

Coupling AGRIF zoom in FOCL-OpenIFS with OASIS

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Kiel, Oct. 30th 2019

Configuration



- FOCI-OpenIFS
 - NEMO-ORCA05 and AGRIF zoom (North Atlantic ocean), version 3.6
 - OpenIFS(T159 and t799), cycle 40
- OASIS coupler (OASIS3-MCT)
 - coupling library
 - API to be called in the model (field and grid definition, put/get commands)
 - includes an interpolation library (SCRIP, hybrid MPI/OpenMP parallel)
 - manages coupling field decomposition between MPI subdomains (MCT)
 - widely used in the community (CMIP6 models, including ESM, 67 laboratories worldwide are currently using the coupler)
- At Geomar, we started from OASIS3-MCT v2, and upgraded to OASIS3-MCT v4 (compatibility)

Main goals

- Increase OpenIFS resolution in FOCI
 - from T159 (~ 125km) to T799 (~25km)
- Cannot be done without redefining the coupling strategy

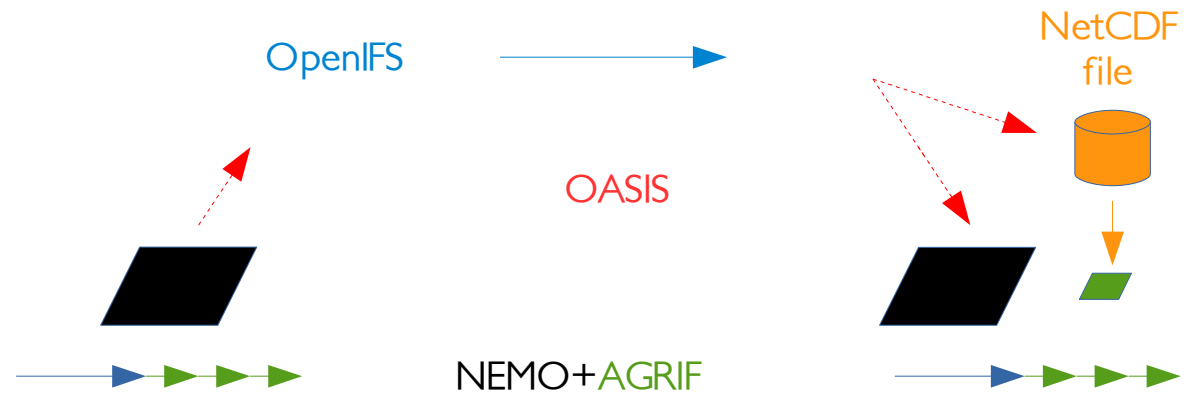
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 - support from CERFACS (OASIS developer dedicated support during one month at Geomar), thanks to IS-ENES-3 EU program funding
 - work definition from Joakim Kjellsson and Wonsun Park, with help of ESM-Tools and AGRIF users/developers

Methodology

- Replace per-file coupling with MPI communication (via OASIS)

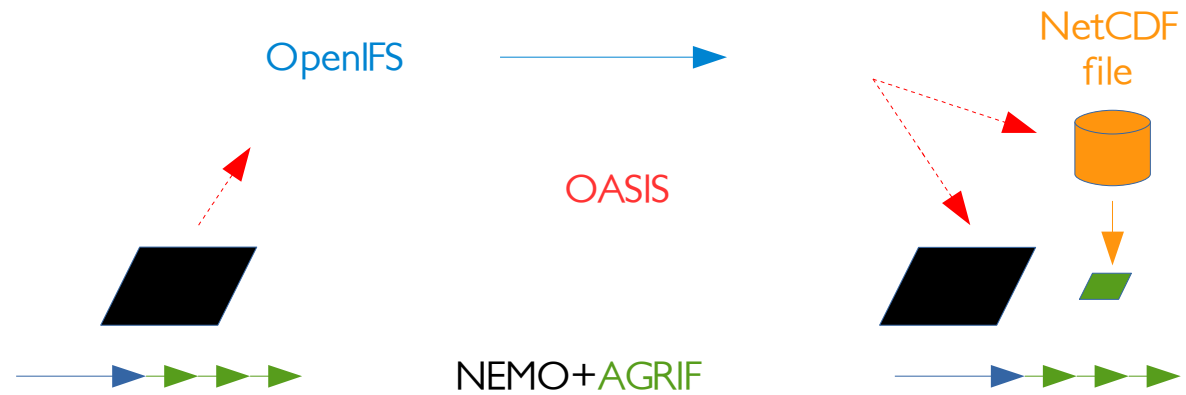
- File coupling



Methodology

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- Full OASIS



Methodology

Step one

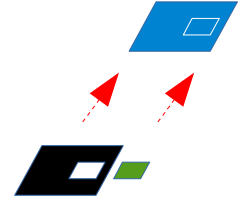
- Modify OASIS parameter files : send the same OpenIFS fluxes twice (once to the NEMO parent grid, once to the NEMO AGRIF child)
- Update NEMO code to be able to receive OpenIFS fluxes on child grid (reported to NEMO system team)



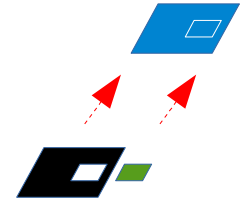
Methodology

Step two

- Merge global and zoom information on OpenIFS grid



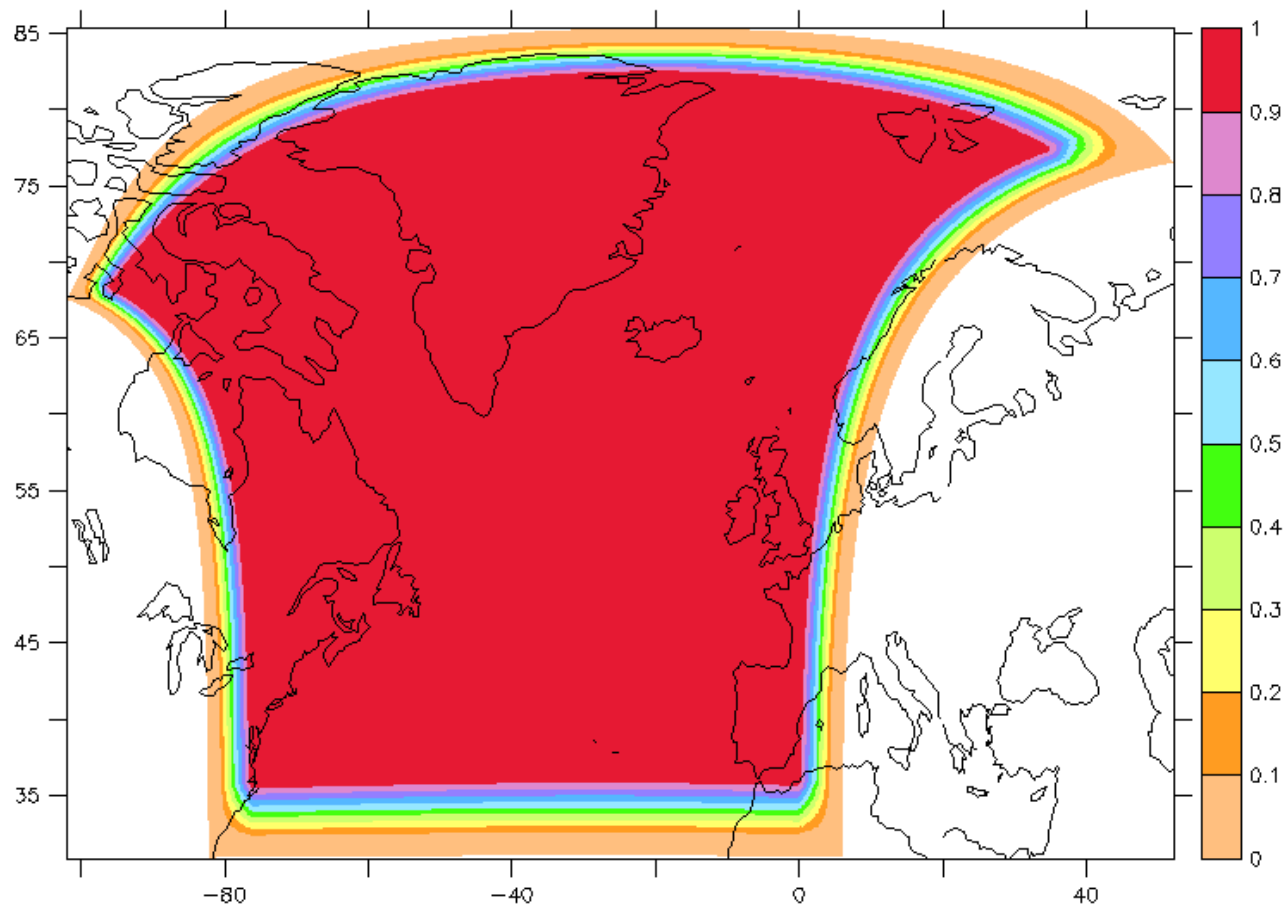
Methodology



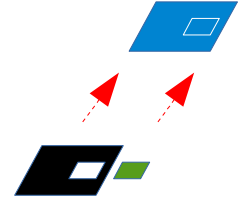
Step two

- Merge global and zoom information on OpenIFS grid

1- NEMO-AGRIF defines a buffer zone on its grid

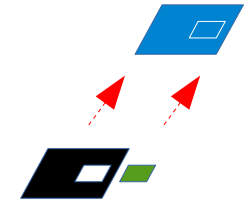


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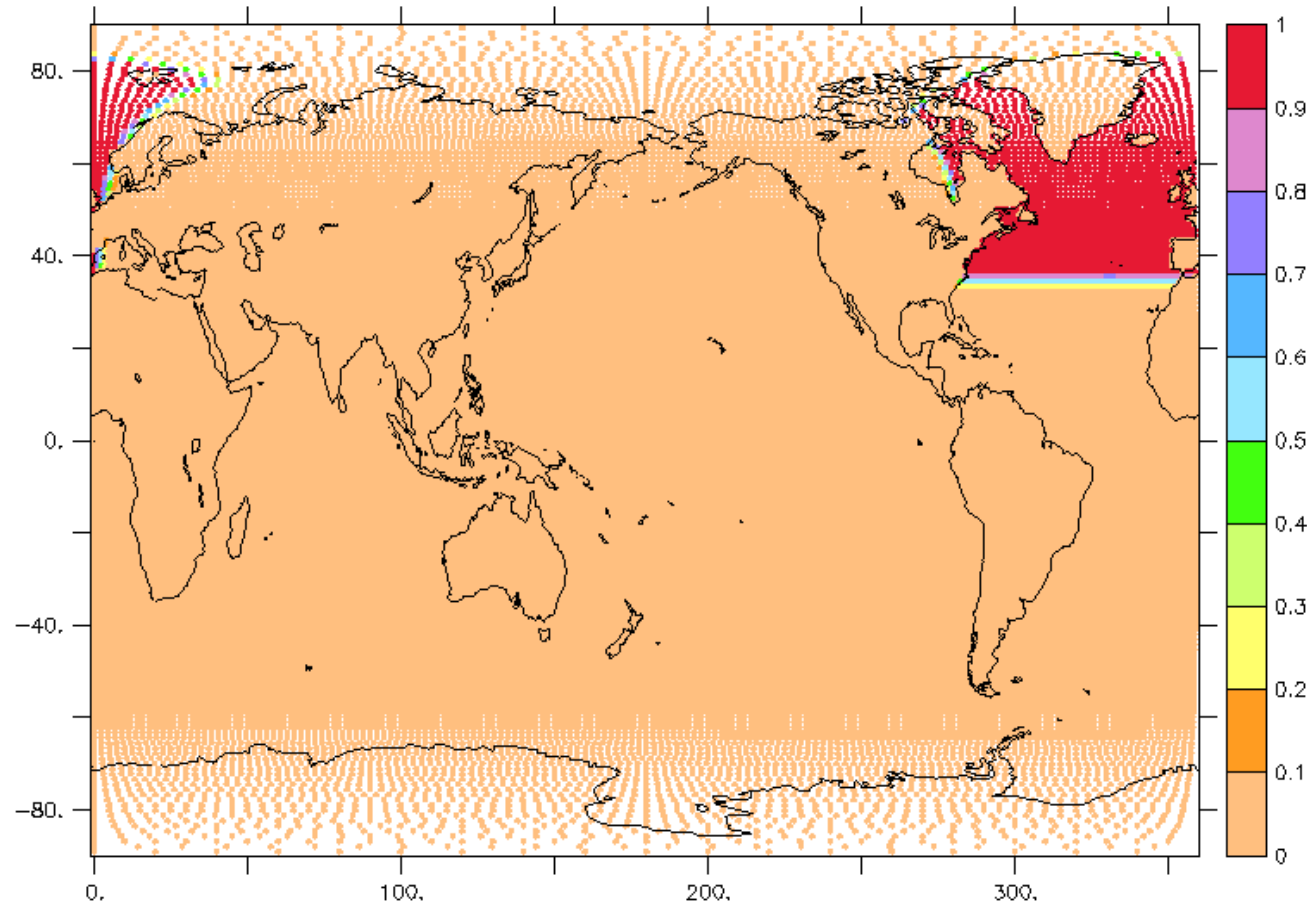


2- OASIS interpolates the buffer zone to OpenIFS grid

Methodology



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3- OpenIFS uses this array to merge coupling fields from global and zoom grids

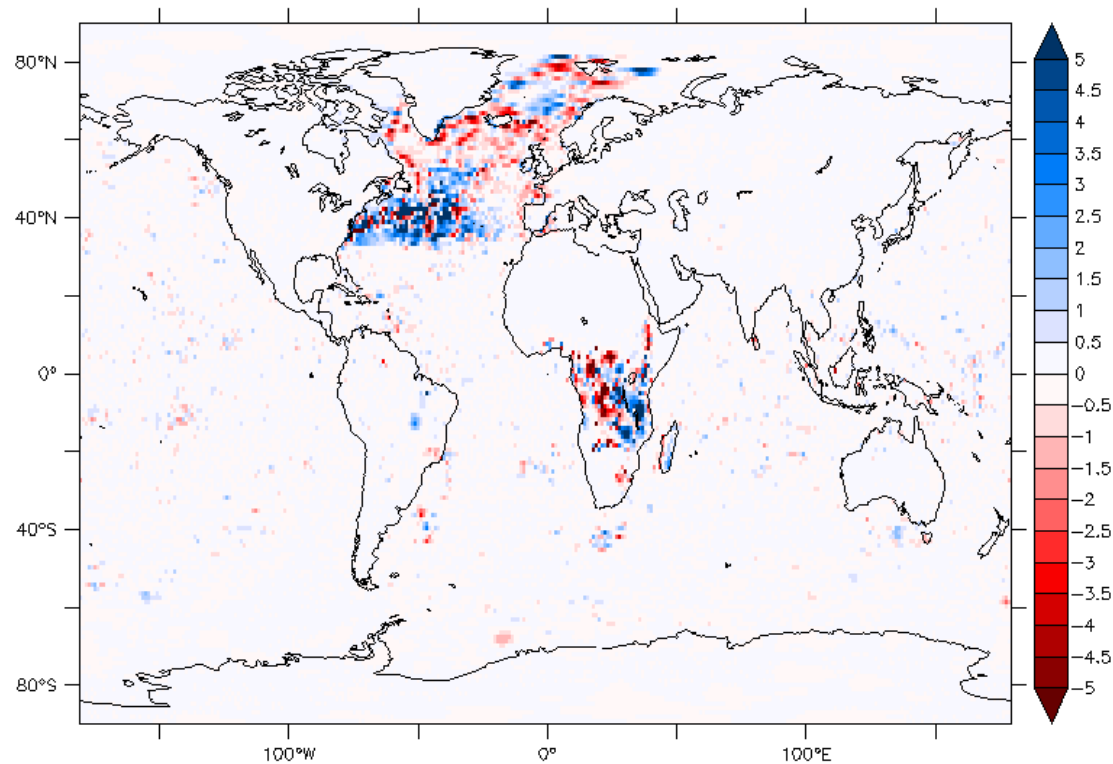
Validation

Effect of AGRIF surface variables on OpenIFS

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Effect of AGRIF surface variables on OpenIFS

Latent heat flux after 12 h, difference between 2 way and 1 way (in OpenIFS, surface variables coming from parent grid only)



High resolution configuration

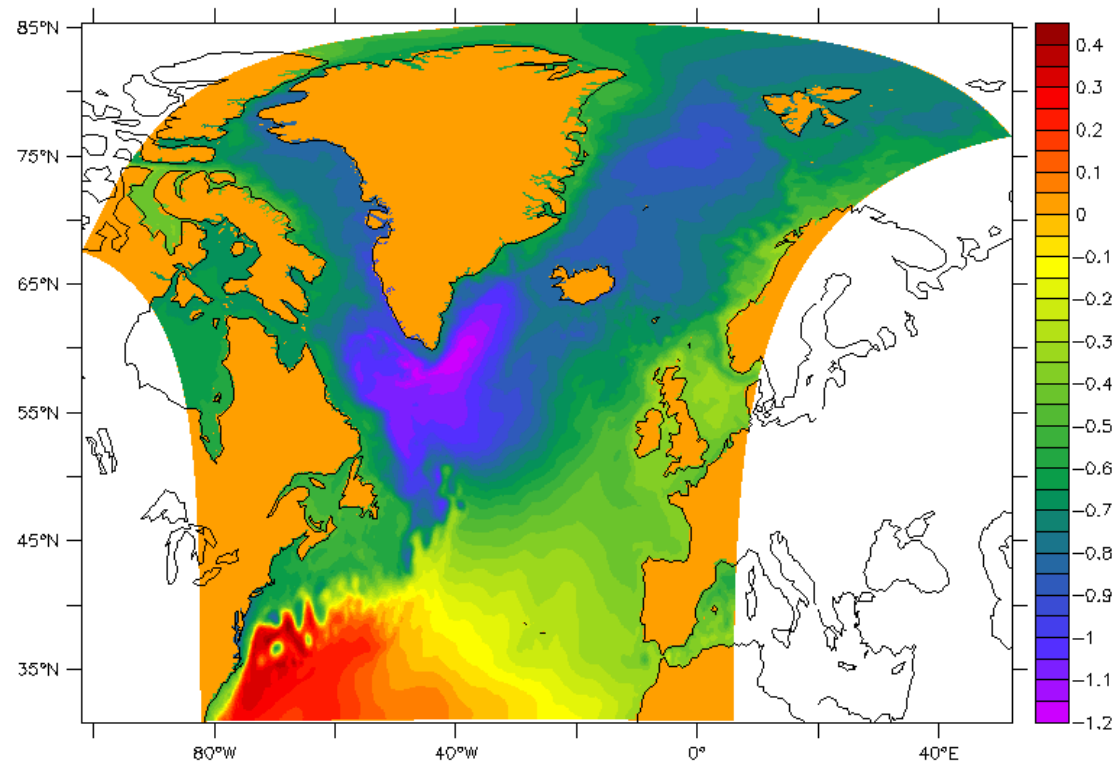
Since file coupling is avoided, resolution can now be increased

- OpenIFS T799 (25km) with NEMO ORCA0.5 (50km) and N-Atl zoom (10km)
- Simple changes in OASIS parameter file, restarts and grid definition files

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SSH 5d average in child AGRIF zoom after a 3 month long simulation

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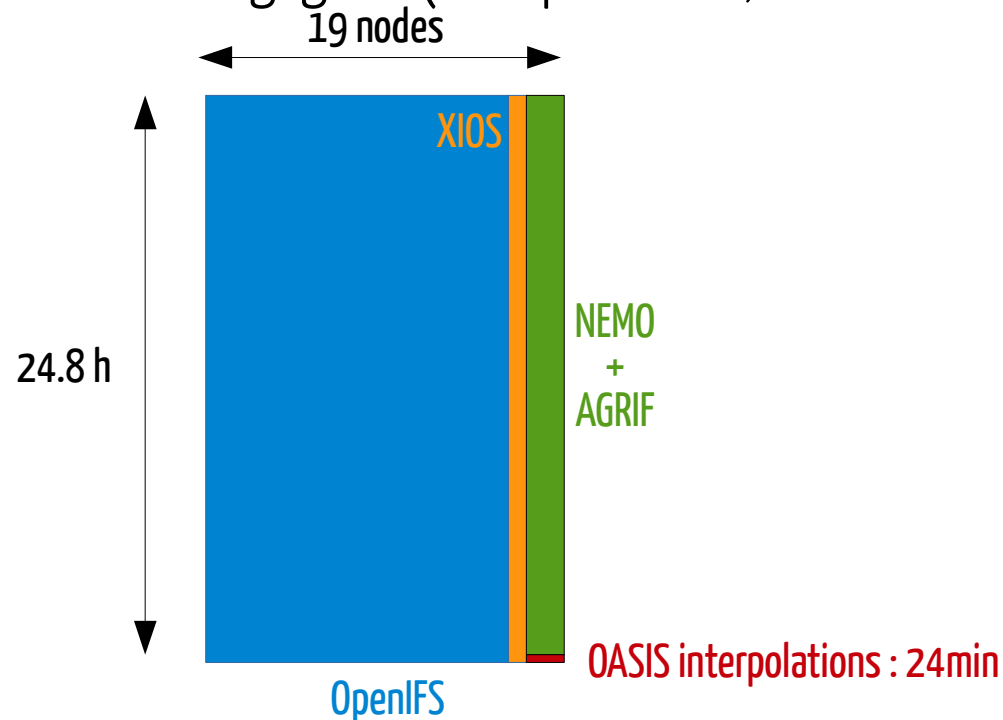
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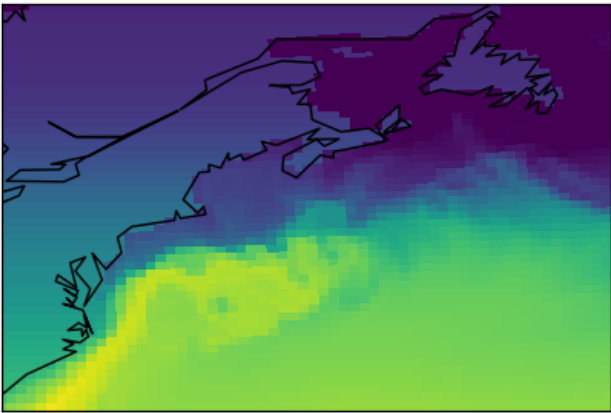
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- Simple changes in OASIS parameter file, restarts and grid definition files
- Speed : 1 SYPD
- Cost : 17,000 CHPSY (19 nodes)
- Coupling additional cost negligible (interpolations, load imbalance ...)



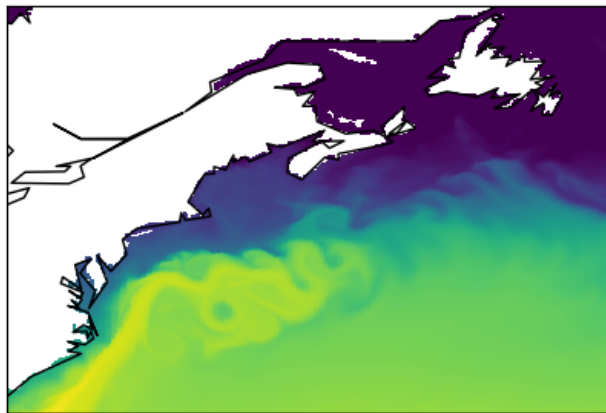
First results

1 way/2 way coupling simulations

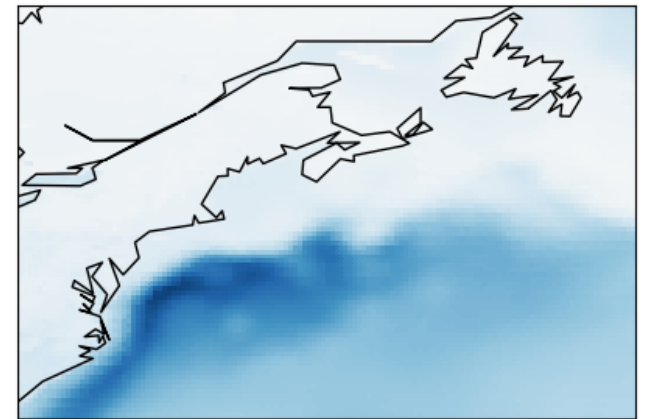
1-way, ORCA05 SST



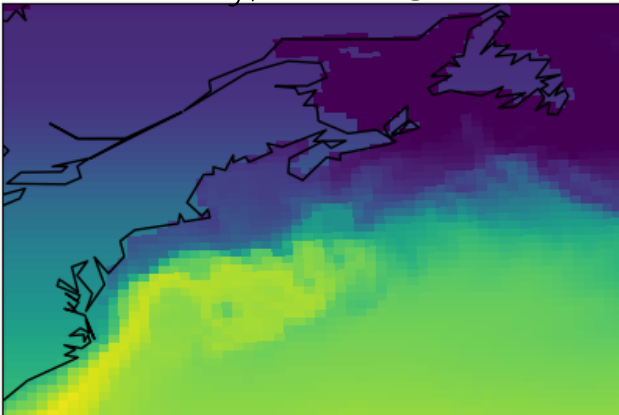
1-way, AGRIF SST



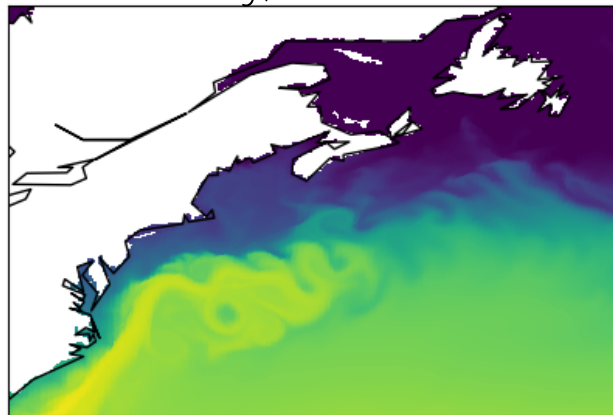
1-way, OpenIFS lat. heat flux



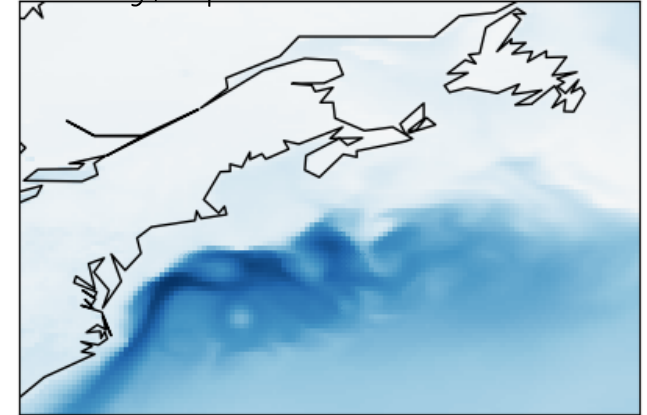
2-way, ORCA05 SST



2-way, AGRIF SST

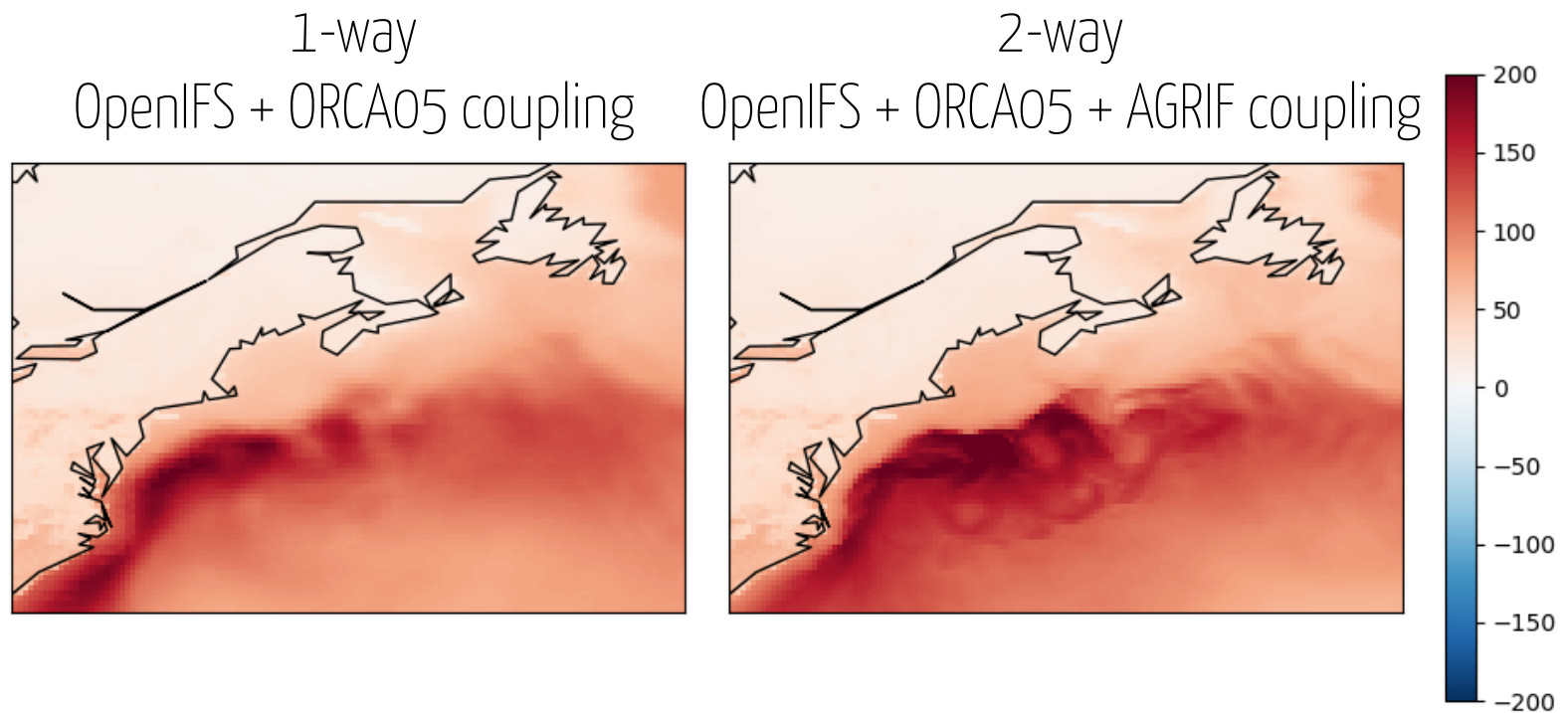


2-way, OpenIFS lat. heat flux



First results

1 month variance of latent heat flux



Coupling with AGRIF increases mean and variance of heat fluxes over eddy-rich regions

Conclusion

Results

- Two OASIS interfaces updated (OpenIFS & NEMO)
- Modifications reported locally (ESM-Tools, DKRZ git repository)
- To be reported on NEMO 4.0 & trunk next week

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Further developments

- Extension to **FOCI-ECHAM** : NEMO upgrade + modification of ECHAM interface, if AGRIF surface conditions needed in ECHAM
- Extension to FESOM ?
- Can be set up with AGRIF zoom in **other geographical regions** (Southern oceans ...), or with **several zooms simultaneously**,
- but atmosphere interface modification needed if extension to **AGRIF nest of nest**
- What about **biogeochemistry** ? Ongoing EU initiative (IPSL, CNRM, CERFACS, MetOffice) to setup OASIS 3D coupling with coarsening ... still ongoing !
- The OASIS interface is supposed to be YAC ~compatible. **ICON coupling** ?

If more collaboration needed,
call for 2020 OASIS Dedicated Support
before end of the week !



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