Tidal and subtidal water level variation in the Rhine-Meuse tidal river network: changes and links to human interference

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Only the mean water level shows a uniform rise...

Change in mean water level equals sea level rise:

But high- and low water levels show no uniform rise and the water level distribution is spatially variable. For example:

Changing tidal amplitudes:

Wavelet analysis: changing tidal amplitudes


Conclusion: human influences overwhelm sea level rise

Human engineering has a profound effect on water levels. These effects are known for large engineering measures, but not for smaller ones. However, several small measures have a bigger effect than sea level rise and should not be overlooked.


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Only 25 km apart

Rising low water

Rising high water

Opening of the western Hartel Canal (1997)

A dam was removed, the canal becomes an active channel, an extra entrance for tides and exit for river discharge

Opening of the eastern Hartel Canal (1981)

Sluices were removed, the canal functions as a retention basin, damping tides

Closure of the Haringvliet estuary (1970)

Dams closed off the estuary, banning tides and regulating discharge

Change-point analysis: three changes

Change-point analysis was carried out for yearly maximum, minimum and mean water level. Three significant change-points were found: 1970, 1981 and 1997.

Wavelet analysis: changing tidal amplitudes


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