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On differences in climate feedback evolution in abrupt4xCO2 climate model experiments

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Climate sensitivity – the response of the Earth's surface temperature to radiative forcing – and climate feedbacks are important and widely used metrics to gauge global climate change. In recent years it has become clear that climate sensitivity and feedback change over time in numerical climate model experiments but the reasons for this change are not yet well understood. We investigate the abrupt4xCO2 experiment as simulated by multiple members of the Coupled Model Intercomparison Project (CMIP) phases 5 and 6 and apply a radiative kernel method to decompose climate feedback into contributions from physical processes. We extract two groups of models, one with small (G1) and one with large (G2) global mean lapse-rate feedback change over time. It is found that the model groups differ with respect to warming and feedback patterns and that the Arctic stands out as the region with the biggest between-group differences. We retrace these Arctic changes to the different evolution of Arctic sea ice in both model groups. A further finding is that G1 members exhibit much more warming over the simulation period than G2s members. This appears to result from a more positive early cloud feedback in G1 than in G2. Further investigation is needed to uncover possible cause-effect relationships between Arctic changes and global feedbacks.