Aerosol-cloud interactions: what's next for GMI

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photo: S.Lance

GMI: Currently Accomplished

- Implemented aerosol-cloud interaction modules
  - ✓The type of cloud-relevant information changes with the met fields used.
  - ✓ Currently using DAO, GISS, GEOS-4.
  - ✓ Wrote basic routines to diagnose large-scale relative humidity and cloud fraction from met fields.
  - ✓ Cloud properties are then calculated from parameterizations.
- Aerosol-cloud droplet parameterizations implemented
  - ✓Boucher and Lohmann (1995) – empirical
  - ✓Nenes and Seinfeld (2003); Fountoukis and Nenes (2005) – mechanistic
- Assessments of indirect effect & sensitivity w.r.t droplet formation parameterization and meteorology.

GMI: Work in Progress

- Incorporate AEROCOM emissions for SO_2 , DMS, black carbon, organic matter, mineral dust, and sea salt

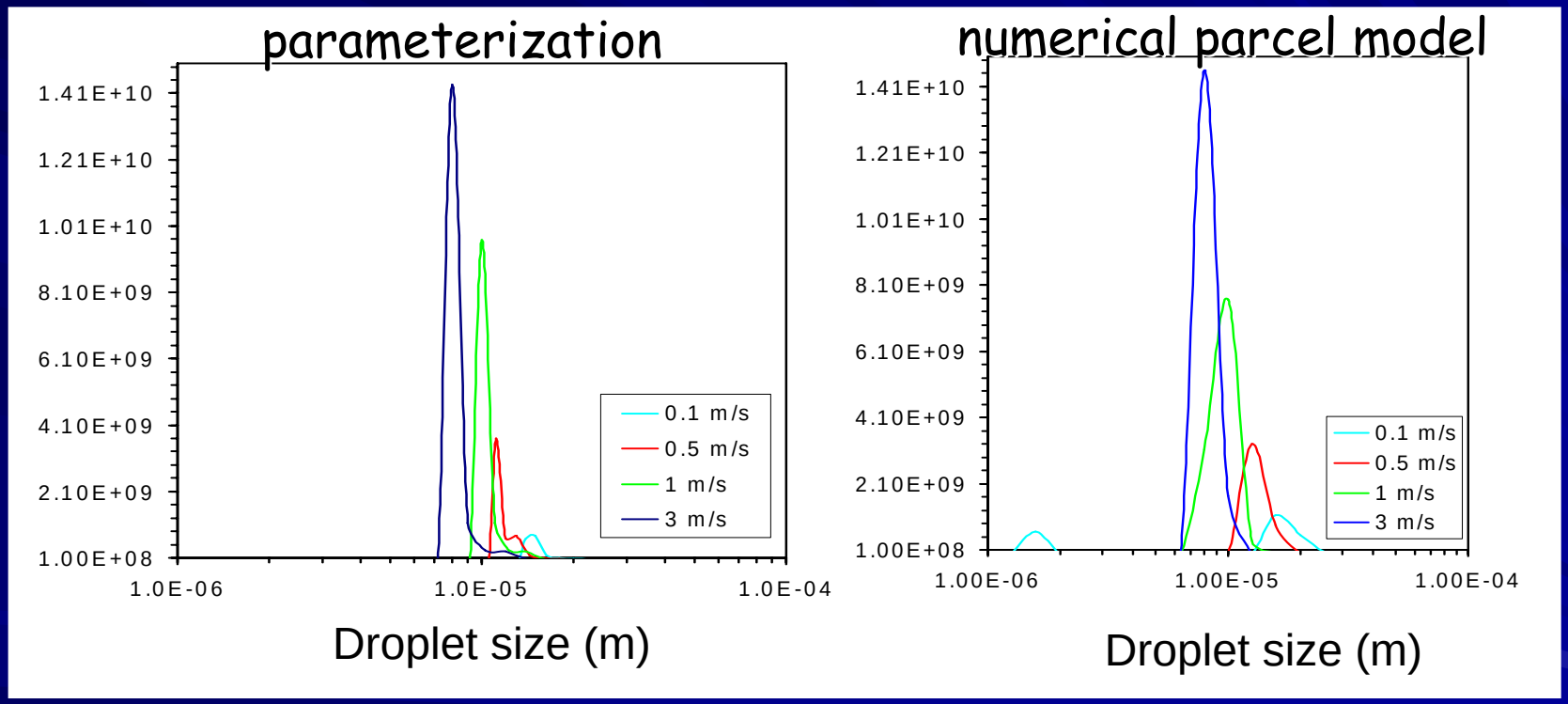
- Updraft Velocity treatment
  - > PDF with predicted *w* and prescribed s_w
    (NS parameterization has already been tested for Gaussian PDF)
  - > $w = \overline{w} + 0.7\sqrt{\mathrm{TKE}}$ (Lohmann et al., 1999)

- Incorporate other cloud droplet activation parameterizations (i.e., Abdul-Razzak and Ghan, 2002)

- Coupling aerosol-cloud interactions to radiation scheme.

GMI: Work in Progress

The Nenes and Seinfeld (2003) parameterization calculates droplet number AND sizes of the droplets at the point of Smax.



Based on our mechanistic parameterization, we are implementing an online calculation of cloud droplet size distribution.

Work in Progress: Cloud droplet size distribution

Prediction of the size distribution can be used in many aspects of GMI:

- Improved calculation of cloud effective radius and OD (indirect effect). Cloud droplet dispersion has a strong impact on r_{eff}.

- Modification of in-cloud chemistry. Each cloud droplet "size" class has different concentration of reactants and size; "bulk" approaches can differ a lot from a size-resolved treatment.

- Wet deposition rates and in-cloud scavenging. These are size-dependant processes and we can treat them as such.

Interesting problems for GMI: Effect of droplet growth kinetics

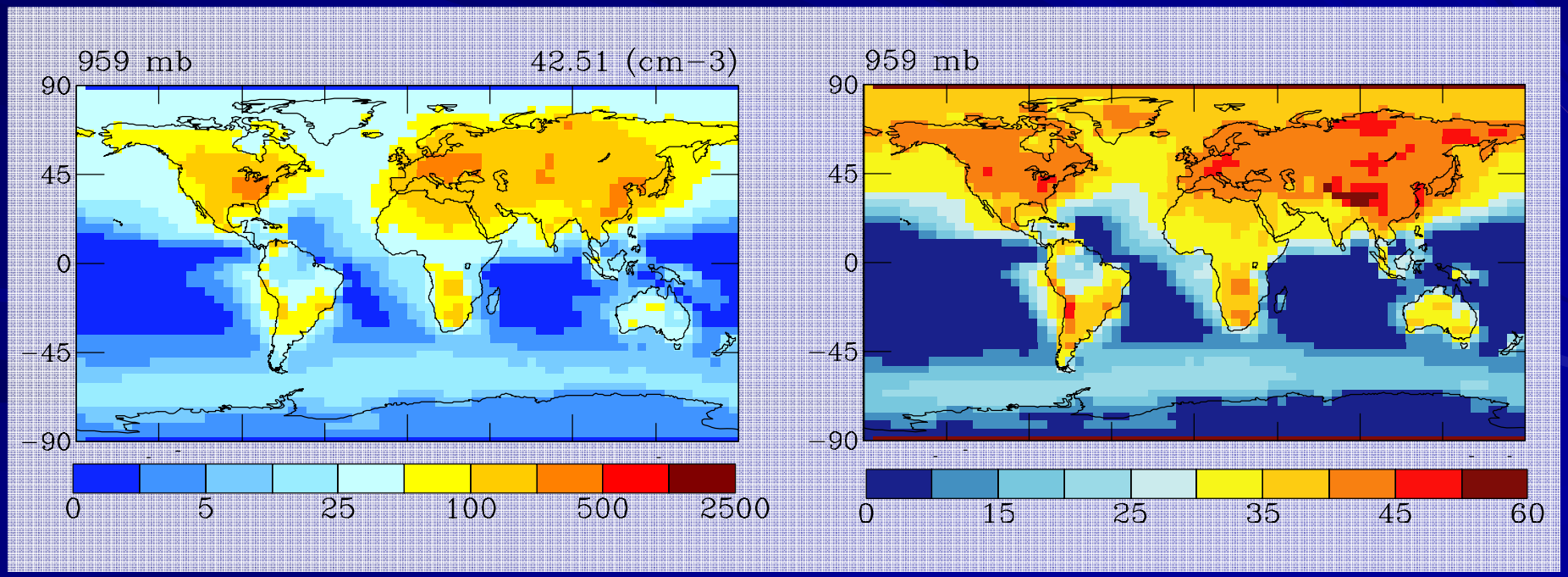
Conditions

GISS II' with TOMAS aerosol microphysics

Nenes and Seinfeld cloud droplet parameterization

Accommodation coefficient range (1.0 - 0.01)

ΔCDNC (cm^{-3}) **ΔCDNC (%)**



Interesting problems: Effect of droplet growth kinetics

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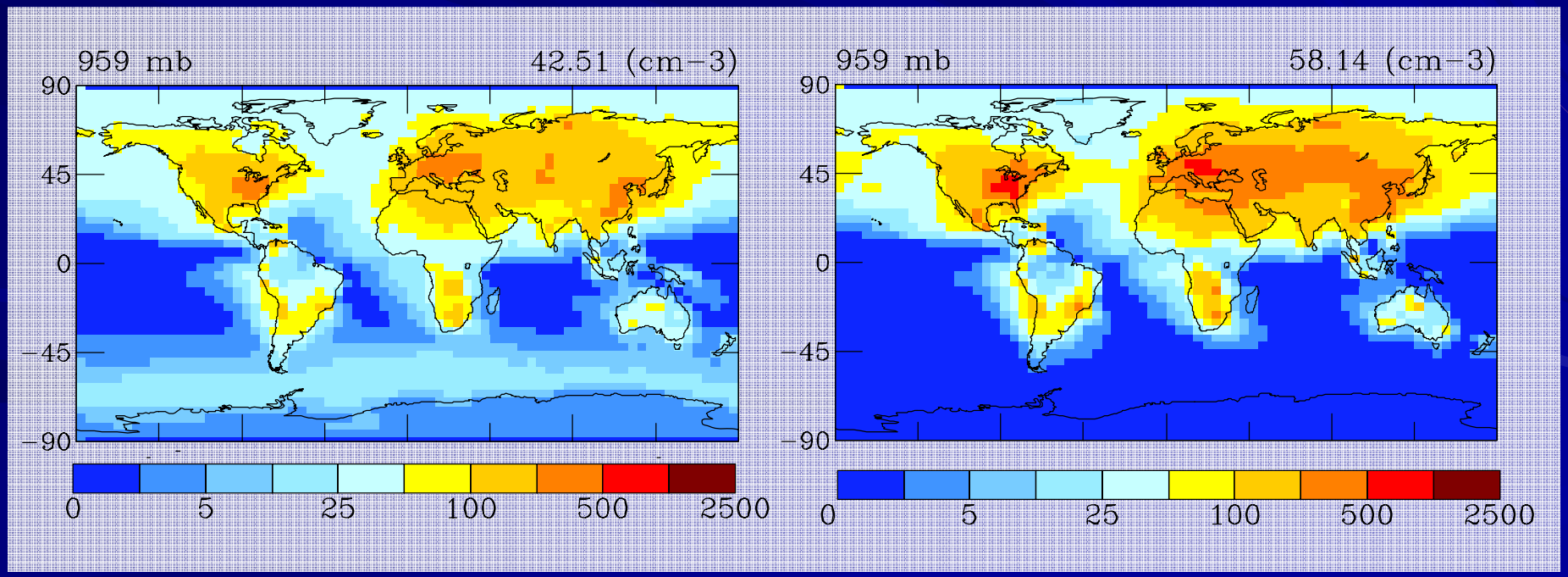
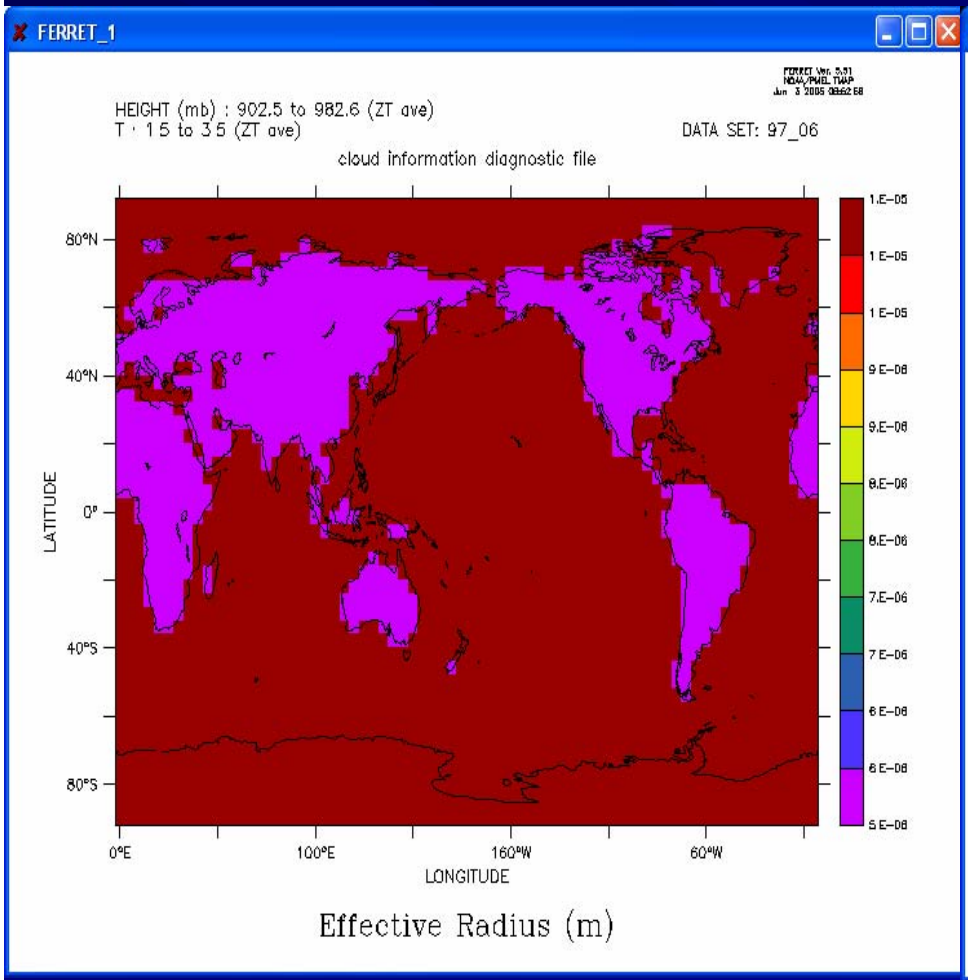
ΔCDNC (α change) **ΔCDNC (Present-Preind)**



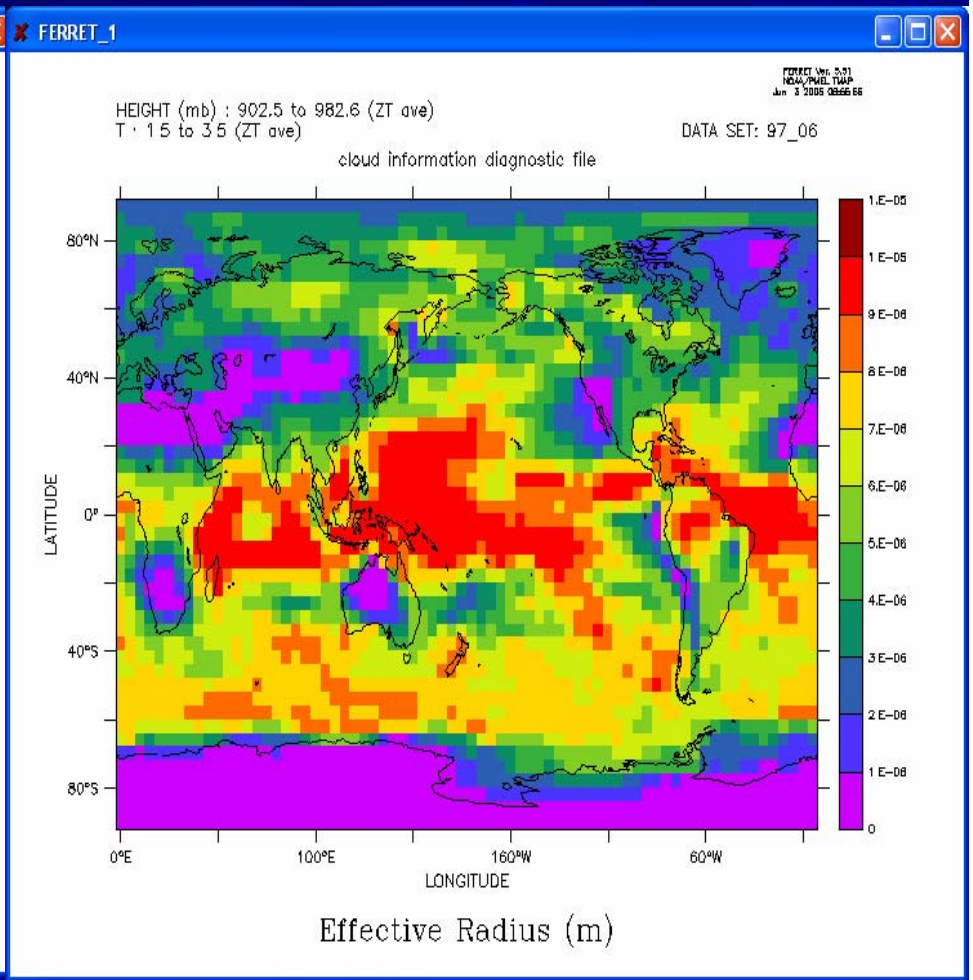
Interesting problems:
"Indirect effect" of aerosols on chemistry

r_{eff}, Default scheme



Effective Radius (m)

r_{eff}: What we calculate



Effective Radius (m)

Interesting problems:
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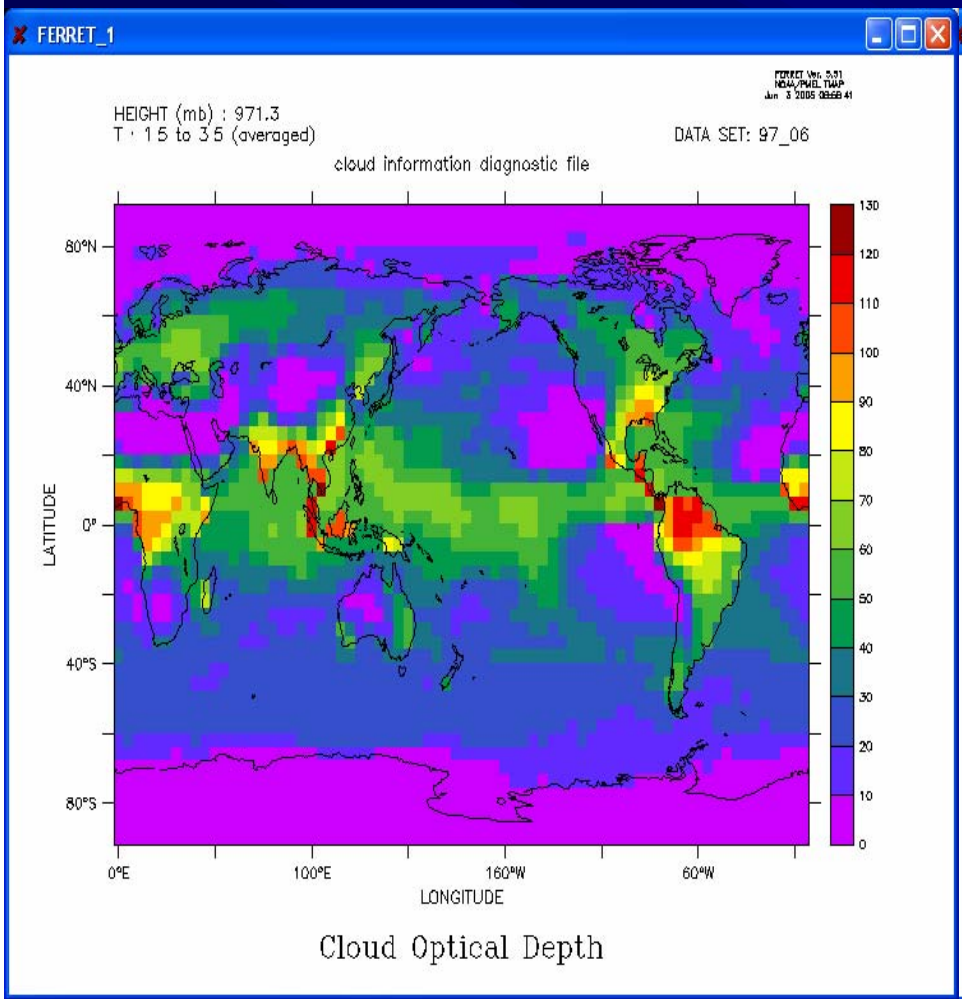
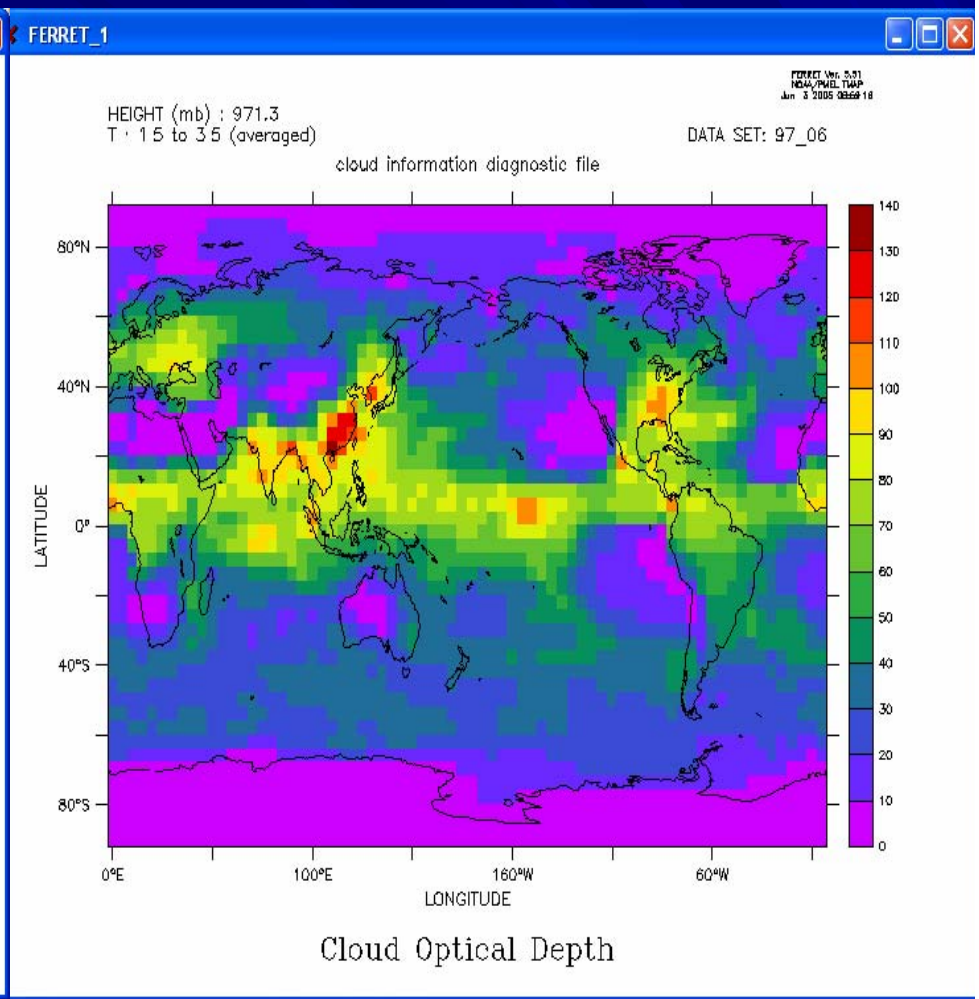
Cloud optical depth used in photochemistry

Default scheme



Cloud Optical Depth

What we calculate



Cloud Optical Depth

THANK YOU !