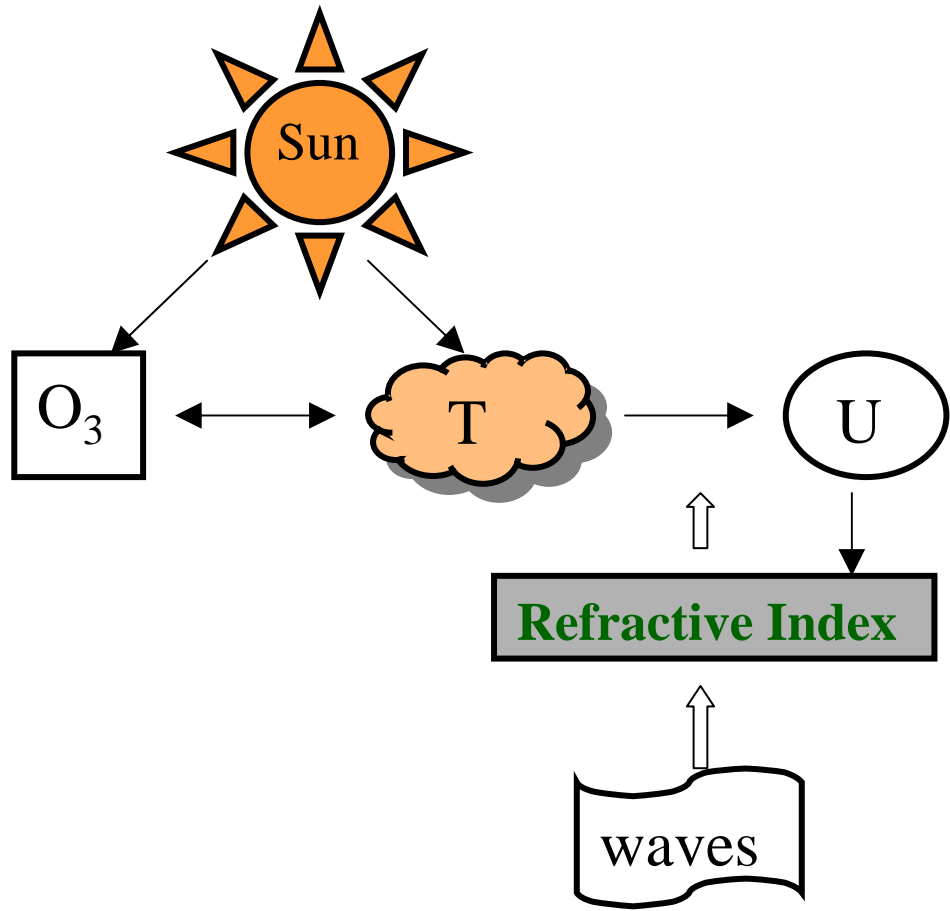


Sensitivity of stratospheric zonal wind to solar cycle variations

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(2004 SORCE science meeting)



Stratosphere

Troposphere

Data

1000-10 hPa : NCEP/NCAR Reanalysis

10 – 0.4 hPa: Balance wind from CPC height analysis

Period: 1980-2003 (288 months)

Regression

$U = \text{const.} + \text{trend} + \text{seasonal cycles}$

+ quasi-biennial (QBO)

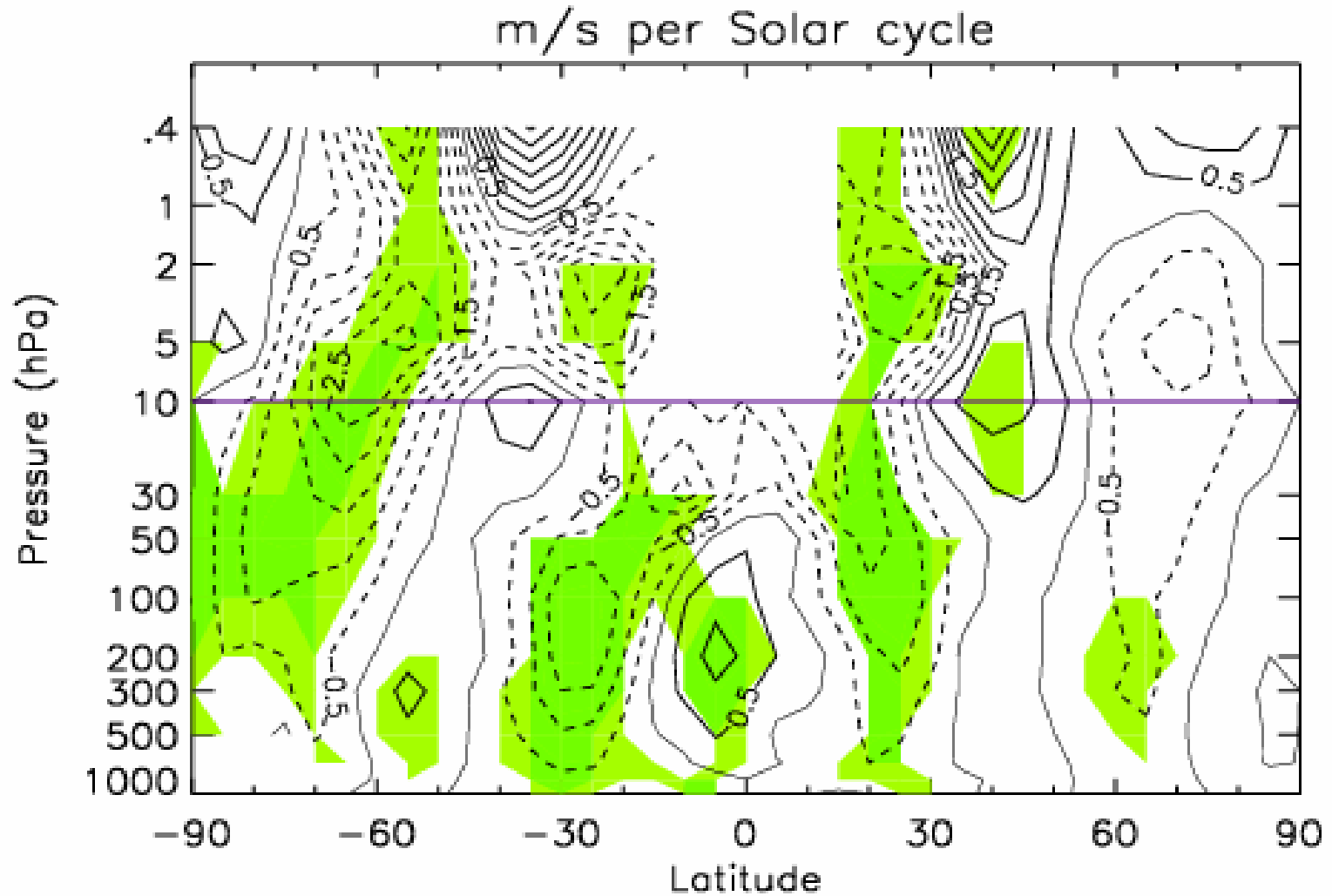
+ solar cycle (MgII)

+ annular modes (AO/AAO)

+ wave forcing (E-P flux)

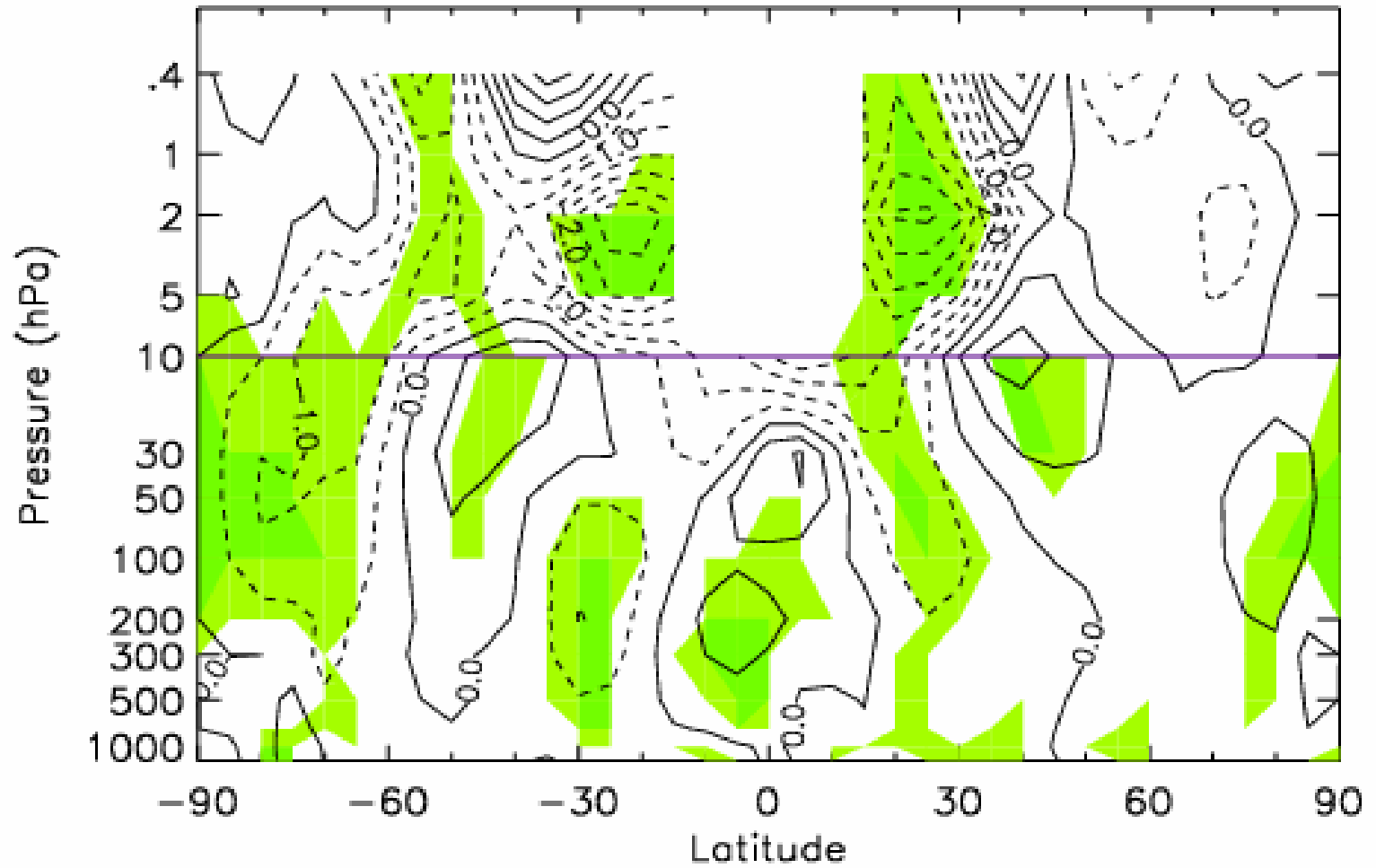
+ volcano effect (cut contaminated data)

Solar regression coefficients

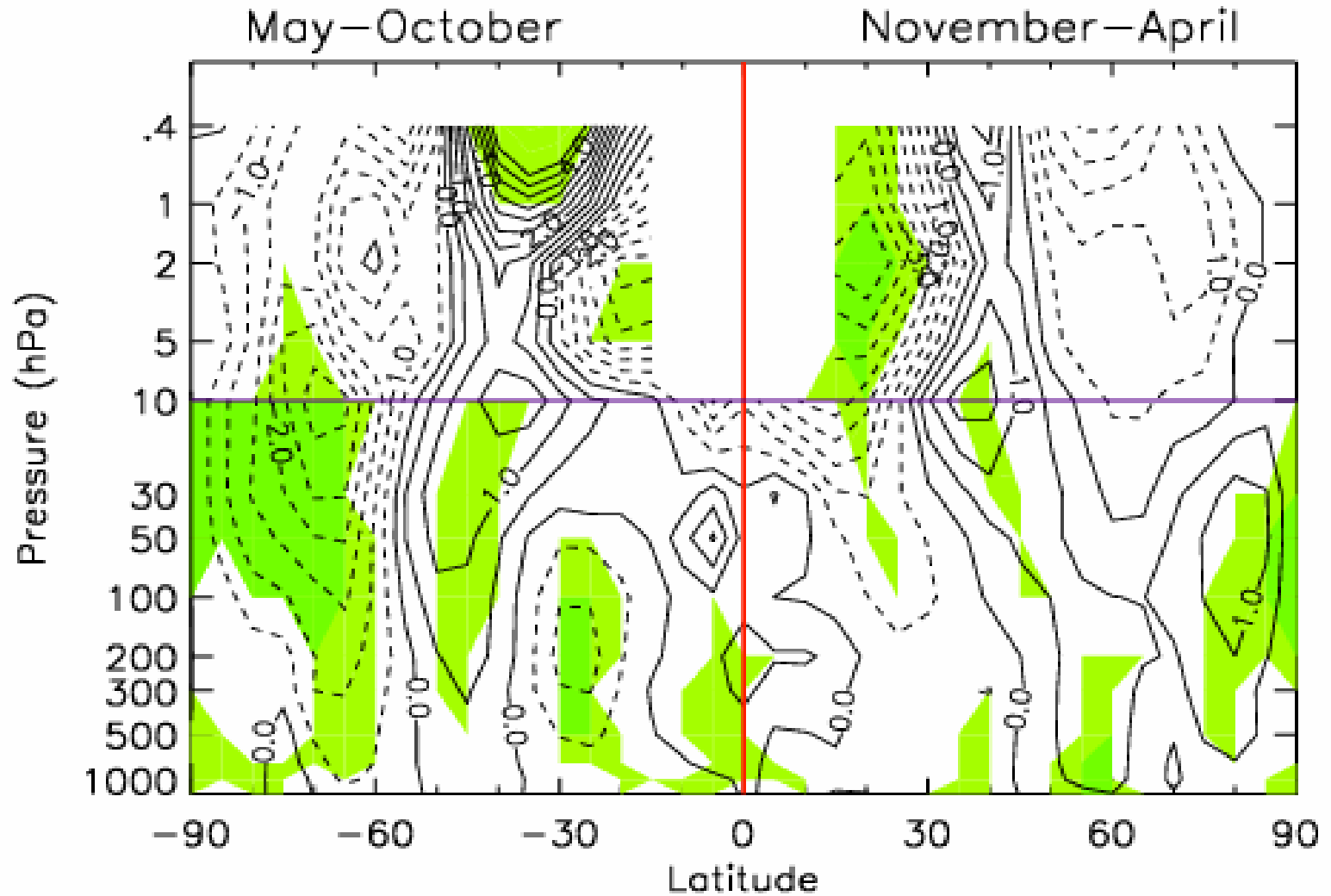


Composite

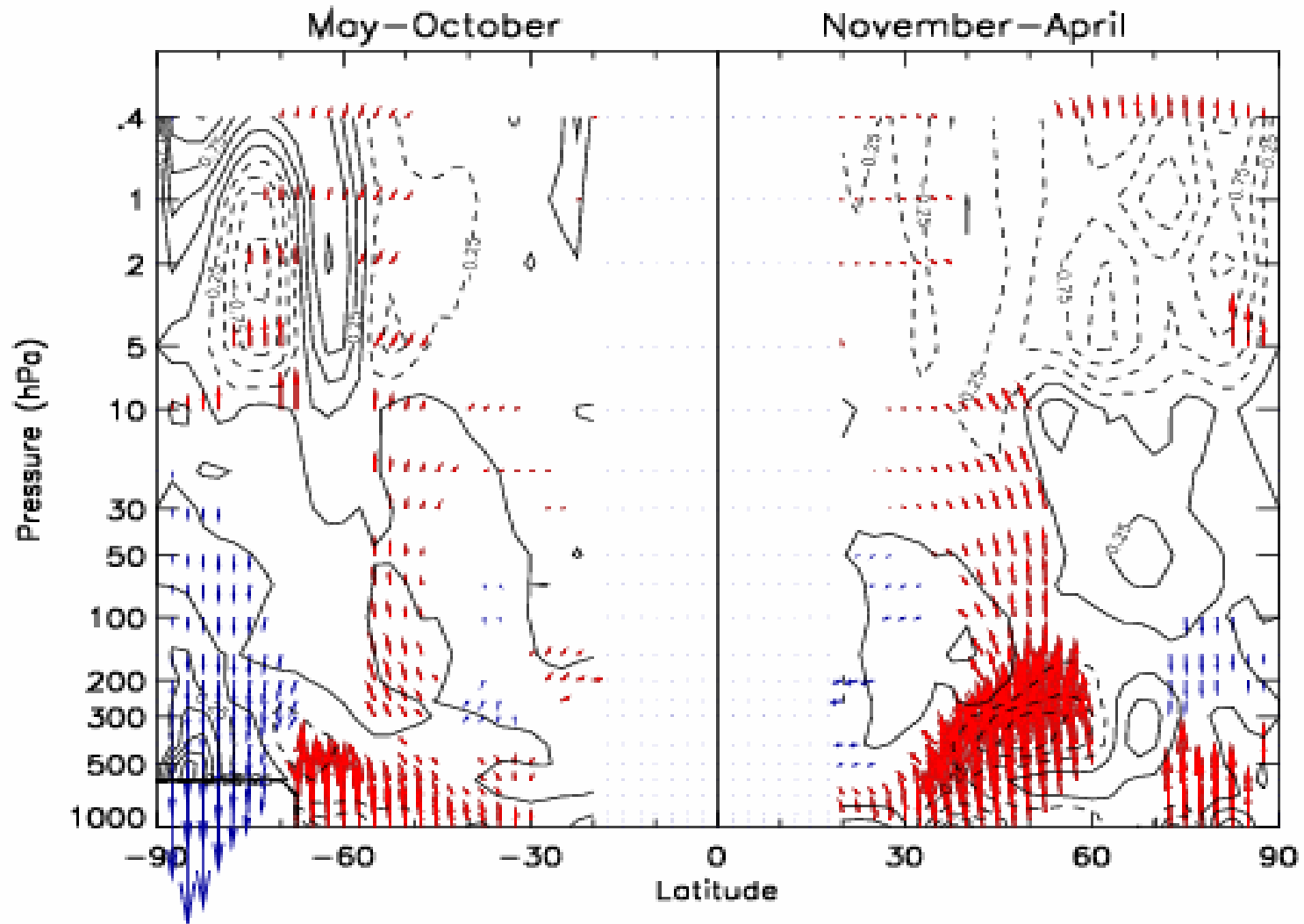
Solar Max–Min



Composite (winter hemisphere)



E-P flux (Solar Max – Min)



Refractive index

$$n^2 = \frac{\bar{q}_\varphi}{\bar{U}} - \frac{s^2}{a^2 \cos^2 \varphi} - \frac{f^2}{4N^2 H^2}$$

where

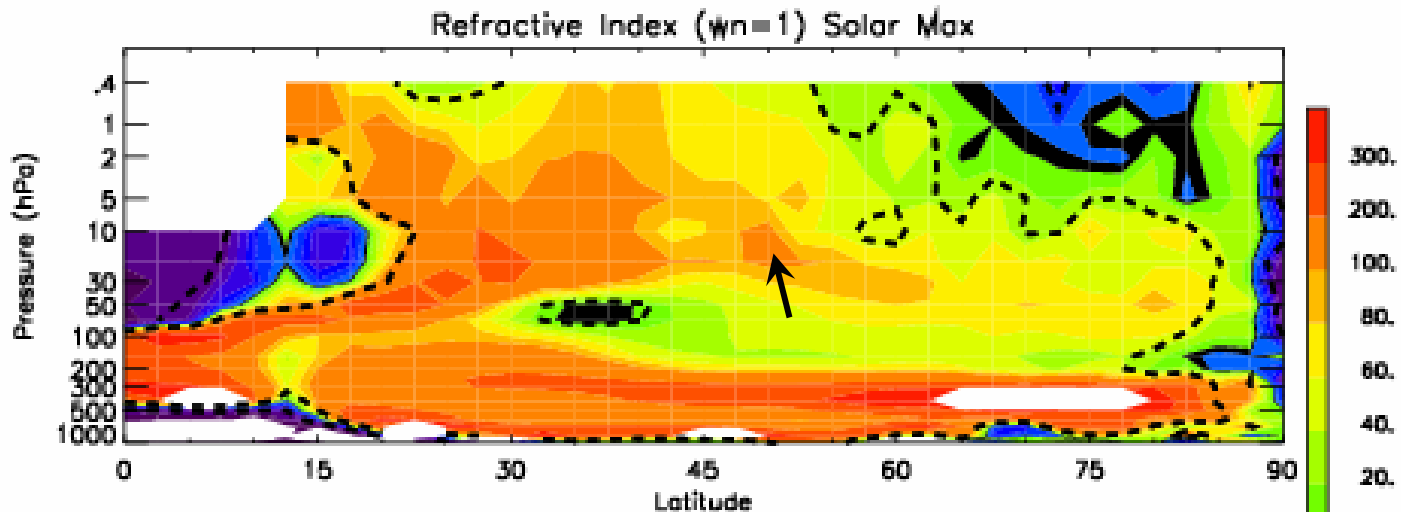
$$\bar{q}_\varphi = a\beta - \frac{\partial}{a\partial\varphi} \left[\frac{\partial(\bar{U} \cos \varphi)}{\cos \varphi \partial\varphi} \right] - \frac{f^2}{a\rho} \frac{\partial}{\partial z} \left[\frac{\rho}{N^2} \frac{\partial \bar{U}}{\partial z} \right]$$

$n^2 > 0 \rightarrow$ Waves propagation

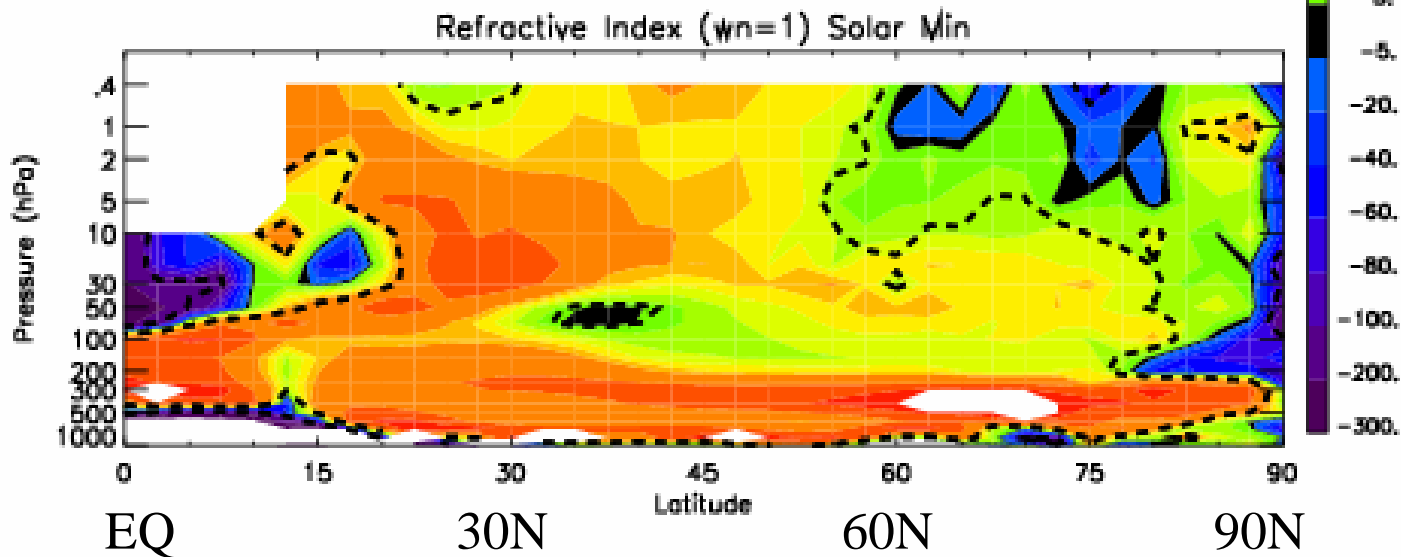
$n^2 < 0 \rightarrow$ Waves evanescence

Wavenumber 1

Solar Max

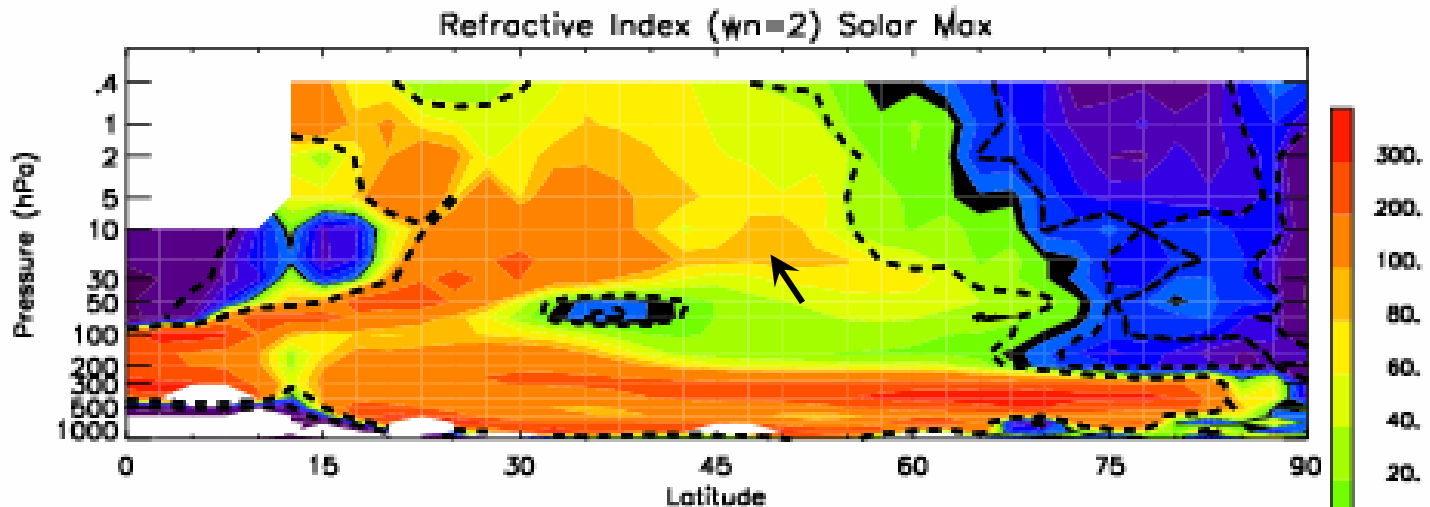


Solar Min

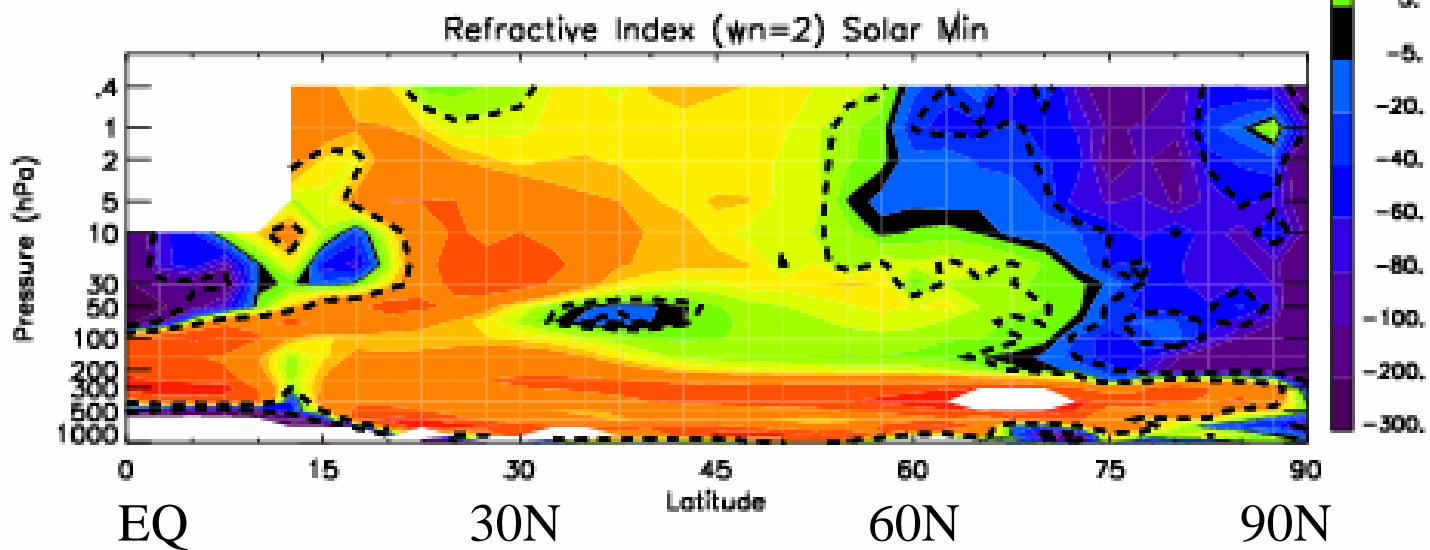


Wavenumber 2

Solar Max

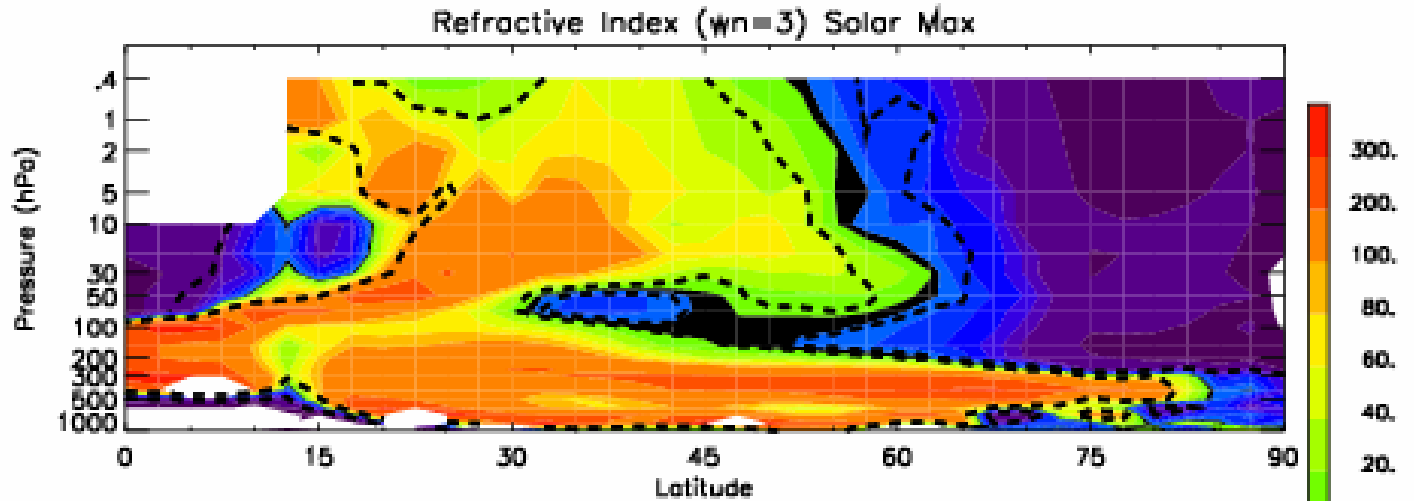


Solar Min

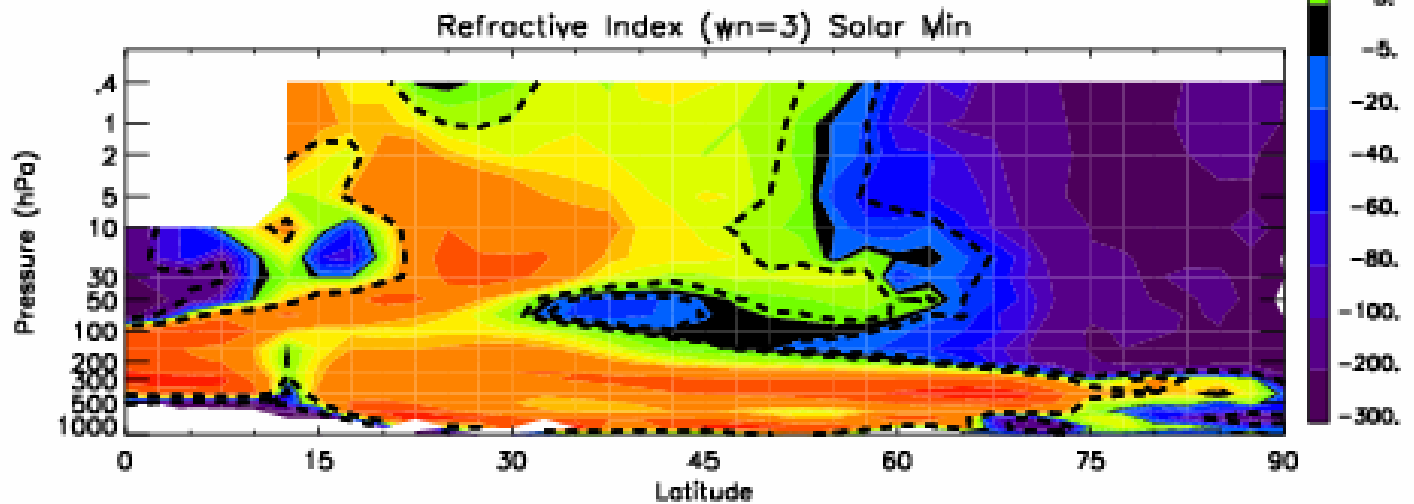


Wavenumber 3

Solar Max



Solar Min



EQ

30N

60N

90N

Conclusions

- Significant zonal wind response to solar cycle is found in the **upper stratosphere of tropics and winter extratropical hemispheres**.
- Maximal sensitivity of zonal wind is **2 - 4 m/s** from solar maximum to solar minimum.
- The upward wave propagation is stronger in solar maximum than in solar minimum, which appears to be related to the subtle differences of refractive index (particularly in NH).