



NextData



SPECIAL PROJECT PP5

HAMMER

Relationships between meteo-climatic parameters and ground surface deformation time series in mountain environments

**F. Ardizzone, P. Allasia, M. Cignetti, D. Giordan,
A. Manconi, M. Manunta**

Consiglio Nazionale delle Ricerche, Istituto di Ricerca per la Protezione Idrogeologica
Consiglio Nazionale delle Ricerche, Istituto di Ricerca per il Rilevamento Elettromagnetico dell'Ambiente



NextData



OUTLINE

- Project introduction
- Motivation and main objectives
- Expected results
- Project organization and activity
- Project state of art



NextData



INTRODUCTION

Topic 5: **Reconstruction** of ground surface deformation **time series** in test areas in **mountain environments**, and **correlation** to **rainfall time series** and **implementation** of the data and results in **digital archives** compatible with the **NextData project archives**

Duration: **21 months** from **January 2014** to **September 2015**

Participating units: (1) **IRPI-CNR** and (2) **IREA-CNR**

Coordinating unit: **IRPI-CNR**

Scientific coordinator: Francesca Ardizzone, **IRPI-CNR**



NextData



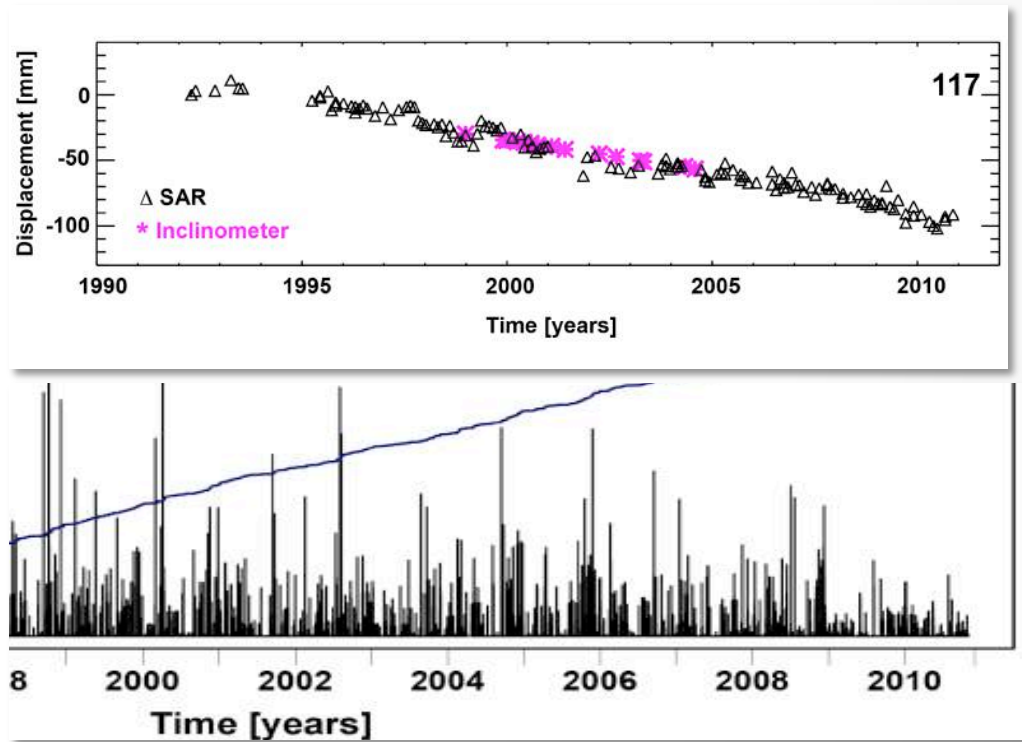
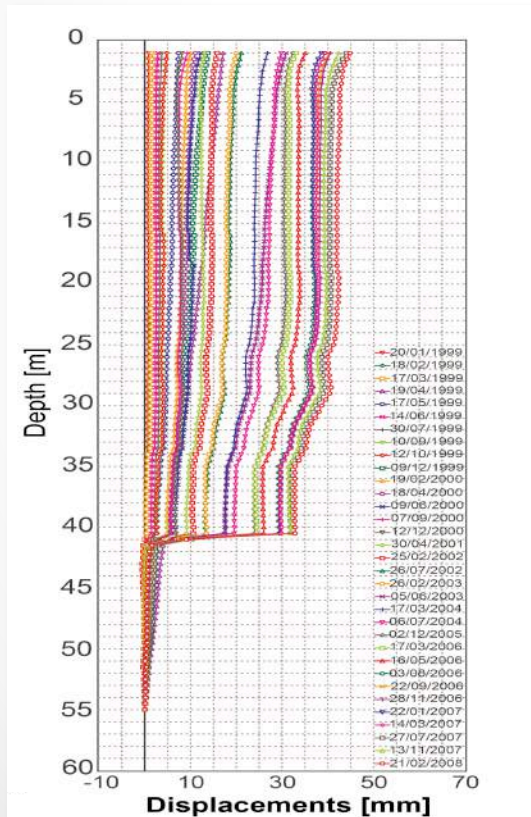
MOTIVATION

Natural and human-driven **climatic** and environmental **changes** can **alter** the **frequency** and the **intensity** of the **slope processes** in mountain areas, with **unknown** short and long-term **effects** on the **landscapes**

There is a **lack** of **information** on the **effects** of climate and environmental **changes** on the **frequency** and the **intensity** of **landslides** and their **triggering phenomena**

MAIN OBJECTIVES

HAMMER intends to **deal with** this gap by **collecting** time series of **ground deformations**, and associated times series of **meteorological** and **climatic measurements**



From: Calò *et al.*, 2014



MAIN OBJECTIVES

Collect time series of **surface** and **sub-surface** ground deformations including ***in situ*** and **DInSAR** measurements **in landslide areas** in the **Alps**, the **Apennines**, the **Pyrenees** and the **Andes**

Collect time series of **meteorological parameters** for the **same** areas

Demonstrate the capability of **DInSAR** techniques to provide **multi-decadal** time series of **ground deformations** in different **physiographical** and **climatic** environments

Attempt statistical **correlations between time series of meteorological parameters and** time series of the ground deformations, for selected test sites



NextData



EXPECTED RESULTS

Review of the **scientific** and **technical literature** to determine **where** quantitative **surface** and **sub-surface** information on ground deformations and for **which periods**

Combined time series of **meteorological parameters**, surface and/or sub-surface **ground deformations** including the products of **SAR data** and **in situ** measurements

Results of the statistical **cross-correlations** of the time series for the **selected test sites** including the **assessment** of their **reliability** and an **interpretation** of the results



NextData



ORGANIZATION

STEPS:

- **Analysing** and **comparing** displacement vs. meteorological parameters using **available data** obtained by **in situ** monitoring techniques, such as Total Stations, GPS receivers, inclinometers, and by **remote sensing** techniques, such as **advanced DInSAR**
- **Producing** ground **displacement** time series for **new sites**, exploiting **SAR images**, where the **findings** of the **previous** step will be **applied**



ORGANIZATION

Work Packages(WPs):

- **WP1** available time series **collection** and **analysis** includes four **tasks** (UNIT 1):
 1. collection of **ground deformation** time series, **deliverables** 1 (month 7) and 2 (month 10)
 2. collection of **meteorological/climate** time series, **deliverable** 2 (month 10)
 3. the **statistical correlation** of the time series **deliverable** 5 (month 19)
 4. the **implementation** of a **database** for the storage of the time series **deliverable** 4 (month 12)
- **WP2** production of new time series exploiting **ERS1/2** and **ENVISAT** satellite images in some selected study areas to be included in the task 1.1 (UNIT 2)



WP1 ACTIVITY

TASK 1

- i. Collection and organization of **surface** and **sub-surface deformation time series** available to **Unit 1** for the **Alps** and the **Apennines** (months: from 1 to 7)
- ii. Collection and organization of **ground deformation DInSAR** time series already processed for the **Apennines**, **Andes** and **Pyrenees** (months: from 1 tot 10) and inclusion of the **new products** obtained by the **new** acquired **SAR images** (months: from 14 to 17)
- iii. Search of the surface **deformation** information **available** through the **Piano di Straordinario Telerilevamento Ambientale** for selected study areas in the **Alps** and the **Apennines** and through a **literature review** (months: from 2 to 14)

WP1 ACTIVITY

TASK 2

- i. Selection of relevant **meteorological stations** (month 3)
- ii. Collection and organization of the **meteorological/climate** time series (months from 3 to 10)

TASK 3

- i. Statistical **analysis** of the **correlation** (or lack of correlation) between **ground deformation** and the **meteorological/climatic** time series (months from 13 to 19)

TASK 4

- i. Design and the implementation of the **database** using the **open source** database system PostgreSQL + PostGIS SW and the **preparation** and **delivery** of the **collected information** for the **NextData** main portal (months from 3 to 13)



TASK 1

WP2 ACTIVITY

- i. Selection of the **new** test sites where the Unit 2 will produce **deformation** velocity **maps** and associated **time series** using **ERS1/2** and **ENVISAT** satellite images provided by the Unit 1 through a **Category-1** project (months: from 10 to 11)
- ii. Processing of the **satellite images** (months: from 12 to 15); the **new products** will be provide to the Unit 1 that will include the **time series** in the WP1



KOM



STATE OF ART

Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
WP1																					
1			✓																		
2			✓																		
3																					
4			✓																		
WP2																					
1																					



NextData



WP1

Ongoing activities:

- **Bibliography review (WP1 – Task 1 and 2):** to determine **where** quantitative **surface** and **sub-surface** information on ground deformations and for **which periods**
- **Data collection of Test Sites (WP1 – Task 1 and 2):** collection of surface and sub-surface deformation (*in situ* and SAR data) and of meteorological/climate time series
- **Design of a database (WP1 – Task 4):** implementation of a database to storage of the collected time series



WP1 – Task 1, 2

Data collection of Test Sites





NextData



WP1 – Task 1,2

Ground deformation time series of Test Sites searching activity

- Literature analysis
- CNR-IRPI (Torino and Perugia) and CNR – IREA internal data
- Agreement with Valle d'Aosta Region for SAR dataset (ERS and RADARSAT)
- Agreement with Altamira Information for SAR dataset (ERS and ENVISAT dataset provided by Terrafirma Project)
- ARPA Piemonte, “Rete Regionale dei Movimenti Franosi” (ReRCoMF)
- Piano Straordinario di Telerilevamento Ambientale for SAR dataset (ERS and ENVISAT)



NextData



WP1 – Task 1, 2

Meteorological/climate time series of Test Sites

- CNR-IRPI (Torino and Perugia) internal data
- Agreement with Valle d'Aosta Region (Centro Rete)
- ARPA Piemonte, “Banca Dati Meteorologica”



NextData

WP1 – Task 1, 2

Design and implementation of a Database for literature review

- Literature review to search surface and/or sub-surface ground deformations (including the products of SAR data and in situ measurements), and the meteorological/climate time series;
- Identification of the published correlations (DInSAR, in situ and meteo-climatic time series), at regional and local scale
- Setup of a dedicated database that classify the selected bibliography according to the previous described elements relevant to slope processes in different physiographic and climatic regions of the World

ON GOING ACTIVITY

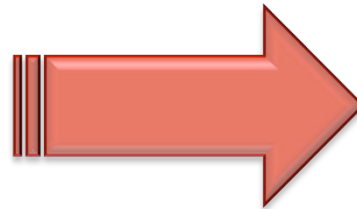
ID	Article category	Article topic	Author	Title	Journal/Volume	Year	Article type	Physiographic environment	Climatic zone	Region	Nation	Lat_Long	Test Sites	Observation period	Data Type	Area extension	Direction	Topographical gradient variation	Land-use
SAR		X-band SAR	d'Notti	Asses	Nat. Hazard Earth	2010	Scientific arti	Mm - Mh	Cfb	Upper Te	Central Spanish Py	Formigal	Maggio-Ottobre 2008	cX-band Terr	47 km ²	WNW-ESE	2500 - 1200 m a.s.l.	Forest, fields	
SAR		DInSAR; Lan	Herrera	Multi-Remote Sensing	o	2012	Scientific arti	Mm		Upper Te	Central Spanish Py	El Portalet	ALOS PALSAR 2006	ALOS PALSAR	47 km ²	WNW-ESE	2500 - 1200 m a.s.l.	Forest, fields	
		Monitoring; G	Herrera	lan Engineering Geolo	2009	Scientific arti	Mm			Upper Te	Central Spanish Py	El Portalet	GB-SAR 5						Land-use
		SPN algorithm	Herrera	Analys	Landslides, 8, 195	2011	Scientific arti	Mm - Mh	Cfb	Upper Te	Central Spanish Py	El Portalet	ERS 1-2	1999-2009	ERS 1-2, ERS 1-2, ERS 1-2	9130 km ²	W-ESE	2500 - 1200 m a.s.l.	
		García-D	DInSAR	Landslides, 11, 22	2014	Scientific arti	Mm - Mh			Upper Te	Central Spanish Py	El Portalet	ALOS PALSAR 2006	ALOS PALSAR	47 km ²	WNW-ESE	2500 - 1200 m a.s.l.	Forest, fields	
				Geografia Fisica d	2013	Book chapt	Mm - Mh												
				Proceedings of	2006	Technical Re	Mm - Mh						ERS 1-2	1991-2001	Dati	47 km ²			
SAR		Herrera		nal Journ	2011	Scientific arti	Montagne terrigene	Cfb	Dfe - Cfb	Arno Riv	Central			pages, 2003	Dati Radars	9130 km ²			
SAR		SAR interfero	Meisina				Scientific arti	Rilievi alpini: Paesaggio glaciale	ET - Dfe - Cfb -	Piedmor	Northern Italy			1999-2009	Dati	47 km ²			
ISM		Storiografia m	Menotti				Local Re	Montagne terrigene	Cfb	Umbria	Central Italy								
ISM		Frane del Coll	Servizio Cons					terrigene	Cfb	Umbria	Central Italy			1979					
ISM		Monitoraggio	Servizio Monit					terrigene	Cfb	Umbria	Central Italy			1990-2009	Dati monitor				
SAR		SAR; Different	Calò F.	Enhai Remote Sensing	o	2014	Scientific arti	Rilievo	Cfb	Umbria	Central Italy			lvanchich lar	C-band ERS 1-2 e Env C-band ERS				
ISM		Landslide; De	Fastellir The	AApl. Geomat., 3,	2011	Scientific arti	Rilievo	rocioso isolato	Cfb	Umbria	Central Italy			lvanchich lar	Geodetic monitoring si	Geodetic m	50 ha		



WP1 – Task 4

Data Collection strategy

- 📁 DATI
- 📁 DATI_METEOROLOGICI
- 📁 ORTOFOTO
- 📁 PROGETTI
- 📁 SAR
- 📁 SHP
- 📁 TOPOGRAFIA



Database for the **storage** of the collected **time series** will be implemented using **open source** PostgreSQL and PostGIS SW



... Thank you for the Attention

francesca.ardizzone@irpi.cnr.it

