Empirical values and assumptions in the convection schemes of numerical models

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Response to editor

Editor comments shown in black
Authors' responses shown in blue

I think that in the current revision, you have addressed the reviewer's comments much better, I find only the answer to point 3 still not adequate. The reviewer states a few important questions:
* Has the use of observations by the convective modelling community so far sufficient?
* Or do we need to find new ways to adequately constrain assumptions and calibrate parameterizations, in a statistically significant way? And if so, how can we most efficiently use modern extensive big datasets to this purpose? I would like to ask you to make sure that these questions are _explicitly_ answered in your text. The reviewer is correct that you are in a unique position, and indeed it would be an omission if this is not done properly.

Thank you very much for the comments. To include and explicit answer to these questions, we have modified lines 1681 to 1688 in the previous version of the manuscript as follows: "The use of observations by the convective modeling community has not been sufficient so far. The reasons being twofold. Basic convective quantities like mass flux and important parameters like adjustment time scale, entrainment and microphysical parameters can often be only indirectly inferred from observations like infrared and microwave satellite data, radar data, rainfall rates, radiosonde networks and reanalysis data. When we say that they are indirectly inferred, we mean that these quantities are adjusted to optimize the model fit to the observed radiative and surface fluxes as well as the observed temperature and wind field. On the other hand, long-term instrumentation deployment at meteorological supersites (e.g. Neggers et al., 2012; Song et al., 2013; Gustafson et al., 2020; Zheng et al., 2021) or dedicated convection field campaigns like GATE, TOGA-COARE, DYNAMO, PECAN (Geerts et al., 2017), EUREC4A (Bony et al., 2017), to mention a few, have been conducted to quantify convection and its effect on the large-scale flow, and powerful LES data are available with statistical samples of the convective updraft and downdraft properties. However, the dilemma is that these data are only available locally or for specific setups, LES data also need to be constrained by observations and an accurate convection parameterization in a global model needs to be constrained globally.
Modern extensive big datasets such as those derived from COPERNICUS data are very relevant to constrain assumptions and calibrate parameterizations. Recently, (Neggers et al., 2012) and (Gustafson et al., 2020), among others, have provided a successful attempt to reconcile observations and LES data. This new approach consists in combining LES outputs with observations. Indeed, high-resolution models provide additional information in 4D that is not possible to be obtained from point-based measurements (Gustafson et al., 2020). The complementary approach consists of new dedicated satellite missions such as INCUS or the follow-on to CloudSat and CALIPSO, which can provide global, homogeneous and time-extended observations. Satellite estimates of the convective mass flux are becoming available (Jeyaratnam et al., 2021) and new missions are in the planning to fill the gap in global, multiple-regime observations of convection".