Review Mosso et al 2024

This study examined the role of cloud radiative feedbacks by comparing full-sky and clear-sky conditions using two methods. The first method diagnosed the feedback from the difference between full-sky and clear-sky fluxes in the full-sky experiment. The second method involved two experiments: one where the radiative effects of clouds were visible and another where they were transparent.

The authors found discrepancies between the suggested impacts from these two approaches. The diagnosed estimate suggested that clear-sky conditions have more negative feedback, while the experiments indicated that clear-sky conditions have a less negative feedback. The less negative feedback is attributed to the absence of the stabilizing role of clouds.

This study presents a compelling experiment along with intriguing findings. The aim is particularly noteworthy; to quantify the difference in impacts between the immediate impact by removing the clouds, without allowing the system to adjust to this change as in the clear-sky simulation are representative of the masking effect of clouds, and the impacts which are attributable to both simple masking and the feedback mechanisms alteration by global circulation response to cloud transparency.

While the experiment and the result are worth publishing, I have a question regarding the experimental setup designed for this study, specifically aimed at elucidating the role of clouds in radiative feedback.

- The solar insolation is decreased to approximate the control climate to preindustrial conditions. However, there is an asymmetrical treatment regarding the transparency of shortwave and longwave radiation. While the reduced solar insolation implicitly accounts for the preindustrial radiative effect of clouds on net shortwave radiation (i.e., incoming minus outgoing), the radiative effect of clouds on longwave radiation is not considered. This experimental setup may influence feedback mechanisms due to differences in the mean state of the control climate.
    - The greater extent of Southern Ocean sea ice observed in the control experiment, compared to the clear-sky experiment, may be attributed to the enhanced cooling of the sea surface due to reduced downward longwave radiation with transparent clouds in the longwave spectrum. This aspect warrants discussion. For instance, have you conducted a comparative analysis of the budget terms over the sea ice regions between the two experiments?
    - Could you please compare the atmospheric profile in the control climate between the clear-sky and full-sky experiments, particularly focusing on lapse rate and stability? How do these comparisons correlate with the differences in feedbacks observed? It's important to examine and provide explanations for these aspects.
    - Since the solar insolation remains constant between the control and 2xCO2 experiments, the former essentially represents an experiment with fixed shortwave radiative cloud effects. However, the radiative impact of changes in albedo from non-cloud sources is diminished due to the reduced solar insolation. Consequently, comparing radiative feedbacks in units of [Wm-2K-1] may not fully elucidate the mechanisms underlying the differences in feedback. While this point may be relatively minor for feedback over the Southern Ocean sea ice, comparing albedo [0-1] and feedback between full-sky and clear-sky conditions could help clarify differences in surface albedo feedback across different regions.

- I would also appreciate it if the authors could elaborate on the reasons for the discrepancy between the immediate impact of the clear-sky condition and the impact observed after the system's response.

Due to the uncertainties mentioned above, proposing an inter-model comparison to understand the role of cloud feedback using the experimental setup in this manuscript appears premature. Therefore, I recommend removing the sentence that proposes the inter-model comparison.

I add minor comments at the bottom of this document.

My suggestion is for a major revision that addresses the points mentioned above.

Minor comments

Figure 2: Having total feedback in this figure will help readers to see quantitative contributions.

Figure 4: Having total forcing in this figure will help readers to see quantitative contributions.

L72 Define 'CR'.

L158 Refer FAT mechanism by Hartmann and Larson (2002) here.

L158-159 I do not understand this. Explain more explicitly why the non-existence of convergence could weaken the LR feedback.

L229 Why is the difference in forcing in full-sky experiment positive over land and predominantly negative over the oceans?

- An experiment in which any change in clouds are transparent could make more sense.
- Reduce the solar constant to stabilize the equilibrium climate system in the preindustrial climate.
    - Overall, clouds cool the earth
    - The equilibrium state of the clear-sky simulation is colder than full-sky simulation. (-0.61K)
        - Cooler over land
        - Warmer in mid-latitude ocean
        - Increased sea ice over the Southern Ocean
    - Interpret the mechanisms
        - Clouds reduces the radiative cooling from the surface
- ECS high in clear-sky simulation
    - It is difficult to attribute it because of the increase in Forcing. (Fig 3)
- More positive surface albedo feedback in clear-sky simulation
    -

Figure 1. ECS high in clear-sky simulation

Figure 2. Big disagreement between the diagnosed clear-sky feedback with clouds and that from the clear-sky simulation.

- Planck feedback: More negative in clear-sky feedback. The diagnosed value is similar to the simulated value.
- Lapse-rate feedback is similar to full-sky in the diagnosed clear-sky feedback but much less negative in the simulaton.
- Water-vapour feedback is much more positive in the diagnosed clear-sky feedback than the full-sky feedback but less positive in the simulated feedback.
- Albedo feedback: More positive in clear-sky feedback.