EGU General Assembly 2022

ARTEMIS: An operational tool to manage the information provided by Persistent Scatterers Monitoring at a regional scale

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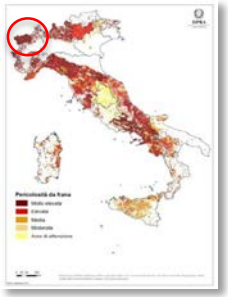
(1) Aosta Valley Geological Survey - Italy

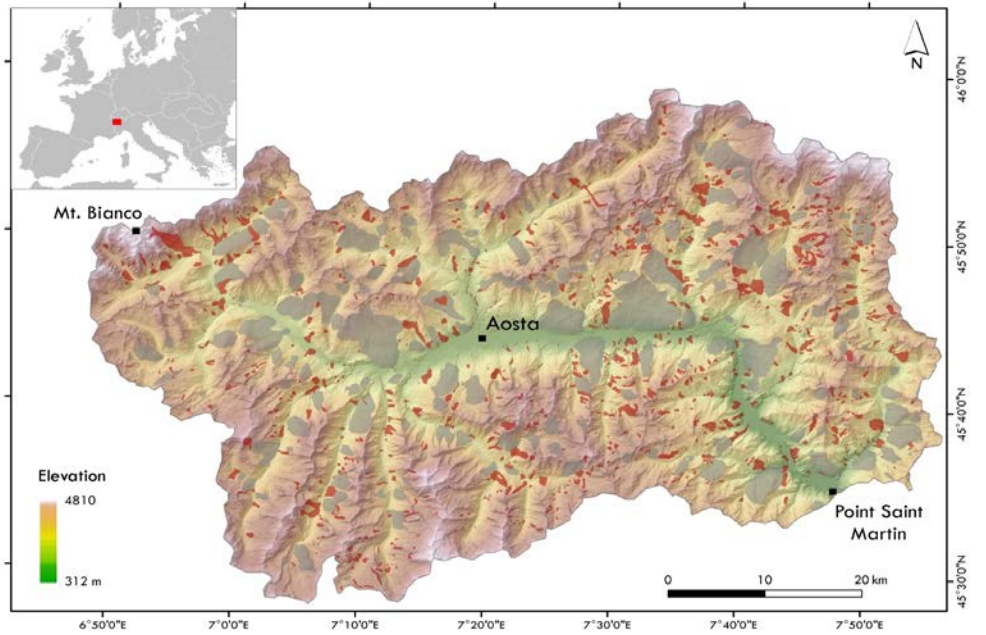
AOSTA VALLEY (VALLE D'AOSTA) LOCATION & FEATURES



SURFACE
3.262 km²
SMALLEST ITALIAN REGION

ONE OF THE HIGHEST LANDSLIDE SUSCEPTIBILITY IN ITALY AND UE
4.359 MAPPED LANDSLIDES

DISCONTINUOSLY MONITORED LANDSLIDES
10
LANDSLIDES MONITORED IN NEAR REAL TIME:
6



IMPORTANT COMMUNICATION AXES TO FRANCE AND SWITZERLAND
COST OF CLOSURE:
> 2M € PER DAY
(damage to the Italian economy calculated after Mt. Blanc Tunnel Fire of 1999)

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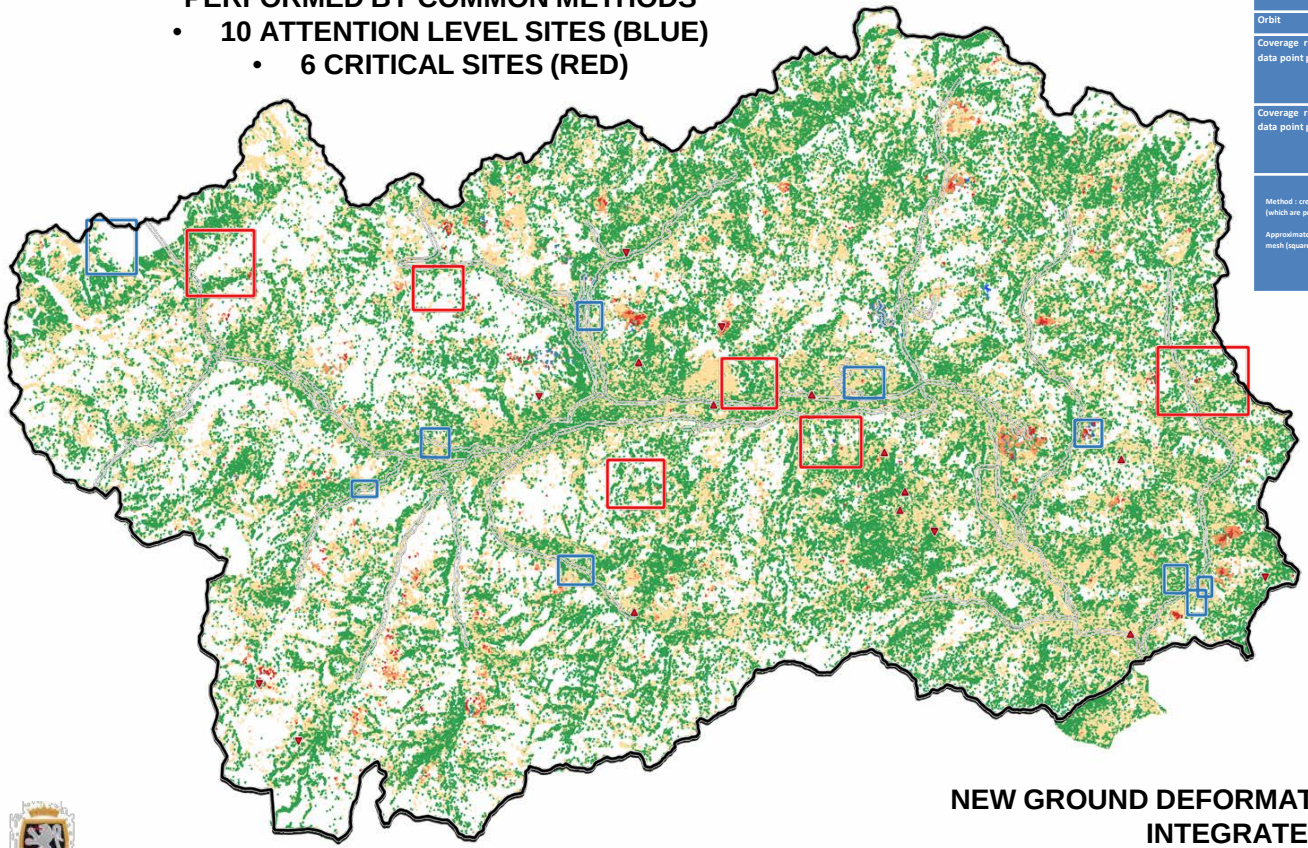
FORMER GROUND DEFORMATION MONITORING NETWORK PERFORMED BY COMMON METHODS

- 10 ATTENTION LEVEL SITES (BLUE)
- 6 CRITICAL SITES (RED)



VALLE D'AOSTA PSINSAR coverage rate (Sentinel-1) calculated for different grid sizes and minimum data point per grid mesh

Grid size (m)	200*200		300*300	
Orbit	Ascending	Descending	Ascending	Descending
Coverage rate with at least 1 data point per grid mesh (%)	87	91	93	98
Coverage rate with at least 3 data point per grid mesh (%)	64	67	69	73

Method : creation of a grid (hexagonal in this case) whose mesh size can vary and use of the function of counting points starting from the layer containing the PSInSar data (which are points) in order to establish a differentiation of meshes according to the number of data points they contain.

Approximate method for several reasons: as the PSInSar data are points, it is necessary to approximate a surface of their own via the size of the grid and the shape of the mesh (square, hexagons etc.). The choice of the number of data points that we consider is also decisive for the result.

NEW GROUND DEFORMATION MONITORING NETWORK INTEGRATED BY PS InSAR

- FIRST LEVEL NETWORK: REGIONAL InSAR COVERAGE
- SECOND LEVEL NETWORK: 10 ATTENTION LEVEL SITES

THIRD LEVEL NETWORK: 6 CRITICAL SITES

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PSInSAR MONITORING APPLICATIONS

	PS MAPPING	PS MONITORING
TYPOLOGY	Product	Service
TIME	Asyncronous	Near-real time
UPDATING	**Yearly/monthly**	**Avg. 12 days**
PURPOSE	• Hot-spot maps • Ground deformation inventories • Susceptiblity maps LAND MANAGEMENT AND PLANNING	• Monitoring • Forecast and prevention

NEW PROCEDURE

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ARTEMIS

- **A**DVANCED
- **R**EGIONAL
- **TE**RRAIN
- **M**OTION
- **I**NFORMATION
- **S**YSTEM

PS IsSAR SCREENING WORKFLOW

NO ACCELERATION

ACCELERATION

CONTINUOUS MONTORING 6/12 d

INVESTIGATION

FALSE POSITIVE

FURTHER INVESTIGATION

LEVEL 2 MONITORING

LEVEL 3 MONITORING

FOLLOW-UP

GEOLOGICAL MODELLING

STRUCTURAL REMEDIATION

ARTEMIS WORKFLOW DOMAIN

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PROCEDURAL STAGES – PHASE 1

PHASE 1	PHASE 2	PHASE 3	PHASE 4
REMOTE	REMOTE	FIELD	FIELD
ANOMALIES DETECTION	REMOTE VALIDATION	OPERATIVE VALIDATION	LEVEL UPSCALING

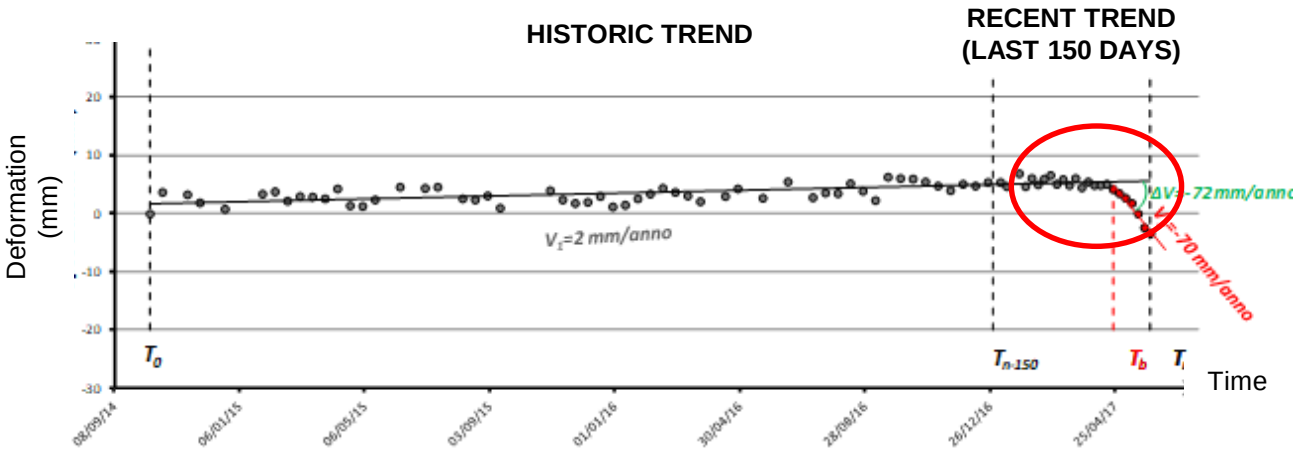
1. Automatic « trend breaking » identification. The service provider issues the layer including the accelerating PS, i.e. the so called « ANOMALIES »

TREND VARIATION THRESHOLD

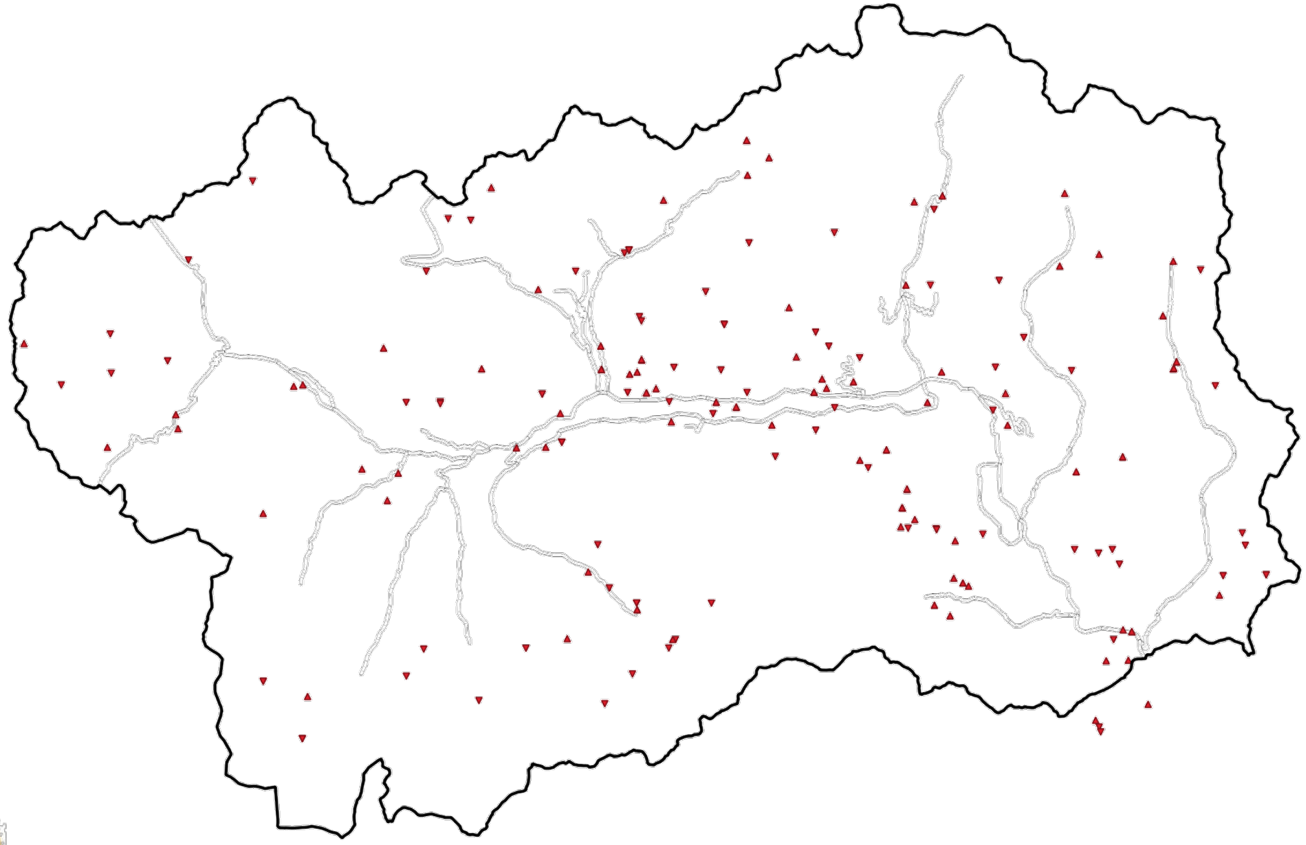
(REGIONAL CUSTOMIZED)

$\Delta V > 10$ mm/y

Deformation value calculated **on the last 150 days**



THE ANOMALIES ARE TOO MANY TO BE FIELD INDIVIDUALLY ANALYZED



EXAMPLE
JANUARY 2020

INCOMING PRODUCT:
ANOMALIES
AUTOMATICALLY DETECTED
ABOUT 200
(Ascending+Descending orbits)

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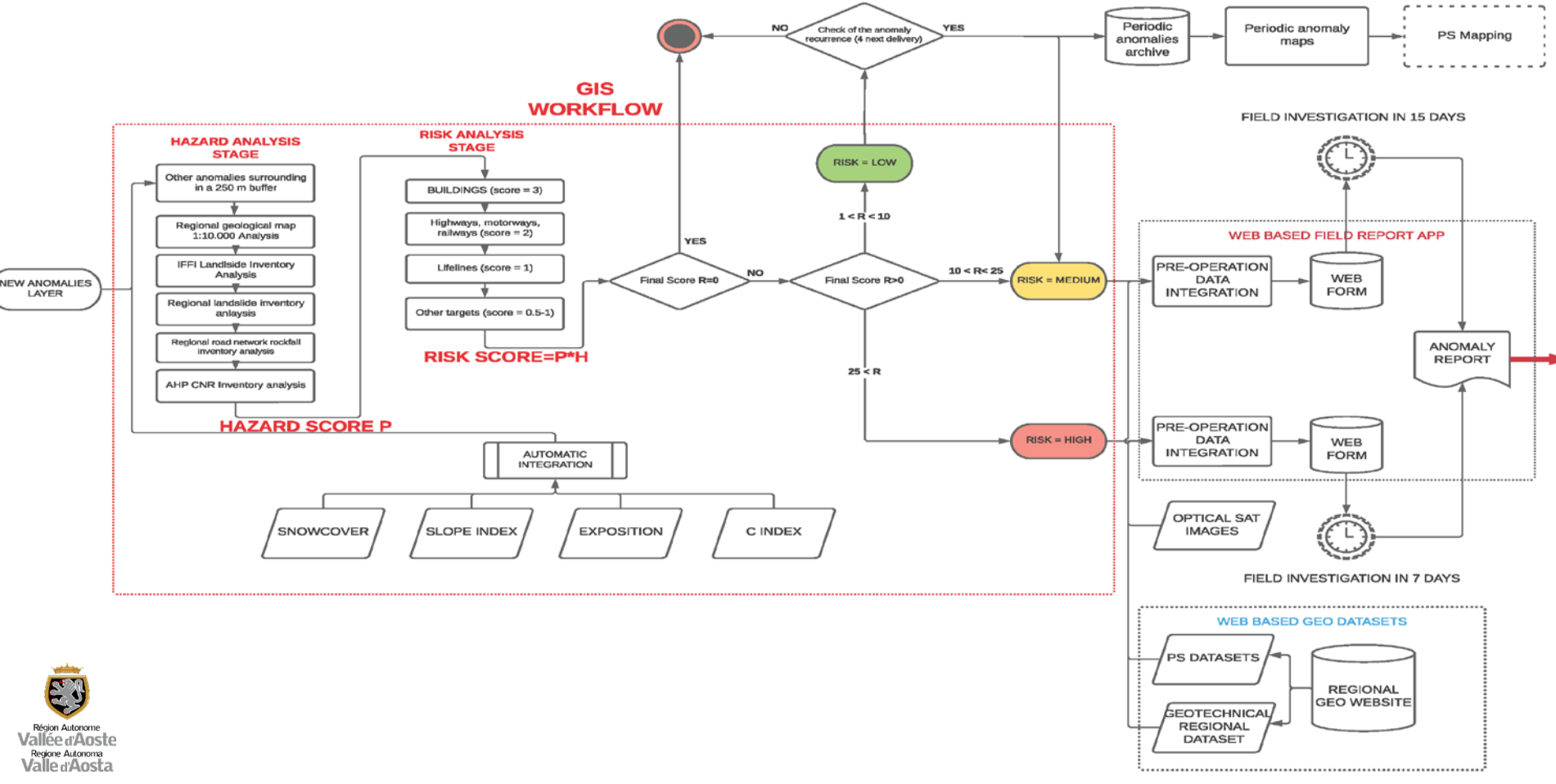
PROCEDURAL STAGES - PHASE 2

PHASE 1	PHASE 2	PHASE 3	PHASE 4
REMOTE	REMOTE	FIELD	FIELD
ANOMALIES DETECTION	**REMOTE VALIDATION (anomalies validation)**	OPERATIVE VALIDATION	EW CIVIL PROTECTION MONITORING

STEP 1: Control of potential alterations of the topographic surface (e.g.: by snow or human activity) by comparison with optical satellite images (Sentinel 2 and Planetscope) or ground images (webcams);
STEP 2: Data spatialization for phenomenon confirmation;
STEP 3: Comparison with PSInSAR data acquired from other satellites, if available, e.g.: Cosmoskymed;
STEP 4: Integration with database data:
- Detailed scale geological maps (1:10.000);
- Landslides National Inventory IFFI;
- Regional inventory of slope instabilities (includes also rockfalls and other);
- Study of susceptibility to rockfalls on regional roads.

STEP 5: Verification of the presence of **targets** (From Hazard to Risk);



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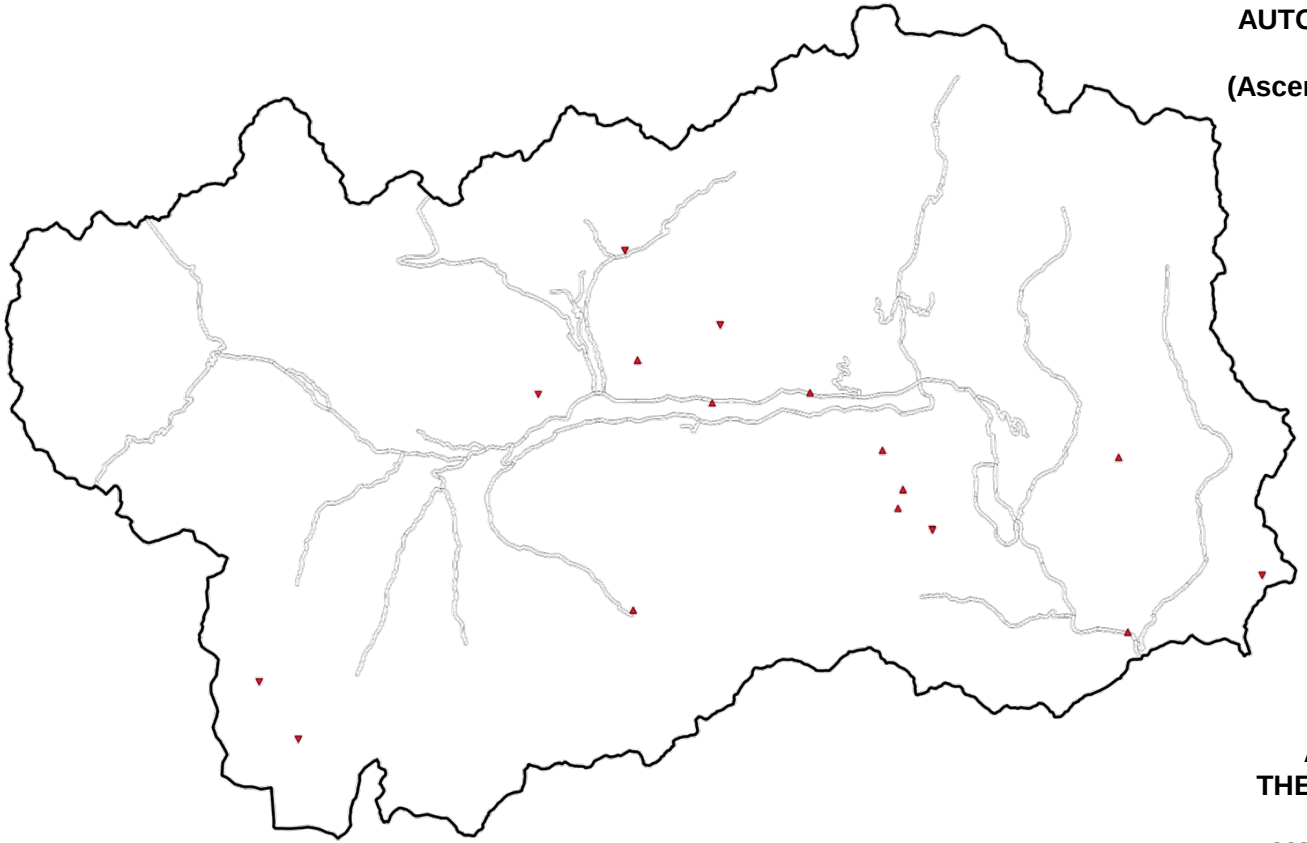
Automatic processing in GIS environment

ANOMALIES BEFORE AND AFTER VALIDATION/FILTERING

INCOMING PRODUCT:
ANOMALIES
AUTOMATICALLY DETECTED
ABOUT 200
(Ascending+Descending orbits)



ANOMALIES AFTER
THE APPLICATION OF THE
ARTEMIS
VALIDATION/FILTERING
PROCEDURE

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PROCEDURAL STAGES - PHASE 3

PHASE 1	PHASE 2	PHASE 3	PHASE 4
REMOTO	REMOTO	FIELD	FIELD
ANOMALIES DETECTION	REMOTE VALIDATION	**OPERATIVE VALIDATION**	EW CIVIL PROTECTION MONITORING

PHASE 3 is activated at the end of the automatic procedure, which provides THREE LEVELS OF PRIORITY OF ACTION, BASED ON RISK: LOW, MEDIUM, HIGH. Depending on the level of risk some actions are taken

LOW RISK: COMPARATIVE EVALUATION WITH FURTHER ANOMALY LAYERS
MEDIUM RISK OR HIGH RISK
FIRST : RISK MEDIUM → WITHIN 15 days since the output. HIGH RISK → within 7 days.

- *PRE-OPERATIONAL DATA INTEGRATION;*
- *FIELD INVESTIGATIONS (Deformation signs in the terrain or infrastructures, cracks, etc.);*
- *POSSIBLE DRONE/HELICOPTER SURVEYS;*
- *POSSIBLE RUNOUT AND EVENT SCENARIOS MODELLING.*

POSSIBLE INCLUSION IN THE LEVEL 2 NETWORK:

- ***Discontinuous instrumental on-site follow up (e.g.: GNSS, RTS, Inclinometers, strain gauges)****;*
- *If the targets are infrastructures owned and exploited by other bodies and/or companies: REPORT TO THE OWNER (Regional DOT, Hydropower companies, Motorways, Railway Companies, etc.);*
- *Possible upgrade to the 3rd level network should the follow-up higlights the need.*

HIGH PRIORITY– LEVEL 3 NETWORK INCLUSION

- ***CONTINUOUS EW*** *monitoring*
- ***GEOLOGICAL AND DETAIL RUNOUT MODELLING***
- ***CIVIL PROTECTION PLAN***

EACH ANOMALY IS REPORTED IN A MONOGRAPHIC WEB-BASED REPORT
TO KEEP RECORD OF WHAT TYPE OF ACTION HAS BEEN TAKEN

App | Sito ufficiale della R... | Cruscotto ATTGEO | Profilo utente | Can... | Geologia.VdA - Reg... | ReNDIS-web ISPRA

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Rilevazioni satellitari

HOME | DISSESTI | CANTIERI | PARERI | RECENTI | MAPPA | LOGOUT

Visualizza per Valore di Rischio

Comune	Località	Valore di rischio	Nome File	Codice	Data rilevazione
					-Giorno -Mese -Anno Applica

VENERDÌ, 12 FEBBRAIO, 2021

ASCE_2021_02_12.GEOJSON

TITOLO	COMUNE	LOCALITÀ	VALORE DI RISCHIO	ATTENDIBILITÀ/RILEVANZA
ASCE RILEVAZIONE COGNE - 12/02/2021	COGNE		0	
ASCE RILEVAZIONE ISSIME - 12/02/2021	ISSIME		6	
ASCE RILEVAZIONE GRESSONEY-SAINT-JEAN - 12/02/2021	GRESSONEY-SAINT-JEAN		12	
ASCE RILEVAZIONE BIONAZ - 12/02/2021	BIONAZ		0	
ASCE RILEVAZIONE SAINT-DENIS - 12/02/2021	SAINT-DENIS		0	
ASCE RILEVAZIONE LA SALLE - 12/02/2021	LA SALLE		33	
ASCE RILEVAZIONE SAINT-MARCEL - 12/02/2021	SAINT-MARCEL		21	
ASCE RILEVAZIONE GRESSONEY-SAINT-JEAN - 12/02/2021	GRESSONEY-SAINT-JEAN		0	
ASCE RILEVAZIONE AYMAVILLES - 12/02/2021	AYMAVILLES		21	

EACH ANOMALY IS REPORTED IN A MONOGRAPHIC WEB-BASED REPORT
TO KEEP RECORD OF WHAT TYPE OF ACTION HAS BEEN TAKEN

Mappa:

Comune: LA SALLE

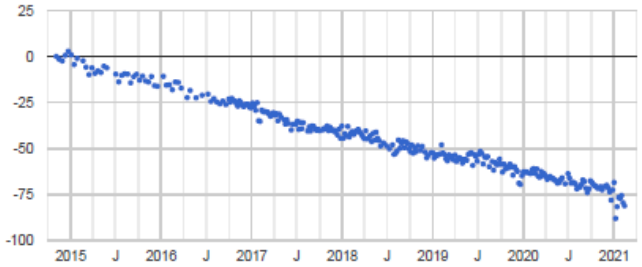
Località: Sconosciuta

LEGENDA

Anomalia orbita ASCE
Valori di rischio e priorità intervento

0.0 - 1.0 / nessuna priorità
1.0 - 10.0 / priorità bassa
10.0 - 20.0 / priorità media
20.0 - 100.0 / priorità alta

CODE	NEVE	cindasce	esposizion	pendenze	#ASCE
EEL1LXD	0	0.785	32	37.4	1



Note:

Note:

CODE	p_spazio	p_geo	p_geo2	p_geo3	p_geo4	p_IFFI	p_DGPV	p_CATDISS	p_DISS_p	p_ROSI	p_STRADE	p_EDIFICI	p_GAS	p_ELETTRIC	p_FUNIVIE	p_SEGGIOVI
EEL1LXD	0	0	2	1	0	0	0	0	0	1	2	3	0	1	0	0

FIELD INVESTIGATION ADDS TO THE REPORT THE FIELD DATA TO SUPPORT FURTHER ACTIONS

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Crea Scheda sopralluogo

☰ Menu

Titolo *

Rilevazione satellitare *

- Selezionare un valore -

Dati rilevazione associata

Comune

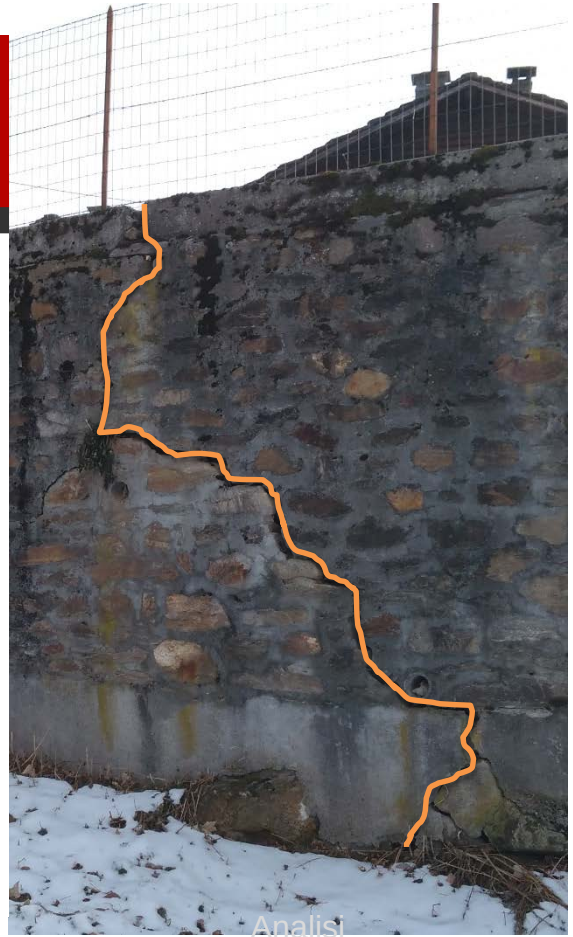
Località

Codice punto

Data rilevazione

Valore di rischio

Salva | Anteprima



Dati sopralluogo

Rilevatore

- Nessuno -

Data sopralluogo

05/03/2021

Formato: 05/03/2021

Ricorrente *

No

Tipologia di elementi a rischio

- [x] Puntuale
- [ ] Lineare
- [ ] Areale

Elemento a rischio

Distanza elemento a rischio (m)

Deformazioni elementi antropici

- [ ] Strade
- [ ] Muri
- [ ] Recinzioni

Salva | Anteprima

remote sensing

MDPI

Technical Note

Integration of Satellite Interferometric Data in Civil Protection Strategies for Landslide Studies at a Regional Scale

Silvia Bianchini [1,*], Lorenzo Solari [2], Davide Bertolo [3], Patrick Thuegaz [3] and Filippo Catani [4]

Level 1	Level 2	Level 3
Regional Near-real time + Deferred time	Local Near-real time	Local Real Time
Remote sensing	Remote sensing + on site discontinuous	on site continuous
12 days + twice/year	12 days + periodic update	continuous
• PSI («PS mapping» + «PS monitoring»)	• PSI anomalies («PS monitoring») • GNSS discontinuous • GBInSAR discontinuos • Inclinometers • RTS	• GNSS continuous • GBInSAR continuous • GPS • DMS • RTS
• Preliminary screening (new deformations and acceleration of existing phenomena) • Environmental planning	• Investigation of potentially critical situations • Validation of data from Level 1 • Potential upgrade to level 3	• Alert and monitoring • Civil Protection
Phase 1: Identification of PSI clusters Phase 2: Remote double check + On-site control validation	Definition of further monitoring and/or remediation activities	Specific hazardous sites under continuous early warning monitoring

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A SHORT SYNTHESIS

WE ARE IMPLEMENTING A LANDSLIDE- HAZARD SCREENING TOOL;

AS ANY SCREENING TOOL (SEE MEDICINE), IT IS:

- ➢LOW COST;
- ➢PRODUCES FALSE POSITIVES ═► FILTERING PROCEDURE
- ➢SOME SLOPES ARE NOT COVERED ═►TRADITIONAL MONITORING/BETTER ALLOCATION OF RESOURCES
- ➢PHENOMENA WITH EVOLUTION FASTER THAN 800mm/Y ═►NOT BEING MONITORED

AN ACCURATE INTERPRETATIONE NEEDS:

- ➢SITE/REGION KNOWLEDGE OF SITE/REGIONAL GEOLOGY AND (IN SOME CASES) GROUND CALIBRATION
- ➢ A PLATFORM OR A SISTEM TO GATHER ALL THE DATA (OPTICAL SATELLITE, INVENTORIES, SUBSURFACE, IN ORDER TO SPEED THE EVALUATIONS BEFORE ACTIVATING THE FIELD SURVEYS WHICH COULD PROVE TO BE USELESS;

THANK YOU !

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