Ozone Products from the NCEP GFS

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May 2006
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 $f(\text{lat, time, pressure})$
  - 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)
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

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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

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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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