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wadden sea
LONG-TERM ECOSYSTEM RESEARCH

Estimates of exposure times in the Wadden Sea using contrasting methods

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Introduction

In this study we compare two methods to estimate the exposure times of the tidal flats in the Wadden Sea. One is based on a triangulation method applied to tidal gauge data (Rappoldt, 2014); the other uses output of the General Estuarine Transport Model (GETM) set up for the Dutch Wadden Sea (Duran-Matute et al., 2014).
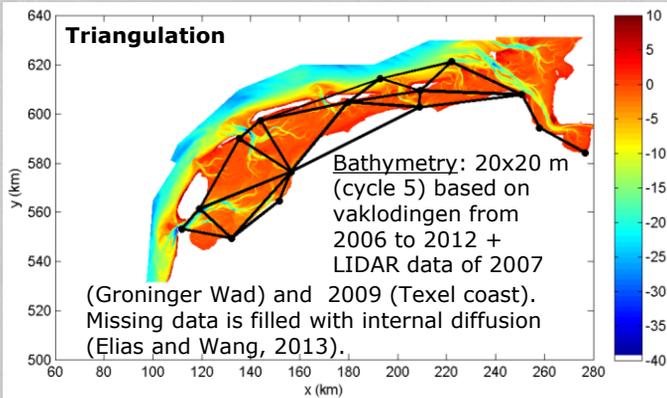
Triangulation

Bathymetry: 20x20 m (cycle 5) based on vaklodingen from 2006 to 2012 + LIDAR data of 2007 (Groninger Wad) and 2009 (Texel coast). Missing data is filled with internal diffusion (Elias and Wang, 2013).

Figure 2: Cycle 5 bathymetry and triangles connecting tidal gauges.

Approach: Sea Level Height (SLH) data at the tidal gauges are obtained from www.waterbase.nl (Rijkswaterstaat). SLH is linear interpolated between 2 or 3 nearest tidal gauges and waterlines are detected for which SLH=D_{cycle5}.
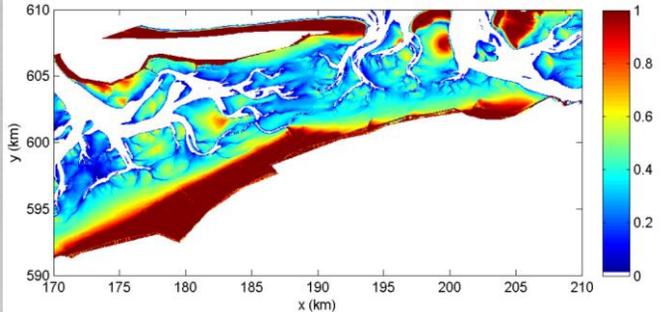

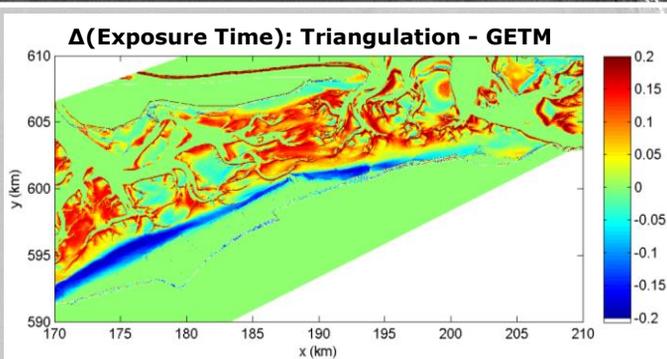**Figure 3**: Exposure time (fraction) for April 2009 using triangulation.

General Estuarine Transport Model (GETM)

Bathymetry: 200x200 m interpolated from vaklodingen from 2004 to 2012 and smoothed afterwards (Duran-Matute et al., 2014). Results are projected on same grid as cycle 5 (see Fig. 2 and approach).
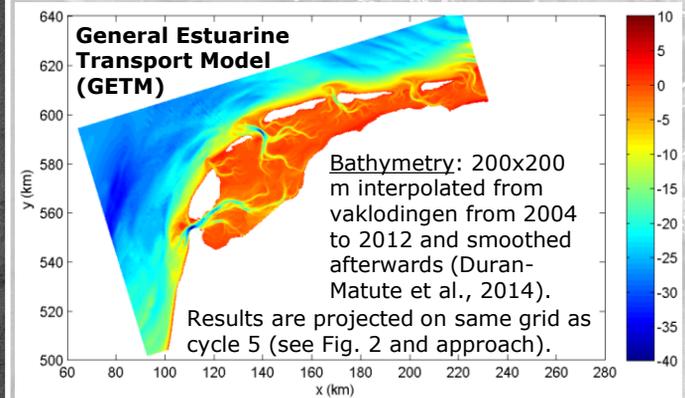
Figure 4: Bathymetry used in GETM runs.

Approach: The model is run from 2009 to 2011. Water depths have been stored every 30 minutes. Drying and flooding are taken into account by reducing the influence of the non-linear terms for water depths $D_{crit}<0.3$ m and imposing a minimal depth of $D_{min}=0.1$ m. SLH data at water depths > D_{crit} are interpolated to the grid of cycle 5.
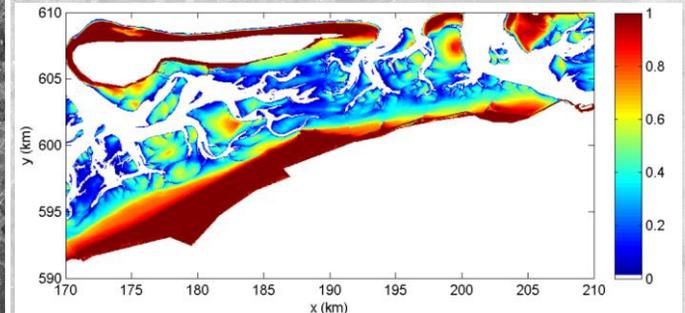

Figure 5: Exposure time (fraction) for April 2009 using results GETM.

Δ(Exposure Time): Triangulation - GETM

Figure 6: Δ Exposure time (fraction): TRIA-GETM (April, 2009).

Waterlines and exposure times vary significantly between the methods!

Waterline: SLH=D_{cycle5}
Area GETM: 37 + 15 km^2
Area TRIA: 38 + 7 km^2

Bibliography
Duran-Matute et al. (2014) Residual circulation and fresh-water transport in the Dutch Wadden Sea: a numerical modeling study *Ocean Science Discussions, 11*, 197-257
Elias and Wang (2013) Abiotische gegevens voor monitoring effect bodemdaling, Deltares.
Rappoldt (2014) Exposure times in the Dutch Wadden Sea using triangulation on tidal gauge data.

Figure 1: Background: SAR image of 2009-04-30, 6:08 UTC; Foreground, waterline GETM (yellow) and triangulation (red).