



Aerosol Radiative Forcing

The AeroCom Prescribed Experiment:
Towards the Quantification of Host Model Errors

AeroCom Meeting, Oxford

27/09/2010

Philip Stier

Department of Physics / Oriel College

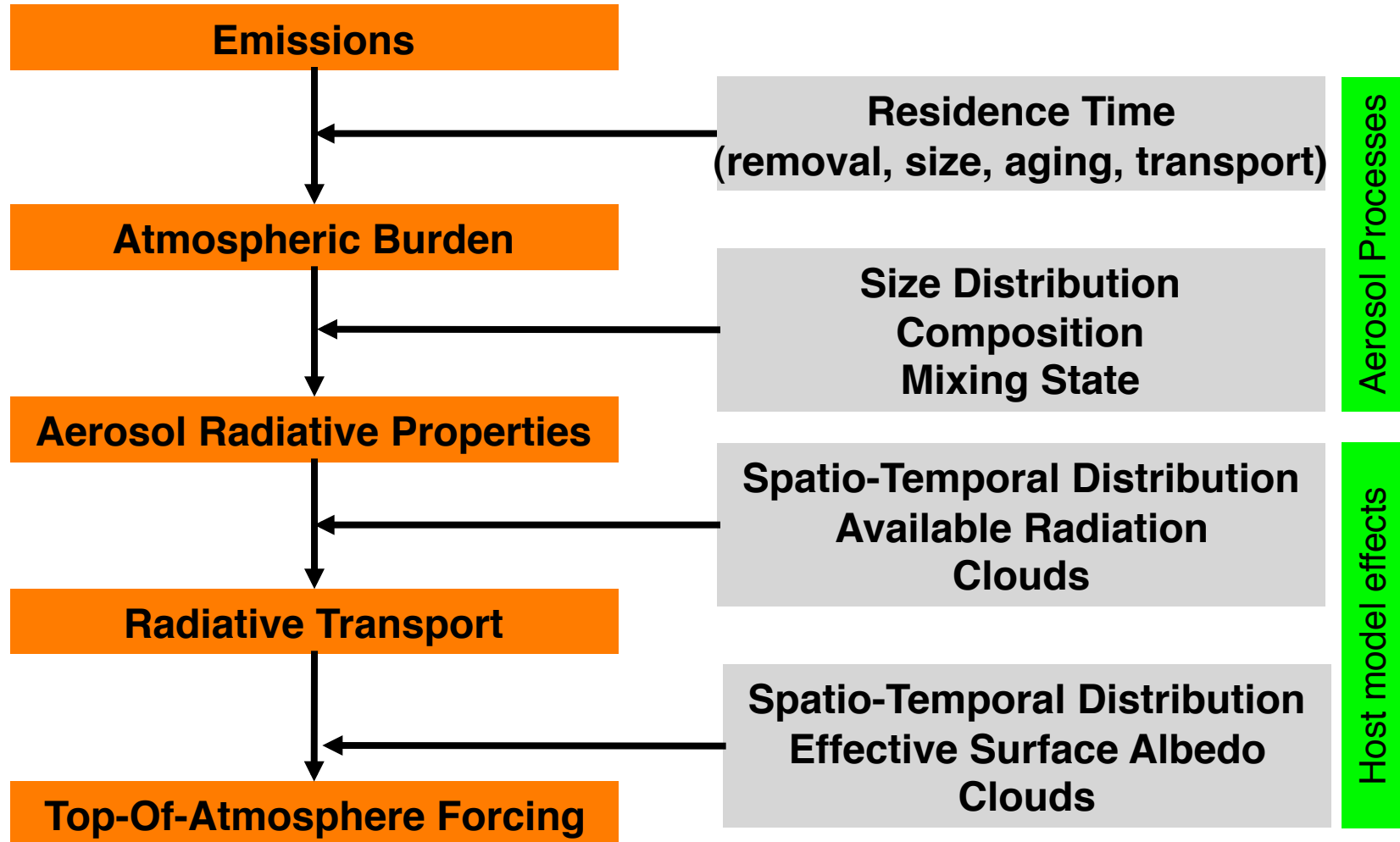
University of Oxford

Stefan Kinne, Michael Schulz, Gunnar Myhre, John Seinfeld



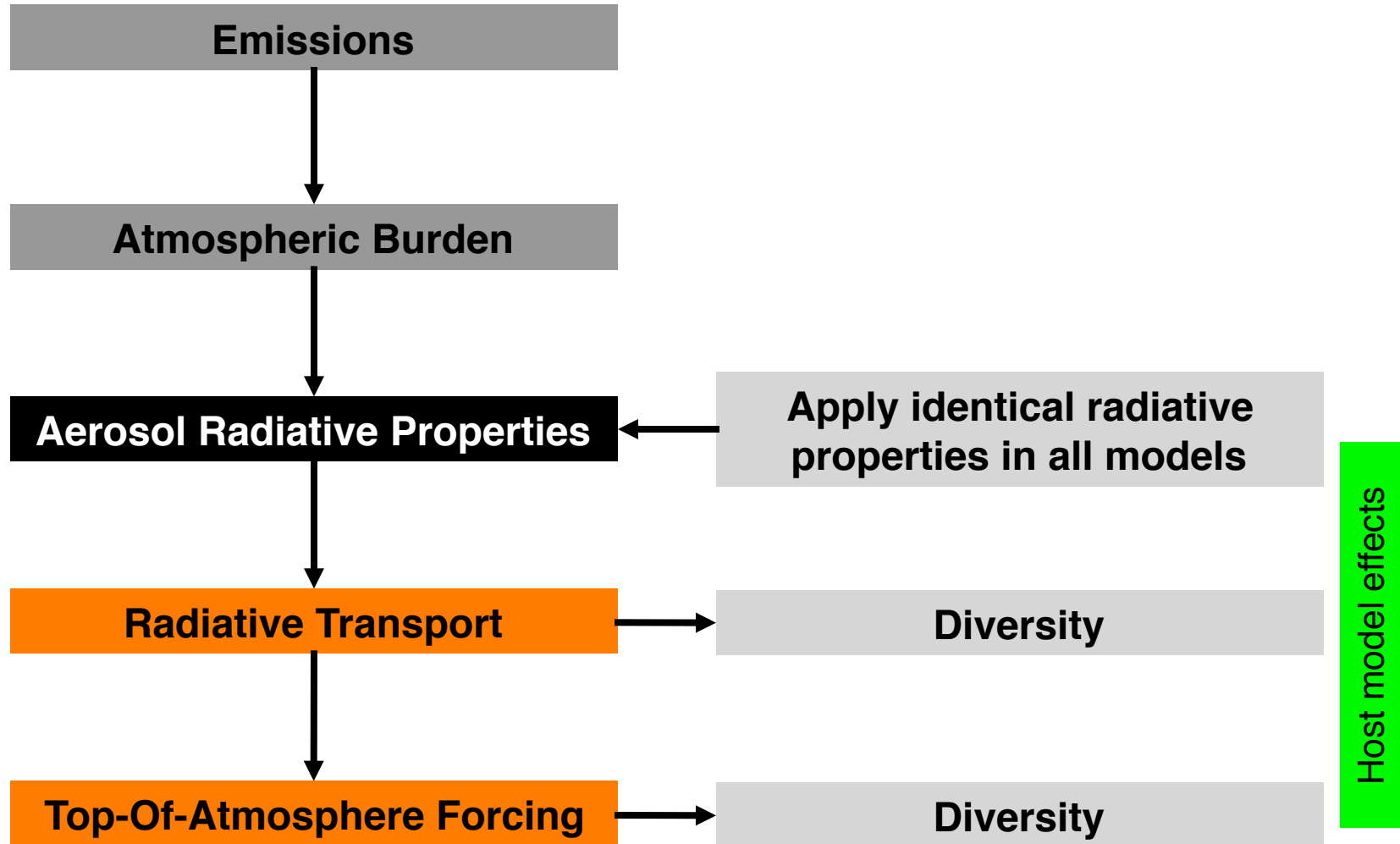
Assessment of aerosol direct radiative forcing

AeroCom: Intercomparison and assessment of the underlying process representations



The AeroCom Prescribed Experiment

Facilitate inter-comparability through fixing 3D aerosol radiative properties

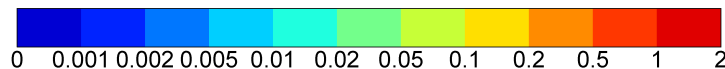
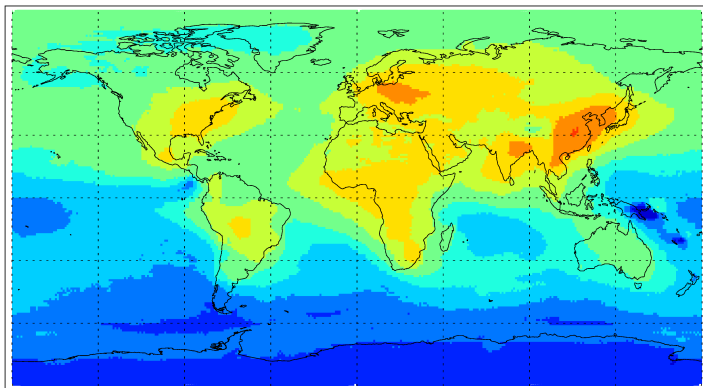


AeroCom Prescribed - Set-up

Prescribe aerosol radiative properties identically in all “**models**”:

- Extinction, Single Scattering Albedo, Asymmetry Factor:
 - 3D distributions
 - 24 SW wavelengths
 - “fool proof” offline mapping tools to model resolution and radiation bands

Anthropogenic AOD (545nm): 0.042



Total AOD (545nm): 0.132

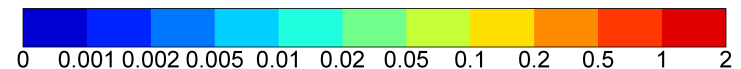
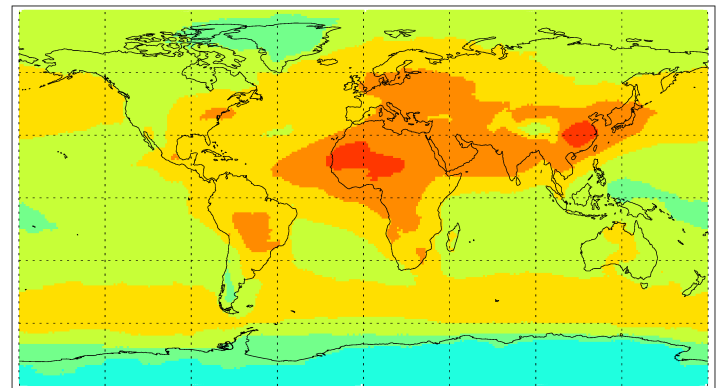


Figure: Annual-mean anthropogenic and total aerosol optical depth at 550 nm derived from AeroCom median model and AERONET.

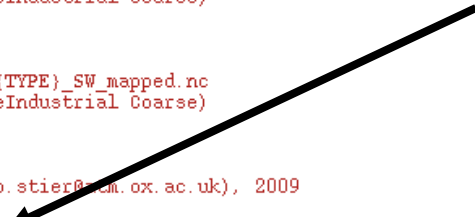
Input Data Set-up - Step 1 out of 3

```
emacs@cloud.atm.ox.ac.uk
File Edit Options Buffers Tools Insert Help
# /bin/bash -xv
#
#####
# AeroComPrescribed_Step_1_SpectralMapping.sh
#
# Purpose:
# =====
# Performs spectral mapping from 24 streamer short-wave bands to
# respective model bands.
#
# Usage:
# =====
# Adjust weighting from 24 streamer bands to spectral model resolution:
# in two steps:
#
# 0) Adjust the commented lines according to your model bands and note
# the respective streamer indices x (in band[x]) for each band
# (for your own sanity, this has no effect on script)
#
# 1) Group the streamer bands into your respective model bands through
# addition or deletion of the respective streamer indices x into
# the respective model bands sw_YY. For example: group streamer bands
# from 315nm to 420nm with indices band[2]-band[5] into model band 2
# through defining sw_02=( 2 3 4 5 ) as given in the example below.
# Add or delete model_bands as necessary by adding or deleting the
# sw_yy arrays.
#
# 2) If you added or deleted model bands adjust the definition of the
# mapping table mbands. For example if your model has only 4 bands
# then define sw_01 - sw_04 accordingly and modify mbands to
# mbands=( sw_01 sw_02 sw_03 sw_04 ).
#
# Note: the band mapping is entirely defined through the mapping
# table mbands with the contained streamer band indices sw_yy.
#
# Example set-up for 6 SW bands of ECHAM5 provided.
#
# Input:
# =====
# - AeroComPrescribed_RadiativeProperties_${TYPE}_SW.nc
#   for each TYPE ( Fine_PresentDay Fine_PreIndustrial Coarse)
#
# Output:
# =====
# - AeroComPrescribed_RadiativeProperties_${TYPE}_SW_mapped.nc
#   for each TYPE ( Fine_PresentDay Fine_PreIndustrial Coarse)
#
# Authors:
# =====
# Philip Stier, University of Oxford (philip.stier@atm.ox.ac.uk), 2009
#
# Required tools:
-- AeroComPrescribed_Step_1_SpectralMapping.sh Top L1 (Shell-script[bas
```

Input data on 2D 1x1 degree with 24 spectral bands

Step 1:
Mapping to model specific spectral bands.

Required:
NetCDF operators
(nco tools)



Input Data Set-up – Step 2 out of 3

```
emacs@cloud.atm.ox.ac.uk
File Edit Options Buffers Tools Insert Help
|/bin/tcsh -xv
#
#####
# AeroComPrescribed_Step_2_Regridding.sh
#
# Purpose:
# =====
# Regridding of created spectrally weighed aerosol radiative properties to
# horizontal resolution and regridding of 3D Aerosol Optical Depths for
# vertical distribution from 1x1 degree with 31 levels to the respective
# 3D model resolution.
#
# Usage:
# =====
# Example set-up for 6 SW bands of ECHAM5. Simply adjust the number of
# model bands as processed in Step 1. Please include the 545nm band as
# below for quality control.
#
# Warning:
# =====
# This step should work well for models with hybrid p-sigma coordinates in CF
# compliant standard format. For other models it might need to be replaced by
# a model specific regridding scheme.
#
# Input:
# =====
# - AeroComPrescribed_RadiativeProperties ${TYPE}_SW_mapped.nc
#   for each TYPE ( Fine_PresentDay Fine_PreIndustrial Coarse)
#   (from Step 1)
# - Provided 3D Aerosol Optical Depths (AeroComPrescribed_AODs_3D.nc)
# - Model specific output grid definitions as input for CDO regridding
#   tools. These can be automatically created by CDO using the following
#   commands (echam5 example):
#   cdo vct ECHAM5-FILE.nc > echam5_levels_L19.txt (creates vertical coordinate table)
#   cdo griddes ECHAM5-FILE.nc > echam5_grid_T21.txt (creates grid description)
#
# Output:
# =====
# - Horizontally regridded spectrally mapped aerosol radiative properties
#   AeroComPrescribed_RadiativeProperties ${TYPE}_mapped_${HRES}.nc
#   for each TYPE ( Fine_PresentDay Fine_PreIndustrial Coarse) and the
#   horizontal resolution HRES
# - 3D Aerosol Optical Depths regridded to the model resolution
#   AeroComPrescribed_AODs_3D_${HRES}${VRES}.nc with horizontal and
#   vertical resolutions HRES and VRES, respectively.
#
# Authors:
# =====
# Philip Stier, University of Oxford (philip.stier@atm.ox.ac.uk), 2009
#
# Required tools:
# =====
-- AeroComPrescribed_Step_2_Regridding.sh Top L1 (Shell-script[tcsh])-----
No indentation for this shell type.
```

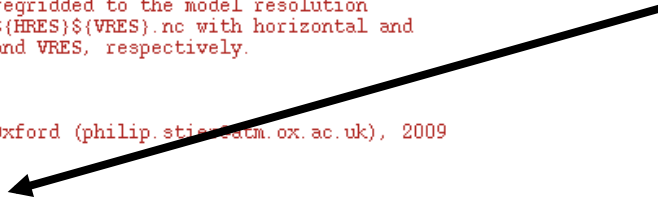
Input data on 2D 1x1 degree with 24 spectral bands

Step 2:
Regridding to respective spatial model resolution.

Required:

NetCDF operators
(nco tools)

Climate Data Operators
(CDO)



Input Data Set-up – Step 3 out of 3

```
emacs@cloud.atm.ox.ac.uk
File Edit Options Buffers Tools Insert Help
#####
#!/bin/tcsh -xv
#
#####
# AeroComPrescribed_Step_3_2D_To_3D.sh
#
# Purpose:
# =====
# Creates 3D fields of aerosol radiative properties from spectrally
# mapped 2D input data (Step 1) and an input file of 3D fractional AODs
# for fine and coarse mode AODs regridded to the respective model resolution
# (Step 2).
#
# Usage:
# =====
# Example set-up for ECHAM5. Simply adjust the model resolution according
# to Step 2. Coordinate system and grid information in last step will need
# to be adjusted (optional)
#
# Input (from Step 2):
# =====
# - AeroComPrescribed_RadiativeProperties_${TYPE}_SW_mapped_${HRES}.nc
#   for each TYPE ( Fine_PresentDay Fine_PreIndustrial Coarse) and the
#   horizontal resolution HRES
# - 3D Aerosol Optical Depths regridded to the model resolution
#   AeroComPrescribed_AODs_3D_${HRES}${VRES}.nc with horizontal and
#   vertical resolutions HRES and VRES
#
# Output:
# =====
# - AeroComPrescribed_RadiativeProperties_${PERIOD}_3D_${HRES}${VRES}_mapped_${BAND}.nc
#   for each PERIOD (PreIndustrial and PresentDay), BAND (sw_01,...sw_01), HRES and VRES
#
# Authors:
# =====
# Philip Stier, University of Oxford (philip.stier@atm.ox.ac.uk), 2009
#
# Required tools:
# =====
# NetCDF Operators (nco-tools) available from http://nco.sourceforge.net
# Climate Data Operators (CDO) available from http://www.mpimet.mpg.de/cdo
#
### Change your resolution here: #####
#
set HRES=T63
set VRES=L31
#
### You should not need to edit below here #####
#
foreach PERIOD ( PresentDay PreIndustrial )
#
set IFILE_FINE=AeroComPrescribed_RadiativeProperties_Fine_${PERIOD}_SW_mapped_${HRES}.nc
set IFILE_COARSE=AeroComPrescribed_RadiativeProperties_Coarse_SW_mapped_${HRES}.nc
#
AeroComPrescribed_Step_3_2D_To_3D.sh Top L1 (Shell-script[tcsh])-----
No indentation for this shell type.
```

Input data on 2D 1x1 degree with 24 spectral bands

Step 3:
Creation of 3D files from 2D fields using 3D fractional optical depth input file.

Required:
NetCDF operators (nco tools)
Climate Data Operators (CDO)

