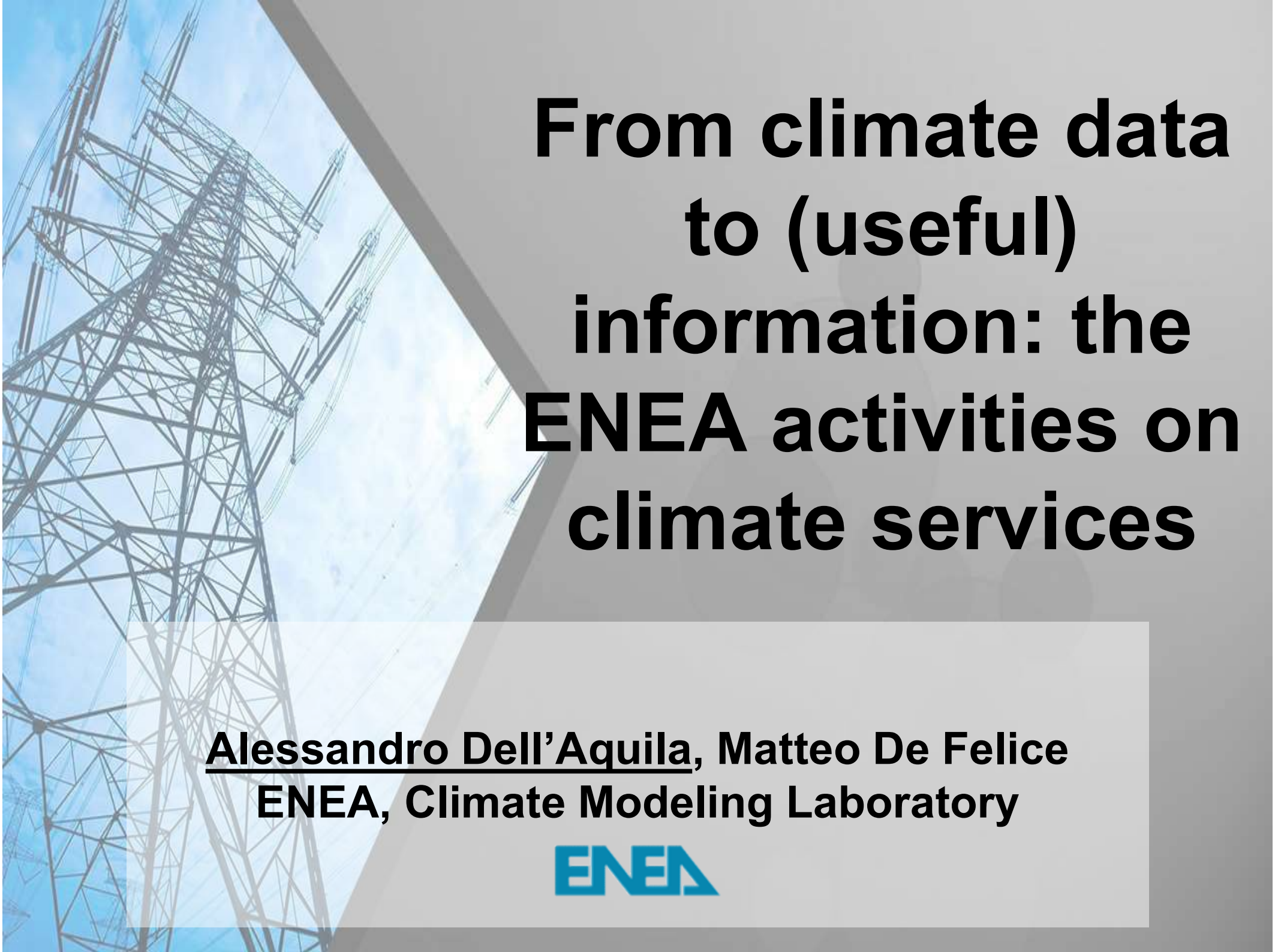


From climate data to (useful) information: the ENEA activities on climate services

Alessandro Dell'Aquila, Matteo De Felice
ENEA, Climate Modeling Laboratory

Energy & Climate

- Link between Energy and Climate is strengthening for several reasons:

1. Diffusion of Renewable Energies
2. Widespread use of air conditioning
3. Necessity of improving efficiency/reliability of power networks (electric utilities)

ENEA contribution to climate services for energy

1. An Italian Experience: the ENEA-TERNA collaboration
2. An European initiative: the Copernicus ECEM project

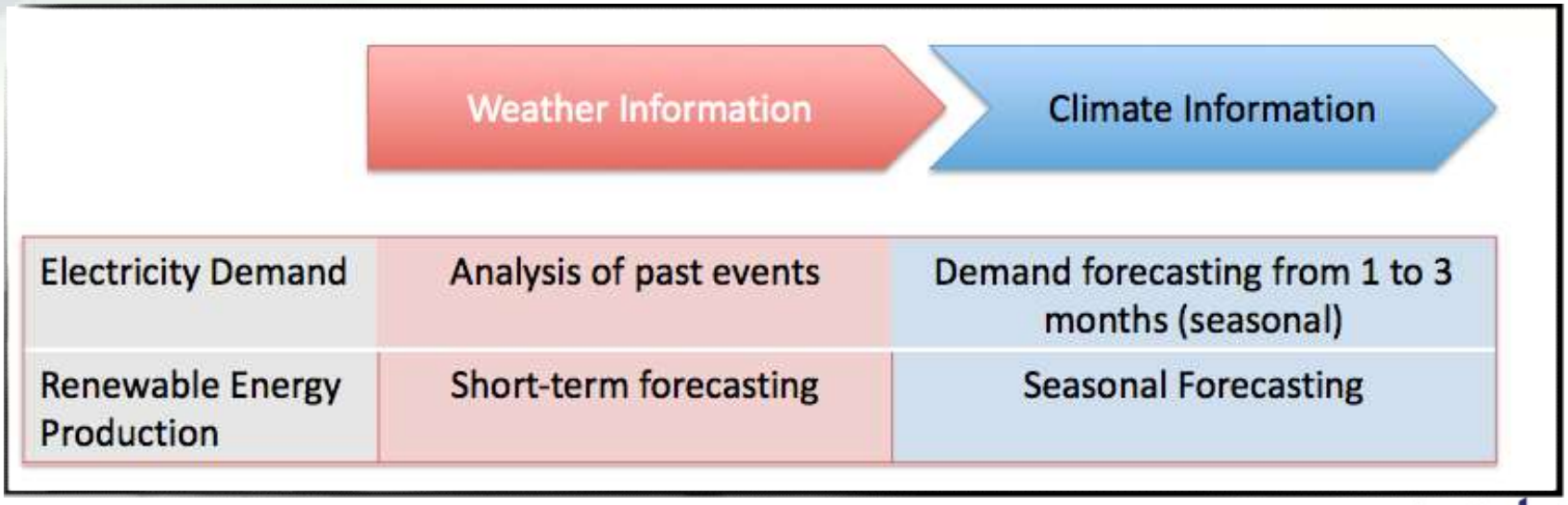
The ENEA-TERNA collaboration

Climate & TSO

Transmission System Operators (TSOs) are responsible for:

- ensuring the long-term ability of the system to meet demands for electricity
- contributing to security of supply
- managing electricity flows on the system

EUR-Lex - Internal market in electricity - 2009/72/EC



Terna

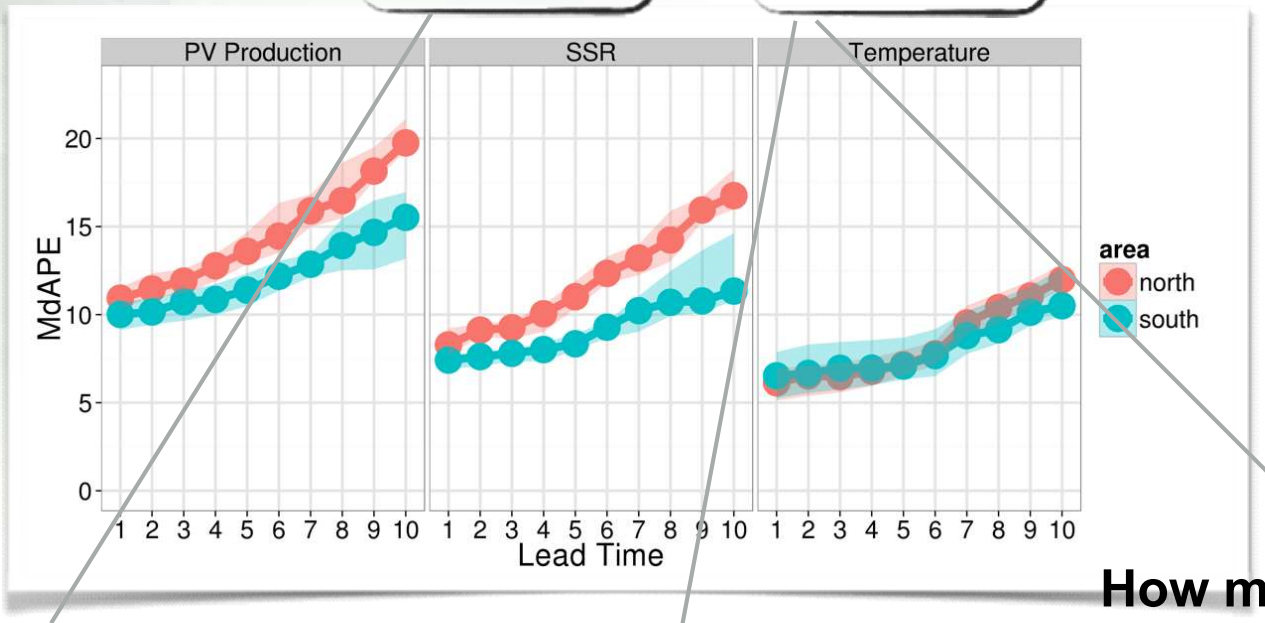
entsoe
Reliable Sustainable Connected

The ENEA-TERNA collaboration

Supply: solar power

- Photovoltaics: estimate & predict

Data from TERNA



How much are we producing now?

How much we will produce tomorrow?

How much we will produce next summer?

M. De Felice, M. Petitta, and P. M. Ruti, "Short-term predictability of photovoltaic production over Italy," Renewable Energy, vol. 80, pp. 197-204, 2015.

SPECS
Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

The ENEA-TERNA collaboration

Going seasonal…

- Short-term solar forecasting/prediction

About 112,000 results (**0.10** sec)

- Seasonal solar forecasting/prediction

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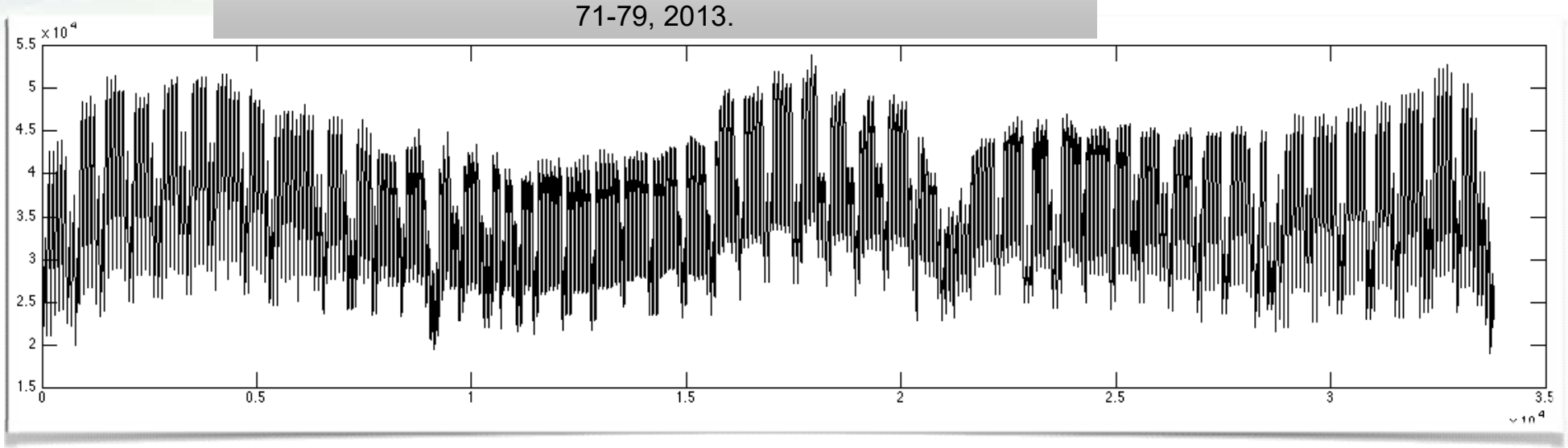
The ENEA-TERNA collaboration
Electricity Demand

- Electricity demand sensitive to weather conditions
- Currently only climatological data are used for time-scales >14 days
- Demand affected by “human activities” (calendar effects) and economic trends

- …how it is affected by temperature
- …its predictability at short-time scales

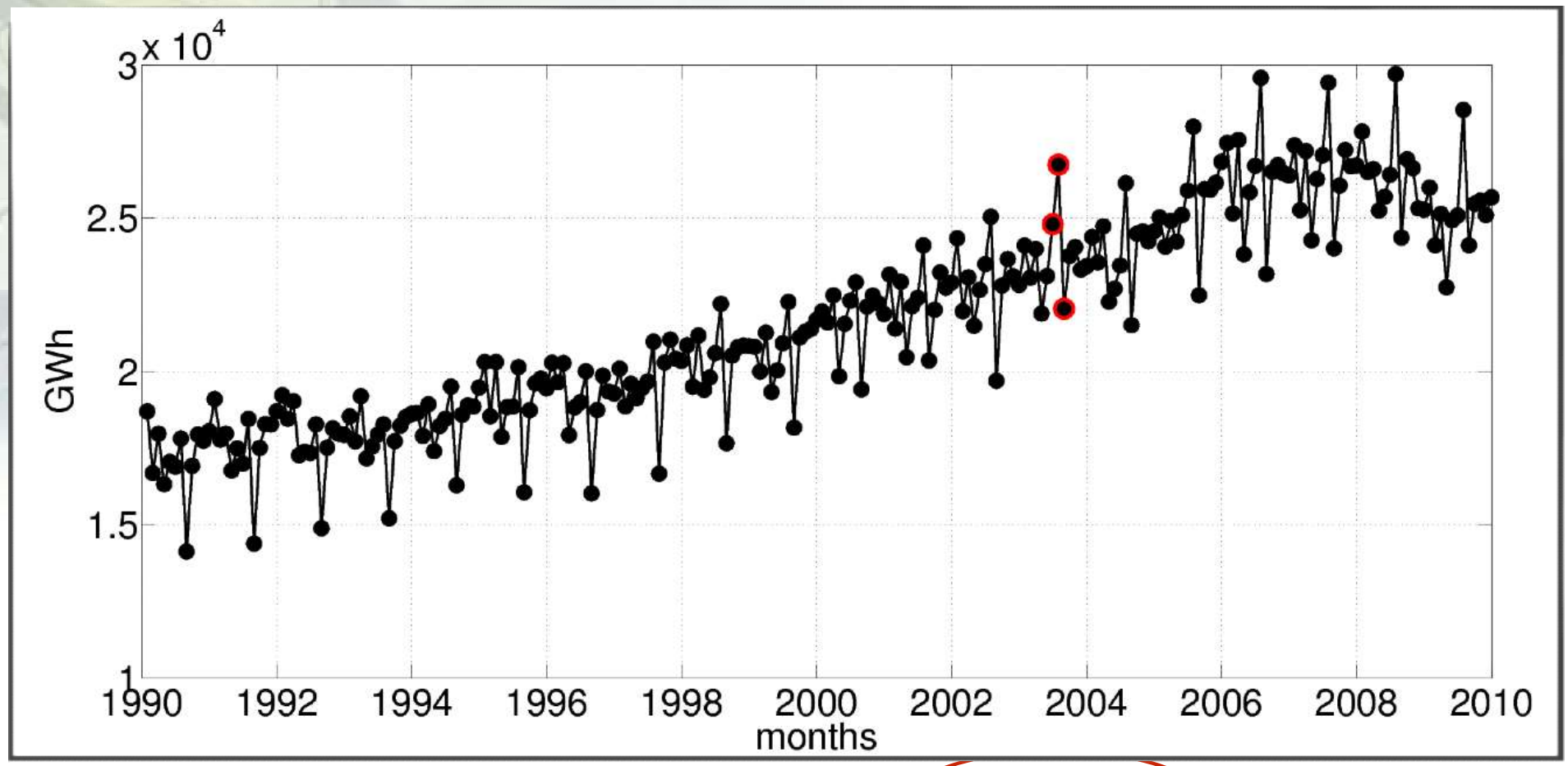
M. De Felice, A. Alessandri, and P. M. Ruti, “Electricity Demand Forecasting over Italy: Potential Benefits using Numerical Weather Prediction models,” Electric Power Systems Research, vol. 104, pp. 71-79, 2013.



Annual energy demand over Italy

The ENEA-TERNA collaboration

Electricity Demand…

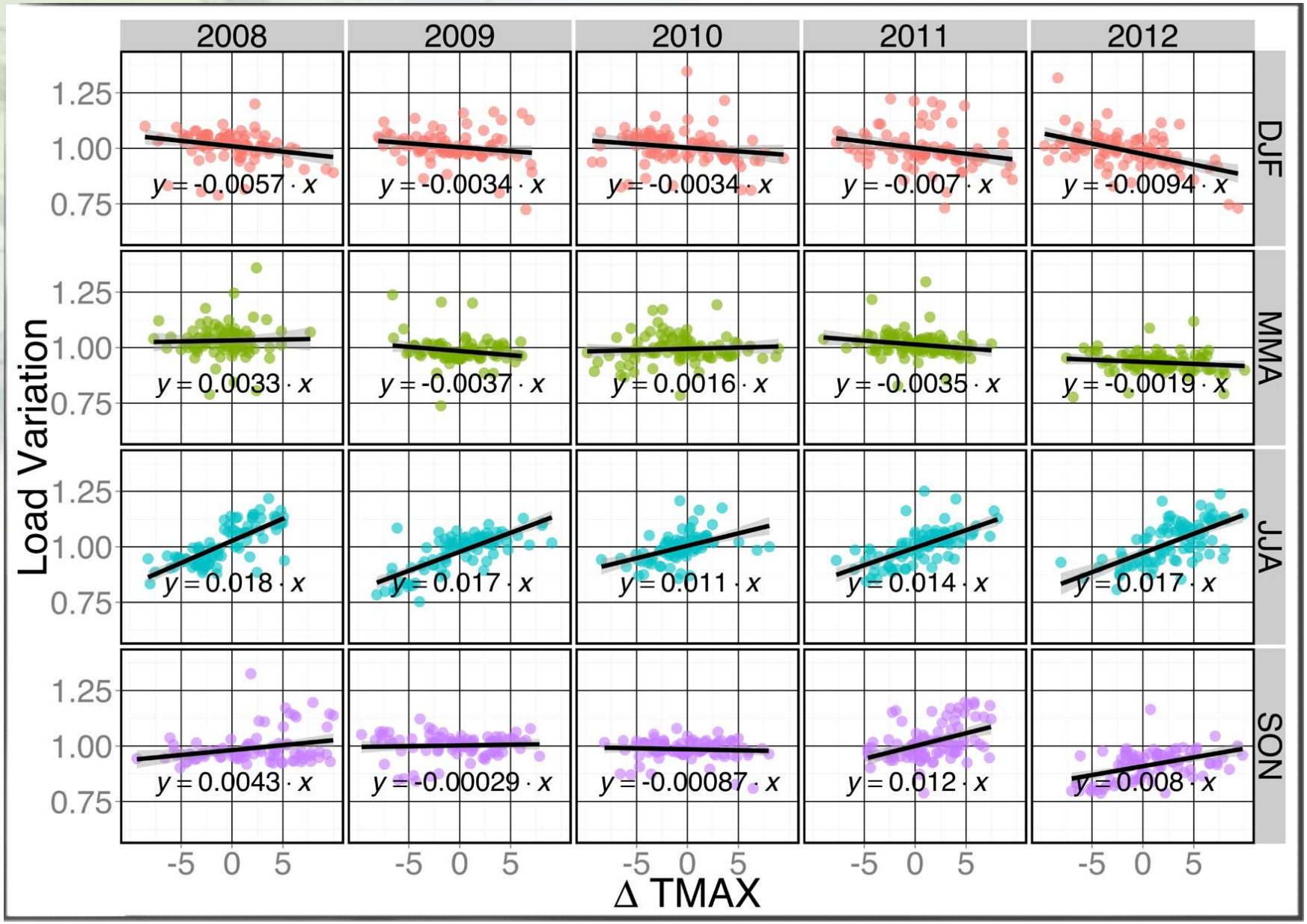


JJA 2003

- E.g. During European 2003 heat-wave France reduced electricity export in August of 50% (EDF)

The ENEA-TERNA collaboration

Observe



The ENEA-TERNA collaboration

Going seasonal

- What will be the probability of having the demand above/below the normal?
- Use of “statistical downscaling” of seasonal forecasts
- Interesting result: significant skill (BSS > 0.3) on some Italian regions with one-month of lead time

De Felice M., Alessandri A., and F. Catalano, “Seasonal climate forecasts for medium-term electricity demand forecasting,” Applied Energy, vol. 137, pp. 435-444, 2015

The ENEA-TERNA collaboration

Seasonal Forecast

The ENEA-TERNA collaboration

Probabilistic product for TERNA

	Center (C)			South (S)		
Year	Above normal?	May	April	Above normal?	May	April
1990	Yes	37.3%	33.3%	No	31.4%	33.3%
1991	No	23.5%	20%	No	25.5%	26.7%
1992	No	43.1%	46.7%	Yes	60.8%	46.7%
1993	No	13.7%	46.7%	No	35.3%	46.7%
1994	Yes	86.3%	33.3%	No	49%	33.3%
1995	No	29.4%	53.3%	Yes	15.7%	40%
1996	No	29.4%	40%	No	25.5%	46.7%
1997	No	39.2%	26.7%	Yes	60.8%	33.3%
1998	No	31.4%	33.3%	Yes	52.9%	46.7%
1999	No	5.9%	6.7%	No	0%	6.7%
2000	No	29.4%	6.7%	No	2%	0%
2001	No	23.5%	20%	No	2%	0%
2002	Yes	52.9%	26.7%	Yes	41.2%	20%
2003	Yes	68.6%	46.7%	Yes	94.1%	46.7%
2004	No	15.7%	53.3%	No	47.1%	46.7%
2005	Yes	33.3%	26.7%	No	49%	46.7%
2006	Yes	41.2%	73.3%	No	7.8%	53.3%
2007	No	13.7%	26.7%	No	27.5%	46.7%

Next summer demand

The C3S ECEM project

ECEM

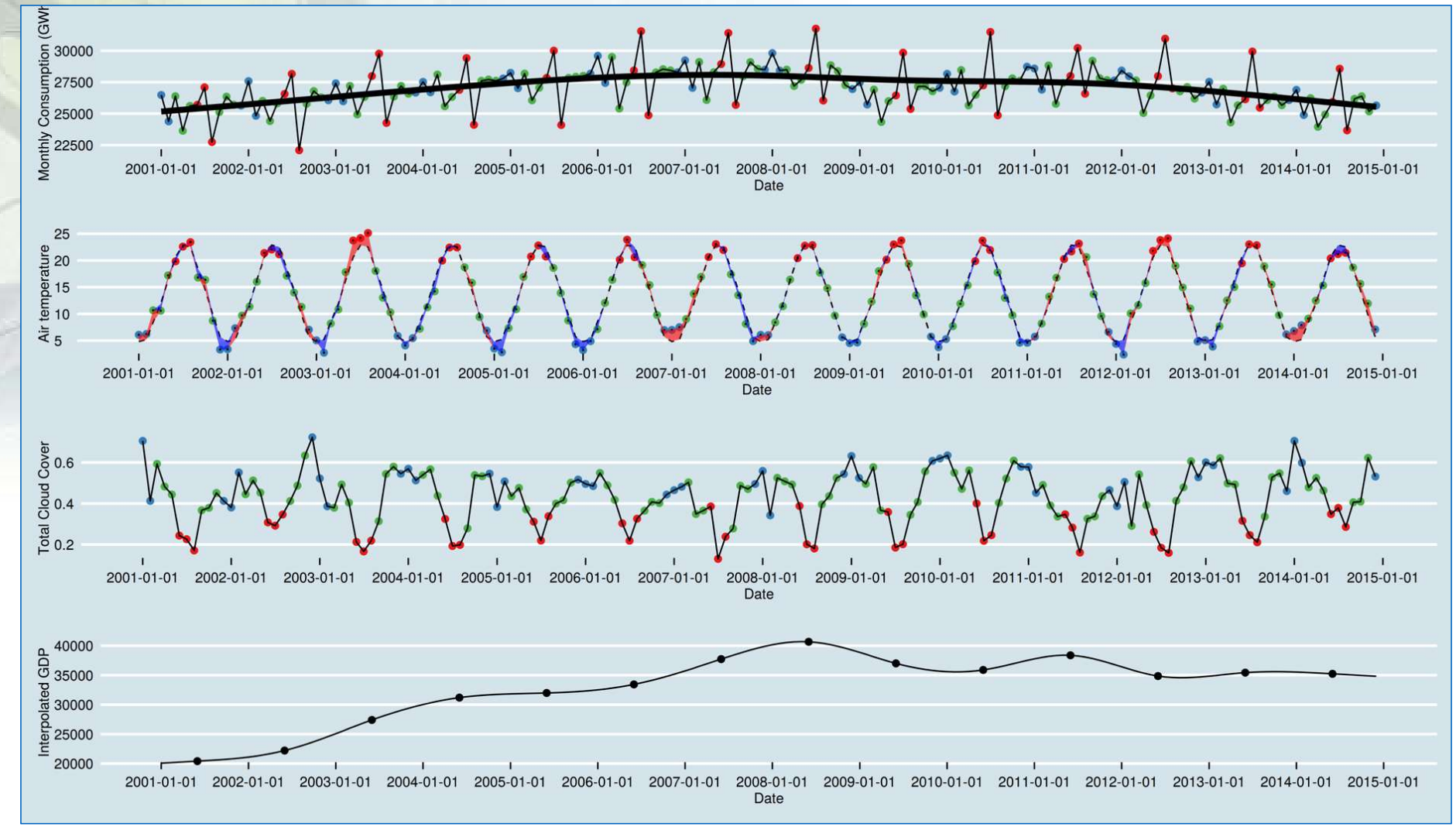
- It is a **Copernicus Climate Change Services Project (C3S)** with the aim to enable the energy industry and policy makers to assess how well energy supply will meet demand in Europe over **different time horizons**
- Demand/Supply for historical/seasonal/climate change scenarios
- 2 stakeholders workshops
- Demonstrator for energy demand and supply (not only renewables) at national scale

European Climatic Energy Mixes

The C3S ECEM project

Monthly Outlook

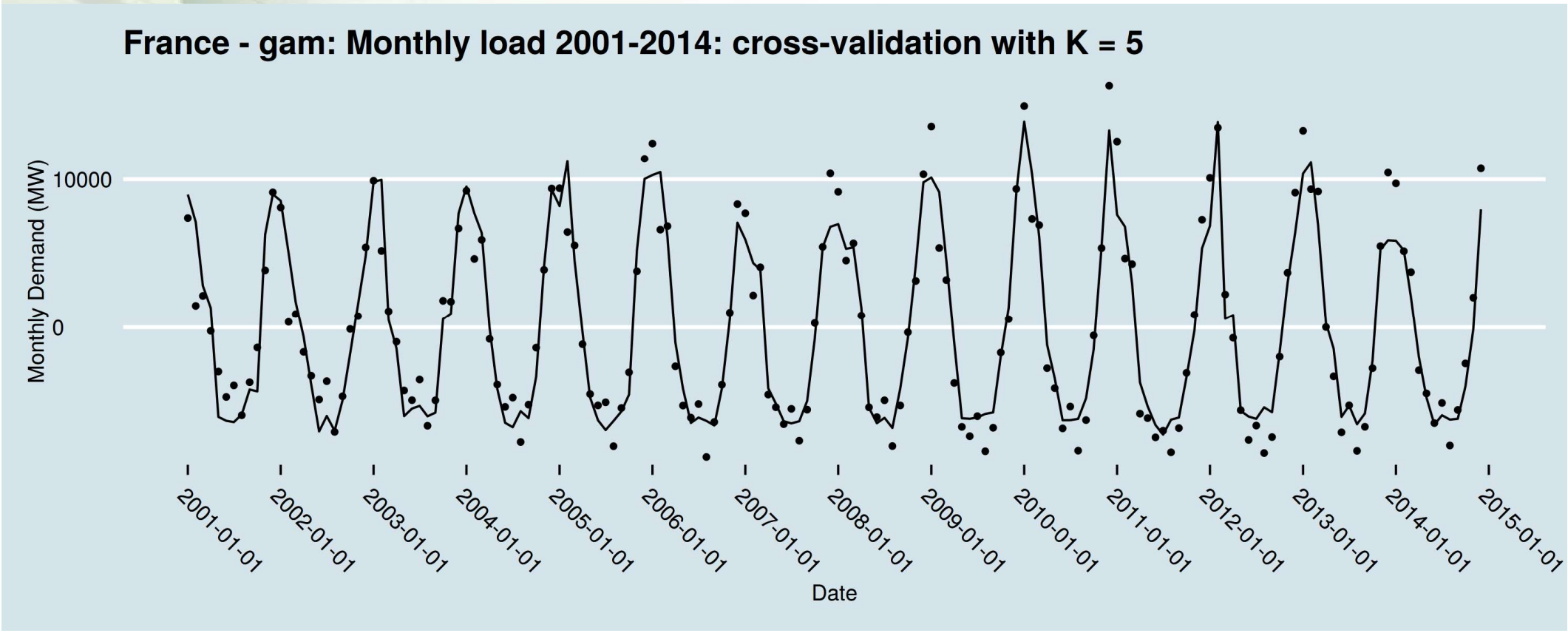
Italy (ENTSO-E data)



The C3S ECEM project

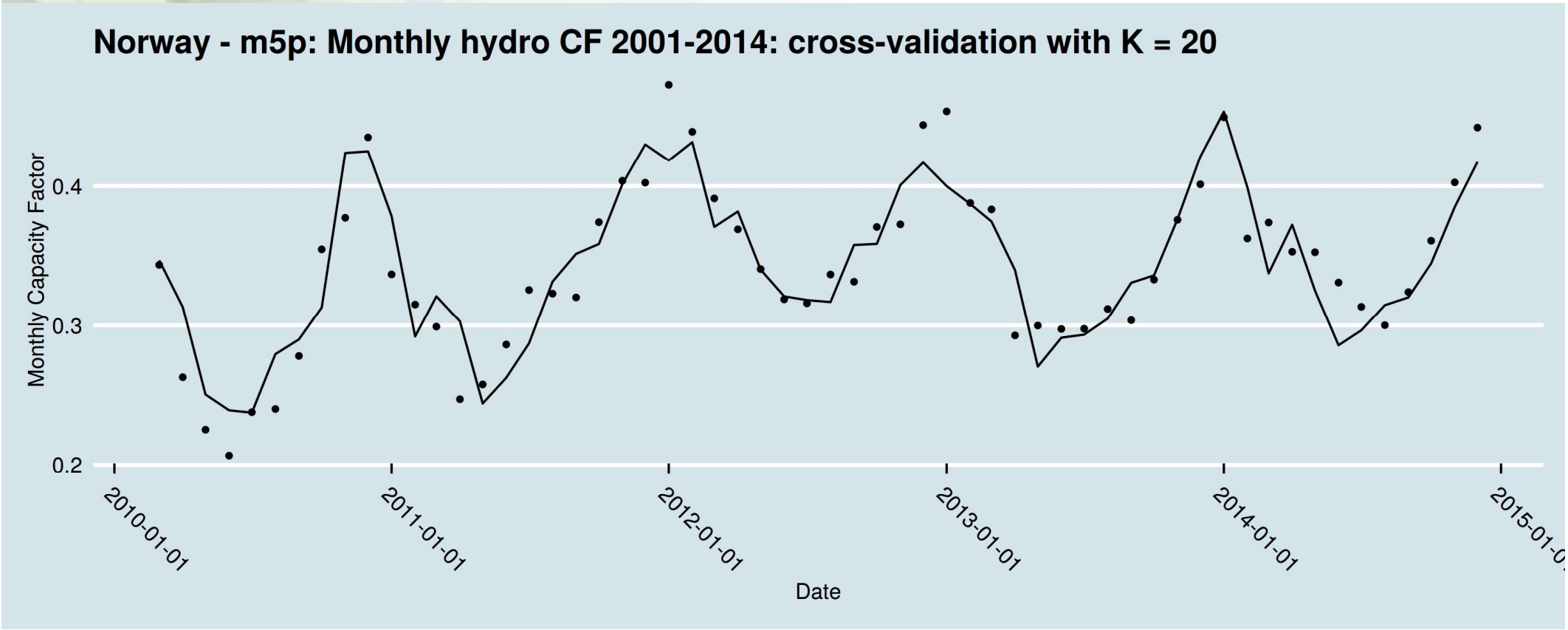
Monthly Consumption

- Modeled by using statistical Generalised Additive Model (GAM) with temperature



The C3S ECEM project

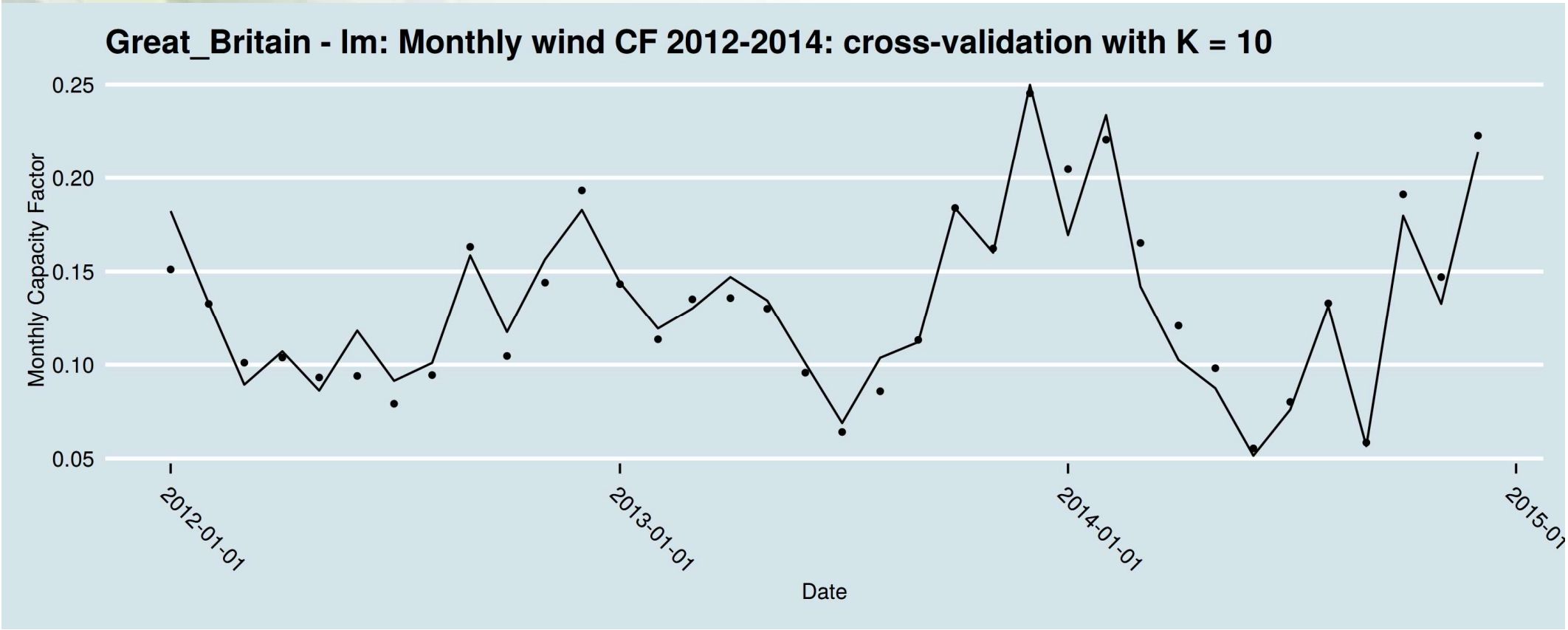
Monthly hydro production in Norway



- Modeled by using Regression Tree with precipitation as predictor

The C3S ECEM project

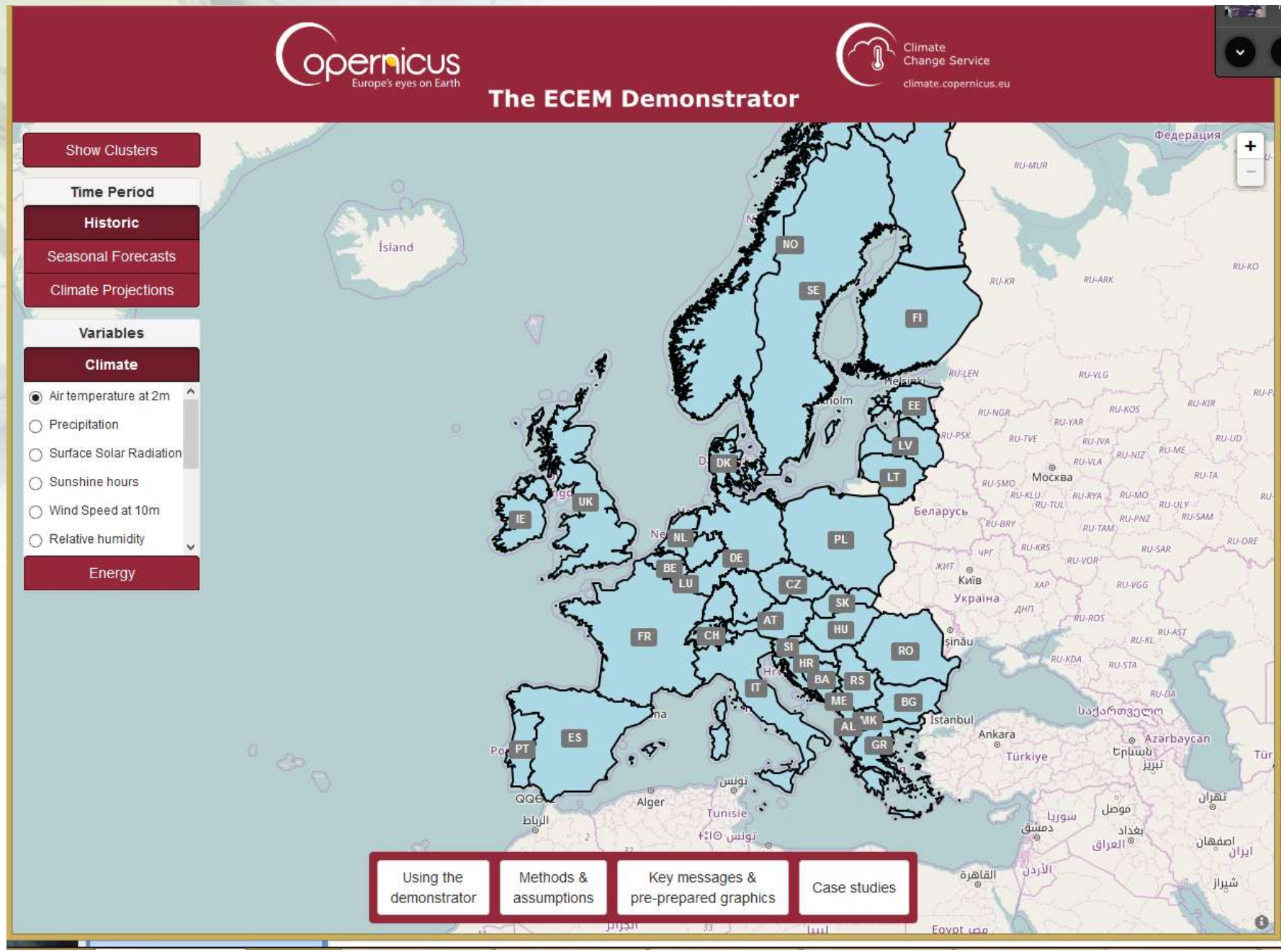
Monthly wind production in UK



- Modeled by using Linear Model with wind speed as predictor

The C3S ECEM project

Demonstrator for energy demand and supply (not only renewables) at national scale



Climate predictions for Energy sector

- Large spread of time scales interested, from shorter to seasonal and longer

- For the Italian TSO TERNA our services is focused on seasonal forecasts, while ECEM project covers all the time scales

- In terms of expertise in energy sector with the use and exploitation of probabilistic forecasts the landscape is quite complex (generally high skill in Europe, lower in Italy)

- The main barriers identified are the difficulties in finding sectoral information, (i.e. **difficult access to data**). Capacity building issue

INFORMATION IS

POWER