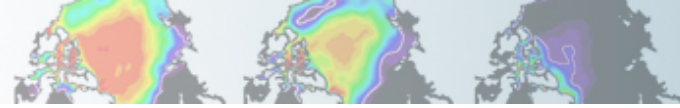# Ocean / Sea-ice Tutorial Session

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Your Friends: The Users Guides
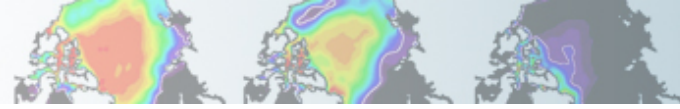
CESM Users Guide:

http://www.cesm.ucar.edu/models/cesm2

CICE Users Guide:

http://www.cesm.ucar.edu/models/cesm2/sea-ice

POP2 and Ecosystem Users Guides:

http://www.cesm.ucar.edu/models/cesm2/ocean

Getting Help/Getting Involved

- Read the documentation.

- Use the CESM bulletin board (http://bb.cgd.ucar.edu/) to tap into community expertise and to share solutions to common problems

- Send mail to cesm-help@cgd.ucar.edu

- Join a CESM Working Group
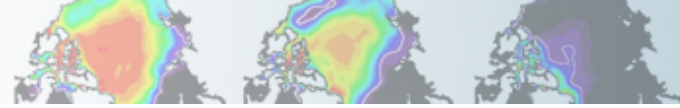
Today's Exercises

1. Control case (out-of-the-box)

2. Ocean model overflow turn-off experiment

3. Ice model "albedo" increase experiment

4. Increase zonal wind stress in the ocean

- You will be using the "G" component set at T62_g37 resolution.
- Each simulation will be run for 1 year.
- You will then use 'ncview' to see how each experiment differs from the control simulation.

What is a G case?

(G) 2000_DATM%NYF_SLND_CICE_POP2_DROF%NYF_SGLC_WW3

(G1850ECO) 1850_DATM%NYF_SLND_CICE_POP2%ECO_DROF%NYF_SGLC_WW3

./query_config --compsets

./query_config --grids

- Coupled ocean – sea-ice

- Forced with the Coordinated Ocean-ice Reference Experiments (CORE) version 2, atmospheric data sets (Large and Yeager 2009)

- G by default is forced with normal year forcing (NYF)

    - 12 months of data that repeats

- GIAF is interannually varying forcing (we will not use this in the tutorial)

- Note that the CORE forcing is being replaced by the JRA55
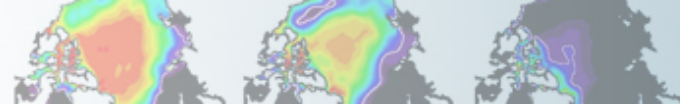
Ocean and Ice Resolved Namelists

> cd $CASE1

> ./case.setup

> cd CaseDocs
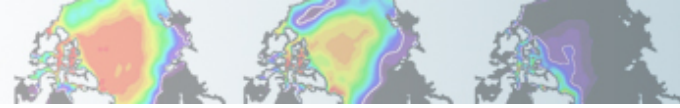
> ls

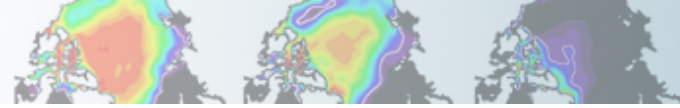ice_in   pop_in

* Note that you do not edit the resolved namelists. You put the relevant changes into user_nl_cice and user_nl_pop.

Ocean Namelist

```
 n_lat_aux_grid = 180
 n_salt_trans_requested = .true.
 n_transport_reg = 2
 transport_reg2_names = 'Atlantic Ocean', 'Mediterranean Sea', 'Labrador Sea', 'GIN Sea', 'Arctic Ocean', 'Hudson Bay'
/
&context_nml
 b4b_flag = .false.
 lccsm = .true.
 lccsm_control_compatible = .false.
 lcoupled = .true.
 ldebug = .false.
/
&overflows_nml
 overflows_diag_outfile = '/glade/scratch/dbailey/gtest/run/./gtest.pop.do'
 overflows_infile = '/glade/scratch/dbailey/gtest/run/gx1v7_overflow'
 overflows_interactive = .true.
 overflows_on = .true.
 overflows_restart_type = 'ccsm_startup'
 overflows_restfile = './gtest.pop.ro'
/
&niw_nml
 lniw_mixing = .false.
 niw_boundary_layer_absorption =  0.7
 niw_energy_file = '/glade/p/cesmdata/cseg/inputdata/ocn/pop/gx1v6/forcing/niw_gx1v6_20100915.ieeer8'
 niw_energy_file_fmt = 'bin'
 niw_energy_type = 'blke'
 niw_local_mixing_fraction = 0.5
 niw_mix_max = 100.0
 niw_mixing_efficiency = 0.2
 niw_obs2model_ratio = 2.0
 niw_vert_decay_scale = 2000.0e02
/
```

Sea-Ice Namelist

```
   aspect_rapid_mode = 1.0
   conduct = "MU71"
   dsdt_slow_mode = -1.5e-07
   kitd = 1
   ktherm = 2
   phi_c_slow_mode = 0.05
   phi_i_mushy = 0.85
   rac_rapid_mode = 10
/
&dynamics_nml
   advection = "remap"
   cf = 17.0
   kdyn = 1
   krdg_partic = 1
   krdg_redist = 1
   kstrength = 1
   mu_rdg = 4.0
   ndte = 120
   revised_evp = .false.
/
&shortwave_nml
   ahmax = 0.3
   albedo_type = "default"
   albicei = 0.45
   albicev = 0.75
   albsnowi = 0.73
   albsnowv = 0.98
   dt_mlt = 1.50
   kalg = 0.0
   r_ice = 0.0
   r_pnd = 0.0
   r_snw = 1.25
   rsnw_mlt = 1500.
   shortwave = "dEdd"
/
```
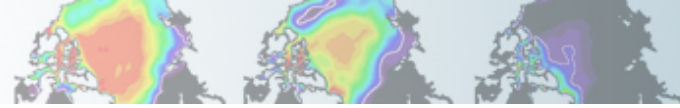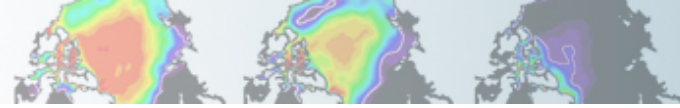
Exercise #1
Control Simulation

1. Make sure to do "unsetenv CESM_BLD_TEMPLATE" or delete this from your startup script!

2. Create a new case using the following details. Indicate in the case name that this is the "control".

    - component set: G

    - resolution: T62_g37

2. The default is for the simulation to run for 5 days. Change this to 1 year in env_run.xml

3. Build and run the model.

4. *Optional* Try setting up a similar case with the G1850ECO component set. Note the differences with the G component set. You can run this if you wish.

  Don't forget to run case.setup!

Exercise #2

Turn off the overflow parameterization

1. Create a clone of your control simulation. Verify that it retained the run time of 1 year. In the $CODEROOT/cime/scripts directory, issue the following command:

   create_clone --case $NEWCASEDIR --clone $OLDCASEDIR

2. In $NEWCASEDIR, add the relevant namelist changes to the user_nl_pop file in the following way. (Hint: search for overflows_nml in CaseDocs/pop_in)

   overflows_on = .false.

   overflows_interactive = .false.

3. Build and run the model for 1 year.
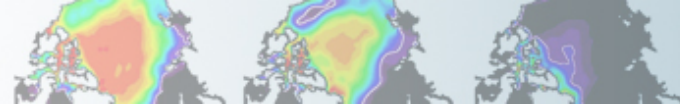
Exercise #3

## Change the snow albedo (on sea ice)

1. Create a clone of your control simulation.

2. Find the r_snw namelist parameter (in CaseDocs/ice_in) and increase this value to +2.00, by adding the change to user_nl_cice.

3. Build and run the model for 1 year.

   * Note that this is a tuning parameter that specifies the number of standard deviations away from the base optical properties in the shortwave radiative transfer code.

   rsnw_nonmelt = 500 – r_snw * 250 (in microns);
     - higher r_snw → lower rsnw_nonmelt,
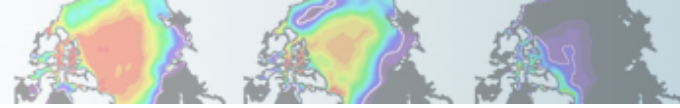   - lower rsnw_nonmelt → higher albedos
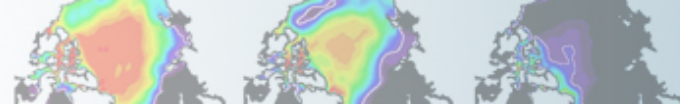
More advanced modifications that require changes in the source model modules / subroutines: SourceMods

> cd $CASEDIR

> ls SourceMods

   src.cice   src.pop …………

Exercise #4
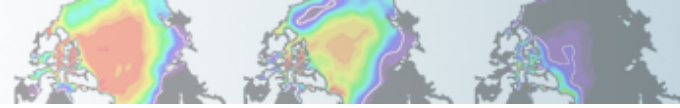
Increase zonal wind stress in the ocean

1. Create a clone of your control simulation.

2. Copy forcing_coupled.F90 file:

    cp $CODEROOT/components/pop/source/forcing_coupled.F90
        $CASEDIR/SourceMods/src.pop

3. Modify subroutine rotate_wind_stress in forcing_coupled.F90 to increase the first (x) component of the wind stress by 25%.

4. Build and run the model for 1 year.

```fortran
!BOP
! !IROUTINE: rotate_wind_stress
! !INTERFACE:

  subroutine rotate_wind_stress (WORK1,WORK2)

! !DESCRIPTION:
!   This subroutine rotates true zonal/meridional wind stress into local
!   coordinates, converts to dyne/cm**2, and shifts SMFT to the U grid
!
! !REVISION HISTORY:
!  same as module

! !INPUT PARAMETERS:

  real (r8), dimension(nx_block,ny_block,max_blocks_clinic), intent(in) ::   &
     WORK1, WORK2          ! contains taux and tauy from coupler


!EOP
!BOC
#if CCSMCOUPLED
!-----------------------------------------------------------------------
!
!  local variables
!
!-----------------------------------------------------------------------

  integer (kind=int_kind) :: iblock
  integer (POP_i4)        :: errorCode


!-----------------------------------------------------------------------
!
!  rotate and convert
!
!-----------------------------------------------------------------------

  SMFT(:,:,1,:) = (WORK1(:,:,:)*cos(ANGLET(:,:,:)) +  &
                   WORK2(:,:,:)*sin(ANGLET(:,:,:)))*  &
                  RCALCT(:,:,:)*momentum_factor
  SMFT(:,:,2,:) = (WORK2(:,:,:)*cos(ANGLET(:,:,:)) -  &
                   WORK1(:,:,:)*sin(ANGLET(:,:,:)))*  &
                  RCALCT(:,:,:)*momentum_factor
```
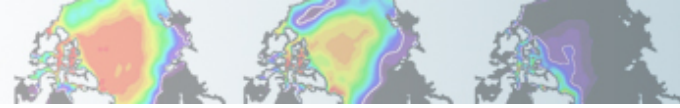
Post Processing and Viewing

1. Create an annual average of the 1st year's data for each of the simulations using the 'ncra' command.

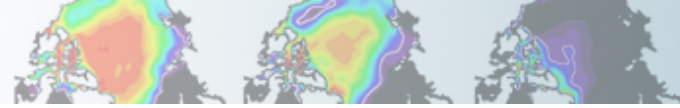   ncra $OUTPUT_DIR/*.pop.h.0001*nc $CASENAME.pop.h.0001.nc

2. Create a file that contains the differences between each of the experiments and the control simulation.

   ncdiff $CASENAME.pop.h.0001.nc $CONTROLCASE.pop.h.0001.nc
          $CASENAME_diff.nc

3. Examine the variables within each annual mean and the difference files using 'ncview'.

   ncview $FILENAME.nc

4. You can also take a look at other monthly-mean outputs or component log files.

Exercise Questions

1. What variables do you expect to change when you turn off the overflow parameterization? What variables show a difference between this experiment and the control case and how different are they?

2. What changes do you see from the control case with an increased snow albedo? What time of year did you start your run and which season do you expect to see the biggest impact for shortwave changes?

3. What are the impacts of increased zonal wind stress? Where do you think the impacts would be the largest in the ocean?