Radar backscatter properties of the Dragonfly landing site

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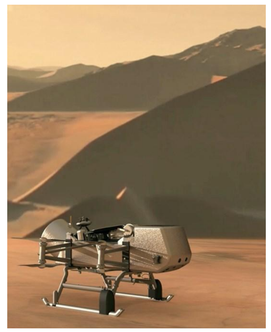
INTRODUCTION



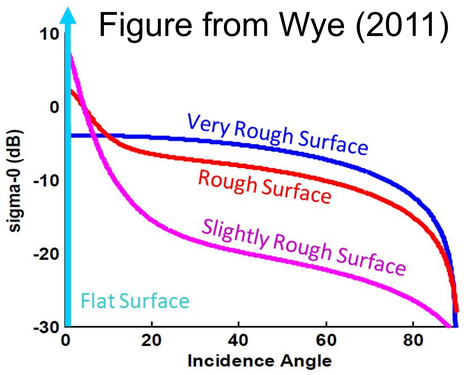
The Dragonfly mission, selected as the next New Frontiers mission by NASA, will send a rotorcraft to Titan in the mid-2030s (launching in 2027). The chosen landing site (Lorenz et al., 2021), in the Shangri-la dune field near the geologically young Selk crater (6.5°N, 161.5°E), has been observed by several instruments onboard the Cassini spacecraft (in orbit around Saturn from 2004 to 2017), with the Radar in Synthetic Aperture Radar (SAR) mode providing the highest resolution data (up to ~300 m/pixel).

METHOD

Measured backscattered radar signal (the normalized radar cross-section σ^0) depends on:

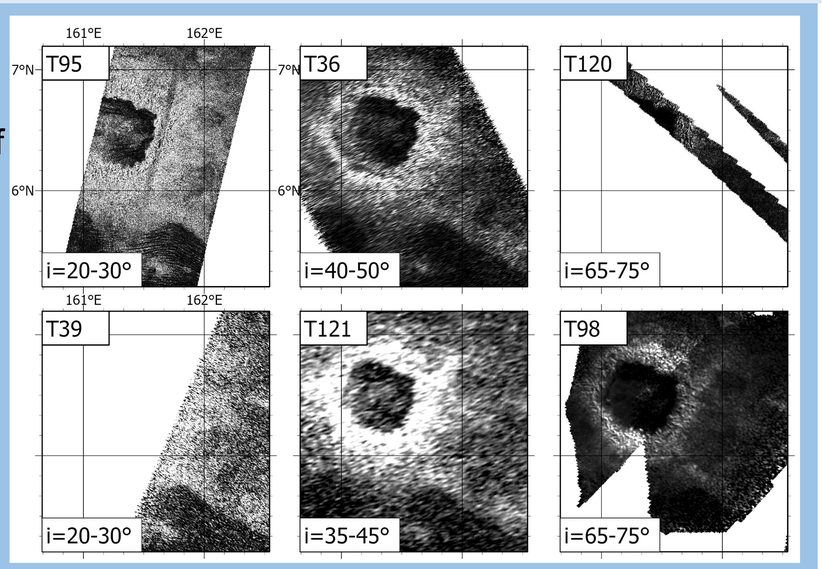
- Surface roughness
- Subsurface roughness and structures (cracks, layers, grain sizes)
- Composition (dielectric constant, probed depths)
- Surface slopes (which modify incidence angles)

Figure from Wye (2011)

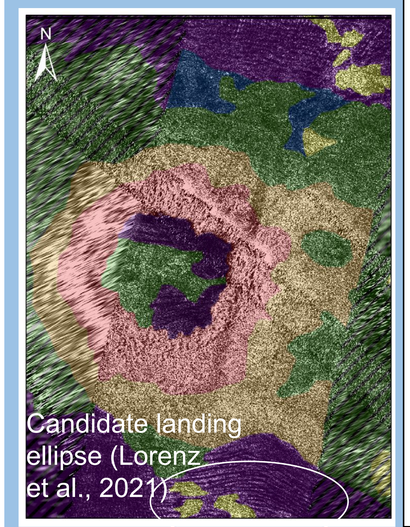


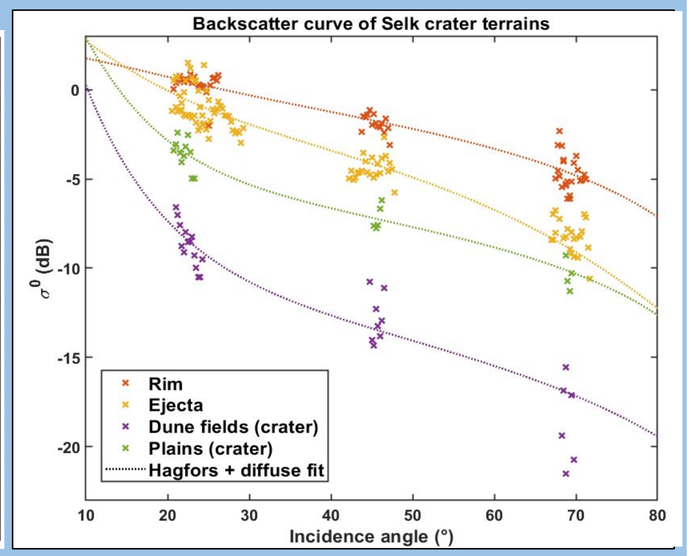
RESULTS

Resolved SAR observations of Selk crater have been acquired during six Cassini flybys, with incidence angles that vary between 20° and 70°.



We mapped four terrain units in the immediate vicinity of Selk crater and constructed their **backscatter curves**, revealing variations in the composition and structure of the medium.





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DISCUSSION

The **dunes** are radar-dark, especially at high incidence angles, similar dunes in Belet, Shangri-la, and Fensal (e.g., Lucas et al., 2019), indicating a smooth and absorbing surface consistent with organic, fine-grained sand.

The radar-bright **Selk crater rim** likely presents:

- High 2.2-cm scale surface roughness
- Multiple subsurface scattering on organized structures (cracks, layering)
- A radar-transparent material like water ice (allowing for multiple scattering)

 The impact excavated the icy bedrock and created a rough, blocky, cracked surface.

PERSPECTIVES

Current and future work include:

- Analysis of distant radar scatterometry to complete the backscatter curve
- Analysis of radar altimetry over nearby terrains
- Application of physical models to constrain surface properties (e.g., Lucas et al., 2019)
- Comparison with similar craters over Titan

REFERENCES

[1] Lorenz, R. D. et al., Planetary Science Journal, 2021 [2] Wye, L. C., PhD thesis, 2011 [3] Lucas, A. et al., J. Geophys. Res.: Planets (2019)