An Update on Trends in the Vertical Distribution of Ozone


Summary
• recent years confirm significant ozone increase in upper stratosphere
• observed magnitude + latitude-altitude pattern consistent with recovery
• no significant trends below 10 hPa / 30 km (as expected)
• SBUV-, MLS- and OSIRIS – based records give consistent picture
• ground-based records generally agree, but some outliers
• uncertainty margins of SII2N (Harris et al. 2015) very conservative

1. Recent的变化
2. Summary of results
3. Discussion of uncertainty
4. Conclusion

References


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http://www.dwd.de/ozone

"Recovery" near 2 hPa / 40 km
• all records show significant increase in upper stratosphere (>2 hPa)
• additional years tighten results (expected –N~5)
• spread (of these records) smaller than SII2N uncertainty range, trend larger
• observed trends consistent with CCMVal2 simulations (2.7±1.8 vs. 2.8±0.7 %/dec)
• some station trends differ (lidar @ 2 hPa, FTIR @ 100 hPa, µWave @20 hPa)

Trend patterns
• largest trends near 2 hPa, high latitudes
• post-2000 increase mirrors old decline
• no significant increase below 10 hPa
• recent years confirm WMO 2014
• OSIRIS, MLS (GOZCARDS, SWOOSH), and SBVU (NASA, NOAA) give consistent results

Multiple linear regression
• monthly anomalies (%) vs. time
• hockey-stick trend (1997) with volcanic aerosol
• fit linear trend (2000 to 2015/16)
• uncertainty from fit residuals, AR1 corrected

Trend period

Trend (2hPa, 35°N to 60°N)
SI2N (J): +1.3±4.8 %/dec WMO 2014: +3.9±1.3 %/dec here (J,sat): +2.7±1.8 %/dec

latitude - altitude pattern of ozone trends
• observed, 2000-2013
• observed, 2000-2016
• observed, 2000-2015

vertical profile of ozone trends (35°N to 60°N)
• observed, 2000-2013
• observed, 2000-2015
• observed, 2000-2016

Ozone anomalies (1993 to 2012 baseline)
GOZCARDS, SWOOSH, SAGE II + OSIRIS
NDACC, lidar, GOZCARDS, occultation ozone profile data records

CCMVal2, trend at 50 hPa

observed, 1984-1997

simulated, 2000-2015

simulated, 2000-2016

observed, 2000-2013

observed, 2000-2015

observed, 2000-2016

observed, 2000-2013

observed, 2000-2015

observed, 2000-2016

observed, 2000-2015