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Influence of non-hydrostatic equilibrium and subsurface ocean flow on the polar motion of Titan

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Abstract

We investigate the influence of a deviation from hydrostaticity and of a flow inside the subsurface ocean on the polar motion of Titan.

1. Introduction

In the classical rotation studies, Titan is usually assumed to be in a hydrostatic equilibrium state. However, the observed shape of Titan is more flattened at the poles than expected for a satellite in hydrostatic equilibrium [3]. Moreover, a non-zero degree-3 gravity signal indicates a deviation from hydrostatic equilibrium [2]. Using Airy-like models of isostasy, we here construct a large set of interior models of Titan based on the observed degree-2 gravity field and shape of Titan [2, 3]. We then model the rotation variations of these different models.

2. Rotation model

We model the rotation of Titan from the Liouville equations of the different internal layers of Titan. Our model includes the effects of tidal deformations of the different layers, of the deviation from the hydrostatic equilibrium, of the dense atmosphere of Titan and of the flow in the subsurface ocean.

3. Results

Our results (published in [1]) showed that, for thick shells (thicker than 50 km), the polar motion has a main annual period with an amplitude of about 500 m. For thinner shells, the polar motion amplitude can be amplified by a resonance with the Chandler Wobble. The polar motion is strongly influenced by the flow in the subsurface ocean. Deviation from the hydrostatic shape has a smaller influence on the polar motion, except for interior models close to a resonance.

Acknowledgements

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References

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