Scientific Studies
(Experimental Design and Analysis)

- from a user's point of view

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2012 GFDL Summer School

Overview

- Check out standard xml files with cvs
- Customize xml for your own research
- Edit input data and parameter settings
- Edit output variables and diagTable
- Set simTime and runTime for your own experiments
- Create your own analysis figures
- Discuss model outputs and analyze figures with fbrowser

To acquire xml files that have been tested with code releases

```
> cvs co -r (RELEASE) xml
```

- Code releases named after cities such as siena_201204 (Please don't try in class at the same time)
- Standard xml from a formal release may not satisfy your own research needs
- You can design your own experiments based on newly released model code by modifying xml

Customize xml for your own research

```
<?xml version="1.0"?>

<!--
  Simplified AM3 xml (20120618_ssam revision, siena_201204)
  For more info:
http://wiki.gfdl.noaa.gov/index.php/2012_GFDL_Summer_School_101
-->

<experimentSuite rtsVersion="4"
                 xmlns:xi="http://www.w3.org/2003/XInclude">

  <property name="RELEASE"  value="siena_201204"/>
  <property name="FRE_STEM" value="ssam2012/$(RELEASE)"/>
  <property name="ANALYSIS_SWITCH"  value="on"/>
```

Customize xml

```
  <setup>
    <platform name="ncrc2.intel">
      <project>gfdl_f_c2</project>
      <directory stem="$(FRE_STEM)">
        <src>$HOME/$(stem)/$(name)/src</src>
        <scripts>$HOME/$(stem)/scripts/$(platform)-$(target)</scripts>
        <stdout>
/lustre/ltfs/scratch/$USER/$(stem)/$(name)/$(platform)-$(target)/stdout
        </stdout>
      </directory>
      <property name="F2003_FLAGS" value="-DINTERNAL_FILE_NML"/>
      <property name="CM3_INPUT_ROOT"
                value="/ncrc/home1/Larry.Horowitz/fms/riga/input" />
      <property name="SSAM_INPUT_ROOT"
                value="/ncrc/home2/Ni-Zhang.Golaz/ssam2012/input"/>
      <property name="FMS_ARCHIVE_ROOT"
                value="/lustre/ltfs/scratch/Larry.Horowitz/archive" />
      <csh><![CDATA[
        …...
      ]]></csh>
    </platform>
```

Customize xml

```
    <platform name="gfdl.ncrc2-intel">
      <directory stem="$(FRE_STEM)">
        <analysis>
/home/$USER/$(stem)/$(name)/analysis_figures
        </analysis>
      </directory>
      <property name="F2003_FLAGS" value="-DINTERNAL_FILE_NML"/>
      <property name="CM3_INPUT_ROOT"
                value="/home/cm3/ipcc_ar5/input" />
      <property name="SSAM_INPUT_ROOT"
                value="/home/niz/ssam2012/input" />
      <property name="FMS_ARCHIVE_ROOT" value="/archive"/>
      <csh><![CDATA[
        source $MODULESHOME/init/csh
        module use -a /home/fms/local/modulefiles
        module purge
        module load fre/bronx-2
        module load fre-analysis
        ]]>
      </csh>
    </platform>
```

Customize xml

```
<input>
  <namelist file="$(SSAM_INPUT_ROOT)/c48L48_am3p10.nml"/>
  <namelist file="$(SSAM_INPUT_ROOT)/mom4p1_22jun2012.ssam.nml"/>

  <namelist name="coupler_nml">
    months = $months,
    days   = $days,
    current_date = 2000,1,1,0,0,0,
    calendar = 'julian'
    dt_atmos = 1800,
    dt_cpld  = 7200,
    use_lag_fluxes = .true.
    concurrent = .false.
    do_ocean = .false.
    atmos_npes = $npes
    atmos_nthreads = $nthreads
  </namelist>
  ......
```

Customize xml

```
<namelist name="fv_core_nml">
  layout   = $fv_layout
  io_layout = $fv_io_layout
  … … …
</namelist>

<namelist name="atmosphere_nml">
  physics_window = $physics_window
</namelist>
......
```

```
  .......
  <namelist name="ice_model_nml">
    spec_ice = .true.,
    alb_sno = 0.80
    t_range_melt = 10.0
    layout = $ice_layout
    io_layout = $ice_io_layout
  </namelist>
  <namelist name="land_model_nml">
    layout   = $land_layout
    io_layout = $land_io_layout
    tau_snow_T_adj = 604800.,
  </namelist>
  <namelist name="ocean_model_nml">
    dt_ocean =7200,
    time_tendency='twolevel'
    vertical_coordinate='zstar'
    baroclinic_split = 1
    surface_height_split = 1
    barotropic_split = 80
    debug=.false.
    layout = $ocean_layout
    io_layout = $ocean_io_layout
  </namelist>
</input>
```

Customize xml

```
if ( "$npes" == "96" ) then
  .......
else if ( "$npes" == "288" ) then
  set nthreads = "1"
  set physics_window = "0,0"
  set fv_layout    =  "4,12"; set fv_io_layout    = "1,12"
  set land_layout  =  "4,12"; set land_io_layout  = "1,12"
  set ocean_layout = "12,24"; set ocean_io_layout = "1,24"
  set ice_layout   = "12,24"; set ice_io_layout   = "1,24"
else if ( "$npes" == "432" ) then
  set nthreads = "1"
  set physics_window = "0,0"
  set fv_layout    =  "6,12"; set fv_io_layout    = "1,12"
  set land_layout  =  "6,12"; set land_io_layout  = "1,12"
  set ocean_layout = "18,24"; set ocean_io_layout = "1,24"
  set ice_layout   = "18,24"; set ice_io_layout   = "1,24"
else if ( "$npes" == "576" ) then
  set nthreads = "2"
  set physics_window = "12,2"
  set fv_layout    =  "4,12"; set fv_io_layout    = "1,12"
  set land_layout  =  "4,12"; set land_io_layout  = "1,12"
  set ocean_layout = "12,24"; set ocean_io_layout = "1,24"
  set ice_layout   = "12,24"; set ice_io_layout   = "1,24"
  .......
```

Customize xml

```
<dataFile label="input" target="INPUT/" chksum="" size="" timestamp="">
   <dataSource platform="$(platform)">
$(FMS_ARCHIVE_ROOT)/cm3/ipcc_ar5/input/historical/emissions.1x1.1859_2020.tar
   </dataSource>
</dataFile>

<dataFile label="initCond" target="INPUT/" chksum="" size="" timestamp="">
   <dataSource platform="$(platform)">
/lustre/ltfs/scratch/Ni-Zhang.Golaz/ssam2012/input/siena_201204_20yr/
restart/20000101.tar
   </dataSource>
</dataFile>

<dataFile label="gridSpec" target="INPUT/" chksum="" size="" timestamp="">
   <dataSource platform="$(platform)">
$(FMS_ARCHIVE_ROOT)/cm3/ipcc_ar5/input/common/C48.C48.tripolar.mosaic.cpio
   </dataSource>
</dataFile>

<dataFile label="fieldTable" target="INPUT/" chksum="" size="" timestamp="">
   <dataSource platform="$(platform)">
$(CM3_INPUT_ROOT)/field_table/field_table_am3p8_o3s
   </dataSource>
</dataFile>
```

AM3_ssam01.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_control" inherit="c48L48_am3p10">

</experiment>
```

AM3_ssam11.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_radiative_gases_co2"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="radiative_gases_nml">
      verbose = 3
      gas_printout_freq = 240
      time_varying_co2 = .false.,
      co2_variation_type = 'linear',
      co2_dataset_entry = 1860,1,1,0,0,0  (can be any year between 1860-2010)
      co2_specification_type = 'time_series',
      co2_floor = 100.0E-06,
      co2_ceiling = 1600.0E-06,
      co2_data_source = 'input'
      ... ... ...
      f22_data_source = 'input' /
    </namelist>
  </input>
</experiment>
```

Change time varying CO2 to a fixed value at year 1860's level. (please see V. Ramaswamy and Dan Schwarzkopf's talk).

AM3_ssam12.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_dust_emis" inherit="c48L48_am3p10_control">
  <input>
    <namelist name="dust_nml">
      dust_source_name = 'source',
      dust_source_filename = 'dust_source_Iceland_1x1.nc'
      uthresh = 1.
      coef_emis = 5.0e-9          (1.25e-10 in controlled run)
    </namelist>
  </input>
</experiment>
```

Global coefficient to scale the dust emissions.

The new setting is the Last Glacial Maximum (LGM) condition, dust source locations were very different compare to current days.

AM3_ssam06.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_entrain_beta_rad"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="entrain_nml">
      convect_shutoff = .true.,
      apply_entrain = .true.,
      parcel_buoy   = 0.25,
      parcel_option = 2,
      beta_rad      = 0.23,          (0.5 in controlled run)
      Ashear        = 25.0,
      radperturb    = 0.10,
      critjump      = 0.10,
      num_pts_ij    = 0,
      i_entprt_gl   = 112, 96, 89,105, 81, 97,
      j_entprt_gl   =  71, 61, 56, 64, 53, 46
    </namelist>
  </input>
</experiment>
```

Parameter that controls the cloud top entrainment in PBL scheme

AM3_ssam07.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_strat_cloud_vfact"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="strat_cloud_nml">
      use_online_aerosol = .true.,
      ... ... ...
      Vfact = 1.0           (1.5 in controlled run)
      cfact = 1.0
      do_liq_num = .true.
      use_kk_auto = .false.
      var_limit = 0.7
      num_mass_ratio1 = 1.0
      num_mass_ratio2 = 0.
      use_sub_seasalt = .false.
    </namelist>
  </input>
</experiment>
```

Parameter to scale the ice sedimentation velocity, to make snow falls faster or slower

AM3_ssam04.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_donner_deep_PES"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="donner_deep_nml">
      do_donner_lscloud = .true.
      do_dcape          = .true.        (false in controlled run)
      do_lands          = .false.
      do_freezing_for_cape = .true.
      do_freezing_for_closure = .true.
      gama              = 0.0
      tau               = 28800.
      tke0              = 0.5
      cape0             = 1000.
      lochoice          = 10
      do_capetau_land   = .false.
      use_llift_criteria= .true.        (false in controlled run)
      ... ... ...
    </namelist>
  </input>
</experiment>
```

This experiment setting is to obtain “Parcel Equilibrium Solution” With improved MJO and rain fall intensity distribution. Discussion of this change is in the paper Donner et al (2011, J. Climate)

AM3_ssam05.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_donner_deep_capeThreshold"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="donner_deep_nml">
      do_donner_lscloud = .true.
      do_dcape          = .false.
      do_lands          = .false.
      do_freezing_for_cape = .true.
      do_freezing_for_closure = .true.
      gama              = 0.0
      tau               = 28800.
      tke0              = 0.5
      Cape0             = 3000.      (1000 in controlled run)
      lochoice          = 10
      do_capetau_land   = .false.
      use_llift_criteria= .false.
      ... ... ...
    </namelist>
  </input>
</experiment>
```

The **above** experiment "donner_deep_capeThreshold" is to change cape threshold for deep convection. Discussion about both of these can be found in the same paper Donner et. al. (2011, J. Climate, section 3e)

AM3_ssam14.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_donner_deep_capeRelaxation"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="donner_deep_nml">
      do_donner_lscloud = .true.
      do_dcape          = .false.
      do_lands          = .false.
      do_freezing_for_cape = .true.
      do_freezing_for_closure = .true.
      gama              = 0.0
      Tau               = 3600.      (28800 in controlled run)
      ... ... ...
      arat =  1.0, 0.26, 0.35, 0.32, 0.3, 0.54, 0.66
      erat =  1.0, 1.30, 1.80, 2.50, 3.3, 4.50, 10.0
    </namelist>
  </input>
</experiment>
```

This experiment “donner_deep_capeRelaxation” changes cape relaxation time. Discussion about both of these can be found in the same paper Donner et. al. (2011, J. Climate, section 3e)

AM3_ssam15.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_donner_deep_MP"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="donner_deep_nml">
      ... ... ...
      ANVIL_PRECIP_EFFICIENCY = 0.51      (0.55 in controlled run)
      MESO_DOWN_EVAP_FRACTION = 0.48      (0.4  in controlled run)
      MESO_UP_EVAP_FRACTION   = 0.01      (0.05 in controlled run)
      wmin_ratio      = 0.05,
      arat =  1.0, 0.26, 0.35, 0.32, 0.3, 0.54, 0.66
      erat =  1.0, 1.30, 1.80, 2.50, 3.3, 4.50, 10.0
    </namelist>
  </input>
</experiment>
```

"donner_deep_MP" is an experiment to change moisture partitioning in mesoscale. All numbers must sum to 1.

Discussions can be found in Donner (1993, J. Atmos Sci)

AM3_ssam08.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_uw_conv_rkm_sh"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="uw_conv_nml">
      use_online_aerosol = .true.,
      iclosure        = 0,
      rkm_sh          = 10.0,            (13.5 in controlled run)
      cldhgt_max      = 50.e3,
      do_uwcmt        = .false.,
      apply_tendency  = .true.,
      wmin_ratio      = 0.05,
      do_lands        = .false.
      .........
    </namelist>
  </input>
</experiment>
```

Controls lateral entrainment rate in shallow convection scheme. Higher value of rkm_sh will increase the entrainment and affect the precipitation (please see Ming Zhao's talk).

AM3_ssam09.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_uw_plume_auto_th0"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="uw_plume_nml">
      rmaxfrac = 0.15
      auto_th0 = 1.5e-3,              (0.5e-3 in controlled run)
      tcrit    = -50.0,
      wmin     = 0.5,
      deltaqc0 = 0.5e-3
      do_pdfpcp= .false.
      do_pmadjt= .true.
      do_emmax = .true.
      do_pnqv  = .true.
    </namelist>
  </input>
</experiment>
```

Parameter to control the onset of precipitation in shallow convection scheme, larger value make it harder to precipitate. (please see Ming Zhao's talk)

AM3_ssam02.xml: Experiment and Parameter settings

```
<experiment name="c48L48_am3p10_tropchem_lght"
            inherit="c48L48_am3p10_control">
  <input>
    <namelist name="tropchem_driver_nml">
      ... ... ...
      file_ub = 'ub_vals.mozart.nc',
      file_dry = 'depvel.nc',
      inv_list = '',
      file_aircraft = 'emissions.aircraft.1x1.1859_2020.nc',
      lght_no_prd_factor = 0.8,          (0.6 in controlled run)
      ... ... ...
    </namelist>
  </input>
</experiment>
```

Coefficient controlling the global production of NOx by lightning.
(please see Larry Horowitz's talk)

AM3_ssam13.xml: Experiment and Input Data Variation

```
  <experiment name="c48L48_am3p10_so2_emission" inherit="c48L48_am3p10_control">
    <input>
       ... ... ...
       ... ... ...
       <dataFile label="input" target="INPUT/" chksum="" size="" timestamp="">
         <dataSource platform="$(platform)">
$(FMS_ARCHIVE_ROOT)/cm3/ipcc_ar5/input/common/tropchem_oct2011.cpio
         </dataSource>
       </dataFile>
       ... ... ...

       <dataFile label="input" target="INPUT/" chksum="" size="" timestamp="">
          <dataSource platform="$(platform)">
$(FMS_ARCHIVE_ROOT)/cm3/ipcc_ar5/input/historical/emissions.1x1.1859_2020.tar
          </dataSource>
          <dataSource platform="$(platform)">
/lustre/ltfs/scratch/Ni-Zhang.Golaz/ssam2012/input/emissions/2xso2/
emissions.so2.1x1.1859_2020.nc
          </dataSource>
       </dataFile>
    </input>
  </experiment>
```

Double SO2 emission in the input data (please see Larry Horowitz's talk)

A short script to modify historical SO2 emission file

> mkdir -p ssam2012/input/emisssions/so2
> cd ssam2012/input/emissions/so2
> cp /lustre/ltfs/scratch/Ni-Zhang.Golaz/ssam2012/input/emissions/so2/* .

The sample bash script:

==========

```
#!/bin/bash -x

### CHECK IDIR and ODIR, make sure they are right for you ###
IDIR=/lustre/ltfs/scratch/Ni-Zhang.Golaz/ssam2012/input/emissions/so2
ODIR=/lustre/ltfs/scratch/Ni-Zhang.Golaz/ssam2012/input/emissions/2xso2
mkdir -p $ODIR

tmpDir=/lustre/fs/scratch/Ni-Zhang.Golaz/tmp
cd $tmpDir
cp $IDIR/emissions.so2.1x1.1859_2020.nc .

infile=$tmpDir/emissions.so2.1x1.1859_2020.nc
outfile=$ODIR/emissions.so2.1x1.1859_2020.nc

ncap -s "anthro=anthro*2" $infile tmp.nc
ncatted -a
history,anthro,o,c,"SO2:emiss_awb+SO2:emiss_dom+SO2:emiss_ene+SO2:emiss_ind+SO2:emiss_tra+SO2:emiss_wst"
-a long_name,anthro,o,c,"anthropogenic emissions (incl. biofuels)" -a units,anthro,o,c,"molecules/cm2/s" tmp.nc

mv tmp.nc $outfile
rm -f tmp.nc
```

AM3_ssam03.xml: Experiments and Parameter settings

```
<experiment name="c48L48_am3p10_aerosolrad" inherit="c48L48_am3p10_control">
  <input>
    <namelist file="$(SSAM_INPUT_ROOT)/c48L48_am3p10_sulf.nml"/>
    <namelist name="land_model_nml">
      layout   = $land_layout
      io_layout = $land_io_layout
      tau_snow_T_adj = 604800.,
    </namelist>
  </input>
</experiment>
```

New namelist at:
/ncrc/home2/Ni-Zhang.Golaz/ssam2012/input/c48L48_am3p10_sulf.nml

Changes sulfate_indices upper bound to limit the hygroscopic growth of sulfate aerosols (please also see Yi Ming and Larry Horowitz's talk).

Output variables

- Choose output variables for your own research
  - The simplified diagTable creates about 2Gb / year diagnostic output vs. extended version at about 70Gb /year
- Output variable names can be different than in the model
  - Convenient for inter-model comparisons

Output variables

```
      <diagTable>
$name
$baseDate
# Simplified diag_table for running AM3 AMIP experiments
"grid_spec",            -1, "months",  1, "days", "time",
"atmos_8xdaily",         3,  "hours",  1, "days", "time",
"atmos_daily",          24,  "hours",  1, "days", "time",
"atmos_month",           1, "months",  1, "days", "time",
"atmos_month_aer",       1, "months",  1, "days", "time",
"atmos_tracer",          1, "months",  1, "days", "time",

# #########
# grid_spec
# #########
"dynamics", "grid_lon",  "grid_lon",  "grid_spec", "all", .false.,  "none", 2
"dynamics", "grid_lat",  "grid_lat",  "grid_spec", "all", .false.,  "none", 2
......

# #############
# atmos_8xdaily
# #############
"moist",  "precip",  "precip",    "atmos_8xdaily",   "all", .true.,  "none", 2
"moist",  "prec_ls", "prec_ls",   "atmos_8xdaily",   "all", .true.,  "none", 2
......
```

Output variables

```
......
# ###########
# atmos_daily
# ###########
"flux",      "land_mask",  "land_mask",  "atmos_daily", "all", .false., "none", 2
"dynamics",  "zsurf",      "zsurf",      "atmos_daily", "all", .false., "none", 2
"radiation", "olr",        "olr",        "atmos_daily", "all", .true.,  "none", 2
"flux",      "t_ref",      "t_ref_min",  "atmos_daily", "all",  min,    "none", 2
"flux",      "t_ref",      "t_ref_max",  "atmos_daily", "all",  max,    "none", 2
# ###########
# atmos_month
# ###########
......
"dynamics",  "slp",        "slp_dyn",    "atmos_month", "all", .true.,  "none", 2
"moist",     "precip",     "precip",     "atmos_month", "all", .true.,  "none", 2
"moist",     "prec_conv",  "prec_conv",  "atmos_month", "all", .true.,  "none", 2
......
# ###############
# atmos_month_aer
# ###############
......
"radiation", "so4",     "sulfate",    "atmos_month_aer", "all", .true., "none", 2
"radiation", "so4_col", "sulfate_col","atmos_month_aer", "all", .true., "none", 2
......
      </diagTable>
```

Run Configuration

```
<runtime>
     <production simTime="11" units="years" npes="576" runTime="16:00:00">
        <segment simTime="12" units="months" runTime="05:20:00"/>
     </production>

     <regression name="basic">
        <run days="8" npes="288" runTimePerJob="00:45:00"/>
     </regression>
      … … …
</runtime>
<postProcess>
    <component type="atmos" zInterp="era40" start="2001" source="atmos_month"
               cubicToLatLon="90,144">
       <timeSeries freq="3hr" source="atmos_8xdaily" chunkLength="5yr"/>
       … … …
    </component>
</postProcess>
```

- Changes in the atmosphere are relatively quick
- With different parameter settings, changes in the results are evident even in a short run of 3 years
- For sensitivity analysis, use only **three year runs** in your exercises

Analysis figures

- GFDL has a set of standard figures that are part of the workflow. (see Amy Langenhorst's post-processing talk.)
- You can create your own analysis figure scripts and add them into your XML.
- You can also utilize diagnostic packages from other institutions and implement them into GFDL's workflow.
- GFDL scientist Charles Seman has created analysis scripts to make model-to-observation figures using NASA's A-Train datasets, and also adapted UCAR's AMWG Diagnostics Package (See 2012 Summer School Diagnostics Exercises).

Customizing The XML For Your Own Analysis

```
  <experiment name="c48L48_am3p10_3yrs" inherit="c48L48_am3p10">
    <postProcess>
      <component type="atmos" zInterp="era40" start="2001" source="atmos_month"
                                          cubicToLatLon="90,144">
        <timeSeries freq="monthly" chunkLength="2yr">
          <xi:include href="/home/fms/local/opt/fre-
analysis/test/cjg/xml/analysis_scripts.xml"
xpointer="xpointer(*/atmosMonthTS/*)">
            <xi:fallback/>
          </xi:include>
        </timeSeries>
        <timeAverage source="monthly" interval="2yr">
          <xi:include href="/home/fms/local/opt/fre-
analysis/test/cjg/xml/analysis_scripts.xml"
xpointer="xpointer(*/atmosMonthAve/*)">
            <xi:fallback/>
          </xi:include>
          <analysis script="/home/YourID/...../...../myFigure_diag.csh"/>
          <analysis script="/home/YourID/fms.ana/fre-
analysis/...../...../myFigure_atmos_av_mon.csh"/>
        </timeAverage>
      </component>
    </postProcess>
  </experiment>
```

Discussion of model outputs and analysis figures

Analysis tools – /home/fms/bin/fbrowser
ncview for viewing netCDF files
Ferret to analyze netCDF files
MatLab (license required)

Summary

- Designing your own experiment with GFDL models requires some familiarity with GFDL's workflow and XML.

- Setting up your own experiment for research may not require changing model code. Many projects can be done by utilize settings in XML.

- GFDL's workflow allows scientists to spend more time on science and less time on technical details.

Useful Analysis Figures:

* Annual top-of-the-atmosphere radiation: model vs CERES-EBAF ed 2.6
  - SW absorbed – Klein.radiation/Seman.swabs.ceres_ebaf_ed2.6/swabs.ceres_ebaf_ed2.6.ann.ps.gz
  - Outgoing longwave radiation (OLR) – Klein.radiation/Seman.olr.ceres_ebaf_ed2.6/olr.ceres_ebaf_ed2.6.ann.ps.gz
  - Net radiation – Klein.radiation/Seman.netradtoa.ceres_ebaf_ed2.6/netradtoa.ceres_ebaf_ed2.6.ann.ps.gz
  - SW cloud forcing – Klein.radiation/Seman.swcf.ceres_ebaf_ed2.6/swcf.ceres_ebaf_ed2.6.ann.ps.gz
  - LW cloud forcing – Klein.radiation/Seman.lwcf.ceres_ebaf_ed2.6/lwcf.ceres_ebaf_ed2.6.ann.ps.gz

* Annual surface precipitation: model vs GPCP v2 – Klein.precip.gpcpv2/precip.gpcpv2.ann.ps.gz

* Partitioning of the precipitation between various cloud schemes – Golaz.av/prec_part.ps.gz

* Annual zonal mean temperature: model vs ERA – Wyman.zmtemp_logp.era/zmtemp_logp.ann.ps.gz

* Annual zonal mean u wind: model vs ERA – Wyman.zmu_logp.era/zmu_logp.ann.ps.gz

* Annual 200mb u wind – Kushner.u200/u200.ann.ps.gz

* Annual 850mb u wind – Kushner.u850/u850.ann.ps.gz

* Annual daily average surface air temperature: model vs CRU – Wyman.t_ref/ave/t_ref_ave.global.ann.ps.gz

* Cloud liquid water path – Klein.all_lwpwg/all_lwpwg.ann.ps.gz

* Total cloud amount – Klein.totcldamt/totcldamt.ann.ps.gz

* Aerosol diagnostics – Ginoux.aerosol/aerosol_monthly_1981-2000.ps.gz