



Grant Agreement No. 718679
Safety – Sentinel for geohazard
prevention and forecasting

Deliverable C2.1: Canary Islands area deformation activity map V0

A deliverable of

Task C: Sentinel-1 software development and data processing

Due date of deliverable: 30/06/2016

Actual submission date: 29/06/2016

Lead contractor for this deliverable: CTTC

Partners: CTTC

Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the Consortium (including the Commission Services)	
CO	Confidential, only for members of the Consortium (including the Commission Services)	
TN	Technical Note	X





Table of Content

<i>EXECUTIVE SUMMARY</i>	3
<i>REFERENCE DOCUMENTS</i>	4
1 INTRODUCTION	6
2 DATASET DESCRIPTION	6
3 MAP DESCRIPTION	8
4 OBSERVATIONS	9



EXECUTIVE SUMMARY

This document contains a short description of the delivered deformation activity map over the Tenerife, Gomera and Gran Canaria Islands.




REFERENCE DOCUMENTS

N°	Title
RD1	DoW Part C

CONTRIBUTORS

Contributor(s)	Company	Contributor(s)	Company
Oriol Monserrat	CTTC		
Anna Barra	CTTC		

REVIEW: CORE TEAM

Reviewed by	Company	Date	Signature
Michele Crosetto	CTTC		

1 INTRODUCTION

This document is a short report on the delivered deformation activity map (version 0) of the Canary Islands test site.

The data processing has been done by using the software tools developed and owned by the CTTC. The used procedure has two main steps. The first phase consists in the calculation of the stack of interferograms and coherences and the second phase consist in the generation of the deformations maps. The type of analysis has been chosen taking into account the characteristics of the site: a very high temporal coherence in most of the covered area. The procedure used for this processing is based in the method described in Devanthery et al. 2014⁽¹⁾. However, it is worth noting that even if the analysis has allowed the detection of several deformation phenomena, the time series are still short to get the best performances in terms of quality and precision. It is expected to improve the final results in the forthcoming updates.

The point selection has been based in some statistical parameters provided by the processing procedure. The final result has been derived as the intersection using three different parameters. First the sigma zero of the residues between the final estimated deformation and the original interferometric phases. Secondly by using the sigma zero of the velocity. And, finally, a spatial criterion based on the variability of a point with respect its neighbors. The threshold for the three parameters has been fixed in ± 5 mm. Finally, the noise level of the deformation measurements has been estimated to be ± 10 mm.

In section 4 are briefly described the key aspect to be taken into account when analyzed the provided map. In this sense, it is worth noting that the longitude of the Sentinel time series is still too short to obtain the best performances in terms of deformation measurements. This means that the results can be still affected by atmospheric residues or by periodical phenomena related to the land use, but not to deformations. It is expected that this issues will improve notably in forthcoming deliveries.

The document consists of 3 sections: after the introduction, Section 2 describes the Sentinel-1 dataset at hand; Section 3 describes the delivered map and finally Section 4 underline particular aspects about the results.

2 DATASET DESCRIPTION

The processed dataset consists of 34 Sentinel-1 Wide Swath images acquired during the period spanning from 5th November 2014 to 4th February 2016 (see Table 2-1 and Table 2-2). Table 1 shows the acquisition dates of the images: it can be observed that the maximum time interval of consecutive images is 48 days. The red square of Table 1 shows the super master date. The main characteristics of the used images are summarized in Table 2. Figure 2 shows the footprint of the processed datasets consisting in 18 bursts divided in 3 swaths.

To process the interferometric products, we have used the SRTM Digital Elevation Model provided by NASA, and the precise orbits.

To derive the deformation map we have generated a network of 227 interferograms with a maximum temporal baseline of 108 days. This number has been selected by analyzing the decrease of the temporal coherence.

The selected resolution has been the multi-look 2x10 that corresponds to a footprint of approximately 40x40 m. This resolution is a compromise between density of measureable points, due to coherence, and resolution high enough to detect small deformation phenomena.

¹ Devanthery, M. Crosetto, O. Monserrat, M. Cuevas-González, B. Crippa . An approach to persistent scatterer interferometry Remote Sens., 6 (7) (2014), pp. 6662–6679.

Nº image	Date	Nº image	Date	Nº image	Date	Nº image	Date
1	05/11/2014	10	02/21/2015	19	08/08/2015	28	24/11/2015
2	17/11/2014	11	03/05/2015	20	20/08/2015	29	06/12/2015
3	29/11/2014	12	03/17/2015	21	01/09/2015	30	18/12/2015
4	11/12/2014	13	03/29/2015	22	13/09/2015	31	30/12/2015
5	23/12/2014	14	04/22/2015	23	25/09/2015	32	11/01/2016
6	04/01/2015	15	06/09/2015	24	07/10/2015	33	23/01/2016
7	16/01/2015	16	07/03/2015	25	19/10/2015	34	04/02/2016
8	28/01/2015	17	07/15/2015	26	31/10/2015		
9	09/02/2015	18	07/27/2015	27	12/11/2015		

Table 2-1 Dates of the 34 processed Sentinel-1 images. In red is highlighted the date of the super-master image.

<i>Satellite</i>	Sentinel-1
<i>Acquisition mode</i>	Wide Swath
<i>Period</i>	Nov 2014 - January 2016
<i>Minimum revisit period [days]</i>	12
<i>Wavelength (λ) [cm]</i>	5.55
<i>Polarization</i>	VV
<i>Full resolution (azimuth/range) [m]</i>	14/4
<i>Multi-look 1x5 resolution (azimuth/range) [m]</i>	14/20
<i>Multi-look 2x10 resolution (azimuth/range) [m]</i>	28/40
<i>Orbit</i>	Descending
<i>Incidence angle of the area of interest</i>	36.47° - 41.85°

Table 2-2 Main characteristics of the processed data.



Figure 2-1 Mean amplitude image geocoded and superimposed to a Google earth image.

3 MAP DESCRIPTION

The delivered map consists in a shape file with the following fields:

Field	Description	Units
<i>ID</i>	Name of the point	-
<i>Row</i>	Radar image line	-
<i>Col</i>	Radar image column	-
<i>Fi</i>	WGS84 Geographic Latitude	[°]
<i>Lambda</i>	WGS84 Geographic Longitude	[°]
<i>E</i>	UTM East	[m]
<i>N</i>	UTM North	[m]
<i>H</i>	SRTM Height	[m]
<i>Velocity</i>	Point displacement velocity	[mm/year]
<i>SO</i>	Sigma zero of the velocity	[mm]
<i>aaaa/mm/dd</i>	Deformation value at date aaaa/mm/dd	[mm]

Table 3-1 Description of the fields of the final deformation map shape file.

4 OBSERVATIONS

- The total number of points is 1082727: 618412 in Tenerife, 399739 in Gran Canaria and 64576 in La Gomera.
- The deformations are in **Line of Sight**, i.e. they represent the projection of the real 3D displacement in the direction “satellite-point”.
- The positive values represent points that are going far from the satellite (i.e. subsidence in case of vertical displacements). The negative ones represent those which are moving towards the satellite.
- The spatial variability is still high. We expect to improve it when processing longer periods.
- The north area of the Tenerife Island is affected by atmospheric residues (latitude higher than 28.515810). In this area it has been not possible to remove them in a reliable way. However, we have keep the result because it can be analysed locally.
- The results have been analysed only from the radar processing point of view. It is needed a geological analysis in order to interpret correctly the provided results.