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Remote sensing and field observations of wind streaks

Aviv Lee Cohen-Zada (1), Shimrit Maman (2), and Dan Blumberg (1)

(1) Department of Geography and Environmental Development, Ben-Gurion University of the Negev, Beer-Sheva, Israel (avivlee@post.bgu.ac.il), (2) Homeland Security Research Institute, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Wind streaks are common aeolian features observed on planetary surfaces. They occur by the thousands on Mars, Venus and Earth and it has been suggested that they form also on the moons Titan and Triton. Due to their global distribution, compared to other aeolian features, wind streaks serve as a primary indicator for the prevailing wind direction near the surface over time. The climatic perspective of wind streaks in the planetary context has been supported by recent studies on Earth, their interpretation in remote sensing images is still lacking. The geomorphological properties of wind streaks are diverse and may involve changes in surface composition, thickness, grain size or the presence of aeolian bedforms compared to their surroundings. The appearance of wind streaks in optical or radar images is significantly different. Optical images are mostly affected by the mineralogy of the surface, whereas, radar is sensitive to the surface roughness and the viewing geometry. Because Venus is constantly shrouded with clouds, its surface was imaged solely by radar. Mars, on the other hand, has been imaged only by optical sensors (visible and infrared spectrum). Therefore, the observations of Martian and Venusian wind streaks are not comparable. Currently, Earth is the only planet where wind streaks were imaged by both optical and radar sensors and a comprehensive data set can be created.

This study presents a wide-ranging comparison of remote sensing means, using various sensors, both optical and radar. The purpose of this study is to examine the effects imposed by the sensor type on wind streak identification and interpretation. Six case studies of Earth wind streaks are demonstrated which were imaged by both radar and optical sensors. Results indicate that wind streak identification is constrained to a specific combination of sensor settings fit for the local surface properties. Bright and dark (reflectance and backscatter) are relative terms and should be used with caution. Only half of the optical-visible wind streaks are also radar-visible, but all wind streaks observed in radar images were observed in optical images. The results suggest that the Venusian wind streak population was not revealed entirely and more wind streaks are waiting to be discovered.

In addition, data collected during field investigations from five sites in Mojave Desert, California, USA supports the results obtained by remote sensing. Field data includes spectral measurement, GPS, documentation of the environment conditions and soil sampling for further laboratory analyses. Preliminary results from x-ray diffraction analysis and spectral signatures of both the streak and surroundings imply on little mineralogical difference in four case studies. Spectral differences between the streaks and their surroundings correspond to what is observed and measured in imagery.