Geophysical Research Abstracts
Vol. 20, EGU2018-5167, 2018
EGU General Assembly 2018

Atmospheric blocking and upper-level Rossby wave forecast skill dependence on model configuration

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Weather models differ in their ability to forecast, at medium range, atmospheric blocking and the associated structure of upper-level Rossby waves. Here, we evaluate the effect of a model's dynamical core on such forecasts. Operational forecasts from the ensemble prediction systems (EPSs) of the European Centre for Medium-range Weather Forecasts (ECMWF), the Met Office (MO) and the Korean Meteorological Administration (KMA) are used. Northern hemisphere model output is analysed from winters before and after a major upgrade to the dynamical core of the MO-EPS. The KMA-EPS acts as a control as it uses the same model as the MO-EPS, but used the older dynamical core throughout. The confounding factor of resolution differences between the MO-EPS and the KMA-EPS is assessed using a MO forecast model hindcast experiment with the more recent dynamical core, but the operational resolution of the KMA-EPS.

The introduction of the new dynamical core in the MO-EPS has led to increased forecast blocking frequency, at lead times of five and seven days, counteracting the typically-observed reduction in blocking frequency with lead time. The hit rate of blocked days is also increased in the main blocking regions (without a corresponding increase in false positive rate). The previously-found reduction of upper-level ridge area and tropopause sharpness (measured by isentropic potential vorticity gradient) with lead time is also reduced with the new dynamical core. This dynamical core improvement (associated with a reduction in implicit damping) is thus demonstrated to be at least as effective as operational resolution improvements in improving forecasts of upper-level Rossby waves and associated blocking.