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Rotational motion of Venus and Envision determination

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1. Introduction

The interior structure of Venus is still puzzling. The shape of this slow retrograde rotating planet is non-hydrostatic and the presence of a fluid core and solid iron core are still enigmatic [2, 4]. In order to assess information on its interior structure, it is crucial to determine geophysical parameters such as the k_2 Love number [3] and its moment of inertia [2], on which we will focus here. The moment of inertia can be deduced from the measurement of the rotational motion of Venus and notably the length-of-day variations and precession-nutation [1]. More precisely the rotational motion constrains the relative moment of inertia and then by using the gravity field coefficients $(C_{2,0}, C_{2,2})$ it is possible to determine its mean moment of inertia.

2. Rotational model

The length-of-day of Venus seems to vary by 7 minutes according to the comparison of the observations taken at different epoch over 40 years [1]. The present study explores the different mechanisms, tidal torque from the Sun, atmospheric torques acting on the surface and fluid core-mantle coupling, that could play a role in this excitation of 7 minutes. In addition, a precession-nutation model of Venus is built and their determination bears information on the relative moment of inertia. The interior parameters are estimated from recent viscoelastic models of Venus [2].

3. Envision mission

The determination of the rotational variations of Venus can be improved by the future Envision mission, that is presently pre-selected in Phase-A by ESA in the M5-program. Indeed, the radar instrument would observe some surface features several times during the mission (example of the simulation in Figure 1). These control points will provide accurate measurements of Venus' rotation. The present work simulates the accuracy on the rotational parameters as a function of the characteristics of the control point network. It discusses the implications for the determination of Venus' interior structure.

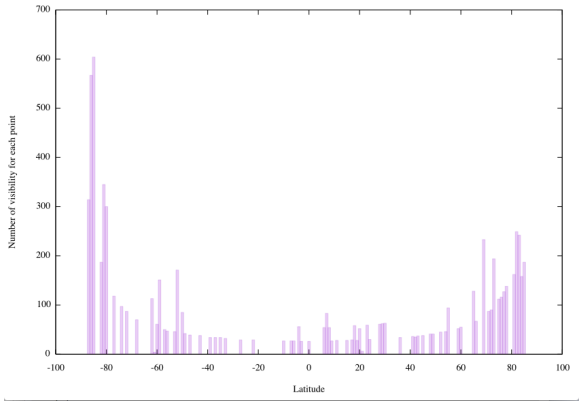

Figure 1: Number of control point visbility during Envision mission as function of the latitude. The high latitude control points are favored to determine the spin axis orientation and the low latitude control points are favored to determined the lod variations.

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