Numerical analysis of polar vortex stability

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Polar vortices, significant cyclonic circulations near the poles of planetary atmospheres, are instrumental in shaping weather patterns and atmospheric dynamics. While extensively investigated on Earth, similar phenomena have also been observed on other celestial bodies within our solar system. Notably, Venus exhibits a polar dipole pattern with cyclonic circulation at the north pole and anticyclonic circulation at the south pole. On Jupiter, polar cyclones (PC) are surrounded by a ring of circumpolar cyclones (CPC) at each pole, while Saturn, sharing similarities with Jupiter, only harbors a solitary cyclone in its polar regions.

Comprehending the intricacies of polar vortex dynamics is crucial for understanding the underlying atmospheric processes. In this talk, we employ linear stability analysis and solve the associated eigenvalue problems numerically to investigate the influence of planetary rotation frequency and its variability, as well as the characteristics of circumpolar cyclones including their number, location, relative strength, and radius, on the overall stability of the system. Through this analysis, we aim to advance our understanding of polar vortex behavior across planetary atmospheres, contributing to the broader comprehension of planetary meteorology.

This work is partly supported by the Austrian Science Fund (FWF) under the grant P 35485-N.