Generic Forcing Interface: Requirements and Design

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Contents

Chapter 1

Summary

MPAS-Ocean needs a forcing interface in order to couple with other components of a Climate system. This document details fields required to couple, along with potential interfaces that can be used for coupling. The coupling interface will be designed to be generic, meaning it can work in a standalone data driven run in addition to a fully coupled Climate system run.

Chapter 2

Requirements

2.1 Requirement: Generic Interface

Date last modified: 11/20/12
Contributors: (Doug Jacobsen)

The interface used for coupling should be generic meaning it should be driver run, similarly to other parts of the ocean model. Under the main driver each option of forcing will exist, where the options are something like annual mean forcing, monthly forcing, and coupled forcing.

2.2 Requirement: Generic Data Structures

Date last modified: 11/20/12
Contributors: (Doug Jacobsen)

As with the interface, the data structures used should be generic in the sense that any of the options for forcing can be used with the exact same data structures. Although the data structures might have different dimensions depending on the type of forcing used, and some data structures will not be used for specific forcing methods in general all data structures will be named and created in a way that makes them applicable to all forcing options.

2.3 Requirement: Includes Coupled Forcing

Date last modified: 11/20/12
Contributors: (Doug Jacobsen)

One necessary component of the forcing module is that it contains a coupled forcing to include MPAS-O in the CESM.

Currently, MPAS-O can run within the CESM but no data is used from the CESM to force the Ocean model.

2.4 Requirement: Includes Monthly Forcing

Date last modified: 11/20/12
Contributors: (Doug Jacobsen)

The forcing module should include a monthly forcing option, that can be used in stand-alone mode.

This uses interpolation within a month to determine the surface wind-stress, temperature restoring, and salinity restoring.

2.5 Requirement: Includes Annual Mean Forcing

Date last modified: 11/20/12
Contributors: (Doug Jacobsen)

The forcing module should include an annaul mean forcing option, that can be used in stand-alone mode.

2.6 Requirement: Ease of Extensibility for Future Coupling Fields

Date last modified: 11/20/12
Contributors: (Doug Jacobsen)

The forcing module should be easy to modify in order to add extra coupling fields.

2.7 Requirement: Ease of Extensibility for Future Coupling Options

Date last modified: 11/20/12
Contributors: (Doug Jacobsen)

The forcing module should be easy to modify in order to add extra coupling options (like Daily forcing).

Chapter 3

Description of Fields

3.1 Stand Alone simulations

- Wind Stress
- Temperature Restoring
- Salinity Restoring

3.2 Coupled Simulations

3.2.1 Fields from Coupler to Ocean

General Fields

Wind Stress

- Foxx_taux - Zonal Wind Stress
- Foxx_tauy - Meridonal Wind Stress

Surface Temperature Flux

- Foxx_lat - Latent Heat
- Foxx_sen - Sensible Heat
- Foxx_lwup - Long Wave Up
- Faxa_lwdn - Long Wave Down
- Foxx_evap - Evaporation

- Fioi_melth - Heat Flux (From CICE)
- Faxa_snow - Snow

Surface Salinity Flux

- Fioi_meltw - Fresh Water Flux (From CICE)
- Fioi_salt - Salinity Flux (From CICE)
- Forr_roff - River Runoff
- Forr_ioff - Ice Runoff

Short Wave Radiation

- Foxx_swnet - Short Wave Net

Precipitation

- Faxa_snow - Snow
- Faxa_rain - Rain

Miscallenous Fields

- Sa_pslv - Sea Level Pressure
- Si_ifrac - Ice fraction

Biogeochemistry Fields

- Sa_co2prog - Prognistic CO2
- Sa_co2diag - Diagnostic CO2
- So_duu10n - 10 Meter Wind Speed (Maybe Squared)

3.2.2 Fields from Ocean to Coupler

General Fields

- Fioo_q - q flux, sea ice formation potential
- So_t - State Temperature
- So_s - State Salinity

- So_u - State Zonal Velocity
- So_v - State Meridonal Velocity
- So_dhdx - SSH Gradient
- So_dhdy - SSH Gradient

Biogeochemistry Fields

- Faoo_fco2_ocn - co2 flux
- Faoo_fdms_ocn - dms flux
- Faoo_fco2_ocn

Chapter 4

Design and Implementation

In implementing generic forcing within MPAS-O there actual code can be broken out into two separate categories. The first of these includes routines used to compute the flux and forcing arrays, while the second includes routines used to apply the flux and forcing arrays as body forces to the appropriate equations.

4.1 Array Computation Routines

The array computation routines will live under separate drivers in a forcing category. This will have the following hierarchy:

```
mpas_ocn_forcing.F
|-mpas_ocn_forcing_monthly.F
|-mpas_ocn_forcing_annual.F
\-mpas_ocn_forcing_cesm.F
```

Monthly and annual forcing will have subroutines similar to the following:

```
mpas_ocn_forcing_monthly_compute_arrays
mpas_ocn_forcing_monthly_init
```

while cesm forcing will look like the following:

```
mpas_ocn_forcing_cesm_compute_input_arrays
mpas_ocn_forcing_cesm_compute_output_arrays
mpas_ocn_forcing_cesm_init
```

In this case, the compute_input_arrays routine will take as input the cesm forcing arrays, and convert them to a form that is compatible with MAPS-

O. compte_output_arrays will take as input the current state of MPAS-O and output arrays in the form the cesm coupler wants (q-flux for example, or gradient of ssh).

4.2 Forcing Routines

Each part of MPAS-O will have an additional forcing module, where the arrays computed in the previous section are applied. This involves things like windstress, heat fluxes, salinity fluxes, virtual salinity fluxes, mass fluxes, and short wave radiation.

Each of the fluxes will be applied to their relative equations as a body force. Windstress is applied similarly to the current implementation. Short wave radiation will be applied similarly to POP, allowing the radiation to penetrate the surface.

Chapter 5

Testing

5.1 Testing and Validation: Annual Mean Forcing

Date last modified: 11/28/12
Contributors: (Doug Jacobsen)

The new annual mean forcing should be bit reproducible with the current version of annual mean forcing.

5.2 Testing and Validation: Monthly Forcing

Date last modified: 11/28/12
Contributors: (Doug Jacobsen)

The new monthly forcing option should be bit reproducible with the current version of monthly forcing.