Ozone Products from the NCEP GFS

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Outline

- **Ozone in the NCEP/GFS and Model Development**
  - **Past**
  - **Present**
  - **Future**
- **Comparisons with SMOBA, OMI**
  - **Satellite Monitoring Ozone Blended Analysis**
    - **Blending SBUV/2 and HIRS (TOVS, TOAST)**
  - **Analyses & zonal mean diff**
- **Quality of forecasts**
  - **RMS errors (absolute and percent)**

Past

- **Prior to June 1998 ozone was prescribed climatology**
- **Model was T126/L28**
  - **105 km horz res**
  - **3 layers above 100 hPa**
- **SBUV/2 total & profile ozone began being assimilated in June 1998.**
  - **Model was T170/L42**
  - **80 km horz res**
  - **10 levels above 100 hPa**
  - **More ozone layers than model layers**
- **In 2002 model upgraded to T254/L64**
  - **55 km horz res**
  - **21 levels above 100 hPa**
  - **Able to utilize SBUV/2 vertical resolution**
  - **Not all SBUV/2 layers assimilated**

Present

- **Present model is T382/L64**
  - **35 km horz res**
  - **Extended 64 levels for all 14 days**
  - **Improves stratosphere fcsts beyond day 5**
- **GFS output resolution**
  - **standard 1°x1°**
  - **Available at 0.5°x 0.5°**
  - **3 hour forecast output out to 14 days**
- **Currently assimilating both NOAA-16 and NOAA-17 SBUV/2 ozone products**
- **Ozone is assimilated for**
  - **LW and SW radiation**
  - **Extraction of Temp info from ozone sensitive HIRS channel**
- **Use as boundary conditions for NCEP AQ model**
- **Ozone forecasts used in UV Index forecasts**

Present *(cont.)*

- **GFS has ozone chemistry**
  - **P+L terms *f*(lat, time, pressure)**
  - **Currently out of balance, GFS looses ozone with time**
- **Brewer-Dobson circulation also suspect for being too aggressive in transporting ozone from tropics to poles.**
- **No ozone observations in polar night.**
  - **SMOBA uses TOAST in polar night region**
- **Leave only dynamic transport**
- **Model does not have heterogeneous ozone destruction chemistry.**

Future

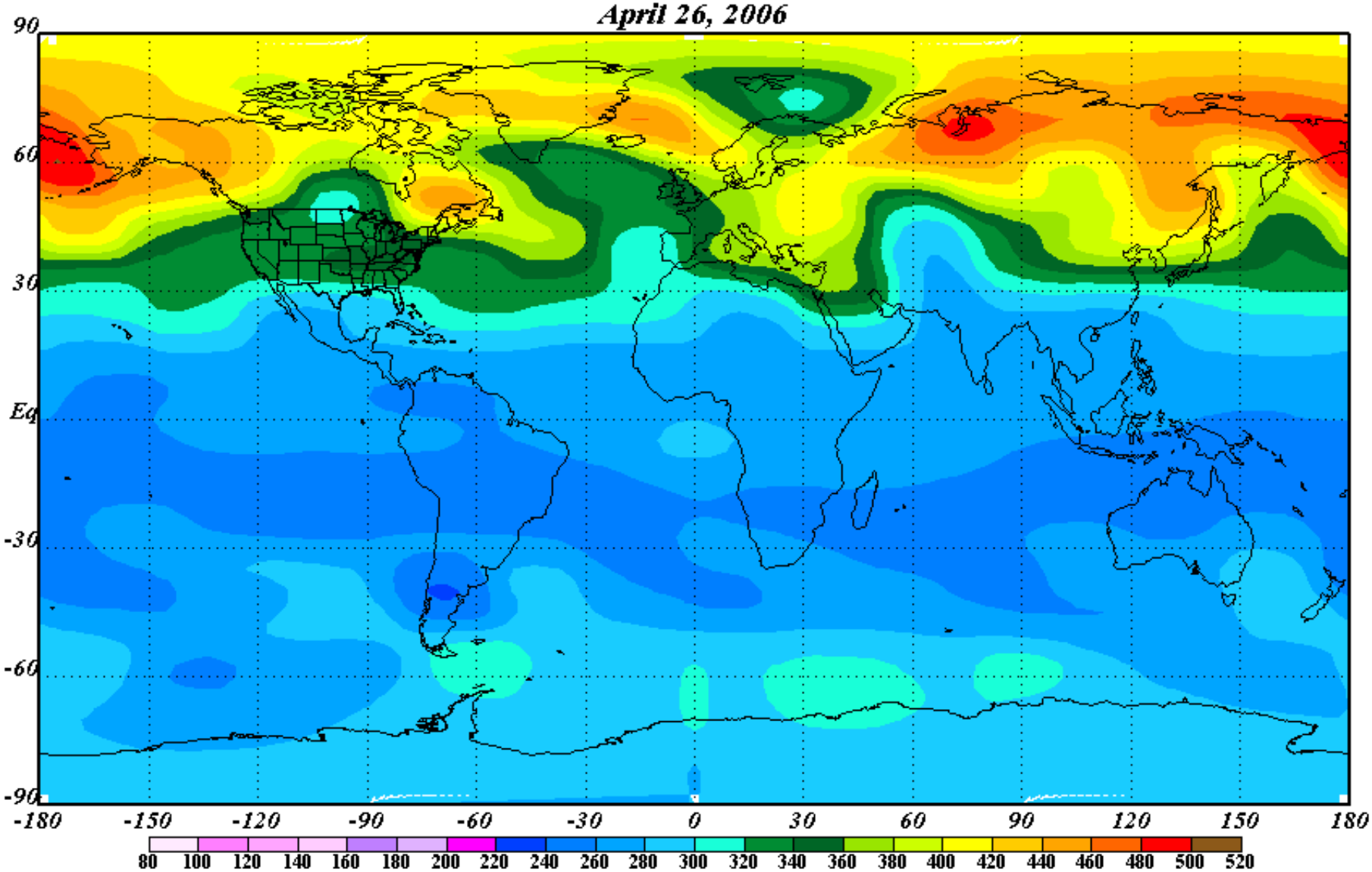
- New ozone chemistry parameterization
  - Tuned to model
- Additional ozone sources
  - Aura/OMI total and profile ozone (scans)
  - Aura/HIRDLS ozone profiles
  - MetOp GOME-2
  - AIRS ozone products as possible source of polar night obs
  - NPP and NPOESS OMPS
    - Replaces SBUV/2
    - Downward scanning and limb profiler
- Additional obs affecting ozone
  - Water vapor
  - Methane

Comparisons between GFS, SMOBA, and OMI
Total Ozone

- **Qualitative**
  - **Differing resolutions**
  - **Differing analyses**
  - **Differing inputs**
- **Quantitative**
  - **Zonal mean agreement (differences)**

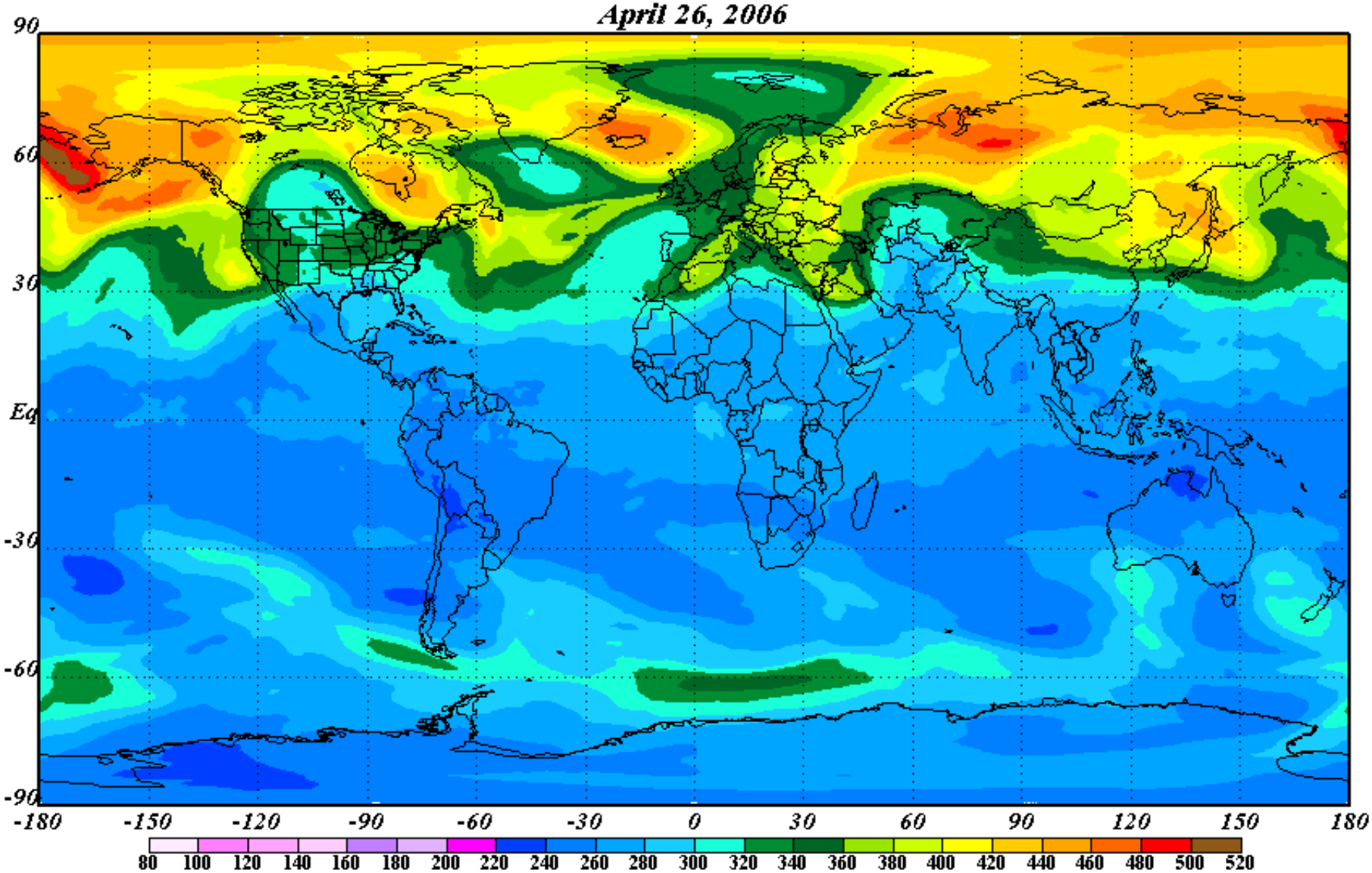
SMOBA TOTAL OZONE

April 26, 2006



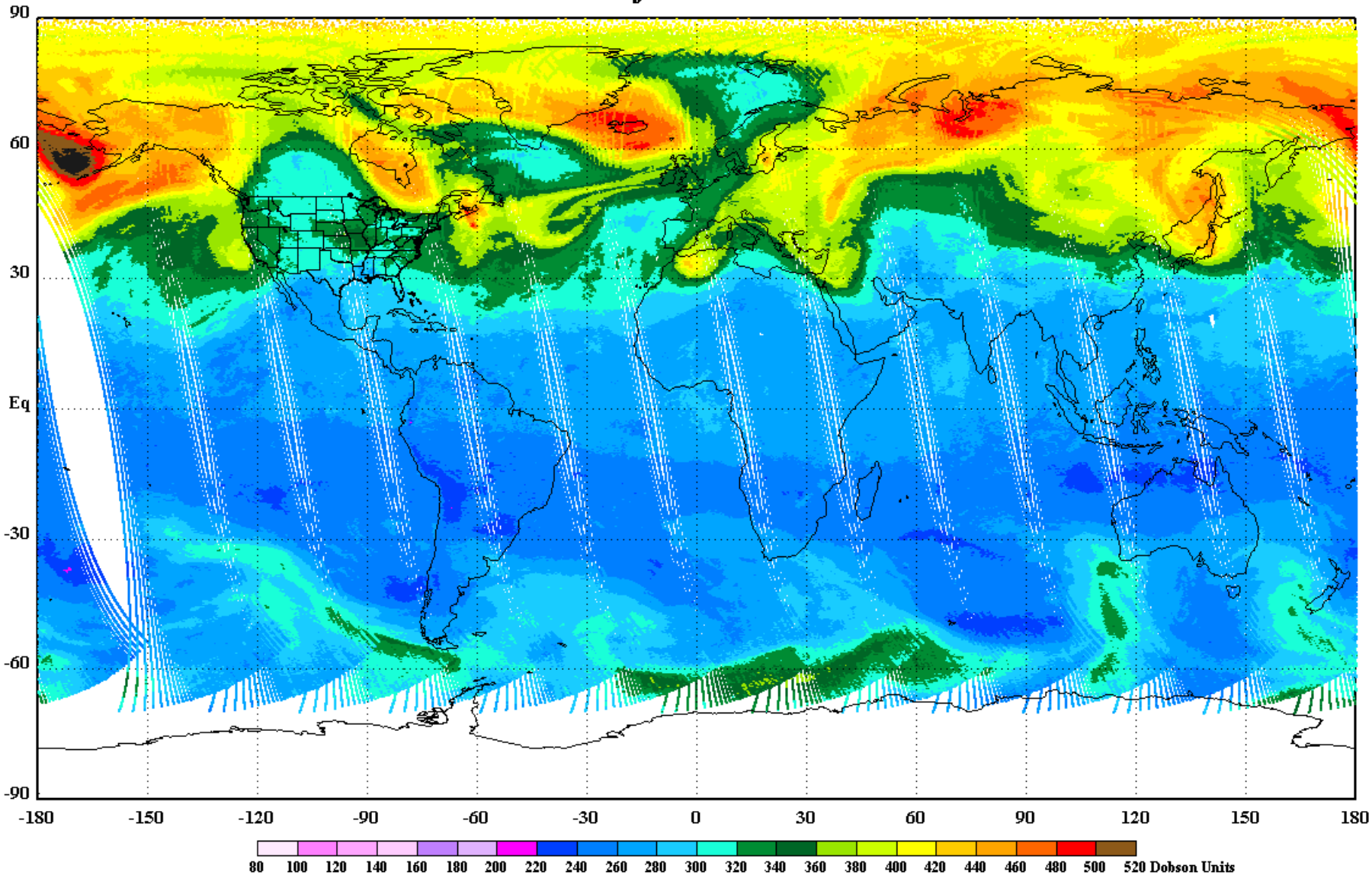
NCEP/GFS TOTAL OZONE

April 26, 2006

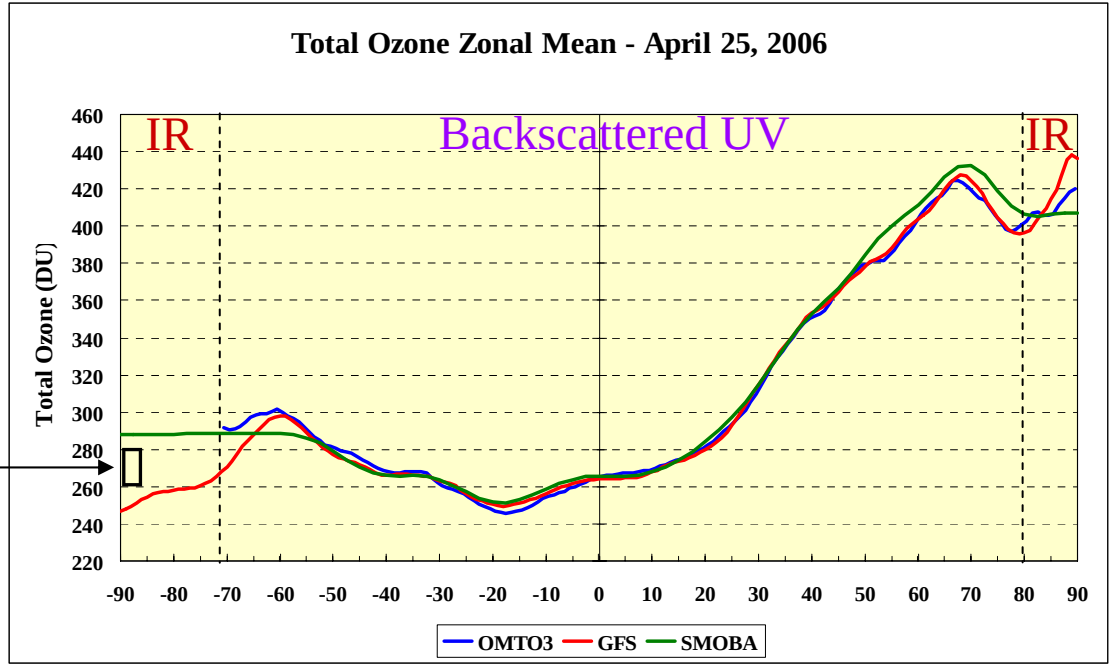


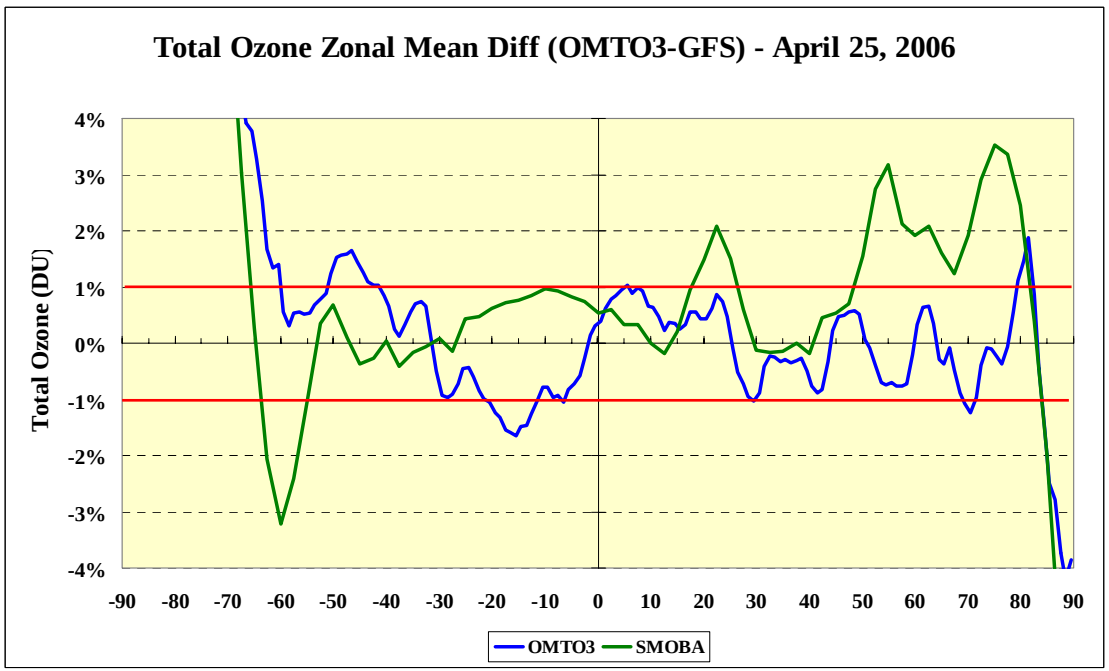
AURA/OMI TOTAL OZONE OBSERVATIONS

Data for : 04/25/2006



Climatological range of SP April observations

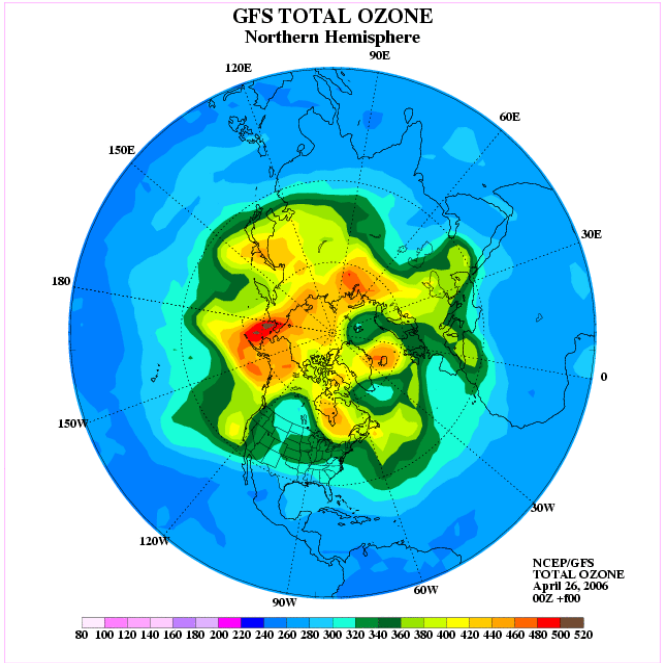


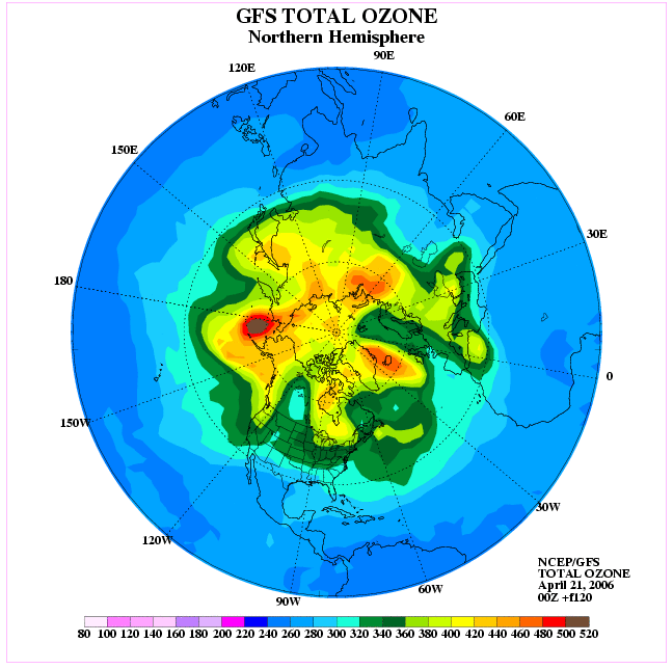


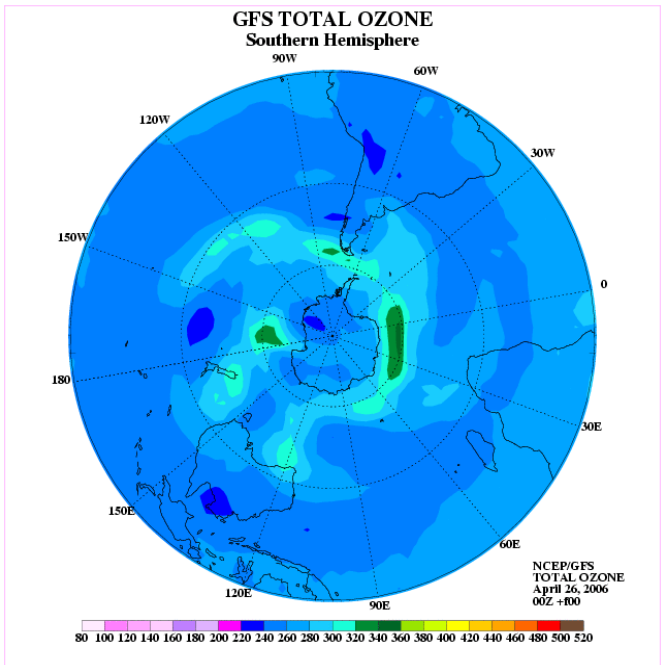
Quality of GFS Total Ozone Forecasts

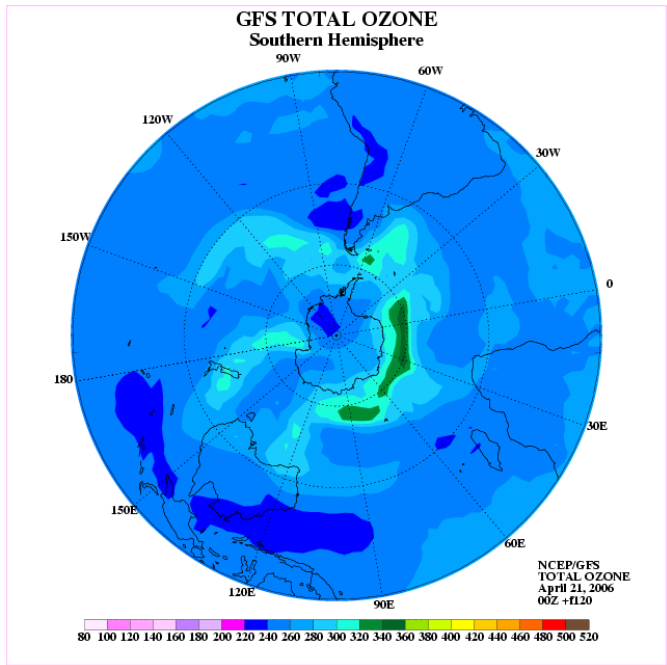
- **Qualitative**
  - **Comparison of 5 day forecast field with validating analysis**
- **Quantitative**
  - **Zonal mean RMS errors for 1, 2, and 3 day forecasts**

Analyses
For
00Z April 26







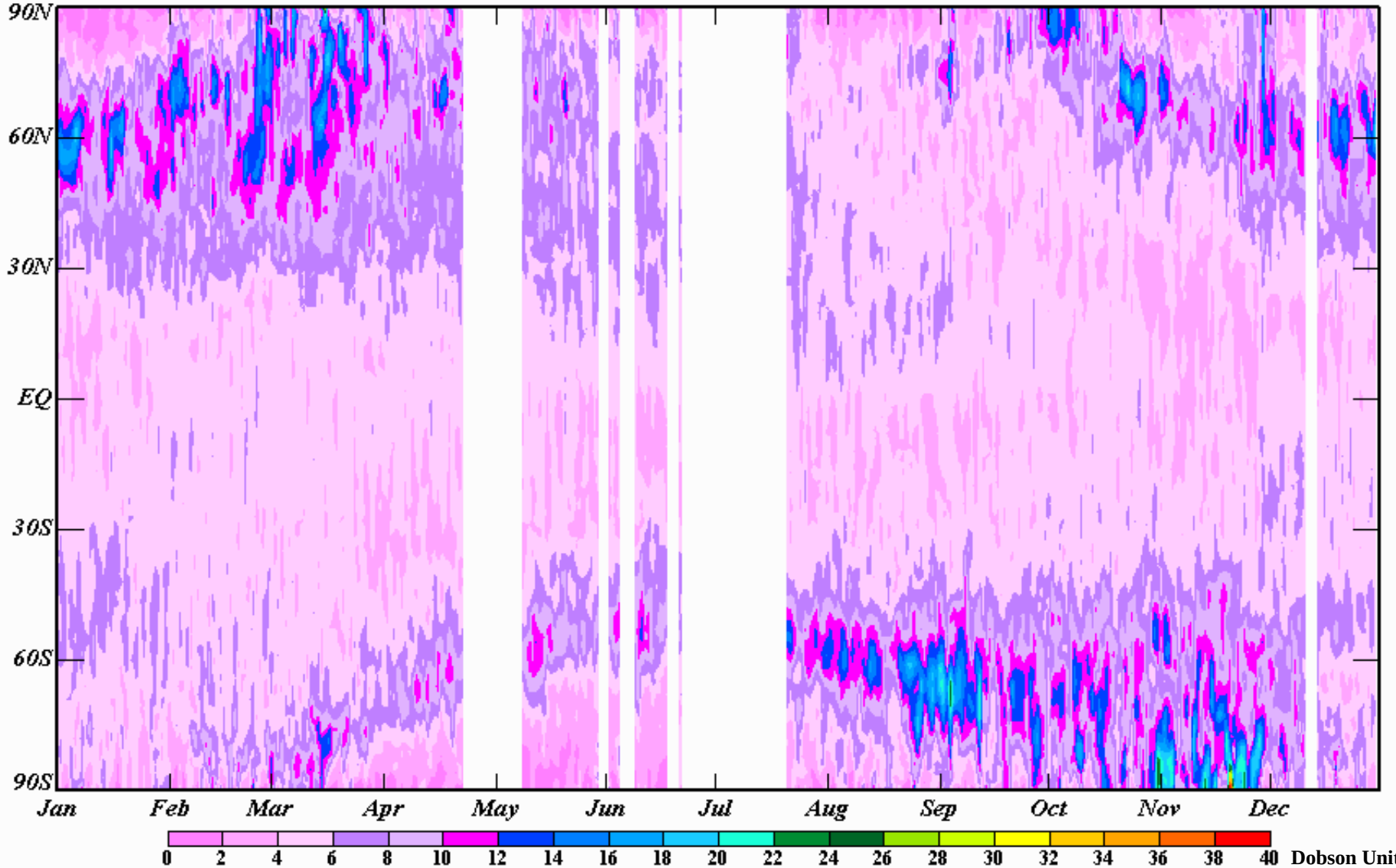


5 Day
Forecasts
Valid at
00Z April 26

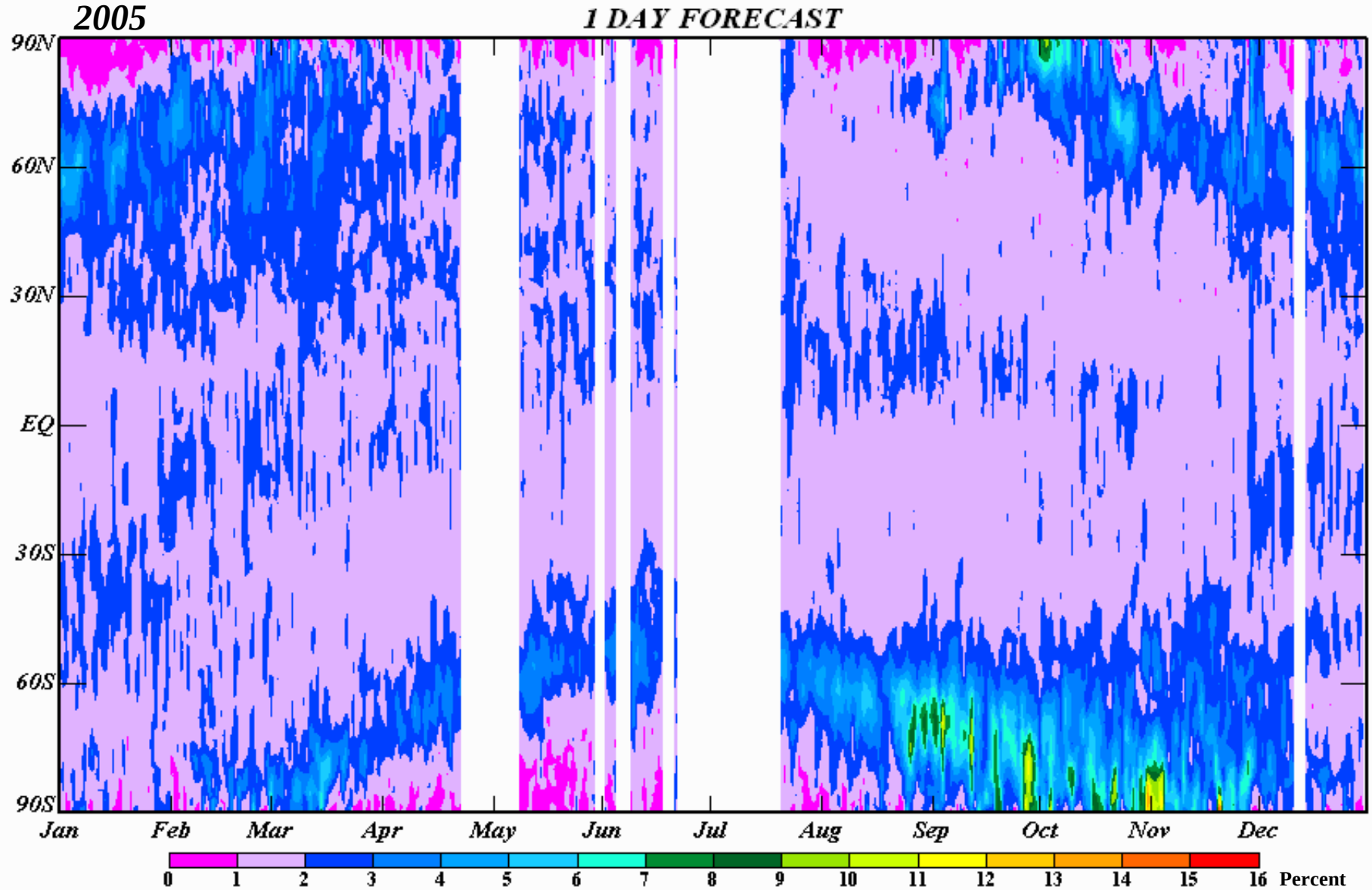
NCEP/GFS TOTAL OZONE FORECAST RMS

2005

1 DAY FORECAST



NCEP/GFS TOTAL OZONE FORECAST PERCENT RMS ERROR



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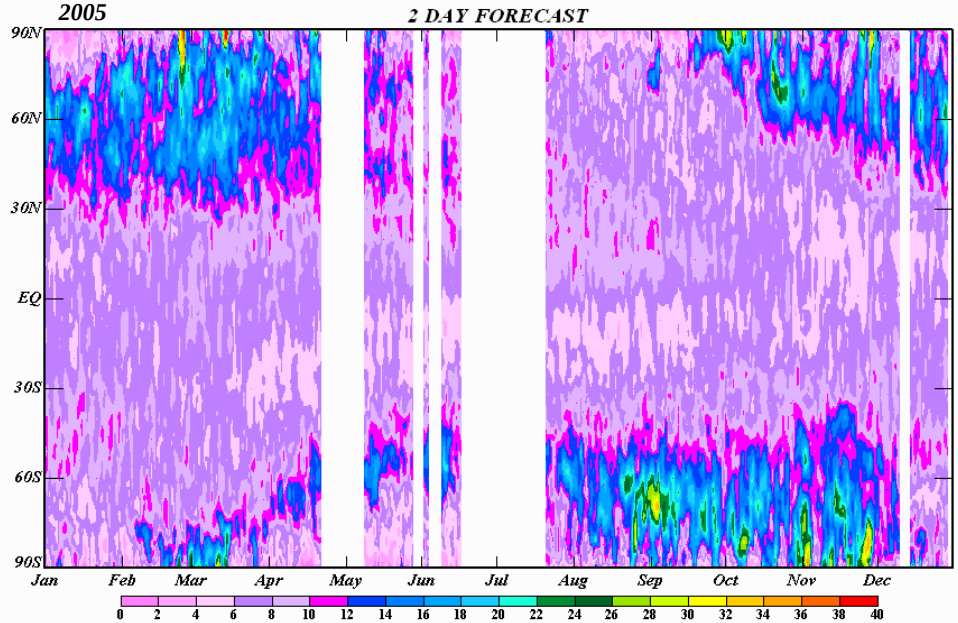

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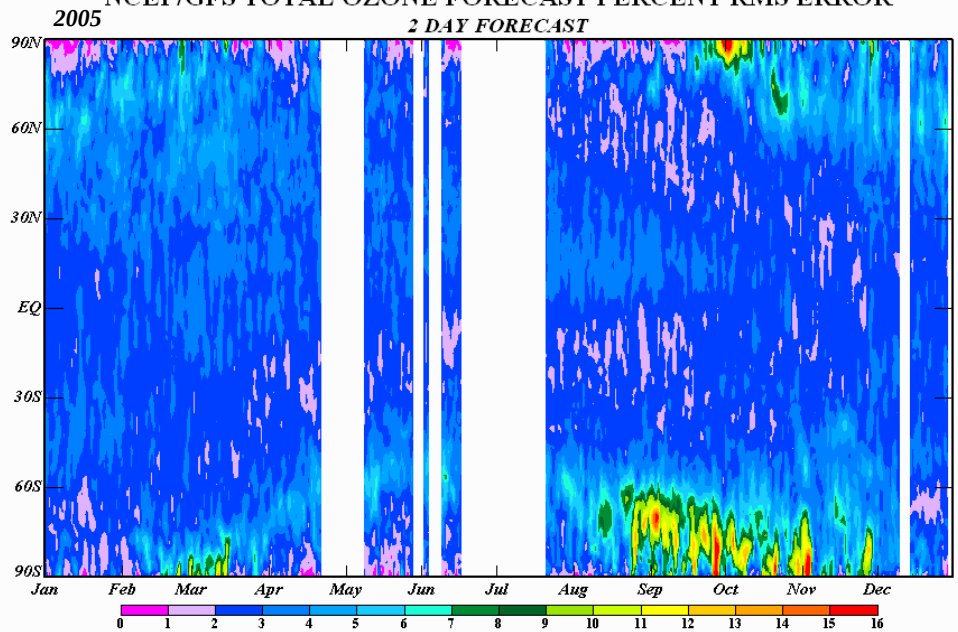

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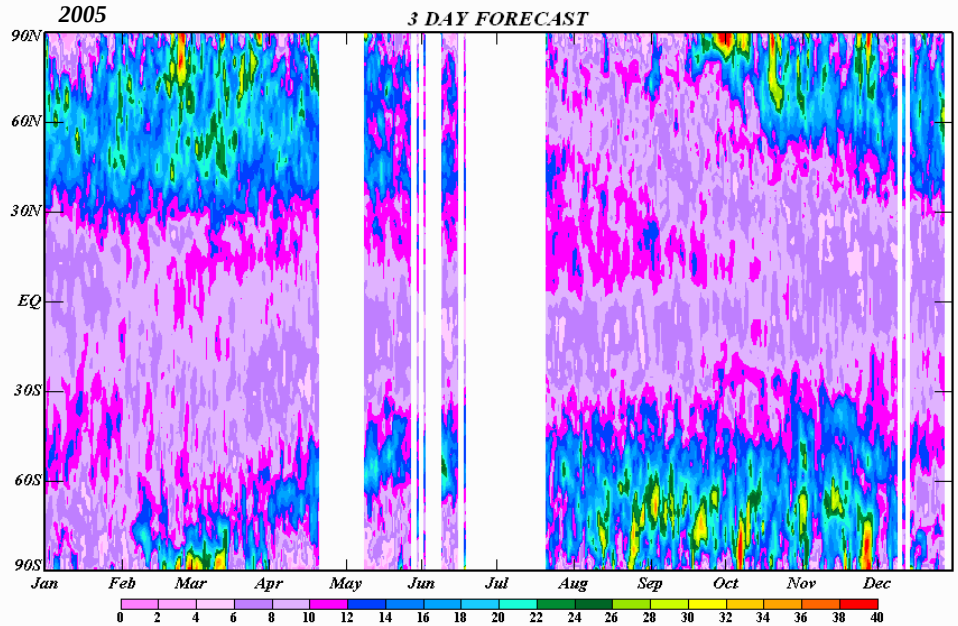

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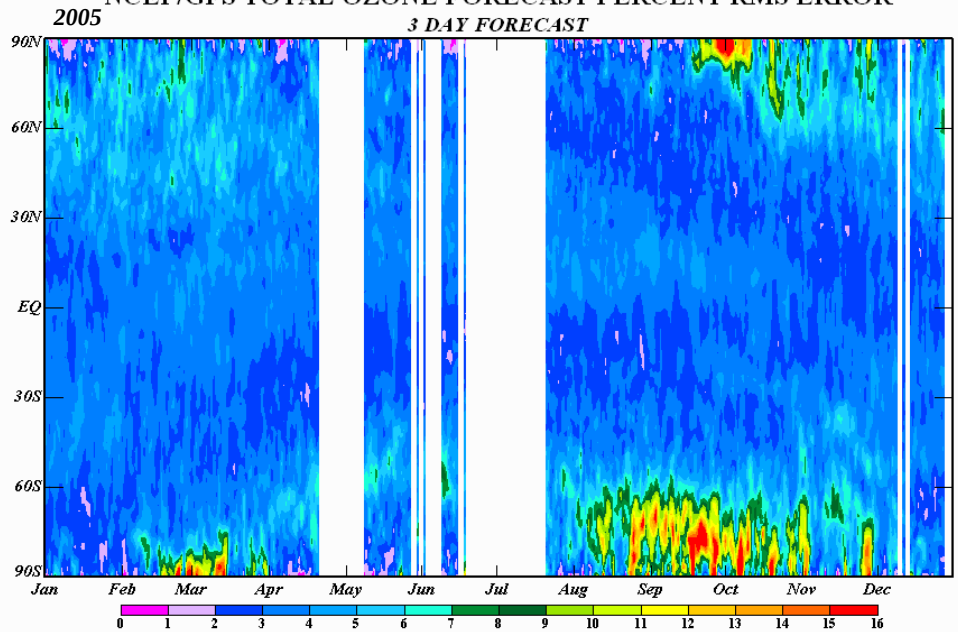
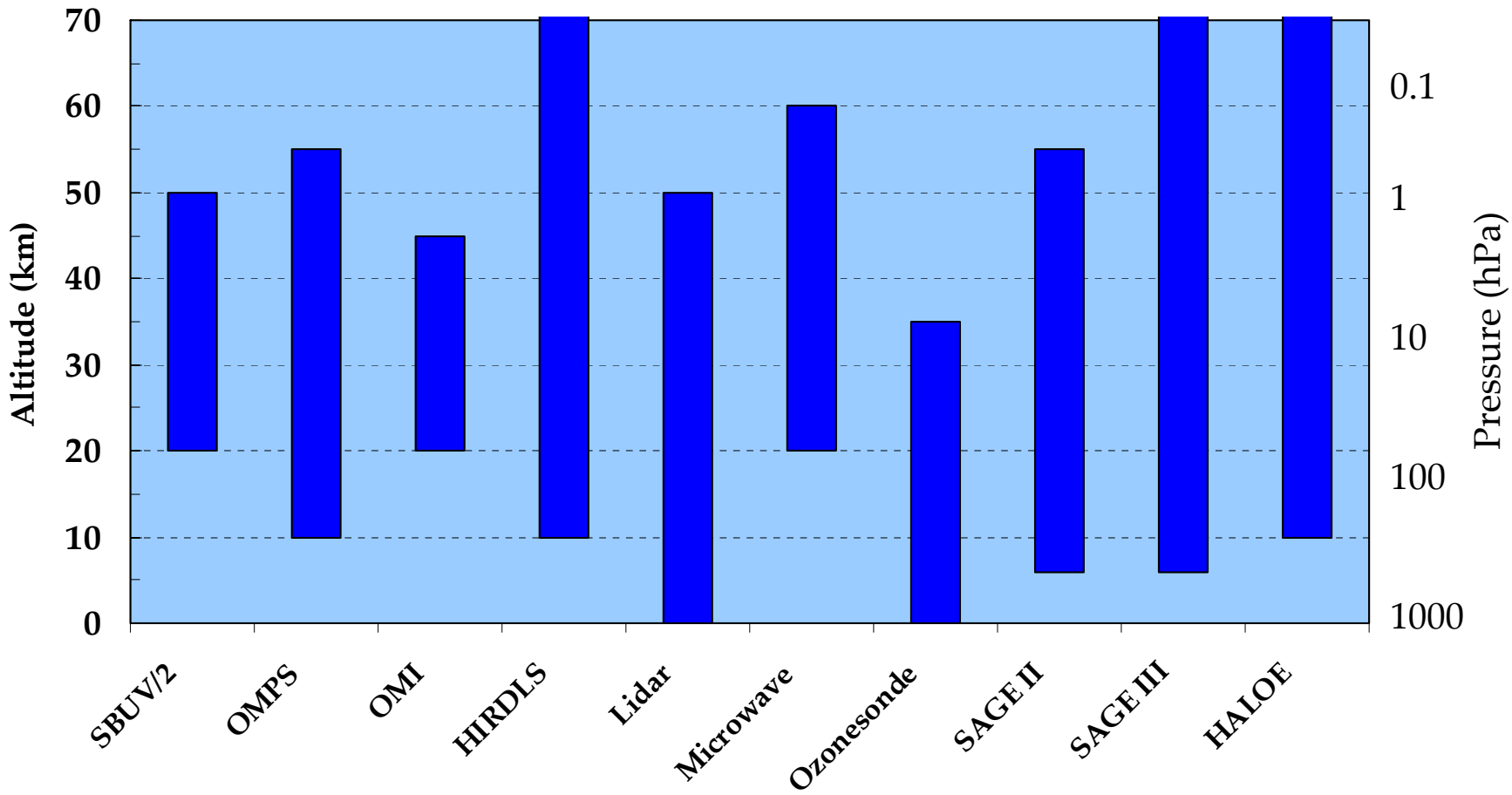


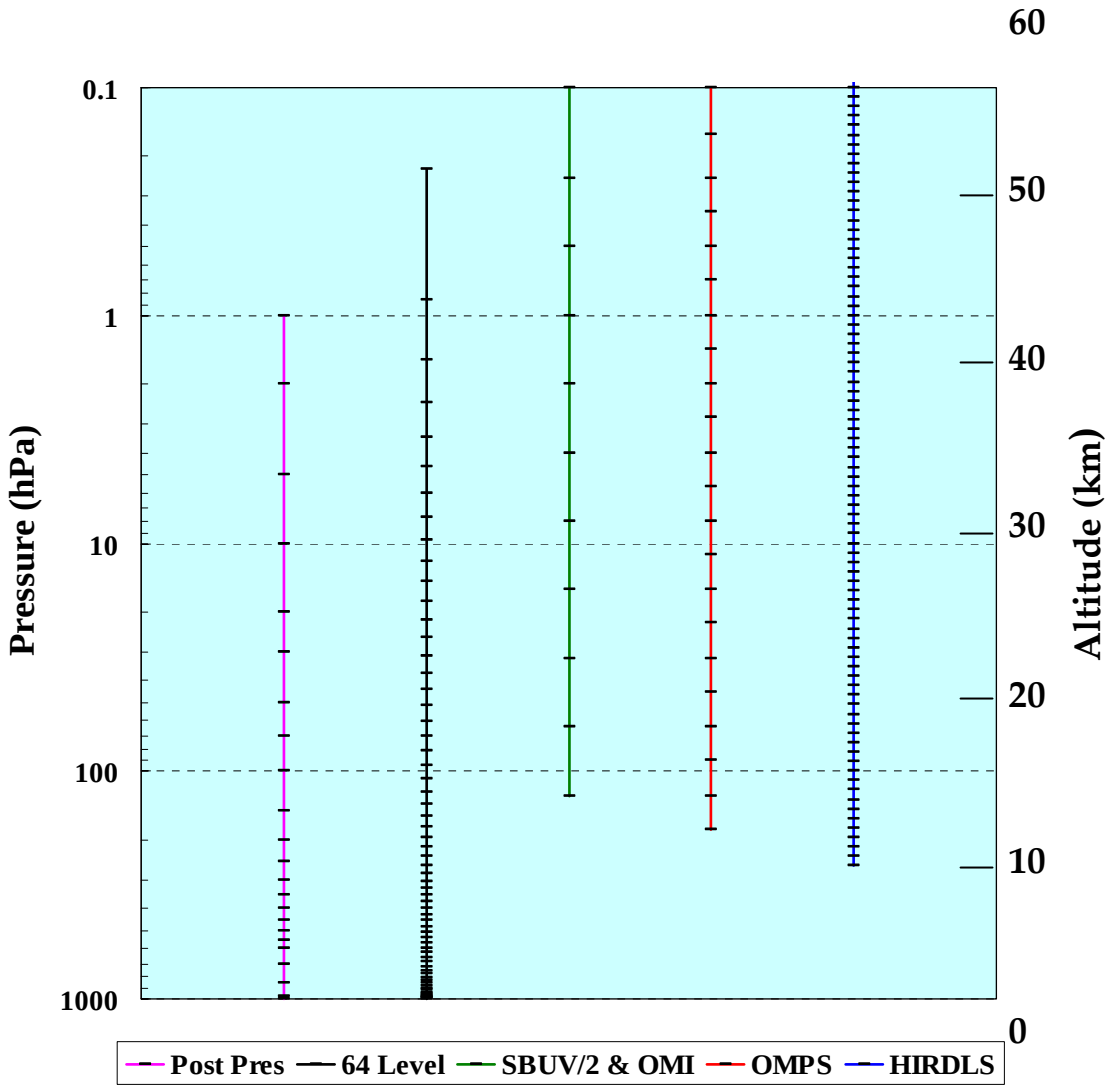
Ozone Profile Information

- **More, higher vertical resolution observations will soon be tested in parallel**
  - **OMI profile scanner**
  - **HIRDLS**
  - **GOME-2**
- **Future profile information from**
  - **OMPS (NPP, NPOESS)**

Vertical Extent of Various Ozone Data Sources



NCEP Global Model Vertical Resolutions



Summary

- **NCEP/GFS ozone products provide:**
  - **High resolution data set.**
  - **Forecasts with small rms errors out to 5 days.**
  - **Potentially better information in polar night.**
  - **Will provide highly resolved vertical profiles with addition of OMI, HIRDLS, and OMPS profile data.**
  - **Could be the backup in the rare event of missing SMOBA obs**

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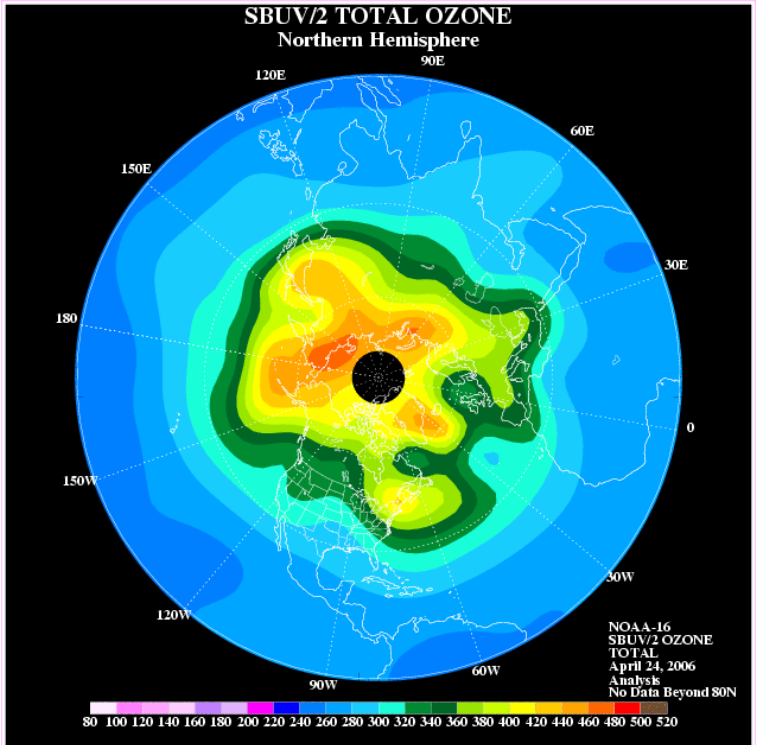
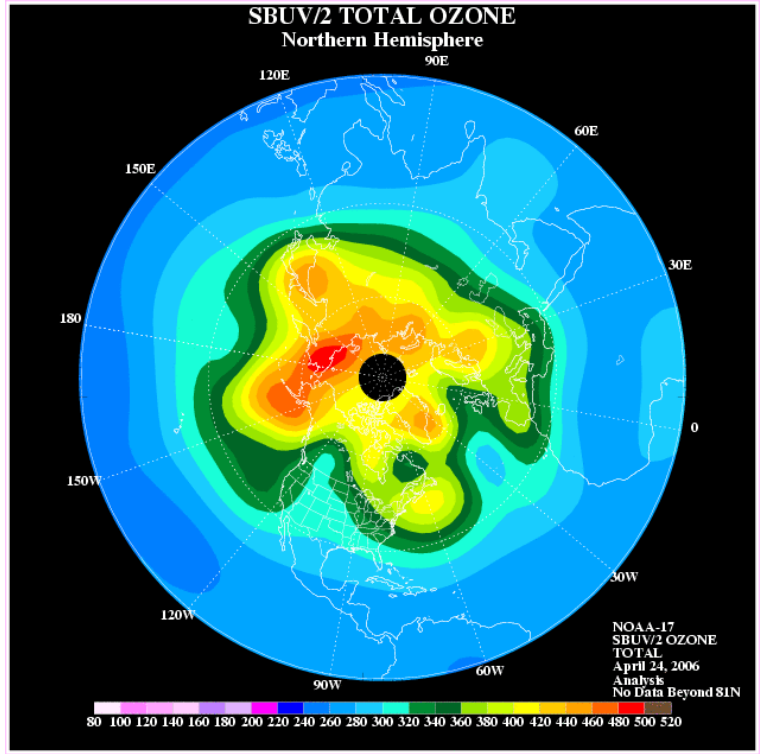

SBUV/2 TOTAL OZONE
Northern Hemisphere
90E
120E
60E
150E
30E
180
0
150W
30W
120W
60W
90W
NOAA-16
SBUV/2 OZONE
TOTAL
April 24, 2006
Analysis
No Data Beyond 80N
80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520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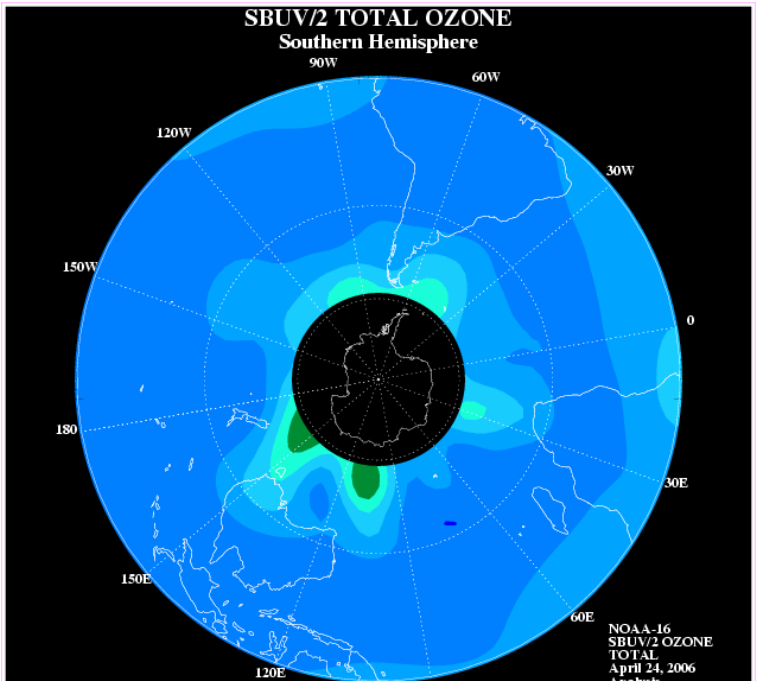
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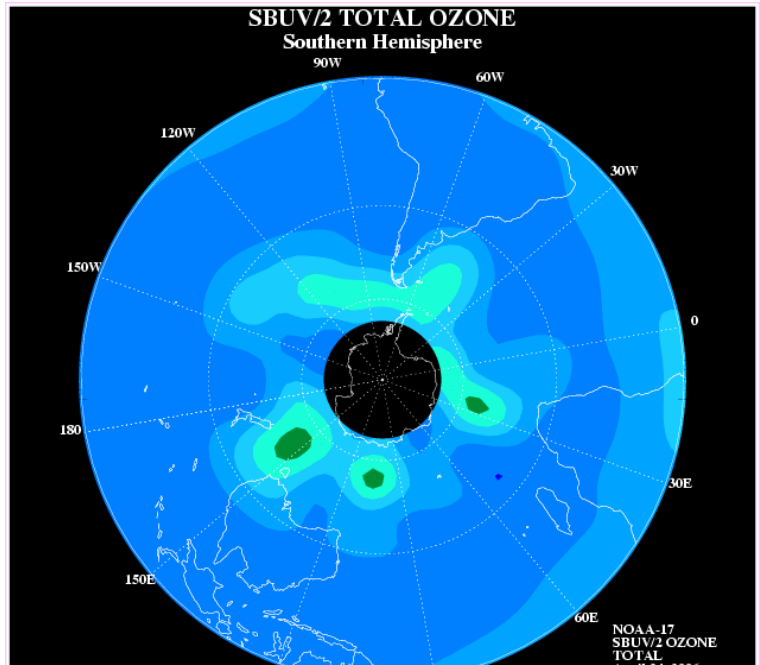
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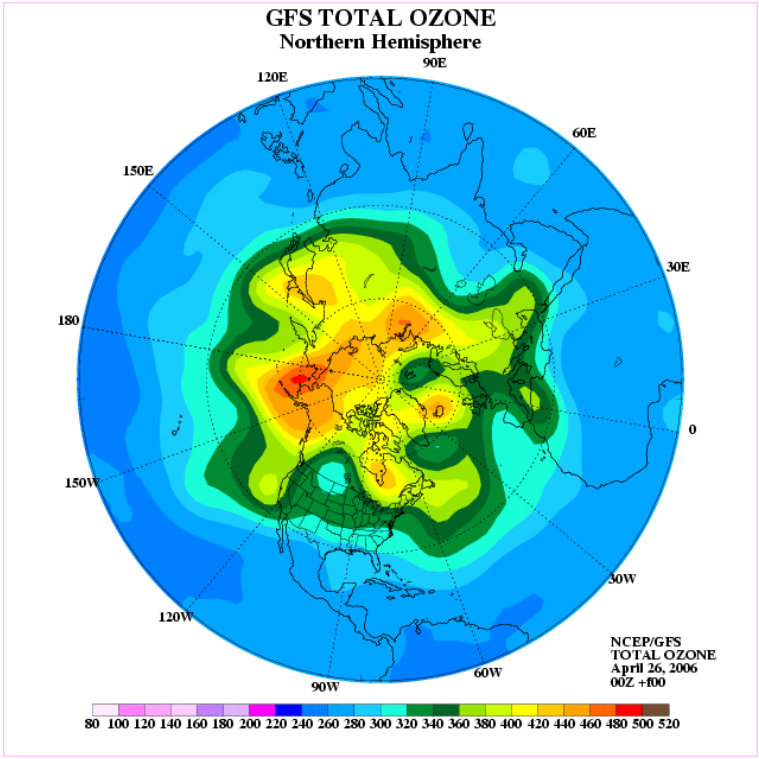
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30E
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30W
120W
60W
90W
NCEP/GFS
TOTAL OZONE
April 26, 2006
00Z +f00
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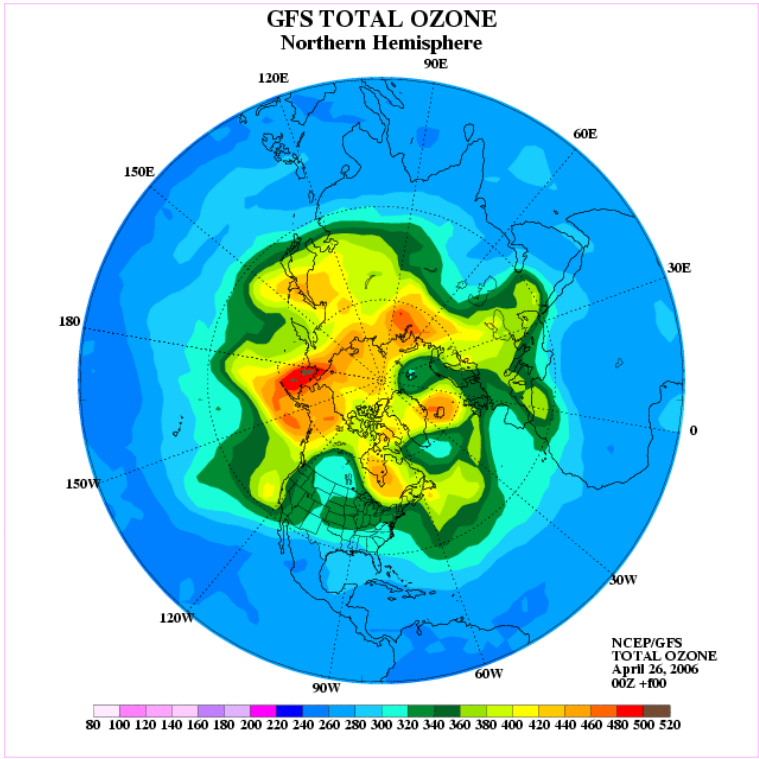
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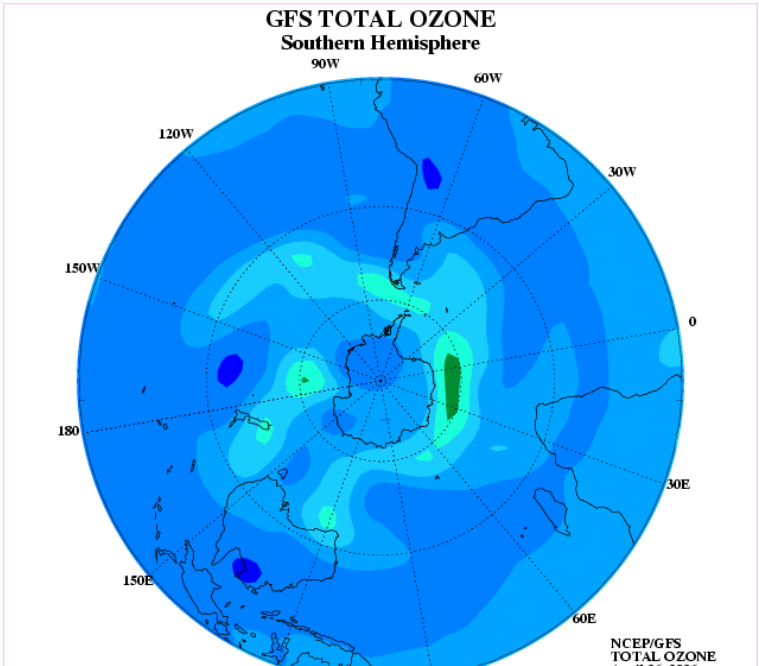
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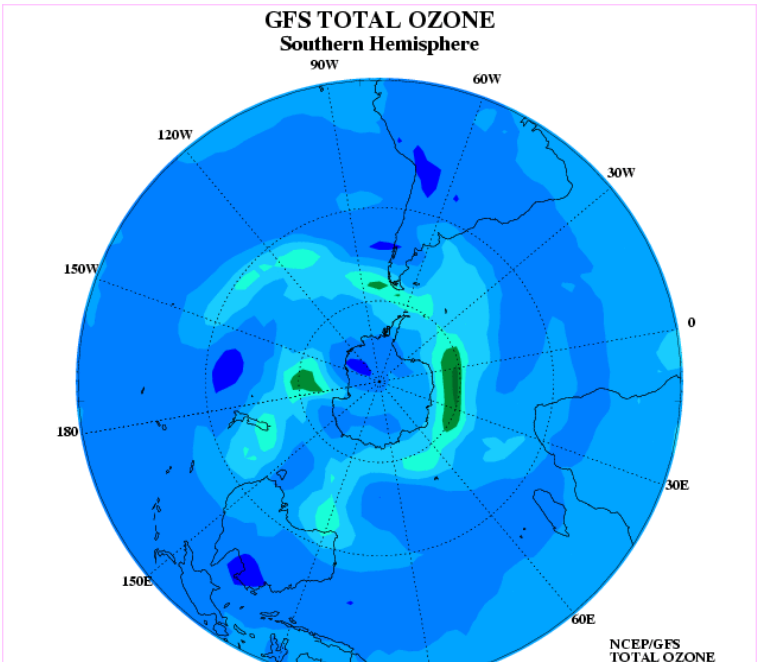
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