

# New Aerosol Diagnostics Package

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# Current Status

- Provide users and model developers a quick look at aerosol simulations
- About 200 figures + budget analysis for each aerosol species are generated by a simple run script (specifying where the climo files are)
- Takes about 3 minutes to complete
- Includes lat-lon plots, lat-height plots, scatter plots, vertical profile plots, seasonal cycle plots



# PNNL Aerosol Diagnostics

Test case: **CAM5\_1deg**

Control case: **CAM5\_2deg**

## Model-to-Model Comparison

1. [Aerosol budget](#)
2. [Vertical contour plots of zonal means](#)
3. [Horizontal contour plots](#)

## Model-to-Observation Comparison

1. [Scatter plots](#)
2. [Vertical profile plots](#)
3. [Seasonal cycle plots](#)
4. Size distribution plots
5. Satellite simulator plots



# Aerosol budget

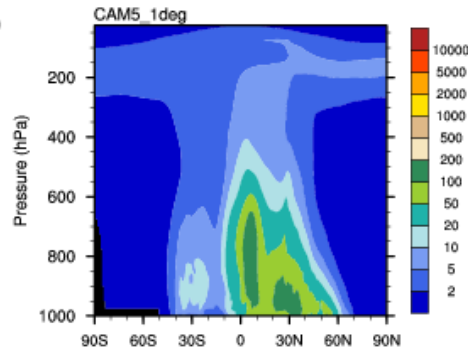
Black carbon	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Dust	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Primary organic matter	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sea salt	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Secondary organic aerosol	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sulfate	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>

S04	CAM5_1deg	CAM5_2deg	difference	rel diff(%)
Sources (TgS/yr)	43.409	43.448	-0.039	-0.090
emission	1.664	1.664	-0.000	-0.011
gas-phase prod	13.772	13.989	-0.218	-1.579
aq-phase prod	27.942	27.764	0.178	0.638
nucleation	0.030	0.030	0.000	0.214
Sinks (TgS/yr)	43.418	43.453	-0.035	-0.081
dry_dep	5.031	5.017	0.014	0.278
wet_dep	38.387	38.436	-0.049	-0.128
Lifetime (days)	5.836	5.877	-0.041	-0.702
Burden (TgS)	0.447	0.447	-0.000	-0.060
accumulation	0.425	0.426	-0.001	-0.190
Aitken	0.014	0.013	0.001	6.327
coarse	0.008	0.008	-0.000	-3.580

# Vertical contour plots

- Black carbon
- Dust
- Primary organic matter
- Sea salt
- Secondary organic aerosol
- Sulfate

BC (DJF) (ng/kg)



[JJA](#)

[ANN](#)

[JJA](#)

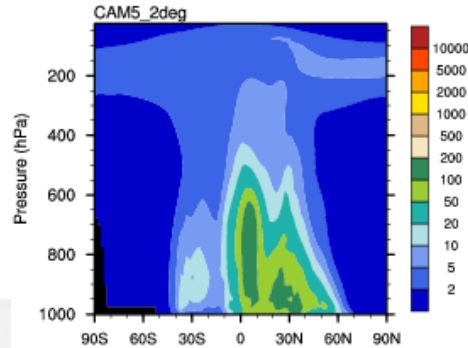
[ANN](#)

[JJA](#)

[ANN](#)

[JJA](#)

[ANN](#)

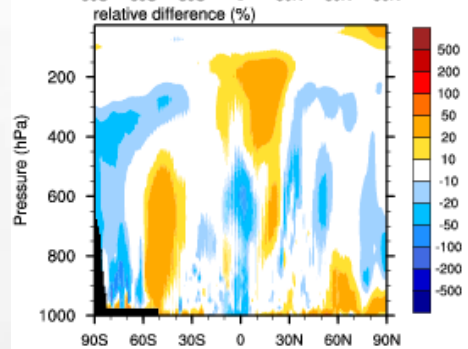
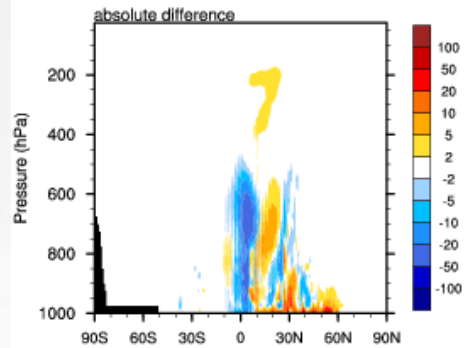


[JJA](#)

[ANN](#)

[JJA](#)

[ANN](#)



# Horizontal contour plots

## Column-integrated burden

Black carbon	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Dust	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Primary organic matter	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sea salt	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Secondary organic aerosol	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sulfate	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>

## Surface

Black carbon	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Dust	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Primary organic matter	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sea salt	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Secondary organic aerosol	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sulfate	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>

## 850 hPa

Black carbon	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Dust	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Primary organic matter	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sea salt	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Secondary organic aerosol	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sulfate	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>

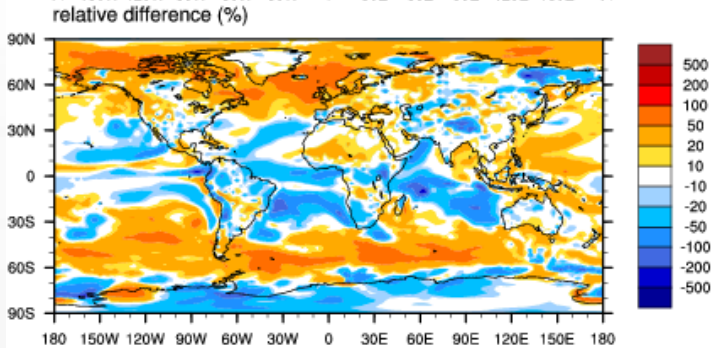
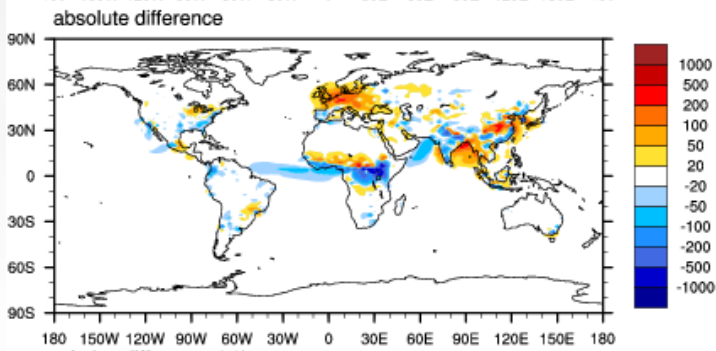
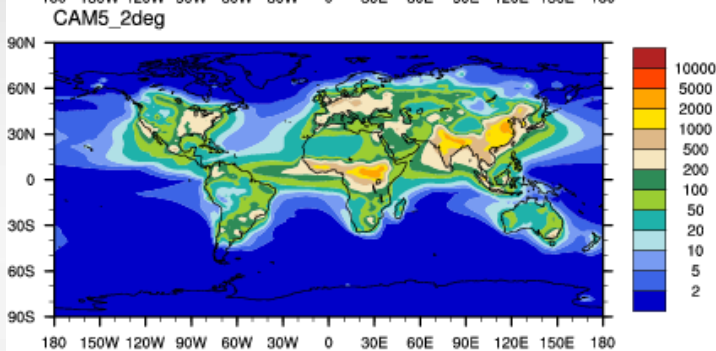
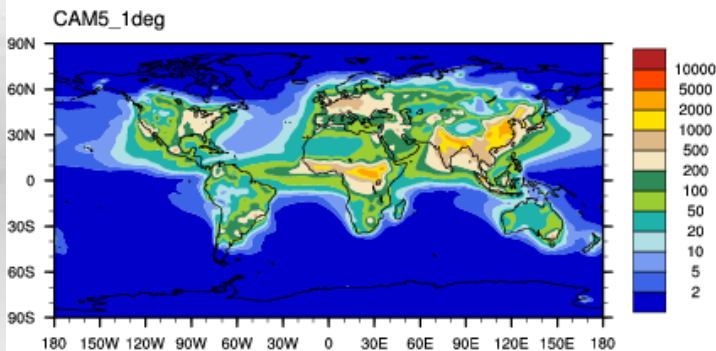
## 500 hPa

Black carbon	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Dust	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Primary organic matter	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sea salt	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Secondary organic aerosol	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sulfate	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>

## 200 hPa

Black carbon	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Dust	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Primary organic matter	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sea salt	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Secondary organic aerosol	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>
Sulfate	<a href="#">DJF</a>	<a href="#">JJA</a>	<a href="#">ANN</a>

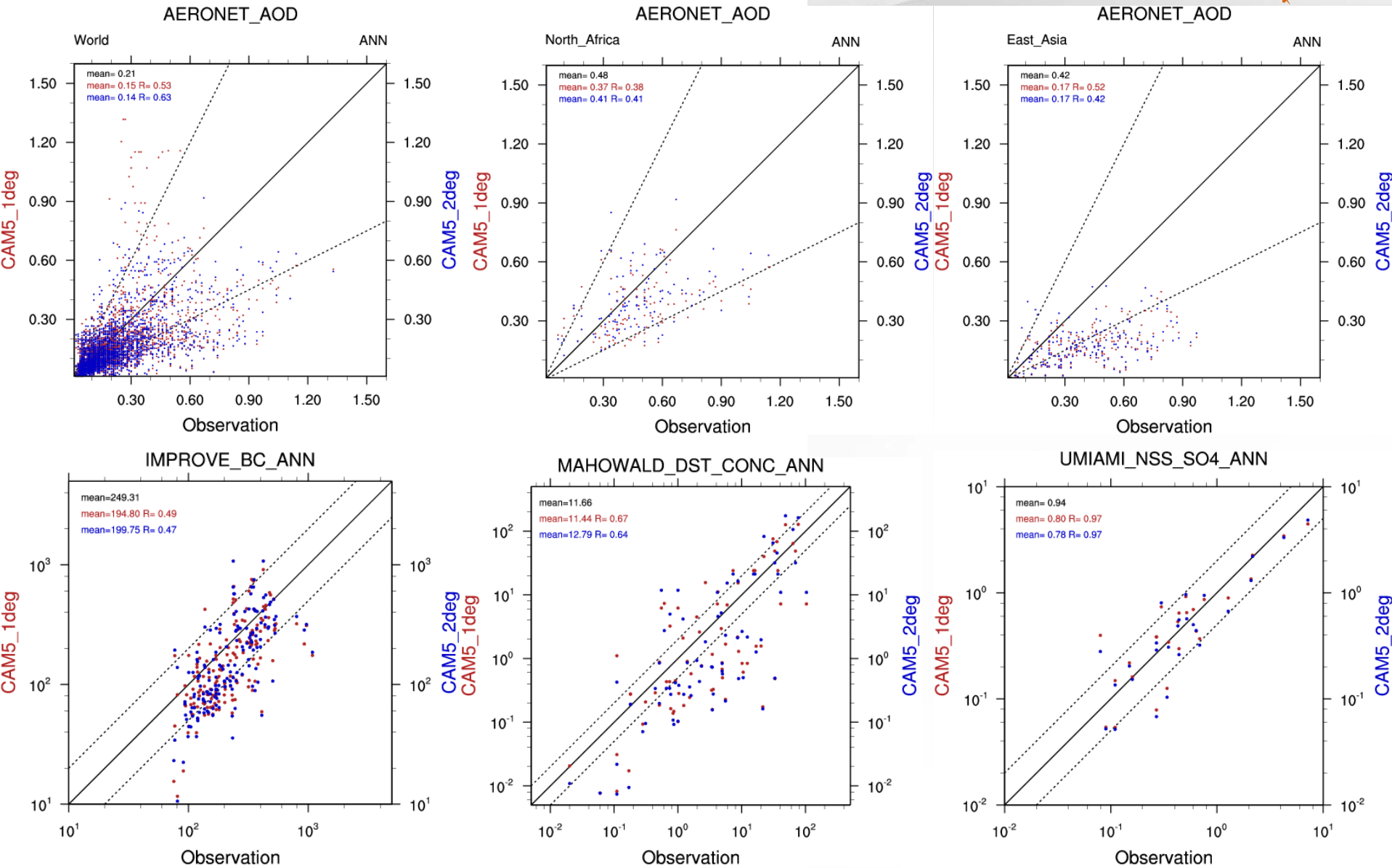
# BC (DJF) at surface (ng/kg)



Pacific Northwest  
NATIONAL LABORATORY

Proudly Operated by **Battelle** Since 1965

# Scatter plots



IMPROVE sites (1990-2005)      [BC](#)      [OC](#)      [Total SO4](#)

Mahowald (2009)      [Dust concentration](#)      [Dust deposition](#)

University of Miami marine sites      [Non-sea-salt SO4](#)      [Sea salt](#)

# Vertical profile plots

## BC

ARCPAC (2008)

[spring](#)

ARCTAS DC8 (2008)

[spring](#)

[summer](#)

ARCTAS P3B (2008)

[spring](#)

[summer](#)

AVE-Houston (2004)

[au](#)

CARB (2008)

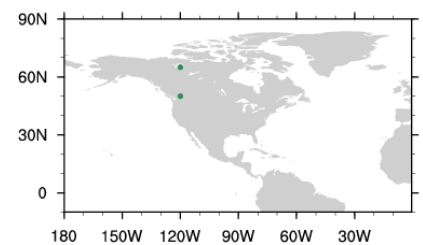
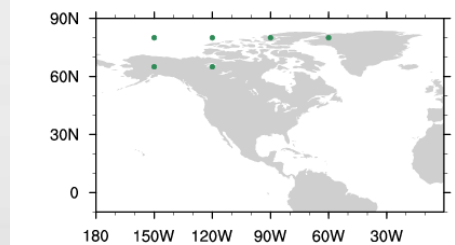
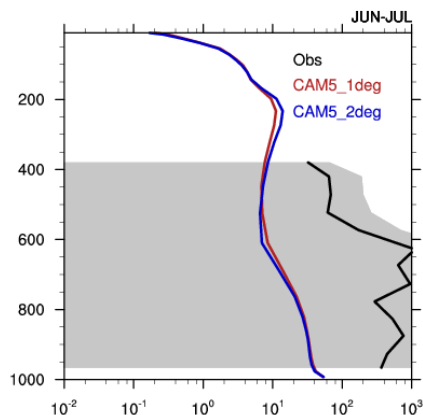
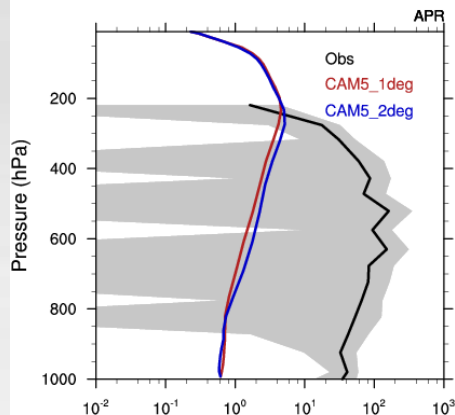
[summer](#)

CR-AVE (2006)

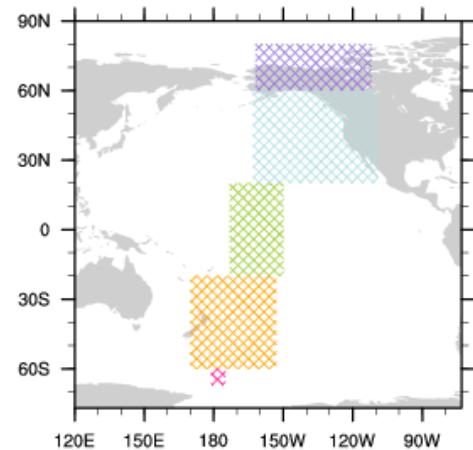
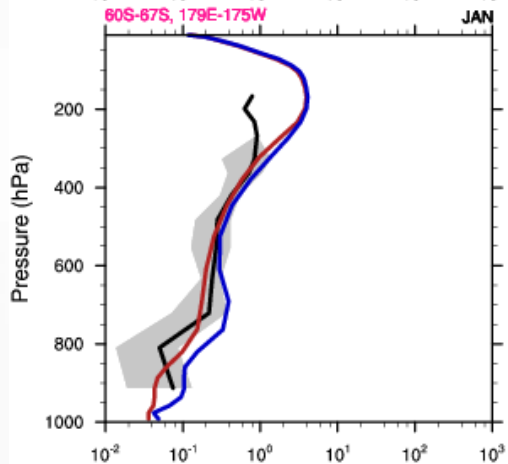
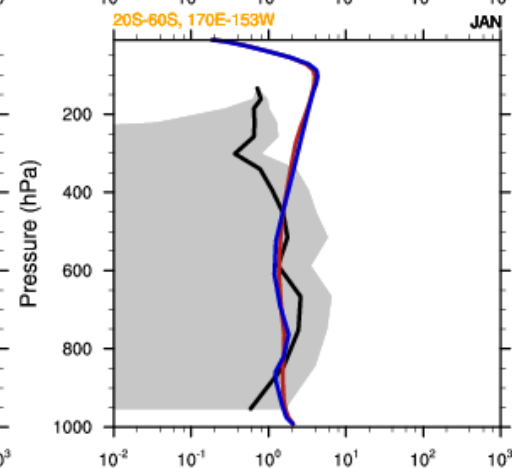
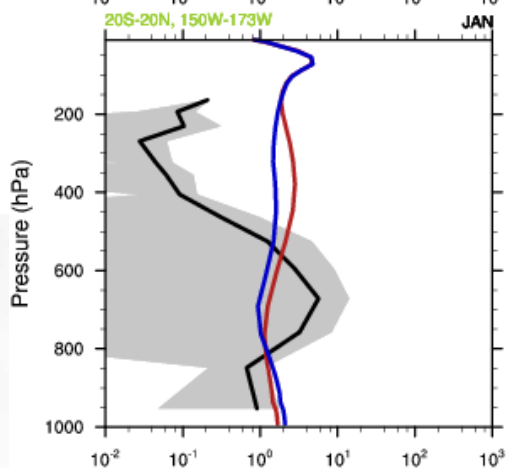
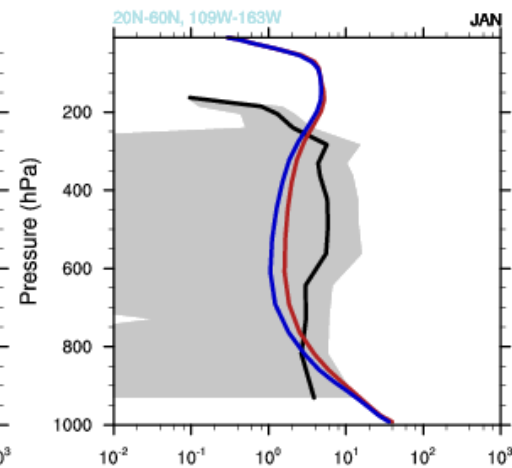
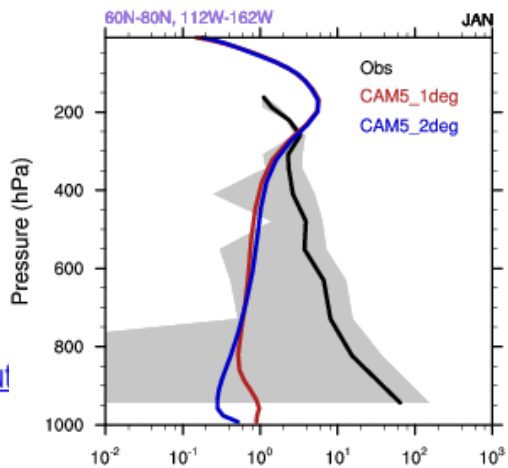
HIPPO (2009)

ARCTAS\_DC8\_SPRING

ARCTAS\_P3B\_SUMMER



## HIPPO



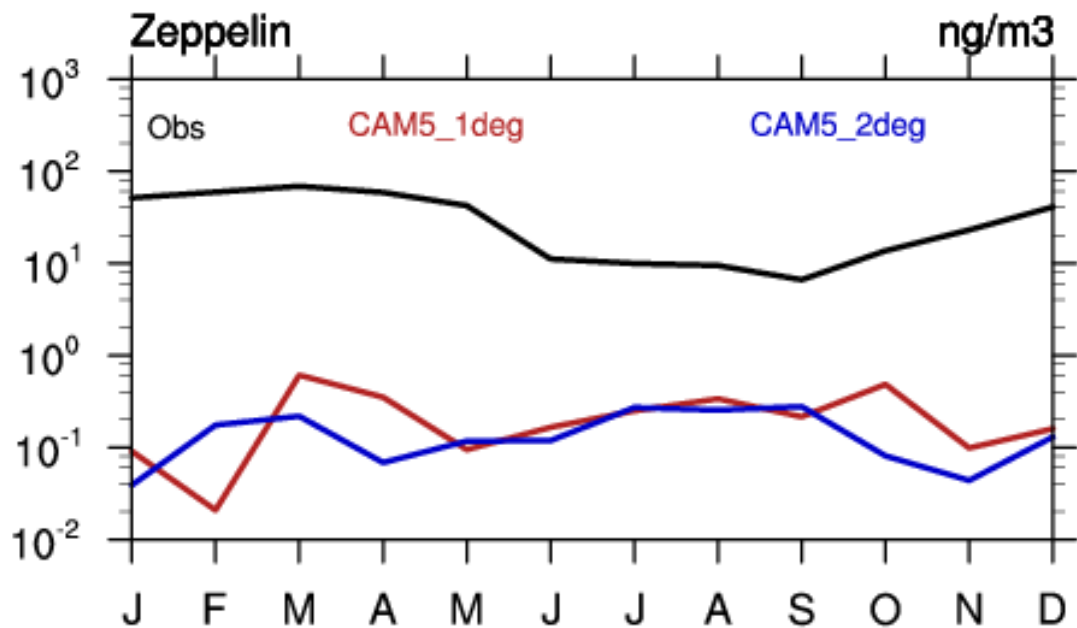
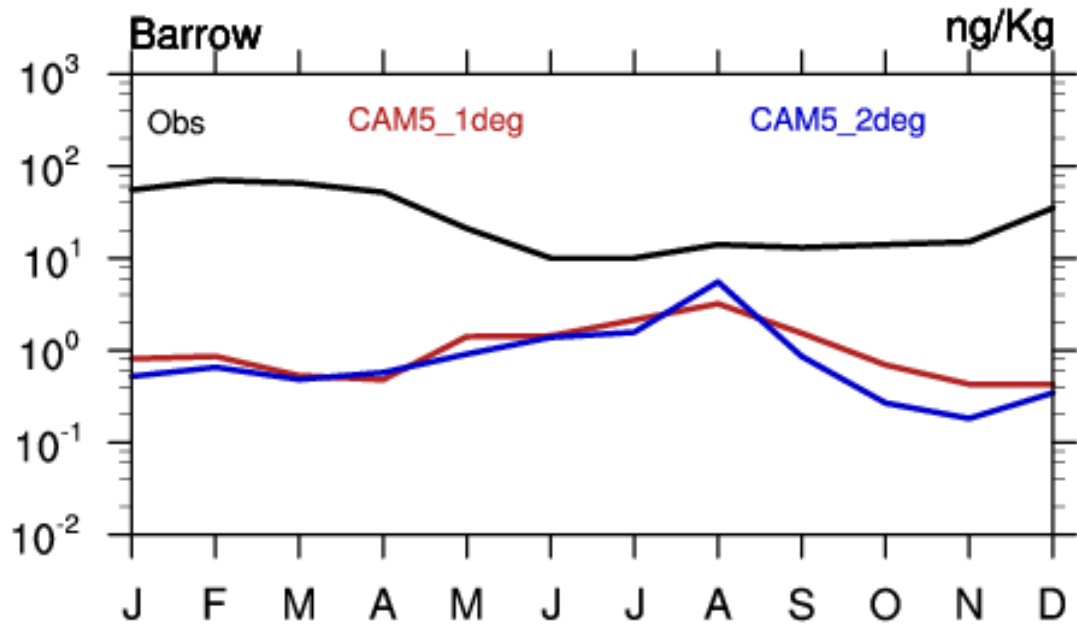


# Seasonal cycle plots

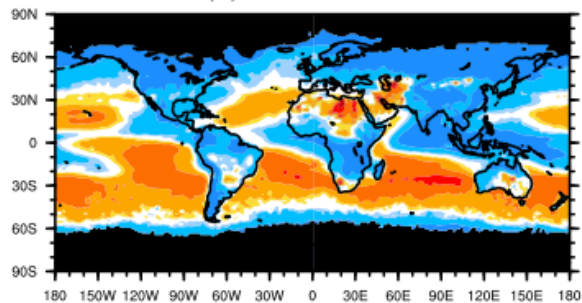
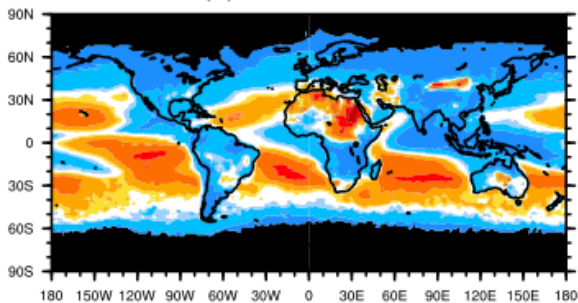
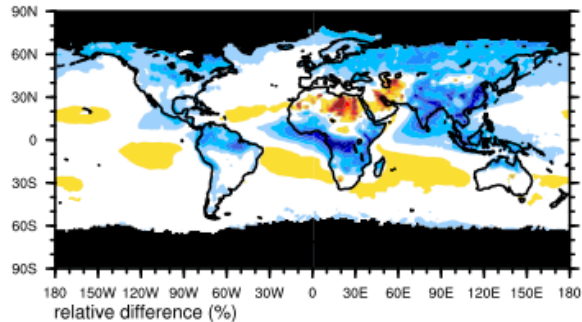
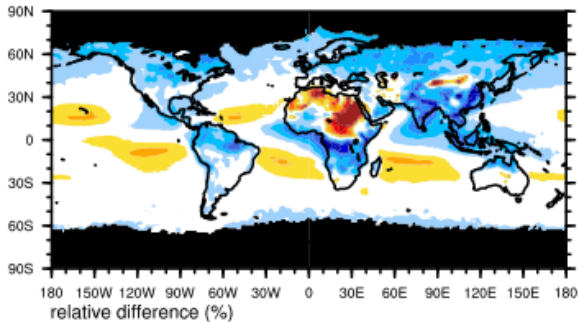
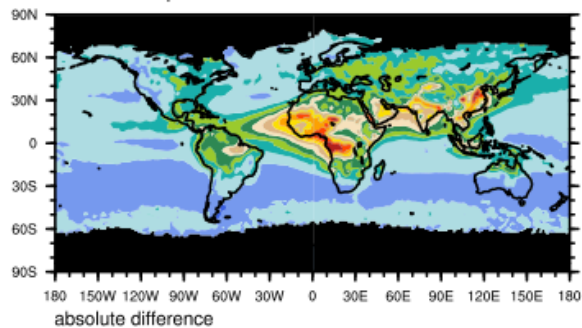
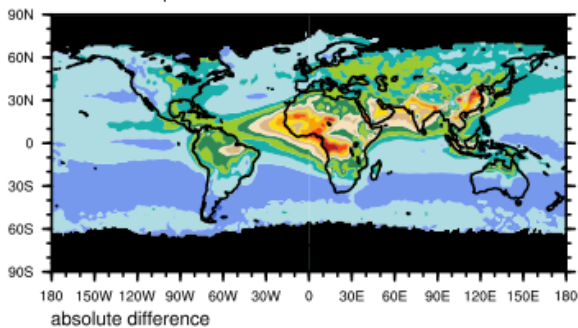
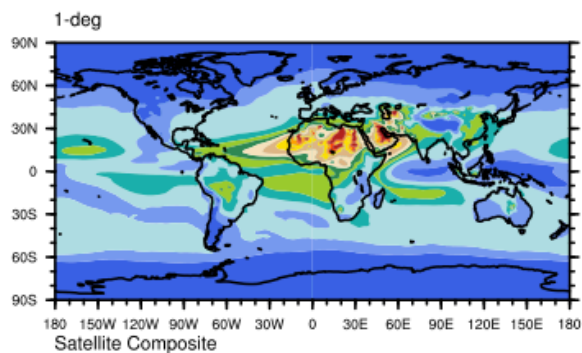
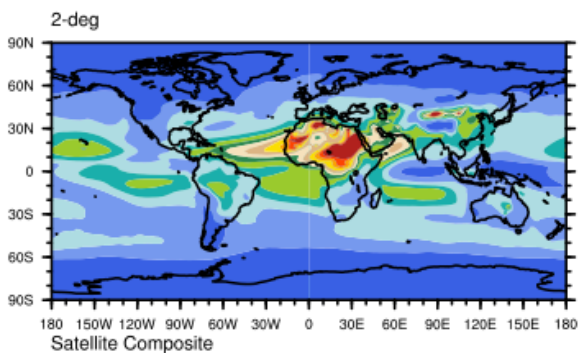
**BC**

Barrow

Zeppelin



# Aerosol Optical Thickness at 550nm



# To-dos

- Evaluation metrics: aerosol forcing, Taylor diagram, skill scores, etc.
- Diagnostics: number concentration, size distribution, budget for aerosol number, absorption AOD, etc.
- Observations: CALIOP, CARIBIC, MPLNET, complete HIPPO, etc.
- Compatibility with other aerosol models: MAM4, MAM7, BAM, sectional treatment, new SOA representation, NTU aerosol model
- Merge with chemistry (trace gases) diagnostics and eventually merge into the AMWG diagnostics package