In situ measurements of nitric acid during the WB-57F Aura validation experiments

Peter J. Popp

Aeronomy Laboratory
National Oceanic and Atmospheric Administration

T.P. Marcy, E.J. Jensen, B. Kärcher, D.W. Fahey, R.S. Gao, T.L. Thompson, K.H. Rosenlof, E.C. Richard, R.L. Herman, E.M Weinstock, J.B. Smith, R.D. May, H. Vömel, J.C. Wilson, A.J. Heymsfield, M.J. Mahoney, A.M. Thompson, M.L. Santee and the MLS Team

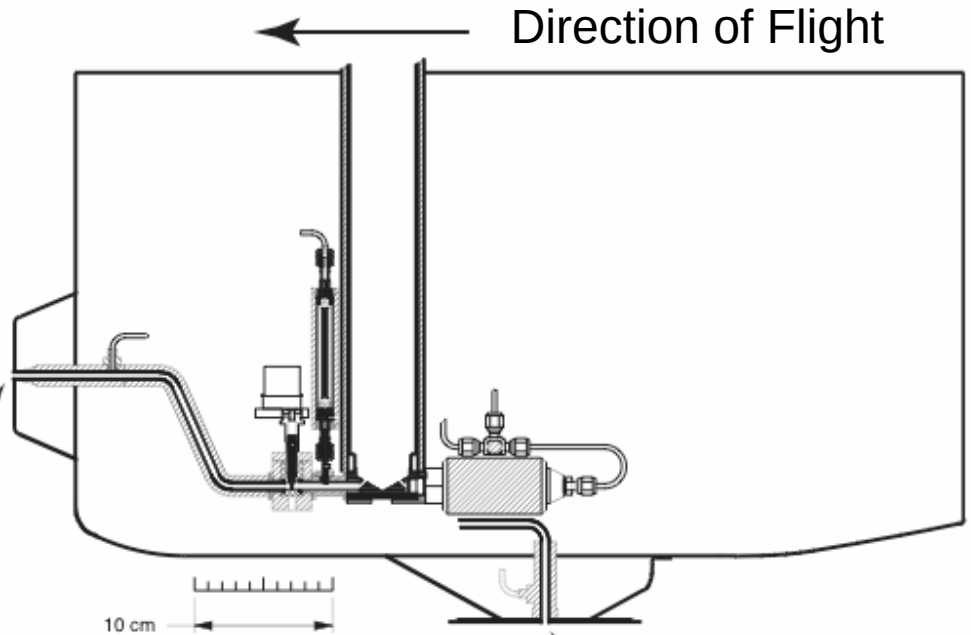
In situ measurements of nitric acid during the WB-57F Aura validation experiments

- The observation of nitric acid-containg particles in the tropical lower stratosphere during Pre-AVE
- Validation of MLS HNO_3 using in situ measurements during AVE-October 2004

NOAA CIMS instrument

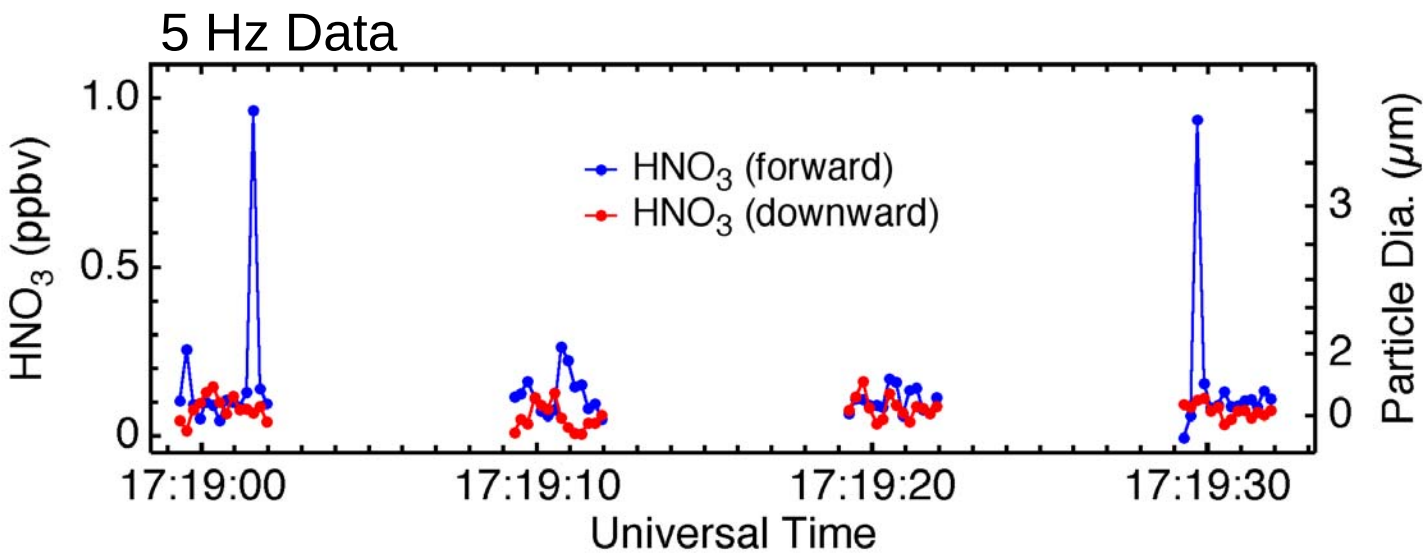
- Two independent channels of detection allow us to measure both gas- and particle-phase HNO_3
- Precision: 40 pptv (1σ at 1 second)
  Accuracy: 25%

$SF_5^- + HNO_3 \rightarrow SF_4 + HFNO_3^-$

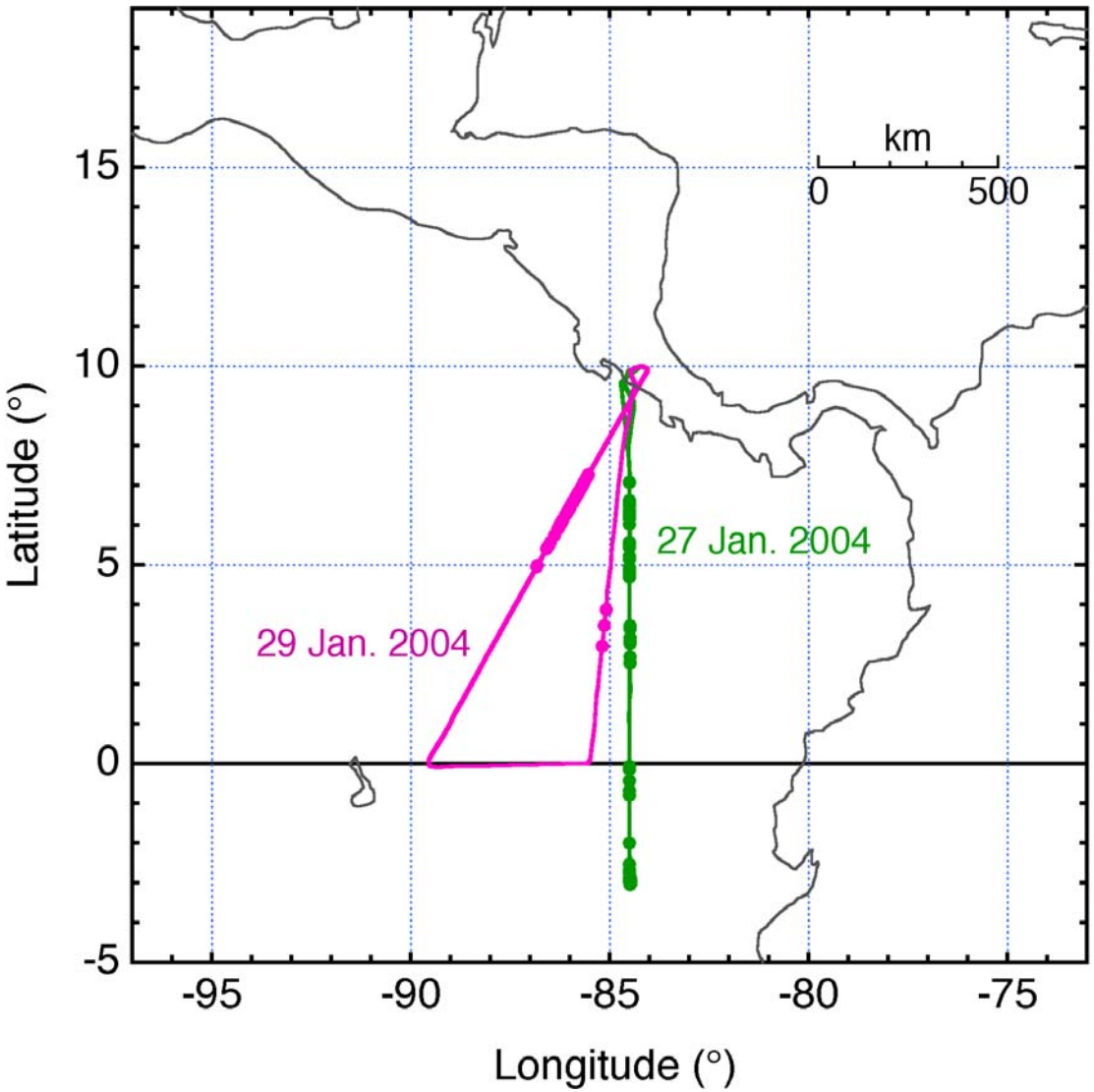


Nitric acid-containing particle observations

Flight date: 29 January 2004

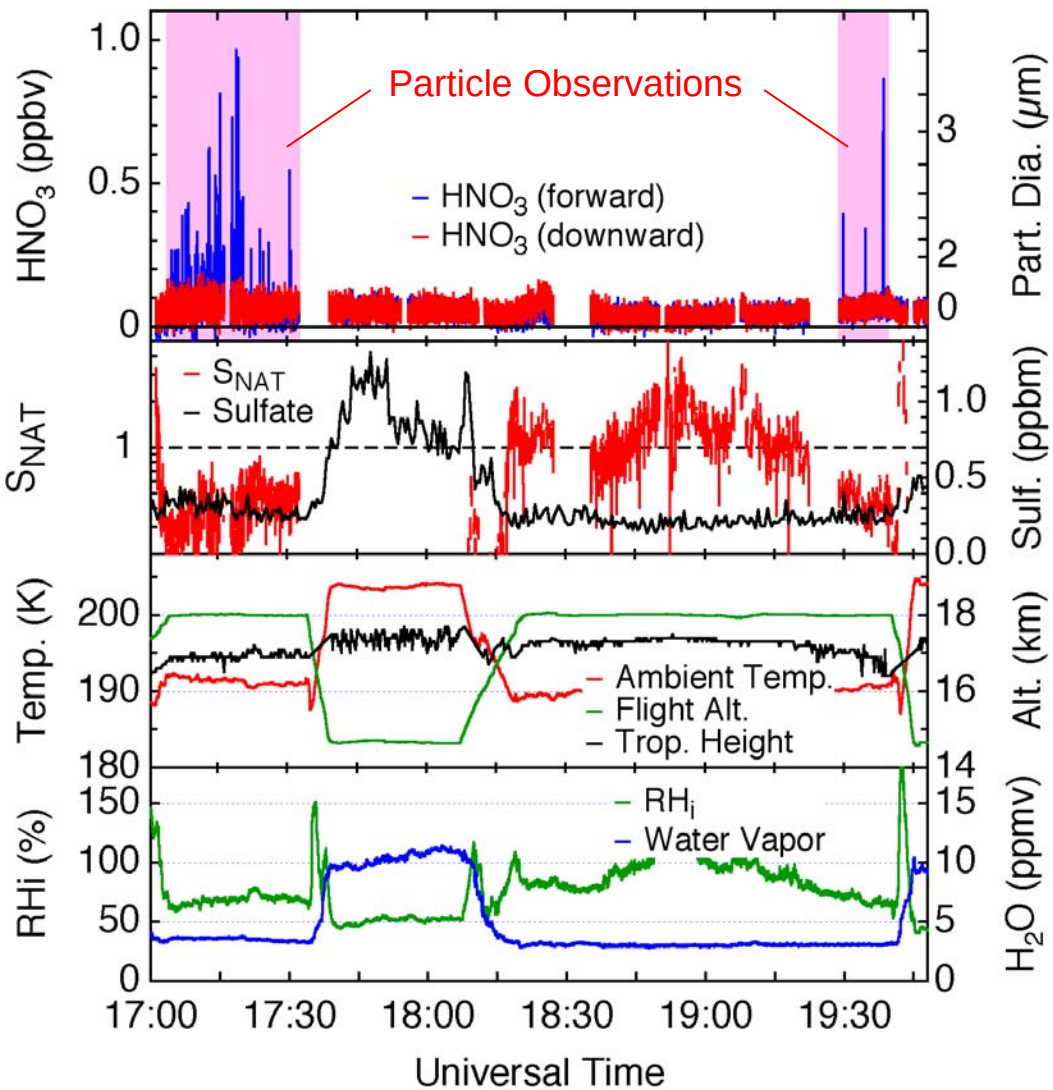


Pre-AVE flight tracks and particle locations



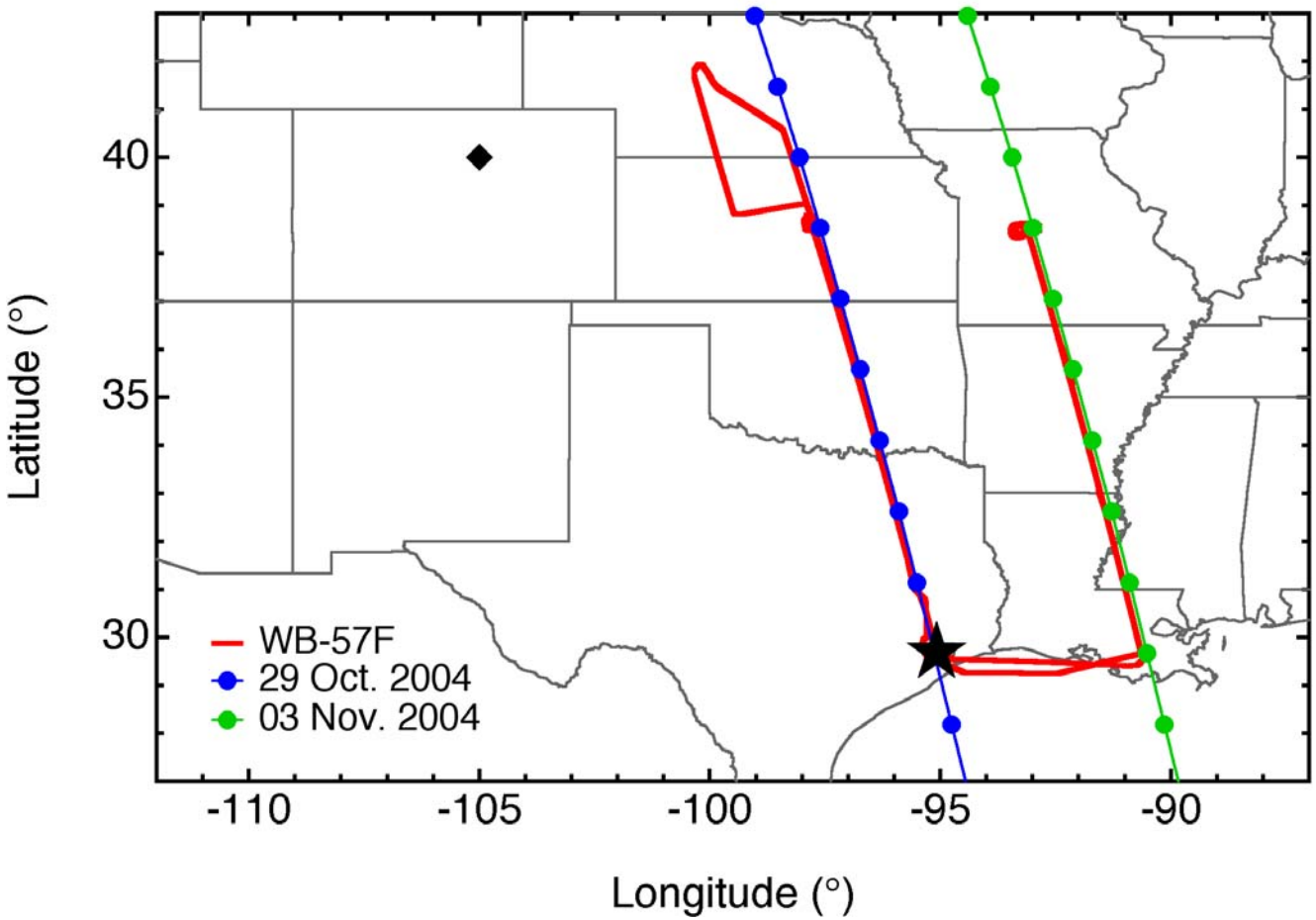
Particle observation conditions

Flight date: 29 January 2004



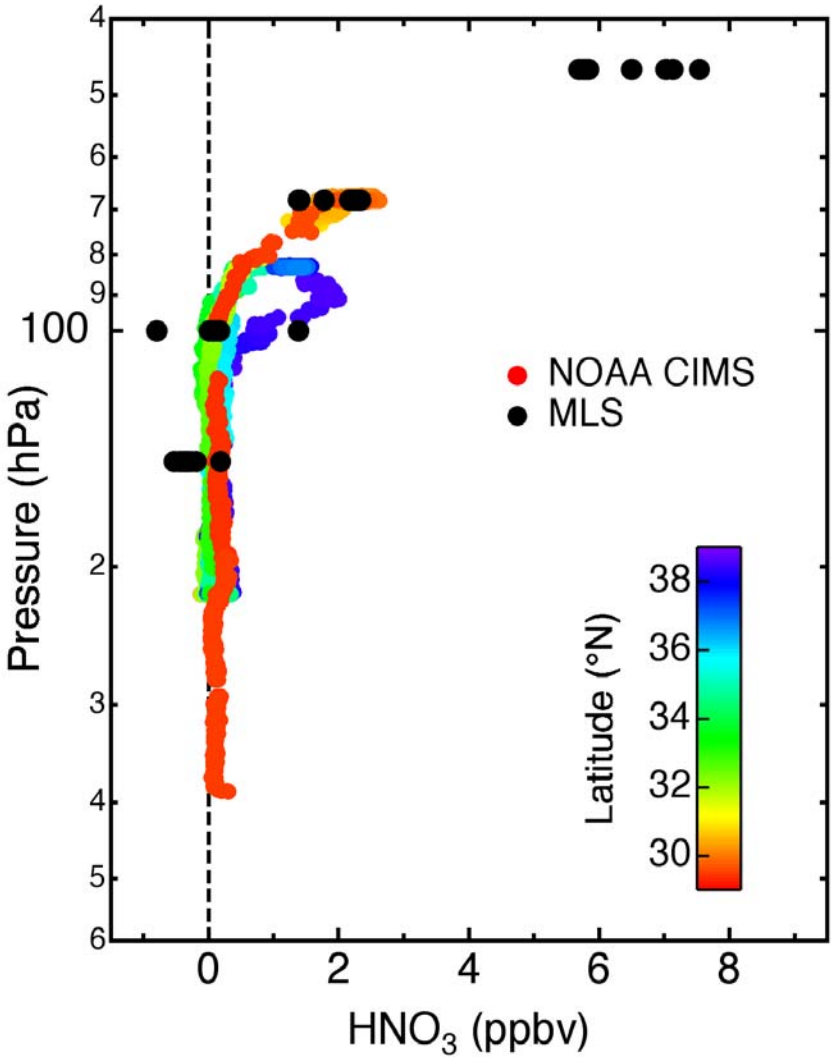
- Altitude 18 ± 0.1 km
- ~1 km above tropopause
- Temperature 188 - 192 K
- Water vapor ~3.5 ppmv
- S_{NAT} ~0.1 - 10
- Particle Conc. $6 \cdot 10^{-5}$ cm^{-3}

NASA Aura and WB-57F flight tracks

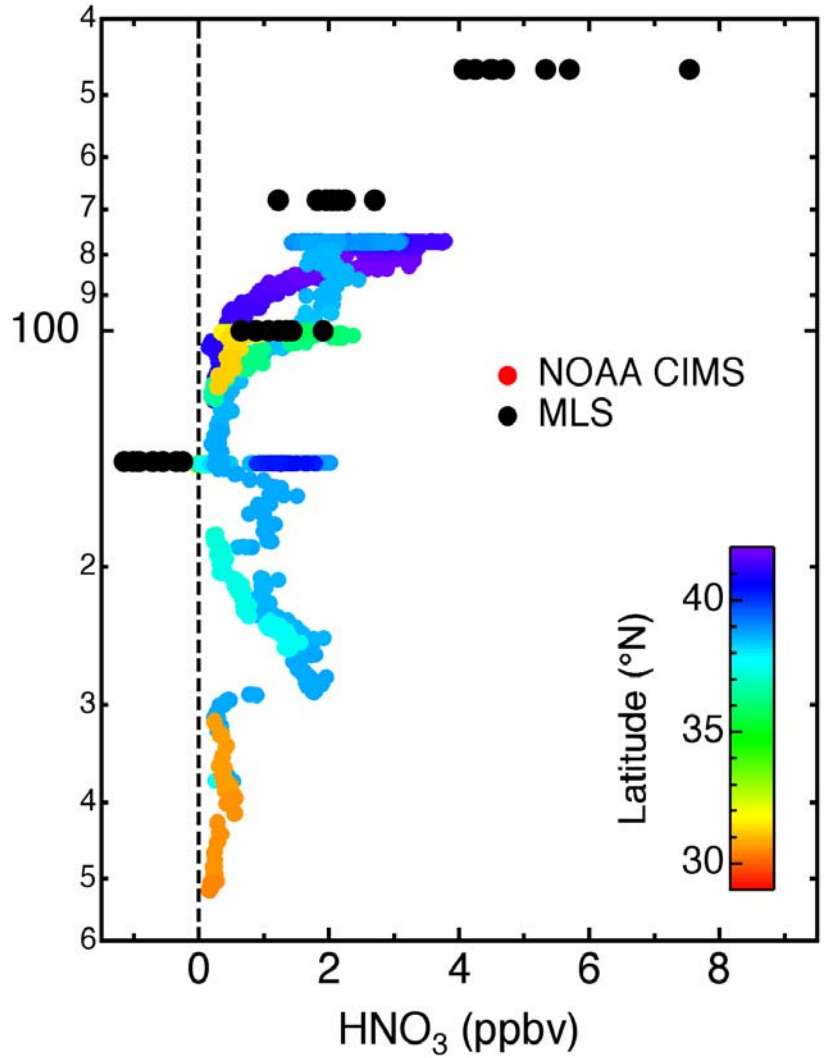


HNO_3 vertical profiles

29 October 2004

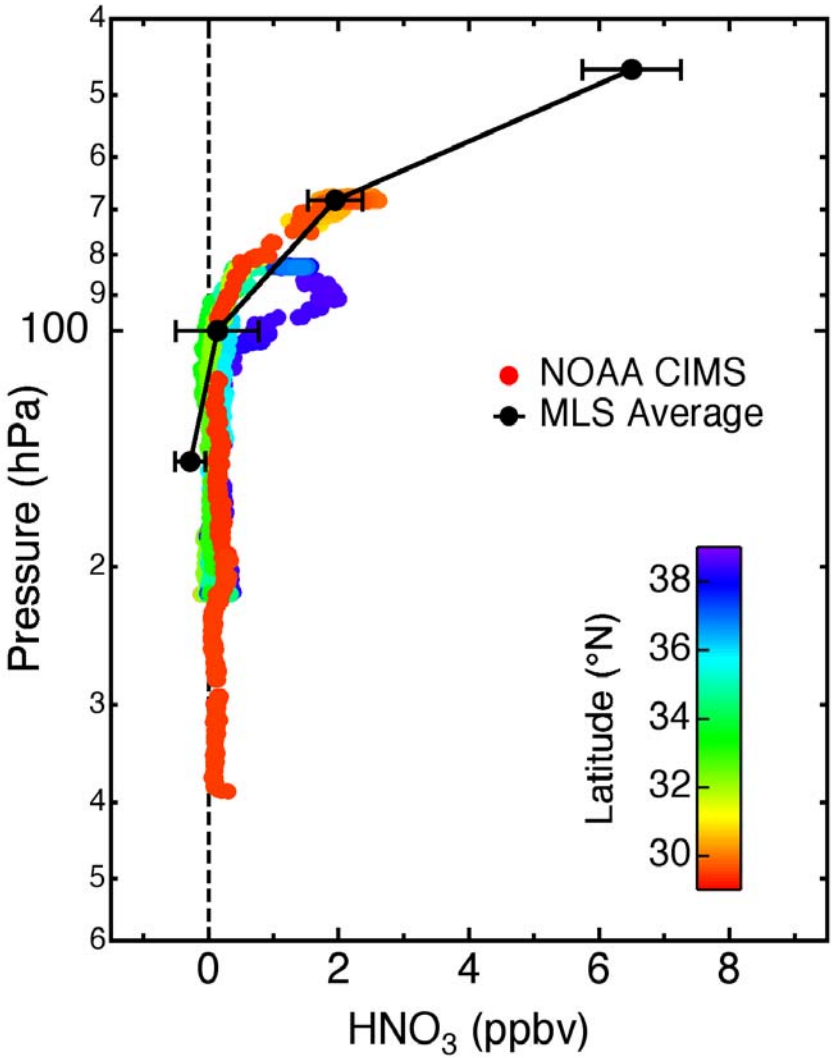


03 November 2004

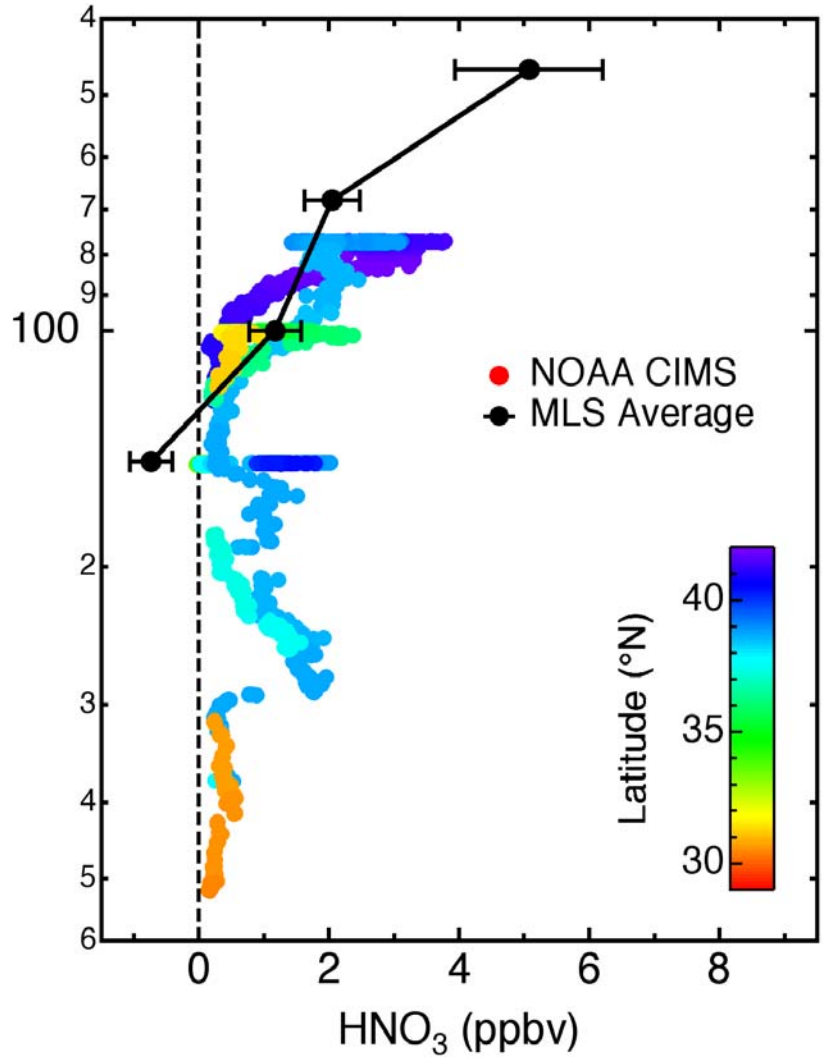


HNO_3 vertical profiles

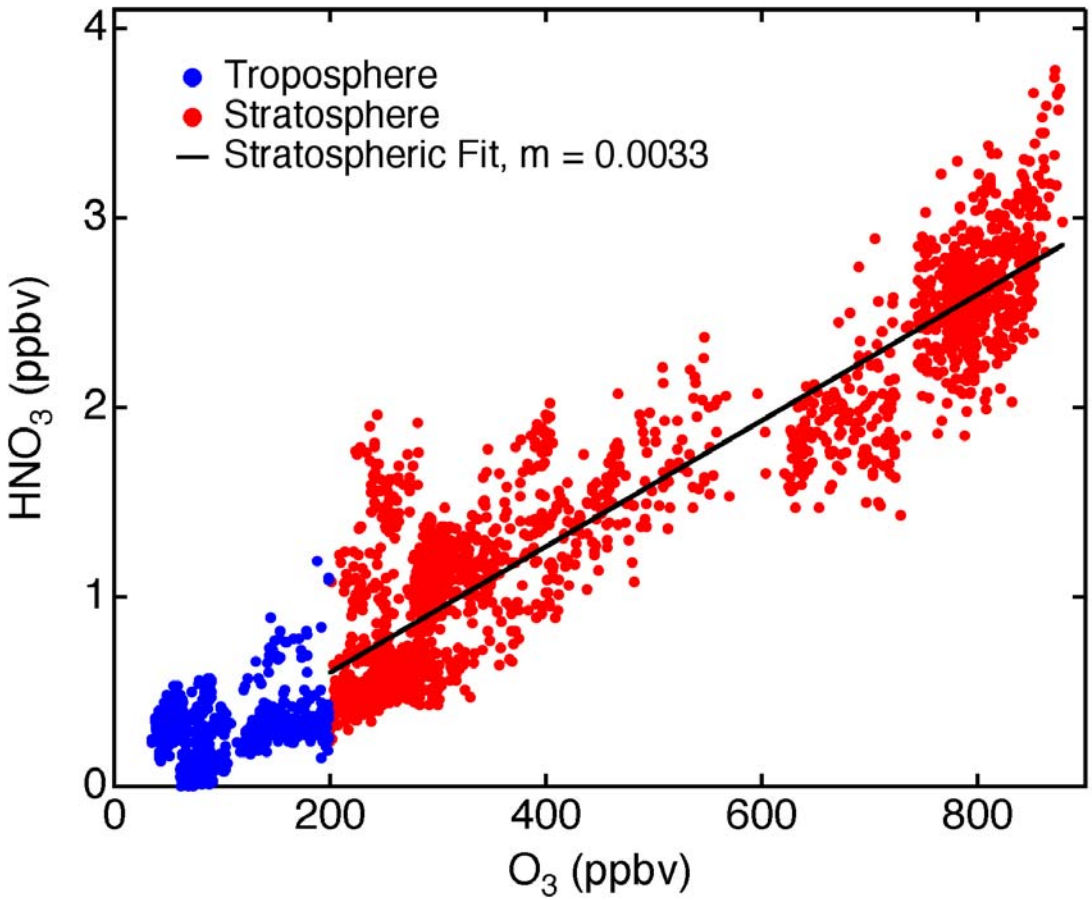
29 October 2004



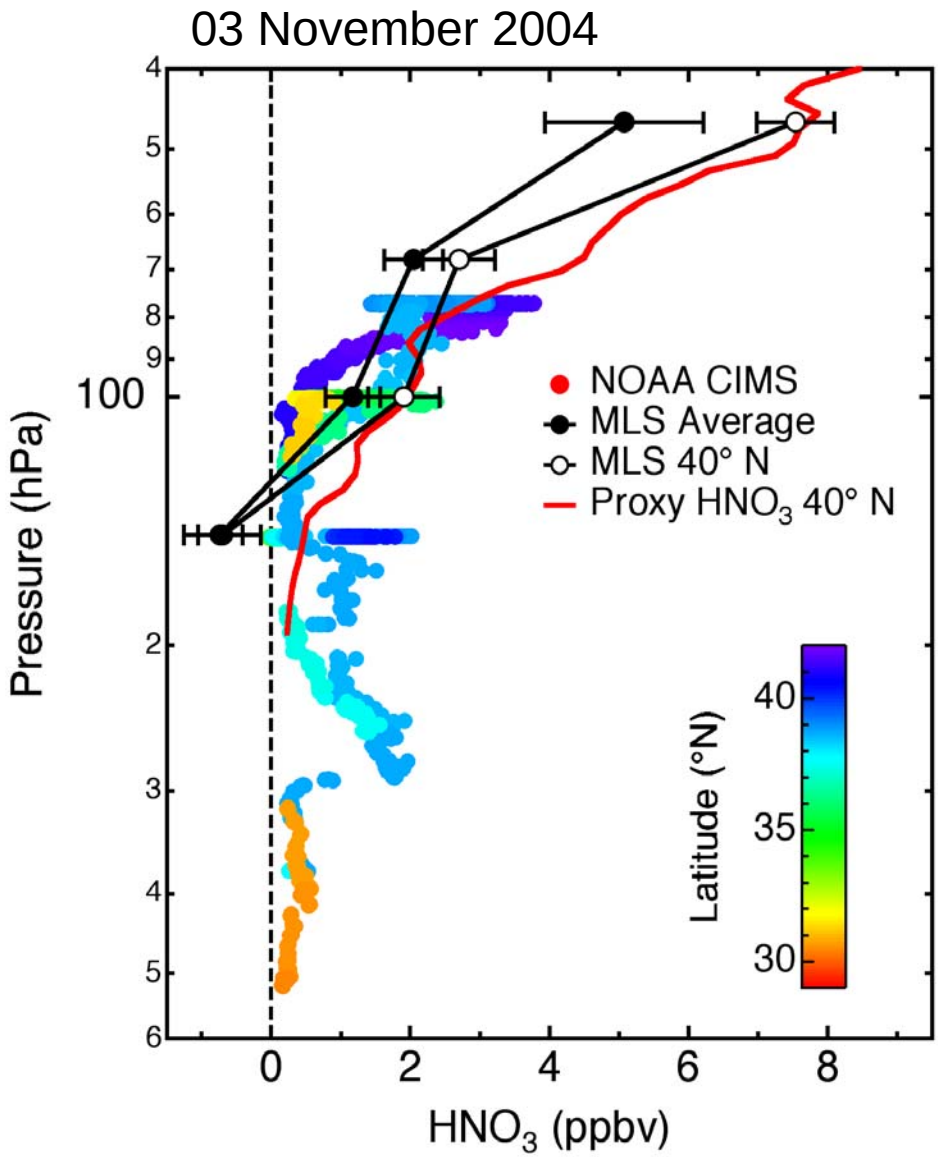
03 November 2004



HNO_3-O_3 relationship in the lower stratosphere



HNO_3 vertical profiles



Conclusions

- Nitric acid trihydrate (NAT) particles were discovered in the tropical lower stratosphere during the Pre-AVE campaign.
- A preliminary investigation of the MLS and CIMS HNO_3 datasets during AVE-Houston 2004 shows a favorable comparison between the two instruments in the upper troposphere and lower stratosphere.
- HNO_3-O_3 correlations might be a useful validation tool where in-situ data is not available.
- Fundamental differences between the two measurement methods need to be considered when comparing the datasets.

Many thanks to the air and ground crews of the NASA WB-57F aircraft.