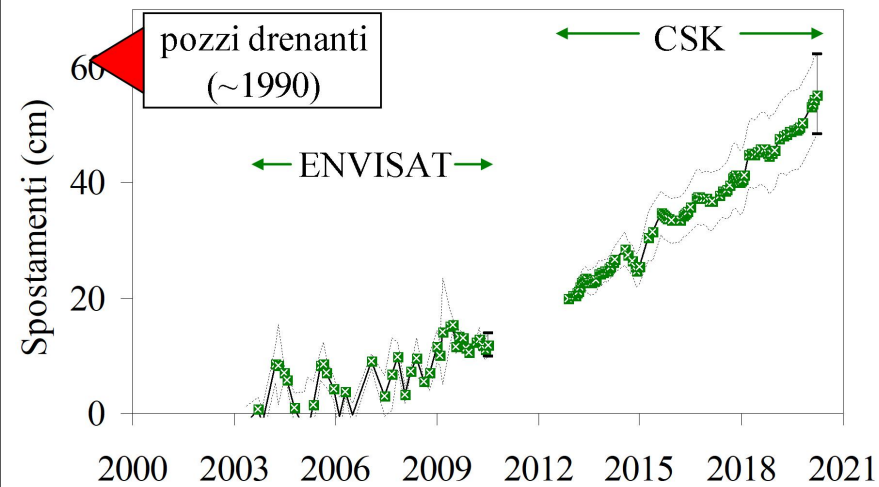
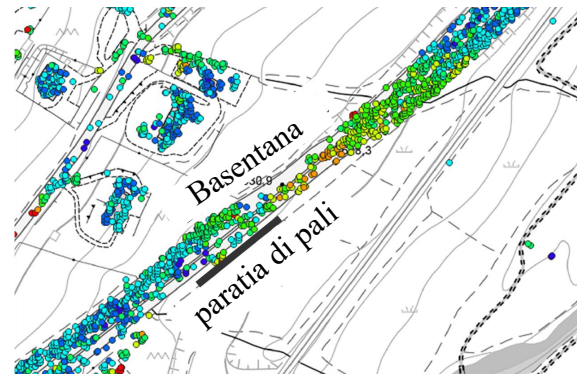
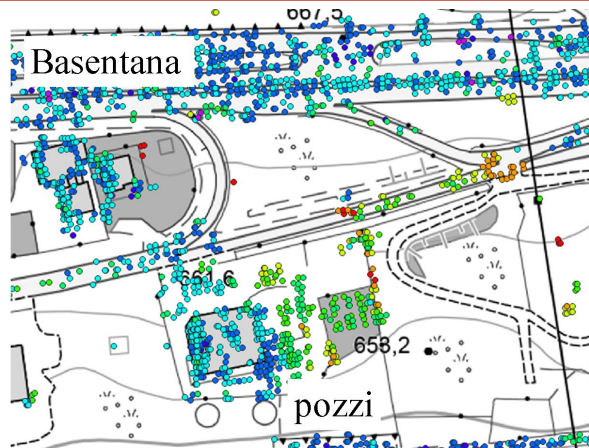
SS. Basentana



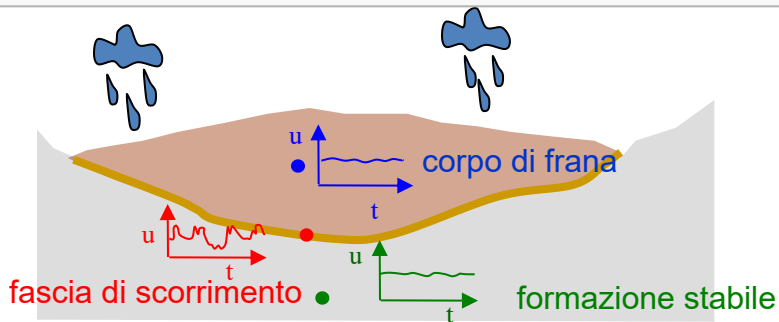


Possibili interventi:

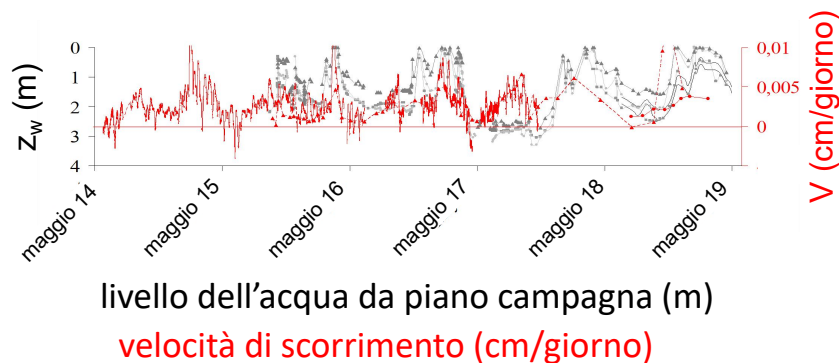
- drenaggi dove le superfici di scorrimento sono molto profonde;
- opere di sostegno per le riattivazioni meno profonde;
- interventi sull'alveo del Basento dove il fiume è concausa dell'attività delle frana;
- piantumazione di specie vegetali opportunamente scelte nelle restanti parti del versante

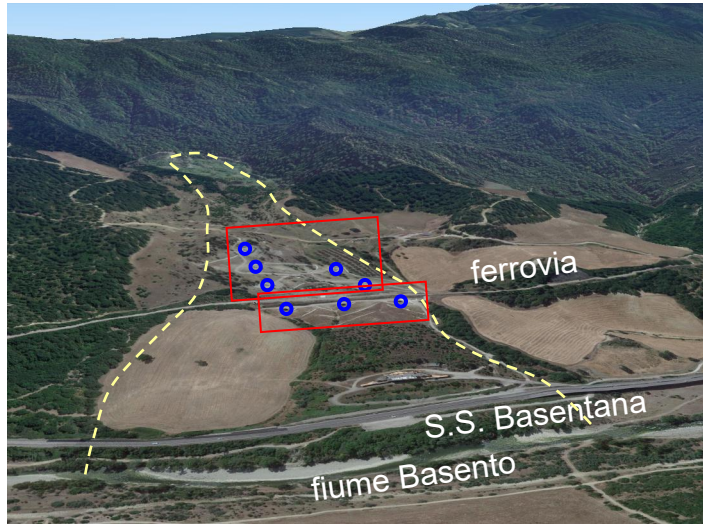
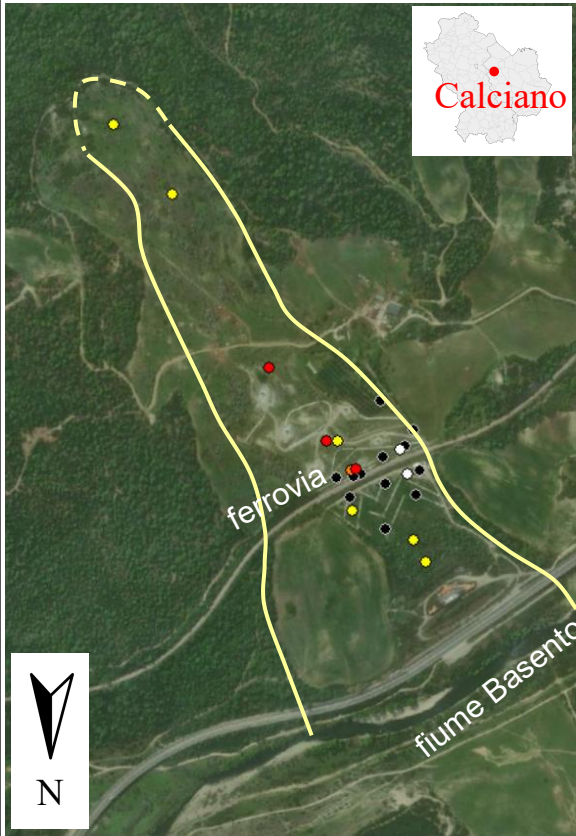


Le piogge provocano notevoli variazioni di pressioni interstiziali lungo la fascia di scorrimento



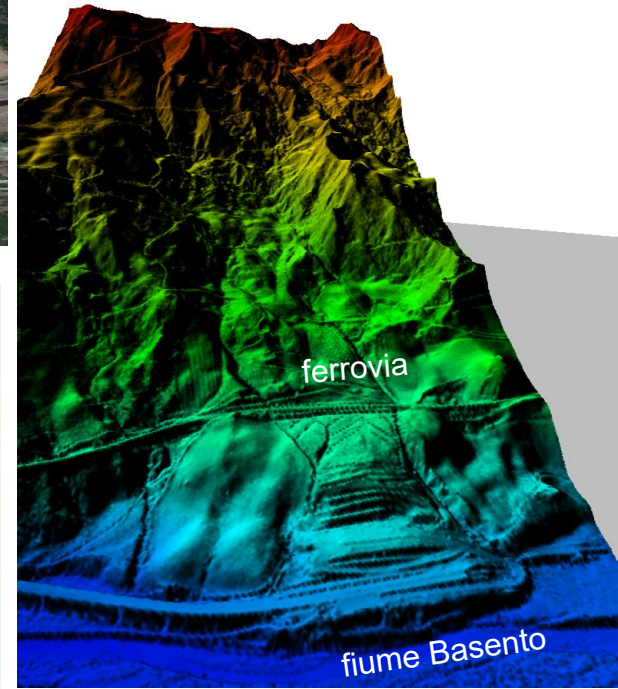
Le variazioni di pressioni interstiziali producono variazioni di velocità di scorrimento

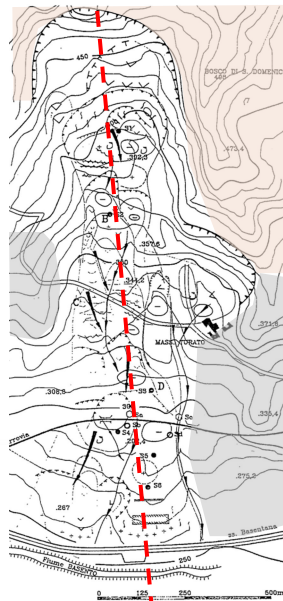
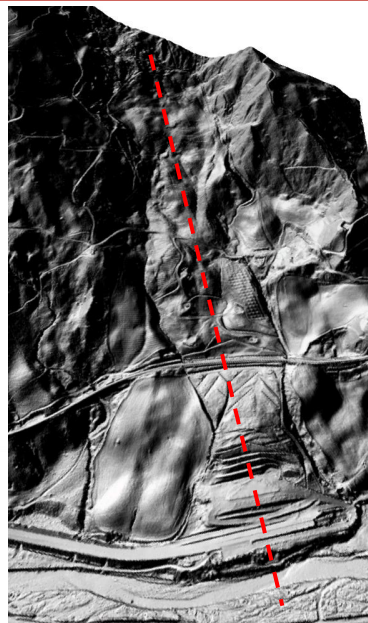




GEOCART

DTM (vertical exaggeration: x2)



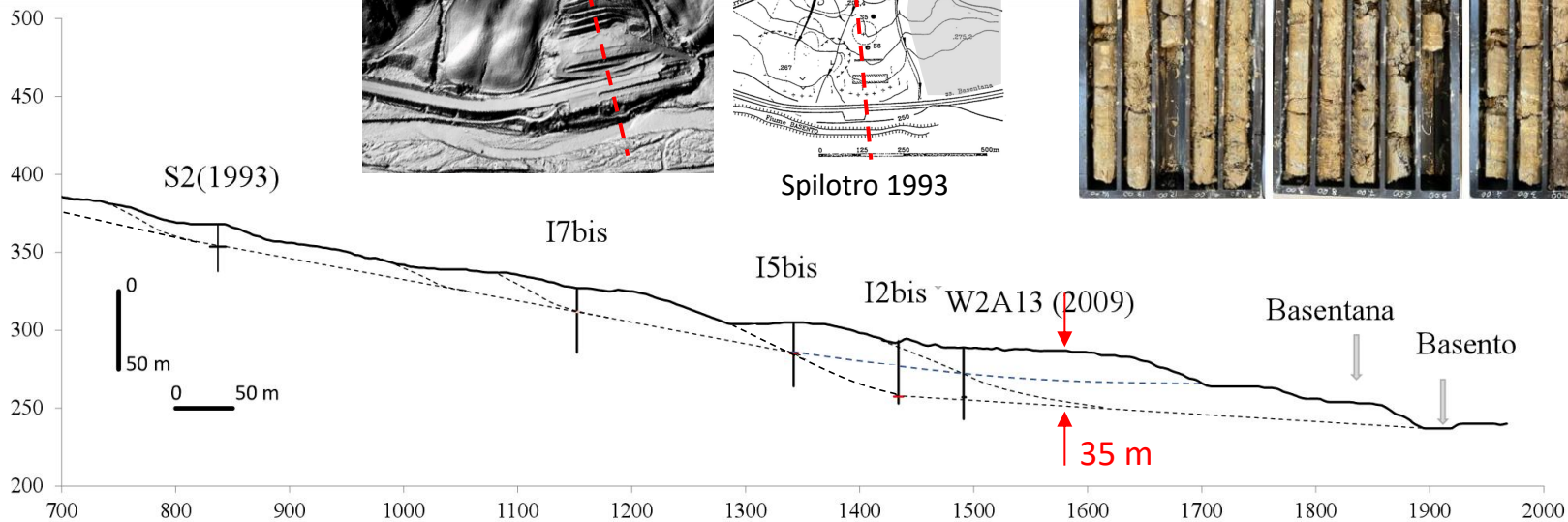


Flysch numidico: strati e banchi di quarzareniti/argille/marne

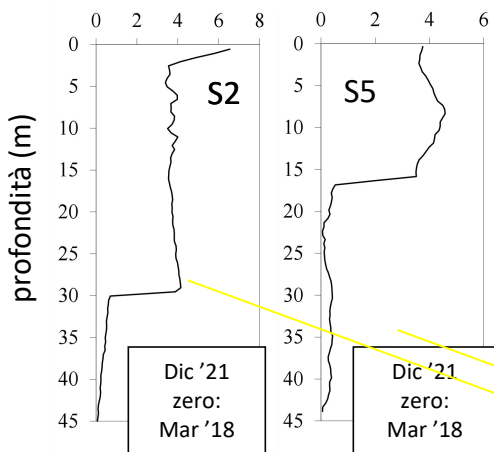


Serra Palazzo: strati e banchi di marne/argille/calcarei

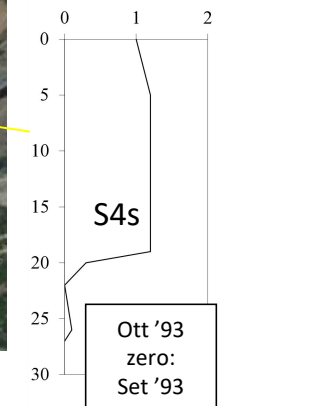
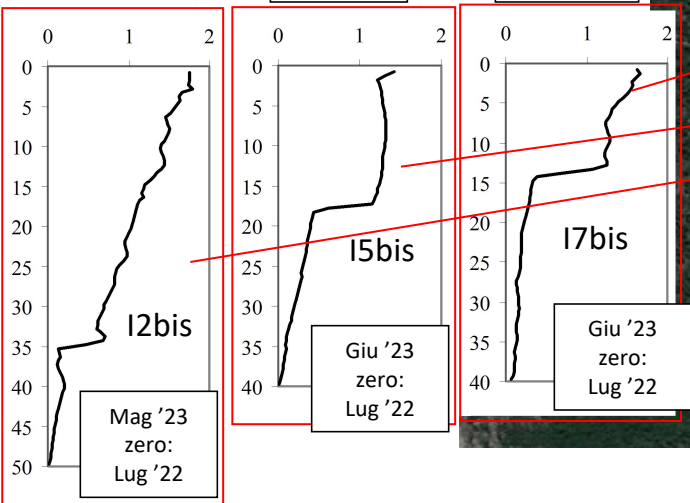
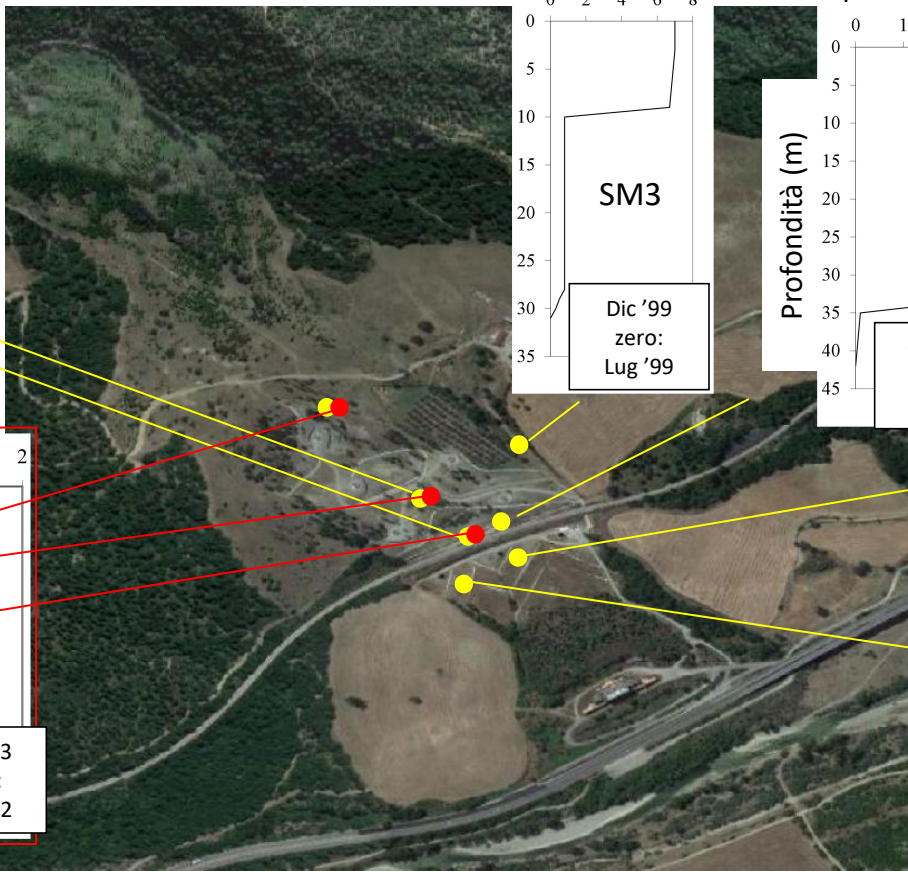
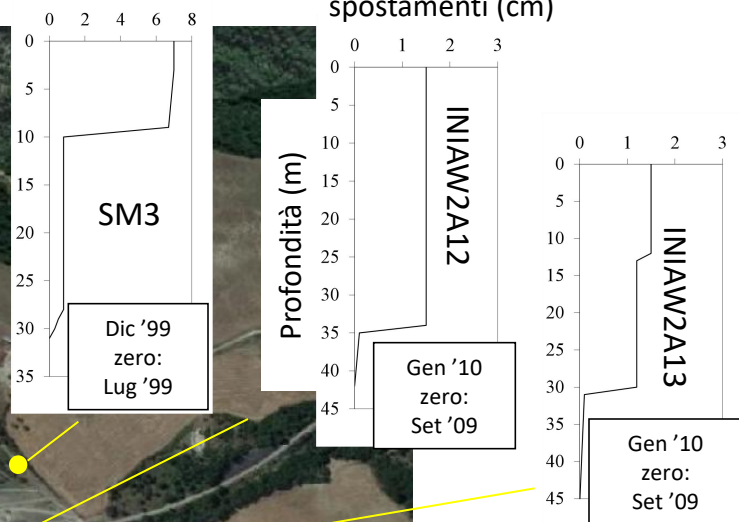
I2bis 0-15 m

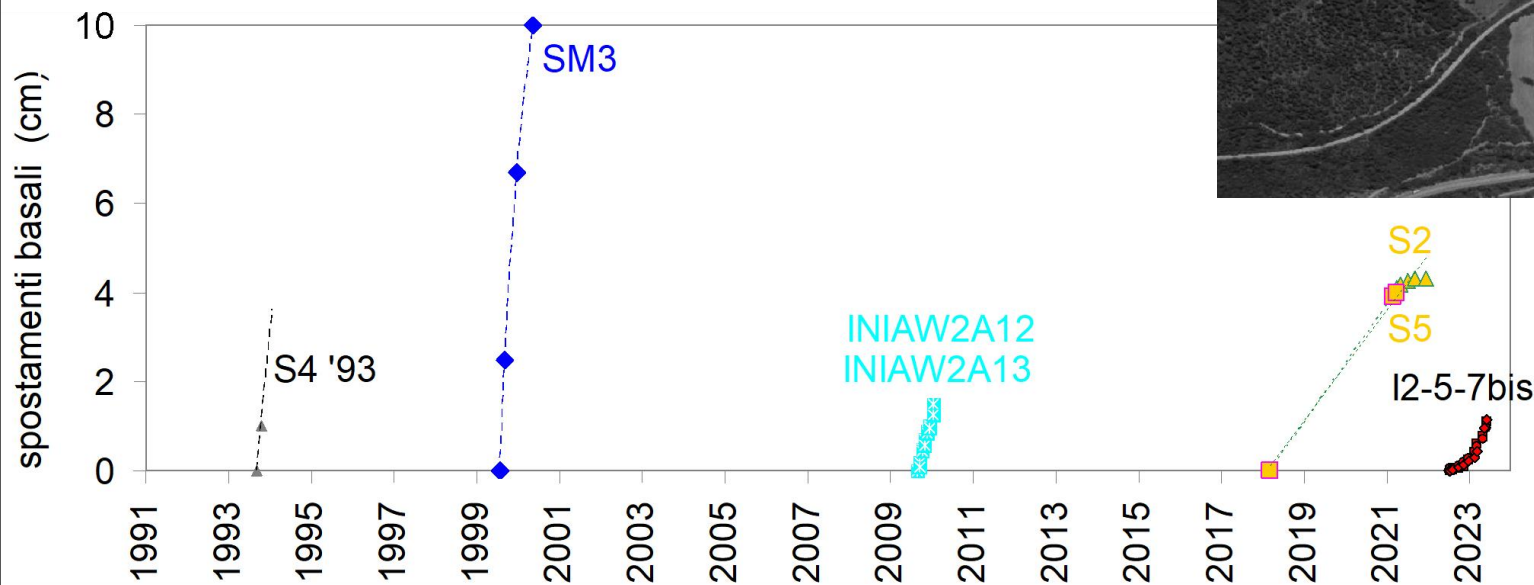
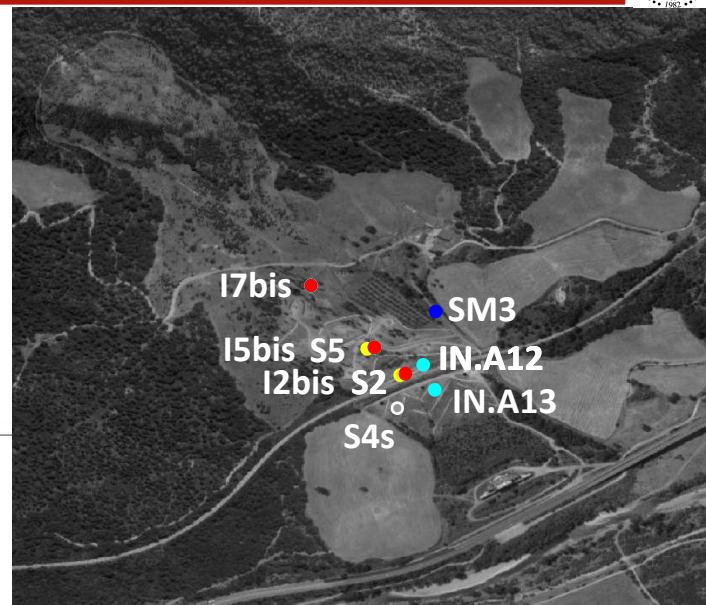
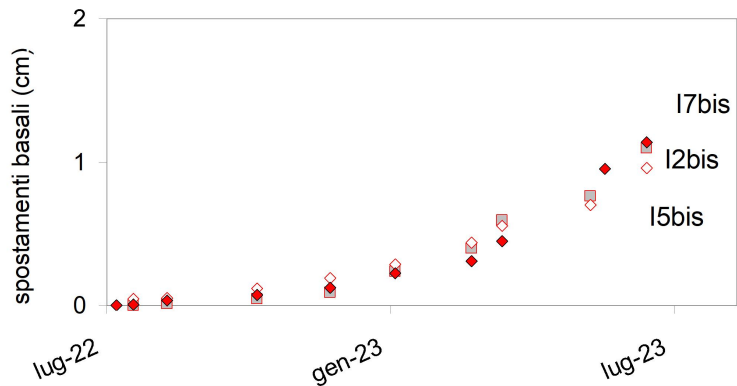


spostamenti (cm)



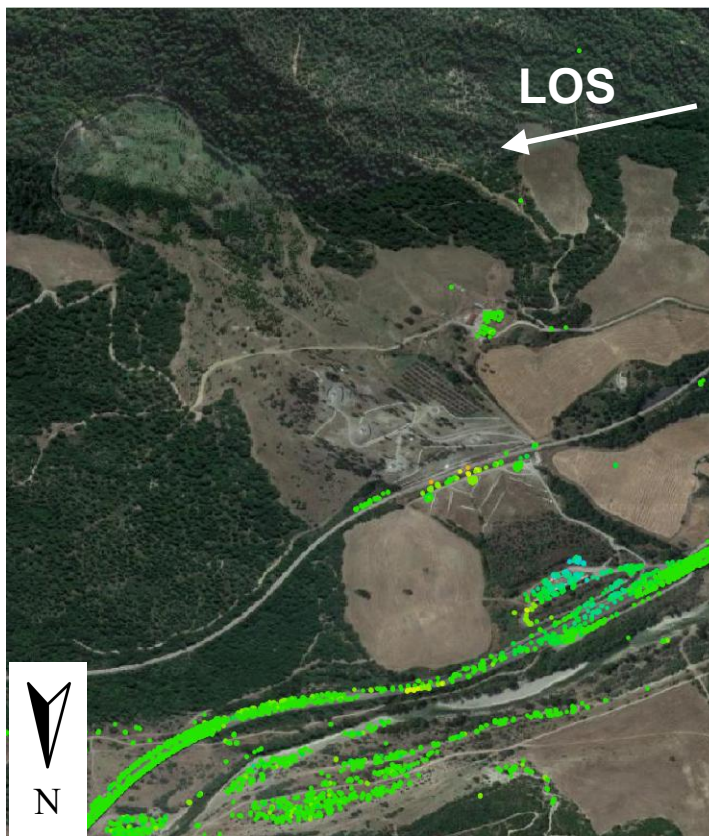
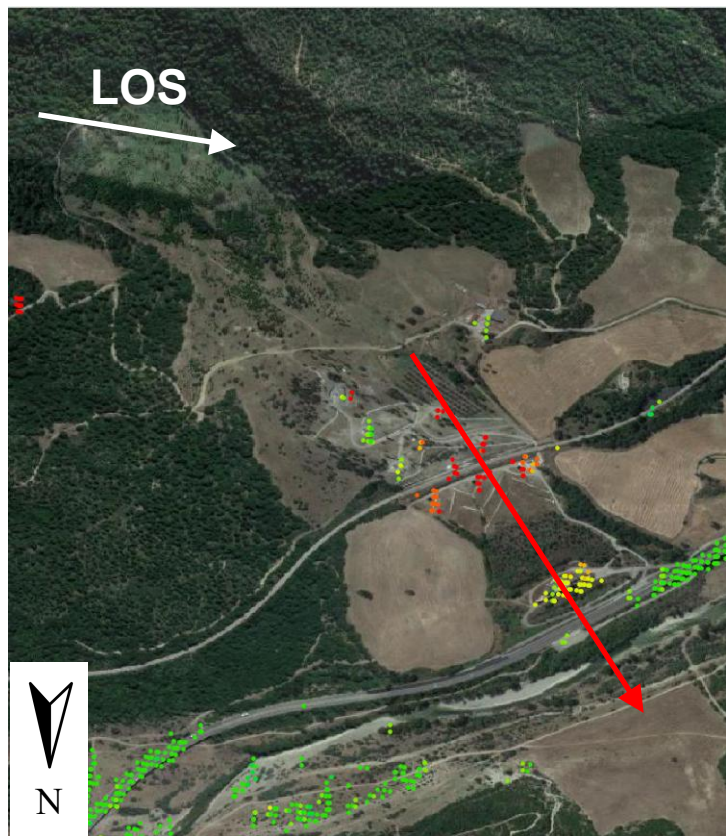
spostamenti (cm)



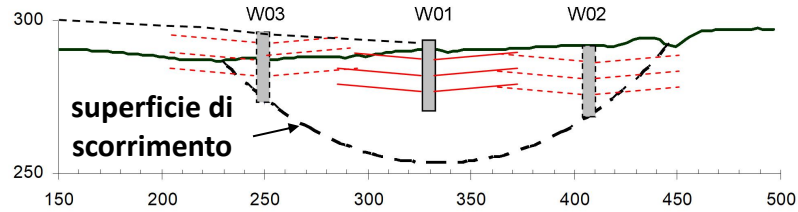
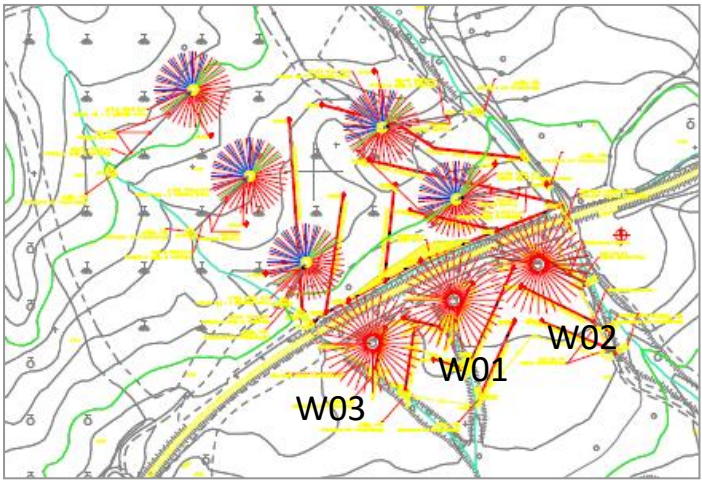
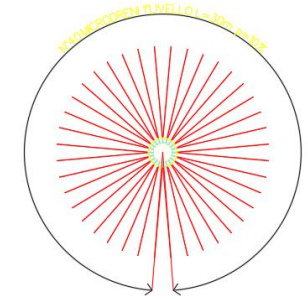
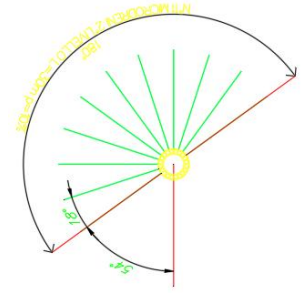
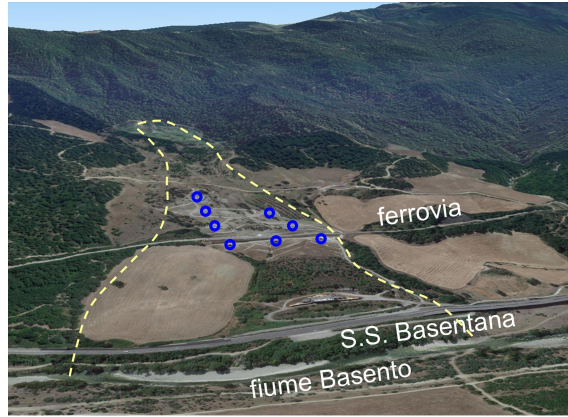


Sentinel-1 desc (2015-2021)

COSMO-Skymed asc (2011-2021)

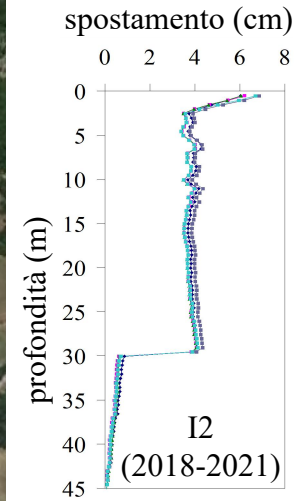
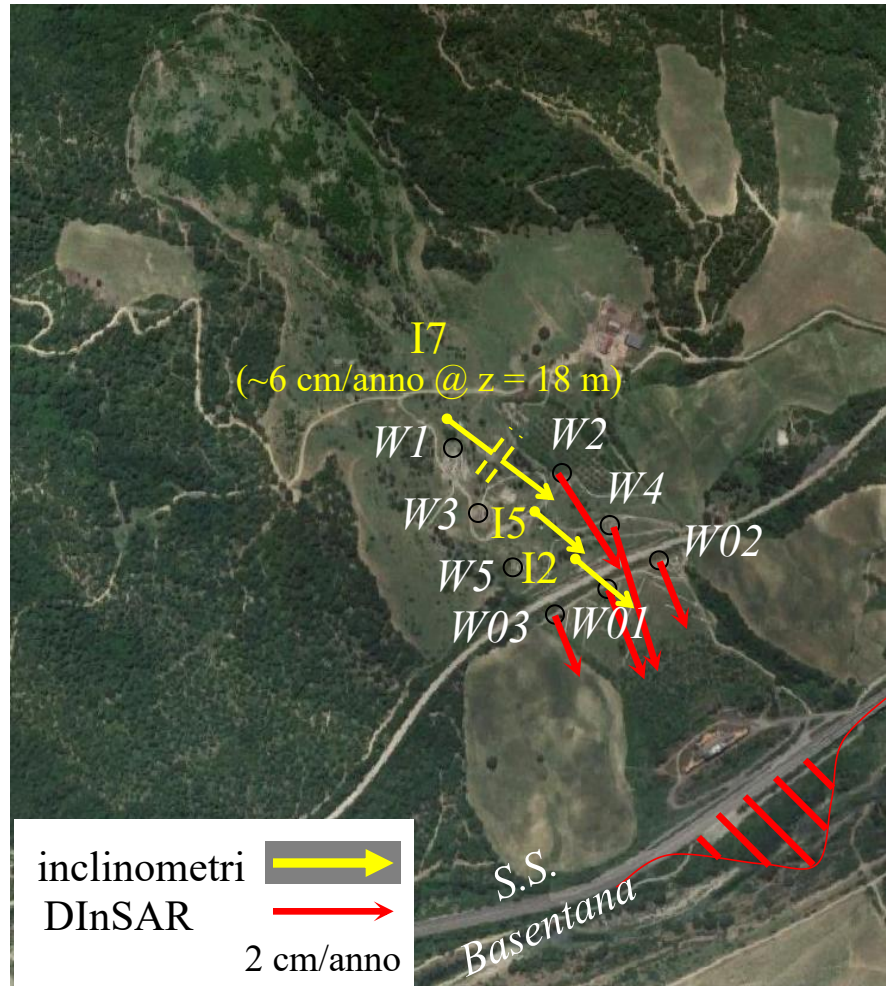


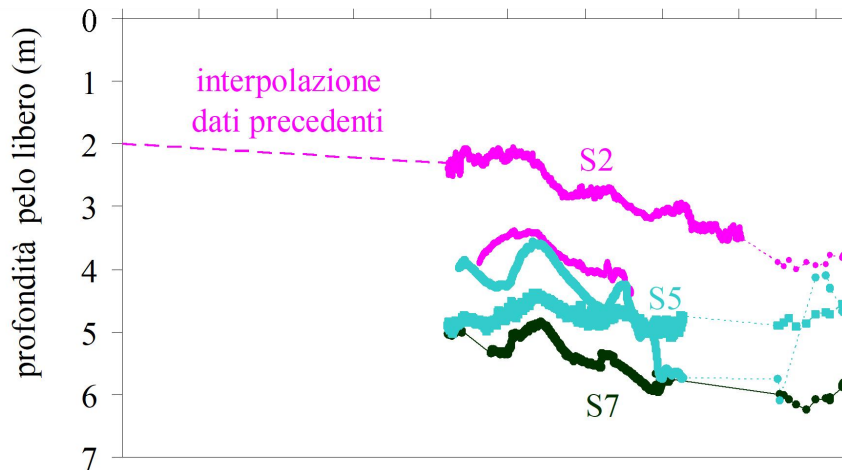
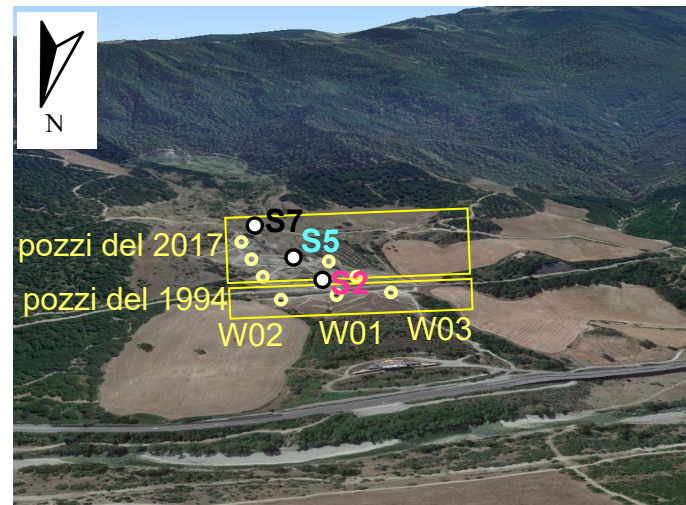
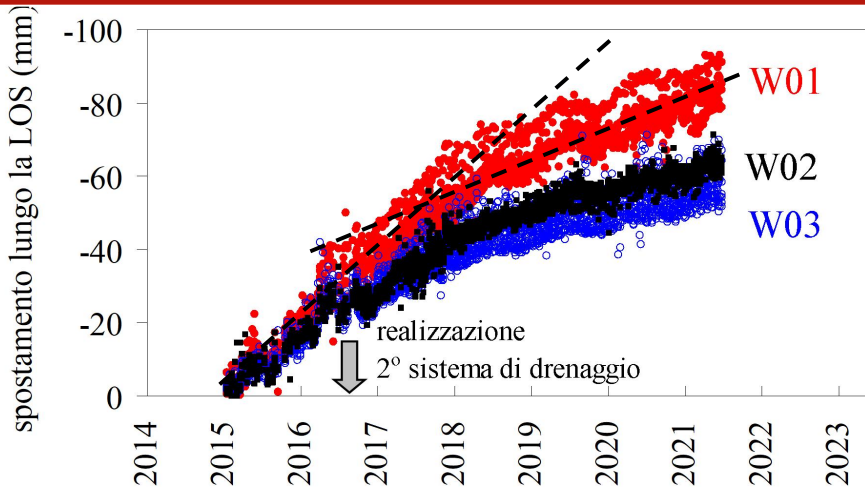
v_{LOS} (mm/anno)		
● < -9	● -3 ÷ -1	● < +5 ÷ +7
● -9 ÷ -7	● -1 ÷ +1	● +7 ÷ +9
● -7 ÷ -5	● +1 ÷ +3	● > +9
● -5 ÷ -3	● +3 ÷ +5	

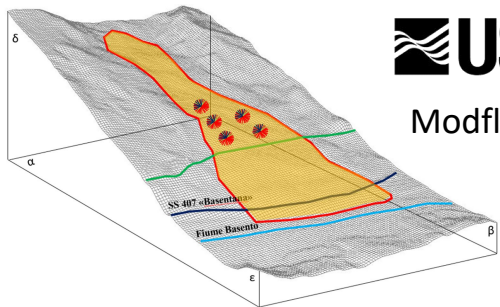


diametro pozzi: 7.5m
lunghezza pali: 21m
3/4 livelli di microdreni
lunghi 30/40m

2018-2022



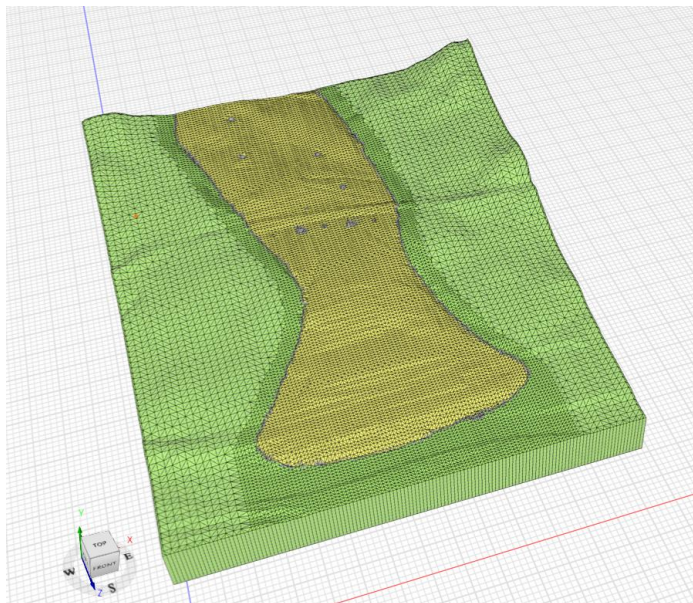




USGS

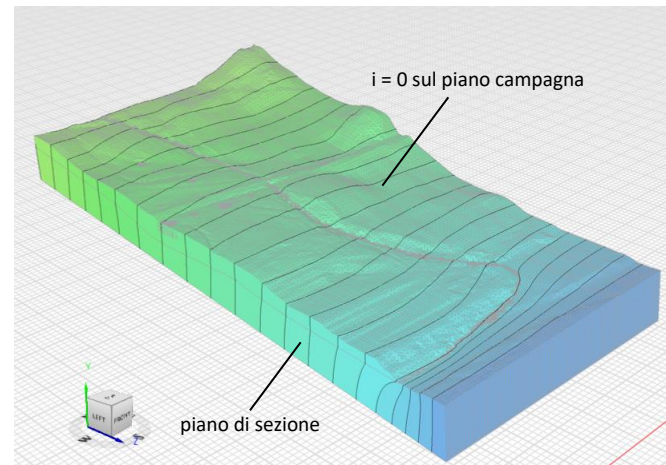
Modflow 3D

piogge ↔ pressioni interstiziali ↔ spostamenti ↔ efficacia degli interventi di stabilizzazione esistenti



GeoStudio

SEEP/W 3D



[caso in assenza del sistema drenante]

- Il versante di Costa della Gaveta è interessato da vari sistemi franosi. Il monitoraggio e le indagini che si stanno effettuando da vari anni hanno consentito di comprenderne la cinematica e ipotizzare le tipologie di intervento.
- A Calciano, i dati satellitari hanno fornito informazioni praticamente continue sugli spostamenti degli ultimi 10 anni permettendo quindi, assieme ai risultati del monitoraggio da terra, di valutare l'efficacia dei sistemi di drenaggio realizzati nel passato.
- L'integrazione dei dati di monitoraggio da terra con quelli satellitari DInSAR ha consentito di descrivere in modo più completo gli spostamenti di strutture e infrastrutture interagenti con le frane.
- Lavori in corso: tipizzazione.