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Titan's Lakes: Croll-Milankovitch and seasonal methane cycles

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A set of lakes filled or partially filled with liquid hydrocarbon and empty lake basins have been discovered in the high latitudes of Titan and were mapped by the RADAR instrument on the Cassini orbiter. A pronounced hemispheric asymmetry exists in the occurrence of the lakes. We propose that the observed difference in lake distribution may be caused by an asymmetry in the seasons on Titan that results from the eccentricity of Saturn's orbit around the Sun. We suggest that the consequent hemispheric difference in the balance between evaporation and precipitation could lead to an accumulation of lakes in one of Titan's hemispheres. This effect would be modulated by, and reverse with, dynamical variations in the orbit. We propose that much like in the Earth's glacial cycles, the resulting vigorous hydrologic cycle has periods of tens of thousands of years or more, and leads to active geologic surface modification in the polar latitudes.

The proposed long-term cycle is distinguishable from Titan's volatile exchange on seasonal timescales, now measured. Repeat images covering Titan's South Polar region reveal temporal changes; lake features recede and disappear between observations. The net flux is estimated to be approximately 1 ± 0.2 m/yr in depth, using multiple observations of shoreline recession and radar backscatter variations. The observations and models offer a window into the various volatile flux rates in Titan's hydrologic system and demonstrate that the surface plays an active role in its evolution.