

# TM5-MP meets HERMES

- current state -

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# Motivation

- Goal: Combine TM5MP with the Emission Election Tool HERMESv3
- This enables a (more) easy
  - selection of emission inventories
  - modification of single datasets based on maps and sectors (e.g. double the emissions from energy sector in Germany)
  - change of conversion factors speciation
  - edit of vertical profile per sector

# Outline

- (current) workflow
- current state
- problems and questions

# Workflow

## 1. Preprocess original inventories to be used with HERMES

changed once

mostly fixed

change year (multiple years possible)

only changed when using new version of inventory

mostly run with True-True

```

37 # ===== CONFIGURATION PARAMETERS =====
38 #INPUT_PATH = '/mnt/beegfs2/emis/cmip6_future'
39 INPUT_PATH = '/mnt/beegfs2/tm_input/tm5dvar/tm5-input/TM5_EMISS/CMIP6'
40 #OUTPUT_PATH = '/mnt/beegfs/emis/HERMESv3/jgcri/ceds'
41 OUTPUT_PATH = '/mnt/beegfs/user/slmeyer/Promotion/HERMES/model/cmip6_future_preproc'
42
43 #-----
44
45 LIST_POLLUTANTS = ['BC', 'NH3', 'NOx', 'OC', 'SO2', 'CH4', 'CO']
46 NMVOC_POLLUTANTS = ['HC00H', 'HCN', 'Higher-Alkanes', 'Higher-Alkenes', 'HOCH2CHO', 'MEK', 'Toluene-lump',
47 'C10H16', 'C2H2', 'C2H4', 'C2H4O', 'C2H5OH', 'C2H6', 'C2H6S', 'C3H6', 'C3H6O', 'C3H8', 'C5H8',
48 'C6H6', 'C7H8', 'C8H10', 'CH2O', 'CH3COCHO', 'CH3COOH', 'CH3OH']
49 VOC_POLLUTANTS = ['VOC01', 'VOC02', 'VOC03', 'VOC04', 'VOC05', 'VOC06', 'VOC07', 'VOC08', 'VOC09', 'VOC12', 'VOC13',
50 'VOC14', 'VOC15', 'VOC16', 'VOC17', 'VOC18', 'VOC19', 'VOC20', 'VOC21', 'VOC22', 'VOC23', 'VOC24',
51 'VOC25']
52 BF_POLLUTANTS = ['BC_BF', 'OC_BF']
53
54 #-----
55
56 LIST_SECTORS = ['agriculture', 'energy', 'industry', 'transport', 'residential', 'solvents', 'waste', 'ships']
57 LIST_YEARS = [2015]
58
59 #-----
60
61 INPUT_NAME = '<pollutant>-<kind_pfx>_input4MIPs_emissions_ScenarioMIP_IAMC-AIM-ssp370-1-1_gn_201501-210012.nc'
62 NMVOC_INPUT_NAME = 'NMVOC-<nmvoc_name>-em-speciated-VOC-openburning_input4MIPs_' + \
63 'emissions_ScenarioMIP_IAMC-AIM-ssp370-1-1-supplemental-data_gn_201501-210012.nc'
64 SECTOR_INPUT_NAME = '<pol_name>-openburning-share_input4MIPs_' + \
65 'emissions_ScenarioMIP_IAMC-AIM-ssp370-1-1-supplemental-data_gn_201501-210012.nc'
66 VOC_INPUT_NAME = '<voc_name>-em-speciated-VOC-anthro_input4MIPs_emissions_ScenarioMIP_' + \
67 'IAMC-AIM-ssp370-1-1-supplemental-data_gn_201501-210012.nc'
68
69 BF_INPUT_NAME = '<pollutant>-em-SOLID-BIOFUEL-anthro_input4MIPs_emissions_ScenarioMIP_IAMC-AIM-ssp370-1-1-supplemental-data_gn_201501-210012.nc'
70
71 AIR_INPUT_NAME = '<pollutant>-em-AIR-anthro_input4MIPs_emissions_ScenarioMIP_IAMC-AIM-ssp370-1-1_gn_201501-210012.nc'
72
73
74 #-----
75
76 #Set both to false to get anthropogenic emissions
77 DO_AIR = True
78 DO_BMB = False
79
80 #For tm5 we do not need the splitting into multiple air phases, so set tm5 to true when using air
81 TM5 = True
82
83 # =====
  
```

# Workflow

1. Preprocess original inventories to be used with HERMES
2. Create **HERMES** file
  1. Edit herms.conf

change name according to case  
Name always:  
HERMESv3\_inventory\_sector\_year.  
nc

```

26 # ***** domain_type=[global, global_tm5, regular, lcc, rotated, mercator] *****
27 domain_type = global_tm5
28 # domain_type = global
29 # domain_type = regular
30 # domain_type = lcc
31 # domain_type = rotated
32 # domain_type = mercator
33
34 vertical_description = <input_dir>/data/profiles/vertical/TM5_MP_25layers_vertical_description.csv
35 #vertical_description = <input_dir>/data/profiles/vertical/Benchmark_15layers_vertical_description.csv
36 #vertical_description = <input_dir>/data/profiles/vertical/TM5_MP_15layers_vertical_description.csv
37 auxiliary_files_path = <input_dir>/data/auxiliar_files/<domain_type>_<resolution>
38 gph_data_path = <input_dir>/data/tm5_data
39 meteo_data_path = /mnt/beegfs2/met/ecmwf/era4/tm5/meteo/ec/ei/fc012up2tr3/ml60/glb100x100/
40
41 # if domain_type == global:
42     inc_lat = 2.0
43     inc_lon = 3.0
44
  
```

set resolution (equal to  
resolution set in TM5MP)

```

1 [GENERAL]
2 log_level = 3
3 input_dir = /mnt/beegfs/user/slmeyer/Promotion/HERMES/model/hermesv3_gr
4 data_path = /mnt/beegfs2/emis/HERMESv3
5 output_dir = /mnt/beegfs/user/slmeyer/Promotion/HERMES/output/tm5_data
6 output_name = HERMESv3_MEGAN_MEGAN_MACC_single_<date>.nc
7 start_date = 2015/01/01 00:00:00
8 # ***** end_date = start_date [DEFAULT] *****
9 # end_date = 2017/01/02 00:00:00
10 # ***** output_timestep_type = [hourly, daily, monthly, yearly] *****
11 output_timestep_type = monthly
12 output_timestep_num = 3
13 output_timestep_freq = 1
14 first_time = 0
15 erase_auxiliary_files = 1
16
  
```

# Workflow

1. Preprocess original inventories to be used with HERMES
2. Create HERMES file
  1. Edit herms.conf
  2. edit EI\_configuration.csv

```

1 ei;sector;ref_year;active;factor_mask;regrid_mask;pollutants;path;frequency;source_type;p_vertical;p_month;p_week;p_hour;p_speciation;p_day
2 #CMIP6_future;agriculture;2015;1;;;bc,bc_bf,ch4,co,nh3,nox_no2,oc,oc_bf,so2,voc01,voc02,voc03,voc04,voc05,voc06,voc07,voc08,voc09,voc12,voc13,voc15,voc16,voc17,voc18,voc19,voc20,voc21,voc22,voc23,voc24,voc25;/mnt/beegfs/user/slmeyer/Promotion/HERMES/model/cmip6_future_preproc/monthly_mean;monthly;area;V013;;;H001;E006;
3 #CMIP6_future;energy;2015;1;;;bc,bc_bf,ch4,co,nh3,nox_no2,oc,oc_bf,so2,voc01,voc02,voc03,voc04,voc05,voc06,voc07,voc08,voc09,voc12,voc13,voc15,voc16,voc17,voc18,voc19,voc20,voc21,voc22,voc23,voc24,voc25;/mnt/beegfs/user/slmeyer/Promotion/HERMES/model/cmip6_future_preproc/monthly_mean;monthly;area;V008;;;H001;E006;
4 #CMIP6_future;industry;2015;1;;;bc,bc_bf,ch4,co,nh3,nox_no2,oc,oc_bf,so2,voc01,voc02,voc03,voc04,voc05,voc06,voc07,voc08,voc09,voc12,voc13,voc15,voc16,voc17,voc18,voc19,voc20,voc21,voc22,voc23,voc24,voc25;/mnt/beegfs/user/slmeyer/Promotion/HERMES/model/cmip6_future_preproc/monthly_mean;monthly;area;V010;;;H001;E006;
  
```

inventory

sector

year

species  
(inventory!)

path to  
preproce  
sed files

Vert. profile  
(regsame  
avail.)

Spec. profile  
(regsame  
avail.)

At the moment: One line per run, use comment for easy changing (active=0/1 also possible)  
Future: Run all lines automatically one by one

# Workflow

1. Reprocessors original inventories to be used with HERMES
2. Create HERMES file
  1. Edit Terms.contra
  2. edit EI\_configuration.CSU
3. Run **TM5MP**
  1. Place Hermes files in ,TM5-MP/data'
  2. Make sure names are valid
  3. run using the project ,hermes'

# Current state



# Current state

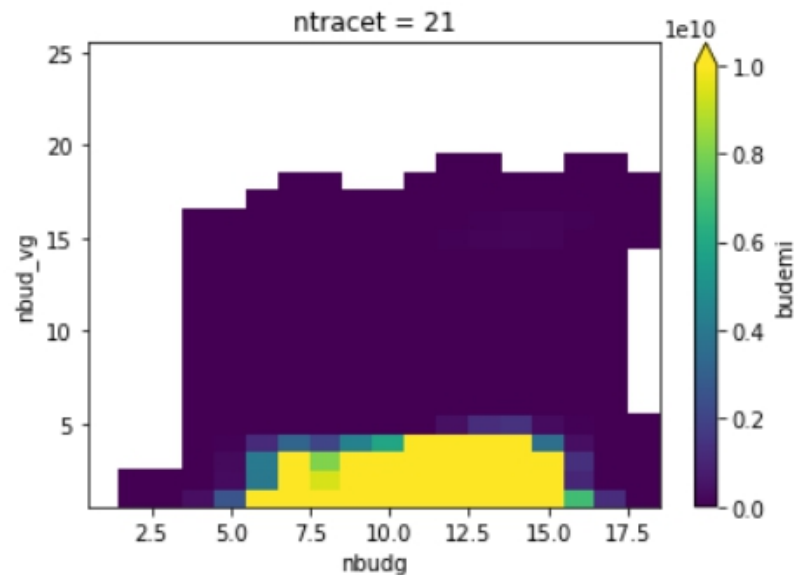
- Hermes side - working\*
  - preprocessor ready for CMIP6 (CEDS+BMB & future), Megan,...
  - Speciation factor done for CMIP6 & Megan
  - Speciation factors to be done for CMIP6 BMB
  - *\*Vertical dist. has to be fixed*
  
- TM5MP side in progress
  - Able to include input files in TM5-MP
  - *\*problems in vertical distribution*

# Current state - CO

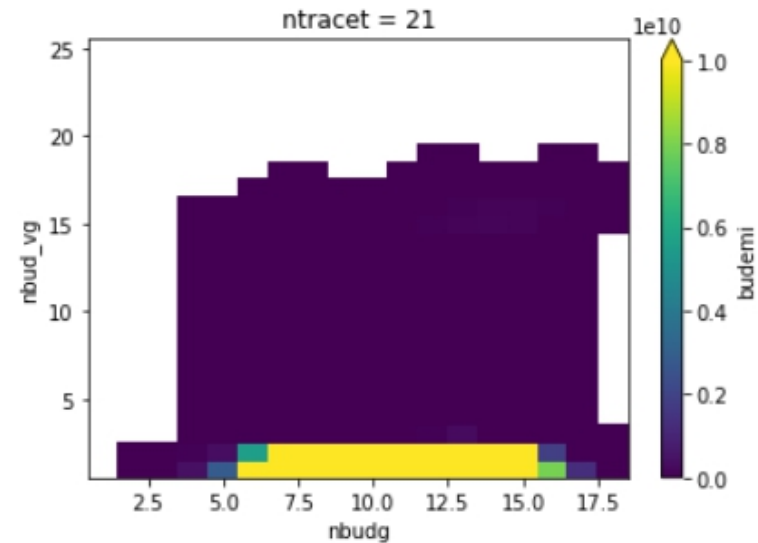
- Read in total mass is identical
- Budget files (bud\_emis)  $\frac{\sum ref - \sum hermes}{\sum ref} \approx -1.6 \cdot 10^{-6}$

# Current state - CO

- Read in total mass is identical
- Budget files (bud\_emis)  $\frac{\sum ref - \sum hermes}{\sum ref} \approx -1.6 \cdot 10^{-6}$



ref

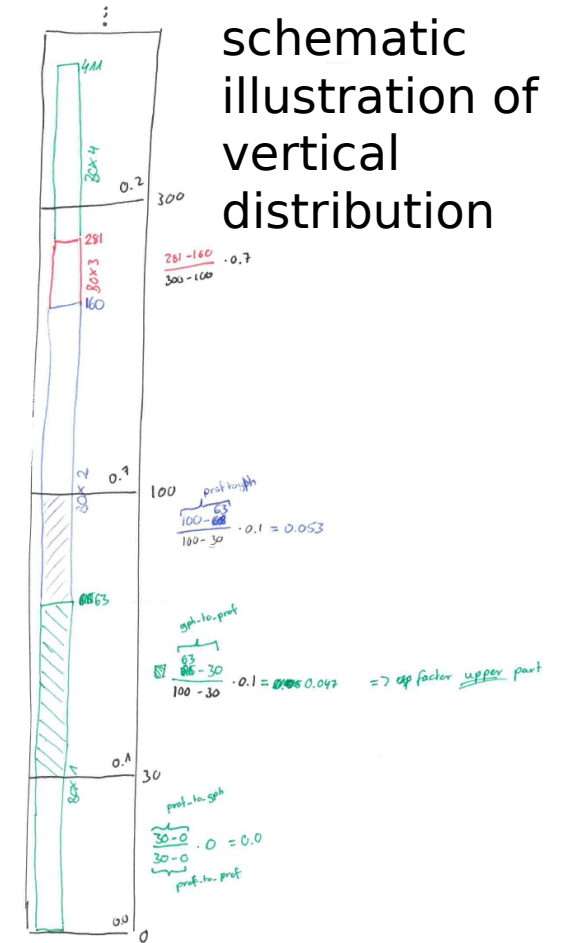


herme

S

# Current state - Vertical Profile

- Vertical distribution
  - using same profiles as in TM5-MP
  - HERMES uses factors based on altitude
    - using GPH data as in TM5-MP to convert 2D profile into 3D
    - use 3D profile in HERMES to distribute data
- Check how much of ,profile box' is occupied by each ,GPH box'



# Potential errors

- GPH data wrong
- mid box data instead of boarder data or vice versa (checked)
  - calcualted dh ,wrong' (checked)
  - ,wrong' meteo
    - era5 vs. era interim (checked, both ei)
    - monthly averaged vs. non-averaged data (to be evaluated)
- mistakes in vertical profiles (checked)
- ?
  
- How to fix?

# Future tasks - Vertical Distribution for BMB

- For biomassburning (forest fires) vertical dist. in TM5MP is based on region
  - Not possible in HERMES, since only one 2D profile given per sector
  - => Problem?

# Future tasks - Aerosols

- Test BC Code with fixed vert. dist
- Apply BC code on other aerosols
- Currently Aerosol (BC) Code is structured as in original, only with new (hermes based) input data
  - splitting in modes and conversation in number concentration is done in TM5MP
- Last meeting there were wishes regarding number concentration
  - Which modification should be able to be done easily?

# Future tasks - Gaseous species

- Apply CO code on other gaseous species
- Code for e.g. CO is structured in
  - Init, Declare, Apply, Done
- For NO<sub>x</sub>: Apply is missing (corresponding code is part of declare)
  - Why?



# Conclusion/Outlook

- After vert. dist. is fixed start developing code for other species
- Include megan data
- Include CMIP6bmb data
  
- Start case studies
  
- Improve hermes - TM5-MP coupling
  - Aerosols?
  - automatic run of multiple HERMES

Thank you for your attention!