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Atmosphere-surface Interactions on Titan and the Role of Methane

TETSUYA TOKANO[1]
[1]*Institut für Geophysik und Meteorologie, Universität zu Köln, 50923 Köln, Germany*

Until recently the troposphere and surface of Titan were hidden from direct exploration, giving rise to plenty of ideas about the processes occurring at the "mysterious" surface. Unlike many other satellites of Saturn, Titan's recent geology appears to be not primarily dominated by impacts, but by more Earth-like exogenic processes, owing to a dense atmosphere and condensable gases. One likely agent connecting the atmosphere and surface of Titan is methane and there is ample observational evidence for the presence of an active methane cycle in analogy to the terrestrial hydrological cycle. A likely scenario is that methane condensation limits the upward transport of methane into the upper atmosphere, it washes out the haze in the lower troposphere and methane precipitation contributes to the erosion of the surface. More subtly methane cycle affects the atmospheric circulation, thermal structure and controls the presence or absence of tropospheric chemistry that may or may not be relevant for astrobiology. The physical state of the surface governs the transport of methane from subsurface reservoirs to the atmosphere and vice versa, and also the climate of the planetary boundary layer. This talk focuses on the physical (rather than chemical) aspect of the atmosphere-surface interaction with emphasis on the role of methane, and much of the discussion is based on comprehensive climate modelling by a general circulation model (GCM) in which inherently the surface represents a major boundary condition. Previous considerations and model results can now be better constrained by the new data of Huygens which landed on Titan in January of this year.

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