



# *Optical properties evaluation in AeroCom*

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# Goals “optical properties evaluation”

- ❖ Evaluate/Document/Overview Control 2018/2019 experiment
- ❖ Evaluate history of ERF forcing in AeroCom/AerChemMIP  
= synergy with “historical experiment” (Gunnar)
- ❖ Compare AeroCom 1+2+3 model results – progress?
- ❖ Expand AOD evaluation to more parameters...  
closure ground, column, profile – link to other observables
- ❖ Get an overview of state of the art model performance
- ❖ Understand what works well in some models
- ❖ Establish bias of regional and global features in optical properties  
relevant for forcing
- ❖ Make the associated python based evaluation available
- ❖ Assess if models are fit for purpose (forcing, regional AQ, trends)



# Portrait Diagram Display of Relative Error Metrics

## AeroCom Phase III Models vs Multiple Observational datasets

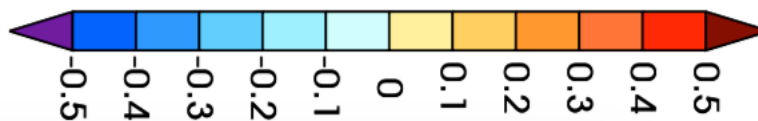
Aerosol Optical Properties																						
Total AOD	Aeronet Sun mode	-0.45	-0.02	0.14	2.38	0.10	-0.04	-0.06	0.08	-0.22	0.02	0.23	-0.27	-0.23	0.03	0.19	0.11	-0.12	-0.30	0.05	-0.21	
Coarse mode AOD	Aeronet SDA			1.22		-0.04	0.00	0.11		-0.01				-0.18	-0.33	0.29		-0.15		0.00	0.07	
Fine Mode AOD	Sky inversion	-0.42	-0.52	0.28	0.08						-0.02	0.10			0.08	0.30	-0.05	0.00	0.00		-0.26	
Surface Concentrations																						
Black Carbon	EMEP			0.05		0.04	-0.02	-0.02		0.00		0.11		0.05						-0.01	-0.02	
Dust	Aeroce Climatology	0.13		-0.07		0.02	-0.04	0.10	0.00	-0.12		0.30		0.00		0.08		-0.05		-0.07	0.52	
Sulfate	EMEP	0.31		0.30		2.19	0.19	0.52	-0.15	-0.07		0.06	-0.30	0.04			-0.26	-0.04		-0.18	-0.10	
Seasalt	EMEP			-0.57		23.88	0.14	0.00	-0.66	-0.60		0.60	1.74	-0.49		1.91		0.64		-0.43	-0.12	
Sulfate	EMEP			0.02		0.00			-0.44	0.00		0.00									0.00	
		AeroCom-Median2000	CAM5-CTRL2016	CAM53-Oslo-AP3-CTRL2016-PD	Chaser	CNRM_CM6.2_CTRL2015	ECHAM-Salsa-CTRL2015	ECHAM6-HAM2	EMEP_BASE	GEOSChem-v11-CTRL2016	GFDL-AM3p10-GLOFIR1	GISS-MATRIX-NGLOBASE	GOCARTV5Base	IFS-AP3-CTRL2016-PD	IMPACT	INCA-BCinCTRL2016PD	INCA-GLOFIR1	OsloCTM3-CTRL2015	OsloCTM3-CTRL2016	SprintarsT213_CTRL2016	TM5-CTRL2016	
		2000	2010	2010	2010	2010	2010	2010	2010	2010	2008	2010	2010	2010	2010	2008	2006	2008	2010	2010	2010	2010

$$E'_{mfr} = \frac{E_{mfr} - \overline{E}_{fr}}{\overline{E}_{fr}}$$

$E_{mfr}$  = RMS error of model  $m$

$\overline{E}_{fr}$  = typical model error

GOOD



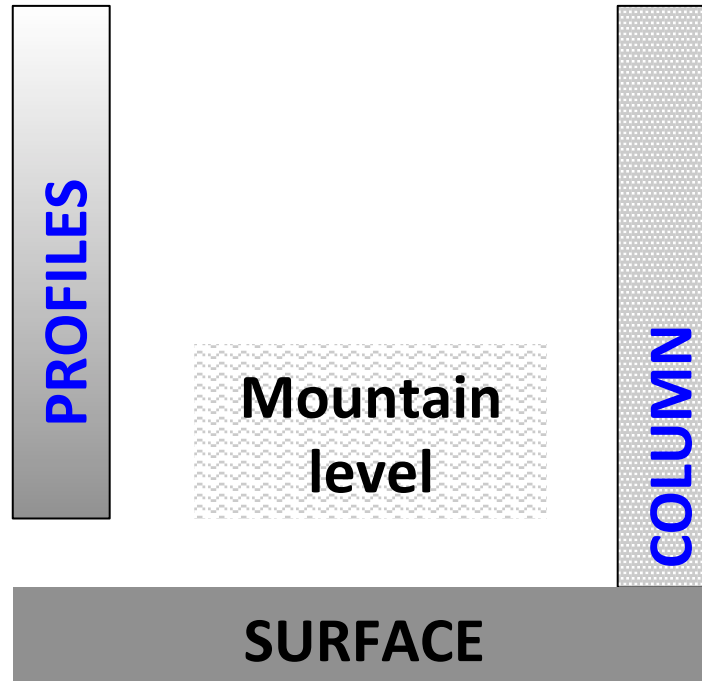
BAD

# Which optical measurements can be combined?

Caliop-Lidar

Remote sensing satellites

Lidars  
Ceilometers



Sun/lunar  
photometers

Aerosol  
@AMBIENT RH  
@DRY 50%RH

In-situ scattering  
and absorption measurements



# Status of data and model workup for performance matrix

## Parameters

## Data sources

- AOD
- Fine mode AOD
- Dust AOD
- Absorption AOD
- Angstrøm Exp
- AOD 0-1 km
- Backscatter 0-1 km
- AOD 1-4 km
- Backscatter 1-4 km
- Char Height 2/3 AOD
- Char Height 2/3 Backscatter
- Surface scattering dry
- Surface absorption dry
- Surface extinction dry
- Surface SSA dry
- Mountain scattering dry
- Mountain absorption dry
- Mountain extinction dry
- Mountain SSA dry

Ground Lidars  
Caliop  
Ceilometers

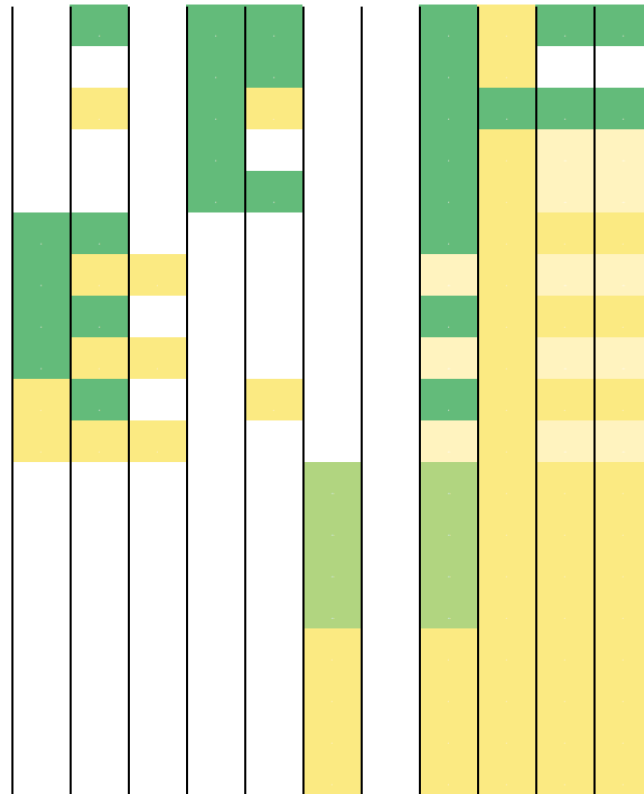
Photometers  
Satellite Rem Sens  
In Situ Instruments

AeroCom Model Sens 1-X

CMIP6/AerChem  
Model Ensemble

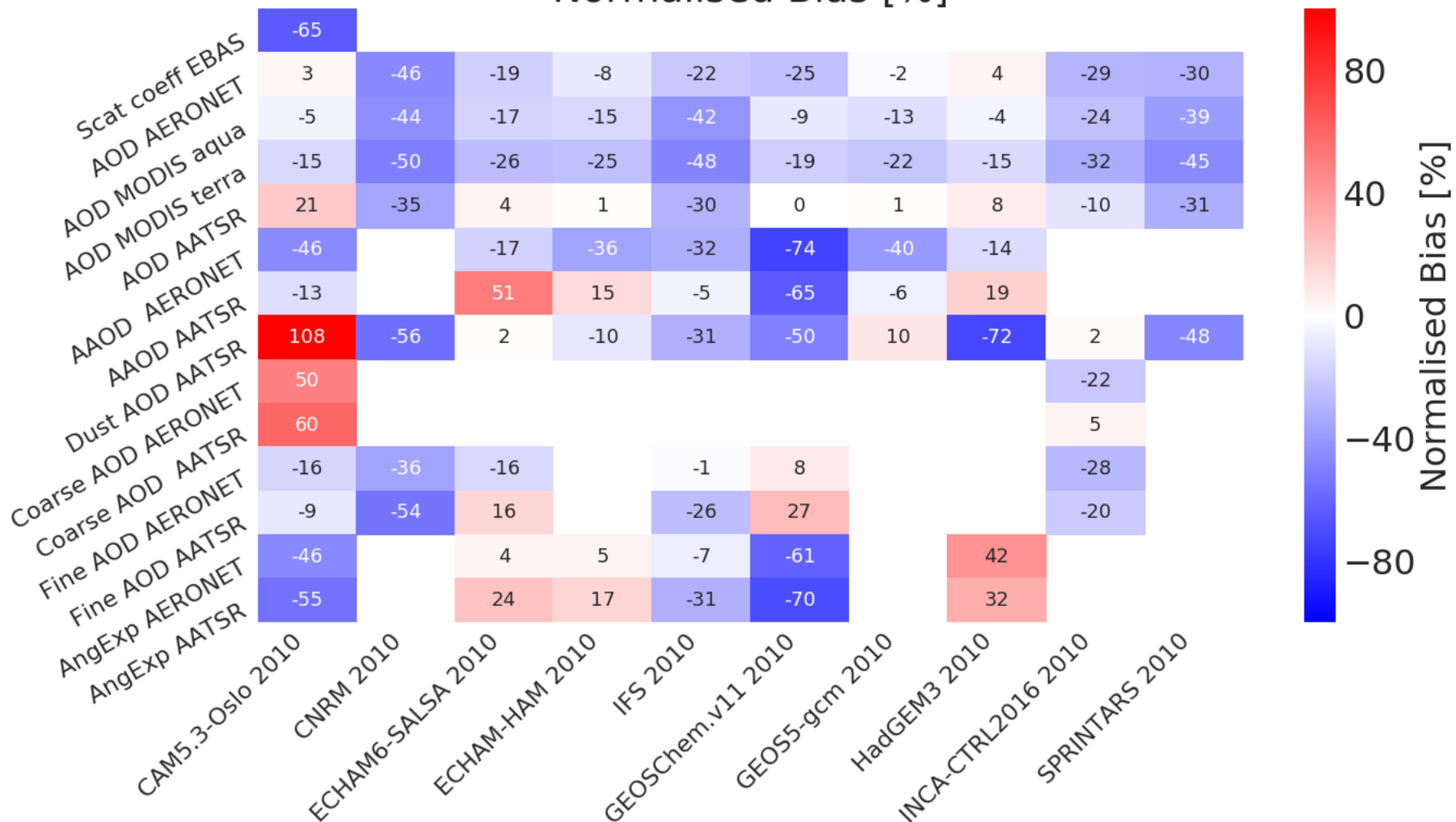
CAMS forecast  
CAMS reanalysis

 in work  
 ready

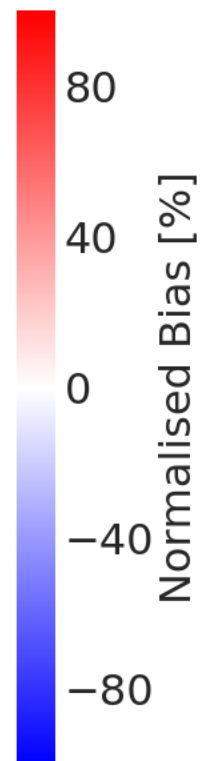


# Normalised Bias [%]

Parameter & Source

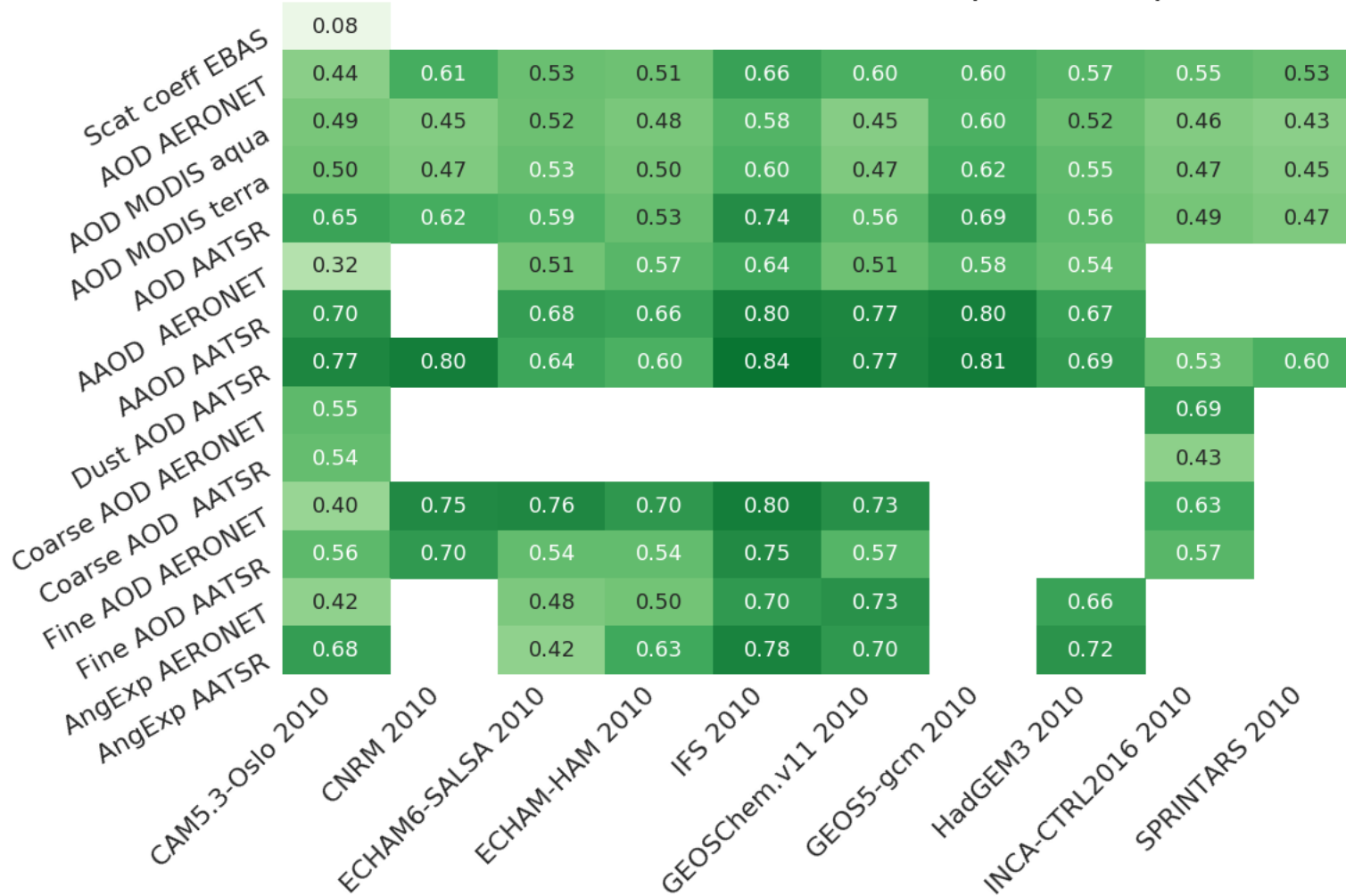


Model Version & Year



# Correlation coefficient (Pearson)

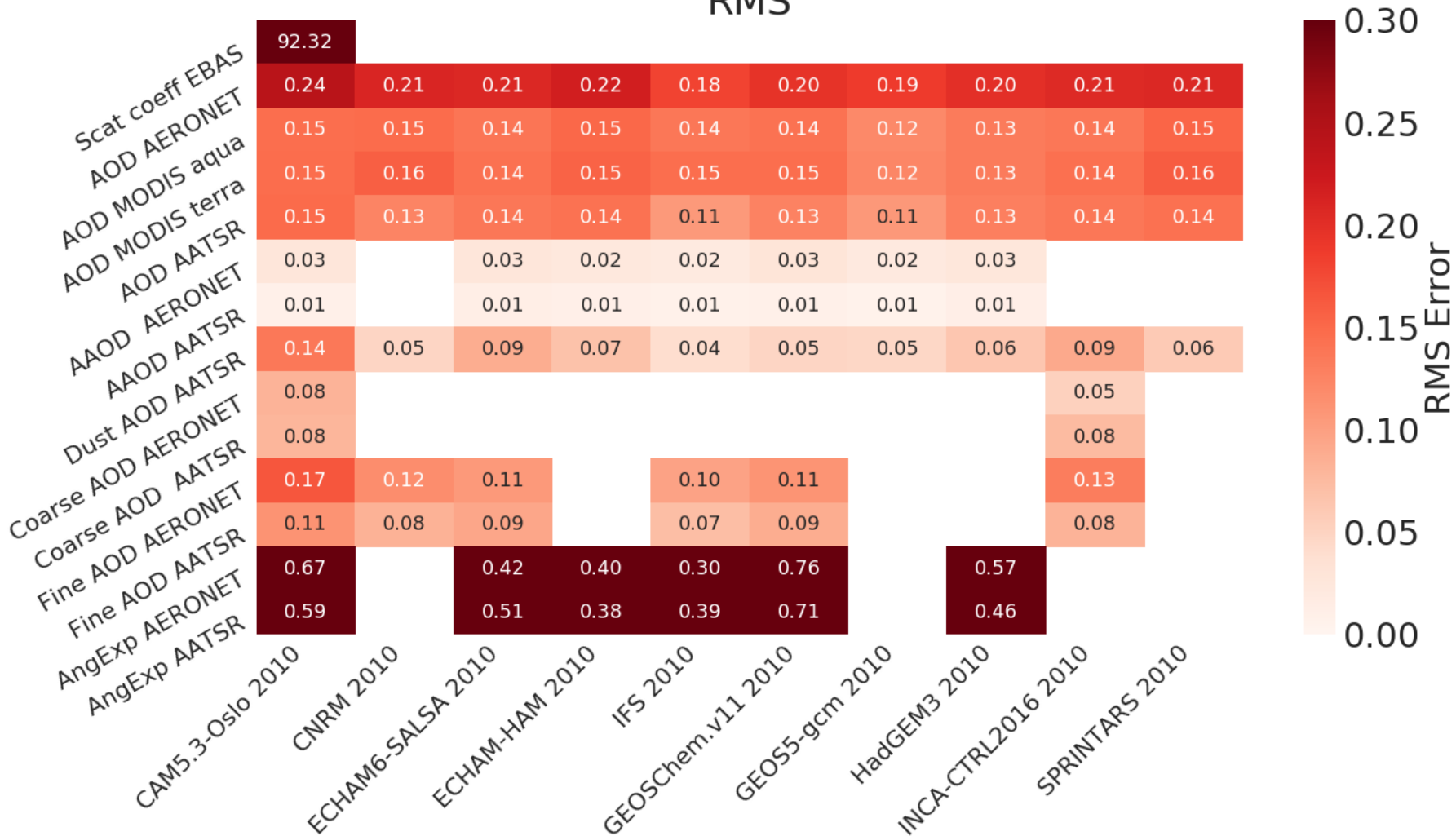
Parameter & Source



Model Version & Year

# RMS

Parameter & Source



Model Version & Year

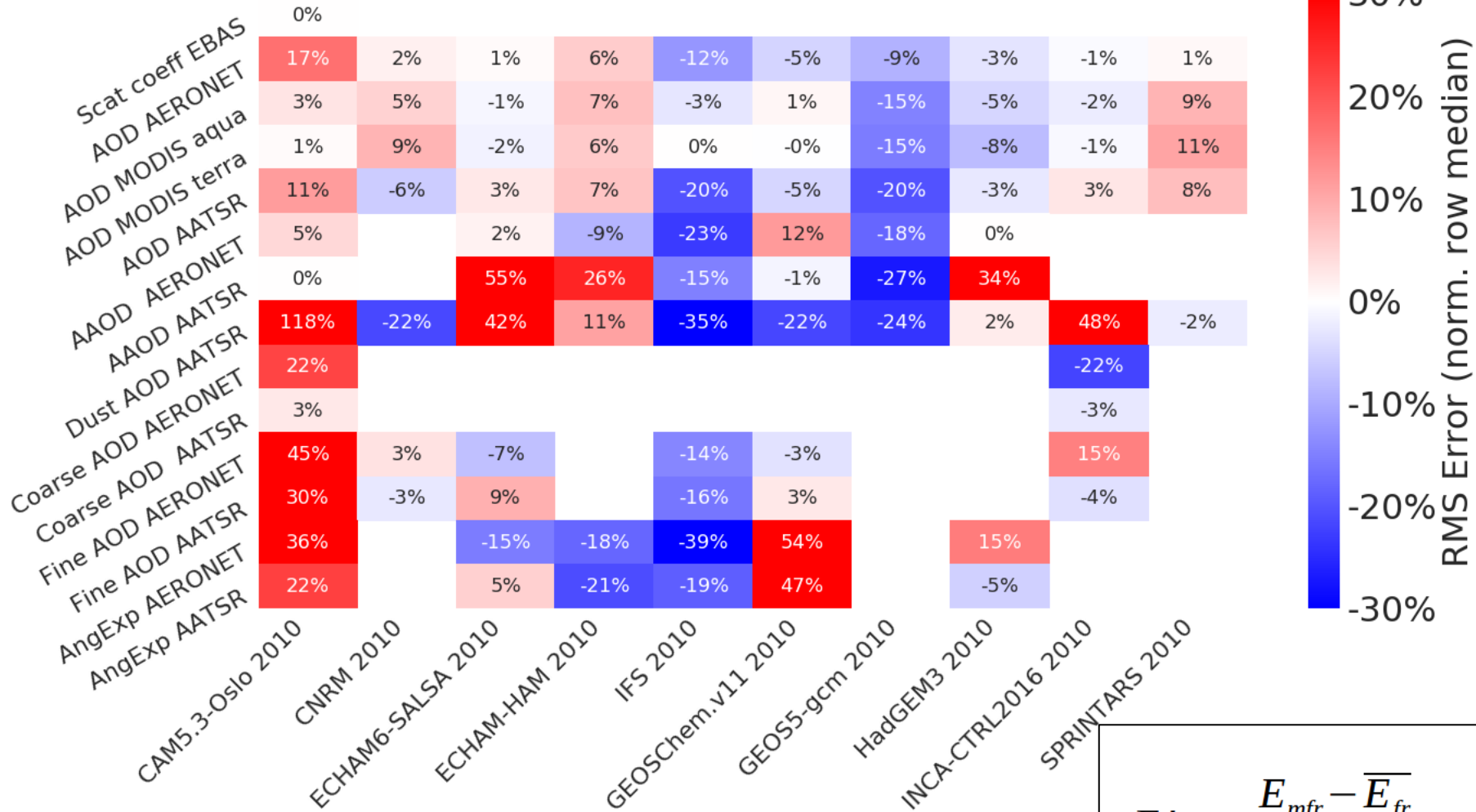
RMS Error





# RMS

Parameter & Source



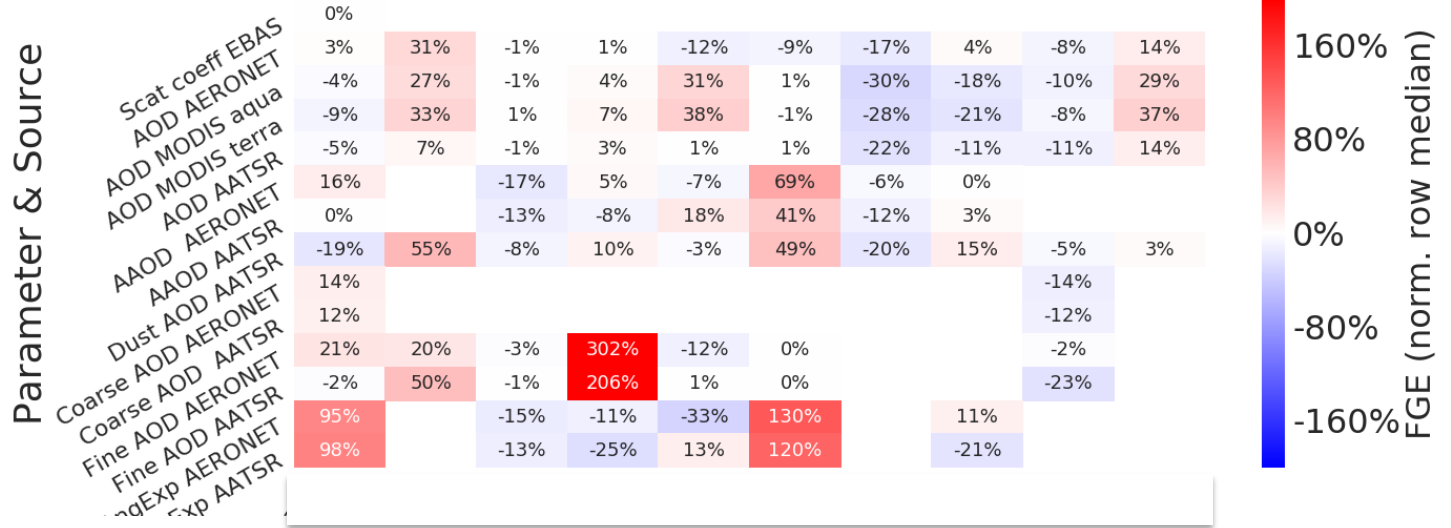
Model Version & Year

$$E'_{mfr} = \frac{E_{mfr} - \overline{E}_{fr}}{\overline{E}_{fr}}$$

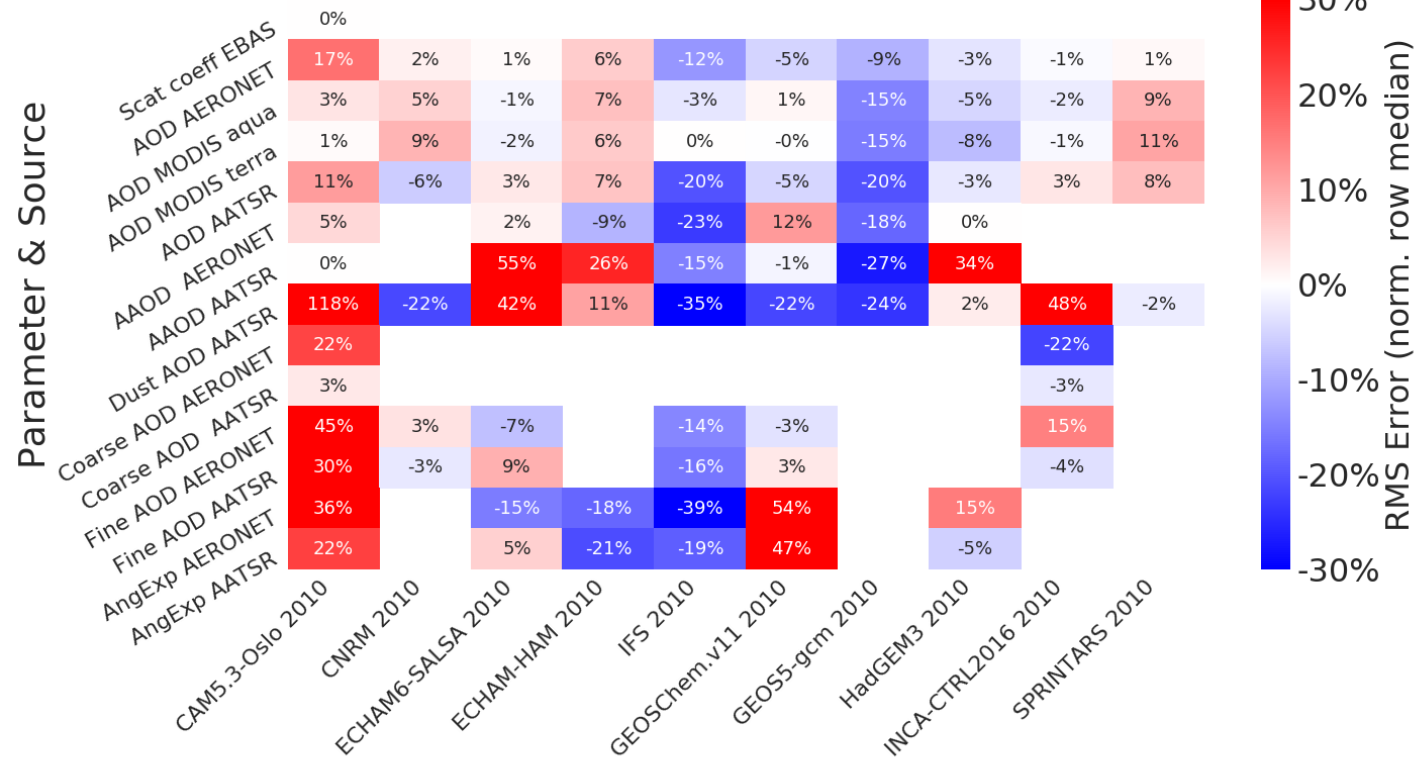
$E_{mfr}$  = RMS error of model  $m$

$\overline{E}_{fr}$  = typical model error

## Fractional Gross Error



## RMS



# Summary – first evaluation tests

- A new set of control simulations can be analysed now quickly with pyaerocom tool against multiple measurements (challenges model completeness, vertical data, read of special data)
- Model bias against different observation sources of the same parameter (eg vs AOD Aeronet & satellite) is similar = robust
- Errors against AOD, AAOD, fine mode AOD, Angström Exp are not correlated among models – models can do better
- Different statistics provide similar performance pattern (eg FGE and RMS) => performance independent of metric
- *Model data are still with large gaps in AeroCom database => Control and historical experiment 2018/19 !!*





**Thanks for the attention**