



Lower Atmosphere Diagnostic Analysis for a Sun-Earth Connection

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Stability Concepts in Brief

Two Level Baroclinic Model Concept

Increased static stability should affect the synoptic long wave pattern -- the shorter waves become more stable and the critical wavelength for instability shifts to longer waves.

$$L_C = \Delta p \pi (2\sigma)^{1/2} / f_0$$

- L_C is the critical wavelength
- Δp is the change in pressure
- π is a numerical constant
- σ is the static stability
- f_0 is the coriolis

Static Stability

$$N = \sqrt{\frac{g}{T} \left(\frac{\partial T}{\partial z} + \frac{g}{C_p} \right)} \quad N = \sqrt{\frac{g}{T} \left(\frac{\partial T}{\partial z} \right)}$$

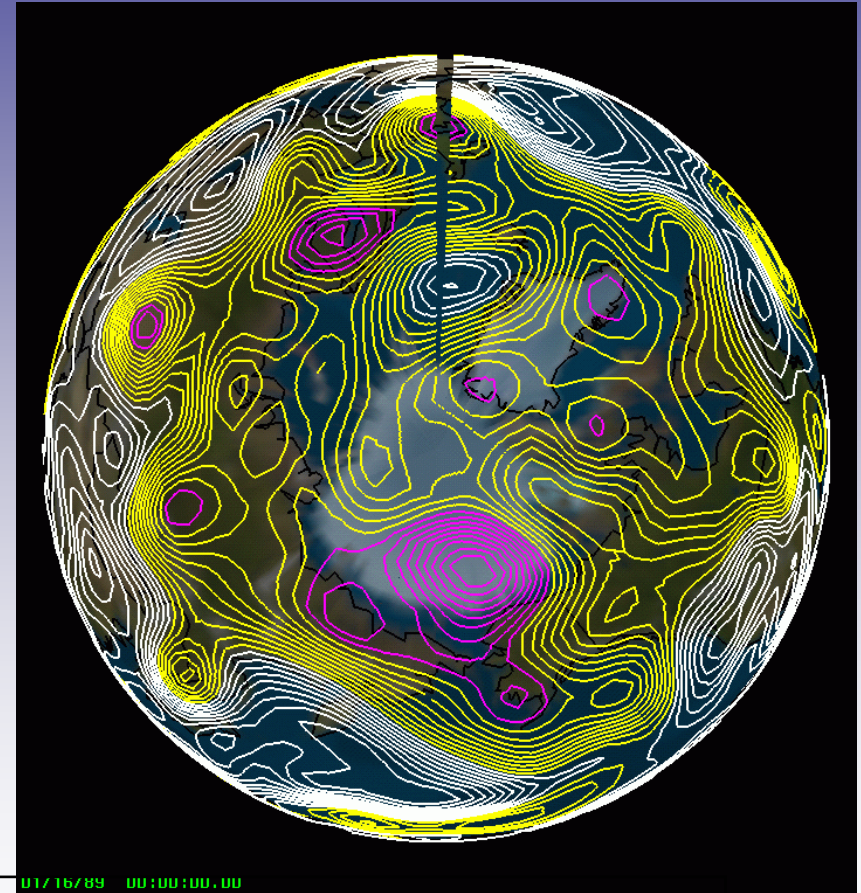
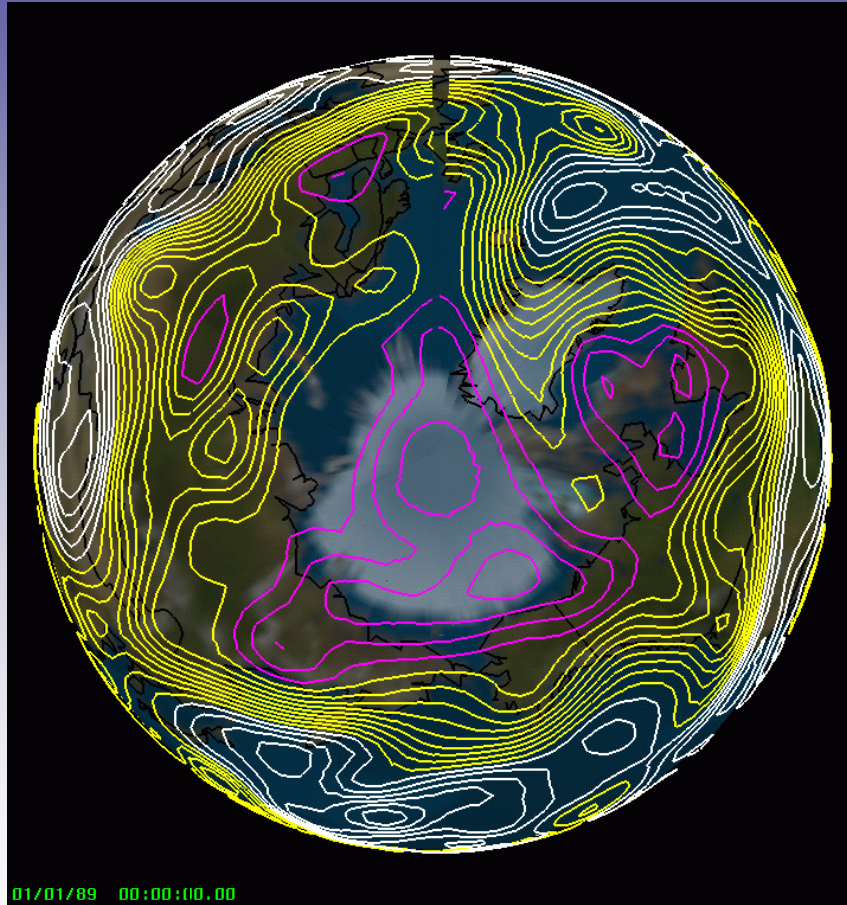
Shear Stability

$$S = \sqrt{\left(\frac{\partial u}{\partial z} \right)^2 + \left(\frac{\partial v}{\partial z} \right)^2}$$

Richardson Number

$$Ri = \frac{N^2}{S^2}$$

200 mb Temp Pattern Changes



200 mb key

— <220 deg K

200 mb Temperatures (K) - January 1989

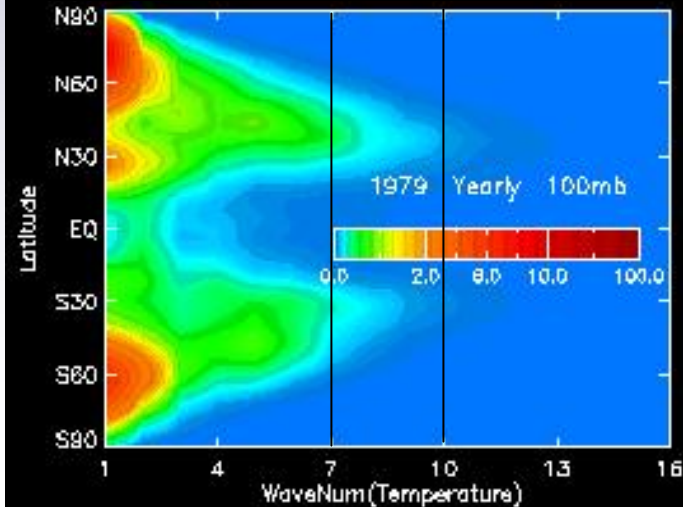
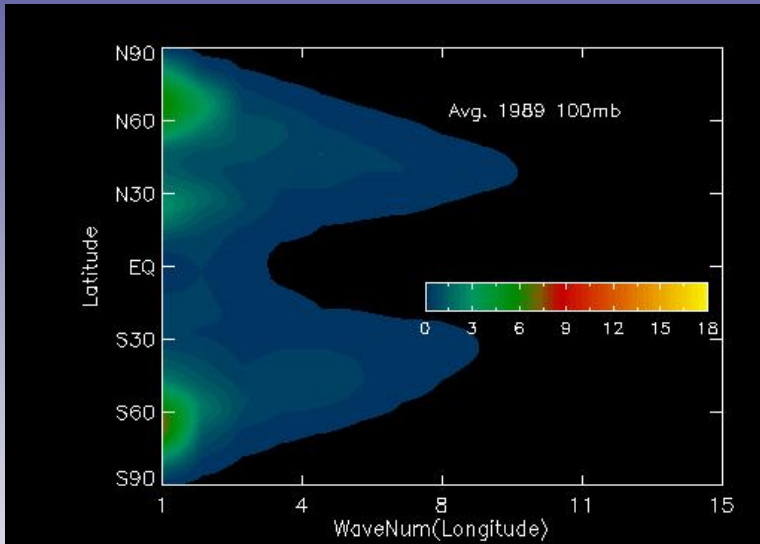
— 221-229 deg K

— >230 deg K

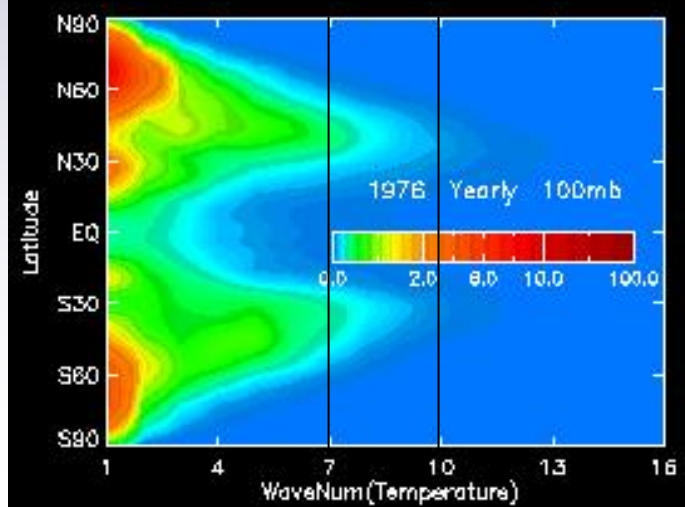
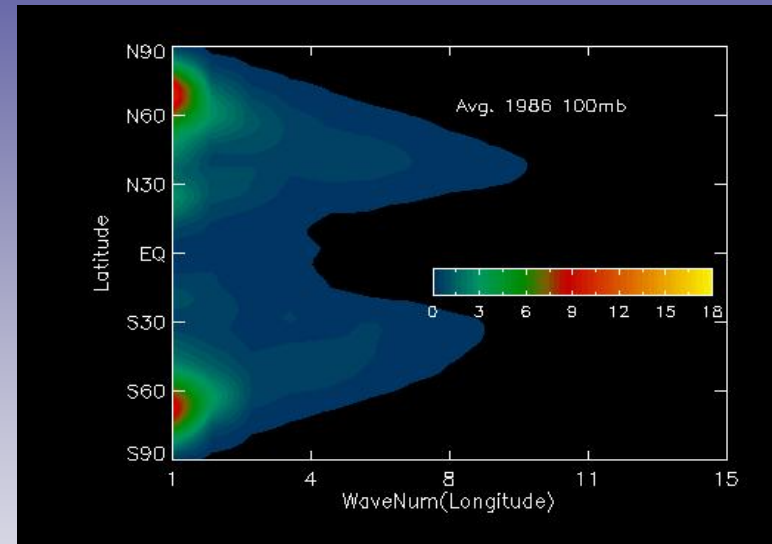
One degree contours

Comparison of Annual Wave Energy Solar Max vs Solar Min

Solar Maximum



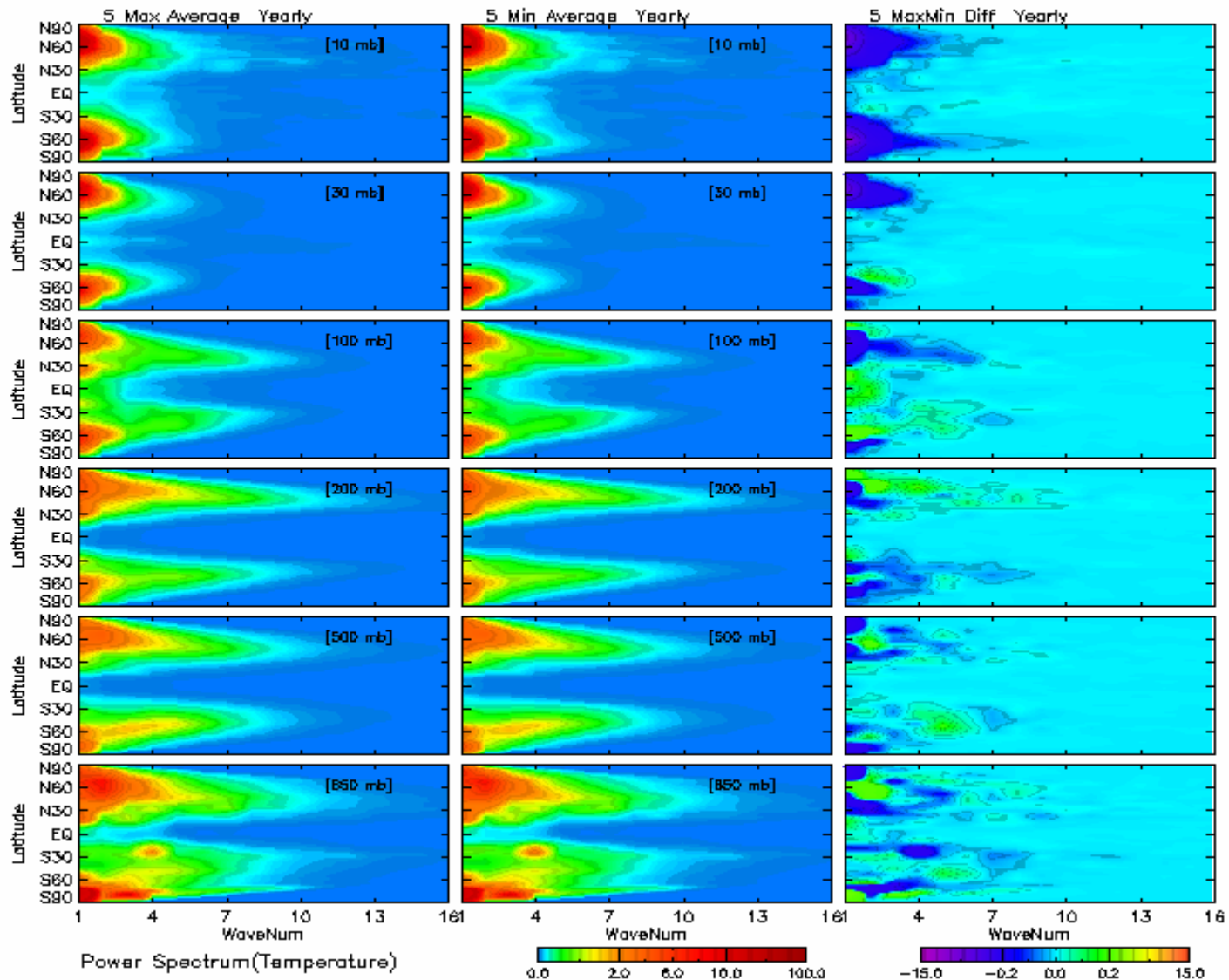
Solar Minimum



Wave Energy By Pressure Level

5-year means

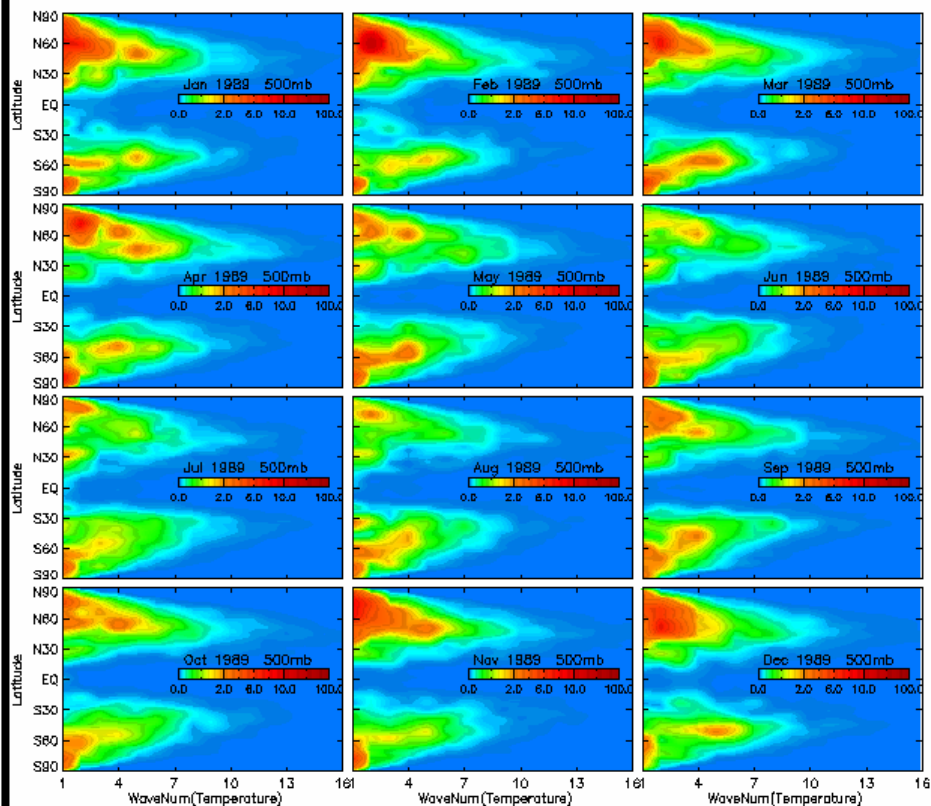
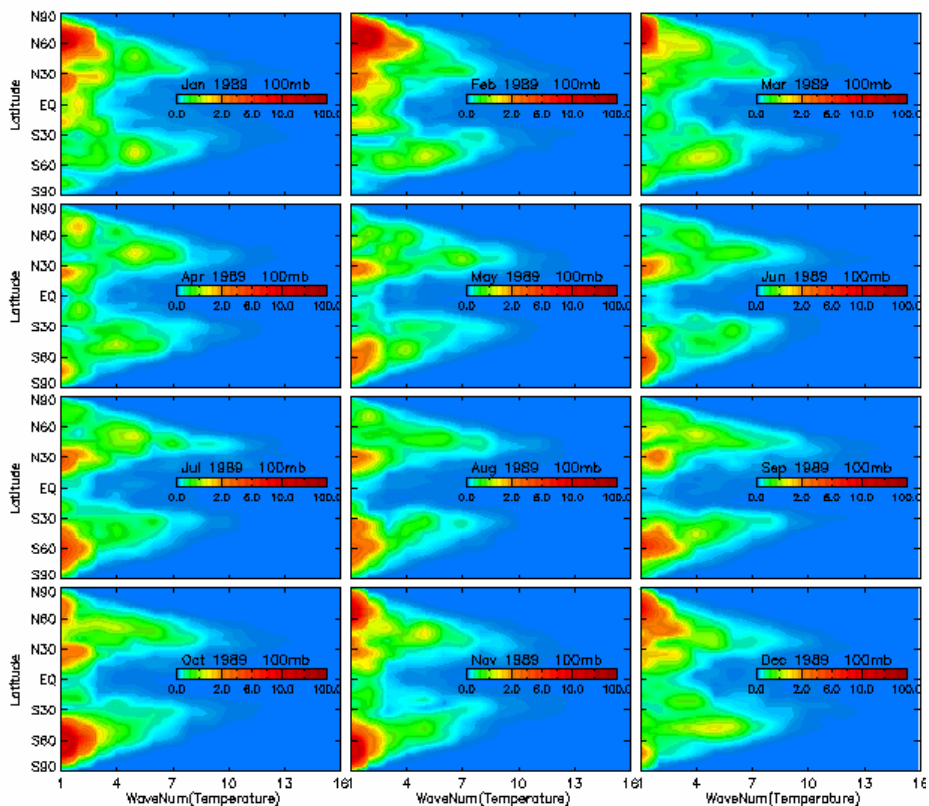
Solar Max minus Solar Min



Typical Wave Energy Change 1989 Monthly Mean Solar Maximum Year

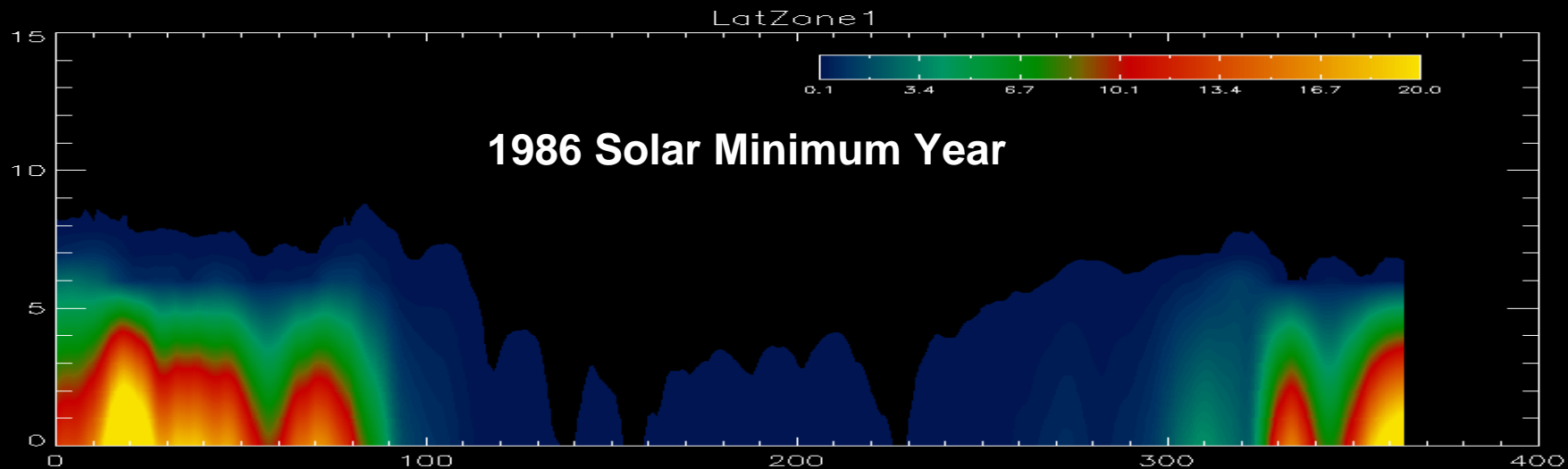
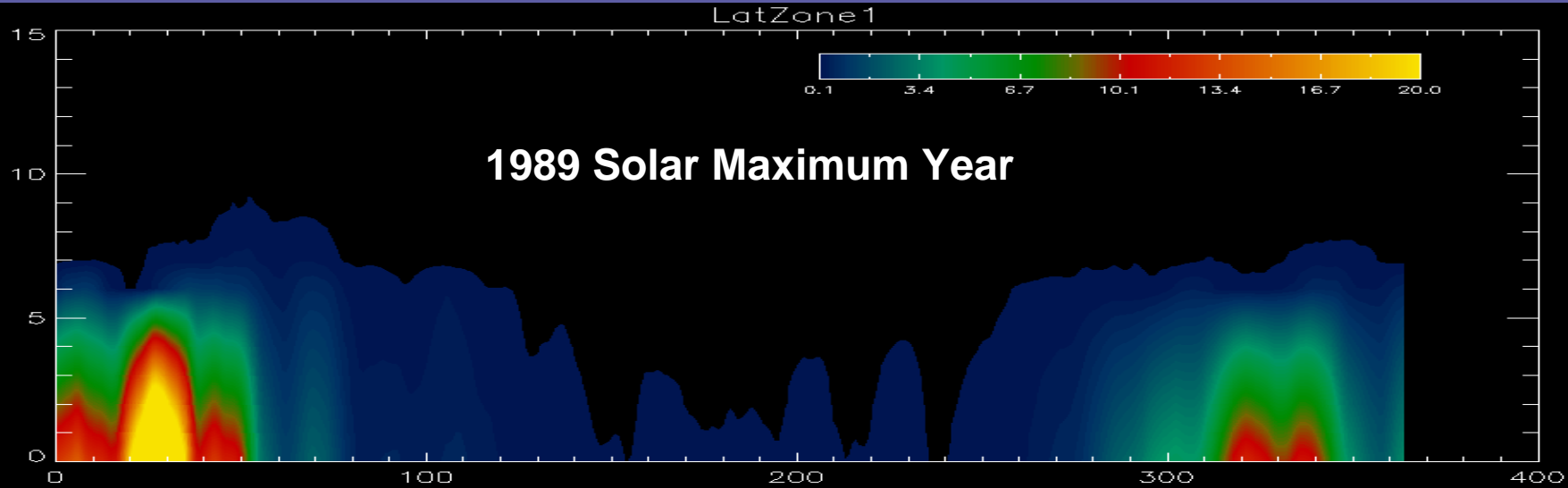
100 mb

500 mb



Annual Spectrum Comparison

Stratospheric **30 mb**, Mid-Lat, 30-60N
1989 Solar Max to 1986 Solar Min Comparison



1989 Zonal Spectrum Comparison

By Level and Latitude Zone, **Solar Maximum Year**

30 MB

0.1 to 20

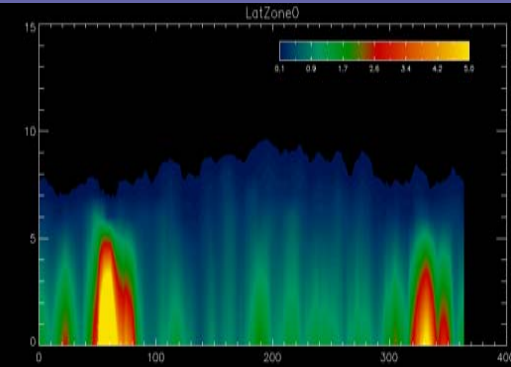
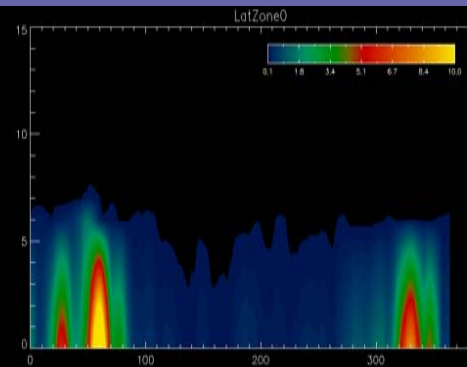
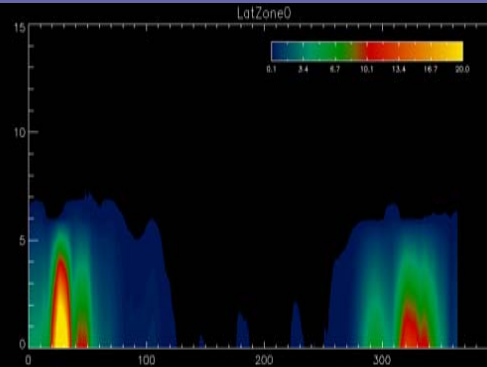
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0.1 to 10

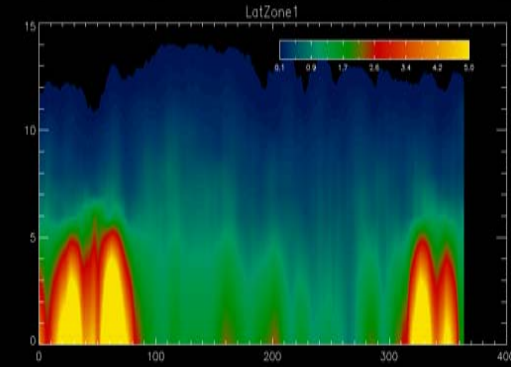
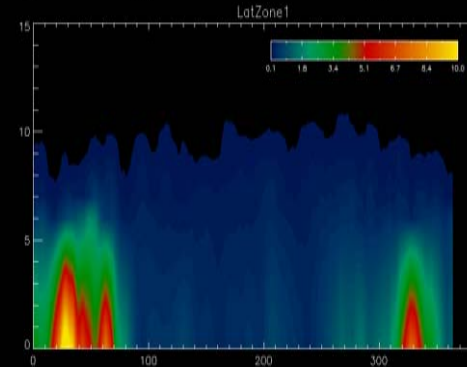
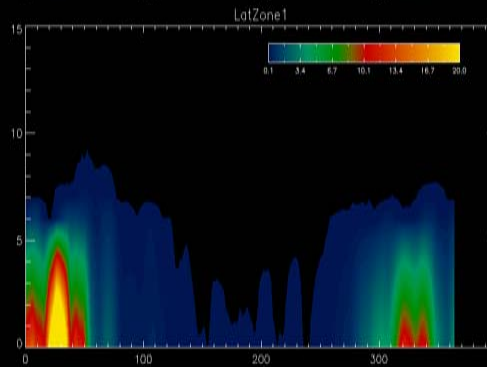
200 MB

0.1 to 5

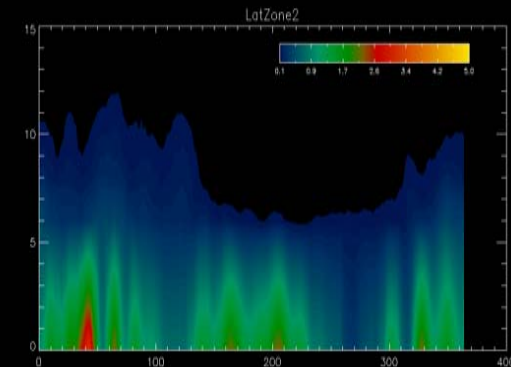
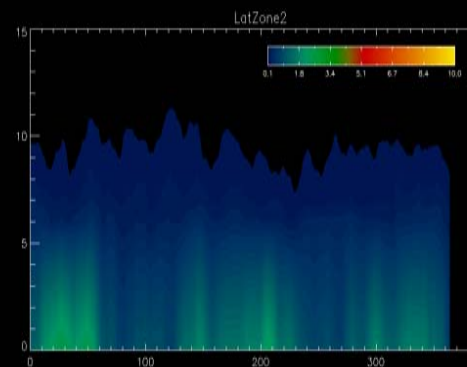
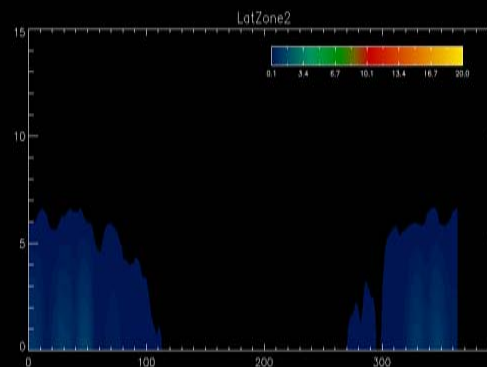
Polar Zone
60-90 Deg Lat



Mid-Latitude
Zone
30-60 Deg Lat



Tropic Zone
0-30 Deg Lat



1986 Zonal Spectrum Comparison

NH By Level and Latitude Zone, **Solar Minimum Year**

30 MB

0.1 to 20

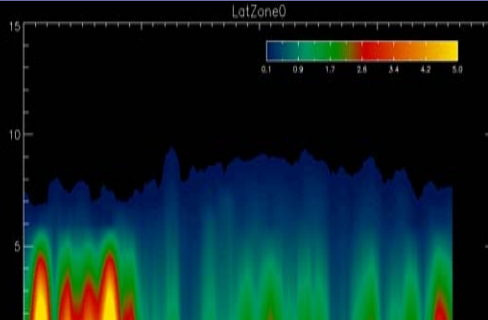
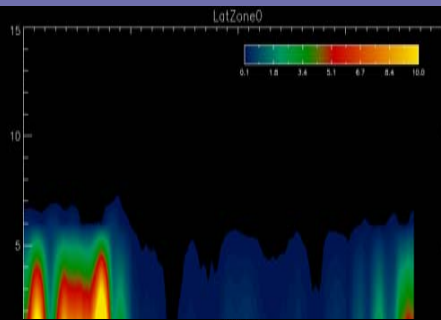
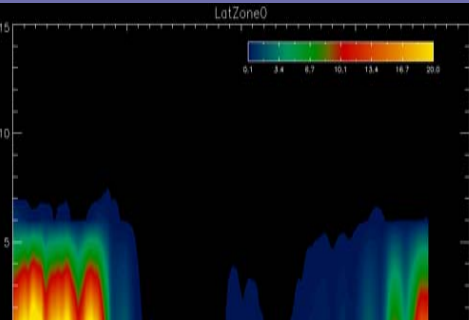
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0.1 to 10

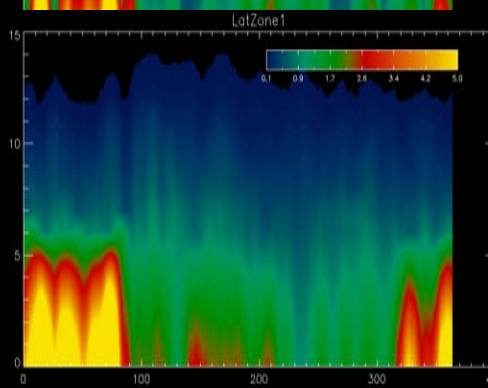
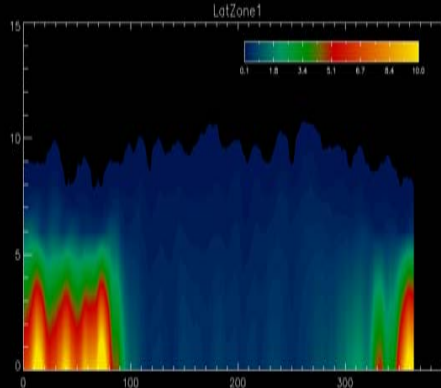
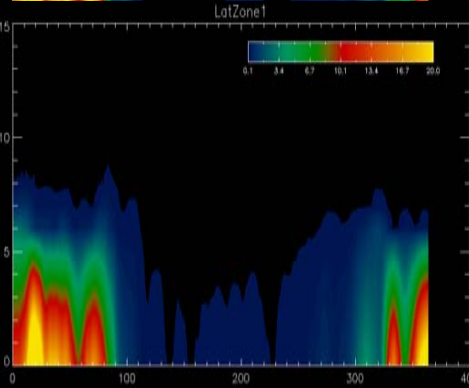
200 MB

0.1 to 5

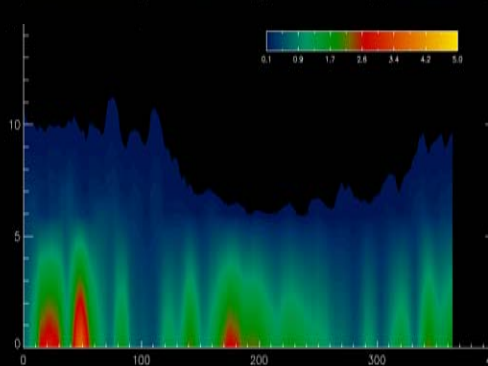
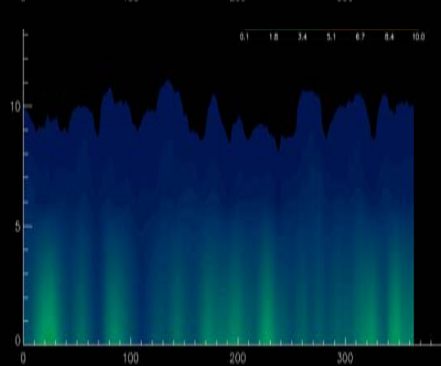
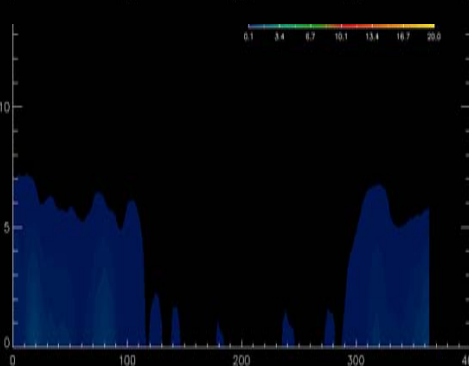
Polar Zone
60-90 Deg Lat



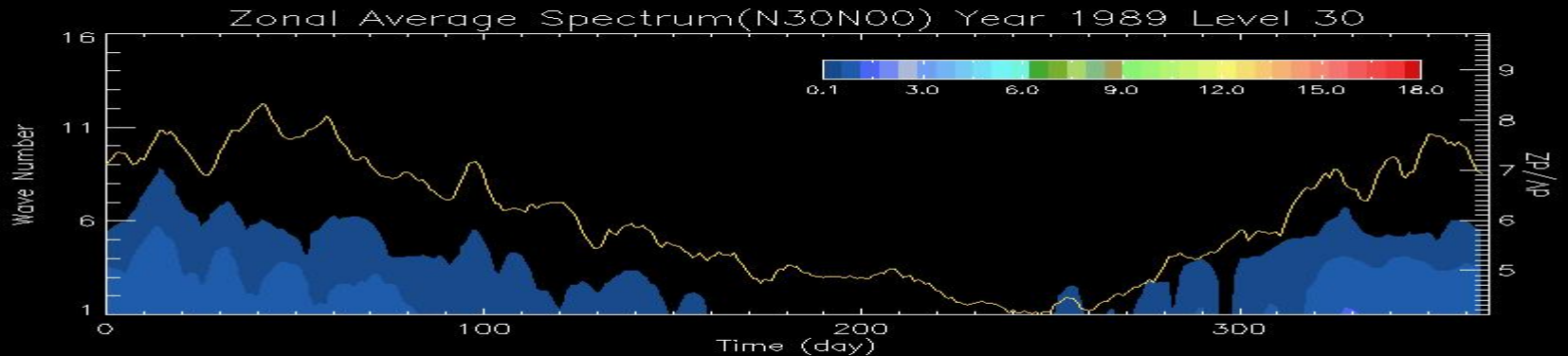
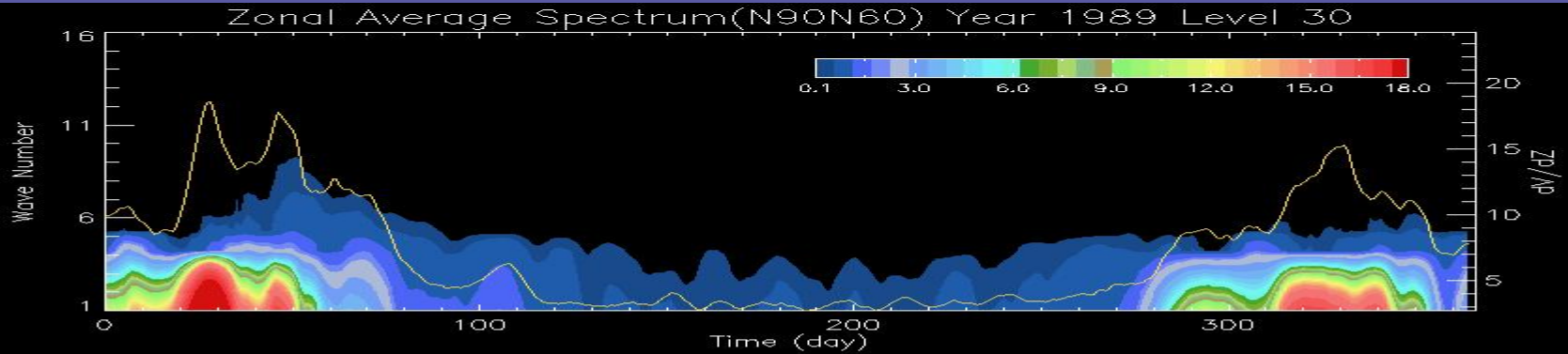
Mid-Latitude
Zone
30-60 Deg Lat



Tropic Zone
0-30 Deg Lat

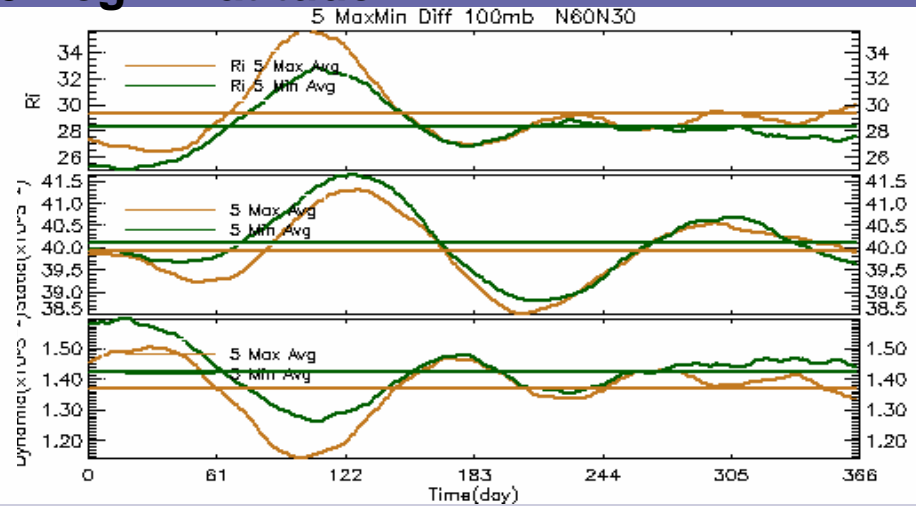
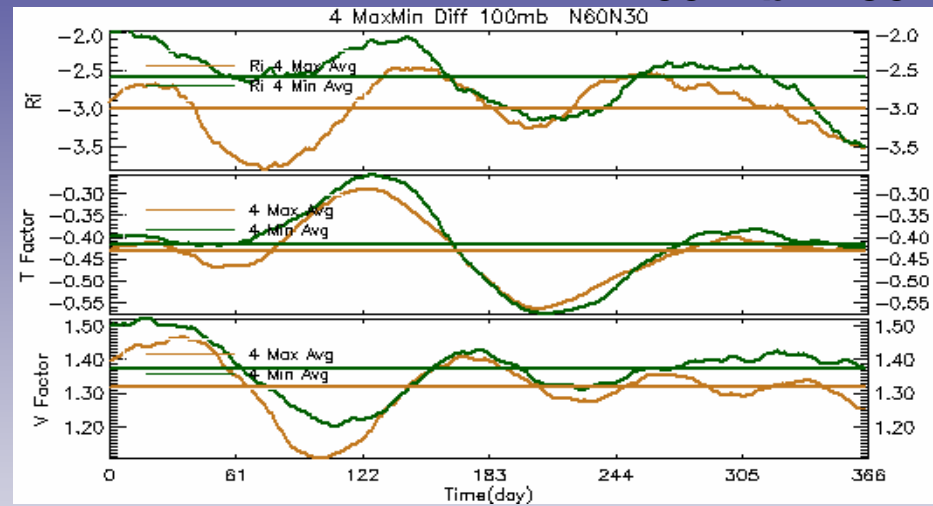


NH 30mb Thermal Wind Change With Wave Energy

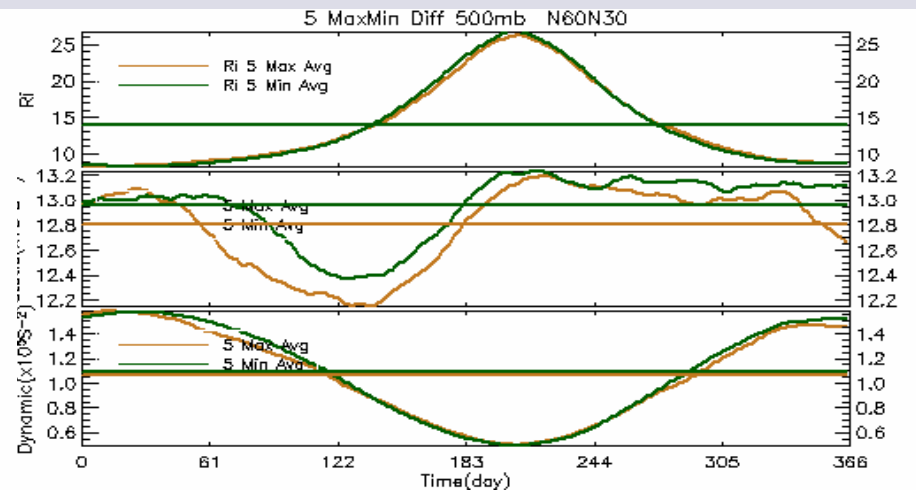
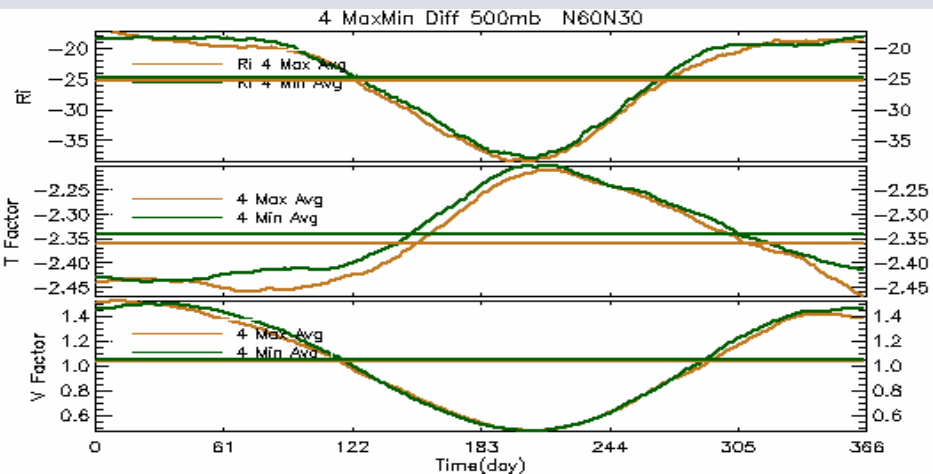


Stability Changes Means of Solar Max and Min Years

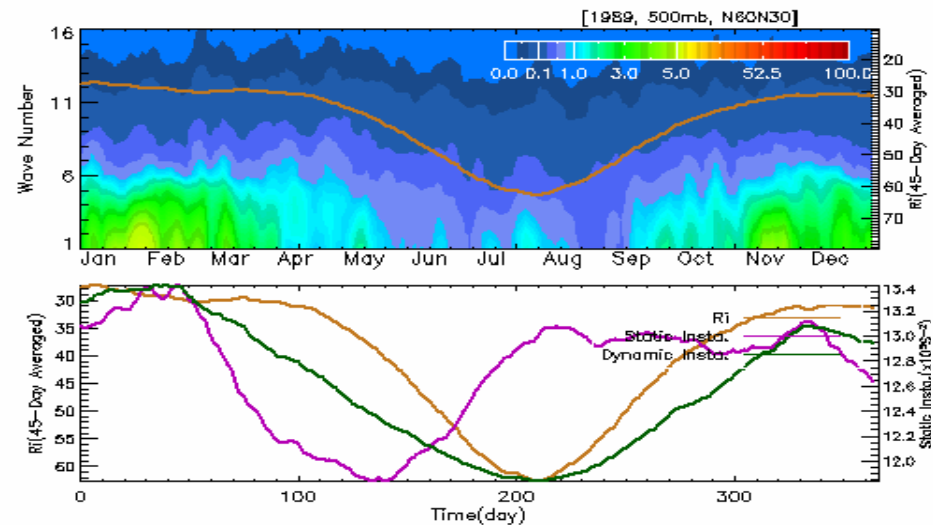
100 mb 30-60 Deg N Latitude



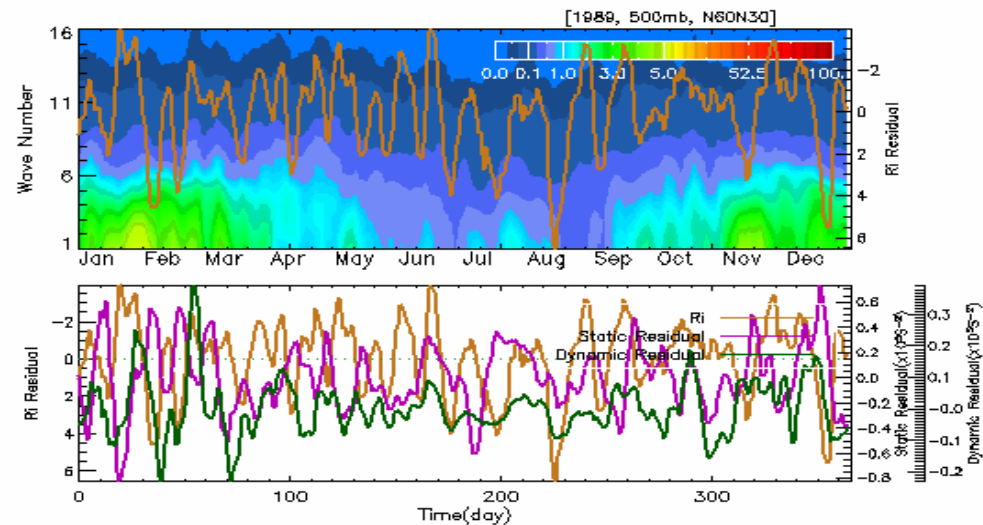
500 mb 30-60 Deg N Latitude



500 mb Annual Atmospheric Wave Energy Changes 1989



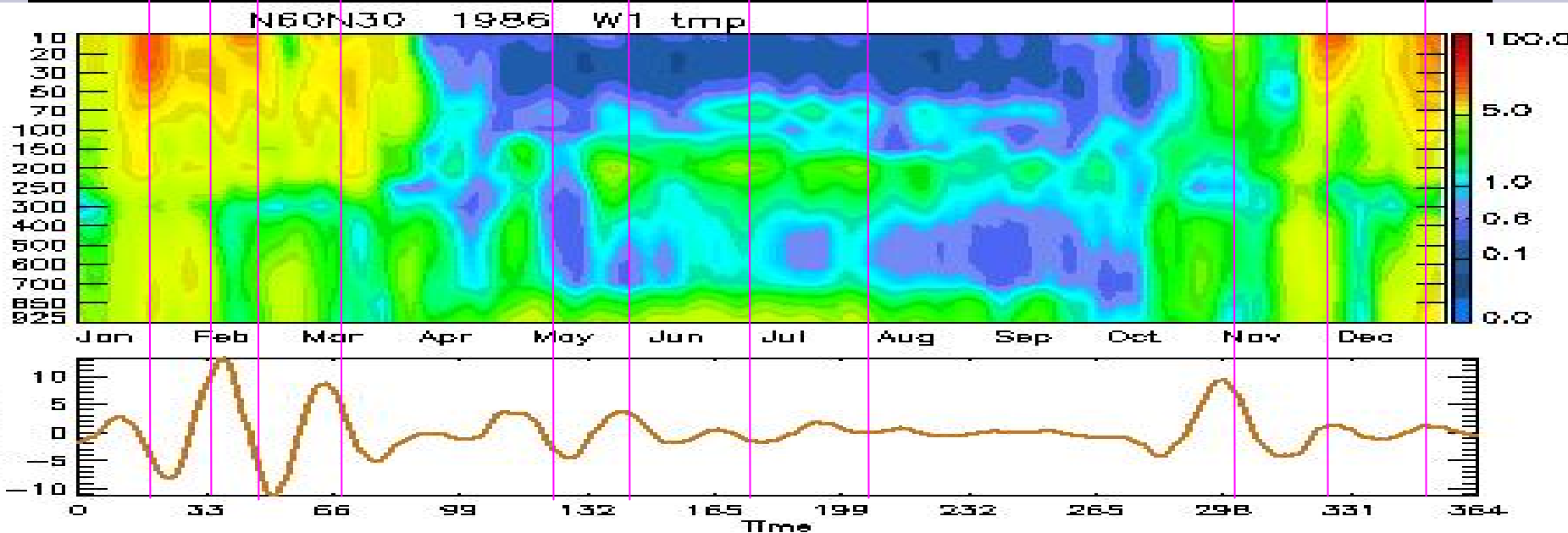
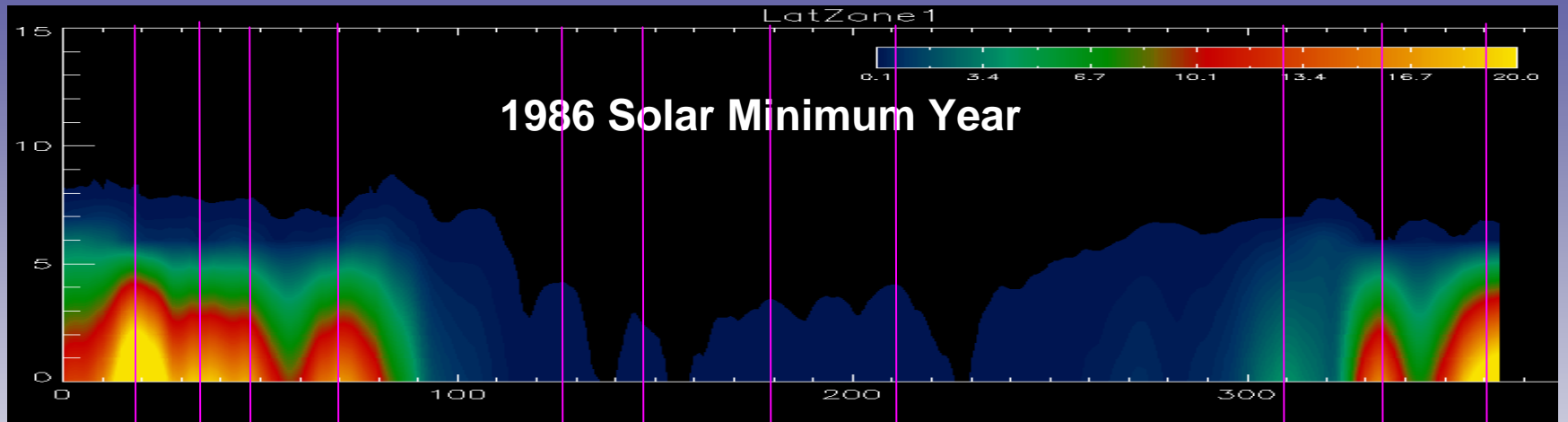
45-Day Means



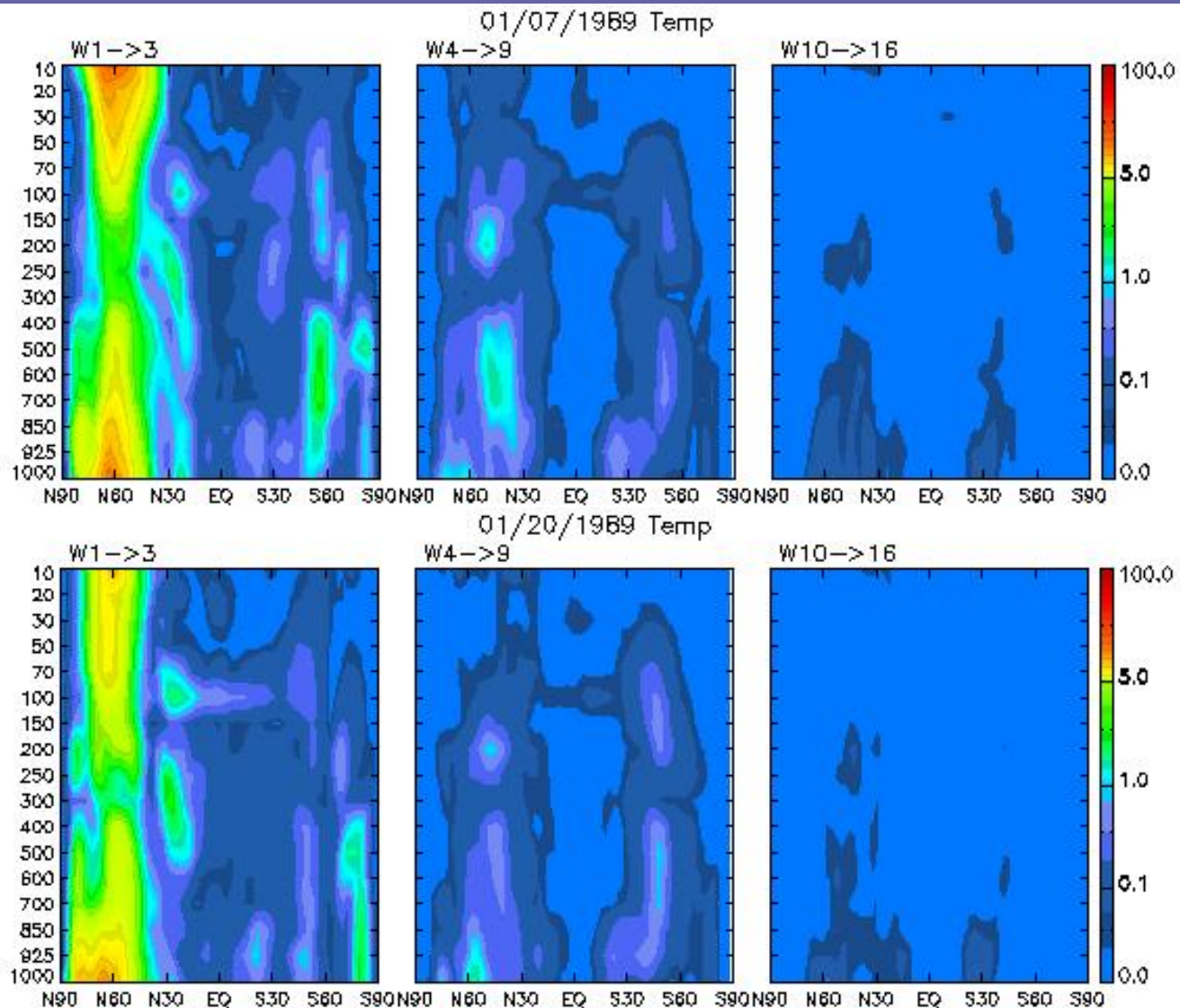
Residual

Annual Spectrum Comparison

Stratospheric 30 mb, Mid-Lat, 30-60N
1986 Solar Min Comparison



Vertically Propagating Wave Energy

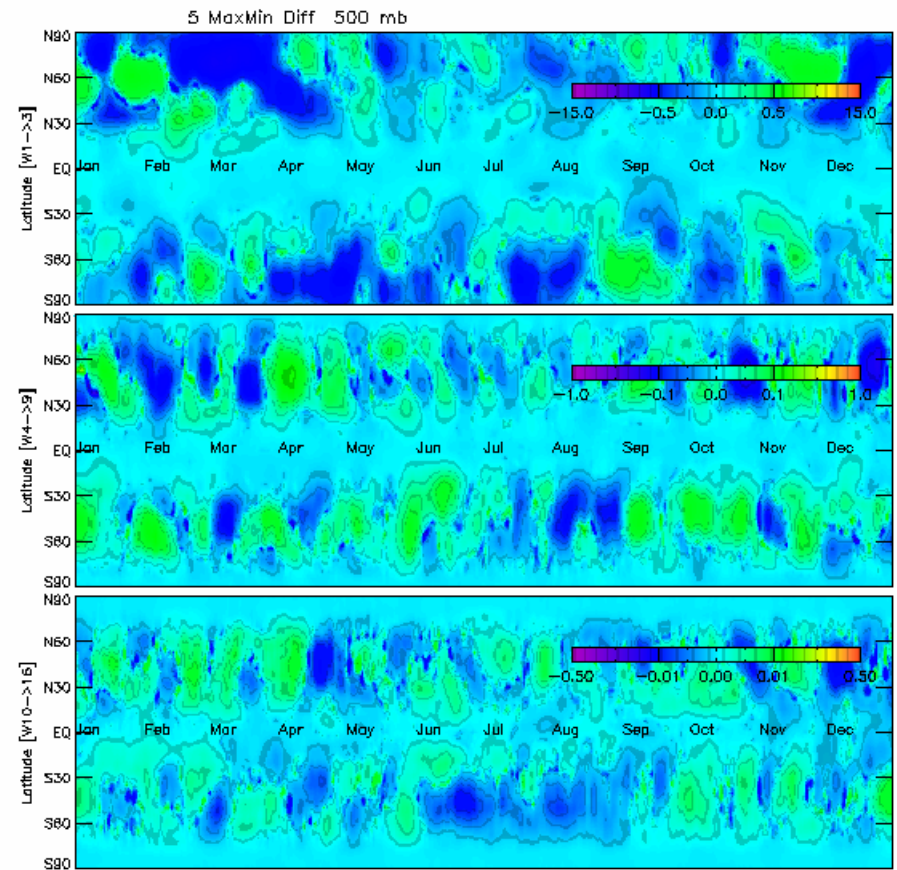
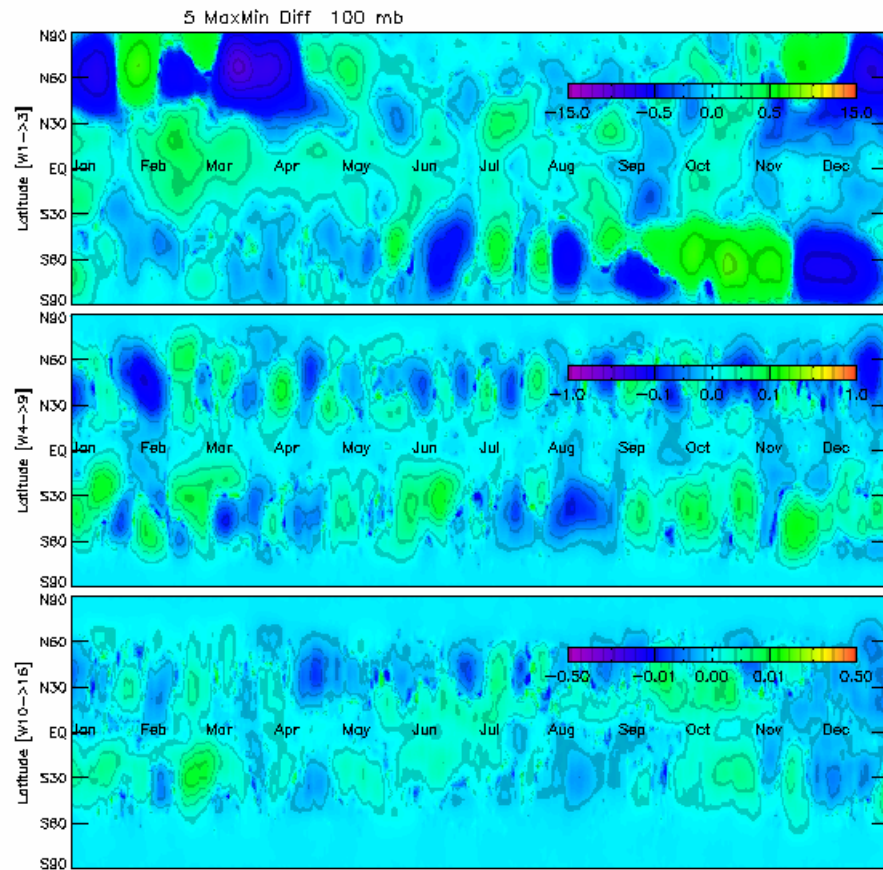


Solar Min vs Solar Max

Difference of 5-year Mean Max Minus Min

100 mb

500 mb



Solar-Terrestrial Mechanism Summary

- Analysis using the NCAR/NCEP Reanalysis Data is consistent with proposed S-T mechanisms premise of being associated with stability
- Power spectrum analysis supports concept
 - 11-year cycle:
 - Solar Min is long wave dominant
 - Solar max is short wave dominant
 - Annual cycle: wave energy changes consistent with stability changes
 - 28-day cycle: Possible association – more research required
- Vertical waves and horizontal wave energy changes (on a pressure surface) appear coupled