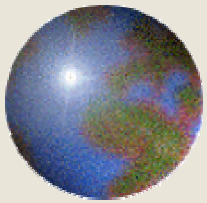
Long-term Ice Cloud Observations from Lidar Ground Measurements



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Ice clouds

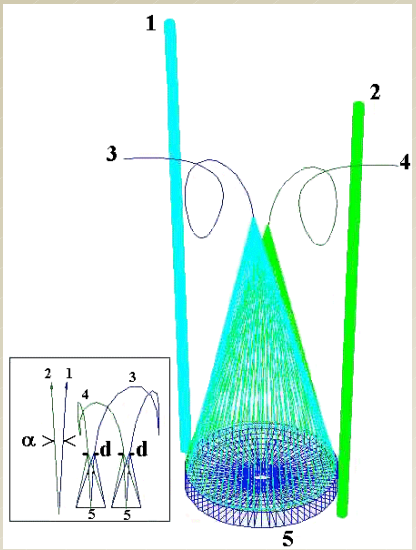
1/ Polar Stratospheric Clouds

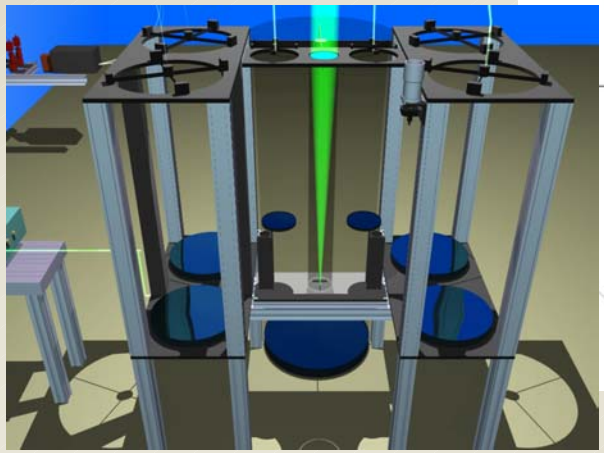
- Stratosphere (15-25 km)
- Polar regions

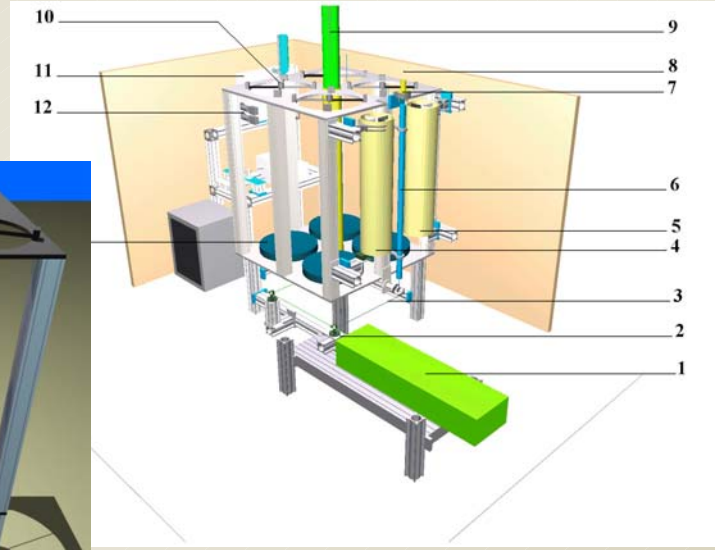
2/ Cirrus Clouds

- Upper troposphere (8-17 km)
- Global coverage 20-30%
- Sub-visible cirrus (τ) < 0,03

Investigations with ground-based lidars



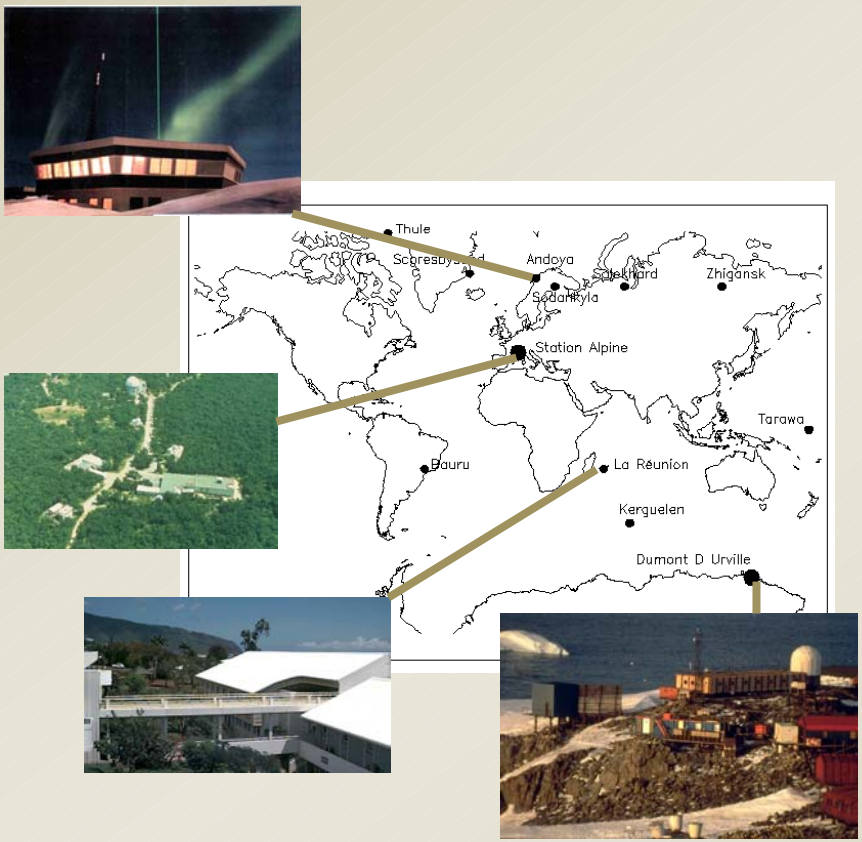




- Powerful lidars dedicated to the stratosphere
  Network of Detection of Stratospheric Changes
- Night-time long-term routine measurements
- Extend to the upper troposphere in the mid 1990's
  Cirrus, O3, H2O, T with a single instrument

NDSC French stations

NDSC : Network of Detection of Stratospheric Changes

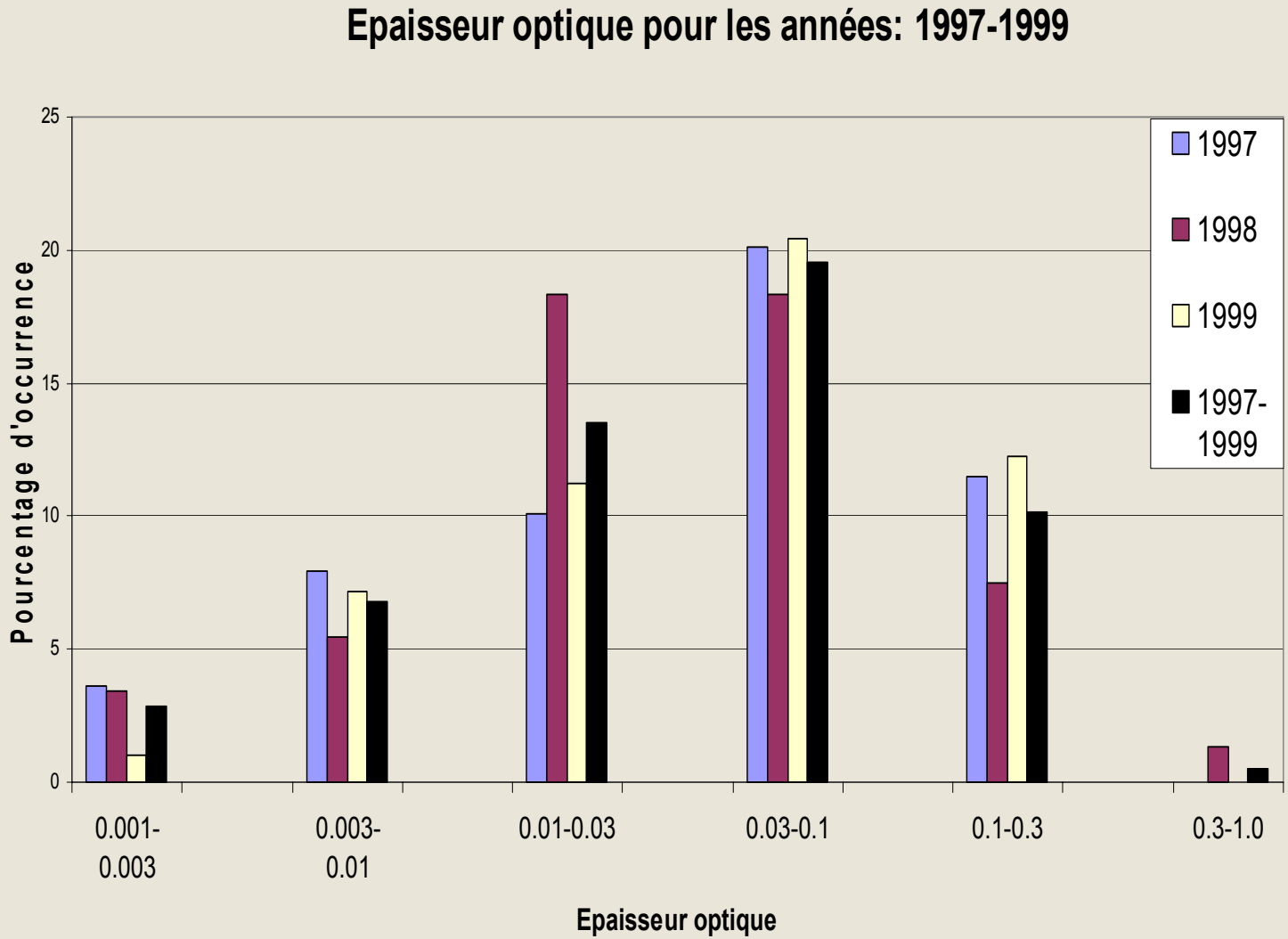


- ALOMAR (69°N),
  - PSC, O3, T
- OHP (44°N),
  - Cirrus, O3 and H2O tropo
- La Réunion (21°S),
  - Cirrus, O3 and H2O tropo
- Dumont D'Urville (69°S)
  - PSC, O3, T

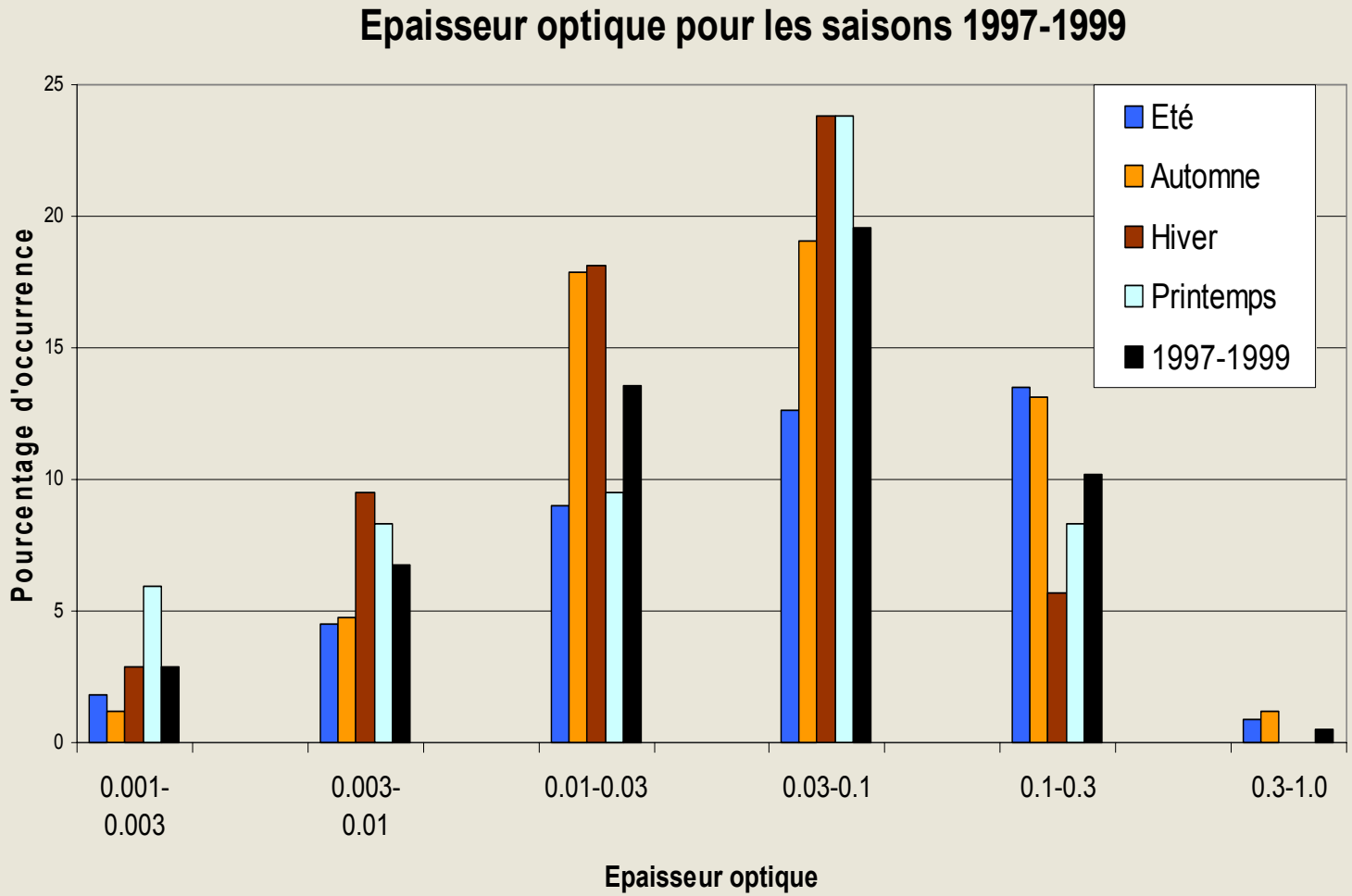
Cirrus data analysis

- Scattering Ratio = [ß(Mie)+ß(Rayleigh)]/Polynomial Fit
- Night-time operations
- Algorithm studies (SA, LPA and Sirta/LMD)

Cirrus optical depth / years



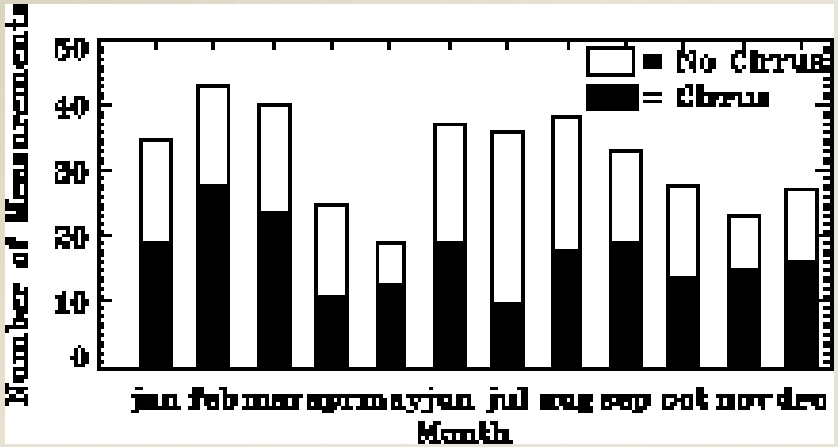
Cirrus optical depth / seasons

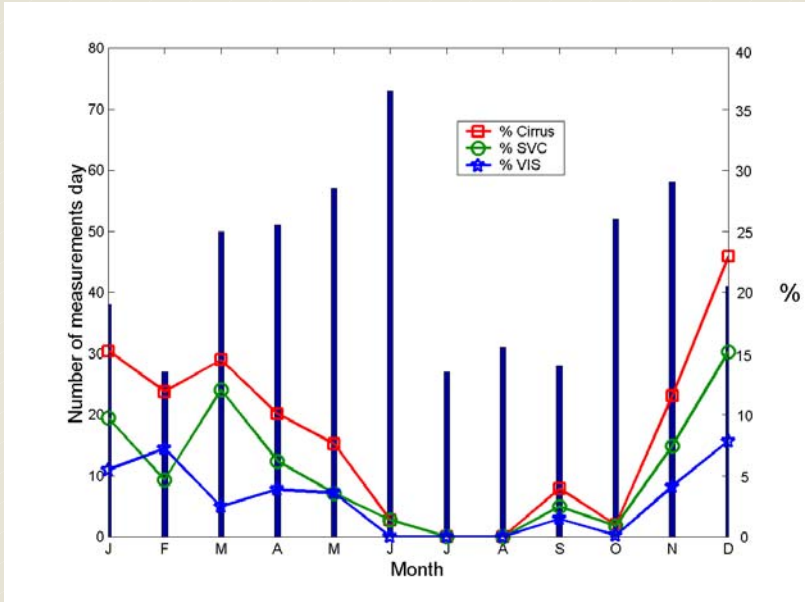


Cirrus Climatology

50% all year round

From 0 to 20%

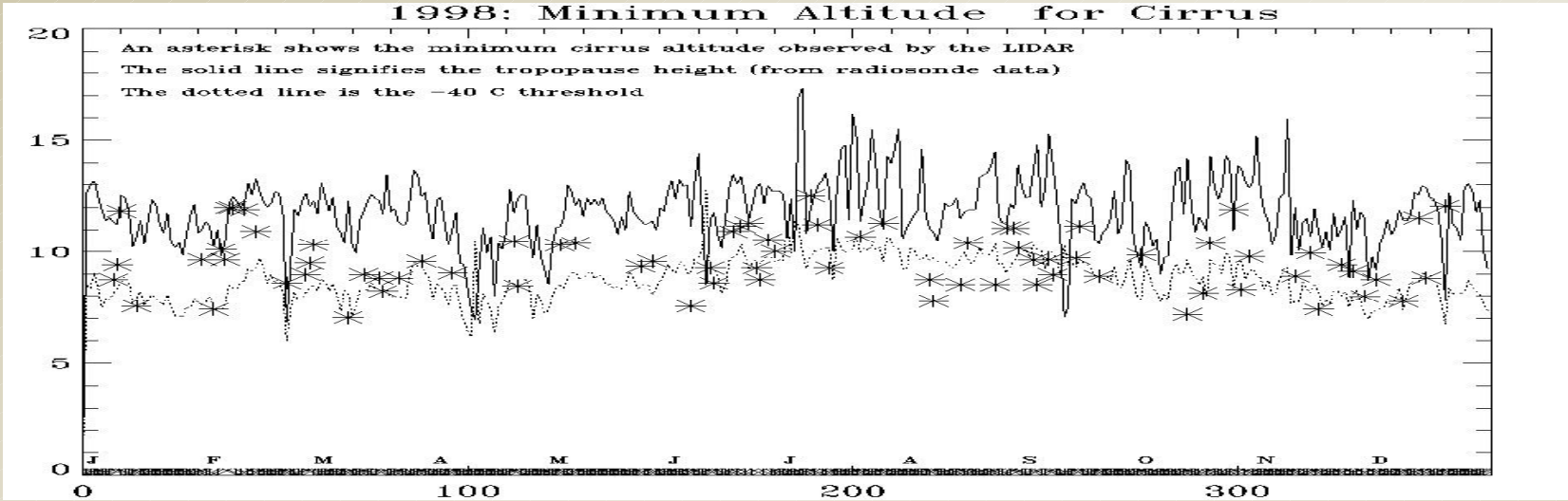




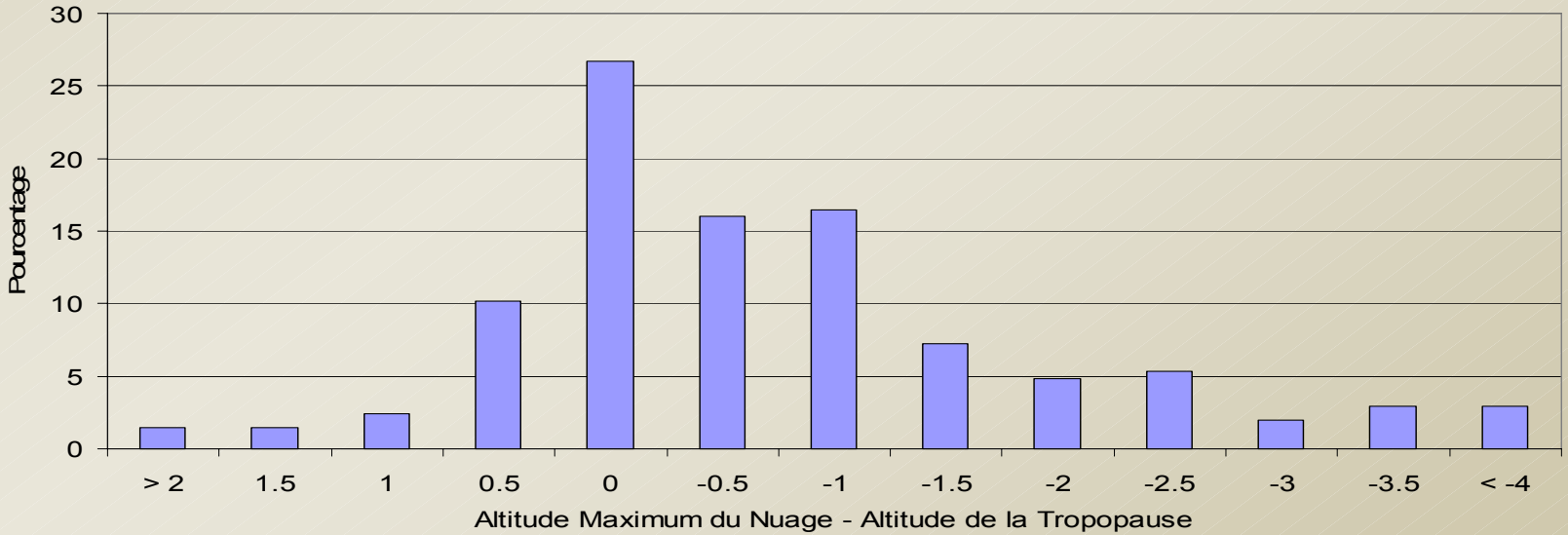
Mid-latitude (44°N)
(from Goldfarb et al., 2001)

Southern tropic (21°S)
(from Cadet et al., 2002)

Cirrus in the stratosphere

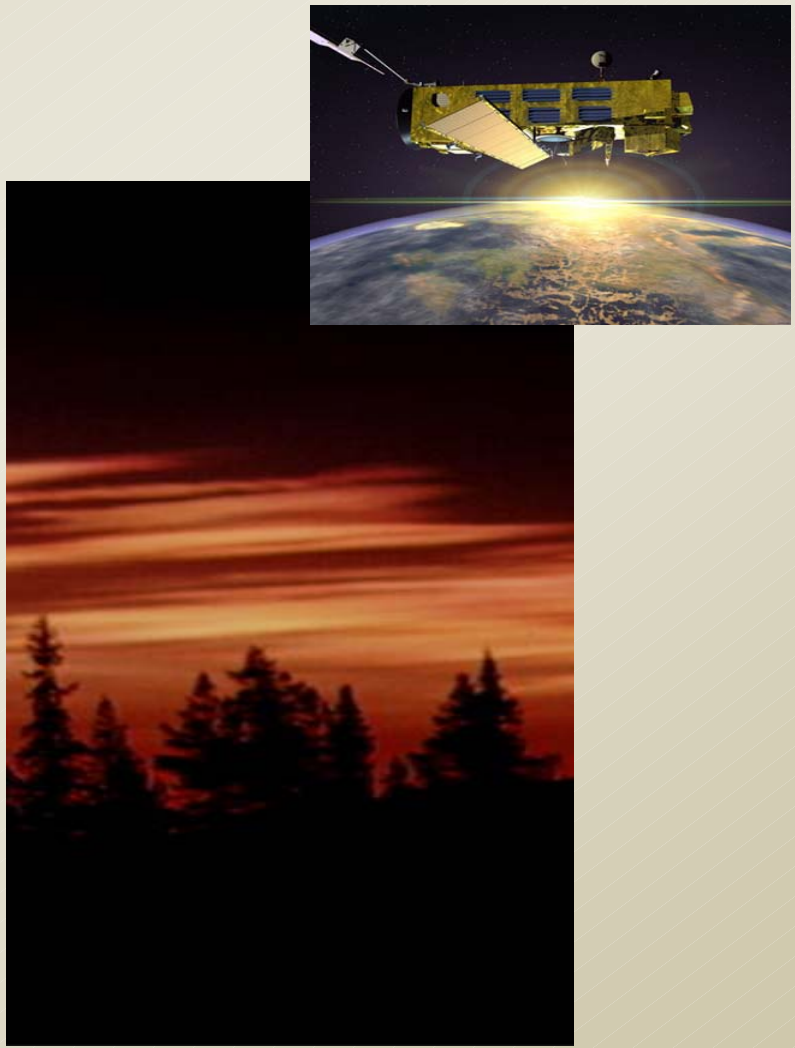


Différence entre l'altitude maximum du nuage et la tropopause



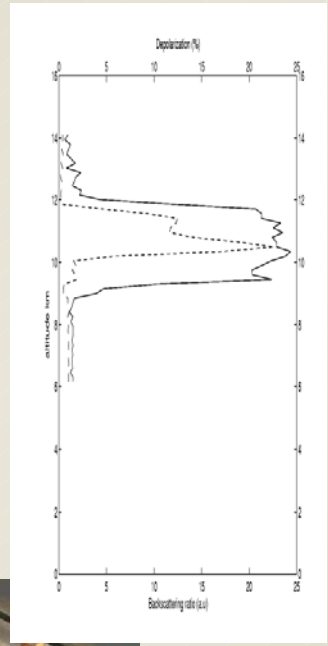
Calipso/ground based-lidars synergy

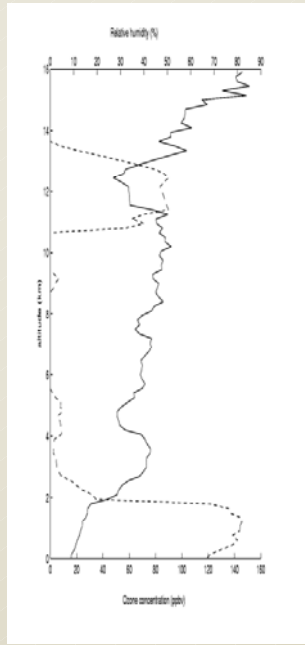
- PSC
  - Calipso validation with DDU lidar (new system 2004) + Alomar
  - Sensitivity tests and specific algorithms
  - Global PSC climatology (Calipso)
  - PSC formation and relation with Ozone losses using Envisat
- Cirrus
  - Calipso validation with OHP lidar + La Réunion
  - Operational algorithms (Coll. Sirta/LMD/IPSL)
  - Role of cirrus on the chemistry (tropo + strato)
  - Cirrus formation / air mass origin



The specific studies

- Pursue climatologic and morphologic studies with the lidar data bases
- Climatology associated with ozone and water vapor simultaneous lidar measurements
  - Complementary atmospheric observations
- Contrail studies and diurnal cycle
  - Daytime measurements
  - Visual observations
- Radiative impact
  - Associated with UV and visible ground-based radiometers
  - TUV model





(from Roumeau et al., 2000)