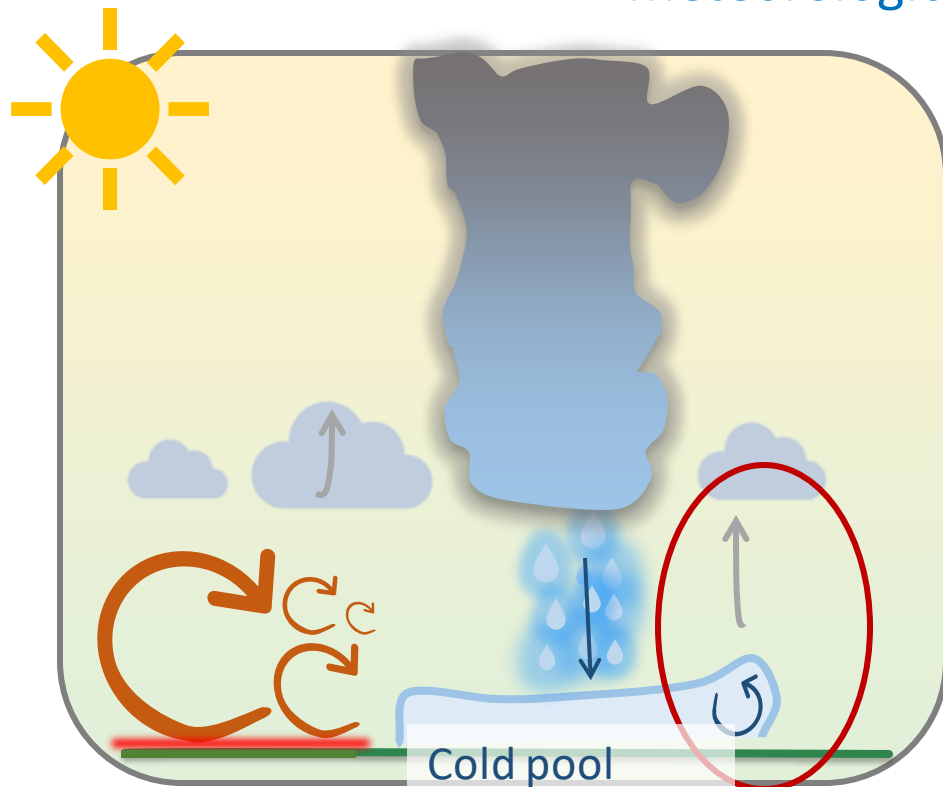# A cold pool perturbation scheme to improve convective initiation in convection-permitting models

Mirjam Hirt, George C. Craig
Meteorological Institute, LMU, Munich, Germany

Cold pool

- Cold pools originate from evaporation at convective downdrafts

- At their gust fronts, new convection is often triggered

→ Cold pools are relevant for **Convective initiation** and **organization of convection** (secondary initiation)

# Cold pools are not well represented in convection permitting models!

- Cold pools are **more frequent**, **smaller** and **less intense** in lower resolutions (156m – 612m; HDCP2 ICON-LEM simulations).

- Their **gust fronts** are **weaker** and **trigger less** new convection in lower resolutions.

- **Causal graph analysis**: RGB path dominates: Lower model resolution causes weaker gustfronts, which reduces convective initiation.

→**Develop perturbations to strengthen cold pool gust fronts**

Hirt, M., Craig, G. C., Schäfer, S. A. K., Savre, J. and Heinze, R. (**2020**) "Cold pool driven convective initiation: using causal graph analysis to determine what convection permitting models are missing", Quarterly Journal of the Royal Meteorological Society.
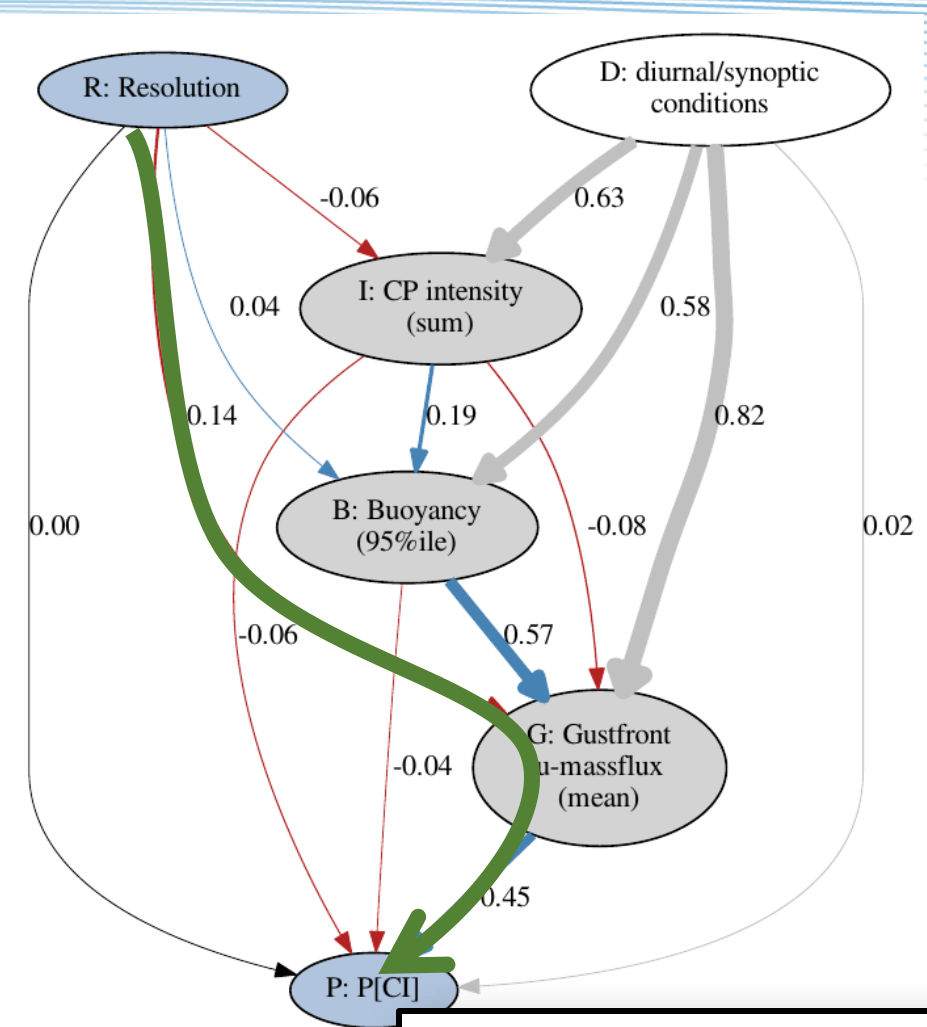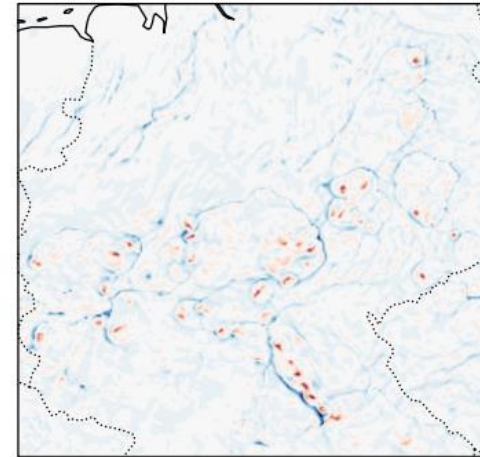

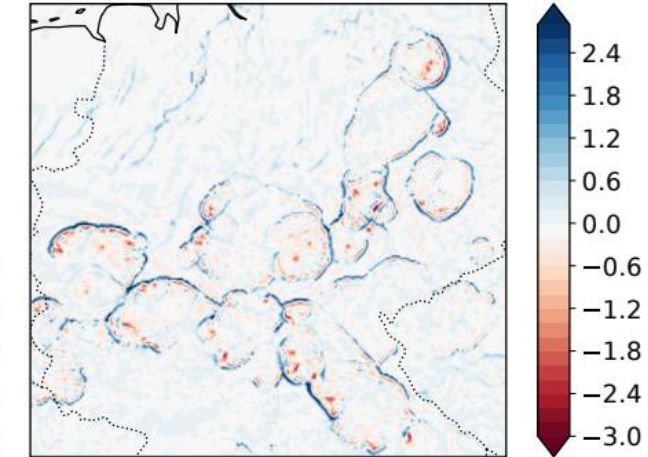
Probability of convective initiation
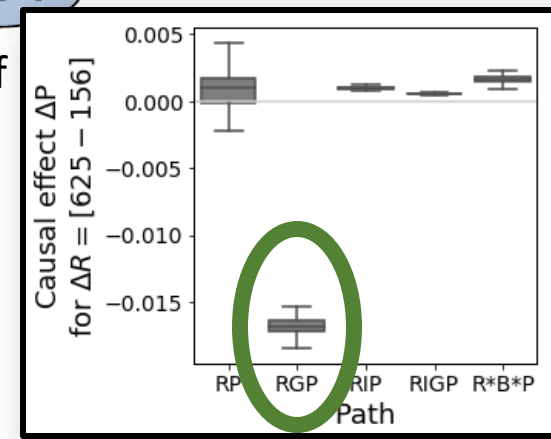
The Cold Pool Perturbation Scheme (CPP)
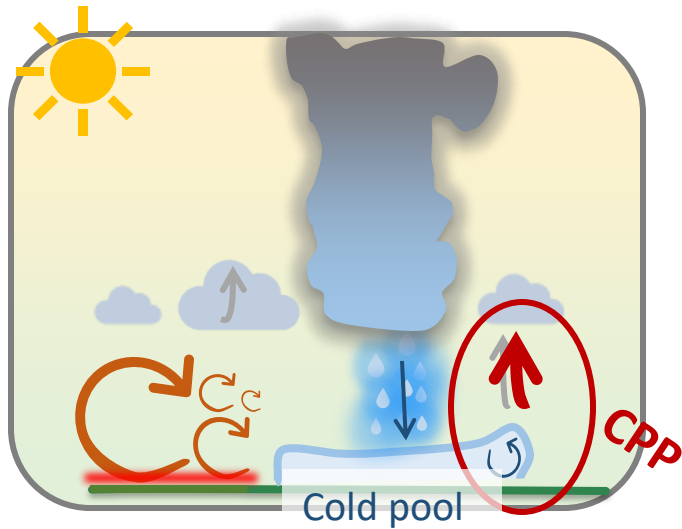
(a) Reference w (level 38)

(b) CPP w (level 38)

CPP: We relax the model vertical velocity towards a target vertical velocity w_0 at cold pool gust fronts:

$$\left.\frac{\partial w}{\partial t}\right|_{cp} = \frac{w_0 - w}{\tau_{cp}}$$

w_0 is the vertical velocity a fully resolved cold pool would ideally have: $w_0 = \alpha\sqrt{BH}$

Impact of CPP:

- More pronounced gust fronts
- More convective Initiation → more precipitation
- More organization of precipitation

⊞ Hirt, M. and Craig, G.C. (**2021**), A **cold pool perturbation scheme** to improve convective initiation in convection-permitting models. Q J R Meteorol Soc. Accepted Author Manuscript. https://doi.org/10.1002/qj.4032