Notes on running MOM5-SIS ocean/sea-ice simulations forced with JRA55-do surface dataset

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Abstract

This document provides the necessary steps to preprocess and prepare the JRA55-do surface atmospheric data sets for MOM5-SIS ocean-sea-ice simulations.

1 JRA55-do dataset

JRA55-do (Tsujino et al., 2018) is a surface dataset for driving ocean-sea ice models and used in phase 2 of OMIP (OMIP-2; Griffies et al., 2016). JRA55-do corrects the atmospheric reanalysis product JRA-55 using satellite and other atmospheric reanalysis products. The merits of JRA55-do are the high horizontal resolution (~55 km) and temporal interval (3 h). JRA55-do can suitably replace the current CORE/OMIP-1 dataset (Tsujino et al., 2020).

The JRA55-do datasets (Table 1) are downloaded from `input4MIPs` and any update from:

`https://climate.mri-jma.go.jp/pub/ocean/JRA55-do/`.

Presently, v1.5.0 covers the period 1958 to 2022.

2 Preprocessing of JRA55-do dataset

All forcing files are yearly, from 1958 to 2022. In order to produce a single file for each surface forcing variable we need to:

1. *Padding*: [optional] padding is necessary when using single files as it includes on each file the last and first time step of the previous and next year, respectively. This is done using the routines in `/pad_JRA_main`.
2. *Concatenation*: next we concatenate all years into a single file with the `NCO` command `ncrcat`. I have found that the `CDO` commands `mergetime` and `cat` would modify the metadata for variables and axes causing the FATAL error:
   "friver / couldnt recognize axis atts in time_interp_external".
3. *Edit the attributes*: the model might crash because `mpp_io_read.inc` returns a FATAL error:
   "VAR ATT too long".
   In this case modify the attributes with `nco`:
   `ncatted -h -O -a history,,d,,name_of_file.nc`
4. The required surface forcing files are:
   - `JRA_psl.1958_2022.nc`
   - `JRA_tas.1958_2022.nc`
   - `JRA_huss.1958_2022.nc`
   - `JRA_uas.1958_2022.nc`
   - `JRA_vas.1958_2022.nc`
   - `JRA_rlds.1958_2022.nc`
   - `JRA_rsds.1958_2022.nc`
   - `JRA_prra.1958_2022.nc`
   - `JRA_prsn.1958_2022.nc`

2.1 Interpolation of files

Some of the forcing fields, and the SSS restoring field, need to be interpolated onto the model grid.

1. *SSS*: Sea surface salinity is restored to the JRA field:
   `sos_input4MIPs_atmosphericState_OMIP_MRI-JRA55-do-1-5-0_gr_195501-2012-clima.nc`
   (a) SSS is interpolated using the routines in
   `/OM4_025_salt_restore` including `interp_and_fill.py`.
   Necessary input are `ocean_hgrid.nc` and `ocean_mask.nc`.
   (b) The model might crash because `mpp_io_read.inc` returns a FATAL error:*"VAR ATT too long"*.
   In this case modify the attributes with `nco`:
   `ncatted -h -O -a history,,d,,salt_sfc_restore.nc`
   `ncatted -h -O -a comment,,d,,salt_sfc_restore.nc`
   (c) The sea surface salinity restoring file, with variable `salt` is:
   - `salt_sfc_restore.nc`
2. *friver and licalvf*: Both liquid and solid runoff are regridded on the model grid.
   (a) (optional) First, both variables are padded.
   (b) Then, *friver and licalvf* are regridded using the routines in
   `/OM4_025_runoff` including `regrid_runoff.py`.
   Necessary input are `ocean_hgrid.nc` and `ocean_mask.nc`.
   (c) `kshedstrom@alaska_edu` suggested to modify both variables by remove NaNs (with xarray: `.fillna(0)`) and deleting the `_FillValue` attribute as FMS would not accept it.
   I have found this would cause the model to crash with a FATAL error:
   "friver / couldnt recognize axis atts in time_interp_external".
   (d) Finally, both variables are concatenated into a single file with the `NCO` command `ncrcat`:
   - `JRA_friver.1958_2022.nc`
   - `JRA_licalvf.1958_2022.nc`

3 Important namelist changes from CORE runs

JRA55-do forcing fields have a temporal frequency of 3 hours. Variables in past atmospheric states like CORE1 and CORE2 were provided at daily intervals, and the diurnal cycle for short wave was added through the SIS model. When using JRA55-do forcing dataset, it is important to set:

```
&ice_model
add_diurnal_sw = .false.
```

Table 1: JRA-55 based surface dataset for driving ocean/sea-ice models (JRA55-do)

variable	long name	units	frequency	resolution
uas	eastward near-surface (10m) wind speed	[m s^{-1}]	3hr	50 km
vas	northward near-surface (10m) wind speed	[m s^{-1}]	3hr	50 km
tas	Near-Surface (10 m) Air Temperature	[K]	3hr	50 km
huss	Near-Surface (10 m) Specific Humidity		3hr	50 km
psl	Sea Level Pressure	[Pa]	3hr	50 km
rsds	Surface Downwelling Shortwave Radiation	[W m^{-2}]	3hr	50 km
rlds	Surface Downwelling Longwave Radiation	[W m^{-2}]	3hr	50 km
prra	Rainfall Flux	[Kg m^{-2} s^{-1}]	3hr	50 km
prsn	Snowfall Flux	[Kg m^{-2} s^{-1}]	3hr	50 km
friver	Water Flux into Sea Water from Rivers (liquid water runoff)	[Kg m^{-2} s^{-1}]	day	25 km
licalvf	Land ice calving flux (solid ice runoff)	[Kg m^{-2} s^{-1}]	day	25 km

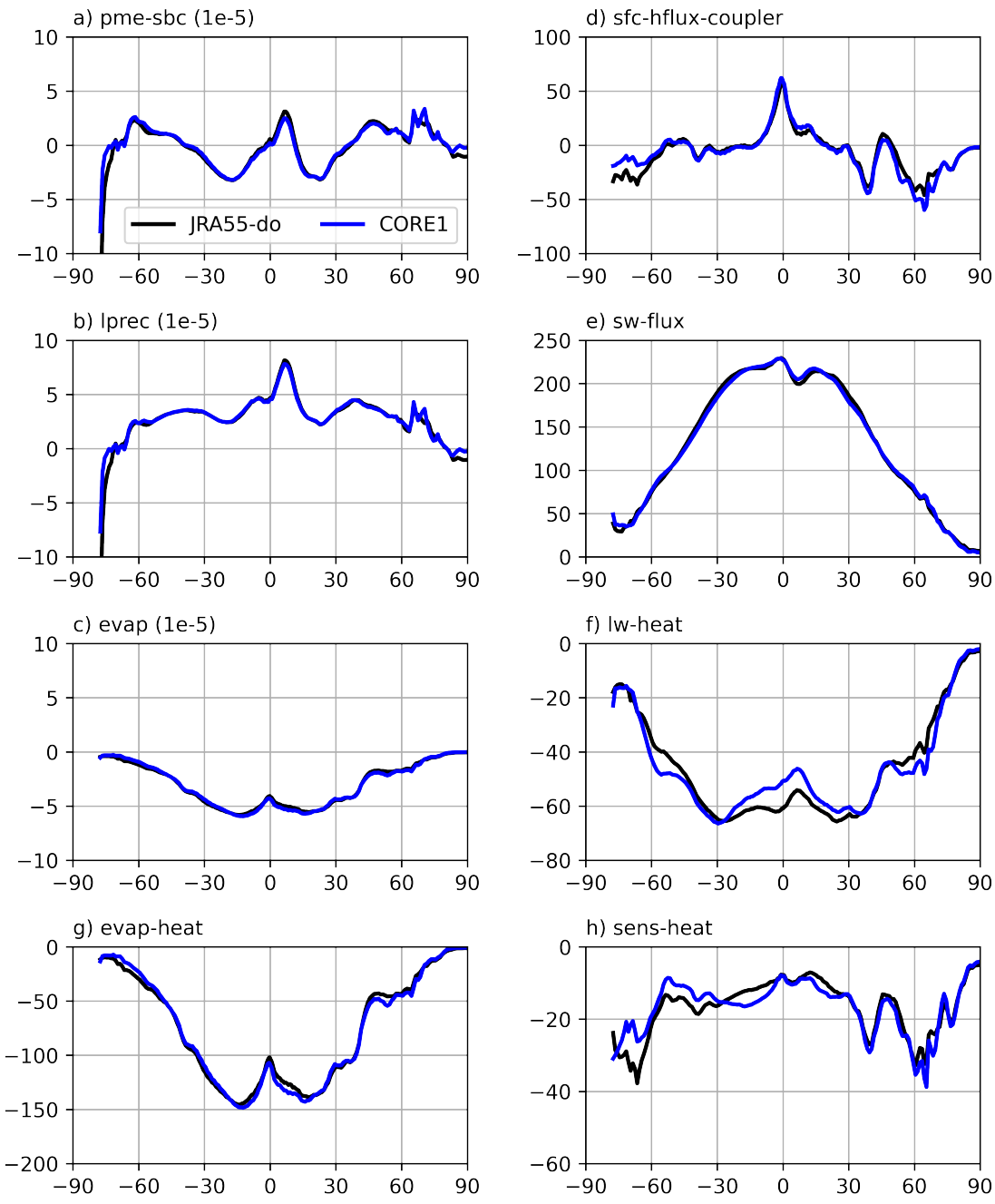

Figure 1: Zonal-mean fluxes in JRA55-do forced experiments (1958-2022 time-mean, black lines) and CORE1 climatology (blue lines).

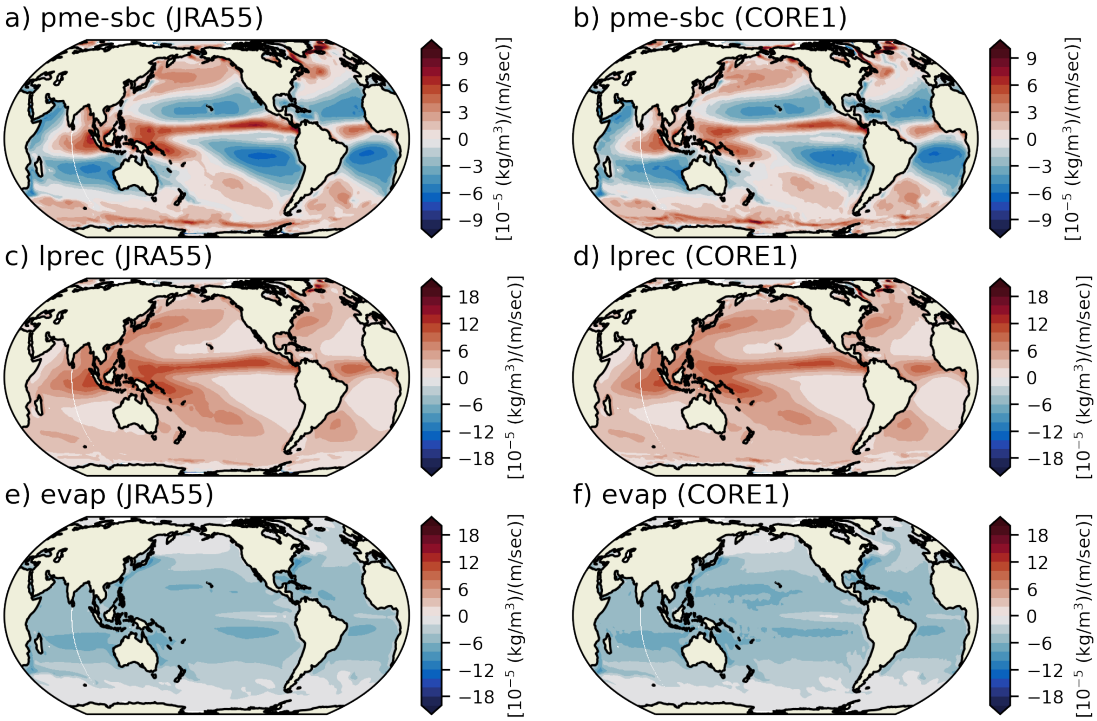

Figure 2: Fresh water fluxes in JRA55-do forced experiments (1958-2022 time-mean) and CORE1 climatology.

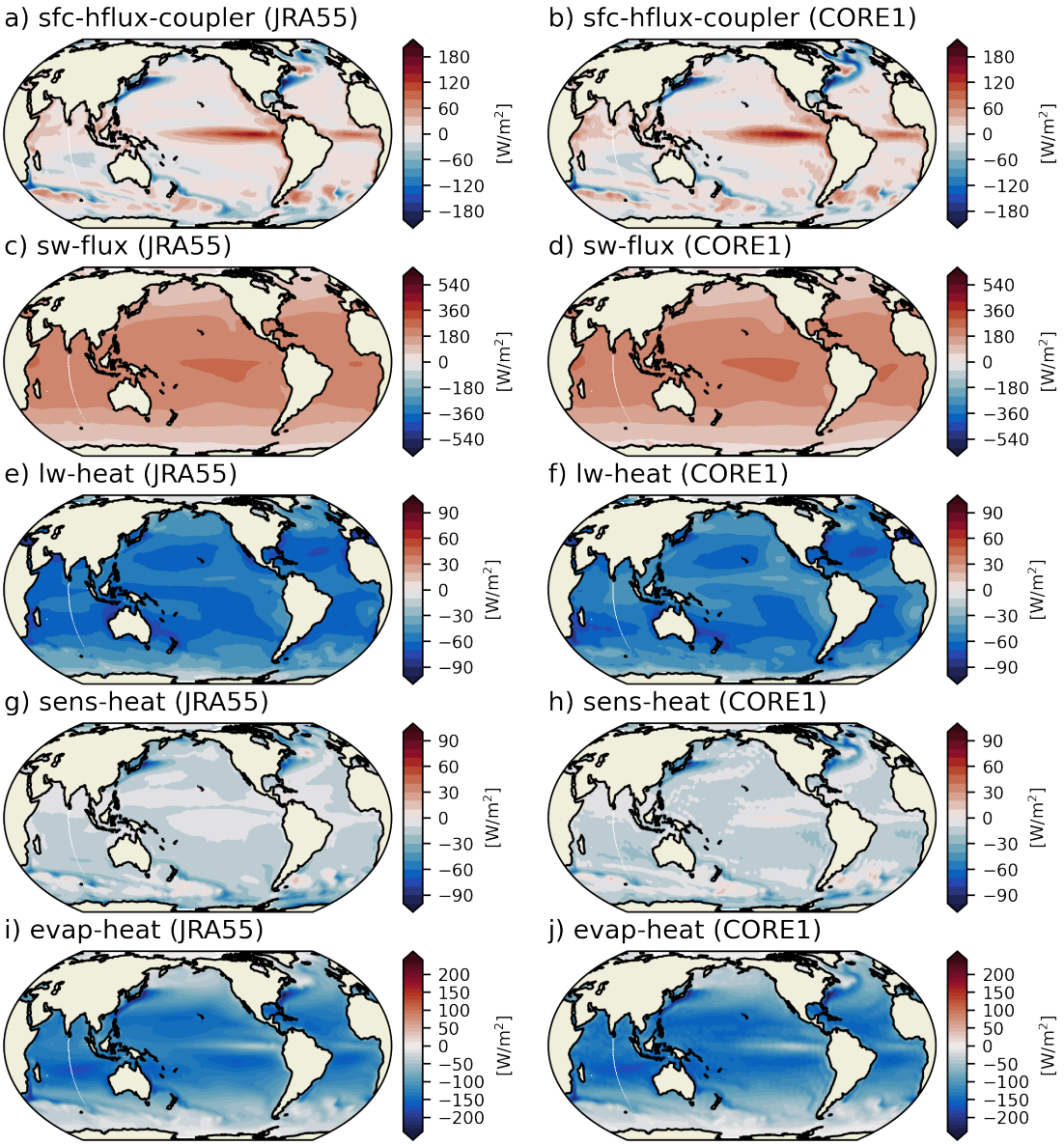

Figure 3: Heat fluxes in JRA55-do forced experiments (1958-2022 time-mean) and CORE1 climatology.

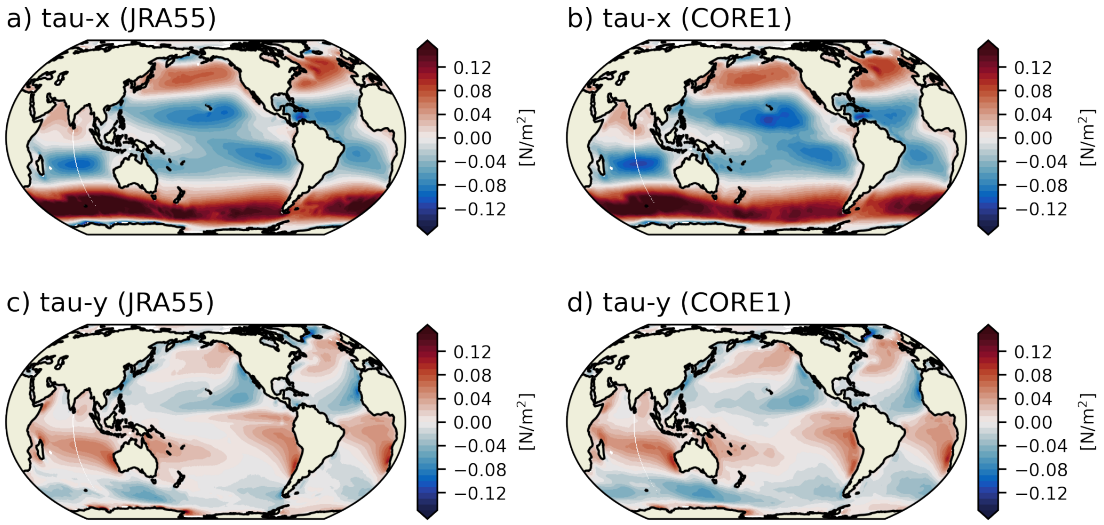

Figure 4: Wind stress in JRA55-do forced experiments (1958-2022 time-mean) and CORE1 climatology.

References

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