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Overview

- required (desired) input parameters
- data sources
- methods
- results (examples)
Input Requirements: Climate (1)

Monthly 2m air temperature values, °C:
• monthly mean air temperature (TT)
• monthly average of daily minima (TDmin)
• monthly average of daily maxima (TDmax)
• monthly minimum of air temperature (TTmin)
• number of frost days in the month.
Input Requirements: Climate (2)

• Monthly sum of precipitation (RR), in mm.
• Photosynthetically active radiation (PAR), monthly average between sunrise and sunset, in \( \mu E \, m^{-2} \, s^{-1} \), derived from global solar radiation G (1 \( \mu E = 1 \mu\text{mol photons} = 6.022 \times 10^{17} \text{photons} \))
• Monthly mean CO\(_2\) concentration in the air, in ppm (so far not used by ForSAFE-VEG)
• (planned) Monthly mean ozone concentration in the air, in ppm.
Source (1): Weather Stations

Spatial interpolation (3-D inverse distance model):
Mean TT, RR and G for base period 1961-1990
Site-specific climate, average of the base period 1961-1990

dm-site „Beatenberg“
METEONORM: data and tools

• Data and interpolation models to calculate mean values for any site (in the world).
• From the monthly values (measured, interpolated or imported data), METEONORM calculates hourly values using a stochastic model with autocorrelation. These time series correspond to "typical years".
• TDmin, TTmin, frost derived from hourly values.
• www.meteonorm.com by METEOTEST, supported by Swiss Federal Office of Energy.
METEONORM (2)

- Effects of high horizon considered for radiation
- Effects of large lakes and (southern) slopes considered for temperature
Photosynthetically active radiation (PAR)

- photon flux density in the 400–700 nm waveband, expressed in µE m⁻² s⁻¹ (1 E = 1 mol photons = 1 Einstein)
- Alados-Aboledas et al. (2000) empirical function: \( \text{PAR} = f(\text{global solar radiation, solar zenith angle, clearness index}) \)
- Example Beatenberg, average of base period:
Source (2): Climate Reconstruction

- Measurements and documentary proxy evidence.
- Mean monthly temperature (TT) 1659-1900: Luterbacher et al. (2004), Xoplaki et al. (2005).
Reconstructions of RR and TT, January 1659 to December 2002

Luterbacher 2007 supplied 0.1°•0.1° grids for RR

0.5°•0.5° for TT
Anomalies of TT and RR related to base period 1961-1990

- monthly deviations 1659-2002 with respect to the base period means
Source (3): Climate Projections

IPCC TAR (2001): CO$_2$ emission scenario IS92a
Future Anomalies of TT and RR

Hadley CM3 model

http://www.metoffice.gov.uk/research/hadleycentre/models/modeldata.html

http://www.ipcc-data.org/

Resulting time-series temperature

Example Beatenberg

CCE Workshop Bern,
Resulting time-series precipitation (mm / month)

Example

Beatenberg

Conclusions

• Important to obtain optimal input data: combine site-related (or interpolated) meteorological data with long-term relative trends (anomalies) available only at a coarse spatial resolution.

• For the greater Alpine region: good historical data from University of Bern.

• A sensitivity analysis would be useful to identify the importance of single input parameters and periods.

• Introduce inter-annual variations of TT and RR 2000-2100 (besides the general trend).