Clim2Power

Next Generation Challenges in Energy-Climate Modelling

23rd June 2020

Sofia G. Simoes

Where we stand - nutshell

Objectives:

- making energy and power models respond to climate variability
- statistical meaningfull approach to enhance the predictive skill of the current models over Europe, instead of "just" numerical downscaling

Hydrological models, Machine Learning

PV & Wind Power Simulation Tools

Hydro, solar, wind availability

Climate

- next season
- 'season' in 2050

Climate Data

Electricity, Heating, & Cooling Demand

Power demand

Optimisation of whole energy/ power system

Energy System & Power System Models

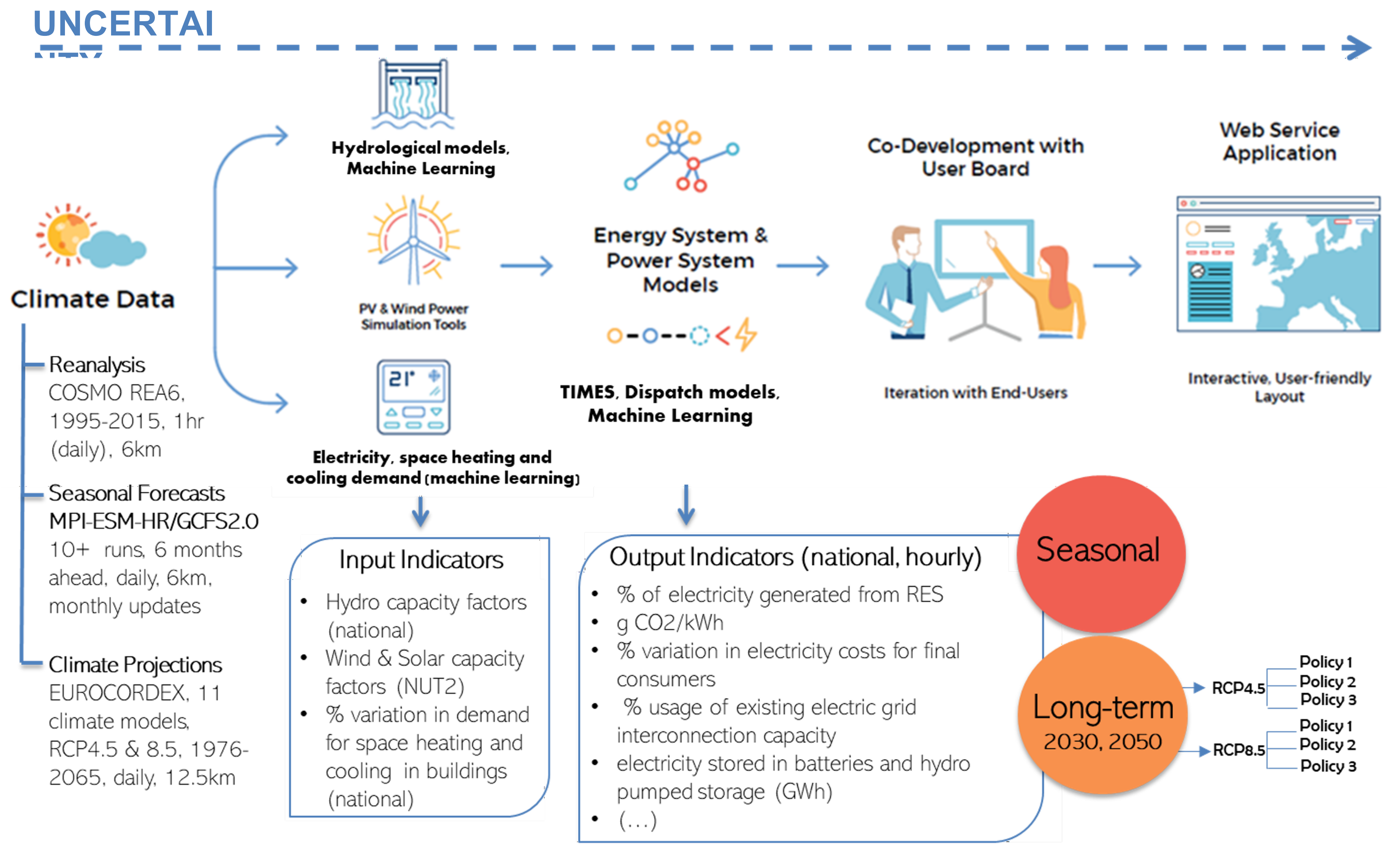
Hydro-storage
acq. & storage of fossil fuels
electricity prices
dispatch constraints
operational & maintenance costs
CO2 emissions
EU ETS allowance costs
electricity trade

Changes in termal and RES power plant operation

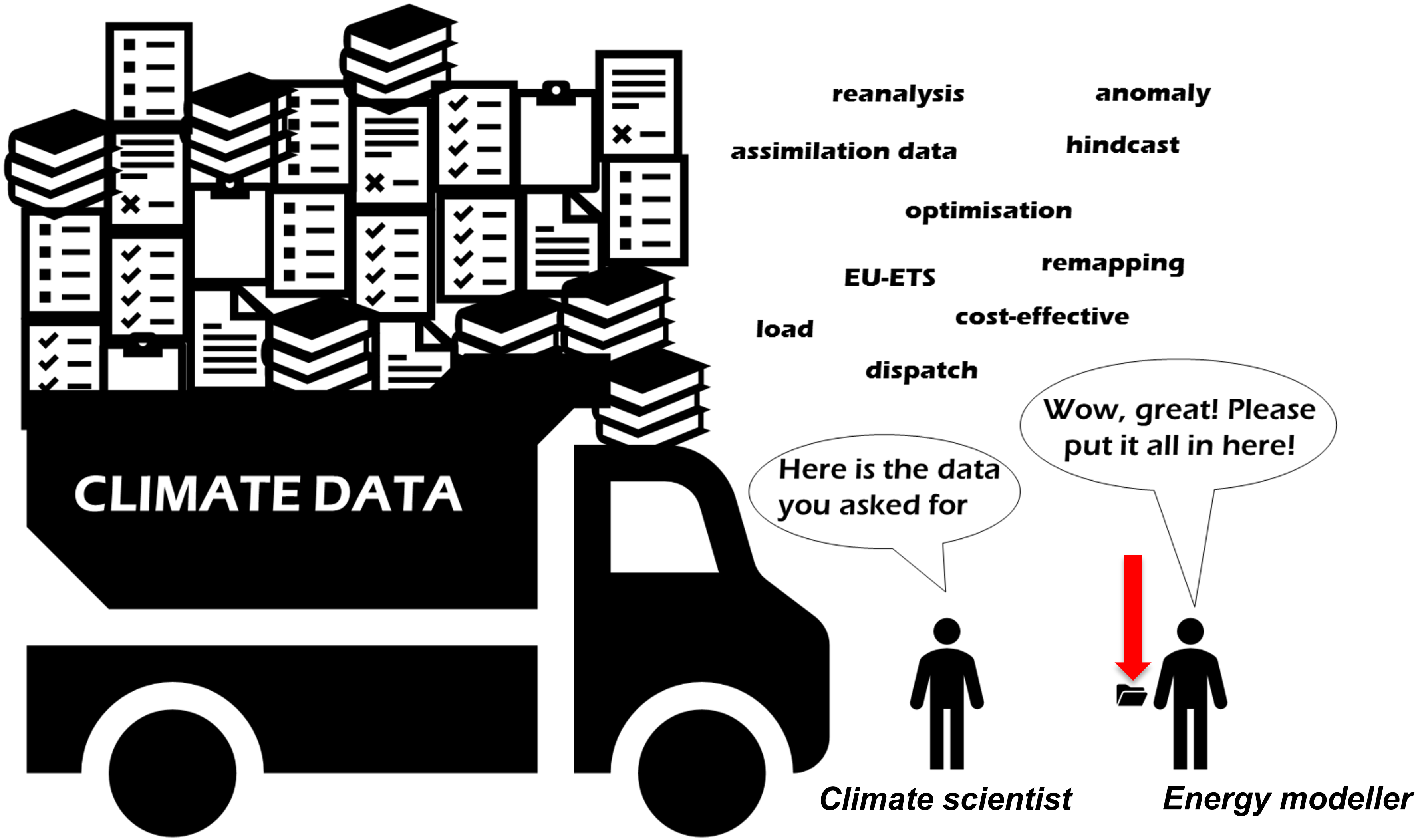
Concurrent water uses

biodiversity, flood protection, agriculture, transboundary

Clim2Power Pipeline



Lessons learnt



Challenges / difficulties

- **combining expertise** of persons with a multi-disciplinary background
- **different data demands** on the spatial/temporal resolution
- **tight/challenging timings** for processing the seasonal forecasts and downscaling
- how to **assess uncertainty** in the modelling cascade
- communicating to users the **limited skill of seasonal forecasts** over Europe
- **process and store the large amount of climate data** - get familiar with different data types and storage protocols
- **computation limits** of energy system model for Europe

How useful is C2P to users (which users)?
How insights of national case-studies feed the EU analysis?
Can we recommend the Seasonal Forecasts for some months/regions?

Some insights

- many other factors affecting the energy system evolution (technology evolution, market dynamics, policy decision as shutting down nuclear or not, etc.) than climate

- changing with the more clear effects of climate change and increasing shares of RES power plants – yet climate change trends are still not a very major factor - how to deal with extreme events in energy models with some degree of reliability?

- In energy system modelling we do not quantify risk - although climate scientists deal competently with assessing risks and uncertainty, energy systems modellers do not assess uncertainty (or risk). We simply deal with it by creating many scenarios but we cannot attribute a probability to each one of our scenarios

- Increasing substantially our time-slices and geographical disaggregation led to huge computational problems (in fact the models stopped running) - still trying to find solutions for this.

- in the power domain we are lacking a coordinated time series of daily/hourly power outputs for each country in Europe – ENTSO-E only has at the moment a 3 year time-series. Thus, integrating bias adjustment from GCM into "bias adjustment" of power plants output becomes a big challenge

Some Publications

Published

1. Amorim, F., Simoes, S.G., Siggini, G., Assoumou, E. (2020) **Integrating Climate Variability in energy system models.** Energy (Q1; IF: 5.537) https://doi.org/10.1016/j.energy.2020.118089
2. Saint-Drenan, Y.M., Besseau, R., Jansen, M., Staell, I., Troccoli, A., Dubus, L., Schmidt, J., Gruber, K., Simoes, S.G., Heier, S. (2020) A **parametric model for wind turbine power curves incorporating environmental conditions.** Renewable Energy Journal (157) pp. 754-768 (Q1; IF: 5.439) https://doi.org/10.1016/j.renene.2020.04.123
3. Baumgartner, J., Schmidt, J., Gruber, K., Simoes, S.G., Saint-Drenan, Y-M., (2020). **Less Information, Similar Performance: Comparing Machine Learning-Based Time Series of Wind Power Generation to Renewables.ninja**. Energies 13(9), 2277; https://doi.org/10.3390/en13092277 (Q1; IF: 2.747) https://www.mdpi.com/1996-1073/13/9/2277/htm

SUBMITTED

1. Sessa, V., Assoumou, E., Bossy, M., Carvalho, S. Simoes, S.G. (n.d.) **Machine learning for assessing variability of the long-term projections of the hydropower generation on a European scale**. Applied Energy (submitted March 2020)
2. Simoes, S.G., Amorim, F, Siggini, G., Sessa, V., Saint-Drenan, Y-M., Carvalho, S., Mraihi, H., Assoumou, E. (n.d.) **Climate proofing the renewable electricity deployment in Europe - introducing climate variability in large energy systems models.** Energy Strategy Reviews (submitted October 2019)

UPCOMING

1. Adaptation needs for EU power sector
2. Review existing web-based climate services highlight the importance of user-centred approach + integration of transdisciplinary perspectives and cross-disciplinary expertise

More on CLIM2POWER:

https://clim2power.com/

sgcs@fct.unl.pt

Project CLIM2POWER is part of ERA4CS, an ERA-NET initiated by JPI Climate, and funded by FORMAS (SE), BMBF (DE), BMWFW (AT), FCT (PT), EPA (IE), ANR (FR) with co-funding by the European Union (Grant 690462).