Upscale impact of diabatic processes from convective to near-hemispheric scale
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Three stage error growth concept (Zhang et al., 2007)
1) Convective instability and saturation (0 - 12 h)
2) Transition and geostrophic adjustment (8 - 24 h)
3) Large-scale baroclinic growth (> 24 h)

Convection permitting simulations
The COSMO model was used to study the three-stage concept on a summertime weather event over Europe (Selz and Craig, 2015a).

Development of a balanced synoptic-scale perturbation from fast error growth in convective instability. Black lines show 500 hPa geopotential, blue shading precipitation rate of the unperturbed run. Yellow shading shows difference total energy (DTE) and red boundaries contours 500 hPa geopotential difference between perturbed and unperturbed run.

Idealized convection permitting simulations
The hypothesized Coriolis parameter dependence of the three stage concept was tested with idealized COSMO simulations.

Global simulations with stochastic convection
The global ICON model and the PC convection scheme were used to investigate upscale error growth from convection to planetary saturation.

Simulations with stochastic convection scheme
COSMO simulations on coarser grids with different convection schemes were compared to the high-resolution results (Selz and Craig, 2015b).

Global simulations with stochastic convection
Jet structure at 300 hPa of the two simulations with different realizations of the convection. Each colored contour shows a 1000 m2/s2 geopotential interval.

The Plant-Craig stochastic convection scheme can be used to simulate the effect of upscale error growth from convection on larger scales without the need to resolve the convection.

References
Zhang, H., et al., 2007: Mesoscale predictability of neutral transient waves: Convective-permitting experiments and multiscale error growth dynamics. Journal of the Atmospheric Sciences 64, 3575-3594.

These result suggests intrinsic predictability limits to be in general...
• predictability time of synoptic scales is limited to 7-10 days
• predictability time of planetary scales is limited to 14 days
• perfect initial conditions could increase predictability by 3 days