Information gain from regional high resolution **ensemble** weather **prediction systems**

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Introduction and Motivation

Many of the high impacts of hazardous weather are associated with small meso- and convective-scale weather phenomena, the prediction of which can be uncertain even in a short range. Furthermore probabilistic forecasting is necessary because physical laws governing atmospheric motions are chaotic and initial conditions are uncertain too. This has motivated the development of "convection-permitting resolutions" ensemble models. Since running these models is computationally very expensive the **overarching aim** of this project is therefore try to answer to this **question**:

- To what extent **increasing the resolution** of the ensemble forecasts allow one to make **better quantitative probabilistic predictions** about future weather events than a coarser resolution ensemble ?

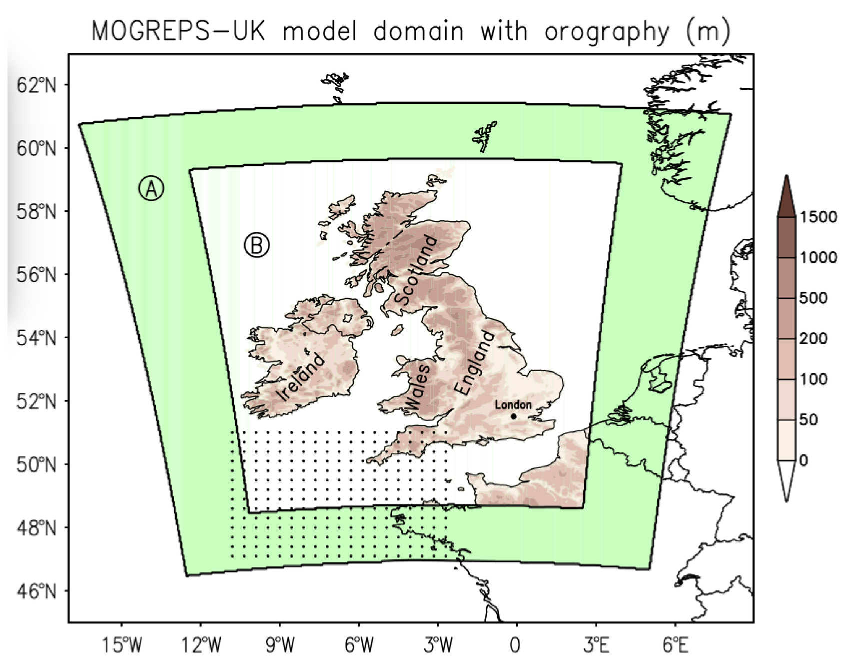
The utility of this information is strongly **user-dependent** (e.g. wind energy sector). This aim gives rise to other **four scientific questions**:

- How high resolution and low resolution **dynamical fields differ**?
- Are there any *systematic* relationships between the two ensemble models that could lead to a **recalibration** of coarser resolution field?
- What is the **forecast skill** of the two models? (w.r.t. time and spatial scale)
- What are the **dynamical phenomena** contributing to this information gain?

Operational models setup

The Met Office has been running since July 2012 operationally a short-range (up to 36 hours ahead) ensemble prediction system (**MOGREPS**). This system consists of global (**MOGREPS-G**, 33 km grid) and regional ensembles (**MOGREPS-UK** 2.2 km grid), which is a 12-member ensemble that is run every 6 h, by **downscaling** the 3 h forecast of the matching 0000/0600/1200/18UTC. MOGREPS-G ensemble members. So this means that:

- The initial conditions (IC) for each MOGREPS-UK are simply interpolated by the previous updated 3 h MOGREPS-G forecast.
- Also the boundary conditions (BC) are derived from the same corresponding MOGREPS-G ensemble member.

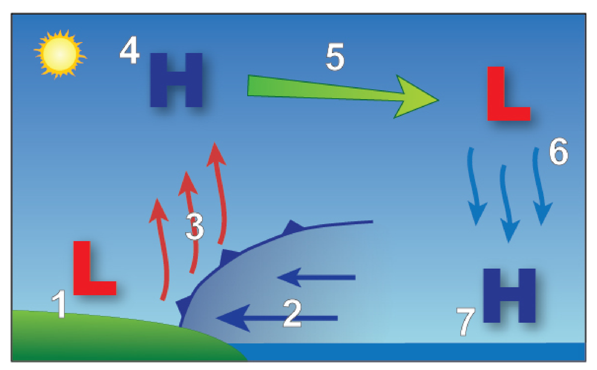


(a) *Limited domain covered by the MOGREPS-UK with boundaries.*

Model	Grid length in mid-latitudes	Grid points	Vertical levels	Forecast length	Run times (UTC)	Initial conditions
MOGREPS UK ensemble	2.2 km	532 x 654	70 (lid ~40 km)	36 hours	03, 09, 15, 21	12 member, perturbations interpolated from global ensemble
MOGREPS Global ensemble	33 km	800 x 600	70 (lid ~80 km)	7 days (12 members) 9 hrs (33 members for Hybrid analysis)	00, 06, 12, 18	Global analysis + 45 member ETKF perturbations (of which 12 run to full forecast length at each cycle)

(b) *MOGREPS-G and MOGREPS-UK operational setup.*

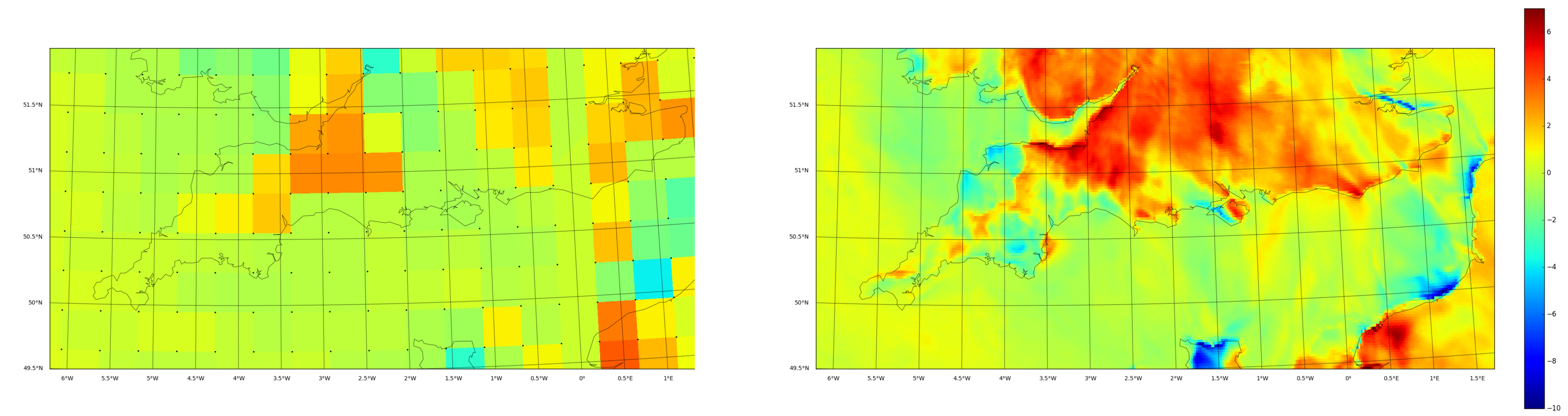
First case study: sea-breeze phenomenon



Why sea breeze?

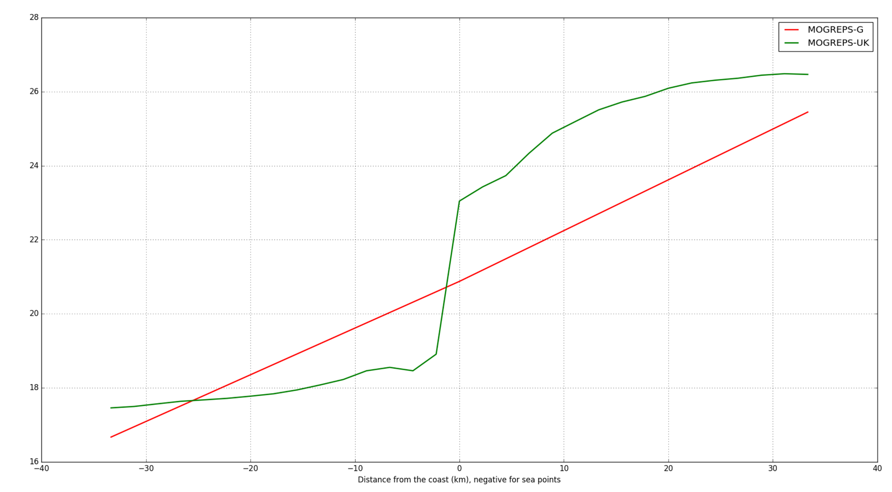
- Sea breeze fronts are inherently mesoscale phenomena, driven by land-sea thermal contrast. This makes the comparison between models straightforward as the location of the phenomena is known. Later these techniques will be applied to more complex mobile flow phenomena such as banding and role up at fronts.
- Forecasting sea-breeze occurrence and impact is important for air quality bodies and litoral industries (e.g. wind factory).

An example of comparisons between deterministic members for Summer 2015 data field



(a) MOGREPS-G (b) MOGREPS-UK

Table : 2 m Temperature field change between 15 UTC and 12 UTC on 01/07/2015 (look at the coastal differences).



(a) Pairs of temperature profile of both the models across the south coast averaged in the x-direction at same distance from the coast on 01/07/2015 12UTC.

(b) The inverse of sea-breeze index $\left(\frac{c_p \Delta T}{u^2}\right)$ used as a predictor of the occurrence of sea breeze for May-Sep 2015.

Future work

In the forthcoming weeks statistical comparisons between ensemble members of both models with respect to sea breeze index, introduced by Biggs and Graves (1962). Therefore the most important evaluation will be the quantification of information gain for sea breeze (applying or improving if possible the technique found in Case et. al (2004)), compared with station and radar observations.

References

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