

## APPENDIX TO

## DATA INTEGRATION AND FAIR DATA MANAGEMENT IN SOLID EARTH SCIENCE

Daniele Bailo<sup>\*,1</sup>, Keith G. Jeffery<sup>2</sup>, Kuvvet Atakan<sup>3</sup>, Luca Trani<sup>4</sup>, Rossana Paciello<sup>1</sup>,  
Valerio Vinciarelli<sup>5</sup>, Jan Michalek<sup>3</sup>, Alessandro Spinuso<sup>4</sup>

<sup>1</sup> Istituto Nazionale di Geofisica e Vulcanologia (INGV), Via di Vigna Murata 605, Rome, Italy

<sup>2</sup> Keith G Jeffery Consultants, United Kingdom

<sup>3</sup> Universitetet i Bergen (UiB) 5020 Bergen, Norway

<sup>4</sup> Department of R&D Seismology and Acoustics, Royal Netherlands Meteorological Institute (KNMI), Utrechtseweg 297, 3731 GA, De Bilt, The Netherlands

<sup>5</sup> EPOS ERIC, Via di Vigna Murata 605, Rome, Italy

The Appendix A provides an overview of TCS services heterogeneity by reporting (a) TCS name, (b) Service Group Name, (c) Service Name, (d) Representation types of Data provided by Service (i.e. georeferenced, time-series, non-georeferenced), (e) Service Response Payload<sup>1</sup> Standard, (f) Service Specification, (g) Service Response Formats.

---

<sup>1</sup> We refer to payload in meaning adopted in the information communications technology (ICT): when data is sent over the Internet, each unit transmitted includes both header information and the actual data being sent. The latter is referred to as the payload. So, the payload refers to the data sent by a web-service as a response to a request. Such data can be structured according to a certain standard (e.g., OGC WMS) and are serialized in a certain encoding format (e.g., XML, JSON, etc.)

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
<b>Anthropogenic Hazard Observations</b>	Anthropogenic services	List of episodes	georeferenced	Custom	Custom	json
	Anthropogenic services	List of applications	non-georeferenced	Custom	Custom	json
	Anthropogenic episodes	Episode CZORSZTYN: shallow water reservoir - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode SONG TRANH: deep water reservoir - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode MONTEYNARD: water reservoir - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode VAL D'AGRI: water reservoir - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode VOUGLANS: water reservoir - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode GROSS SCHOENEBECK: geothermal energy production experiment - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode SOULTZ-SOUS-FORETS 1993 STIMULATION - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode SOULTZ-SOUS-FORETS 2000 STIMULATION - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode SOULTZ-SOUS-FORETS 2003 STIMULATION - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode THE GEYSERS Prati 9 and Prati 29 cluster: Treated wastewater injection for geothermal power production - dataset	georeferenced, time-series	Custom	Custom	json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Anthropogenic episodes	Episode THE GEYSERS: geothermal energy production - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode ST. GALLEN: geothermal project - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode SOULTZ-SOUS-FORETS 2004 STIMULATION - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode SOULTZ-SOUS-FORETS 2005 STIMULATION - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode COOPER BASIN: geothermal energy production - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode LGCD: regional seismicity and ground motion associating underground hard rock mining - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode USCB: regional seismicity and ground motion associating underground coal mining - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode BOBREK MINE: local seismicity linked to longwall mining - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode PYHASALMI MINE: in situ underground laboratory - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode GISOS-CERVILLE: underground solution mining - dataset	georeferenced, time-series	Custom	Custom	json
Anthropogenic episodes	Episode THORESBY COLLIERY: underground coal mining - dataset	georeferenced, time-series	Custom	Custom	json	

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Anthropogenic episodes	Episode ASFORDBY: underground coal mining - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode NORTHWICH: underground salt extraction cavities - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode PREEALL MINE: underground salt extraction cavities - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode LACQ GAS FIELD: conventional hydrocarbon extraction - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode VAL D'AGRI FIELD: conventional hydrocarbon extraction - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode OKLAHOMA: conventional and unconventional hydrocarbon extraction and wastewater injection - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode GRONINGEN FIELD: conventional hydrocarbon production - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode GAZLI: hydrocarbon field - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode STARFISH: underground gas storage - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode VAL D'AGRI FIELD: conventional hydrocarbon extraction - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode OKLAHOMA: conventional and unconventional hydrocarbon	georeferenced, time-series	Custom	Custom	json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
		extraction and wastewater injection - dataset				
	Anthropogenic episodes	Episode PREESE HALL: Shale Gas - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode OKLAHOMA: conventional and unconventional hydrocarbon extraction and wastewater injection - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode LUBOCINO: Shale Gas - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode WYSIN: Shale Gas - dataset	georeferenced, time-series	Custom	Custom	json
	Anthropogenic episodes	Episode COTTON VALLEY: hydraulic fracturing - dataset	georeferenced, time-series	Custom	Custom	json
<b>Geological Information and Modeling</b>	Borehole data	Borehole Discovery Service	georeferenced	OGC WFS	OGC	json
	Borehole data	Borehole View Service	georeferenced	OGC WMS	OGC	jpeg, geotiff, png, gml2
	Geological maps	Geological Map 1:1,000,000 (OneGeology-Europe layer)	georeferenced	OGC WMS	OGC	png, jpeg, gml2, geotiff
	Geological maps	Geological Feature Discovery Service	georeferenced	OGC WFS	OGC	json
	3D/4D models	3D/4D Model View Service	georeferenced	OGC WMS	OGC	gml2, png, geotiff, jpeg
	3D/4D models	3D/4D Model Discovery Service	georeferenced	OGC WFS	OGC	json
	Mineral resources	Mine Discovery Service based on Minerals4EU dataset	georeferenced	OGC WFS	OGC	json
	Mineral resources	Mine View Service based on Minerals4EU dataset	georeferenced	OGC WMS	OGC	jpeg, geotiff, png, gml2
<b>Geomagnetic Observations</b>	Geomagnetic data	INTERMAGNET Geomagnetic Observatory Data	time-series	IAGA2002	Custom	pdf, xml, iaga2002, json, imfv122, jpg, html, imagcdf, covjson, wdc, excel

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Geomagnetic data	World Data Centre (WDC) Geomagnetic Observatory Station List	georeferenced	Custom	Custom	json
	Geomagnetic data	INTERMAGNET Geomagnetic Observatory Station List	georeferenced	Custom	Custom	json
	Geomagnetic data	World Data Centre (WDC) Geomagnetic Observatory Data	time-series	Custom	Custom	json, xml, csv
	Geomagnetic data	Magnetometer data of the International Monitor for Auroral Geomagnetic Effects (IMAGE)	time-series	Custom	Custom	txt
	Geomagnetic data	IMAGE station list	georeferenced	Custom	Custom	json
	Geomagnetic data	Global geomagnetic survey data collected by the World Data Centre (WDC)	georeferenced	Custom	Custom	csv, json, geo-json
	Geomagnetic models	World Magnetic Model (WMM)	non-georeferenced	Custom	Custom	json, xml, csv, html, txt
	Geomagnetic models	International Geomagnetic Reference Field (IGRF), global model	non-georeferenced	Custom	Custom	xml, csv, txt, json, html
	Geomagnetic indices and events	Index data from the International Service for Geomagnetic Indices (ISGI)	time-series	IAGA2002	Custom	zip
	Geomagnetic indices and events	Event data from the International Service for Geomagnetic Indices (ISGI)	time-series	IAGA2002	Custom	zip
	Geomagnetic indices and events	IMAGE station list (electrojet indicators)	georeferenced	Custom	Custom	json
	Geomagnetic indices and events	Electrojet indicators for the IMAGE network	time-series	Custom	Custom	txt
	Geomagnetic indices and events	Event indicators for the IMAGE network	time-series	Custom	Custom	txt

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Geomagnetic indices and events	IMAGE station list (electrojet events)	georeferenced	Custom	Custom	json
	Magnetotelluric models and data	Magnetotelluric time series	time-series	Custom	Custom	json
	Magnetotelluric models and data	Magnetotelluric sites view	georeferenced	Custom	Custom	json
	Magnetotelluric models and data	Magnetotelluric transfer functions	non-georeferenced	Custom	Custom	json
	Magnetotelluric models and data	Electrical conductivity models	non-georeferenced	Custom	Custom	json
<b>GNSS Data and Products</b>	GNSS data	List RINEX Files search parameters	non-georeferenced	Custom	Custom	json
	GNSS data	Download RINEX file Metadata from EPOS Validated Providers	non-georeferenced	Custom	Custom	json
	GNSS data	GNSS Stations with RINEX Data	georeferenced	Custom	Custom	json
	GNSS data products	Raw GNSS Position Time Series from WUT-EUREF Distribution	time-series	Custom	Custom	pbo, covjson, xml, midas, json, hector
	GNSS data products	Cleaned GNSS Position Time Series from UGACNRS Distribution	time-series	Custom	Custom	midas, json, pbo, hector, covjson, xml
	GNSS data products	Cleaned GNSS Position Time Series from INGV Distribution	time-series	Custom	Custom	json, hector, pbo, covjson, midas, xml
	GNSS data products	Cleaned GNSS Position Time Series from ROB-EUREF Distribution	time-series	Custom	Custom	hector, json, covjson, pbo, xml, midas
	GNSS data products	Cleaned GNSS Position Time Series from LTK Distribution	time-series	Custom	Custom	midas, xml, pbo, json, hector, covjson
	GNSS data products	Cleaned GNSS Position Time Series from LTK-EUREF Distribution	time-series	Custom	Custom	json, xml, covjson, hector, midas, pbo

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	GNSS data products	GNSS Station Velocities from ROB-EUREF Distribution	georeferenced	Custom	Custom	json
	GNSS data products	GNSS Station Velocities from LTK- Distribution	georeferenced	Custom	Custom	json
	GNSS data products	GNSS Station Velocities from LTK-EUREF Distribution	georeferenced	Custom	Custom	json
	GNSS data products	List Product Download Search Criteria	georeferenced	Custom	Custom	json
	GNSS data products	GNSS Stations with Products	georeferenced	Custom	Custom	json
<b>Near Fault Observations</b>	Seismological data	CRL Velocity and Acceleration Waveform - RESIF	time-series	MiniSEED	FDSN	bin
	Seismological data	CRL Velocity and Acceleration Waveform - NOA	time-series	MiniSEED	FDSN	bin
	Seismological data	Vrancea Velocity and Acceleration Waveform	time-series	MiniSEED	FDSN	bin
	Seismological data	TABOO Velocity and Acceleration Waveform	time-series	MiniSEED	FDSN	bin
	Seismological data	Marmara Velocity and Acceleration Waveform	time-series	MiniSEED	FDSN	bin
	Seismological data	IRPINIA Velocity and Acceleration Waveform	time-series	MiniSEED	FDSN	bin
	Seismological data	CRL Stations - NOA	georeferenced	FDSN StationXML	FDSN	xml
	Seismological data	CRL Stations - RESIF	georeferenced	FDSN StationXML	FDSN	xml
	Seismological data	IRPINIA Stations	georeferenced	FDSN StationXML	FDSN	xml
	Seismological data	Marmara Stations	georeferenced	FDSN StationXML	FDSN	xml
	Seismological data	Vrancea Stations	georeferenced	FDSN StationXML	FDSN	xml, json, text
	Seismological data	TABOO Stations	georeferenced	FDSN StationXML	FDSN	xml
	Seismological data	IRPINIA Events	georeferenced	QuakeML	FDSN	text, xml



TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Seismological data	CRL Events	georeferenced	QuakeML	FDSN	xml, text
	Seismological data	Vrancea Events	georeferenced	QuakeML	FDSN	text, xml
	Seismological data	TABOO Events	georeferenced	QuakeML	FDSN	xml, text
	Seismological data	Vrancea Vp/Vs	time-series	Custom	Custom	json
	Seismological data	TABOO Vp/Vs	time-series	Custom	Custom	json
	Seismological data	IRPINIA Vp/Vs	time-series	Custom	Custom	json
	Seismological data	Historical earthquakes of interest for the Vrancea NFO (FDSN-event)	georeferenced	QuakeML	FDSN	xml, text, json
	Seismological data	Historical earthquakes of interest for the SISZ NFO (FDSN-event)	georeferenced	QuakeML	FDSN	json, text, xml
	Seismological data	Historical earthquakes of interest for the VALAIS NFO (FDSN-event)	georeferenced	QuakeML	FDSN	json, xml, text
	Seismological data	Historical earthquakes of interest for the TABOO NFO (FDSN-event)	georeferenced	QuakeML	FDSN	text, json, xml
	Seismological data	Historical earthquakes of interest for the CRL NFO (FDSN-event)	georeferenced	QuakeML	FDSN	json, xml, text
	Seismological data	Historical earthquakes of interest for the MARMARA NFO (FDSN-event)	georeferenced	QuakeML	FDSN	text, xml, json
	Seismological data	Historical earthquakes of interest for the IRPINIA NFO (FDSN-event)	georeferenced	QuakeML	FDSN	text, json, xml
	Geochemical data	TABOO Rn concentration and local temperature	time-series	Custom	Custom	json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Geochemical data	Vrancea Rn concentration and local temperature	time-series	Custom	Custom	json
	Geochemical data	Vrancea Radon Stations	georeferenced	Custom	Custom	json
	Geochemical data	TABOO Radon Stations	georeferenced	Custom	Custom	json
	Geochemical data	TABOO Meteo at CO2 site	time-series	Custom	Custom	json
	Geochemical data	TABOO CO2 soil dynamic concentration	time-series	Custom	Custom	json
	Geochemical data	TABOO CO2 Stations	georeferenced	Custom	Custom	json
	Geophysical data	CRL Strainmeter Waveforms and Water level-pressure Data	time-series	MiniSEED	FDSN	bin
	Geophysical data	CRL Strainmeter Station Information	georeferenced	FDSN StationXML	FDSN	xml
	Geophysical data	Vrancea Infrasound Waveform Data	time-series	MiniSEED	FDSN	bin
	Geophysical data	Vrancea Infrasound Station Information	georeferenced	FDSN StationXML	FDSN	text, xml, json
<b>Satellite Data</b>	InSAR data	Wrapped Interferograms	georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json
	InSAR data	Spatial Coherence	georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json
	InSAR data	Unwrapped Interferograms	georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	InSAR data	Map of LOS Vector	georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json
	InSAR data	Interferogram Atmospheric Phase Screen from Global Atmospheric Model	georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json
	InSAR data	DEM in radar geometry	non-georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json
	InSAR data	Lookup table from radar coordinates to ground coordinates	non-georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json
	InSAR data	LOS Displacement Time Series	georeferenced	OGC Earth Observation Metadata profile of Observations & Measurements	OpenSearch	json
<b>Seismology</b>	Waveform services	Seismic waveforms distributed by EIDA (federated access)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by the RESIF Data Center, France	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by LMU (Ludwig Maximilian University Munich)	time-series	MiniSEED	FDSN	bin

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Waveform services	Seismic waveforms distributed by NOA (National Observatory of Athens, Greece)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by GFZ (German Research Centre for Geosciences)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by SED/ETHZ (Swiss Seismological Service at ETH Zurich, Switzerland)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by ICGC	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by UIB-NORSAR (University of Bergen & NORSAR)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by KNMI (ORFEUS Data Center)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by INGV (Italian National Institute of Geophysics and Volcanology)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by NIEP (National Institute for Earth Physics, Romania)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by KOERI (Kandilli Observatory and Earthquake Research Institute, Turkey)	time-series	MiniSEED	FDSN	bin
	Waveform services	Seismic waveforms distributed by BGR (Federal Institute for Geosciences and Natural Resources, Germany)	time-series	MiniSEED	FDSN	bin

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Waveform services	Quality metrics distributed by EIDA (federated access)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by KNMI (ORFEUS Data Center)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by NIEP (National Institute for Earth Physics)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by GFZ (German Research Centre for Geosciences)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by UIB-NORSAR (University of Bergen & NORSAR)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by NOA (National Observatory of Athens, Greece)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by KOERI (Kandilli Observatory and Earthquake Research Institute, Turkey)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by ICGC	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by BGR (German Federal Institute of Geosciences and Natural Resources)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by SED/ETHZ (Swiss Seismological Service at ETH Zurich, Switzerland)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by RESIF Data Center, France	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Quality metrics distributed by INGV (Italian National Institute	georeferenced, time-series	FDSN availability JSON schema	FDSN	json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
		of Geophysics and Volcanology)				
	Waveform services	Quality metrics distributed by LMU (Ludwig Maximilian University Munich)	georeferenced, time-series	FDSN availability JSON schema	FDSN	json
	Waveform services	Station metadata distributed by EIDA (federated access)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by ICGC	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by KOERI (Kandilli Observatory and Earthquake Research Institute, Turkey)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by NIEP (National Institute for Earth Physics, Romania)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by GFZ (German Research Centre for Geosciences)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by BGR (Federal Institute for Geosciences and Natural Resources, Germany)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by UIB-NORSAR (University of Bergen & NORSAR)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by NOA (National Observatory of Athens, Greece)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by LMU (Ludwig Maximilian University Munich)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by SED/ETHZ (Swiss	georeferenced	FDSN StationXML	FDSN	xml

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
		Seismological Service at ETH Zurich, Switzerland)				
	Waveform services	Station metadata distributed by the RESIF Data Center, France	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by INGV (Italian National Institute of Geophysics and Volcanology)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Station metadata distributed by KNMI (ORFEUS Data Center)	georeferenced	FDSN StationXML	FDSN	xml
	Waveform services	Engineering Strong-Motion (ESM) Flatfile 2018	non-georeferenced	Custom	Custom	zip
	Waveform services	USGS Shakemap input files from the ESM (manual) database	non-georeferenced	Custom	Custom	xml
	Waveform services	USGS Shakemap input files from the RRSN (automatic) database	non-georeferenced	Custom	Custom	xml
	Seismological products	Bibliography for historical earthquakes	non-georeferenced	Custom	Custom	rdf, bib, xml, xml_oai, xml_dc
	Seismological products	Flinn-Engdahl region lookup service	non-georeferenced	Custom	Custom	geojson, xml, json
	Seismological products	Seismic Event Identifier mapping service	non-georeferenced	Custom	Custom	text, json
	Seismological products	Parameters of modern earthquakes (1998-present) - FDSN event	georeferenced	QuakeML	FDSN	json, xml, text
	Seismological products	Seismic moment tensor data	georeferenced	QuakeML	FDSN	xml, quakeml, text, json
	Seismological products	Parameters of historical earthquakes (1000-1899) - FDSN event	georeferenced	QuakeML	FDSN	text, xml, json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Seismological products	Parameters of historical earthquakes (1000-1899) - OGC WFS	georeferenced	OGC WFS	OGC	kml, csv, gml2, json, shape-zip, excel, gml3, excel2007
	Seismological products	Parameters of historical earthquakes (1000-1899) - OGC WMS	georeferenced	OGC WMS	OGC	kml+xml, kmz, rss+xml, png, atom+xml, pdf, tiff, geotiff, gml2, tiff8, png, geotiff8, html, gif, json, jpeg, svg+xml
	Seismological products	Felt reports for modern earthquakes (2012-present)	georeferenced	Custom	Custom	json, geojson, text
	Seismological products	Macroseismic intensity data for historical earthquakes (1000-1899)	georeferenced	QuakeML	Custom	xml, textmacro, text, jsonmacro, json
	Seismological products	Fault rupture models (SRCMOD)	georeferenced	Custom	Custom	geojson, json
	Earthquake hazard and risk products	European Database of Seismogenic Faults - Crustal Faults (OGC WFS)	georeferenced	OGC WFS	OGC	gml3, csv, gml32, ogr-kml, ogr-mif, ogr-tab, shape-zip, json, ogr-csv, gml2, kml
	Earthquake hazard and risk products	European Database of Seismogenic Faults - Subductions (OGC WFS)	georeferenced	OGC WFS	OGC	json, ogr-tab, kml, csv, gml3, ogr-mif, gml2, shape-zip, ogr-csv, ogr-kml, gml32
	Earthquake hazard and risk products	European Database of Seismogenic Faults (OGC WMS)	georeferenced	OGC WMS	OGC	geotiff8, jpeg, png, svg+xml, gif, gml2, tiff, png, tiff8, jpeg, geotiff
	Earthquake hazard and risk products	ESHM13 475 yr mean PGA hazard map (OGC WMS)	georeferenced	OGC WMS	OGC	gml2, png
	Earthquake hazard and risk products	European Exposure Model Level 0 (OGC WMS)	georeferenced	OGC WMS	OGC	plain, html, jpeg, png, gml2, xml
	Earthquake hazard and risk products	European Exposure Model Level 1 (OGC WMS)	georeferenced	OGC WMS	OGC	jpeg, xml, gml2, plain, html, png
<b>Volcano Observations</b>	Seismological data	Seismic stations Guadeloupe Martinique Reunion	georeferenced	FDSN StationXML	FDSN	xml



TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Seismological data	Seismic waveforms Guadeloupe Martinique Reunion	time-series	MiniSEED	FDSN	bin
	Seismological data	Seismic Waveforms Santorini	time-series	MiniSEED	FDSN	bin
	Seismological data	Seismic stations Santorini	georeferenced	FDSN StationXML	FDSN	xml
	Geodetic data	GNSS raw data Iceland	time-series	RINEX	Custom	json
	Geodetic data	Tiltmeter waveforms Guadeloupe Martinique Reunion	time-series	MiniSEED	FDSN	bin
	Geodetic data	Tiltmeters Guadeloupe Martinique Reunion station	georeferenced	FDSN StationXML	FDSN	xml
	Geodetic data	Tide stations Guadeloupe	georeferenced	FDSN StationXML	FDSN	xml
	Geodetic data	Tide waveforms Guadeloupe	time-series	MiniSEED	FDSN	bin
	Geodetic data	GNSS station list Iceland	georeferenced	Custom	Custom	json
	Geodetic data	GNSS Station information in Iceland	georeferenced	Custom	Custom	json
	Geochemical data	Geochemical analysis of melt inclusions from magmatic rocks and gases samples	georeferenced	Custom	Custom	geo-json
	Geochemical data	Geochemical analysis of magmatic rocks from the DYNVOLC database	georeferenced	Custom	Custom	geo-json
	Geochemical data	Bulk Rock Analysis FileDistribution	non-georeferenced	Custom	Custom	txt
	Geochemical data	Bulk Rock Analysis WSDistribution	non-georeferenced	Custom	Custom	json
	Satellite data	Geostationary satellite derived Volcanic Ash and SO2 plumes products	georeferenced	Custom	Custom	json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Satellite data	Geostationary satellite derived Volcanic Thermal Anomalies products	georeferenced	Custom	Custom	json
	Satellite data	Wrapped Differential Interferograms	georeferenced	Custom	Custom	json
	Satellite data	InSAR Wrapped Interferogram over the Piton de la Fournaise Volcano	georeferenced	Custom	Custom	json
	Satellite data	Lava flow contour derived from InSAR data	georeferenced	Custom	Custom	json
	Ground based remote sensing data	Ground based radar data Iceland	georeferenced	Custom	Custom	json
	Ground based remote sensing data	Ground based visible and thermal/IR camera Iceland	georeferenced	Custom	Custom	json
	Ground based remote sensing data	Doppler radar near source eruptive parameters	georeferenced	Custom	Custom	json
	Ground based remote sensing data	Ground based UV spectra (DOAS) Iceland	georeferenced	Custom	Custom	json
	Ground based remote sensing data	OPGC Doppler radar raw spectra	georeferenced	Custom	Custom	json
	Volcanological/petrological data	Volcanic activity reports Iceland	non-georeferenced	Custom	Custom	json
	Volcanological/petrological data	Reports on volcanic activity Guadeloupe Martinique Reunion	non-georeferenced	Custom	Custom	json
	Volcanological/petrological data	Weekly Volcanic Report Italy	non-georeferenced	Custom	Custom	json
	Volcanological/petrological data	VONA reports for the Icelandic volcanoes	non-georeferenced	Custom	Custom	json
	Volcanological/petrological data	Volcano Observatory Notice for Aviation Guadeloupe Martinique Reunion	non-georeferenced	Custom	Custom	json

TCS Name	Service Group Name	Service Name	Data Representations	Service Response Payload Standard	Service Standard	Service Response Formats
	Volcanological/petrological data	Aviation color codes for Icelandic volcanoes	non-georeferenced	Custom	Custom	json
	Volcanological/petrological data	Volcano Observatory Notice for Aviation Italy	non-georeferenced	Custom	Custom	json
	Volcanological/petrological data	Catalogue of Icelandic volcanic eruptions	non-georeferenced	Custom	Custom	json
	Volcanological/petrological data	Collection of Magmatic Rocks and Samples	non-georeferenced	Custom	Custom	json
	Geohazards products	S02 probabilistic hazard maps Iceland	georeferenced	Custom	Custom	json
	Geohazards products	Susceptibility Maps Distribution	georeferenced	Custom	Custom	json
	Geohazards products	Lava flow invasion hazard maps	georeferenced	Custom	Custom	json
	Geohazards products	Tephra fallout hazard maps for explosive volcanoes	georeferenced	Custom	Custom	json
	Geohazards products	Tephra fallout hazard maps Iceland	georeferenced	Custom	Custom	json
	Geohazards products	PDCs Hazard maps	georeferenced	Custom	Custom	json
	Geohazards products	Probabilistic Hazard maps	georeferenced	Custom	Custom	json
	Geohazards products	Guideline on S02 health effects	non-georeferenced	Custom	Custom	pdf
	Geohazards products	Daily ash/gas forecasting Iceland	non-georeferenced	Custom	Custom	json
	Geohazards products	Software catalog Italy	non-georeferenced	Custom	Custom	json