

Variation in Titan' s polar sea distribution due to orbital forcing simulated by a sea balance model

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Titan' s polar sea distribution is highly asymmetric about the equator in that most seas and lakes are found near the north pole, while the south polar region has only few lakes, among which Ontario Lacus. This hemispheric dichotomy in the polar sea distribution raised the question as to whether it may be a manifestation of the Croll-Milankovitch-type orbital forcing of Titan' s methane hydrological cycle, which would periodically reverse the hemispheric asymmetry in the polar sea distribution. This study investigates how the lake distribution in Ontario Basin near the south pole may have evolved over the past 45 kyr as a consequence of orbital forcing. The temporal variation in lake distribution is simulated by a lake balance model with meteorological output of a global climate model and considering the topography map measured by Cassini. The long-term variation in lake size is mainly caused by the temporal variation in precipitation rate rather than that in evaporation rate. The lake size of Ontario Lacus changes by a factor of approximately 2. In no epoch do the predicted area and volume of Ontario Lacus become nearly as large as the inferred paleosea in Ontario Basin or the observed present seas near the north pole. This implies that orbital forcing alone is not capable of reversing the hemispheric asymmetry in Titan' s polar sea distribution and a climate with substantially larger precipitation would have been necessary to explain the southern paleoseas.

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