"Atmospheric Chemistry and Climate Initiative" AC&C

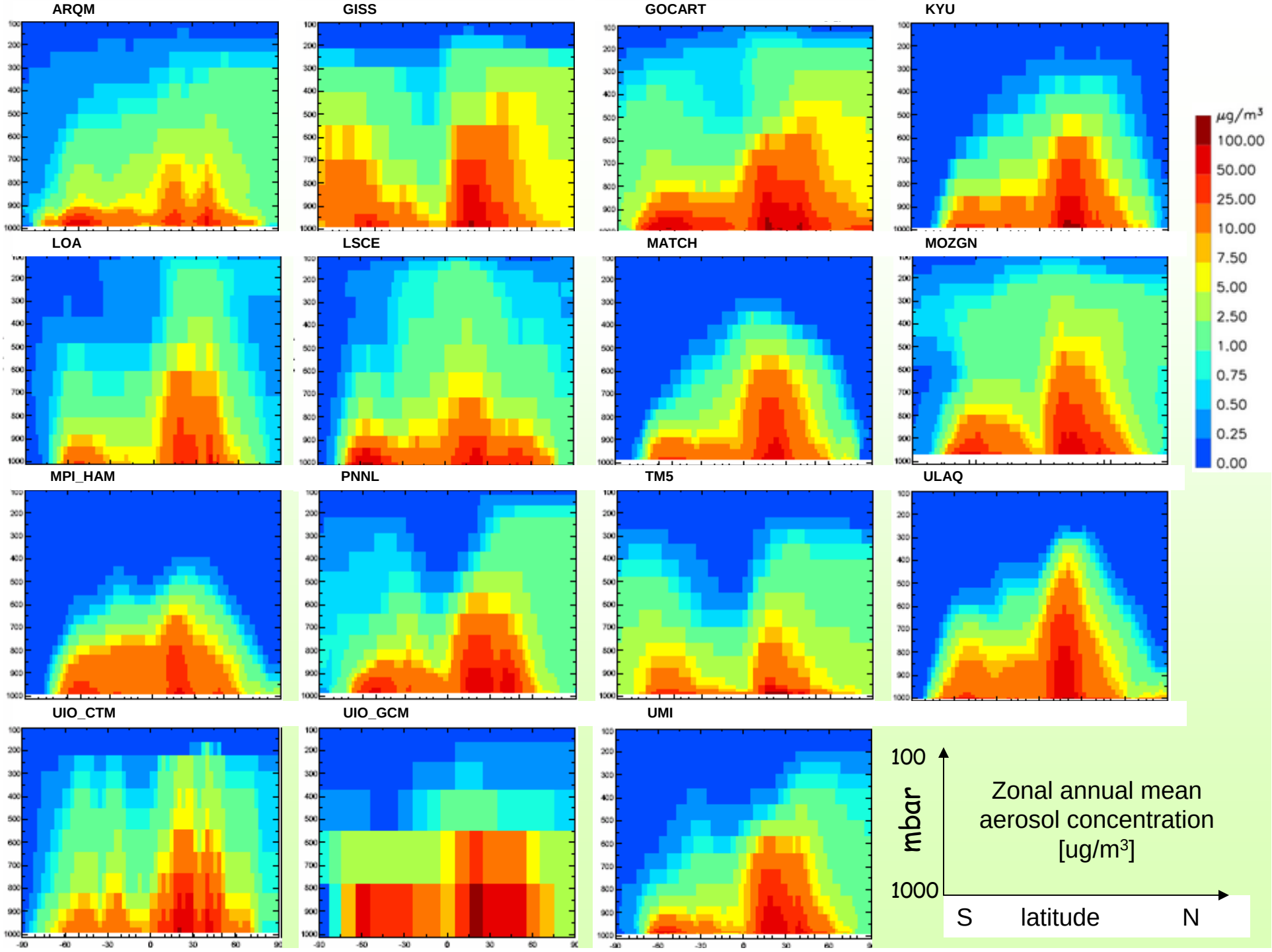
- Endorsed in March 2006 joint effort of **WCRP** and **IGBP**, with the **SPARC** and **IGAC** projects tasked to take the lead in its implementation.
- The role of the AC&C project is **coordination**
- Improving **process** representation in chemistry-climate models
- Connecting to
  - the global Aerosol model inter-Comparison (**AeroCom**)
  - the **CCM-Val** (Chemistry-Climate Model Validation activity of SPARC): stratospheric chemistry-climate models
  - the European ACCENT project Model Inter-comParison (**ACCENT-MIP**): IPCC scenarios for global reactive gas chemistry
  - the **TF HTAP** (Task Force on Hemispheric Transport of Atmospheric Pollutants): northern hemispheric transport of gaseous and particulate air pollutants

AC&C **Research Activities**

1. 20 year hindcast for tropospheric gases and aerosols
2. Processes that determine tropospheric composition above 5 km
3. Cloud/aerosol/chemical interactions
4. Future scenarios; sensitivities & uncertainties

Planning of sensitivity studies to improve processes understanding

AeroCom “working group” on vertical profiles, transport and removal


ARQM
GISS
GOCART
KYU
LOA
LSCE
MATCH
MOZGN
MPI_HAM
PNNL
TM5
ULAQ
UIO_CTM
UIO_GCM
UMI
µg/m³
100.00
50.00
25.00
10.00
7.50
5.00
2.50
1.00
0.75
0.50
0.25
0.00
100
mbar
1000
S
latitude
N
Zonal annual mean
aerosol concentration
[ug/m³]

Goals

- Understanding of model diversity in spatial distribution and in removal processes
- Evaluate simulated spatial distribution and processes with observations
- Establish/quantify an acceptable diversity in global aerosol simulations
- Find methods to evaluate process parameterisations
- Define dedicated diagnostics of model results
- Elaborate recommendations
- Collect data for model evaluation (vertical profiles&processes) including uncertainty
- This working group has a special focus on dust.

Why these differences?

- Vertical profiles are determined by
  - Transport (large scale and sub scale)
  - Removal processes
- How to distinguish their effects?
  - Passive tracer experiments?
  - Methods to evaluate process parameterisations

Objective of Today (30 min)
Activities on vertical aerosol distribution

- Who does what and when?

  Plan realistic studies & people to evaluate vertical aerosol distribution
- Model diagnostics and simulations needed for these studies
- Define obs. data products and create tight links between observationalists and modellers

Specific scientific questions

- **How realistic are the simulated (vertical and horizontal) spatial aerosol distributions?**
- **How to validate aerosol processes?**
- Is the diversity of simulated vertical dispersal caused by differences in transport or by removal processes?
- How much complexity of aerosol models is necessary?
- How much complexity of aerosol models is justified?
- More, but later?

Links to other activities

- HTAP
- TRANSCOM
- AC&C
- NASA GMI project

Data to look at (1/2)

Satellites

- GLASS
- MISR (R. Kahn)
- CALIPSO (D. Winker, ICARE web site): backscatter ratio, extinction

Ground-based remote sensing

- ARM LIDAR (R. Ferrare)
- MPLNET LIDAR (Judd Welton)
- EARLINET LIDAR (J. Boesenberg, G. Pappalardo)
- NOAA LIDAR data from Mauna Loa (John Barnes)?
- Single particle soot photometer light-absorbing (Joshua.P.Schwarz@noaa.gov)?

- Wet deposition of SO4?

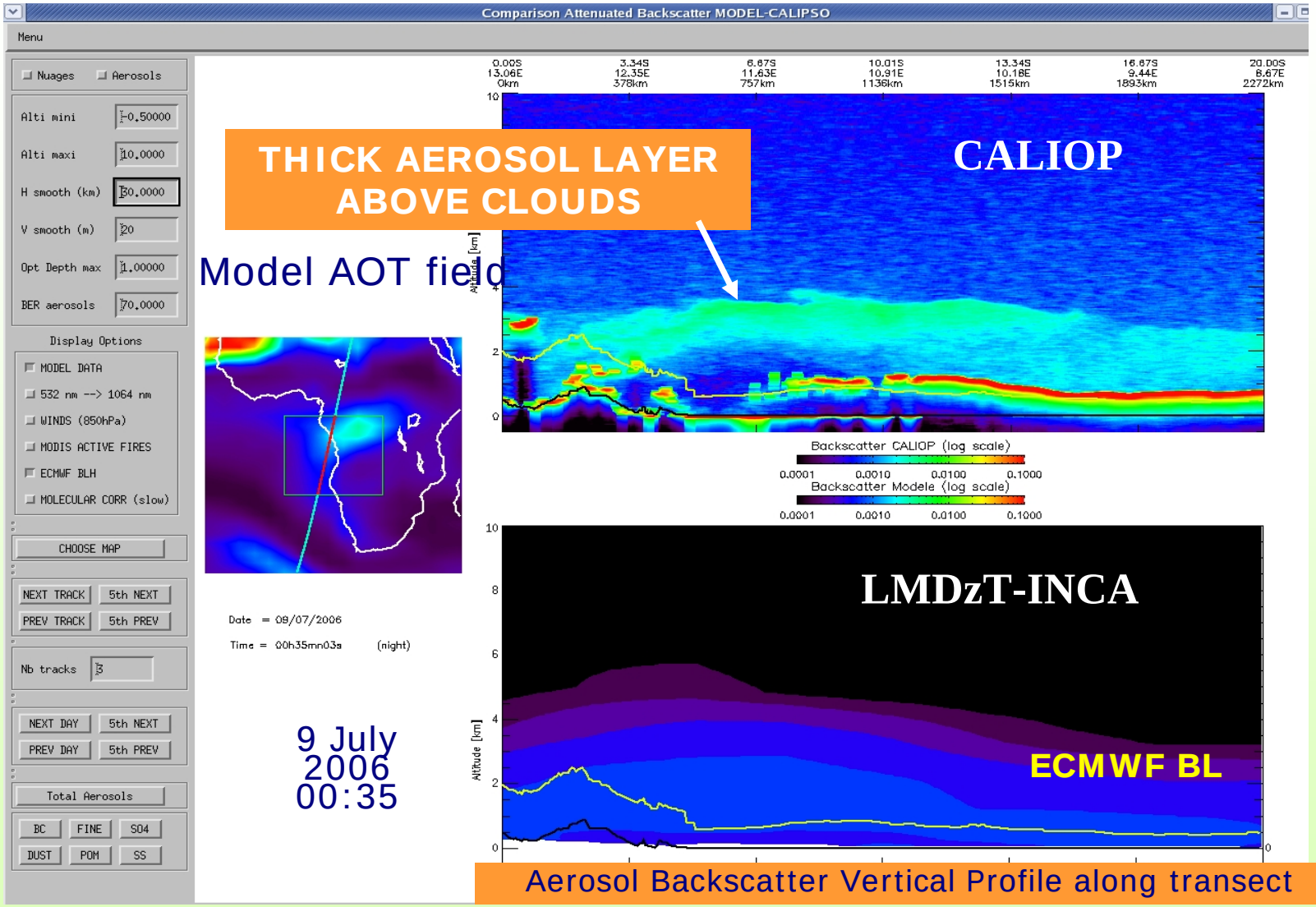
Model simulations

- AeroCom, HTAP, AC&C

Data to look at (2/2)

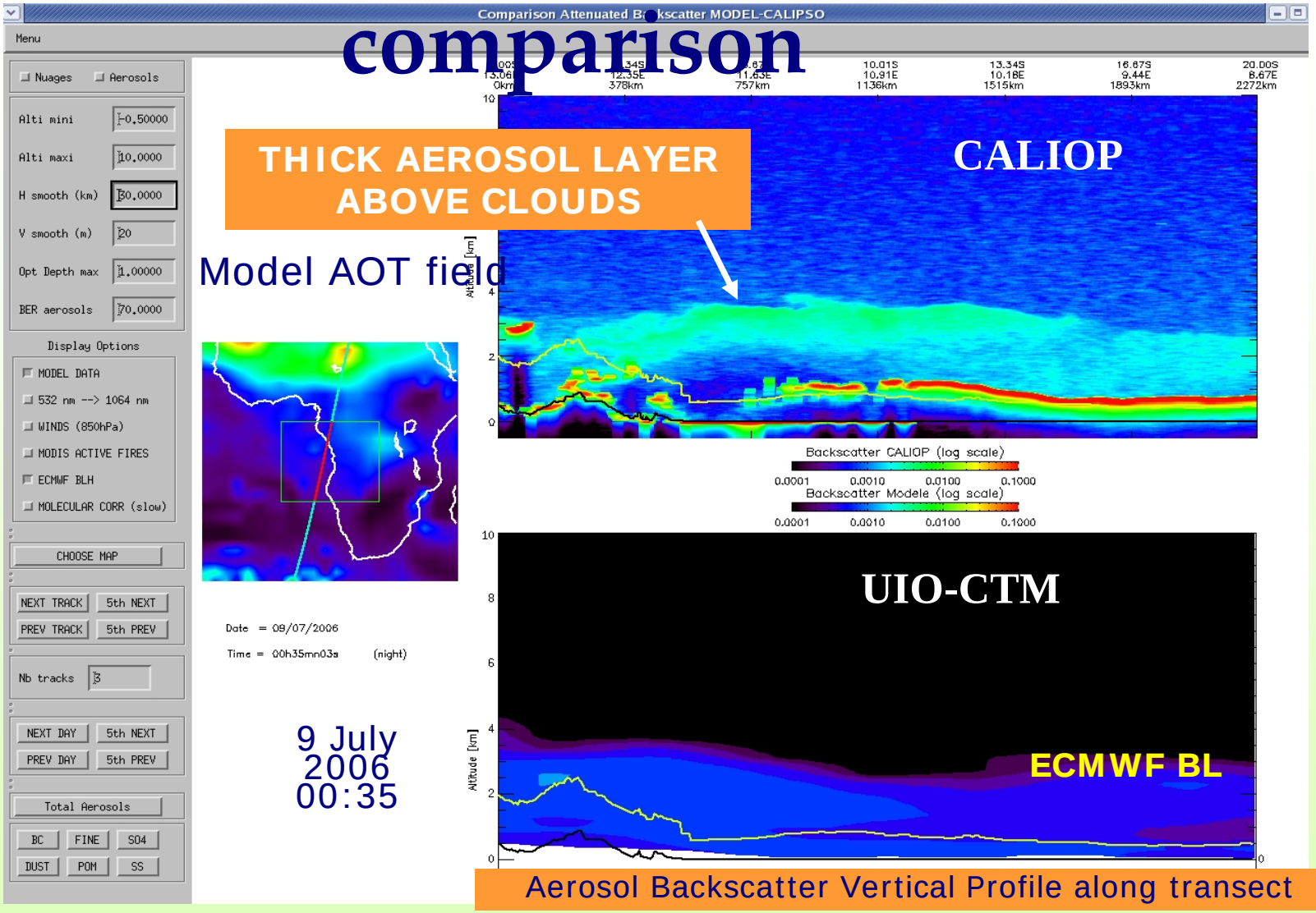
- **Specific regional Analysis** (apart from above mentioned data)
- West Africa : AMMA campaigns dust, bb (Jacques Pelon)
- Europe:
  - GEOmon (Global Earth Observation and Monitoring) www.geomon.eu,
  - EUCAARI (European Integrated project on Aerosol Cloud Climate and Air Quality Interactions) www.atm.helsinki.fi/eucaari
  - EUSAAR (European Supersites for Atmospheric Aerosol Research) ww.eusaar.net
- USA:
  - Wyoming balloon measurements, specific field campaigns (Haflidi Jonsson?)
- Other: ?

Calipso-Model direct comparison



We have developped a tool for the direct and easy comparison of Calipso profiles and modeling

Calipso-Model direct comparison

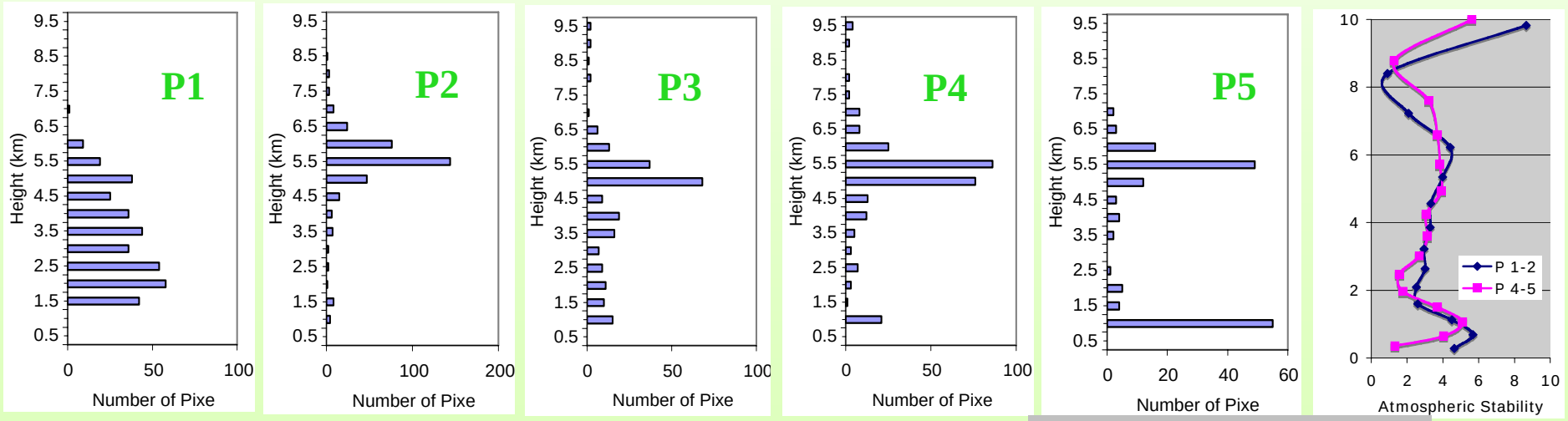


We have developped a tool for the direct and easy comparison of Calipso profiles and modeling

Where We Stand Currently with the MISR Aerosol Products

- *Quantitative* **Plume Height** in Aerosol Source Regions

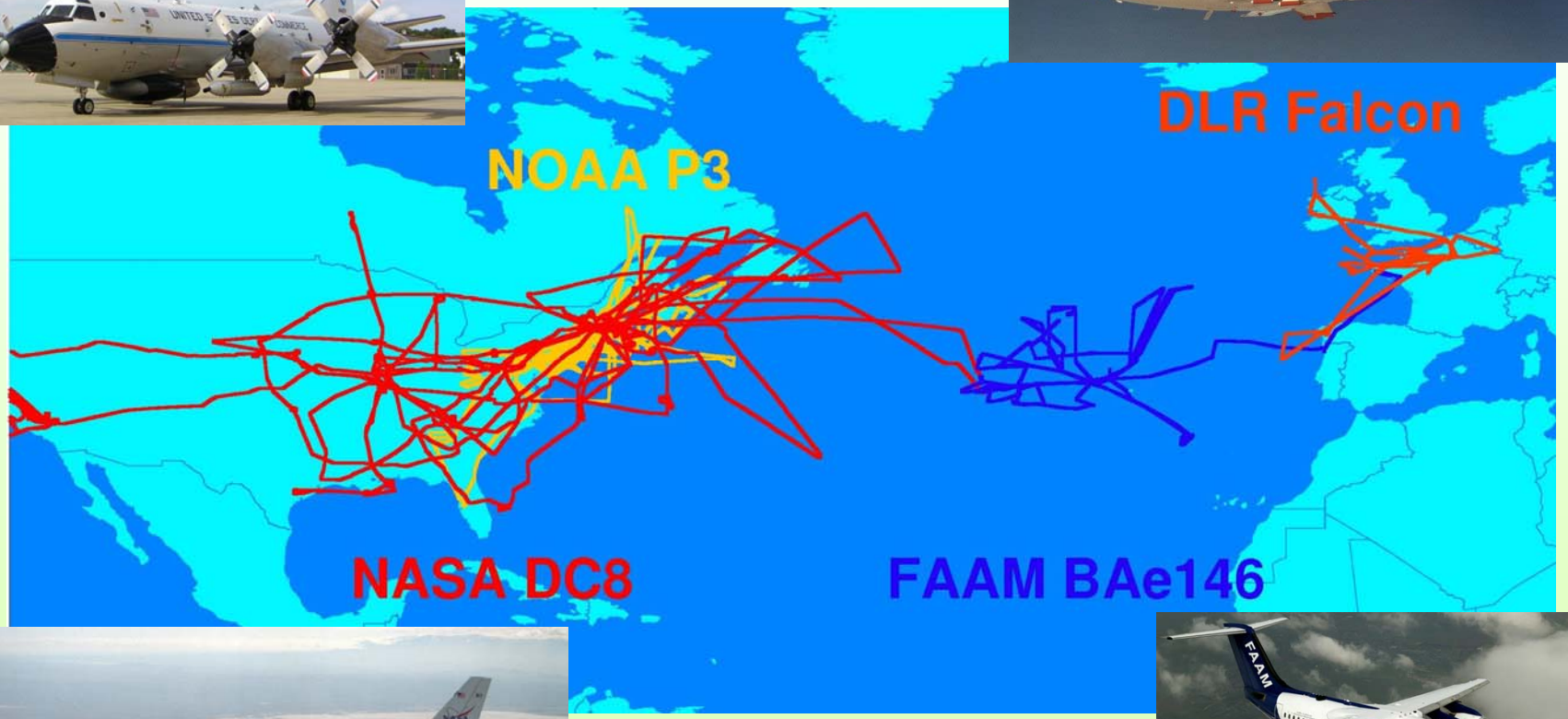
Oregon Fire Sept 04 2003
Orbit 19753 MISR Stereo Heights V13 (no winds)



From: *Kahn, et al.*, JGR 2007

Modified from presentation R. Kahn, yesterday

Evolution of anthropogenic and biomass burning plumes during the transport: Model evaluation using specific observations from the ICARTT campaign (summer 2004)

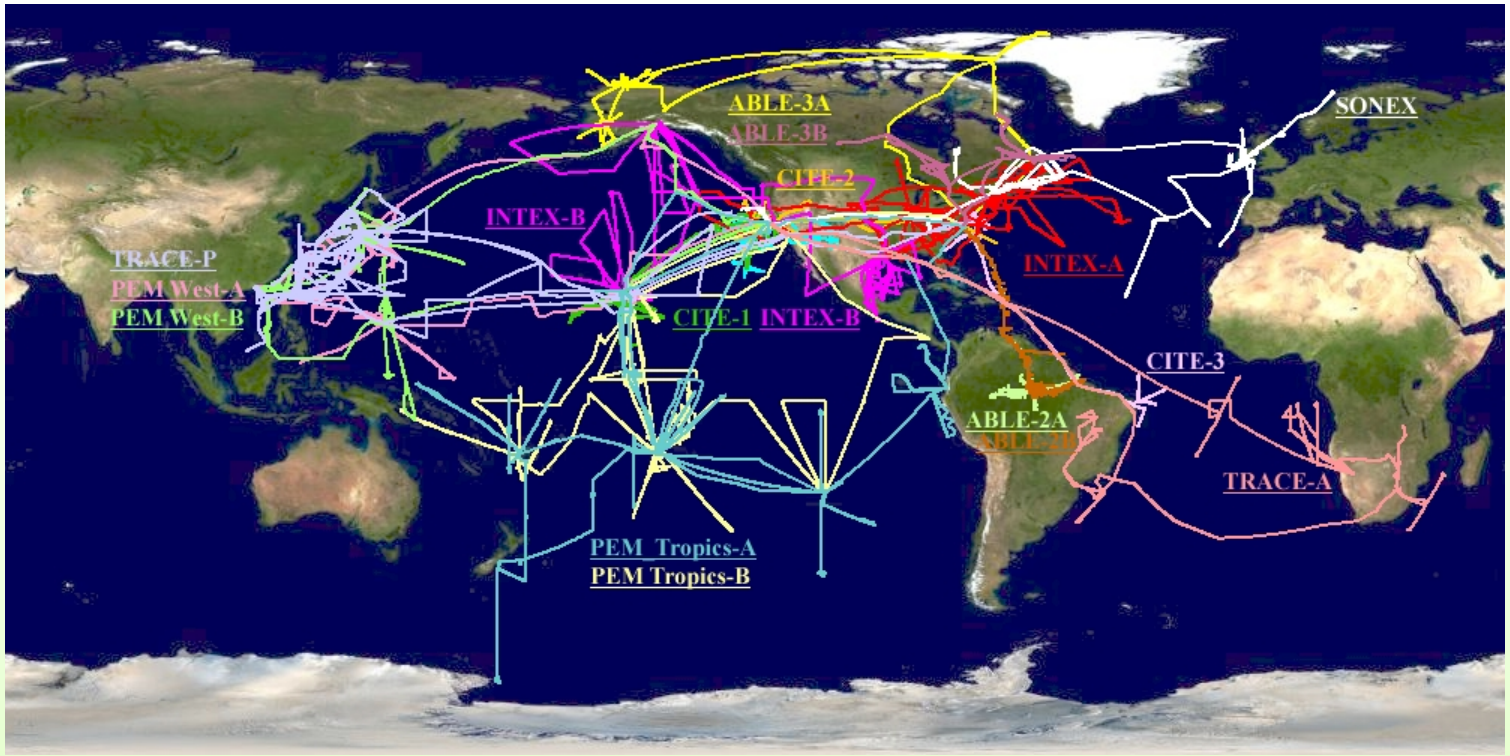


Presentation of Isabelle Bey at HTAP meeting last week

Air craft campaigns

- TexAQS/GoMACCS (August-Sept, 2006, Houston, Texas) (R. Ferrare)
- ARM in situ aircraft data (R. Ferrare)
- UK FAAM in situ aircraft data (100 flights Atlantic Ocean, around the UK, around the Po Valley& Adriatic region, sub Saharan Africa) (data by Hugh Coe SEAES University of Manchester, UK, to be analyzed by G. Mann, Uni Leeds, UK)
- NOAA regular profiles over the US (John Ogren)

NASA Airborne Database



Other Important Airborne Databases includes:

NOAA: SOS, NARE, TexAQS 2000, ITCT 2K2, NEAQS 2004, and TEXAQS 2006.
NSF: ACE-1, ACE-2, ACE-Asia, TOPSE, and MILAGRO.
JAXA: PEACE-A and PEACE-B.

Presentation of Gao Chen at HTAP meeting last week

Creating a Unified Airborne Database for Assessment and Validation of Global Models of Atmospheric Composition

A Proposal Submitted to NASA MEaSURES Program

by Gao Chen, Margaret Pippin, Mary Kleb, and Jennifer Olson
NASA Langley Research Center
Hampton, VA 23693

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margaret.r.pippin@nasa.gov
mary.m.kleb@nasa.gov
jennifer.r.olson@nasa.gov

Presentation of Gao Chen at HTAP meeting last week

Compilation of inventory of airborne aerosol observations over the past 5 years

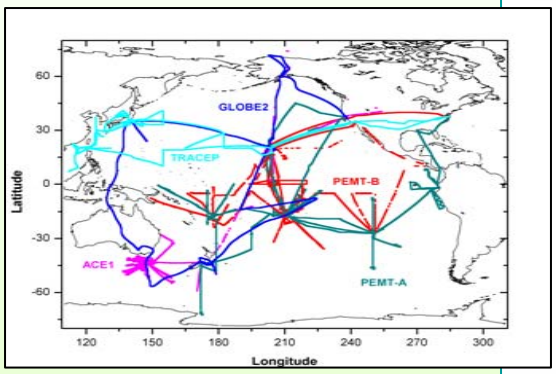
aerosol number, mass and optical properties including log-normal fit statistics and f(RH) measurements:

Cameron S. McNaughton, Antony Clarke,
Department of Oceanography, University of Hawai'i ManoaI'm

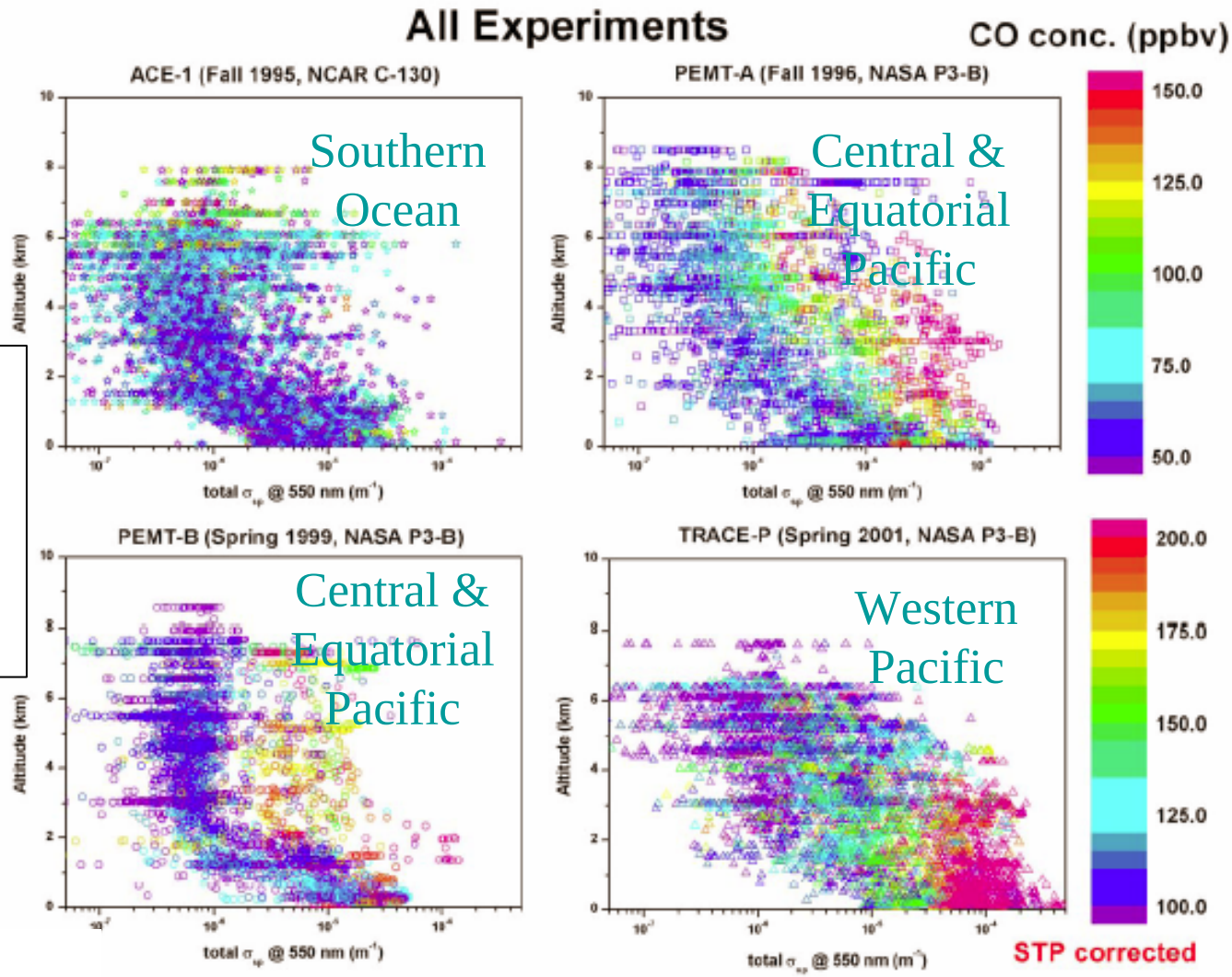
Experiment	Season -Year	Location	Number of Flights
TRACE-P	Spring - 2001	Coastal East Asia	24
ACE-Asia	Spring - 2001	Coastal East Asia	19
INTEX-NA	Summer - 2004	Eastern N. America	20
INTEX-B	Spring - 2006	Gulf of Mexico & Mexico Hawaii Alaska	6 5 5
MIRAGE	Spring - 2006	Mexico City	12
IMPEX	Spring - 2006	West Coast N. America	12

HIGEAR
Hawaii Group for Environmental Aerosol Research

Antony Clarke et al.
Dept. of Oceanography
University of Hawaii



Extinction vs Height, color coded with CO conc



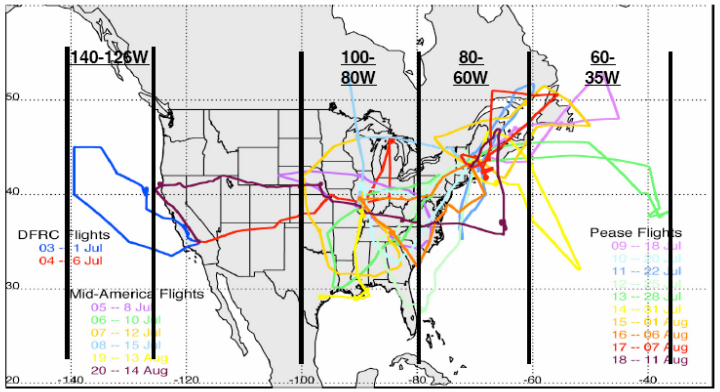
X: extinction (scatter)
Y: altitude
Color: CO conc (combustion)

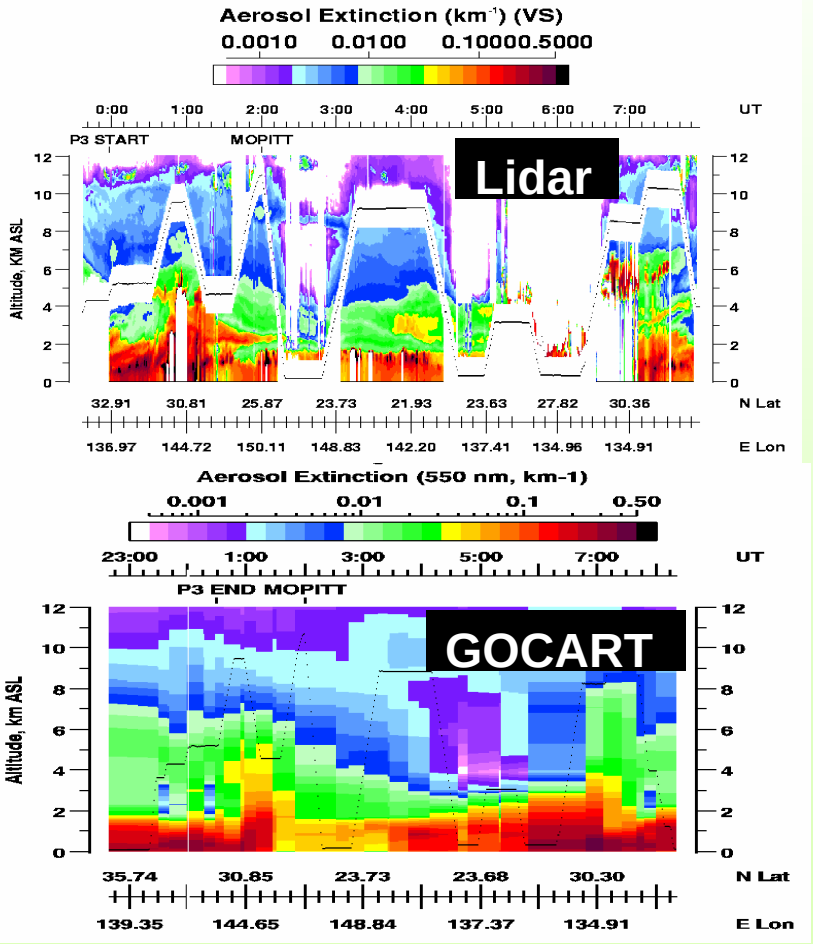
High Scattering associated indicates combustion aerosol superimposed on clean cloud-scavenged background (blue-violet) aerosol

Overarching Objectives

- To assemble a measurement evaluation panel, including both measurement experts and modelers from a broad spectrum of institutions and agencies
- To provide objective assessment of measurement uncertainties and biases
- To generate a standardized in-situ observational database
- To determine how to best integrate these observations into forms useful for model comparison.

Modified from Presentation of Gao Chen at HTAP meeting last week

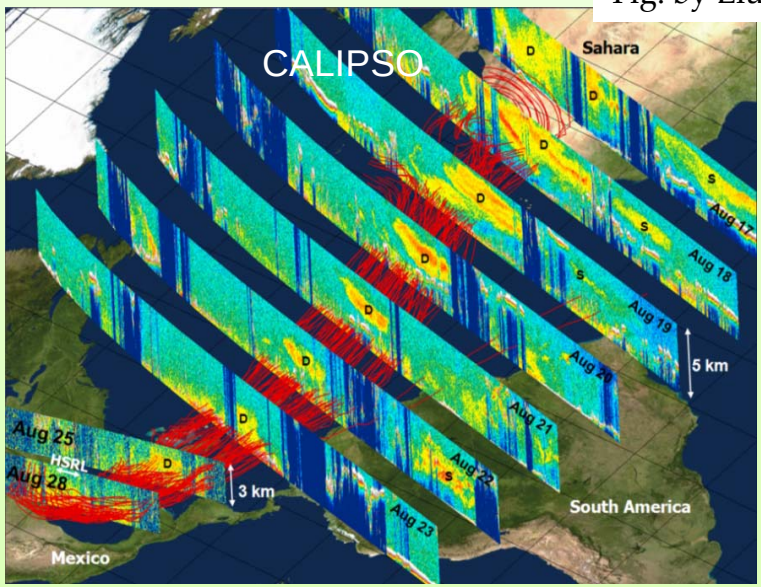




Airborne (regional) **and spacebased** (global) **lidar** measurements can be used to evaluate model aerosol simulations of:

- aerosol vertical distributions – profiles of:
  - Backscatter
  - Extinction
- aerosol composition – profiles of:
  - depolarization (dust)
  - lidar ratio (size, composition)
  - multiwavelength backscatter profiles (size)

Fig. by Liu et al. 07



Slide by Rick Ferrare

Specific Questions

- Temporal variation of vertical distribution
- How to average the obs and the models?
- Best use of field campaign data
- Suggestions for averaging obs and models for suitable comparisons?
- How to integrate observations of different types (parameters)?

Short-term actions/experiments

- CALIPSO over Africa, Biomass Burning Labonne/Breon/Textor/Schulz
- Airborne LIDAR/CALIPSO – GOCART/INCA/other models? For 2006 Eastern US and Gulf of Mexico (Ferrare and Chin)
- Analyse UK FAAM in situ aircraft data (100 flights Atlantic Ocean, around the UK, around the Po Valley& Adriatic region, sub Saharan Africa) (obs by Hugh Coe SEAES University of Manchester, analysis by Graham Mann UK)

Additional Diagnostics needed for these studies

- 2006 / 2007 simulation?
- Wavelength dependent backscatter & extinction per component at ambient RH conditions
- 3d output of these components
- Higher temporal resolution: daily?

Objective of Today (30 min)
Activities on vertical aerosol distribution

- Who does what and when?

  Plan realistic studies & people to evaluate vertical aerosol distribution
- Model diagnostics and simulations needed for these studies
- Define obs. data products and create tight links between observationalists and modellers

What is sulfate aerosols AOD

CF convention

- atmosphere_optical_thickness_due_to _sulfate_compounds_ambient_aerosol
- Sulfate_compounds comprise all non-sea salt compounds containing sulfate that occur in the atmosphere (e.g. (NH4)2SO4, NH4HSO4, Na2SO4, NaHSO4, condensed H2SO4, etc). Please indicate the specific compounds you include in this variable.

AeroCom with unified emissions

annual mean 2000
Concentration of BC+POM
Cross section at 25 E (30S to 20 N)