A comparison of statistical properties of diurnal tides between eCMAM30 and SABER

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ABSTRACT

In this research we investigate and compare statistical characteristics of the diurnal tides and illustrate how these statistical characteristics change with season, latitude and altitude from the troposphere to the thermosphere/ionosphere, using data from the extended Canadian Middle Atmosphere Model (eCMAM30) run (1979-2010) and the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on NASA's TIMED (Thermosphere Ionosphere Mesosphere Energetics Dynamics) satellite.

This poster show the comparison of statistical properties (correlations and probability density functions) of short-term and long-term tidal variability of migrating tide (DW1) as a function of time, height, altitude, and latitude between eCMAM30 and SABER. Wavelet analysis is used to analyze localized variations of power within the time series.

Future work involves the development of the statistical amplitude/frequency probability density functions (PDFs) to examine the underlying statistics governing the short-term tidal variability and to what extent these PDFs changes temporally and spatially and apply to the thermodynamic equation to study physical mechanism.

MOTIVATION

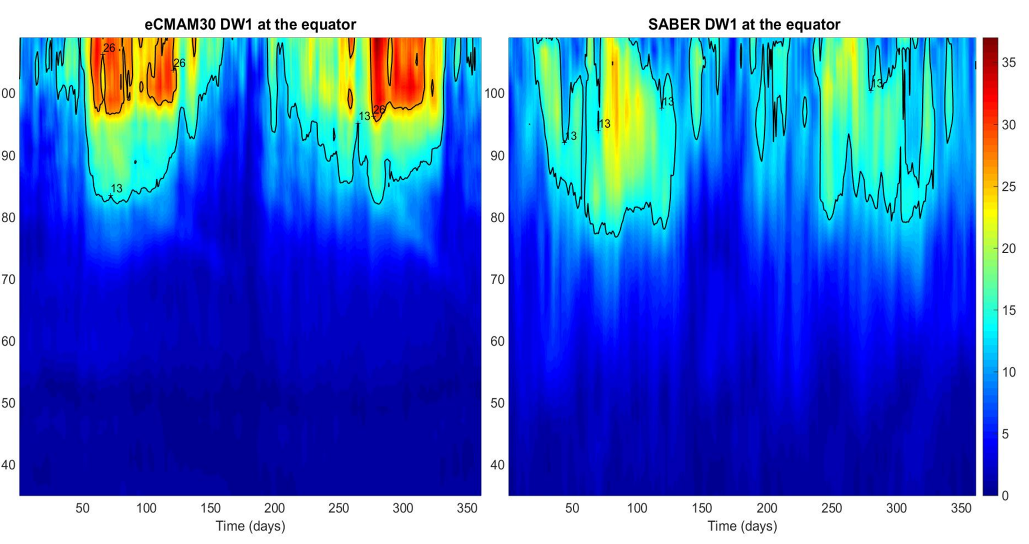

Figure 1: Day to day variation of DW1 T amplitude at the equator in year 2007 for eCMAM30 (left) and SABER (right).

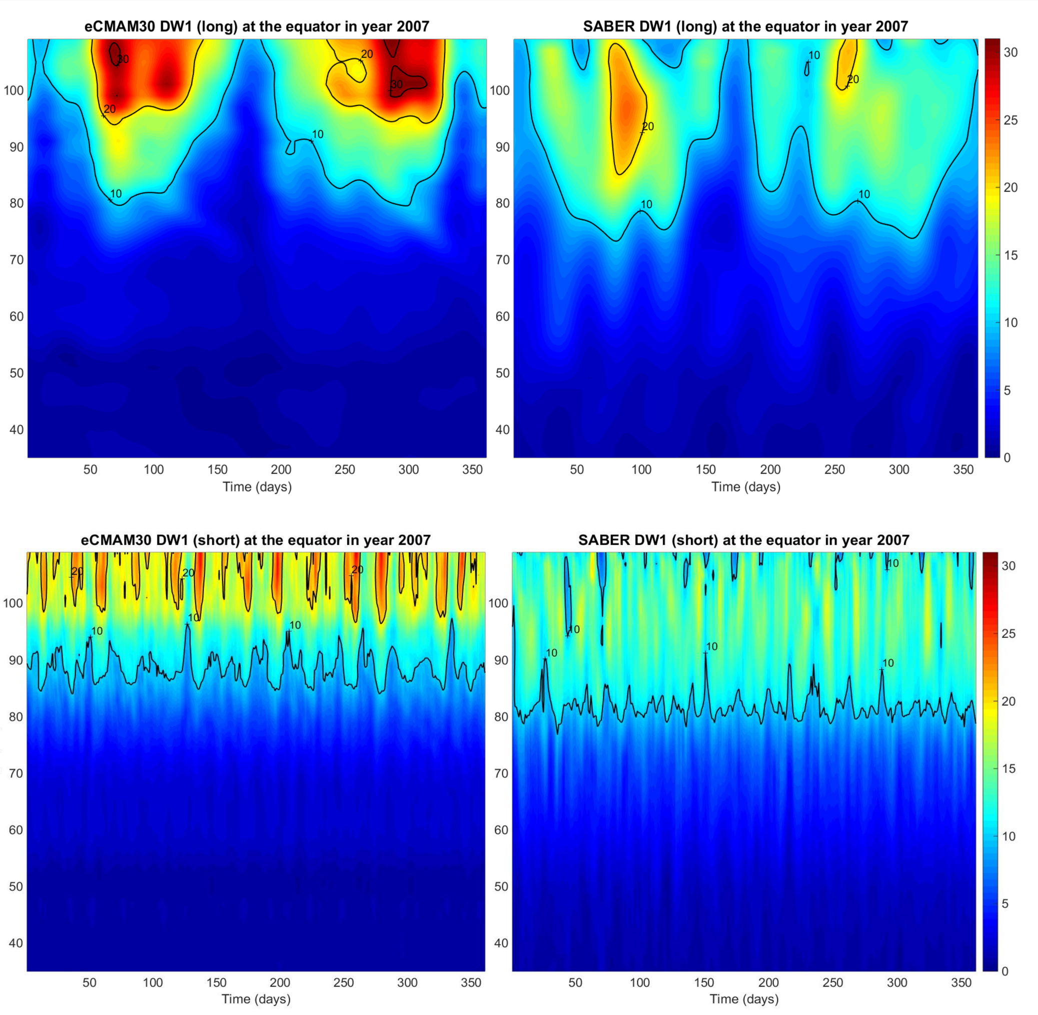

Figure 2: (Top) Long-term variation (>30 days) and (Bottom) short-term variation (< 30 days) of DW1 T amplitude at the equator in year 2007 for eCMAM30 (left) and SABER (right).

RESULTS

Section A: Wavelet analysis

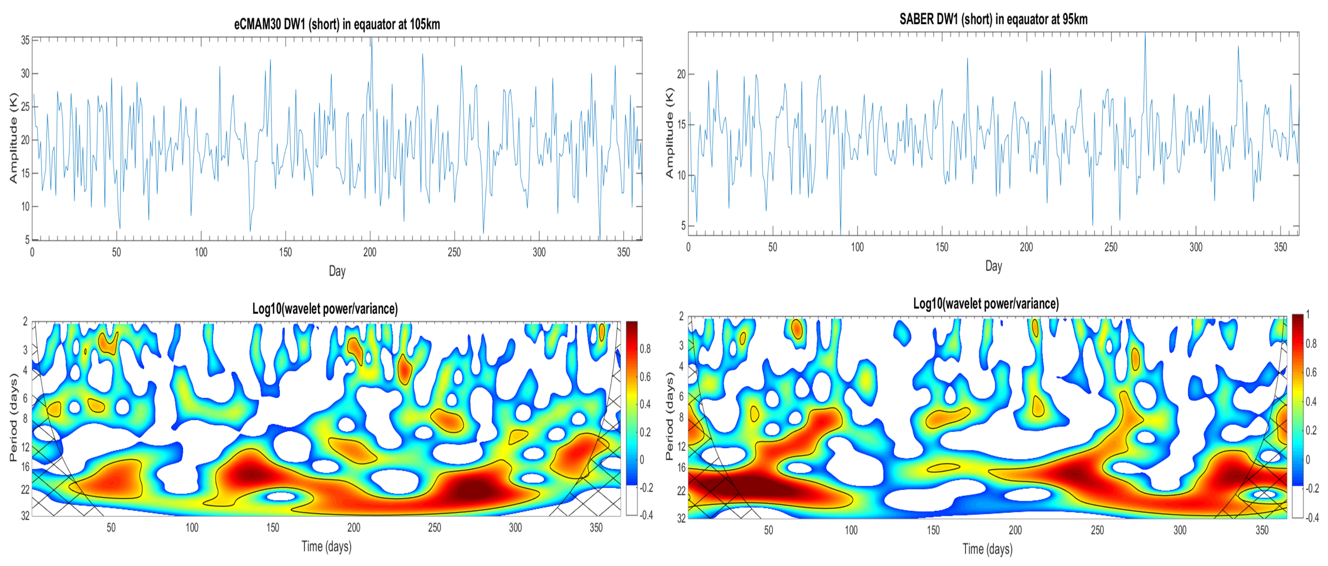

Figure 3: (Left) Short-term time series of migrating diurnal tide DW1 temperature amplitude at equator and 105 km simulated in 2007 of eCMAM30 and its wavelet analysis. The wavelet power spectrum used in this analysis is the Morlet wavelet. The hatched lines represent the cone of influence. (Right) same but for SABER at 95 km where it maximize.

One day data window used for figure 3 and 5 day average moved by 1 day is used for all other results.

Section B: Spatial and temporal correlations

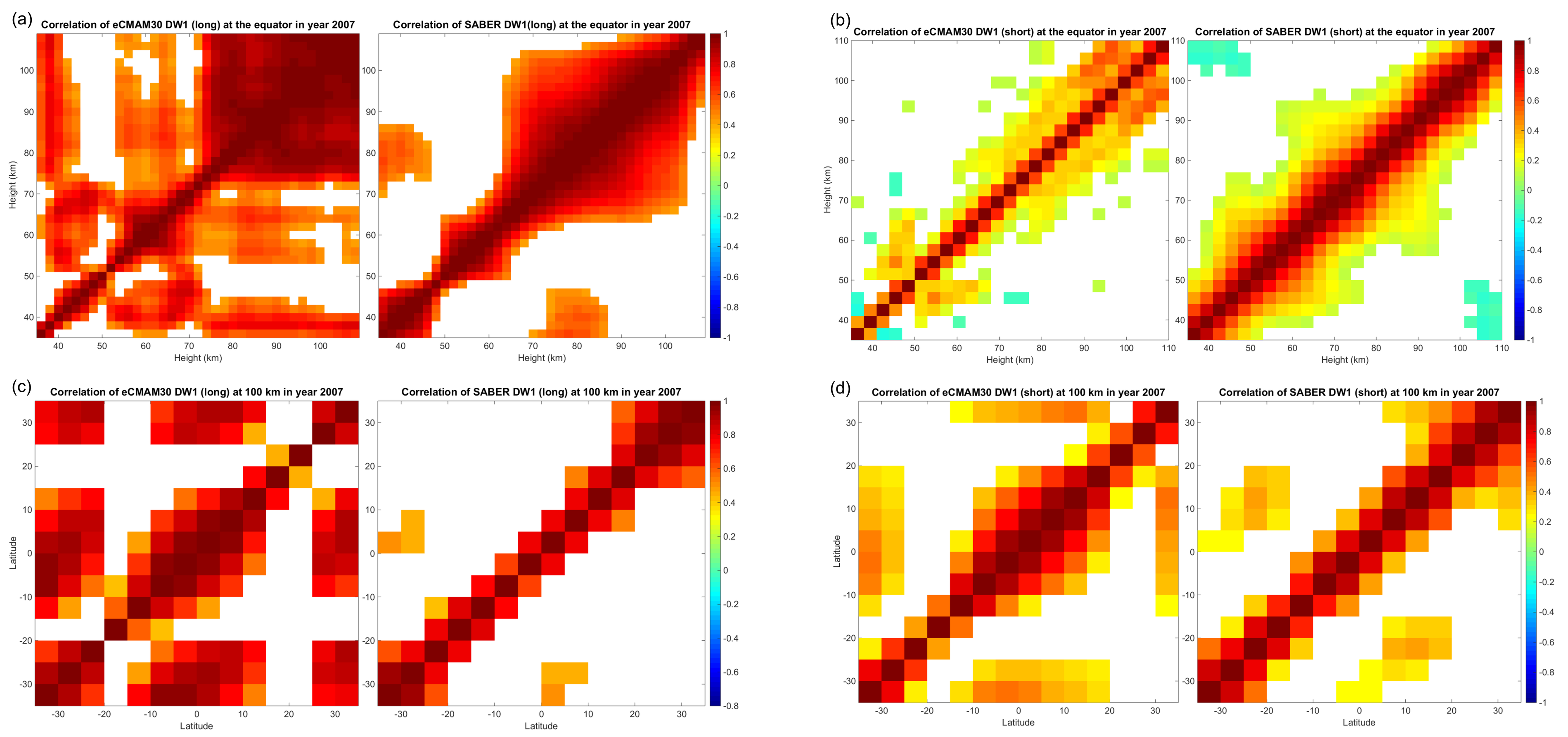

Figure 4: Spatial correlation (altitude) of migrating diurnal tide DW1 temperature amplitude at equator for long-term variation (a) and short-term variation (b). Spatial correlation of DW1 with latitude for long-term variation (c) and short-term variation (d). Significant tests were done using Montecarlo simulation.

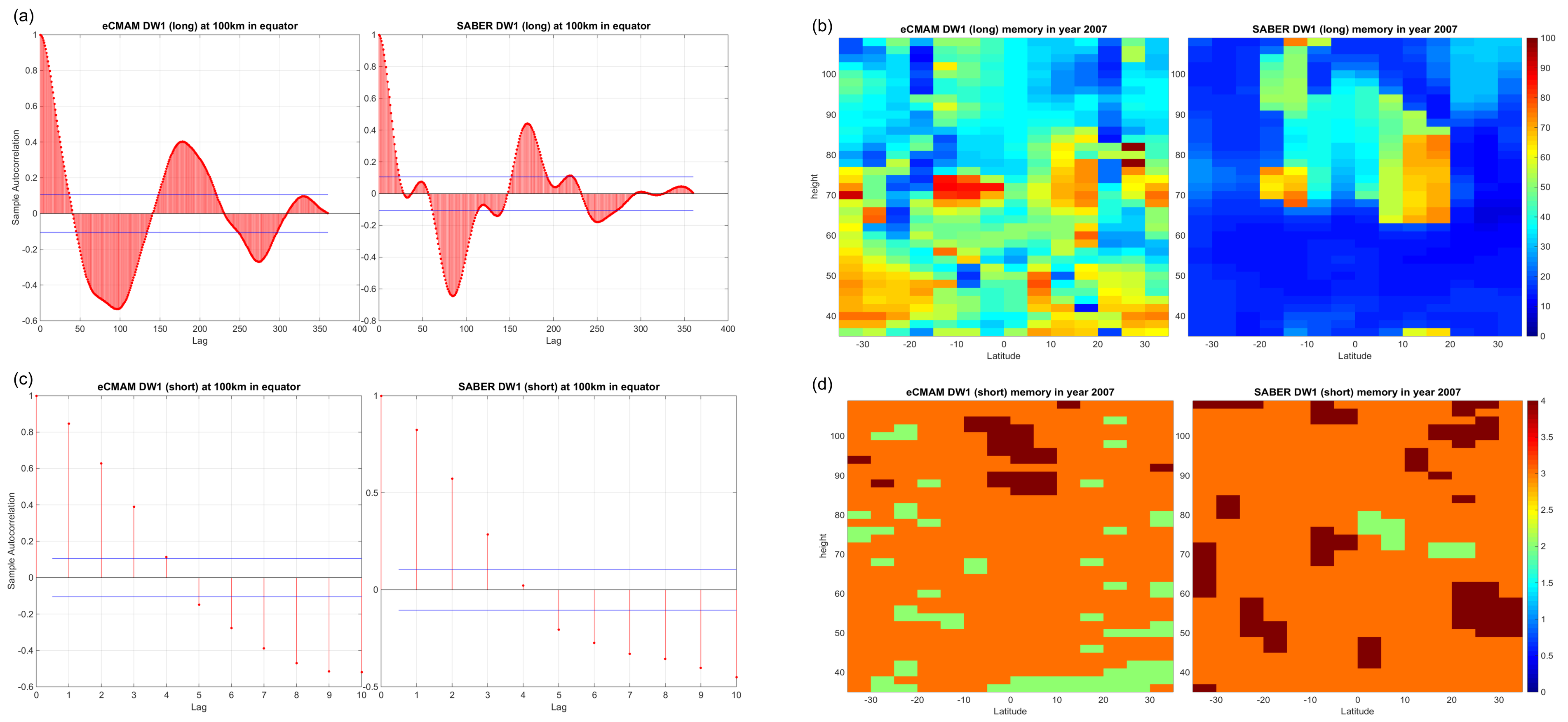

Figure 5: (a & c) Self correlation with lag (memory) for migrating diurnal tide DW1 temperature amplitude long-term and short-term time series at equator and 100 km in year 2007 for eCMAM30 and SABER. Lag was plot (b & d) along the latitudes and heights to compare how they carried the memory. In each auto correlation plot, lag was count when it first fade its memory.

Section C: PDFs & Histograms

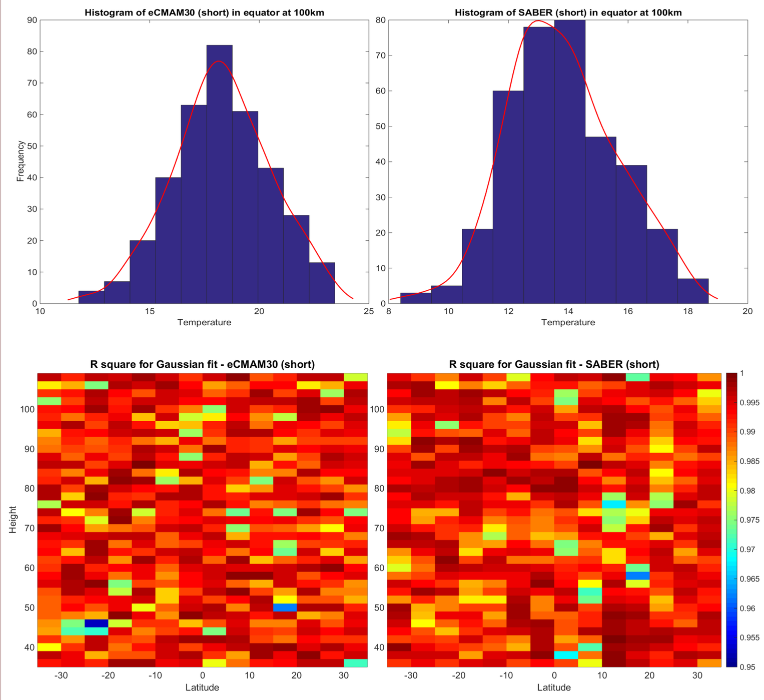

Figure 6: Kernel density function fitted to the histograms (Top). Goodness-of-fit for Gaussian Distribution for the short-term time series (bottom).

CONCLUSIONS

The short-term tidal variability is not correlated between adjacent latitudes or adjacent days, strong correlation within adjacent heights of only 10 – 20 km.

The PDF of the short-term tidal variability can be fitted with a Gaussian distribution, which ensembles white noise.

The discrepancies between the model and SABER include: eCMAM DW1 maximizes 10 km higher than SABER with stronger amplitude over the equator; narrower correlation with adjacent heights for short-term tidal variability; PDF of the long-term tidal variability (likely due to stronger seasonal variability).

The agreement between the eCMAM and SABER include: correlation with adjacent latitudes, correlation with adjacent heights for long-term tidal variability, self-memory, PDF of short-term tidal variability (Gaussian fit).

We intend to further our investigation by developing the statistical probability density functions (PDFs) to examine the underlying statistics governing the short-term tidal variability and apply to the thermodynamic equation to study physical mechanism.

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