Meso Scale Modelling for Long Term River Morphology

Upal Mahamud, Ziaur Rahman, Syed Arefin
IWM

Dano Roelvink, Mick van der Wegen and Johan Reyns
IHE Delft & Deltares

Objectives

- To hindcast and predict the morphological development of meso-scale systems along the Bangladesh coast on decadal time scales:

  - Can we understand the major morphological changes,
  - What processes drives the major morphological changes and
  - How will these systems change under future scenarios of climate change and anthropogenic interventions?

- To provide boundary conditions in terms of large-scale bed elevation change and sediment concentrations to micro-scale models.

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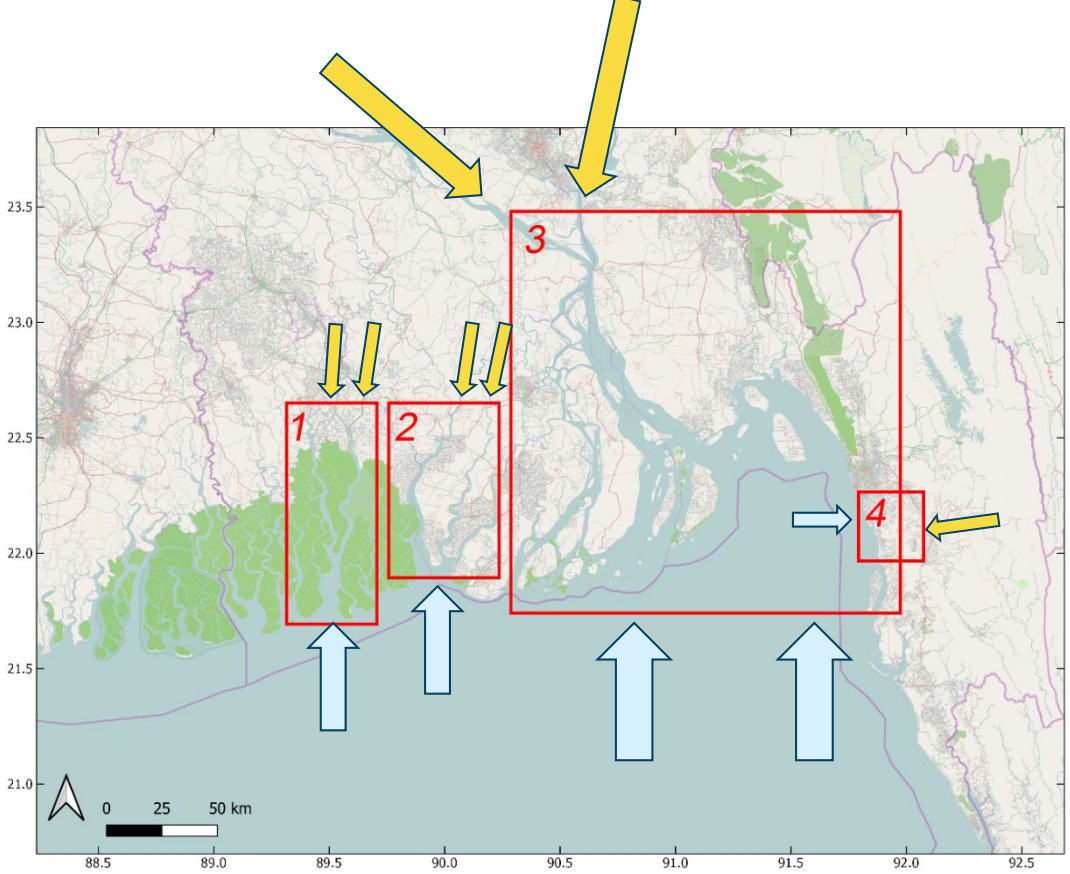

1. Pussur-Sibsa system
2. Baleswar-Bishkali system
3. Lower Meghna model
4. Sangu River

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Methodology

- The development of four morphodynamic models based on Delft3D FM software;
- Validation of modelled hydrodynamic and suspended sediment concentration (SSC) against available measurements;
- Validation against observed ~10-year morphodynamic development;
- Predictions by scenarios of SLR, sediment supply decrease and human interventions including dredging and cross-dam construction;

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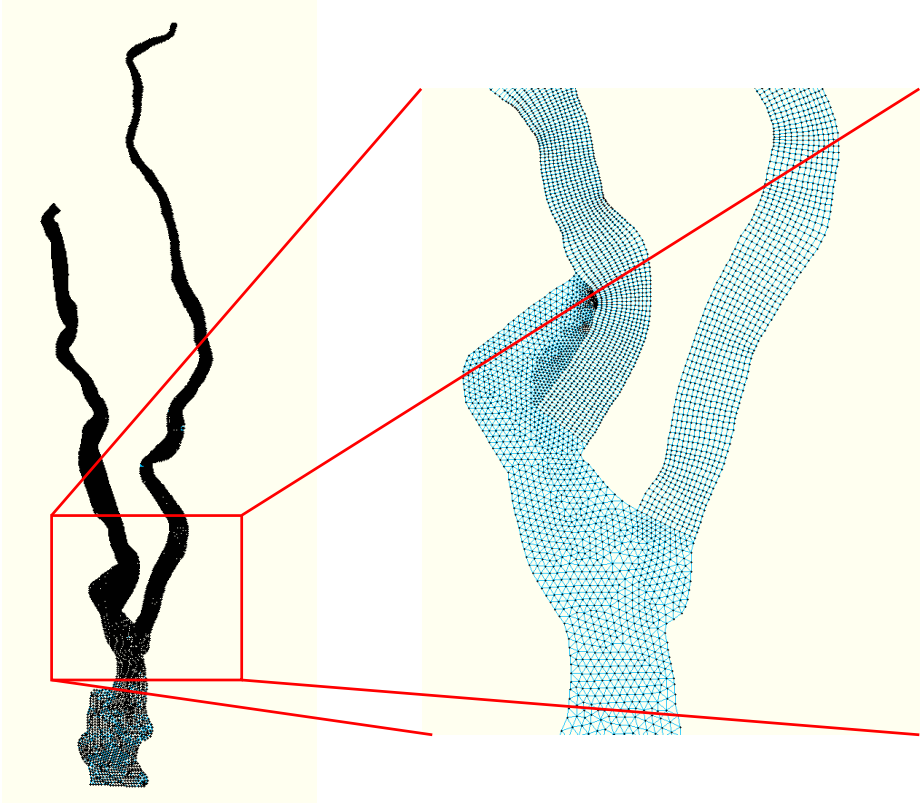
The development of four morphodynamic models based on Delft3D FM software;



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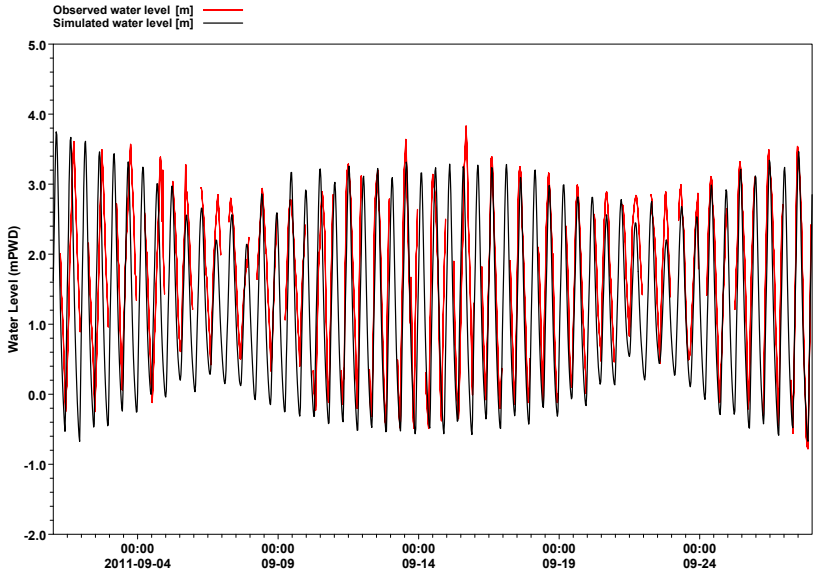
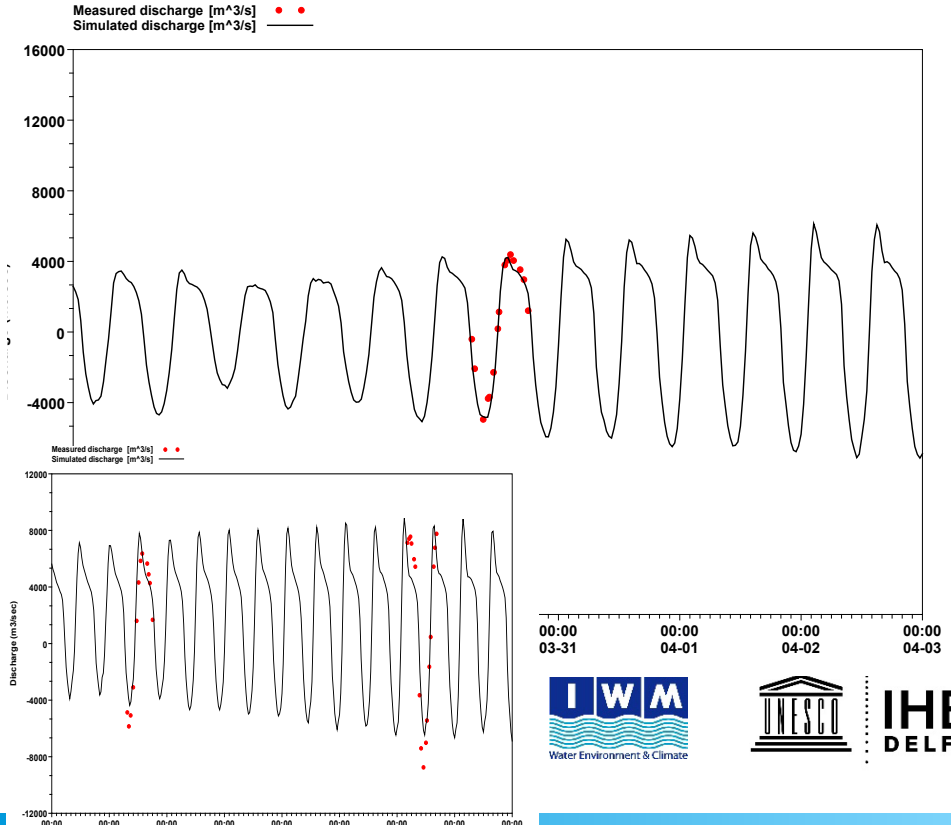
Validation of modelled hydrodynamic and suspended sediment concentration (SSC) against available measurements;

Waterlevel validation



Discharge validation



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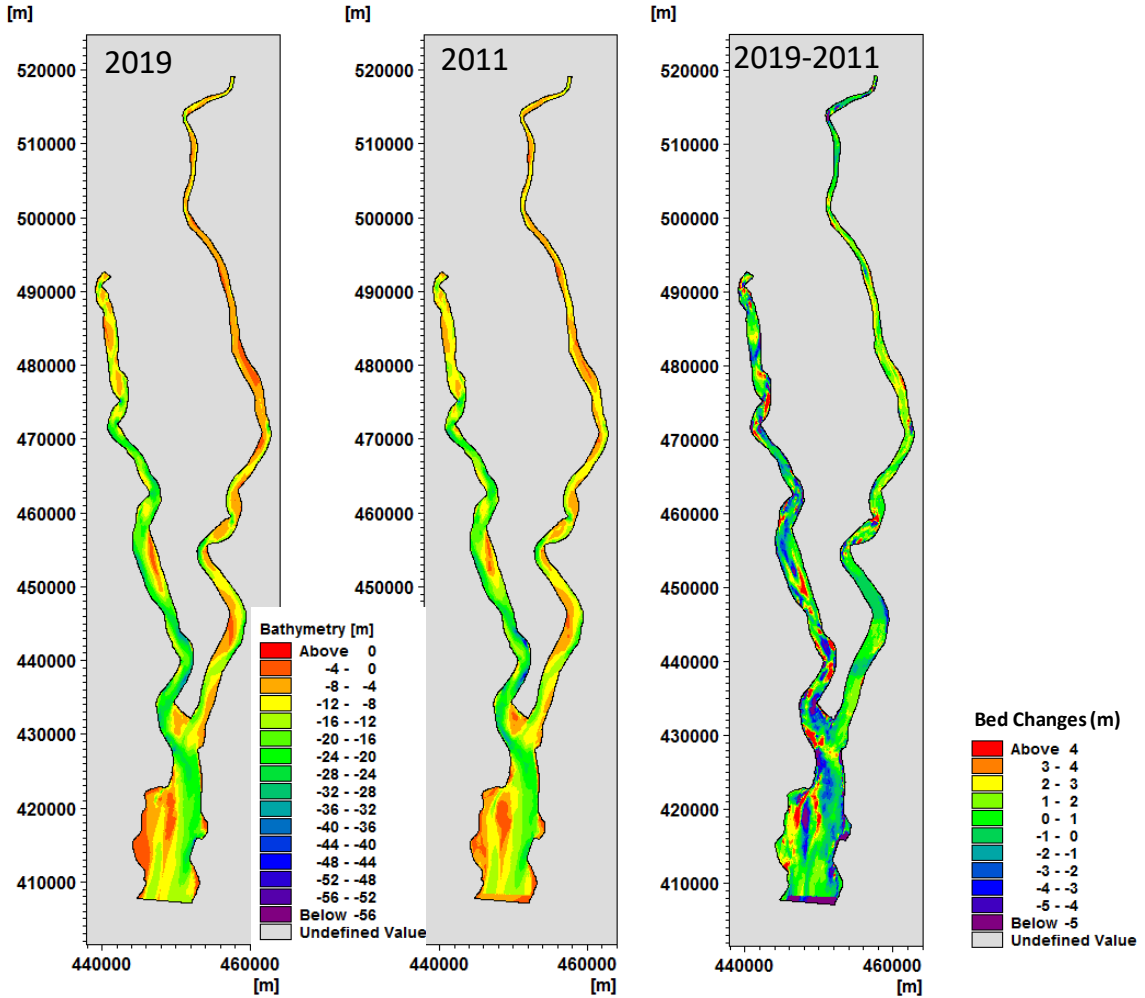
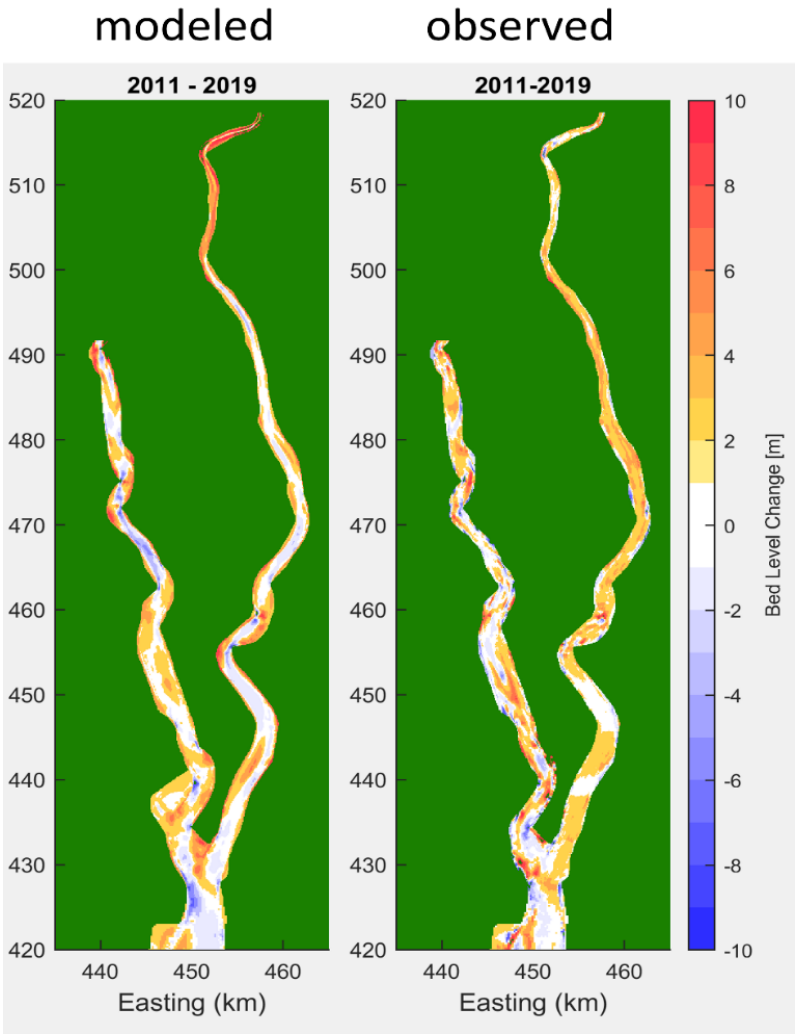
Validation against observed ~10-year morphodynamic development;





Skilfull morphodynamic hindcast

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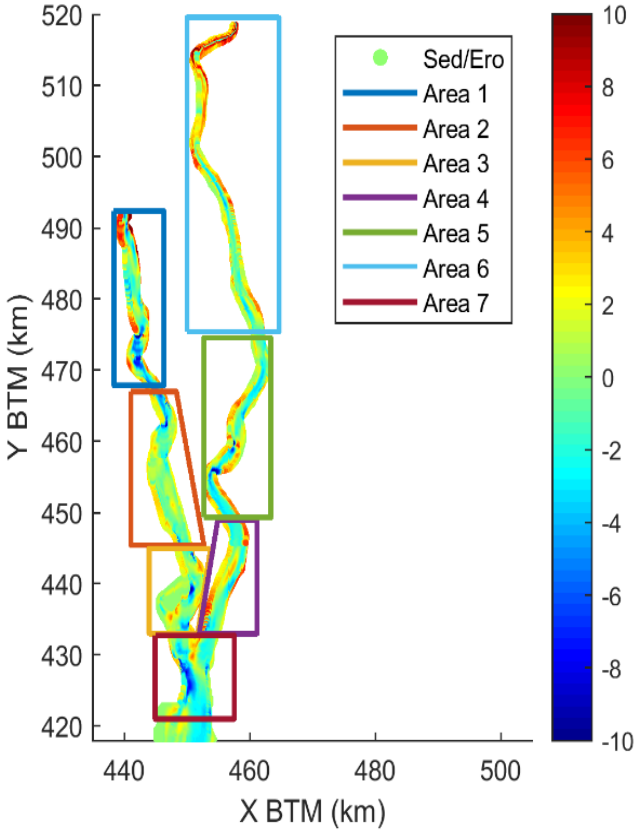

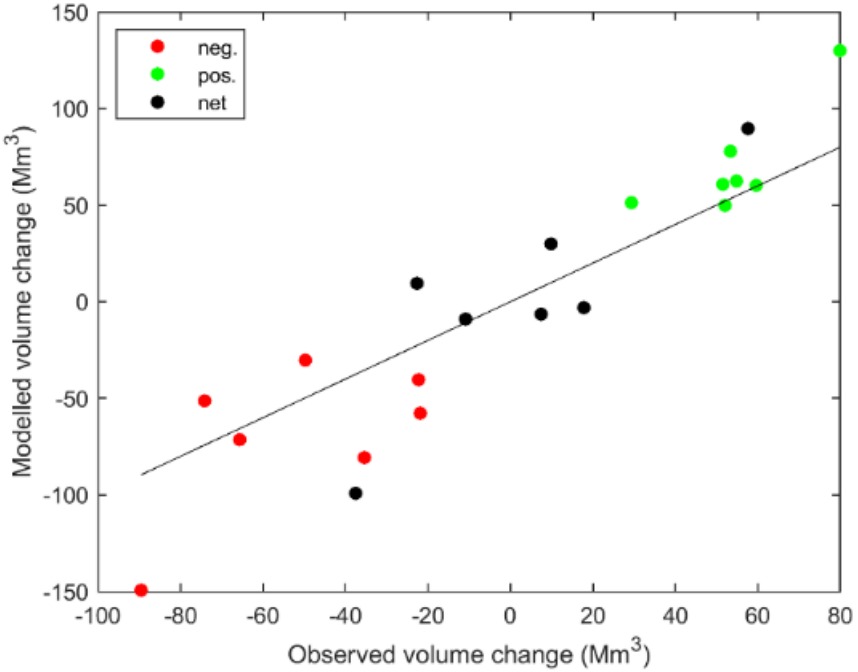

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- Predictions by scenarios of
  - SLR
  - dredging
  - cross-dam construction
  - sediment supply decrease.

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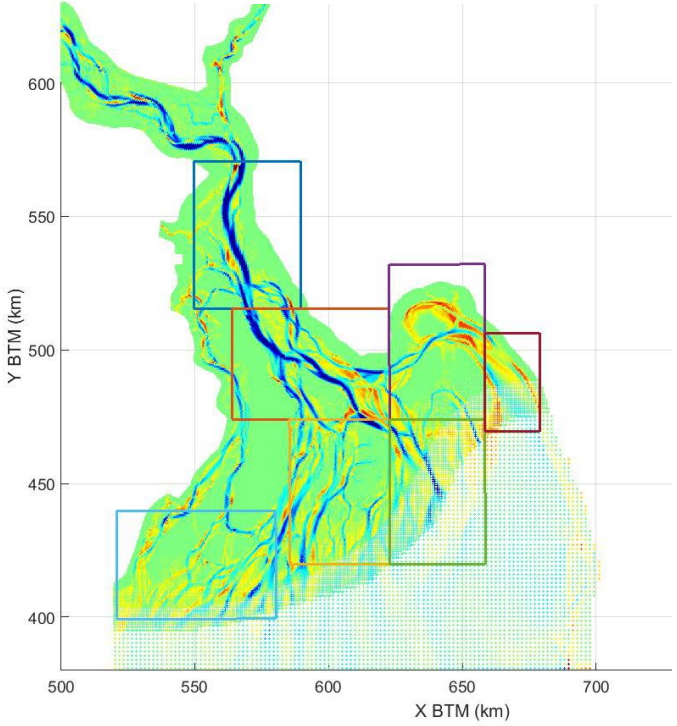
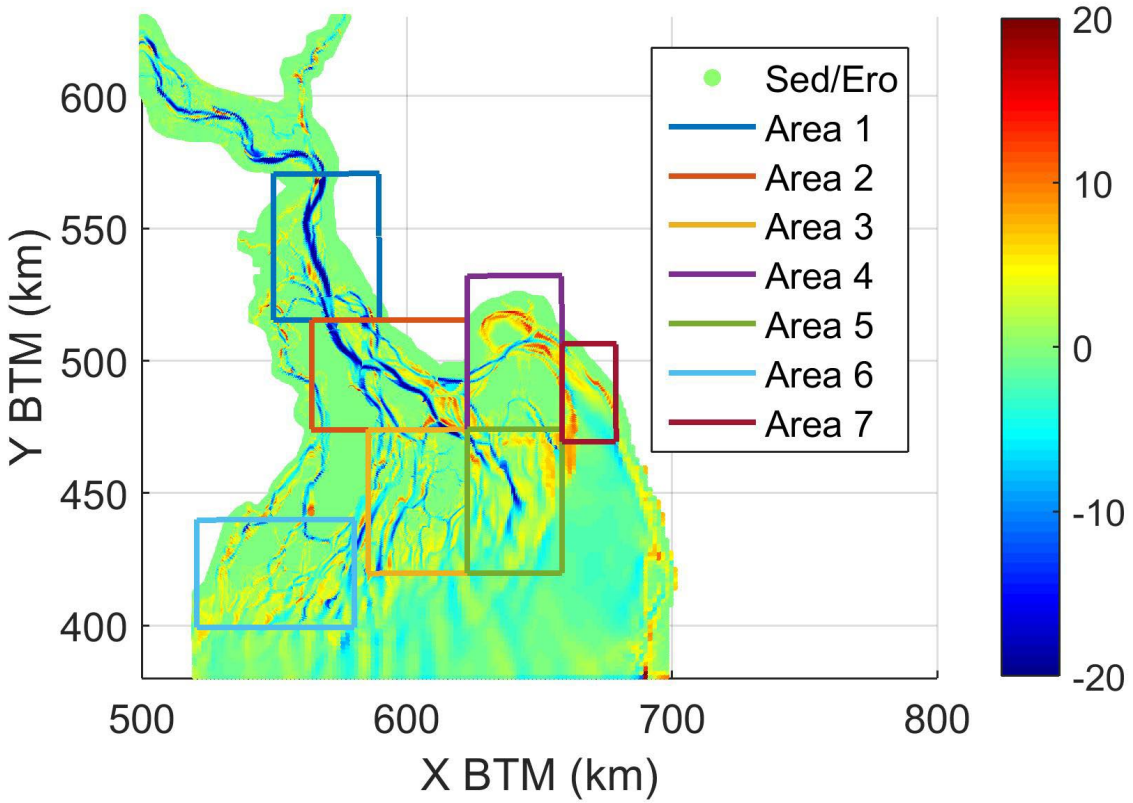
Morphodynamic impact of sea level rise after 30 years

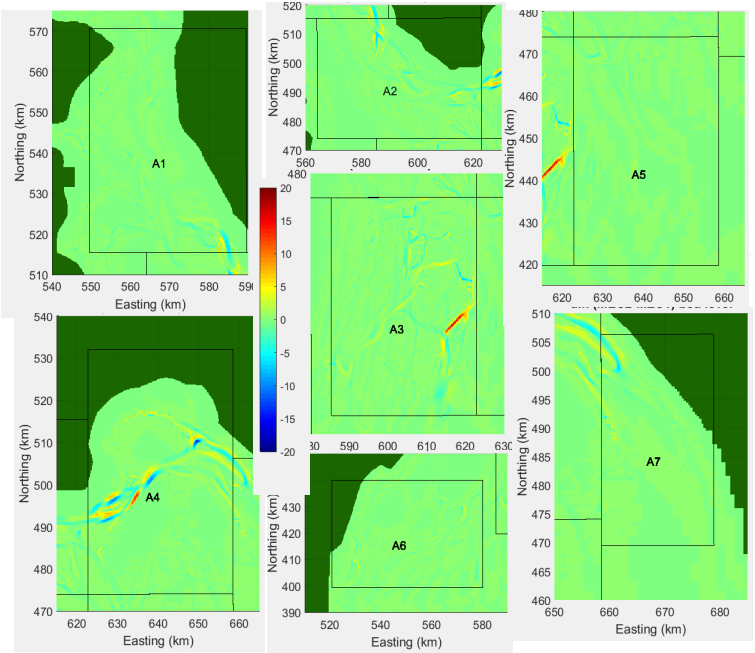
No SLR

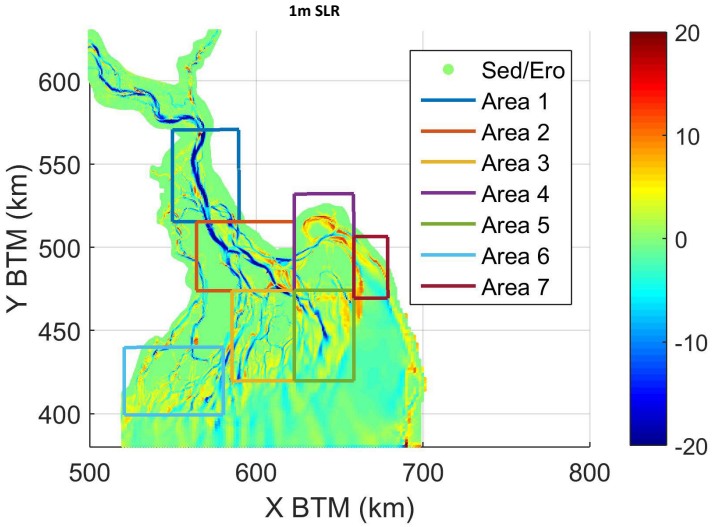


30 cm SLR



SLR: impact much smaller than ongoing developments





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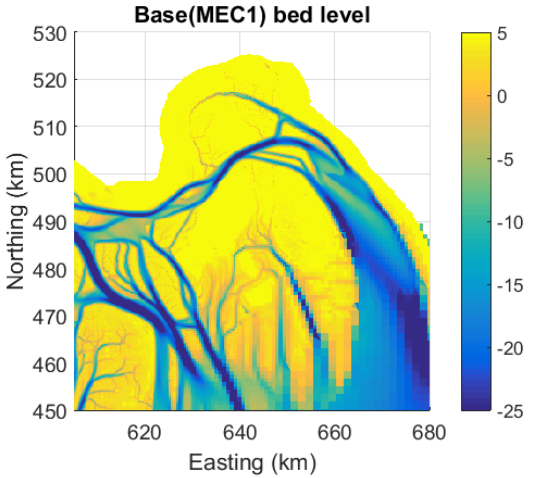
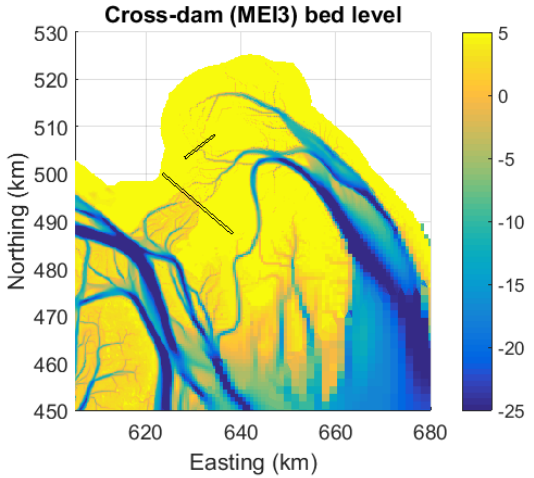
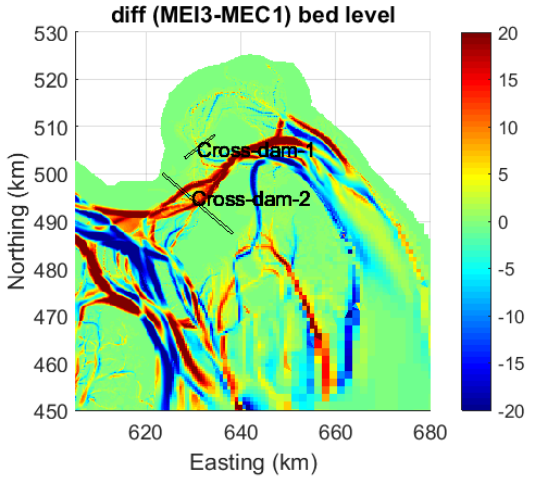
Cross-dam construction: considerable and wide impact







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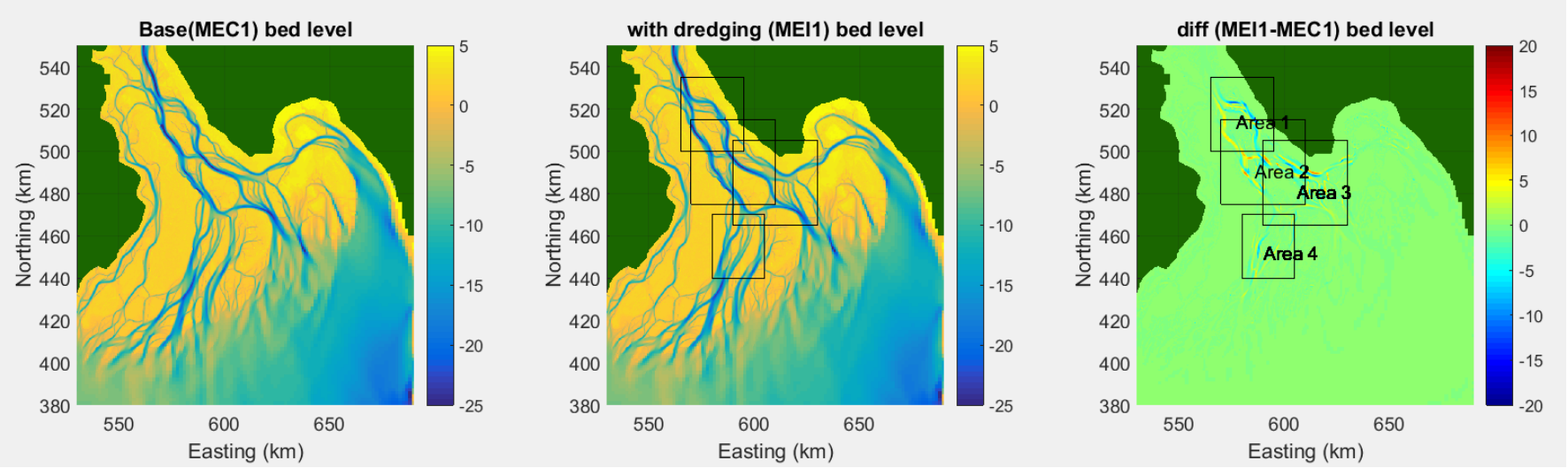
Dredging activities: pronounced but local effect



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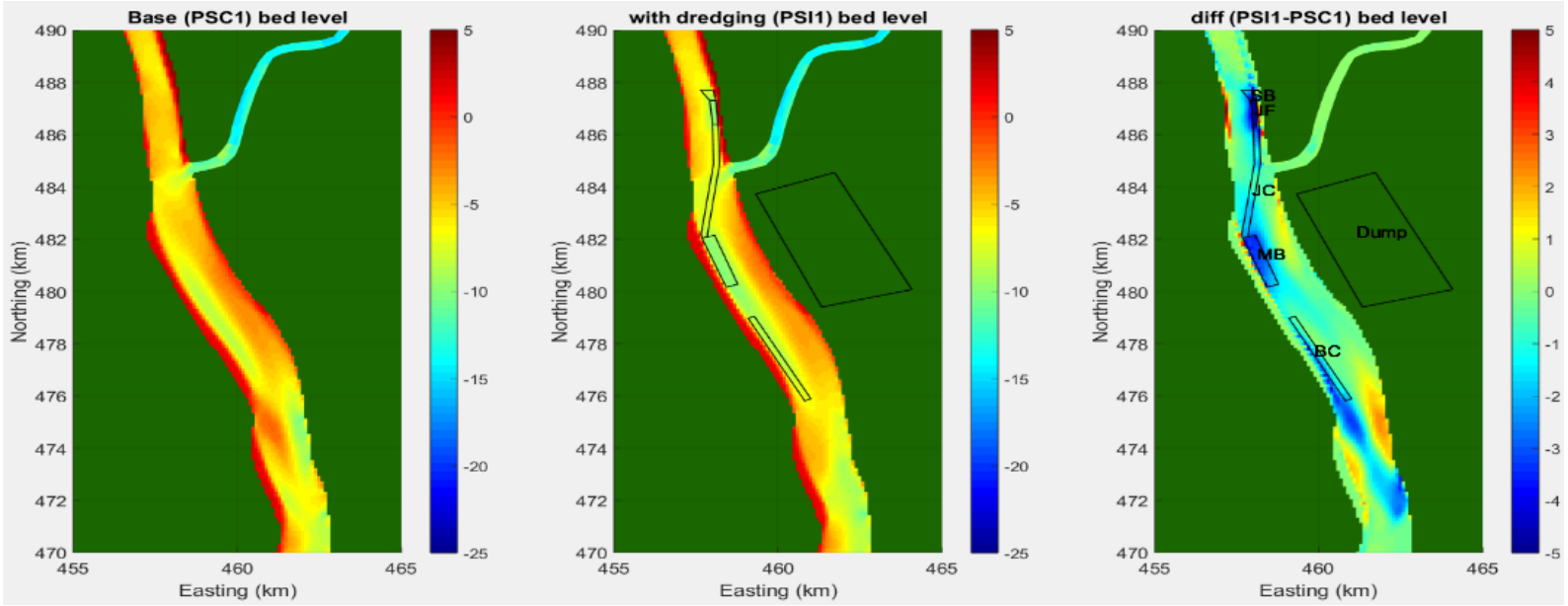
Dredging effects on Pussur-Sibsa system



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SSC and discharge decrease:

- Considerable effect in upstream reaches by decreasing sediment volumes
- Downstream effects (eg. Sandwip area) remain limited over 30 years due to inertia of morphodynamic system.

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Conclusions

- Delft3D FM model skilfully reproduces observed waterlevels, discharges, SSC and morphodynamic development
- The impact of SLR after 30 years is much smaller than ongoing morphodynamic development.
- The impact of potential cross-dam construction is pronounced with wide system range.
- The impact of dredging is pronounced but remains local.
- The impact of decreasing SSC and river discharge is considerable in upstream reaches but remains low over 30 years in more downstream reaches due to morphodynamic inertia.

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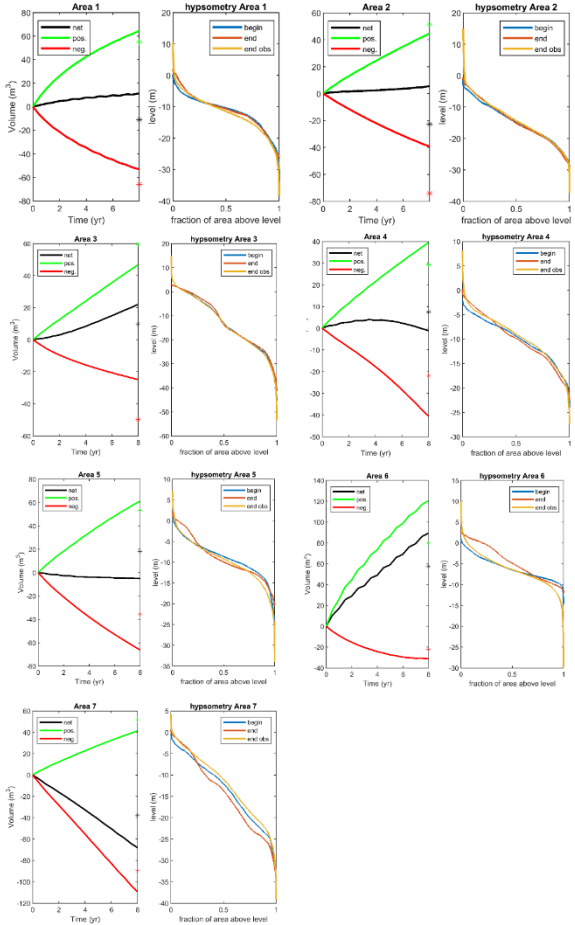

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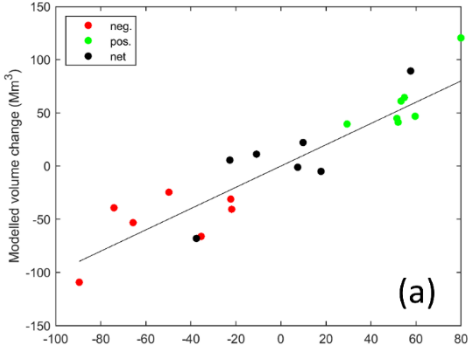
neg.
pos.
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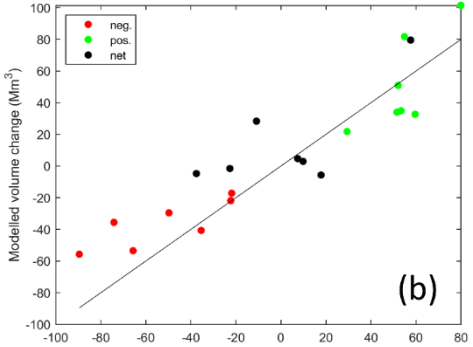
Modelled volume change (Mm3)
(a)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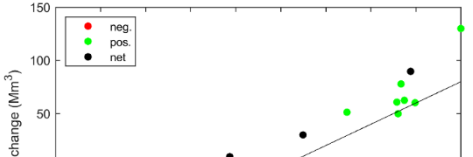
Modelled volume change (Mm3)
(b)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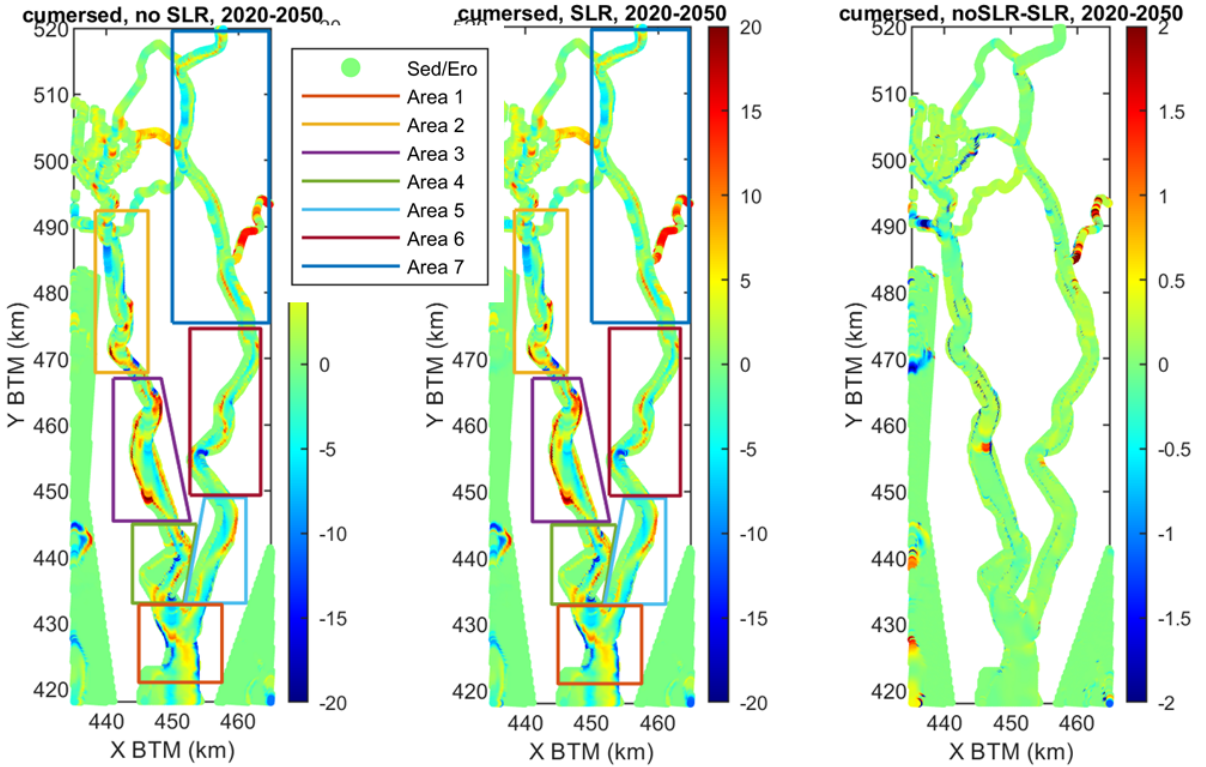

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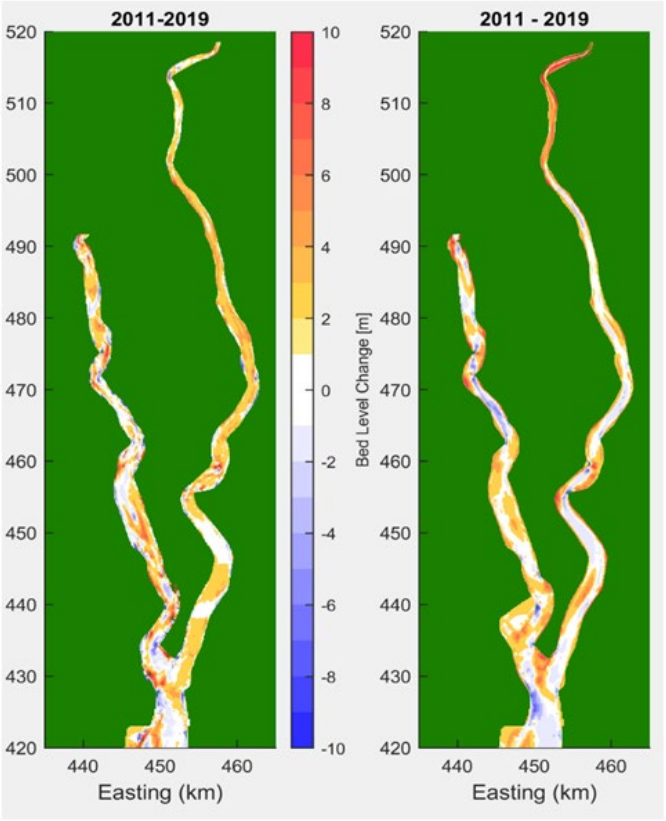
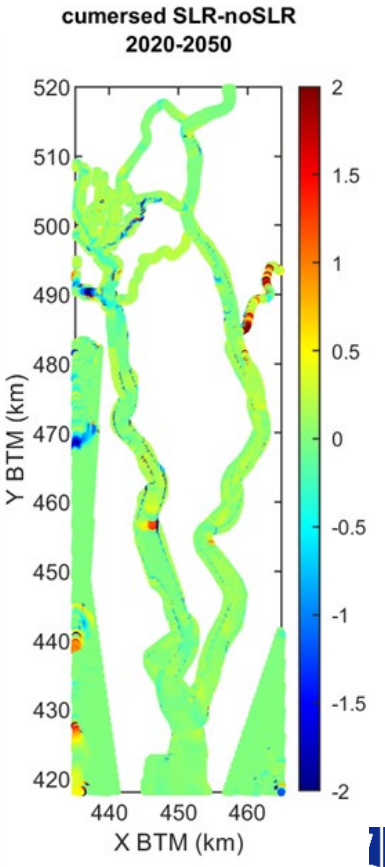

2011-2019
2011 - 2019
Bed Level Change [m]
10
8
6
4
2
0
-2
-4
-6
-8
-10
520
510
500
490
480
470
460
450
440
430
420
440
450
460
Easting (km)


cumersed SLR-noSLR
2020-2050
Y BTM (km)
X BTM (km)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
520
510
500
490
480
470
460
450
440
430
420
440
450
460