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MEDSCOPE

*MEDiterranean Services
Chain based On climate PrEdictions*

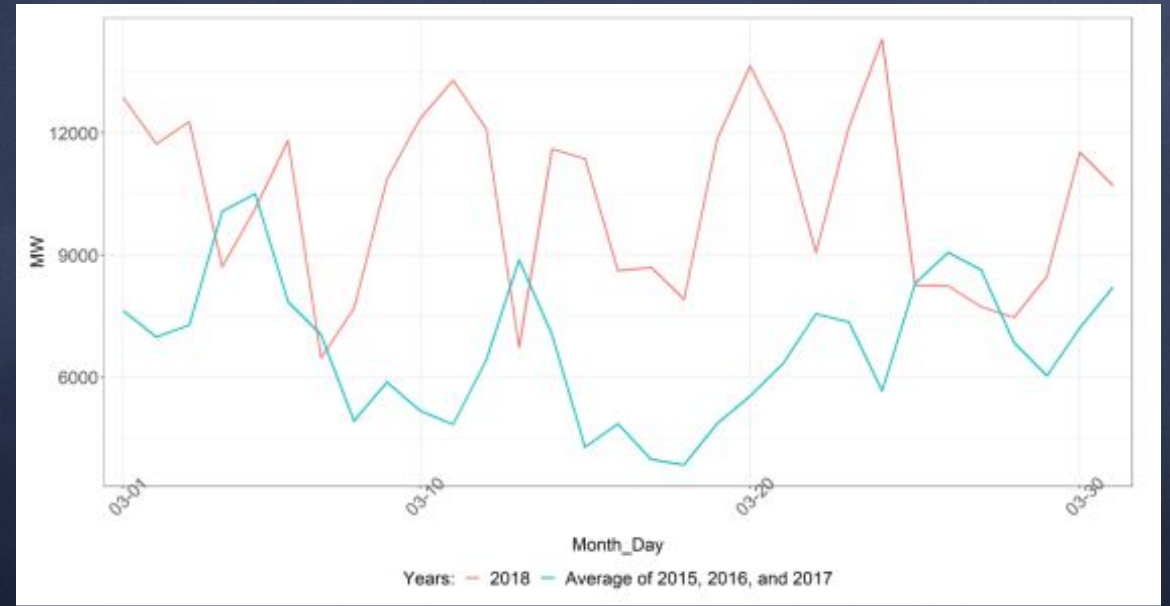
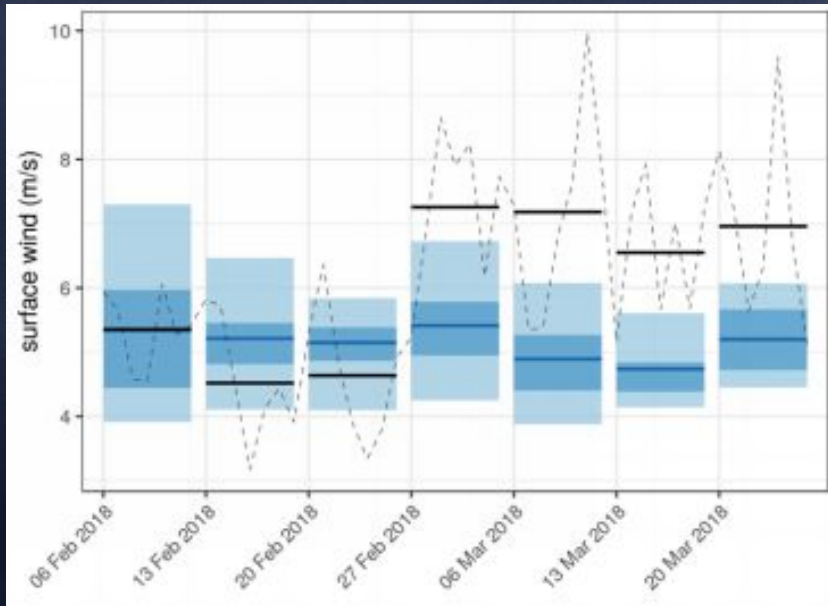
WP4 prototypes: renewable energy wind power capacity factor forecasts

Llorenç Lledó

May 25th 2020

Girona

Windy conditions in Spain, on March 2018



Four weeks in a row above P90!

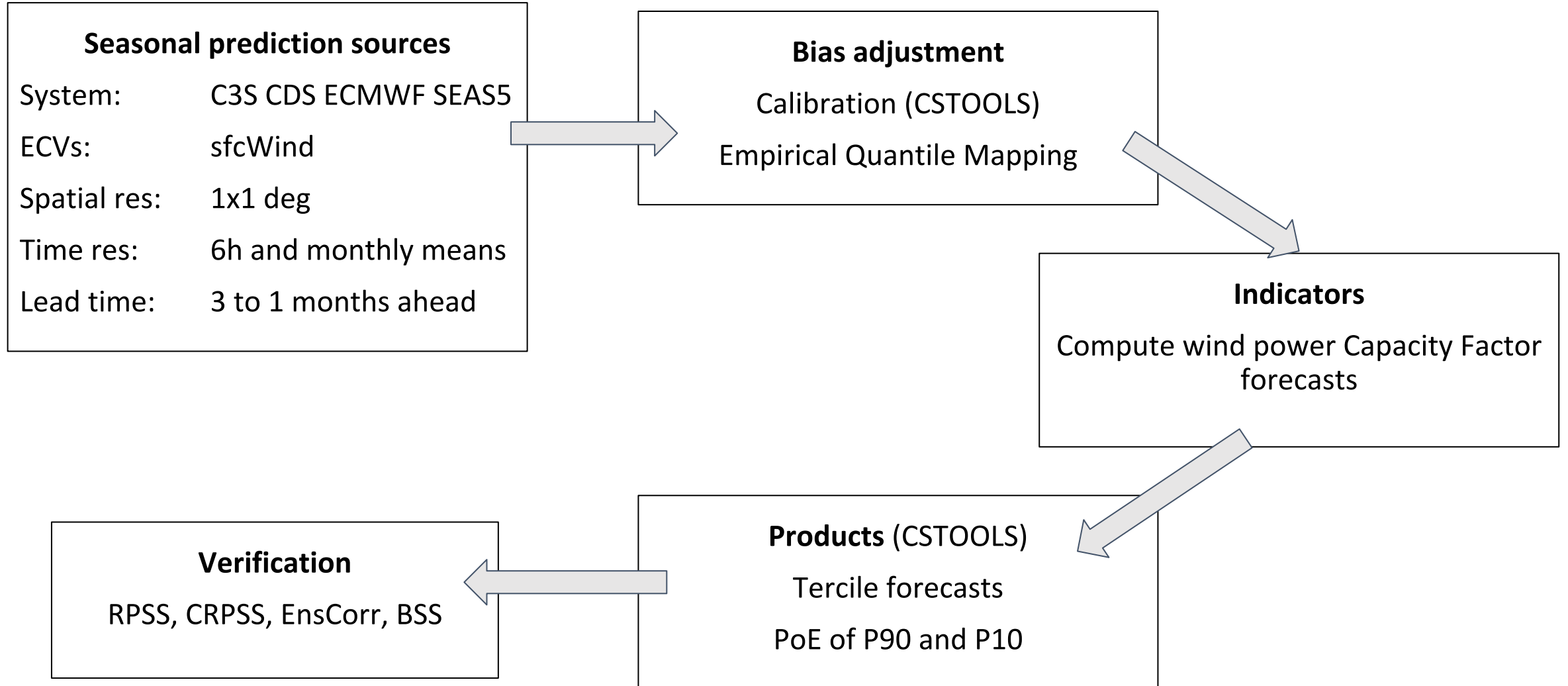
Wind power generation almost doubled



Implications for the energy sector

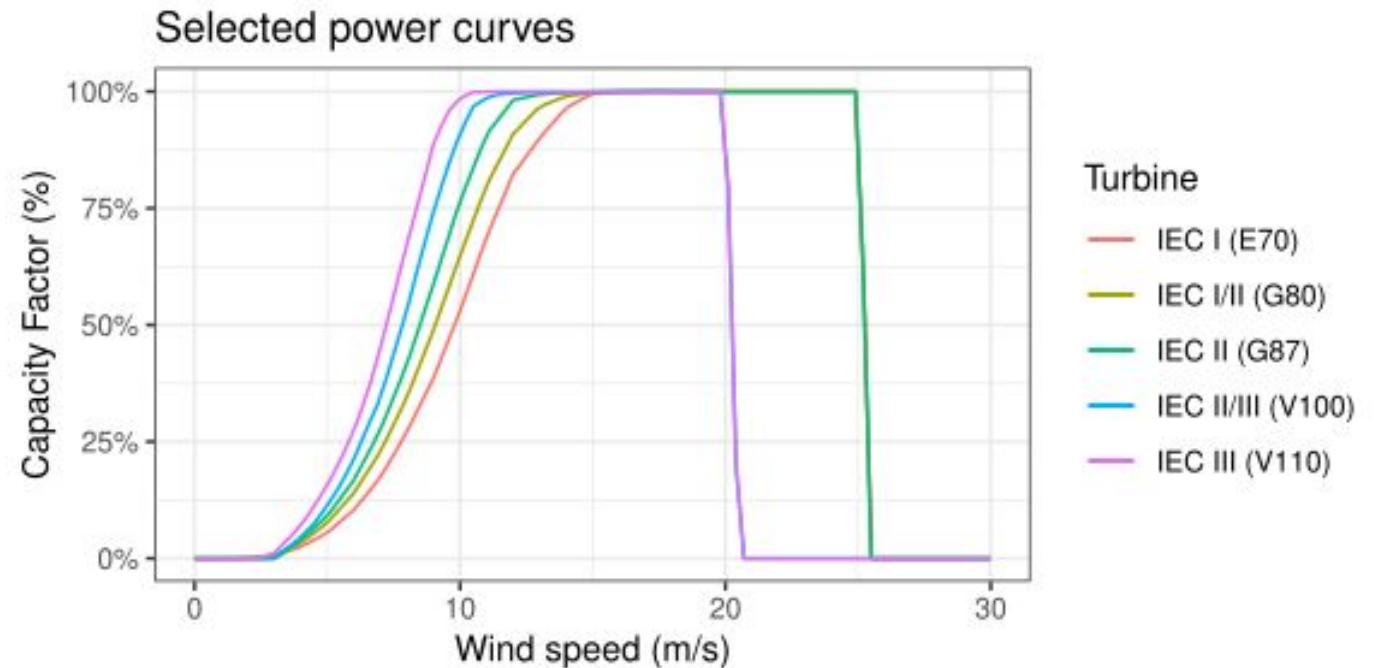
- Transmission System Operator:
 - turn down conventional generation power plants
- Energy trading company:
 - power prices will go down
- Wind farm owner:
 - this month will have high revenues
- Wind farm operator:
 - bad time for maintenance (high losses and bad conditions for operating safely)

Prototype development



Sectoral indicator: Capacity Factor

- $CF = \text{total production} / \text{maximum theoretical production}$
- fair comparisons between generation of power plants of different sizes and types
- Indicates how good have been the meteorological conditions for producing energy

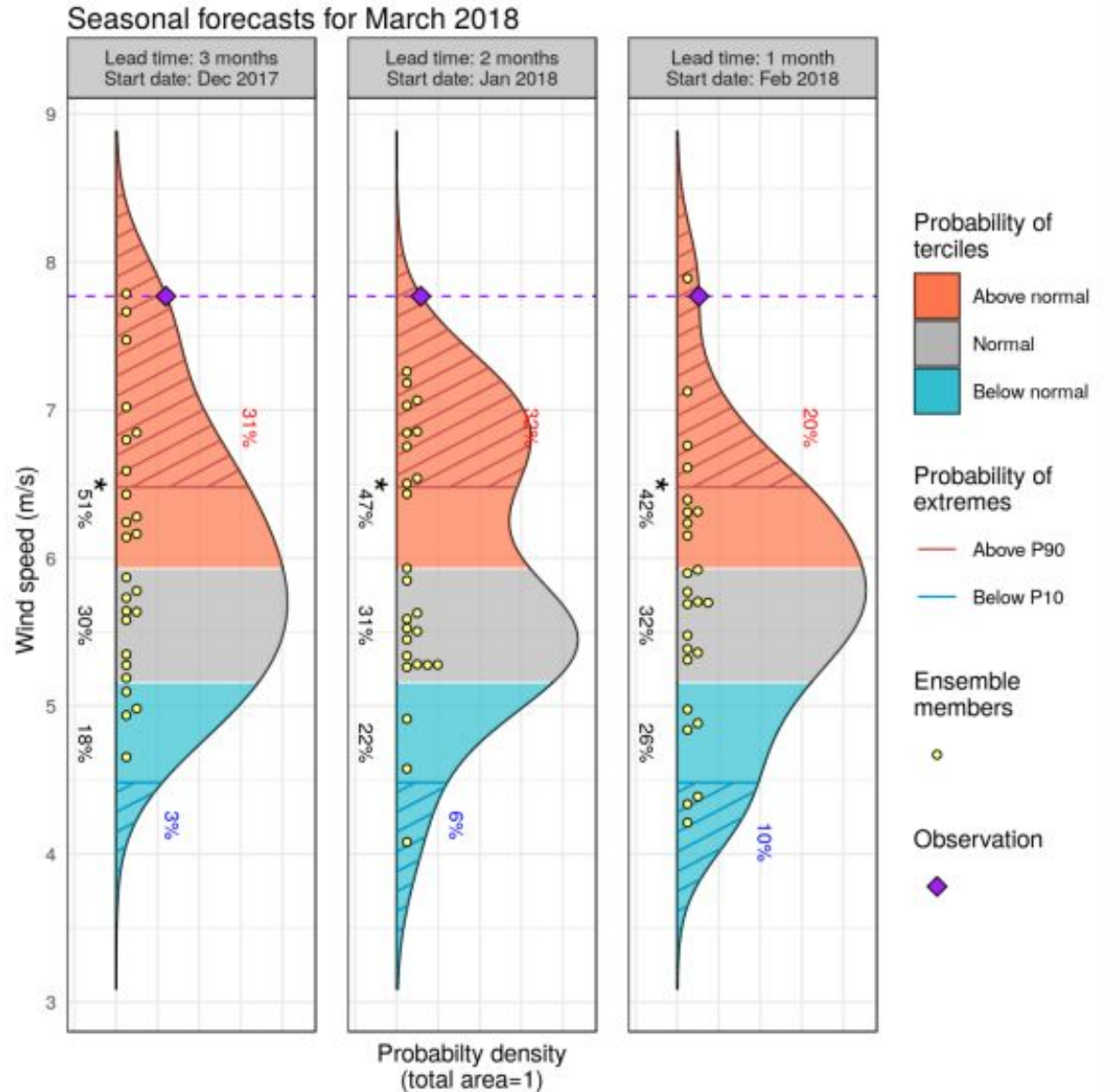


Surface wind forecasts for March 2018

in NW Spain (9W-7W and 42N-44N)

3 months ahead:

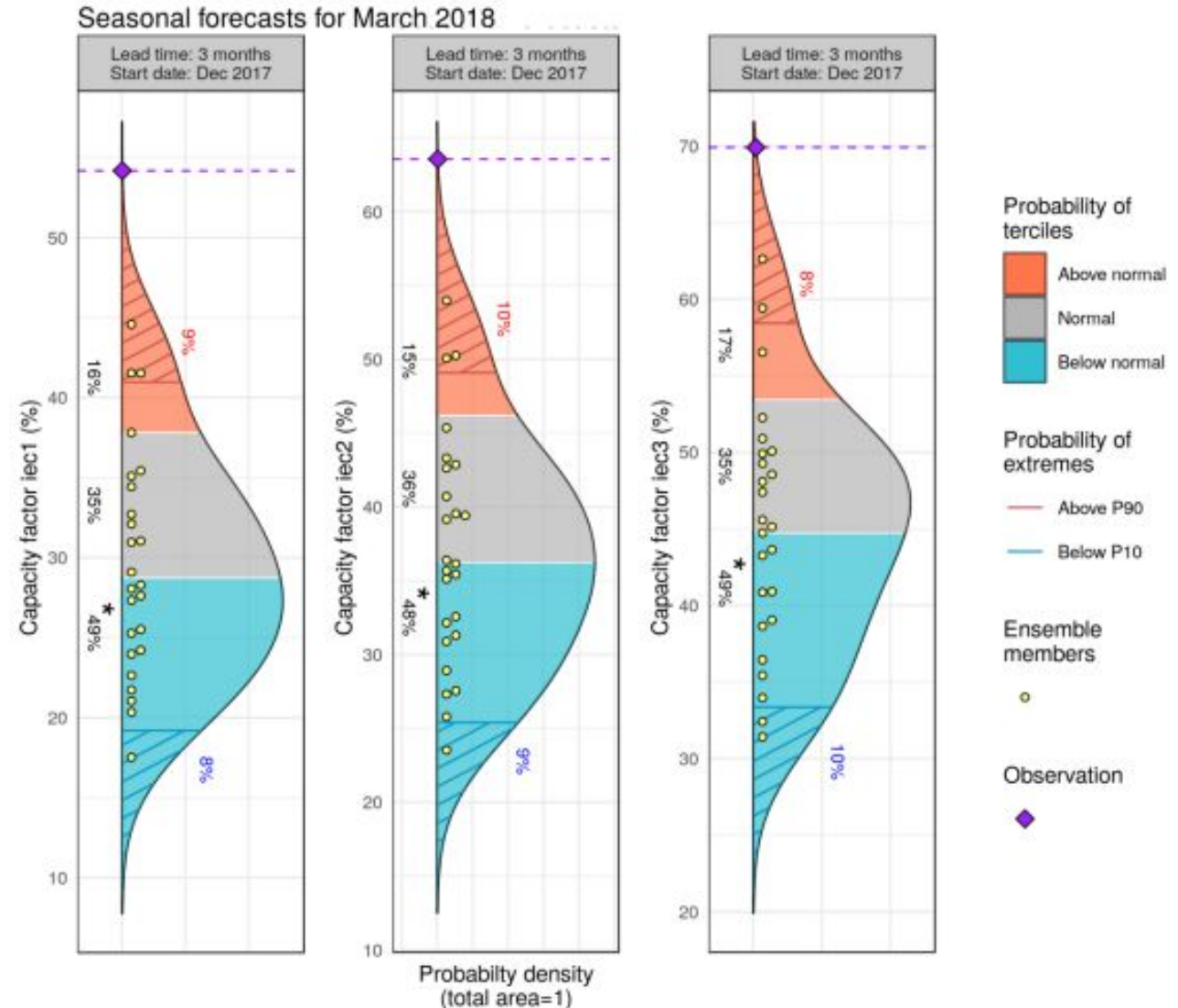
- PoE P90 three times bigger than normal
- Prob. above normal conditions: 51%



CF forecasts for March 2018

in NW Spain (9W-7W and 42N-44N)

- Very high wind power generation
- ...but ...
- CF fcsts showed more probability of below normal conditions
- Turbines stop at high winds
- Different forecasts for different turbine types



Forecast quality assessment

Hindcast: 1993-2015

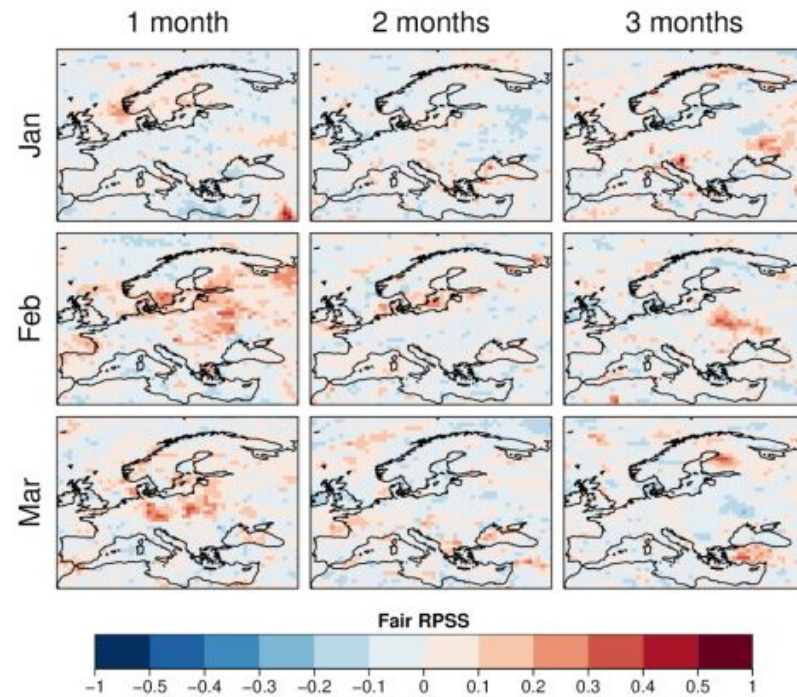
Bias adjustment: leave-one-out cross-validation

Verification metrics: related to the different products

- Ensemble mean correlation for potentially available skill.
- Ranked Probability Skill Score (RPSS) for probabilistic tercile forecasts.
- Continuous Ranked Probability Skill Score (CRPSS) for the ensemble distribution.
- Brier skill score (BSS) for above P90 and below P10 categorical probabilistic forecasts.

Verification results

	sfcWind			CF IEC I			CF IEC II			CF IEC III		
	Dec	Jan	Feb	Dec	Jan	Feb	Dec	Jan	Feb	Dec	Jan	Feb
<i>RPSS</i>	-0.06	-0.03	0.05	-0.16	-0.09	-0.01	-0.16	-0.11	-0.06	-0.18	-0.14	-0.07
<i>BS P10</i>	-0.24	-0.06	-0.05	-0.1	-0.14	-0.04	-0.1	-0.09	-0.08	-0.14	-0.04	-0.09
<i>BS P90</i>	-0.03	-0.03	-0.16	-0.18	-0.18	-0.09	-0.18	-0.18	-0.09	-0.13	-0.15	-0.11
<i>CRPSS</i>	-0.17	-0.19	-0.08	-0.15	-0.13	-0.04	-0.15	-0.14	-0.05	-0.13	-0.14	-0.06
<i>EnsCorr</i>	-0.05	-0.45	0.35	-0.36	-0.24	0.16	-0.35	-0.26	0.12	-0.35	-0.28	0.04



Lessons Learnt

Technical challenges:

- **Bias adjusting sub-daily wind speeds** requires careful attention: biases can be larger than individual wind values, leading to negatives.
- Computing **capacity factors** is very sensitive to biases (e.g. vertical extrapolation) and can lead to very **biased** estimates of CF.
- **Short hindcast periods** and **small ensemble sizes** hinder the possibilities of obtaining better predictability.

User uptake challenges:

- Probabilistic forecasts are **difficult to understand** and uptake
- **Case studies** that impacted the industry are needed to put those forecasts in **value**
- **Predictability** of wind speed over Europe and the Mediterranean **still limited** to some areas and periods of the year
- Stakeholders are more willing to take **actions** when a fcst shows a **strong signal**



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Thank you

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