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A latitude-based correction for the Martian harmonic pressure model

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Being able to predict the daily mean Martian atmospheric pressure on any given location and any given sol is interesting both for theory and for applications. One simple model used for this purpose is the harmonic model, first used for Mars for analyzing the seasonal variations of the Viking Lander data. The basic idea of the model is that 0'th ... n'th harmonics are calculated from a data set by using e.g. Fourier transformation. After the harmonic components are calculated for one location, the components can be adjusted for other locations with the aid of a scale height.

However, the elevation-adjusted harmonic factors calculated from Viking Lander 1 data do not accurately match the measurements of Viking Lander 2, Pathfinder, Phoenix or Curiosity. Specifically, the model overestimates both the pressure level and the rate of pressure growth during the first 90 sols of the Curiosity mission. For Pathfinder, the level is overestimated and the rate of pressure growth likewise, although for the latter the difference seems fairly small. Also, the model underestimates the level of pressure during the Phoenix mission, and underestimates the rate of decline. The errors are of the order of tens of Pascals during the observed periods, and prone to be even larger, especially for Curiosity since it produces new data constantly and the error seems to be growing.

In this work we have devised an additional correction for the harmonic factors. This correction is based on latitude and tries to compensate for the fact that the CO_2 cycle should be stronger near the poles where the CO_2 originates from and condensates to. We find simple latitude–based scaling and translating functions that seem to produce good match to data when the factors are calculated from VL1 data for VL2, Phoenix, Pathfinder and Curiosity.