



A dynamical mechanism for Southern Hemisphere climate change due to the ozone hole

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We report the dynamical mechanism responsible for the remarkable strengthening of the Southern Hemisphere circumpolar westerlies from the lower stratosphere to the surface due to the Antarctic ozone hole. The cooling of the lower stratosphere associated with ozone depletion strengthens the stratospheric vortex, conditioning the vortex so that less planetary waves propagate up from the troposphere. This initiates a feedback leading to i) a strengthening of the zonal wind downwards towards the troposphere, and ii) a dynamical enhancement of the anomalously cold polar lower stratosphere temperatures. The direct impact of these anomalies, imposed by planetary wave forcing, in the troposphere is weak. However, the associated eastward shear results in the increased generation of synoptic-scale waves in the troposphere. The effect of this on the momentum budget is to drive the tropospheric eddy-driven jet polewards and to strengthen it. Our results will enable improved prediction of the tropospheric westerlies in the Southern Hemisphere summer as they change with the anticipated stratospheric ozone recovery in the first half of the 21st century.