THE EFFECT OF LAND SURFACE PROPERTIES ON THE FORMATION OF SAND SEAS ON SATURN'S MOON TITAN. M. Q. Collins[1], [1]University of Hong Kong (maxqc@connect.hku.hk)

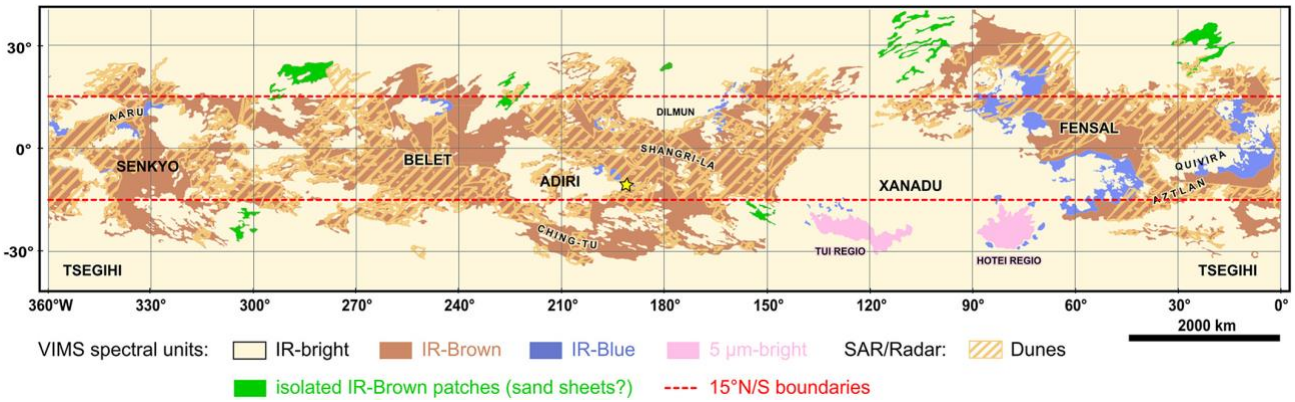

Figure 1[1]: A map of the spectral units and the SAR dunes by using Visual and Infrared Mapping Spectrometer (VIMS) and SAR Radar from the Cassini mission. IR-Bright regions refer to hills and plains, IR-Brown units to regions of organic grains which make up dunefields. IR blue units are enriched in water ice and the 5 µm may be evaporitic deposits. They are displayed in a cylindrical projection centered at 180°W and 0°N.

Introduction: Titan is one of Saturn's moons and the second largest moon in the solar system; 1.5 times larger than Earth's moon and 1.8 times as massive. It is the only body in space with clear evidence of stable surface liquid. Titan's thick atmosphere is primarily composed of nitrogen with ~5% methane and 1% hydrogen and has a surface pressure of 1.5 bar. Titan has a hydrological cycle that is similar Earth, albeit based on liquid hydrocarbons. This, combined with Titan's complex photochemistry, allows for the deposition of organic compounds at the surface. These particles are the basis for Titan's equatorial dune system, in part due to relatively dry conditions as a result of Titan's general circulation, and because of the dense atmosphere and low gravity. Titan's dunes act as a large reservoir for organic compounds which may be conducive to early life and may be used to understand the moon's complex methane-based hydrological cycle. Equatorial dune formation on Titan is currently poorly understood and few general circulation models (GCM) have successfully explained the conditions required to match observations.

Here, I use the ROCKE-3D GCM to explore the hypothesis of Tokano (2010)[2] that dune formation on Titan is a result of westerly equatorial equinoctial gusts. Using a combination of wind statistics, including drift potential, resultant drift direction, and wind roses, I show the influence of surface roughness and topography on the occurrence of dune forming winds. This study expands upon previous models in the application of topography and surface roughness heterogeneity using backscattering model approximations[3] as a function of sand sea region and interdune fraction. Four model sensitivity tests are run with the inclusion or exclusion of sand sea surface roughness variability, topography, or a combination of both. These are compared to a flat and smooth control simulation.

Results indicate it may not be accurate to measure instantaneous equinoctial winds (i.e. at Solar Longitude L_s = 0, 180) as indicative of the only period of high magnitude westerlies. Westerly winds above a given saltation threshold level are present during the transitionary period of Titan's equinox and are experienced asymmetrically due to orbital parameters affecting the magnitude and duration of summers. Preliminary results show topography acts as the dominant factor in controlling wind orientation, although surface roughness may play a secondary role in deflecting or reducing surface winds. The results of this study may be used to advise future missions in locations of interest given an enhanced understanding of the general circulation and the dominant factors controlling equatorial surface winds and as an analogue to early Earth and origins of life studies.

References:

[1] J. F. Brossier et al. (2018) *JGR Planets, 123(5)*, 1089-1112. [2] Tokano T. (2010) *Aeolian Research, 2(2)*, 113–127. [3] Lucas et al. (2019) *JGR Planets, 124(11)* 3140-3163.