

“Atmospheric Chemistry and Climate Initiative” AC&C

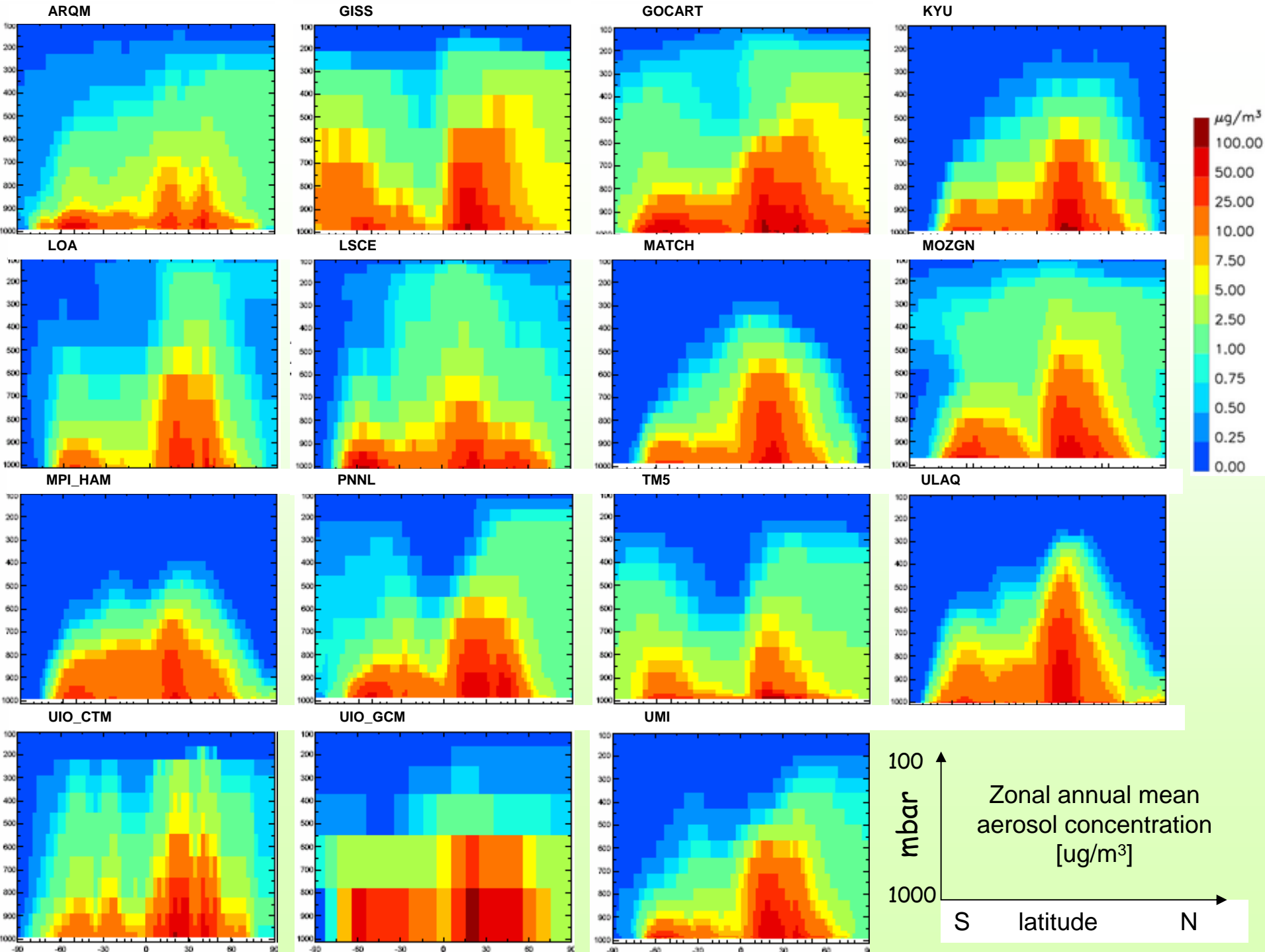
- Endorsed in March 2006 joint effort of **WCRP** and **IGBP**, with the **SPARC** and **IGAC** projects tasked to take the lead in its implementation.
- The role of the AC&C project is **coordination**
- Improving **process** representation in chemistry-climate models
- Connecting to
 - the global Aerosol 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



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?

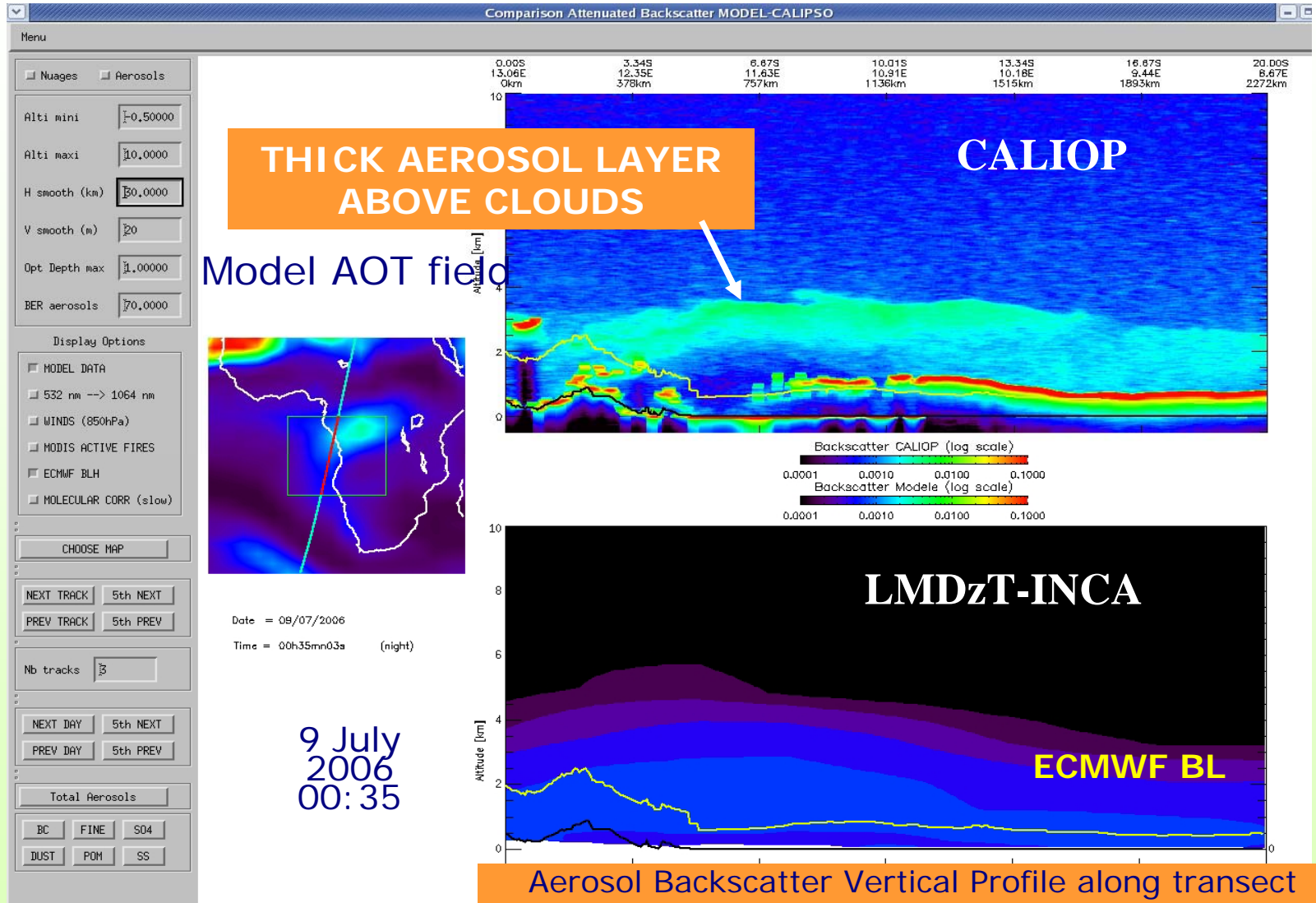
Model simulations

- AeroCom, HTAP, AC&C

Data to look at (2/2)

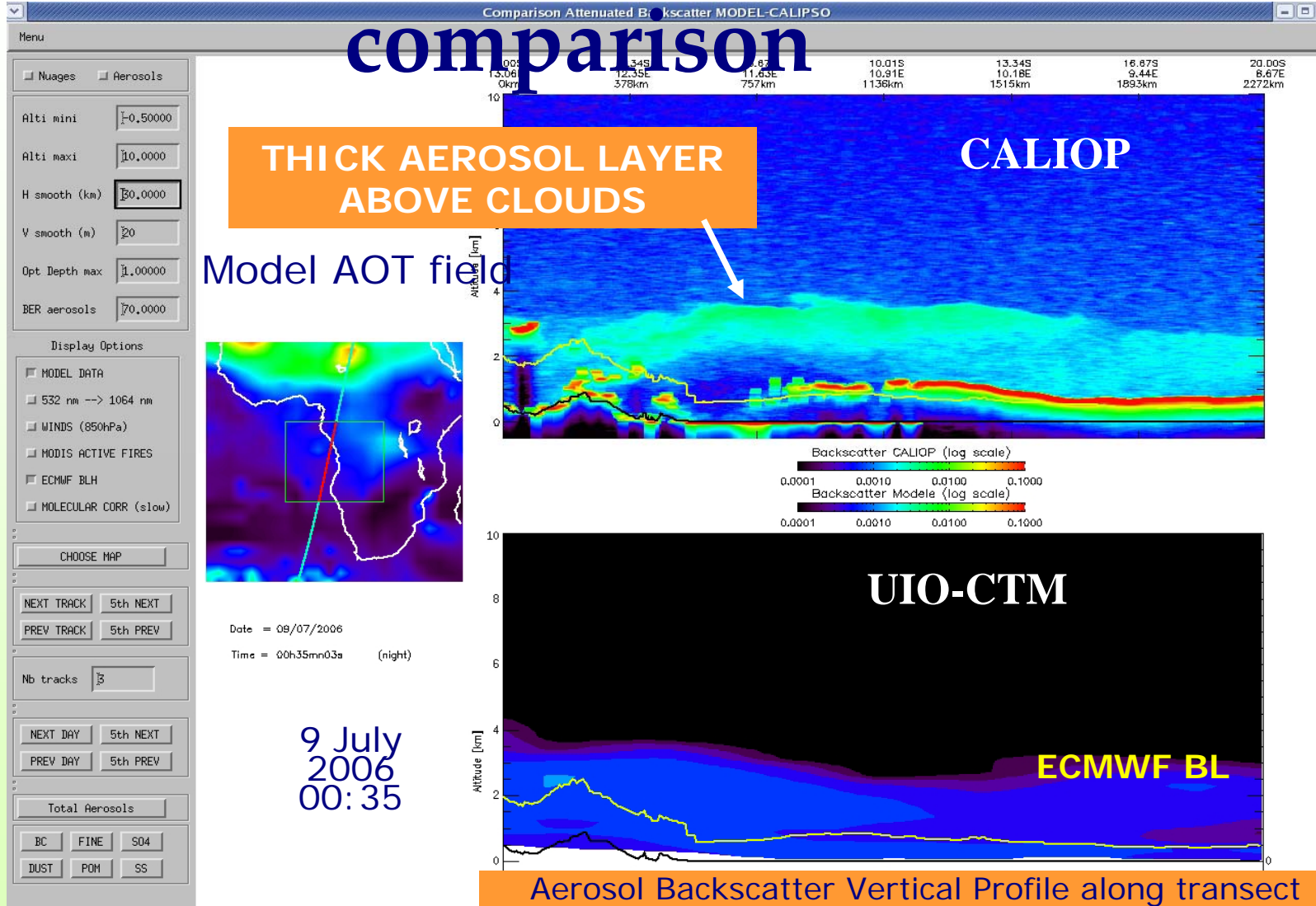
- **Specific regional Analysis** (apart from above mentioned data)
- West Africa : AMMA campaigns dust, bb (Jacques Pelon)
- Europe:
 - GEOMon (Global Earth Observation and Monitoring) www.geomon.eu,
 - EUCAARI (European Integrated project on Aerosol Cloud Climate and Air Quality Interactions) www.atm.helsinki.fi/eucaari
 - 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 developed a tool for the direct and easy comparison of Calipso profiles and modeling

Calipso-Model direct comparison

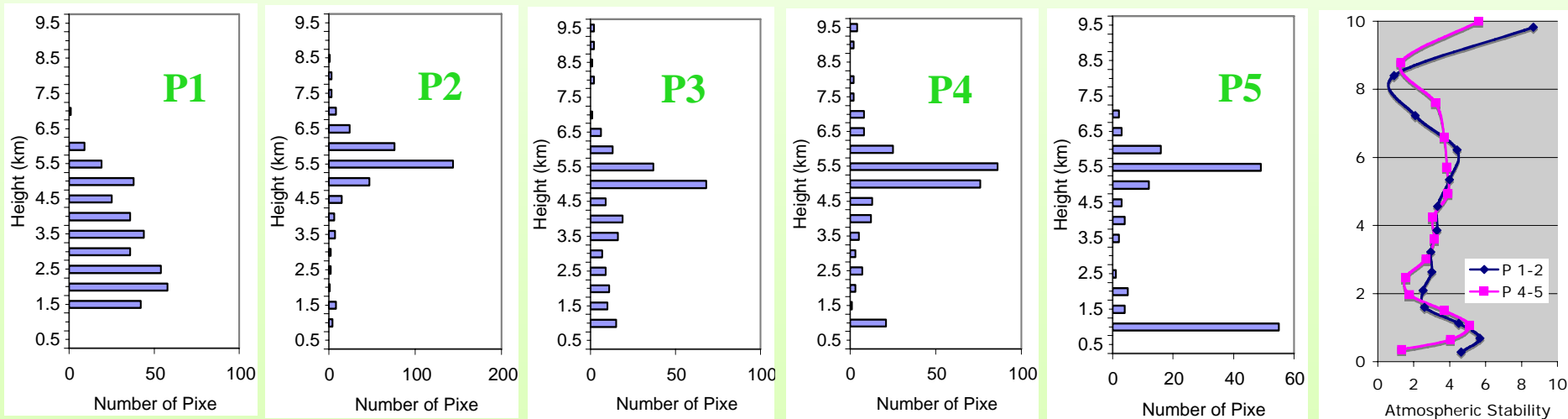


We have developed a tool for the direct and easy comparison of Calipso profiles and modeling

Where We Stand Currently with the MISR Aerosol Products

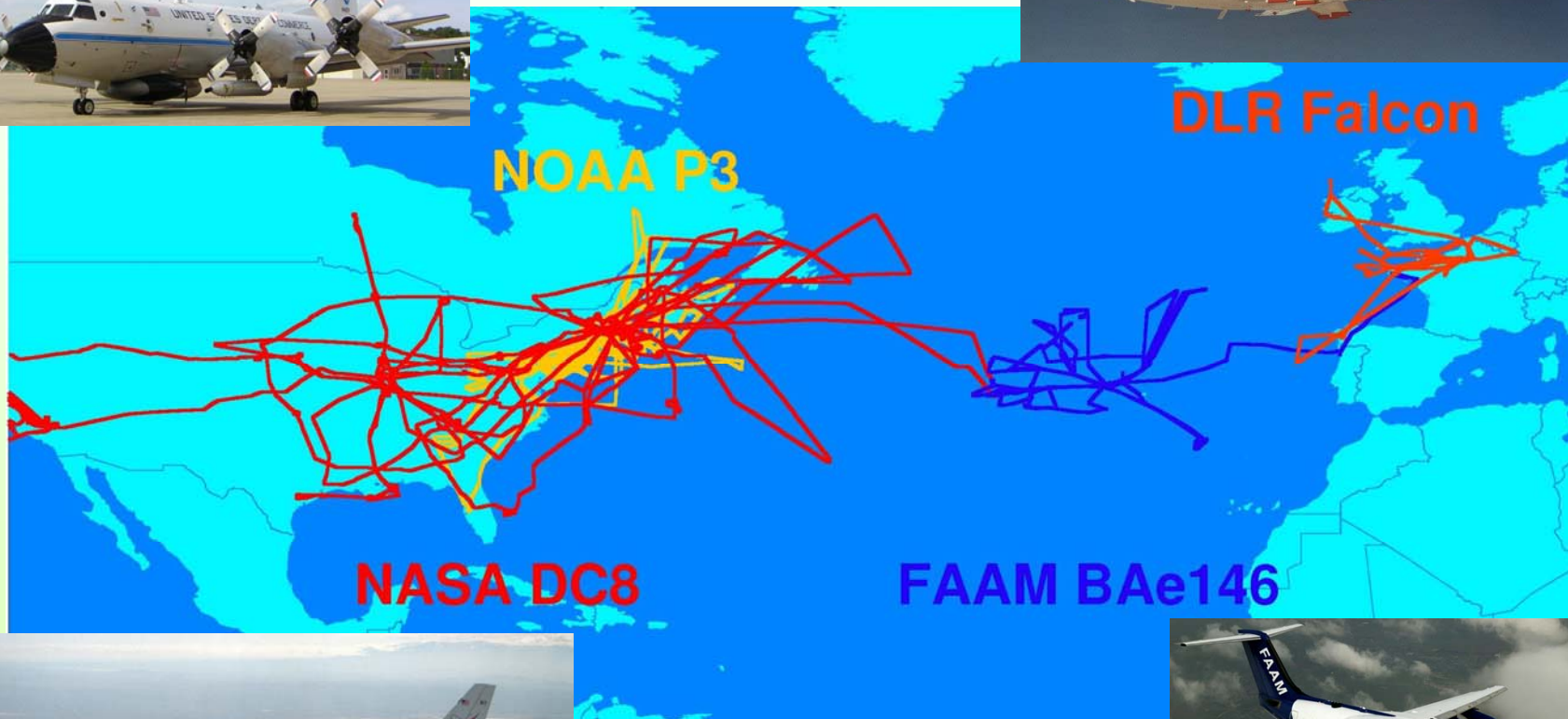
- *Quantitative* **Plume Height** in Aerosol Source Regions

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



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

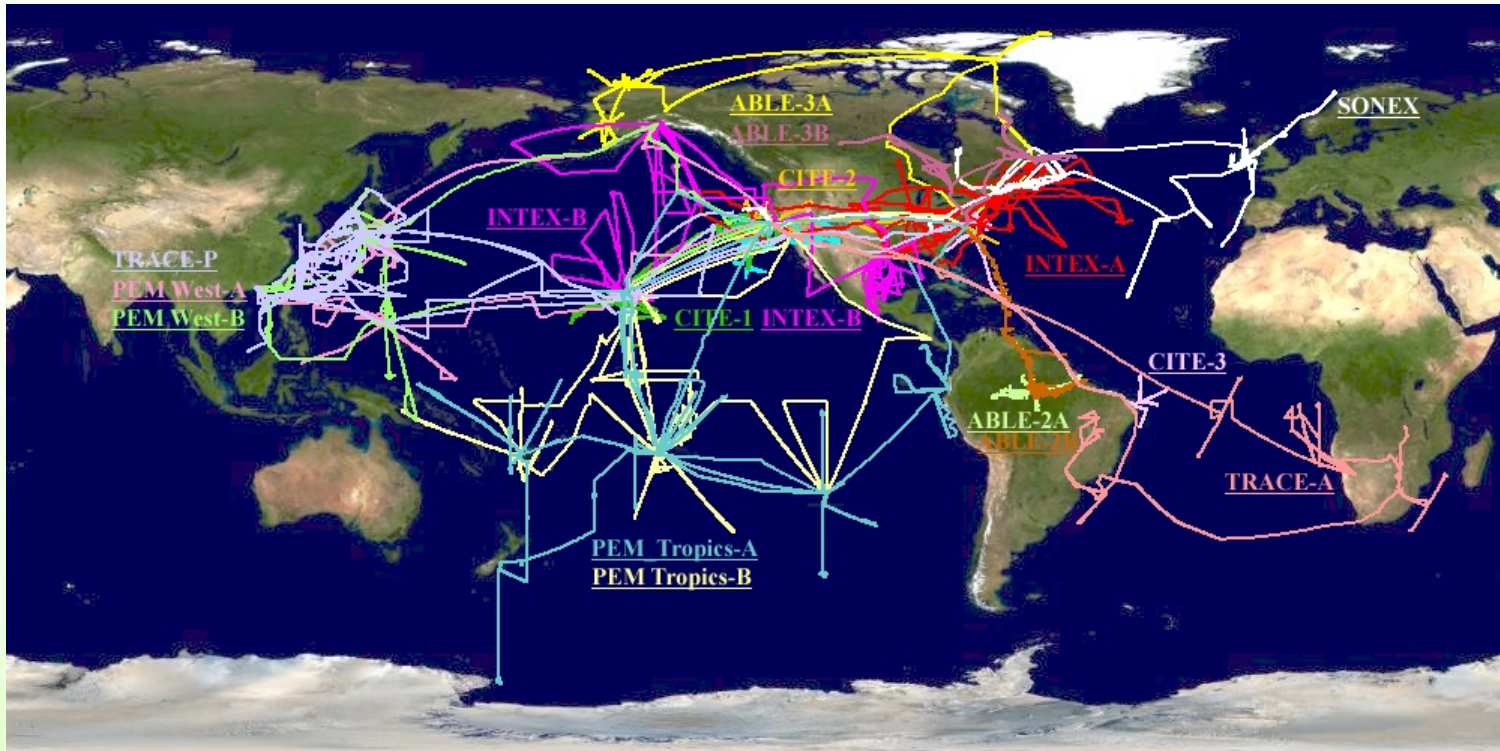
Evolution of anthropogenic and biomass burning plumes during the transport: Model evaluation using specific observations from the ICARTT campaign (summer 2004)



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.

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
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jennifer.r.olson@nasa.gov

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

aerosol number, mass and optical properties including log-normal fit statistics and $f(\text{RH})$ measurements:

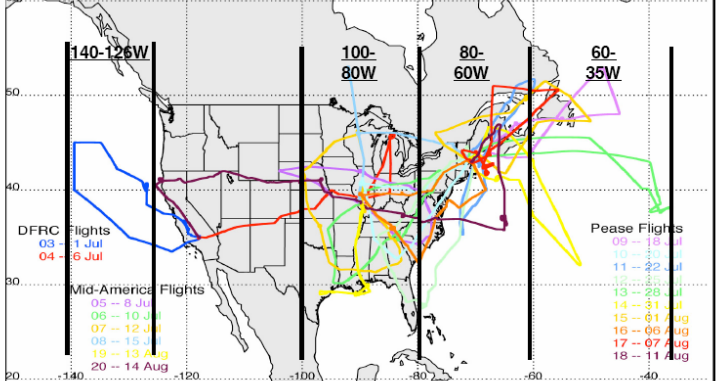
Cameron S. McNaughton, Antony Clarke,

Department of Oceanography, University of Hawai'i Manoa I'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
		Gulf of Mexico & Mexico	6
		Hawaii	5
INTEX-B	Spring - 2006	Alaska	5
MIRAGE	Spring - 2006	Mexico City	12
IMPEX	Spring - 2006	West Coast N. America	12

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.



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)

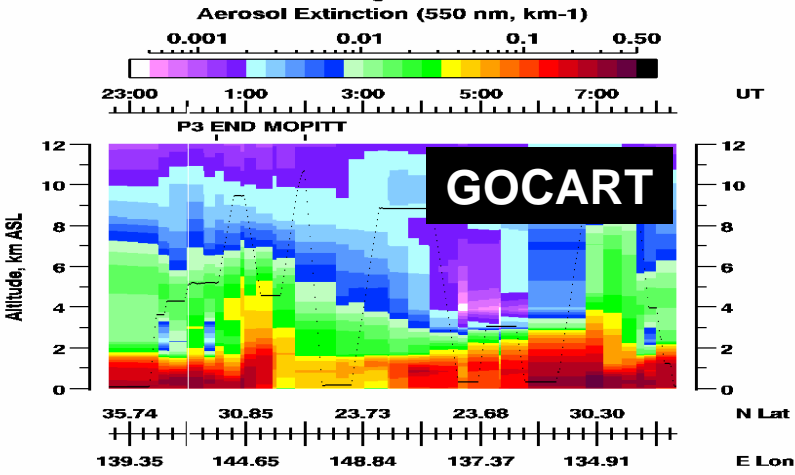
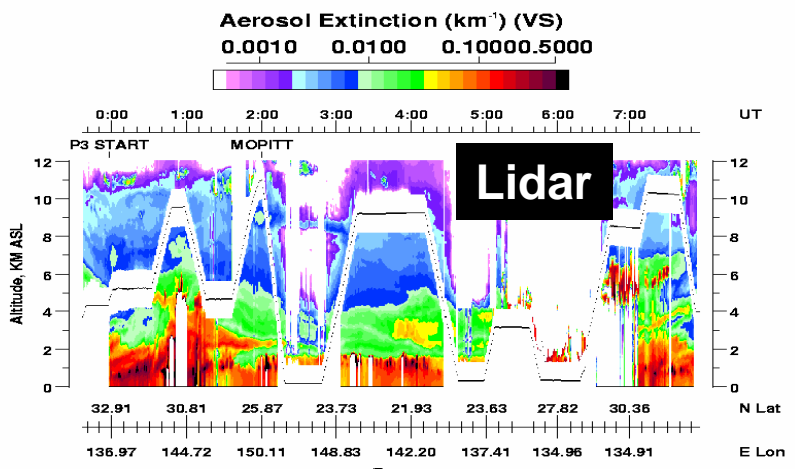
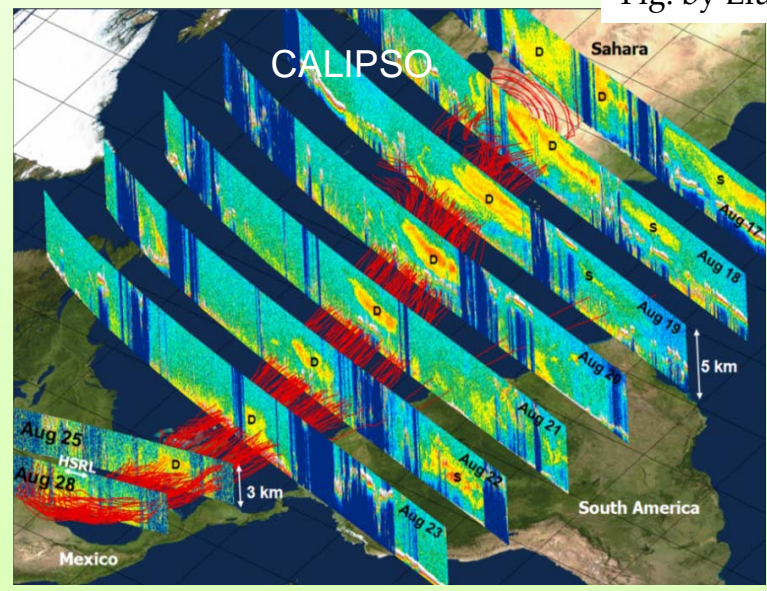


Fig. by Liu et al. 07



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?

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