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Estimating ship-induced sediment transport in confined waters

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Fig. 1: Flow and turbidity regime before (a), during (b), and after (c) a passing ship in confined waters.

Kiel Canal field campaign

- Three probes at the canal bed (turbidity, pressure, 3D flow velocity; see example in Fig. 4), recording for 8 days.
- AIS recorder at a nearby bridge (length, width, draft, speed/course over ground, position, ship identifier).
- ADCP flow/SSC profiles (ship-based).

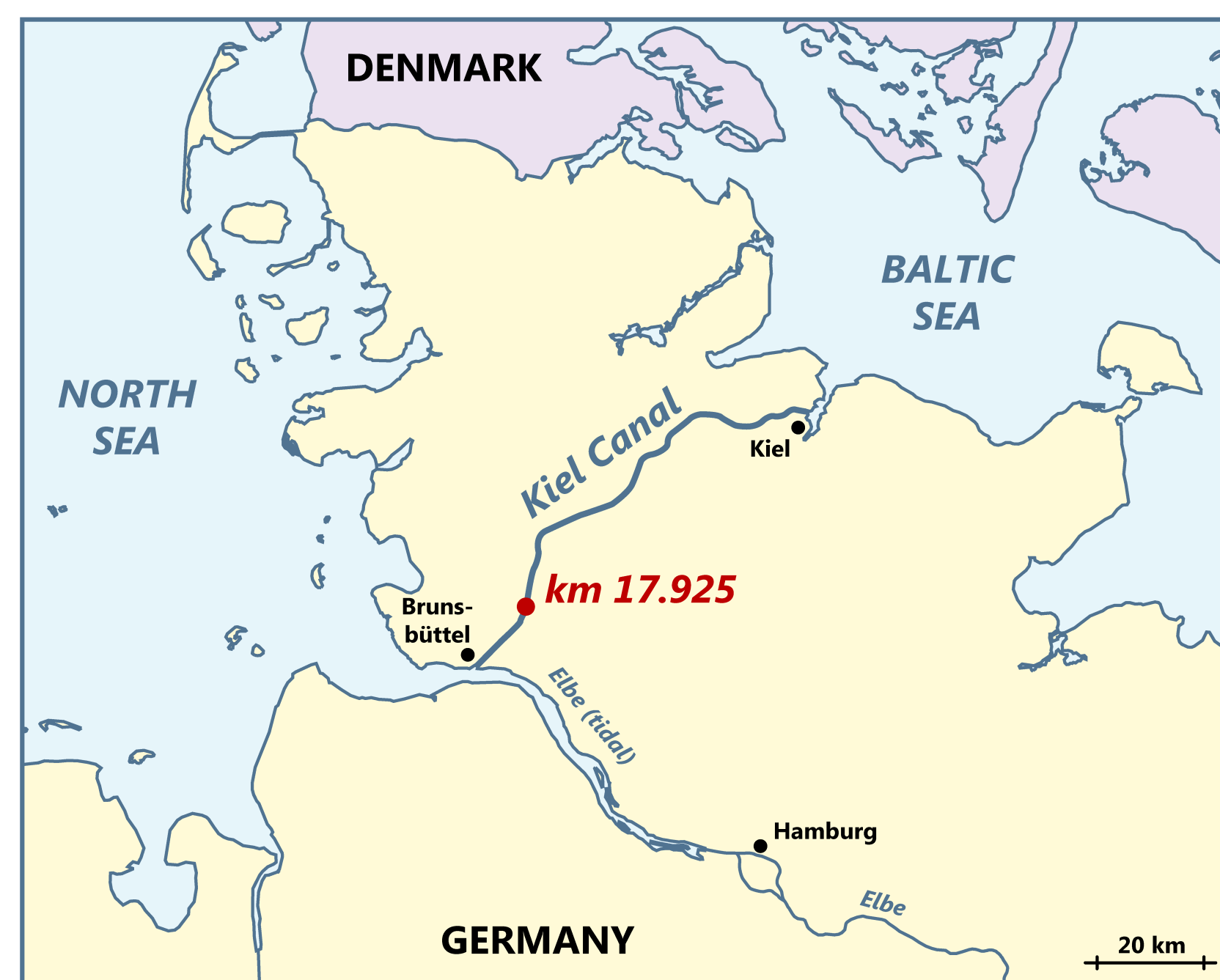


Fig. 2: Map of the Kiel Canal.

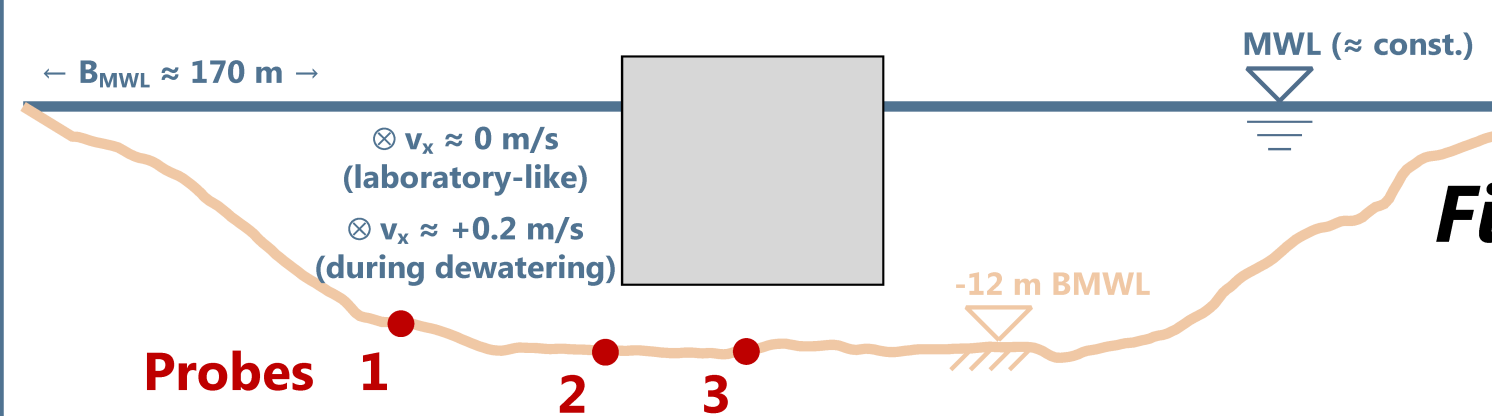


Fig. 3: Cross-section at km 17.925, probe locations and exemplary vessel.

currents (mainly dewatering) including the ship-induced volume (A).

3. Removing all ship-induced signals from turbidity and flow data using smoothing techniques.
- Smoothed data yield the “naturally” transported sediment volume (B). The ship-induced volume results from the volume difference (A-B).

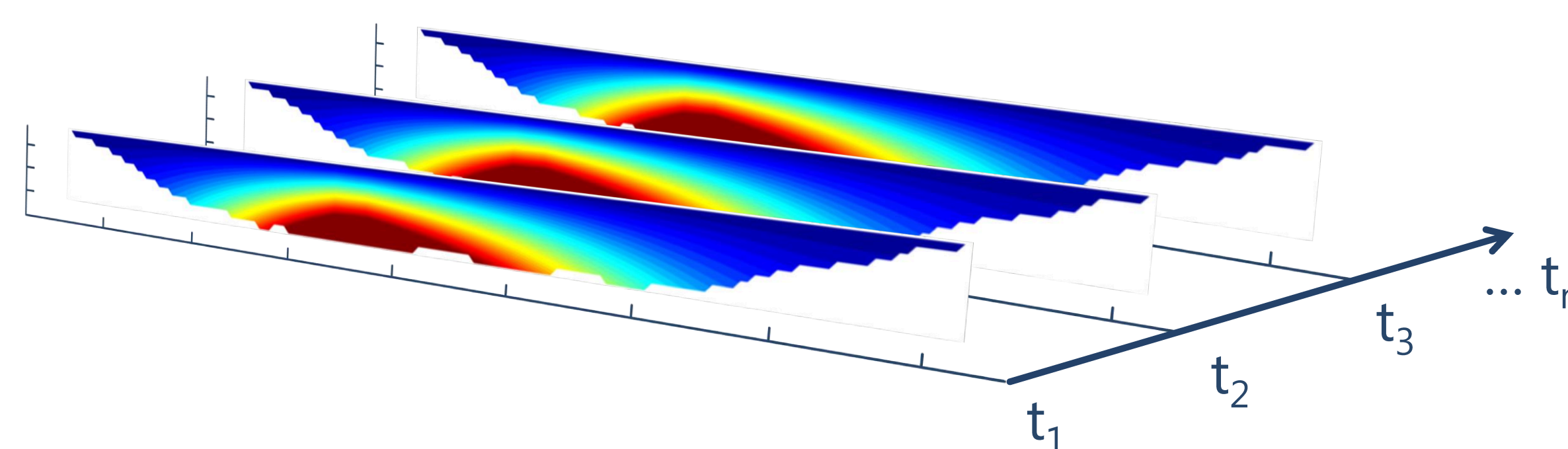


Fig. 5: Schematic illustration of the transport simulation with extrapolated turbidity distributions for each time step.

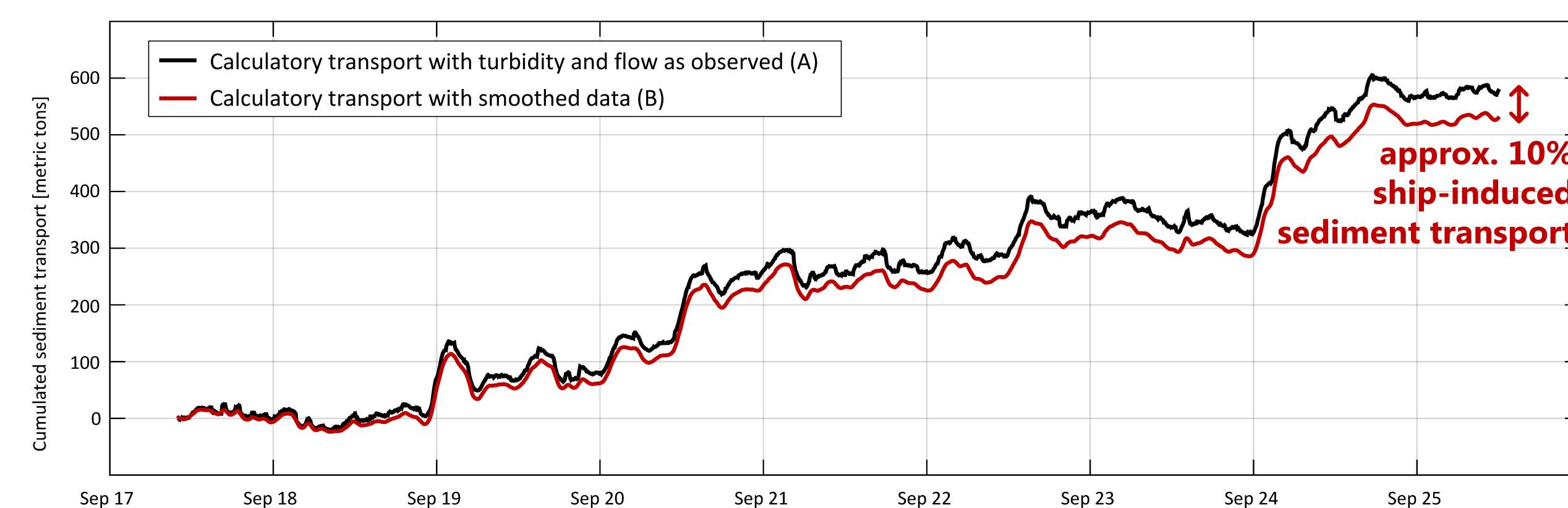


Fig. 6: Cumulated sediment transport, calculated with observed and smoothed data using the full record (8 days).

- A proportion of about 10% of the entirely transported sediment can be attributed to ship-induced resuspension under laboratory-like conditions in the Kiel Canal.
- Especially tidal but also discharge flows in the Elbe river dominate the transport regime. The ship-induced proportion of the totally transported sediment volume is <2%.

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