ANALYSIS PIPELINE and RESULTS of PLANETFOUR CITIZEN SCIENCE PROJECT

K.-M. Aye¹, M. E. Schwamb², G. Portyankina¹, C. J. Hansen³.
¹Laboratory for ATMOS at and Space Physics, CU Boulder, CO, USA (michael.aye@lasp.colorado.edu)
²Institute of Astronomy and Astrophysics, Academia Sinica, 11F of Astronomy-Mathematics Building, National Taiwan University, No.1, Sec. 4, Roosevelt Rd, Taipei 10617, Taiwan,
³Planetary Science Institute, 1700 E. Fort Lowell, Suite 106, Tucson 85719, AZ, USA

INTRODUCTION
During local spring, the south polar region of Mars exhibits a host of exotic phenomena associated with sublimation of the seasonal CO₂ polar cap. Images from the Mars Reconnaissance Orbiter (MRO) High Resolution Imaging Experiment (HiRISE) document activity best described by the "Kieffer" (2007) model: In winter the CO₂ forms a translucent slab of impermeable ice. Penetration of sunlight through the ice, which warms the ground below, results in basal sublimation of the ice. Trapped gas escapes through ruptures in the ice, eroding and entraining material from the surface below. When this dust-laden gas is expelled into the atmosphere, the dust settles in fan-shaped deposits on the top of the ice in directions oriented by the wind, as shown in the figures below.

PLANETFOUR
We report preliminary results of the analysis of crowd-sourcing data on the fan-shaped deposits that are produced by CO₂ gas jets described on the left. A database of over 98,000 HiRISE subframes has been produced that is embedded into a web-based graphical interface for marking the position and outline of the fan deposits. Clustering techniques (DBSCAN) are used to combine these data into coordinates and orientations to provide data on the intra- and inter-seasonal developments of the fan-shaped deposits in several active south polar regions.

planetFour tile
This is one of the 98,000 840x648 HiRISE tiles that is shown to the Citizens in the PlanetFour project. In the right column a zoom into the lower left is shown. This first row shows all the PlanetFour markings for "blotches", i.e. jet deposits that don't show any discernible direction or similarity to a wind-blown fan. This row shows all the PlanetFour markings for "fans", i.e. jet deposits that show a clear trend. One can see that the Citizens have a hard time deciding between both.

First, we cluster fans and blotches independently, using DBSCAN with a distance parameter of 10 px and a minimum cluster member of 3. Not shown: This minimum cluster member is now dynamically calculated from the number of volunteers that analyzed the image tile.

One a cluster has been defined, we take the average of all marking parameters to determine a mean marking for each fan and blotch cluster respectively. The mean markings closely outline the deposits in the image.

Due to the confusion of the Citizens, most markings have been both classified as blotches and fans as can be seen in this overlay of the mean markings.

This requires to store the number of Citizens that mark both to create relative weights, on which we can apply cuts for a final decision on the kind of marking, shown here.

lower-left corner zoom

The PlanetFour data reduction and analysis pipeline. It consists of 4 main lines:
• Data cleanup (green),
• Clustering (orange),
• Fnotching (combining fan and blotch results, blue),
• Ground-Projection (red).

The projection to ground coordinates is required due to the fact that the PlanetFour project is based on unprojected data.

Reference: