Contributions of EPP-NO_x and Solar UV Radiation to Interannual O_3 Variations in the Polar Stratosphere

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Acknowledgments: Boris Soukharev, Ellis Remsberg, Cora Randall, Charles Jackman

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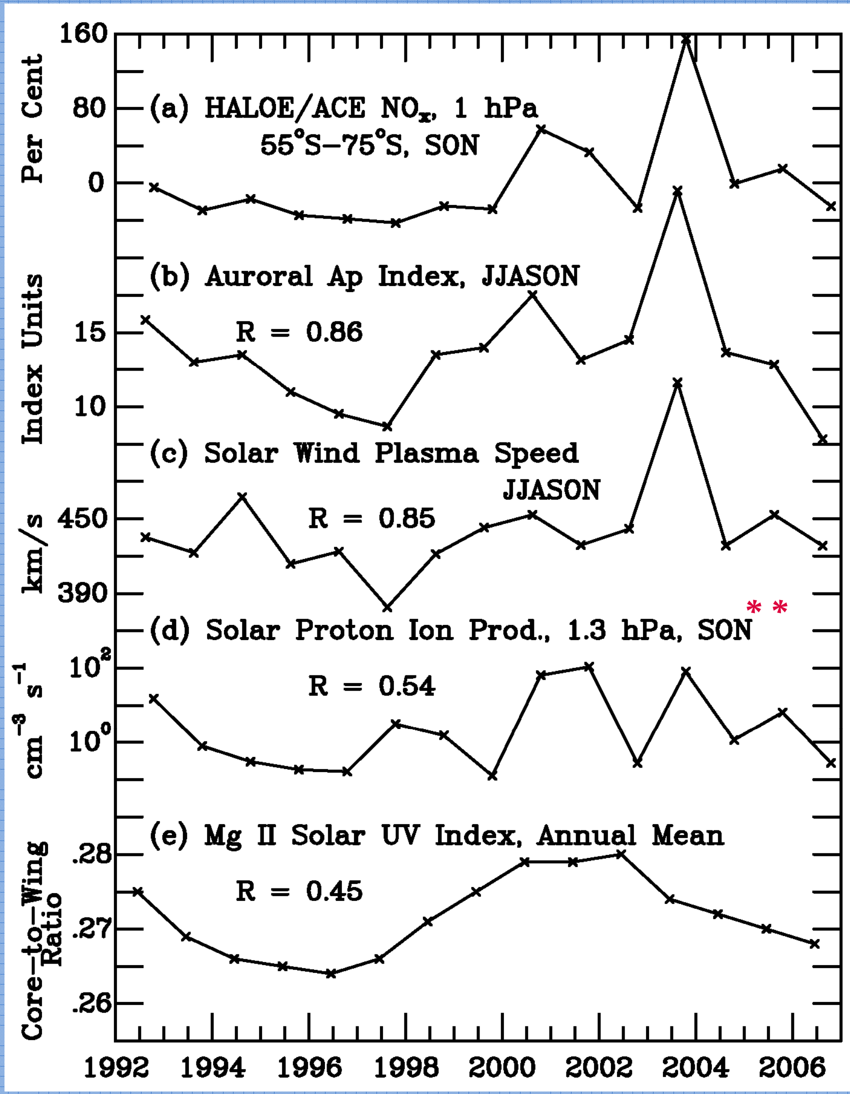
DEPARTMENT OF PLANETARY SCIENCES
LUNAR AND PLANETARY LABORATORY
The University of Arizona, Tucson AZ 85721

1. EPP-NO_x Contribution in SH Spring:

HALOE NO + NO_2 sunset data for SON, 55° S to 75° S, supplemented by 3 years of ACE data*



** ACE data provided by Cora Randall, P. Bernath, and ACE team*

** * Solar Proton Ion Production Rates Provided by C. Jackman*

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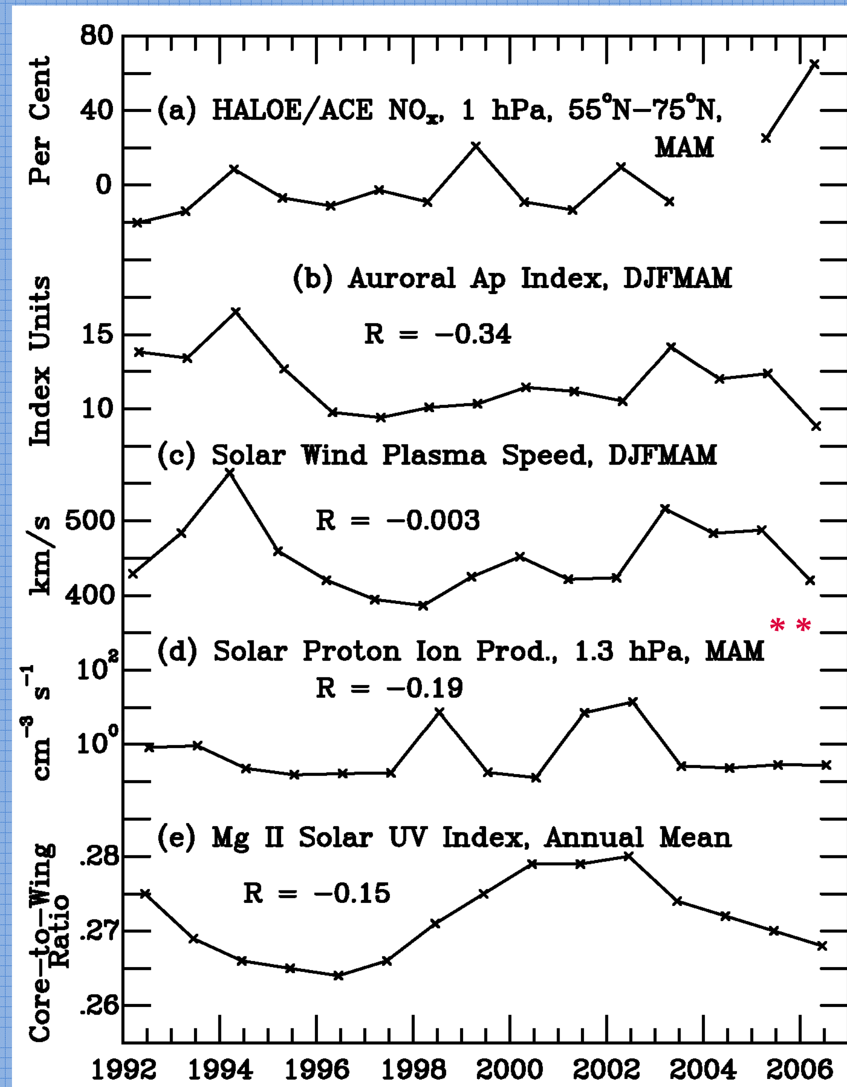

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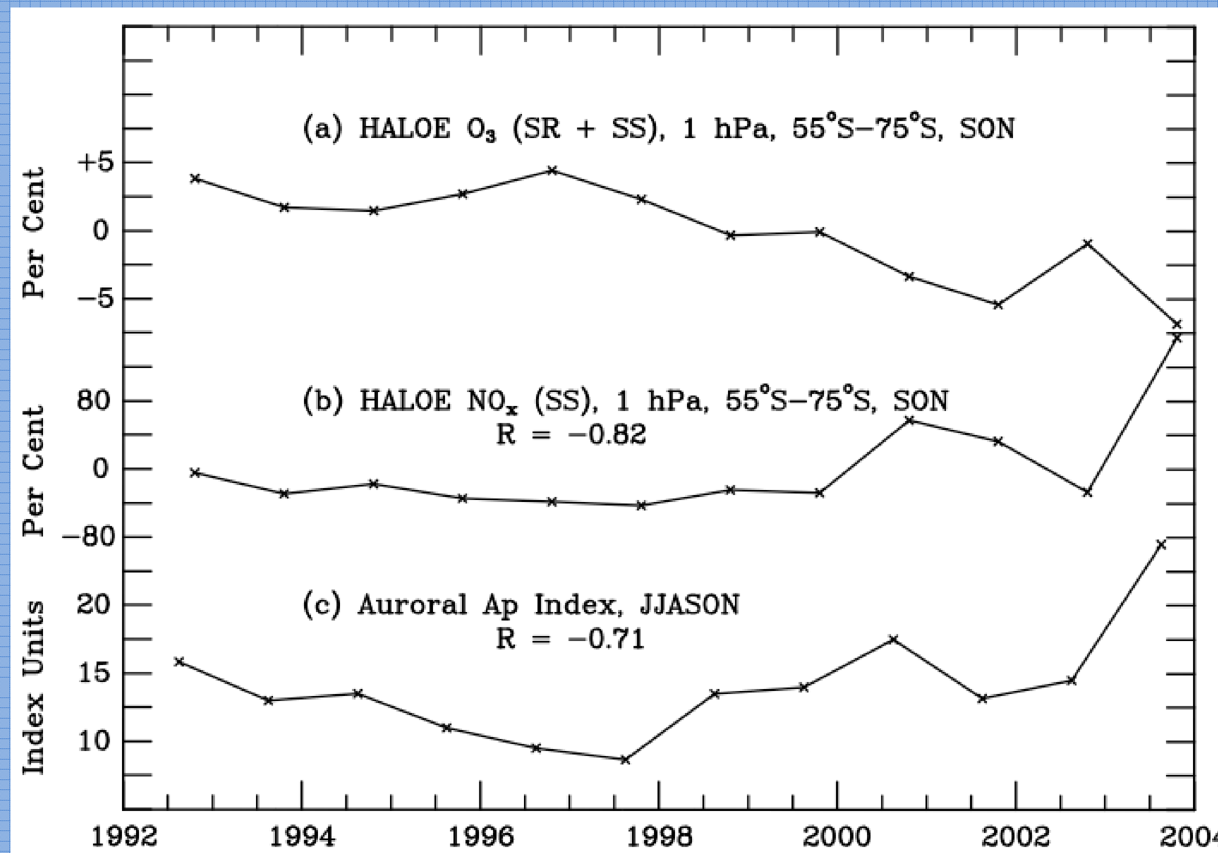

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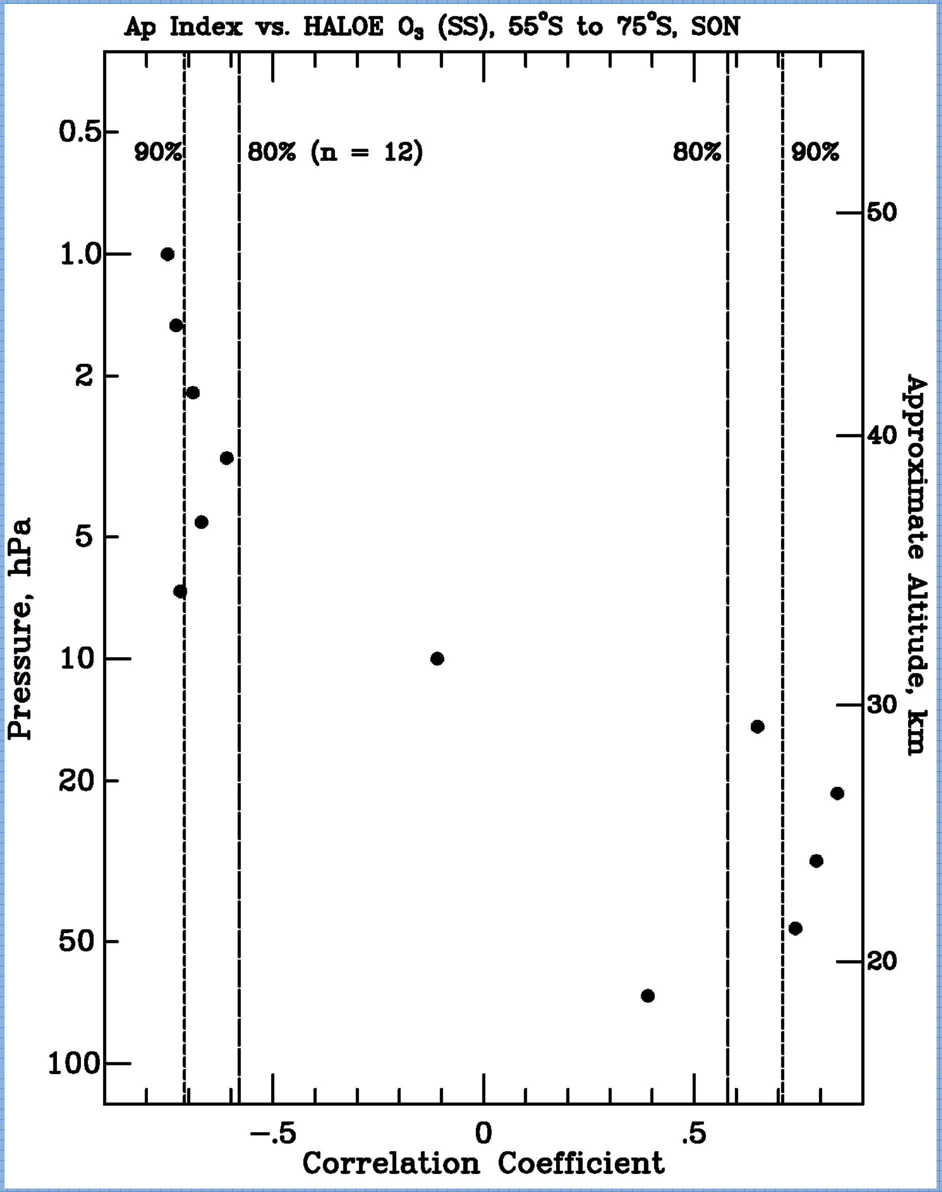
Correlation of HALOE O_3 sunset data for SON, 55° S to 75° S, versus the auroral Ap index:



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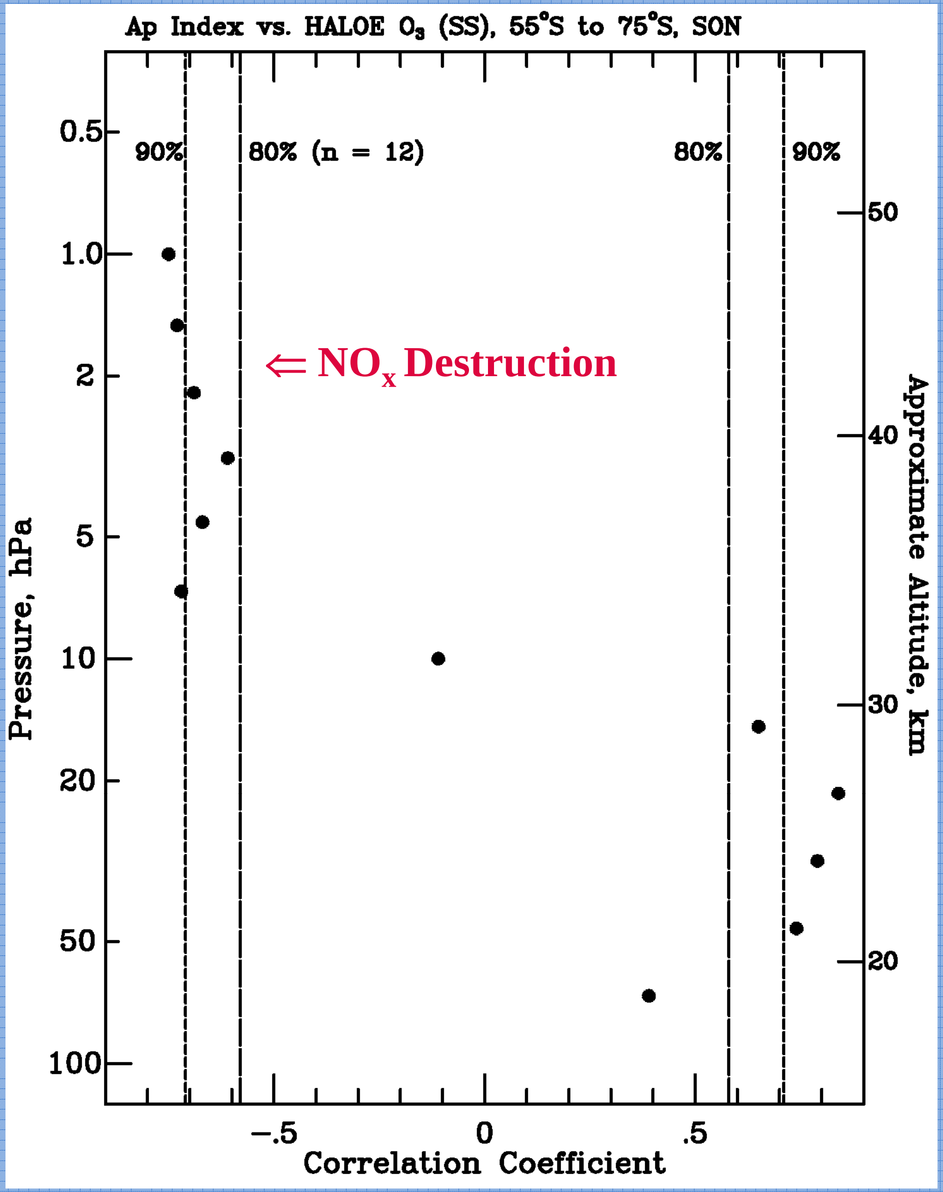

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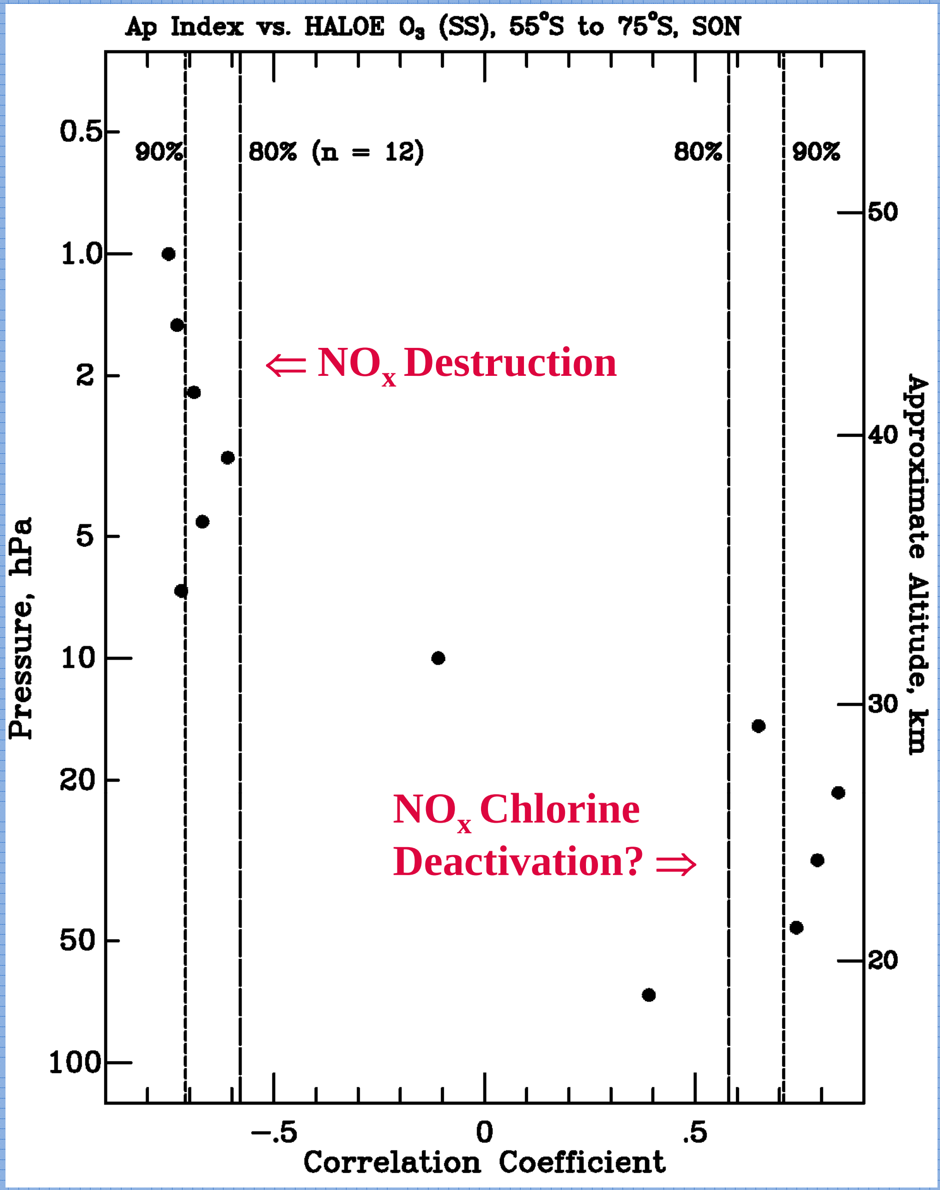

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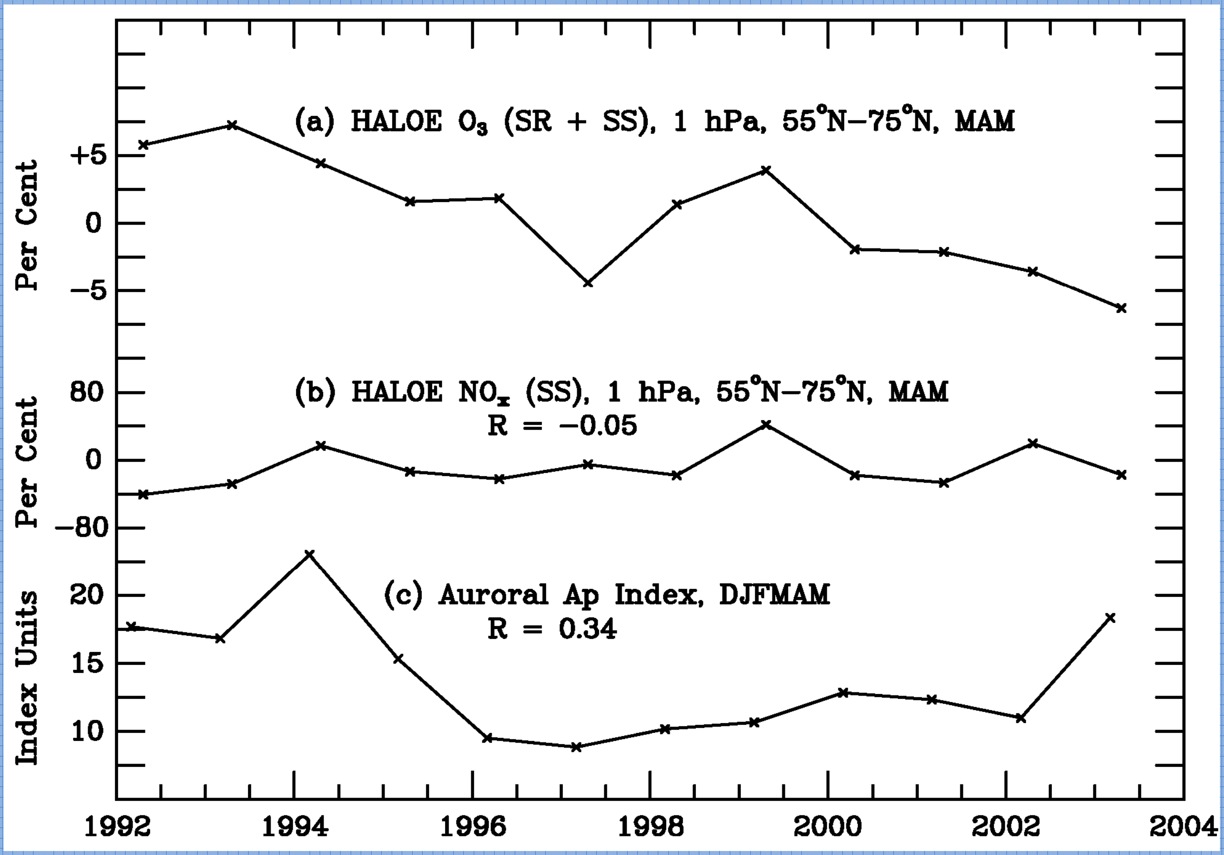

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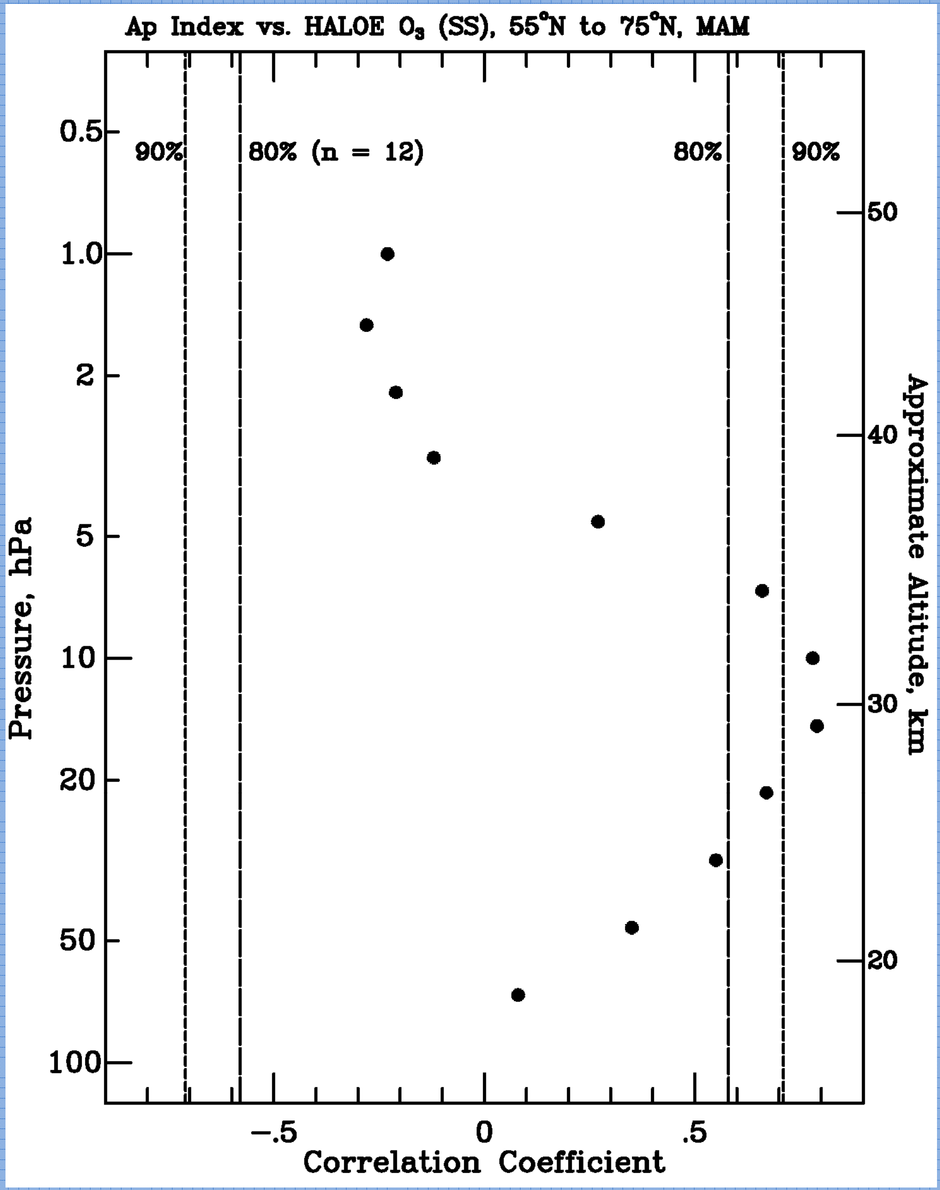
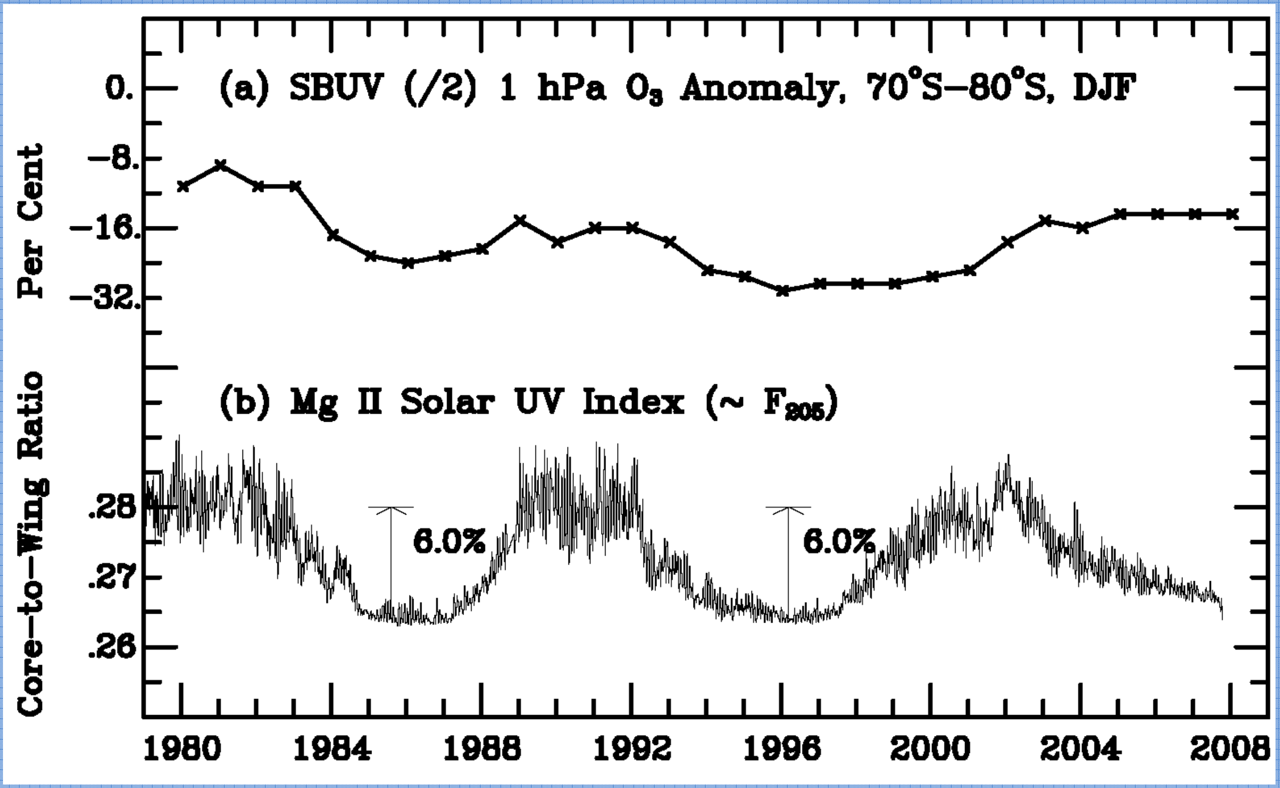


2. Solar UV Contribution to O_3 in SH Summer:

SBUV (/2)* 1 hPa O_3 DJF deviations, 1979 - 2008 (early afternoon nadir soundings):



*** Version 8 Merged Ozone Data calibrated by Rich Stolarski and Stacey Frith, GSFC**

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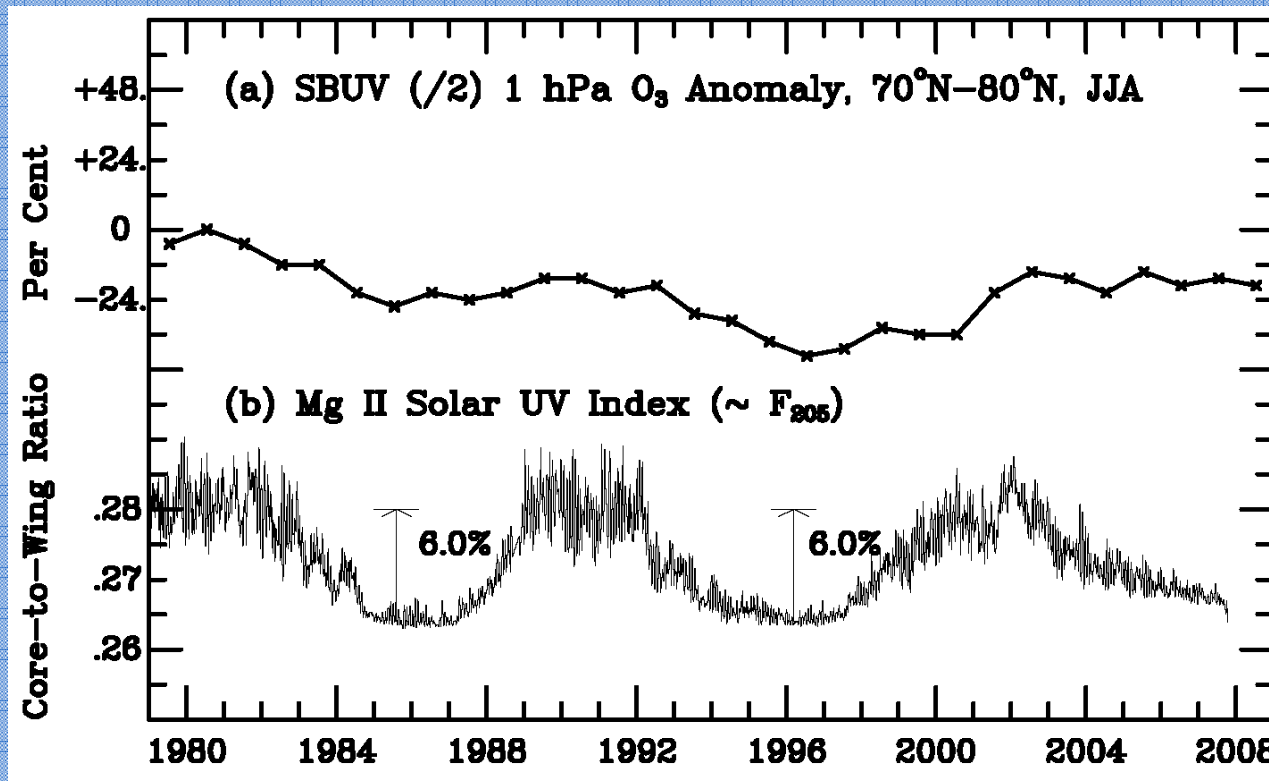

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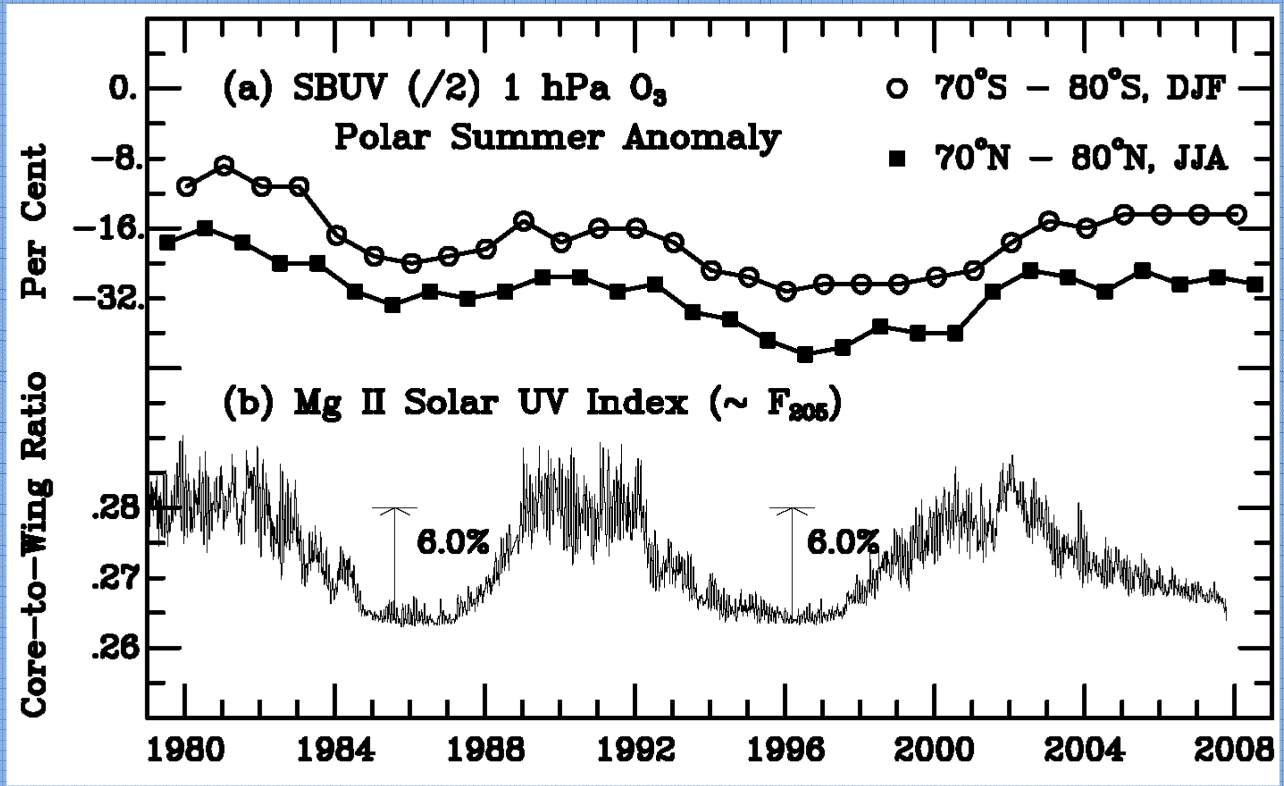
2. *Solar UV Contribution to O_3 in NH and SH Summer:*

SBUV (/2) 1 hPa O_3 DJF and JJA deviations, 1979 - 2008 (early afternoon nadir soundings):*



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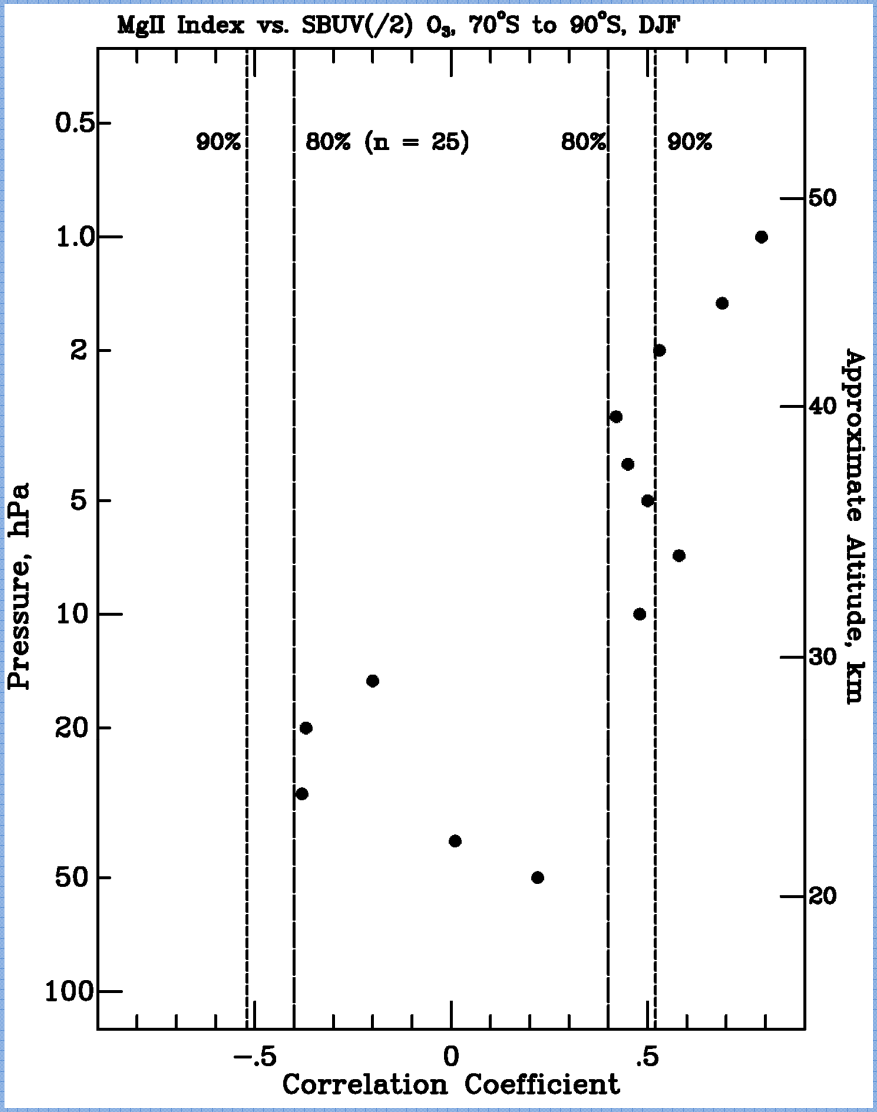
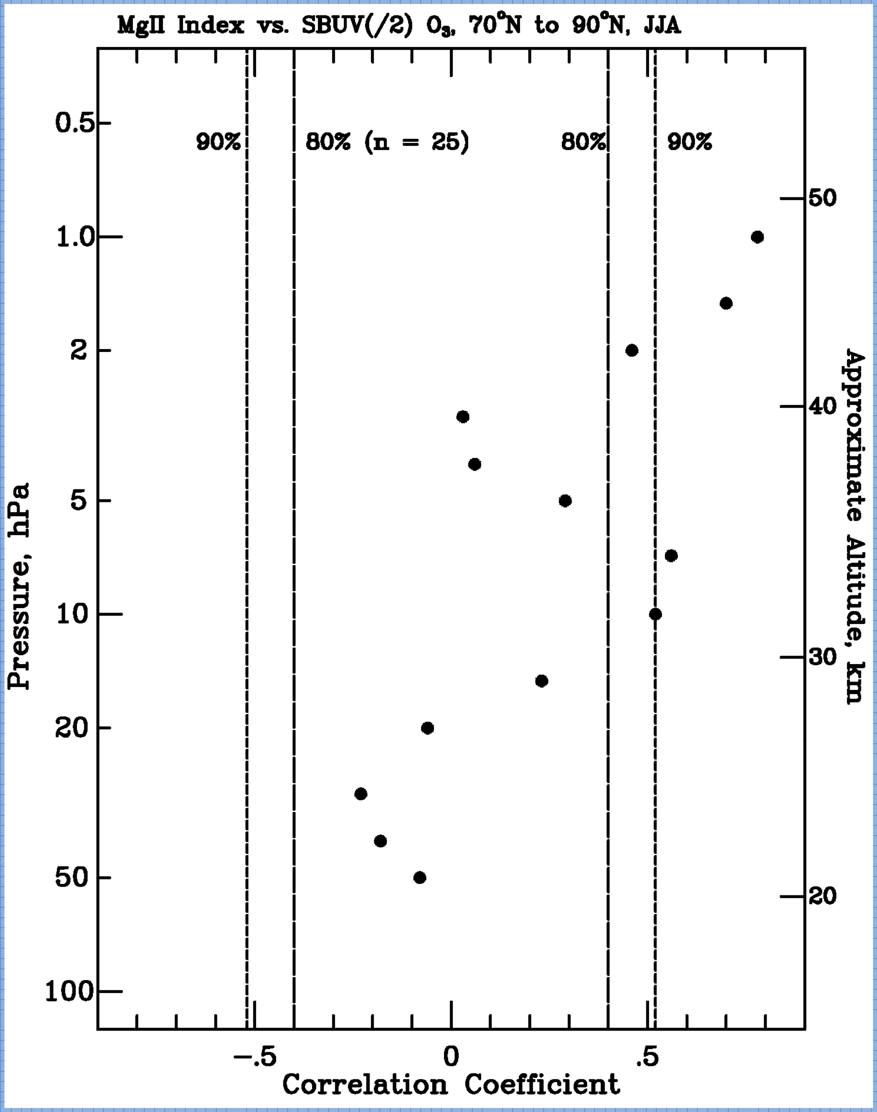


NH Summer:



MULTIPLE REGRESSION STATISTICAL MODEL:

$$O_3(t)' = c_{trend}t + c_{QBO1}u_{30mb}(t\text{-}lag_{QBO1}) + c_{QBO2}u_{10mb}(t\text{-}lag_{QBO2})$$

$$+ c_{volcanic}Aerosol(t) + c_{solar}\,MgII(t) + d_{ENSO}N3.4(t\text{-}lag_{ENSO}) + \varepsilon(t)$$

where:

$O_3(t)$ = deviation of ozone from the seasonal mean

t = time measured in 3-month seasonal increments

$U_{30(10)mb}(t\text{-}lag_{QBO})$ = NCEP 30(10) mb equatorial wind speed (lagged)

Aerosol(t) = Volcanic aerosol index (10 hPa and below only)

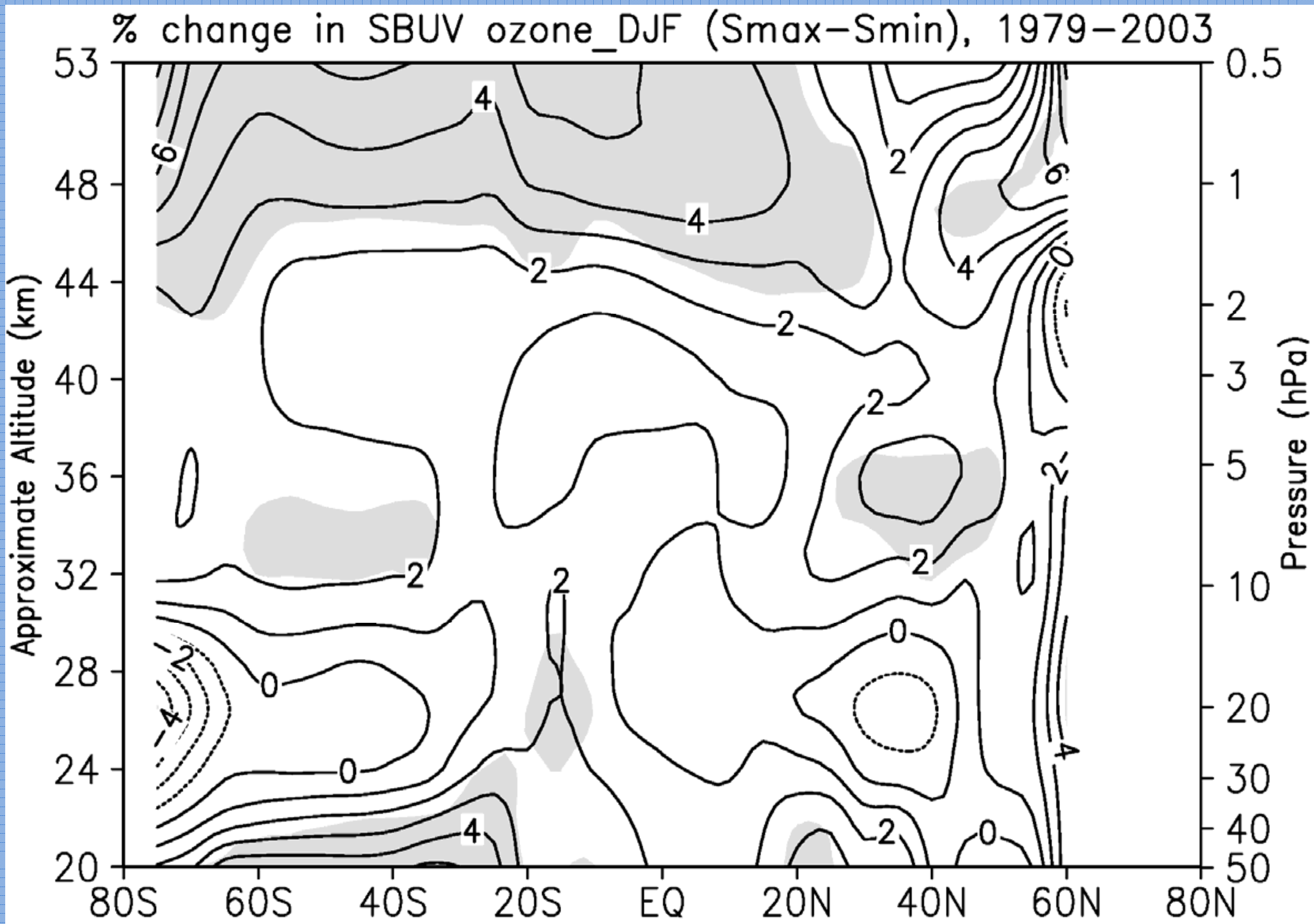
MgII(t) = Solar MgII UV index

$N3.4(t\text{-}lag_{ENSO})$ = Mean SST, $5^oS - 5^oN$, $120^oW - 170^oW$ (lagged)

$\varepsilon(t)$ = residual error term

2. *Solar UV Contribution to O_3 in NH and SH Summer:*

SH Summer:



Shaded areas are significant at 95% Confidence

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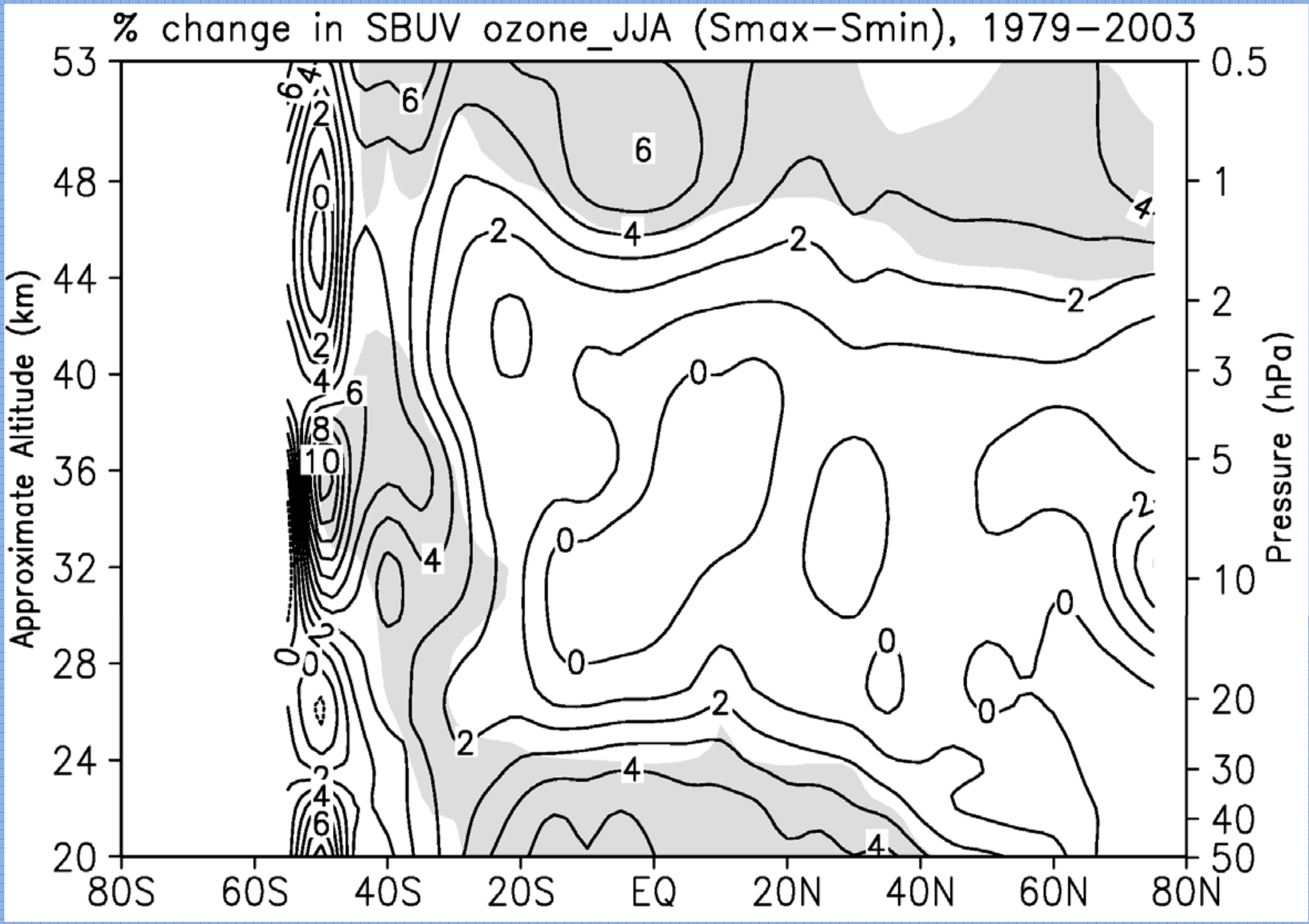

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CONCLUSIONS

1. **In the SH in spring, HALOE sunset interannual O_3 anomalies at polar latitudes are significantly negatively correlated with the auroral Ap index in the upper stratosphere but are significantly positively correlated with Ap in the lower stratosphere. The upper stratospheric correlation is attributable to EPP-NO_x chemical destruction while the lower stratospheric correlation may reflect EPP-NO_x deactivation of chlorine in the ozone hole, which would reduce the O_3 loss rate there.**

2. **In both hemispheres in summer, SBUV (/2) O_3 anomalies at polar latitudes in the uppermost stratosphere (1 - 2 hPa) correlate positively with the Mg II solar UV index over a 30-year period. A nearly significant positive correlation also occurs in the middle stratosphere (~ 7 hPa). The positive correlation in the uppermost stratosphere in summer is attributable to increased ozone production through O_2 photolysis. Multiple regression statistical analyses confirm these correlative results.**