



geohazards
tep

Optical processing services pilot project

Project Kick Off

André Stumpf, Jean-Philippe Malet, 2 * XX
(Arnaud Durand, Bernard Allenbach, Cecile Doubre)

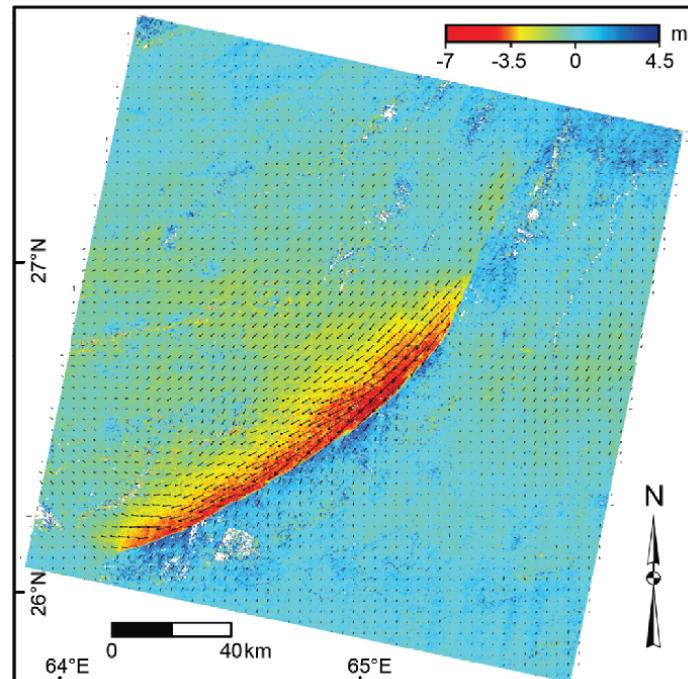
2015-10-21



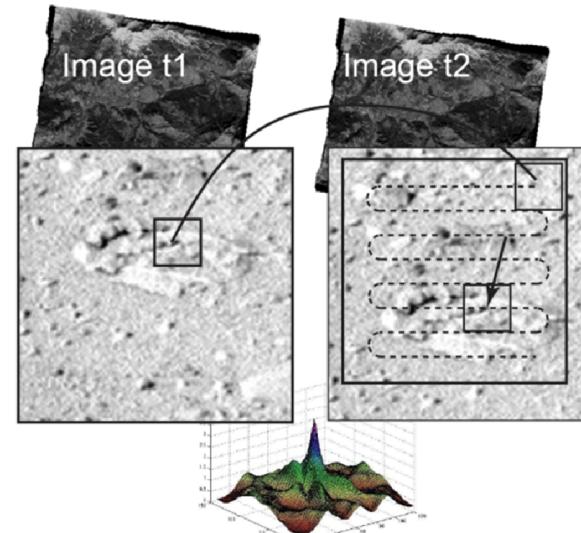
Introduction

Sup-pixel image correlation for measuring horizontal surface displacement

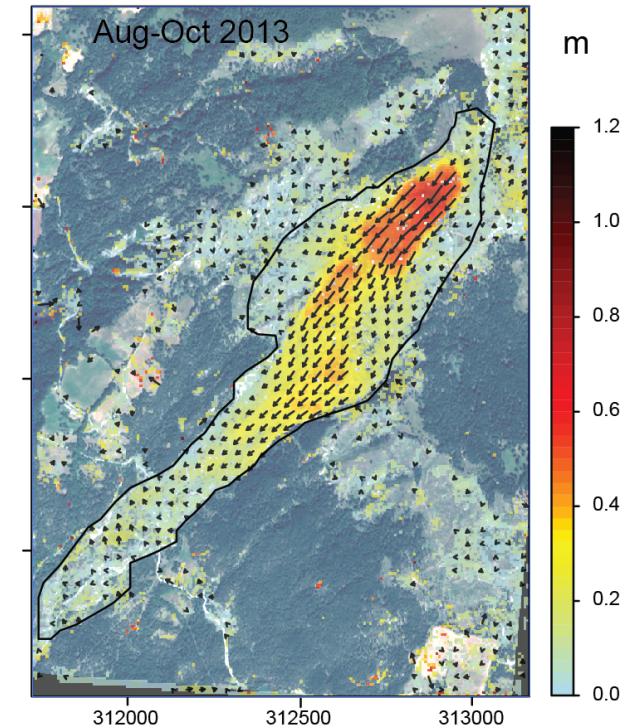
Resulting from
coseismic slip



Landsat-8, Avouac et al. 2014

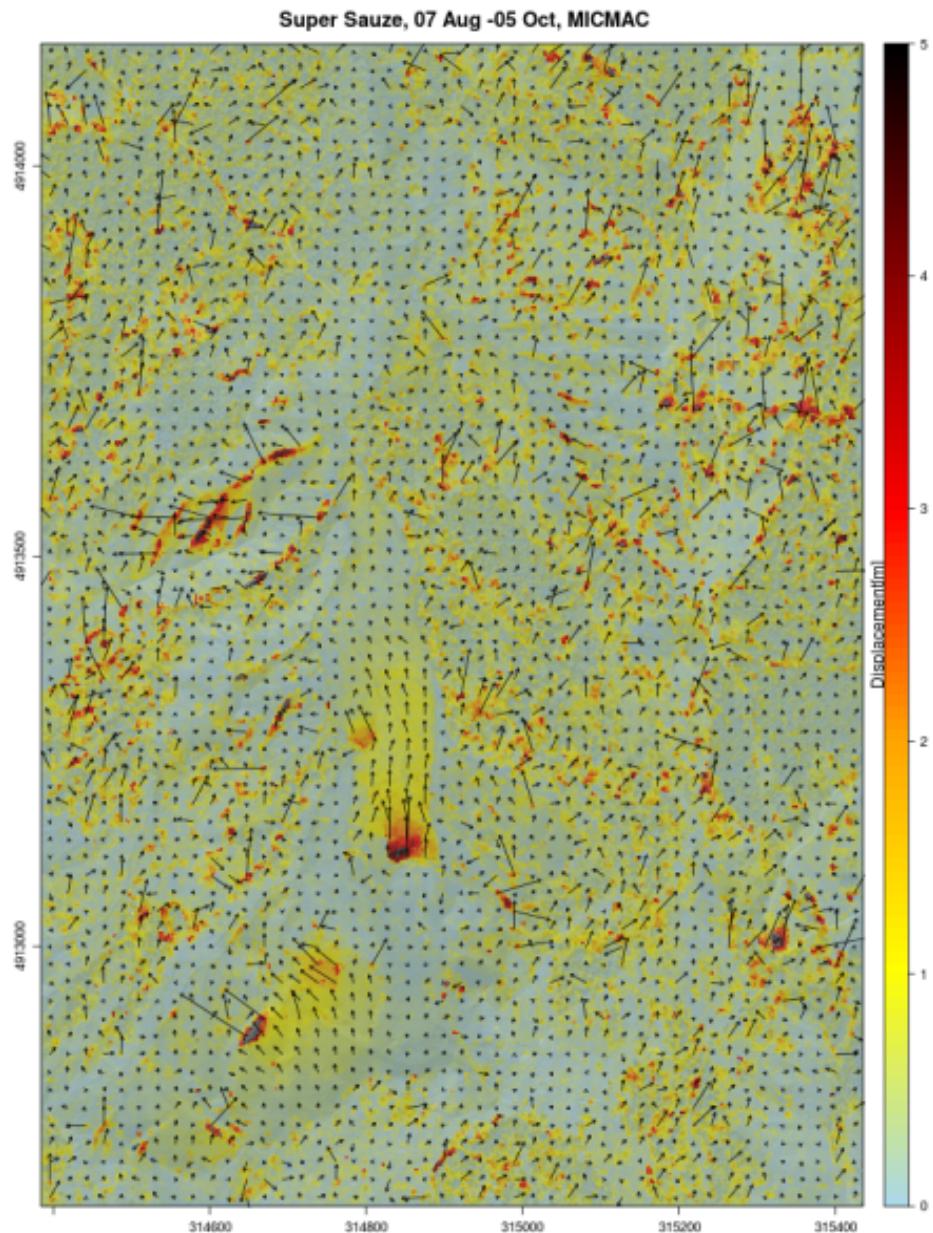


Resulting from active
landslides

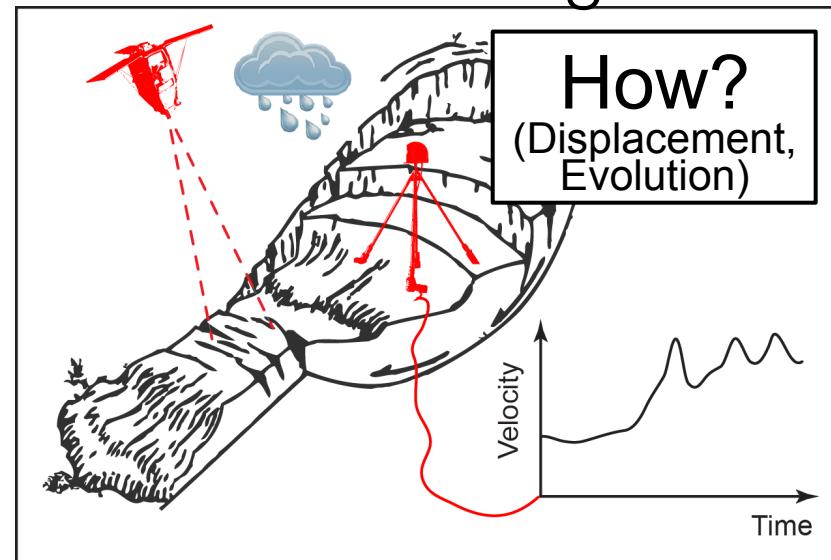


Pléiades, Stumpf et al. 2014

Introduction



Monitoring

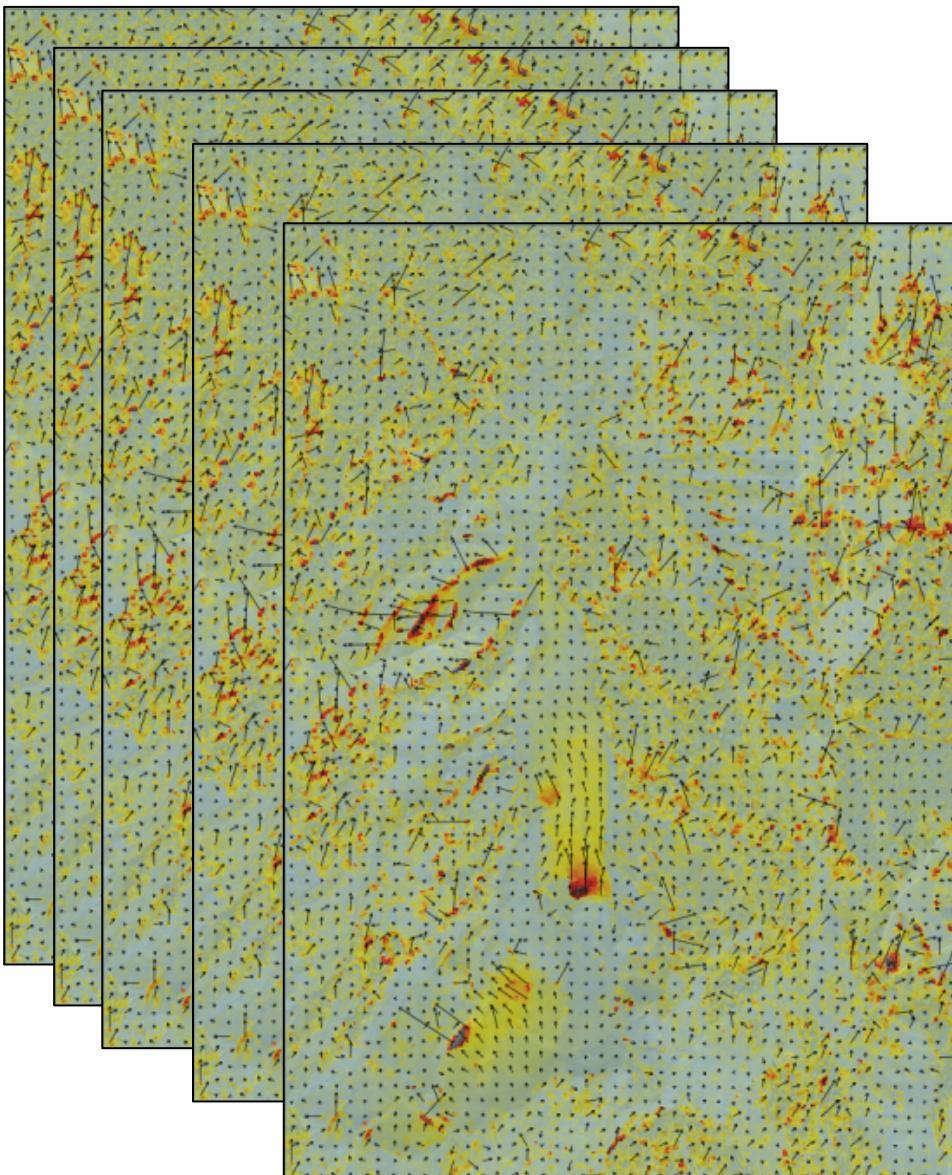


- Currently prior knowledge on the affected area is required



geohazards
tep

Introduction



Mapping



- Robust automatic detection needs more sophisticated processing
 - Time-series analysis
 - or image classification techniques

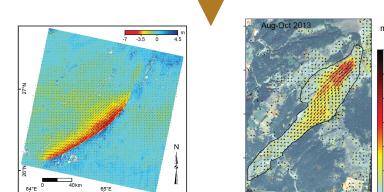
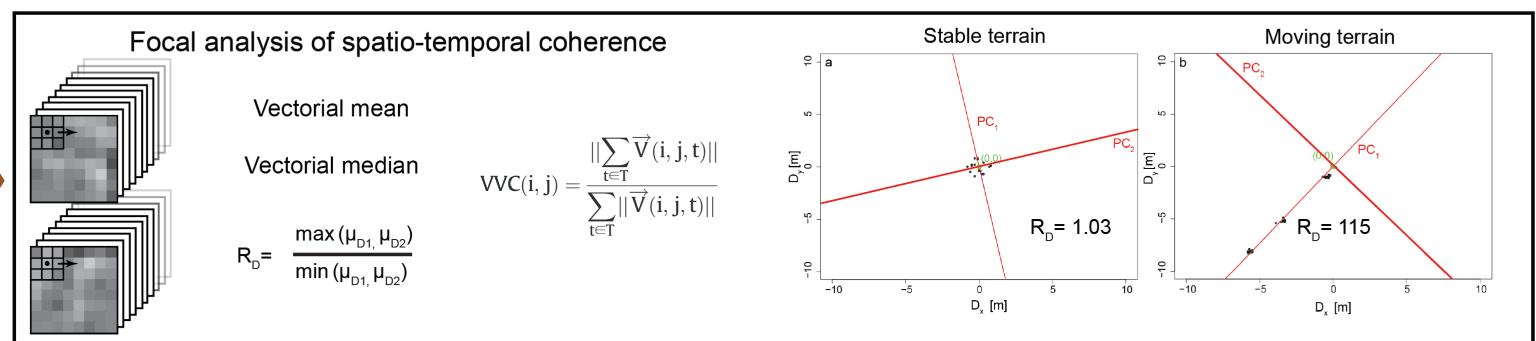
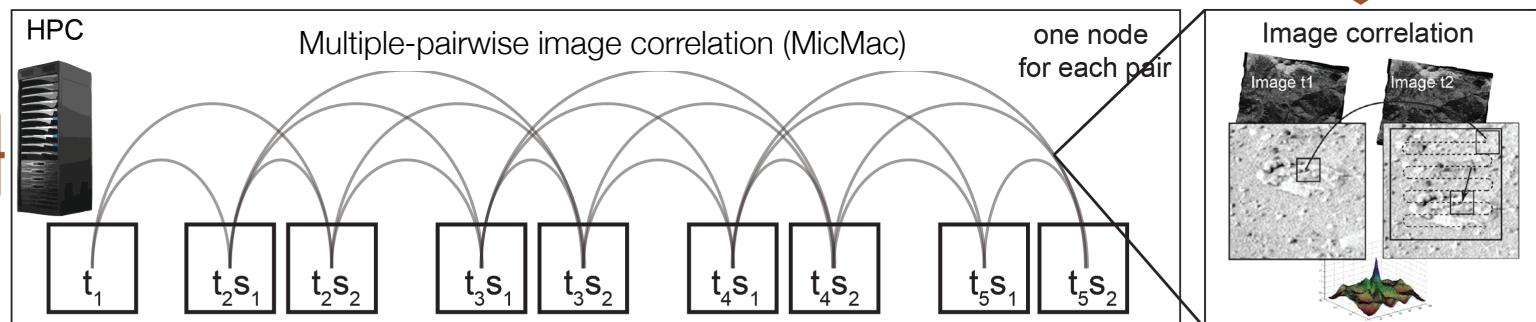
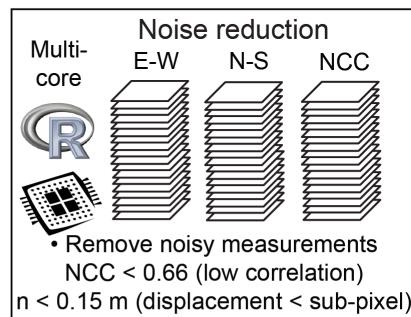


geohazards
tep

Current processing chain

- Focus on the exploitation of redundancy from multi-temporal measurements > eliminate false positive detection
- Sub-pixel precision measurements

- Sentinel-2 (Level 1B-C)
- Landsat 8
- Orthoimages generated from Pléïades, Spot 6/7, WorldView-2



geohazards
tep

Technical development

- Code optimization and additional features

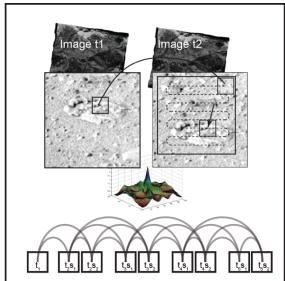
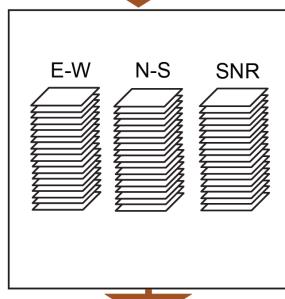


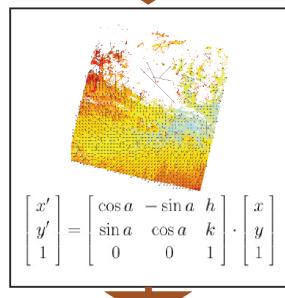
Image correlation

- Enable subsampling for speed up if required
- Enable SNR output in addition to correlation coefficient



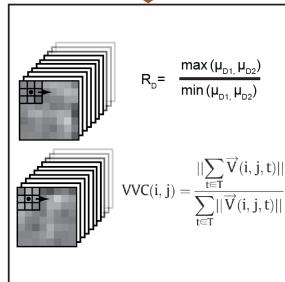
Stacking and noise removal

- Port code from R to GDAL / Numpy



Model residual misregistration (NEW)

- Robust (RANSAC) fitting of a linear transformation (rotation + translation) with dense measurements on stable terrain



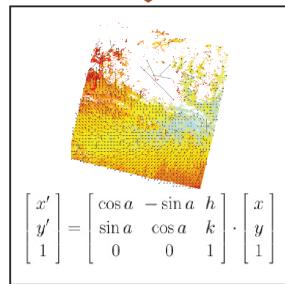
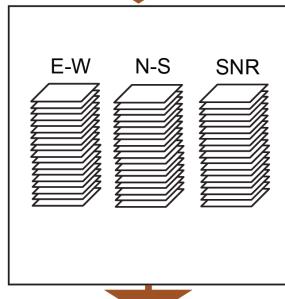
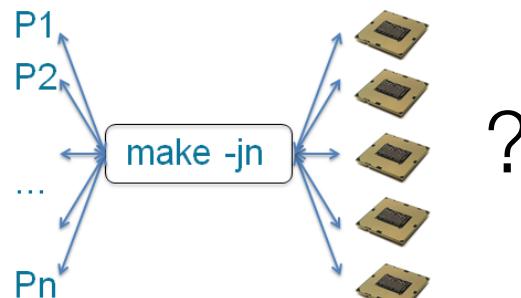
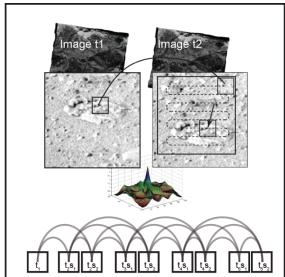
Focal coherence measures

- Port parts of the code from R to C/C++ (or Scala?)
- Enable tiling and distributed processing?



Technical development

- Integration



python™

R

C/C++

Diagram illustrating the calculation of VVC(i, j).

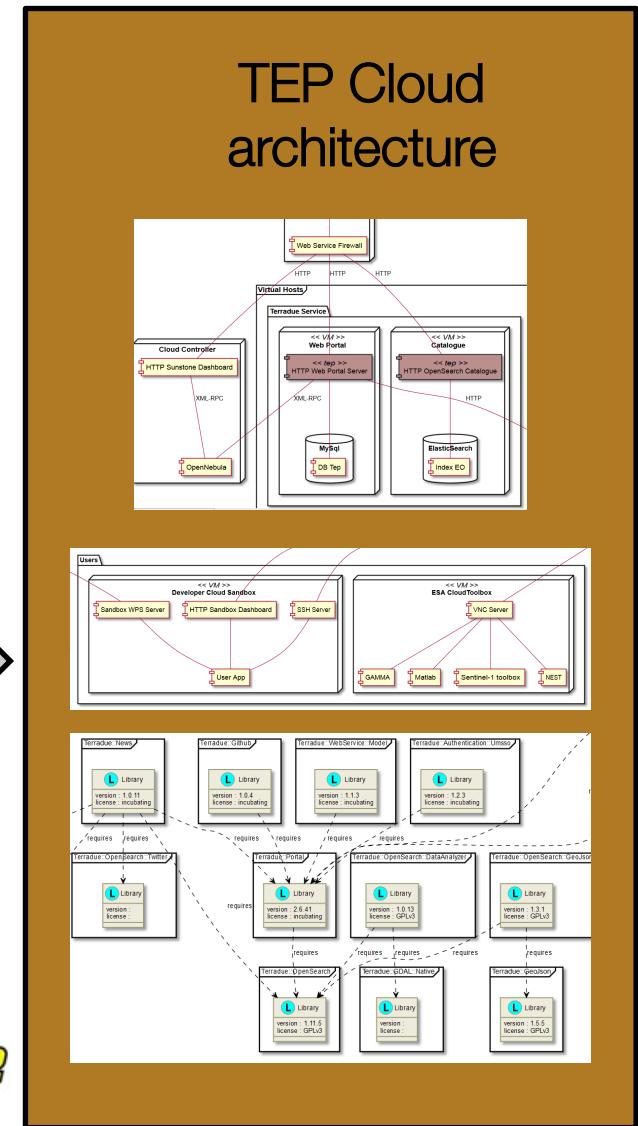
$$R_o = \frac{\max(\mu_{o1}, \mu_{o2})}{\min(\mu_{o1}, \mu_{o2})}$$

$$VVC(i, j) = \frac{||\sum_{t=1}^T \vec{V}(i, j, t)||}{\sum_{t=1}^T ||\vec{V}(i, j, t)||}$$

VS.

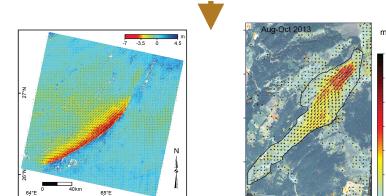
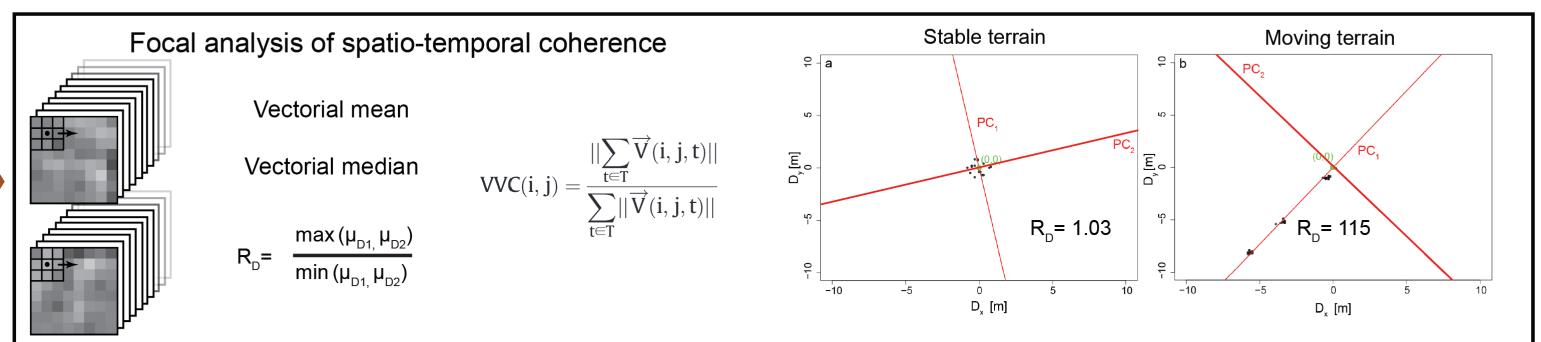
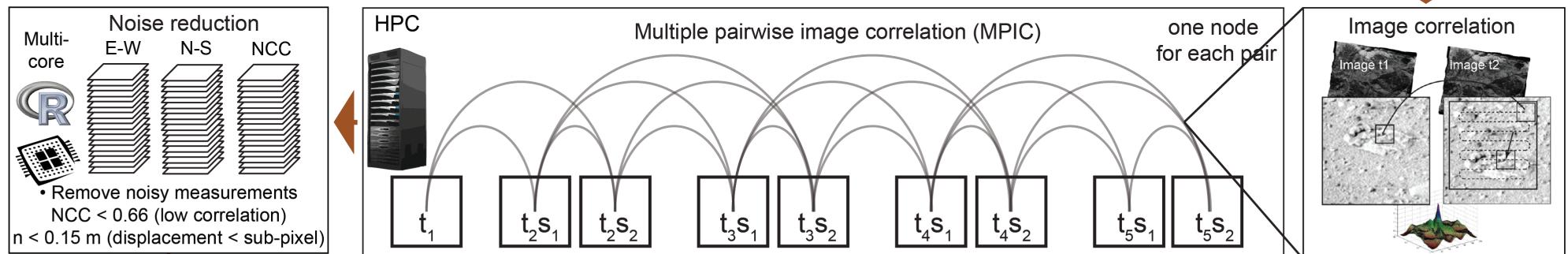
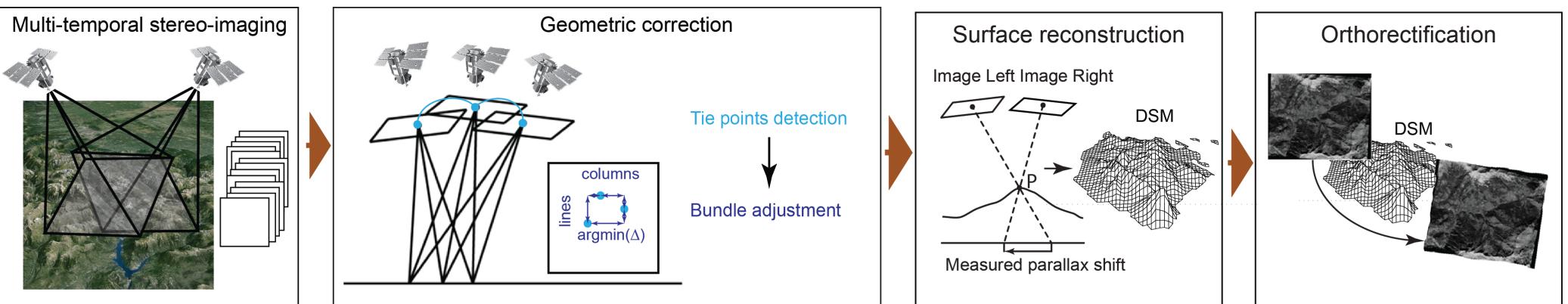
hadoop
mapReduce

Streaming?



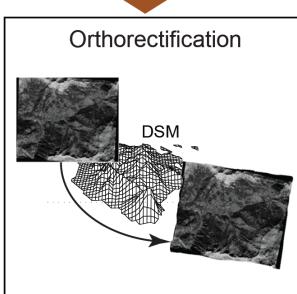
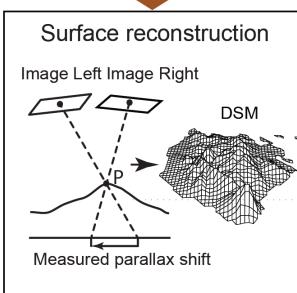
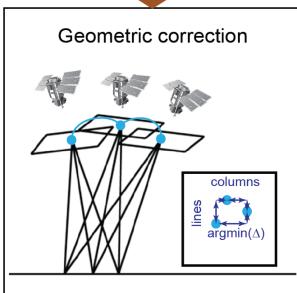
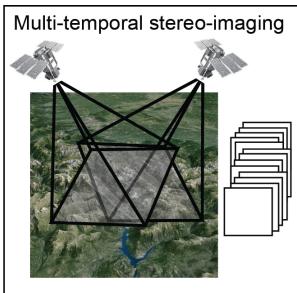
geohazards
tep

Extended processing chain



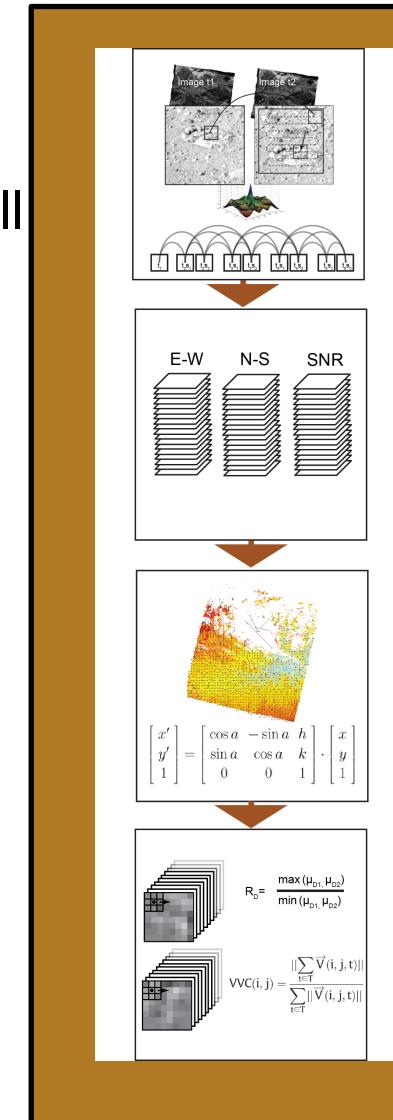
geohazards
tep

Technical development

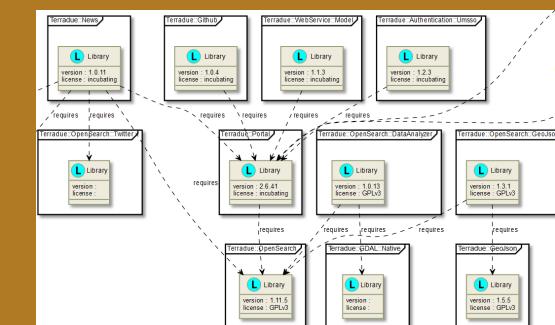
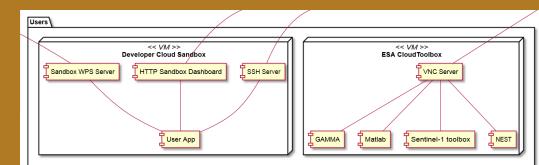
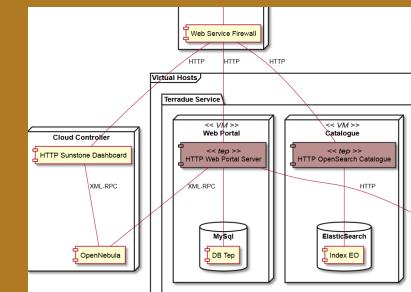


- Development in progress, collaboration IPGP / IGN / EOST (till June 2016)
- Integration into the TEP will start after

- Spatio-triangulation and bundle-adjustment
- DEM extraction
- Orthorectification



TEP Cloud architecture



geohazards
tep

Targeted user community

- Geophysics researcher working on tectonics, fault mechanics and earthquake hazard assessment (EOST, Univ. Cambridge)
- Geophysics researcher working on landslide mechanics and hazard assessment (EOST, Univ. Nice, Univ. Florence)
- State agencies such as geological surveys or watershed management authorities (RTM)
- Eventually everybody interested in high-resolution topographic data from VHR stereo satellite images



geohazards
tep

Validation sites and data

Earthquake

- **Balochistan earthquake 2013**

- validation against state-of-the art on S-2 like data > Landsat-8

- **Gorkha earthquake 2015**

- more challenging, recent event, S-2 like data > Landsat-8, Pléiades, WV-2 if available

- **Further sites for Phase 2b**

- sites of major events during the project > demonstrate rapid response capability
 - e.g. North Anatolian Fault (earthquake), North Apennines (large landslides), Afar Rift (Ethiopia, earthquake, dyking), Hinsdale county (Colorado, USA, large landslides)

Landslide

- **Southern French Alps**

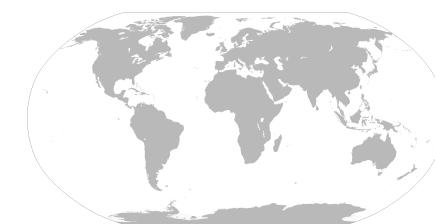
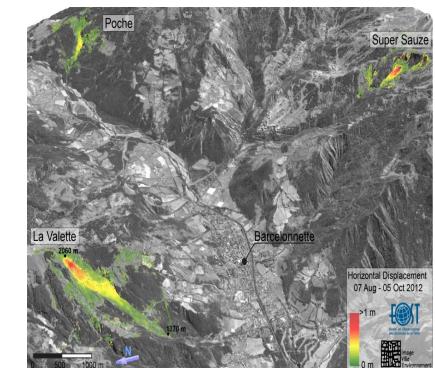
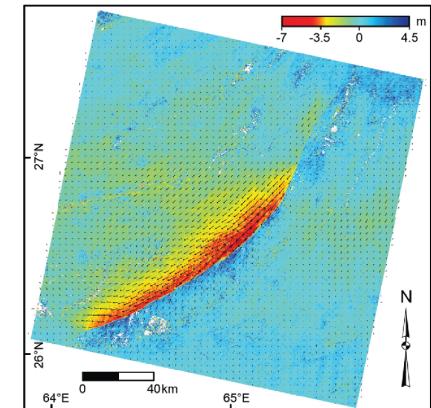
- validation site for landslides, Pléiades time series and ground truth already available, Sentinel-2, Spot 6/7



geohazards
tep

Deliverables

- D3.6.4 Optical data processing Pilot Project specification sheet (KO+4M)
- D5.5.4 Optical data processing Service Utility Report (KO+24M)
- D5.6.4 Optical data processing Pilot Project integrated service (KO+14M)
- D5.7.4 Optical data processing Pilot Project Terms and Conditions (KO+14M)
- D5.8.4 Optical data processing Pilot Project Operations Manual (KO+14M)



geohazards
tep