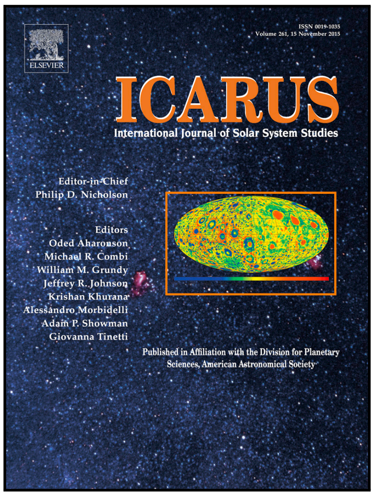

On the dynamical nature of Saturn's North Polar hexagon

Masoud Rostami, Vladimir Zeitlin, Aymeric Spiga

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On the dynamical nature of Saturn's North Polar hexagon.

Masoud Rostami[a], Vladimir Zeitlin[b ⋆], and Aymeric Spiga[c]

[a,b,c] *Laboratoire de Météorologie Dynamique (LMD)/IPSL, Université Pierre et Marie Curie (UPMC), Paris, France*

[a,b] *Ecole Normale Supérieure(ENS), Paris, France*

ABSTRACT

An explanation of long-lived Saturn's North Polar hexagonal circumpolar jet in terms of instability of the coupled system polar vortex - circumpolar jet is proposed in the framework of the rotating shallow water model, where scarcely known vertical structure of the Saturn's atmosphere is averaged out. The absence of a hexagonal structure at Saturn's South Pole is explained similarly. By using the latest state-of-the-art observed winds in Saturn's polar regions a detailed linear stability analysis of the circumpolar jet is performed (i) excluding ("jet-only" configuration), and (2) including ("jet+vortex" configuration) the north polar vortex in the system. A domain of parameters: latitude of the circumpolar jet and curvature of its azimuthal velocity profile, where the most unstable mode of the system has azimuthal wavenumber 6, is identified. Fully nonlinear simulations are then performed, initialized either with the most unstable mode of small amplitude, or with the random combination of unstable modes. It is shown that developing barotropic instability of the "jet+vortex" system produces a long-living structure akin to the observed hexagon, which is not the case of the "jet-only" system, which was studied in this context in a number of papers in literature. The north polar vortex, thus, plays a decisive dynamical role. The influence of moist convection, which was recently suggested to be at the origin of Saturn's north polar vortex system in the literature, is investigated in the framework of the model and does not alter the conclusions.

Keywords: Saturn's Hexagon ; Barotropic Instability ; Rotating Shallow Water Model

⋆ Corresponding author. Email: zeitlin@lmd.ens.fr Address: LMD-ENS, 24 Rue Lhomond, 75005 Paris, France