WACCM Versions

- 3.1.9
  - Released version
- 3.5.48
  - CCMVal simulations
  - Gravity wave improvements
  - Chemistry updated to JPL-2006
  - https://wiki.ucar.edu/display/~fvitt/WACCM+Versions
- 3.6.16
  - WACCM/CAM-Chem codes combined (mostly)
  - More flexible

WACCM3.6 Developments

- Combined WACCM and CAM-Chem chemistry codes
  - WACCM adopted CAM-Chem flexibilities
  - Common namelist specifications
- Configure changes
  - Invokes the chemistry preprocessor
  - Easier the change chemical mechanisms
- Flexible photolysis scheme
- Ability to specify non-transported short lived species

WACCM/CAM-Chem Code Merge

- Share common routines
  - Easier to maintain
  - Examples:
    - Surface emissions
    - Lightning NOx production
    - Dry Deposition
  - WACCM adopted CAM-Chem flexibilities
    - Use helper functions
    - Flexible namelist specifications
    - Easier to change mechanisms

Surface Emissions

- Easy to add/remove tracer emissions without code changes
- Can be 'CYCLICAL','SERIAL', or 'FIXED'

```
srf_emis_specifier =
     'CH2O -> /inputdata/atm/waccm/emis/emis.ch2o.c080919.nc',
     'CO   -> /inputdata/atm/waccm/emis/emis.co.c080919.nc',
     'NO   -> /inputdata/atm/waccm/emis/emis.nox.c080919.nc'
srf_emis_type      = 'CYCLICAL'
srf_emis_date      = 19970101
```

Elevated Emissions

- Ability to specify 3D time dependent emissions
- Example aircraft emissions
- Can be 'CYCLICAL','SERIAL', or 'FIXED'

```
ext_frc_specifier =
     'CO   -> /inputdata/atm/waccm/emis/vrt_emis.co.nc',
     'NO   -> /inputdata/atm/waccm/emis/vrt_emis.nox.nc'
ext_frc_type    = 'CYCLICAL'
ext_frc_date    = 19970101
```

Addition Namelist Changes

Flexible specifications:

```
drydep_list = 'NO','NO2','HNO3','HO2NO2','O3','H2O2',
              'CH2O','CH3OOH','CO'

flbc_file = '../lb/LBC_1850-2100_1.9x2.5_REF2_za_c080114.nc'
flbc_list = 'N2O', 'HCFC22', 'H2', 'CO2', 'CH4', 'CH3CL',
            'CH3CCL3', 'CH3BR', 'CFC11', 'CFC113', 'CF3BR',
            'CF2CLBR', 'CFC12','CCL4'
flbc_type = 'CYCLICAL'|'SERIAL'|'FIXED'
flbc_date = 20000101

sad_file  = '../sulf/SAD_SULF_1850-2100_1.9x2.5_c080220.nc'
sad_type  = 'CYCLICAL'|'SERIAL'|'FIXED'
sad_date  = 20000101
```

Changes to Configure Utility

- Easier to customize chemical mechanism
- Invokes the chemistry preprocessor
- Option added:
  - **`-usr_mech_infile $mechanism_file`**
    - Allows user to specify a customized preprocessor input file
    - Determines the number of advected tracers
- Ability to configure with non-transported chemical tracers via preprocessor

Preprecessor input file

List solution species

List prescribed species

List species not transported

Longer lived species

Shorter lived species

Photolysis reactions

Gas phase reactions

Gas phase wet removal

Prescribed prod/loss rates

```
SPECIES
  Solution
  End Solution
  Fixed
  End Fixed
  Not-transported
  End Not-transported
END SPECIES
SOLUTION CLASSES
  Explicit
  End Explicit
  Implicit
  End Implicit
END SOLUTION CLASSES
CHEMISTRY
  Photolysis
  End Photolysis
  Reactions
  End Reactions
  Heterogeneous
  End Heterogeneous
  Ext Forcing
  End Ext Forcing
END CHEMISTRY
```

Non-transported chemical tracers

mechanism file:

```
SPECIES

   ...

   NOT-TRANSPORTED
     OH, e, ..
   END NOT-TRANSPORTED

END SPECIES
```

build script:

```
$cfgdir/configure \
     -chem waccm_mozart \
     -usr_mech_infile $mechanism_file \
```

Flexible Photolysis

- Easier to change photolysis
- Only the cross sections needed are read in
- Re-assignment of rates are straight forward

```
     Photolysis
[jo2_a=userdefined,] O2 + hv -> O + O1D
[jo2_b=userdefined,] O2 + hv -> 2*O
[jo3_a]              O3 + hv -> O1D + O2_1D
[jo3_b]              O3 + hv -> O + O2
[jn2o]               N2O + hv -> O1D + N2
 ...
[jh2o2]              H2O2 + hv -> 2*OH
[jch3ooh]            CH3OOH + hv -> CH2O + H + OH
[jpooh->,jch3ooh]    POOH + hv -> CH3CHO + CH2O + HO2 + OH
[jch3co3h->,0.28*jh2o2] CH3COOOH + hv -> CH3O2 + OH  + CO2
 ...
[jeuv_1=userdefined,userdefined]    O + hv -> Op + e
[jeuv_2=userdefined,userdefined]    O + hv -> Op + e
 ...
     End Photolysis
```