Problems for Theoreticians and Experimentalists in Parameterizing the Effects of Internal Atmospheric Gravity Waves

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In the theoretical efforts of parameterizing the internal atmospheric gravity waves, it is usual for almost all the theoreticians to compare the theoretically derived and experimentally observed log-log plots of wavenumber or wavefrequency and the power spectral density of the atmospheric or oceanic thermodynamic parameters. And it is the claim from all of them that the spectral slope is "Universal" in nature irrespective of the observations made in different heights, latitudes and longitudes and different climatic and weather conditions, agreeing with theoretical expectations. And for the last few decades, the theoreticians have been struggling a lot to explain this universal slope. This paper makes an attempt to find where something is going wrong either with theoreticians or the experimentalists. Detailed analyses on the frequency and vertical wavenumber spectra (log-log spectrum) of lower atmospheric wind (3-22 km) and middle atmospheric (25-70 km) temperature perturbations measured respectively by MST radar and Nd-Yag Rayleigh backscattering lidar, collocated at Gadanki, India have shown spectral slope values in the range of ~ -1.7 - -3.5. The same has been reported many times elsewhere using different measurement techniques. The important question regarding these spectral slope values is why they are varying so much against the expected theoretical value of either -1.7 and -3 respectively for frequency and wavenumber spectra.? Active modeling efforts are continuing still for more than a decade to adequately explain the discrepancy between the expected and observed slope values. To address this issue in the line of finding whether mathematical artifacts play a role, we analyzed millions of random number sets with different lengths of FFT points such as 64, 128, 256, 512, 1024 points etc. and calculated spectral slopes of log-log spectra as we did for the observed winds and temperature. From the analyses of random number sets, it is found the same range of spectral slopes as for the atmospheric parameters observations, indicating that there is something fundamentally wrong in the Fast Fourier Transform analyses methods, which produces these range of spectral slope values as mathematical artifacts. Coincidentally these values happened to be near the expected theoretical values in the study of internal atmospheric gravity waves. Resolving this mathematical artifact problem not only helps in the study of clear understanding of internal atmospheric gravity waves but also in all fields of research utilizing the log-log power spectrum plots and the slopes associated with them.