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On Mars too, expect macroweather

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Terrestrial atmospheric and oceanic spectra show drastic transitions at $\tau_w \approx 10$ days and $\tau_{ow} \approx 1$ year respectively; this has been theorized as the lifetime of planetary scale structures. For wind and temperature, the forms of the low and high frequency parts of the spectra (macroweather, weather) as well as the τ_w can be theoretically estimated, the latter depending notably on the solar induced turbulent energy flux. We extend the theory to other planets and test it using Viking lander and reanalysis data from Mars. When the Martian spectra are scaled by the theoretical amount, they agree very well with their terrestrial atmospheric counterparts.

Although the usual interpretation of Martian atmospheric dynamics is highly mechanistic (e.g. wave and tidal explanations are invoked), trace moment analysis of the reanalysis fields shows that the statistics well respect the predictions of multiplicative cascade theories. This shows that statistical scaling can be compatible with conventional deterministic thinking. However, since we are usually interested in statistical knowledge, it is the former not the latter that is of primary interest. We discuss the implications for understanding planetary fluid dynamical systems.