



Yale-NUIST Center on Atmospheric Environment

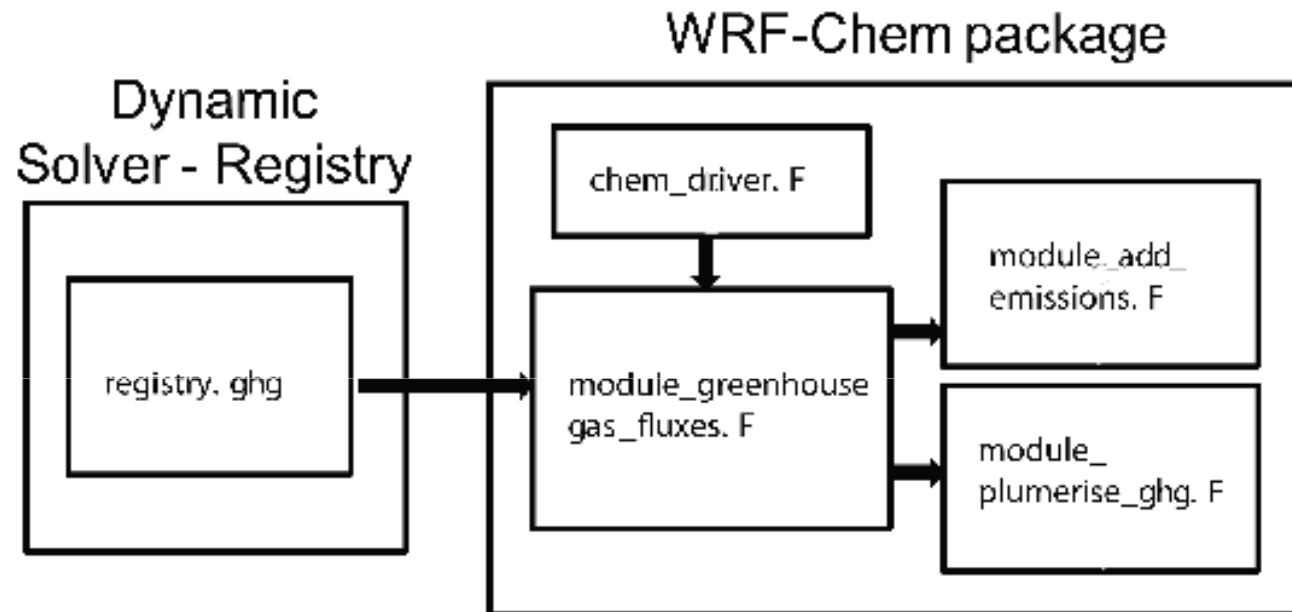


WRF-GHG For Methane Simulation

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The code structure of WRF-GHG



- WRF with a module greenhouse gases (chem_opt=98, includes VPRM, wetland-odel,plumerise,etc.)

Veronika Beck, et al. 2011. Technical Reports 25 - Max-Planck-Institut

CH₄ tracer variables defined in the registry.ghg

CH ₄ _1	Total atmospheric CH ₄ mixing ratio
CH ₄ _2	Changes in CH ₄ mixing ratio from wetland emissions
CH ₄ _3	Changes in CH ₄ mixing ratio from anthropogenic emissions
CH ₄ _4	Changes in CH ₄ mixing ratio from biomass burning
CH ₄ _5	Changes in CH ₄ mixing ratio from termite emissions
CH ₄ _6	Changes in CH ₄ mixing ratio from soil uptake
CH ₄ _7	Changes in CH ₄ mixing ratio from vegetation
CH ₄ _B	Atmospheric CH ₄ background mixing ratio

module_add_emissions.F

CH ₄		
fl_wet	Wetland [ext.]	Hourly [30]
fl_ant4	Anthropogenic [ext.]	Daily [1]
fl_antch4	Anthropogenic [ext.]	Hourly [30]
fl_bbch4	Biomass burning [ext.]	Daily [1]
bb_ch4	3d biomass burning	WRF timestep
fl_term	Termite emission [ext.]	Daily [1]
fl_soilu	Soil uptake [ext.]	Hourly [30]
fl_veg	Vegetation [ext.]	Hourly [30]
ch4_emiss	Wetland [int.]	WRF timestep
ch4_term	Termite emission [int.]	WRF timestep
ch4_soil	Soil uptake [int.]	WRF timestep
ch4_veg	Vegetation [int.]	WRF timestep

module_greenhouse_gases.F

- Subroutine Kaplan provide on-line ch4 flux
 - External input fields for the Kaplan: CPOOL - from the Lund-Postdam-Jena (LPJ) model [Sitch et al., 2003]) and a wetland inundation map [Kaplan, 2002, Bergamaschi et al., 2007]
 - Or using Walter wetland model for off-line ch4 flux
- Subroutine Soiluptake

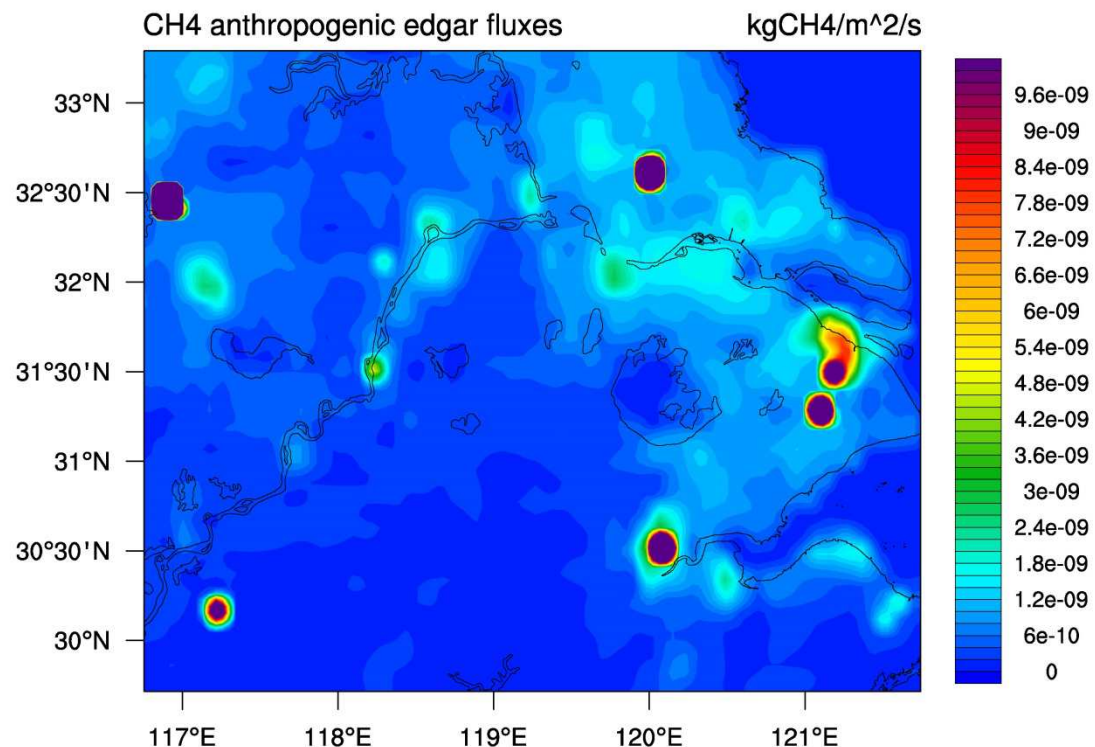
Initial and boundary conditions

- Meteorology IC/BC: NCEP FNL(2nd) or CFSR(3rd)
- Initial and boundary conditions for CH₄: three-dimensional fields from global transport models
- CarbonTracker output for IC/BC of CH₄_1 ... CH₄_B
- Matlab Scripts: CH₄_TM5_LBCs.m

CH4 fluxes in WRF-GHG

- Online calculated fluxes: CH4 fluxes from wetlands (I)Kaplan model,
 - T_soil: soil temperature from WRF
 - C_pool: carbon content of the fast carbon pool at time 0 - from the LPJ model 2000
 - Wet_map: potential wetland map of Jed Kaplan gives the percentage of wetland area covered by each grid cell
 - CH4_wet: methane wetland emissions - output from kaplan model
- Online SOILUPTAKE: Soil moisture (SMOIS), soil type (ISLTYP) and soil parameters (SOILPARM.TBL), total CH4 atmospheric concentration (CH4_1), precipitation (RAINC + RAINNC), potential evaporation (POTEVP), landuse (LANDUSE), soil temperature (TSLB) and the wetland map (WETMAP) to exclude soil uptake for grid cells that are mainly covered by wetland area.
- CH4 flux from vegetation: vprm model
- CH4 fluxes from wetlands (II) - External flux data sets: the Walter model
- Matlab Scripts: VPRM_INIT.m, WETEXT_INIT.m for Walter model, WETKAPLAN.m for LPJ carbon pool and WETMAP.

Anthropogenic emissions for CH₄



- Using NCL script to interpolate the hourly emissions from the EDGAR into the WRF flux vars, FL_ANTCH₄, etc.

Steps to run

1. Compile WRF-GHG, WPS

2. Namelist settings

		Variable	Value	Description
		chem_opt	98	defines GHG_TRACER package and allows for GHG tracer transport
		vertmix_onoff	1	to allow for vertical mixing of the tracer
		have_bcs_chem	.true.	uses the right scheme to fill in the boundary conditions
		chem_in_opt	0	no external emissions for WRF-Chem allowed
		emiss_inpt_opt	0	no external emissions for WRF-Chem allowed
		chem_conv_tr	1	to allow for subgrid convective tracer transport
		wetland_type	0	no CH ₄ wetland emissions
			1	<u>floodplain and peatland CH₄ wetland emissions (Kaplan)</u>
			2	only floodplain CH ₄ wetland emissions (Kaplan)
			3	only peatland CH ₄ wetland emissions (Kaplan)
			4	external CH ₄ wetland emissions (Walter)
		file_term		“CH4_termite_NW.txt” *.txt file containing table of biomass and corresponding termite emissions for America and Australia (NW)
soil_id	0	no calculation of soil uptake fluxes		“CH4_termite_OW.txt” for Europe, Africa and Asia (OW) located in <run/CH4_input>
	1	<u>calculation of soil uptake fluxes</u>		
	2	<u>external soil uptake dataset</u>		
veg_id	0	no calculation of CH ₄ emissions from vegetation		
	1	<u>calculation of CH₄ emissions from vegetation</u>		
	2	<u>external CH₄ emissions from vegetation</u>		
oce_id	0	no CO ₂ ocean fluxes		
	1	external CO ₂ ocean fluxes (hourly time step)		

Summary and on-going work

- Prepare modis09a1 datasets, LPJ map, etc.
- Preprocessing vprm parameters (vprm-prep), IC/BC (matlab, ncl): all the R, matlab and ncl pre-prpocessor has been debuged and run smoothly.
- Test ch4 simulation in YRD region during this summer
- Long term simulation for CO₂ in full China region in selected years (i.g., extreme dry or water logging). So, we need to prepare a detailed plan.

Thank you !