SUMMARY

ObsPy in a Nutshell

Python combines the power of a **fullblown programming language** with the flexibility and fast code development of an **interactive scripting language**. Its extensive standard library and large variety of freely available high quality scientific modules cover most needs in **developing scientific processing workflows**.

ObsPy extends Python's capabilities to fit the specific needs that arise when working with seismological data. It a) provides **read and write support for all of the most important waveform, station and event metadata formats** b) enables **direct access to all important data centers, web services and databases** to easily retrieve waveform data and station/event metadata and c) comes with a continuously growing **powerful signal processing toolbox** that covers all everyday tasks in seismological analysis.

In combination with mature and free Python packages like NumPy, SciPy, Matplotlib, IPython/Jupyter, sympy, pandas and scikitlearn, **ObsPy makes it possible to develop complete seismological processing workflows**, ranging from reading locally stored data or requesting data from one or more different data centers via signal analysis and data processing to visualization in GUI and web applications, output of modified/derived data and the creation of publicationquality figures. All functionality is **extensively documented** and the online **ObsPy Tutorial and Gallery** give a good impression of the wide range of possible use cases. ObsPy is tested and **running on Linux, Mac OS X and Windows** and comes with installation routines for these systems. ObsPy is developed in a test-driven approach and is available under the **LGPLv3 open source licence**.

Users are welcome to request help, report bugs, propose enhancements or contribute code via either the user mailing list or the **project page on GitHub**.

OBSPY AS A BRIDGE

The Scientific Python Ecosystem

Over the last decade, Python grew a vast and rich ecosystem of scientific third party libraries. **ObsPy serves as a bridge** and enables its users to effortlessly tie into this system giving access to large amounts of tools designed to process and analyze data.

STEADY EVOLUTION

What's New?

· New Formats: Guralp GCF, Reftek 130, AH (write support added), NNSK KB Core, Nordic s-file, SCARDEC catalog files, GSE2.0 bulletin, SC3ML, IASPEI ISF ISM 1.0 Bulletin, SEED/RESP (now with inventory integration), Arclink XML, Receiver Gather 1.6, Seismic Handler EVT files

· Full normalization in correlations for template matching

· Client for the Nominal Response Library (NRL)

· Support for two FDSNWS routing services (IRIS federator + EIDAWS routing)

· New QC module, ... and much more!

ObsPy

A Python Framework for Seismology

Try it now: seismo-live.org

Tobias Megies[1], Lion Krischer[2], Derrick JA Chambers[3], Tom Eulenfeld[4], Calum John Chamberlain[5], Robert Barsch[6] & the ObsPy Development Team

[1]Ludwig Maximilians University of Munich, Germany; [2]ETH Zürich, Switzerland; [3]Centers for Disease Control and Prevention, WA, USA; [4]Friedrich Schiller University of Jena, Germany; [5]Victoria University of Wellington, New Zealand; [6]EGU Office Munich, Germany

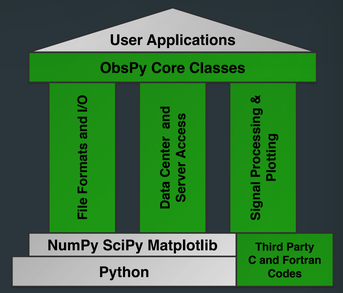
@ devs@obspy.org | obspy | http://obspy.org | obspy

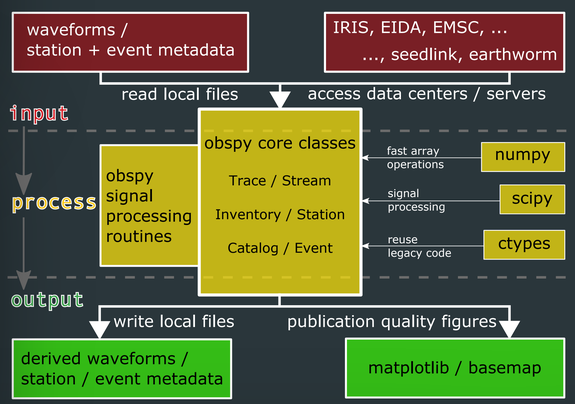
What Can I Do With ObsPy?

Easy to use helper functions to access local files and online data centers give **quick access to all data necessary for seismological data analysis**.

All acquired information is exposed to the user in **ObsPy's core classes that handle waveform data, station and event metadata in a unified, consistent fashion, regardless of the data source**. This makes it easy to combine data from different sources in unified work flows, both interactively and automated.

ObsPy's core classes have many convenience routines for signal processing directly attached for **quick, reproducible and well tested execution of common processing tasks**.





SUPPORTED WAVEFORM FILE FORMATS

AH, ASCII, CSS, Guralp GCF, GSE2, KINEMETRICS, MiniSEED, NIED.KNET, PDAS, RG16, REFTEK 130, SAC, SEISAN, SEG-2, SEG-Y, SH, WAV, WIN, Y

SUPPORTED STATION FILE FORMATS

ArcLink, CSS, KML, SACPZ, Seiscomp, Seismic Handler EVT, Shapefiles, StationTXT, StationXML, XSEED, SEED, RESP

SUPPORTED EVENT FILE FORMATS

CMTSOLUTION, CNV, GSE2, IASPEI, JSON, KML, NDK, NIED.F-NETMT, NLLOC, Nordic, PDE, Seiscomp, SCARDEC, Shapefiles, QuakeML, Zmap

IS IT USED?

Impact, Sustainability, and Applications

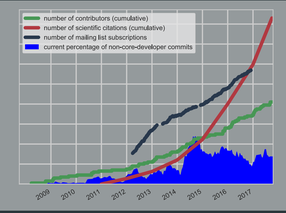
Nine years after the beginnings of the project, ObsPy is used by seismologists all around the world. With **tens of thousands conda downloads in the last year** (only one of many ways to install ObsPy), **we estimate — including Mac, Windows and other Linux/Unix users — an active user base of several thousand people**.

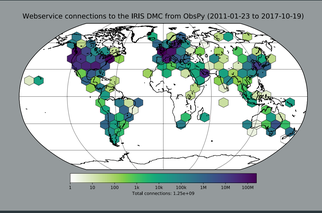
Cross -platform single-line installation:

```
$ conda install -c conda-forge obspy
```

Since ObsPy's start by a core developer team of 3 – 5 people at LMU Munich, ObsPy has evolved into a com munity effort with direct **contributions to the code base by over 70 individuals**.

The busy user mailing list currently has around **580 subscribers** and serves as a place for discussions and asking for help from more experienced users.



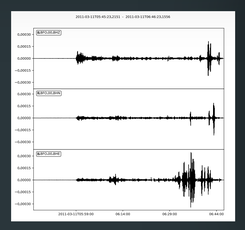


The **impact of ObsPy and the appreciation within the seismological community** finds expression in the increasing number of scientific citations, which stands at about 512 as of Dezember 2018. Applications are numerous and include event (re)locations, ambient seismic noise analysis, seismic tomography, rotational seismology studies, timedependent seismology, and more. Additionally, a large variety of programs built on top of ObsPy are appearing (full list including URLs at http://obspy.org):

scisola · instaseis · pyasdf · SALVUS IMAGE EVERYTHING · EQcorrscan Correlation for earthquake detection in Python · REDPy Repeating Earthquake Detector

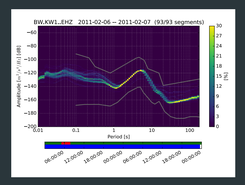
Basic Example

```
import obspy

# The read() method can read data from all kinds of sources (files, web,
# archives, ...) and auto-detects the data format and parses it to a common
# structure.
st = obspy.read("data.mseed")

# The read_inventory() method does the same for station meta information.
inv = obspy.read_inventory("station.xml")

# Remove a linear trend.
st.detrend("linear")
# Taper the ends.
st.taper(max_percentage=0.05, type="hann")
# Go to M/S.
st.remove_response(inventory=inv, output="VEL",
                   pre_filt=(3.0 / 100.0, 1.0 / 50.0, 10.0, 20.0))
# Bandpass filter - note that this is a 20th order filter which is still
# unstable.
st.filter("bandpass", freqmin=0.1, freqmax=1.0,
          corners=10, zerophase=True)
# Resample to 100 Hz. This uses an almost ideal sinc-based reconstruction
# filter. `a` is the support samples of the filter.
st.interpolate(method="lanczos", sampling_rate=100.0, a=12)

# Finally plot it.
st.plot()
```



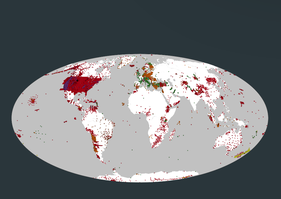
Probabilistic Power Spectral Densities

```
import obspy
from obspy.signal import PPSD
from obspy.io.xseed import Parser

# Read data directly from a web address.
st = obspy.read("https://examples.obspy.org/BW.KW1..EHZ.D.2011.037")
parser = Parser("https://examples.obspy.org/dataless.seed.BW_KW1")

# Init PPSD object and add meta information.
ppsd = PPSD(st[0].stats, metadata=parser)
# Add data.
ppsd.add(st)

# Add more data.
st = obspy.read("https://examples.obspy.org/BW.KW1..EHZ.D.2011.038")
ppsd.add(st)

# Plot it.
ppsd.plot()
```



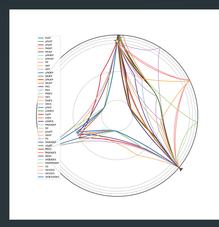
Mass Downloader Example

```
import obspy
from obspy.clients.fdsn.mass_downloader import CircularDomain, \
    Restrictions, MassDownloader

origin_time = obspy.UTCDateTime(2011, 3, 11, 5, 47, 32)

# Circular domain around the epicenter.
domain = CircularDomain(latitude=37.52, longitude=143.04,
                        minradius=70.0, maxradius=90.0)

restrictions = Restrictions(
    # Temporal bounds:
    starttime=origin_time - 5 * 60, endtime=origin_time + 3600,
    # Discard gaps/overlaps and short traces.
    reject_channels_with_gaps=True, minimum_length=0.95,
    # No two stations should be closer than 10 km to each other.
    minimum_interstation_distance_in_m=10E3,
    # Only HH or BH channels. If a station has HH channels, those will
    # have priority, and BH channels will be discarded.
    channel_priorities=["HH[ZNE]", "BH[ZNE]"],
    location_priorities=["", "00", "10"])

mdl = MassDownloader()  # Download from all FDSN web service providers.
# The data will be downloaded to the "waveforms/" and "stations/" folders.
mdl.download(domain, restrictions, mseed_storage="waveforms",
             stationxml_storage="stations")
```



TauP Example

```
import matplotlib.pyplot as plt
from obspy.taup import TauPyModel
# Initialize model, 1066a is default.
# Currently available built-in models are: 1066a, 1066b, ak135, ak135f,
# ak135f_no_mud, herrin, iasp91, jb, prem, pwdk, sp6
#
# Non-earth models work as well.
m = TauPyModel(model="ak135")

# Get the ray paths. Alternatively one can also get just the arrival times or
# pierce points.
arrivals = m.get_ray_paths(source_depth_in_km=500, distance_in_degree=130)
# plot() is a convenience function.
arrivals.plot(show=False)
plt.savefig("taup_plot.pdf")
```



THANK YOU

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