Introduction: H₂O and CO₂ are exchanged between the atmosphere and the surface of Mars from autumn through spring. Deposition extends from the Poles to the mid latitudes with approximately 30% of CO₂ condensing out of the atmosphere when temperatures reach 148°K [under typical martian pressures, 1]. Work has shown that CO₂ may precipitate as snowfall and although not directly observed due to observational constraints, ‘cold spots’ [20 µm brightness temperatures as low as 130°K, 2] are considered to be a signature of combined CO₂ atmospheric condensates and freshly fallen CO₂ snow [3-8]. However the majority of CO₂ ice is thought to form directly on the surface as a result of radiative cooling [9] or as direct condensation onto the surface.

Pressurized CO₂ gas that forms beneath the seasonal ice cap during sublimation [10] has been shown to be an important geomorphic process that can transport sand on North Polar sand dunes. Hansen et al, [10] proposed that subsurface pressurized gas can mobilize sediment down avalanche faces, contributing to dune migration. Bourke and Cranford [11] demonstrated that dune ‘furrow’ formation was linked to the polygonal cracking of the seasonal CO₂ ice and documented that these dune surface morphologies formed seasonally.

It is important therefore to document the distribution, thickness and persistence of the seasonal CO₂ deposit, particularly those that overlap dunes on the North Polar Sand Seas (Figure 1).

Previous estimates of the distribution of CO₂ frost at the North Pole using data from the Neutron Spectrometer on board the Mars Odyssey Spacecraft plotted the deconvolved epithermal neutron count rates and estimated the CO₂ ice column abundance for the North Polar Region [12]. Our work builds upon this. We apply Pixon image reconstruction methods to the North Polar Epithermal Neutron data to increase the spatial resolution of the count rates.

Method: During CO₂ ice-free conditions, the epithermal range of neutron energies is nearly uniquely sensitive to the hydrogen content of surface soils, which should likely be in the form of H₂O/OH molecules/radicals. We therefore convert epithermal counting rates in terms of Water-Equivalent-Hydrogen, WEH. Given the summer count rates as a proxy for water content in the top meter of soil we can compute the CO₂ ice column abundance using Prettyman et al’s [12] results. However, MONS counting-rate data have a FWHM of ~550 km., which is sufficiently broad to prevent a close association of WEH variability with images of geological features. In this study, we reduce spurious features in the instrument smeared neutron counting rates through deconvolution. We choose the PIXON numerical deconvolution technique for this purpose. This technique uses a statistical approach [13, 14] which is capable of removing spurious features in the data in the presence of noise. We have previously carried out a detailed study of the martian polar regions applying such a methodology to Martian epithermal neutrons [15,16]. In the present study, we will apply this technique to the recent reanalysis of MONS epithermal data [17], which is marked by significantly lower statistical and systematic uncertainties that have plagued older versions of these data.

Results: Preliminary data are encouraging. Figure 2 shows a pixon reconstruction of the Mars
Odyssey data for $0^\circ <Ls < 30^\circ$. It shows the large deposits of CO$_2$ on the top of the water ice perennial cap. In addition it shows a spatial pattern that is consistent with the spatial distribution of the most dense distributed sand dunes. Previously we have shown a similar pattern of the epithermal count rates for H$_2$O [17] suggesting a genetic link between the water distribution in the dune subsurface and the spatial variation in the seasonal CO$_2$ ice deposits.

**Conclusion:**
- The application of the Pixon technique improves the spatial resolution of the MONS data to ~150 km FWHM.
- A heterogeneous distribution in the deconvolved epithermal count data suggest spatial variability associated with the dunes in the CO$_2$ abundance of the circum-polar area.
- Ongoing work will determine the potential role of buried H$_2$O ice within the dunes in controlling the build up and decay of seasonal CO$_2$ ice and its annual variability.

**References**


