EGU21-9497
https://doi.org/10.5194/egusphere-egu21-9497
EGU General Assembly 2021

When the trigger of deep convection gets tricky in idealized climate simulations

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On the evening on July 2, 2011 a severe cloud burst occurred in the Copenhagen area. During the late afternoon deep moist convection developed over nearby Skåne (the southernmost part of Sweden) in an airstream from east-northeast. In the early evening the DMC passed over Øresund to Copenhagen, where it created a severe flash flood. Between 90 and 135 mm of precipitation in less than 2 hours was recorded ooding cellars, streets, and key roads. The deluge caused 6 billion Danish kroner in damage. Although that such extreme events are rare, the impacts on society is important and should be understood under a warmer climate. Although regional climate models have recently reached the convection permitting resolution, reproducing such events is still challenging.

Several studies suggest that extreme precipitations should increase under a future warmer climate using transient simulation or a pseudo-warming approach. It is still unclear how such event would behave under warmer or colder synoptic conditions. Using a forecast-ensemble method, but keeping a climate perspective, this study assesses the risk rising from such an event under otherwise almost identical, but warmer or colder conditions. With this set-up, we find that the development of the system that resulted in observed downpour exhibit quite a sensitivity to the initial conditions and contrary to a linear thinking, the risk of flooding is decreasing as the climate warms due to the inhibition of the CAPE by the additional lapse-rate anomalies used in this study. We therefore propose that the PGW method should be used with caution and that extreme precipitation events also in transient simulations of future climates need to be studied in detailed to address the limitations to models ability to produce those most extreme and by nature inherently rare events.