European Climatic Energy Mixes (ECEM)

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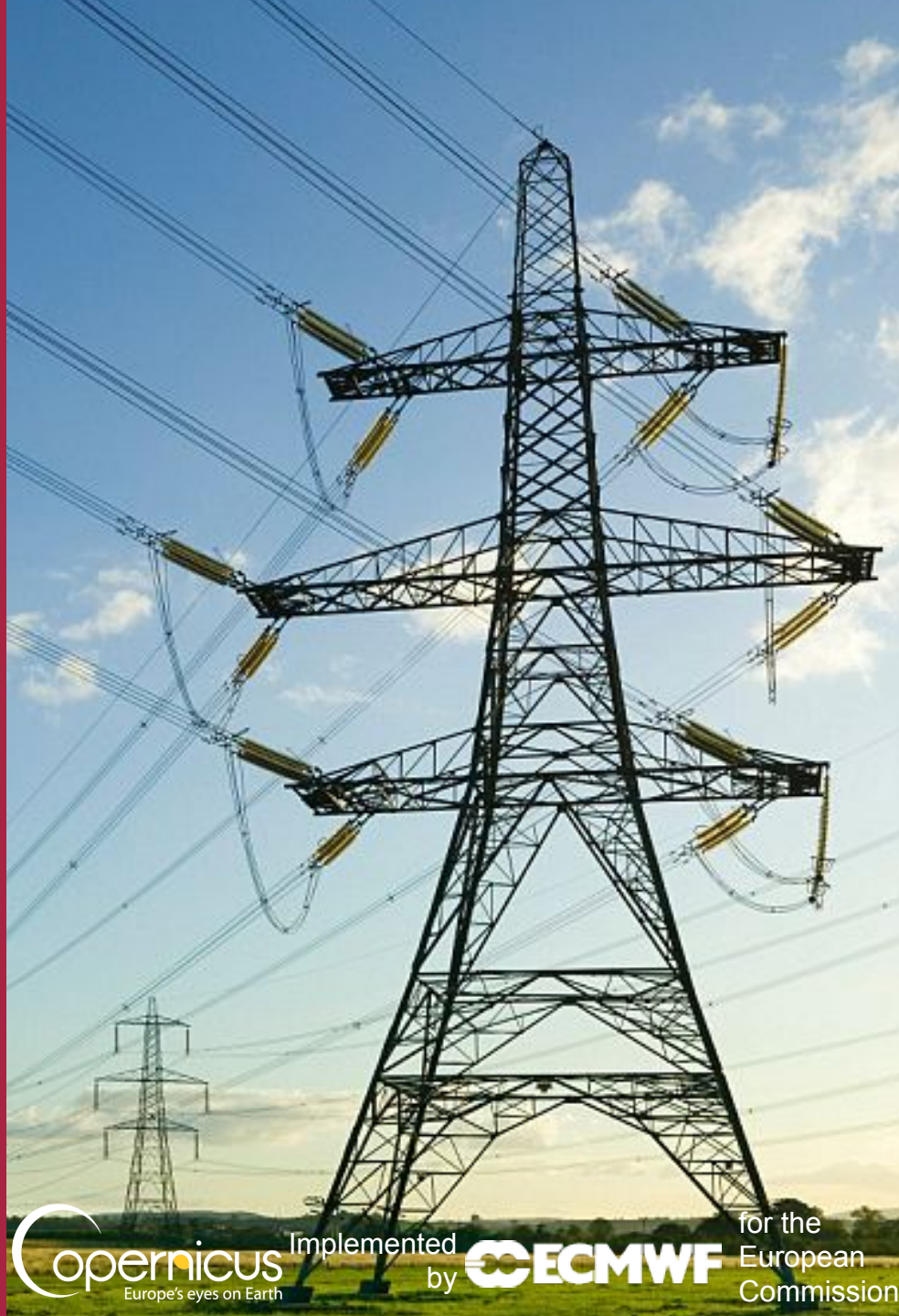
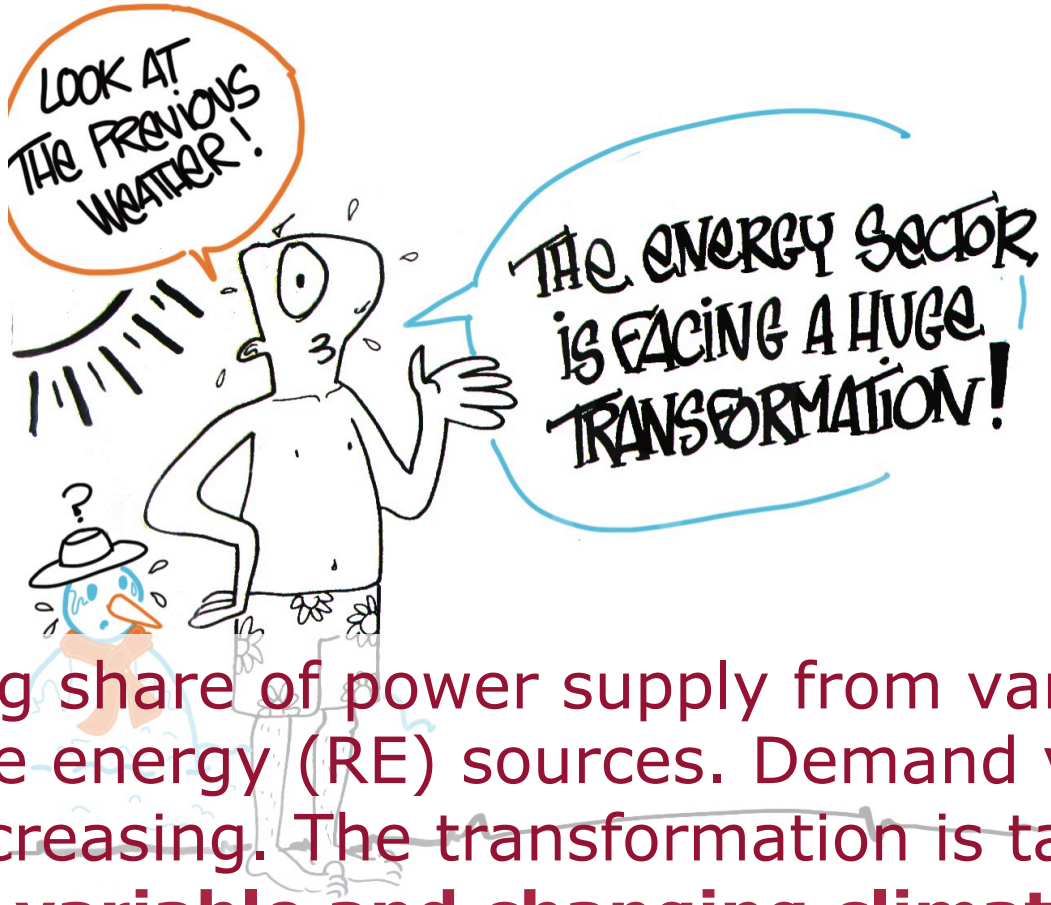
University of East Anglia &
World Energy Meteorology Council



Motivation & Target



★ Increasing share of power supply from variable renewable energy (RE) sources. Demand variability is also increasing. The transformation is taking place against a **variable and changing climate**.

Uniqueness

Integration of energy & climate information for energy mixes assessment

- ★ Is climate important for energy planning?
- ★ What can climate R&D learn from interaction with energy sector and make output more easily adopted by the industry/policy makers?

European Climatic Energy Mixes (ECEM) is developing a demonstrator to assess how well **different energy supply mixes** in Europe will meet demand, over different time horizons, focusing on the role climate has on the mixes.

ECEM responses to key messages from WS1

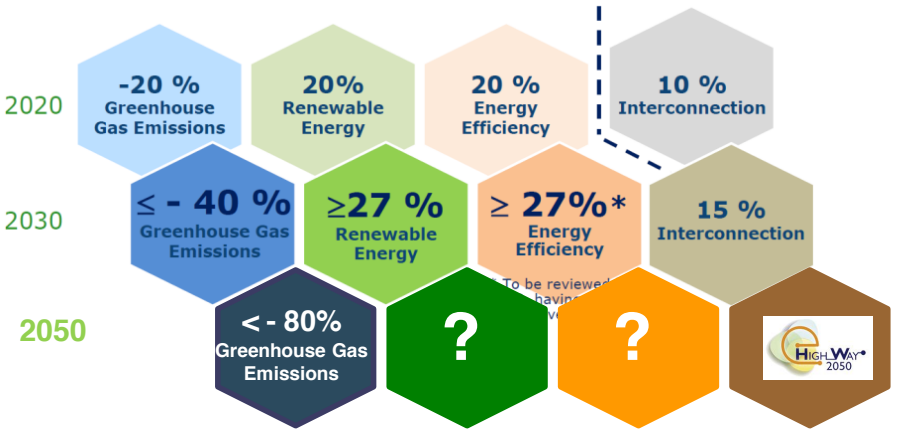
- ★ Give more emphasis to data access and download
- ★ Provide information at the eHighway-2050 cluster scale (96 clusters) as well as at the country scale (33 countries)
- ★ Possibly include more climate variables (snow cover, snow water equivalent, relative humidity), offshore wind and biofuels
- ★ Ensure that access to information about underlying methods and assumptions is a prominent feature of the demonstrator

ECEM responses to key messages from WS1

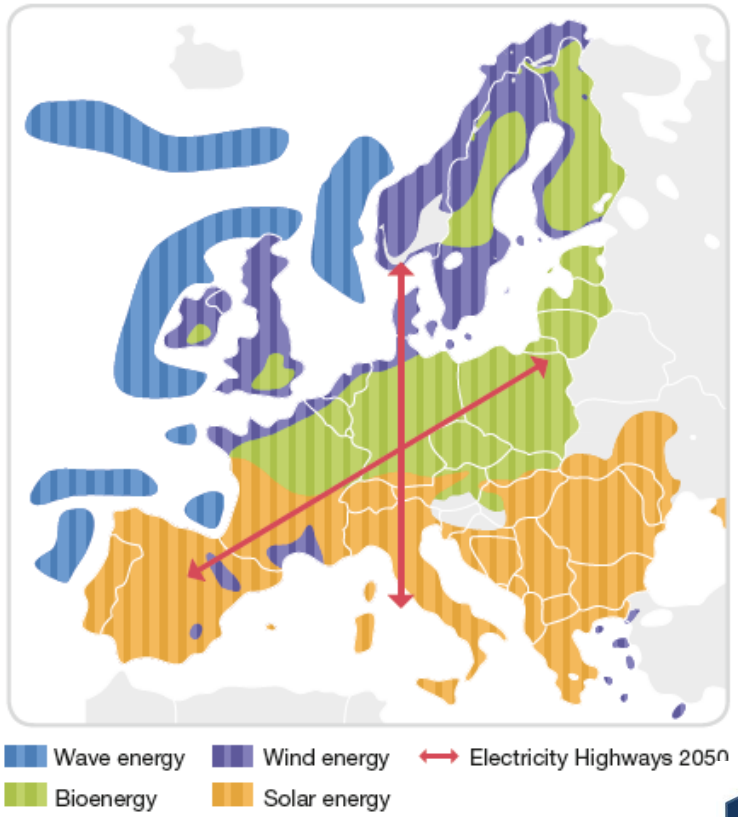
- For this proof of concept service, we cannot:
  - Provide information at very high temporal (sub-hourly) or spatial (e.g., a single wind farm/turbine) resolutions
  - Include wind direction
  - Incorporate economic information (e.g. investment costs, energy prices) – but some of the case studies may do so
  - Consider short-term forecasts (not part of Copernicus)

EU Project e-Highway 2050

"Planning for **European Electricity Highways** to ensure the reliable delivery of renewable electricity and **Pan-European** market integration"



The Energy Roadmap 2050 is the basis for developing a long-term European framework



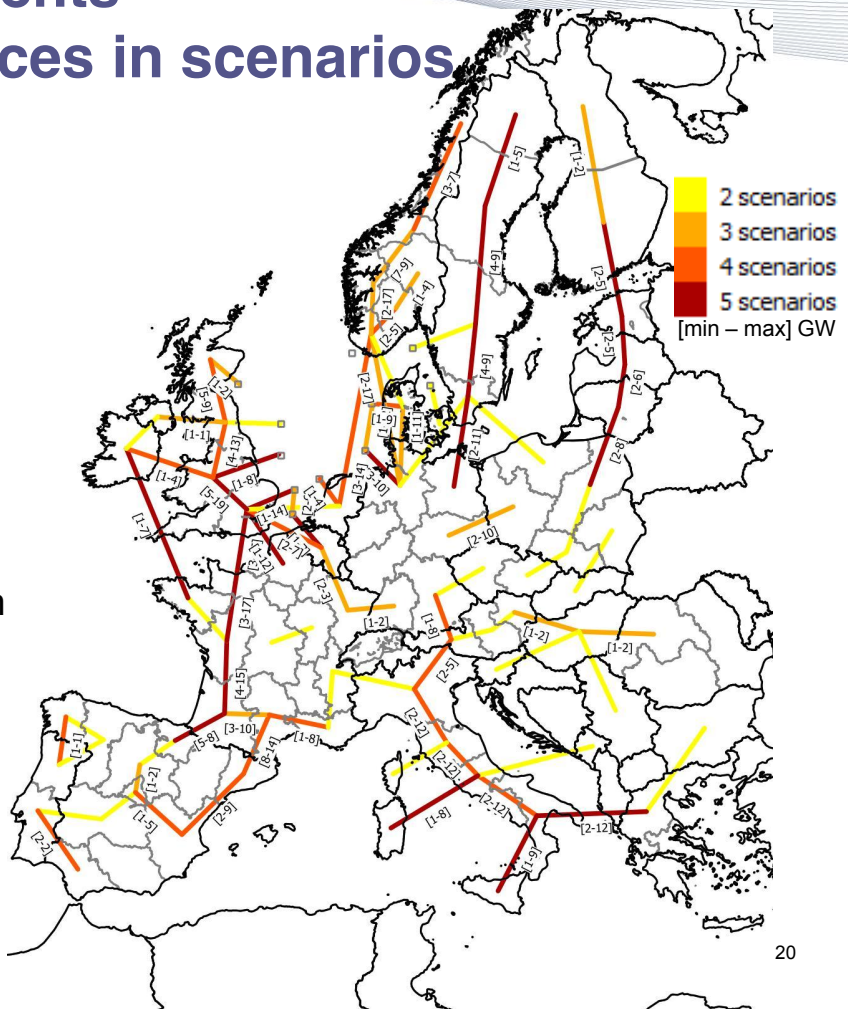
< - 80% Greenhouse Gas Emissions

40 month project, from **September 2012 to December 2015**

e-Highway 2050 – Summary results

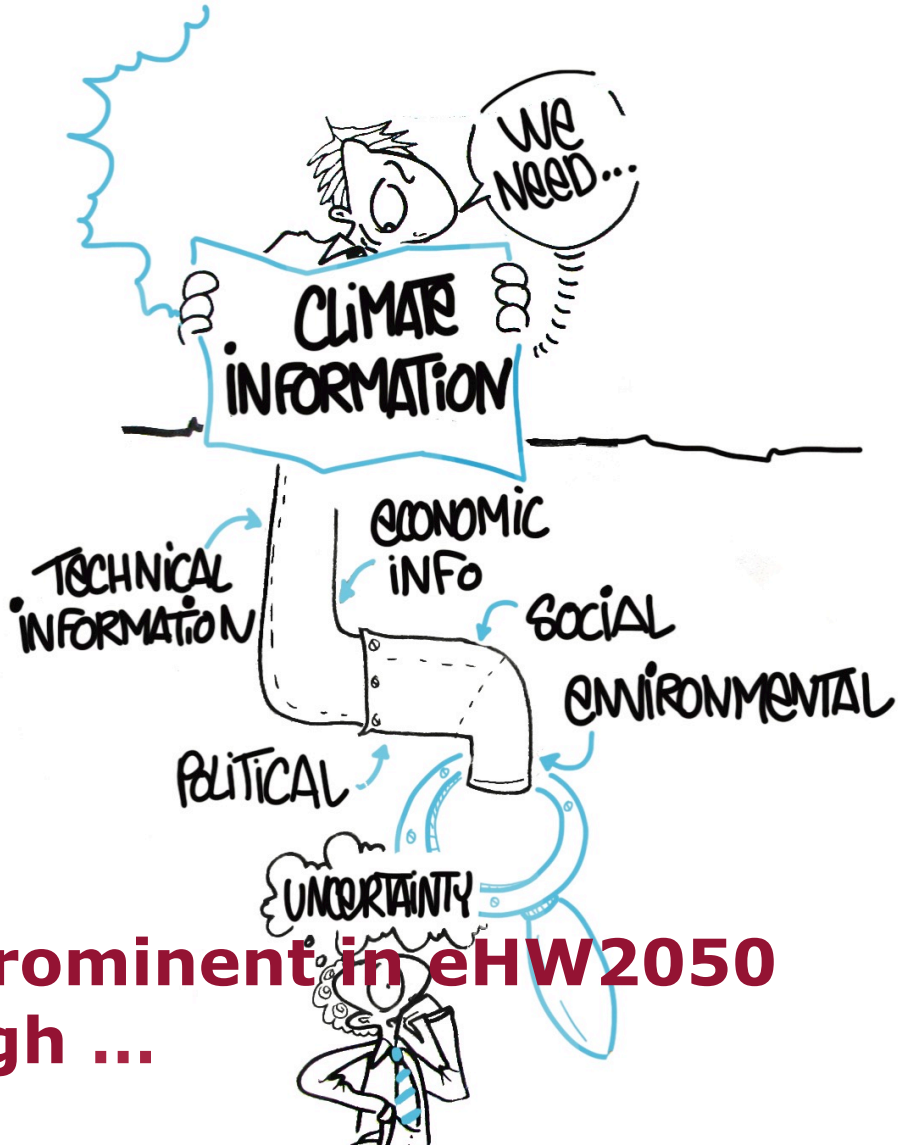
Common reinforcements
Number of appearances in scenarios

- Displayed are all lines reinforced throughout all five scenarios
- Colors according to number of appearances in scenarios
- Need to transport energy from renewable sources from “European periphery” to central Europe



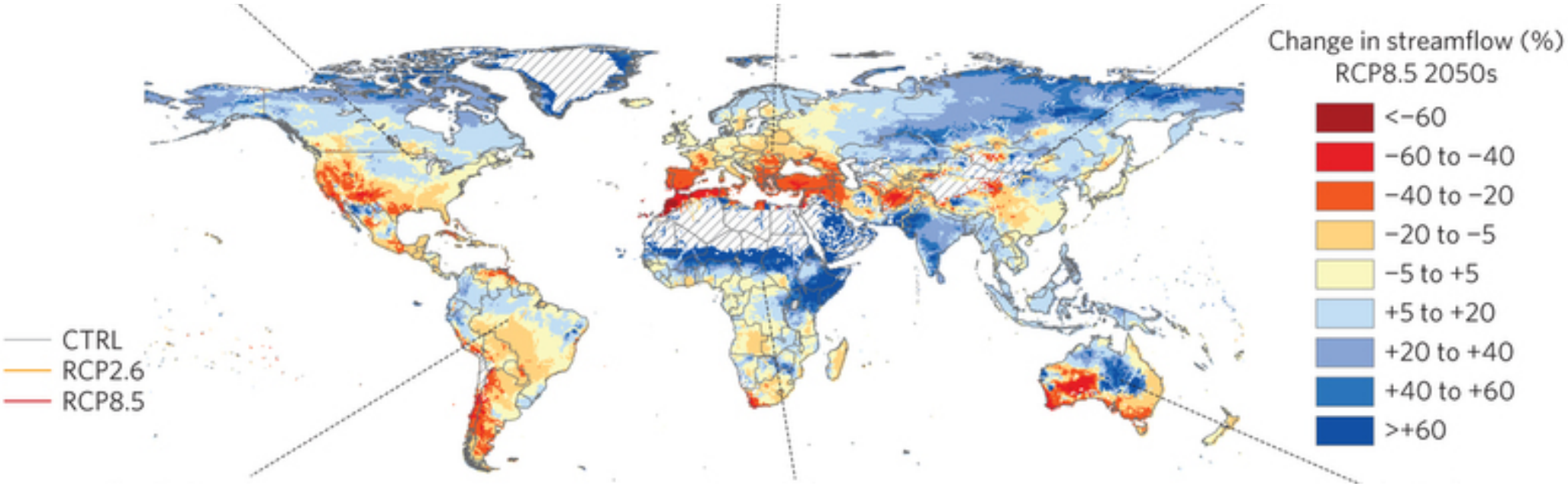
Issues considered by e-Highway 2050

- ★ Technical
- ★ Economic/financial
- ★ Political/socio-political and environmental
- ★ Research, development and deployment (RD&D)



However climate not very prominent in eHW2050 even though …

Global changes in streamflow projections

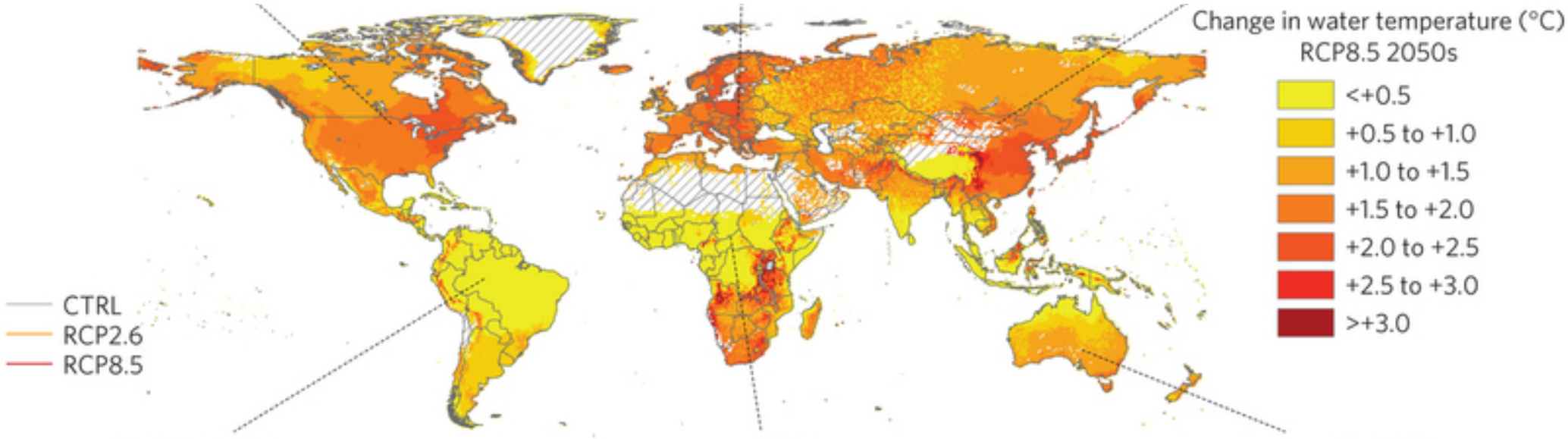


Change in streamflow for RCP8.5, 2040–2069 (2050s) vs1971–2000

Reductions in usable capacity for 61–74% of the hydropower plants

van Vliet et al. (2016)

Global changes in water temperature projections



Change in water temperature for RCP8.5, 2040–2069 (2050s) vs 1971–2000

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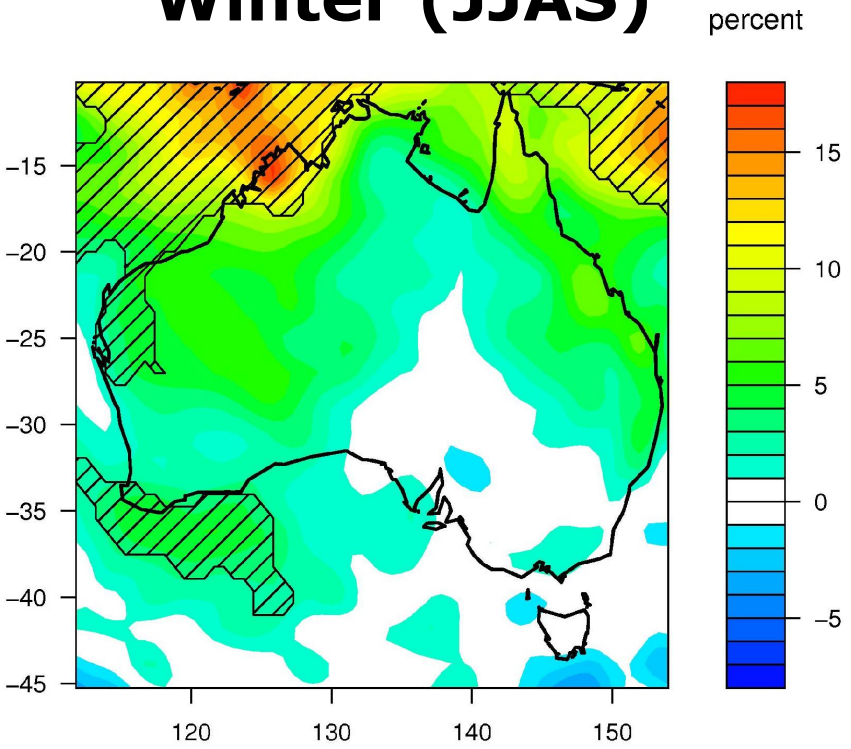
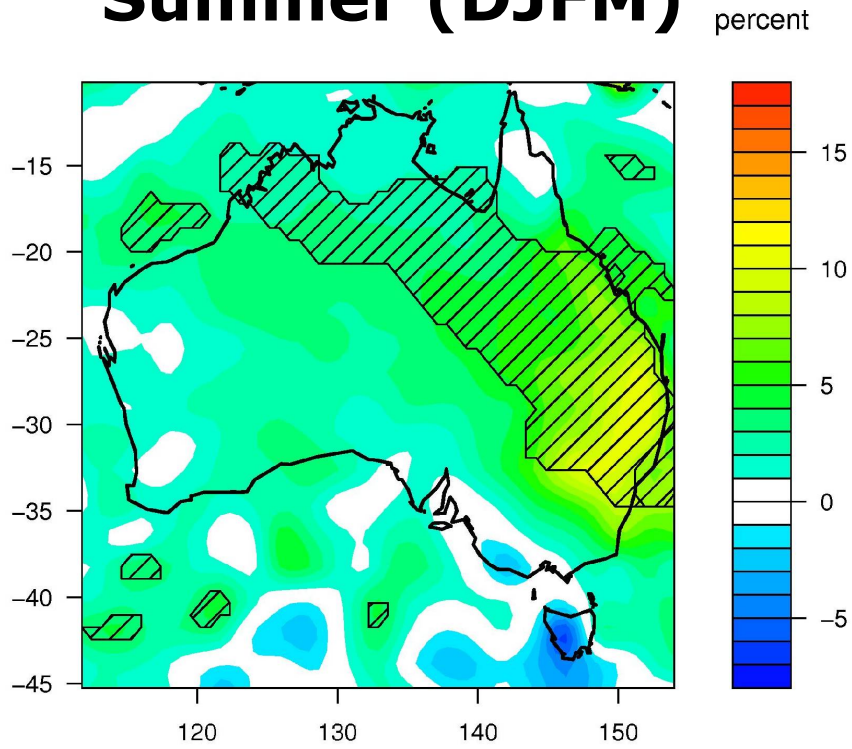
Solar Radiation Inter-annual Variability

Winter (JJAS)



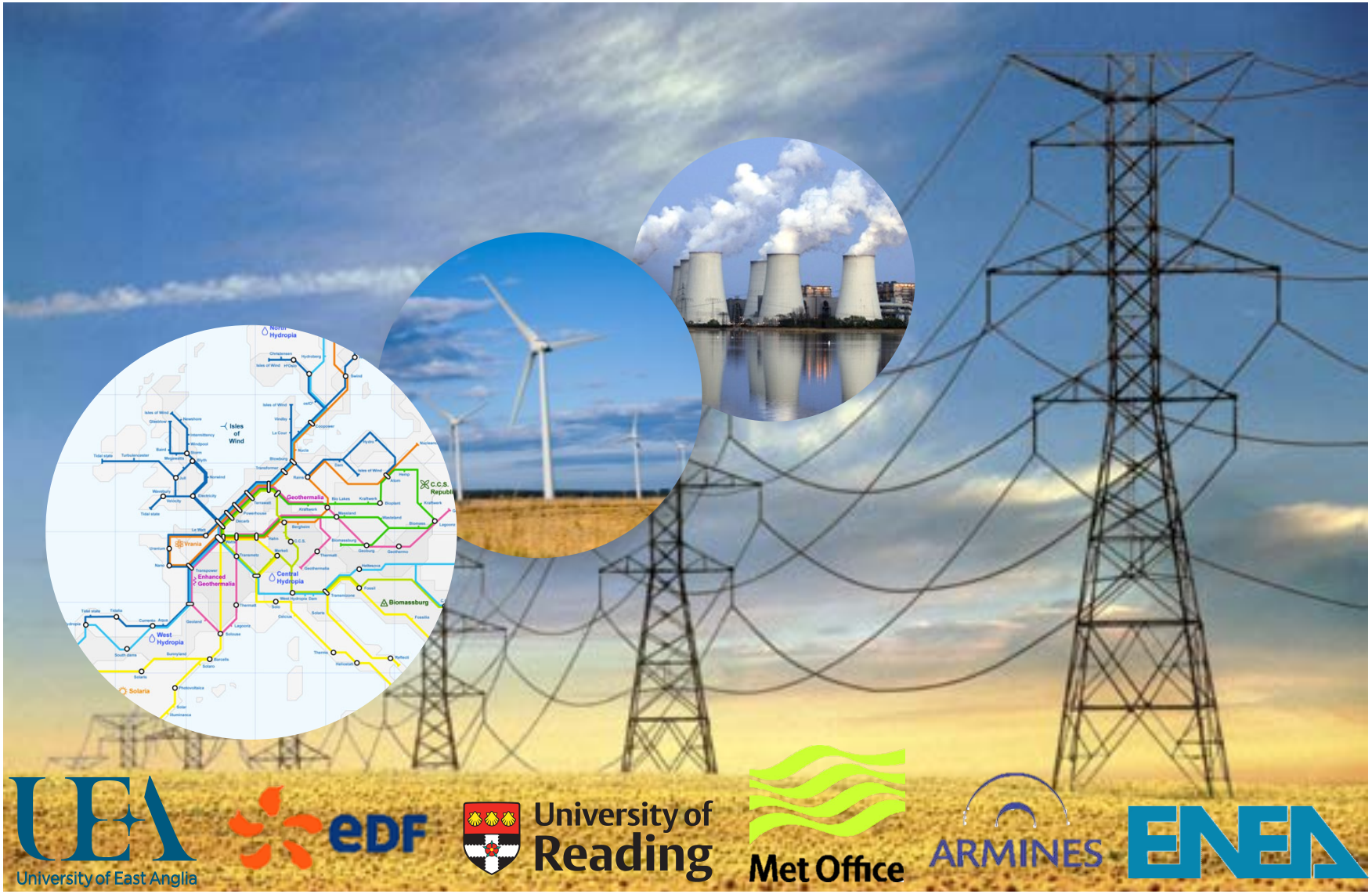
Summer (DJFM)



Percentage difference in monthly solar radiation in El Niño relative to La Niña

Davy and Troccoli (2012)

ECEM - A Copernicus Climate Change Service



Quick Facts

- A 27-month EU Copernicus Climate Service project
  - Started in November 2015
- Led by the University of East Anglia (UEA, UK), with:
  - Electricité De France (EDF, France)
  - The Met Office (UK)
  - ARMINES (France)
  - The University of Reading (UK)
  - The Agency for new technologies, energy and sustainable development (ENEA, Italy)
- Five work-packages
  - Clear focus on stakeholder engagement – one workshop every six month, so as to create strong engagement

Target

- **Energy Mix assessment for:**
  - **Present day**
  - **Seasonal Forecasts**
  - **Climate Change**

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

From Climate variables to Energy systems

Calibrated Climate Variables

- Temperature
- Rainfall
- River Discharge
- Wind Speed
- Cloud Cover
- Solar Radiation
- Others ?

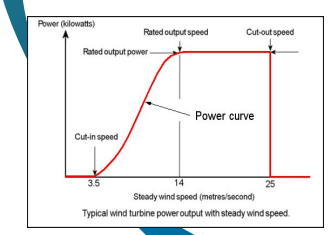
+Ancillary

- Skill & Reliability
- Assessment of Seasonal Forecasts of Energy Variables

+ Extreme Events Case Studies

Impacts of Climate Variability & Change on Energy Variables

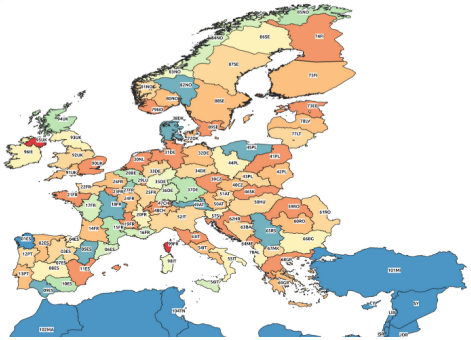
Define models & transfer functions
Select / Gather relevant datasets



Energy Variables

- Demand
- Hydro Power
- Wind Power
- Solar Power
- Thermal Power

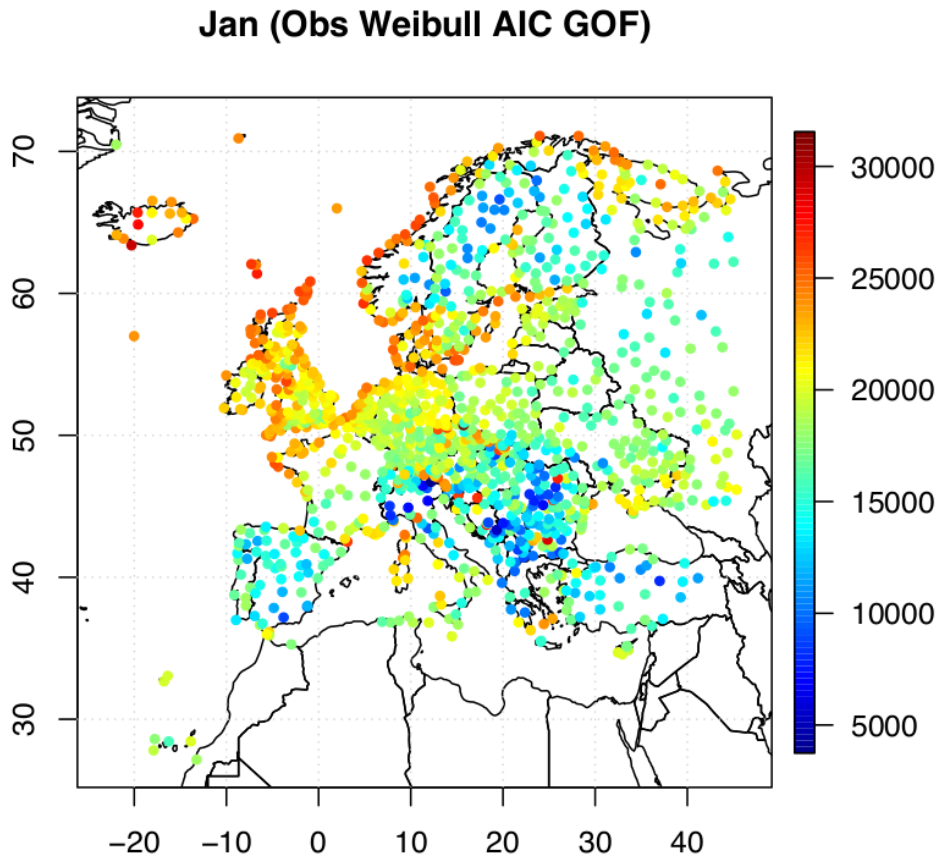
- Sub-Country Scale
- Historical Period
- Seas. Fcst
- Clim. Proj.

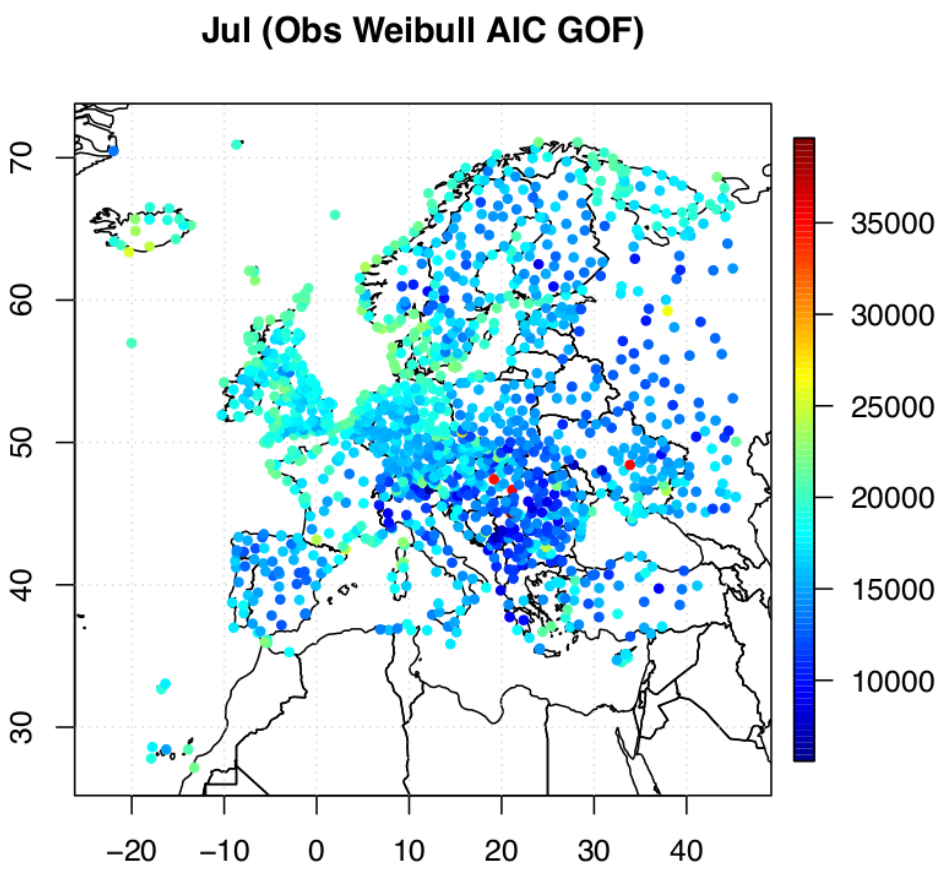


European Commission | Copernicus Europe's eyes on Earth | ECMWF |

Climate Variables: Wind Speed Assessment

Fit of 10 m observations to Weibull distribution

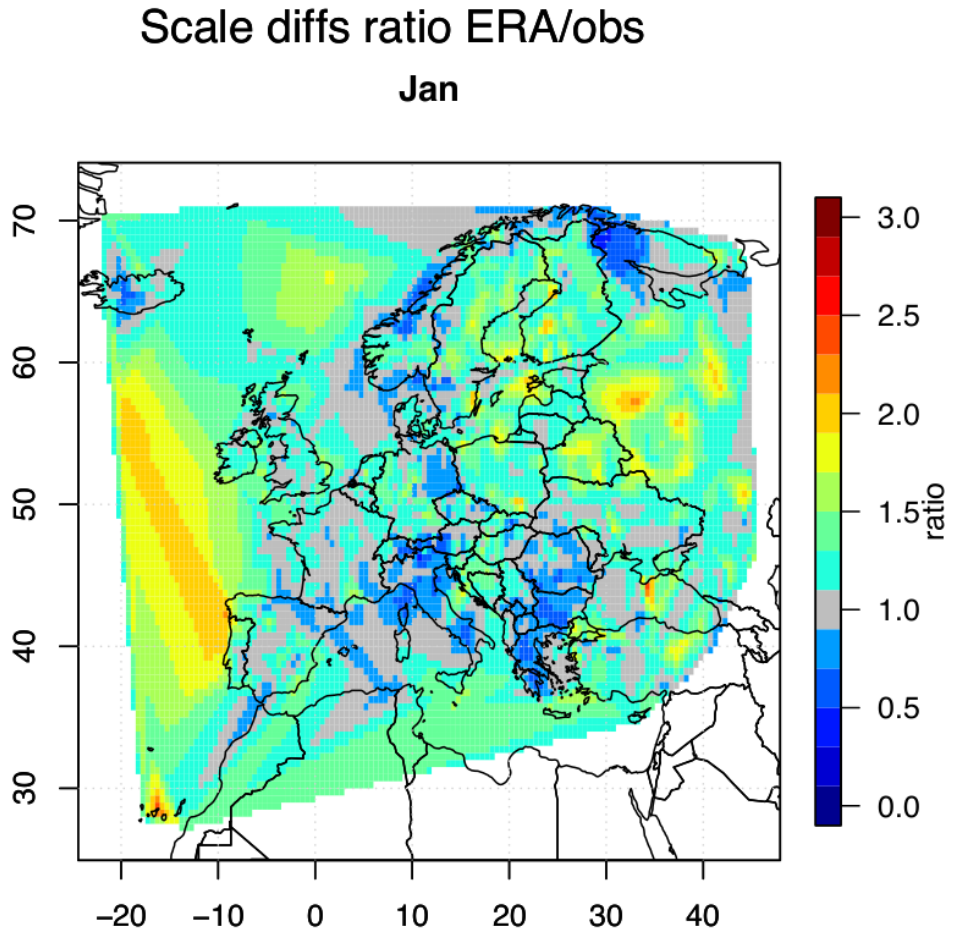


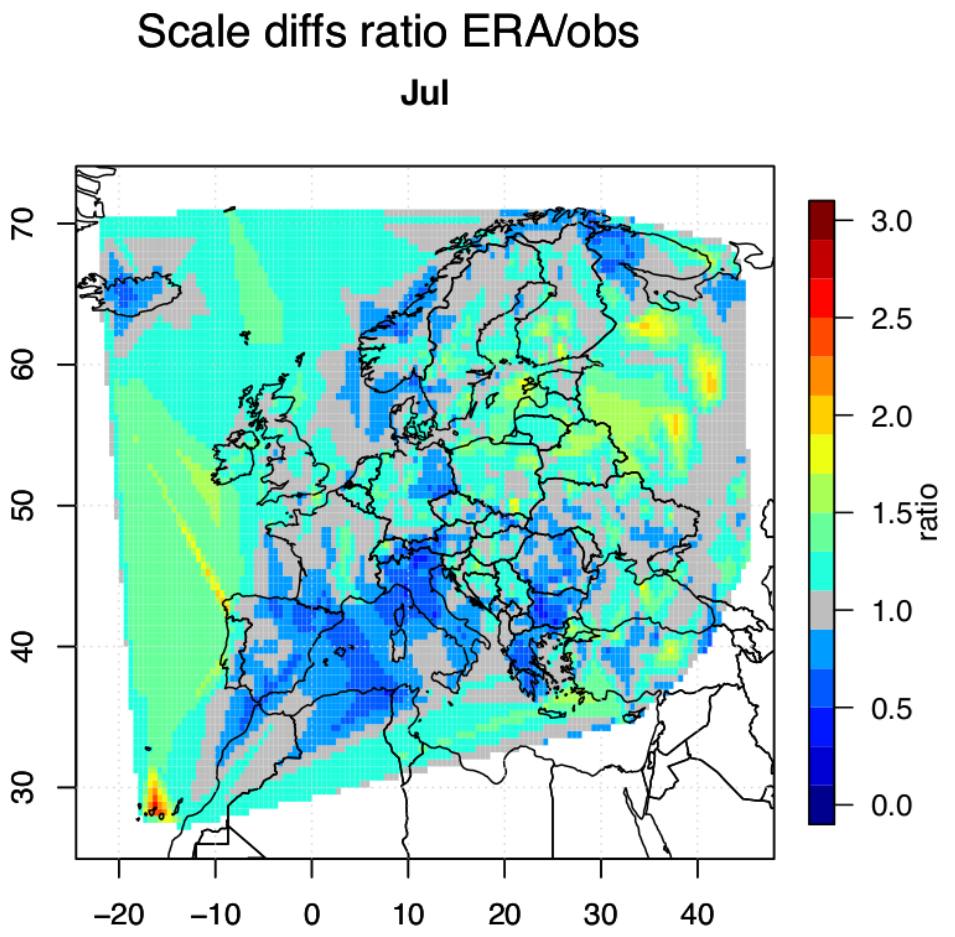


Low number (blue) good fit; high number (red) poor fit

Climate Variables: Wind Speed Assessment

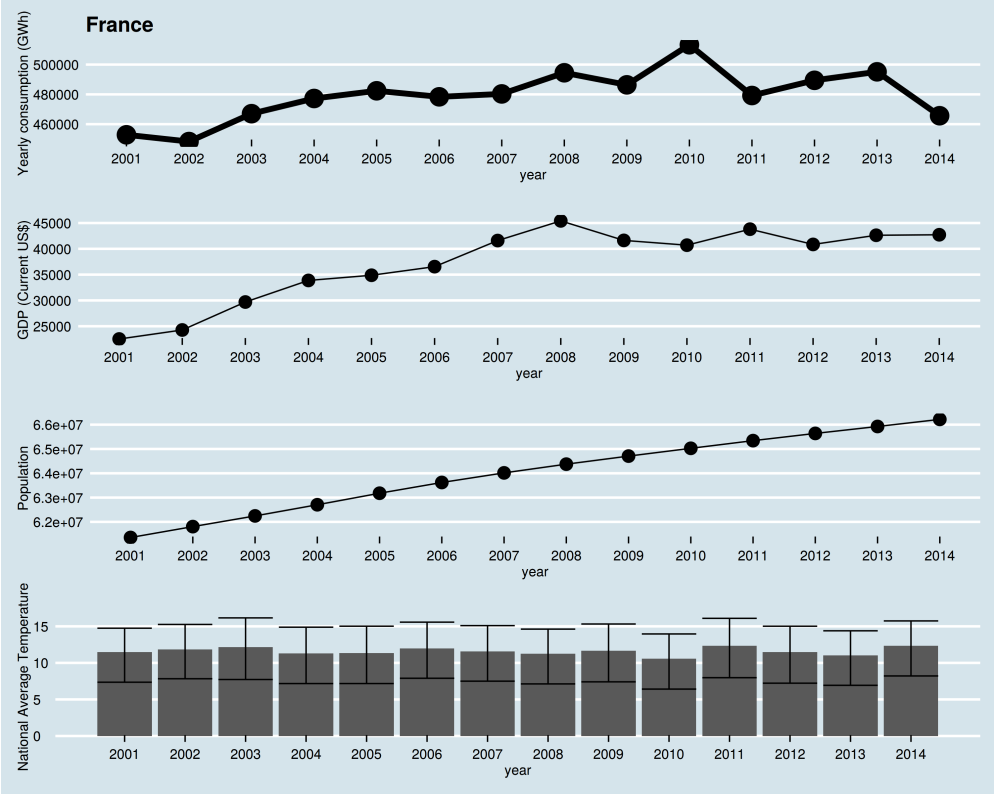
ERA-I Re-analysis versus 10 m obs

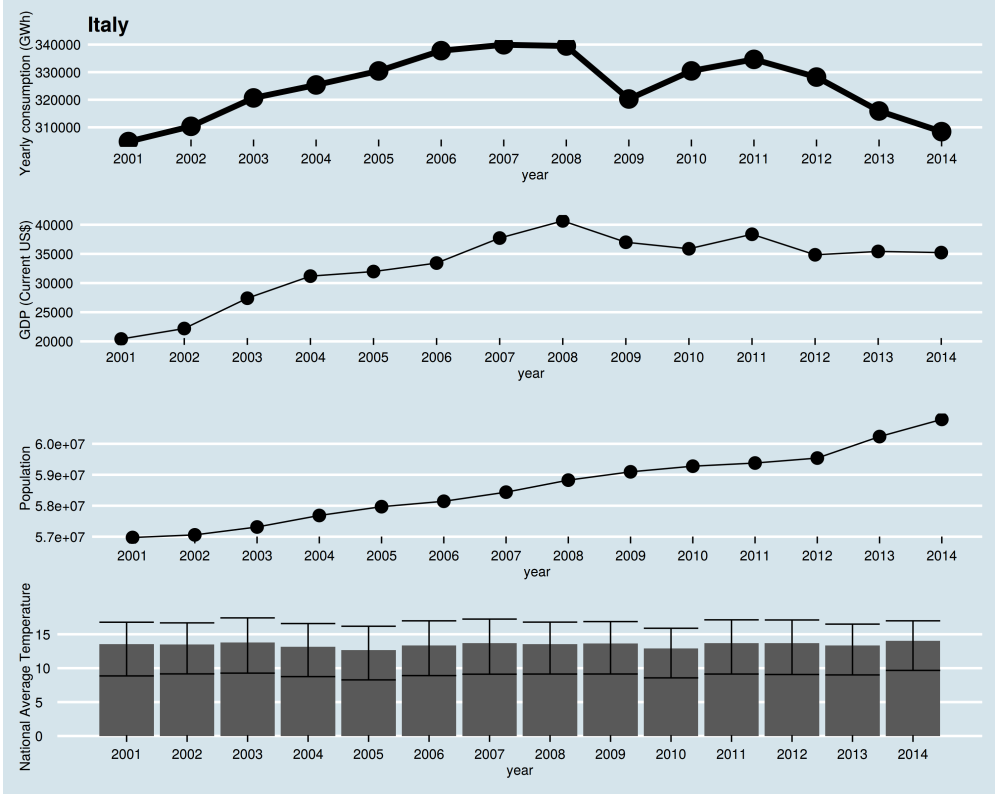




Demand modelling

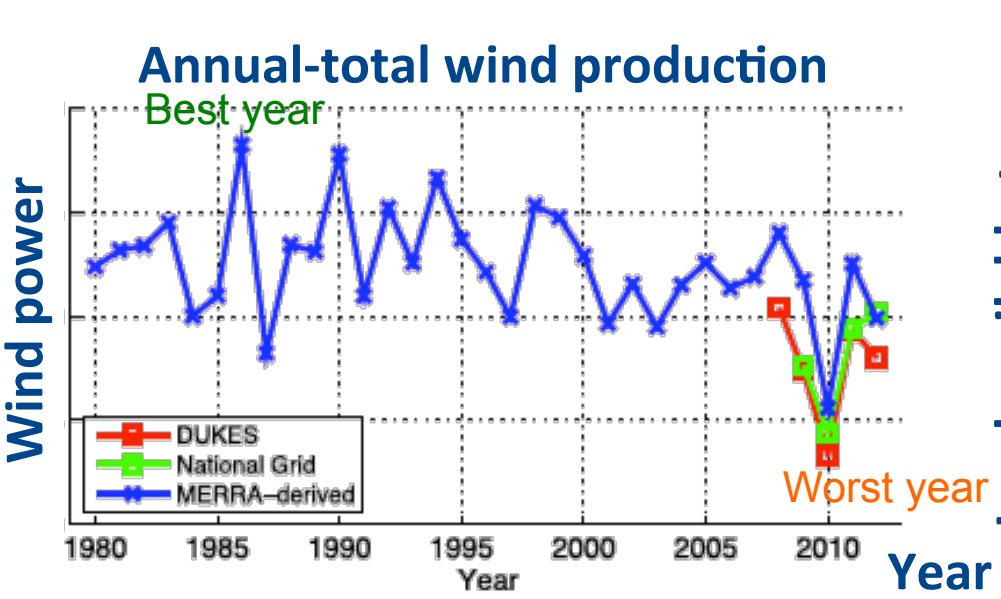
Challenge: remove non-climatic factors

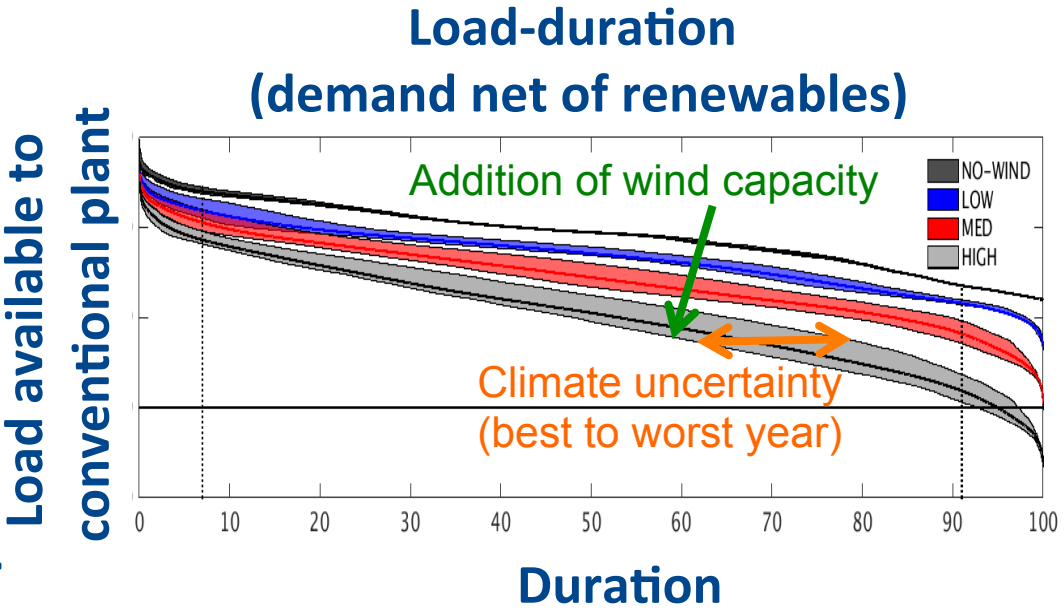




Risk climatologies - examples

★ Investor/owner/planner: Volumetric generation risk



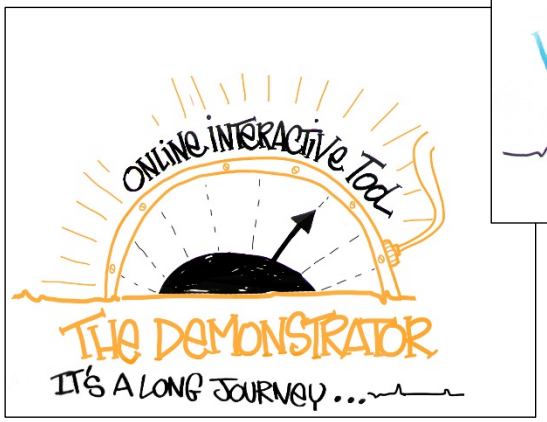


★ Ideas:
- ★ p5-p95 of production volume for RE
- ★ p5-p95 of annual hours at a specified load level for conventional plant
- ★ "best" and "worst" case years
- ★ Curtailment
- ★ Spatial correlations maps for neighbouring zones

Figures:
Cannon et al (2015, RE)
Bloomfield et al (submit, Nat. Energy)

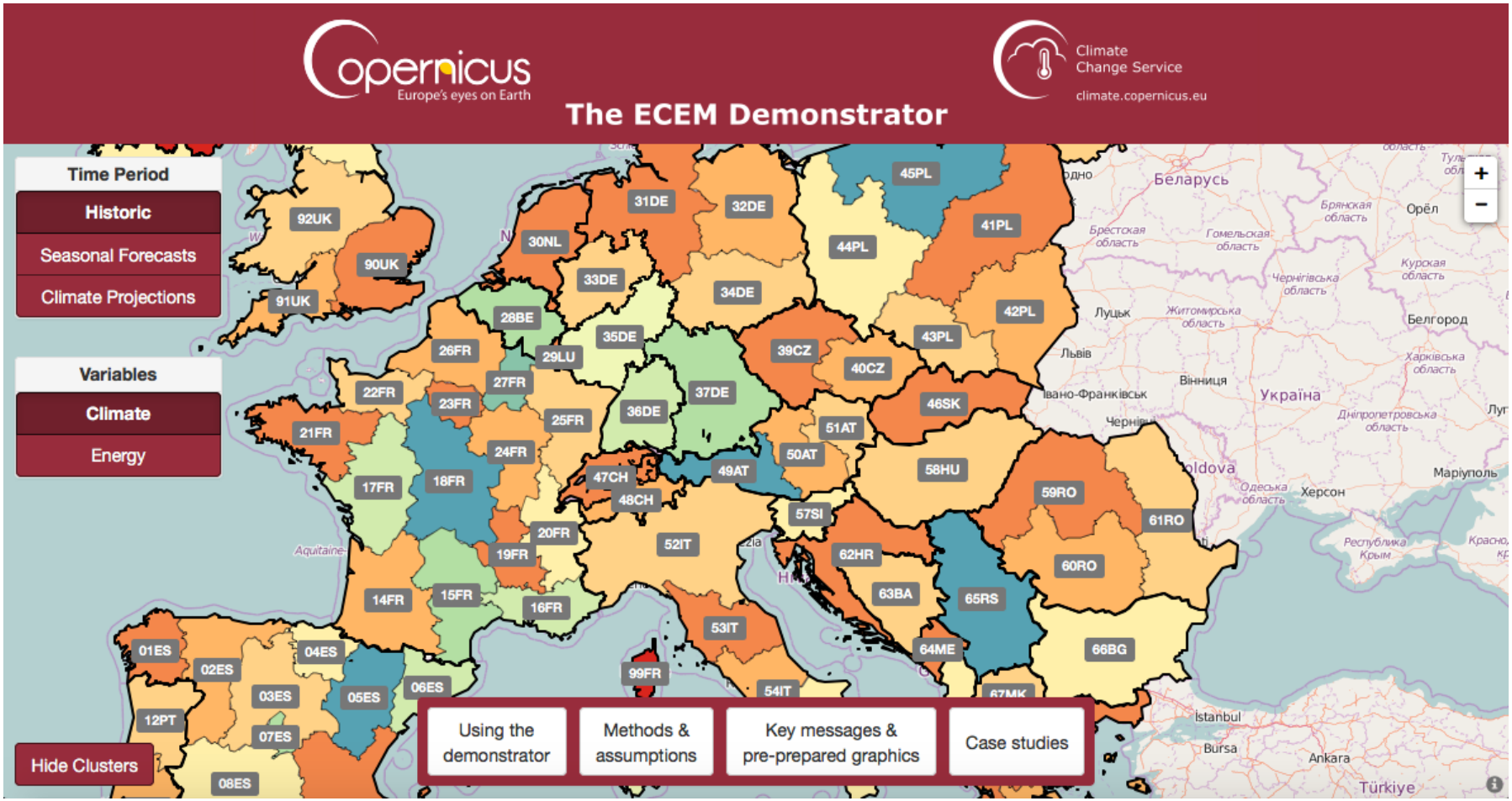
The ECEM Demonstrator

The purpose of the ECEM demonstrator is to enable the energy industry and policymakers to assess how well different energy supply mixes in Europe will meet demand, over different time horizons (from seasonal to long-term decadal planning), focusing on the role climate has on the mixes.



How will the demonstrator look like?

An online interactive tool to test energy mixes



Summary

Integration of energy & climate information for energy mixes assessment

- ★ Is climate important for energy planning?
- ★ What can climate R&D learn from interaction with energy sector and make output more easily adopted by the industry/policy makers?

Stakeholder Engagement

Co-development with prospective users is key to a successful implementation of ECEM

- ★ We welcome feedback at any time, including offers for co-development and/or to be a champion for the ECEM demonstrator

Feedback form, Twitter, Presentations

- **Feedback** form: http://tiny.cc/ECEM_WS2
- **Twitter**: #USER_ECEM
- **ECEM presentations**:
  - http://tiny.cc/ECEM_USER2_a
  - http://tiny.cc/ECEM_USER2_b
  - http://tiny.cc/ECEM_USER2_c
  - http://tiny.cc/ECEM_USER2_d
  - http://tiny.cc/ECEM_USER2_e
- **More information on ECEM**:
  - http://ecem.climate.copernicus.eu/
  - http://www.wemcouncil.org/wp/projects/ecem/


Thank you