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Mars Energy Spectrum studies from Assimilated MCS data using the UK MGCM

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Introduction

The energy spectrum (ES) analysis is a renowned tool for understanding the driving mechanisms behind atmospheric turbulence (Lindborg, 1998). We aim to investigate whether energy and enstrophy inertial ranges exist in the kinetic energy spectrum (KES), and to quantify the corresponding cascades (with their ranges), and relationship with the atmospheric forcing and energy dissipation scales.

The calculation of the ES from observational data is known to be highly non-trivial due to the lack of global coverage in space and time. Gage and Nastrom (1984) were the first to overcome this problem for Earth but this has not so far been attempted for Mars. Our approach is to take the sparse observational data and assimilate it using a global numerical model. We present preliminary results using the Mars Climate Sounder (MCS) retrievals and the LMD-UK Mars GCM (MGCM). This was pioneered by Lewis and Read (1999).

Methodology

The equations we used to calculate the Eddy and Zonal Mean kinetic energies are derived from total KES formula presented in Lindborg and Augier (2013). Hence, adding the two spectra together, we obtain the full KES spectrum as presented in
their paper. For the Available Potential Energy Spectrum (APES), we have used a preliminary simplified version of the approach presented in Lindborg and Augier (2013).

The Energy Spectra

To date we have assimilated the MCS data at the resolution of T31 (triangular truncation), hence the ES only spans up to total wavenumber 31. This encompasses a portion of the energy inertial range, which might be expected to manifest the -3 exponential law by analogy with the Earth (Gage & Nastrom, 1984).
Features:
- velocities and corresponding KEs are higher with increasing height compared to Earth,
- "-3" slope is restricted to ~30 km altitude, suggesting an early departure from the enstrophy inertial range,
- boundary layer velocities are similar to Earth

References

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