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Distribution and intensity of water ice signature in South Xanadu and Tui Regio

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Titan is a complexe moon of Saturn, with dense atmosphere, hydrocarbon cycle, and water-ice crust. Titan was targeted by two major space missions: *Voyager* and *Cassini*, and has been the subject of many studies. Lakes and seas of liquid hydrocarbons were discovered

by *Cassini*'s RADAR in Titan's polar regions [15, 14]. This instrument also detected on equatorial regions geomorphological structures related to the presence of liquid, like fluvial valleys incised in the bedrock, and alluvial fans [8, 3]. The existence of evaporitic terrains where also suggested [1, 4, 9], often in place of paleo-sea [12]. Water ice signal is not present everywhere on Titan, contrary to other icy moon of Saturn and Jupiter. It was detected with *Cassini*'s VIMS instrument in Titan's dark region, often at the transition between a dark and bright unit, and mixed with a darkening material [11, 13]. Ref. [6] also highlighted an equatorial corridor of exposed water-ice using a principal component analysis (PCA) with VIMS, showing on a large scale terrains with low and high water ice content.

We accentuate our study on Titan's river bed, where the erosion due to liquid hydrocarbon can reveals the bedrock, and where we can have clues on the sediment transport. Here we propose a study of the water ice signal distribution in Xanadu and Tui regio, where we have channels [8] and paleo-seas of hydrocarbures [12].

We focused on 2 radar bright channels [8], and the surrounding areas. The channels are located at the south of Xanadu, directly exiting the mountains. They are at the north of the evaporitic region Tui

Regio [10], and form dry dendritic fluvial valleys [7], with a width up to 8~km. We apply a radiative transfer analysis to retrieve the surface albedo of 2 VIMS cubes located in our area of study : 1590648776_1, and 1809727868_1.

We establish a criteria δ representing the intensity of the water-ice signature, based on wavelength ratios and means of the surface albedo significant for the identification of the water-ice spectrum. They are detailed in Tab. 1. Those ratio and mean are normalized with respect to themselves. Then, they are added if the expected value indicating a high water ice signal is high or >1, and subtracted otherwise. We then have a range of values going from δ = -4 for no water ice signature, and δ = 1 for a high water ice signal. The results of this multicriteria analysis are in Fig. 1 and 2. An example of the different spectra for a low and high δ are given is Fig.3.

Wavelength ratio and mean	Expected value if water-ice signature
1.58/1.28	< 1
2.03/1.28	< 1
2.03/1.58	< 1
2.7/2.8	high
4.85 - 5.1µm	low

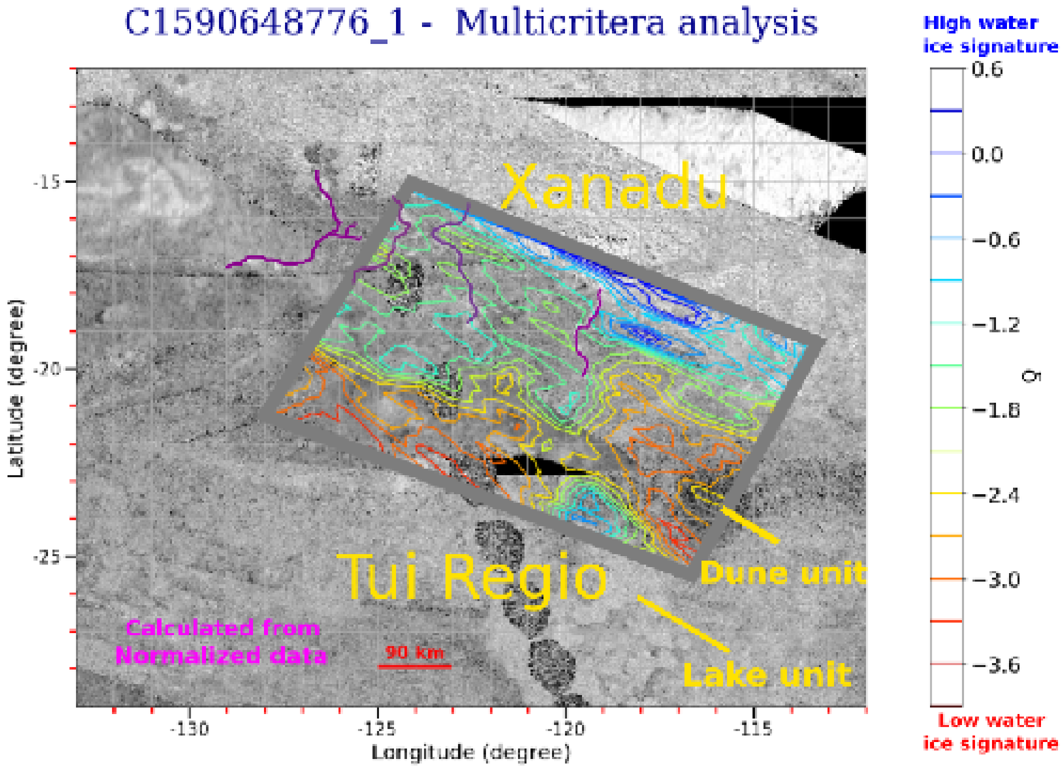
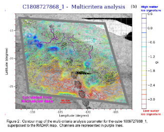


Figure 1 : Contour map of the multi-criteria analysis parameter δ for the cube 1590648776_1 superposed to the RADAR map. Channels are represented in purple lines. Regions of interest are annotated in yellow.



The radiative transfer analysis highlighted areas of high water-ice signal on Xanadu mountains, and also at the end of the dry channels, corresponding to potential deltas or alluvial fans, supporting [2] and [7] hypothesis of sediment transport from the mountains of Xanadu to downstream of the channels. The ice signal is lower inside the channels, perhaps due to their sizes, smaller than the spatial resolution of a pixel. The Fig. 3 shows that water ice lower the surface albedo.

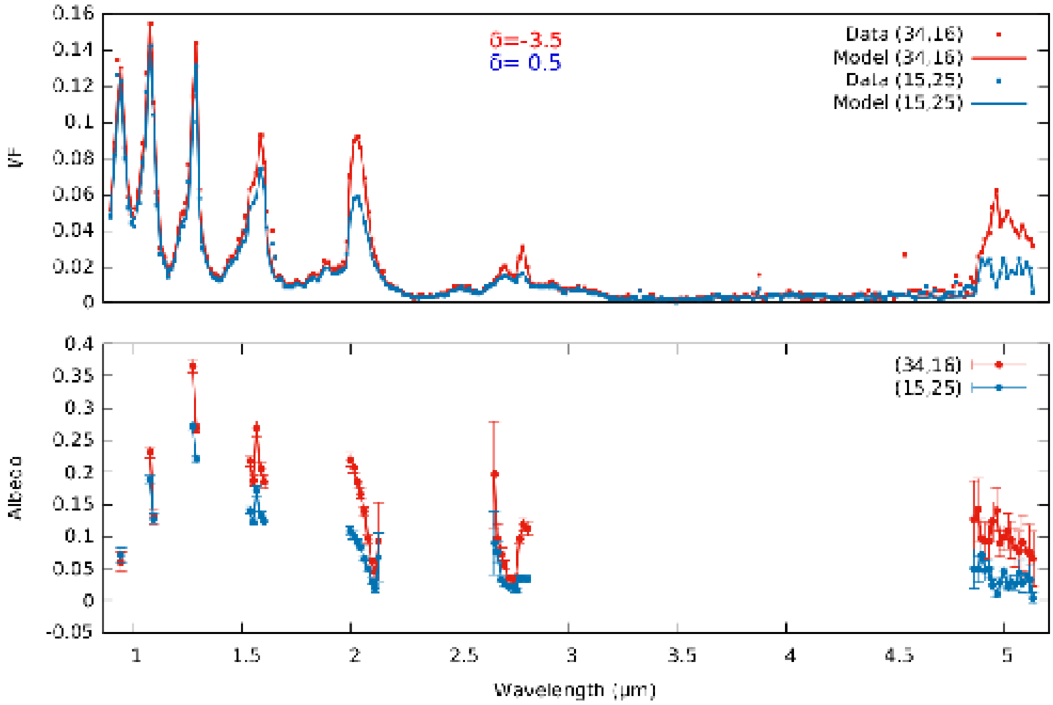


Figure 3 : I/F spectra of pixels (34,16) and (15,25) of the cube 1809727868_1 with low (red) and high (blue) values of δ (top panel), and their respective albedo (bottom panel)

This combined analysis also shows a gradient of low water-ice signal perfectly superposed to Tui Regio in the RADAR map. This gradient could correspond to the decreasing thickness from the center to the border of the evaporite layer of Tui Regio, as suggested by [5].

Detailed analysis of the retrieved albedo could bring further information on the composition of those terrains if the error bars are low enough. A map of the inversion of the surface signal allows us to have a finer vision than just an analysis of the I/F. With the parameter δ, we have better contrasts, and a direct appreciation of the strength of the water-ice signature.

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