Comparison of spatio-temporal evolution of extreme precipitation events between two high-resolution models in a northern Europe case study

Emma D. Thomassen¹,²,³, Elisabeth Kendon⁴, Hjalte J. D. Sørup¹, Steven Chan⁵,³, Peter L. Langen², Ole B. Christensen², and Karsten Arnbjerg – Nielsen¹

¹Department of Environmental Engineering, Technical University of Denmark, Denmark (edth@env.dtu.dk)
²Danish Meteorological Institute, Denmark
³Visiting scientist at Met Office Hadley Centre, UK
⁴Met Office Hadley Centre, UK
⁵Newcastle University, UK
Comparison of representation of extreme events between a 2.2 km Convection-Permitting Model (CPM) and a 12 km Regional Climate Model (convection parameterised, RCM).

AIM
Data

• Both models are from UK Met Office\textsuperscript{1} and ERA-Interim driven.

• CPM 2.2 km model is remapped to 12 km resolution on the same grid as the RCM.

• Both models are in hourly time steps.

• Both models cover a pan-European area (pink domain).
### Methods

- The DYMECS tracking algorithm\(^2\) is applied to both datasets (blue domain) between 1999 and 2008.

- The tracking algorithm tracks precipitation fields above a threshold of 1mm/hr. No areal threshold is set.

- Events within a northern Europe case area is analysed (red box).
Events

• Different number of events between the two models.
• More intermittent rainfall in CPM is seen as several independent events in the tracking algorithm.

<table>
<thead>
<tr>
<th></th>
<th>RCM</th>
<th>CPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Events</td>
<td>4,219,064</td>
<td>6,456,733</td>
</tr>
<tr>
<td>Events within case area</td>
<td>1,140,859</td>
<td>2,084,733</td>
</tr>
</tbody>
</table>
Extreme events

• Extreme events are defined based on maximum 1-hour intensity for a single grid box within each event.

• Only intensities within the case area are considered.

• The 99.99th, 99.9th and 99th percentiles are analysed.
Sampled northern Europe extreme events

- RCM: Large density of event tracks over the British Isles and Atlantic Ocean. West to east moving direction.
- CPM: Large density of event tracks over central Europe and southern Scandinavia. South to north moving direction.
Simplified event evolution

• Event track and spatial extent of a single event (left).
• Simplified evolution based on maximum intensity (middle).
• Simplified evolution based on mean intensity (right).

1: Birth 
2: Peak **maximum** intensity over event lifetime 
3: Maximum area 
4: Death 
2: Peak **mean** intensity over event lifetime
Median simplified event evolution

- Median simplified event evolution for each percentile.

MAXIMUM INTENSITY (TOP):
- RCM events larger than CPM events.
- RCM events have larger maximum intensity than CPM events.

MEAN INTENSITY (BOTTOM):
- CPM events have larger mean intensity than RCM events.
Other variables

- Variables shown for the 100 most intense events (1-hour maximum intensity).

- The life time of the storm is normalised around the hour of peak maximum intensity.
Conclusion (ongoing work)

• Tracks of most intense events differ in location and movement direction between RCM and CPM

• Representation of extreme events between the two models (CPM and RCM) is very different. The most extreme RCM events are more intense and larger than CPM sampled events.

• The 99.99th percentile most intense events seem to be highly influenced by grid point storms in the RCM data.

• For lower percentiles (than 99.99th) RCM events still have higher intensities than CPM events, which might be caused by the spatial smoothing of the CPM data when remapping to 12 km resolution.

• CPM sampled events have for all percentiles higher mean intensities compared to RCM events.
References
