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EGU General Assembly 2022

EGU22: GTSM

Recent developments in the Global Tide and Surge Model

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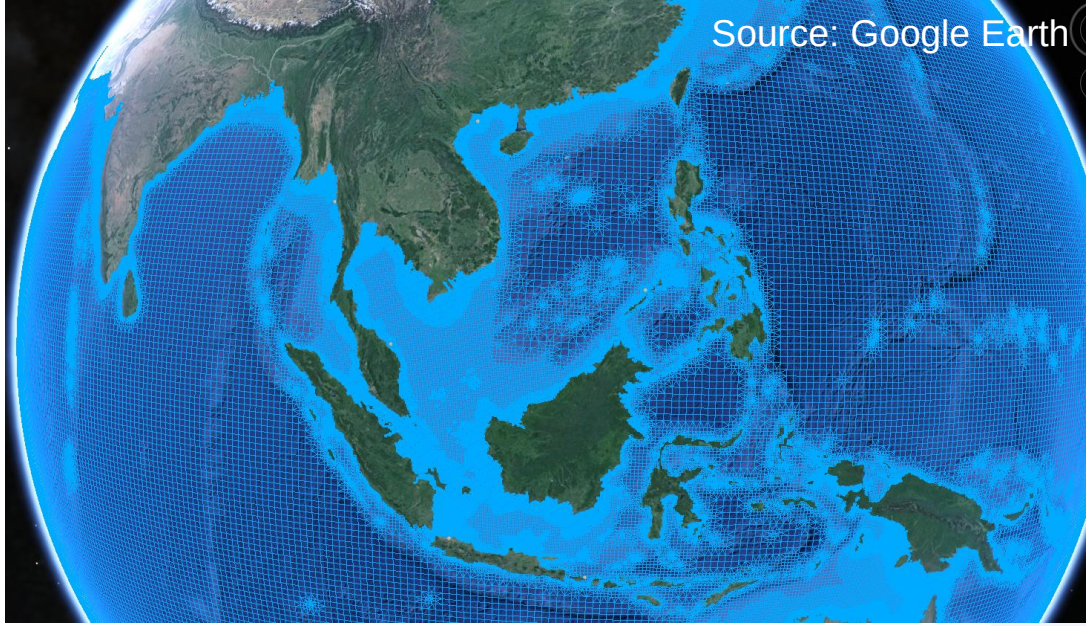
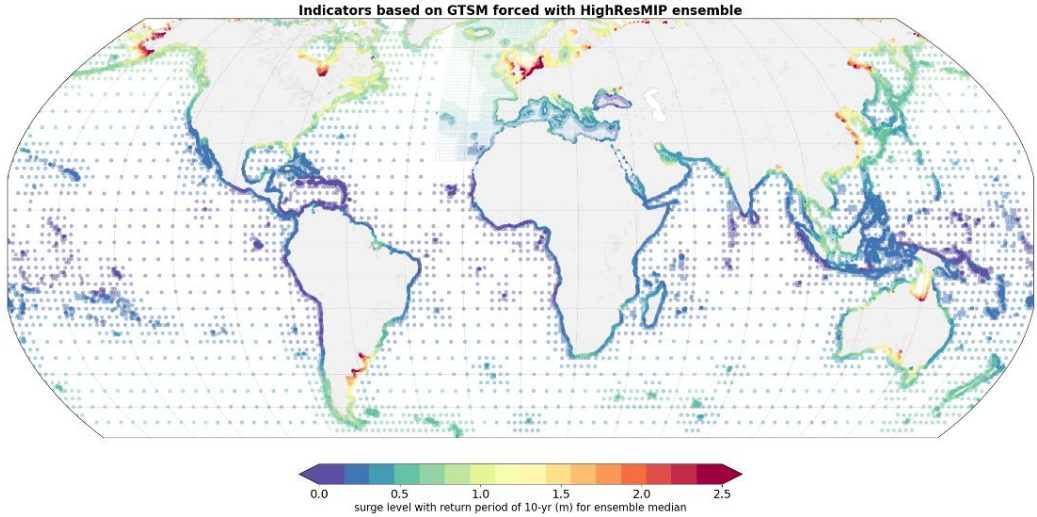
GTSM in general

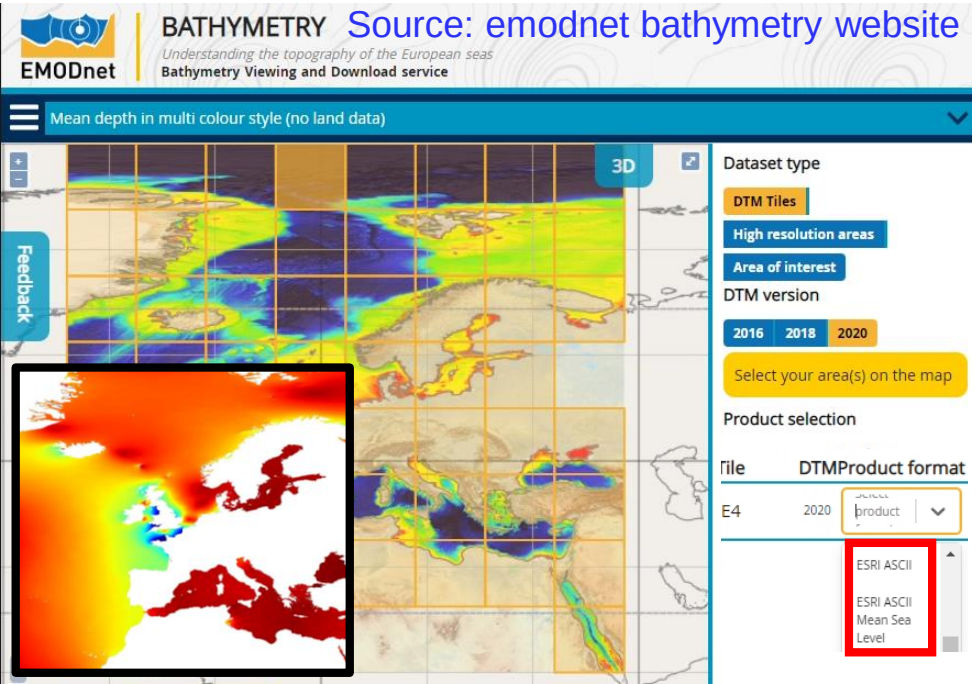


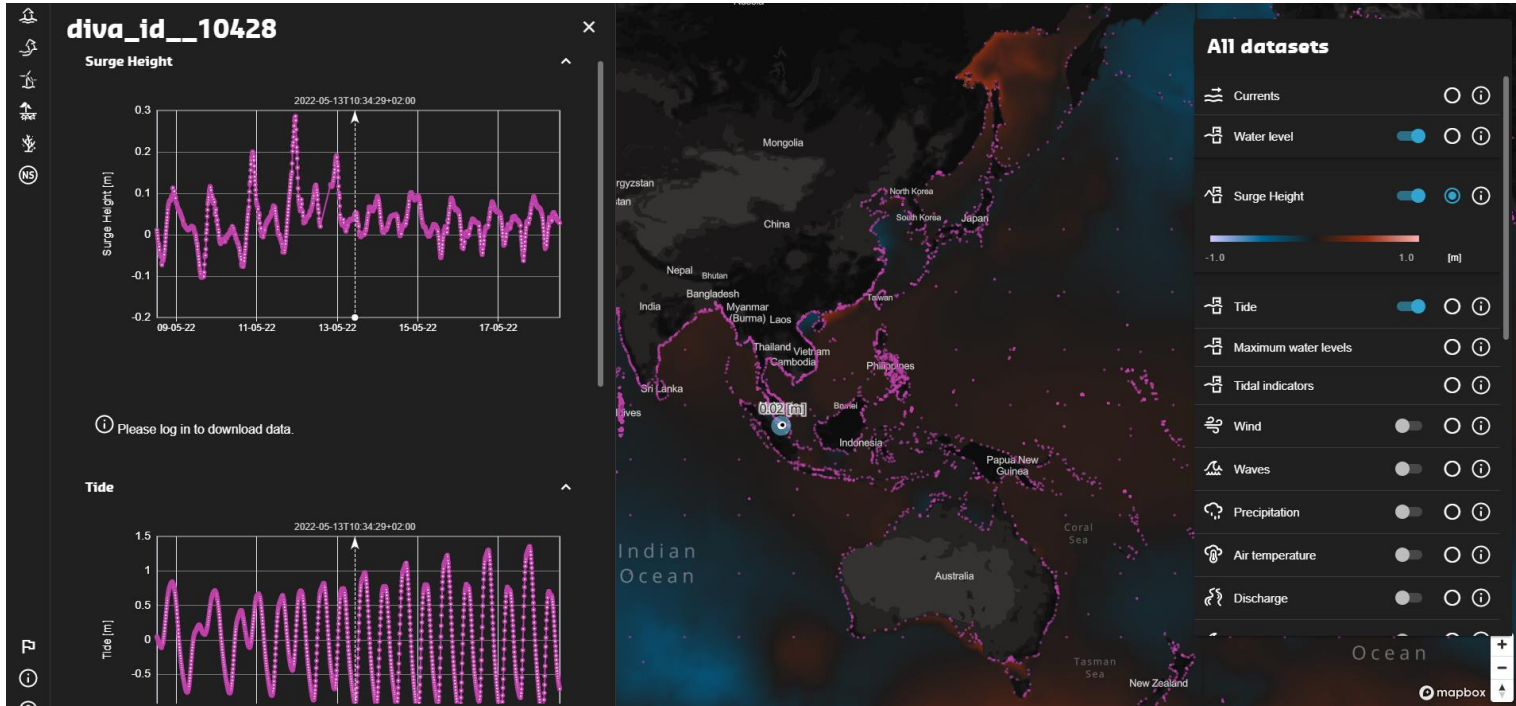
- Depth averaged hydrodynamic D-Flow FM model
- Global unstructured grid:
  - Global base grid refined based on bathymetry (Courant-like)
  - Coarse in open ocean (25km) and fine at coasts (up to 800m)
  - Extra refinement at steep topographies
- Bathymetry: GEBCO2021 and EMODNET2018 bathymetry with LAT correction
- Global, so no (lateral) boundary conditions
- Physical processes include:
  - Tidal forcing on a 1 degree grid
  - Bottom friction dissipation
  - Self Attraction and Loading (SAL)
  - Internal tide friction dissipation (2D parameterization of a 3D process, mainly relevant at steep topographies)
- Pretty good global and local statistics (and improving)

Applications



- Climate projections GTSMip
- LAT correction fields for e.g. EMODNET Bathymetry
- Operational GTSMv4.1 model data available via GLOSSIS and BlueEarthData.org
- More info on the GTSM publicwiki





GTSM statistics development

Year	version	developments	resolution	Std [cm] FES2014	Std [cm] coastalABC	Time** [hr/5wk]
2020	GTSMv4.0 (EM66)	Improved bathy, calibration, Improved tidal potential	2.5/1.25km	6.3	*** 19.6	21.08
2020	GTSMv4.0 + CA (EM64)		2.5/1.25km	4.6	*** 18.3	20.11
2021	GTSMv4.1 (EM74)	Improved IT diss, Chezy re-tweaking, re-calibration XW	2.5/1.25km	5.8	16.8	18.58
2021	GTSMv4.1 + CA (EM75)		2.5/1.25km	3.2	14.1	19.14
2022	GTSMv5.0* (GM42)	Improved grid (ortho), new bathy, improved ITfrict, cutcell	2km/800m	4.7	15.5	18.68
2022	GTSMv5.0* (GM42+cutcell)		2km/800m	4.2	12.8	19.23
2022	GTSMv5.0 + CA (-)		2km/800m	-	-	-

- Results are for tide only for January 2014
- * GTSMv5.0 is under development
- ** on 2x4 normal-e3-c7 nodes
- *** with non-snapped observation locations

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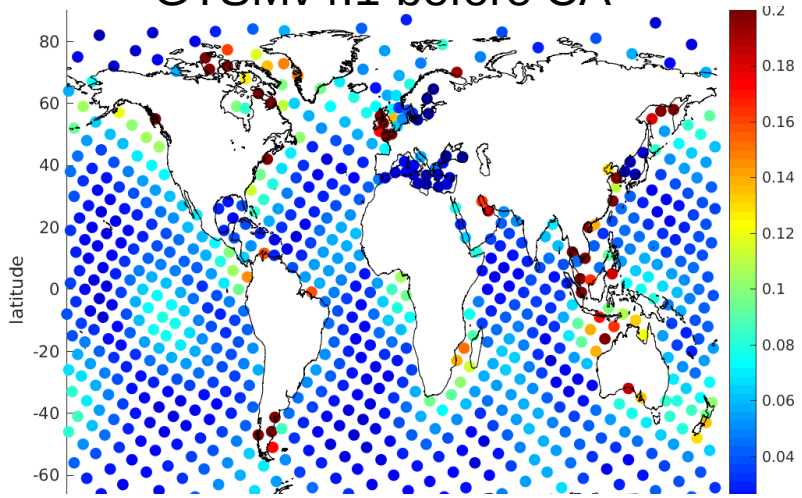
STD for GTSMv4.1 (before and after calibration)

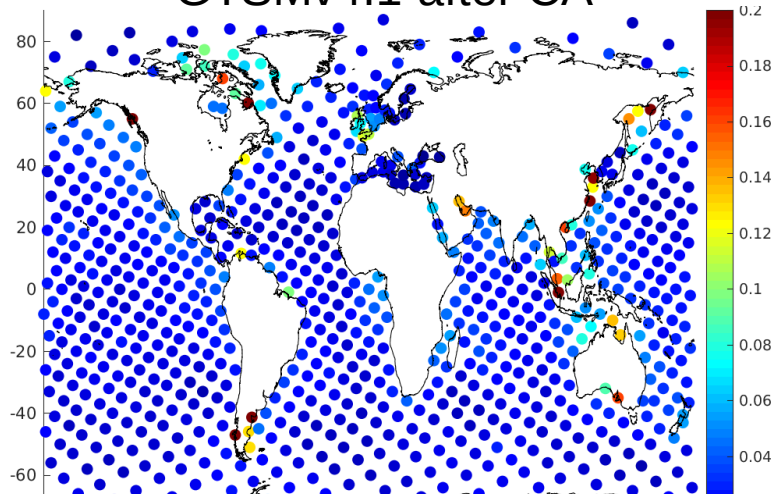
Compared to FES2014 deep water stations (GTSMv4.1 before and after calibration)

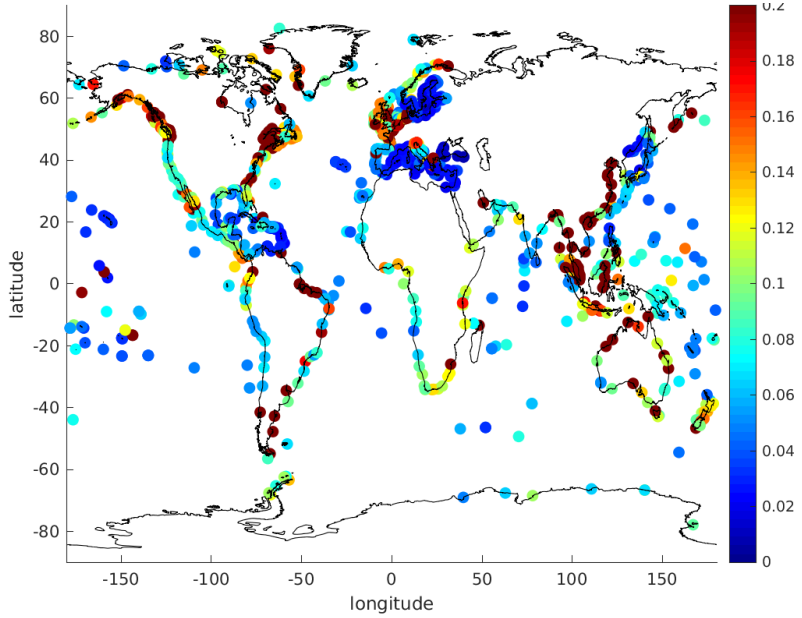
Compared to coastal stations (GTSMv4.1 before and after calibration)

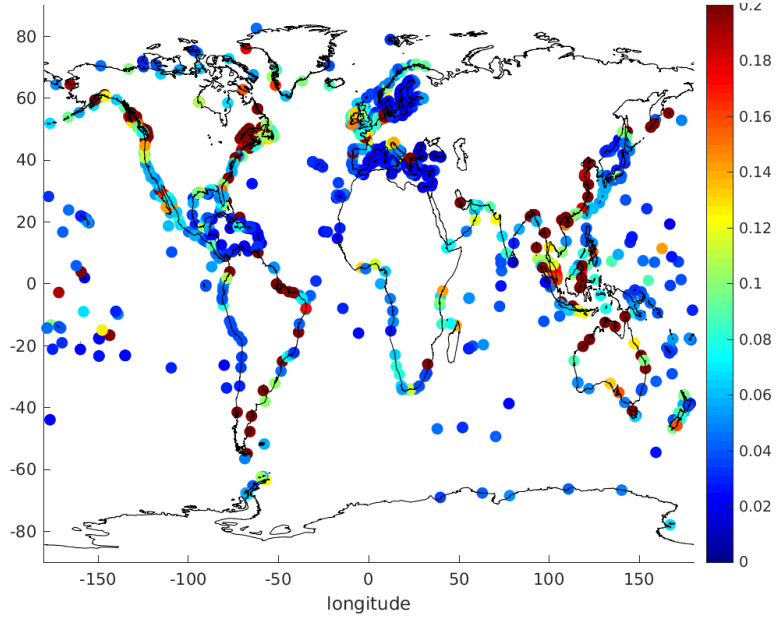
GTSMv4.1 before CA



GTSMv4.1 after CA







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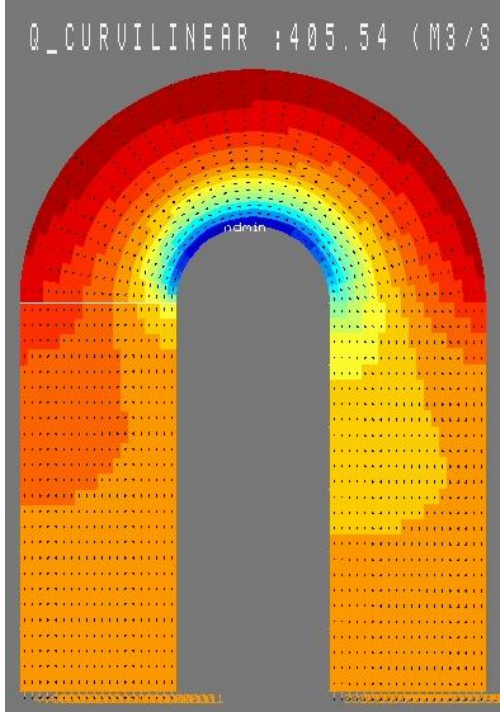
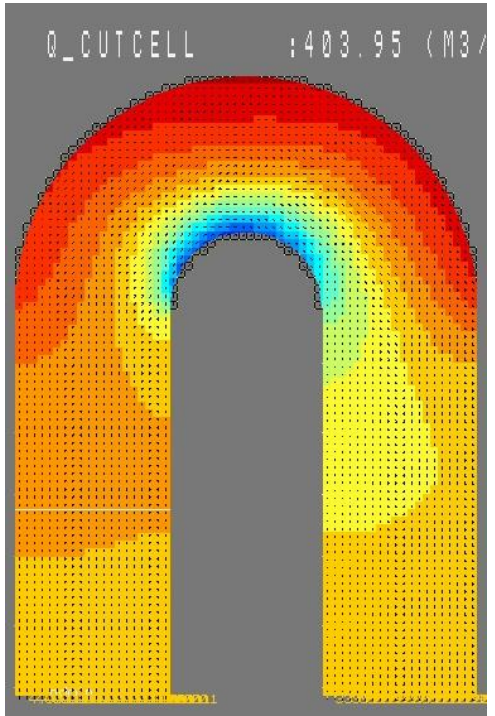
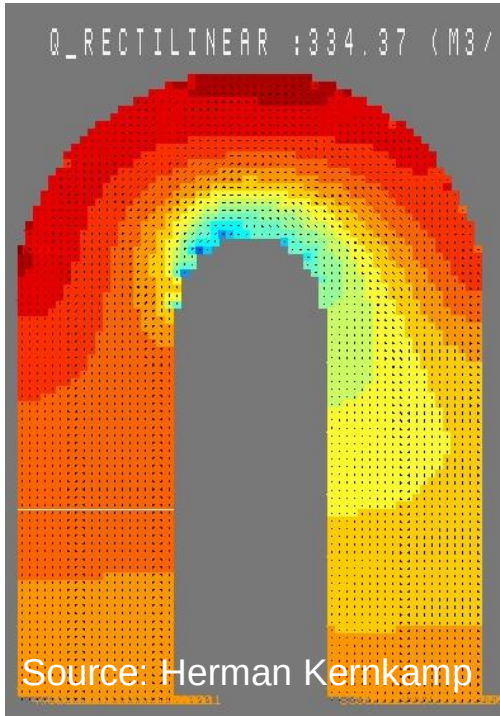
GTSMv5.0 update

- Improved grid, bathymetry, internal tide friction, ***cutcell method***
- Using a global landboundary polygon to cut off landward parts of each cell
- Very schematic testcase shows the effect for a rectilinear grid
- Real world example: English Channel







Source: Herman Kernkamp

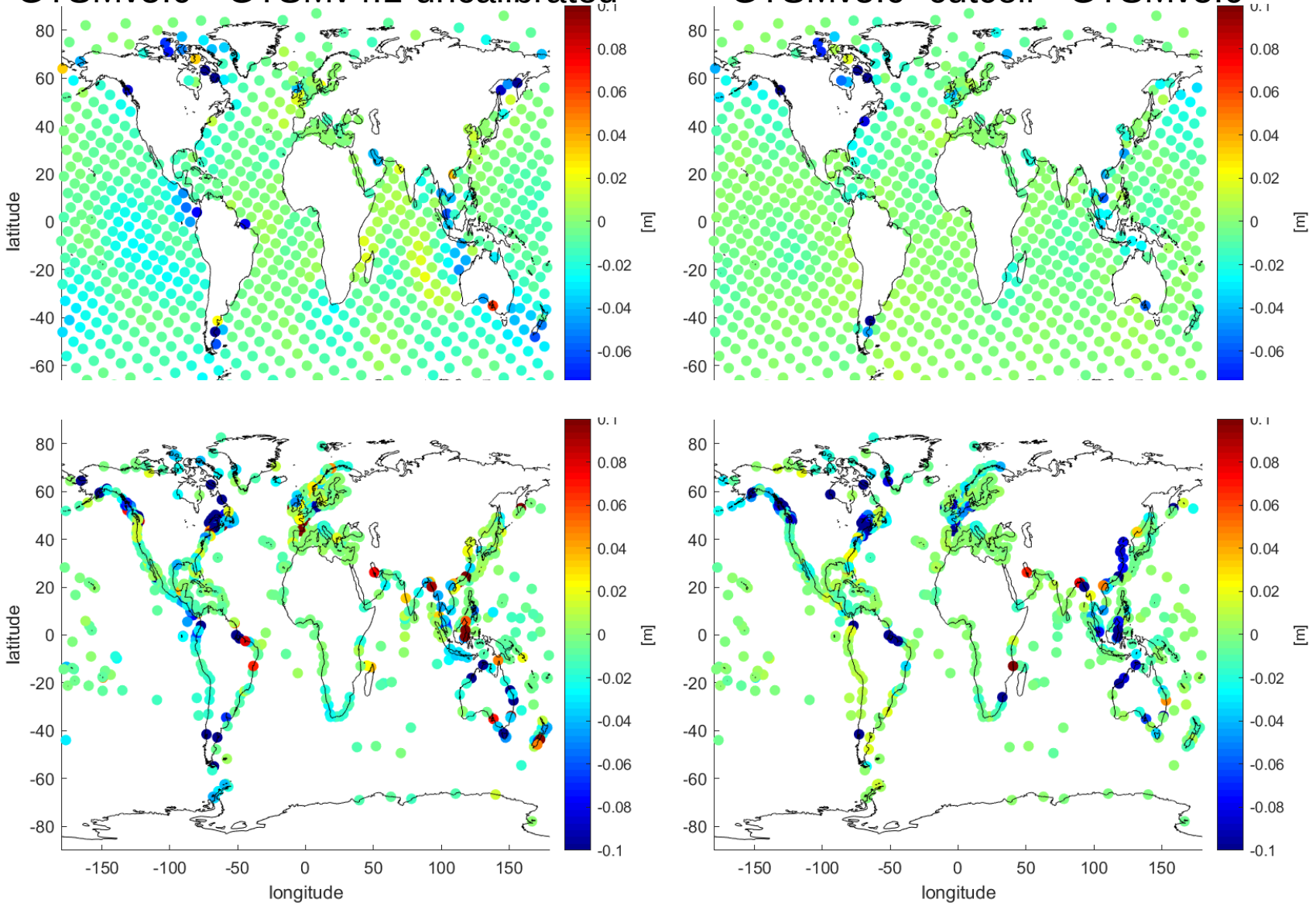
STD change for GTSMv5.0 and GTSMv5.0+cutcell

STD change for FES2014 deep water stations

STD change for coastal stations

GTSMv5.0 - GTSMv4.1 uncalibrated

GTSMv5.0+cutcell - GTSMv5.0



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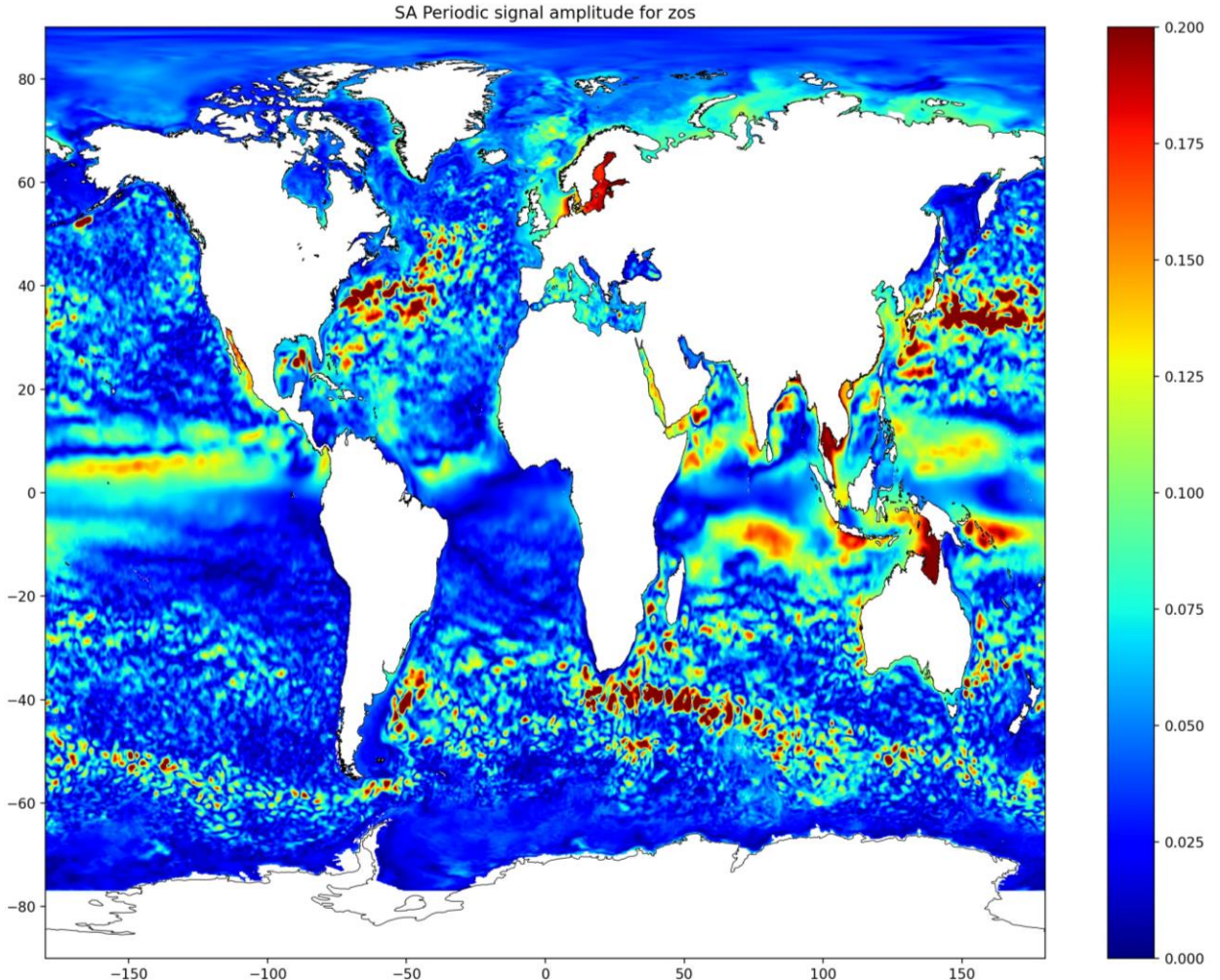
Future GTSM developments

- Finalize and calibrate GTSMv5.0
- Inclusion of steric/radiational effects
  - Figure: steric yearly water level anomaly derived from CMEMS timeseries
- Inclusion of tide/river interaction
- Inclusion of sea ice



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Questions and contact info

- Questions?

- More info at: https://publicwiki.deltares.nl/display/GTSM/
- Contact: jelmer.veenstra@deltares.nl
- Abstract: