ITA18 flat-file

MANUAL

INTRODUCTION

The flat-file are provided in a .zip file, containing

i) the parametric table **ITA18_flatfile_SA.csv** (semicolon separated) which contains several intensity measures (Peak Ground Acceleration, Peak Ground Velocity, Peak Ground Displacement, Arias Intensity, Housner Intensity, Effective Duration and Cumulative Absolute Velocity) and the spectral acceleration ordinates calculated assuming 5% damping in the range 0.01-10s of the ITA18 dataset (Luzi et al. 2017; Lanzano et al. 2019a, b) and the associated metadata;

ii) several dictionaries (.txt files) explaining the fields of the parametric table (each dictionary has the same field name);

iii) the user manual you are consulting.

The dictionary "**reference.txt**" contains the full citations of all the reference fields in the tables.

If you use these data, cite as:
Lanzano, G., Ramadan, F., Luzi, L., Pacor, F., Felicetta, C., Puglia, R., Sgobba, S. and D'Amico, M. (2022). ITA18 SA flatfile [Data set]. Istituto Nazionale di Geofisica e Vulcanologia (INGV). https://doi.org/10.13127/ita18/sa_flatfile

In the following sections, we provide a brief description of the fields, grouping them as i) event metadata, ii) source metadata, iii) station metadata, iv) source to site distances, v) waveforms metadata, and vi) intensity measures.

Each fault is exemplified with a rectangular plane. For the event with moment magnitude larger than 5.5, a fault geometry is defined. When the geometry is not available from literature studies, it has been simulated following the procedure of Kaklamanos et al. (2011), originally developed to convert the different metrics implemented in the Ground Motion Prediction Equations. The virtual fault is constructed using four basic input parameters: strike, dip, seismic moment or moment magnitude and hypocentral coordinates of the event.

The flat-file includes the source-to-site distance measures introduced into the NGA-West2 database (Ancheta et al., 2014). Figure 1 shows how source-to-site distances are calculated. In particular, the right panel illustrates the distance R_X defined to be positive for sites on the hanging-wall side of the fault and negative for sites on the footwall side of the fault. The distance R_{Y0} is zero or positive (Kaklamanos et al., 2011).

The waveform components are flagged as:

- **U**: 1st component;
- **V**: 2nd component;
- **W**: 3rd component.

We used U, V, W for the waveform components, as they can be oriented not only according to the Traditional North-South, East-West, and vertical directions (see

http://www.fdsn.org/seed_manual/SEEDManual_V2.4.pdf, pag. 134).

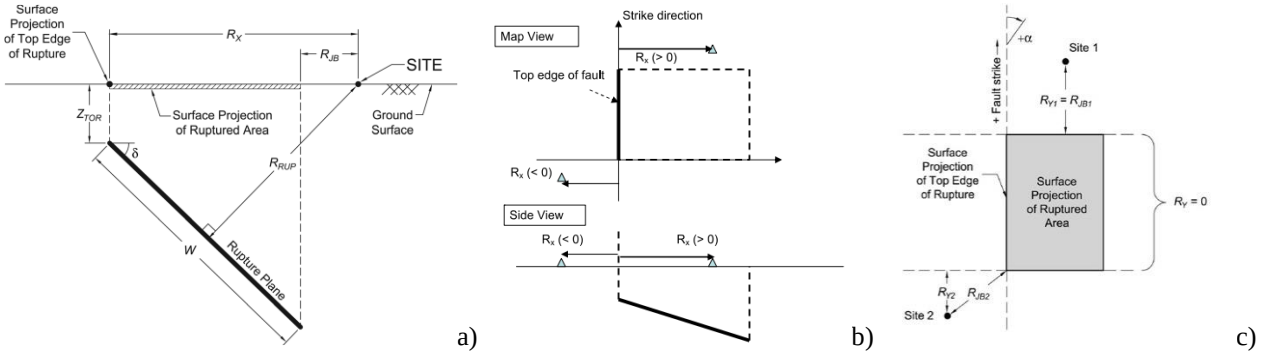

Figure 1. a) Representation of the earthquake source and distance measures using a vertical cross section through a fault rupture plane (taken from Kaklamanos et al., 2011). b) map (top) and side (bottom) view of the source-to-site distance measure (R_X) for an example fault (thick black line) plane and stations located on the hanging wall ($R_X > 0$) and footwall ($R_X < 0$) side (taken from Ancheta et al., 2013). c) map view of R_{Y0} definition.

Combinations of horizontal components of SA are flagged as **RotD50**, i.e., the median value of the distribution of the intensity measures of the rotated waveforms (Boore 2010).

Event metadata

- **event_id**: the unique identifier of the event in ITACA;
- **event_time**: UTC date time of the event (format YYYY-MM-DD hh:mm:ss);
- **ISC_ev_id**: event identifier in the bulletin of the International Seismological Centre (ISC, http://www.isc.ac.uk);
- **USGS_ev_id**: event identifier of the United States Geological Service (USGS, https://earthquake.usgs.gov);
- **INGV_ev_id**: event identifier in the bulletin of the Istituto Nazionale di Geofisica e Vulcanologia (INGV, http://cnt.rm.ingv.it);
- **EMSC_ev_id**: event identifier in the bulletin of the Centre Sismologique Euro-Méditerranéen (EMSC-CSEM, http://www.emsc-csem.org);
- **ev_nation_code**: ISO code of the country where the epicenter of the event is located (see Table A1);
- **ev_latitude** and **ev_longitude**: the geographic coordinates (decimal degrees, WGS84) of the epicenter of the event;
- **ev_depth_km**: depth of the hypocenter of the event [km];
- **ev_hyp_ref**: reference for **ev_latitude**, **ev_longitude** and **ev_depth_km** (see dictionary "reference.csv");
- **fm_type_code**: style of faulting (NF normal fault; TF reverse fault; SS strike-slip fault; O oblique fault; U undefined).
- **ML**: local magnitude;
- **ML_ref**: reference for **ML** estimate (see dictionary "reference.csv");
- **Mw**: moment magnitude;

- **Mw_ref**: reference for **Mw** estimate (see dictionary “reference.csv”);
- **Ms**: surface waves magnitude;
- **Ms_ref**: reference for **Ms** estimate (see dictionary “reference.csv”).

Source metadata

- **event_source_id**: unique identifier for the source;
- **es_nucleation_latitude** and **es_nucleation_longitude**: geographic coordinates [decimal degrees] of the starting point of the rupture on the fault plane (nucleation point);
- **es_nucleation_coord_ref**: reference for **es_nucleation_latitude** and **es_nucleation_longitude**;
- **es_nucleation_depth**: depth [km] of the of the starting point of the rupture on the fault plane (nucleation point);
- **es_nucleation_depth_ref**: reference for **es_nucleation_depth**;
- **es_strike**: fault strike (degrees from North);
- **es_dip**: fault dip [deg];
- **es_rake**: fault rake [deg];
- **es_strike_dip_rake_ref**: reference for **es_strike**, **es_dip** and **es_rake** estimates (see dictionary “reference.csv”);
- **es_z_top**: depth of the fault top [km];
- **es_z_top_ref**: reference for **es_z_top** estimate;
- **es_latul** and **es_lonul:** geographic coordinates [decimal degrees] of the upper left (reference point) of the projection of the fault plane**;**
- **es_latur** and **es_lonur:** geographic coordinates [decimal degrees] of the upper right of the projection of the fault plane;
- **es_latlr** and **es_lonlr:** geographic coordinates [decimal degrees] of the lower right of the projection of the fault plane;
- **es_latll** and **es_lonll:** geographic coordinates [decimal degrees] of the lower left of the projection of the fault plane;
- **es_length**: fault length [km];
- **es_width**: fault width [km];
- **es_geometry_ref**: reference for **es_length** and **es_width** estimate (see dictionary “reference.csv”).

Station metadata

- **network_code**: the code associated to the recording network according to the International Federation of Seismograph Network (http://www.fdsn.org);
- **station_code**: 3 to 5 characters associated to the station;
- **location_code**: a two characters’ code that identifies the sensor location (see

http://www.fdsn.org/seed_manual/SEEDManual_V2.4.pdf, pag 37);

- **instrument_code**: a two characters' code; the first letter specifies the general sampling rate and the response band of the instrument; The second letter specifies the family to which the sensor belongs (http://www.fdsn.org/seed_manual/SEEDManual_V2.4.pdf);
- **sensor_depth_m**: sensor depth [m];
- **proximity_code**: a numeric code indicating the proximity to structures ('0': free-field; '1': close to structure; '2': no information; '3': inside structure; '4': close to ENEL cabs for Italian stations. See also dictionary "d_proximity_code.csv");
- **housing_code**: 3 alphanumeric characters which denote the sensor housing type (see dictionary "d_housing_code.csv");
- **installation_code**: code related to the instrument installation ('P' = installed on a pillar; 'PS' = installed on the building basement; 'T' = installed directly on the ground. See also dictionary "d_installation_code.csv");
- **st_nation_code**: ISO code of the country where the station is located (see Table A1);
- **st_latitude** and **st_longitude**: the geographic coordinates (decimal degrees, WGS84) of the station;
- **st_elevation:** elevation of the station above sea level [m];
- **ec8_code:** EC8 site category (Figure 2; CEN, 2003);
- **ec8_code_method:** method used to estimate **ec8_code** (see dictionary)**;**
- **ec8_code_ref:** reference for **ec8_code** estimate;
- **vs30_m_sec:** the average shear wave velocity in the first 30 m $V_{S,30}$ (CEN, 2003) derived from in-situ measurements [m/s];
- **vs30_ref:** reference for **vs30_m_sec** estimate;
- **vs30_calc_method**: the method used to estimate vs30_m_sec (see dictionary "d_vs30_calc_method_code.csv");
- **vs30_meas_type**: the geophysical surveys carried out to estimate the Vs profile (see dictionary "d_vs_test_type.csv")
- **slope_deg**: slope computed according to Zevenbergen and Thorne (1987), using a 90m DEM (Digital Elevation Map provided by Shuttle Radar Topography Mission);
- **vs30_m_sec_WA:** $V_{S,30}$ inferred from topography, according to Wald and Allen (2007) correlation (m/s);

Ground type	Description of stratigraphic profile	Parameters		
		$v_{s,30}$ (m/s)	N_{SPT} (blows/30cm)	c_u (kPa)
A	Rock or other rock-like geological formation, including at most 5 m of weaker material at the surface.	> 800	–	–
B	Deposits of very dense sand, gravel, or very stiff clay, at least several tens of metres in thickness, characterised by a gradual increase of mechanical properties with depth.	360 – 800	> 50	> 250
C	Deep deposits of dense or medium-dense sand, gravel or stiff clay with thickness from several tens to many hundreds of metres.	180 – 360	15 - 50	70 - 250
D	Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive soil.	< 180	< 15	< 70
E	A soil profile consisting of a surface alluvium layer with v_s values of type C or D and thickness varying between about 5 m and 20 m, underlain by stiffer material with v_s > 800 m/s.			
S_1	Deposits consisting, or containing a layer at least 10 m thick, of soft clays/silts with a high plasticity index (PI > 40) and high water content	< 100 (indicative)	–	10 - 20
S_2	Deposits of liquefiable soils, of sensitive clays, or any other soil profile not included in types A – E or S_1			

Figure 2. EC8 ground types (Table 1.2.3 from EUR 25204 EN – 2012, CEN 2003).

Source to site distance metrics

- **epi_dist**: epicentral distance [km] (Figure 1);
- **epi_az**: event-to-station azimuth [deg];
- **nucl_epi_dist**: distance from the projection of the starting point of the rupture on the fault plane [km] (nucleation point distance). If the source model does not provides information, the nucleation point is located at mid-length and at 2/3 of the fault width assuming a bilateral rupture propagation;
- **JB_dist**: Joyner-Boore distance [km] (Figure 1);
- **rup_dist**: distance from the rupture plane [km] (Figure 1);
- **Rx_dist**: hanging distance [km], calculated according to Ancheta et al. (2014; Figure 1);
- **Ry0_dist**: footwall distance [km], calculated according to Ancheta et al. (2014; Figure 1).

Waveform metadata

- **instrument_type_code**: ‘A’ = analog instrument; ‘D’ = digital instrument; ‘U’ = unknown type of instrument (see also dictionary “d_instrument_type_code.csv);
- **late_triggered_flag_01**: flag for late triggered waveforms (triggered by S waves arrivals);
- **web_availability_code**: code indicating if the record is public on the ITACA

(https://itaca.mi.ingv.it/ItacaNet_32/#/home) or Engineering Strong Motion (ESM, https://esm-db.eu; Luzi et al., 2020) website (see dictionary "d_web_availability_code.csv");

- ***X*_channel_code**: channel code of the *X* component according to the SEED convention http://www.fdsn.org/seed_manual/SEEDManual_V2.4.pdf, pag. 134).
- ***X*_azimuth_deg**: azimuth of the *X* component from the North [deg];
- ***X*_hp**: high pass filter frequency of the *X* component [Hz];
- ***X*_lp**: low pass filter frequency of the *X* component [Hz];

Where *X* = U, V, W and RotD50 (see section 'Introduction').

Intensity measures

- ***X*_pga**: peak ground acceleration [cm/s^2];
- ***X*_pgv**: peak ground velocity [cm/s];
- ***X*_pgd**: peak ground displacement [cm];
- ***X*_T90**: duration [s] of the time interval between the points of 5% and 95% of the total energy (Trifunac and Brady, 1975);
- ***X*_housner**: Housner intensity [cm];
- ***X*_ia**: Arias intensity [cm/s];
- ***X*_CAV**: cumulative absolute velocity [cm/s];
- ***X*_Ty_yyy**: spectral ordinates (SA in cm/s^2) for 'y_yyy' period.

Where:

- *X* component = U, V, W and RotD50 (see section 'Introduction');
- y_yyy identifies the period corresponding to the spectral ordinate (where the '_' indicates the decimal point, e.g. 0_100 corresponds to T=0.100s);

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APPENDIX

Table A1. Nation codes (ISO 3166 Codes).

Code	Country	Code	Country
AL	Albania	JO	Jordan
AM	Armenia	LI	Liechtenstein
AT	Austria	MA	Morocco
AZ	Azerbaijan	MC	Monaco
BA	Bosnia and Herzegowina	MD	Moldova
BG	Bulgaria	ME	Montenegro
CH	Switzerland	MK	Macedonia
CY	Cyprus	PL	Poland
CZ	Czech Republic	PT	Portugal
DE	Germany	RO	Romania
DZ	Algeria	RS	Serbia
ES	Spain	RU	Russia
FR	France	SI	Slovenia
GE	Georgia	SM	San Marino
GR	Greece	SY	Syria
HR	Croatia	TM	Turkmenistan
HU	Hungary	TR	Turkey
IL	Israel	UA	Ukraine
IR	Iran	UZ	Uzbekistan
IS	Iceland	XK	Kosovo
IT	Italy		