Geophysical Research Abstracts
Vol. 20, EGU2018-8355, 2018
EGU General Assembly 2018

Upscale error growth from a quantitative PV perspective

Marlene Baumgart (1), Michael Riemer (1), Tobias Selz (2), Paolo Ghinassi (1), Franziska Teubler (1), Volkmar Wirth (1), and George Craig (2)

(1) Institut für Physik der Atmosphäre, Johannes Gutenberg-Universität Mainz, Mainz, Germany, (2) Meteorologisches Institut, Ludwig-Maximilians-Universität, München, Germany

Upscale error growth is often thought to occur in different stages. A well-known, three-stage error-growth model assumes that errors first grow from convective instability, then geostrophically adjust to a larger-scale balanced state, and in the third stage grow with the background baroclinic instability. A similar upscale error-growth behavior was recently found in a real case study.

In this work, we analyze upscale error growth in terms of identical-twin experiments with a global model that employs the stochastic Plant-Craig convective parameterization scheme. These experiments only differ in the stochastic seed of this scheme. The error growth experiments can thus be interpreted as having a single error source on the convective scale, from which errors grow upscale up to the planetary scale.

We use the potential vorticity (PV) perspective to gain insight into the dynamics of upscale error growth. Using a budget equation for the PV error, we quantify the relative importance of the following processes to error growth near the tropopause: near-tropopause dynamics (influence of upper-level PV anomalies), tropospheric-deep interaction (influence of lower-level PV and potential temperature anomalies), upper-tropospheric divergence (mostly related to latent heat release below), and direct diabatic PV modification. This PV perspective is complemented by a local wave activity diagnostic to gain insight into the error evolution on the Rossby-wave scale.

Our framework shows a distinct sequence of the processes contributing to PV error growth near the tropopause. During the first day, error growth is dominated by diabatic processes, while upper-tropospheric divergence is dominating in the second stage. In the subsequent stage (after 3-4 days) near-tropopause dynamics makes the largest contribution to error growth. These results illustrate that a multi-stage model for upscale error growth can also be derived quantitatively. Furthermore, the PV perspective provides deeper insight into the processes governing upscale error growth.