Dissolution on Saturn's Moon Titan: A 3D Karst Landscape Evolution Model

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Résumé en anglais	Titan is an Earth-like world possessing a nitrogen-rich atmosphere covering a surface showing signs of lacustrine (lakes and depressions), fluvial (channels, valleys), aeolian (longitudinal dunes) activity. The chemistry implied in the geological processes is, however, strikingly different from that on Earth. Titan's extremely cold environment (T ~ -180°C) only allows water to exist under the form of an icy "bedrock". The presence of methane as the second major constituent in the atmosphere, as well as an active nitrogen-methane photochemistry, allows methane and ethane to drive a hydrocarbon cycle similar to the terrestrial hydrological cycle. A plethora of organic solids, more or less soluble in liquid hydrocarbons, is also produced in the atmosphere and can lead, by atmospheric sedimentation over geological timescales, to formation of some kind of organic geological sedimentary layer. [figure_sikun2other] Based on comparisons between Titan's landscapes seen in the Cassini spacecraft data and terrestrial analogues, karstic-like dissolution and evaporitic crystallization have been suggested in various instances to take part in the landscape development on Titan. Dissolution has been invoked, for instance, for the development of the so-called "labyrinthic terrain", located at high latitudes and resembling terrestrial cockpit or polygonal karst terrain. In this work, we aim at testing this hypothesis by comparing the natural landscapes visible in the Cassini/RADAR images of Titan's surface, with those inferred from the use of a 3D Landscape Evolution Model (LEM) based on the Channel-Hillslope Integrated Landscape Development (CHILD), modified to include karstic dissolution as the major geological process. Digital Elevation Models (DEMs) are generated from an initial quasi-planar surface for a set of dissolution rates, diffusion coefficients (solute transport), and sink densities of the mesh. The landscape evolves over millions of years. Synthetic SAR images are generated from these DEMs in order to compare with Titan's landforms seen in the actual SAR images and infer the possible thickness and degree of maturation of the Titan karst

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