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Water vapor feedback amplifies high-latitude warming

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When the climate system is forced by a doubling of the atmospheric CO_2 content, a number of feedback processes are activated, such as changes of water vapor, clouds and surface albedo. Here the CO_2 forcing and the associated feedbacks of water vapor and clouds are studied individually using a general circulation model (the NCAR CAM3) coupled to an aquaplanet mixed-layer ocean. A technique for fixing the radiative effects of moisture and clouds allows for a detailed decomposition of a CO_2 forcing and its associated water vapor and cloud feedbacks in terms of their radiative impact and their responses. The cloud feedback is in this model found to give only a small global average effect. As in previous studies, the water vapor radiative feedback is found to approximately double the climate sensitivity, but while its radiative effect is strongest at low latitudes, the resulting climate response displays about the same degree of polar amplification as the full all-feedback experiment. It is found that although CO_2 forcing and water vapor radiative feedback are not surface processes, their associated high-latitude temperature changes are greatest near the surface. This implies, conversely, that a surface amplified warming is not necessarily due to surface based feedbacks.