Supplement of

AltiMaP: altimetry mapping procedure for hydrography data

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Text S1: WSE caluclation in CaMa-Flood

In CaMa-Flood hydrodynamic model the WSE is diagnosed using following equation.

$$WSE = d + z - b \qquad (S1)$$

Where d is the river water depth, z is the riverbank height, and b is the river channel depth. Hence river bathymetry would be $(z - b)$. z values were obtained from MERIT DEM. Because of river bottom elevation data are not readily available, a power-law relationship was employed to estimate the river channel depth (Yamazaki *et al*., 2011; Zhou *et al*., 2022), as shown below.

$$b = max\left(b_{min}, c_b Q_{avg}^{p_b}\right) \qquad (S2)$$

where b is the channel depth (m) and Q_{avg} is the annual average discharge (m^3/s). Here, the average climatological land surface runoff from the Minimal Advanced Treatment of Surface Interaction Runoff (MATSIRO; Takata *et al*., 2003), simulated by Kim *et al*. (2009), was used. Other parameters were estimated to be $b_{min} = 1.0, c_b = 0.1$, and $p_b = 0.5$.

Table S1: Secondary Flags used in the AltiMaP. Here large and small river are with respective to each river section. The upstream catchment area was used to define the small and large rivers.

| Main Flags	Secondry Flag	Description
10	11	VS was found on the river centerline
	12	VS was found on the river channel but not in the centerline and assigned to the nearest centerline
	13	VS was found in the unit-catchment mouth
20	21	VS was found in the ground and assinged to the nearest single channel centerline
	22	VS was found in the ground near large river channel in in mult-channel river and assinged to the larger river centerline
30	31	VS was found in the ground near small river channel in mult-channel river and assinged to the large river centerline
	32	VS was found in bifuricating channel and assinged to the large river centerline
40	40	VS was found in the ocean and assinged to nearest river channel
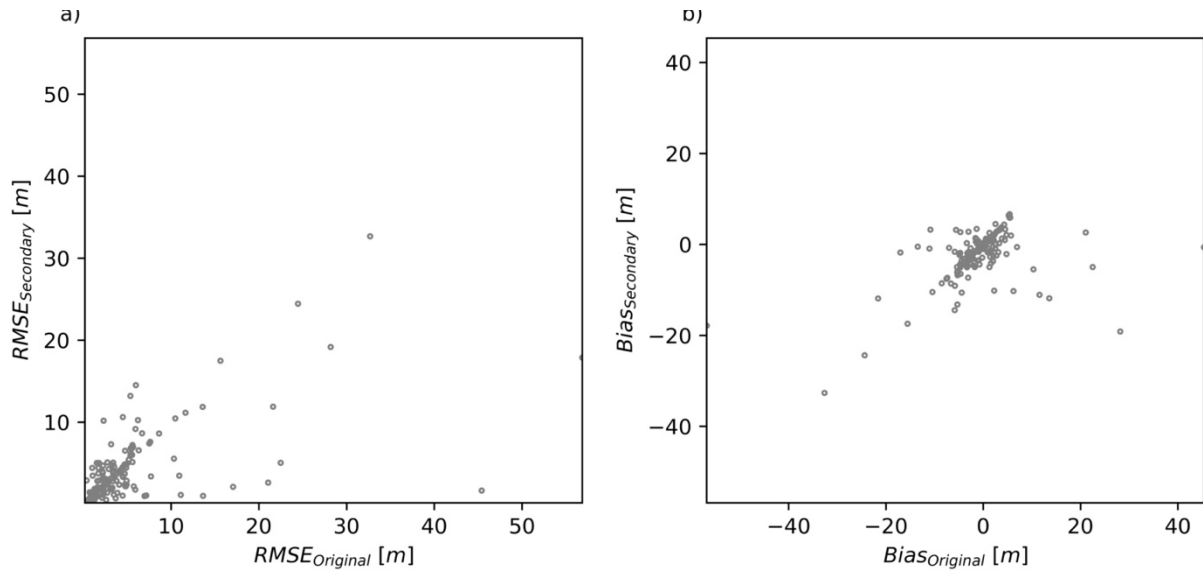
Figure S2: Comparison of root mean squared error (RMSE: a) and bias (b) for Original and Secondary allocations.
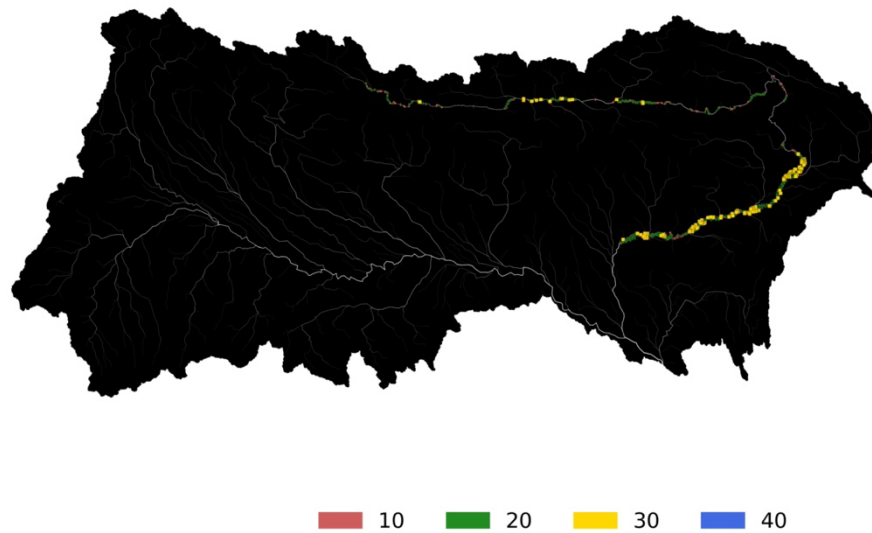

Figure S1: AltiMaP allocation flags for the CryoSat-2 data provided by Schneider et al., (2017). Here each Cryostat-2 observations has been considered as a VS to allocate into MERIT Hydro because of the drifting orbit of CryoSat-2.

Reference:

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Takata, K., Emori, S. and Watanabe, T.: Development of the minimal advanced treatments of surface interaction and runoff, Glob. Planet. Change, 38(1–2), 209–222, doi:10.1016/S0921-8181(03)00030-4, 2003.

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