**Settings for WRF & WRFChem….**

export LC\_LIBRARY\_PATH=/apps/netcdf/installed/lib

module load gcc/4.9.2

module load openmpi/1.8.4

export LC\_LIBRARY\_PATH=/apps/libpng/libpng-1.4.13/lib:$LD\_LIBRARY\_PATH

source "/home/fkaragulian/WRFV3/wrfchem\_env.txt"

export PATH=/apps/cdo/cdo-1.7.2/bin:$PATH

module load ncview

export PATH=/apps/ncl/ncl-6.3.0/bin:$PATH

export NCARG\_ROOT=/apps/ncl/ncl-6.3.0/

**download met data (GFS)……….use Mike’s bash script**

**cd into the directory where you want to download GFS data**

#!/bin/bash  
  
date\_day=20160310  
date\_month=`date +%Y%m -d$date\_day`  
hours=( `seq -f%03.0f 0 6 120` )  
initial=( 06  ) # 06 00  
  
for i in ${initial[@]}; do  
 for h in ${hours[@]}; do  
  #<ftp://nomads.ncdc.noaa.gov/GFS/Grid4/201603/20160310/>  
  echo <ftp://nomads.ncdc.noaa.gov/GFS/Grid4/$date_month/$date_day/gfs_4_$date_day>"\_"$i"00"\_$h.grb2  
  wget -c <ftp://nomads.ncdc.noaa.gov/GFS/Grid4/$date_month/$date_day/gfs_4_$date_day>"\_"$i"00"\_$h.grb2  
 done  
done

**$ chmod +x**

**To run: $** ./download\_gfs.sh

$ cd /disk3/fkaragulian/WRF\_UAE/WPS/

Make changes in the *namelist.wps* file

### introduced subdomain for only UAE area

*&geogrid*

*parent\_id = 1,* ***1****, 2,*

*parent\_grid\_ratio = 1,* ***3****, 3,*

*i\_parent\_start = 1,* ***65****, 31 ,95,*

*j\_parent\_start = 1,* ***65****, 40, 90,*

*e\_we = 187,* ***250****, 127, 106,*

*e\_sn = 184,* ***172****, 142, 109,*

*to plot-check domains*

[*http://www2.mmm.ucar.edu/wrf/OnLineTutorial/Class/cases/nest2.php*](http://www2.mmm.ucar.edu/wrf/OnLineTutorial/Class/cases/nest2.php)

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

To include erodibility map (EROD)

*If you run WRF-Chem, link the GEOGRIB table to GEOGRIB.TBL\_ARW\_CHEM*

**ln -svf GEOGRID.TBL.ARW\_CHEM GEOGRID.TBL**

**without chem use:**

**ln -svf GEOGRID.TBL.ARW GEOGRID.TBL**

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

**./geogrid.exe**

will generate *geo\_em.d01.nc*

will generate *geo\_em.d02.nc*

**link met data**

./link\_grib.csh /home/fkaragulian/WRF\_UAE/forcing\_data/

ln -sf ungrib/Variable\_Tables/Vtable.GFS Vtable

**./ungrib.exe**

will generate *FILE:2017-03-29\_06*

**./metgrid.exe**

will generate *met\_em.d01.2017-03-28\_12:00:00.nc*

will generate *met\_em.d02.2017-03-28\_12:00:00.nc* first date only

$ cd /disk3/fkaragulian/WRF\_UAE/WRFV3/test/em\_real/

**link ungribbed met files…..in the working directory**

ln -sf ../../../WPS/met\_em\* .

ln -sf /home/fkaragulian/WRF\_UAE/WPS/met\_em\* .

link the VEGPARM.TBL from /home/fkaragulian/WRFV3/run/

**ln -sf /home/fkaragulian/WRF\_UAE/WRFV3/run/VEGPARM.TBL\*** .

update NAMELIST.INPUT (WRF-Chem)

**~~~~~~ run below only for WRF with MET data ~~~~~~~~~~~~~~~~~~~~~~~**

**Run real.exe**

bsub -n 6 -J job\_name -o vk.%J.out -e vk.%J.err -q normal mpirun **./real.exe**

will generate *wrfinput\_d01* (initialization file)

will generate *wrfinput\_d02* (initialization file)

will generate wrfbdy\_d01 (boundary conditions file)

**Run wrf.exe**

bsub -n 6 -J job\_name -o vk.%J.out -e vk.%J.err -q normal mpirun **./wrf.exe**

will generate *wrfout\_d01\_2017-03-12\_06:00:00* (these are .nc files)

will generate *wrfout\_d02\_2017-03-12\_06:00:00* (these are .nc files)

**check SUCCESS!!!**

**~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~**

**## ## ## ### ## ### ## ## ## ## ### ## ### ## ## ## ## ### ## ### ## ## ##**

**WRF-CHEM**

Untar wrf code.

Then untar wrfchem code inside wrf code.

tar -xvzf WRFV3.7.1.TAR.gz

tar -xvzf WRFV3-Chem-3.7.1.TAR.gz

WRFV3.7.1.TAR.gz  
WRFV3-Chem-3.7.1.TAR.gz

export LD\_LIBRARY\_PATH=/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/hdf/h4dir/lib:/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/hdf/h5dir\_1.8.13/lib:/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/hdf/h5dir/lib:/home/fkaragulian/local/lib:/home/fkaragulian/gfortran/installed\_noquadmath/lib64:/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local/lib:/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/bin/mpich-install/lib/:$LD\_LIBRARY\_PATH

export JASPERLIB=/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local/lib

export JASPERINC=/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local/include

export EM\_CORE=1

export WRF\_CHEM=1

export NETCDF=/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local

export WRF\_KPP=1

export YACC='/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local/bin/yacc -d'

export PATH=/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/bin/mpich-install/bin/:/home/fkaragulian/local/ncl\_nodap/bin:/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local/bin:/home/fkaragulian/gfortran/installed\_noquadmath/bin:$PATH:/home/fkaragulian/bin

export FLEX\_LIB\_DIR=/home/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local/lib

module load gcc/4.9.2

module load openmpi/1.8.4

Then

**./configure  
./compile em\_real 2>&1 |tee compile.log**

-----------------------------------------------------------------------------------------

Use **./clean -a** to clean previous compilation

**Compilation of Emission Inventory**

Go to directory:

/disk3/fkaragulian/WRFV3/test/em\_real/PREP-CHEM-SRC-1.5/bin/build/

edit file:

Include.mk.gfortan

Add:

**NETCDF=/apps/netcdf/netcdf-4.1.3-usr-gcc** for NETCDF

**HDF5=/apps/hdf5/hdf5-1.8.13** for HDF5

Go to directory

/disk3/fkaragulian/WRFV3/test/em\_real/PREP-CHEM-SRC-1.5/src/

edit file:

edgar\_emissions.f90

go to lines from 840 to 845:

add spaces to the end of the names 'ENERGY', 'INDUSTRY', and 'TRANSPORT', until the length of all the names be the same as each other and equal to the length of 'AGRICULTURE' and 'RESIDENTIAL' (i.e. equal to 11 characters). the final modification must be like bellow:

**CODE:**[**SELECT ALL**](http://forum.wrfforum.com/viewtopic.php?f=39&t=9199)

841         'AGRICULTURE',&  
842         'ENERGY     ',&  
843         'INDUSTRY   ',&  
844         'RESIDENTIAL',&  
845         'TRANSPORT  '/)

Download EGDAR/HTAP emission data

cd /home/fkaragulian/WRFV3/test/em\_real/

wget <http://www.acom.ucar.edu/webt/wrf-chem/processors/EDGAR-HTAP.tgz>

extract the EDGAR/HTAP data:

tar -xvzf EDGAR-HTAP.tgz

**anthro\_emiss**

Download **anthro\_emiss** from this page:

<https://www2.acom.ucar.edu/wrf-chem/wrf-chem-tools-community>

<http://www.acom.ucar.edu/wrf-chem/download.shtml>

….. also EDGAR-HTAP

Load anthro\_emiss in HCP

Untar “ANTHRO.tar”

**cd ANTHRO/src/**

……read the README.anthro\_emis

Set the environmental variable for the right fortran compiler

export FC=/apps/gcc/gcc-4.9.2/bin/gfortran

export NETCDF\_DIR=/apps/netcdf/netcdf-4.1.3-usr-gcc

export NETCDF\_DIR=/disk3/fkaragulian/wrf\_libraries\_gfort\_noquadmath/local/

proceed with the compilation of anthro\_emiss

modfy the MAKEfile in /home/fkaragulian/ANTHRO/src/

compile anthro\_emiss….

./make\_anthro

it will build the executable anthro\_emis

unzip EDGAR-HTAP.tar in a separate folder

cd /home/fkaragulian/EDGAR-HTAP/

look at the file “**MOZCART.inp**” as example of input file for the emission ( /home/fkaragulian/EDGAR-HTAP/INP-Examples/)

Execution DATE\_TIME of the WRFChem will be taken from the files:

wrfinput\_d01 in the /home/fkaragulian/WRF\_UAE/WRFV3/test/em\_real/ directory…that is the one indicated in the namelist.input (from GFS met data)

**make a copy of the MOZCART.inp in the ANTHRO/src/ directroy**

export LD\_LIBRARY\_PATH=/apps/netcdf/netcdf-4.1.3-usr-gcc/lib/:$LD\_LIBRARY\_PATH

To run anthro\_emis issue the command:

**$ cd /home/fkaragulian/ANTHRO/src/**

**./anthro\_emis < MOZCART.inp > MOZCART\_FK.out**

….it will generate files:

**wrfchemi\_00z\_d01**

**wrfchemi\_12z\_d01**

**######### RUN the WRFChem model ####################**

source "/home/fkaragulian/WRFV3/wrfchem\_env.txt"

$ cd /home/fkaragulian/WRFV3/test/em\_real/

**link ungribbed met files…..in the working directory** em\_real/

ln -sf /home/fkaragulian/WRF\_UAE/WPS/met\_em\* . (generate above with ./metgrid.exe above)

**link emission files wrfchemi\_00z\_d01 generated from ANTRO**

ln -sf /home/fkaragulian/ANTHRO/src/wrfchemi\_\* .

update the **NAMELIST.INPUT.CHEM** in /disk3/fkaragulian/WRFV3/test/em\_real/

namelist.input.chem MUST be renamed into namelist.input or just link the “name” of namelist.input to namelist.input.chem

ln -s namelist.input.chem namelist.input

**download wes-coldens.tar to process MOZCART configuration**

**untar wes-coldens.tar in a new directory:** tar –xvf wes\_coldens

**compile the MOZCART source code**

**change to gfortaran processor in the makefile in the /home/fkaragulian/WRFV3/wesely/ directory**

**$ cd /disk3/fkaragulian/WRFV3/wesely/**

make\_util wesely (will generate wesely)

make\_util exo\_coldens (will generate exo\_coldens)

**update the namelist.input (in the wesely folder) as follow:**

&control  
 wrf\_dir = ' home/fkaragulian/WRFV3/test/em\_real/  
 domains = 2,  
  
/

run exo\_colden with the updated namelist.input

**./exo\_coldens < namelist.input**

Will generate ***exo\_coldens\_d01***

cd /home/fkaragulian/WRFV3/test/em\_real/

**link exo\_coldens into working wrf directory**

ln -sf /home/fkaragulian/WRFV3/wesely/exo\_coldens\_d01\* .

**Run real.exe**

bsub -n 6 -J job\_name -o vk.%J.out -e vk.%J.err -q normal mpirun **./real.exe**

will generate *wrfinput\_d01* (initialization file)

will generate *wrfinput\_d02* (initialization file)

will generate wrfbdy\_d01 (boundary conditions file)

**Run wrf.exe (WRFChem also)**

bsub -n 6 -J job\_name -o vk.%J.out -e vk.%J.err -q normal mpirun **./wrf.exe**

will generate *wrfout\_d01\_2017-03-27\_06:00:00* (these are .nc files)

to see al jobs: bjobs

to kill a job: bkill xxxxxx

**WRF post-processing**

#### visualize .nc files #####################################

Load environ. variab

source "/home/fkaragulian/WRFV3/wrfchem\_env.txt"

module load ncview

use **ncdump** to see layers in the .nc “wrfout\_d01\_2017-03-27\_06:00:00”

ncdump -h *wrfout\_d01\_2017-03-27\_06:00:00*

to visualize the .nc wrfchem output file:

ncview *wrfout\_d01\_2017-03-27\_06:00:00*

ncview *"/home/fkaragulian/WRFV3/test/em\_real/wrfout\_d01\_2017-03-27\_06:00:00\_FK\_TRIAL"*

### check variable included in the model run

/home/fkaragulian/WRFV3/Registry/

open **registry.chem**

**#### POST PROCESSING WRF-Chem ######################**

**### Climate Data Operator tool ######**

**# cdo tool**

export PATH=/apps/cdo/cdo-1.7.2/bin:$PATH

**cdo program**

cdo infov wrfout\_d01\_2017-03-27\_06:00:00\_FK\_TRIAL | grep -i "DUST\_1" > federico.txt

**cdo infov wrfout\_d01\_2015-03-31\_00:00:00 | grep -i "SWDOWN"**

cdo infov wrfpost.nc |grep SW\_d|less

**########** ncl tool 🡪 **TO RUN ###########**

**ncl 'file\_in="wrfout\_d01\_2015-03-31\_00:00:00"' wrfpost\_dust\_20161010.ncl**

**Extinction coefficients…**

**ncl 'file\_in="wrfout\_d01\_2015-03-31\_00:00:00"' EXTCOF55.ncl**

#########################################################

Nice GUIDE for namelist settings in WRF-Chem

<https://github.com/hanschen/WRFDA/tree/master/run>

<file:///C:/Users/fkaragulian/Downloads/wrfsolar_users_guide.pdf>

to simulate the solar radiation in the presence of AOD (Aerosols at 550 nm) make the following changes in the WRF-chem **namelist.input** in the physics session:

&physics

aer\_opt = 2, using J. A. Ruiz-Arias method

The following aerosol options allow RRTMG and new Goddard radiation schemes to see it, but the aerosols are constant during the model integration:

aer\_aod550\_opt = 1,

aer\_aod550\_val = 0.12

input constant value for AOD at 550 nm from namelist. In this case, the value is read from aer\_aod550\_val = 0.12 or any value at user’s choice.

aer\_angexp\_opt = [1,2,3] :

1 = input constant value for Angstrom exponent from namelist. In

aer\_type = [1,2,3] : 1 for rural, 2 is urban and 3 is maritime.

Ncl

load "$NCARG\_ROOT/lib/ncarg/nclscripts/csm/gsn\_code.ncl"

load "$NCARG\_ROOT/lib/ncarg/nclscripts/csm/contributed.ncl"

load "$NCARG\_ROOT/lib/ncarg/nclscripts/wrf/WRF\_contributed.ncl"

load "$NCARG\_ROOT/lib/ncarg/nclscripts/wrf/WRFUserARW.ncl"

*begin*

*ncl*

*a = addfile("wrfout\_d01\_2015-03-31\_00:00:00.nc","r")*

print(a)

q

times = wrf\_user\_list\_times(a)   
ntimes = dimsizes(times)

*time = 1*

*EXTCOF55= wrf\_user\_getvar(a,"EXTCOF55",time)*

res = True

opts=res

wks = gsn\_open\_wks("pdf","do3.11.00")

print("min/max data = " + min(EXTCOF55(1,:,:)) + "/" + max(EXTCOF55(1,:,:)))

print("min/max data = " + min(EXTCOF55) + "/" + max(EXTCOF55))

*OPTIONAL:* Turn on the aerosol optical properties (e.g., aer\_op\_opt, opt\_pars\_out) to obtain the extinction coefficient in the wrfout file and rerun the simulation. Examine the EXTCOEF fields. Are these fields non-zero? Do the higher values correlate with locations of higher aerosol concentration? The vertical sum of each EXTCOEF field multiplied by the layer depth is the computed Aerosol Optical Depth (AOD) at a particular wavelength.

dz(1) = z\_at\_w(2) - z\_at\_w(1)  
dz(2) = z\_at\_w(3) - z\_at\_w(2)  
...  
dz(e\_vert-1) = z\_at\_w(e\_vert) - z\_at\_w(e\_vert-1)  
AOD = SUM[EXTCOEF55(1)\*dz(1) + EXTCOEF55(2)\*dz(2) + ... + EXTCOEF55(n)\*dz(e\_vert-1)]