



Using OASIS in the Met Office HadGEM3 coupled model

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Background

- Met Office began using OASIS seriously ~2-3 years ago
 - HadGEM3 coupled models
 - Supporting the next generation climate coupled model
- Previously dabbled with OASIS1/OASIS2
 - No viable infrastructure developed
- Adoption of NEMO ocean and CICE sea-ice models to replace UM ocean/sea-ice prompted serious tests and development
 - Initial tests with OASIS4
 - Switched to OASIS3



Early Coupled Models

- Developed coupling infrastructure
 - Based around UM user interface (UMUI)
 - UM control scripts – extended functionality to control compilation and job submission OASIS-style

- Initial tests
 - 2° UM atmosphere + ORCA2 NEMO - proof of concept.
 - Initially with OASIS4, now reverted to OASIS3 for serious scientific work, though OASIS4 remains goal.
 - HadGEM3 – a new approach to coupled modeling at the MO. Use same model for regional, seasonal-decadal and Earth system modeling.



HadGEM3 Coupled Models

The set-up

- OASIS3
 - Run on a single cpu.
 - Using CONSERV remapping for tracer grid components, BILINEAR for u/v-grid components
 - Had to invent some new fields for the cf_name_table.txt file (e.g. multi category ice fields).
 - Incidental benefits include controlling NEMO-only and CICE-only models through the UMUI.
- ORCA1 NEMO-CICE component
 - Tripolar $\sim 1^\circ$ C grid in NEMO, B grid in CICE
- UM atmosphere
 - C grid
 - 192 East-West (1.875°) x 144 North-South (1.25°) x 38 Vertical
 - 144 U/T rows, 143 V rows



HadGEM3 Coupled Models Issues

- Restart files
 - We don't use OASIS restart files – all necessary data is held in UM dump or Nemo restart files – saves having to manage yet another set of data files for archiving etc – each set of restart data is self consistent.
 - Will probably have to adopt restart files when upgrading to NEMO 3.2
- Remapping weights files
 - Generated off-line prior to run and adjusted by hand if necessary
 - Allows us to cater for awkward land-sea masks and quirks of using tri-polar grids
 - Avoids repeated generation of the same files (saving time and disk space)
 - Just link to central copies at run time.
- Vector rotation
 - Made difficult because atmosphere grid has one row fewer V points than U points
 - Carried out explicitly in NEMO code once coupling fields have been received, rather than letting OASIS do the rotation.



OASIS control via the UMUI

The OASIS Coupler : Job aife.e: "HadGEM3-AO - IBM // put/get - timing"

☒ Use OASIS coupling

☐ Perform coupling exchanges through master PE

Coupling frequency (hours)

Standard Coupling Macro

Choose OASIS version ☒ OASIS3 ☐ OASIS4

Location of OASIS3 build

Location of OASIS3 namcouple and cf_name_table

Controlling namcouple file

Location of remapping weights files

☒ Use existing grids files

Grids netcdf file

Masks netcdf file

Areas netcdf file

Angles netcdf file

NEMO Load flags		
No	Flag value	Use Y/N
1	-L%netcdf_home/lib -berok -L%prism_home/lib	Y
2	-lanaism -lanaism -lpsmile.MPI1	Y
3	-lfscint -lmp_io -lscip -lnetcdf	Y
4		
5		
Next		Edit
Sort		

Help Abandon changes Close

Window Name : smcc_OASIS_Coupling Job aife.e.



OASIS control via the UMUI and control scripts

- UM run scripts automate several aspects of OASIS3 control
 - Automatically edit namcouple – number of CPUs per component
 - But we don't have any means of automating the set-up of coupling fields – ultimate goal (FLUME)
 - Whether coupling performed through all CPUs (leave the gathering/scattering to OASIS) or through master CPU (explicit gather/scatter in UM/NEMO)
 - Run mechanism incorporated into UM – e.g. automatic set up of mpirun command (NEC) or poe command (IBM) for mpmd case.



Spin-off benefits for NEMO/CICE users

- NEMO & CICE model compilation control

FCM Options for NEMO : Job aife.e: "HadGEM3-AO - IBM // put/get - timing"

Usually you should not override FCM configuration default values for NEMO

Job configuration file:

FPP keys configuration file:

☒ Include modifications from branches

No	Type	Branch location	Revision	Use Y/N
1	IOIPSL	fcm:ioipsl_br/dev/hadci/VN3.0_CF_comp	2213	Y
2	IOIPSL	fcm:ioipsl_br/dev/hadci/VN3.0_defprec	2060	Y
3	IOIPSL	fcm:ioipsl_br/test/Share/VN3.0_porting_community	2197	Y
4				
5				
Insert Edit Edit Edit				
Sort				

☒ Include modifications from NEMO working copy

NEMO working copy location:

☐ Include modifications from IOIPSL working copy

IOIPSL working copy location:

Press Back to go to FCM main page

Help Abandon changes Close Back

Window Name : subindep_FCM_NEMO_Opt Job aife.e.

FCM Options for CICE : Job aife.e: "HadGEM3-AO - IBM // put/get - timing"

Usually you should not override FCM configuration default values for CICE

Job configuration file:

FPP keys configuration file:

☒ Include modifications from branches

No	Branch location	Revision	Use Y/N
1	fcm:cice_br/dev/Share/r147_HadCICERun/cice	165	Y
2	fcm:cice_br/dev/hadci/VN4.0_no_vert_check/cice	168	Y
3	fcm:cice_br/dev/frh/VN4.0_ibm_port_debug/cice	191	Y
4			
5			
Insert Edit Edit			
Sort			

☐ Include modifications from CICE working copy

CICE working copy location:

Press Back to go to FCM main page

Help Abandon changes Close Back

Window Name : subindep_FCM_CICE_Opt Job aife.e.



Spin-off benefits for NEMO/CICE users

- NEMO & CICE model run-time control

Links to NEMO model : Job aife.e: "HadGEM3-AO - IBM // put/get - timing"

NEMO model is coupled

No	NEMO input file name	Actual full path and file name
1	data_1m_potential_temperat	\$NEMO_INIT/potemp_1m_EN3_clim_nomask.nc
2	data_1m_salinity_nomask.nc	\$NEMO_INIT/salin_1m_EN3_clim_nomask.nc
3	bathy_level.nc	\$NEMO Ancil/bathy_level.nc
4	bathy_meter.nc	\$NEMO Ancil/bathy_meter_060308.nc
5	subbasins.nc	\$NEMO Ancil/basinlandmask_060308.nc
6	ahmcoef	\$NEMO Ancil/ahmcoef
7	EMPave_old.dat	\$NEMO Ancil/EMPave_old.dat
8	coordinates.nc	\$NEMO GRIDS/coordinates.nc
9	coords_CF.nc	\$NEMO GRIDS/coords_CF_060308.nc
10	geothermal_heating.nc	\$NEMO_FORCE/geothermal_heating.nc

Inert Edit Edit

Remove Blank Lines

NEMO Model control namelist /data/cr/ocean/frh/NEMO/hadgem3/nemo_ahsaa_

NEMO LIM ice namelist

NEMO start dump

Help Abandon changes Close

Window Name : nemo_Science_Link. Job aife.e.

Links to CICE model : Job aife.e: "HadGEM3-AO - IBM // put/get - timing"

CICE model is coupled

No	CICE input file name	Actual full path and file name
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Inert Edit Edit

Remove Blank Lines

CICE Model control namelist ~frh/hadgem3/nl/CICE/cice_ahsaa_hourly

CICE start dump \$CICE_INIT/iced_start_ORCA1_sep.bin

CICE Grid file \$CICE_GRIDS/CICE_ORCA1.grid.nc

CICE kmt file \$CICE_GRIDS/CICE_ORCA1_060308.kmt.nc

Help Abandon changes Close

Window Name : cice_Science_Link. Job aife.e.



HadGEM3 Coupled Models

Current Runs

- NEC SX6/SX8 and IBM Power 6
 - Have completed various climate runs on both systems up to ~100 years
 - Adopted by Seasonal forecasters (typically model runs of ~10-30 years)
 - Recently ported from NEC to IBM – OASIS3 set-up was straightforward
 - Configuration management is a complicated area
 - E.g. Which version of the UM atmosphere is compatible with which version of NEMO, CICE, OASIS, NetCDF etc etc.



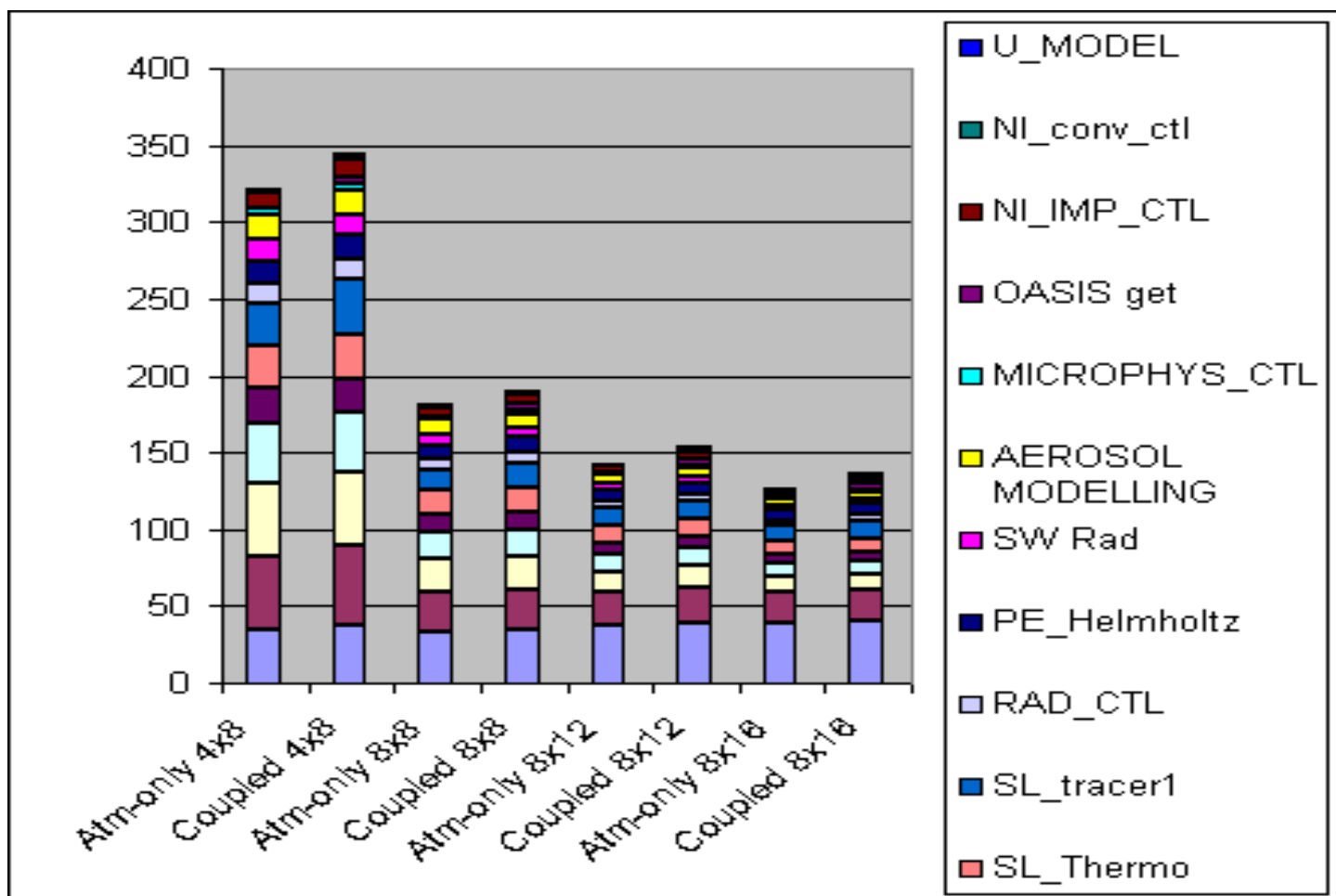
HadGEM3 Coupled Models Performance

- NEC SX6/SX8
 - Typically using 1x6-1-1x1 (Atm-OASIS-NEMOCICE)
 - Atmosphere is slow – NEMOCICE races ahead and waits for atmosphere to catch up

- IBM Power6
 - Typically using a ratio of 5 or 6 atmos CPUs : 1 NEMOCICE
 - e.g. 8x10-1-1x15(15x1)
 - Better options for true load balancing than on NEC.
 - Scalability is not great but this does not appear to be due to any OASIS3 bottleneck
 - The atmosphere scales quite badly beyond about 128 CPUs at this resolution
 - Coupling appears to be a ~fixed cost regardless of CPU numbers.

HadGEM3 Coupled Models Performance

(The ~fixed cost of coupling)





Future Work

- Use multiple instances of OASIS3
 - Is this a viable option?
- Upgrade to OASIS4
 - Parallelism/performance not critical currently
 - Will be an issue for higher resolution models
- Continue upgrading UM
 - New UM atmosphere releases ~4 month intervals
 - UMUI and model control refinement
 - FLUME: A complete modelling infrastructure
- NEMO
 - New version 3.2 due soon – switch to coupling “the NEMO way” – (OASIS restart files!)
 - New CICE versions – keeping everything up-to-date?



Questions?