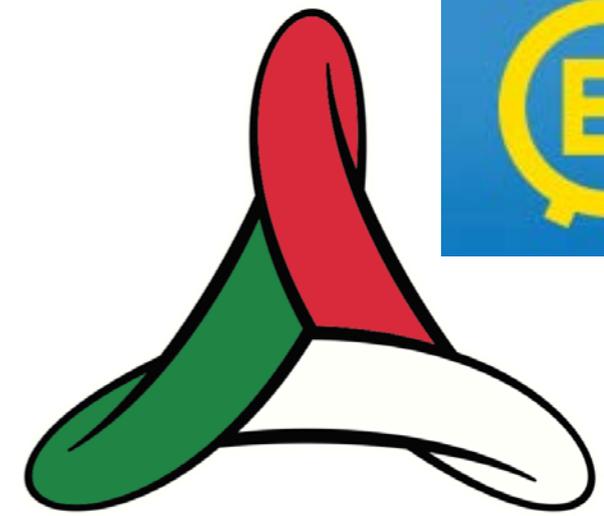




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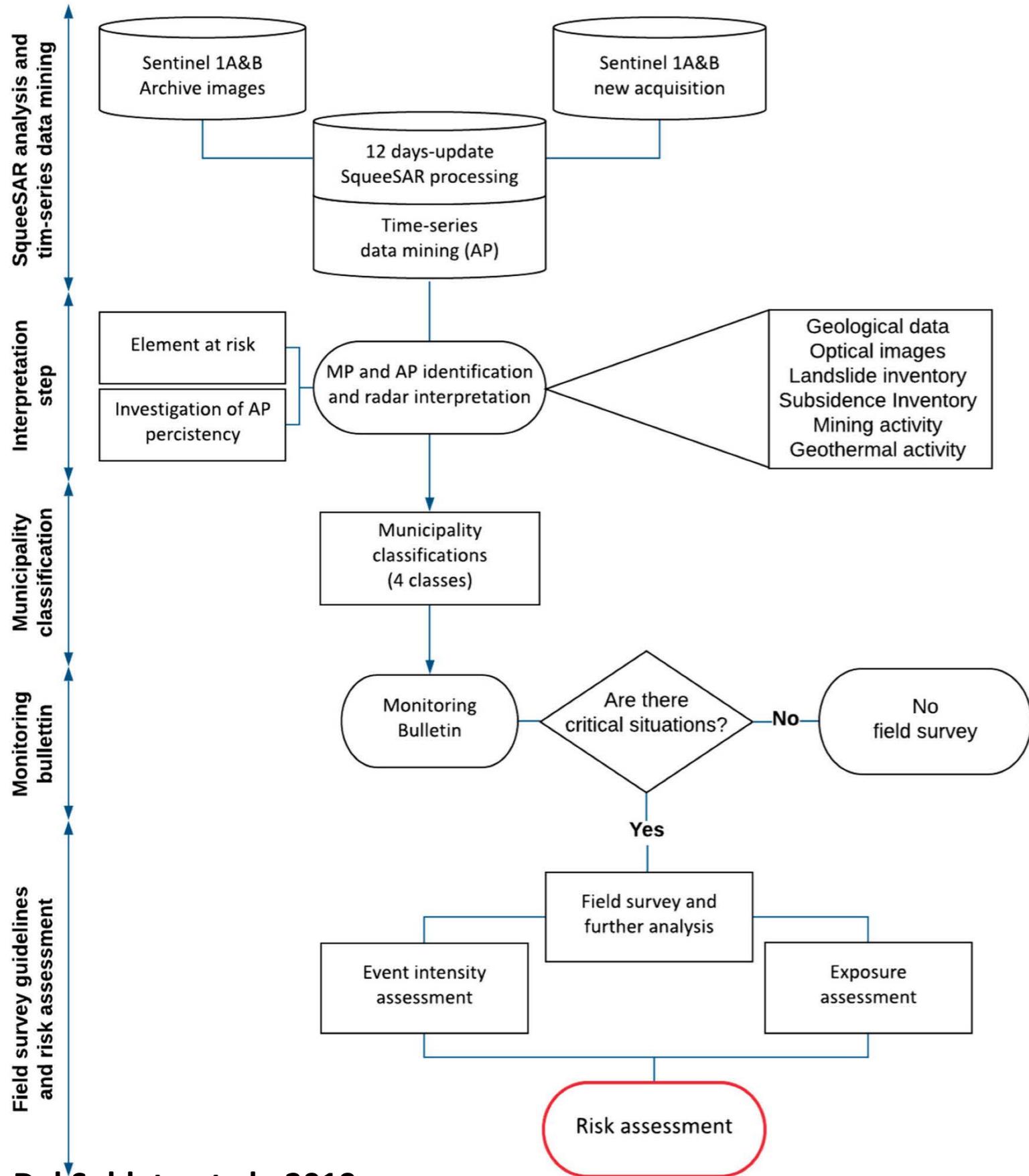
How to manage a monitoring service
based on satellite interferometry: a
practical approach from the Tuscany
region (central Italy)

Matteo Del Soldato

Introduction

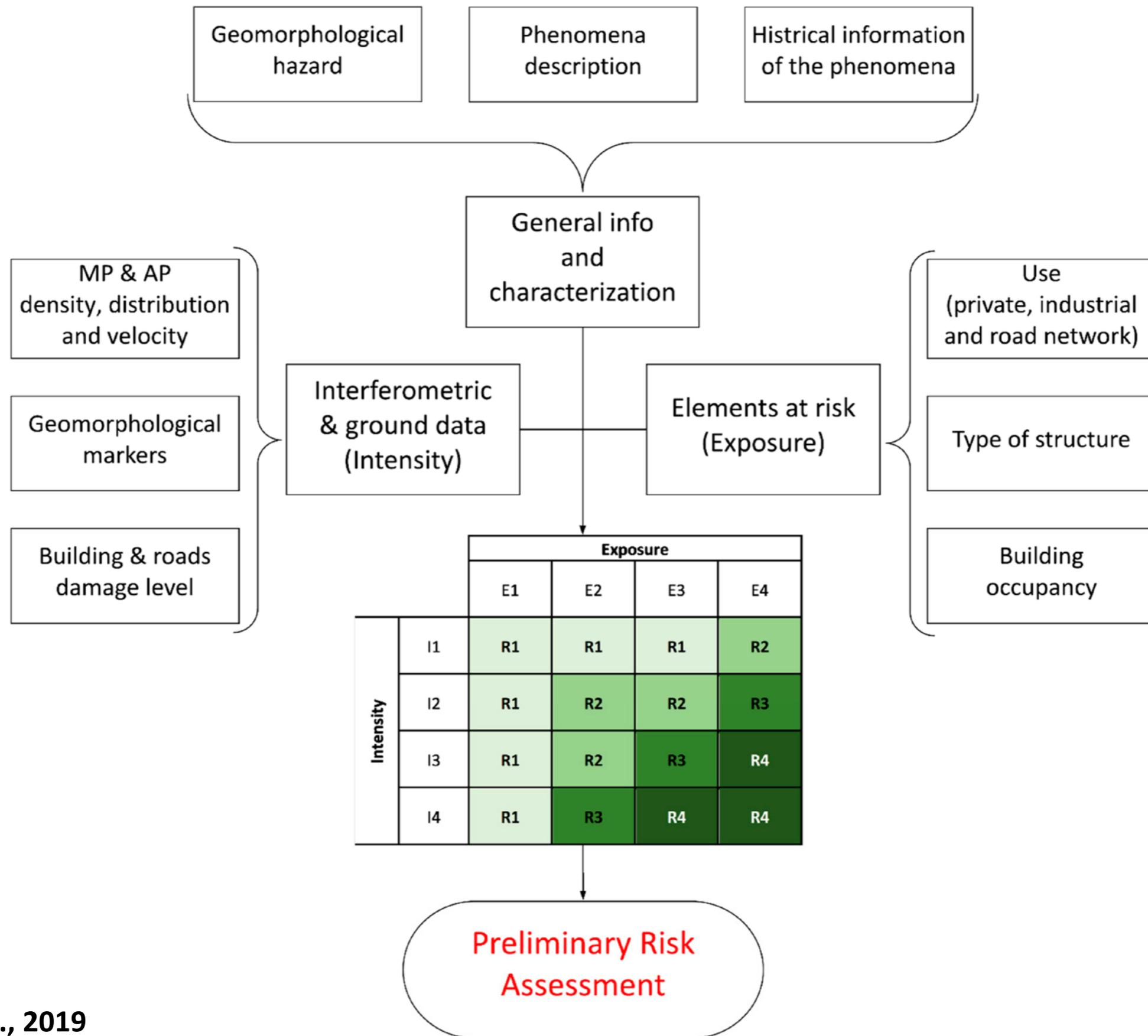
- Systematic and regular acquisition of Sentinel-1 constellation (Sentinel-1A & 1B) by ESA (European Space Agency)
- Knowledge and monitoring ground deformations over wide area (e.g., Tuscany Region)
- Tool to manage and avoid further damaging events
- Knowledge of detailed information on relevant moving areas by a repeatable scheme
- Identification of relevant situation and performing more detailed analyses and/or field surveys
- Address findings to more relevant situations

Methodology



PRELIMINARY RISK ASSESSMENT				
<i>General information</i>				
Date			<i>Historical Information</i>	
Municipality		Geohazard inventory	Y	N
Address		Geomorphological Hazard	NO	LOW
Framework ⁽¹⁾			MED	HIGH
AP cause ⁽²⁾		Previous field survey	Y	N
Coordinates		Notes		
Surveyor				
<i>Intensity</i>				
MP Density		Building Cracks	Y	N
MP ascending velocity		Crack dimension	< 3mm	> 3mm
MP descending velocity		Crack extension		
AP distribution		Ground fissure	Y	N
AP magnitude		Geomorphological markers ⁽³⁾		
	I1	I2	I3	I4
<i>Exposure</i>				
Structures		Inhabitants	< 25	> 25
Infrastructure		Strategic	Y	N
Geothermal area	Y	N	Type ⁽⁴⁾	
Hydraulic work	Y	N	Type ⁽⁵⁾	
Quarry site	Y	N	Type ⁽⁶⁾	
Notes				
	E1	E2	E3	E4
<i>Risk and related suggestions</i>				
R1	No particular precautions have to be taken.			
R2	Systematic field survey Annual to monthly ground-base manual monitoring (e.g. extensiometer and crackmeter) Soil bioengineering countermeasures for restoration of land effects			
R3	Systematic field survey Weekly to daily ground-base manual monitoring (e.g. inclinometer, piezometer, rain gauge) Environmental engineering countermeasures for restoration of land effects Detailed studies			
R4	Systematic field survey Continuous ground-base monitoring (e.g. GB-InSAR, GPS topographical monitoring) Environmental engineering countermeasures for restoration of land effects Detailed studies			
Observations (if other):				

Preliminary risk assessment



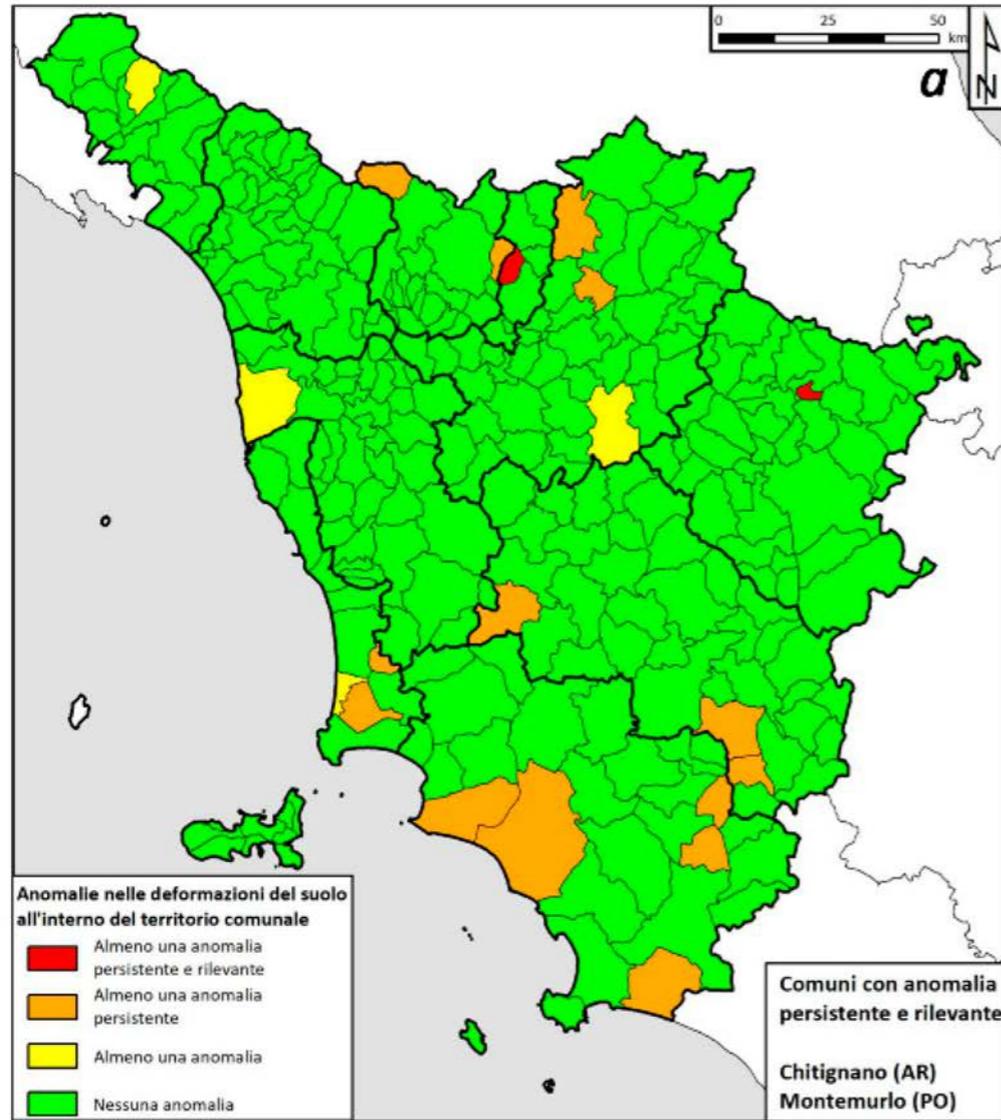
Bullettin



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DST
DIPARTIMENTO DI
SCIENZE DELLA TERRA
CENTRO DI COMPETENZA DEL
SERVIZIO NAZIONALE DELLA
PROTEZIONE CIVILE

BOLLETTINO DI MONITORAGGIO RADAR SATELLITARE DELLE DEFORMAZIONI DEL
TERRENO DELLA REGIONE TOSCANA



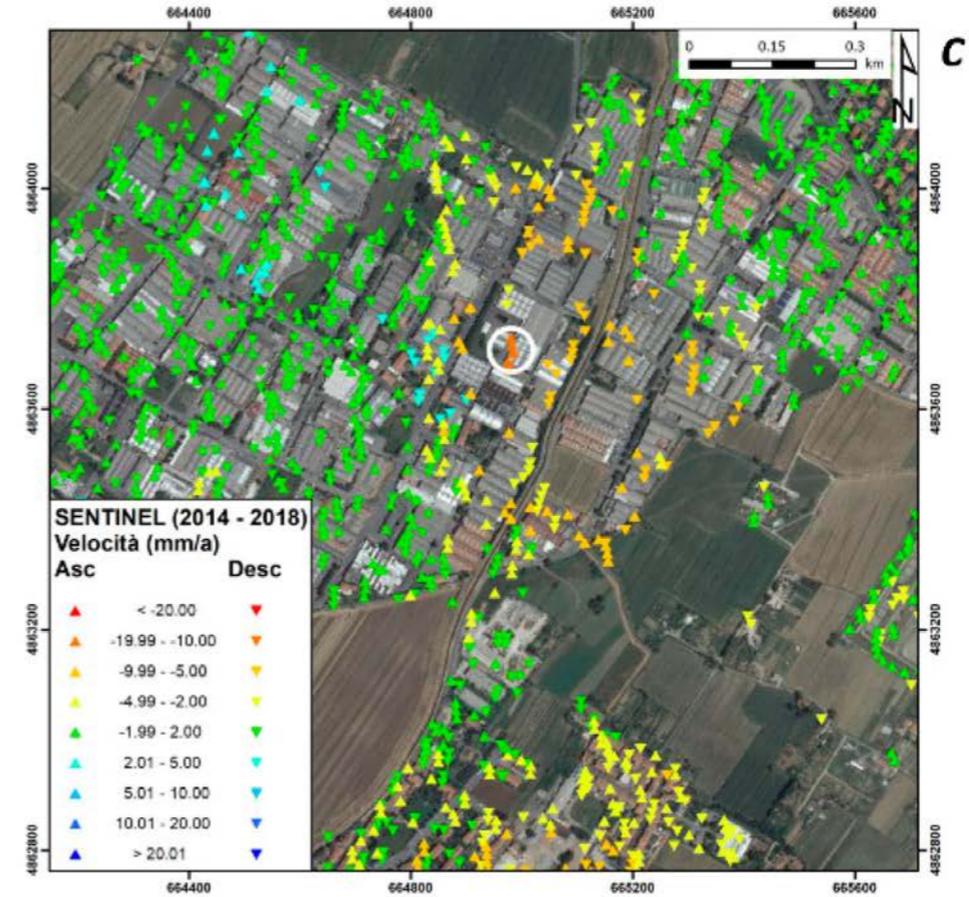
Monitoring bulletin

1	No anomalous points
2	At least one anomalous point
3	At least one persistent anomalous point
4	At least one persistent and relevant anomalous point

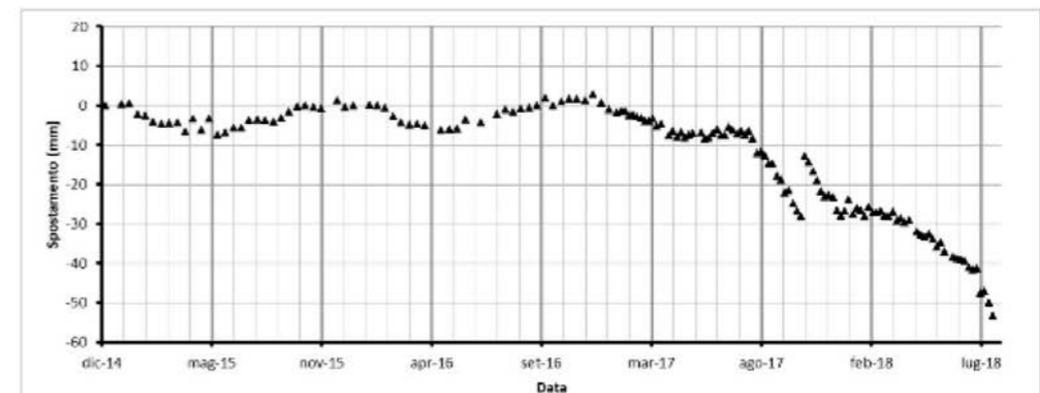
Montemurlo (Prato)

Provincia	Comune	Località	Coordinate (WGS 1984 UTM Zona 32N)	Elemento a rischio	Causa	Persistenza
Prato	Montemurlo	Bagnolo	664981 E 4863716 N	Centri abitati, nuclei abitati e case sparse	Subsidenza	17° e 18° aggiornamento

b



Deformation map



Time-series

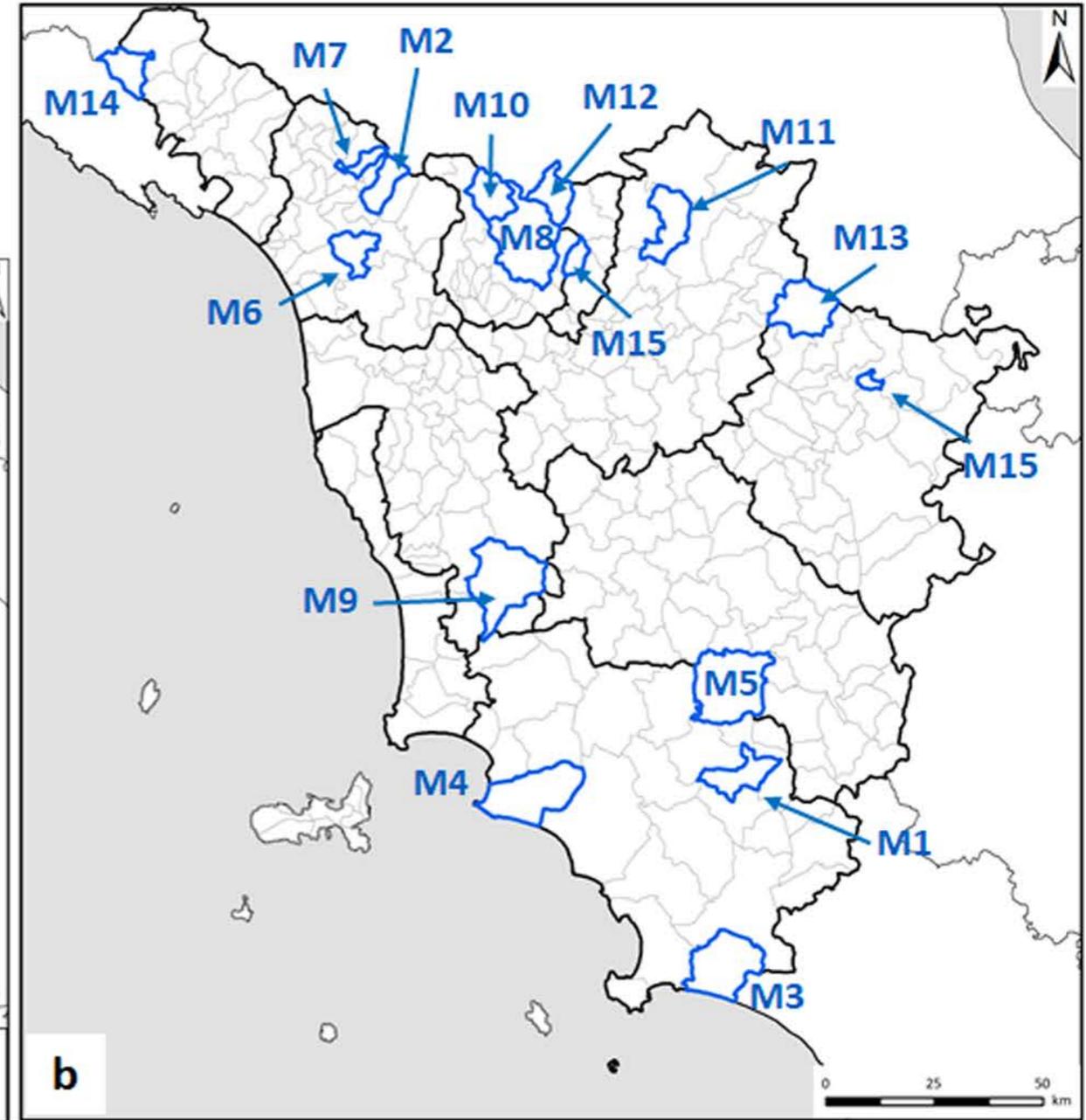
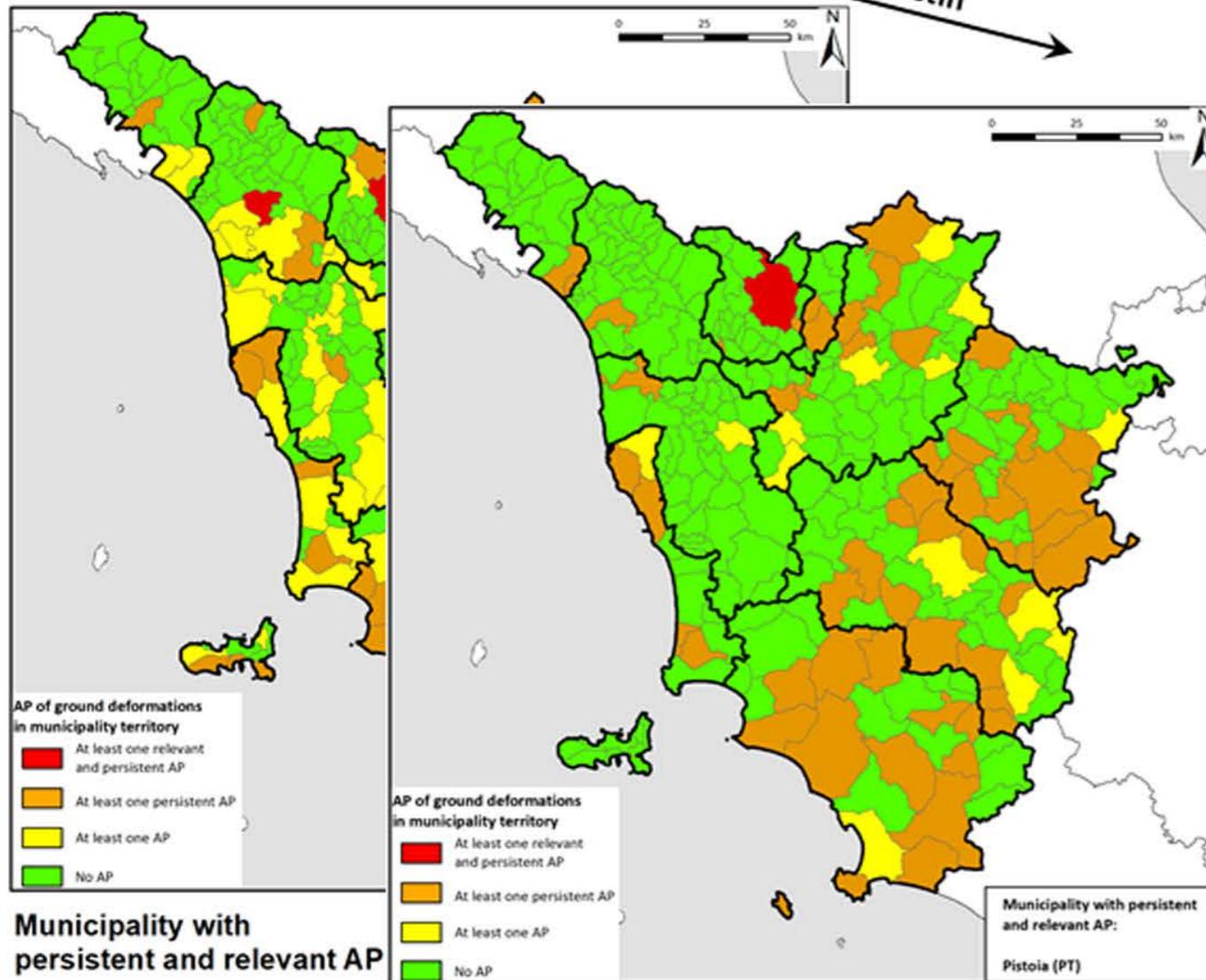
d

Continuous monitoring and highlighted municipalities

Del Soldato et al., 2019

a

12-days monitoring bulletin



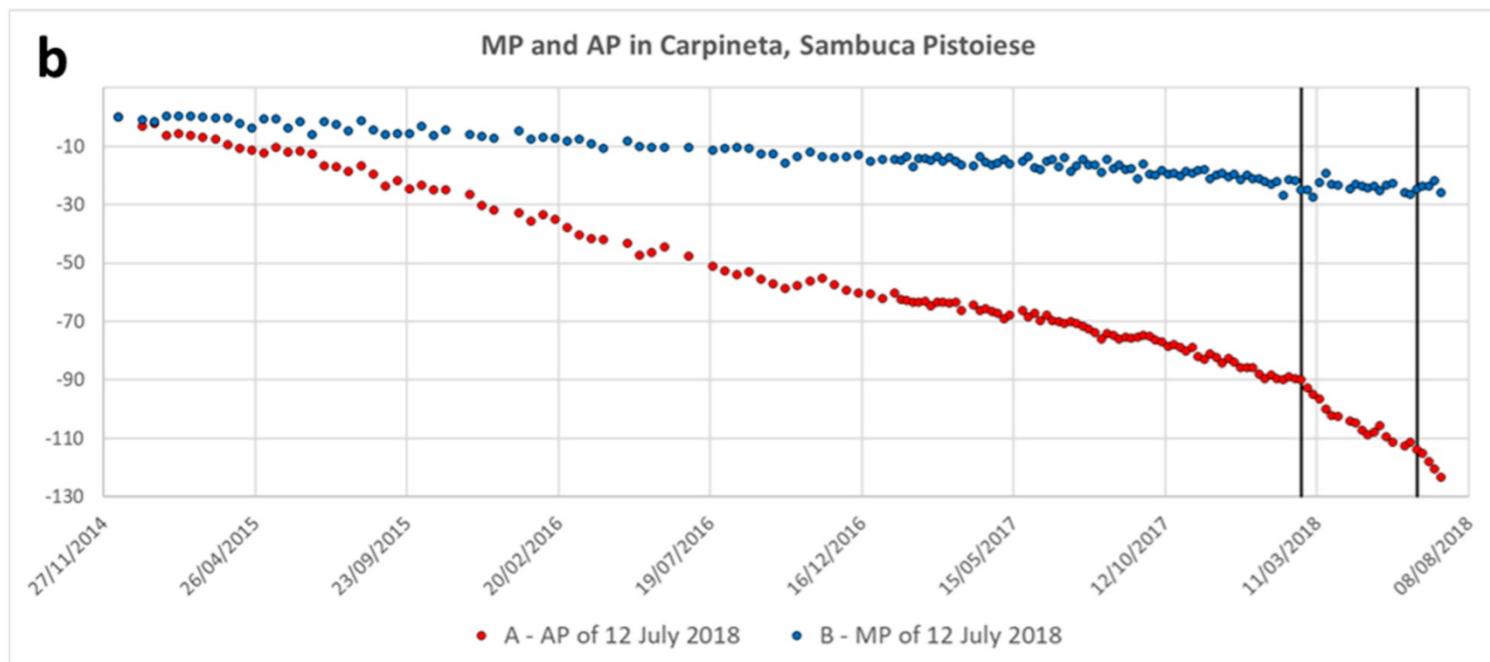
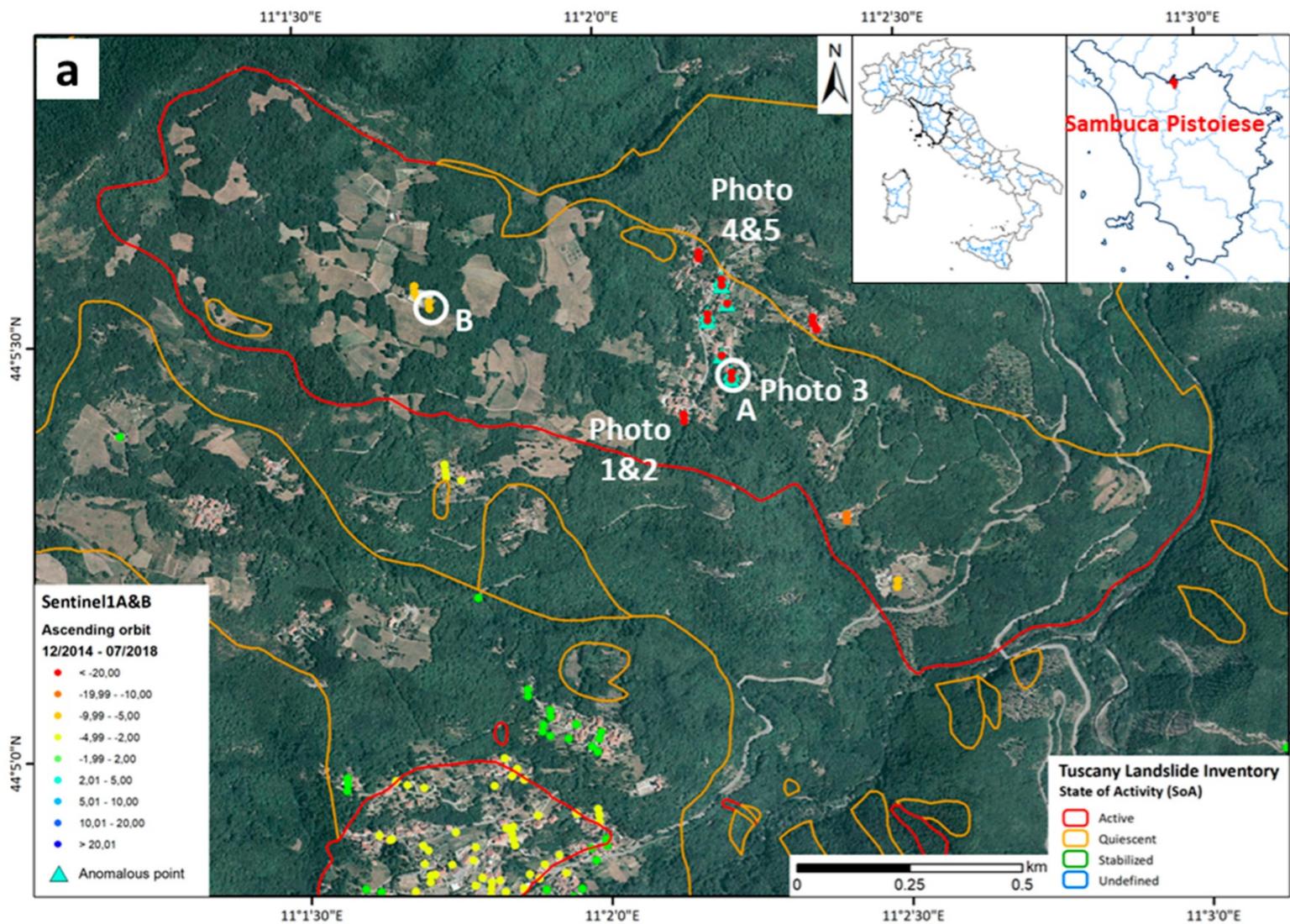
- M1 Arcidosso
- M2 Barga
- M3 Capalbio
- M4 Castiglione della Pescaia

- M5 Montalcino
- M6 Pescaglia
- M7 Pieve Fosciana
- M8 Pistoia

- M9 Pomarance
- M10 San Marcello Pistoiese
- M11 Scarperia e San Piero
- M12 Sambuca Pistoiese

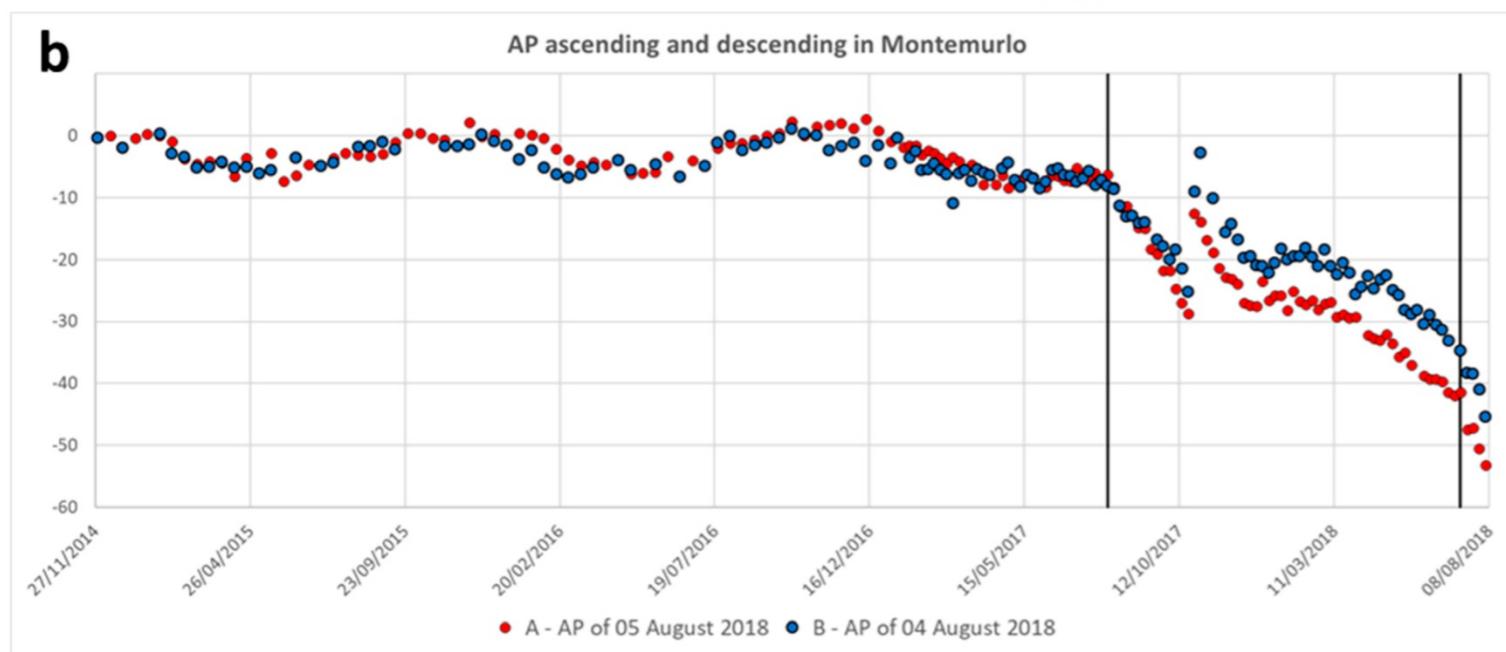
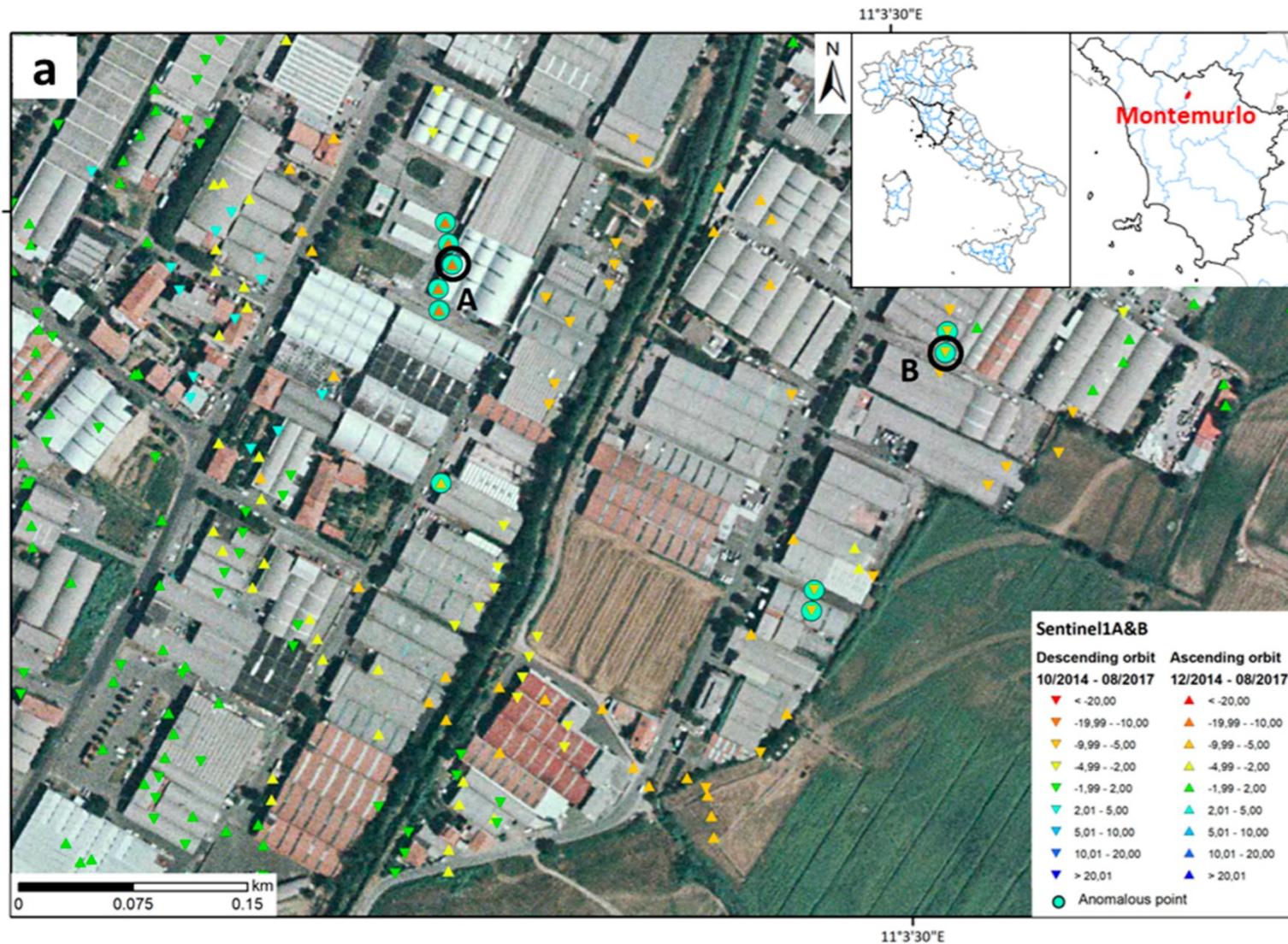
- M13 Pratovecchio Stia
- M14 Zeri
- M15 Chitignano
- M16 Montemurlo

Landslide example



- “Medium” intensity (I3)
- “Medium” exposure of the elements at risk (E3)
- **Preliminary Risk class 3 (“Medium Risk”)**

Subsidence example



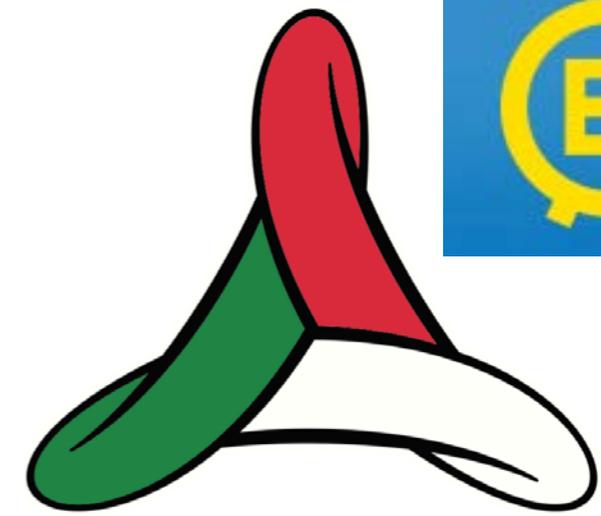
- “High” intensity (I4)
- “High” exposure of the elements at risk (E4)
- Preliminary Risk class 4 (“High Risk”)

Time & people requirements

Step	Activity	Number of Needed People	Time (days)											
			0	1	2	3	4	5	6	7	8	9		
0	S-1 images acquisition (ascending and descending)		█											
0	S-1 images on the Copernicus Open Hub ESA		█											
3.1	Download S-1 images	Auto		█										
3.1	Processing of data by SqueeSAR technique (MP)	3			█	█	█							
3.1	APs detection	2			█	█								
3.2	Interpretation of causes and persistence of APs	4						█	█	█				
3.3	Municipality classification	1									█	█		
3.4	Dissemination to authorities in charge	1										█		
3.5	Field survey and preliminary risk assessment	2											█	█



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Thank you

 International Journal of
Geo-Information



Del Soldato M., Solari L., Raspini F., Bianchini S., Ciampalini A.,
Montalti R., Ferretti A., Pellegrineschi V. & Casagli, N. (2019)
Monitoring Ground Instabilities Using SAR Satellite Data: A
Practical Approach.

ISPRS International Journal of Geo-Information, 8(7), 307.

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