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Wind Streaks on Earth; Exploration and Interpretation

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Wind streaks, one of the most common aeolian features on planetary surfaces, are observable on the surface of the planets Earth, Mars and Venus. Due to their reflectance properties, wind streaks are distinguishable from their surroundings, and they have thus been widely studied by remote sensing since the early 1970s, particularly on Mars. In imagery, these streaks are interpreted as the presence – or lack thereof – of small loose particles on the surface deposited or eroded by wind. The existence of wind streaks serves as evidence for past or present active aeolian processes. Therefore, wind streaks are thought to represent integrative climate processes.

As opposed to the comprehensive and global studies of wind streaks on Mars and Venus, wind streaks on Earth are understudied and poorly investigated, both geomorphologically and by remote sensing.

The aim of this study is, thus, to fill the knowledge gap about the wind streaks on Earth by: generating a global map of Earth wind streaks from modern high-resolution remotely sensed imagery; incorporating the streaks in a geographic information system (GIS); and overlaying the GIS layers with boundary layer wind data from general circulation models (GCMs) and data from the ECMWF Reanalysis Interim project. The study defines wind streaks (and thereby distinguishes them from other aeolian features) based not only on their appearance in imagery but more importantly on their surface appearance. This effort is complemented by a focused field investigation to study wind streaks on the ground and from a variety of remotely sensed images (both optical and radar). In this way, we provide a better definition of the physical and geomorphic characteristics of wind streaks and acquire a deeper knowledge of terrestrial wind streaks as a means to better understand global and planetary climate and climate change.

In a preliminary study, we detected and mapped over 2,900 wind streaks in the desert regions of Earth distributed in approximately 500 sites. Most terrestrial wind streaks are formed on a relatively young geological surface and are concentrated along the equator ($\pm$ 30°). They are categorized by the combination of their planform and reflectance; with linear-bright and dark are the most common. A site-specific examination of remote-sensing effects on wind streaks identification has been conducted. The results thus far, indicate that in images with varying spatial and spectral specifications some wind streaks are actually composed of other aeolian bedforms, especially dunes. Specific regions of the Earth were then compared qualitatively to surface wind data extracted from a general circulation model. Understanding the mechanism and spatial and temporal distribution of wind streak formation is important not only for understanding surface modifications in the geomorphological context but also for shedding light on past and present climatic processes and atmospheric circulation on Earth.

This study yields an explanation for wind streaks as a geomorphological feature. Moreover, it is in this planet-wide geomorphological research ability to lay down the foundations for comparative planetary research.