

Progetto transfrontaliero Italia-Francia ALCOTRA  
*Projet transfrontalier Italie-France ALCOTRA*



RISBA

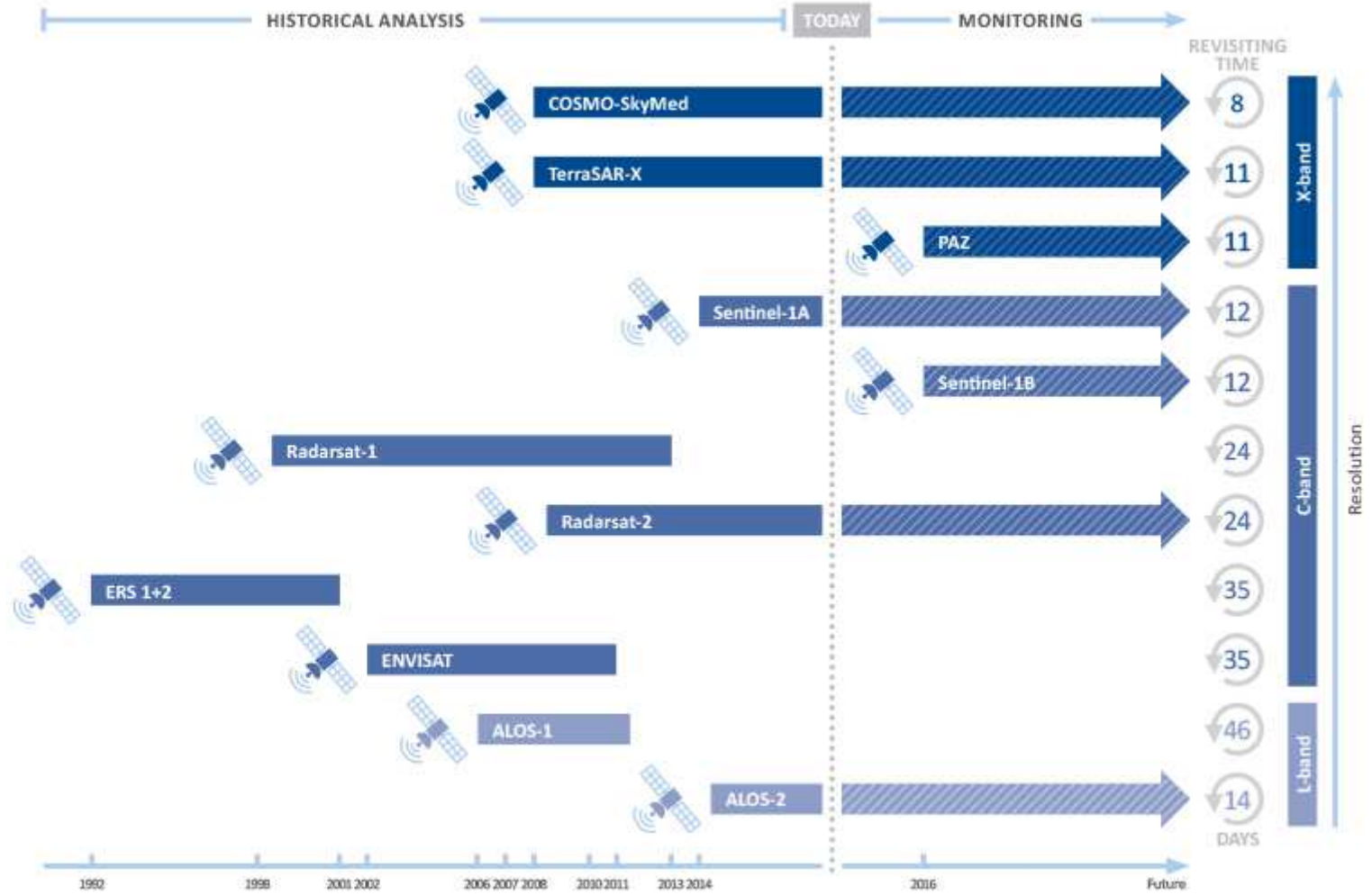
RISCHIO DEGLI SBARRAMENTI ARTIFICIALI  
*RISQUES DES BARRAGES*

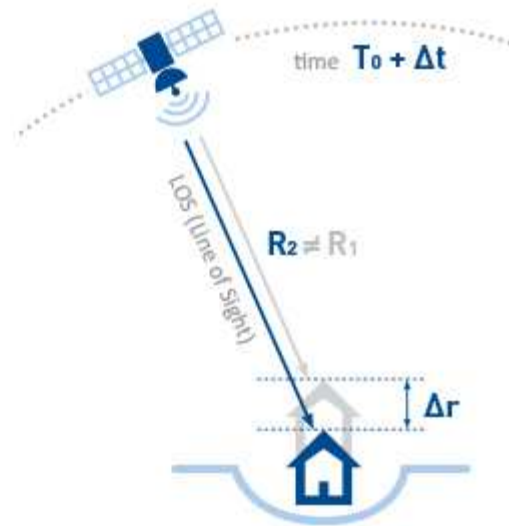
REPORT FINALE

# Analisi CRInSAR

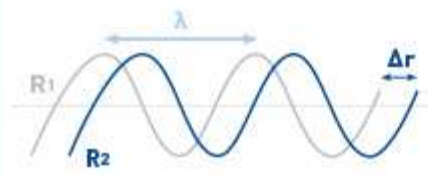
Monitoraggio spostamenti  
mediante riflettori artificiali

Marco Bianchi & Andrea Tamburini (TRE S.r.l., Milano)



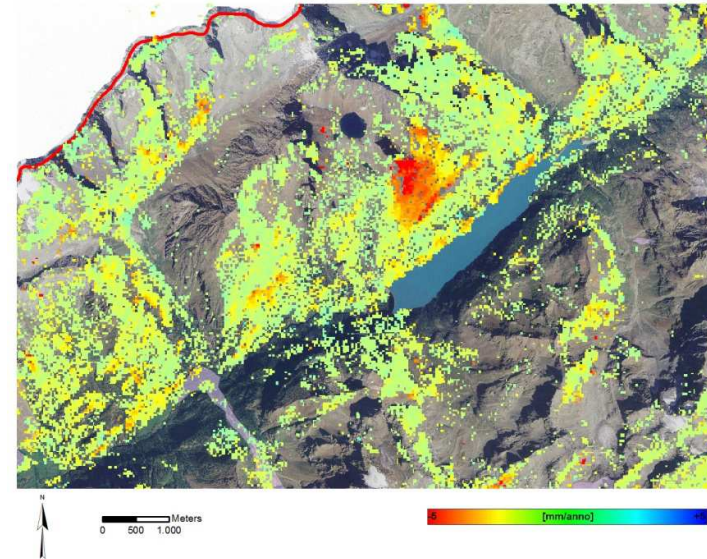


**INTERFEROMETRY**



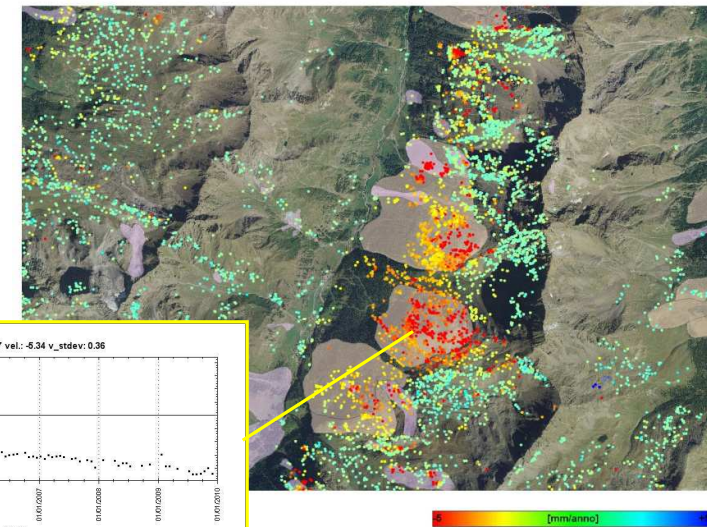
$\lambda$  - wavelength:  
C-band = 5.66 [cm]  
X-band = 3.10 [cm]  
L-band = 24.00 [cm]

raster: mappe di velocità media annua di spostamento

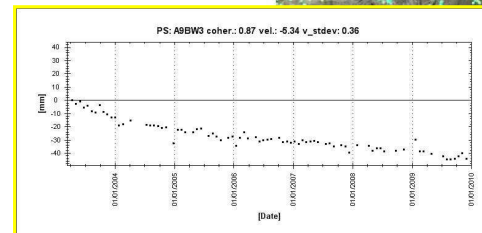


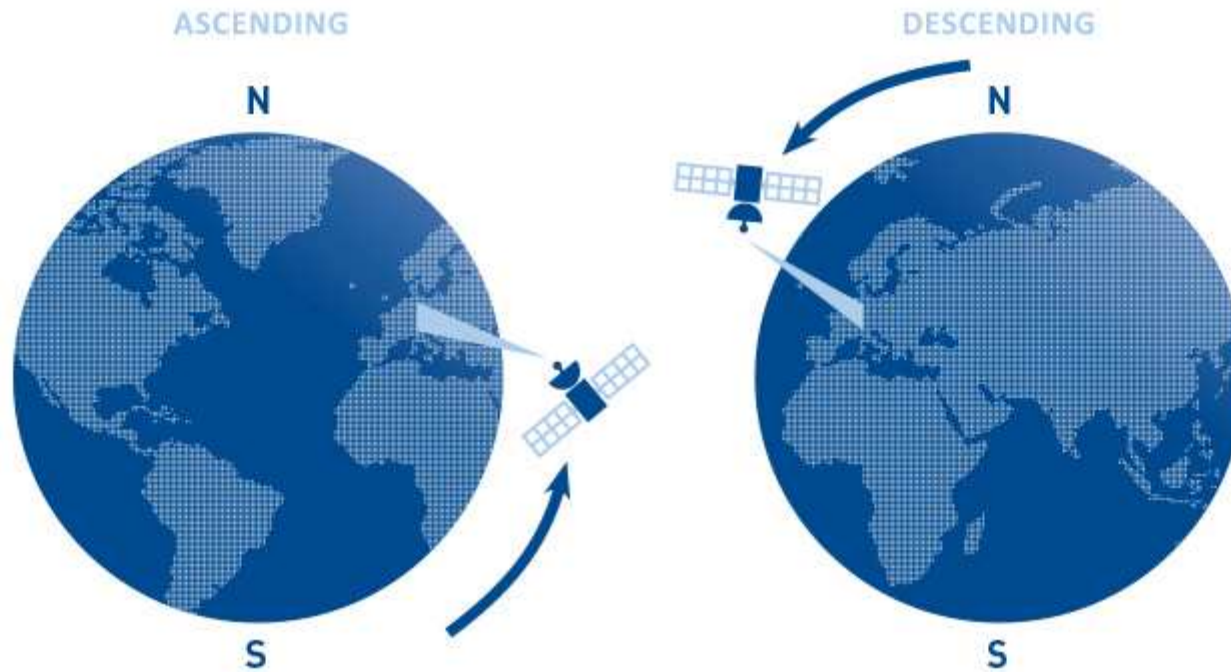
Valori puntuali di velocità media annua di spostamento in formato ESRI© shapefile

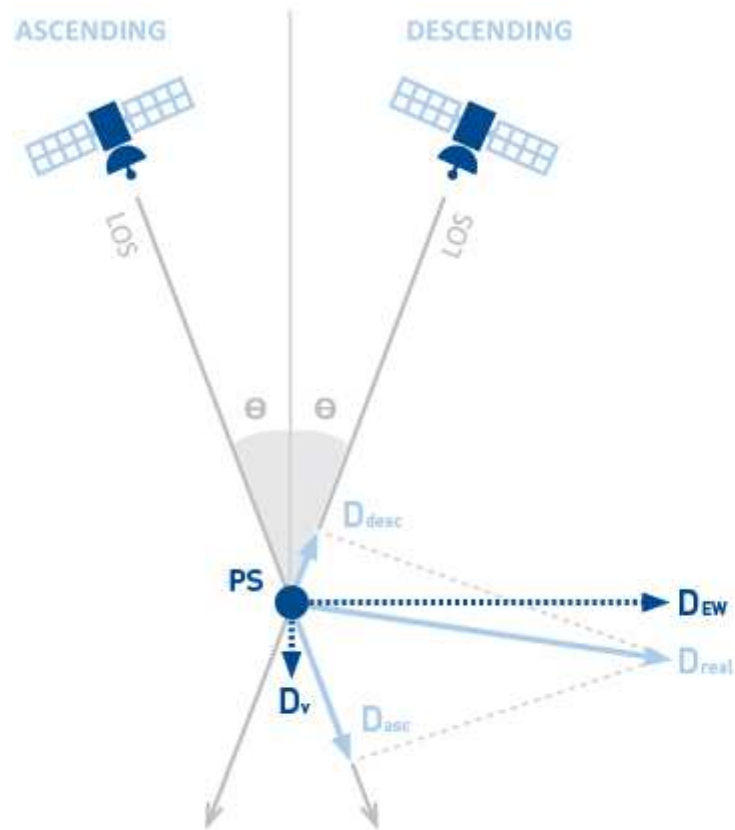
vettoriale:

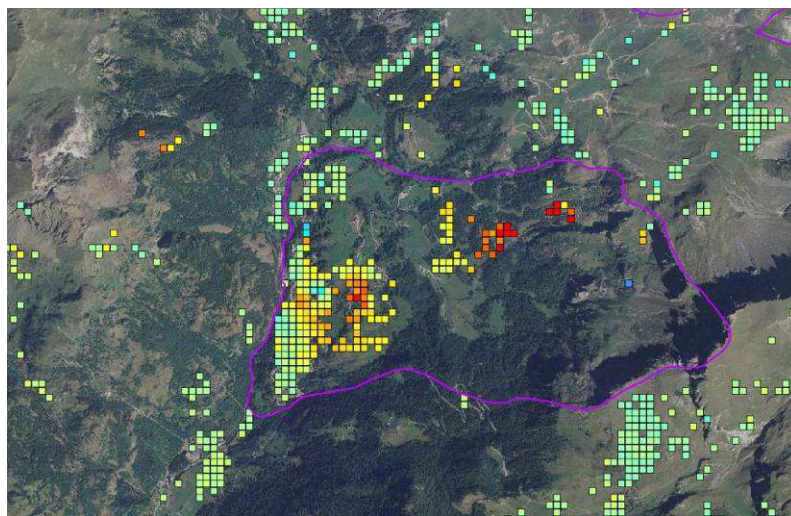
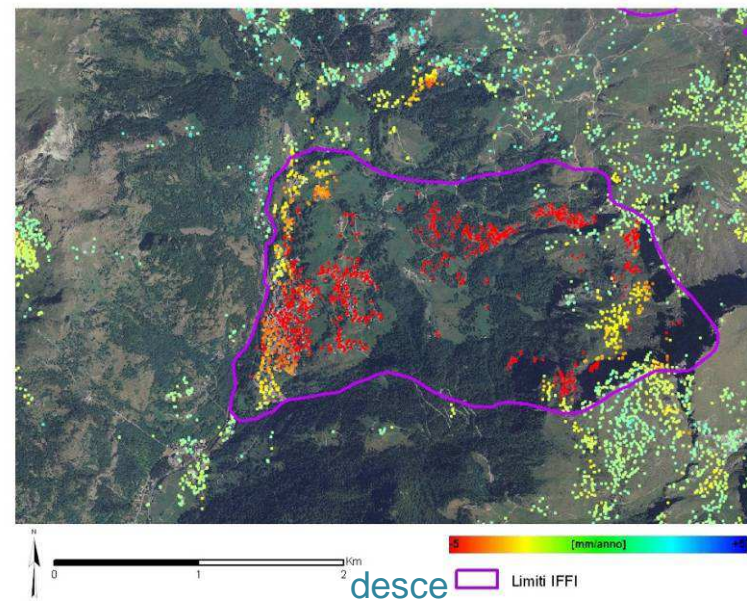
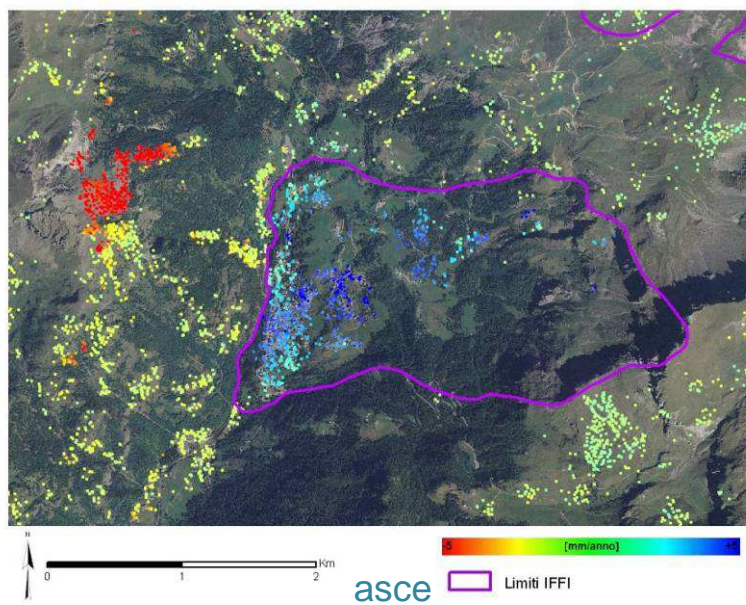


Serie storiche di spostamento

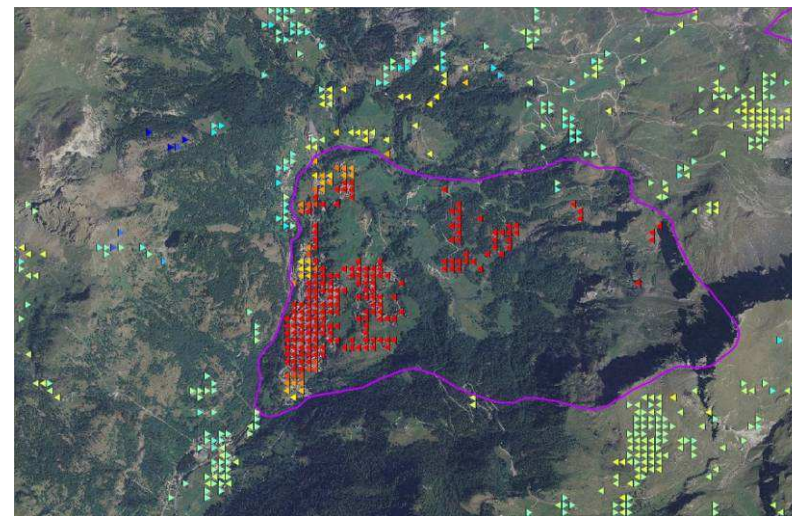








verticale



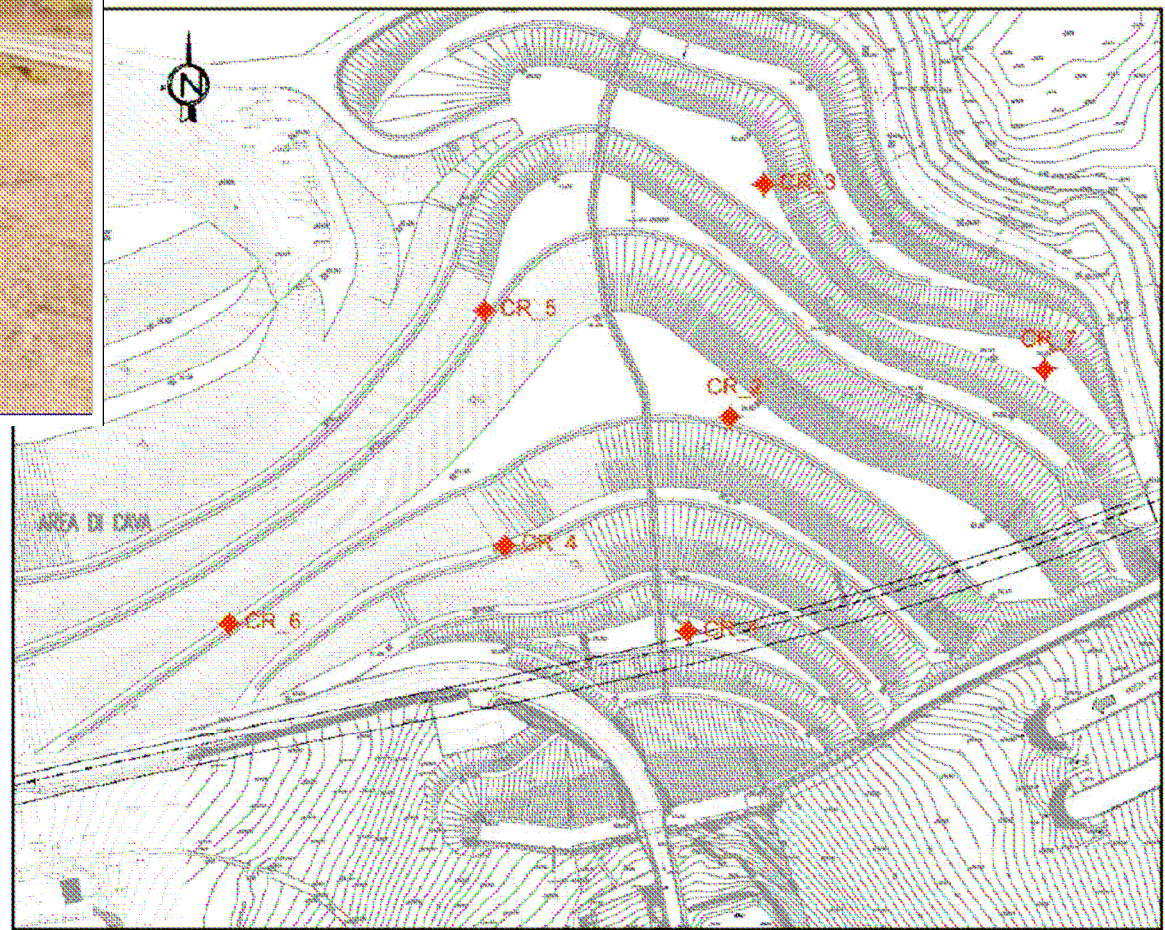
Orizzontale E-W

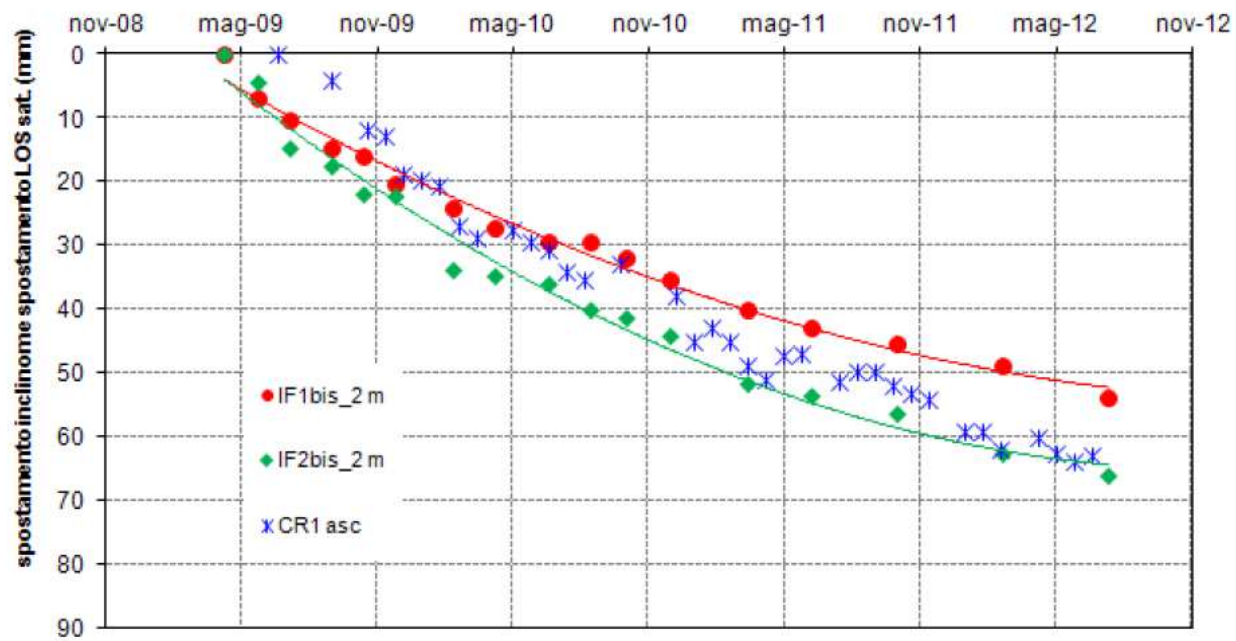






scarpata risagomata



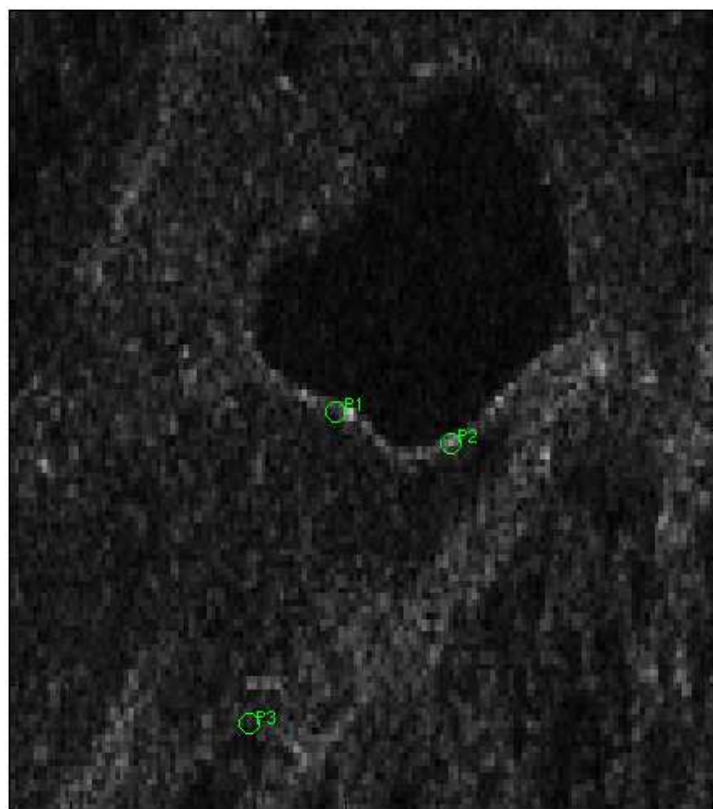




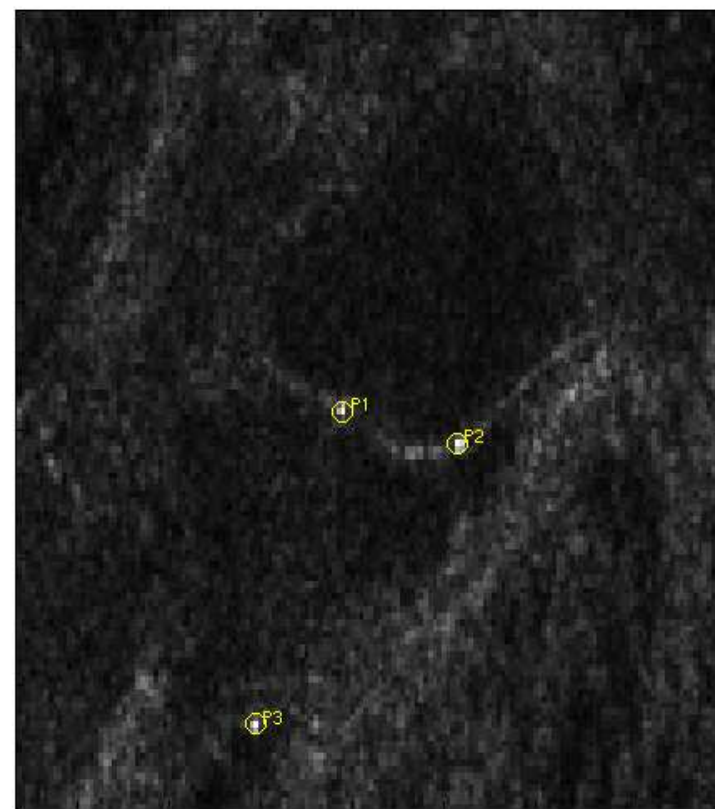
- Fine 2013: preparazione dei siti di Nouva, Weissmatten e Cime Bianche e installazione dei riflettori
- Gennaio 2014: orientamento dei riflettori già installati e calcolo della posizione mediante rilievo GPS geodetico
- Luglio 2014: completamento della rete con installazione ed orientamento dei riflettori a Gran Testa



Nouva: mappa di ampiezza, geometria discendente

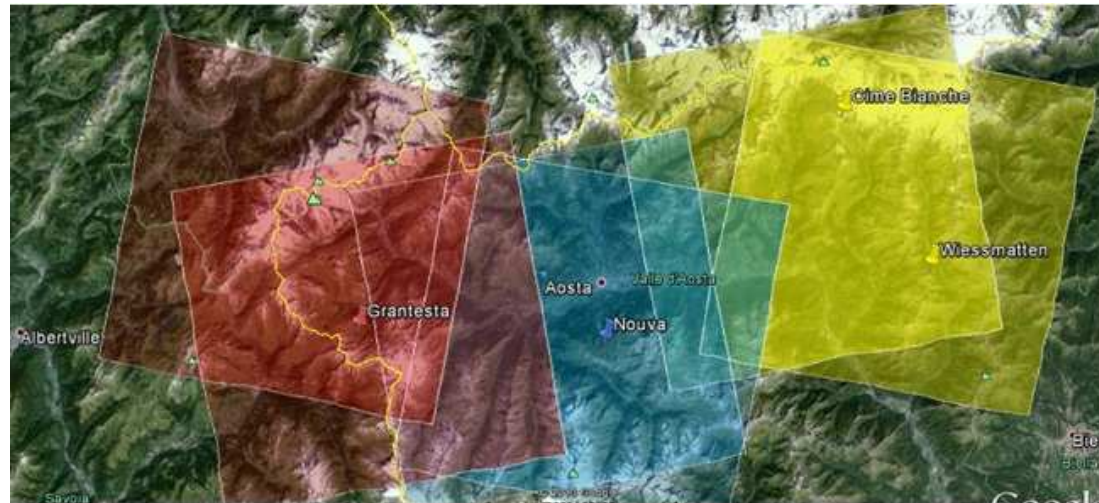


prima



dopo

- I riflettori installati sono stati analizzati mediante elaborazione dei dati satellitari raccolti dal progetto Map Italy (ASI, COSMO-SkyMed) fino all'8 gennaio 2015.
- Le elaborazioni sono state condotte considerando lo spostamento relativo dei due riflettori installati sul coronamento rispetto al riflettore esterno usato come REF; solo nel caso di Weissmatten sono state utilizzati come punti di riferimento due riflettori naturali (PS) presenti in prossimità dell'invaso, causa inadeguatezza del riflettore utilizzato come riferimento
- Le elaborazioni mirano a determinare gli spostamenti lungo la LOS (line of sight) del satellite, sia in geometria ascendente che discendente
- Dalla combinazione tra le due geometrie è stato possibile ottenere le componenti verticale ed E-W; per ragioni legate alla geometria di acquisizione (elevata inclinazione della LOS) la componente E-W è risultata più rumorosa di quella verticale



AOI	CONSTELLATION	GEOMETRIA	SAT	MODE	TRACK
Nouva	COSMO-SkyMed	ascending	sar1	H4-01	2
		descending	sar1	H4-03	128
Weissmatten Cime Bianche	COSMO-SkyMed	ascending	sar2	H4-03	2
		descending	sar2	H4-01	128
Grantesta(*)	COSMO-SkyMed	ascending	sar2	H4-05	165
		descending	sar3	H4-04	128

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<b>Dataset</b>	<b>Sat/Geometria</b>	<b># immagini</b>	<b>Periodo</b>
<b>1 Cime Bianche, Weissmatten</b>	CSK/ascendente	17	26/01/14 - 28/12/14
<b>2 Nouva</b>	CSK/ascendente	19	18/01/14 – 20/12/14
<b>3 Gran Testa</b>	CSK/ascendente	11	16/07/14 – 08/01/15
<b>4 Cime Bianche, Weissmatten</b>	CSK/discendente	16	18/01/14 – 02/11/14
<b>5 Nouva</b>	CSK/discendente	18	26/01/14 – 28/12/14
<b>6 Gran Testa</b>	CSK/discendente	8	15/08/14 – 24/12/14

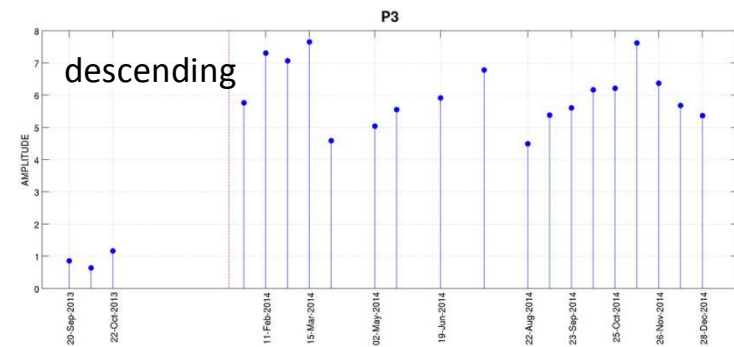
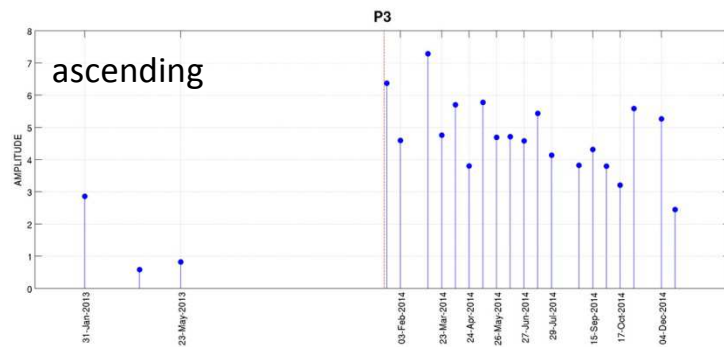
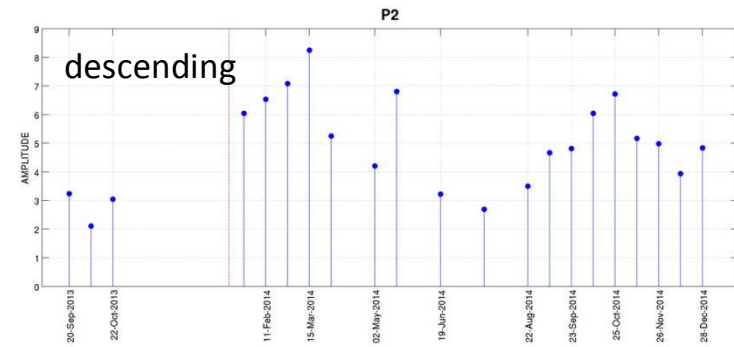
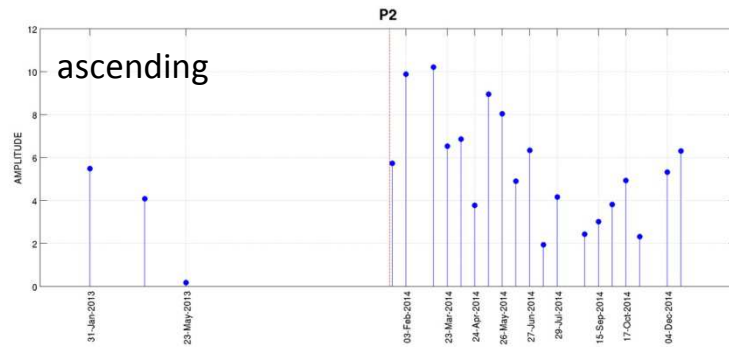
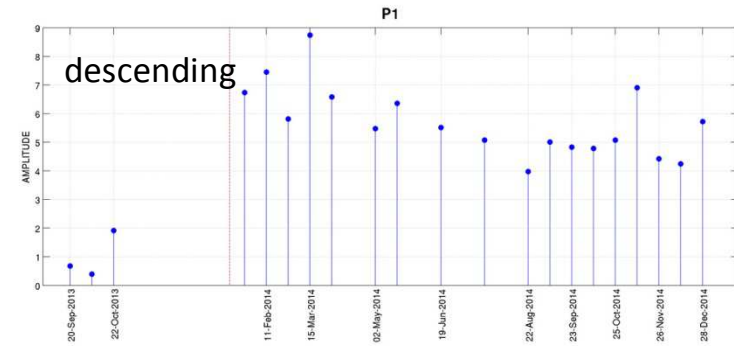
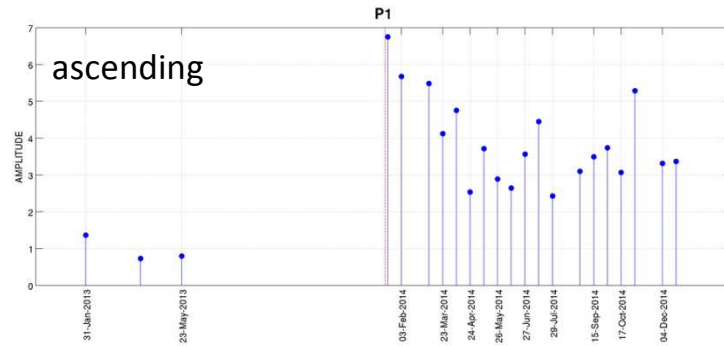
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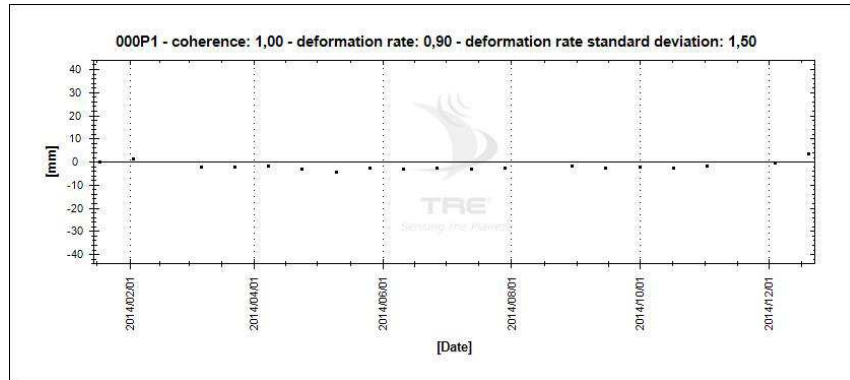


AR	LAT	LON	QUOTA (elliss)
P1	45,66830248	7,31530796	2230,073
P2	45,66781518	7,31501022	2229,949
P3	45,66881129	7,31446053	2214,498

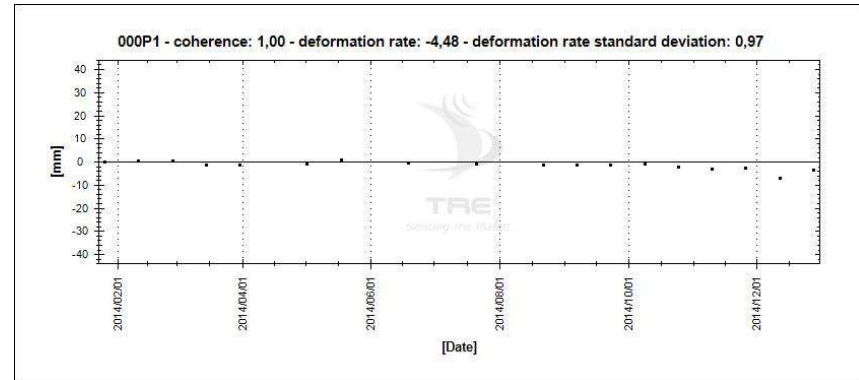
# Nouva (Pila) – Serie storiche di ampiezza



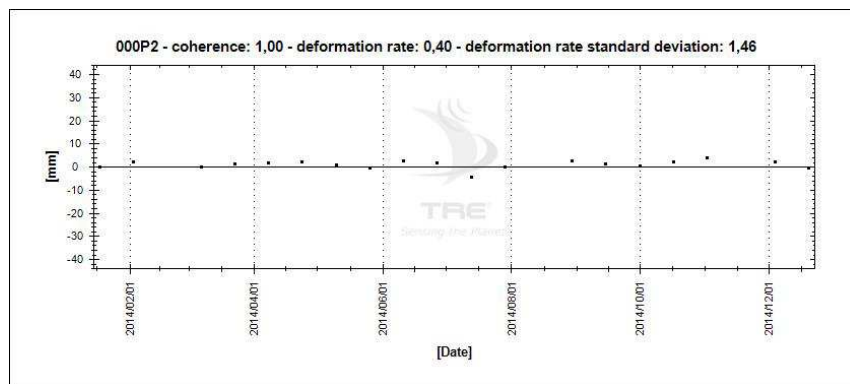
ascending



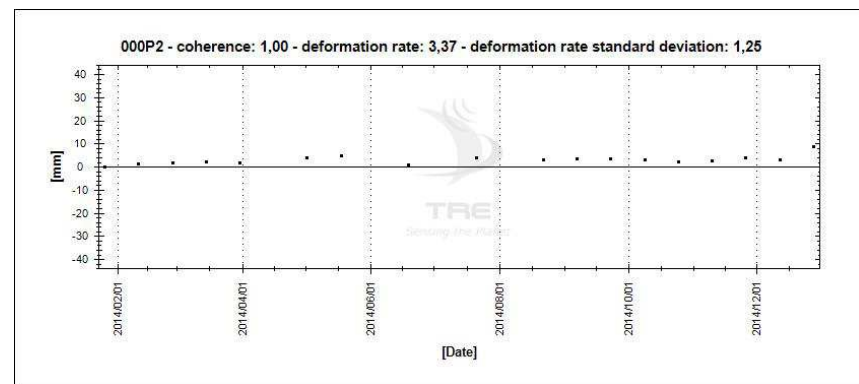
descending



ascending

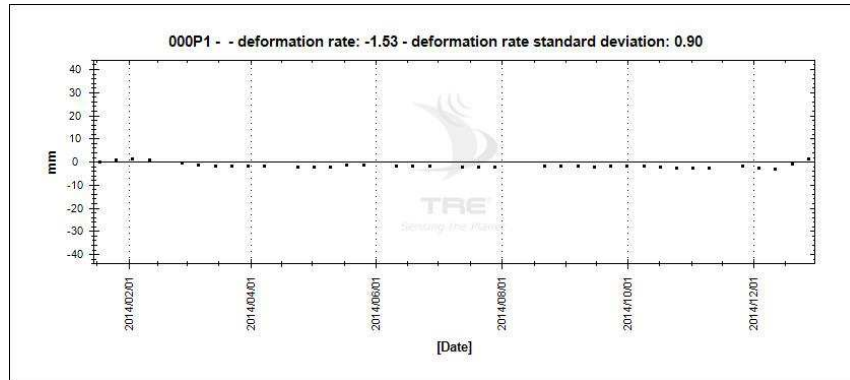


descending

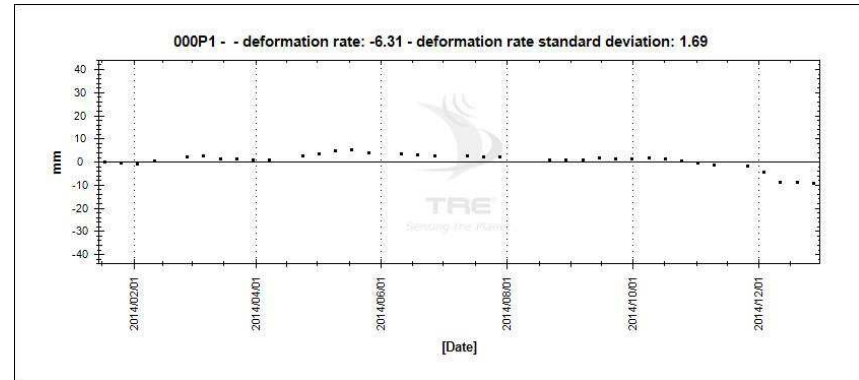




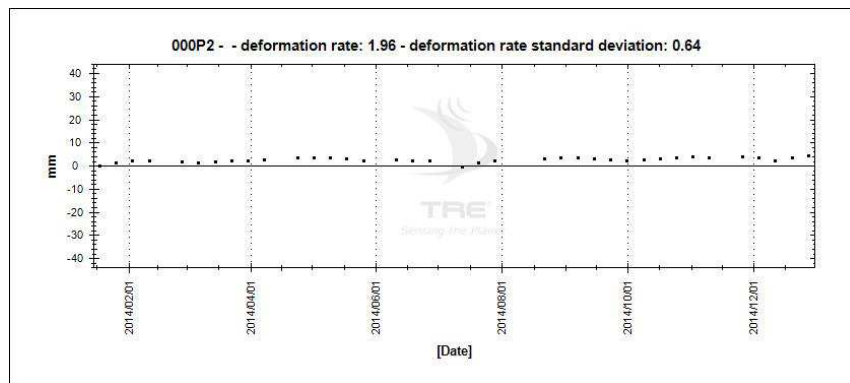
vertical



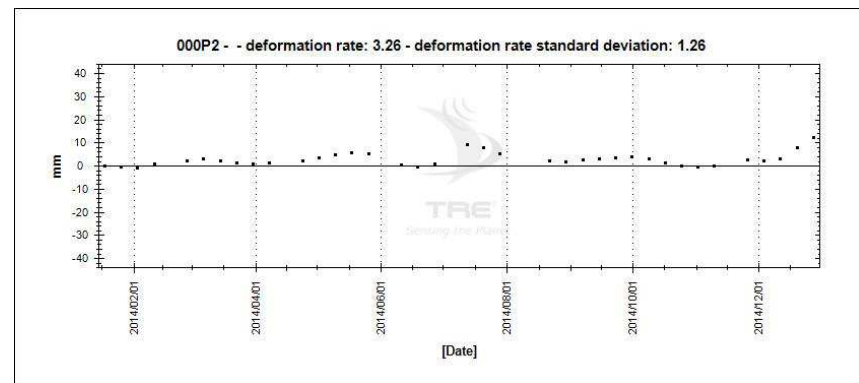
E-W

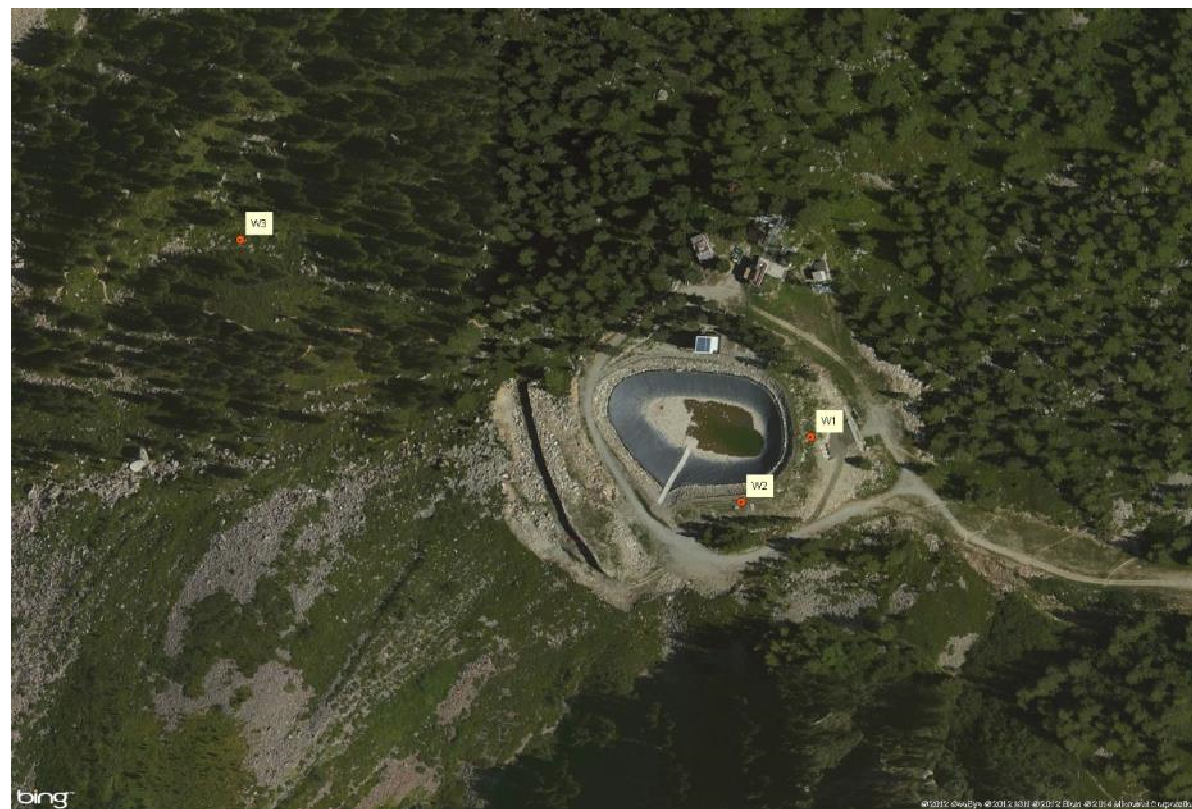


vertical



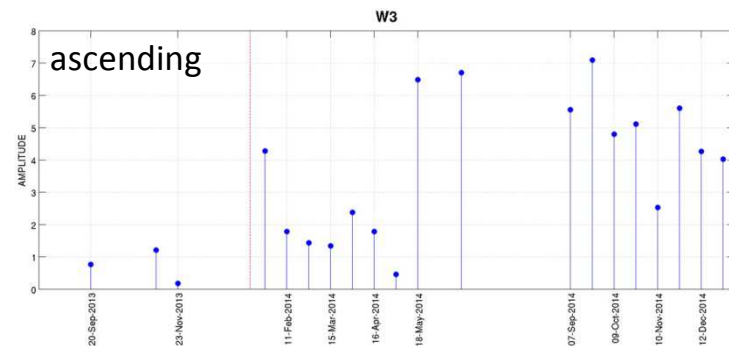
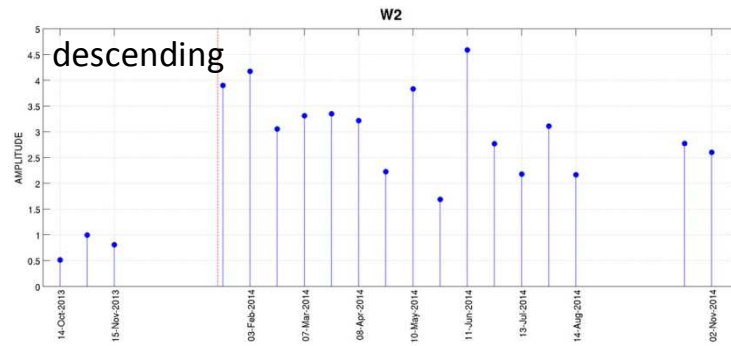
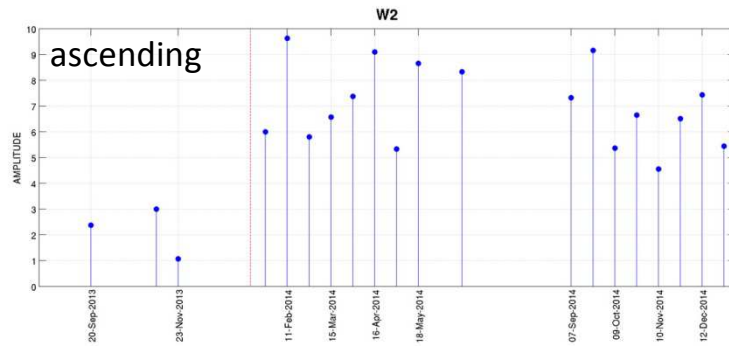
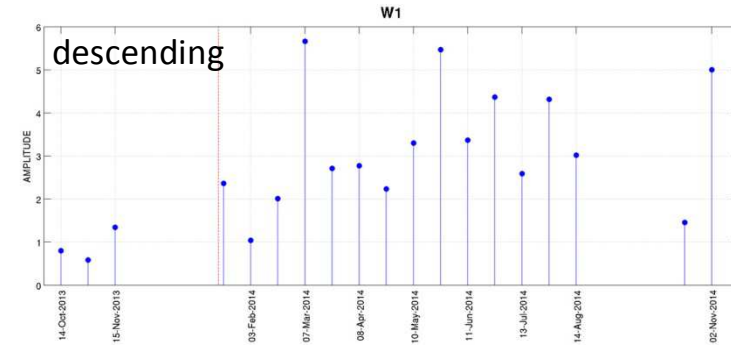
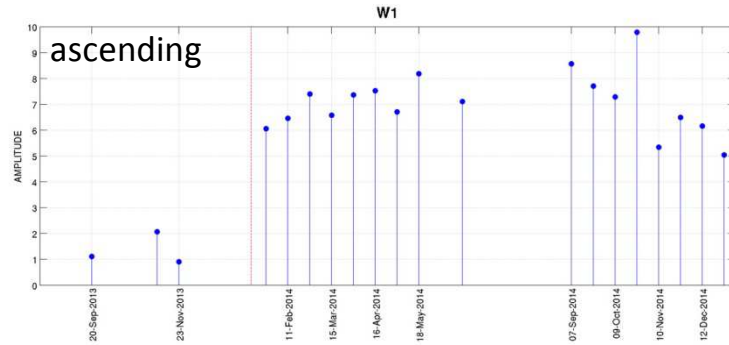
E-W

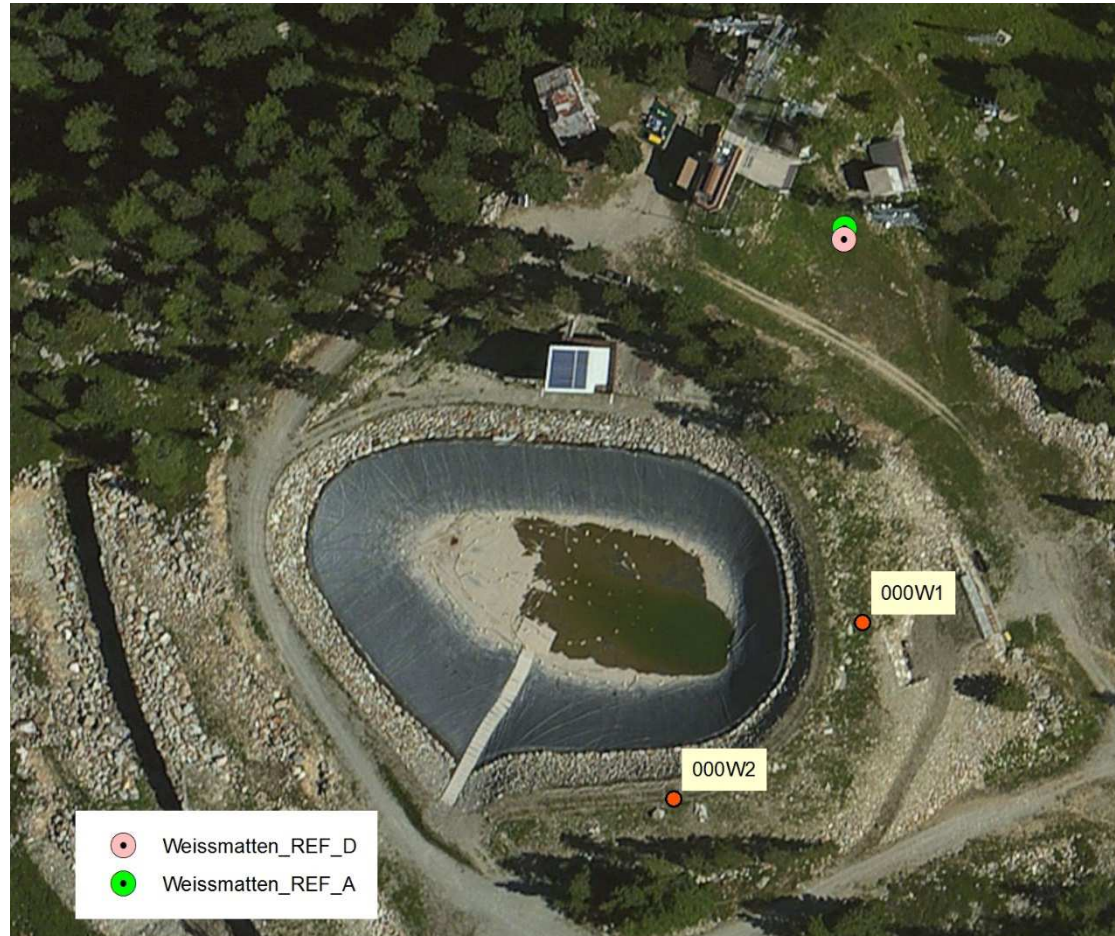




AR	LAT	LON	QUOTA (elliss)
W1	45,74740819	7,82556416	2089,904
W2	45,74707836	7,82507421	2089,677
W3	45,74835973	7,82145865	2133,428

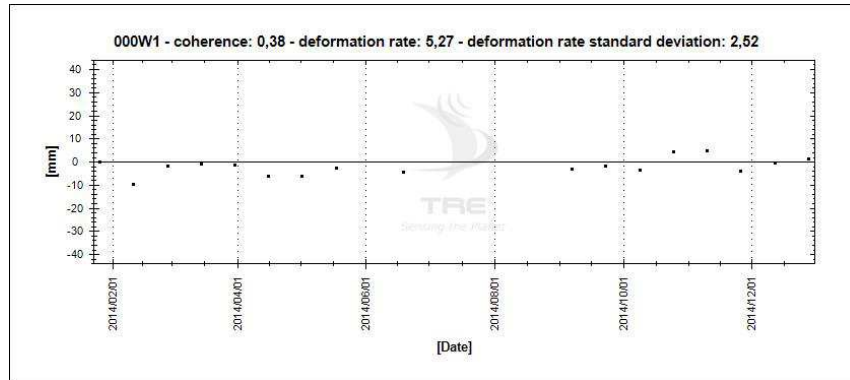
# Weissmatten– Serie storiche di ampiezza



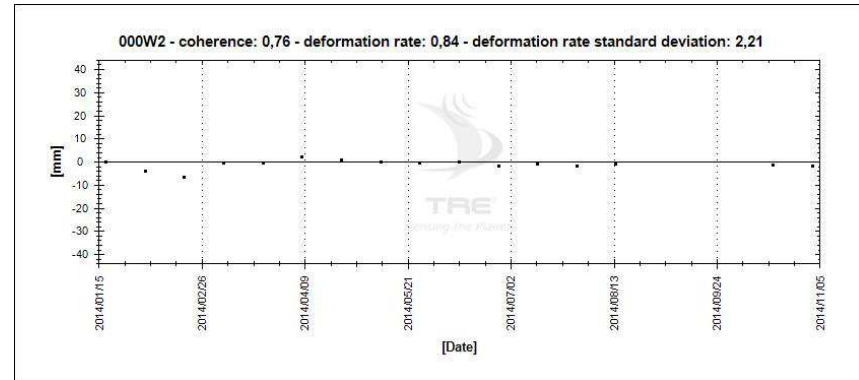


Nell'impossibilità di utilizzare il riflettore W3 come riferimento per entrambe le geometrie di acquisizione, sono stati utilizzati due riflettori naturali ubicati in posizioni tra loro vicine

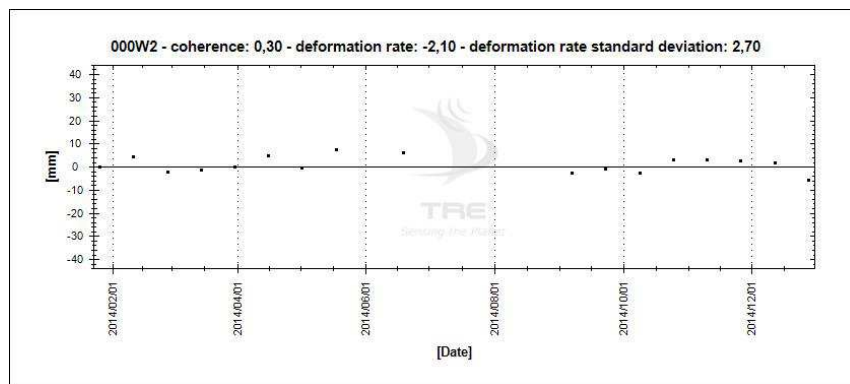
ascending



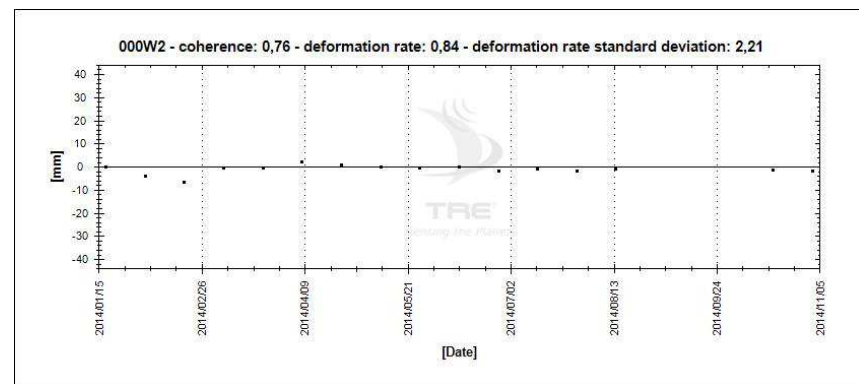
descending



ascending



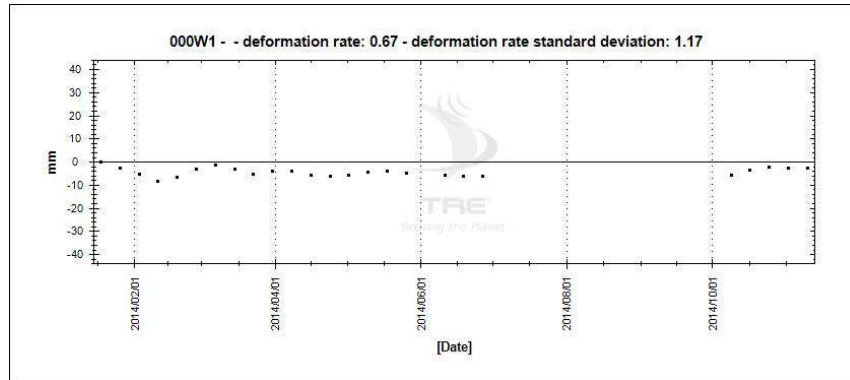
descending



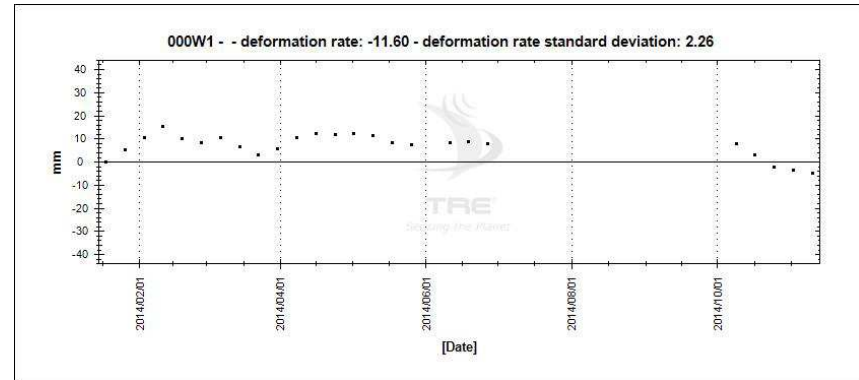




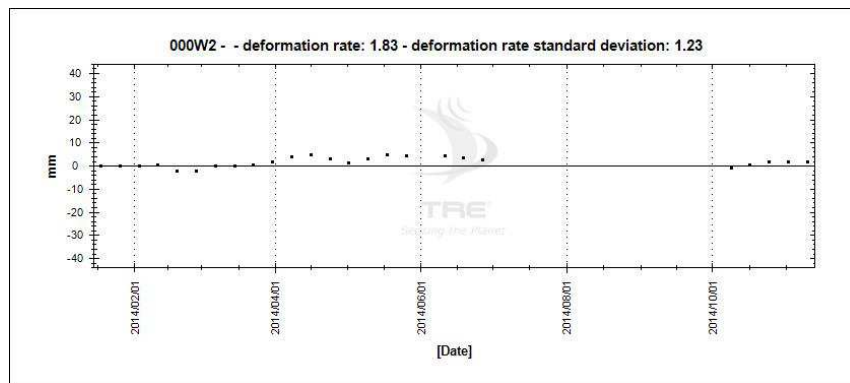
vertical



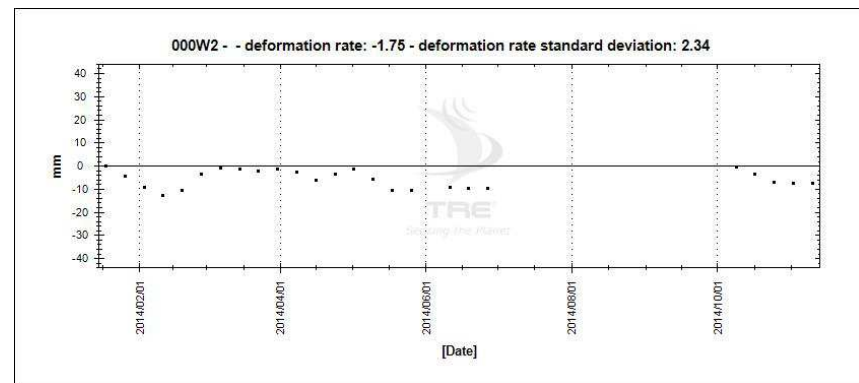
E-W

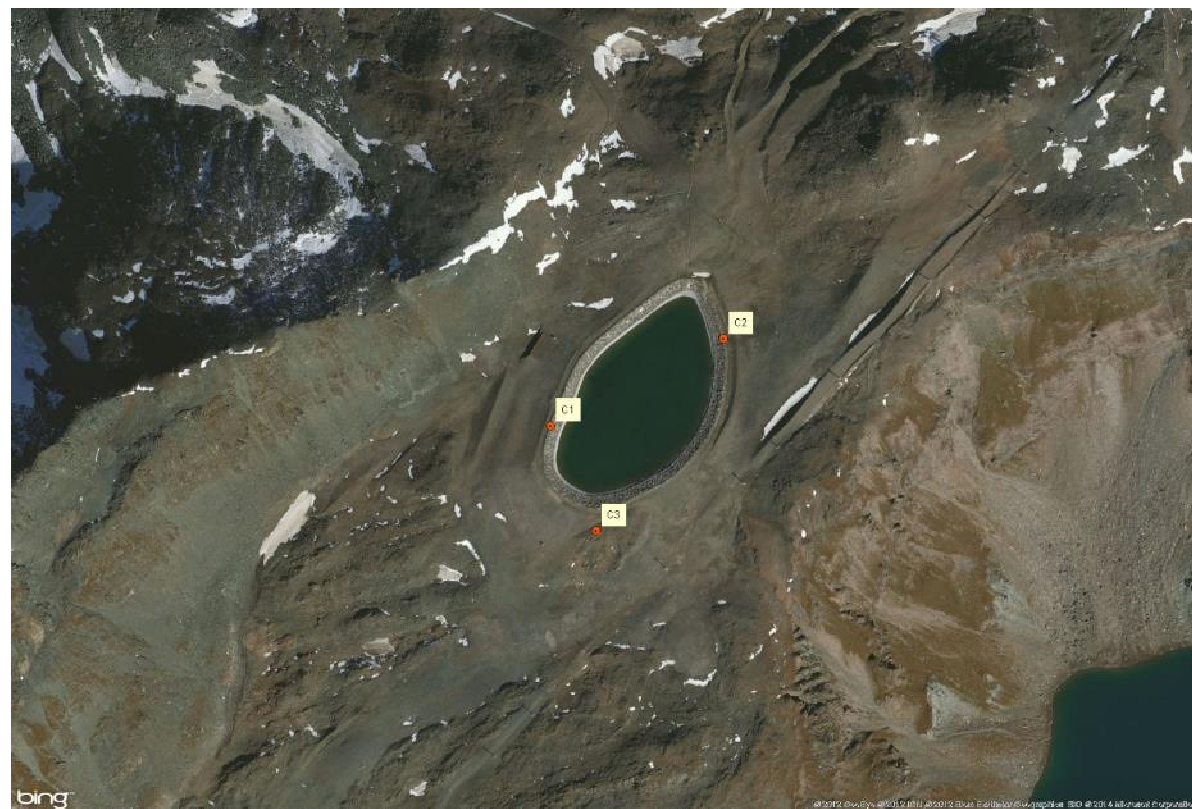


vertical



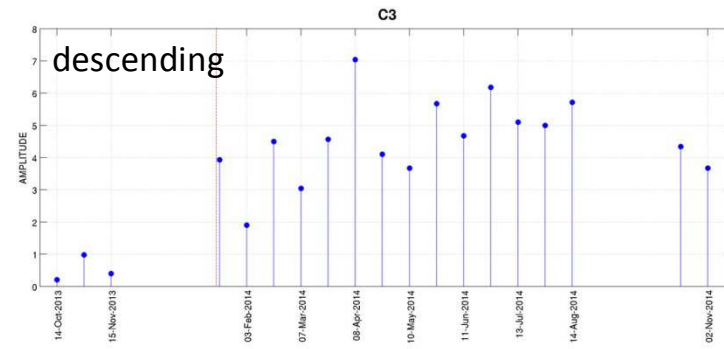
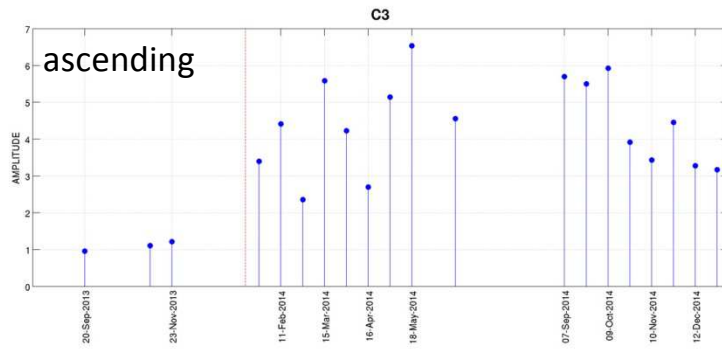
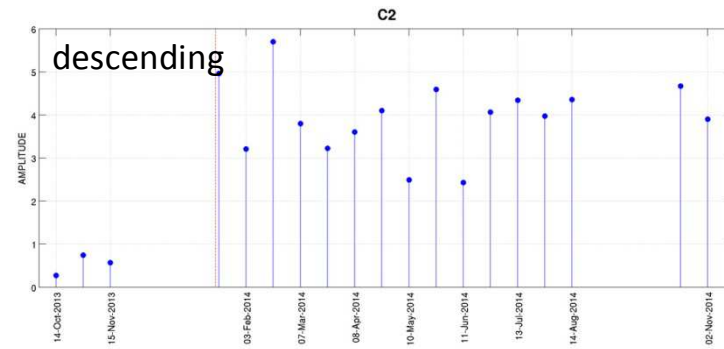
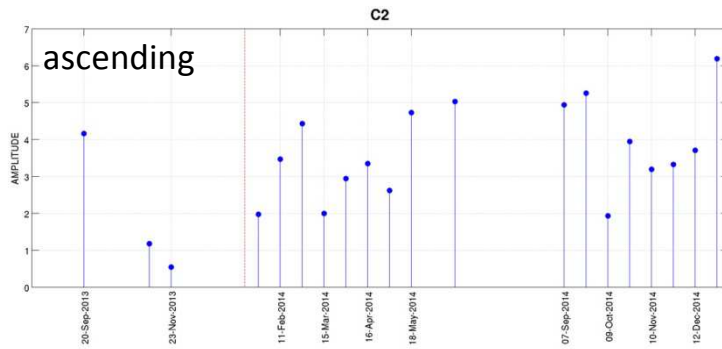
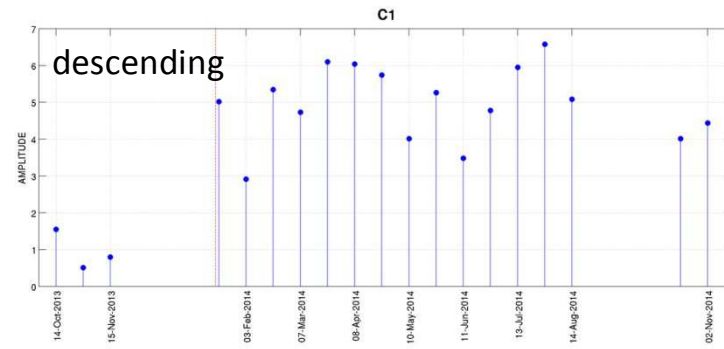
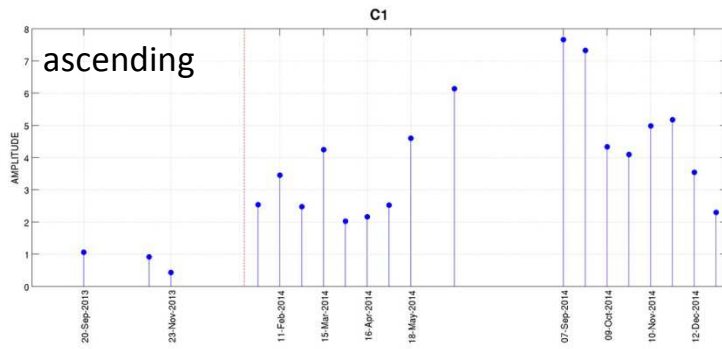
E-W



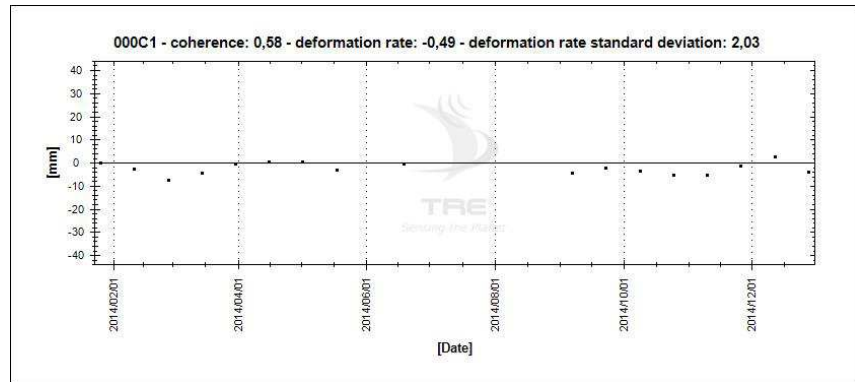


AR	LAT	LON	QUOTA (elliss)
C1	45,91655572	7,68542569	3042,252
C2	45,91722087	7,68724555	3042,62
C3	45,91577821	7,68592775	3043,897

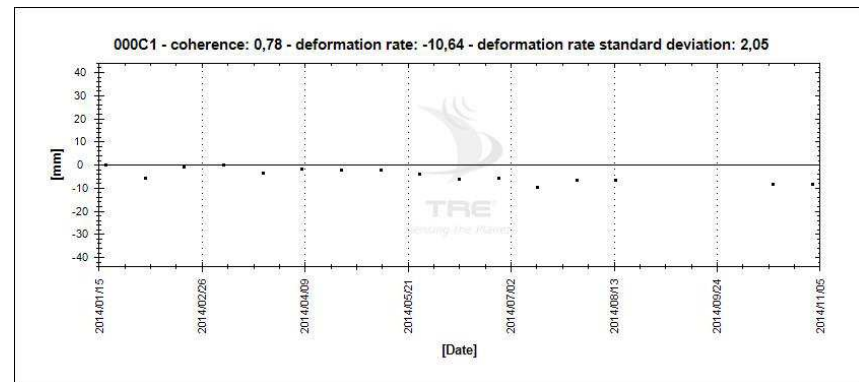
# Cime Bianche – Serie storiche di ampiezza



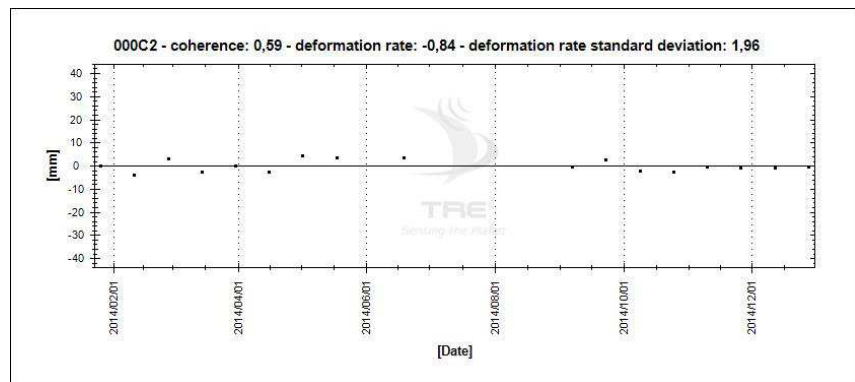
ascending



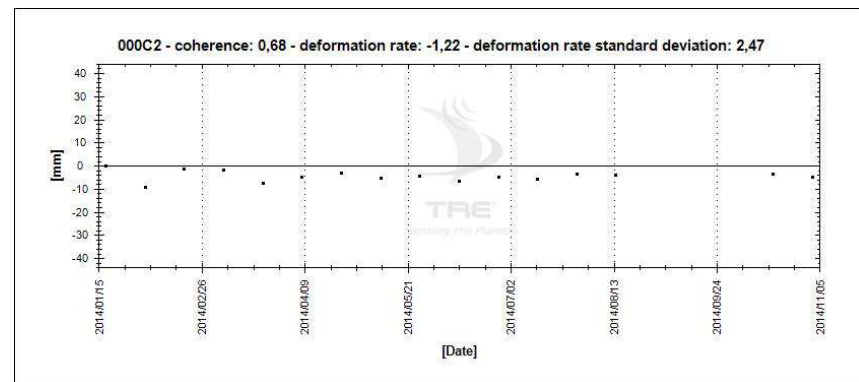
descending



ascending

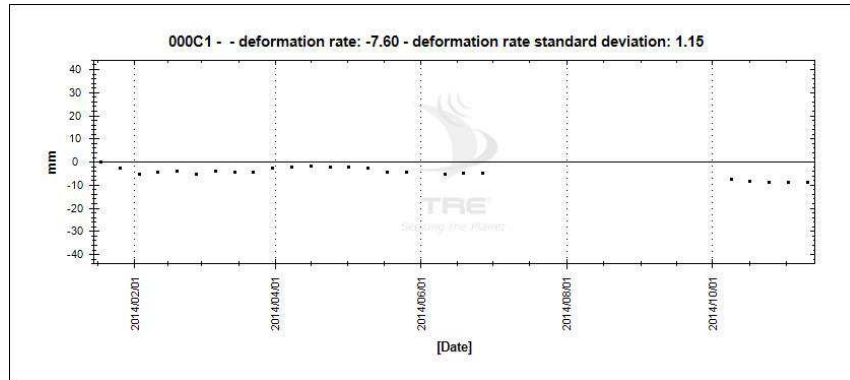


descending

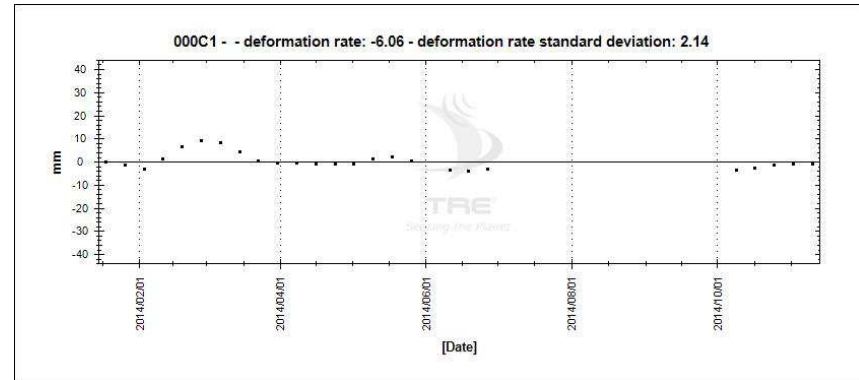




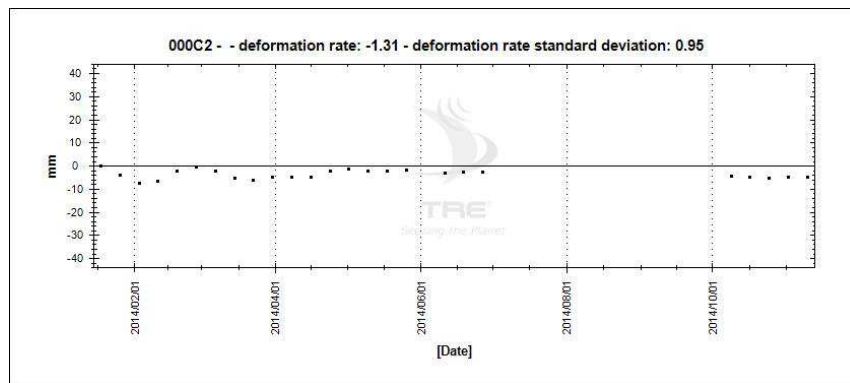
vertical



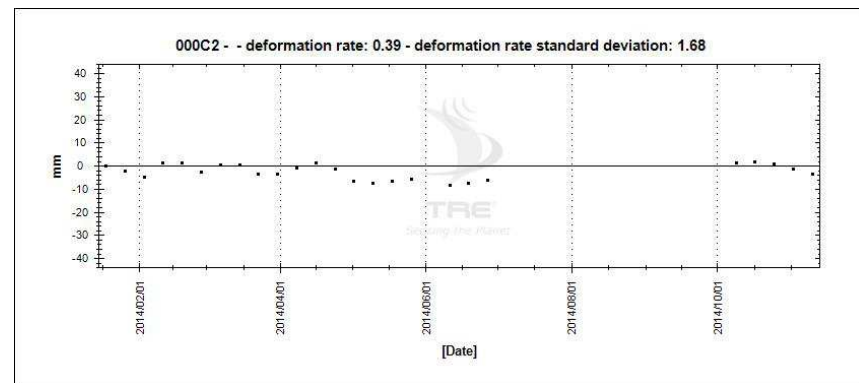
E-W



vertical



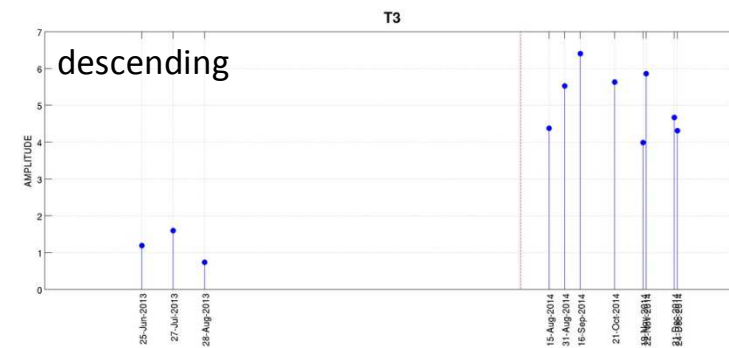
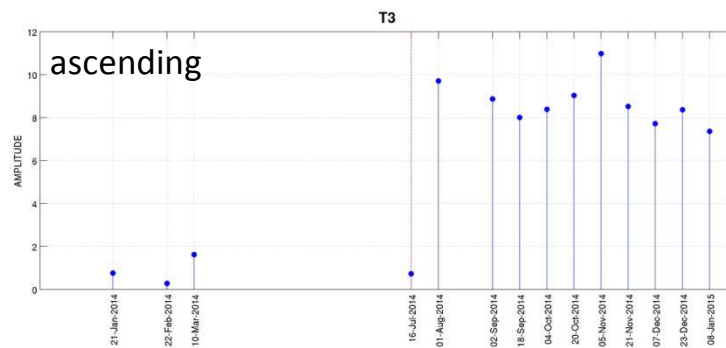
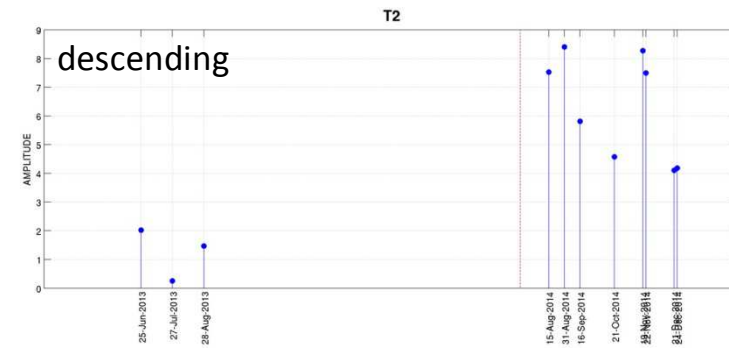
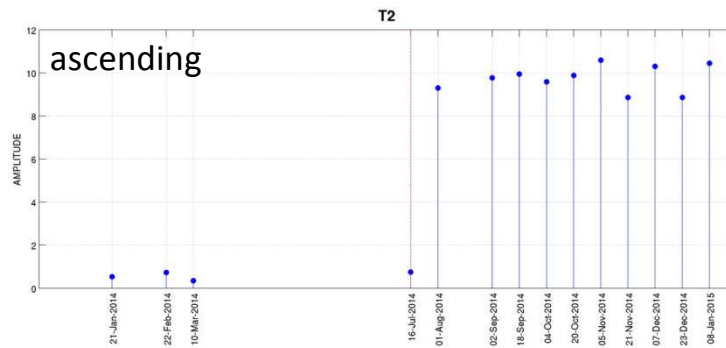
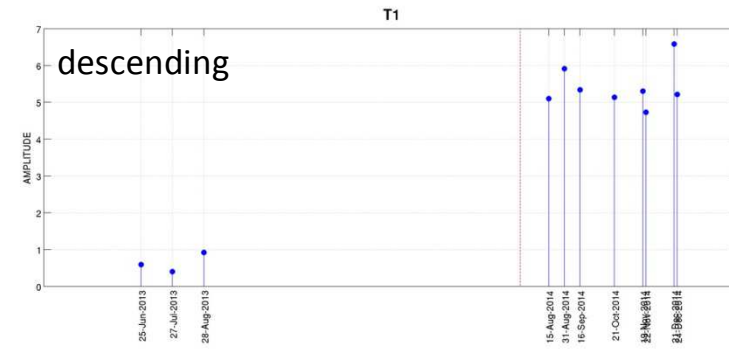
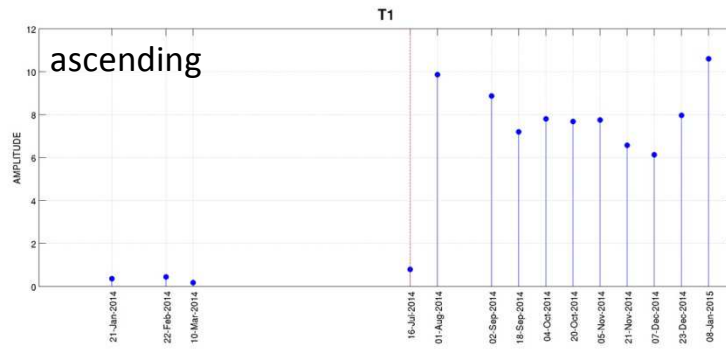
E-W



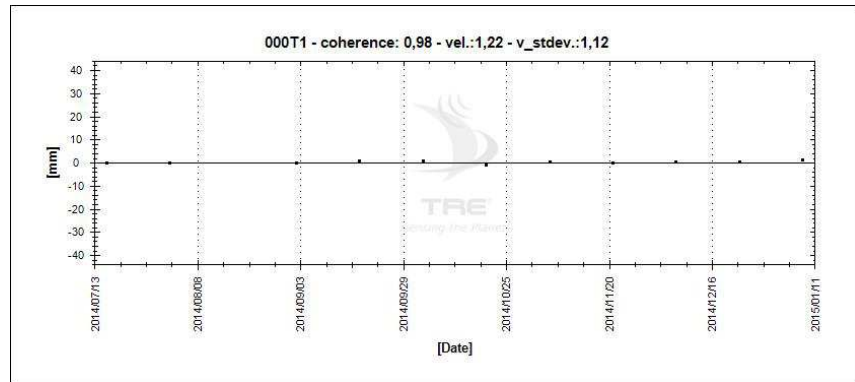


AR	LAT	LON	QUOTA (elliss)
T1	45,682128	6,931426	2281,64
T2	45,682535	6,931539	2281,41
T3	45,681288	6,932840	2263,87

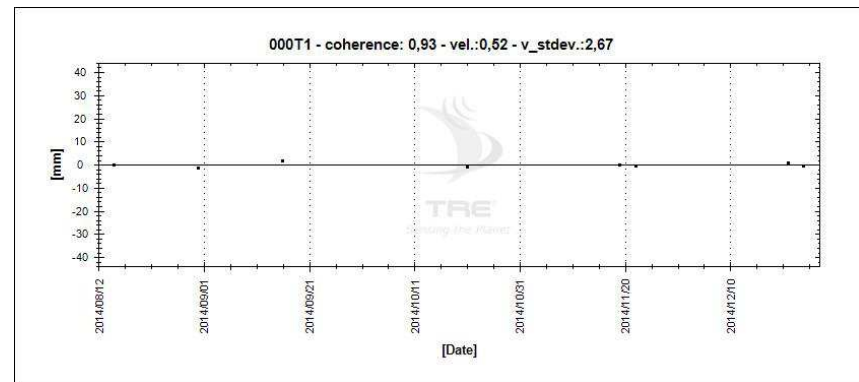
# Gran Testa – Serie storiche di ampiezza



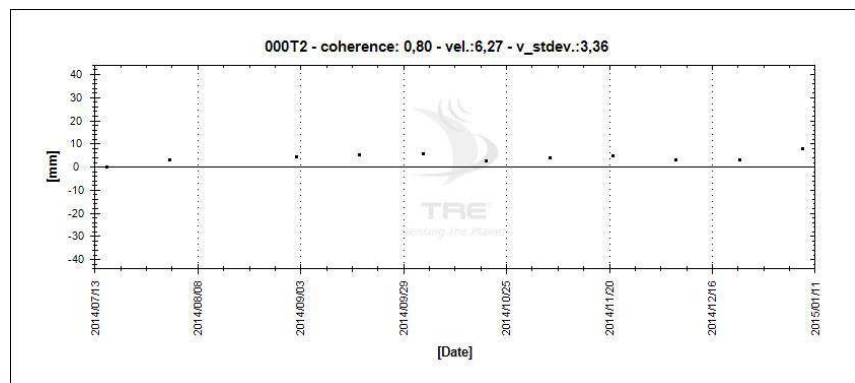
ascending



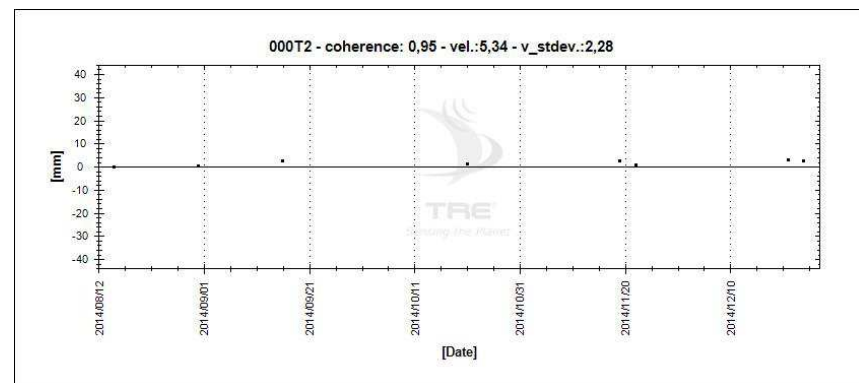
descending



ascending



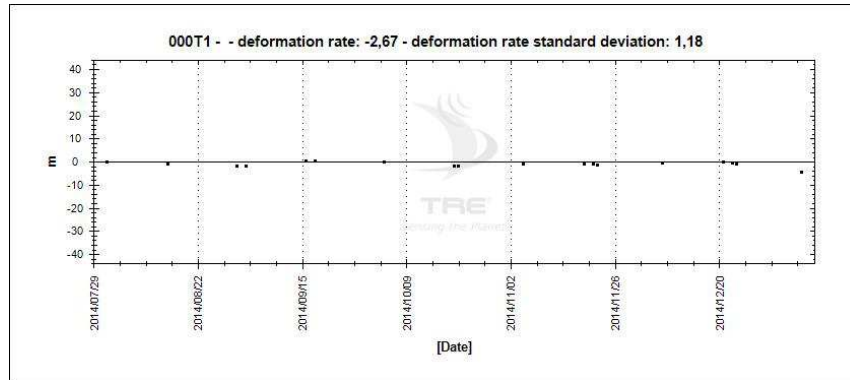
descending



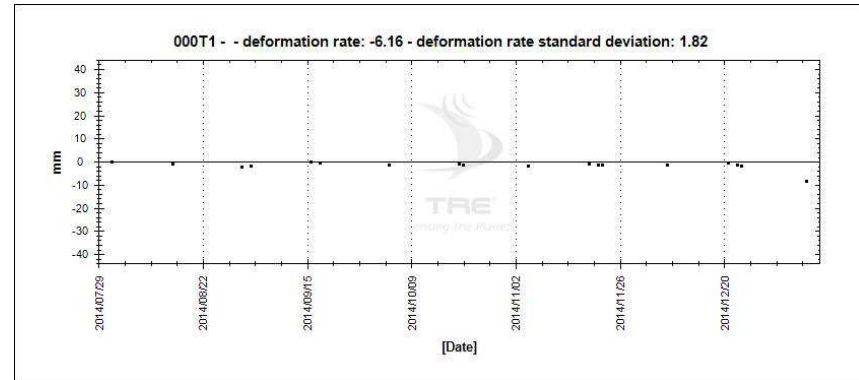




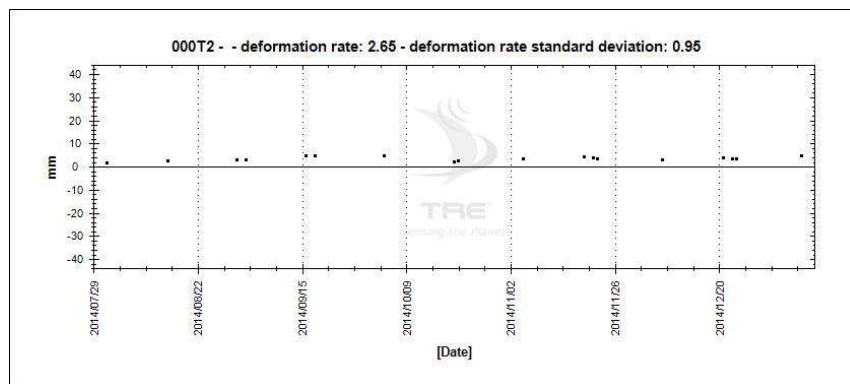
vertical



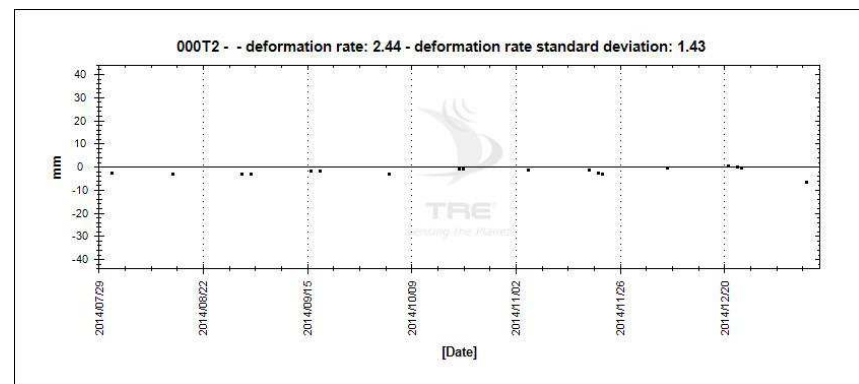
E-W



vertical



E-W



- Le piccole variazioni osservabili nelle serie storiche sono in genere contenute entro i limiti di precisione (1 sigma) della tecnica di misura ( $\pm 1$  mm/anno sulla velocità media di spostamento;  $\pm 5$  mm sulla singola misura di spostamento). Non vi sono quindi evidenze di spostamenti degni di nota.
- Limitazioni:
  - componente orizzontale rumorosa causa elevata inclinazione della linea di vista del satellite rispetto alla verticale, (da  $27^\circ$  a  $30^\circ$ )
  - Cali di riflettività dovuti alla presenza di neve e/o ghiaccio per buona parte dell'anno
- Nonostante le limitazioni sopra riportate, i risultati ottenuti possono essere considerati soddisfacenti, soprattutto perché offrono una continuità temporale difficilmente ottenibile con altre tecniche di misura in questo contesto ambientale e climatico.