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Systematic errors of GCM simulated water vapour in the lowermost extratropical stratosphere

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A comparison between water vapour distributions observed from HALOE/UARS and simulated by the ECHAM4 climate model shows a wet bias in the lower stratosphere culminating in altitudes below 100 hPa in polar and mid latitudes. HALOE values are up to a factor 4 overestimated by the model. Sensitivity experiments indicate that the wet bias leads to a cooling of up to 8 K, explaining about 70% of the cold bias in the lowermost extratropical stratosphere, a bias that ECHAM4 shares with many other general circulation models.

The deficient water vapour distribution is caused by an excessive numerical diffusion of the model's semi-Lagrangian advection scheme. If a non-diffusive Lagrangian scheme is employed instead, wet bias and cold bias at the respective altitudes are simultaneously reduced.