Convergent-Scale Practical Predictability Within Different Convective Regimes

David L. A. Flack1 (d.l.a.flack@reading.ac.uk) | P. A. Clark1 | S. L. Gray1 | R. S. Plant1 | C. E. Halliwell2 | H. W. Lean2 | N. Roberts2

Introduction

• What is the relative importance of initial/boundary condition uncertainty vs. model physics uncertainty for the spatial predictability of convection?
• Does the scale used for post-processing agree with the ensemble agreement scale?
• These practical predictability questions are considered via the use of the Met Office Global and Regional Ensemble Prediction System for the UK (MOGREPS-UK).
• Initial work considering the practical predictability of two distinct cases in MOGREPS-UK is considered here.

Background

Error growth on convective-scales is typically an order of magnitude faster than that of synoptic scales (e.g. Hohenegger and Schär, 2007). However, the spatial predictability of convective events is highly variable (e.g. Dey et al., 2016). The spatial predictability is somewhat linked to whether the convective events are in convective quasi-equilibrium or not (Flack, 2017).

Cases

Two flooding cases are examined (Fig. 1) 16 June 2016 (left) and 15 September 2016 (right). 16 June is a scattered showers case and indicative of convective quasi-equilibrium. 15 September had frontal convection and intense cells that developed near London, and is more suggestive of non-equilibrium convection.

MOGREPS-UK

MOGREPS-UK is a 2.2 km grid length, 12 member ensemble that produces 36 hour forecasts. The operational configuration is used with initial condition and boundary condition perturbations generated from the Met Office’s global ensemble. Model physics perturbations are created from randomly perturbed parameters.

Operational Ensemble: Predictability of Magnitude

There is larger spread for 15 September compared to 16 June, and the control member for the September cases is also significantly different to the ensemble mean often lying beyond the 95th percentile (Fig. 2).

As expected the relative spread of the ensemble decreases with area (Fig. 3). The September case shows greater sensitivity to the magnitude of precipitation at larger areas than the June case, which complements the total ensemble spread, indicating that the magnitude of this event has low predictability.

Operational Ensemble: Spatial Predictability

The average Fractions Skill Score (FSS; Roberts and Lean 2008; Fig. 4) indicates higher spatial predictability at the grid scale for 15 September compared to 16 June, however the larger scales are more uncertain.

There is a large dip in the FSS at T+9 h for 15 September due to a decrease in the number of precipitating points above 1mm.

Stochastic Boundary Layer Scheme

A stochastic boundary layer scheme is currently being developed at the Met Office, in which the variability is governed by the number of thermals over a specified area and time. A smaller number of thermals with a faster turnover-time results in smaller stochastic increments.

Initial runs have been performed with the UKV, and indicates modest spread forming when the convection occurs.

Summary and Future Work

• Perturbation growth is considered for two cases with operational MOGREPS-UK output.
• There is greater predictability of the intensity of the event for the June case compared to the September case.
• The September control is statistically different from the ensemble mean, whereas the June control is close to that of the ensemble mean.
• Given the limited organisation in June compared to September case the perturbation growth is more widespread, in agreement with Flack (2017).
• The stochastic boundary layer scheme shall soon be implemented into MOGREPS-UK to create a super-ensemble.

References


Acknowledgements: This work has been funded by NERC under the work package TINESR4 in the FIR programme, under grant: NE/K00896X/1.