Secular Climate Change on Mars: An Update Using One Mars Year of MSL Pressure Data

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The South Polar Residual Cap (SPRC) on Mars is an icy reservoir of CO2. If all the CO2 trapped in the SPRC were released to the atmosphere the mean annual global surface pressure would rise by ~20 Pa. Repeated MOC and HiRISE imaging of scarp retreat within the SPRC led to suggestions that the SPRC is losing mass. Estimates for the loss rate vary between 0. 5 Pa per Mars Decade to 13 Pa per Mars Decade. Assuming 80% of this loss goes directly into the atmosphere, an estimate based on some modeling (Haberle and Kahre, 2010), and that the loss is monotonic, the global annual mean surface pressure should have increased between ~1-20 Pa since the Viking mission (~20 Mars years ago).

Surface pressure measurements by the Phoenix Lander only 2.5 Mars years ago were found to be consistent with these loss rates. Last year at this meeting we compared surface pressure data from the MSL mission through sol 360 with that from Viking Lander 2 (VL-2) for the same period to determine if the trend continues. The results were ambiguous. This year we have a full Mars year of MSL data to work with. Using the Ames GCM to compensate for dynamics and environmental differences, our analysis suggests that the mean annual pressure has *decreased* by ~ 8 Pa since Viking.

This result implies that the SPRC has *gained* (not lost) mass since Viking. However, the estimated uncertainties in our analysis are easily at the 10 Pa level and possibly higher. Chief among these are the hydrostatic adjustment of surface pressure from grid point elevations to actual elevations and the simulated regional environmental conditions at the lander sites. For these reasons, the most reasonable conclusion is

that there is no significant difference in the size of the atmosphere between now and Viking. This implies, but does not demand, that the mass of the SPRC has not changed since Viking.

Of course, year-to-year variations are possible as implied by the Phoenix data. Given that there has been no unusual behavior in the climate system as observed by a variety of spacecraft at Mars since Phoenix, its seems more likely that the Phoenix data simply did not have a long enough record to accurately determine annual mean pressure changes as Haberle and Kahre (2010) cautioned. In the absence of a strong signal in the MSL data, we conclude that if the SPRC is loosing mass it is not going into the atmosphere reservoir.