



ABENIS AG

AUTONOME PROVINZ BOZEN SÜDTIROL
PROVINCIA AUTONOMA DI BOLZANO ALTO ADIGE
PROVINCIA AUTONOMA DE BULSAN SÜDTIROL



EURAC
research



UNIMORE
UNIVERSITÀ DEGLI STUDI DI
MODENA E REGGIO EMILIA



Ateneo fondato nel 1175
DIPARTIMENTO DI SCIENZE CHIMICHE E GEOLOGICHE

Tecniche di monitoraggio da remoto ed in-situ: Interferometria multi-temporale e GNSS differenziale

Marco Mulas ^{a,b}

a. Università di Modena e Reggio Emilia

b. Istituto per il Telerilevamento Applicato: Eurac

Endkonferenz / Conferenza finale

Bozen, 18/12/2014

Synthetic Aperture Radar characteristics

Multi-Temporal Interferometry practical issues

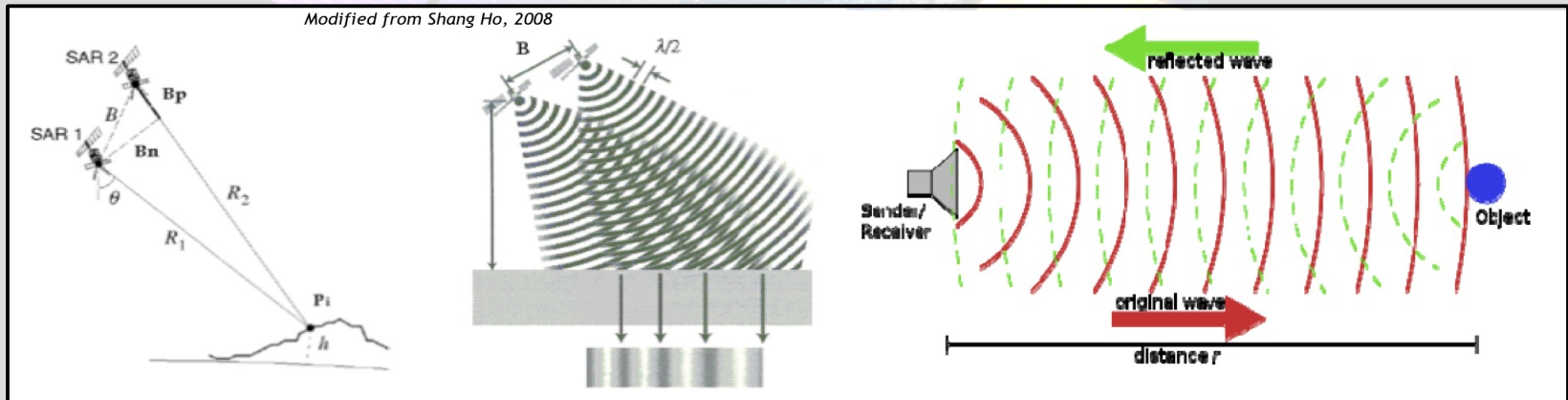
Pro & Cons

Operational in all weather conditions

Cost effective large area analysis

Potentially high precise (depending on geometric parameters and PS density)

Large image stacks necessary



Synthetic Aperture Radar characteristics

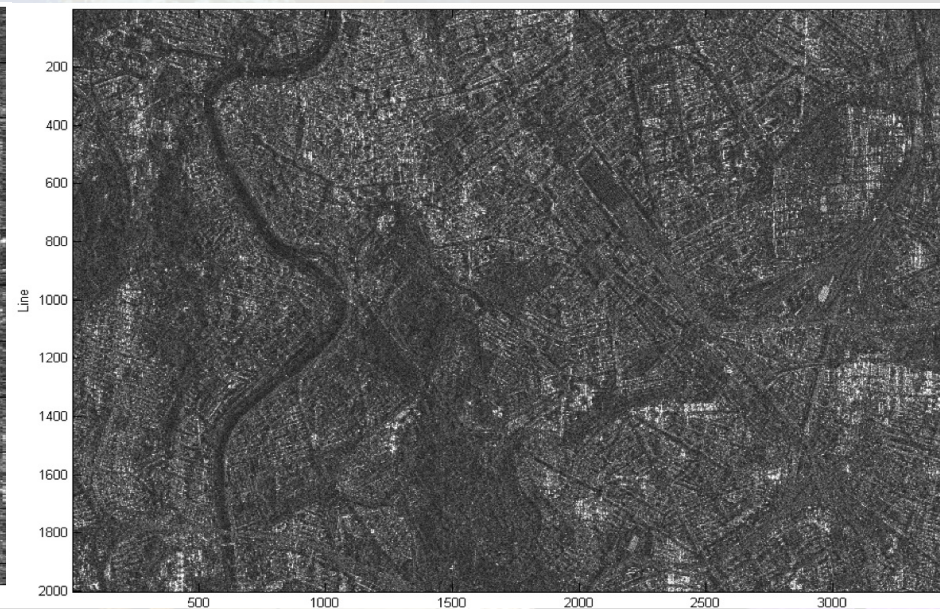
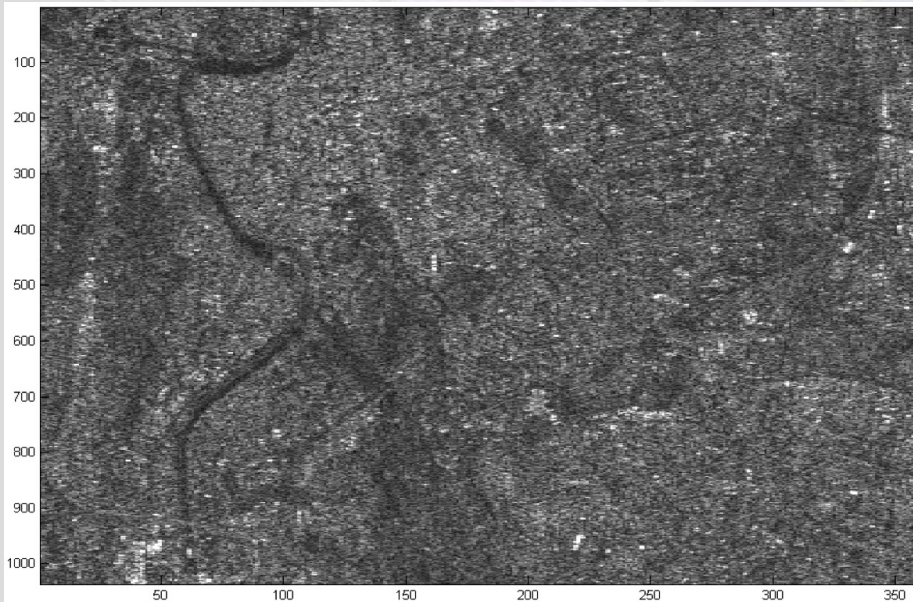
Movement range detection & Geometric Resolution vs. Microwave wavelength

- C-Band (EVISAT,RSAT,SENTINEL) > movements up to 14-21 cm/y
- X-Band (Cosmo-SkyMed: 3.1 cm, re-visiting time 8 days) > movements up to 35 cm/y

C-Band

Rome

X-Band

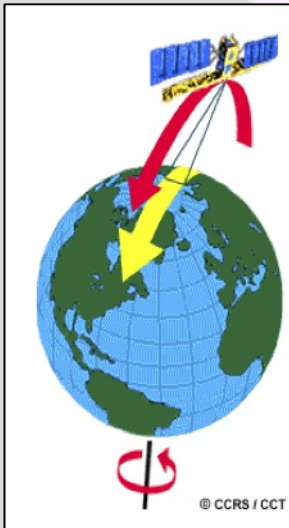
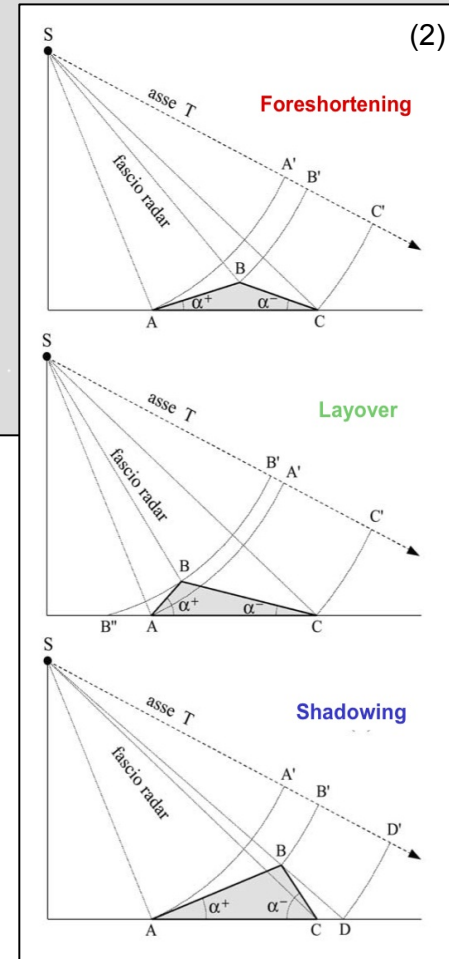


Synthetic Aperture Radar characteristics

To take in mind

LOS direction vs. Movement direction

- PSI technique provides component of ground displacement along LoS (1);
- The side-looking system can be ineffective to detect slopes with specific orientation or in narrow valleys (2)



Deformation Inference

$$d_U = \sin(\alpha_U)$$

$$d_N = \cos(\alpha_U) \cdot \cos(\alpha_N)$$

$$d_E = \cos(\alpha_U) \cdot \sin(\alpha_N)$$

$$LOS_U = \cos(\theta)$$

$$LOS_N = -\sin(\theta) \cdot \cos(\alpha_{az} - 3\pi/2)$$

$$LOS_E = -\sin(\theta) \cdot \sin(\alpha_{az} - 3\pi/2)$$

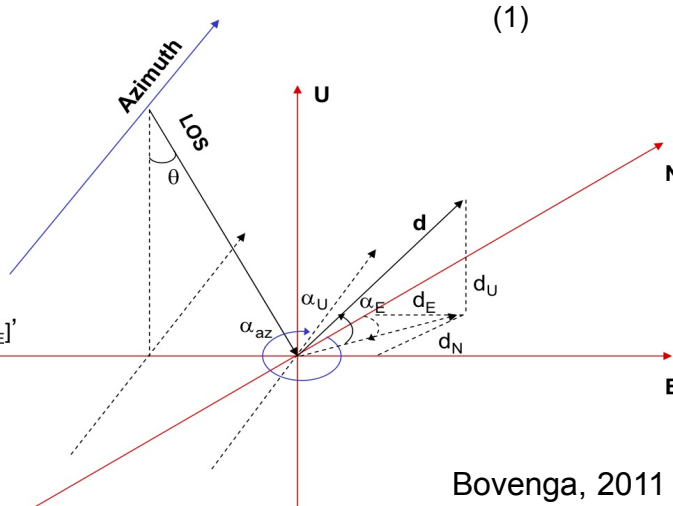
$$d_{LOS} = [d_U, d_N, d_E] \cdot [LOS_U, LOS_N, LOS_E]^T$$

$$\Theta \sim 25.5^\circ \text{ (ENVISAT)}$$

$$LOS_U = 0.92$$

$$LOS_N = 0.07$$

$$LOS_E = 0.38$$



Bovenga, 2011

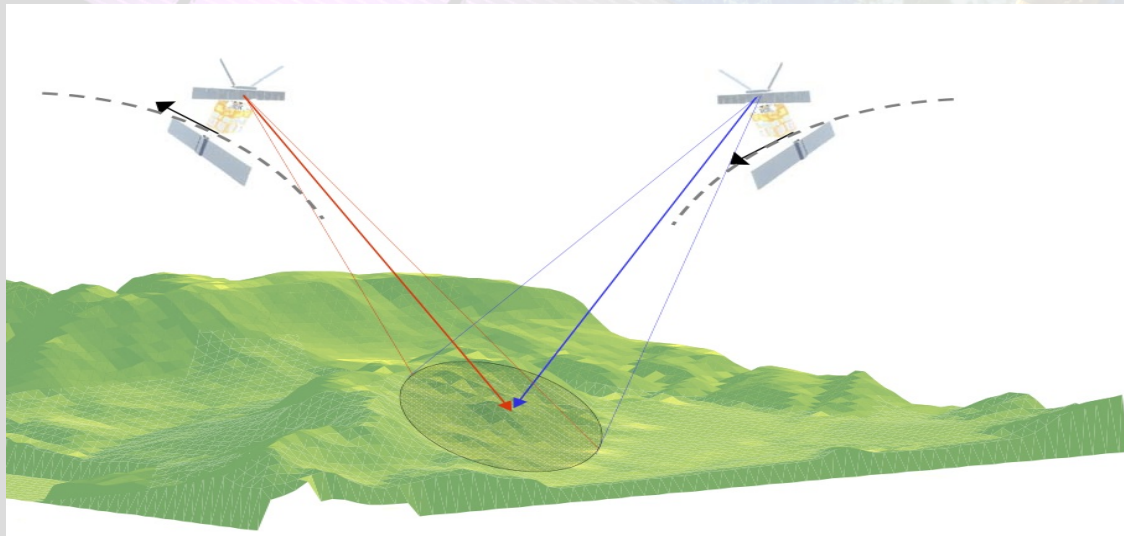


Synthetic Aperture Radar characteristics

To take in mind

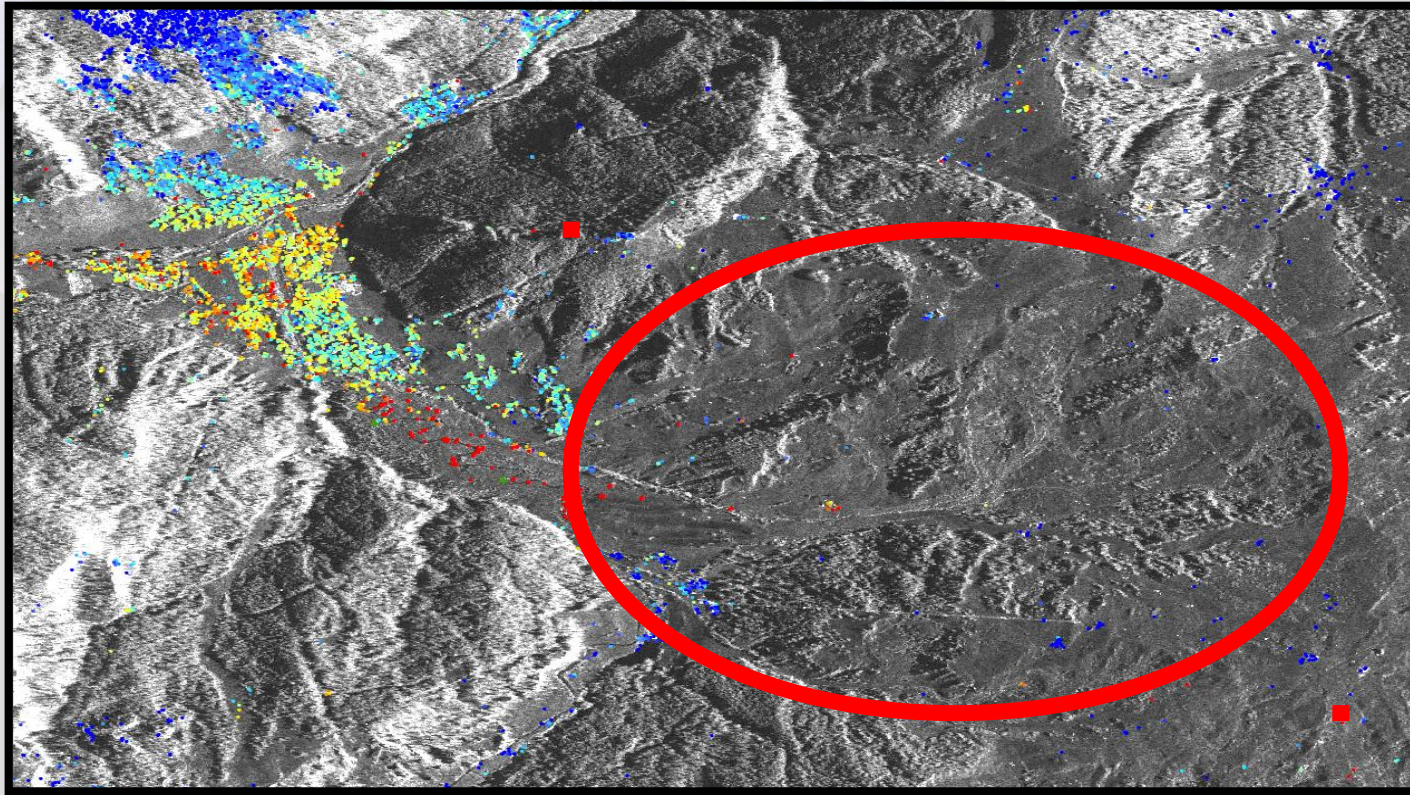
Backscattering features vs. Moving Surfaces

- PSI technique provides better over certain land cover classes only (i.e. building and artefacts);
- Distributed Scatters are examined as provided by SqueeSAR algorithm



Advanced multi-interferometry Limits

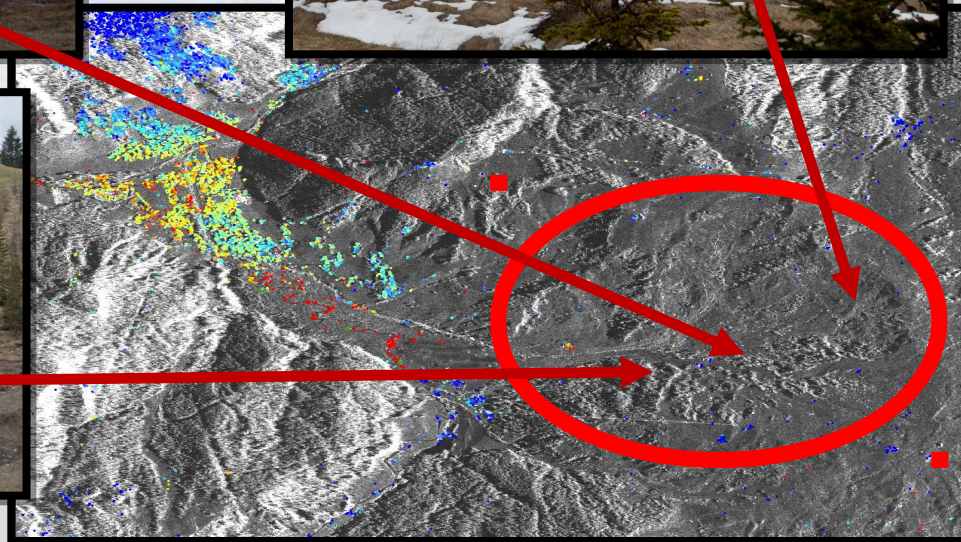
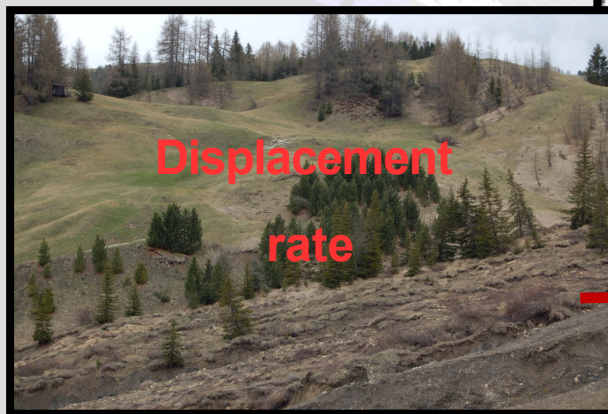
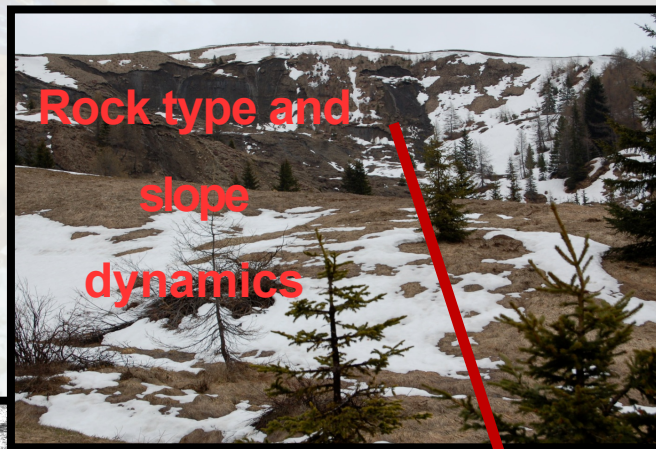
Critical lack of natural scatterers in the landslide area



SqueeSAR elaboration by TRE

Advanced multi-interferometry Limits

Criticalities: coverage of the Landslide area



Point integration

Conventional C-Band

Corner reflectors



Nautical (Non-conventional)

radar reflectors



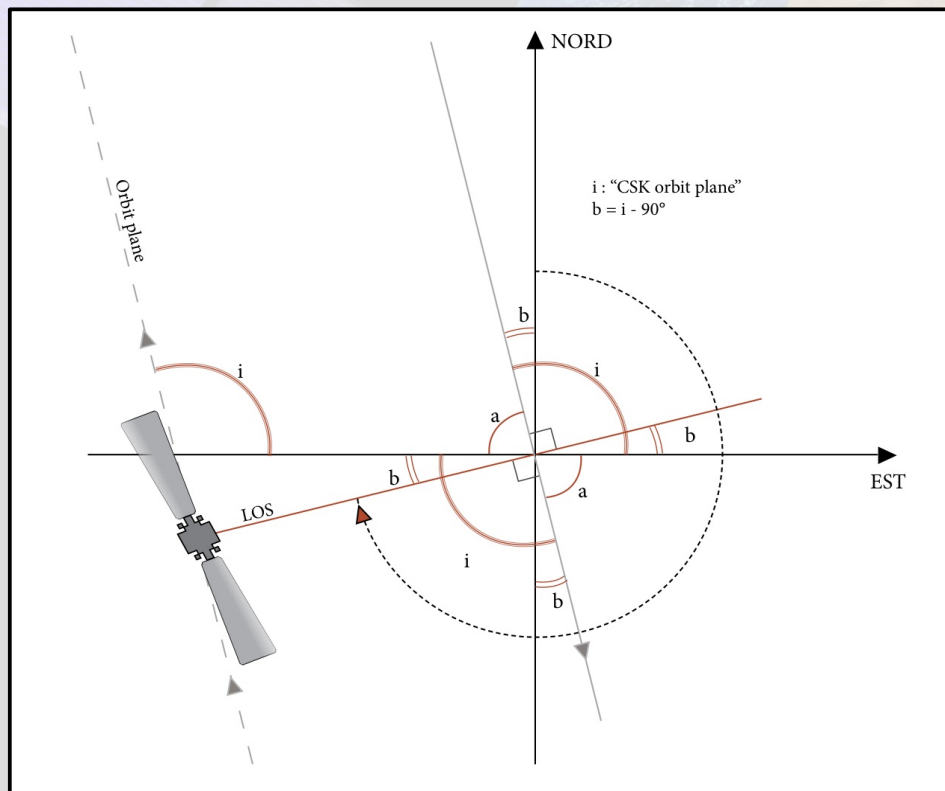
X-Band designed

Corner reflectors

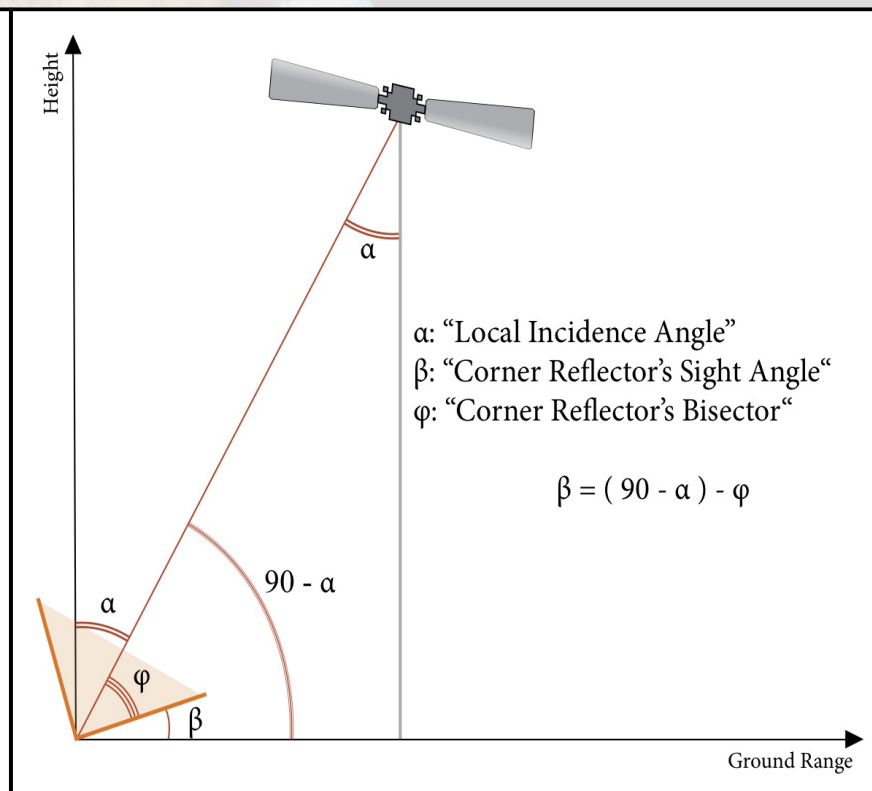
Point integration

Corner Reflector Orientation

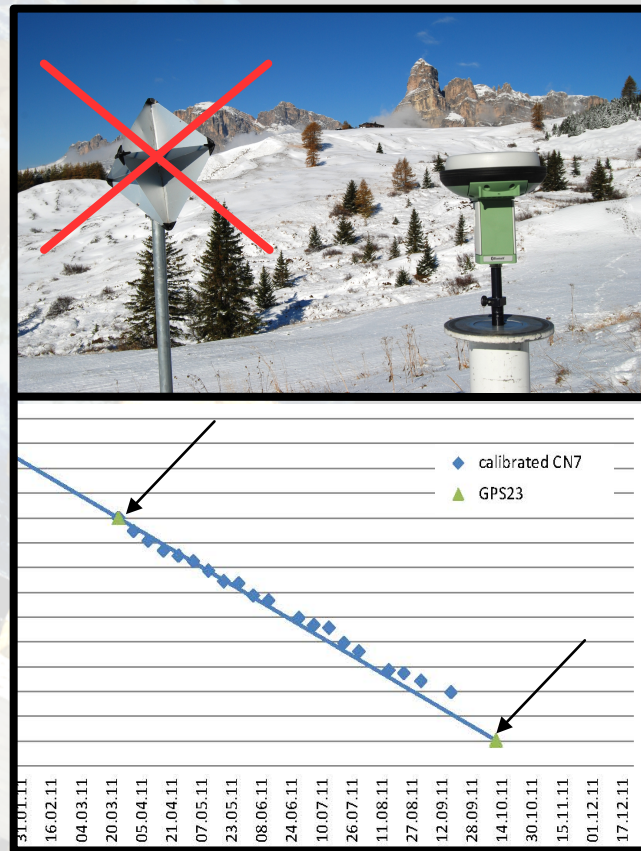
Azimuth Angle Orientation



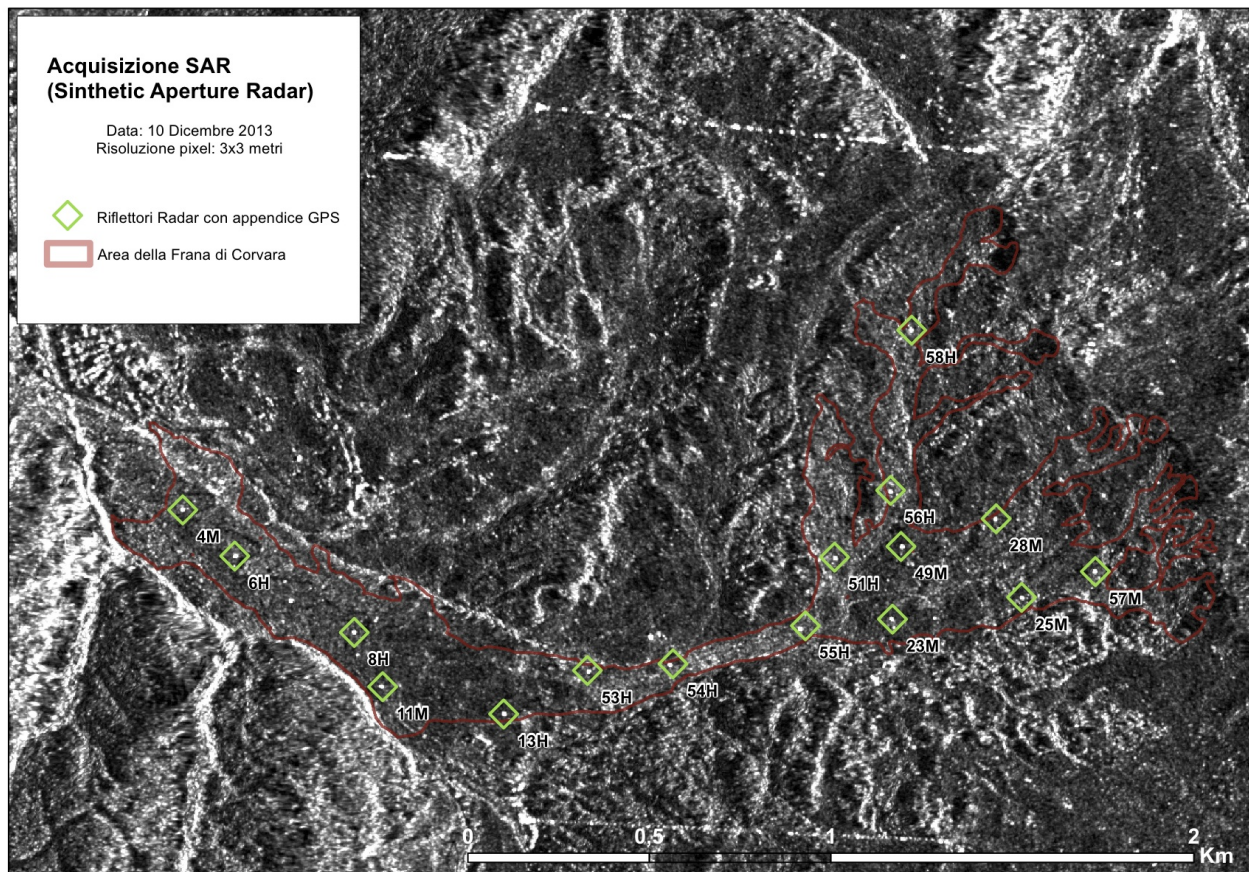
Elevation Angle Orientation



Experience: SAR & GPS

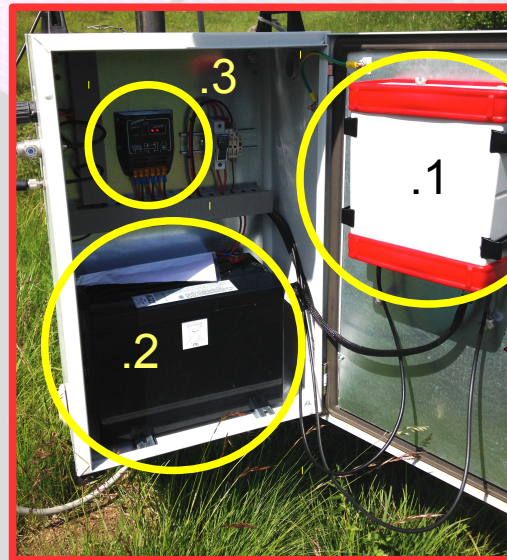
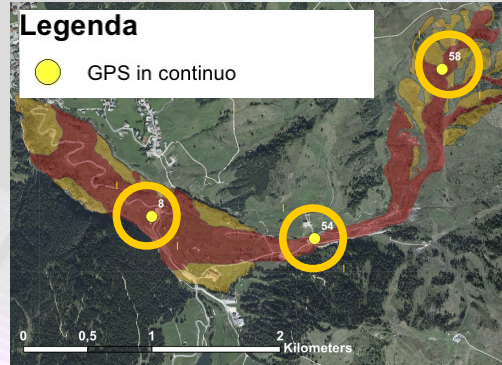


Integrated CR: application 1



Integrated CR: application 2

High Accuracy
validation of
Advanced InSAR
through
Permanent GPS



- 1) GPS receiver;
- 2) Battery;
- 3) Charge controller;
- 4) Solar Panel

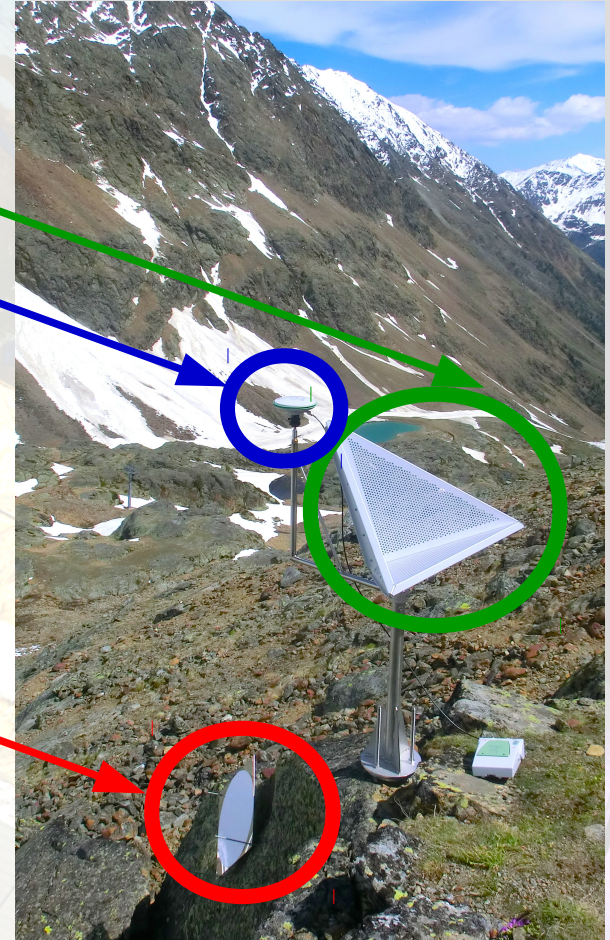
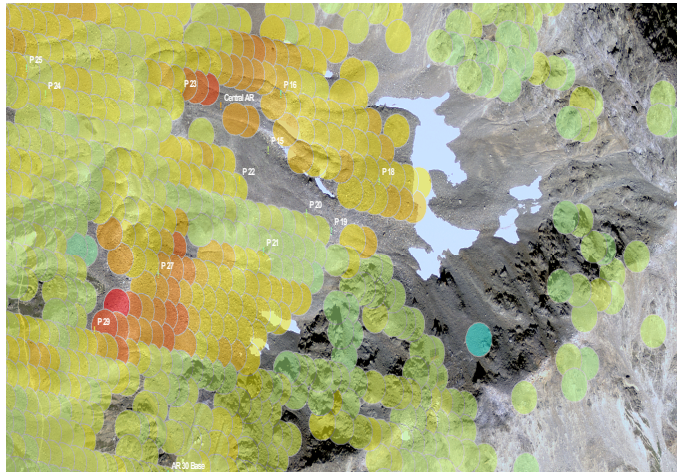
Integrated CR: application 2

Satellite SAR data

(Multi-temporal Interferometry)

D-GPS measurements

Terrestrial Laser Scanner



Thank you for your attention

Contact : marco.mulas@unimore.it

