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Update on Fully Coupling mizuRoute with CESM3

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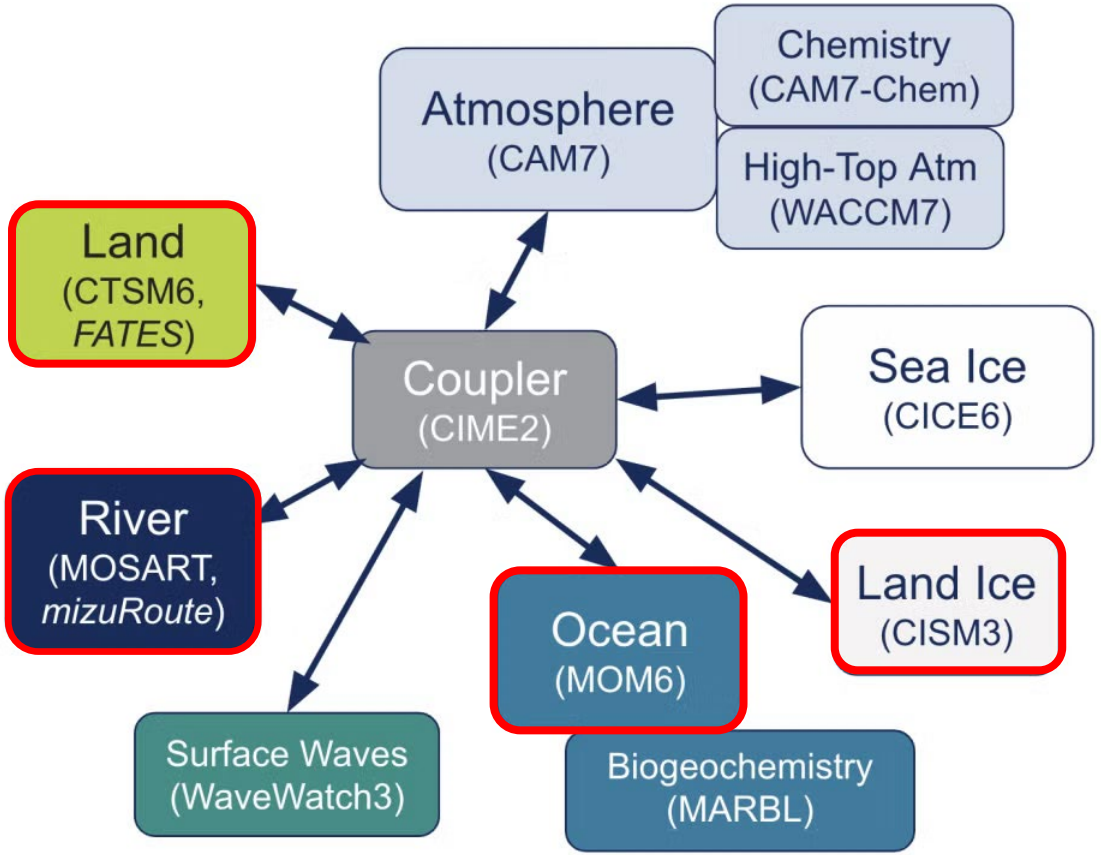
CESM3

Status for mizuRoute

- Land-only couple ✅
- Fully-couple 🚧

River component interacts with:

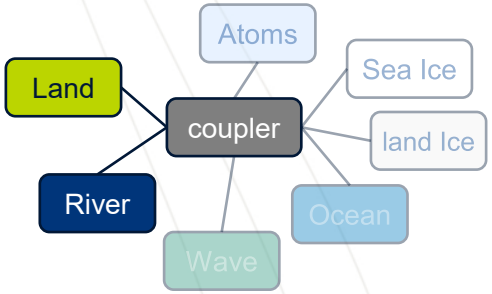
- **Land**
  - total runoff (land → river)
  - irrigation demand (land → river)
  - river water storage (river → land)
  - flood volume (river → land)
- **Land Ice**
  - Ice melt runoff (land-ice → river)
- **Ocean**
  - Discharge to oceans (river → ocean)

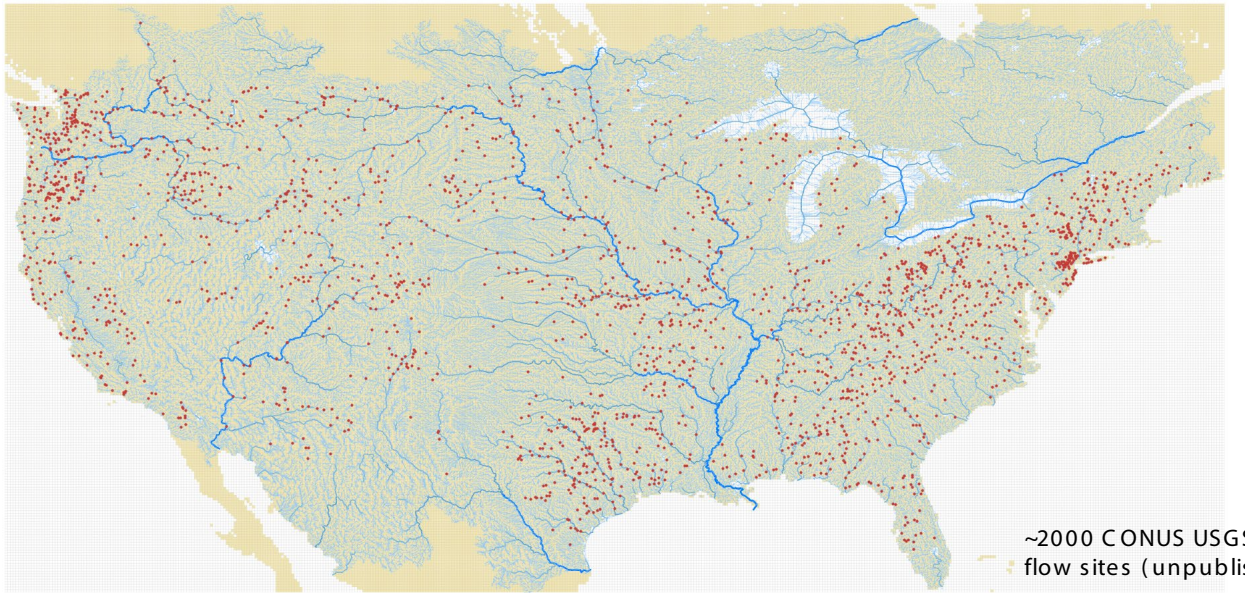


Land - only coupling

Hydrologic applications:

- Streamflow estimate including smaller rivers at any time scale.
- Water managements (lakes, reservoir, irrigation usage)





~2000 CONUS USGS pristine +USACE/USBR "Naturalized" flow sites (unpublished)

Compset: I2000Clm60SpMizGsNldas
Grid: nldas2_nldas2_rMERIT_mnldas2

Working on mizuRoute coupled with CESM3

Test 1. B-case : ne30pg3_t232 grid:

- MOSART: BHISTC_LTso (compset alias)
- mizuRoute: HISTC_CAM70%LT_CLM60%BGC-CROP_CICE_MOM6_MIZUROUTE_DGLC%NOEVOLVE_WW3 (compset long name)

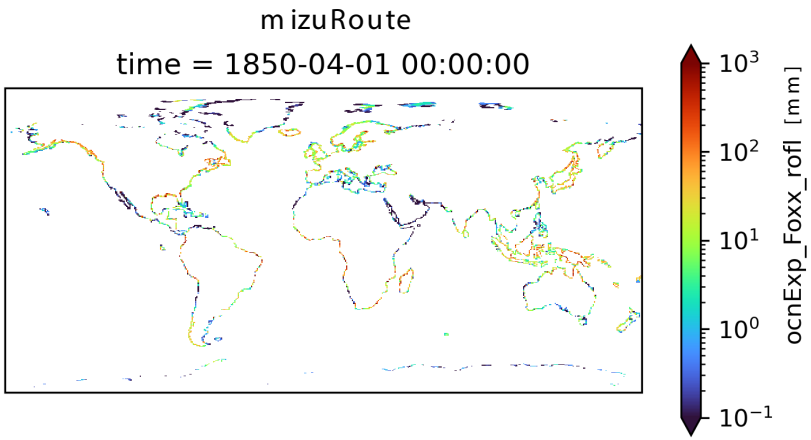
Both mizuRoute and MOSART use 0.5-deg grid and identical river network.

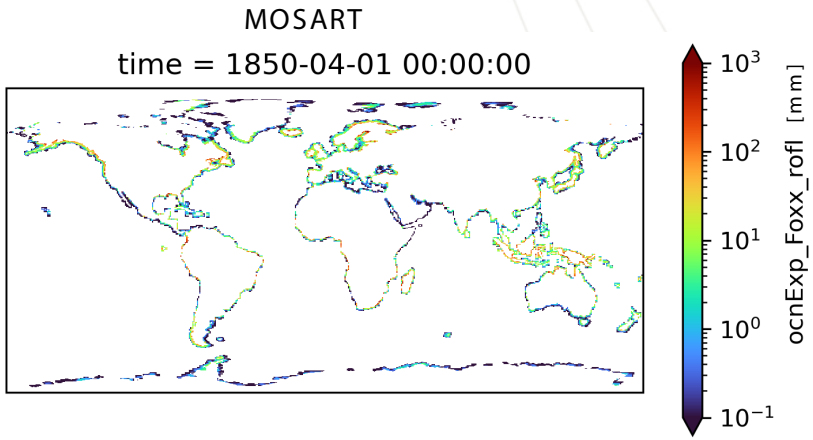
Differences:

	mizuRoute	MOSART
Mesh	Unstructured	Regular 2D grid
Mask	land	land and ocean
Routing physics	Diffusive wave	Kinematic Wave + sub-grid overland routing

🍼🌱 Preliminary 4-month run (not spun-up)

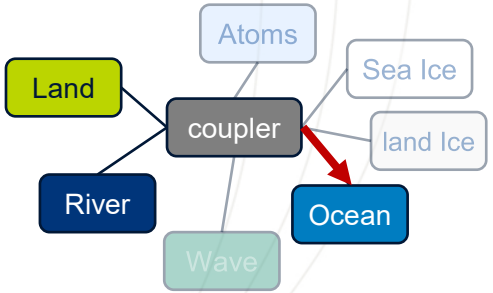
Monthly discharge to oceans



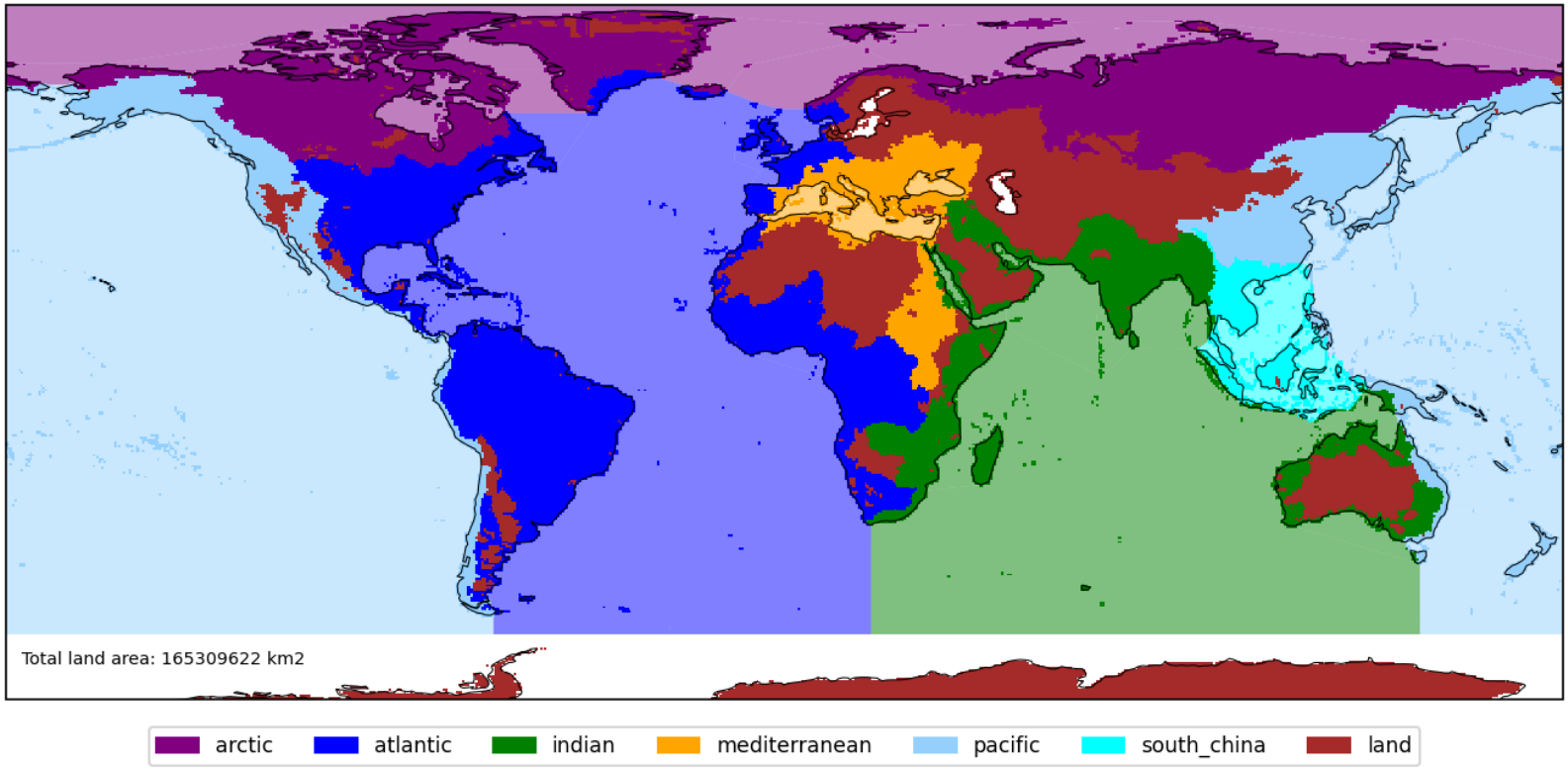


- Missing discharge around Antarctica in mizuRoute (I believe I know the reason but not discussing here).
- In general, discharge in mizuRoute > discharge in MOSART

ocnExp_Foxx_rofl (Coupler variable):
Discharge sent to oceans from coupler



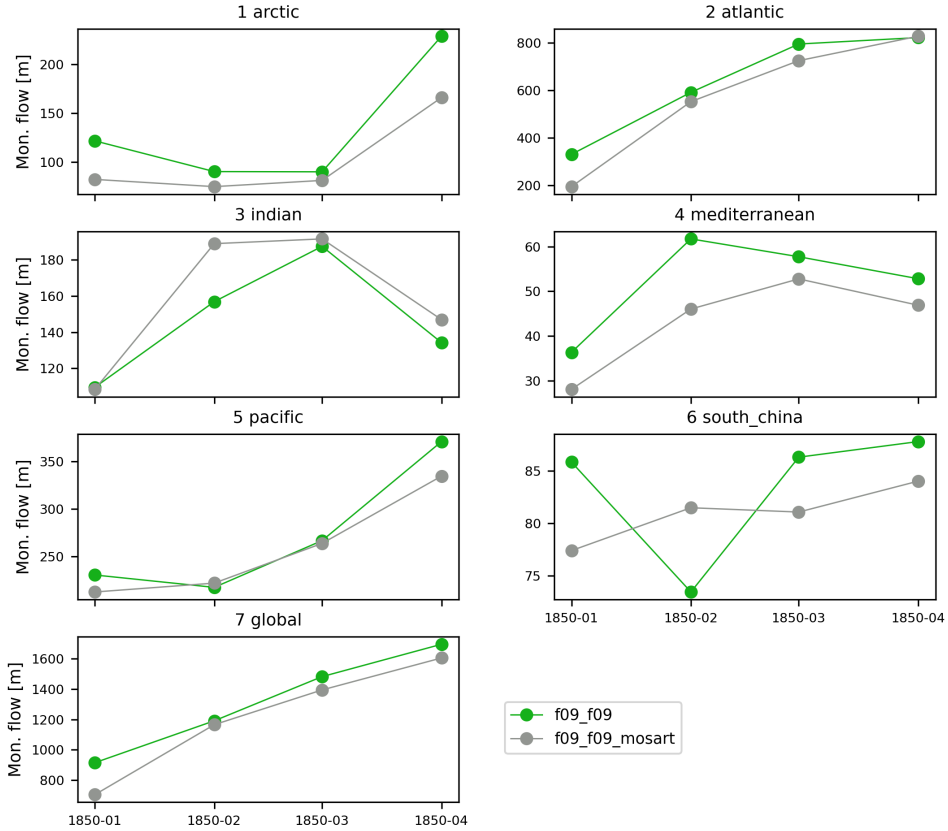
Discharge to ocean: 0.5 degree grid mesh



For fully couple runs, discharge at inland outlets is sent to their nearest ocean

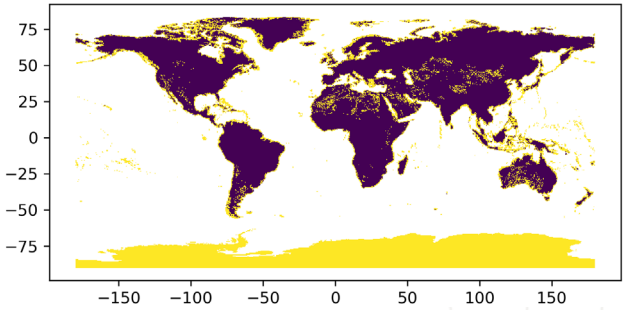
Monthly discharge to oceans (just 4 months)

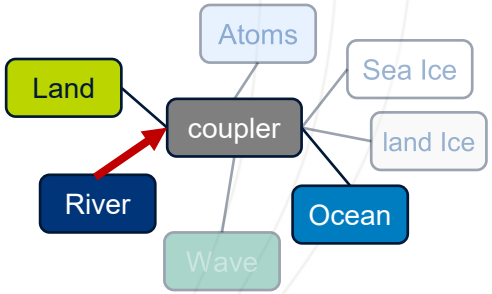
Sum of discharge at river outlet imported from river [m/m2/month]



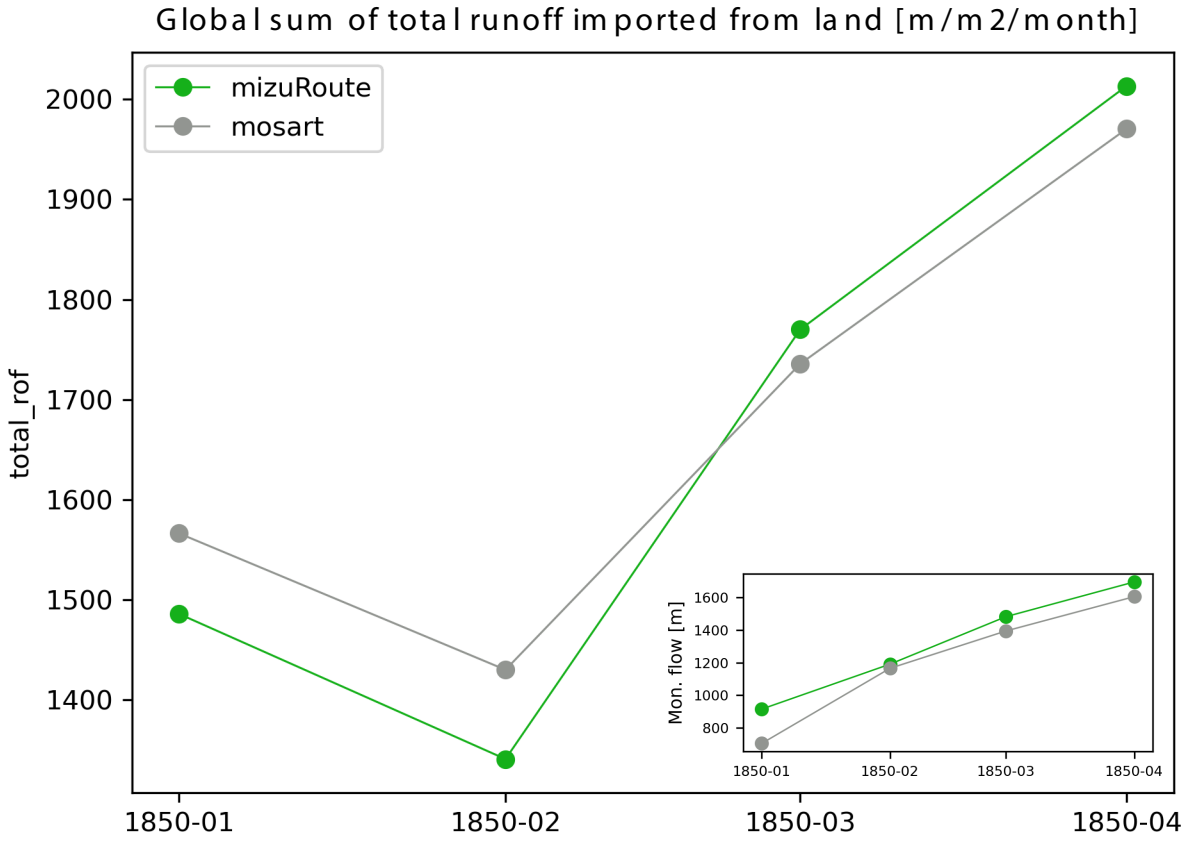
Coupler variable:

Discharge at river outlet (yellow boxes below) imported from river



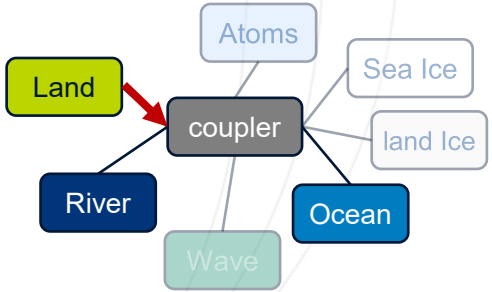


Monthly runoff from land



Coupler variable: runoff received from land [depth/area]

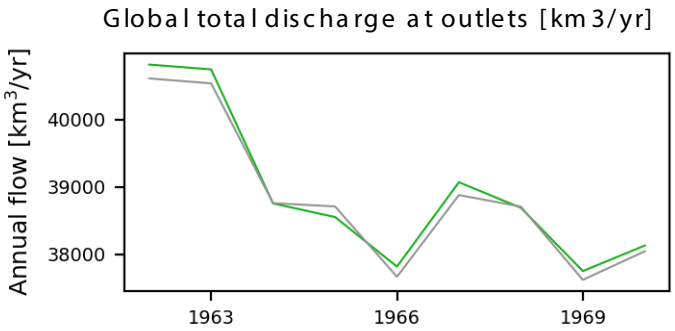
Could increase in runoff input increase discharge.

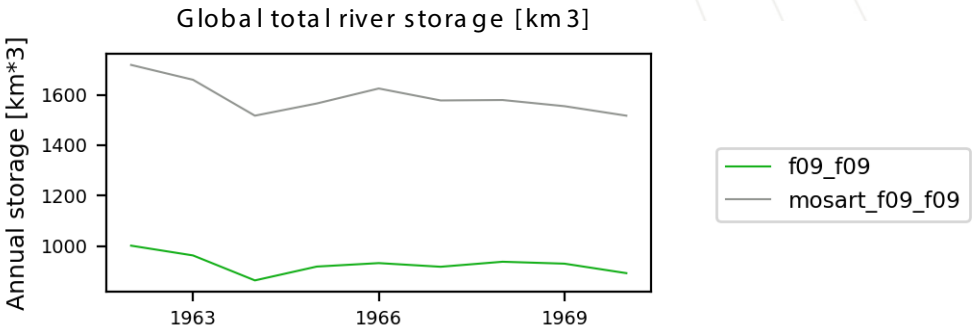


Annual flow & river storage – land only coupling

I-case: f09_f09_mg17 grid for 10 years run (starting in 1960):

- MOSART: I2000Clm60Sp
- mizuRoute: I2000Clm60SpMizGs





Discharge: mizuRoute > MOSART

Storage: mizuRoute < MOSART

From many literatures:

Q: 29,485 - 45,900 km3/yr

S: 1,200 - 2,858 km3

🤔 💡 Routing physics difference causes velocity, and resistance time in rivers.

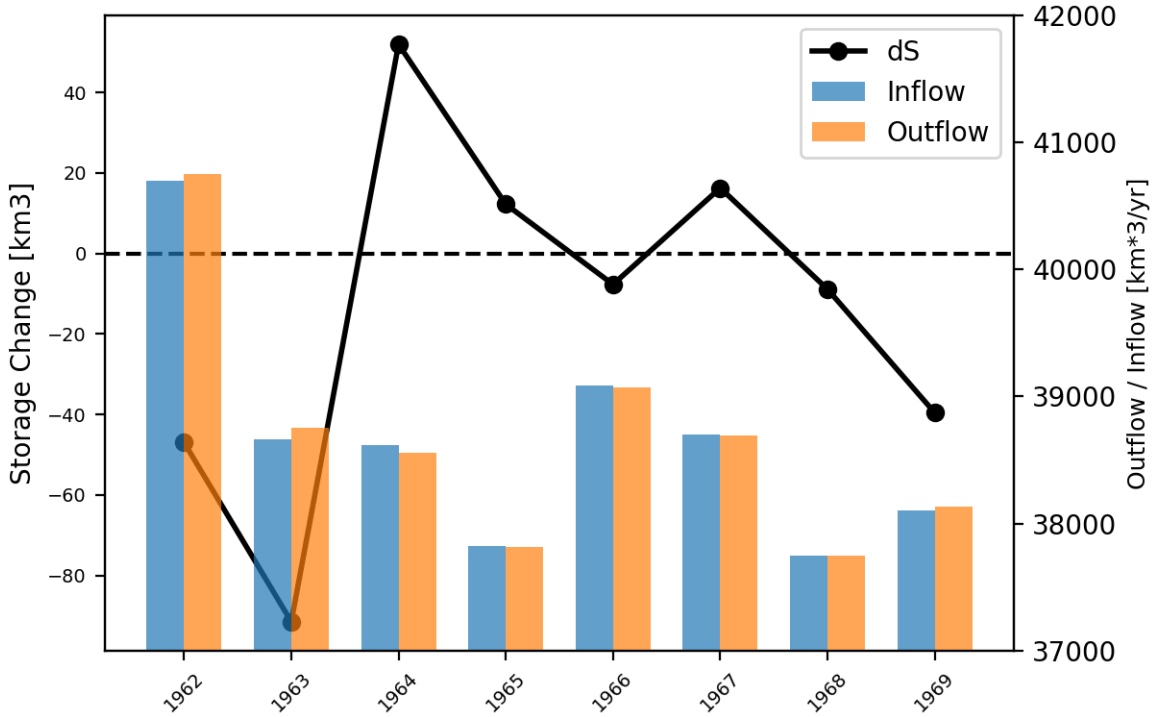
Things need to be completed for mizuRoute coupled with CESM3

- Create off-line mapping file for river-ocean coupling ("nearest neighbor with smoothing") for mizuRoute unstructured grid. Currently, the coupler does not compute nearest neighbor mapping useful for river-ocean.
- Longer CESM3 run and water budget analysis.
- Test mizuRoute using a catchment polygon unstructured grid.

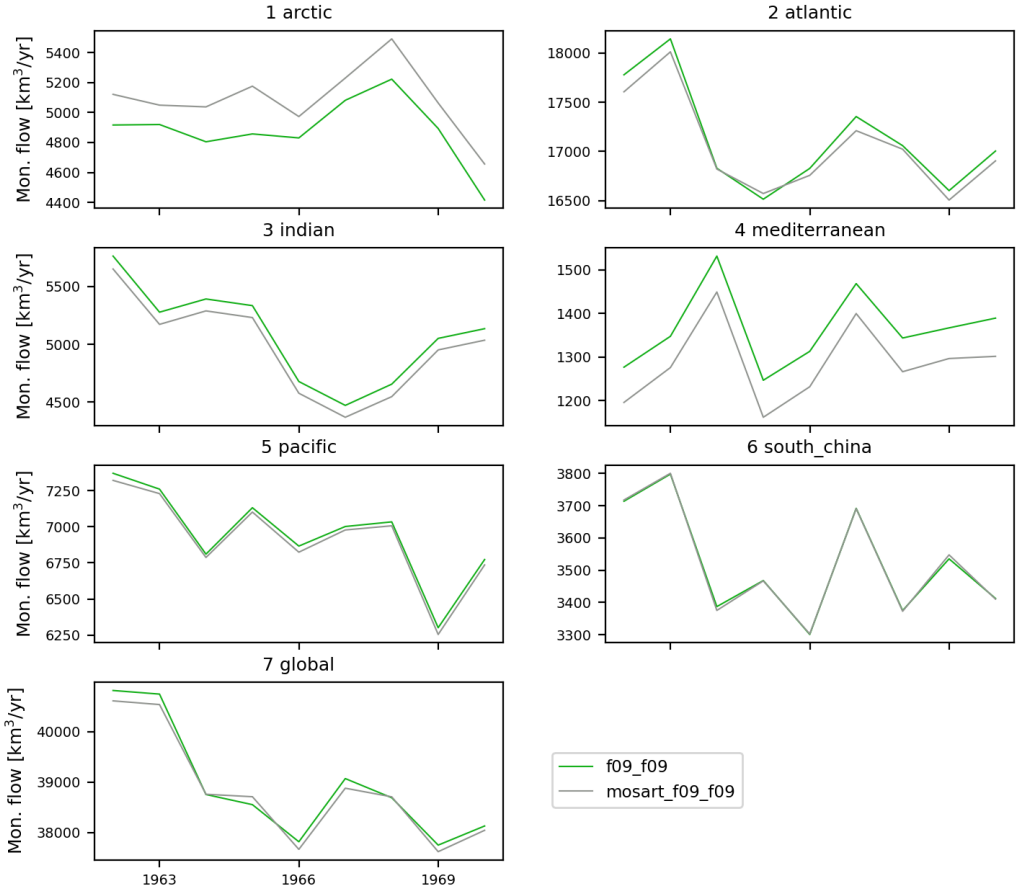
Thanks

Global annual water balance –land only coupling

mizuRoute



Annual discharge at outlet - land only coupling

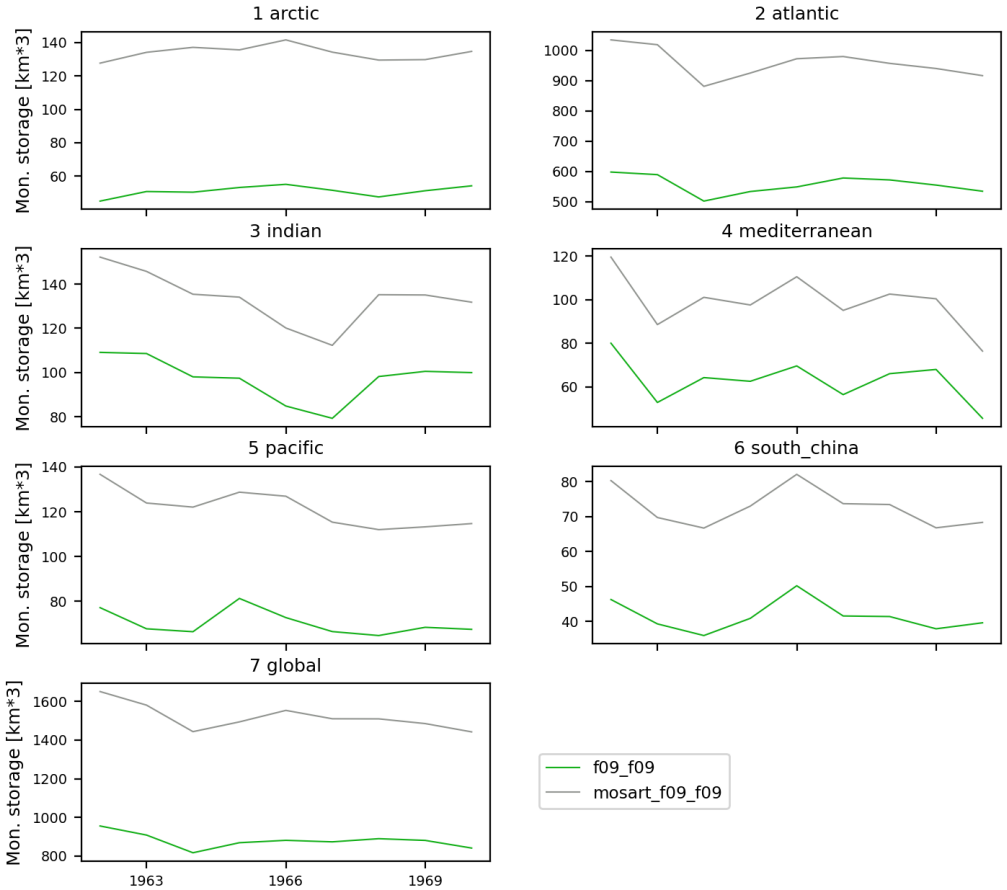


Global plot exclude antarctica.

Ice runoff is discharged in green land and antarctica

Arctic: forgot to add "ice runoff" in mizuRoute

Annual river storage – land only coupling



Global plot exclude antarctica