Titan is unique in the solar system for having an earth-like atmosphere of nitrogen and a cycle of methane similar to hydrological cycle. In this talk we will present our current understanding of the complex meteorological, chemical and geologic nature of Titan’s methane cycle. Methane and nitrogen are intricately coupled. The presence of methane is critical to the existence of a nitrogen atmosphere on Titan. Yet, the chemical reactions between these two major constituents (nitrogen 94% by volume, methane 6%) destroy methane irreversibly in tens to one hundred million years, implying potential collapse of the nitrogen atmosphere many times over in Titan’s geologic lifetime. The evidence of chemical conversion of methane comes from observations of hydrocarbons, nitriles and aerosols in the atmosphere, ionosphere and the surface. Unlike the H2-dominated gas giant planets with hot interiors, these chemical products have little likelihood of recycling the bulk of methane on H2-poor, cold and solid object like Titan. The meteorological cycle of methane does not help either, as it is at best a closed cycle of no net gain in the short run. Thus, other mechanisms of recycling methane are essential for sustained presence of an atmosphere. It is estimated that the interior of Titan has vast reservoirs of methane, only a small fraction of which has passed through the atmosphere in the past 4.5 Gyr. Impacts and cryovolcanism may play an important role in episodically unleashing this methane and recharging the lakes and the atmosphere to replenish the methane lost to photochemistry. [pdf’s of speaker’s publications at www.umich.edu/~atreya]