**EVOLUTION OF THE MARTIAN SOUTHERN SEASONAL POLAR CAP EMISSIVITY DURING SPRING OF MY24-26.** A. Pankine[1], [1]Space Science Institute, 4765 Walnut St, Suite B, Boulder, CO 80301 (apankine@spacescience.org).

**Introduction:** Seasonal Polar Caps (SPC) form on Mars from condensing atmospheric $CO_2$ each winter and recede during spring. A small patch of $CO_2$ ice dubbed Southern Polar Residual Cap (SPRC) is present year-round near the south pole. The temperature of the surface $CO_2$ ice in equilibrium with atmosphere is maintained near 140 K. Early observations from orbiting spacecraft revealed brightness temperatures significantly below the equilibrium temperature over portions of the SPC [1]. Later analysis [2, 3] suggested that this 'cold spots' are due to low surface emissivity associated with the presence of fine-grained $CO_2$ ice on the ground. This work presents the first systematic retrievals of SPC surface emissivity during southern spring (Ls=180–270°) using data collected by Mars Global Surveyor (MGS) Thermal Emission Spectrometer (TES) [4] in Mars Years (MY) 24, 25 and 26. Evolution of the SPC in the Southern Polar region (SPR) was analyzed in [5] using TES data from the pre-mapping aero-braking phase of the mission (MY23 Ls=180–360° MY24 Ls=0–24°). This work expands this analysis to data collected during the mapping phase of the mission and uses a different retrieval approach. MY24 and MY26 were 'typical' Mars year with relatively low dust opacities over southern SPC during spring, while in MY25 a Global Dust Storm (GDS) developed in the early spring (at Ls~185°) significantly increasing dust opacities over SPC until late spring.

**Retrieval methodology:** Retrievals of surface emissivity and atmospheric dust opacity over Martian SPCs is a difficult problem. Low surface and atmospheric temperatures result in a low thermal contrast between atmosphere and surface, and a weak spectral signal for surface emissivity and atmospheric dust (see Figure 1 for examples of TES spectra over southern SPC). In addition, TES spectra of cold targets are significantly affected by a radiometric error at wavenumbers larger than ~800 $cm^{-1}$, which produces an upward slope or very low radiances at this spectral range [6]. To alleviate these problems, the dust opacity τ and surface emissivity ε are retrieved using TES radiances observed at wavenumbers 264 $cm^{-1}$ and 508 $cm^{-1}$ (corresponding to wavelengths of ~40 μm and ~20 μm, respectively). At these wavenumbers the dust extinction differs by a factor of ~2, while the $CO_2$ frost emissivity is similar for a wide range of ice grain sizes [5]. This allows distinguishing the effects of atmospheric dust from surface effects in the TES spectra. The surface temperature was fixed to the condensation temperature of the $CO_2$ ice over the SPC. To improve the quality of the data, 10 consecutive spectra were averaged. To improve retrieval accuracy, only the data collected between local times of 8 am and 8 pm, and only when the sun is above the horizon, were used in the retrieval. Figure 1 shows examples of TES spectra and retrievals over southern SPC in MY24.

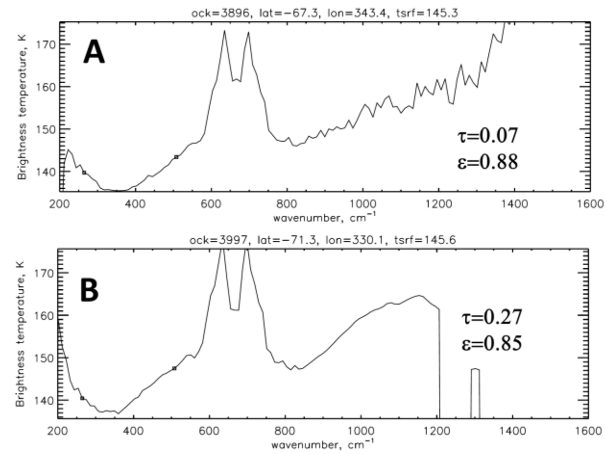


**Figure 1. Examples of TES MY24 spectra and retrievals, with retrieved dust opacity values τ and $CO_2$ frost emissivity ε shown on the plots. A) Spectrum over SPC, low dust opacity, low $CO_2$ frost emissivity. B) Spectrum over SPC, high dust opacity, low $CO_2$ frost emissivity.**

**Results:** Figure 2 shows polar maps of retrieved thermal reflectance (1-ε) at 20 μm at selected time periods during southern hemisphere spring (results for atmospheric dust retrieval will be presented elsewhere). $CO_2$ emissivity varies across the SPC and with time. At the beginning of spring high reflectance (low emissivity) areas are found near the outer edge of the SPC between longitudes 225°–360°–45° E. After Ls~245° high reflectance area occupies most of the area of the receding SPC. The spatial and temporal evolution of $CO_2$ emissivity is remarkably similar in the observed years (MY24–MY26) and also consistent with the evolution observed in MY23 [5]. The areas of high reflectance (low emissivity) were previously interpreted [2,3,5] as areas with small $CO_2$ ice grains. From comparison with emissivity estimates based on Mie modeling [7] the $CO_2$ particles in these areas have sizes between 1 mm and 1 cm with possible admixture of $H_2O$

ice and/or dust. The areas of high emissivity are interpreted as $CO^2$ grains larger than 1 cm and slab ice.

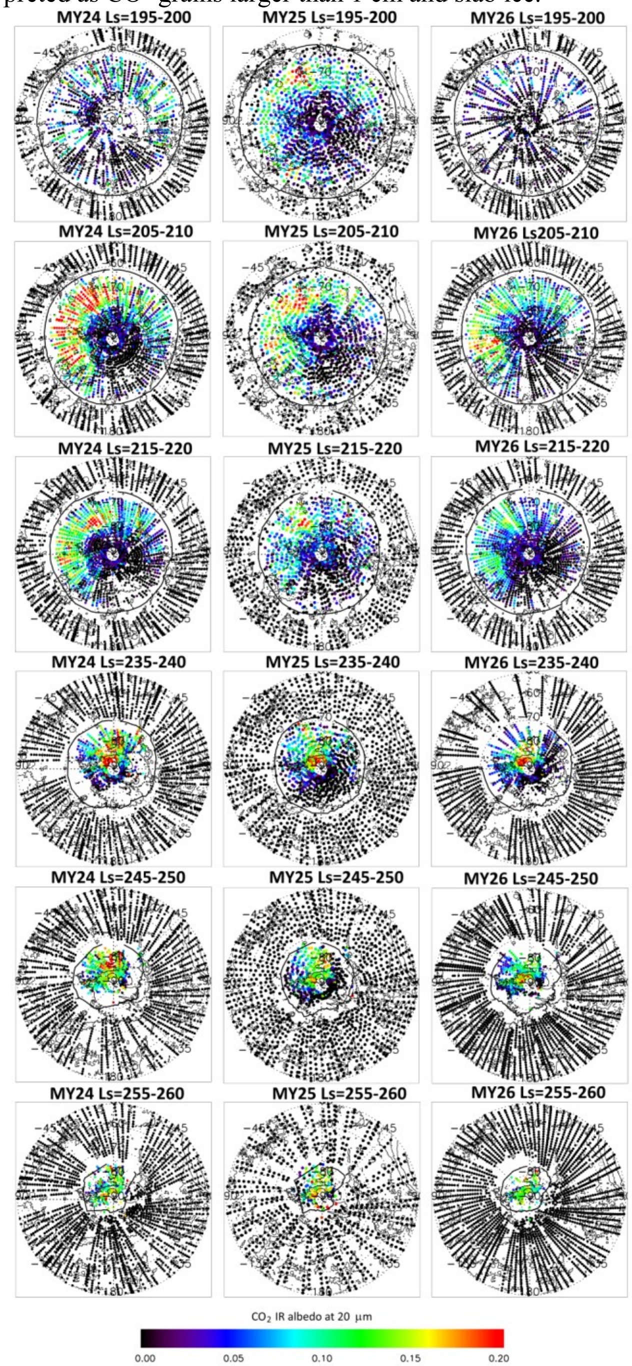


**Figure 2. Polar maps of retrieved surface thermal reflectance (1-ε) at 20 µm in the SPR for Ls=195-260° in MY24–26. Outer edge of the map is at latitude -50°. East longitudes increase clockwise from top. Light contours are MOLA topography, heavy contour is approximate edge of the SPC.**

The peculiar asymmetry in distribution of $CO_2$ grain sizes across SPC was previously interpreted as being due to two different deposition regimes arising from atmospheric circulation modified at the SPR by the large-scale topography of the Hellas impact basin (centered on 25° S and 65° E, upper right on maps in Figure 2) [8]. Over areas west of the Hellas, where low $CO_2$ emissivity areas are found, atmospheric precipitation dominates over surface deposition, forming smaller grains. East of the Hellas frost is accumulated by direct deposition, forming larger grains and dark $CO_2$ slab ice.

**References:**

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