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Simulation of tropospheric molecular hydrogen using chemical GCM: impact of soil sink

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To reproduce temporal and spatial variations of atmospheric molecular hydrogen (H_2), we made model simulations using a three-dimensional atmospheric global chemical transport model, CHASER. The model is coupled with land process model (MATSIRO) and improved dry deposition scheme, which includes the effect of both soil moisture and soil temperature, calculates H_2uptake by enzymes in soil. Model results are compared with aircraft observations of Tohoku University and surface observations of NOAA/ESRL ground stations network.
The model reproduced spatial distributions and seasonal variations of observations well. Simulated H_2concentrations showed large seasonal amplitudes on the continent surface of northern high latitudes, with the maximum and minimum in boreal spring and autumn, respectively. The mean H_2concentration was lowest in the boundary layer near Japan and increased with increasing height. The vertical gradients change seasonally and the model captured these characteristics. The global burden of H_2in the troposphere is 144 Tg and its overall lifetime in the troposphere is 1.9 years. Soil uptake is 58.7 Tg, with the contribution of 76% of total H_2sink. Our results agree well with the previous estimates for the budget term from bottom-up studies and model estimation, which constrained by H_2concentration and/or isotope ratio. The results show that not only soil moisture but also soil temperature plays an important role in the seasonal variation of soil uptake and H_2 concentration at northern high latitudes.

Keywords: Land Ecosystem - Atmosphere interaction, Material Cycle, Soil Sink, Chemical AGCM