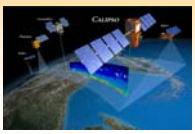
VERTICAL TRANSPORT IN THE TTL AND LOWER STRATOSPHERE FROM CALIPSO

J. P. Vernier and J. P. Pommereau
Service d'Aéronomie IPSL/CNRS, Verrières-le-Buisson cedex, France

Instrument

CALIOP Lidar onboard CALIPSO satellite of the Aqua-Train constellation



Data

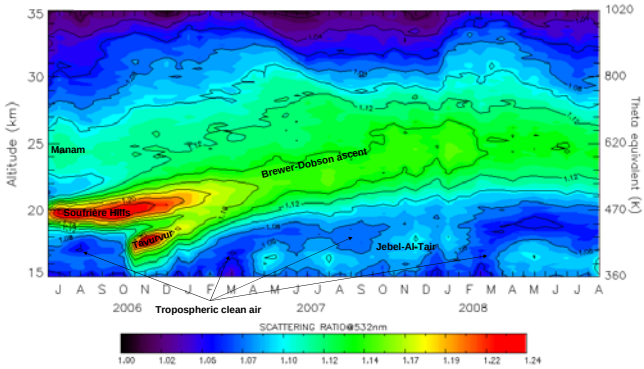
- CALIOP : Total & perpendicular attenuated backscatter 532nm :
  - β'_{532} & $\beta'_{\perp,532}$
- NASA GEOS 5 model :
  - Air density, ozone density
  - Temperature and pressure

Treatment

- Average :
  - Nighttime orbits only (less noisy)
  - 1° latitude on each orbit (~300 profiles)
- Interpolation :
  - Mean map per 16-day period (CALIPSO repeat cycle)
  - Regular grid (lon=2°, lat=1°, z=200m)

- Correction of two-way transmission (T^2) for molecular attenuation and O3 absorption : $\beta_{532} = \frac{\beta'_{532}}{T^2}$
- Clouds mask from depolarization ratio (threshold : $\beta'_{\perp,532} / \beta'_{532} \geq 5\%$)
- Mask of the South Atlantic Anomaly (SAA)
- Molecular backscatter (β_m) calculation from GEOS 5 model
- Display : Scattering ratio : $R = \beta_{532} / \beta_m$
- Recalibration compared to operational data assuming 36-39km level aerosols free

Time/altitude cross-section. zonal mean [20°N-20°S]



✓ Volcanoes :

- Manam (4°S,145°E), 27 Jan 2005, Papua New Guinea
- Soufrière Hills (16°N-62°W), 20 May 2006, Montserrat Island, West Indies
- Tavurvur (4°S,152°E) , 7 October 2006, Papua New Guinea
- Jebel-Al-Tair (15°N-42°E) , 30 September 2007, Yemen

✓ Brewer-Dobson circulation :

- Volcanic tape recorder
- Vertical velocity :
  - Zero at 20km (seen on volcanic aerosols and clean air in Apr-Jul 2008)
  - 0.1mm/s (0.3km/month) between 21-25km

✓ Tropospheric clean air (washed out) injection :

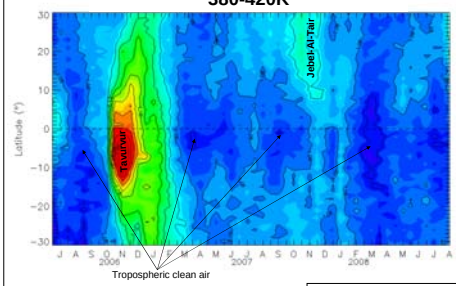
- Up to 20km, within 0.5 month
- During convective season : NH Jul-Sept, SH Feb-Apr (more intense)

✓ Aerosols between 15-17km :

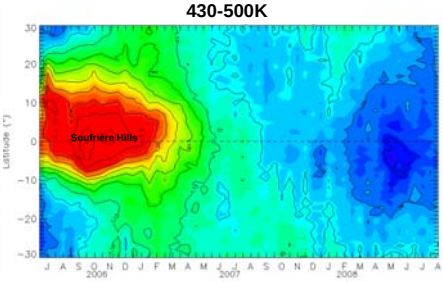
- In Apr-Aug
- Mineral dust? biomass burning?

Latitude/time cross-section

380-420K



430-500K



✓ Meridionnal transport of volcanic aerosols and clean air :

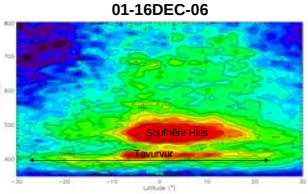
- Faster at 380-430K than 430-500K
- Time constant at 380-430K : 3months

✓ Clean air injection during convective periods :

- 380-430K : 10°N-10°S in Feb-Apr and Jul-Sept
- Fast cleaning of volcanic aerosols in Jan-Feb

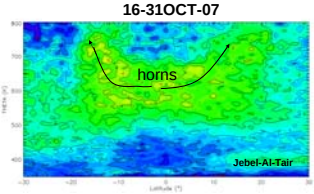
Latitude/altitude cross-section

01-16DEC-06



✓ Fast meridonnal transport of Tavuvur

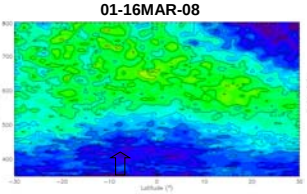
16-31OCT-07



✓ Horns of the Brewer-Dobson circulation (Trepte et al., 1992)

✓ Jebel-Al-Tair meridonnal transport

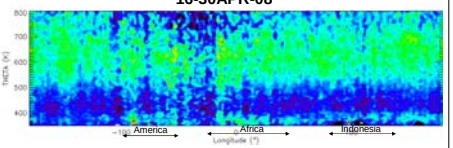
01-16MAR-08



✓ Injection of tropospheric clean air 0-10°S during convective periods

Longitude/altitude cross-section [20°N-20°S]

16-30APR-08



✓ Dust injection at 350-400K above Africa in April

Stratosphere

- Brewer-Dobson tape head at 20km
- Ascent speed Feb-Nov 0.1mm/s (0.3km/month) at 21-25km

lower than 5 years average H20 (Mote et al., 1998) or calculated with radiative heating model by Rosenlof et al. (1997) of 0.2-0.3mm/s (0.5-0.8km/month).

Trop-Strat transport

- Indication of fast convective ascent up to 20km in Feb-Apr in the South Hemisphere (SH).
- Maximum convective lofting at 10N°-10°S, consistent with TRRM overshooting precipitation feature (Liu and Zipser., 2005).
- Consistent with maximum CO concentration at 18-19km in Feb-Mar (Schoeberl et al., 2006).
- Contribution of smaller UT aerosol load in the SH compared to NH (Minikin et al., 2003) to apparent cleaner injected air?
- Relative contributions of radiative ascent and clearing by mixing with clean air in Tavuvur volcanic aerosols removal? Slower vertical velocity during non convective season?

Acknowledgement : The authors thank J. Pelon and A. Garnier (CALIPSO team), the SCOUT-O3 project, the ICARE team, P.Keckut and F. Cairo for the fruitful discussion about CALIPSO.

jean-paul.vernier@aerov.jussieu.fr