

# Parameterization MACv2-SP for aerosol optical properties

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# Why MACv2-SP?

Parameterization of aerosol optical properties

**Constrained by observations**



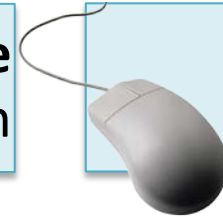
**Computationally efficient**



**Flexible application**



**Easy to implement**



# Why MACv2-SP?

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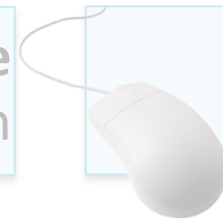
Computationally  
**efficient**



**Flexible**  
application



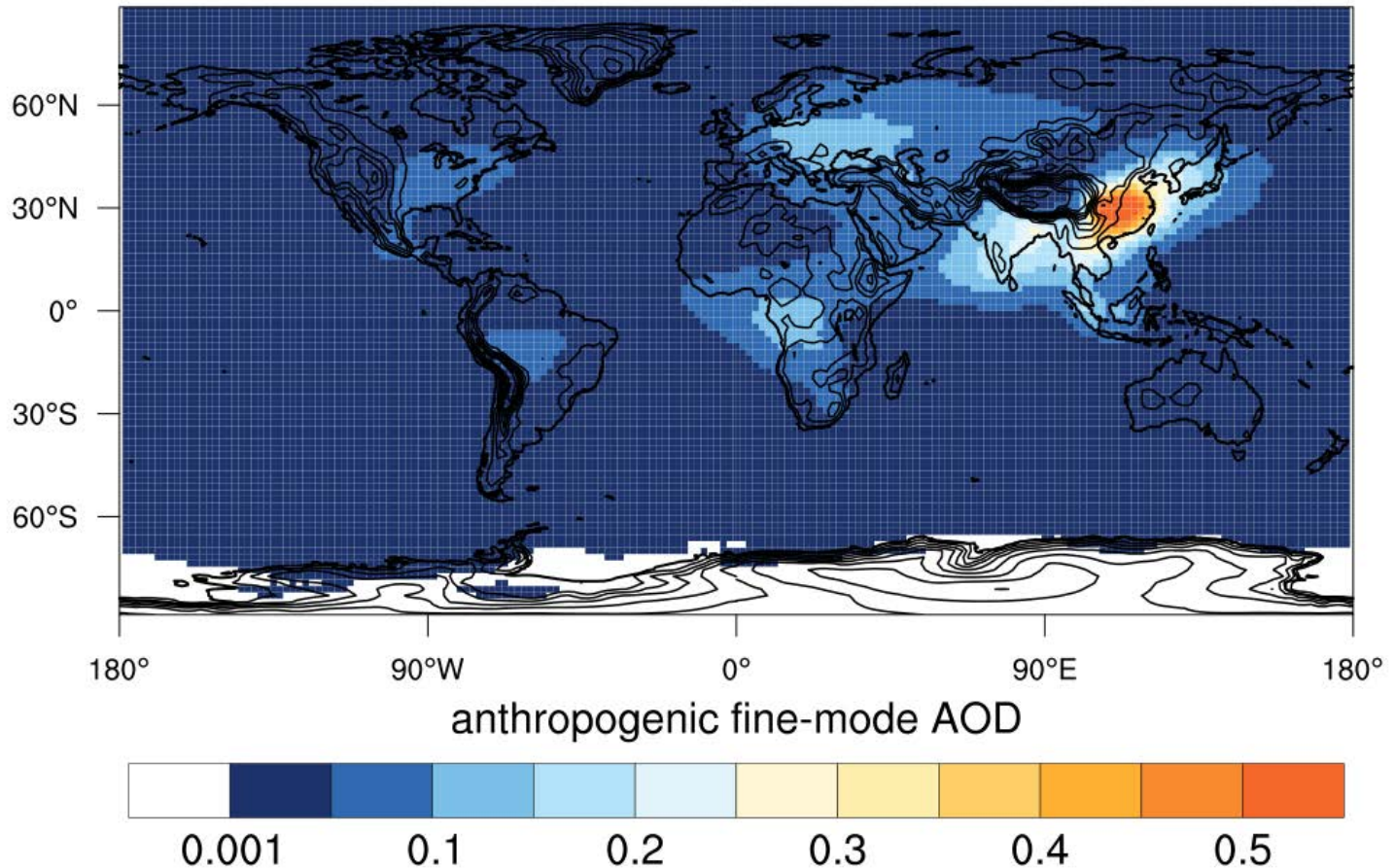
**Easy to implement**



# Observational constraint



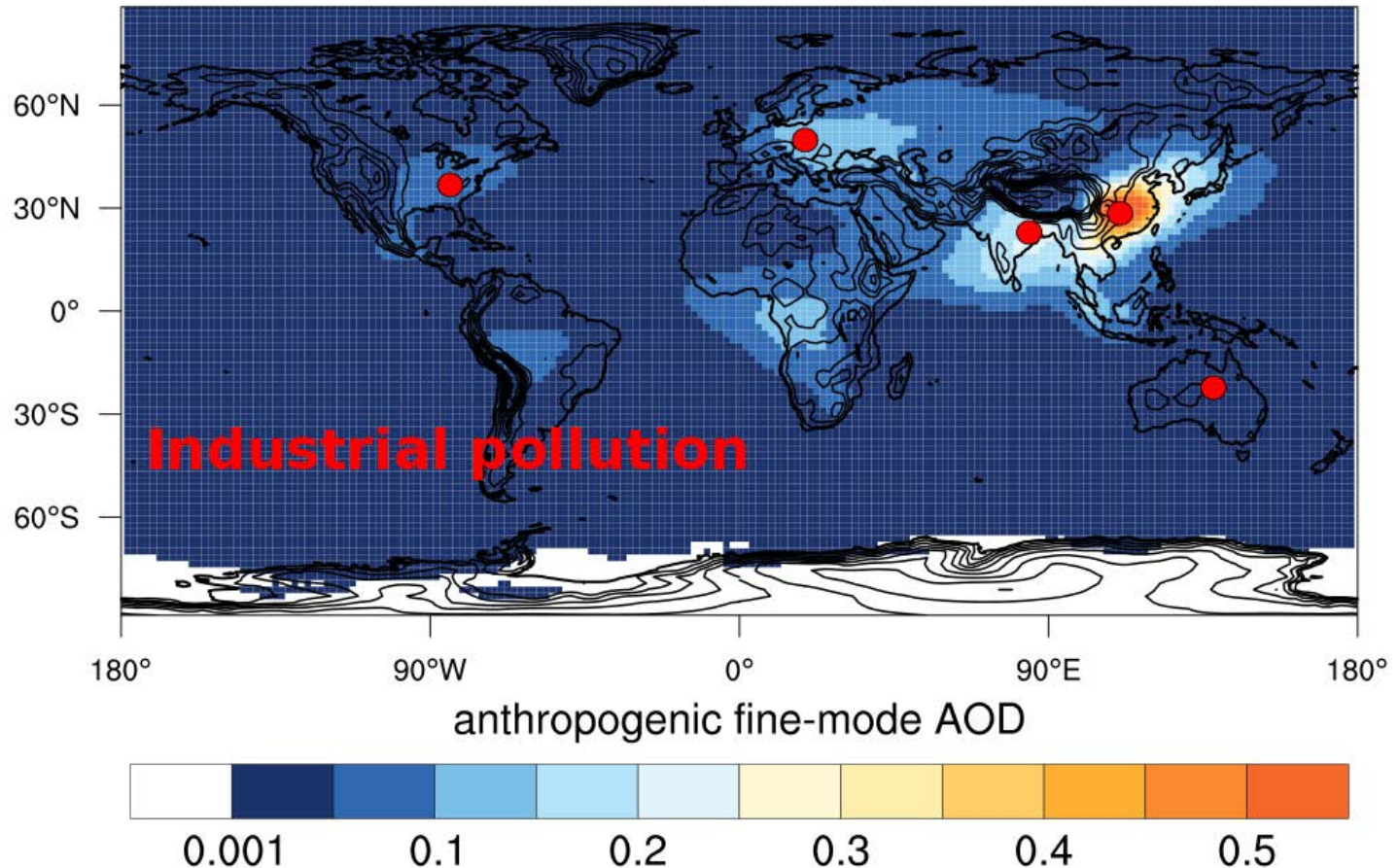
Anthropogenic fine-mode AOD of MACv2



# Observational constraint



Anthropogenic fine-mode AOD of MACv2

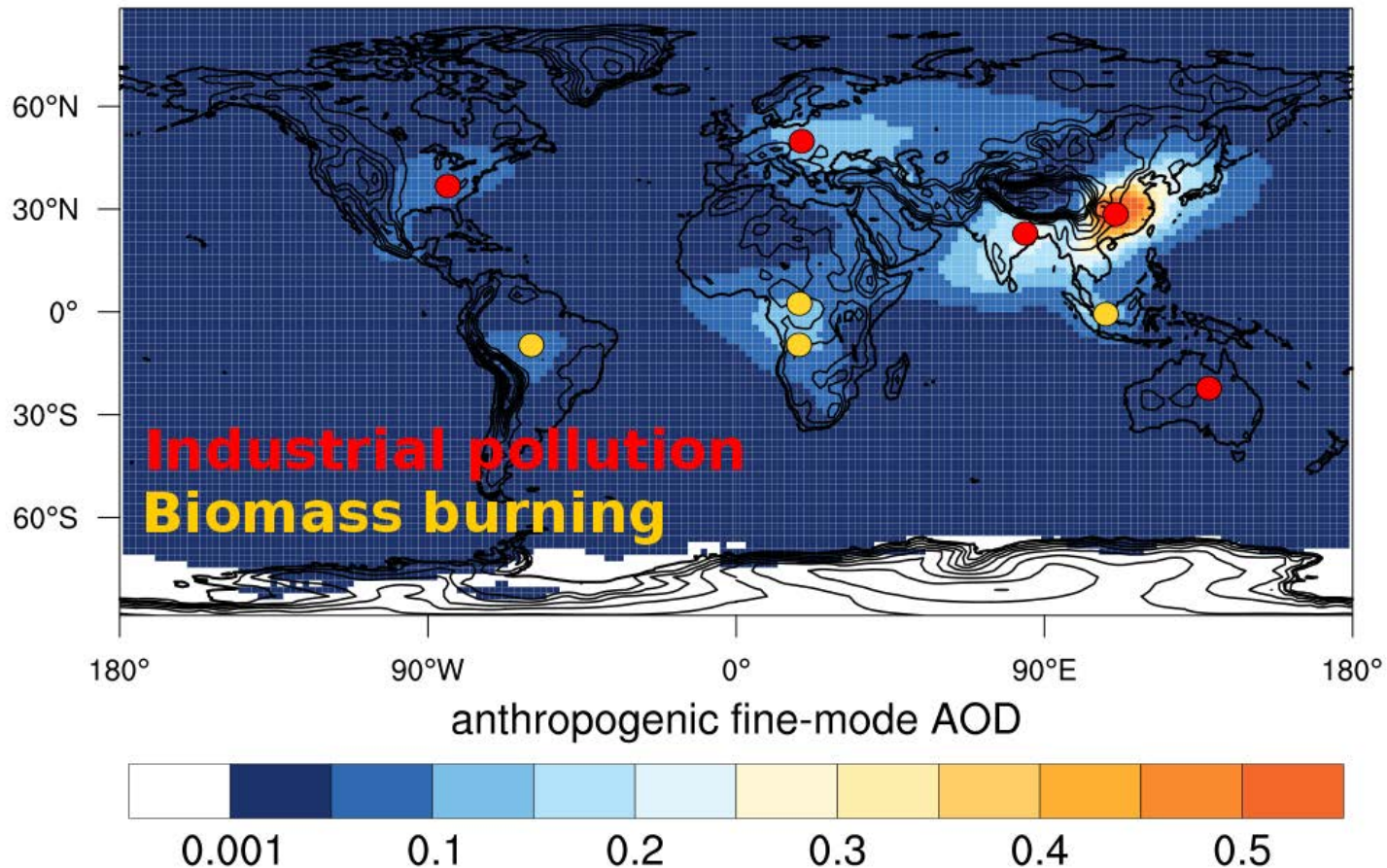




# Observational constraint



Anthropogenic fine-mode AOD of MACv2



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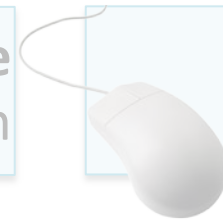
Computationally  
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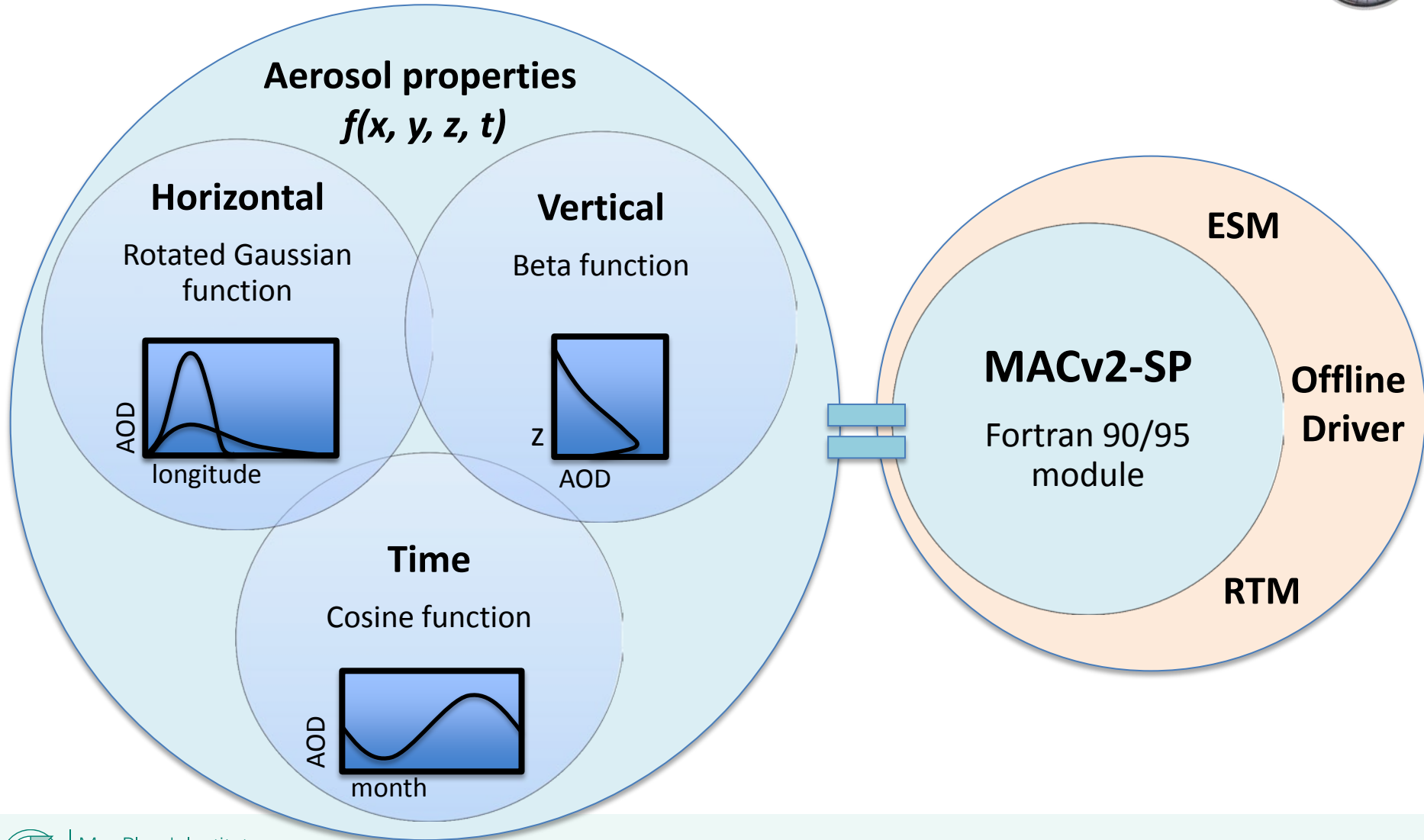
Flexible  
application



Easy to  
implement



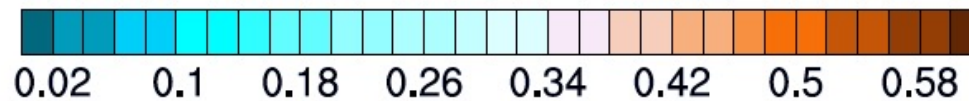
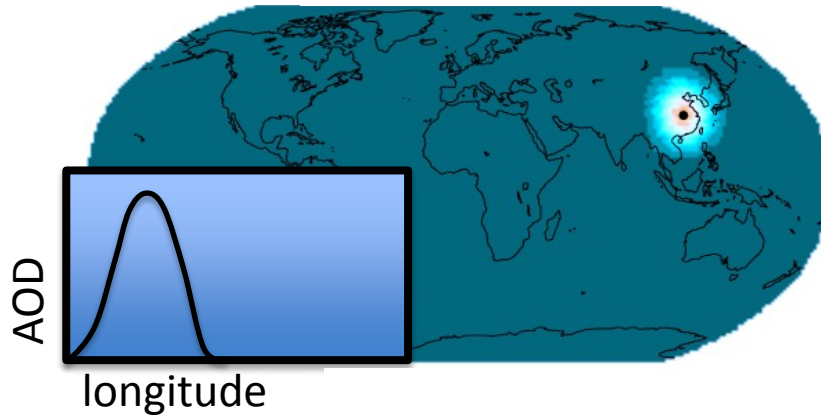
# Efficient and flexible design





# Construction of plume

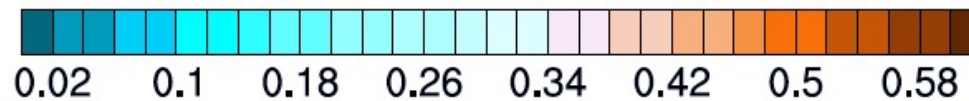
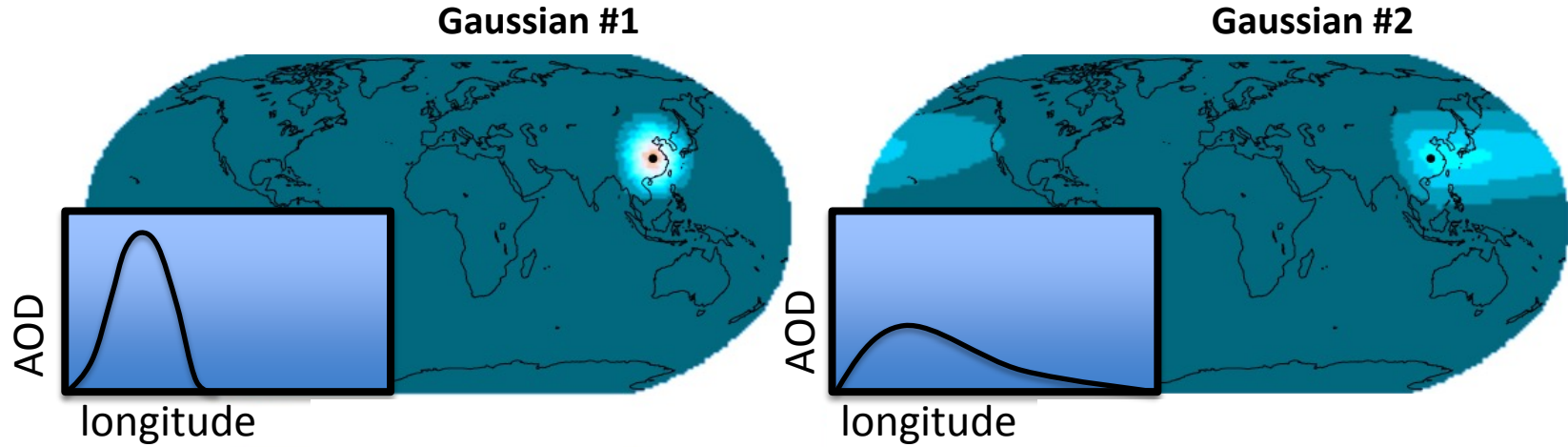
Gaussian #1



AOD (Courtesy: Karsten Peters)



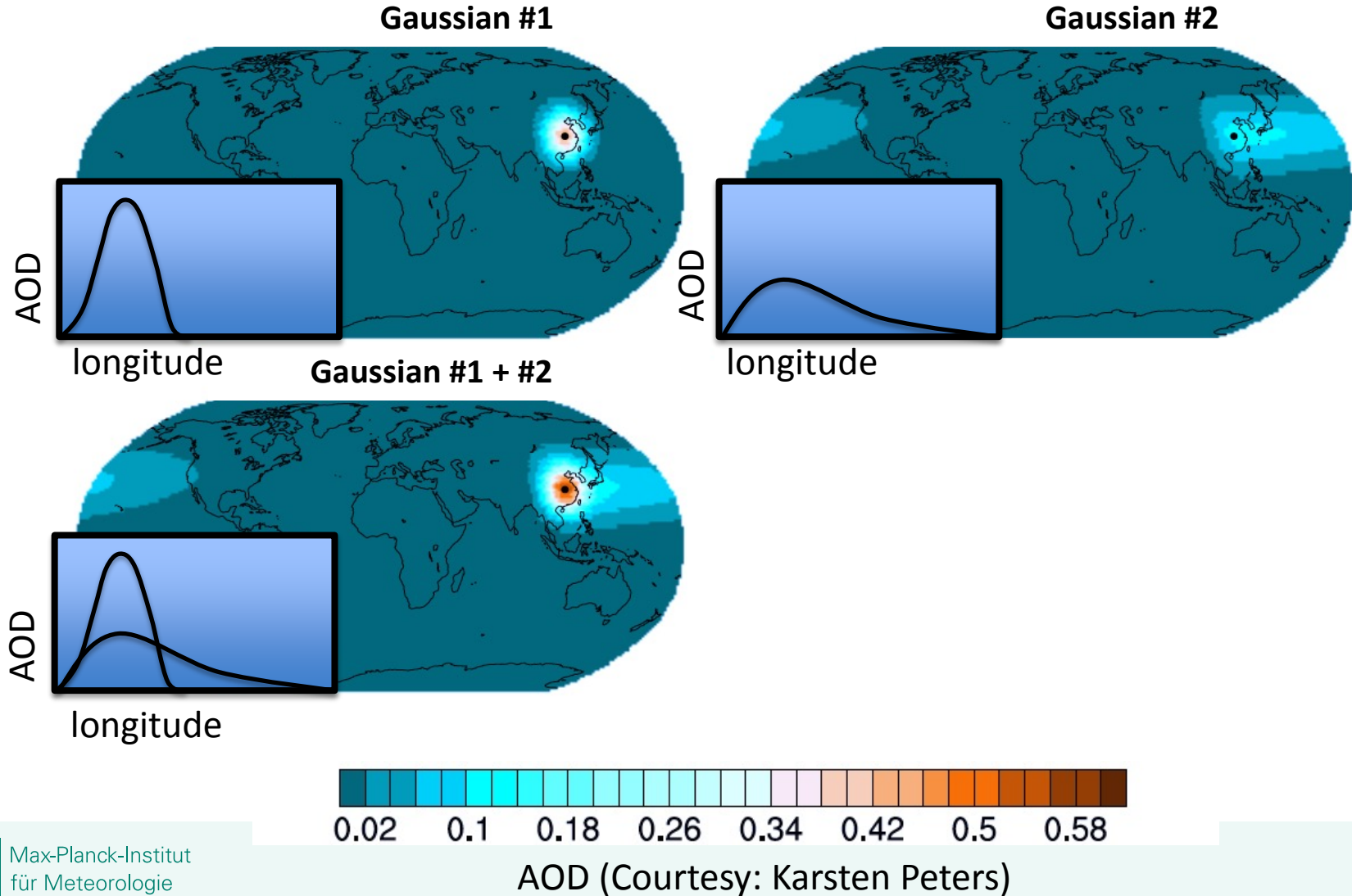
# Construction of plume



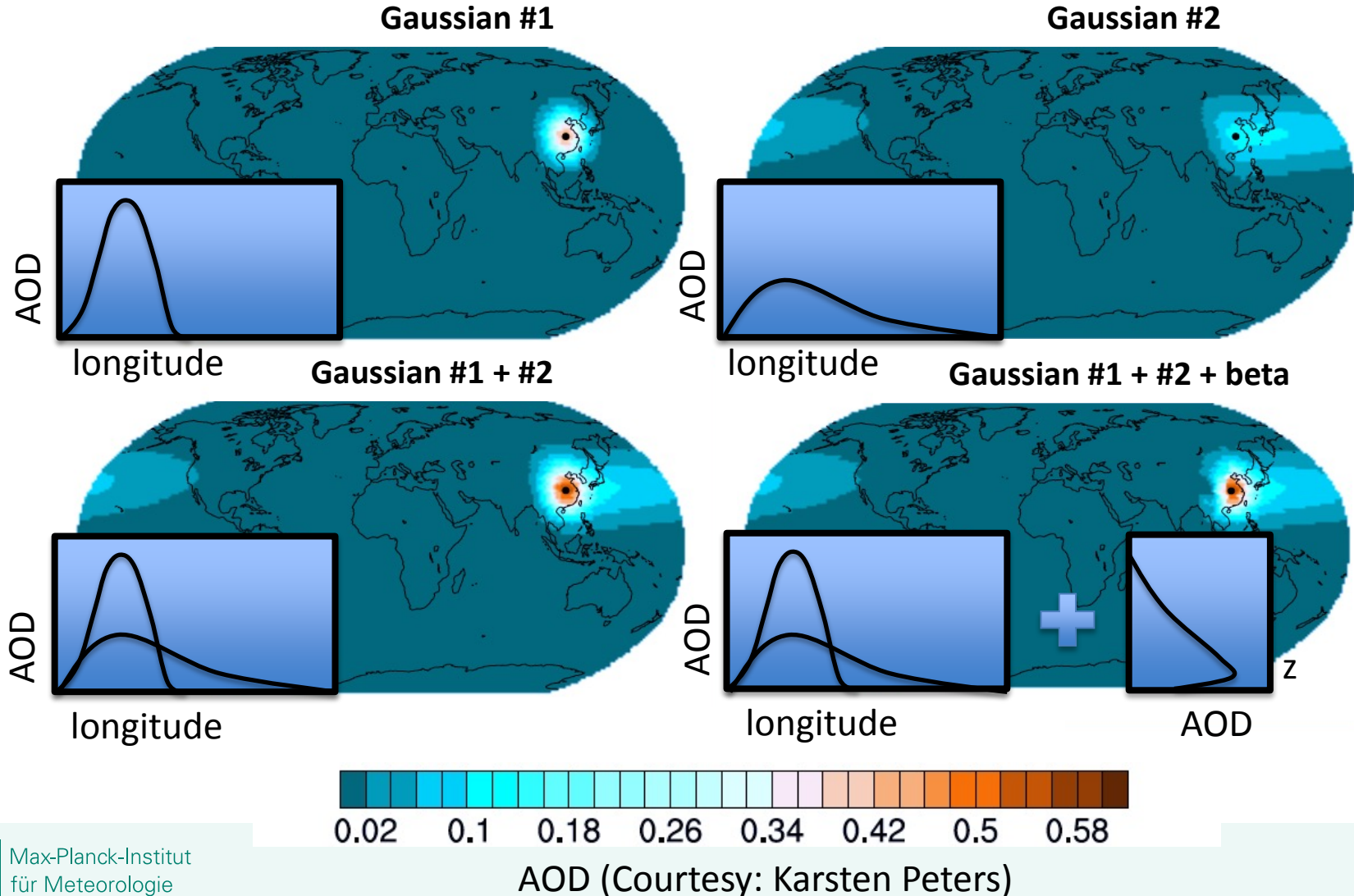
AOD (Courtesy: Karsten Peters)



# Construction of plume

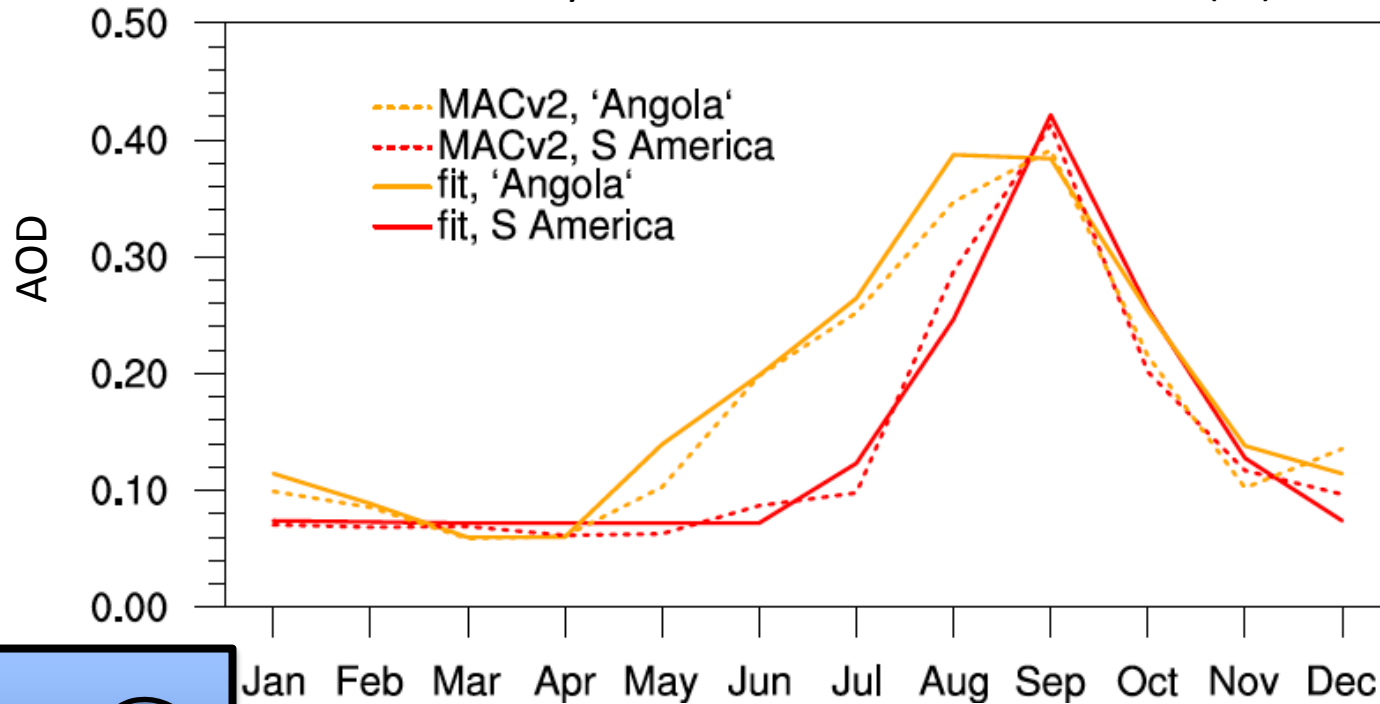


# Construction of plume

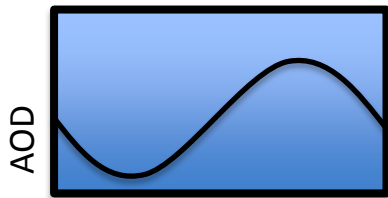


# Construction of seasonal cycle

Seasonal cycle from MACv2 and MACv2-SP (fit)



Courtesy: Karsten Peters



month



# Why MACv2-SP?

Parameterization of aerosol optical properties

**Constrained by**  
observations



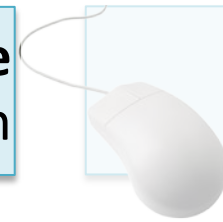
Computationally  
**efficient**



**Flexible**  
application

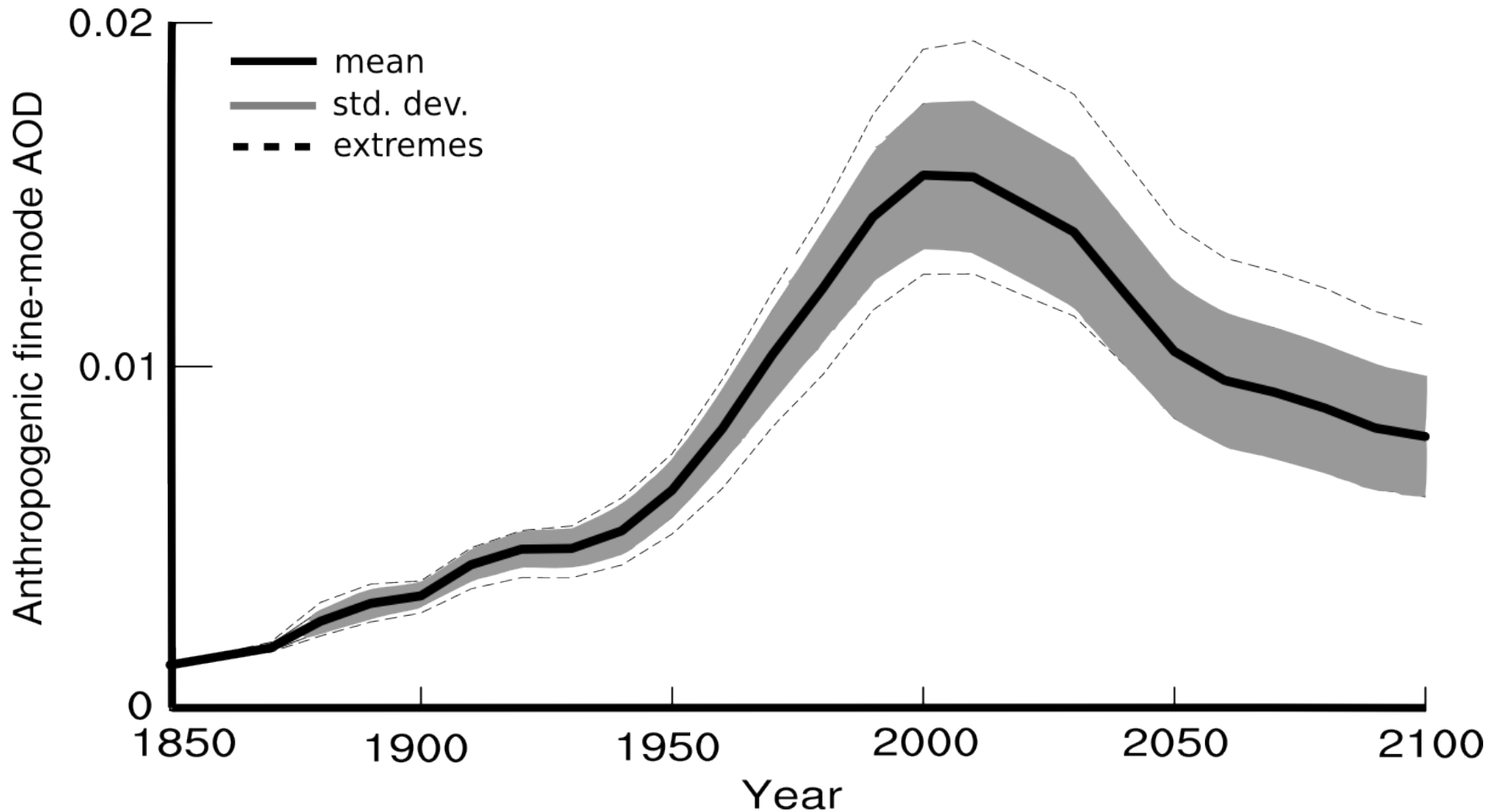


**Easy to**  
implement



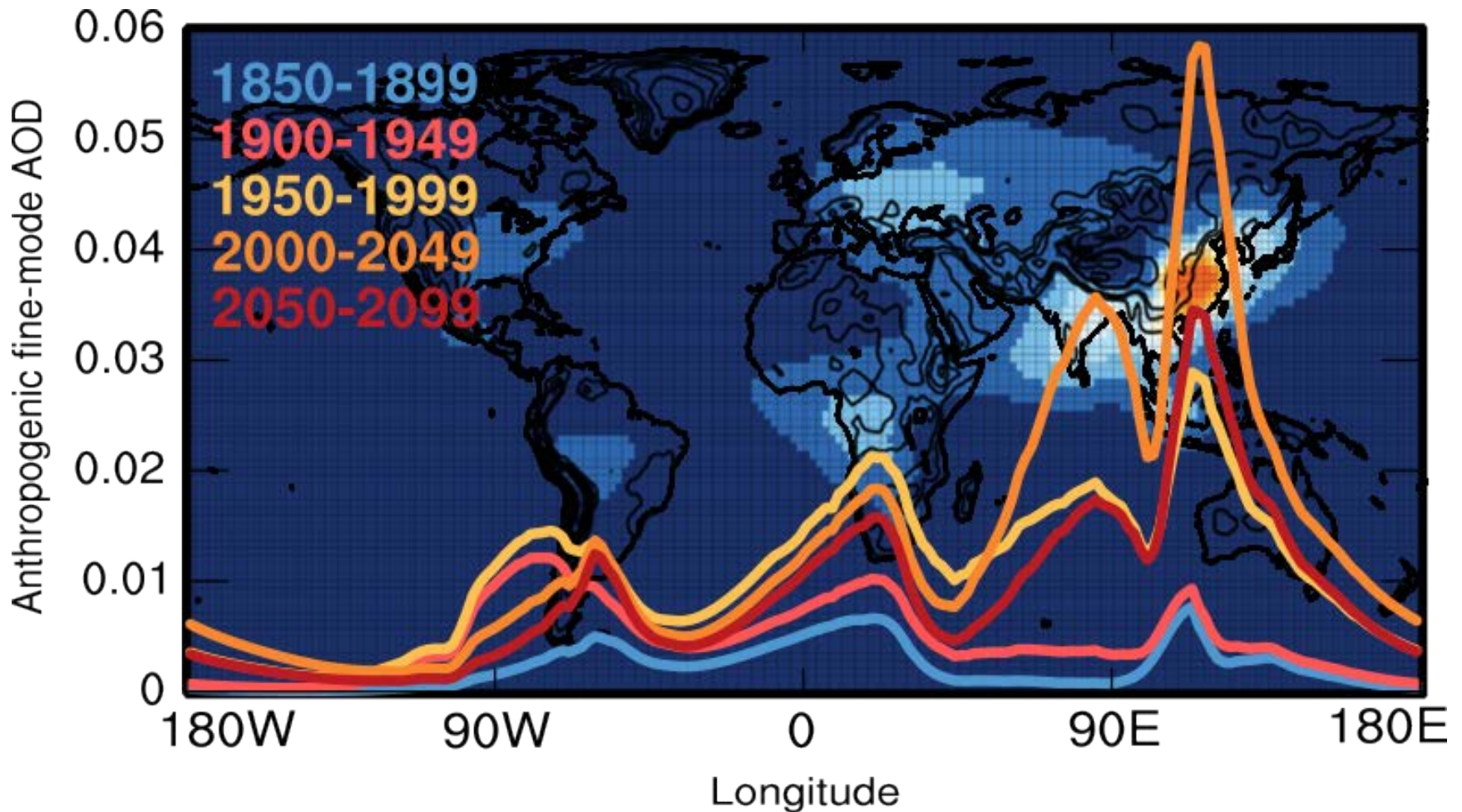
# Pre-industrial to 2100

Global 10year-running mean of anthropogenic AOD



# Pre-industrial to 2100

Development of anthropogenic AOD over years and longitude



# Why MACv2-SP?

Parameterization of aerosol optical properties

**Constrained by**  
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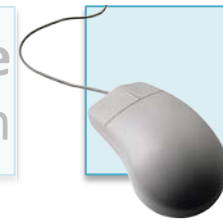
**Computationally**  
**efficient**



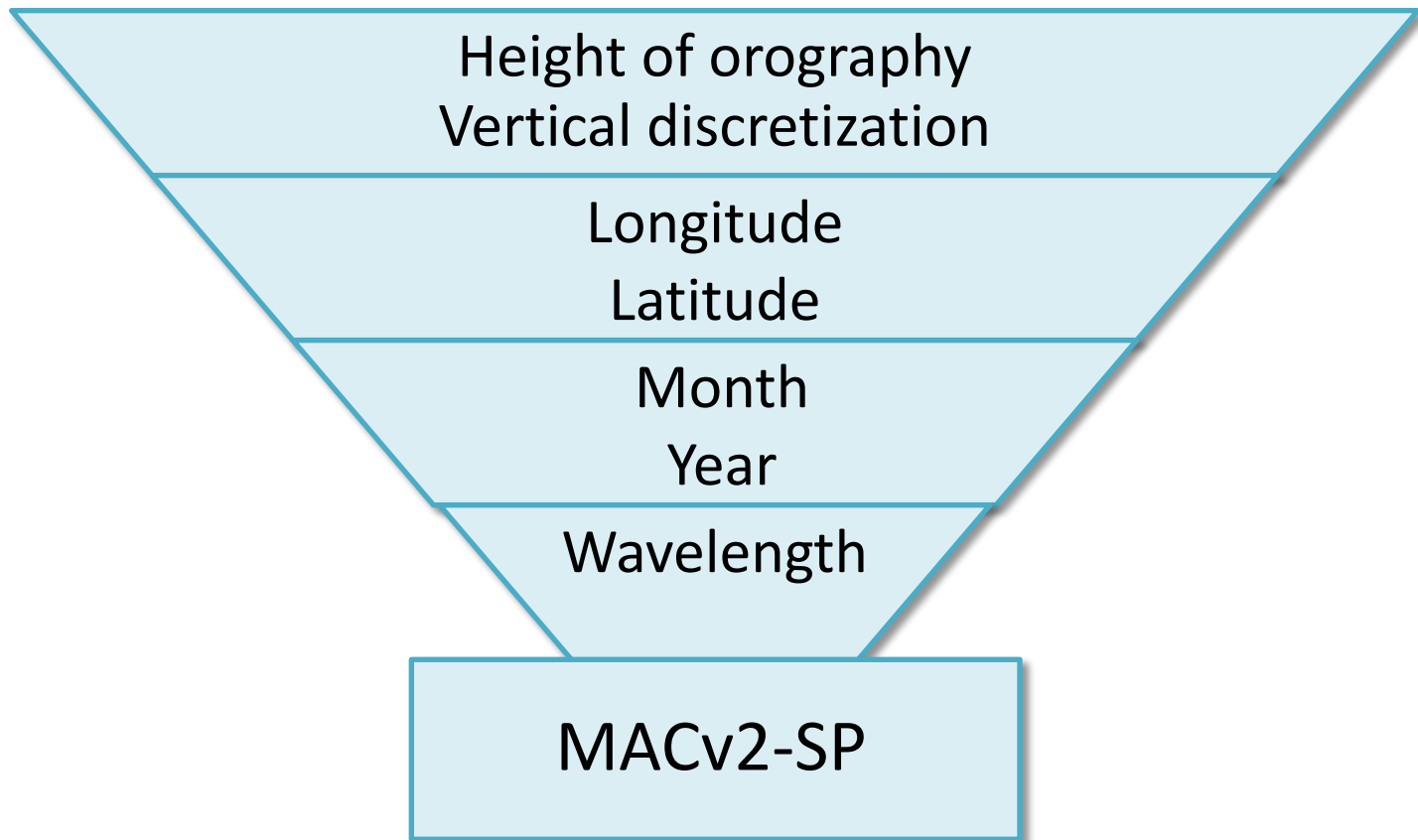
**Flexible**  
application



**Easy to**  
implement



# What input does MACv2-SP need?





# What does MACv2-SP provide?



Calculates for each month, location and wavelength:

**AOD(z)**

Aerosol  
optical depth

**SSA(z)**

Single  
scattering  
albedo

**ASY(z)**

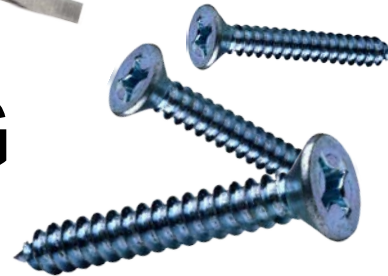
Asymmetry  
parameter





MACv2-SP

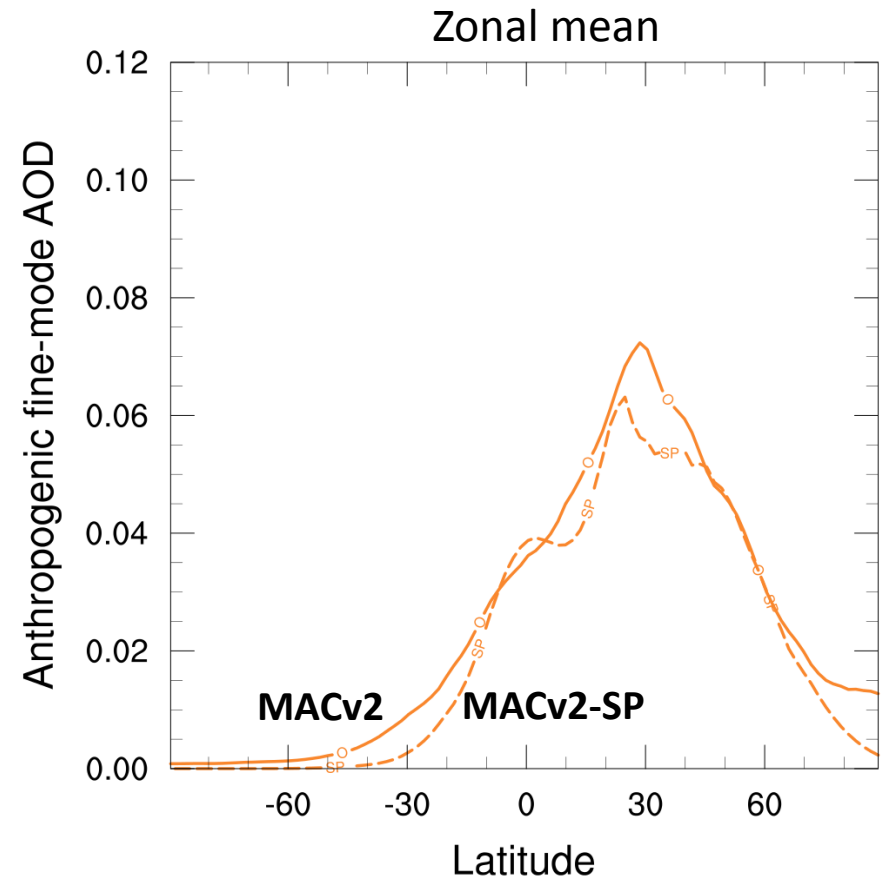
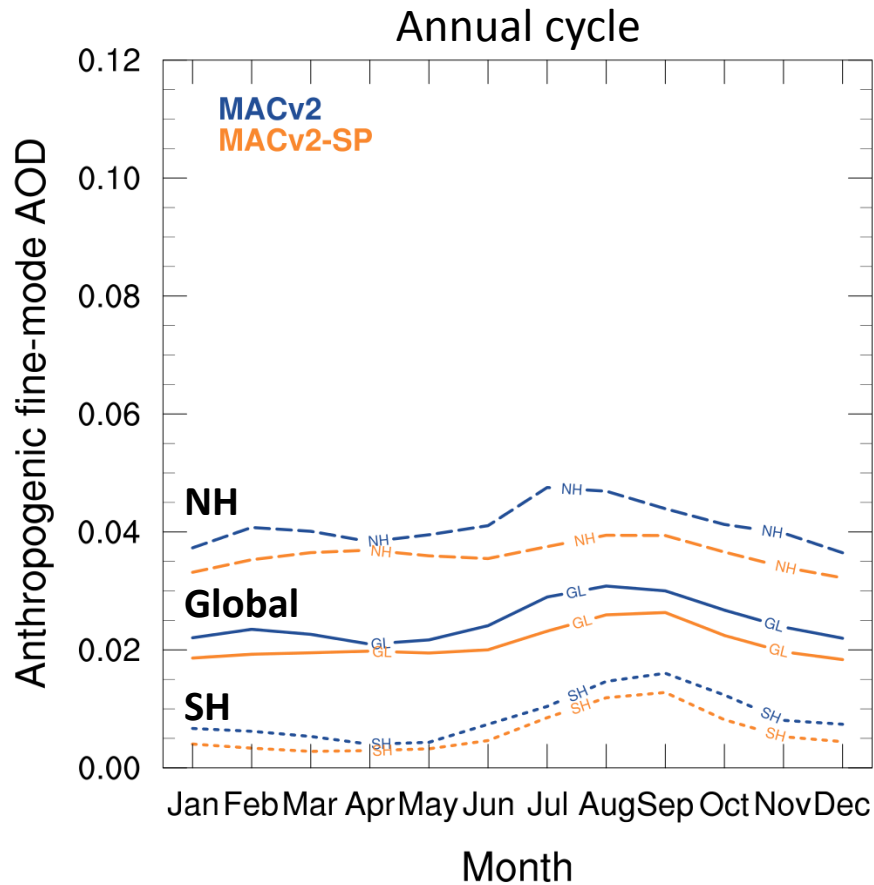
# TUNING



1. **Conserve** globally averaged anthropogenic AOD
2. **Balance** deviations in anthropogenic AOD over sources and oceans

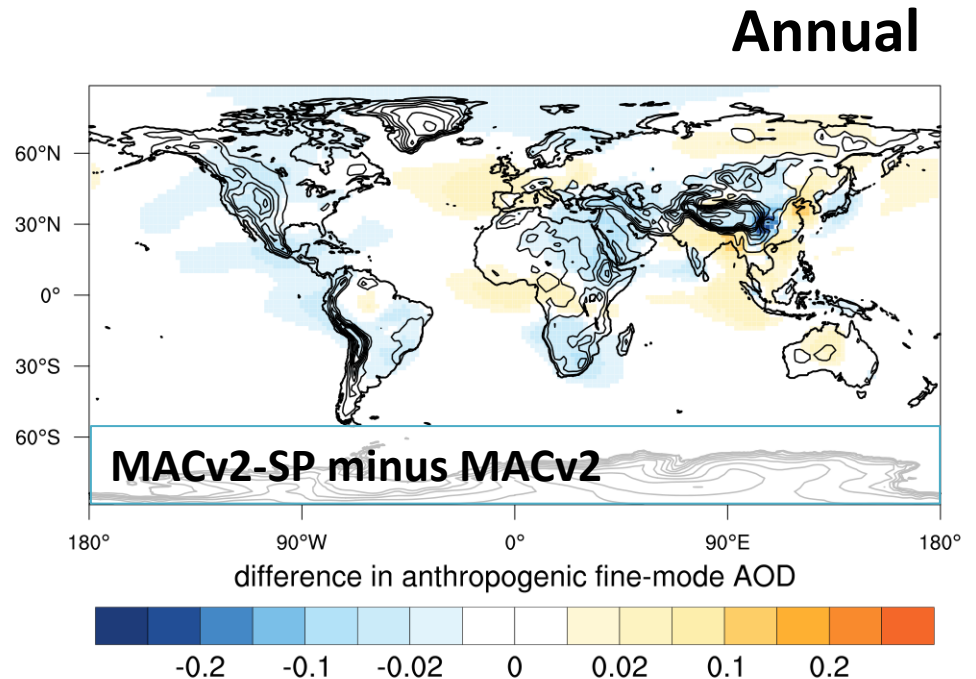
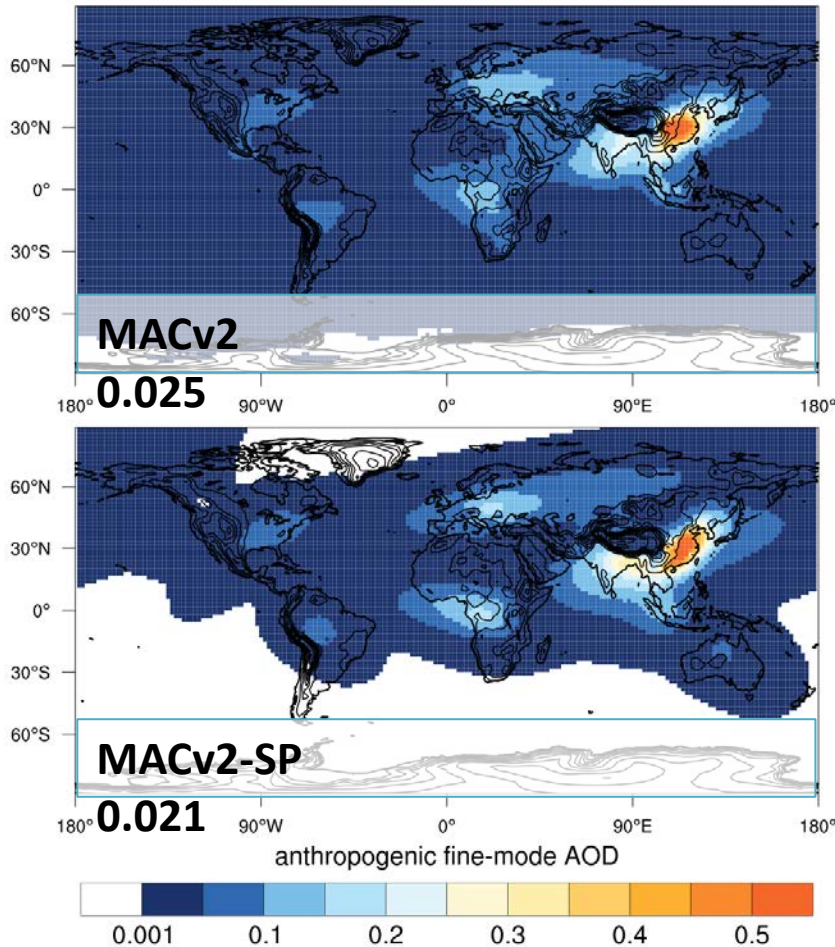
# 1. Global mean AOD

Development of anthropogenic AOD over years and longitude



# 2. Balance sources and oceans

Mean anthropogenic AOD at 550nm for 2005



# What is MACv2-SP's gain?



**Constrained by observations**

Optical properties from MACv2



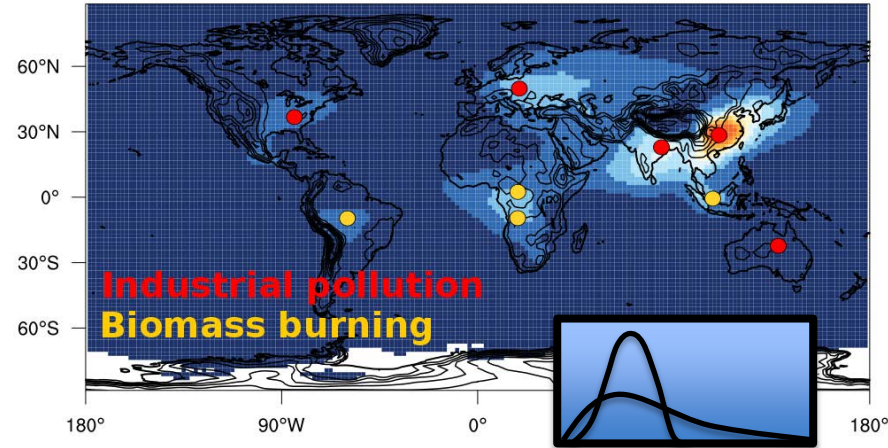
**Computationally efficient**

Mathematical construction of 9 plumes



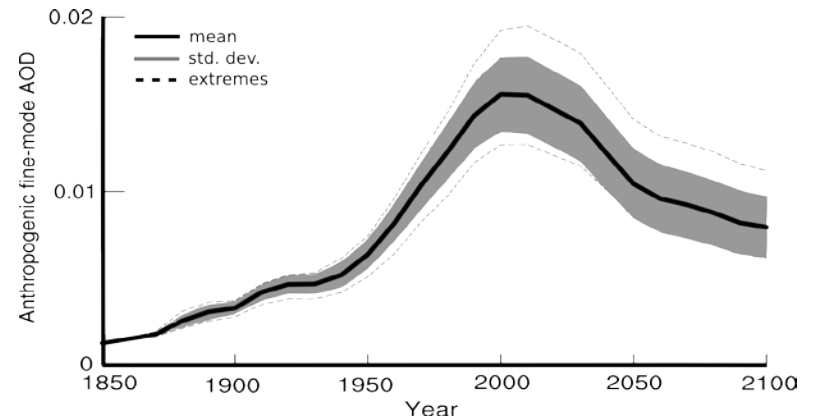
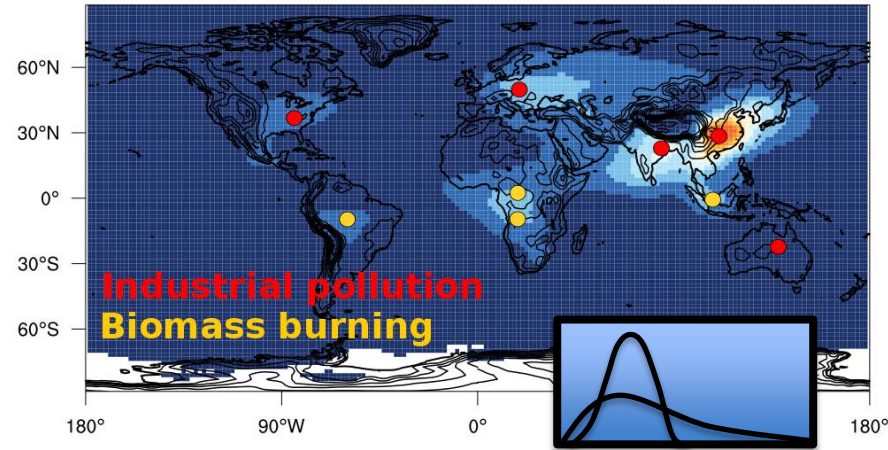
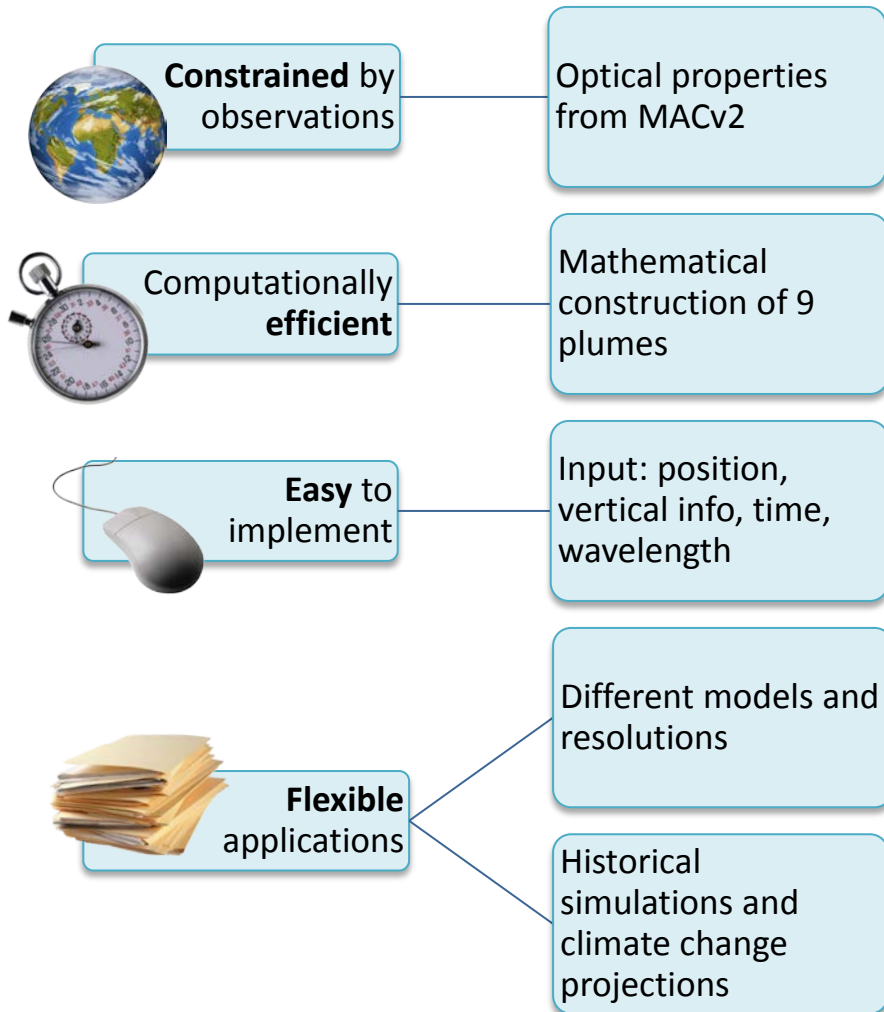
**Easy to implement**

Input: position, vertical info, time, wavelength





# What is MACv2-SP's gain?



# Outlook

- Use MACv2-SP in PSrad-O and MPI-ESM

Implementation into RTMs and ESMs (RFMIP)  
(Time variable and background climatology)

- Validation with other data

Anthropogenic AOD from historical  
simulations of aerosol-climate models

- Incorporate Twomey effect

Approximation from MACv2

Interested in using or contributing to MACv2-SP?

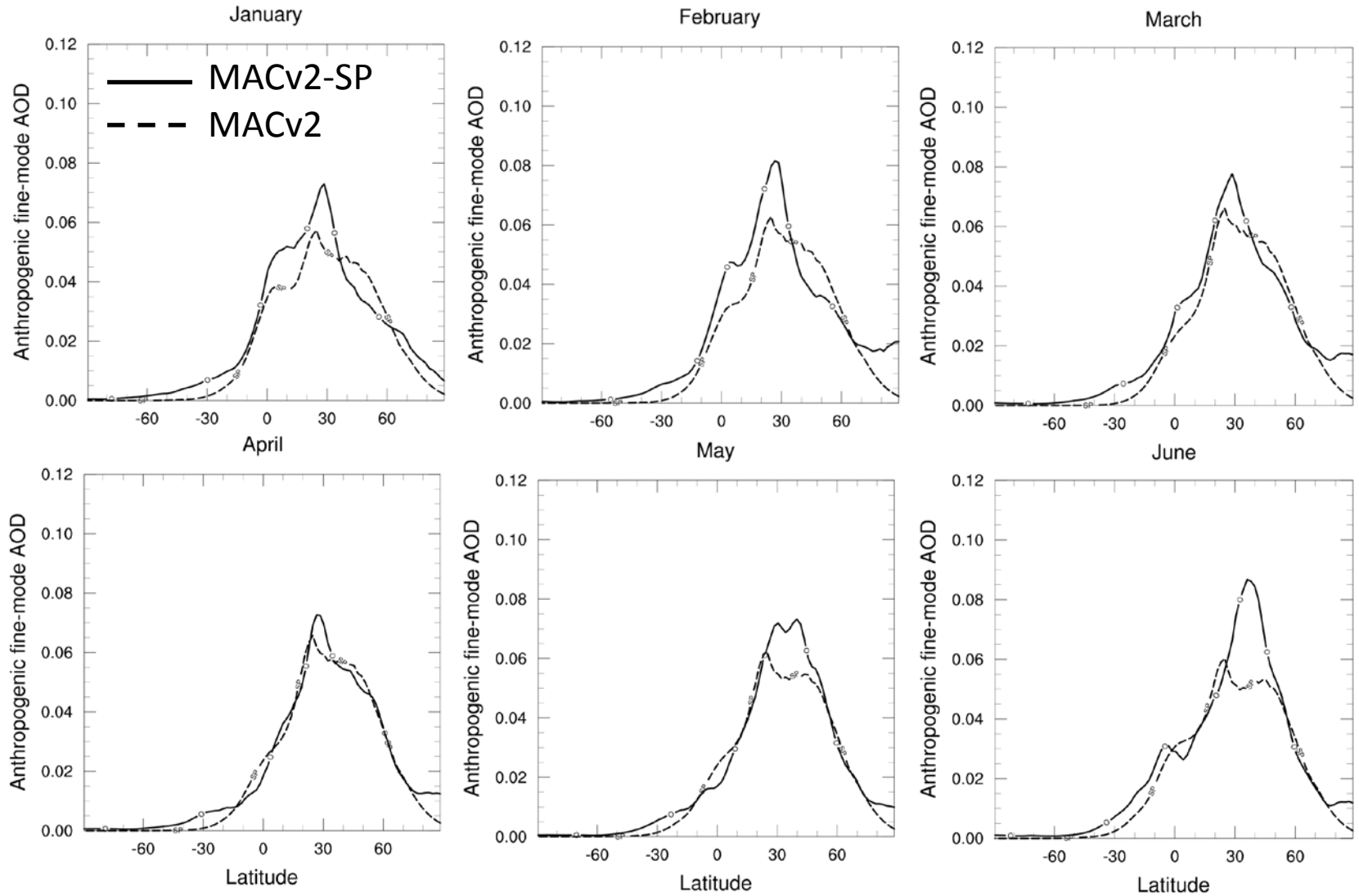
[stephanie.fiedler@mpimet.mpg.de](mailto:stephanie.fiedler@mpimet.mpg.de)



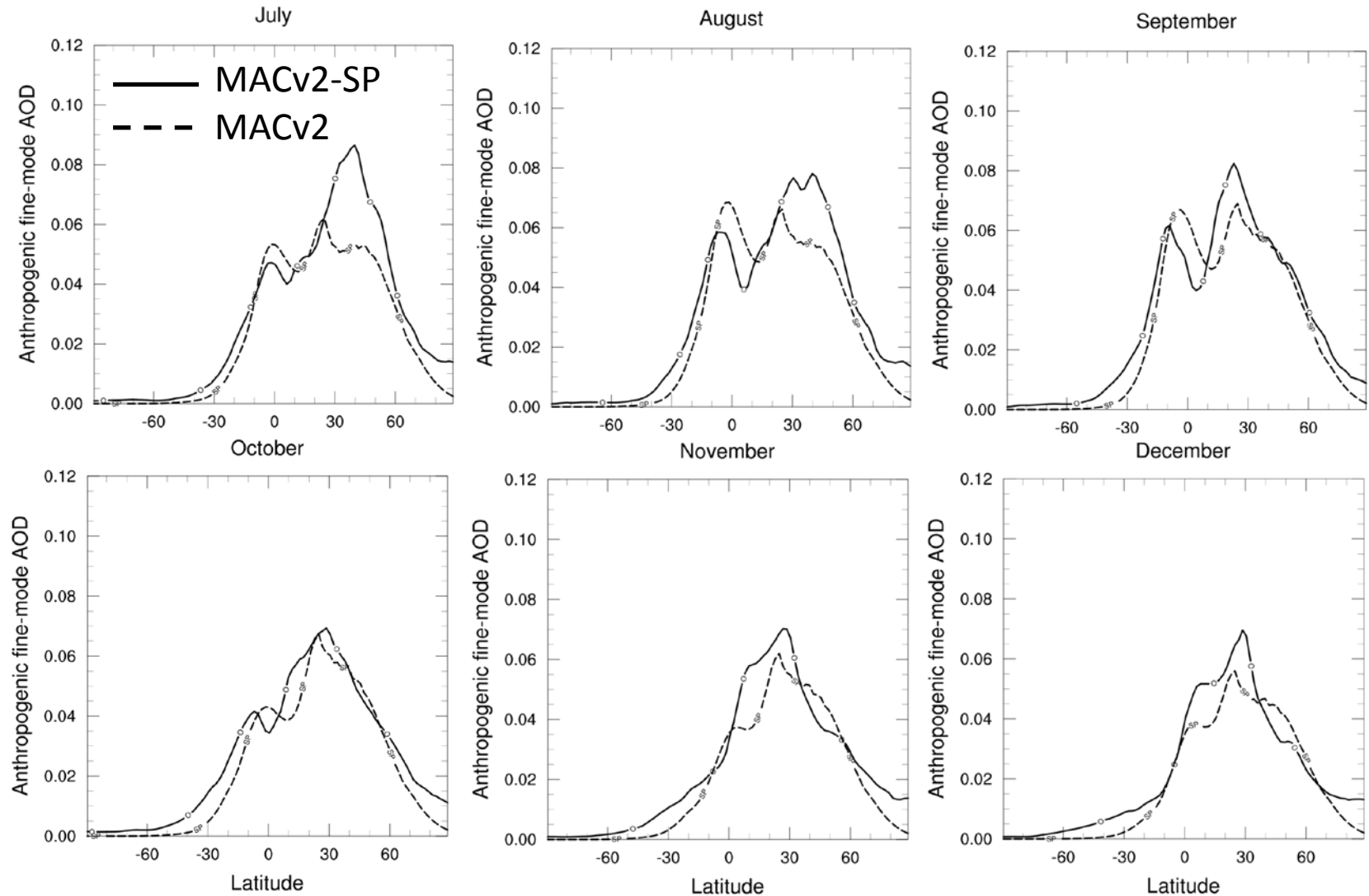
MACv2-SP

**MORE VALIDATION**

# 1. Global mean AOD



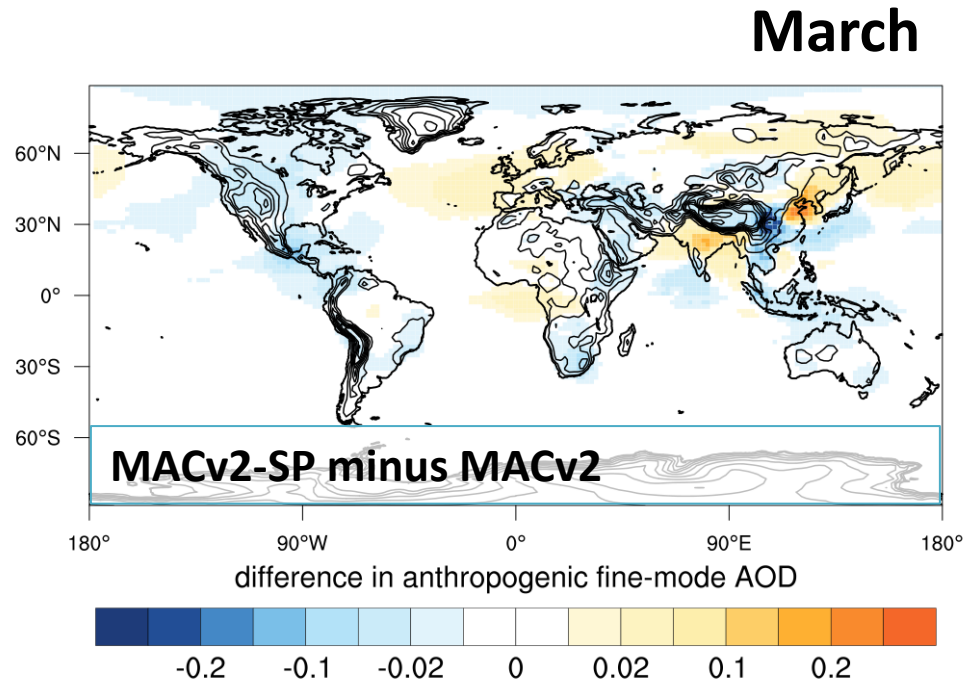
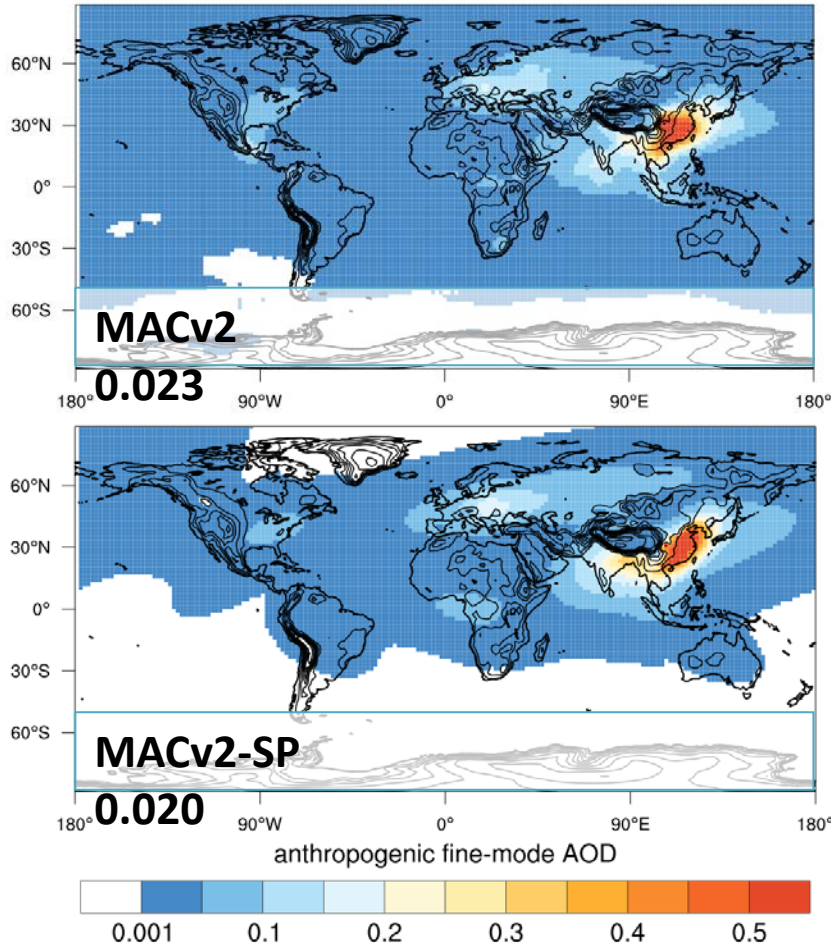
# 1. Global mean AOD





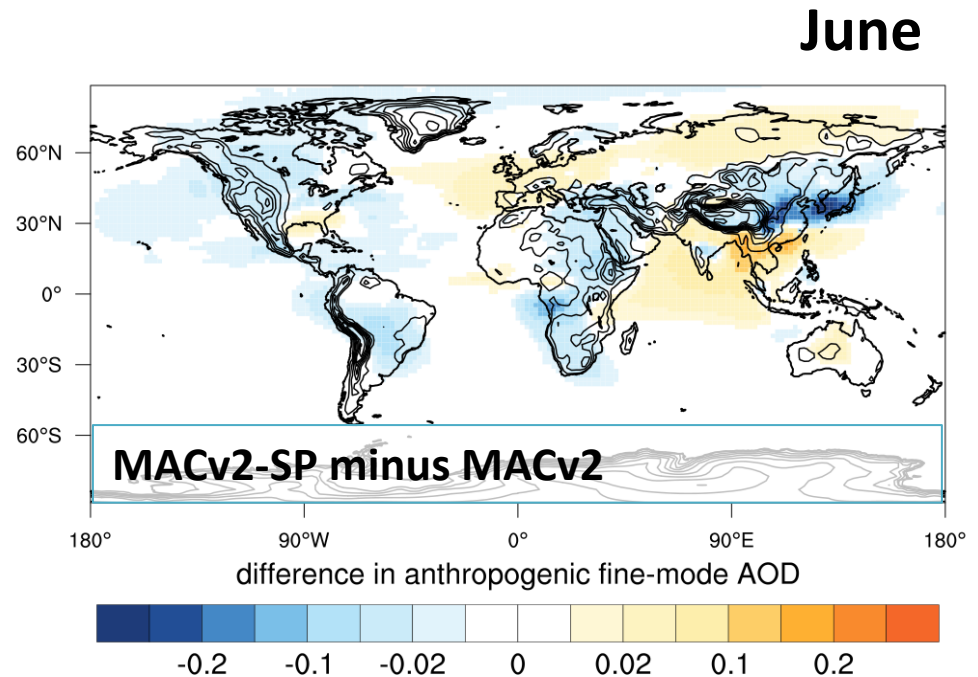
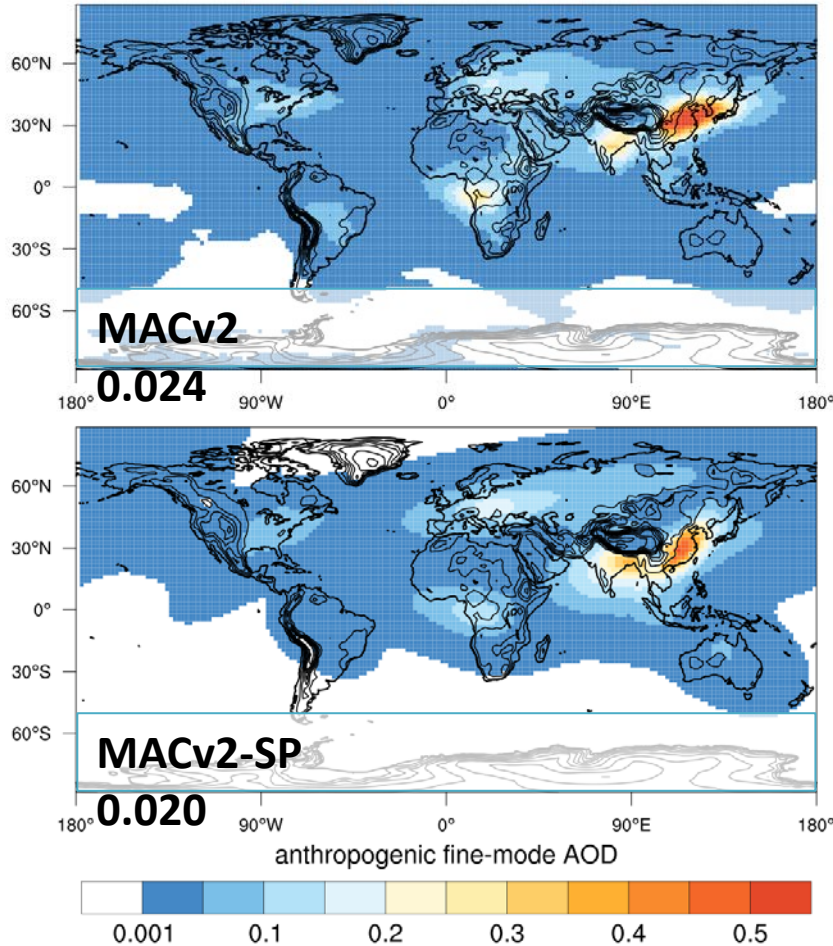
# 2. Balance sources and oceans

Mean anthropogenic AOD at 550nm for 2005



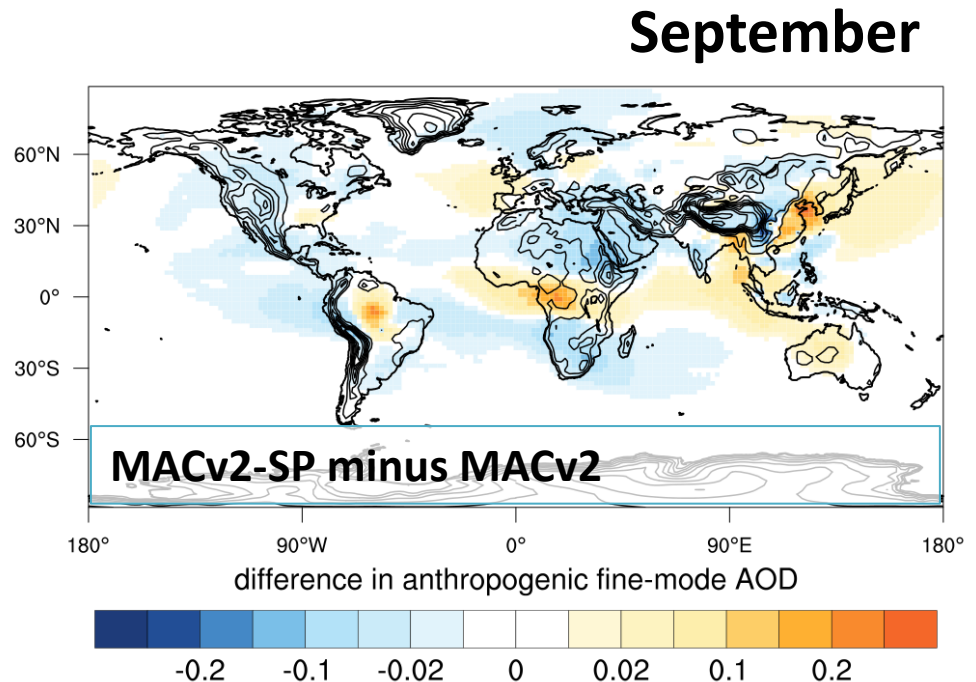
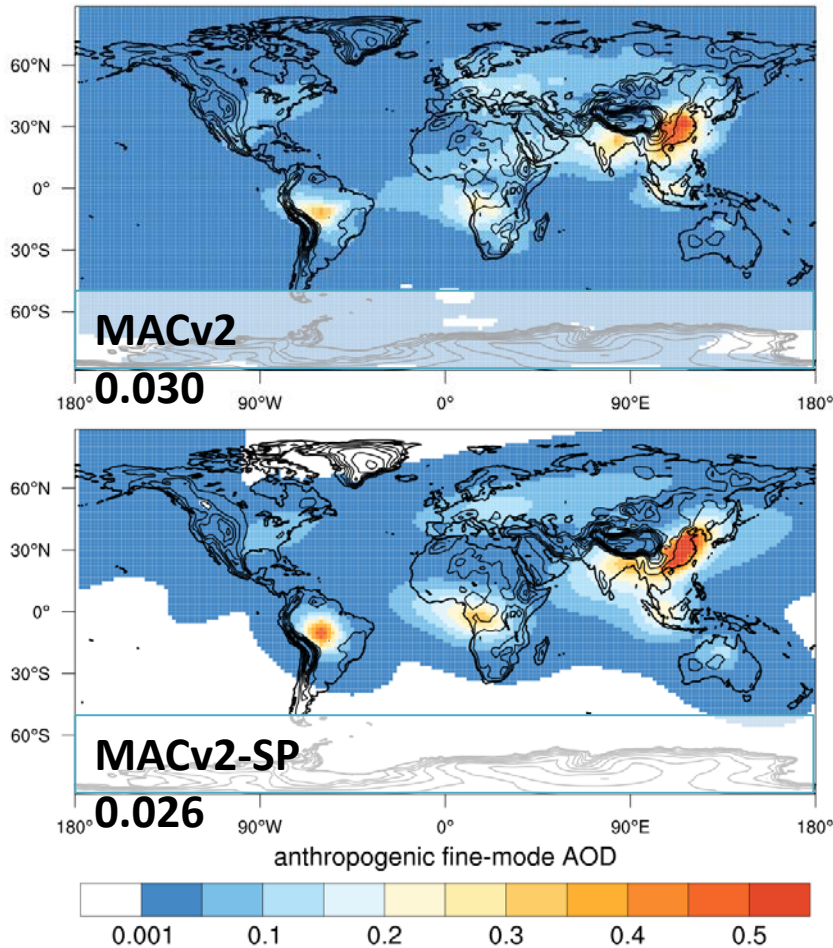
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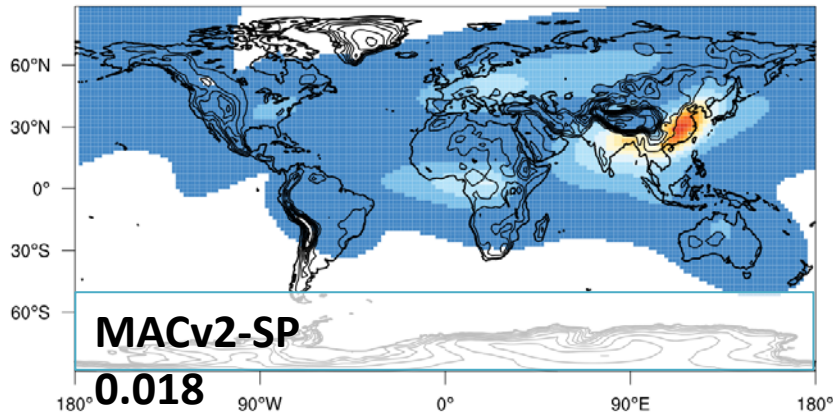
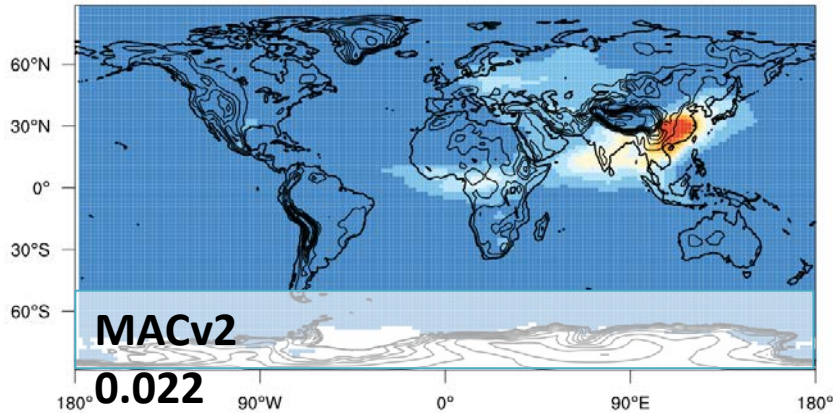
Mean anthropogenic AOD at 550nm for 2005



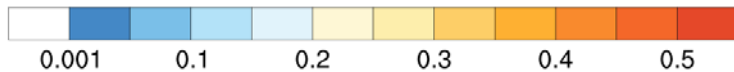


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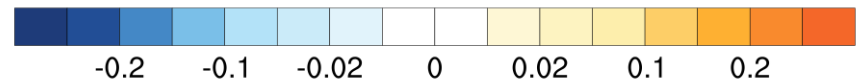
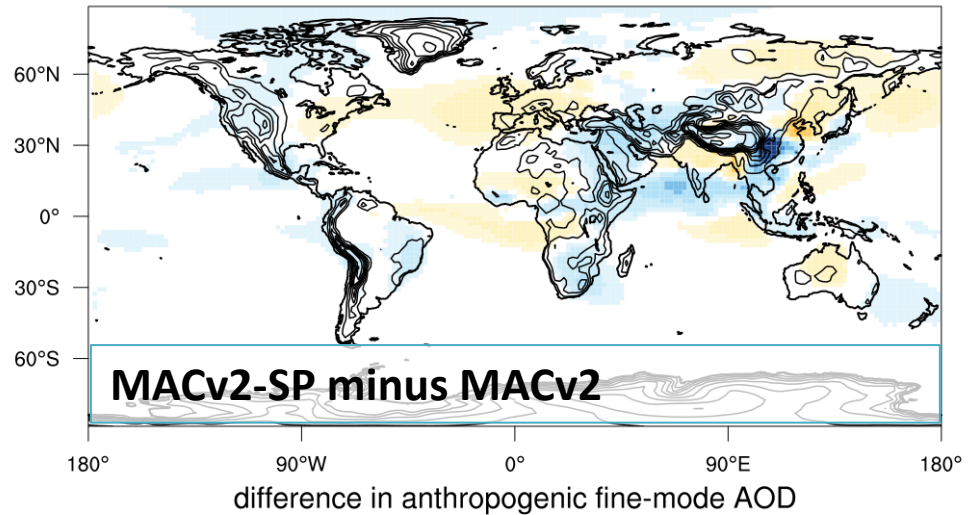
Mean anthropogenic AOD at 550nm for 2005



anthropogenic fine-mode AOD



**December**

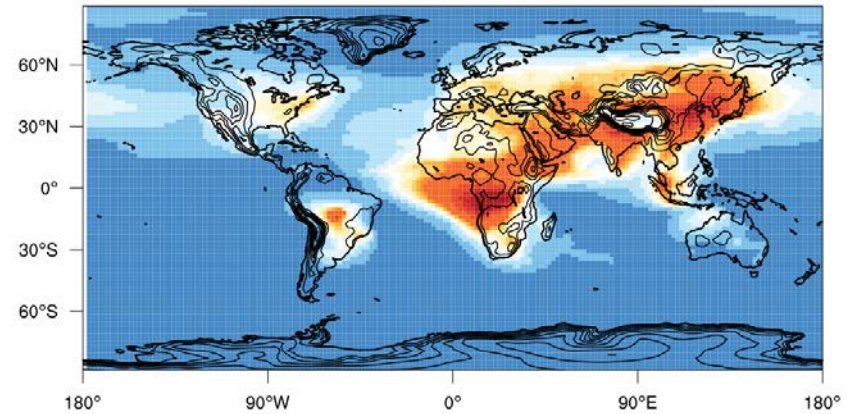
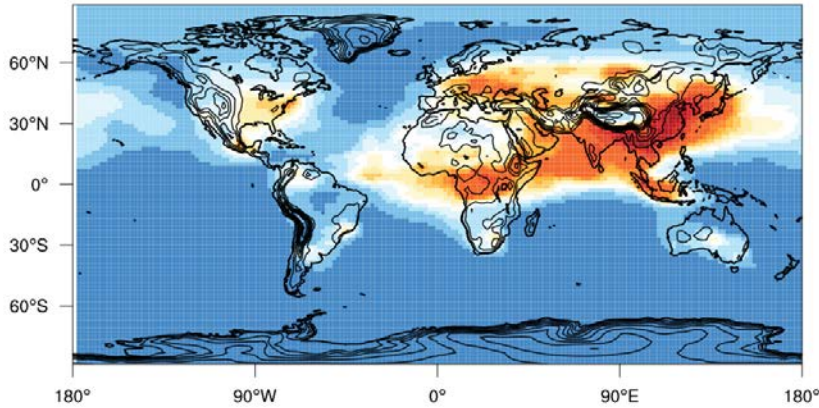


# Evaluation of AAOD

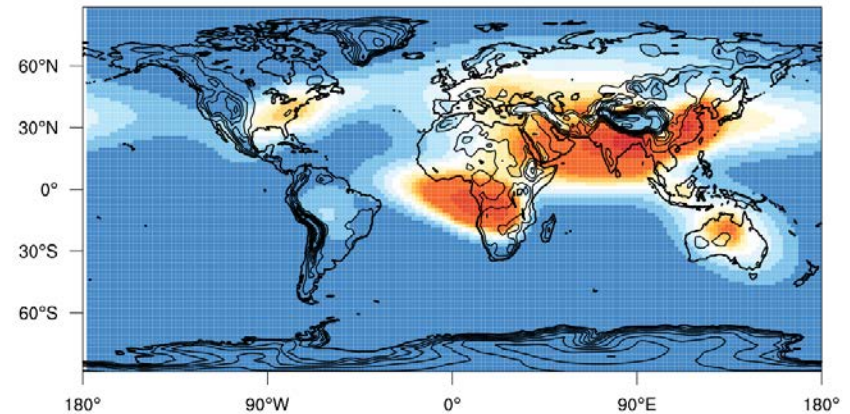
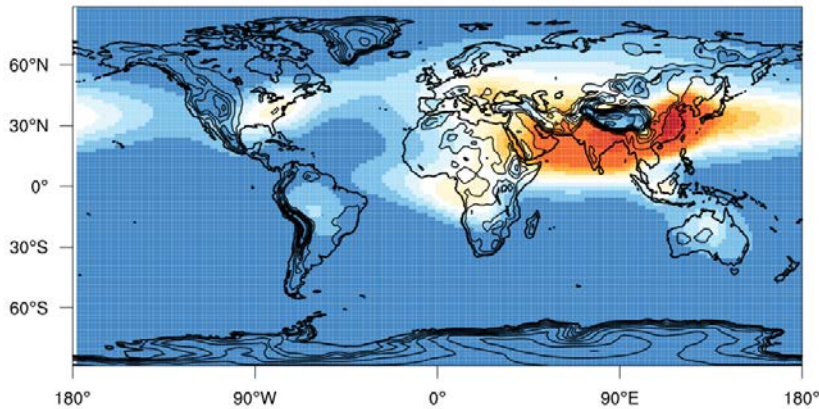
## March

## June

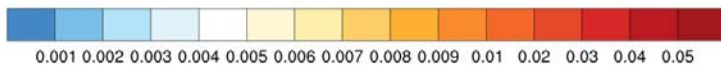
MACv2



MACv2-SP



anthropogenic fine-mode AAOD



$$\text{AAOD} = \text{AOD} \times (1 - \text{SSA})$$

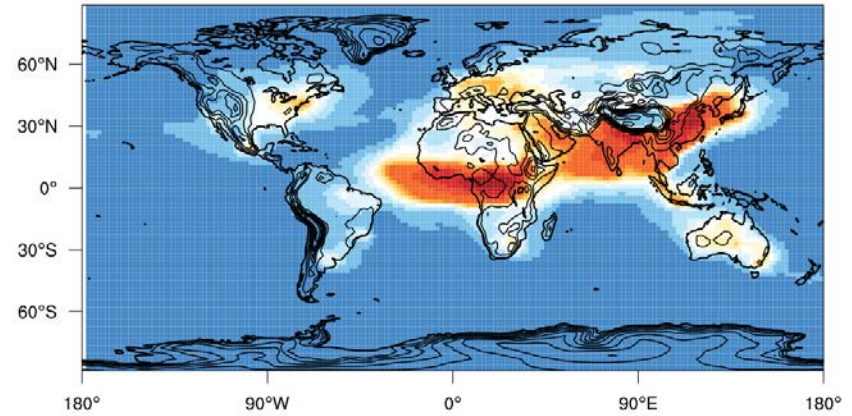
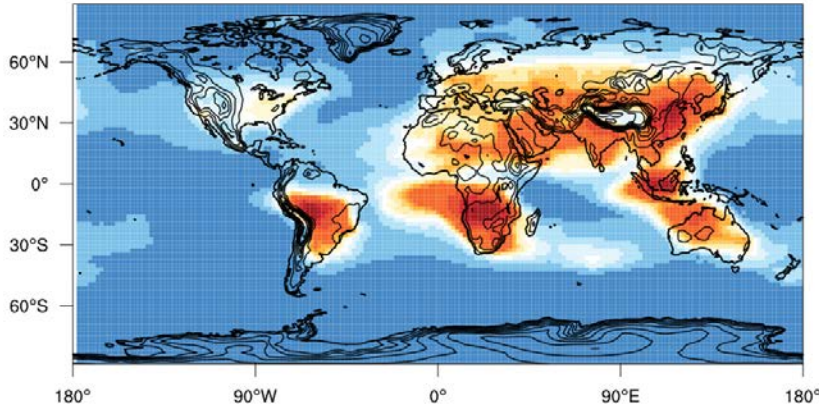


# Evaluation of AAOD

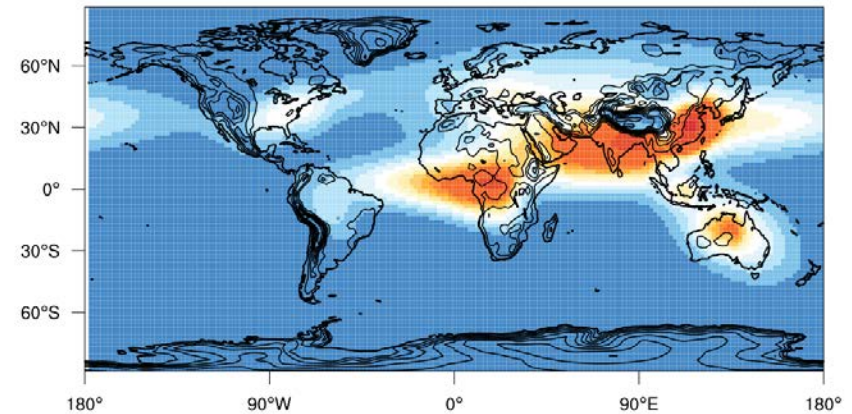
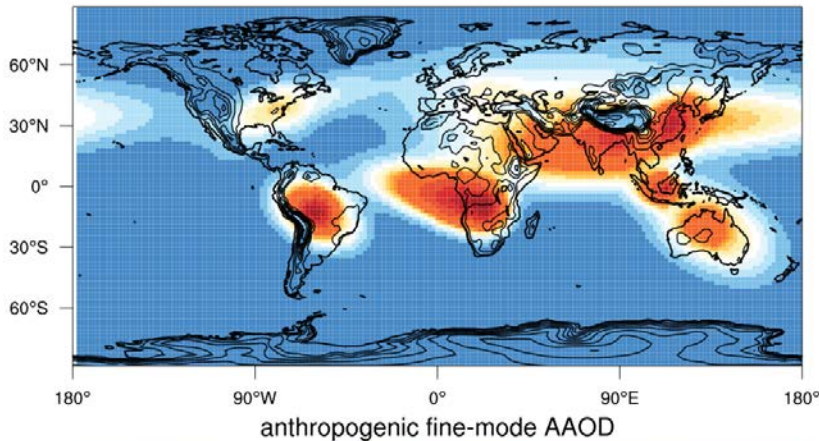
## September

## December

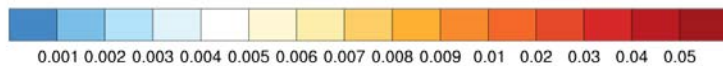
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anthropogenic fine-mode AAOD



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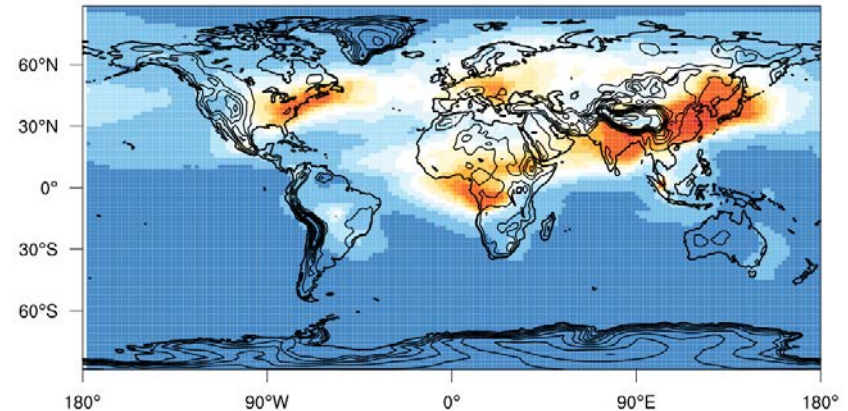
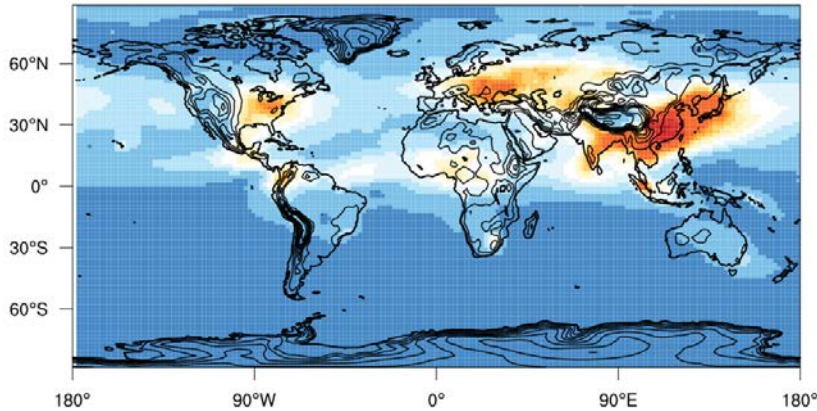


# Evaluation of Asymmetry

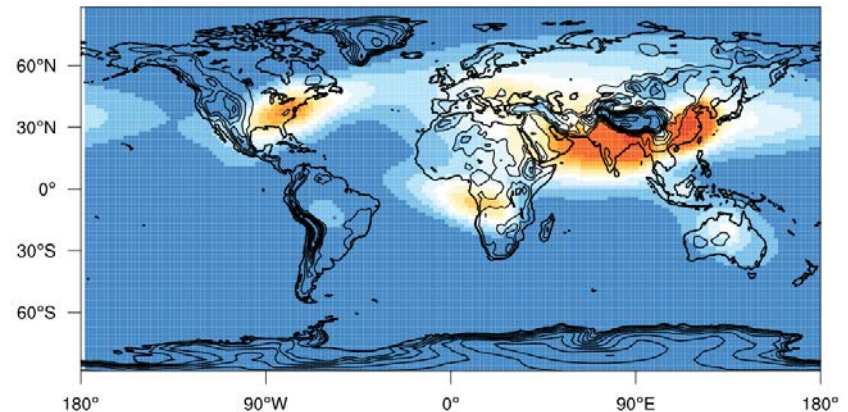
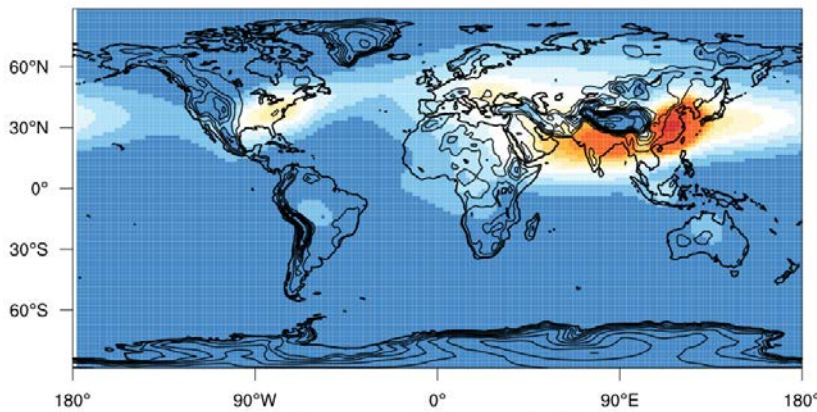
March

June

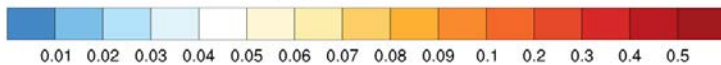
MACv2



MACv2-SP



anthropogenic fine-mode ASY



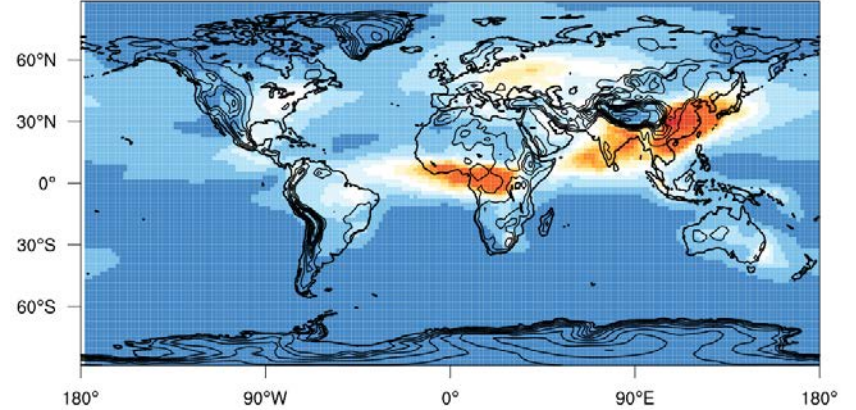
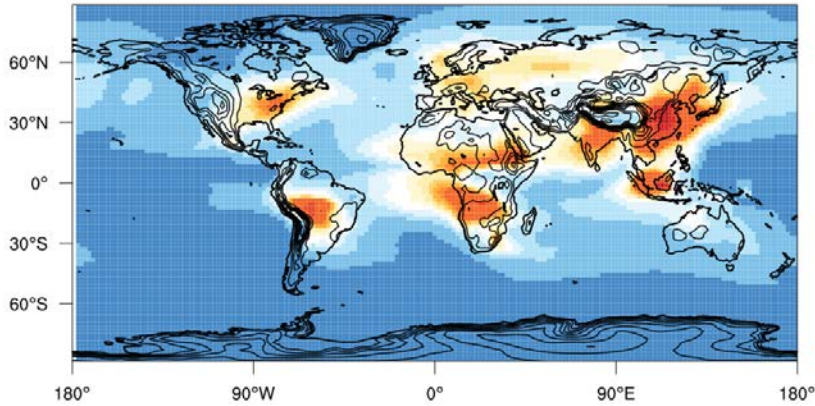
Shown is AOD x SSA x ASY

# Evaluation of Asymmetry

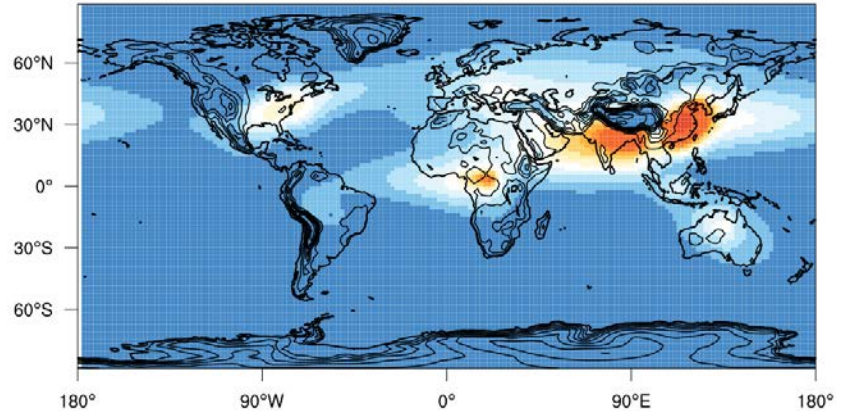
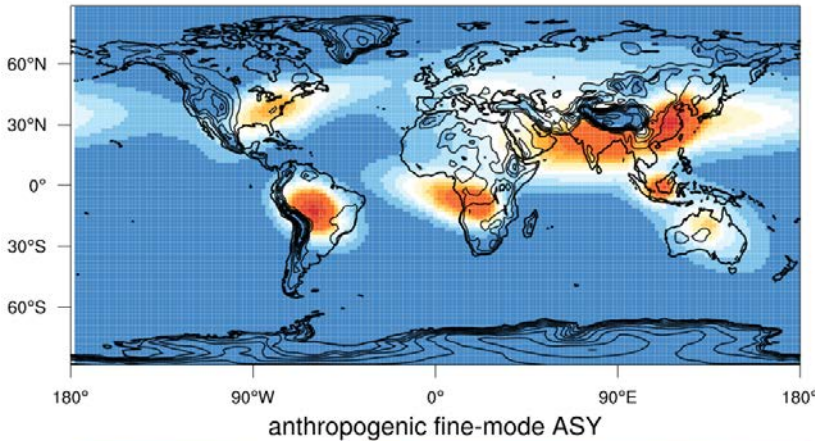
September

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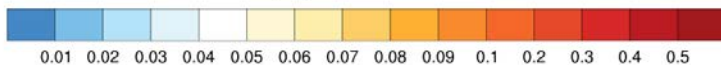
MACv2



MACv2-SP



anthropogenic fine-mode ASY



Shown is AOD x SSA x ASY