Climate Change

Development of the E-OBS wind strength dataset

Irene Garcia Marti, Gerard van der Schrier,
Else van den Besselaar,
Cristina Rojas Labanda, Fidel Gonzalez-Rouco

KNMI, Universidad de Complutense, Madrid

Copernicus Europe's eyes on Earth | European Commission | ECMWF

Climate Change

The need for a pan-European windfield

Aim:
Pan-European observation-based gridded dataset for (daily-averaged) wind speed

Motivation:

- Wind speed has a strong societal impact
- Wind speed is input to derived indices like
  - Penman-Monteith potential evapotranspiration
  - Universal Thermal Climate Index

ECMWF Copernicus Europe's eyes on Earth European Commission

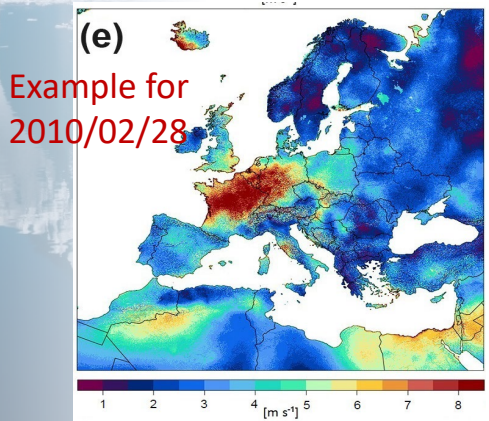
Climate Change

Approach

1. Develop a dataset with observational data
   - dense network of station is required
   - capable QC method

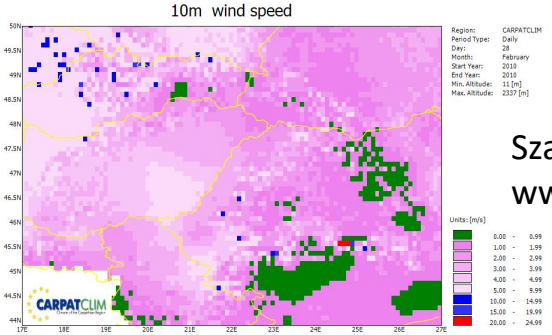
2. Develop an algorithm to grid wind strength which is capable of reflecting the small-scale spatial structure of wind

Examples of other datasets:



Example for 2010/02/28

Brinckmann et al (2016)



Szalai et al. (2013)
www.carpatclim-eu.org al

ECMWF Copernicus Europe's eyes on Earth European Commission

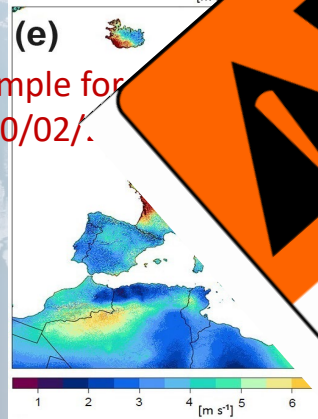
Climate Change

Approach

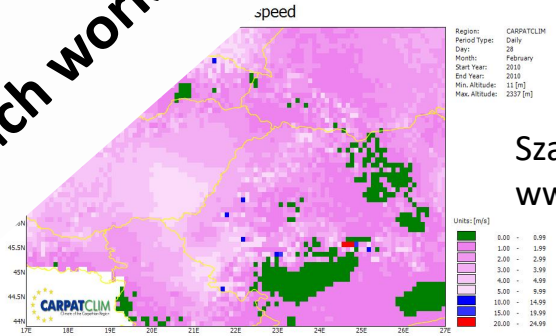
1. Develop a dataset with observation
   - dense network of station is
   - capable QC method

2. Develop an algorithm
   capable of reflecti
   wind

Examples of



Example for
2010/02/



Szalai et al. (2013)
www.carpatclim-eu.org al

.ann et al (2016)

WARNING

Still very much work in progress

ECMWF Copernicus Europe's eyes on Earth European Commission

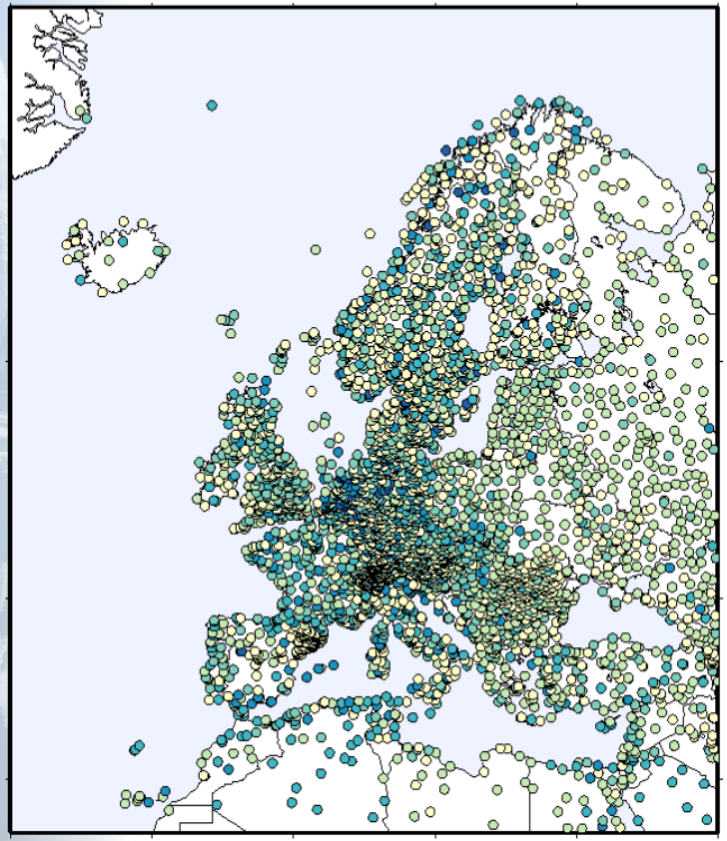
Climate Change

Data and QC: Collaboration with NEWA

NEW EUROPEAN WIND ATLAS newa

Newa's Project: Development of a New European Wind Atlas

http://www.neweuropeanwindatlas.eu/



- How does wind behaves at a local scale?
- How do different models behave in Europe?
- …

Non-existence of a **Quality Controlled Surface Wind Speed and Direction Observational** Database covering **all** the **European region.**

ECMWF Copernicus Europe's eyes on Earth European Commission

WiSED: How is it developed?

Compilation

- Intensive search for available data sets
- Analyzing each data set.
- Data set unification.

Quality Control

- Data management issues.
- Measurement errors.

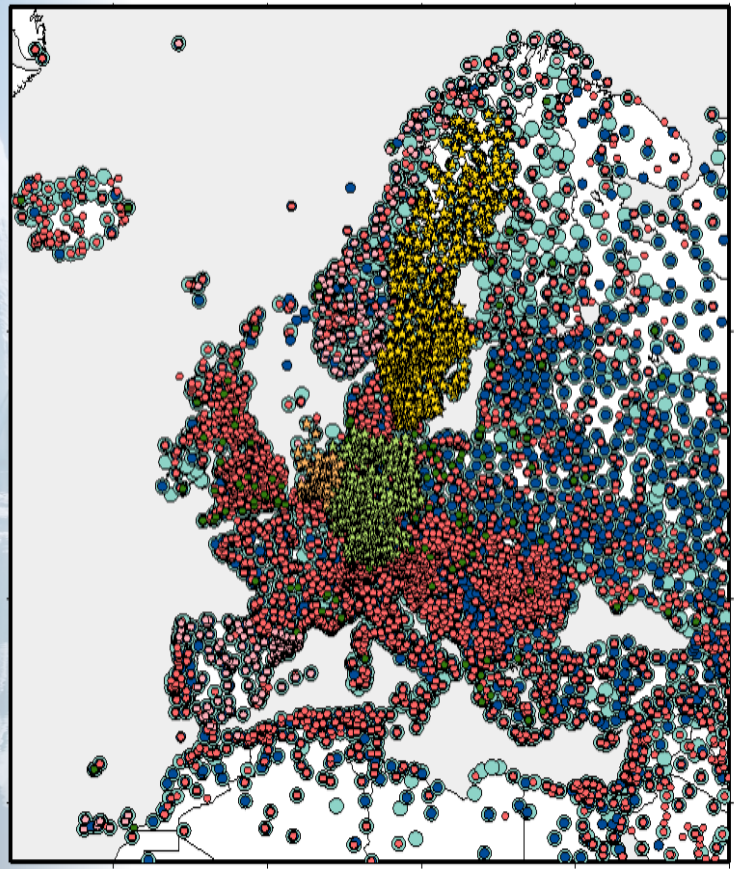
High resolution European quality-controlled database of surface wind speed and direction

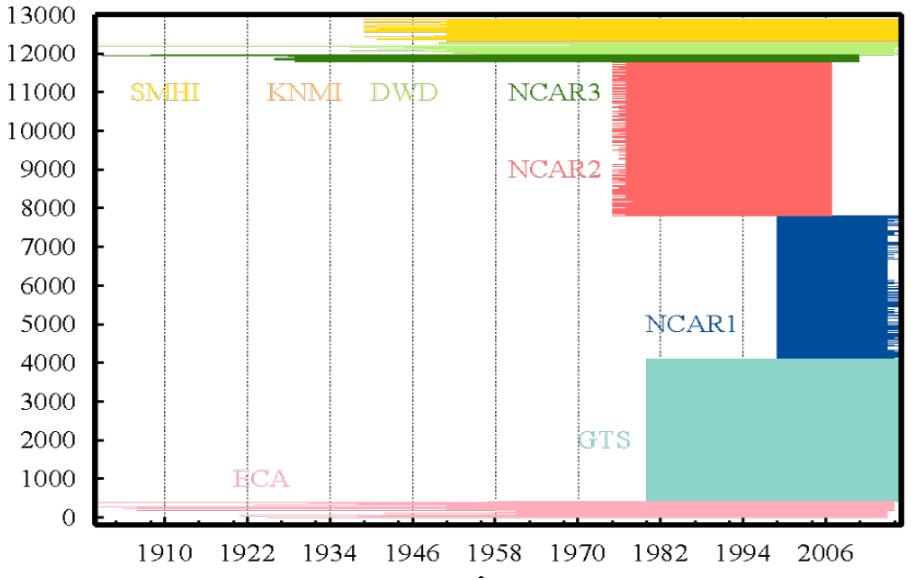
Basis for the windstrength E-OBS

ECMWF Copernicus Europe's eyes on Earth European Commission

Climate Change

WiSED: Compilation





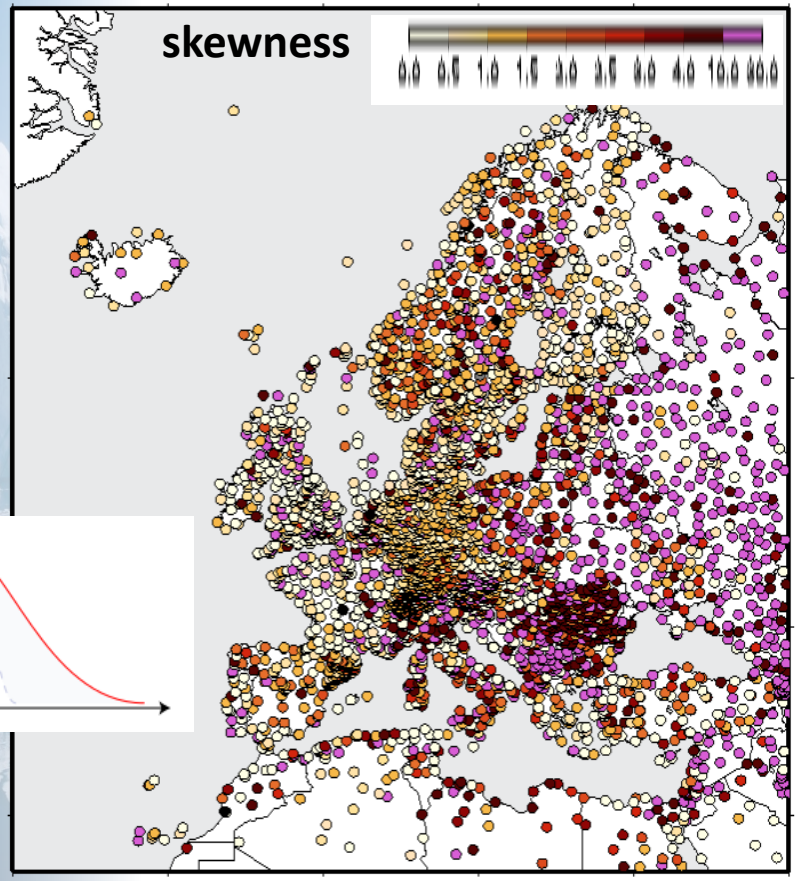
Sources:
NCAR, NMHSs, GTS,ECA&D

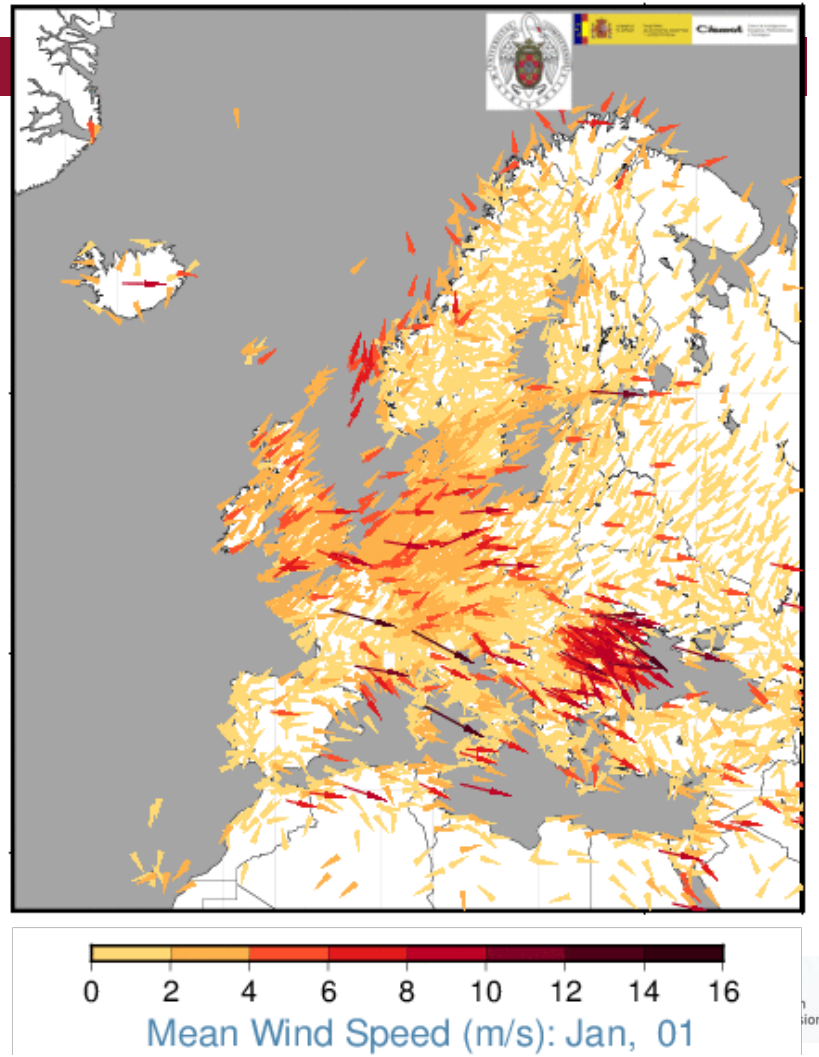
Compilation of **12888** time series

ECMWF Copernicus Europe's eyes on Earth European Commission

Climate Change

WiSED before QC



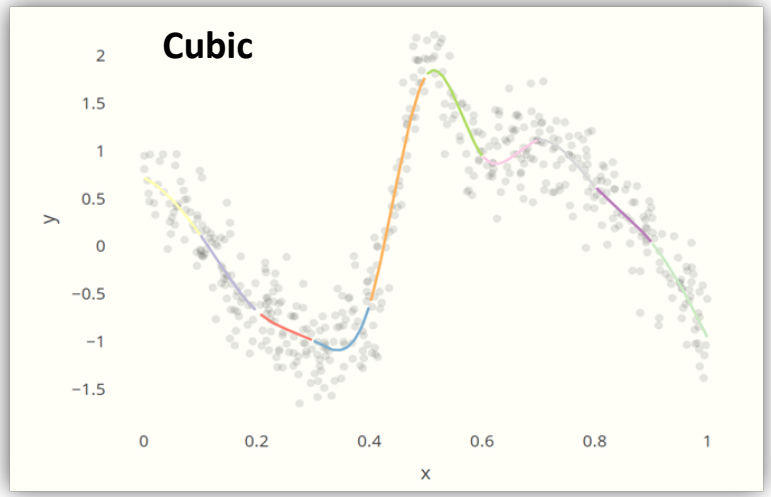


Climate Change

Approach to grid windstrength

Generalized Additive Models (GAM)

- Models assuming smooth relationships between covariates and target variable
- Piece-wise polynomials that are added to obtain final prediction



source: https://m-clark.github.io/generalized-additive-models/technical.html

characteristics:

- Interpretable: feature importance
- Flexibility: captures non-linearities
- Regularization: smoothness/wiggliness

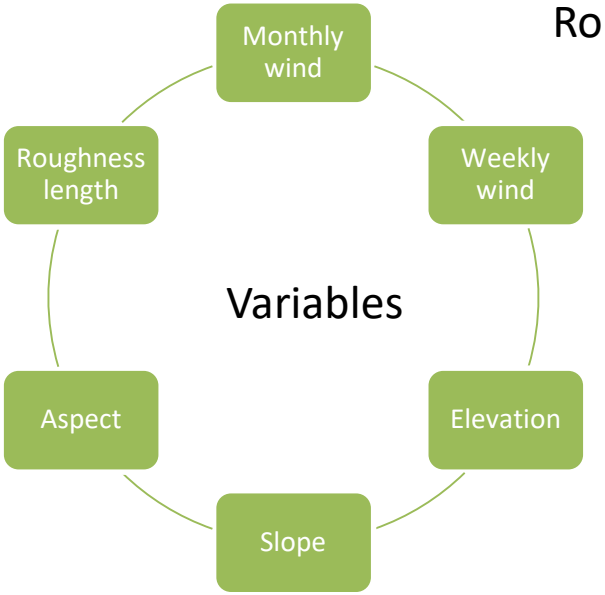
GAM is used in other E-OBS fields

(Cornes et al. 2018)

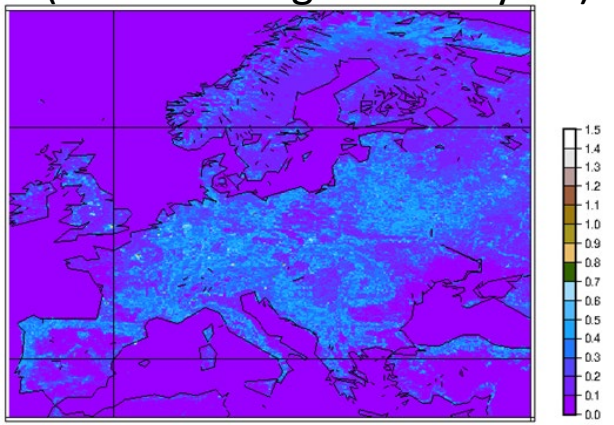
ECMWF Copernicus Europe's eyes on Earth European Commission

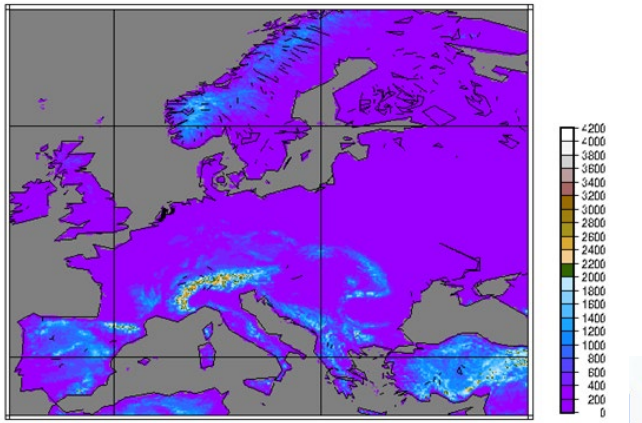
Climate Change

Co-variates



Roughness length (varies throughout the year)





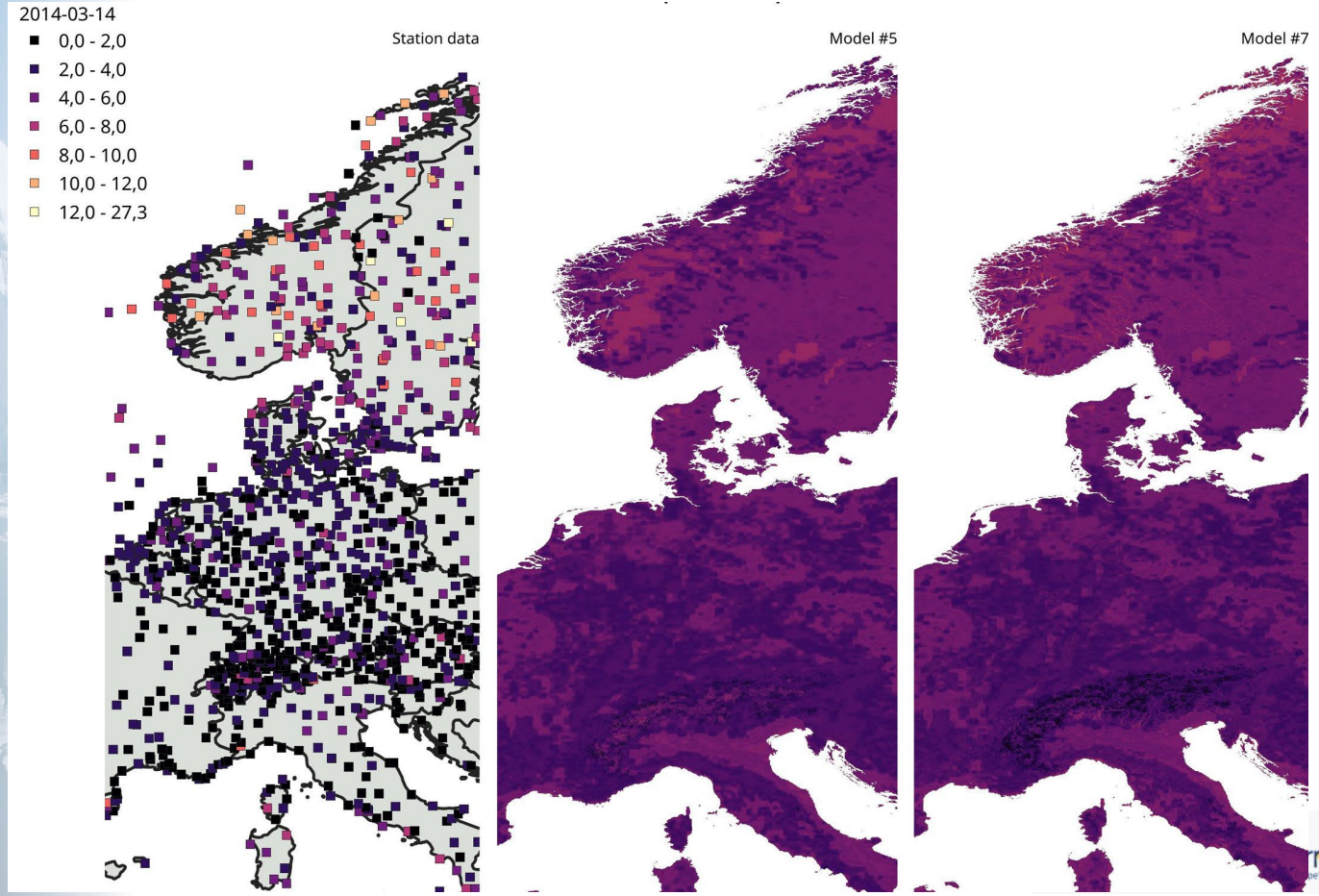
Elevation (plus slope & aspect)

R's **mgcv** package allows to use all variables as smoothly varying predictors or *combinations* of these variables

e.g. effect of elevation varies smoothly with roughness-length

Climate Change

Combination of variables: Stormy day



Climate Change

What did we learn individual modelling?

Variable importance

Variance captured:

- Lat/lon: 15% - 53%
- Background wind: 15% - 37%
- Surface roughness and aspect & slope: < 12%

- "good stable day" vs "turbulent day"
- Some variables may not contribute at all, despite making sense

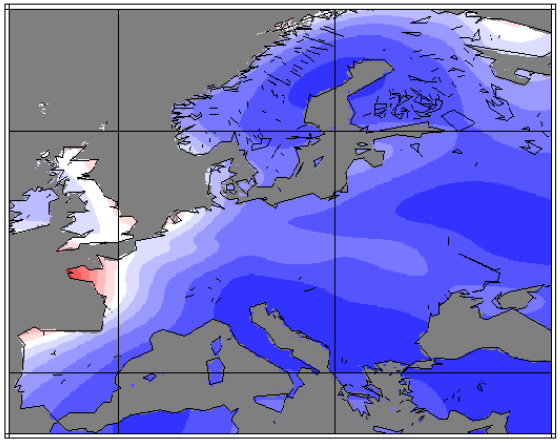
Temporal cost

- Tensor calculations are faster than smooth splines

ECMWF Copernicus Europe's eyes on Earth European Commission

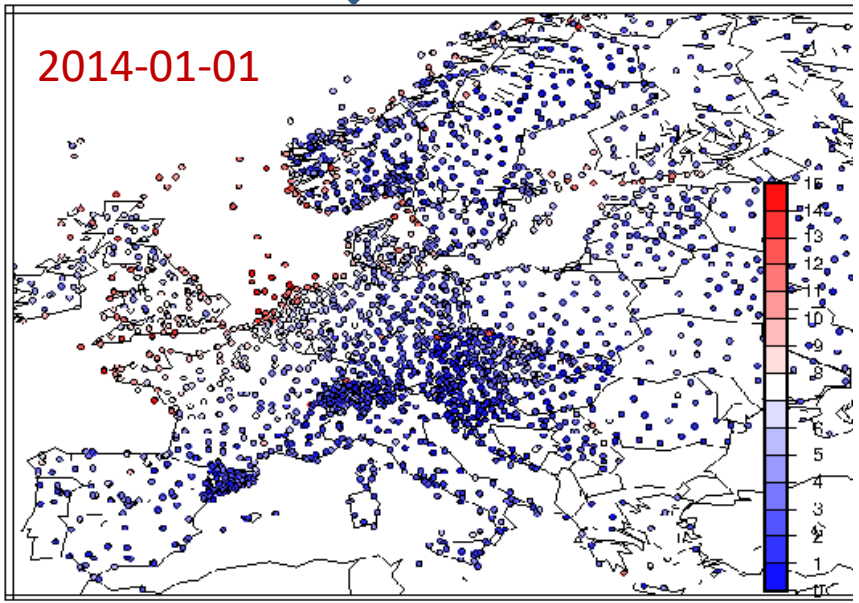
Climate Change

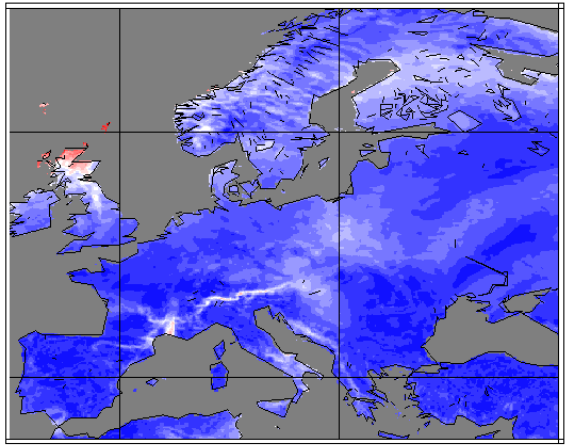
Comparison against reanalysis

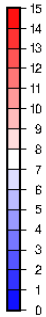


gridded observations

observations





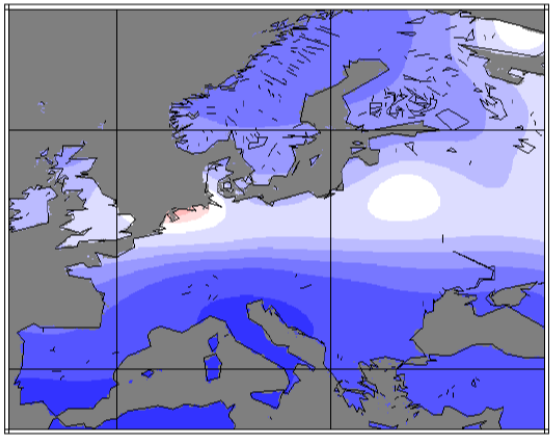


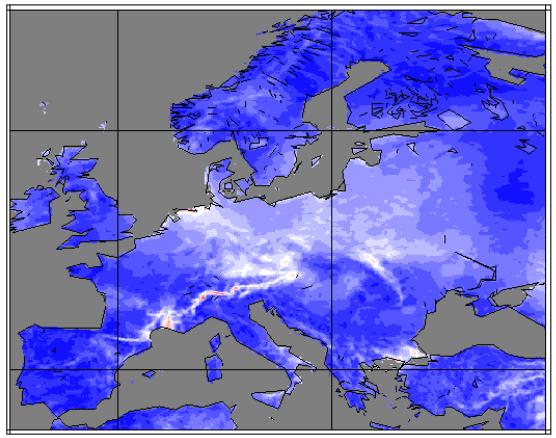
HARMONIE reanalysis

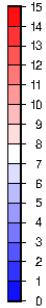
ECMWF Copernicus Europe's eyes on Earth European Commission

Climate Change

Comparison against reanalysis

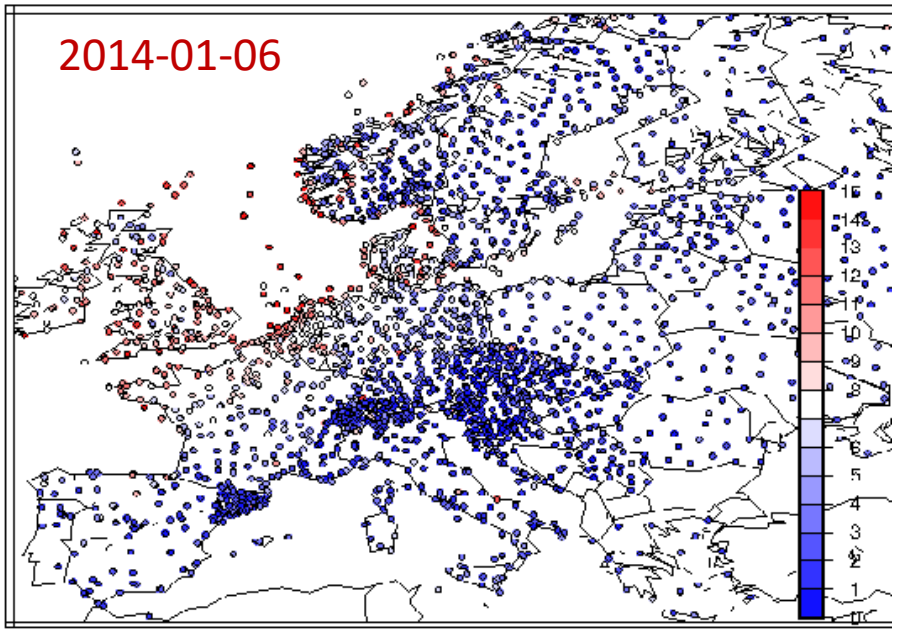






gridded observations

observations



HARMONIE reanalysis

ECMWF Copernicus Europe's eyes on Earth European Commission

Climate Change

Conclusions

E-OBS member for pan-European wind strength

- Collaboration with NEWA: access to a large data set of measurements
- Rigorous quality control

- Generalized Additive Models used to construct daily maps
- Set of variables used to explain data
  - Roughess length, position & altitude, mean (background) value
- Effects of variables modelled as purely additive and interactions between variables

- Resulting maps resemble observations
- … *far* too smooth

ECMWF Copernicus Europe's eyes on Earth European Commission