Elmer/Ice – NEMO coupling

Elmer-Ice Workshop 2022

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Elmer/Ice – NEMO coupling

NEMO role: compute the ice shelf melt.

ELMER role:

- Compute the new ice shelf draft
- Compute iceberg calving

Workflow:

- ELMER and NEMO run sequentially
- Coupling via netcdf files at restart step

Constrain:

- Adjust ocean restart to new geometry => key point for NEMO

Elmer/Ice – NEMO coupling

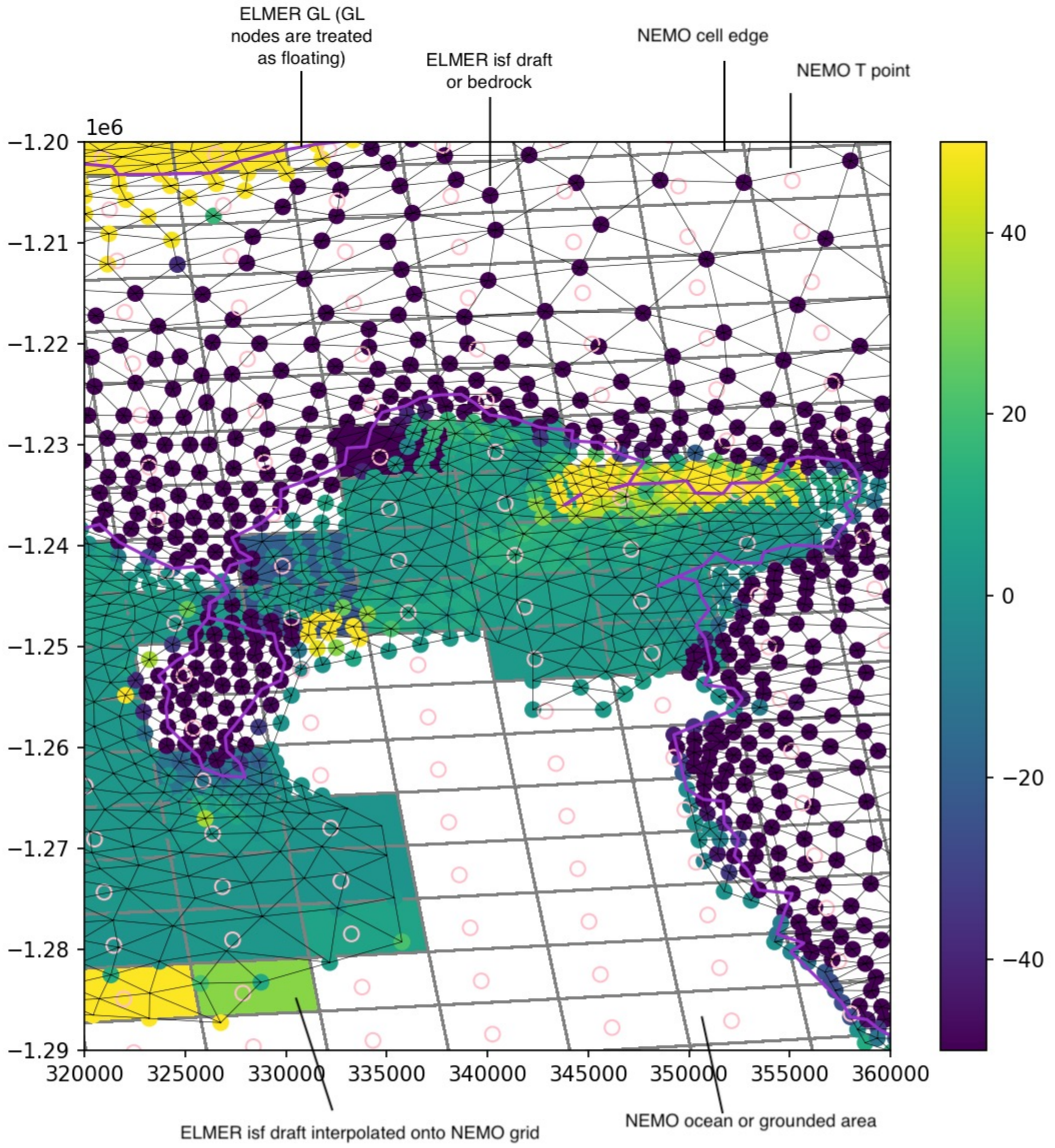
Ice shelf draft interpolation

Method:

- via an ELMER solver

Issues:

- It depends only of the 3 nearest nodes
- It is not representative of the NEMO cell where ELMER resolution much higher than NEMO resolution
- Ice shelf front static in time



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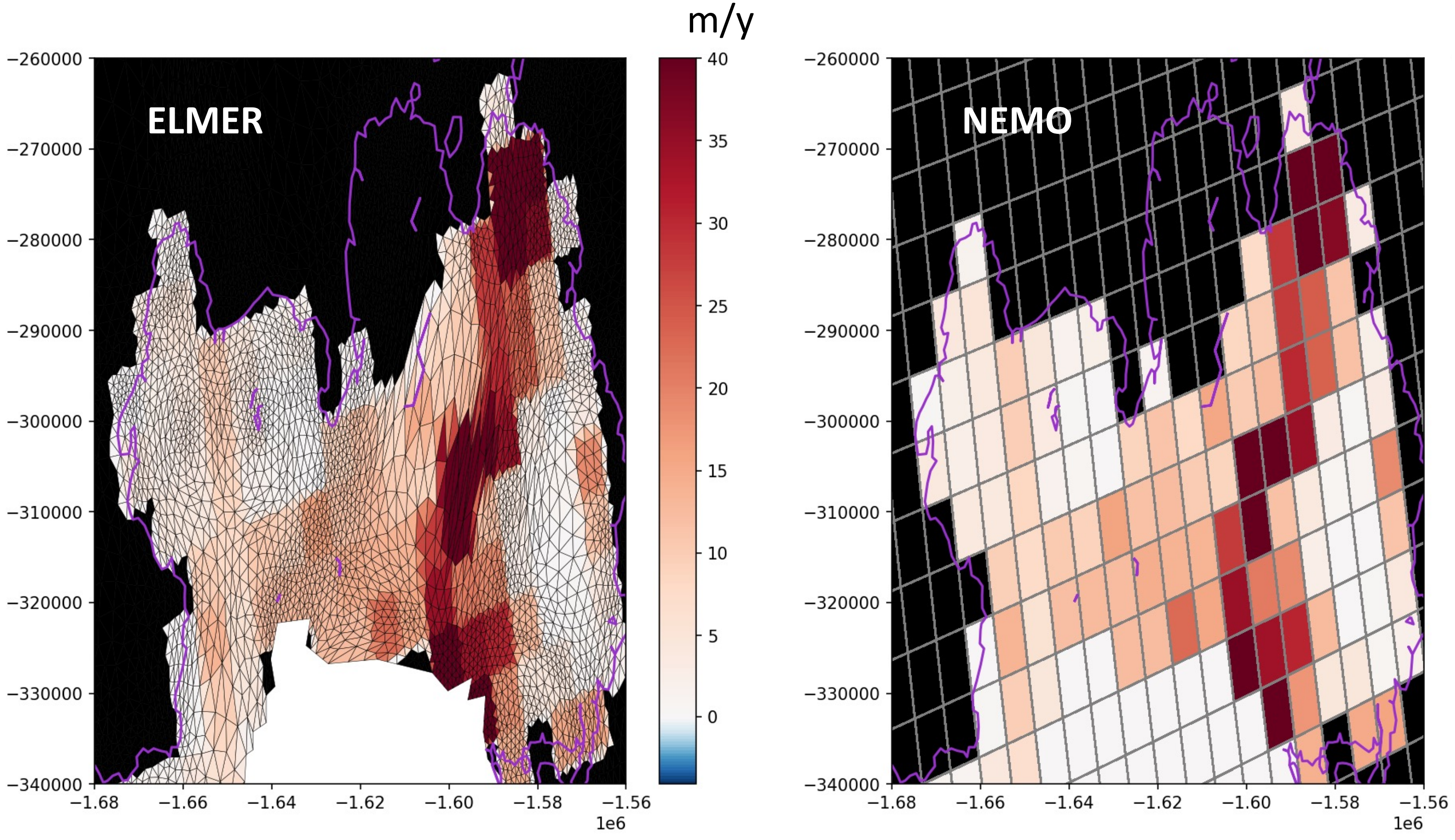
Ice shelf melt interpolation



Method:

- via cdo conservative interpolation

Issue:

- NEMO GL != ELMER GL
  - ⇒ We can have melt beyond the ELMER GL
  - ⇒ Melt could not reach the ELMER GL

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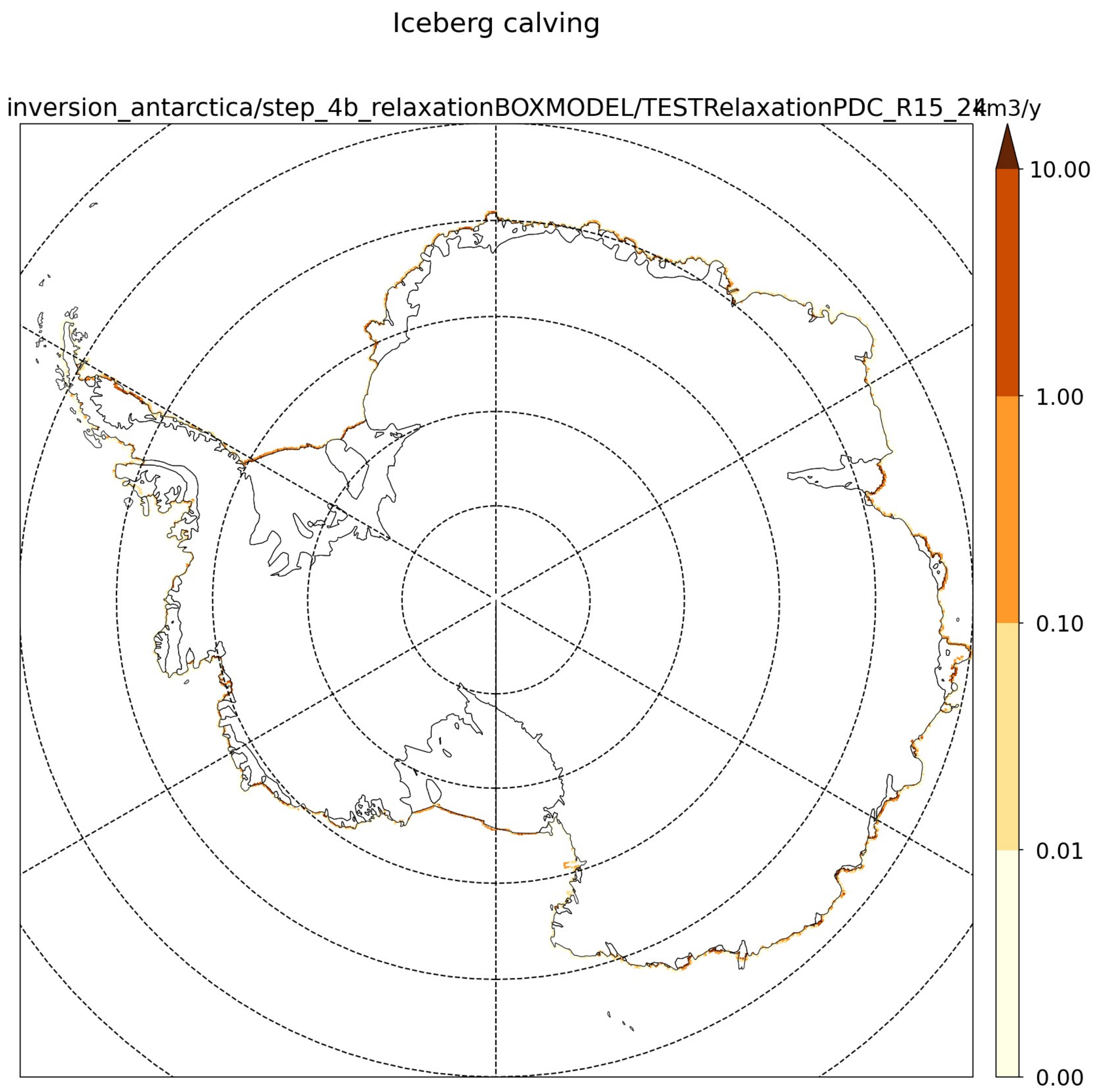
Iceberg calving regridding

Method:

- ELMER solver to compute the flux across the boundary
- Elmer calving assign to nearest NEMO coastal point

Issue:

- Iceberg in NEMO not ready for migration of the ice shelf front.



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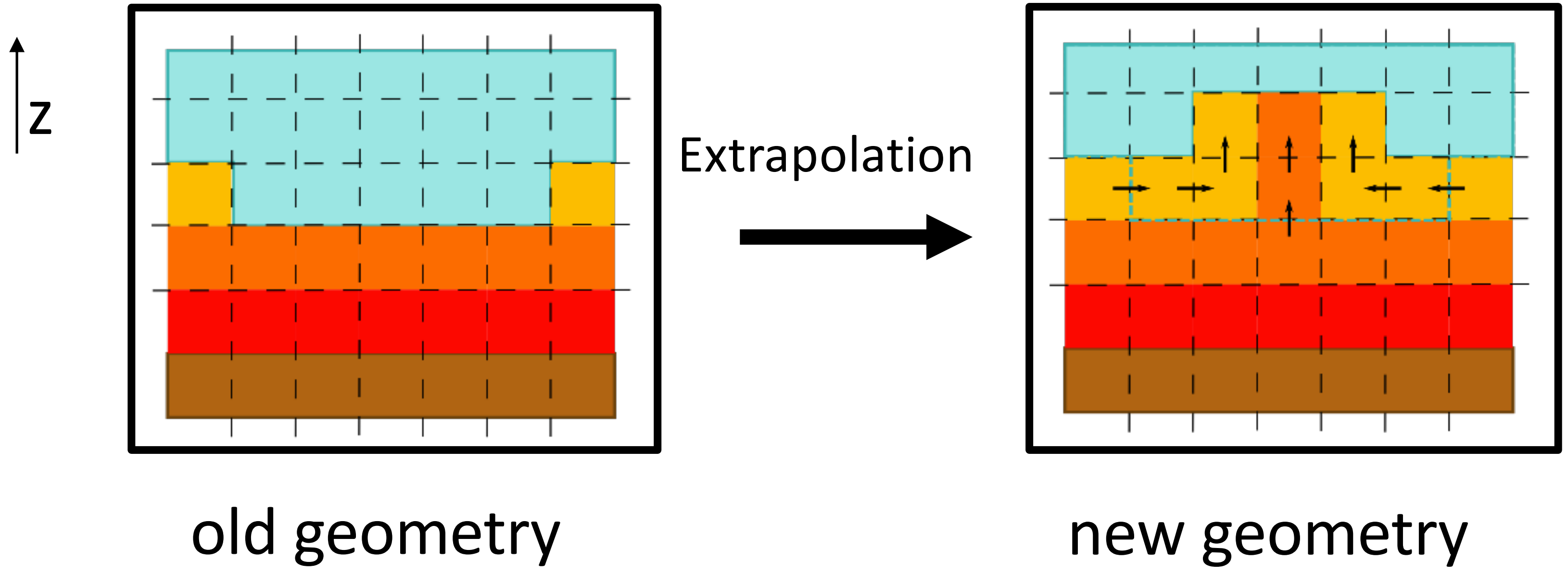
Tracers adjustment



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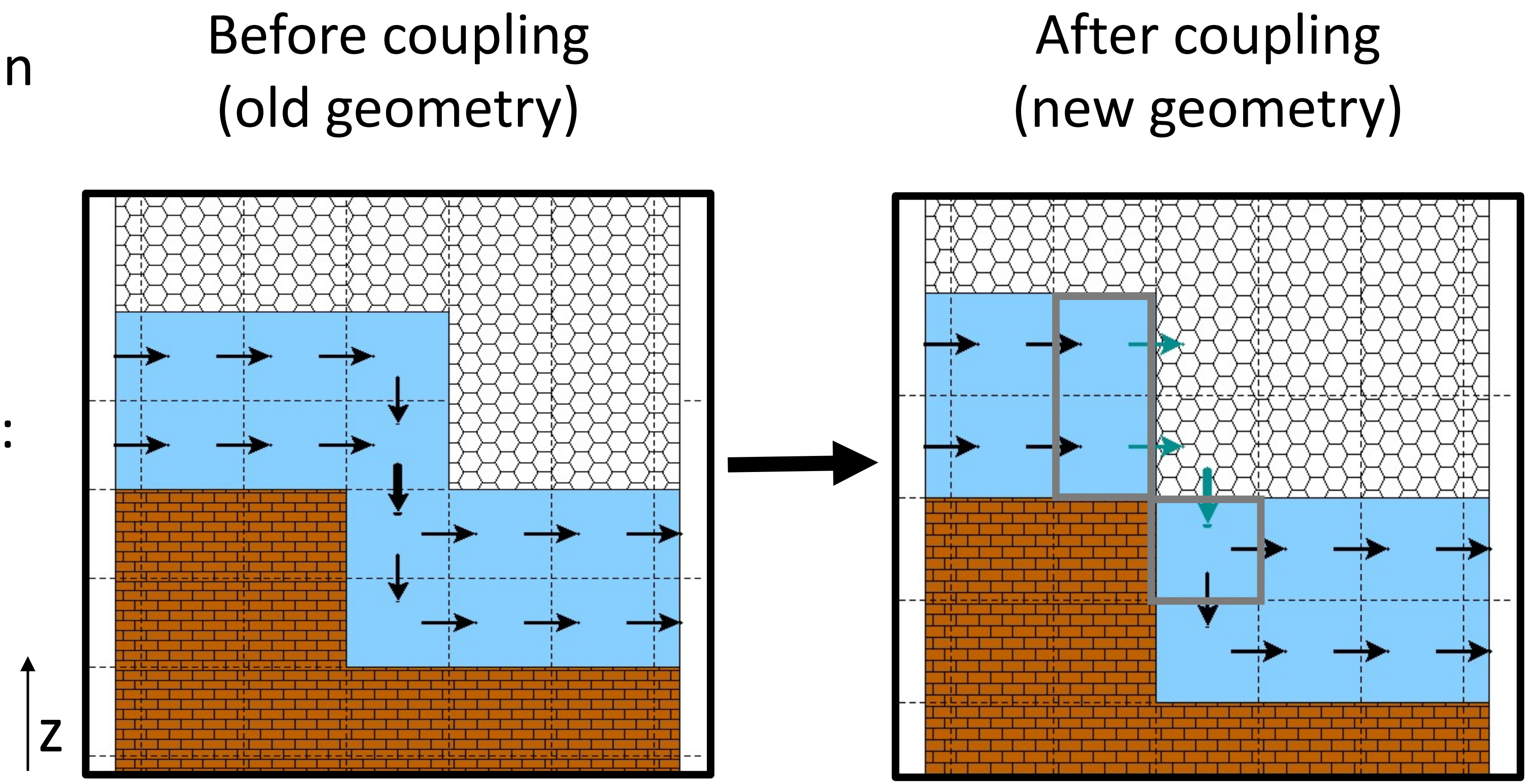
Dynamic adjustment

- In specific condition, w locally can become very large => blow up
- Instead of conserving barotropic transport, we correct horizontal divergence at the first time step : **$div_b(U)=div_a(U)$**
- It is like mimicking the **masked velocity** to compute ssh.

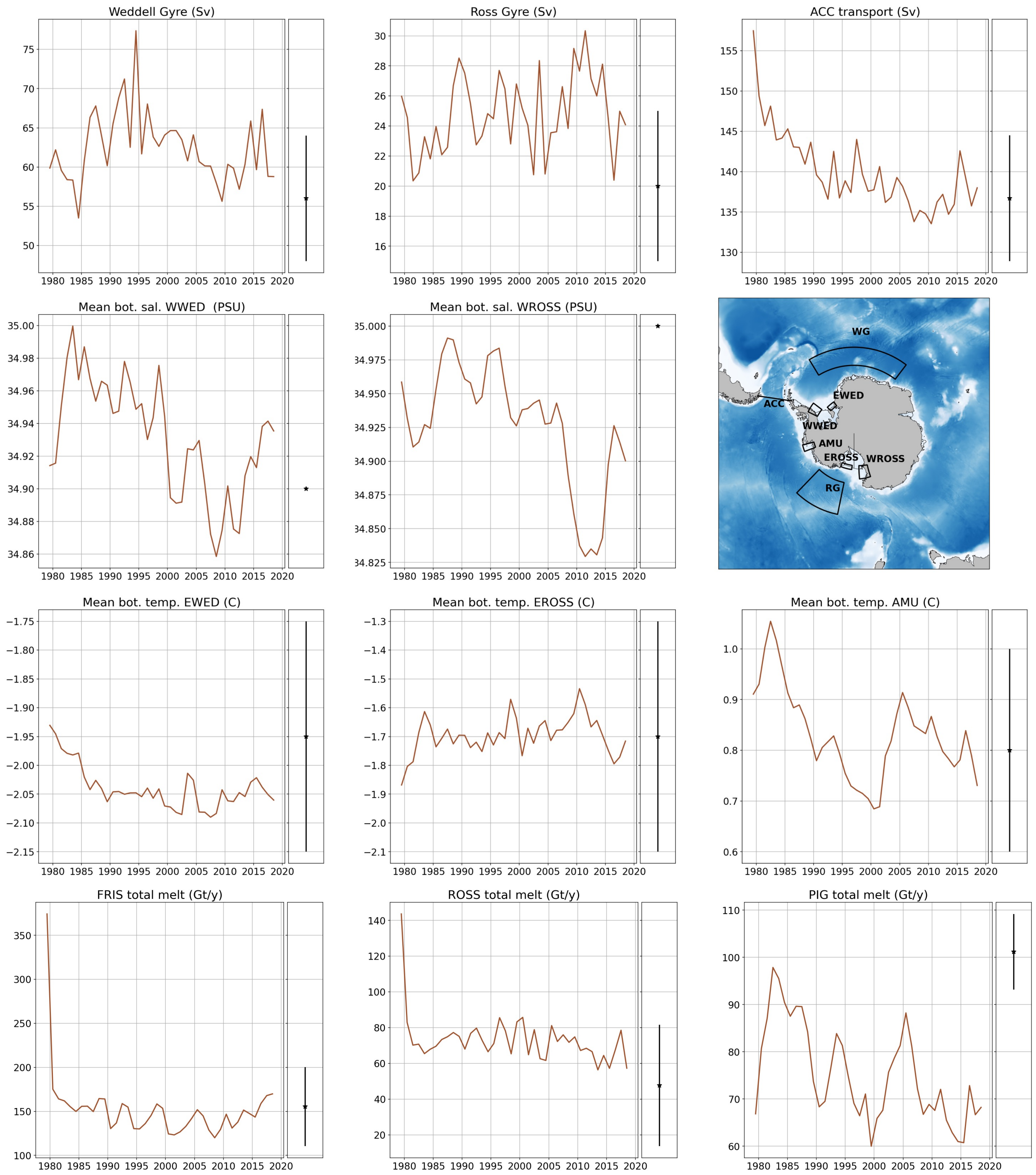


NEMO reference simulation

eORCA025.L121-OPM026

Setting:

- **Period:** 1980-2020
- **Horizontal resolution:** ~10 km at 70S
- **Vertical resolution:** 1m (surf.) and 20m (100m – 1000m)
- **Geometry:** Bedmachine
- **Initial conditions:** WOA2018
- **Atmospheric forcings:** JRA55
- **Tides under ice shelves:** CATS2008
- **Icebergs:** Lagrangian model
- **Calving:** Rignot et al. (2013)



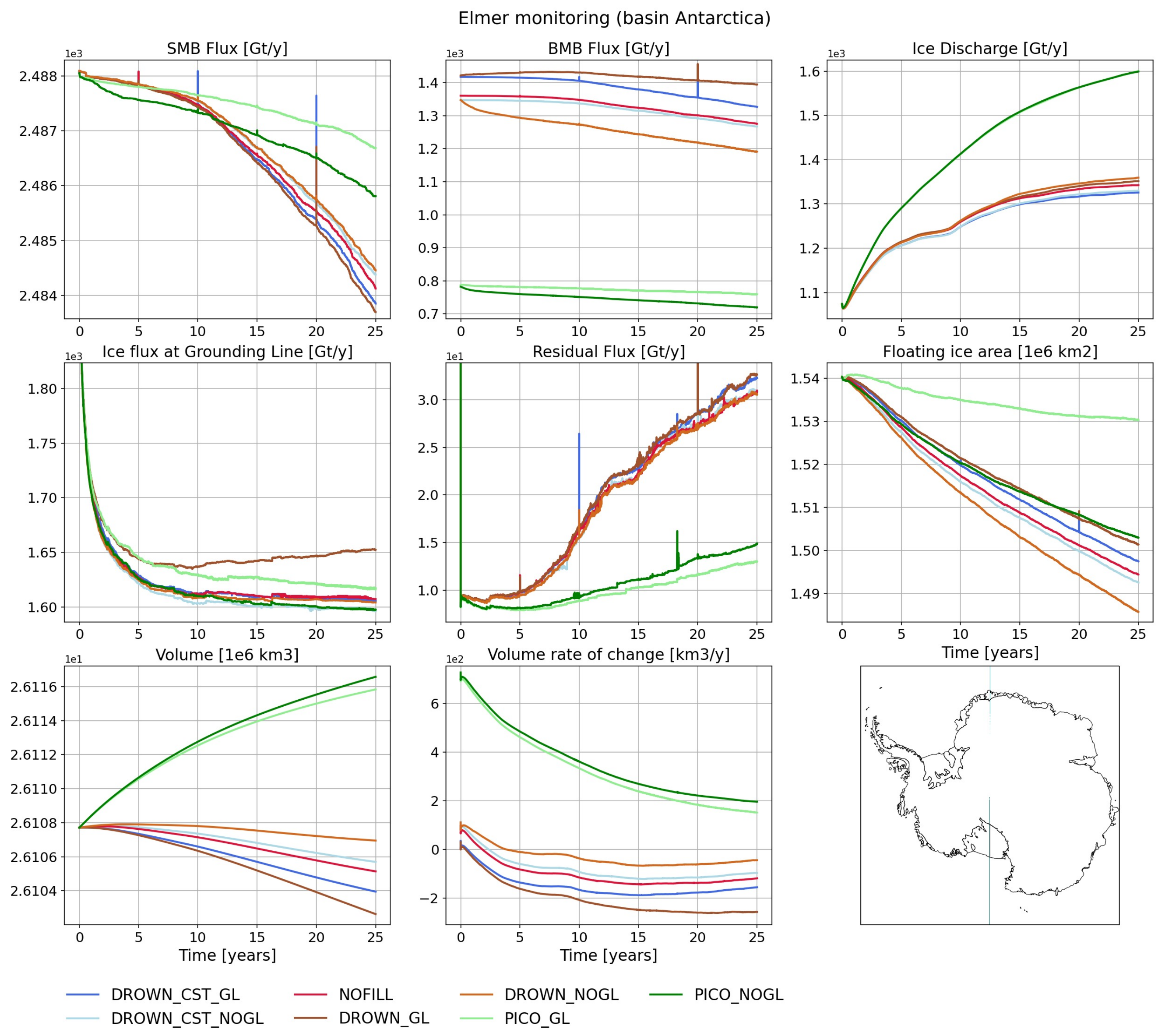
ELMER reference simulation

ANT50.GL1

Settings:

- **Unstructured grid:** 1 km (GL) to 50km
- **SSA**
- **Friction:** Weertman linear
- **Rheology:** Glen's flow law
- **Initialization:** inversion (no relaxation yet)

=> stress test for the coupled model (big changes)



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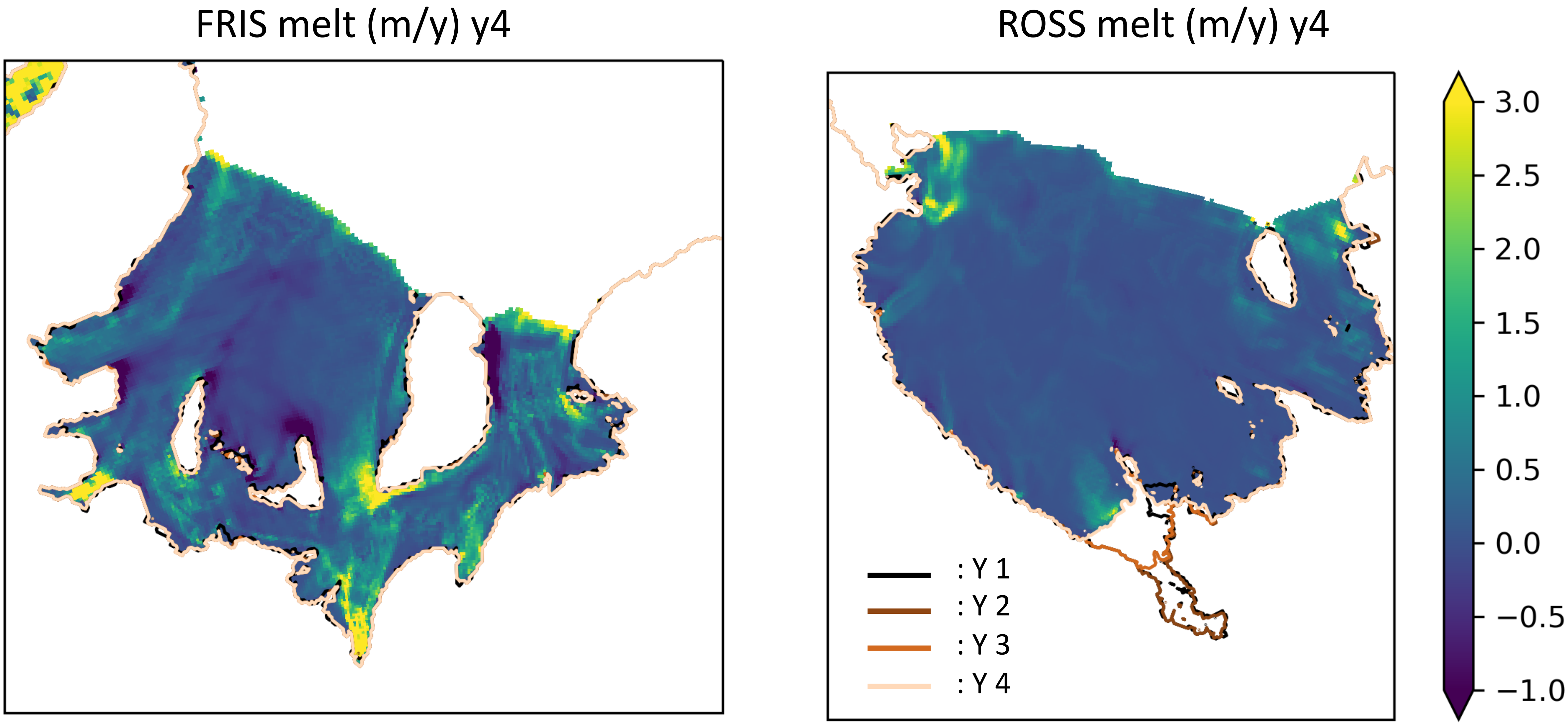
Realistic geometry stress test:



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Conclusion :

- All the building blocks are there
- Realistic NEMO coupled with a realistic Elmer/Ice stable despite large change in the geometry at coupling step.

To do before first starting WP3 runs :

- Build ice sheet initial conditions (discussion with IGE WP2 members)
- Define atmospheric forcing scenario (outcome WP1)

Then :

- Plenty of thing to improve (interpolation at GL, calving front migration, conservation …)

Tipping Points in Antarctic Climate Components

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