SciPro FINAL PROJECT PROPOSAL

A non dimensional mountain height analyzer based on ERA5 data

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Background info.
The non dimensional mountain height H is mainly conceptually used. Aim of the project is to use it for reanalysis and get insights on the flow over a mountain crest.

The non dimensional mountain height is calculated like

$$H = \frac{N\,h}{U}$$

H: non dimensional mountain height
h: real mountain height
N: Brunt-Väisälä Frequency
U: perpendicular to the crest wind component

It calculates if the flow goes over or around the mountain.
Typical the mean flow over the whole layer is used.

H « 1 passes over
H around 1 Nonlinear effects important
H » 1 flow goes around

Main requirements
Small grid real terrain data shall be used for determine the mountain height.
The meteorological data shall be loaded from the ERA5 data store.
The extent of the data and the timing shall be defined by the user
A vertical visualization shall be available.
A horizontal visualization at a single model level shall be available

User
Nerdy scientist that uses the tool via a CLI to get data for the case interested into.

Main Features

Load ERA5 data	**Module Owner:** Lawrence
Load the required meteorological variables from the ERA5 datastore. **Subfunctions needed:** validity check of inputs check if data is available in the datastore authentication at the data store	**Parameters:** extent (lat, lon) time variables (p, t, u,v) **Result:** Dataset

Terrain Module	**Module Owner:** Andi
Load appropriate terrain data from a TBD source Backup the data locally. **Subfunctions needed:** Calculate height contours of the mountain Fit the terrain data to the ERA grid check if data already there or need to be loaded Mark ERA gridpoints that are sticking into the terrain	**Parameters:** extent (lat, lon) **Result:** Terrain Dataset fitting to an ERA dataset

Visualization Module

Plot a horizontal visualization of non-dim mountain height along a cross section.
Enhance with additional available variables
Plot a vertical layer view with topography

Subfunctions needed

Selection of the Data out of the dataset
Calculate a proxy variable (go over / around) for plotting
store the plot

Module Owner: Anna

Parameters:

cross section points (lat, lon, lat, lon)
variables to plot
layer

Result:

png of plot stored

Calculation Module

Perform all calculations to calculate the non dimensional mountain height.

Subfunctions needed

calculate potential temperature
calc_potential_temp()
  pressure levels, Temperure, P0, R C
per level

bunt_väsiälä()
  g, d theta, dz
result N each level

height_out_of_pressure(p)
  baraometirc height formula
return h(m)

calculate perpendicular wind component()
  height contours
  closest gridpoint
  vector calculations
return strength of perpendicular component

calculate H
  calculate the mean flow (flow & mtn dependent)
  calculate_the mean flow over one layer
  d level heights
  delta u, v, of 2 levels
return dir, windspeed

figure out the flow of which girdpoints could be affected by a mountain.

Module Owner: All

Parameters:

cross section points (lat, lon, lat, lon)
variables to plot

Result:

Enhanced Dataset with at least H

Challenges:

- Determine which gridpoints are affected by the terrain
- Clever calculation of the mean flow

Possible Scope reductions to reduce complexity
- plot a fixed in location crosssection (e.g. always N/S section trough IBK)

Mock-up