Ability of COSMO CLM to represent convective events

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INTRODUCTION

To get more realistic long term statistics of extreme weather events in climate models, it is important to improve the representation of correctly simulated convective events. Even regional climate models (RCMs) at high resolved convective permitting scales (CPS) are not able to simulate all kinds of convective weather events with satisfying results. To investigate the ability of the COSMO-CLM to simulate deep convection, we create an ensemble of 81 members. The performance of the COSMO-CLM in reproducing convective activity is shown for three different events and a tracking algorithm is used, which is able to identify and track convective cells using the precipitation field of model and radar data.

AREA

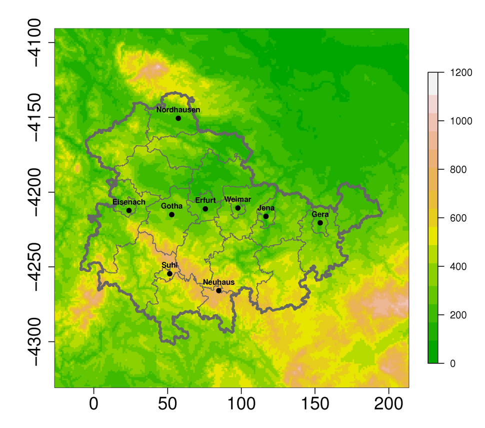


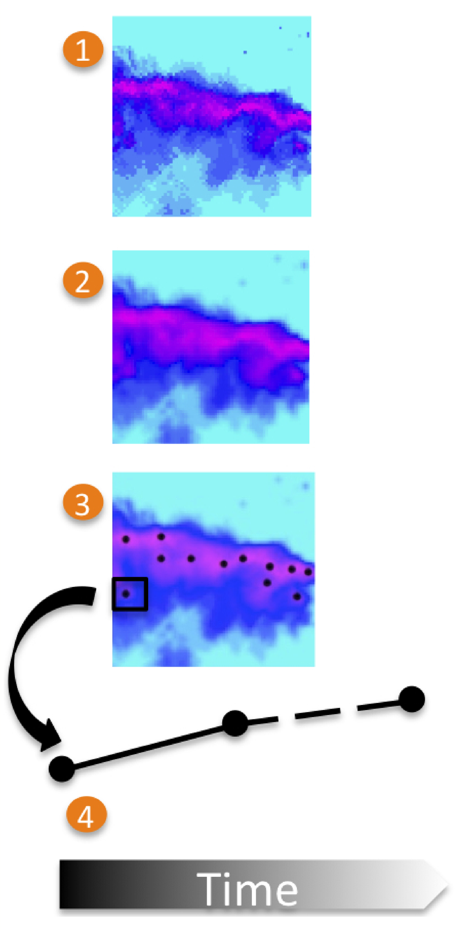
Fig. 1: Orography [m] research area

COSMO CLM

The sensitivity of the COSMO CLM to simulate deep convection has been verified with the following parameters:

- Soil moisture **[sm]** (80%, 100%,120%)
- Roughness length **[rghn]** (80%, 100%,120%)
- Resolution **[res]** (0.01°, 0.025°, 0.05°)
- Beginning of the forecast **[bof]** (-12h, -6h, 0h)

OBS. DATA AND METHOD



DWD radar product (RZ):

- 2D precipitation scan
- Spatial resolution 1 km
- Temporal resolution 5 min

A tracking algorithm is used to identify convective cell cores and determine their tracks (Fig. 2):

1. Raw radar image
2. Filter radar image
3. Identify cell core
4. Track cells

Fig. 2: Scheme tracking algorithm

SELECTED EVENTS

Day	Date	Flow	CAPE	CIN	LI	SWEAT	Dynamic
1	08072004	SW	4.3	-376	1.7	85.5	frontal
2	29072005	SW	239.8	-291	-2.9	165.9	frontal
3	23072006	SW	781.4	-34.2	-2.8	133.8	buoyant

Tab. 1: Overview selected events, convective indices (Meiningen 12 UTC)

LIFE CYCLE

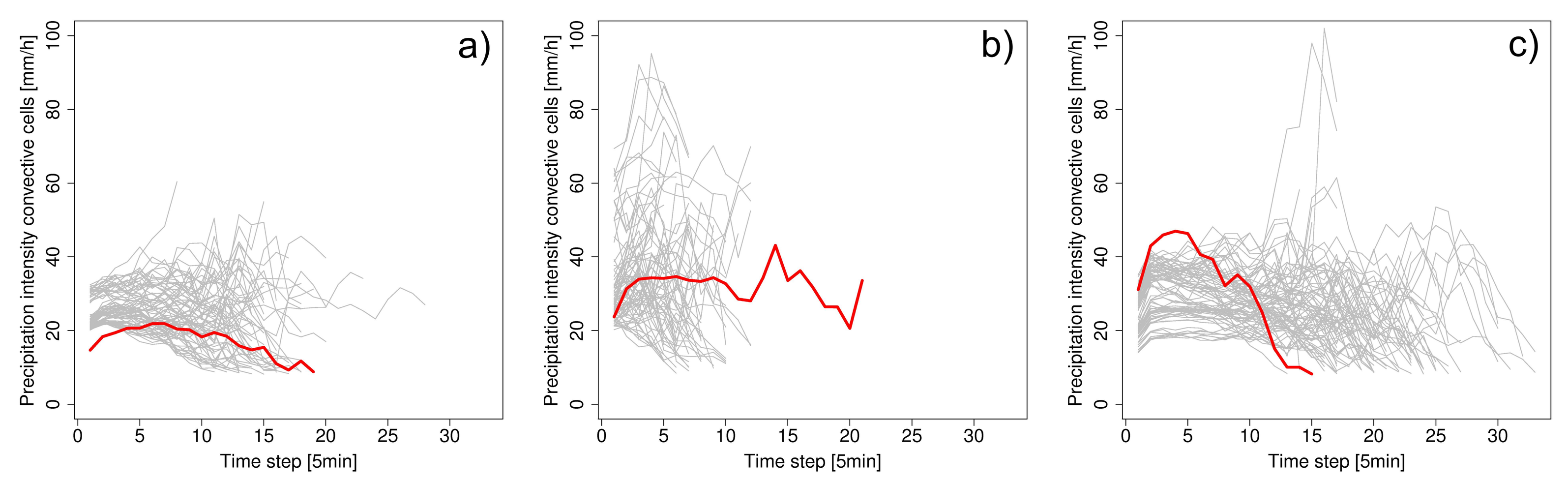


Fig. 3: Mean life cycle of convective cells, ensemble member (grey), observation (red) for a) day 1, b) day 2, c) day 3

SP. PATTERN

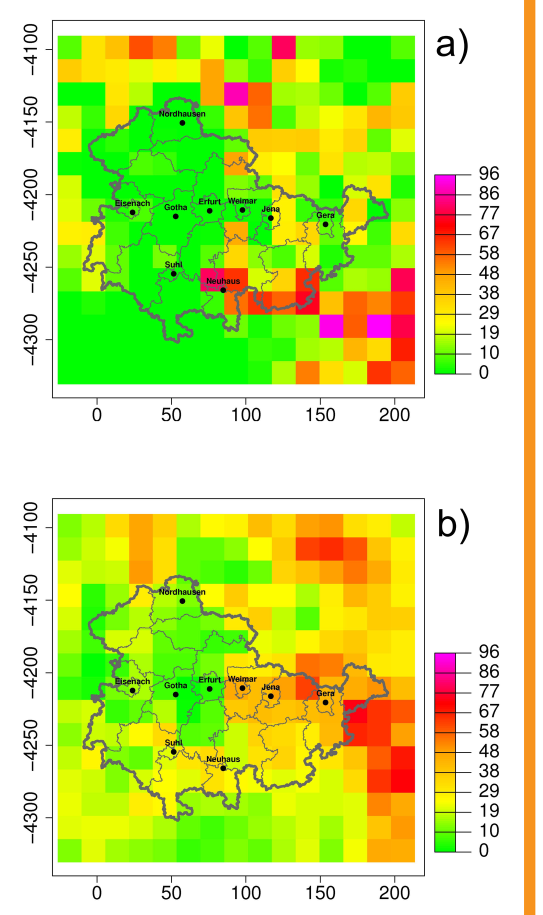


Fig. 4: Spatial pattern tracks of convective cell cores, a) observation, b) mean 27 members of 0.01 resolution, day 3, map 16 km x 16 km resolution

MODEL SENSITIVITY

Ensemble sensitivity

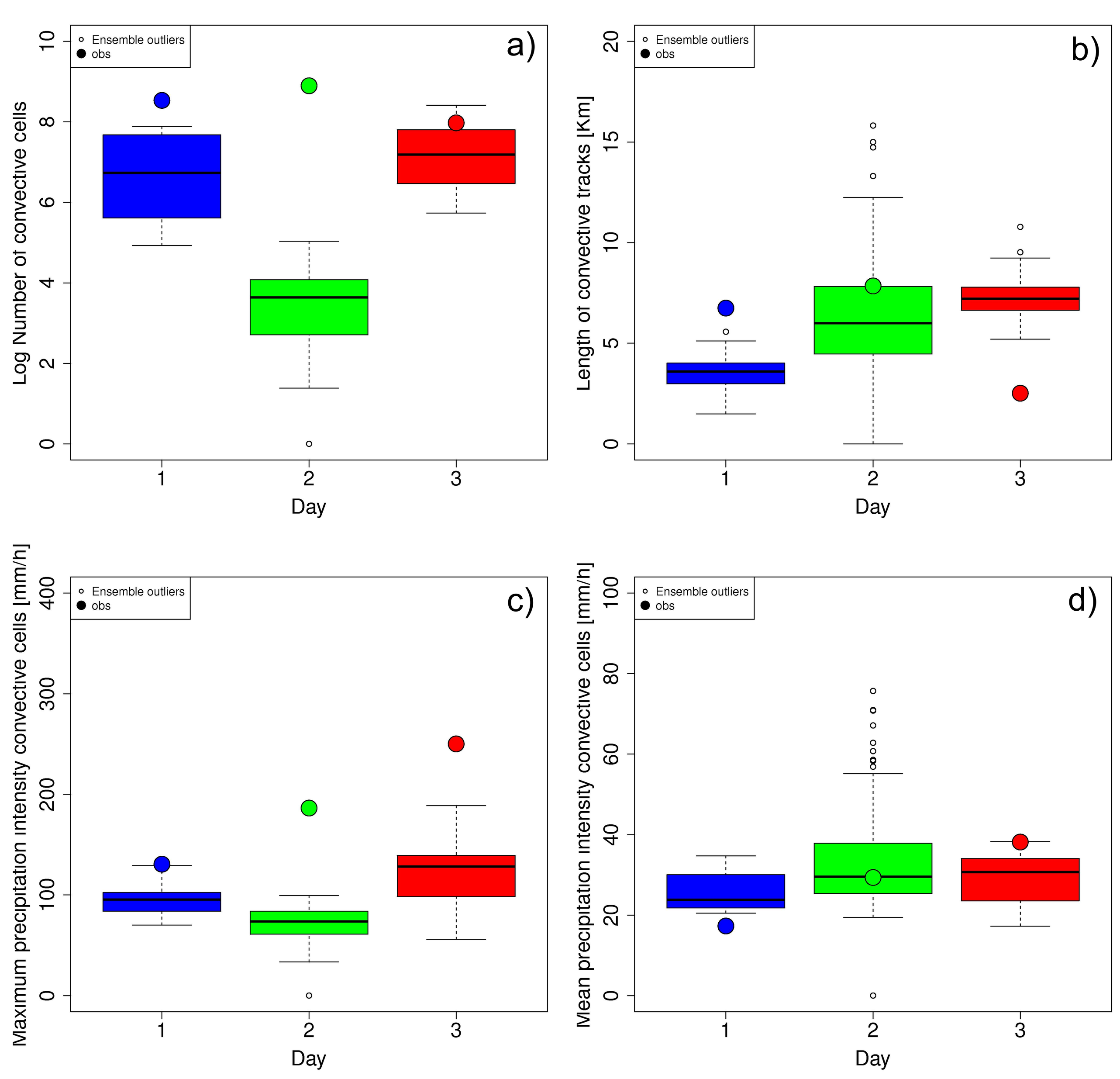


Fig. 5: Overview of the ensemble sensitivity separated for each day for a) number of convective cells, b) length of convective tracks, c) maximum precipitation intensity of all convective cells, d) mean precipitation intensity of all convective cells

Sensitivity of model parameter

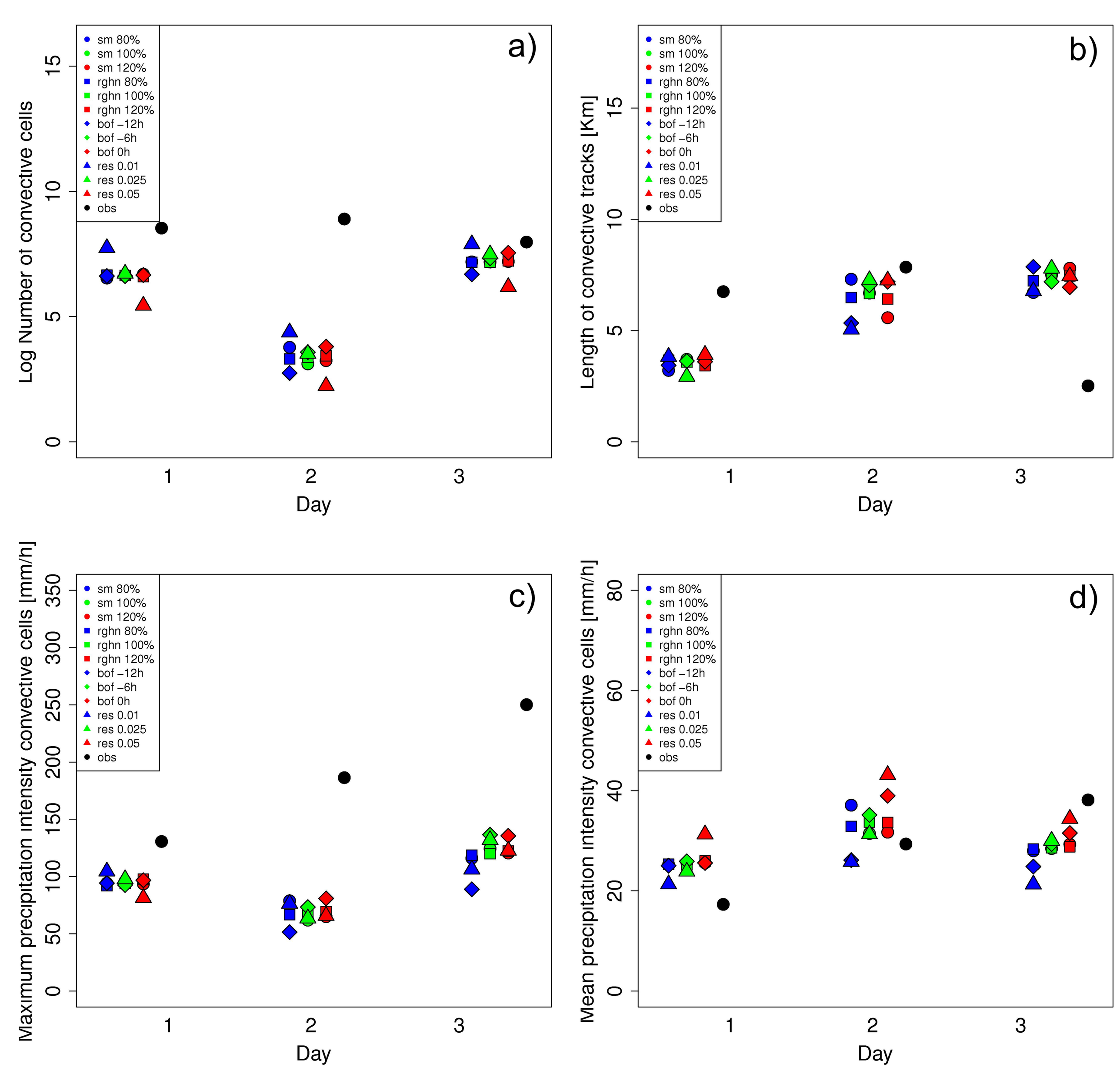


Fig. 6: Overview of the sensitivity of soil moisture, roughness length, resolution and beginning of forecast for means of a) number of convective cells, b) length of convective tracks, c) maximum precipitation intensity of all convective cells, d) mean precipitation intensity of all convective cells

Interdependence of model parameters

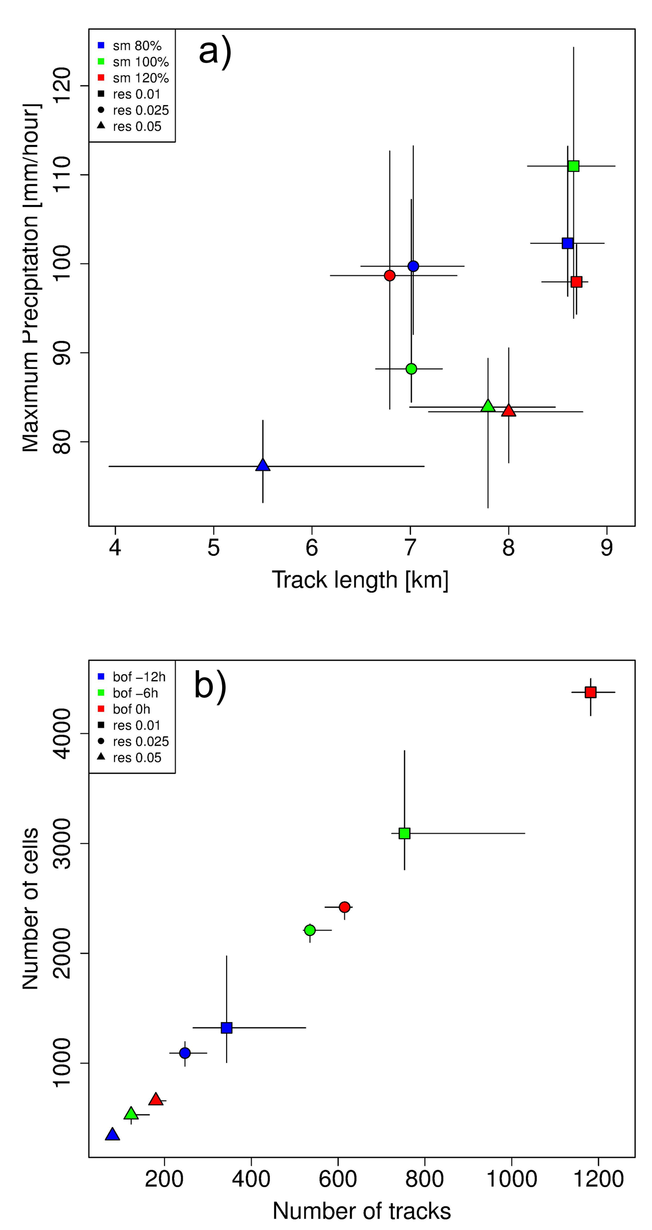


Fig. 7: Example of interdependence of model parameters, a) day 1, b) day 3, bars are showing the 10% and 90% quantiles

CONCLUSION

- The tracking algorithm shows a further opportunity to investigate deep convection from COSMO CLM output
- The ensemble members show high variability for some output variables and days (Fig. 5)
- Observation data are often outside of the ensemble range (Fig. 5)
- An interdependency between model parameters is visible (Fig. 7)

OUTLOOK

Further sensitivity tests are planed, e. g.:

- Microphysics: Fall speed of rain and graupel, first/second moment scheme
- Humidity: Lateral boundary forcing, soil moisture variability
- Turbulence: Horizontal diffusion

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