

# MMM SEMINAR SERIES



## *Upscale Versus “Up-Amplitude” Growth of Forecast-Error Spectra\**

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Atmospheric predictability is measured by the average difference (or “error”) within an ensemble of forecasts starting from slightly different initial conditions. The spatial scale of the error field is a fundamental quantity; for meteorological applications, the error field typically varies with latitude and longitude and so requires a two-dimensional (2D) spectral analysis. Statistical predictability theory is based on the theory of homogeneous, isotropic turbulence, in which 2D spectra are circularly symmetric in 2D wavenumber space. One takes advantage of this circular symmetry to reduce 2D spectra to one-dimensional (1D) spectra by integrating around a circle in wavenumber polar coordinates. In recent studies it has become common to reduce 2D error spectra to 1D by computing spectra in the zonal direction and then averaging the results over latitude. It is shown here that such 1D error spectra are generically fairly constant across the low wavenumbers as the amplitude of an error spectrum grows with time and therefore the error spectrum is said to grow “up-amplitude.” In contrast computing 1D error spectra in a manner consistent with statistical predictability theory gives spectra that are peaked at intermediate wavenumbers. In certain cases, this peak wavenumber is decreasing with time as the error at that wavenumber increases and therefore the error spectrum is said to grow “upscale.” We show through theory, simple examples, and global predictability experiments that comparisons of model error spectra with the predictions of statistical predictability theory are only justified when using a theory-consistent method to transform a 2D error field to a 1D spectrum.

\*Based on Rotunno, Snyder and Judt (2023, *J. Atmos. Sci.*)

**Thursday, 5 January 2023, 2:00pm**

**Refreshments 1:45pm**

**Please also join colleagues for refreshments and informal discussion after the seminar until 3:30pm**

NCAR-Foothills Laboratory, 3450 Mitchell Lane  
FL2-1022, Large Auditorium

**Seminar will also be live webcast**

<https://operations.ucar.edu/live-mmm>

Participants may ask questions during the seminar via Slido.