

Article

A Global Archive of Coseismic DInSAR Products Through Unsupervised Sentinel-1 Data Processing

Fernando Monterroso¹, Manuela Bonano¹, Claudio De Luca¹, Riccardo Lanari¹, Michele Manunta¹, Mariarosaria Manzo¹, Giovanni Onorato¹, Ivana Zinno¹ and Francesco Casu^{1,*}

¹ Institute for Electromagnetic Sensing of the Environment, National Research Council (IREA-CNR), via Diocleziano 328, 80124 Naples, Italy; E-Mails: monterroso.f@irea.cnr.it (F.M.); bonano.m@irea.cnr.it (M.B.) deluca.c@irea.cnr.it (C.D.L.); lanari.r@irea.cnr.it (R.L.); manunta.m@irea.cnr.it (M.M.); manzo.mr@irea.cnr.it (Ma.M.); onorato.g@irea.cnr.it (G.O.); zinno.i@irea.cnr.it (I.Z.); casu.f@irea.cnr.it (F.C.)

* Correspondence: casu.f@irea.cnr.it; Tel.: +39-02-23699-595

Received: date; Accepted: date; Published: 29 September 2020

Abstract

This supplement contains information on the formats and metadata of the generated products, as specified by the European Plate Observing System (EPOS) infrastructure [1]. The provided examples are relevant to the actual wrapped coseismic Sentinel-1 interferogram spanning the Mw 7.1 and Mw 6.4 Ridgecrest (CA) seismic events occurred on July 2019.

Introduction

EPOS defined a set of DInSAR products within the Satellite Data Thematic Core Service (SatD-TCS) group. Each product can be provided by several research infrastructures that participate to the SatD-TCS. Common standards on the product formats and the associated metadata have been defined, to make all of them consistent all the products

Concerning Radar data, the first distinction is on the Static Maps and Time-series. The first are relevant to products that capture an episode or a specific time interval and consist on single maps, while the latter represent the evolution of phenomena along time and are typically represented with multiple maps or time-series. In the following we focus on the Static Maps, which is the “family” of the products generated by our tool, such as Differential interferograms and displacement maps.

Static Map products generated by the different partners of the SatD-TCS can be provided either geocoded or in the native radar coordinates. In both cases, they are represented as raster floating point matrices within a geoTIFF envelope. All the products generated by our tool are geocoded with a WGS84 datum and geographic projection.

A preview image in PNG format is also provided per every product. The preview is typically used to visualize the data within the EPOS portal.

Product metadata are provided as well and are deeply described in the following.

Data Types

EPOS specifications indicates the following data types for the main and ancillary geocoded products related to ground deformation:

- Wrapped Differential Interferograms (Amplitude and Phase);

- Unwrapped Differential Interferograms (Amplitude and Phase);
- Spatial Coherence;
- Map of LOS vector (NEU coefficients).

While the content of the first three products is easily understandable from the product name itself, the last one contains the 3D components of the LOS vector along the North, East and West directions per every image pixel.

Any filtering, multilooking or other operation that alter the original signal must be indicated in the product metadata.

File name convention

File name convention is as follows:

`<DataType>_<UserID>_<MasterDate>_<SlaveDate>_<UniqueCode>.<FileExtension>`

where:

- `<DataType>` can be: `InW` (Wrapped Interferogram), `InU` (Unwrapped Interferogram), `Coh` (Spatial Coherence), `CosNEU` (Map of LOS vector);
- `<UserID>` is the name of the user or service that generated the product;
- `<MasterDate>` date of the Master acquisition in the format `<yyyymmdd>`.
- `<SlaveDate>` date of the Slave acquisition in the same `<MasterDate>` format;
- `<UniqueCode>` a unique code identifier of 4 digit;
- `<FileExtension>` possible values are:
 - `tif`: the actual data in geoTiff;
 - `xml`: the full metadata list in XML format according to the EPOS specifications (see Table S1 for an example);
 - `png`: a quick-look raster image;
 - `pngw`: the geocoding information for the png image;
 - `kmz`: the google format overlay containing the quick-look image;
 - `legend.png`: the color bar for the png image;
 - `zip`: a compressed archive containing all the previous files.

Note that only the first three file type are mandatory (`tif`, `xml` and `png`) for being compliant with the EPOS specifications. However, the products generated by our tool also include the remaining list.

Typical name samples are:

`InW_CNRIREA_20190704_20190716_4522.tif`

`Coh_CNRIREA_20190704_20190716_4522.tif`

Conventions and assumptions

Results are provided in the satellite Line Of Sight (LOS). Positive values indicate that the target moves toward the satellite.

Data access

Presently, the EPOS catalogue population is in progress. Uploaded products (and metadata) can be anonymously searched and visualized through the EPOS portal. The portal allows the users to perform geographic queries and visualize the preview of the retrieved results over a background map. Product download is freely available to all the EPOS users according to a Creative Commons (CC-BY) license. Moreover, the access to the EPOS product is also granted to the GEP users through their GEP credentials.

Metadata

Product metadata have been defined within the SatD-TCS and follow the ISO 19119 standard. Metadata structure leverages on the EOP and SAR classes. A set of Vendor specific parameters has been implemented to map the peculiarity of the DInSAR products, such as the spatial baseline and the reference and subsidiary images. An example of metadata associated to each product is provided in Table S1 (actual values are relevant to the wrapped interferogram covering the Mw 7.1 and Mw 6.4 Ridgecrest (CA) seismic events).

Table S1: EPOS metadata specification for wrapped interferograms

Tag	Example	Notes
Data_Type	WRAPPED_INTERFEROGRAM	Type of data (according to the EPOS categories)
Product_ID	InW_CNRIREA_20190704_20190716_4522	may usually correspond to the file name
Product_format	GEOTIFF	File Format
Product_size	221467468	In byte
Product_url	https://store.terradue.com/gep-epos-datarepo/.../InW_CNRIREA_20190704_20190716_4522.zip	Product file location
Preview_url	https://store.terradue.com/gep-epos-datarepo/.../InW_CNRIREA_20190704_20190716_4522.png	Preview location
Bounding_box	36.4508333 -118.9350000 34.4936111 -115.9266667	The polygon relevant to the processed area
License	https://creativecommons.org/licenses/by/4.0	Product applicable license
User_ID	CNRIREA	User that generated the product
Software_version	CNR-IREA P-SBAS 28	
Applied_algorithm_description	Parallel SBAS Interferometry Chain	Short description of the algorithm used to generate the product
Main_reference	10.1109/TGRS.2002.803792, 10.1109/JSTARS.2014.2322671	DOIs of the main publications describing the used algorithms

Date_of_measurement_start	2019-07-04T13:51:58.270310Z	UTC
Date_of_measurement_end	2019-07-16T13:51:59.052884Z	UTC
Date_of_production	2019-07-20T08:30:01Z	UTC
Date_of_publication	2020-07-24T15:21:12Z	UTC
Service_used_for_generation	EPOSAR	EPOS service used for generating the product
Geographic_CS_type_code	4326	EPSG
Used_DEM	SRTM_1arcsec	DEM used for the interferometric processing
Super_master_SAR_image_ID	S1A_IW_SLC__1SDV_20190704T135158_20190704T135225_027968_032877_1C4D.SAFE	Reference SAR geometry
Master_SAR_image_ID	S1A_IW_SLC__1SDV_20190704T135158_20190704T135225_027968_032877_1C4D.SAFE	Master Image
Slave_SAR_image_ID	S1A_IW_SLC__1SDV_20190716T135159_20190716T135226_028143_032DC3_512B.SAFE	Slave Image
Perpendicular_baseline	-30.4611	In meters
Parallel_baseline	-5.36057	In meters
Along_track_baseline	0.377224	In meters
Ground_spatial_res	74, 74	In meters
Sensor	S1	Used sensor
Mode	IW	Acquisition mode
Antenna_side	Right	Right/Left
Relative_orbit_number	71	Satellite Track
Wavelength	0.055465760	In meters
Number_of_looks_azimuth	5	Applied multilook along azimuth
Number_of_looks_range	20	Applied multilook along range
Applied_corrections	No_Corrections	Description of possible correction applied to the interferograms or time series

Applied_filter	Goldstein_0.5	Possible spatial filter applied to the interferogram
----------------	---------------	--

References

1. EPOS, European Plate Observing System, Available online: <https://www.epos-ip.org/tcs/satellite-data> (accessed on 28 July 2020).



© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).