AEROCOM BIOMASS BURNING EXPERIMENT:

CONSTRAINING AEROSOL EMISSIONS WITH SATELLITE DATA

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AeroCOM Biomass Burning experiment Objectives:

2 phases: *Study period*: *full year 2008*
   emission strength (M. Petrenko)
   emission injection height (M. Val Martin)

☐ Inter-compare & quantify **model BB AOD accuracy and diversity**

☐ Evaluate **factors** that **define regional difference** between satellite and model AOD

   → provide constructive summary to widely used GFED emissions

AeroCOM Wiki https://wiki.met.no/aerocom/phase3-experiments

Snapshots of satellite-measured Aerosol Optical Depth constrain BB aerosol emissions in the GOCART model

Sample Case Russia
2006-07-20

Aerosol Optical Depth (AOD)
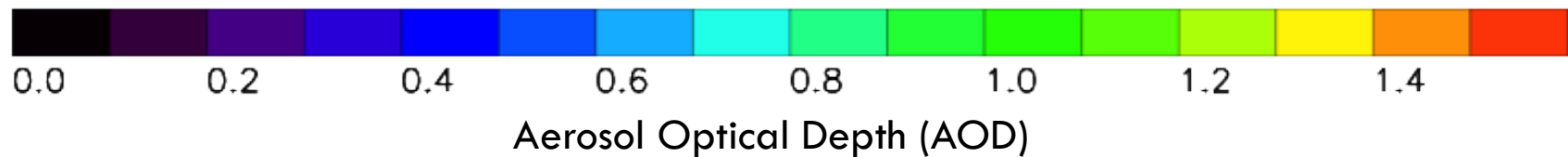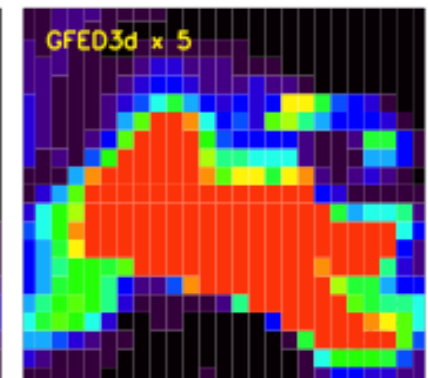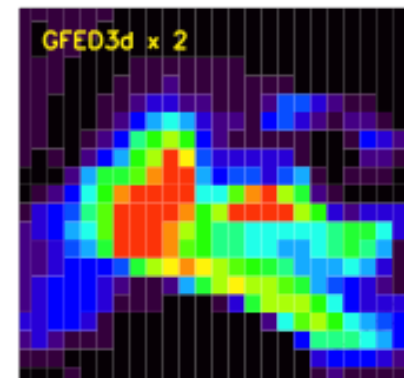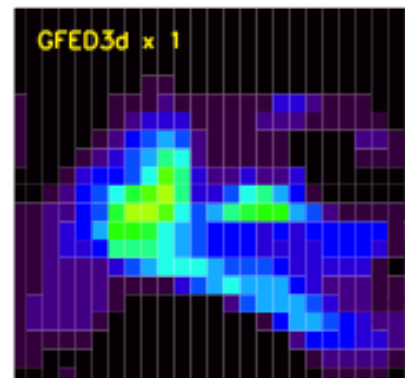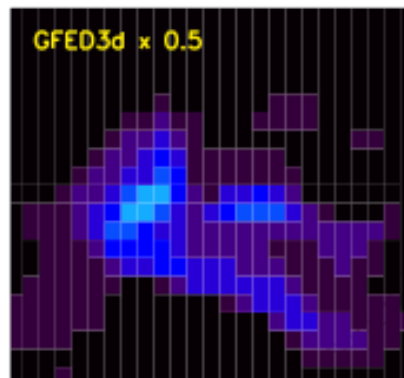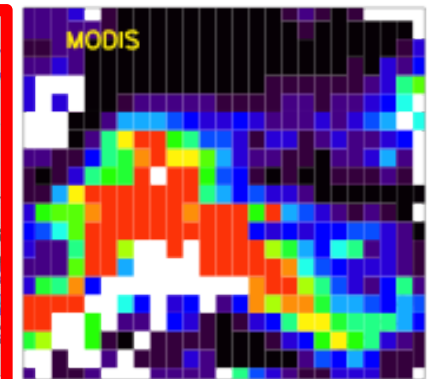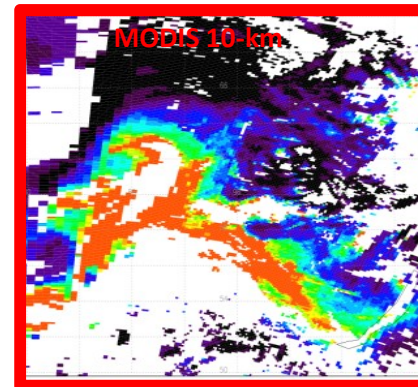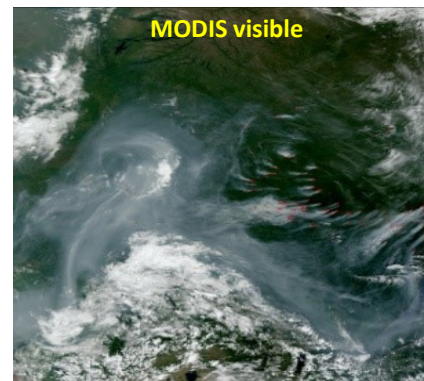
Last Year: Comparison between MODIS average case AOD and AOD from model runs with GFED3x1 emissions

CAM5

ECHAM-SALSA

ECHAM6.1-HAM2.2

GEOSCHEM-v902

GFDL-AM3p10

GOCART

HadGEM3

INCA

OsloCTM2

SPRINTARS

* This is first look at the data. 2008 reference obs dataset is about ¼ complete and more models are running

Ratio of model average case AOD to MODIS average AOD

0.0   0.2   0.4   0.6   0.8   1.3   2.0   3.0   5.0
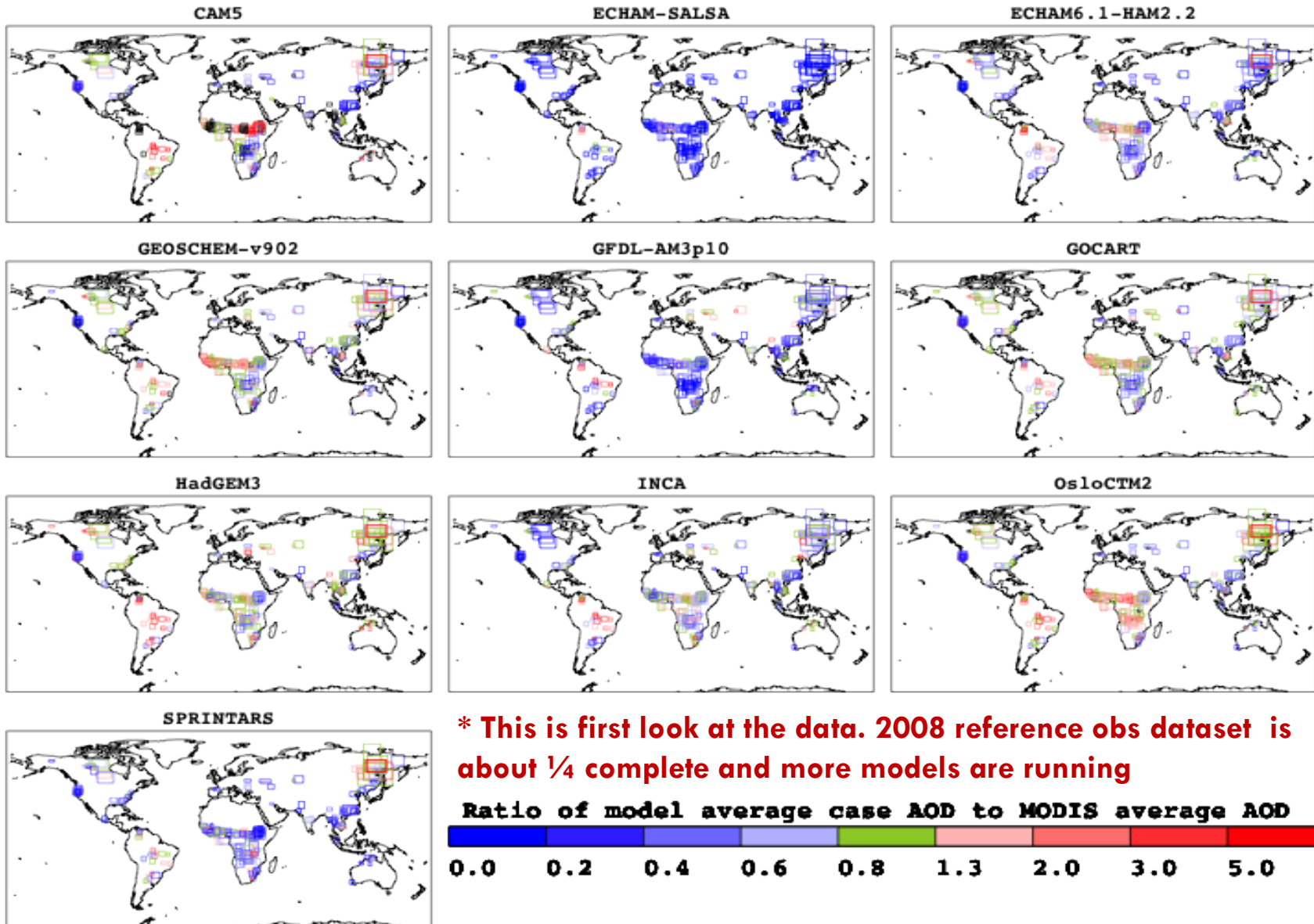
2008 Satellite Observational Dataset of Fire Cases for Global Model Comparisons

- 497 cases

- Based on MODIS-Terra

- Closely tied to the MISR plume height dataset

- Created for global model comparisons

- Will be made public soon

Case:
- detectable smoke in 'visible' MODIS product
- have fire detections (MOD14) associated with smoke
- elevated AOD in aerosol product
- At least 2x2 degree square on the map

Month case was observed

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
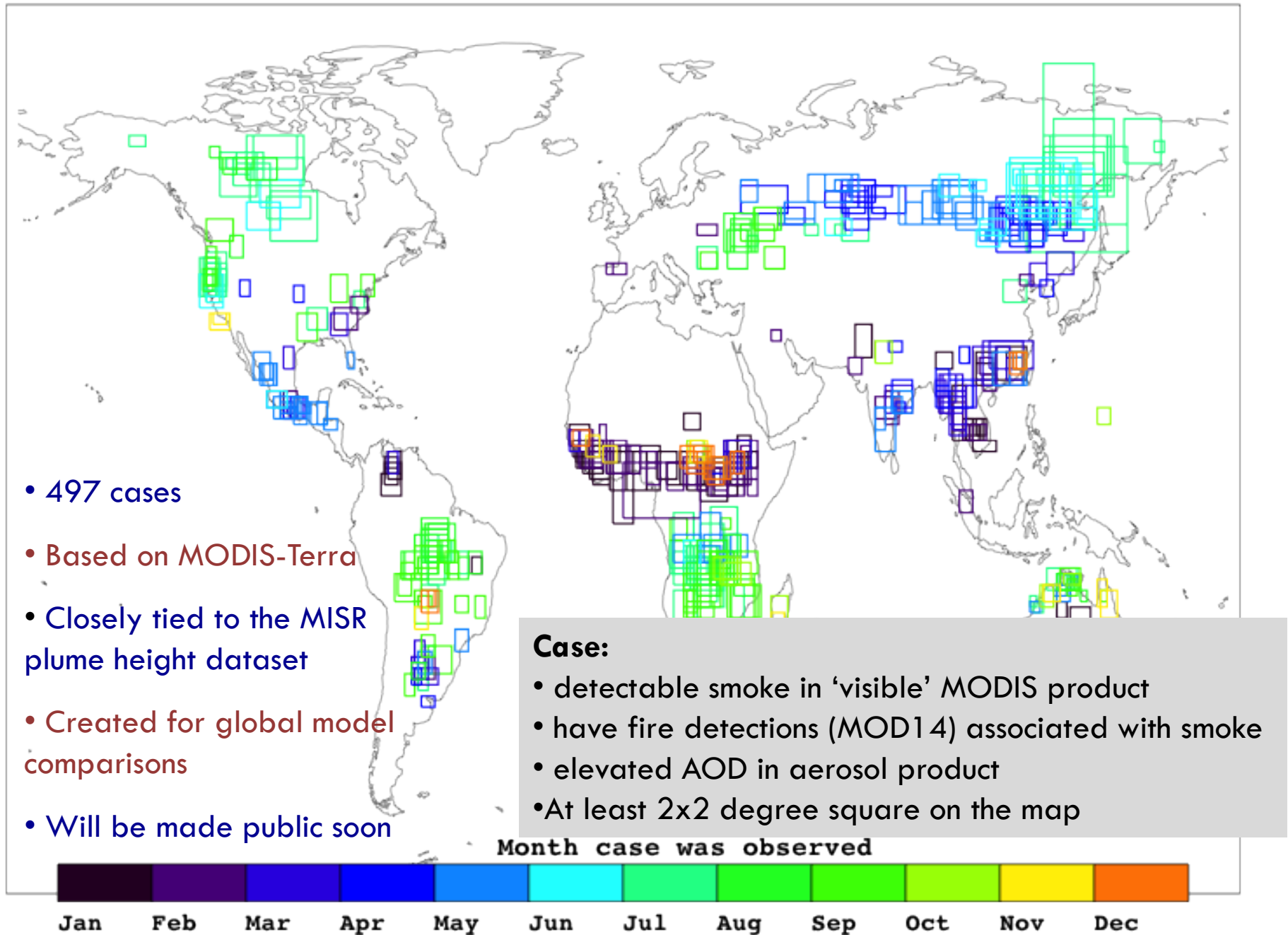
NOW: Ratio of average AOD per case: model/MODIS

Ratio of model average case AOD to MODIS average AOD

0.0   0.2   0.4   0.6   0.8   1.3   2.0   3.0   5.0
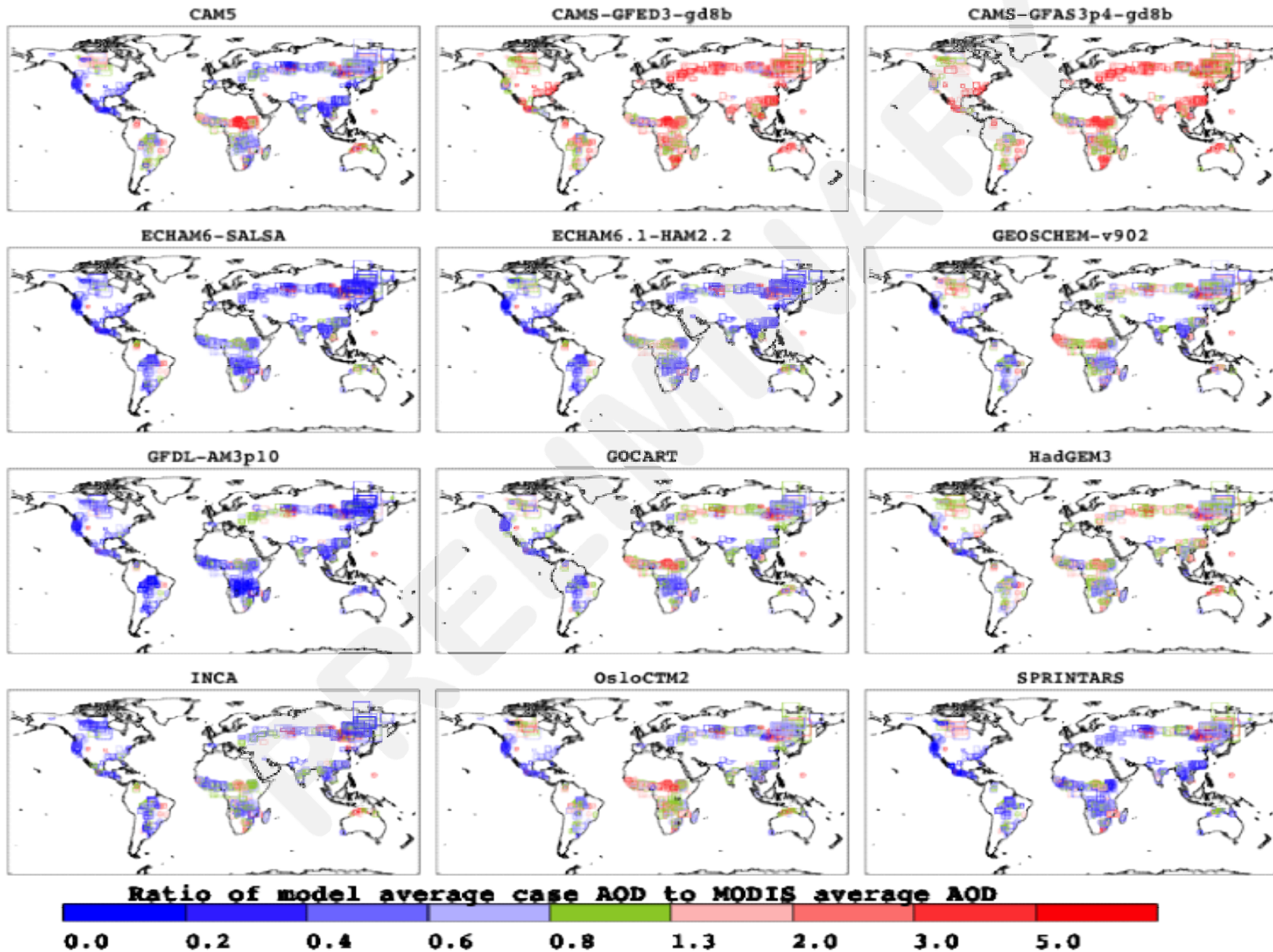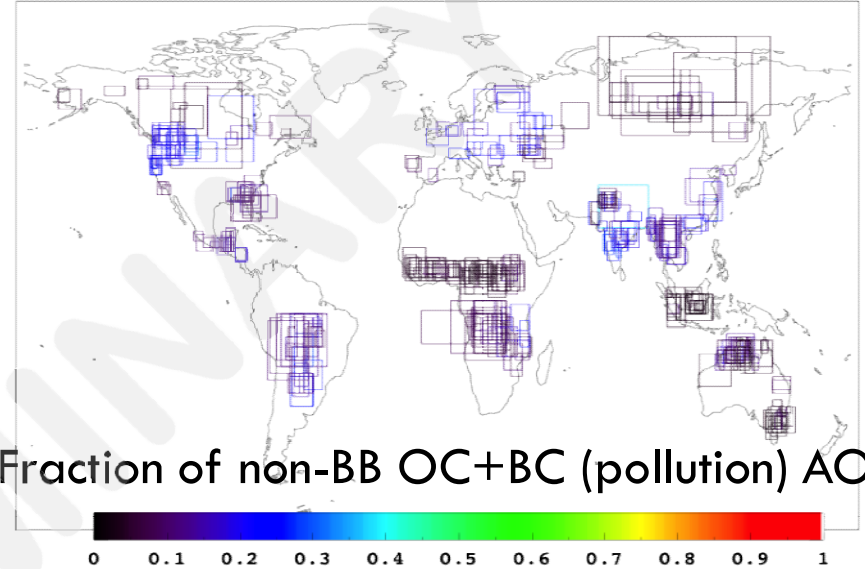
# Fraction of AOD from BB and other species (GOCART)

BB_AOD fraction; 2006-2007; BB=g5e520moc, noBB=g5e560y0z; ratio of averages
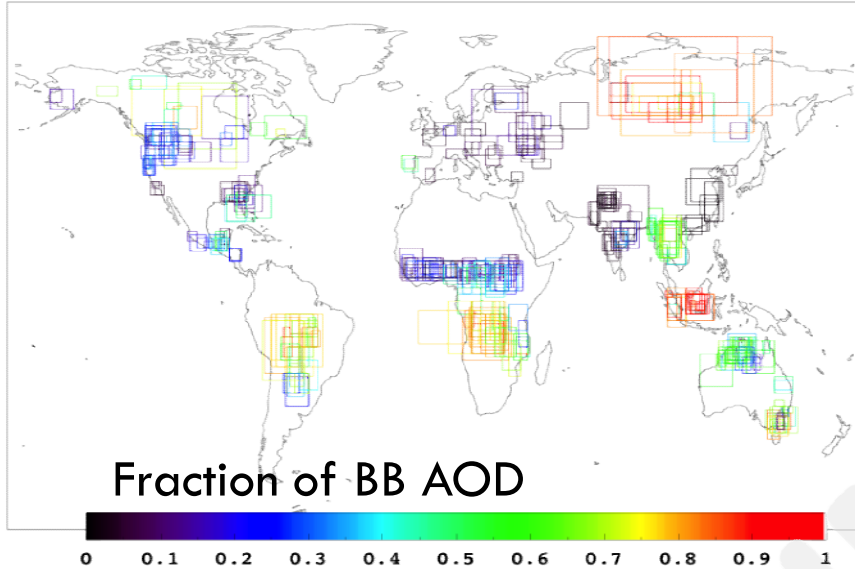
Fraction of BB AOD
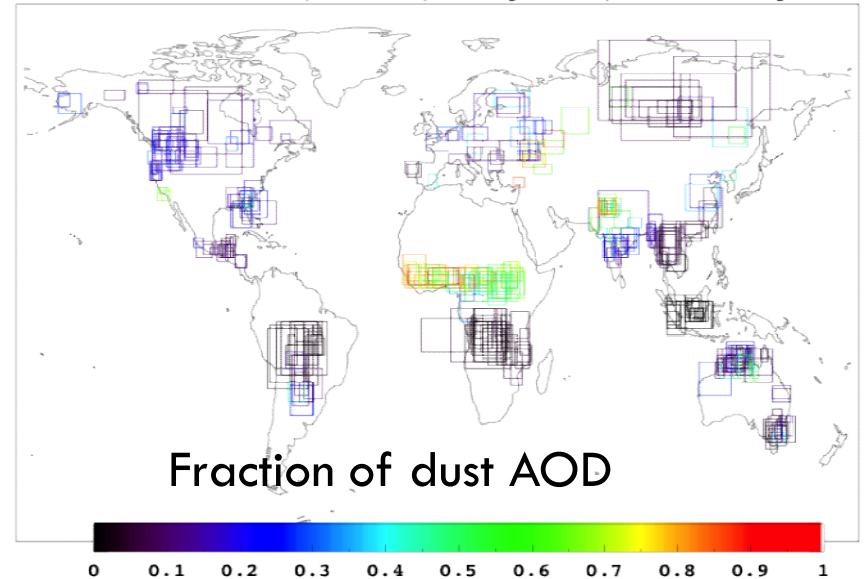
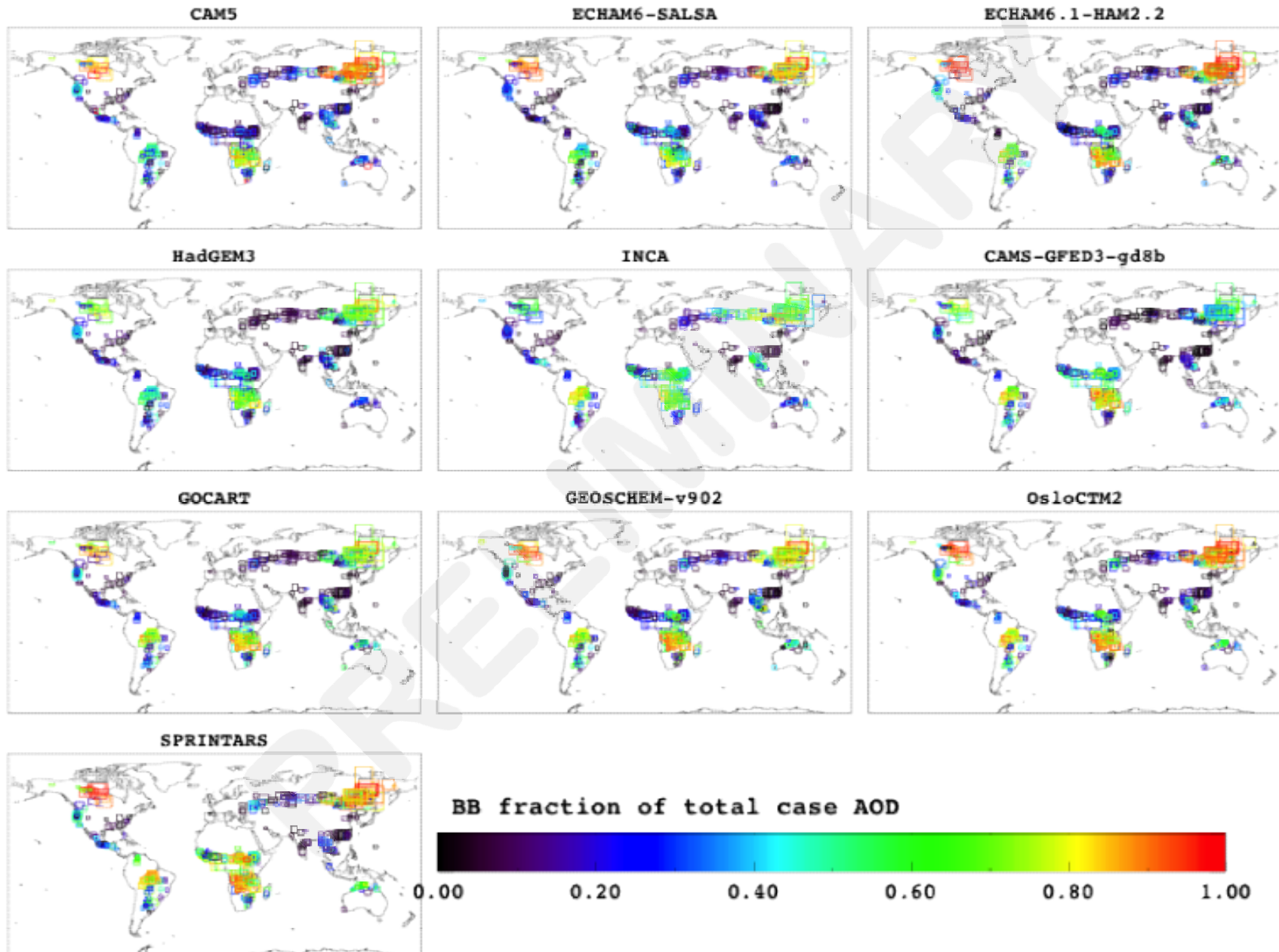noBB-C-520m0c AOD fraction; 2006-2007; total=g5e520m0c, ratio of averages

Fraction of non-BB OC+BC (pollution) AOD

su-520m0c AOD fraction; 2006-2007; total=g5e520m0c, ratio of averages

Fraction of sulphate AOD

du-520m0c AOD fraction; 2006-2007; total=g5e520m0c, ratio of averages

Fraction of dust AOD

BB fraction of total case AOD
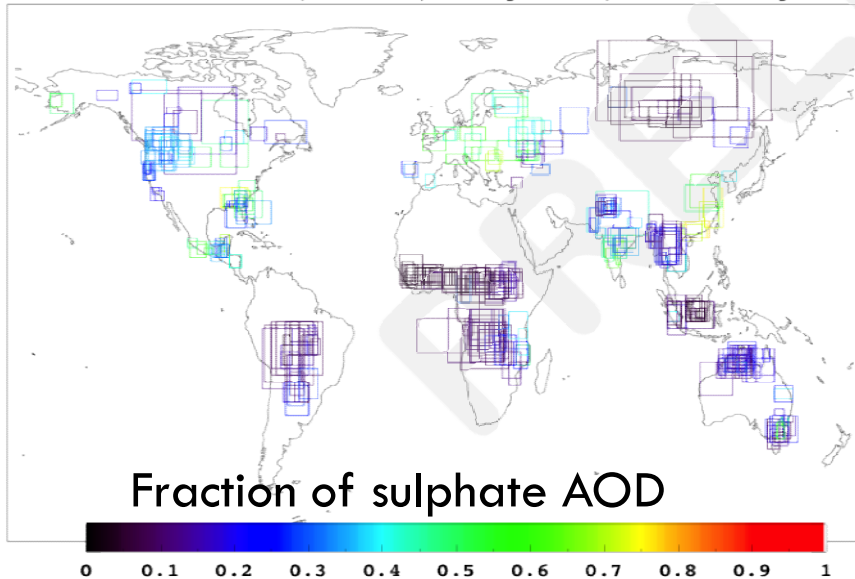
Figure: BB fraction of total case AOD. Model panels: CAM5, ECHAM6-SALSA, ECHAM6.1-HAM2.2, HadGEM3, INCA, CAMS-GFED3-gd8b, GOCART, GEOSCHEM-v902, OsloCTM2, SPRINTARS.

BB fraction of total case AOD

0.00   0.20   0.40   0.60   0.80   1.00

Satellite AOD for comparisons with the models

MODIS visible

MODIS 10-km AOD

MODIS AOD
model grid

MODIS AOD
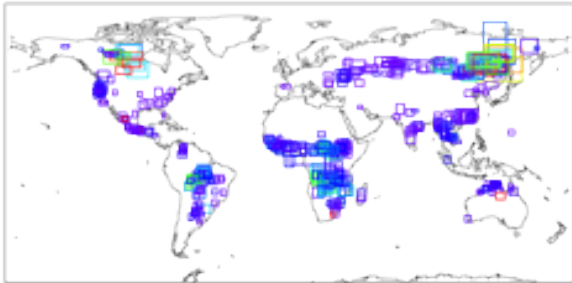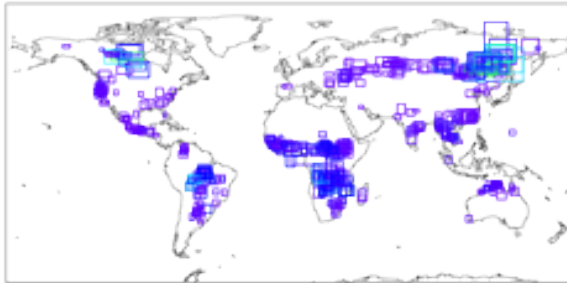No background
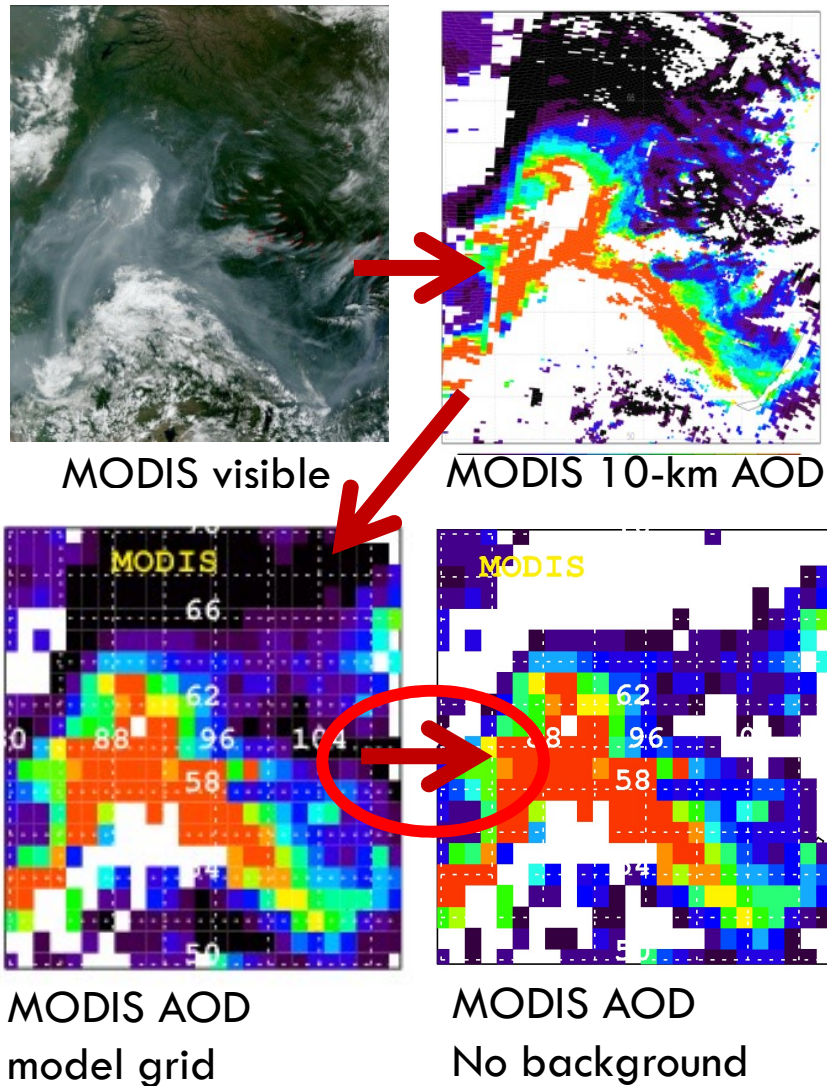
- ~~Define bottom 5-10% AOD as background~~
- ~~Find low AOD range for each region statistically~~
- ~~"Manually" adjust background AOD for each case~~
- ~~Combine several satellite sensors to tease out BB signal~~
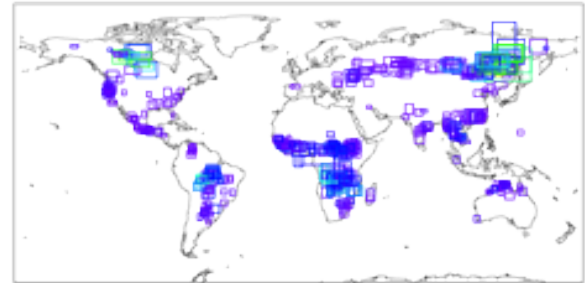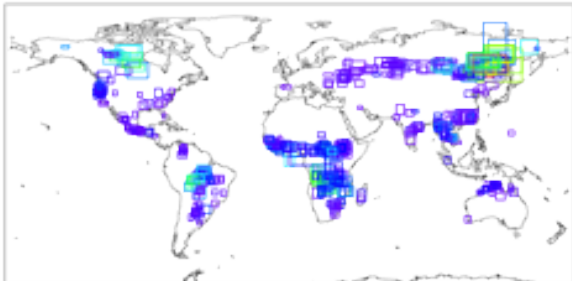- Remove climatological background value (e.g., AOD in each region when BB is not burning)
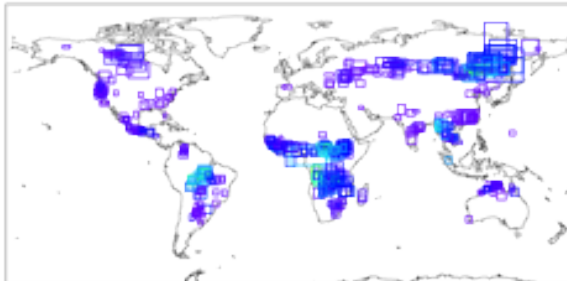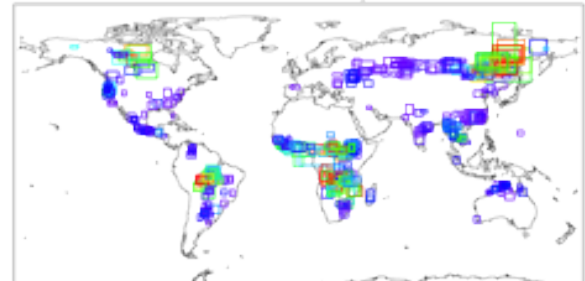
CAM5 ECHAM6-SALSA ECHAM6.1-HAM2.2

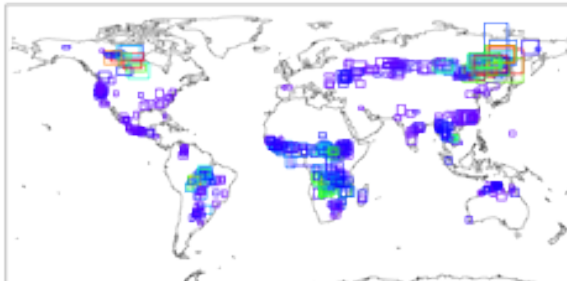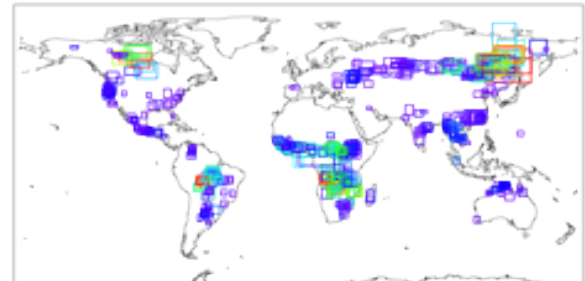HadGEM3 INCA CAMS-GFED3-gd8b
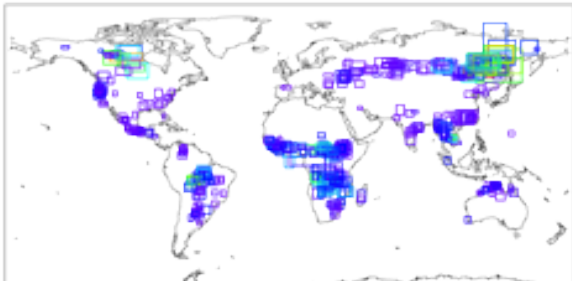
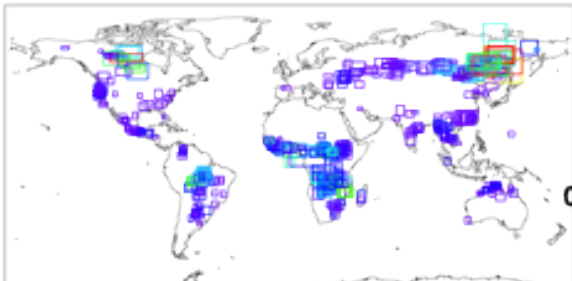GOCART GEOSCHEM-v902 OsloCTM2

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Model average case BB AOD = (GLOFIR1-GLOFIR0)

0.00   0.16   0.32   0.48   0.64   0.80

Theoretical basis for future analysis of regional discrepancies

(1) what natural phenomena are important, and

(2) how these phenomena are simulated in the model

BB emission inventories

parameters describing
- the fire itself and
- its environment

Model-simulated BB AOD

parameters describing how the model
- treats emitted aerosols,
- simulates plume evolution (e.g., aging),
- transport (met fields, parameterizations…),
- removal, and
- translates aerosol amount into AOD (size, optical properties)

Model development

Satellite observations

Do this analysis by BB region, as different parameters are important in different regions

Analysis timeline

- Overview paper (start winter 2016)
  - BB1 and BB0 output
  - Questionnaires
- Regional model intercomparison analysis
  - Brainstorming here → today, during ice-breaker (Monday, ~17:45)
  - Additional files will be requested early next year (2016) based on discussion and initial analysis