

A new global climatology of different types of aerosols in the stratosphere by GOMOS-Envisat data treated with the LPC2E processor



Verónica Salazar, Jean Baptiste Renard



Université d'Orléans, LPC2E, CNRS, Orléans, France



Introduction

- Local studies with balloon-borne instruments have detected the presence of solid particles (mainly soot) in the middle stratosphere free of volcanic aerosols
(Renard et al, JGR, 113, D21303, 2008)
- The vertical and spatial distribution of these aerosols is poorly documented



- Need of global climatology by satellite instrument



- Re-analyse GOMOS transmission spectra with a new data reduction algorithm



- Study of the wavelength dependence of the spectral extinction in order to distinguish between the different families of particles:
 - ❖ Liquid sulfate aerosols
 - ❖ Interplanetary dust
 - ❖ Soot particles

GOMOS instrument

Measurements cover an altitude from 15 to 100 km

Stellar occultation measurement principle

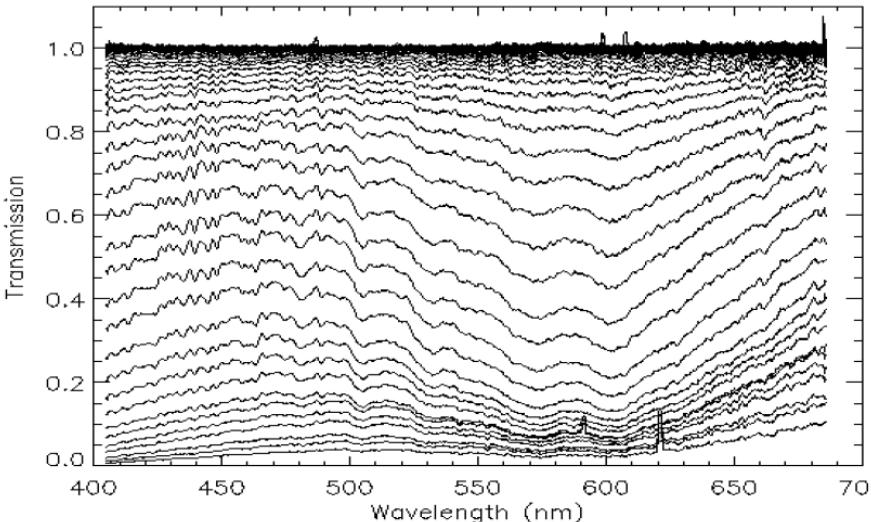
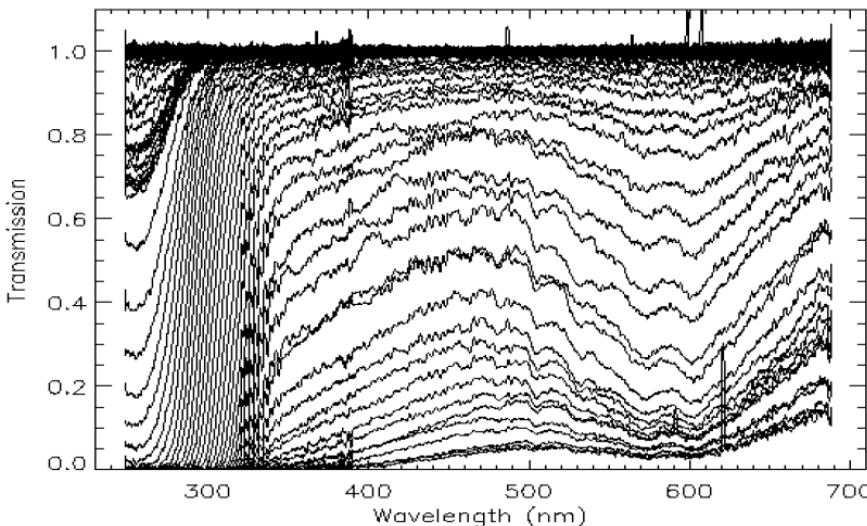
30-50 star occultations per orbit

- ✓ Good global coverage
- ✓ High measurement rate

Presented here:

Reanalysis of level 1b GOMOS data and
comparison with available level2 data

- Only GOMOS night time measurements
 - More than 150000 occultations
 - Analysis for the year 2004



Raw transmission spectra and spectra after correction of chromatic scintillation

Aerosol extinction retrieval

OFFICIAL PRODUCT

Transmission spectra

Spectral inversion

Spectral window from UV to near IR
Species retrieved simultaneously

Vertical Inversion

Spatial inversion of the optical depth profiles

Aerosol Extinction Coefficients

Extinction spectrum modeled as a
second order polynomial of wavelength

LPC2E PROCESSOR

Transmission spectra

Spectral inversion

Spectral domain from 400nm to 700nm
Contribution for all constituents are searched in
dedicated spectral windows and removed

Vertical inversion

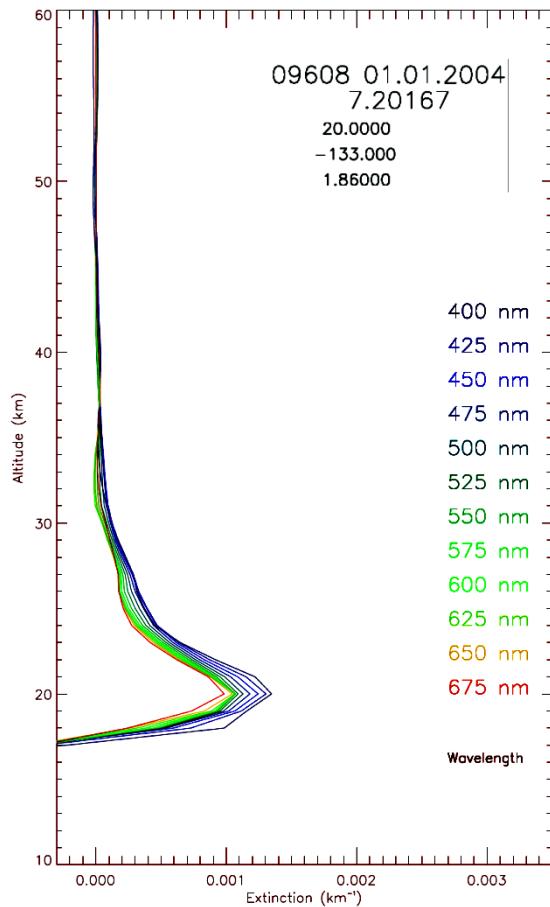
Spatial inversion of the optical depth profiles

Aerosol Extinction Coefficients

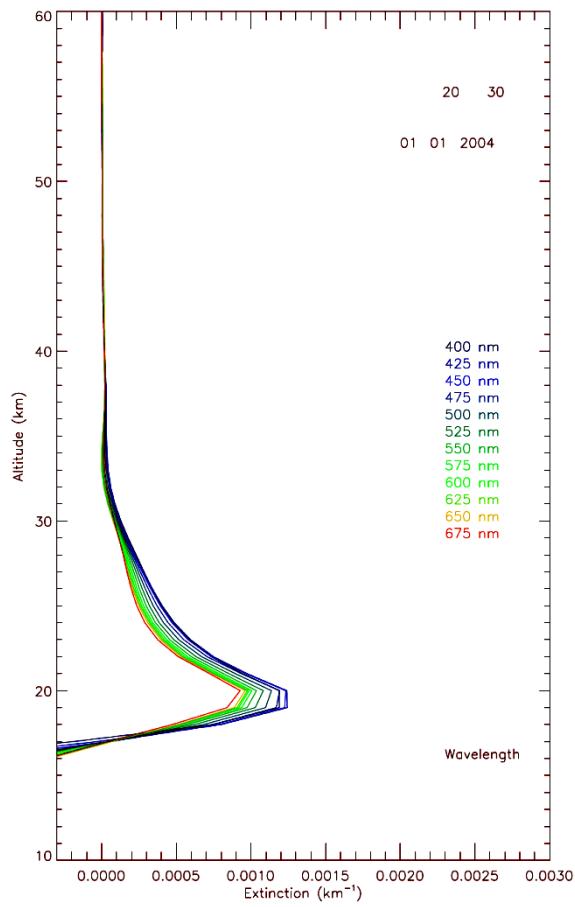
Extinction spectrum modeled as a
quadratic polynomial of wavelength

Selection criteria

- Standard deviation of aerosol extinction is calculated at different wavelengths during spectral inversion and vertical inversion
 - No criteria about magnitude or color of stars
- Profiles with low signal to noise ratio are rejected (73% for 2004)
 - About 40000 profiles are treated for 2004

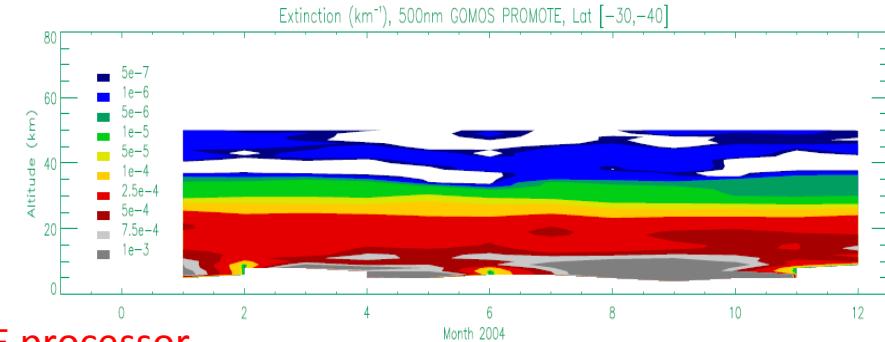
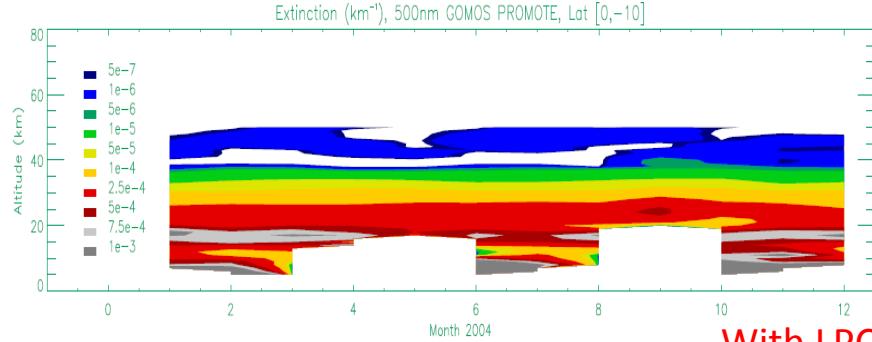
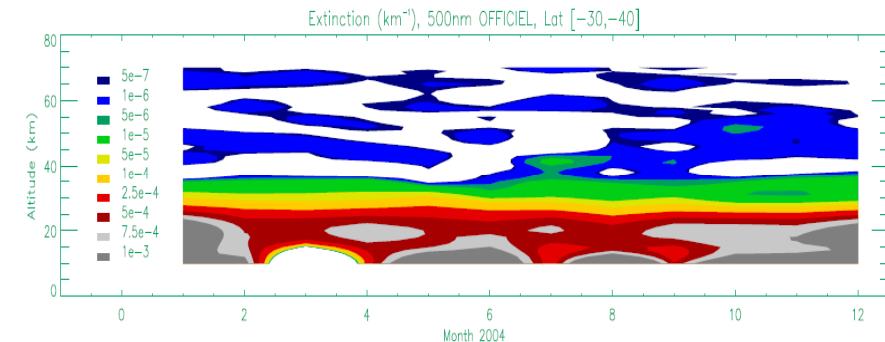
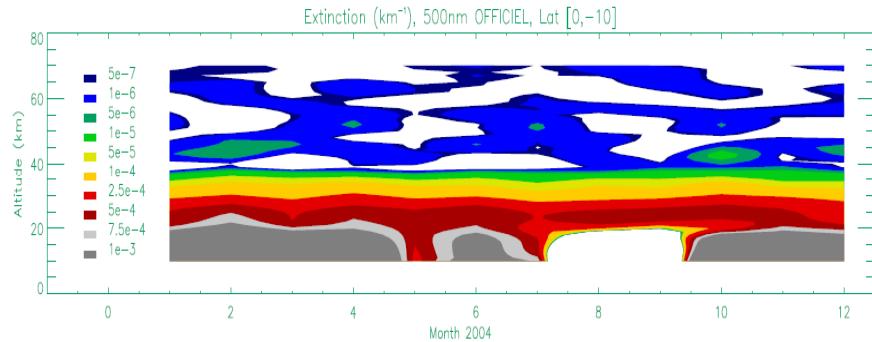
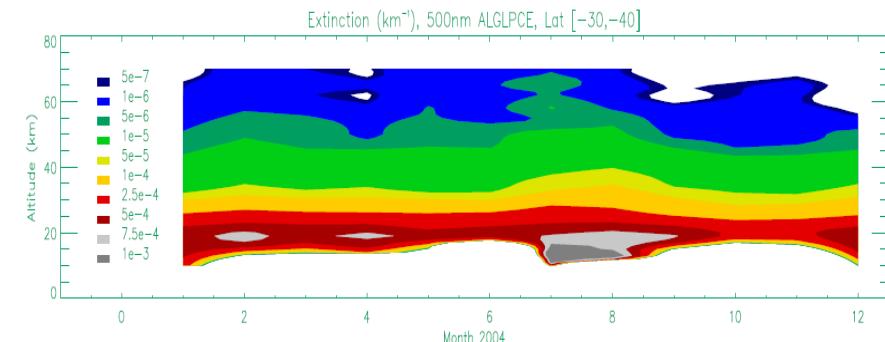
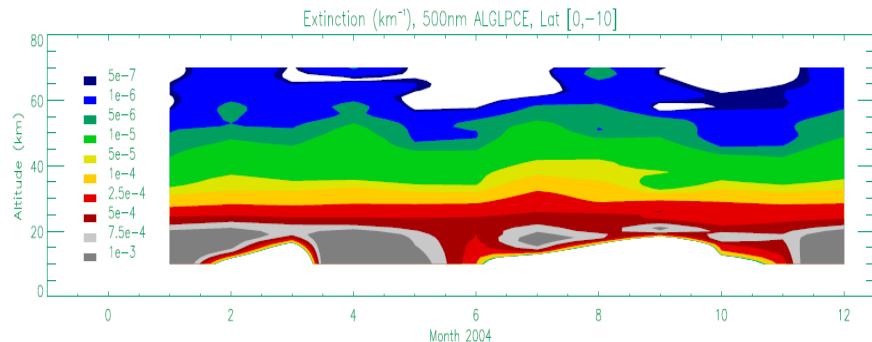


Example of individual profile and mean profile (LPC2E processor)



Equivalent mean profile (official data)

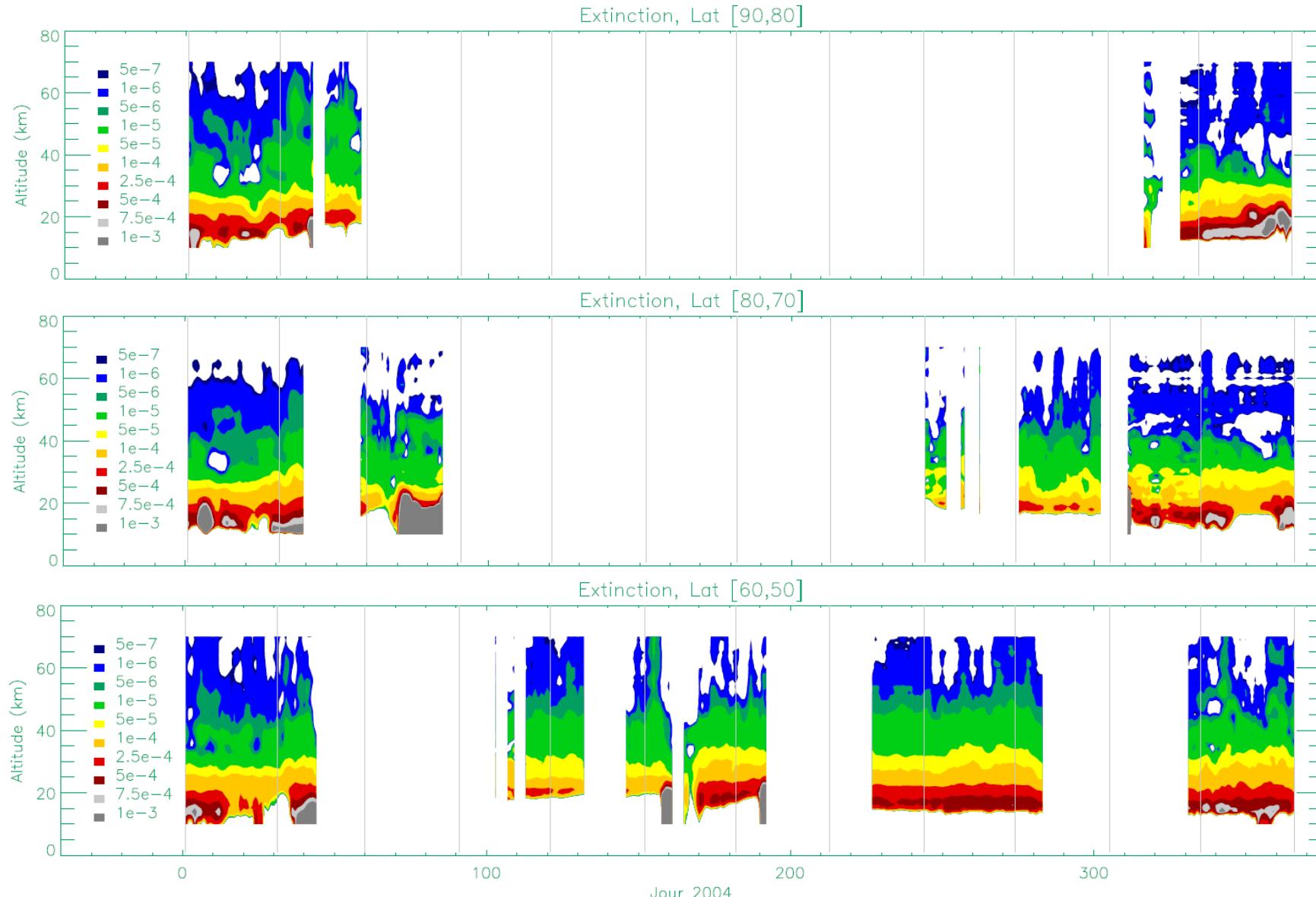
Comparison of monthly averages of 500nm aerosol extinction in 2004 for GOMOS LPC2E processor, official data and official PROMOTE data



With LPC2E processor

More aerosol seem to be detected in the middle and upper stratosphere
 More variability and local enhacements of stratospheric aerosols seem to be identified

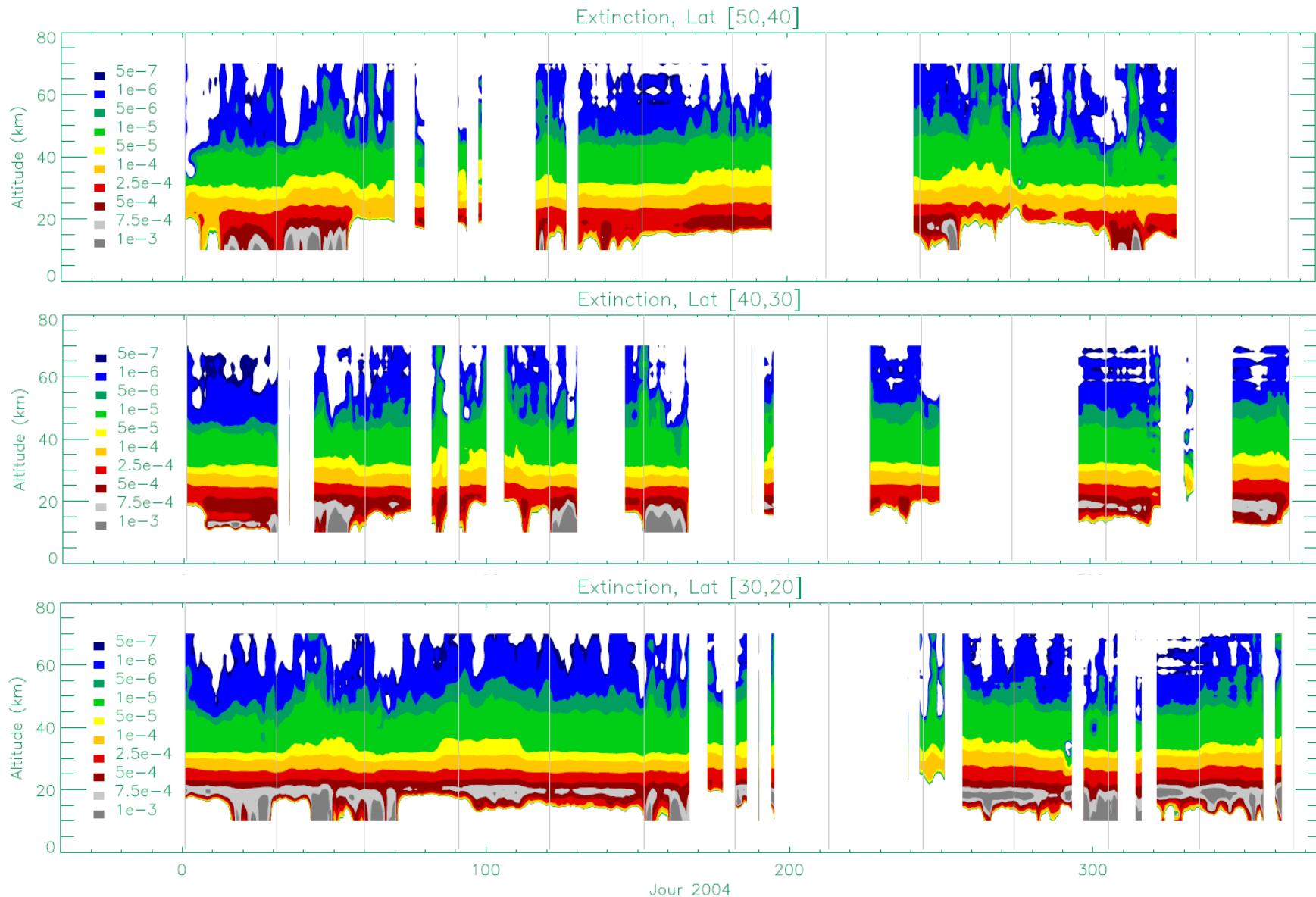
Aerosol extinction at $\lambda=500\text{nm}$ using 10° latitude bins for 2004



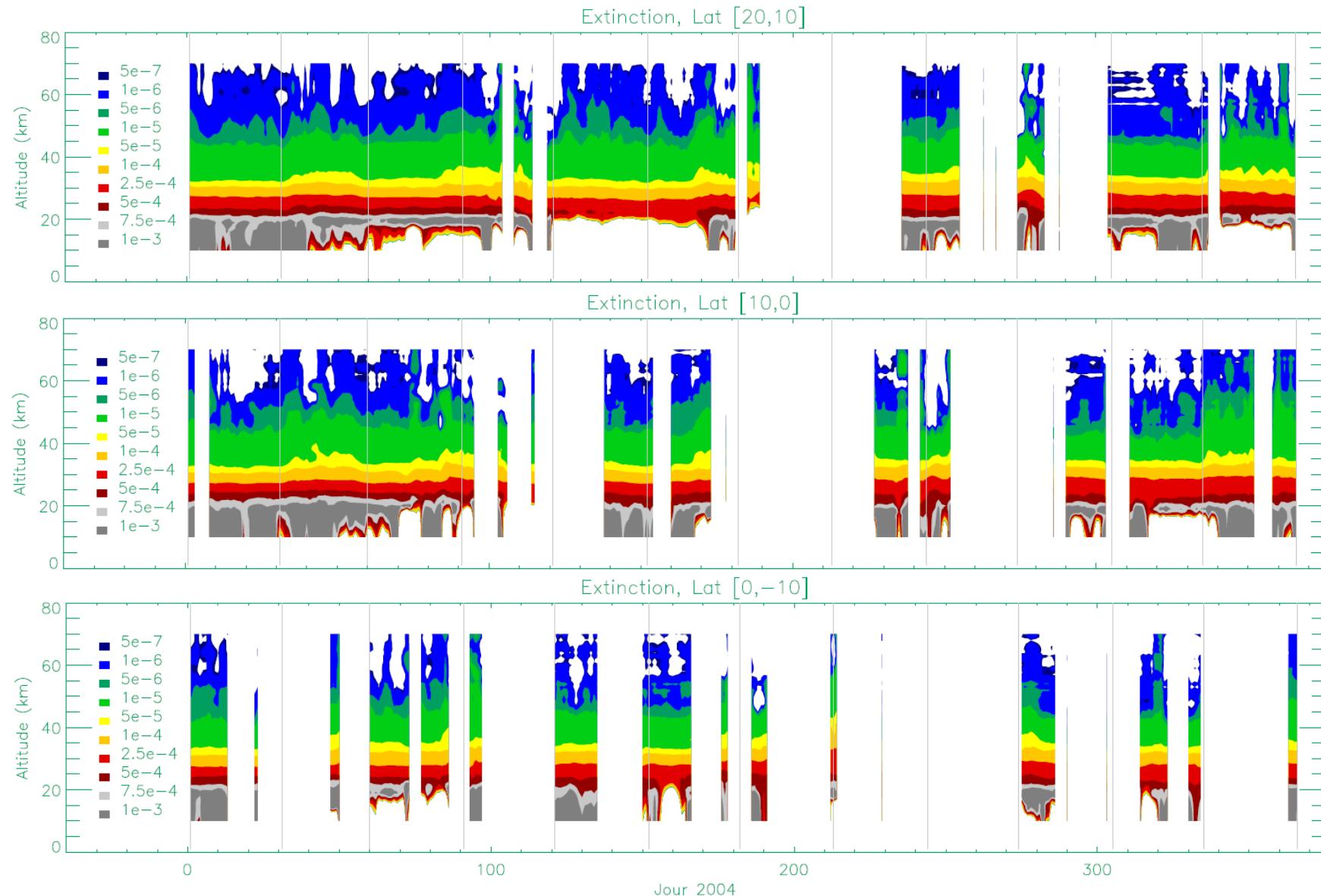
Average for all profiles in one day with 3 day sliding smoothing

White areas due to missing data

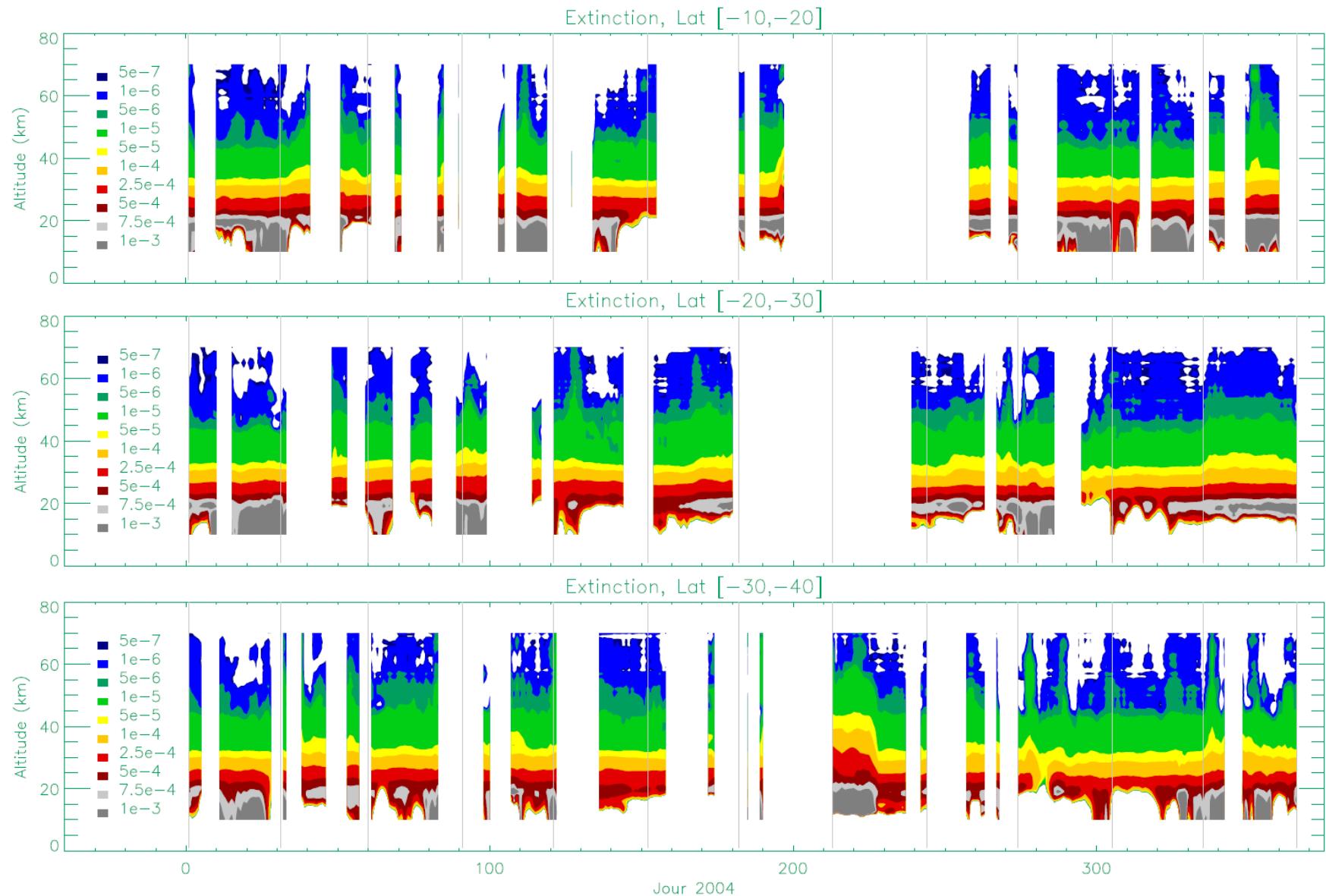
Aerosol extinction at $\lambda=500\text{nm}$ using 10° latitude bins for 2004



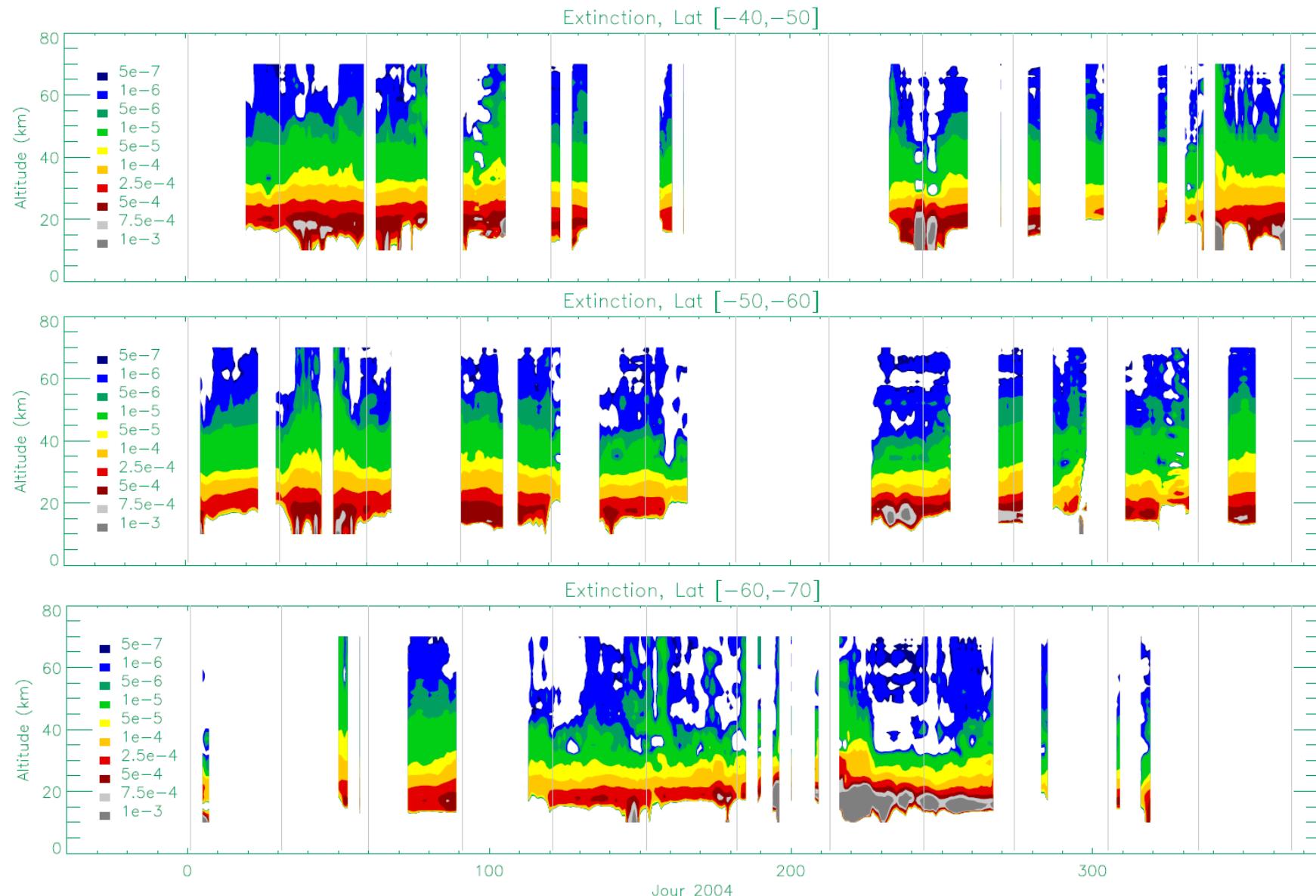
Aerosol extinction at $\lambda=500\text{nm}$ using 10° latitude bins for 2004



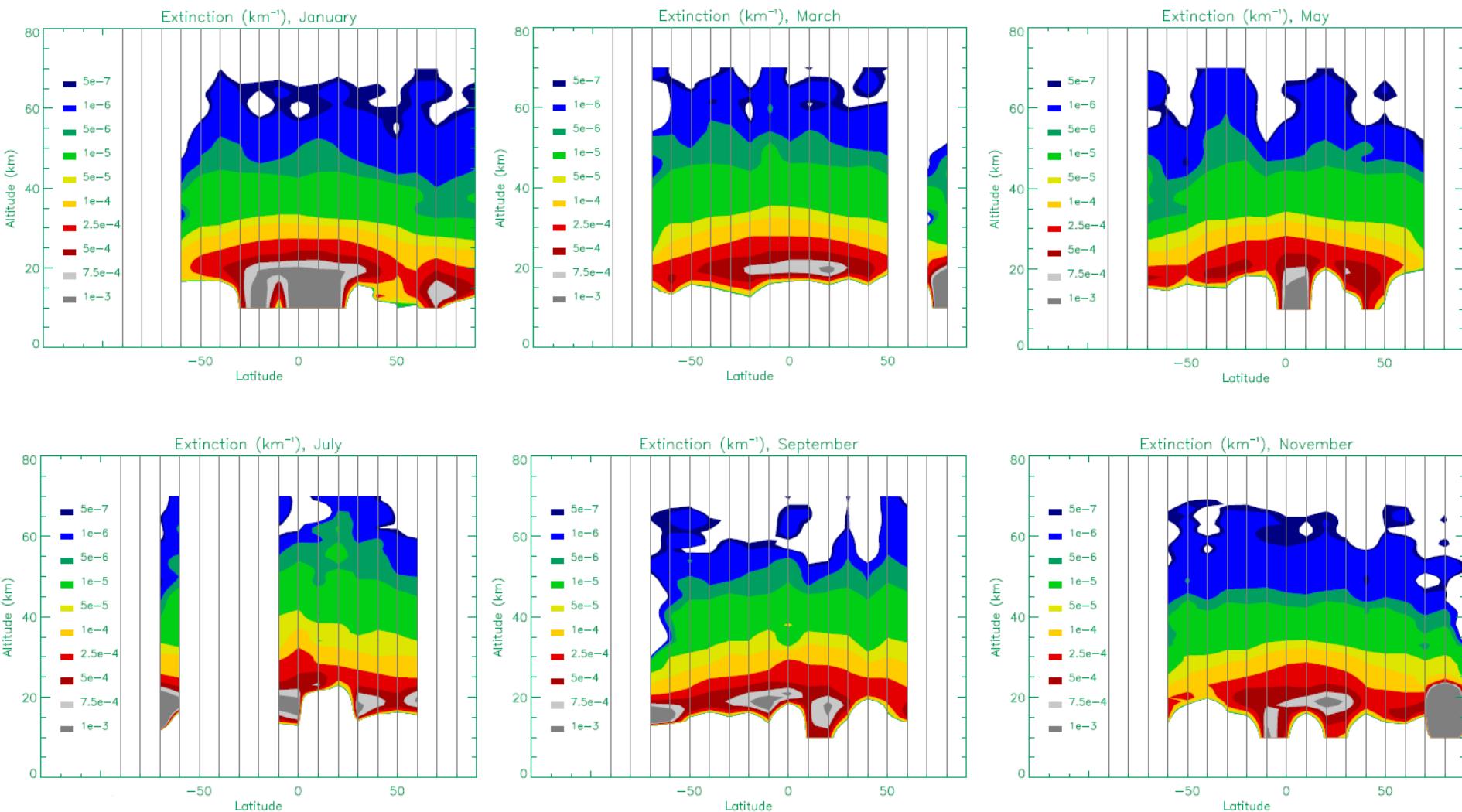
Aerosol extinction at $\lambda=500\text{nm}$ using 10° latitude bins for 2004



Aerosol extinction at $\lambda=500\text{nm}$ using 10° latitude bins for 2004



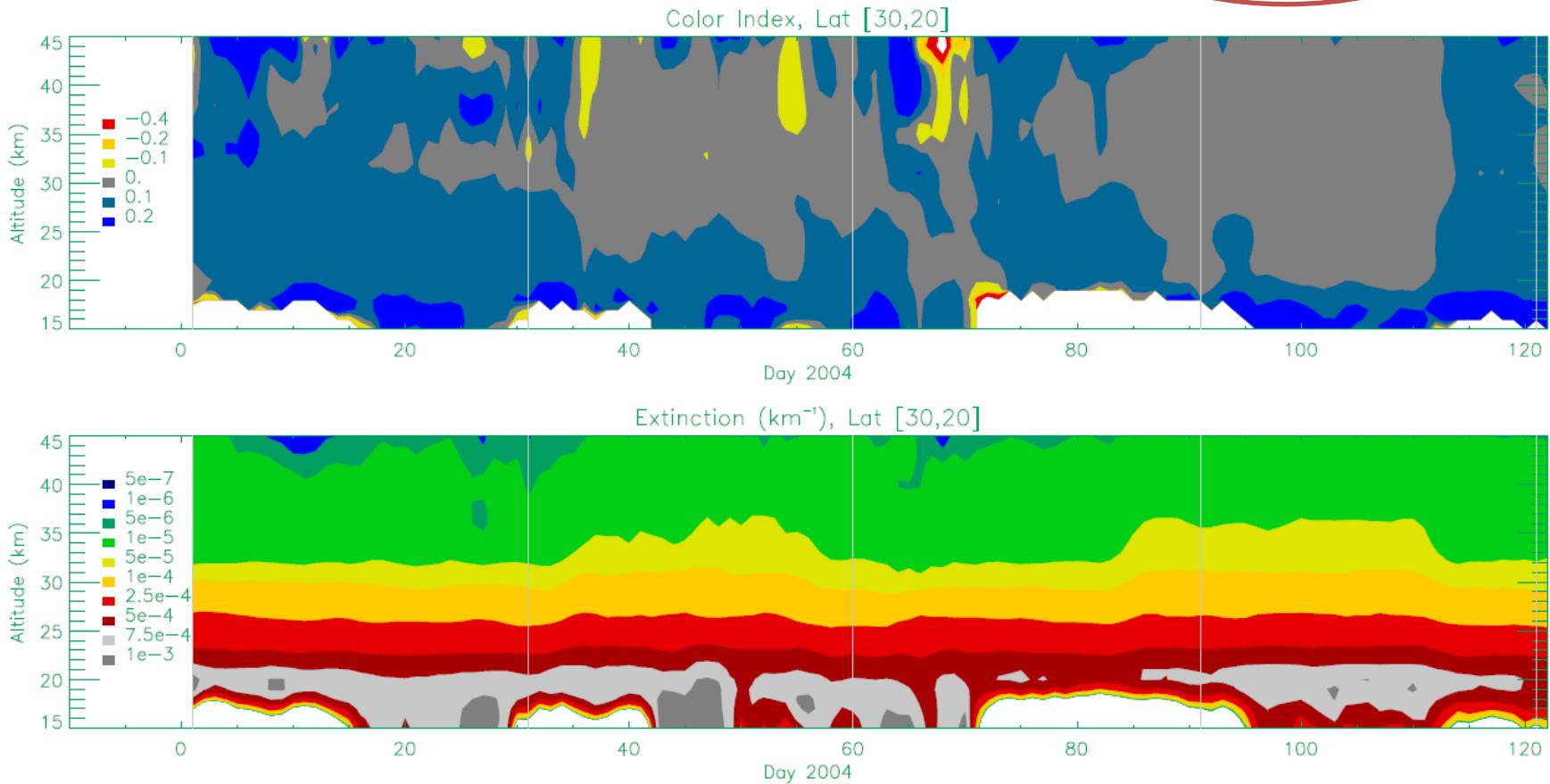
Aerosol extinction for $\lambda=500\text{nm}$ as a function of altitude and latitude for some months in 2004



➤Aerosol extinction has a maximum in the tropics and more or less decreases towards the poles

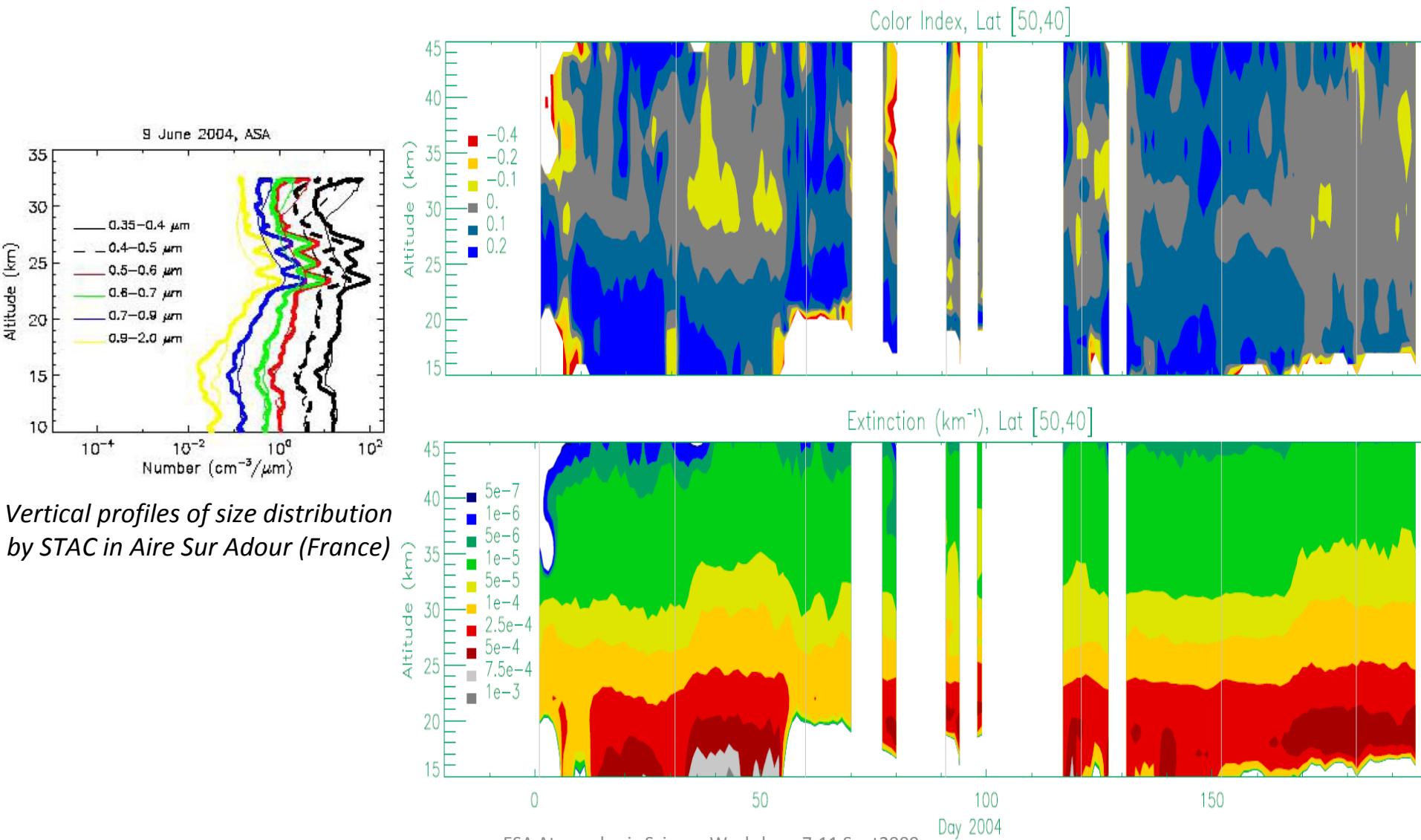
In order to characterize different natures of stratospheric aerosols, **Color Index** is calculated

$$CI = \frac{Ext_{400} - Ext_{675}}{\sqrt{\sum_{400}^{675} Ext^2}}$$



- In the middle stratosphere Color Index is close to zero
- Solid particles of different natures are present from around 25 to 45km

- Aerosols can be found in significant quantities up to 45 km at all latitudes
 - Great variability of stratospheric aerosols vertical content, in agreement with **Aerosol Counter (STAC)** measurements :



Conclusions and perspectives 1/2

- A global climatology of stratospheric aerosols has been performed using the best year of GOMOS data (2004)
 - LPC2E processor works well and the results derived from it are in agreement with particle counter STAC punctual measurements, showing significant amounts of aerosols in the middle and upper stratosphere
 - Solid aerosols are present above 30km at all latitudes; they can be identified by the spectral dependence of aerosol extinction and could be soot and/or meteoritic material

Conclusions and perspectives 2/2

- All the results presented here need forward examination and could help to better understanding the variability of stratospheric aerosols content
- Other years from 2002 to 2006 are under processing...



• In particular, the study of stratospheric aerosol is one objective of Summer Polar Stratosphere balloon campaign StraPolEté (8 flights for STAC particle counter were performed to study the variability of aerosol content in the middle stratosphere)

