
Status of POAM III Version 4 retrievals

Version 4 (V4) is the current operational retrieval version. In the V4 algorithm, gas species and aerosols are retrieved operationally on a uniform 1-km altitude grid between 60 km and a lower limit that is typically in the mid- to upper-troposphere. A detailed discussion of the retrieval errors, information content, and spatial resolution of the POAM Version 3 (V3) retrievals can be found in Lumpe *et al.* [2002a]. This analysis has been updated for the V4 retrievals, and the essential conclusions are summarized in Table 1. The “valid altitude range” for each species is the range over which the retrievals have been validated against correlative data sets or are otherwise considered valid for scientific use (based on information content and total error budget).

Retrieval Species	Valid Altitude Range (km)	Retrieval Error (%)		Vertical Resolution (km)	
		Strat.	Trop.	Strat.	Trop.
O ₃	5 – 60	≤ 5	15 – 30	1	2 – 5
NO ₂	20 - 45	5 – 10	N/A	1.5 – 3	N/A
H ₂ O	5 – 50	5	10 – 15	1 – 4	1
442-nm Aerosol	5 – 25	10 – 15	20 – 30	1 – 2	1
1018-nm Aerosol	5 – 25	10 – 30	5 – 15	1	1

Table 1. Summary of quality parameters for the POAM Version 4 retrievals.

Validation Summary

The POAM V3 data set has undergone extensive validation. The ozone data has been validated with V6.0 Stratosphere Aerosol and Gas Experiment (SAGE) II and V19 Halogen Occultation Experiment (HALOE) satellite data, and balloon-borne ECC ozonesondes in Randall *et al.* [2003]. Also, Lumpe *et al.* [2002b] compared the POAM V3 ozone retrievals to measurements made from a variety of aircraft and balloon platforms during the SOLVE I campaign, and Prados *et al.* [2003] compared POAM ozone measurements in the UT/LS region to airborne *in situ* measurements from the MOZAIC instrument. The V3 aerosol data have been validated with aerosol measurements from the SAGE II and HALOE satellite instruments in Randall *et al.* [2001]. Validation of the NO₂ data using satellite (HALOE), balloon-borne and ground-based measurements is presented in Randall *et al.* [2002]. Finally, the POAM water vapor retrievals have been validated by Lumpe *et al.* [2005] (stratosphere) and by Nedoluha *et al.* [2002] (UT/LS region).

The POAM team is in the process of validating the new V4 data set, and a detailed validation analysis for each species will be published soon. Much of this analysis has already been done. A summary of the overall validation status and the POAM V3/V4 comparisons is given in Table 2.

<p>O₃: V3≈V4 ±5 % from 13-50 km ~ 15-20 % high bias below 12 km No SR/SS bias Range: 10-60 km</p>	<p>H₂O: 10-20 % high bias from 10-45 km 5-10 % SR/SS bias (NH<SH) Range: 10-50 km</p>
<p>NO₂ Agrees within 10-20% from 20-40 km Range: 20-45 km</p>	<p>Aerosol: NH: Agrees within 30 % from 10-25 km SH: -30 % blue bias from 10-25 km +50 % red bias from 10-25 km Range 10-30 km</p>
<p>No long-term trends in comparisons over 7-year data set</p>	<p>Precision of the retrievals improved in version 4 compared to version 3</p>

Table 2. POAM III Version 3/4 Validation Summary

Lumpe, J. D., R. M. Bevilacqua, K. W. Hoppel, & C. E. Randall, POAM III retrieval algorithm and error analysis, *J. Geophys. Res.*, 107(D21), 4575, 10.1029/2002JD002137, 2002a.

Lumpe, J. D., *et al.*, Comparison of POAM III ozone measurements with correlative aircraft and balloon data during SOLVE, *J. Geophys. Res.*, 107, 8316, doi:10.1029/2001JD000472, 2002b.

Nedoluha, G. E., R. M. Bevilacqua, K. W. Hoppel, J. D. Lumpe, and H. Smit, POAM III measurements of water vapor in the upper troposphere and lowermost stratosphere, *J. Geophys. Res.*, 107(D10), 10.1029/2001JD000793, 2002.

Prados, A. I., *et al.*, POAM III ozone in the upper troposphere and lowermost stratosphere: Seasonal variability and comparisons to aircraft observations, *J. Geophys. Res.*, 108(D7), 4218, doi:10.1029/2002JD002819. 2003.

Randall, C. E., R.M. Bevilacqua, J.D. Lumpe, and K.W. Hoppel, Validation of POAM III Aerosols: Comparison to SAGE II and HALOE, *J. Geophys. Res.*, 106, 27,525-27,536, 2001.

Randall, C. E., *et al.*, Validation of POAM III NO₂, *J. Geophys. Res.*, 107(D20), 4432, doi:10.1029/2001JD001520, 2002.

Randall, C. E., D.W. Rusch, R.M. Bevilacqua, K. W. Hoppel, and J. D. Lumpe, Validation of POAM III O₃: Comparison to ozonesonde and satellite data, *J. Geophys. Res.*, 108 (D12), 4367, doi:10.1029/2002JD002944, 2003.

Version 4 Error Bars and Data Quality Flags

The information contained in the archived error bars has been improved and expanded in the V4 retrievals. The V4 data files also contain new data quality flags meant to help the user identify and screen POAM data potentially contaminated by sunspot artifact and aerosol feedback errors. For a description of the error bars and data quality flags, we strongly recommend that the user read the document entitled "Version 4 Documentation".

The HDF files were created using the HDF library included in IDL version 5.3.

The following is a description of the arrays in the file:

```
; 1-DIM ARRAYS ("n" dimension is orbit number, a uniq id)
; -----
; rev(n)      = integer: Orbit Number (unique id)
; date(n)     = long:   Date (YYYYMMDD)
; sec(n)      = float:  Seconds of day (UT)
; lat(n)      = float:  Latitude (deg)
; lon(n)      = float:  Longitude (0-360 deg)
; max_ss(n)   = float:  Maximum sunspot index for event (dimensionless)
; z_ozone(56) = float:  Ozone altitude grid 5-60 (km)
; z_no2(21)   = float:  NO2 altitude grid 20-40 (km)
; z_h2o(41)   = float:  H2O altitude grid 5-45 (km)
; z_aerosol(21) = float:  Aerosol altitude grid 5-25 (km)
; z_anc(61)   = float:  Anc. data altitude grid 0-60 (km)
; wavelength(6) = float:  Wavelengths of Aerosol Extinction (um)
;
; 2-DIM ARRAYS ("n by nz", nz is altitude dimension)
; -----
; ozone(n,56)   = float: Ozone Concentration (cm-3)
; err_ozone(n,56) = float: Ozone Error Bars (cm-3)
; flag_ozone(n,56) = integer: Ozone Data Quality Flag (dimensionless)
; no2(n,21)     = float: NO2 Concentration (cm-3)
; err_no2(n,21) = float: NO2 Error Bars (cm-3)
; flag_no2(n,21) = integer: NO2 Data Quality Flag (dimensionless)
; h2o(n,41)     = float: H2O Concentration (cm-3)
; err_h2o(n,41) = float: H2O Error Bars (cm-3)
; flag_h2o(n,41) = integer: H2O Data Quality Flag (dimensionless)
; temperature(n,61) = float: UKMO Temperature (K)
; pressure(n,61) = float: UKMO Pressure (mb)
; pv(n,61)      = float: UKMO Potential Vorticity
```

```
;
; 3-DIM ARRAYS ("n by 6 by nz")
; -----
; aerosol(n,6,21) = float: Aerosol Extinction wavelengths
;                  defined by 'wavelength' (km-1)
; err_aerosol(n,6,21) = float: Aerosol Error Bar (km-1)
```

Each POAM measurement is uniquely identified by the orbit number and hemisphere. All orbital sunset measurements occur in the southern hemisphere while sunrises are in the northern hemisphere. Because separate IDL files are made for the Southern Hemisphere (denoted by "sh") and Northern Hemisphere (denoted by "nh") data, the REV number serves as a unique identifier within the file. The array dimension "n" identifies the rev/time axis.

POAM III aerosol extinction coefficient measurements are given at the following wavelengths (in microns): 0.355, 0.4421, 0.602, 0.780, 0.923, 1.02

Missing values are indicated by the fill value of -99 in all arrays. The lowest altitude of valid retrievals for each occultation is determined by lowest altitude to which the POAM III instrument was able to track the sun.

The ancillary meteorological profiles are obtained by interpolating the UKMO data to the POAM III measurement position and time.