

# AeroCom **Remote Sensing**, **Convection** & **CCN** Experiments (or diagnostics?!)

AeroCom Workshop 2015

European Space Agency

Frascati

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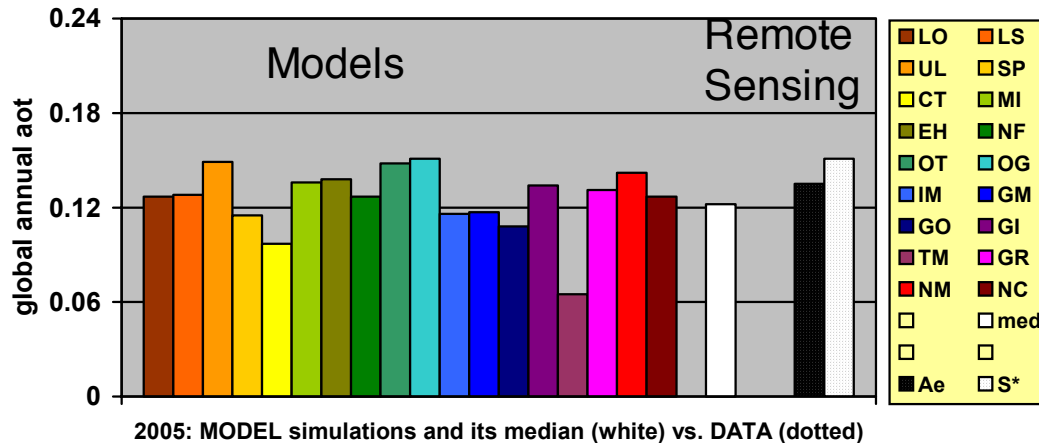
Climate Processes Group

Department of Physics

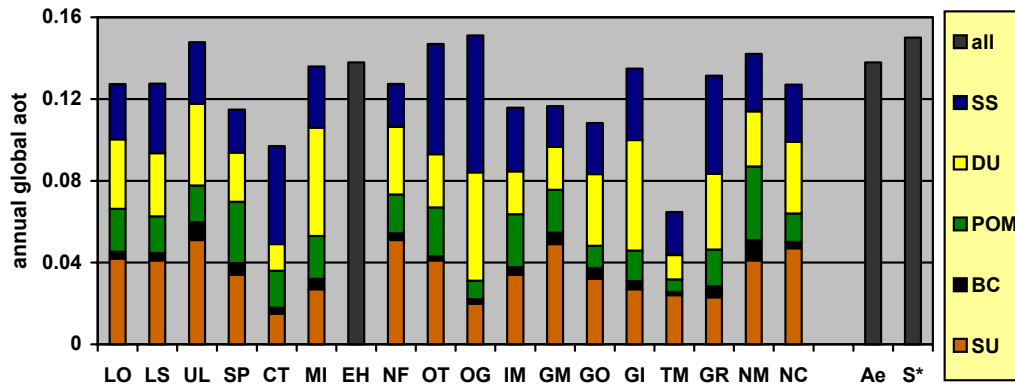
University of Oxford

# AeroCom Remote Sensing

Aerosol Optical Depth from Models and Satellites (Kinne et al., 2006):



Fine for global annual mean

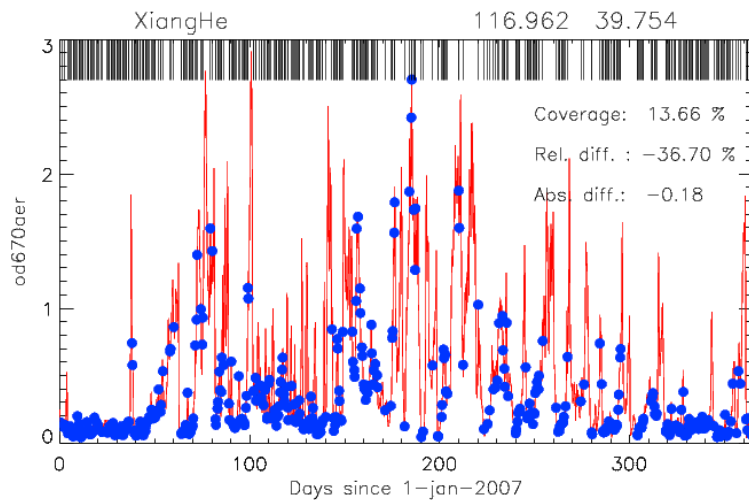


Poor agreement on component basis

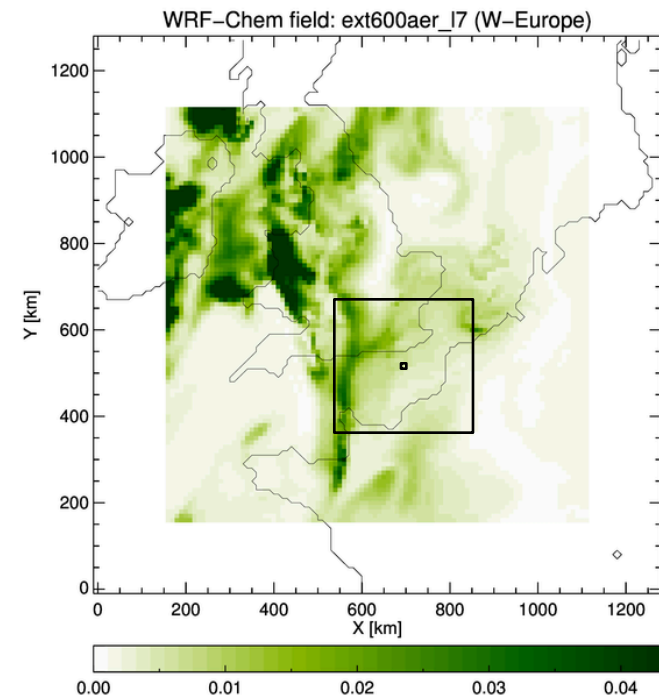
# AeroCom Remote Sensing

Spatio-temporal sampling differences between model and observations cause 'errors'.  
These errors are similar in magnitude to measurement errors & model errors

## Temporal sampling



## Spatial sampling



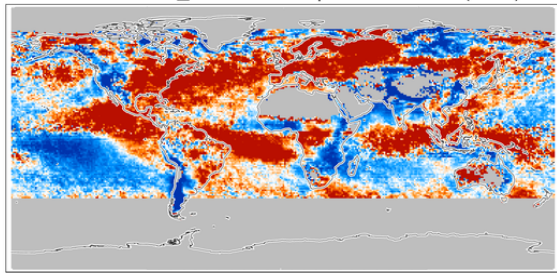
Observations occur intermittently:  
Need to resample model to observations

# AeroCom Remote Sensing

AeroCom model evaluation against a large suite of remote sensing observations

## MODIS AOT

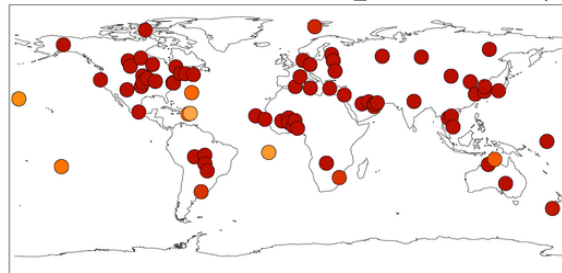
Rel. diff. GFDL\_AM3 – NRL aqua AOT 550nm (2006)



-0.4 -0.2 0.0 0.2 0.4

## AERONET AE

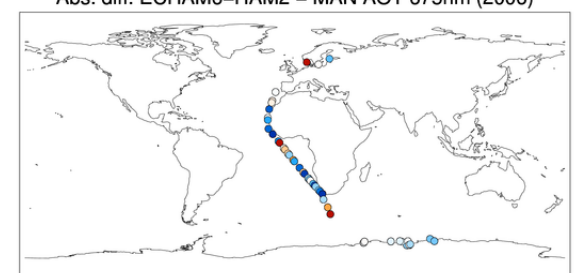
Abs. diff. ModelE2-TOMAS – AERONET\_DS AE 870/440nm (2006)



-0.4 -0.2 0.0 0.2 0.4

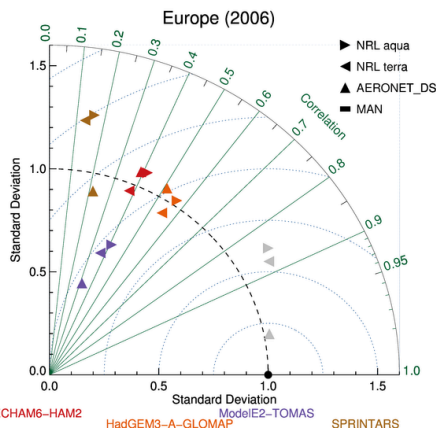
## MAN AOT

Abs. diff. ECHAM6-HAM2 – MAN AOT 675nm (2006)



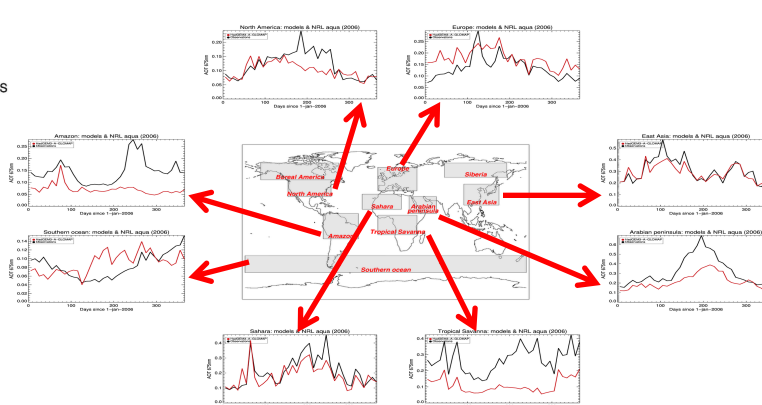
-0.10 -0.05 0.00 0.05 0.10

## Taylor plots AOT

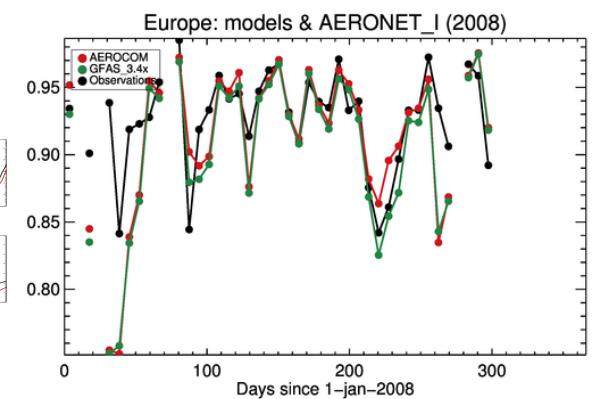


ECHAM6-HAM2 HadGEM3-A-GLOMAP ModelE2-TOMAS SPRINTARS

## Regional AOT



## Time-series AERONET SSA



Climate Processes Group

Nick Schutgens, Stefan Kinne

# AeroCom Remote Sensing

## Experiment proposal

- Either a separate experiment (2006-2008) or additional output for baseline experiment (nudged, best inventories)
- Deals explicitly with difference in spatio-temporal sampling of models and observations

## Observational datasets:

- AERONET +MAN AOT, AE & SSA
- MODIS AOT & AE
- AATSR-ORAC AOT
- MODIS/OMI/CALIOP AOT & SSA
- OMI-OMAERUV AOT & SSA
- POLDER GRASP AOT, AE, SSA
- ?

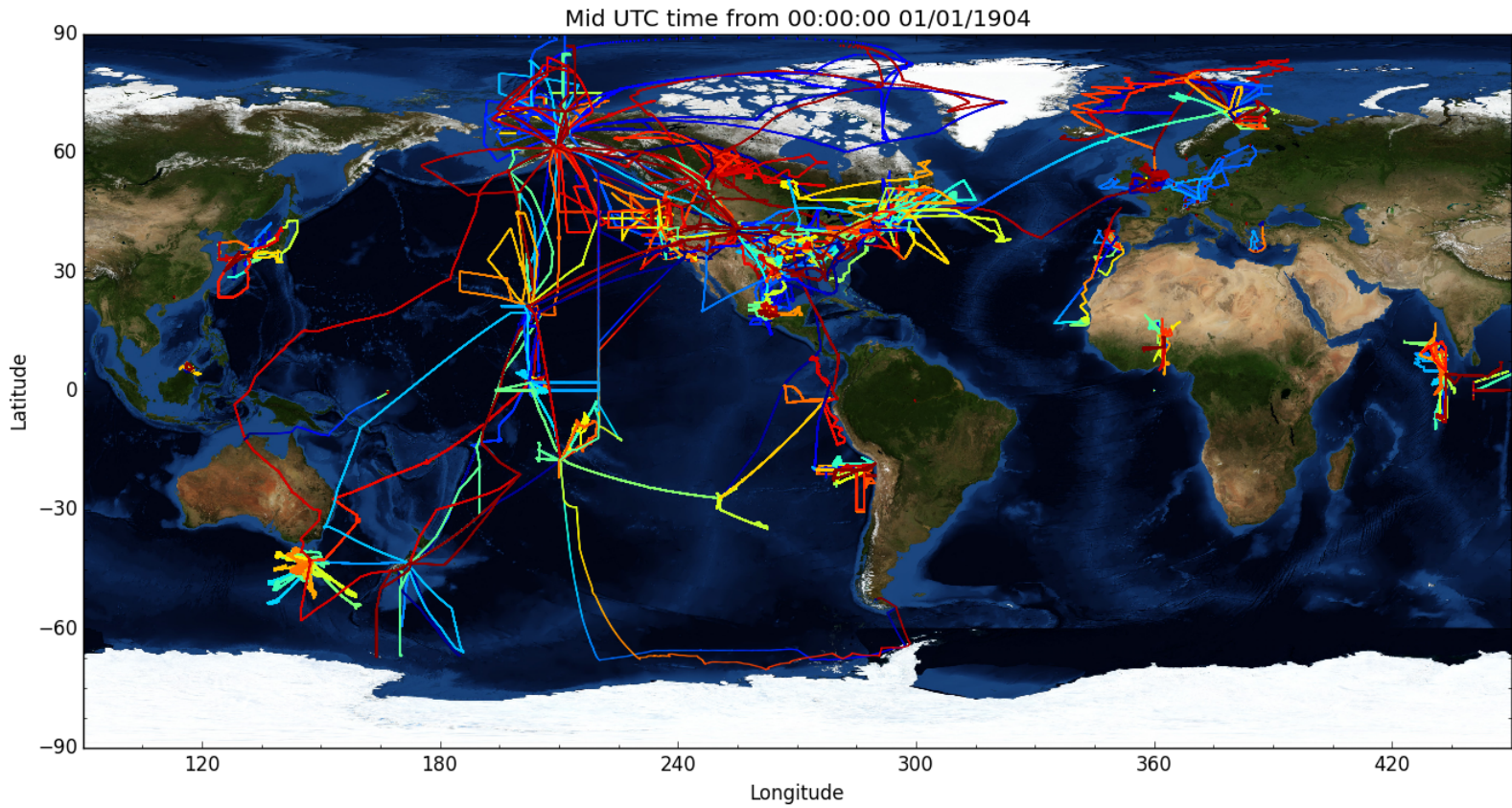
## Requested model data (3-hourly):

- AOT, AE, SSA (2D)
- RH (2D, AOT-weighted)



# AeroCom CCN

**Global Aerosol Synthesis and Science Project (Leeds, Oxford, Manchester) synthesizes in-situ aerosol aircraft data**



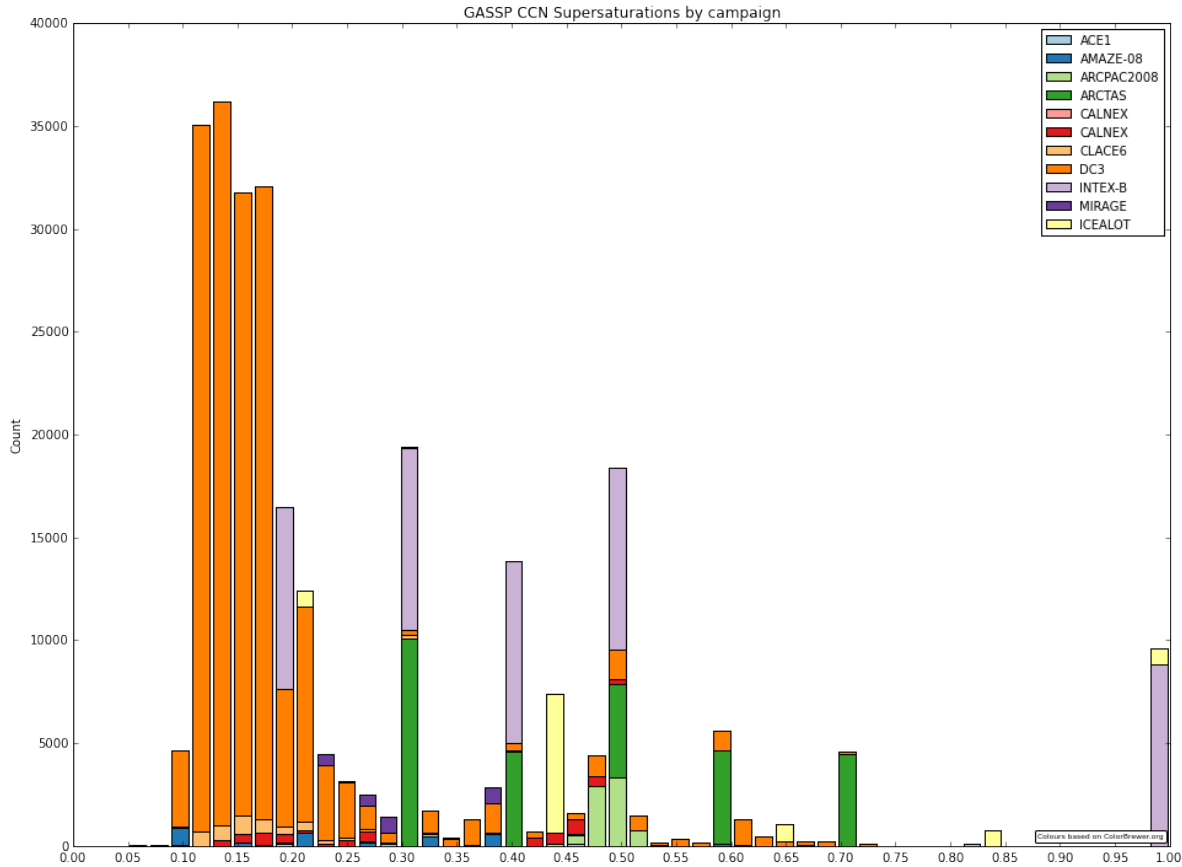
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Reddington et al. (in prep) [www.cistools.net](http://www.cistools.net) [www.gassp.org.uk](http://www.gassp.org.uk)



# AeroCom CCN

## Supersaturations used in CCN measurements:





# AeroCom CCN

## GASSP evaluation of AeroCom models:

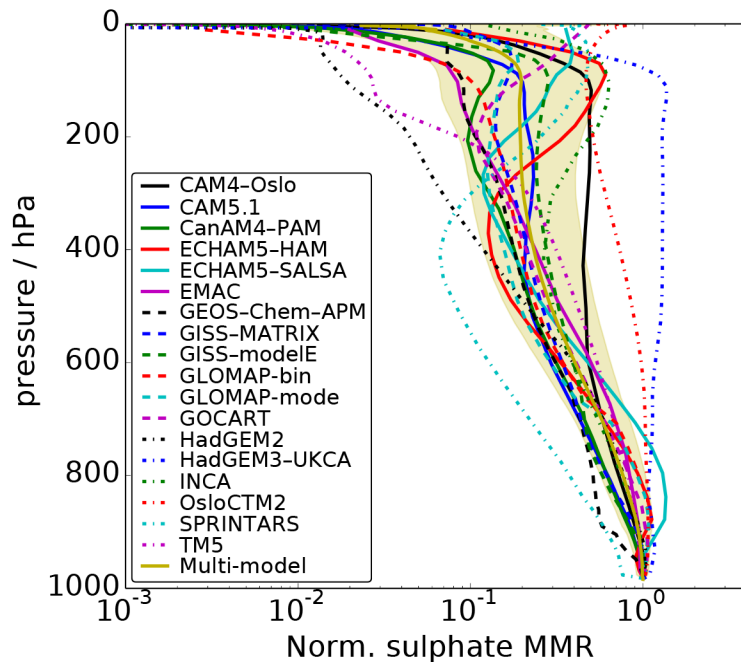
- GASSP database maturing and paper in preparation (Reddington et al.)
- Currently investigating minimal output requirements (single year vs. hindcast, output frequency)
- Use Community Intercomparison Suite to co-locate models to aircraft data (but many AeroCom models not CF conform)
- Request 3D CCN diagnostics at 0.15%, 0.3%, 0.4%, 0.5%, 1% plus ideally at 0.2%, 0.6%, 0.7%
- Propose to make CCN diagnostic standard in AeroCom



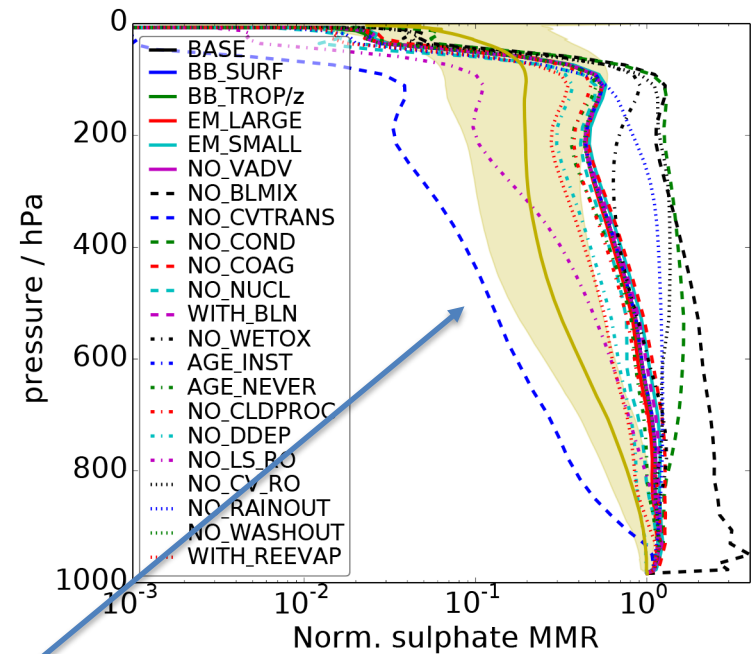
# AeroCom Convection

Processes affecting the aerosol vertical distribution:

AeroCom models



HadGEM process sensitivities



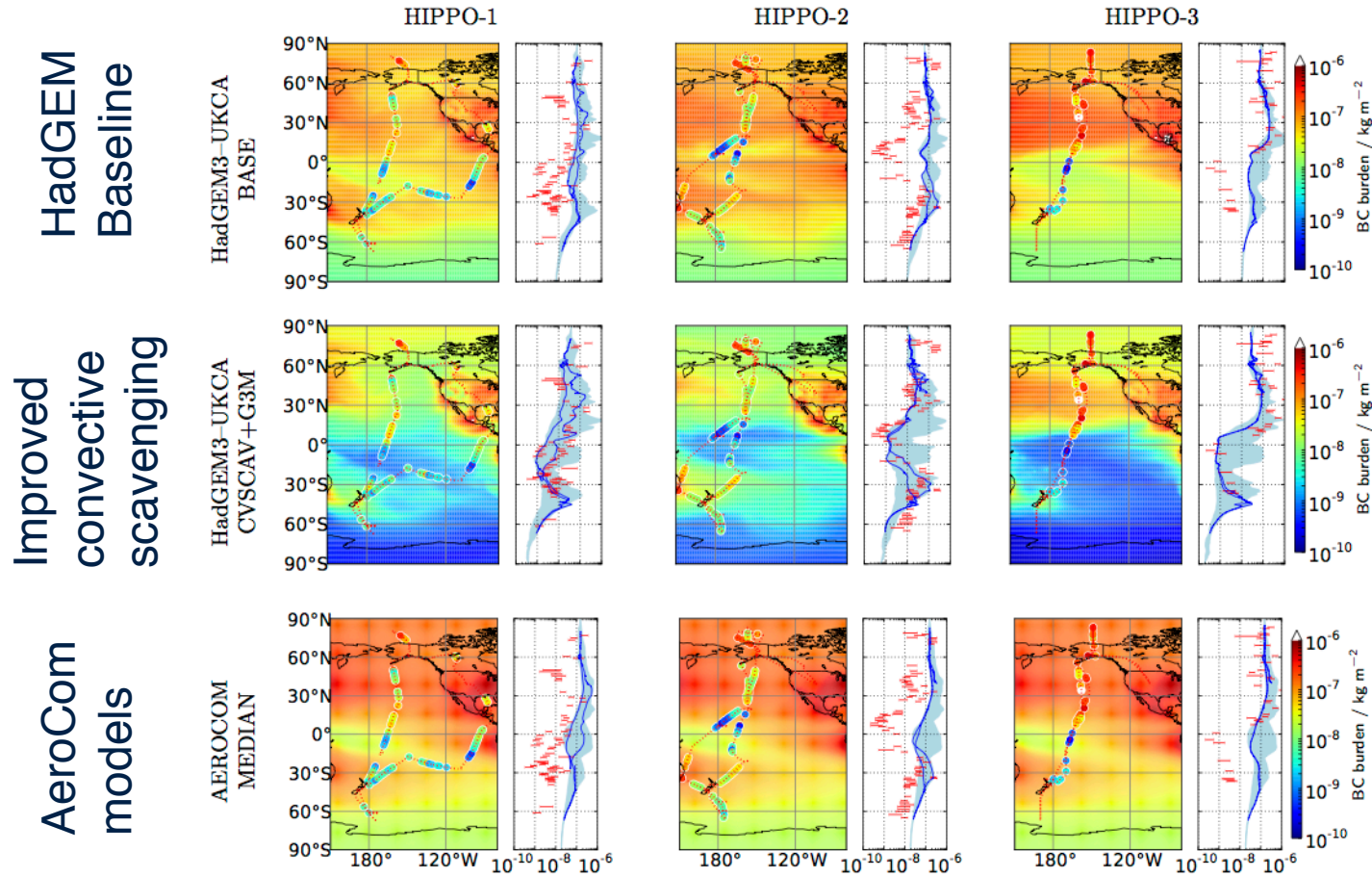
Convective transport key to aerosol vertical distribution

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Kipling et al., ACPD, (2015)

# AeroCom Convection

Convection is also a key aerosol removal mechanism:

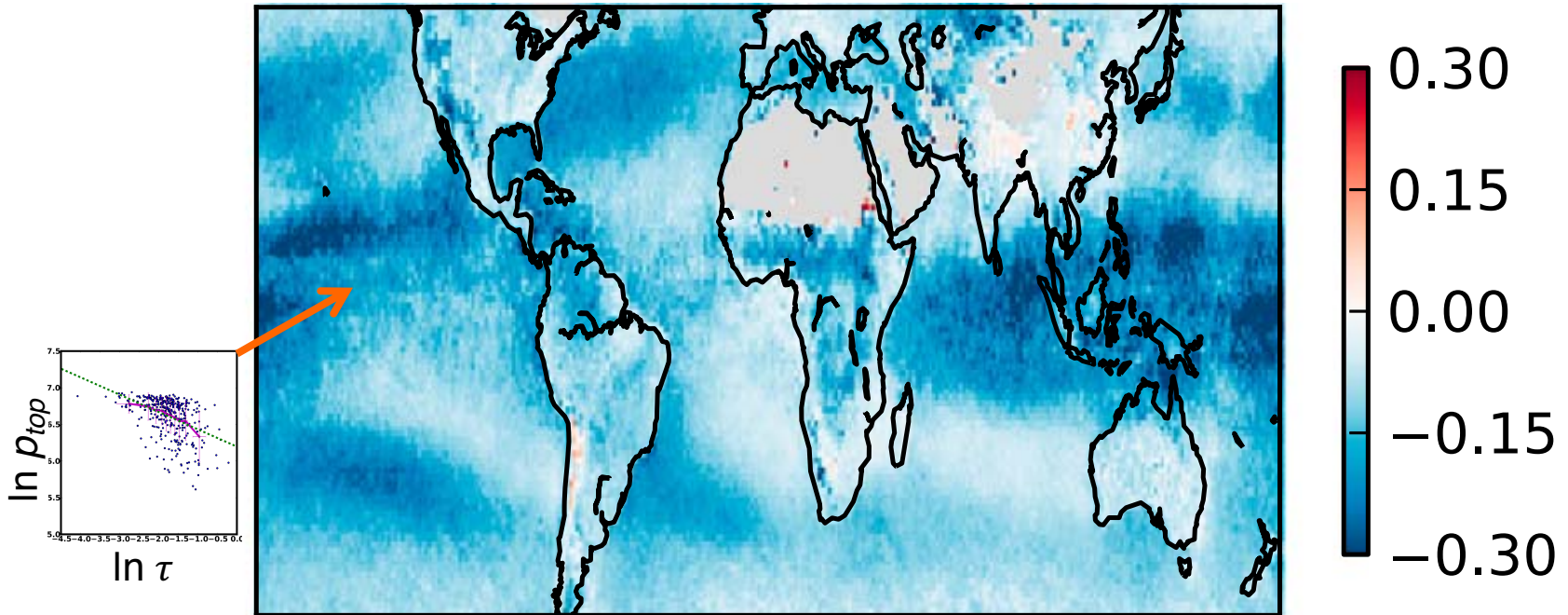


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Kipling et al., ACP, (2013)

# AeroCom Convection

$$d\ln(p_{top})/d\ln(\tau)$$



MODIS retrieved relationship between cloud top pressure ( $p_{top}$ ) and AOD ( $\tau$ )  
Evidence for aerosol effects on convection?

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- (Gryspeerd et al., GRL, 2014)

# AeroCom Convection

Strong potential interactions between aerosols and convection:

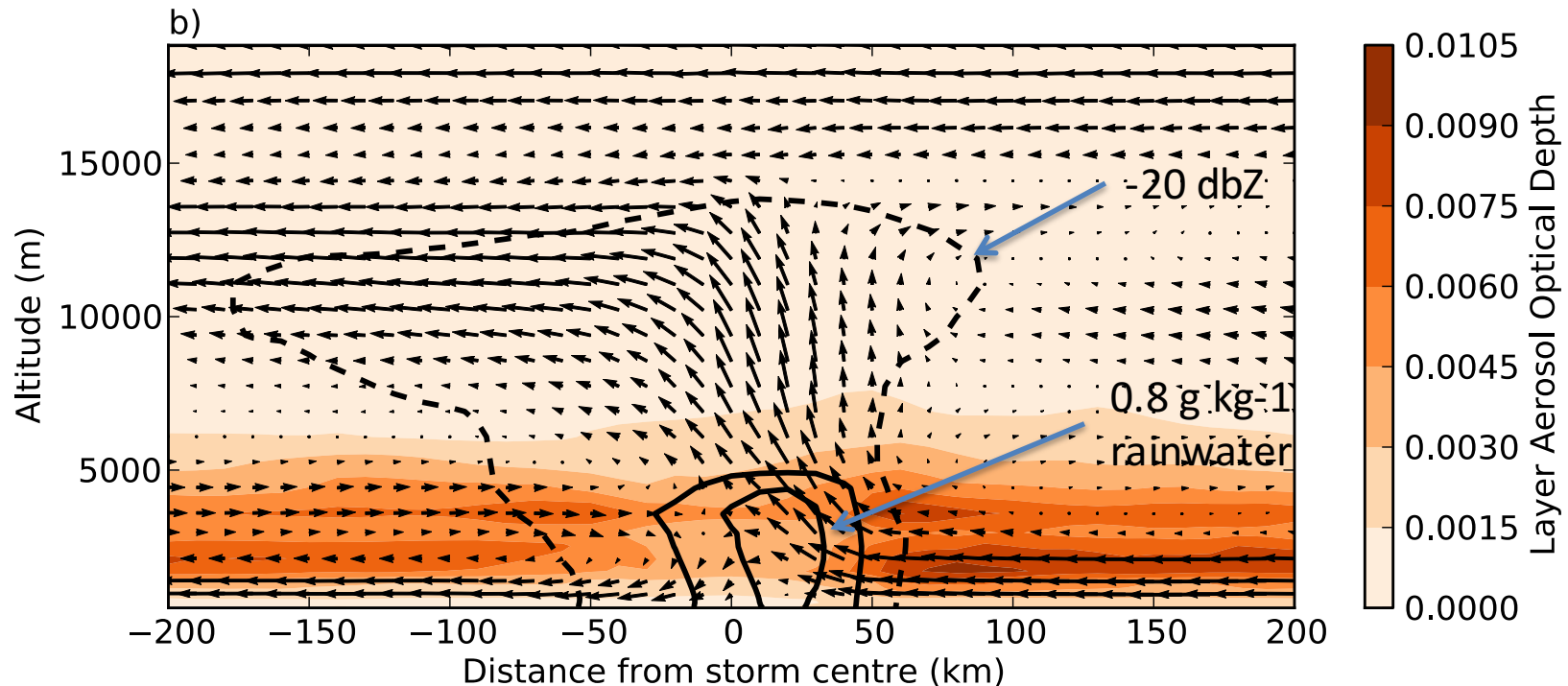
- So far very limited analysis in AeroCom

Proposals:

- Addition of convective mass fluxes (air + tracers) to AeroCom diagnostics (will benefit many experiments)
- Explore intercomparison of aerosol effects on convection with interested global modelling groups

# AeroCom Convection

Convective removal affected by sampling issues



WRF Chem simulated composite of convective clouds in the Congo basin.

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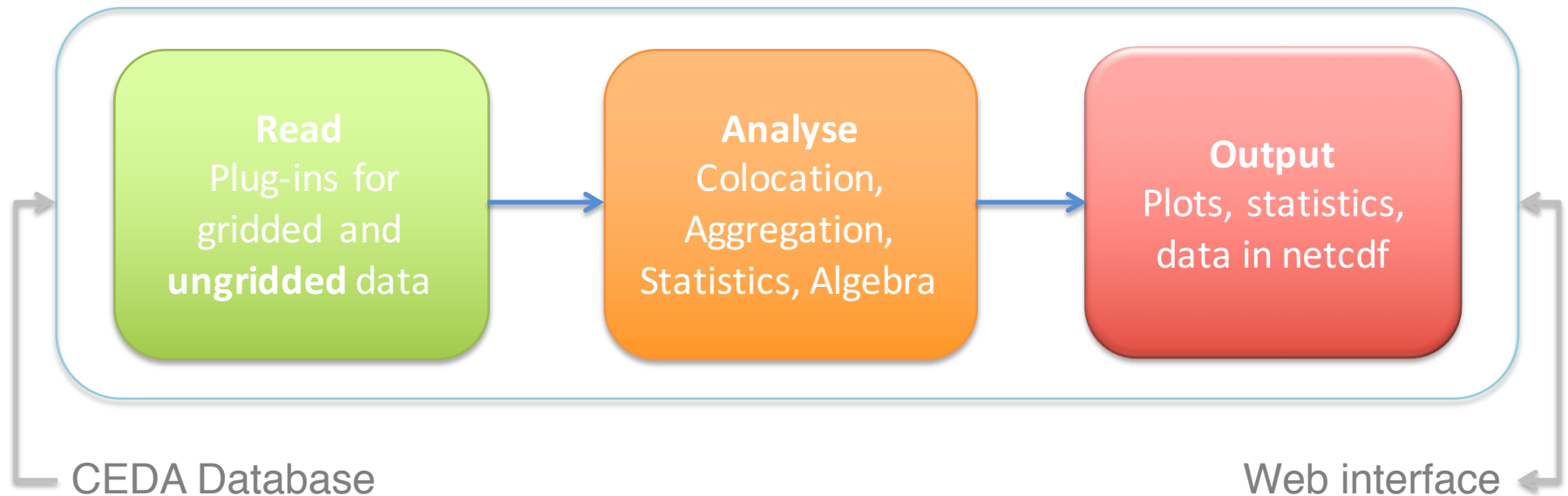
Gryspeerd et al., ACP, (2015)



# Community Intercomparison Suite

Open source python toolbox to efficiently intercompare data

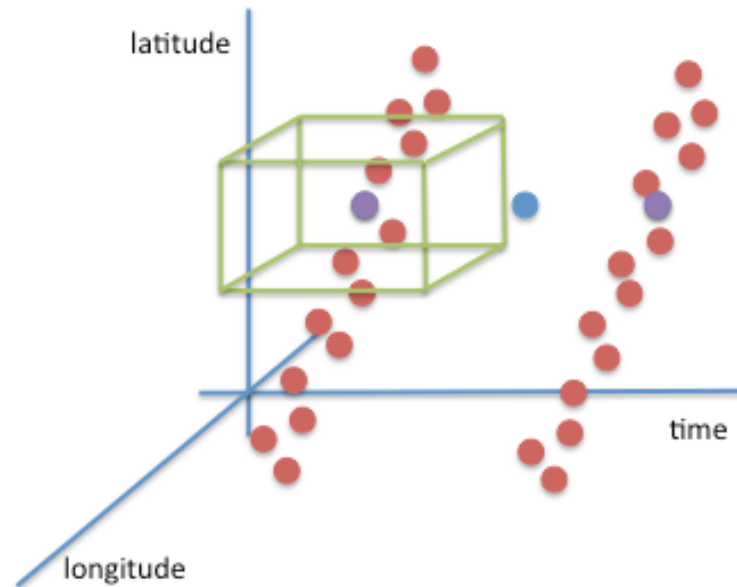
- Generic tool for analysing, visualising and **colocating** datasets
- Handling of complex gridded and **ungridded** data in many formats
- Simple command line syntax with many options
- Flexible approach through plug-ins, e.g. for new data sources
- Open source software & deployed for community use on JASMIN





# Community Intercomparison Suite

## Colocation



### Colocation method:

1. Specify searchbox
  - Horizontal distance
  - Vertical distance
  - Time separation
2. Specify operation
  - Nearest neighbour (time)
  - Nearest neighbour (space)
  - Average
  - User plug-in

```
CIS col <native file> <native variable>:<native file>:<colocation method> -o <file>
```



This file provides the new spatio-temporal sampling



This file provides the data that will be resampled



Nearest neighbour or linear interpolation

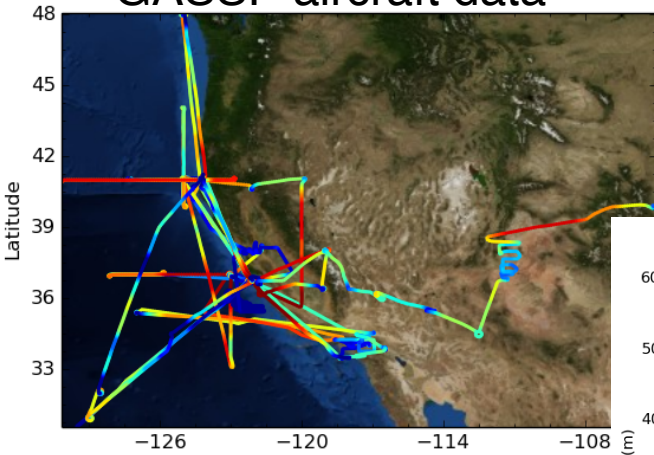


Output (netcdf)

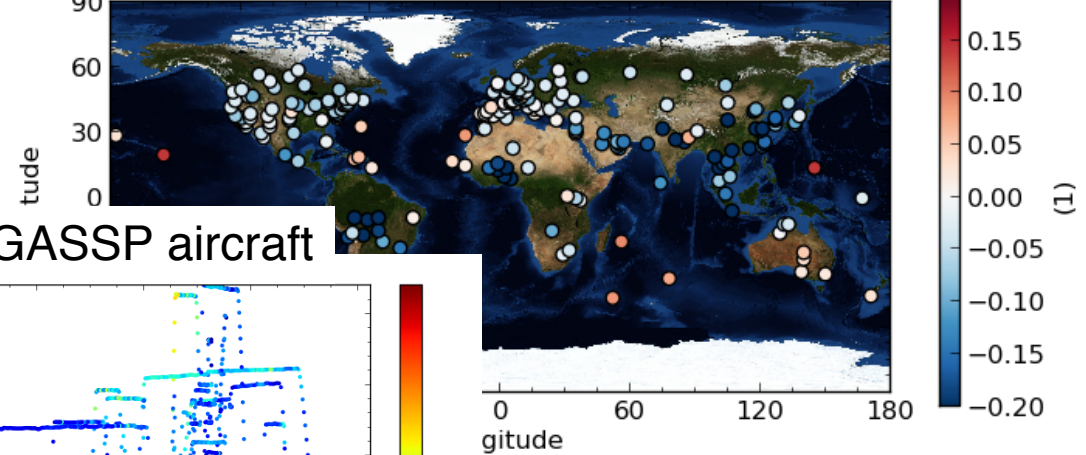


# Community Intercomparison Suite

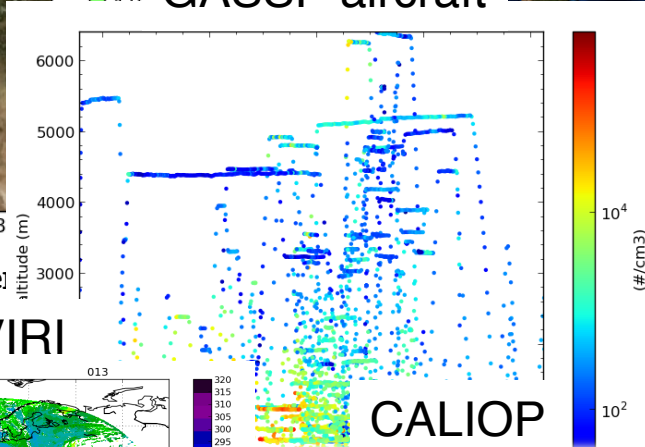
### GASSP aircraft data



### ECHAM-HAM - AERONET difference AOT 675nm (2007)

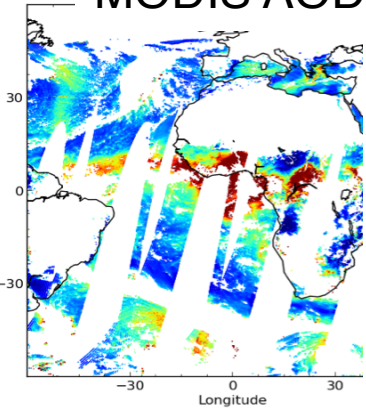


### GASSP aircraft

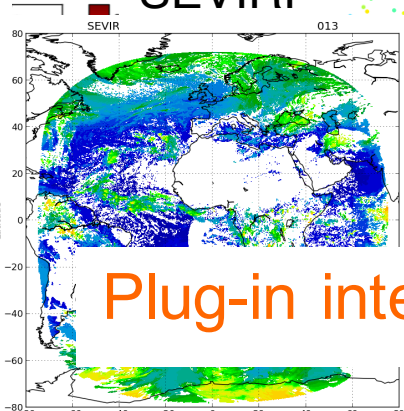


nc plot ALT:\*.\*nc --nasablue

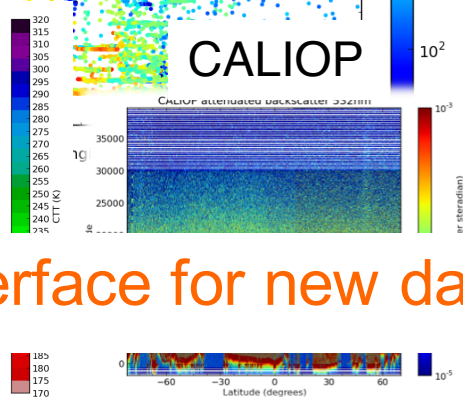
### MODIS AOD



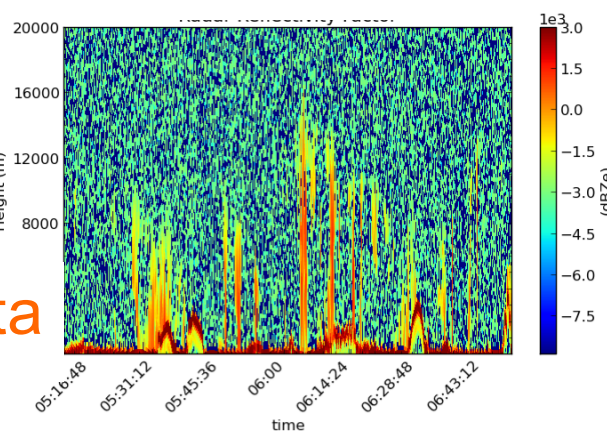
### SEVIRI



### CALIOP



### CloudSat



Plug-in interface for new data