SURFACE PATTERNS OF TERRESTRIAL ICE SHEETS – FROM IN-SITU TO SPACE OBSERVATIONS. C. S. Hvidberg[1], Z. Yoldi[1], and A. Grinsted[1], [1]Physics of Ice, Climate and Earth, Niels Bohr Institute, University of Copenhagen, Denmark (Address: Tagensvej 16, DK-2200 Copenhagen, Denmark. Email: ch@nbi.ku.dk).

Introduction: The vast interior areas of the large terrestrial ice sheets in Greenland and Antarctica accumulates snow all year. The high-elevation plateaus in the interior of these ice sheets are continuously observed from space by visual imagery and radar altimetry. Snow accumulation, snow drifts and other ice-atmosphere interactions are imprinted into these data, but direct observations are sparse and thereby limiting the ability to link these data to actual weather conditions. Here, we present some examples and discuss the potential to infer ice-atmosphere interactions from the remotely sensed surface morphology of terrestrial ice sheets with potential applications for Mars.

Surface patterns and weather: We observe an area in interior NE Greenland through May 2016 (Fig. 1). Dark shadows are consistently visible on all the images and indicate large scale surface undulations due to the ice flow over bedrock topography and with a sharp boundary along the southeastern SE side of the flow stream. The ice thickness is approximately 2500m thick in this area and the flow velocity is in the order of 5-60m/yr (ice flows towards NE).

On May 5 (Fig. 1a), extensive, geometric wind streaks are visible. The weather on May 4 was reported to be “sunny and clear”, temperatures -22°C to -34°C, wind 5-10 kt from WSW, visibility to the horizon, and following a long period of similar, stable weather. On May 12 (Fig. 1b), the surface is smooth with a very small-scale pitted terrain, apart from the shadows related to the ice flow. The weather on May 11 was reported to by “mostly clear”, temperatures -19°C to -30°C, wind 10 kt from W to SW, visibility to horizon, but following two days with overcast and 2 km visibility on May 9-10. On May 28 (Fig. 1c), the surface has linear wind streaks, pitted terrain, particularly in the upper left corner, and the skiway is barely distinguishable. The weather on May 27 was reported to by “overcast, snow and wind all day”, temperatures -16°C to -23°C, wind 10 kt from N turning to E, visibility 0.5-1 km.

Discussion: The weather conditions prior to the images clearly influence the surface pattern and contrasts. Accumulation events create linear wind streaks and pitted terrain, while dry periods create smooth surfaces with geometrically shaped wind streaks. A systematic investigation of the relationship between these surface patterns and the weather conditions can potentially help inform the interpretation of ice-atmosphere interactions of Martian icy terrains, e.g. [1]. In-situ data from weather stations, rovers, drones and ice cores can constrain the satellite data. We will discuss how to use the data and show examples.

References: [1] Howard, A. D. (2000) *Icarus,* 144, 267-288.

a)

b)

c)

Fig. 1. Landsat 8 images (band 8 (panchromatic) in 15m resolution) from the EastGRIP location, NE Greenland (75°38’N, 35°60’W, 2700 masl) in May 2016. The images are 20x20km and contrast enhanced. The skiway (3658m) and camp is visible near the image centers. a) May 5, b) May 12, c) May 28.