



An idealized general circulation model for the atmospheric circulation on Ice Giants

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Uranus and Neptune are the most distant planets in the Solar System, and consequently, our observational data on them is limited. In recent years, several mission concepts have been proposed to explore these ice giants. For such missions to succeed, it is essential to develop tools that support both mission planning and the interpretation of future observations. One such tool is a general circulation model (GCM). However, no published GCM to date has successfully reproduced the observed wind patterns on Uranus or Neptune. To address this gap, we developed a new idealized GCM specifically designed to simulate atmospheric circulation on the ice giants. Using this model, we systematically investigate how the zonal wind structure and meridional circulation respond to variations in model configuration and physical parameters, with a particular focus on the depth of the simulated bottom pressure. Our results demonstrate that the circulation is sensitive to the depth of the model domain. Notably, when the model extends deep enough, the meridional structure of the radiative-equilibrium temperature becomes less critical. Additionally, we find that resolution dependence varies with model depth, indicating a significant role for eddy dynamics. This idealized GCM provides a foundational framework for developing more comprehensive models of Uranus and Neptune, ultimately supporting future observational and mission efforts.