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Mars' atmosphere: Earth's sister and statistical twin

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Satellite-based Martian re-analyses have allowed unprecedented comparisons between our atmosphere and that of our sister planet, underlining various similarities and differences in their respective dynamics. Yet by focusing on large scale structures and deterministic mechanisms they have improved our understanding of the dynamics only over fairly narrow ranges of (near) planetary scales. However, the Reynolds numbers of the flows on both planets are larger than 10^11 and dissipation only occurs at centimetric (Mars) or millimetric scales (Earth) so that over most of their scale ranges, the dynamics are fully turbulent. In this presentation, we therefore examine the high level, statistical, turbulent laws for the temperature, horizontal wind and surface pressure, finding that Earth and Mars have virtually identical statistical exponents: their statistics are very similar over wide ranges. Therefore, it would seem that with the exception of certain aspects of the largest scales (such as the role of dust in atmospheric heating on Mars, or of water in its various phases on Earth), that the nonlinear dynamics are very similar. We argue that this is a prediction of the classical laws of turbulence when extended to planetary scales, and that it supports our use of turbulent laws on both planetary atmospheres.