windpowerlib and hydropowerlib

Reiner Lemoine Institut

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Motivation

Feed-in time series of RE are the basis for all simulations of future energy systems conducted f.i.

- Grid extension planning
- Estimation of needed backup and storage capacities

Therefore they need to be

- Of high quality
- Transparently generated
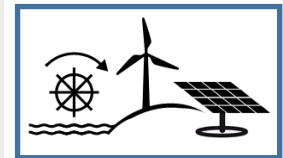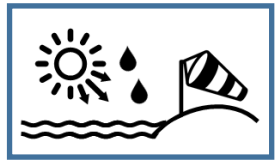- Consistent

Overall Goal

Creation of an **open database** containing

- **Weather data**
- Power plant data
- Other relevant data (e.g. orographie)

With linkage to **open source models** to generate feed-in time series of
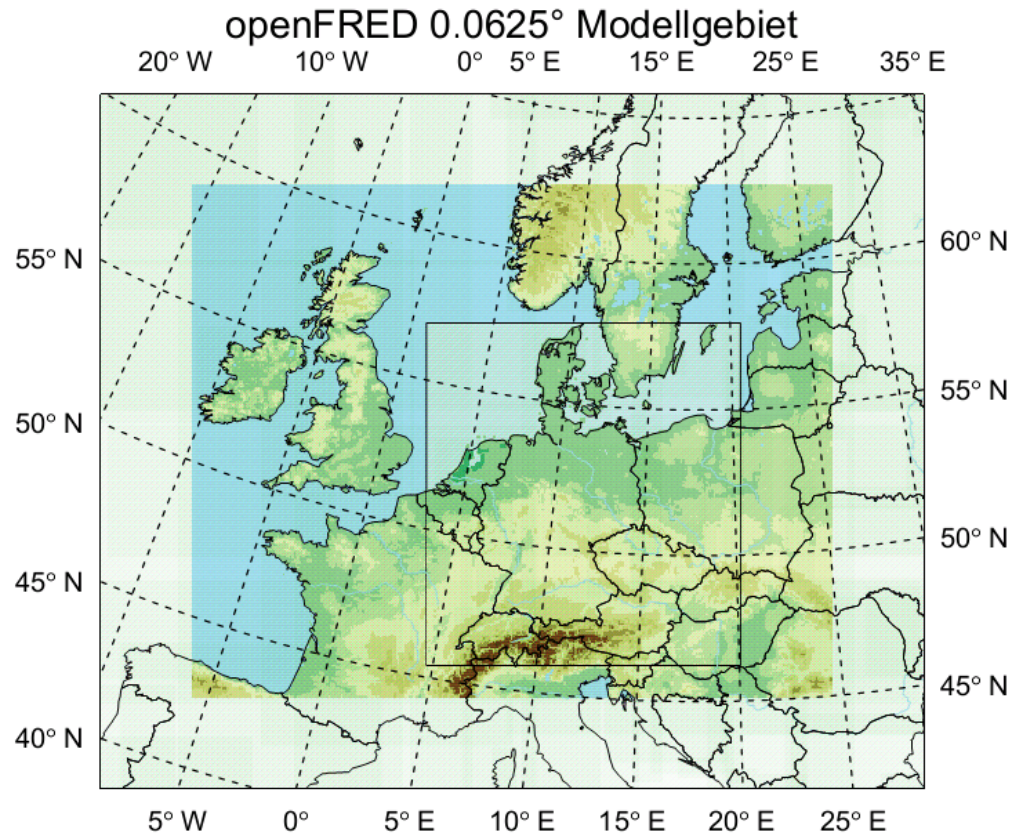
- PV
- Wind
- Hydropower

In **collaboration and communication** with the modeler and user community

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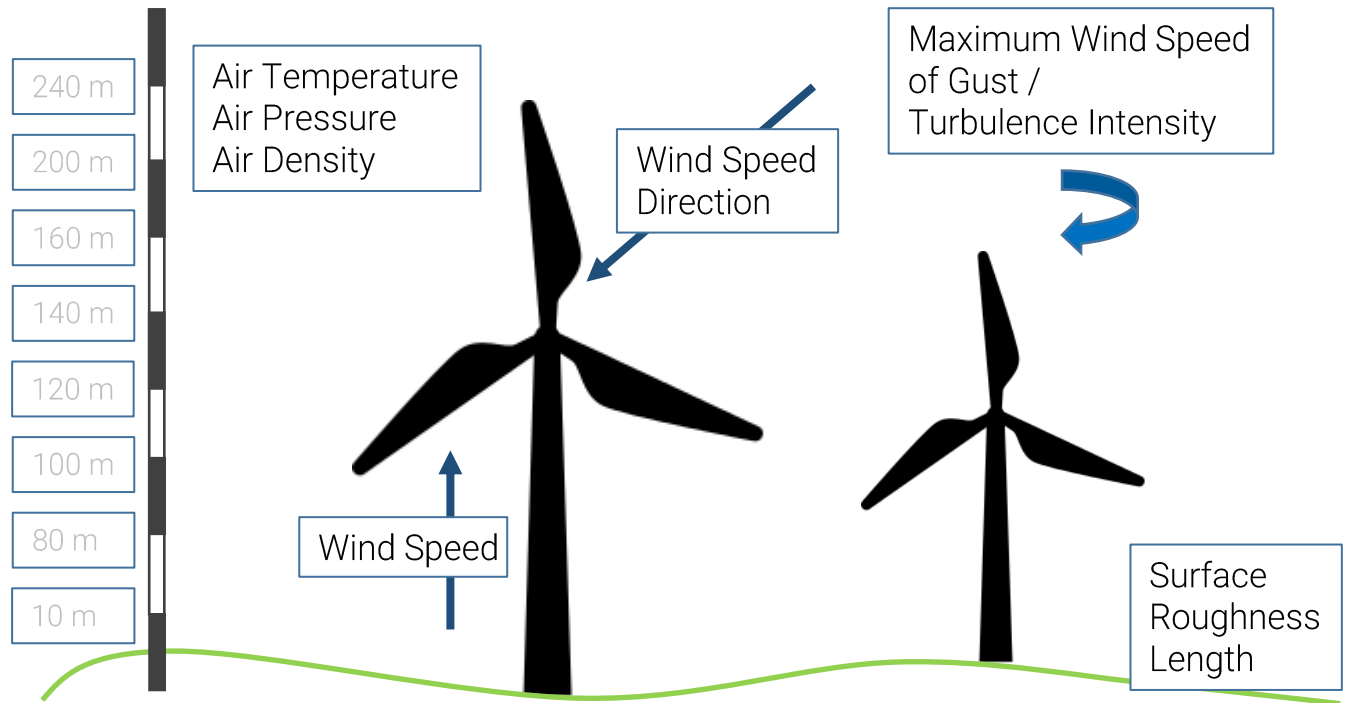
open_FRED Weather Data

COSMO-CLM

- Global reanalyses data MERRA2

- Area: Germany (generous)

- Years: 2000 - 2017

- Temporal Resolution: 30 min

- Spatial Resolution: 0.061°

-

openFRED 0.0625° Modellgebiet

open_FRED Weather Data

Data at various heights

240 m
200 m
160 m
140 m
120 m
100 m
80 m
10 m

Air Temperature
Air Pressure
Air Density

Wind Speed
Direction

Maximum Wind Speed
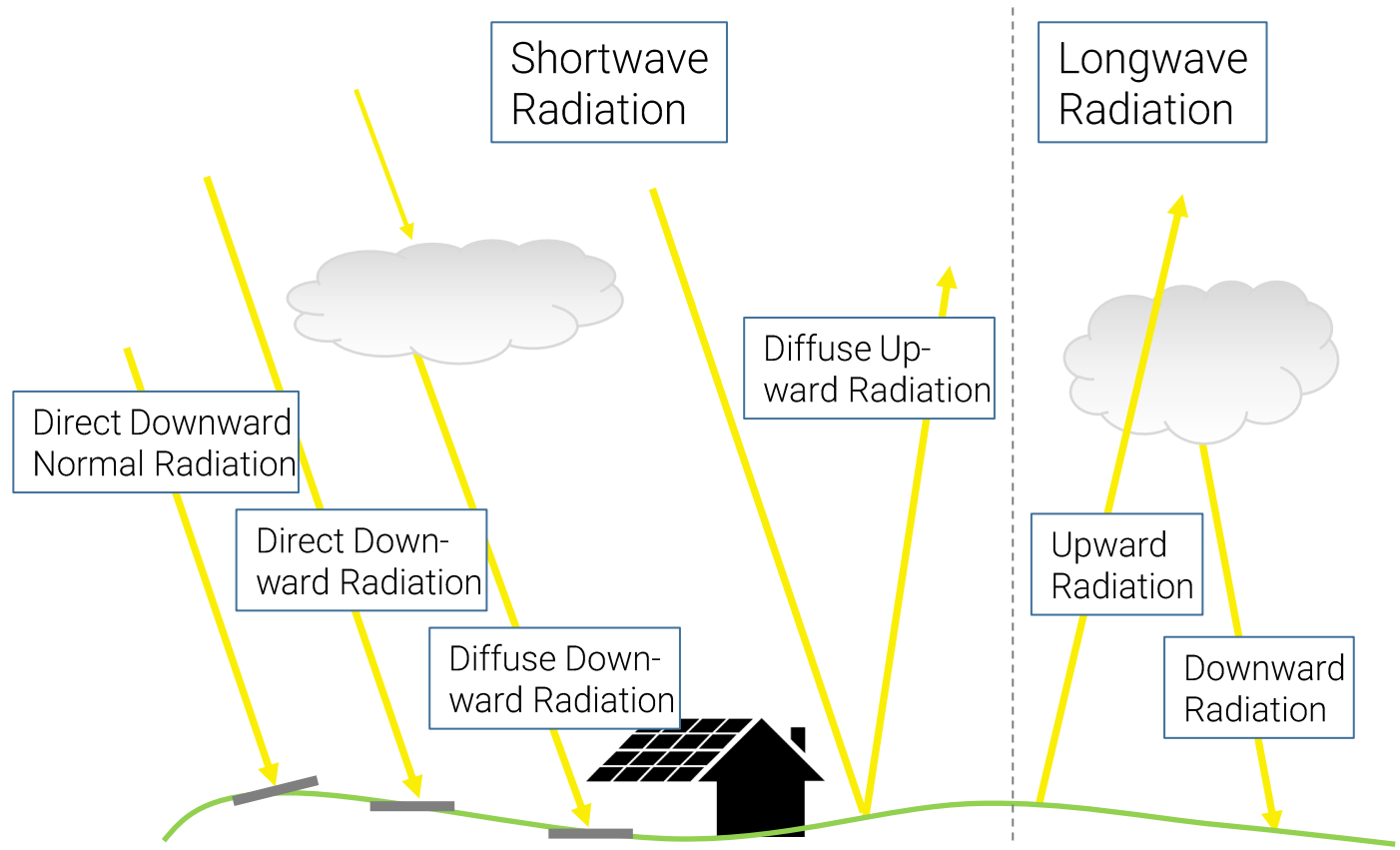of Gust /
Turbulence Intensity

Wind Speed

Surface
Roughness
Length

open_FRED Weather Data

Make use of pvlib

Radiation density
as half-hourly
mean

Direct downward
normal radiation

Shortwave
Radiation

Longwave
Radiation

Direct Downward
Normal Radiation

Direct Down-
ward Radiation

Diffuse Down-
ward Radiation

Diffuse Up-
ward Radiation

Upward
Radiation

Downward
Radiation

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open_FRED Weather Data

Data serves as
input into
hydrological
discharge model
of MPI

Precipitation
Amount

Snow
Amount

Surface
Evaporation

Snow
Thickness

Subsurface
Runoff

Surface
Runoff
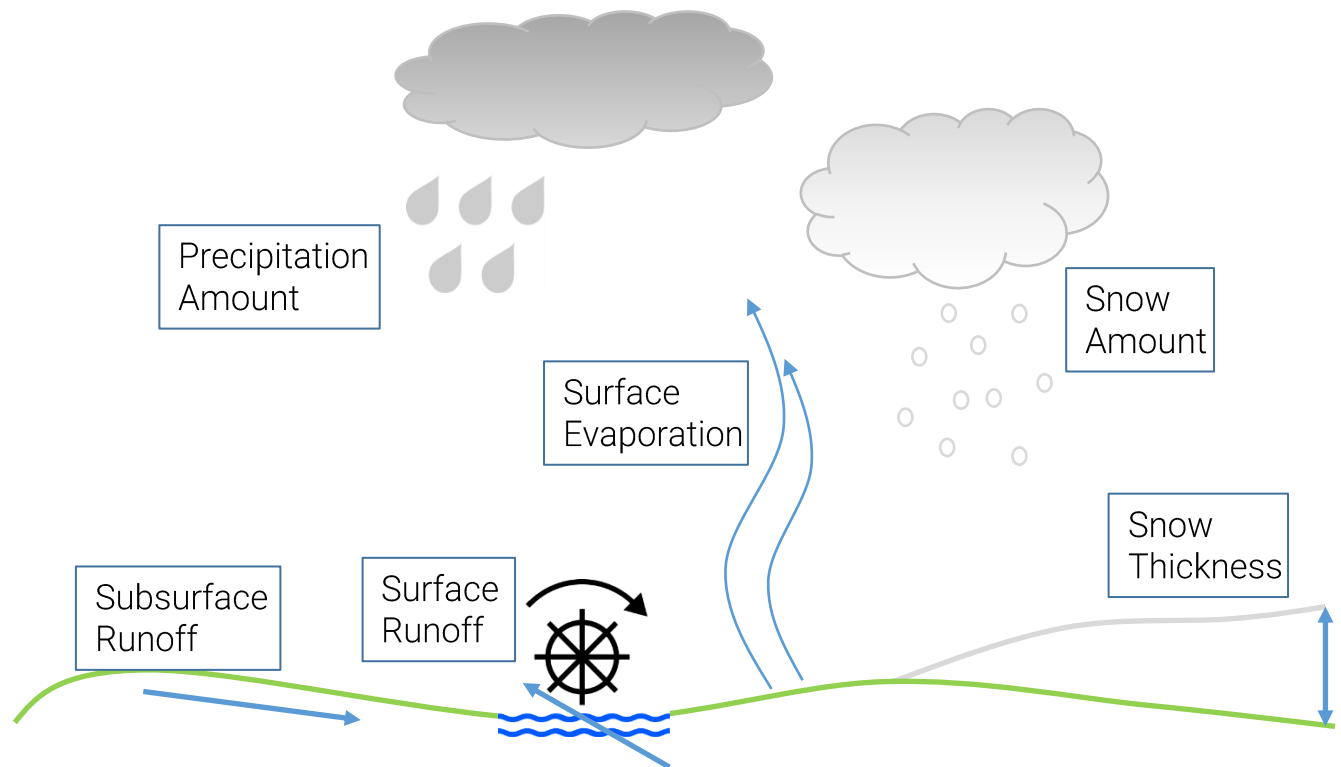
windpowerlib

Features

- Feedinlib: will support different data sources (currently CSV only)
- Calculates atmospheric params for desired height
  → models for wind speed, air density, temperature
- Considers short-term wind speed fluctuations (→ turbulence intensity)
- Define own WEC models with P(v)/cp(v) curves
- Comes with >100 WEC power/cp curves
- Creation of wind farms & wind clusters
  → incl. wind farm efficiency / wind farm power curves

Under development

- Get weather data from OEP
- Validation of feed-in using measurements of various WEC (farms)

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windpowerlib

- Release of v0.0.6
  - major restructuring to make it more generic
  - added functionalities, tests, power (coefficient) curve data

Important Links

- Source code on Github, current version 0.0.6
  - https://github.com/wind-python/windpowerlib
- Documentation on Readthedocs
  - http://windpowerlib.readthedocs.io/en/latest/

Planned developments

- Generic wind turbines (f.i. for future feedin timeseries)
- Generation of time series with time step width of 1 second (for grid calculations)
- Connection to MERRA2 weather data from OPSD

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Thank you!