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Evaluation of the hydrological cycle of MATCH driven by NCEP reanalysis data: comparison with GOME water vapor measurements

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Abstract. This study examines two key parameters of the hydrological cycle, water vapor (WV) and precipitation rates (PR), as modelled by the chemistry transport model MATCH (Model of Atmospheric Transport and Chemistry) driven by National Centers for Environmental Prediction (NCEP) reanalysis data (NRA). For model output evaluation we primarily employ WV total column data from the Global Ozone Monitoring Experiment (GOME) on ERS-2, which is the only instrument capable measuring WV on a global scale and over all surface types with a substantial data record from 1995 to the present. We find that MATCH and NRA WV and PR distributions are closely related, but that significant regional differences in both parameters exist in magnitude and distribution patterns when compared to the observations. We also find that WV residual patterns between model and observations show remarkable similarities to residuals observed in the PR when comparing MATCH and NRA output to observations comprised by the Global Precipitation Climatology Project (GPCP). We conclude that deficiencies in model parameters shared by MATCH and NRA, like in the surface evaporation rates and regional transport patterns, are likely to lead to the observed differences. Monthly average regional differences between MATCH modelled WV columns and the observations can be as large as 2 cm, based on the analysis of three years. Differences in the global mean WV values are, however, below 0.1 cm. Regional differences in the PR between MATCH and GPCP can be above 0.5 cm per day and MATCH computes on average a higher PR than what has been observed. The lower water vapor content of MATCH is related to shorter model WV residence times by up to 1 day as compared to the observations. We find that MATCH has problems in modelling the WV content in regions of strong upward convection like, for example, along the Inter Tropical Convergence Zone, where it appears to be generally too dry as compared to the observations. We discuss possible causes for this bias and demonstrate the value of the GOME WV record for model evaluation.

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