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Earth System Dynamics
Discussions

Interactive comment on "Improving the representation of anthropogenic CO_2 emissions in climate models: a new parameterization for the Community Earth System Model (CESM)" *by* Andrés Navarro et al.

Anonymous Referee #4

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The authors developed a novel POPEM parameterization and applied it to CESM to enhance the realism of global climate modeling by improving the direct representation of human activities and climate. They argued that modeling CO_2 emissions and pollutants directly at model grid points is a better approach. As such, their new approach will help understand the potential effects of localized pollutant emissions on long-term global climate statistics, thus assisting adaptation and mitigation policies.

The topic is interesting and the approach is provoking. However, I am not quite convinced by the validation part (Part 3.2). I therefore recommend major revision.

First, I cannot find a remarkable improvement using POPEM based on the comparison of precipitation and temperature biases. There are some differences between POPEM and CONTROL but these differences are buried in the large biases in either set. It is true that observations have uncertainties and a new parameterization does not have to improve the model performance in every aspect. Nevertheless, could the authors show some improvements more robust than the current ones (precipitation and temperature) for validation? Maybe TOA radiation balance, ENSO index, Arctic sea ice, etc?

Actually, I am somewhat interested in the Arctic sea change. It is known that climate models (like CESM CONTRL) cannot capture a rapid observed decline of Arctic sea ice during recent decades. In Fig. 5(B), POPEM is colder than CONTROL over the Barents Sea area. Will this mean that Arctic sea ice decline in POPEM is even slower than that in CONTROL?

Besides, to be consistent with GPCP, the authors may want to use a globally (land+ocean) covered temperature dataset GISTEMP (https://data.giss.nasa.gov/gistemp/) to examine temperature bias.

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