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Supporting Information for

Ground deformation and source geometry of the 24 August 2016 Amatrice earthquake (Central Italy) investigated through analytical and numerical modeling of DInSAR measurements and structural-geological data

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Introduction

This supplement contains supporting figures and tables cited in the main document. In particular, it is aimed to provide additional information on:

- Geological and seismological data (Figures S1 and S2; dataset S1);
- DInSAR measurements (Table S1);
- analytical modeling results for the two planar sources (Figure S3);
- analytical modeling results for the single fault (Figure S4);
- FE modeling results (Figure S5).

An ESRI shape file (Dataset S1: VE-GO 1.0) that contains the fault traces of the Vettore (VE) and Gorzano (GO) normal faults and their depth contour lines, as preliminarily reconstructed in this paper (Figures 1c and 1d in the main document), is made available on request at glavecchia@unich.it.

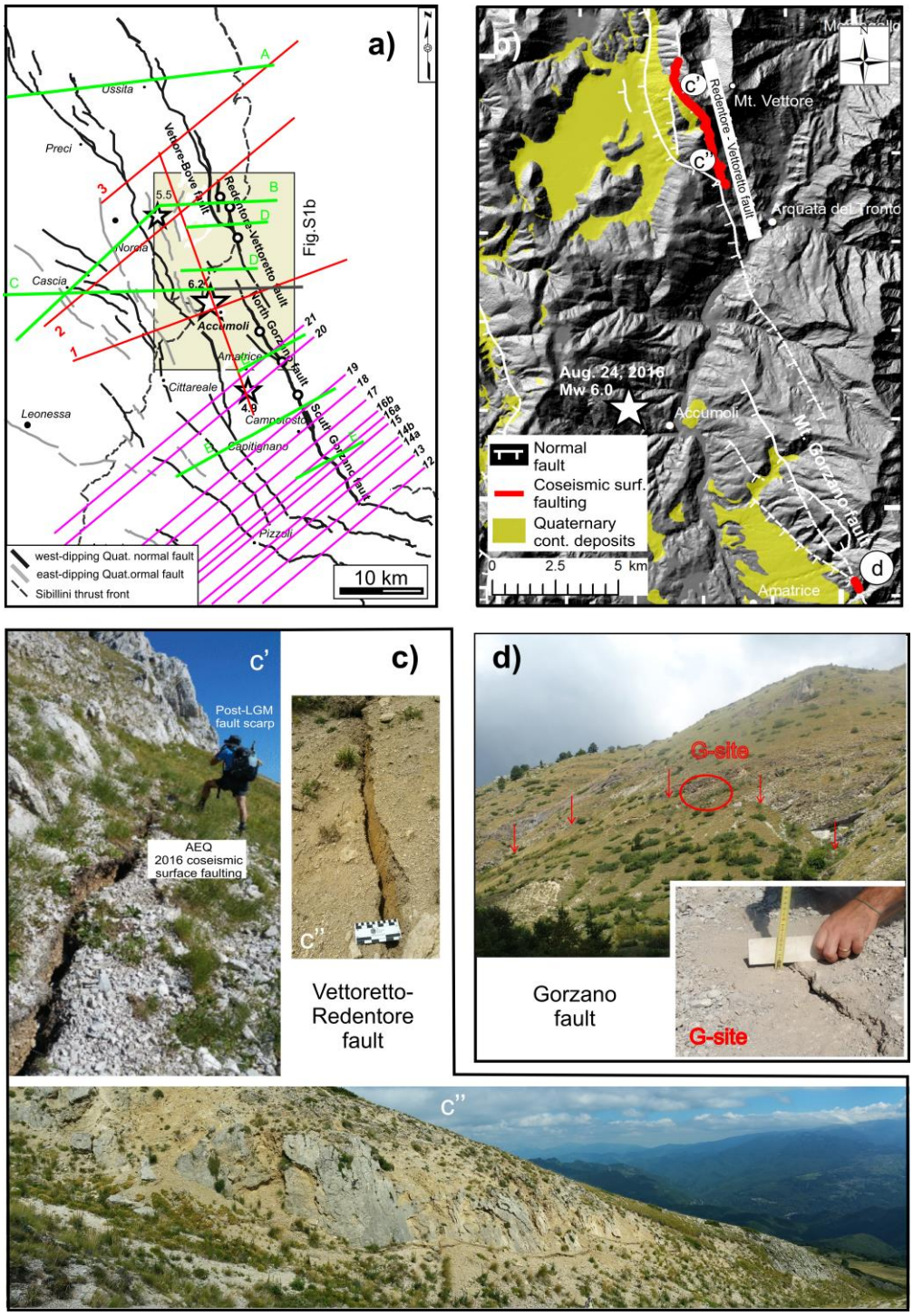

Figure S1. (a) Trace of the sections used to build the 3-D fault model presented in Figures 1c and S2d. Key: green traces = geological sections from Lavecchia, 1985; Barchi, 1991; Brozzetti & Lavecchia, 1994; Boncio et al., 2004b; Lavecchia et al., 2012; pink traces = earthquake sections across the 2009 L'Aquila sequence from Valoroso et al., 2013; red sections = preliminary earthquake sections across the Amatrice sequence from Gruppo di Lavoro INGV sul terremoto di Amatrice (2016).

(b, c, d) Coseismic surface ruptures of the 24 August 2016 earthquake: b) structural sketch of the VF and GF traces with location of the coseismic ruptures (red heavy lines); (c) photos of primary coseismic fractures with offset up to 25 cm, surveyed along the Redentore (c')-Vettoretto (c'') faults; (d) evidence of coseismic rupture on the Gorzano fault.

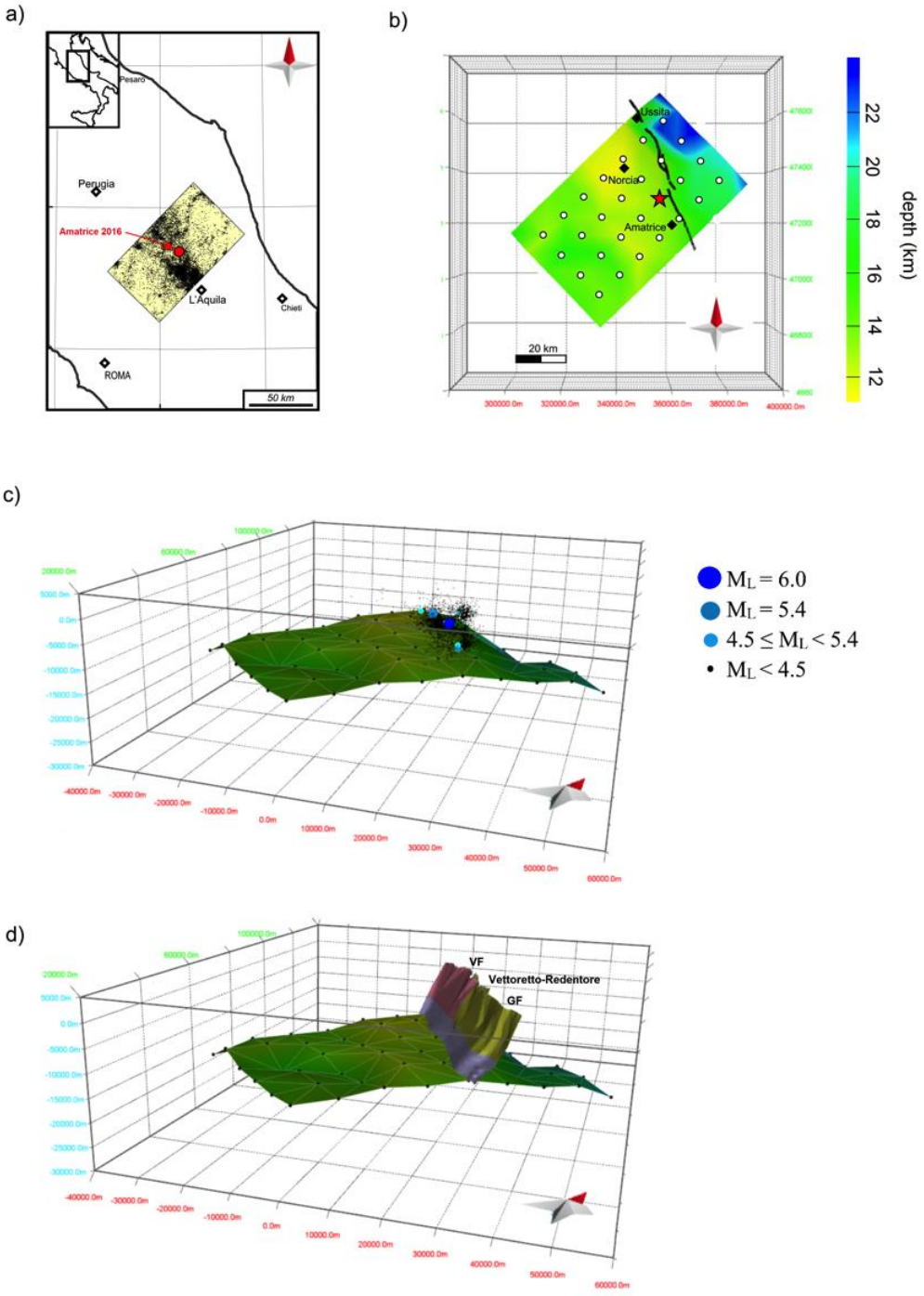

Figure S2. Base of seismogenic layer computed on a regular grid (10 x 10 km^2) considering the cumulative frequency distribution versus depth of the crustal events occurred in the period 2005–2012 (revised BSI 2005-2012; Chiarabba et al., 2015). The evaluation was performed detecting the layer that releases the 90% of events as in Sibson, 1984. (a, b) Maps showing the instrumental seismicity distribution (0.4 ≤ML≤5.1) occurred within the study area (black dots on map a) and the regular grid considered for the cut off seismicity estimates (white dots on map b). (c) 3-D view of the calculated base of the seismogenic layer (green surface) and of the Amatrice seismic sequence from 24 to 31 August 2016; (d) 3-D view the of the Gorzano (GF) and Vettore (VF) fault surfaces as reconstructed in this paper (see Figure 1d in the main document).

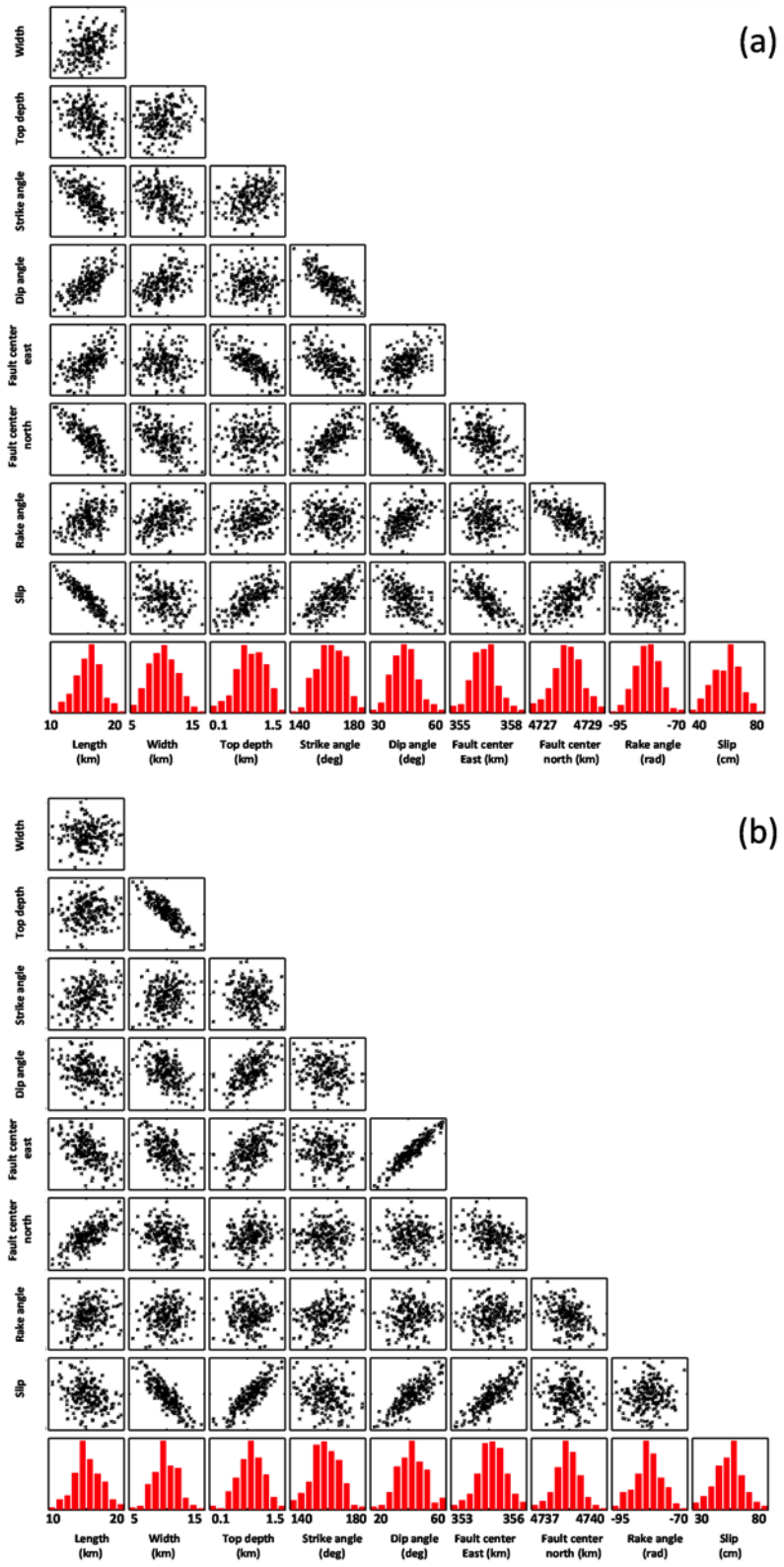

Figure S3. Two planar sources uncertainty analysis for the nonlinear inversion for the Fault 1 in panel 'a' and the Fault 2 in panel 'b': standard deviation (red histograms) and trade-offs (scatter plots) between the model parameters are shown.

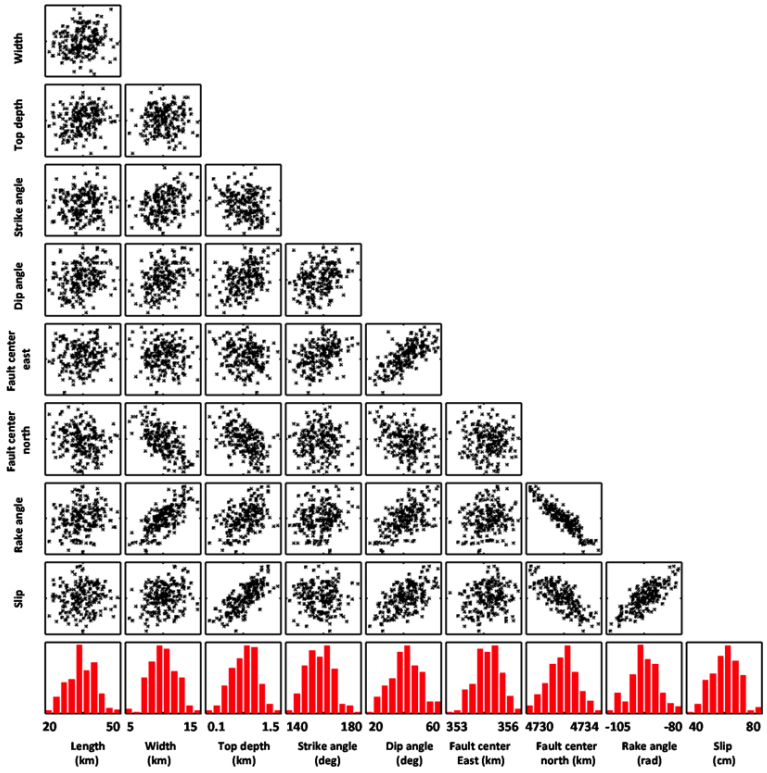

Figure S4. Single fault uncertainty analysis for the nonlinear inversion: standard deviation (red histograms) and trade-offs (scatter plots) between the model parameters are shown.

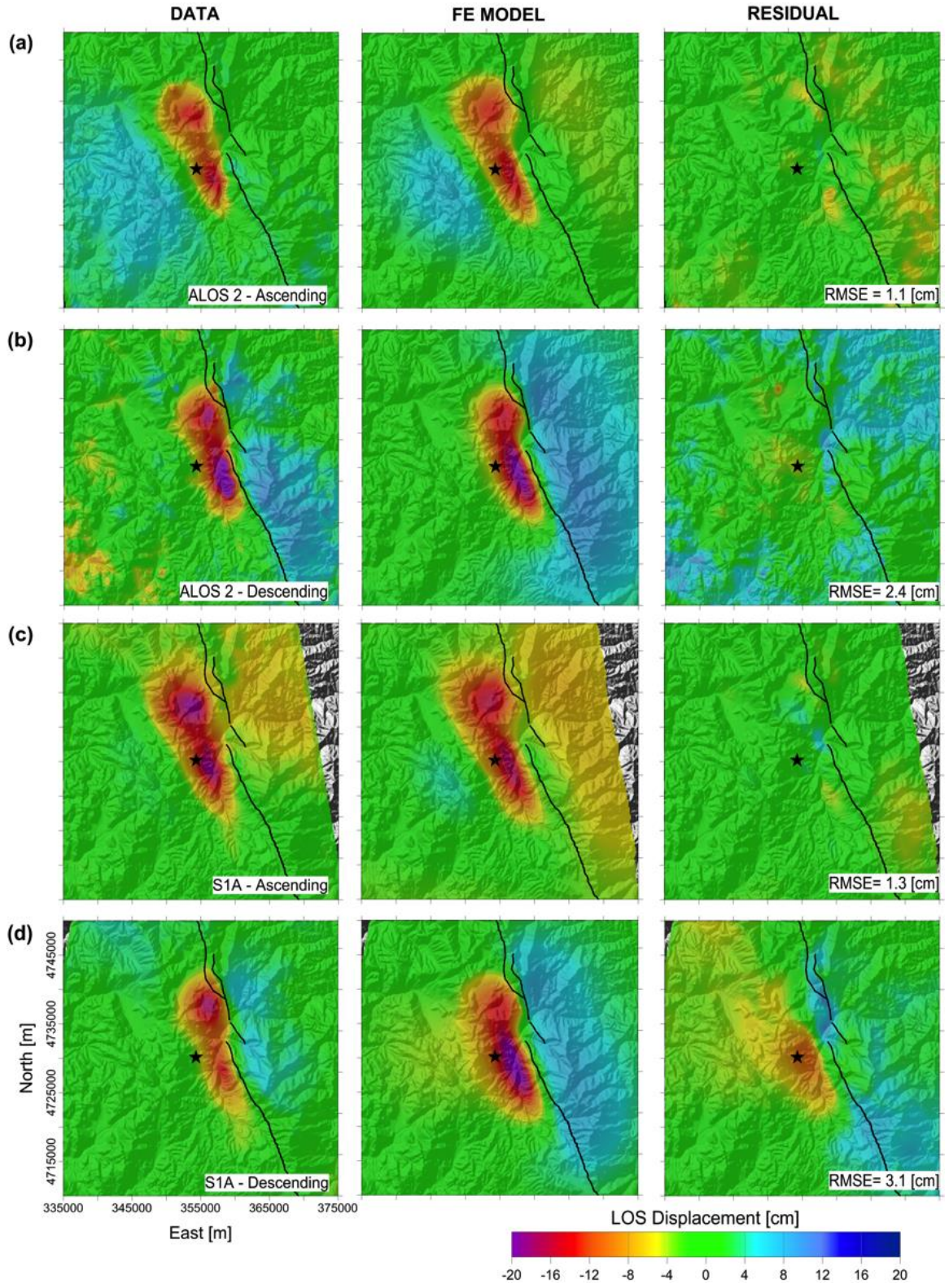

Figure S5. FE modeling results. (a) DInSAR (LOS) coseismic map computed by using ALOS2 data acquired from ascending orbit on 09 September 2015 and 24 August 2016 (left panel); LOS projected FE solution (central panel); residual map (right panel). (b) Same as (a), but using ALOS2 data acquired from descending orbit on 25 May 2016 and 31 August 2016. (c) Same as (a), but using S1 data acquired from ascending orbit on 15-27 August 2016. (d) Same as (a) using S1 data acquired from descending orbit on 21-27 August 2016. The black star represents the main shock epicenter (Amatrice, 24 August 2016); the computed RMSE values are also shown on the bottom right corner of the right panels.

Table S1. Coseismic interferometric pairs exploited for the DInSAR analysis.

Sensor	Acquisition Mode	Interferometric pair	λ** [cm]	Perpendicular baseline [m]	Orbit	Sensor Look Angle [deg]	Figure 2
ALOS 2	Stripmap	09092015-24082016	24.2	-198	ASC	36.6	a
ALOS 2	Stripmap	25052016-31082016	24.2	88	DESC	32.9	b
S1	IWS*	15082016S1A-27082016S1A	5.56	32	ASC	39	c
S1	IWS*	21082016S1A-27082016S1B	5.56	79	DESC	39	d

*IWS: Interferometric Wide Swath

**λ: is the sensor wavelength