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Southern Hemisphere high latitude temperature trend simulated by CCMVal-2 models

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Significant stratospheric temperature trend has been found in Southern Hemisphere (SH) high latitudes during last three decades from observations and reanalysis. This trend is strongest in SH Spring, especially in September. CCMVal-2 REF-B1 simulations are found to generally underestimate the mean trend in September. The October mean trend is overall well captured despite large variations among models or even ensemble members of the same model. But the November and December mean trend is unrealistically overestimated in these simulations. On the other hand, the observed temperature trend is characterized as a dipolar pattern whose phase varies among different months. These simulations generally underestimate the amplitude of this dipolar structure in SH Spring and overestimate it in SH summer, consistent with the commonly known "late breakdown of the Antarctic polar vortex". The phase of this trend pattern is also difficult to simulate. For example, the observed phase shifts by about 75 degrees from September to October, which is captured by only a few simulations. Individual ensemble members of a single model typically do not simulate the phase consistently, implying either larger ensemble is required to produce robust results or the phase shift is intrinsically chaotic. This trend could be induced radiatively by ozone depletion and greenhouse gas (GHG) increases, or dynamically by circulation response. Scenario simulations forced by fixed GHG or ozone depleting substances have been investigated to isolate these effects. Both forcings are found to be responsible for the temperature trend and dynamic feedback is likely involved.