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Sensitivity of the global circulation to uncertain cloud parameters in EC-EARTH simulations

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The representation of clouds in global climate models remains an important source of uncertainty in climate simulations. Cloud-climate feedbacks are studied in sensitivity experiments with the global climate model EC-EARTH that is based on the ECWMF seasonal prediction system. These feedbacks prove difficult to understand. The formation of clouds impacts the local diabatic heating of the atmosphere through the release of latent heat as water vapor condenses and the absorption and reflection of short and long wave radiation. The latter depends critically on the micro-physical properties of the clouds. As clouds are organised by the large-scale atmospheric flow into large-scale formations, the cloud-related diabatic heating is also of large-scale and forces the large-scale atmospheric flow. The large-scale flow adjusts to this forcing and in turn changes the large-scale organisation of the cloud fields. This mutual dependency makes it difficult to unravel cause and effect relationships. The sensitivity experiments show that convection over the Pacific warm pool depends sensitively on the efficiency of lateral entrainment by unresolved turbulent motions of environmental air into rising air parcels.