SLOW-MOVING LANDSLIDE MONITORING WITH MULTI-TEMPORAL TERRASAR-X DATA BY MEANS OF DINSAR TECHNIQUES IN CROTONE PROVINCE (SOUTHERN ITALY)

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Outline

• Motivation
• Study area
• Methodologies
• Comparison of the techniques used
• Conclusions
• Outlook & Ideas
Motivation

«Hundreds of main landslide events every year in Italy» (Ispra-Summary report on geo-hydrological instability of 2014)

Maps of the landslide events with 'victims' between 1964 – 2013 (CNR-IRPI (2015))
Study Area

[Map showing locations such as Crotone, Santa Severina, and Cutro with corresponding photos of the areas shown on the map.]
Papanice Landslide

23 February 2012
Papanice – Geological setting

1) Holocene deposits; 2) Plio-Pleistocene deposits; 3) Tortonian-Pliocene deposits; 4) Mesozoic Liguride Complex; 5) Crystalline bedrock; 6) Fault; 7) Transpressive shear zone; 8) Study Areas. Modified from Corbi (2009)
Geological setting

Recent alluvial deposits (Holocene)

Sant’Anna Synthem (Upper Pleistocene)

Cutro marly clay (Upper Pliocene – Lower Pleistocene)
Papanice urban growth

Courtesy of the ARPACAL
Methodology

Traditional geological survey

Remote sensing
Landslide inventory map (2001)
Papanice landslide – Main features

23 February 2012
- Landslide updated as active
- Retrogressive trend
Available Dataset
TerraSAR-X Dataset

TerraSAR-X Science Proposals
Geo 1589 - Geo 2641

Ascending Dataset:
66 Images
Track 146
Orbit 9498

Descending Dataset:
67 Images
Track 108
Orbit 4784

Slope failure
DInSAR Techniques

1. **SUBSOFT processor**
   - Coherent Pixel Technique (CPT - Mora et al., 2003, Blanco et al., 2008, Iglesias et al., 2015)

2. **SARscape® Software**
   - Persistent Scatterers Interferometry (PSI – Ferretti et al., 2001)

   - **Dispersion index**
     \[ D_a = \frac{\mu}{\delta} \]
R-Index (Notti et al., 2004, 2010)

![Ascending Dataset](image1)

![Descending Dataset](image2)
Temporal Sublook Spectral Coherence Application
TSSC Application

Amplitude Map

Temporal Sublook Spectral Coherence Map

Pixel selected with a TSSC threshold of 0.7
Points referable to the displacement: 109
Average velocity of the displacement: -27.7 mm/yr
Maximum value of velocity: -36 mm/yr
Minimum value of velocity: -14.8 mm/yr
Persistent Scatterers
Interferometry
Application
- Application of a temporal baseline threshold, splitting the stack in two periods
- Application of a spatial baseline threshold
PSI Application

Amplitude Map

Final PSs with a product coherence threshold of 0.6

Coherence Map
PSI Application

**PS 1st period**
- Image selected: 29
- Point selected: 1393
- Point referable to the displacement: 7
- Average velocity of the displacement: -25.4 mm/yr
- Maximum value of velocity: -32.1 mm/yr

**PS 2nd period**
- Image selected: 27
- Point selected: 1543
- Point referable to the displacement: 1
- Value of velocity: -32.1 mm/yr
Comparison
TSSC & PSI
Comparison

- General agreement among the two MTI methods exploited (displacement rates and detection of the landslide)
Comparison

• Higher number of points, referred to the landslide, recognized by the TSSC

• Shift of 150 m westward for the SARscape software

• Confirmation of the results also with preliminary processing through CPT (Coherence pixel selection) and SBAS
Rainfall Analysis

Cumulated Rainfall: 184.4 mm
Conclusions

- Reliability of DInSAR techniques, especially when coupled with geological and geomorphological surveys

- Ability of MTI techniques to recognize precursor stages of future slope failures

- Ability of MTI techniques to analyze displacements at a local scale
• Processing of the 2013-2014 stacks for post-failure analysis and validation with traditional instruments

• Improving the analysis with CPT (Coherence pixel selection) and SBAS

• Application of MTI techniques for regular monitoring shortly after each acquisition
Thanks for your attention!

Any Questions?