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Modelling the mud-induced wave damping with SWAN-Mud and Delft3D-Wave

This study aims to: (1) Find the effect of fluid mud presence on incoming waves at the Suriname Coast, (2) find difference in mud dissipation for different wave input and (3) find the influence of mud on the wave energy density

Context

- *Mudbanks contain **fluid mud** and often work as a barrier in front of the coast and protect the coast against erosion.*
- *They propagate alongshore due to **wave forcing**, this causes cyclicity in coastal erosion and accretion of the coastline*
- *Modelling the **Energy dissipation** by the fluid mud has been limited and complicated*

Aims

1. **Modelling the influence of the mud banks on the waves for the coast of Suriname**
2. **Finding the effect of different wave input conditions on the mud dissipation**
3. **How is the energy density spectra of the waves influenced by the mud?**

Tools

- Use of **SWAN-Mud** and **Delft3D-Wave**
- Spectral wave model: wave growth, propagation and dissipation
- Two-layered viscous model (Fig.1) → most used formulation: **DELFT**
- Delft3D-Wave works around SWAN-Mud as an user-friendly interface

Result 1 *(Figure 3 & 4)*

- The Hsig is around 50% smaller at the coast for coasts with mud banks
- The total dissipation is much higher for the mud coast at the mud edges
- The total dissipation is lower for situations with mud further on the mud compared to the situation without mud

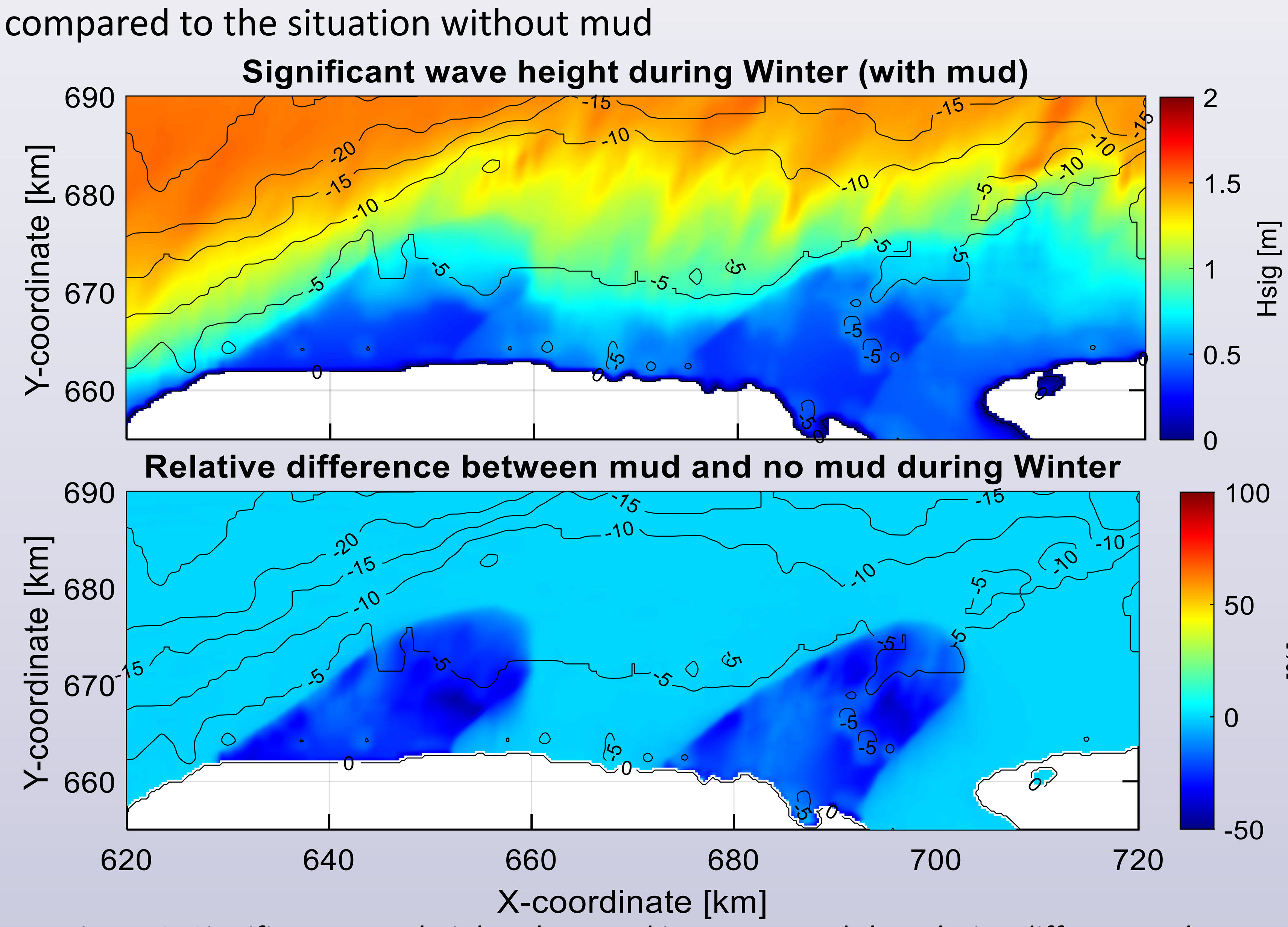


Figure 3: Significant wave height when mud is present and the relative difference when mud is absent

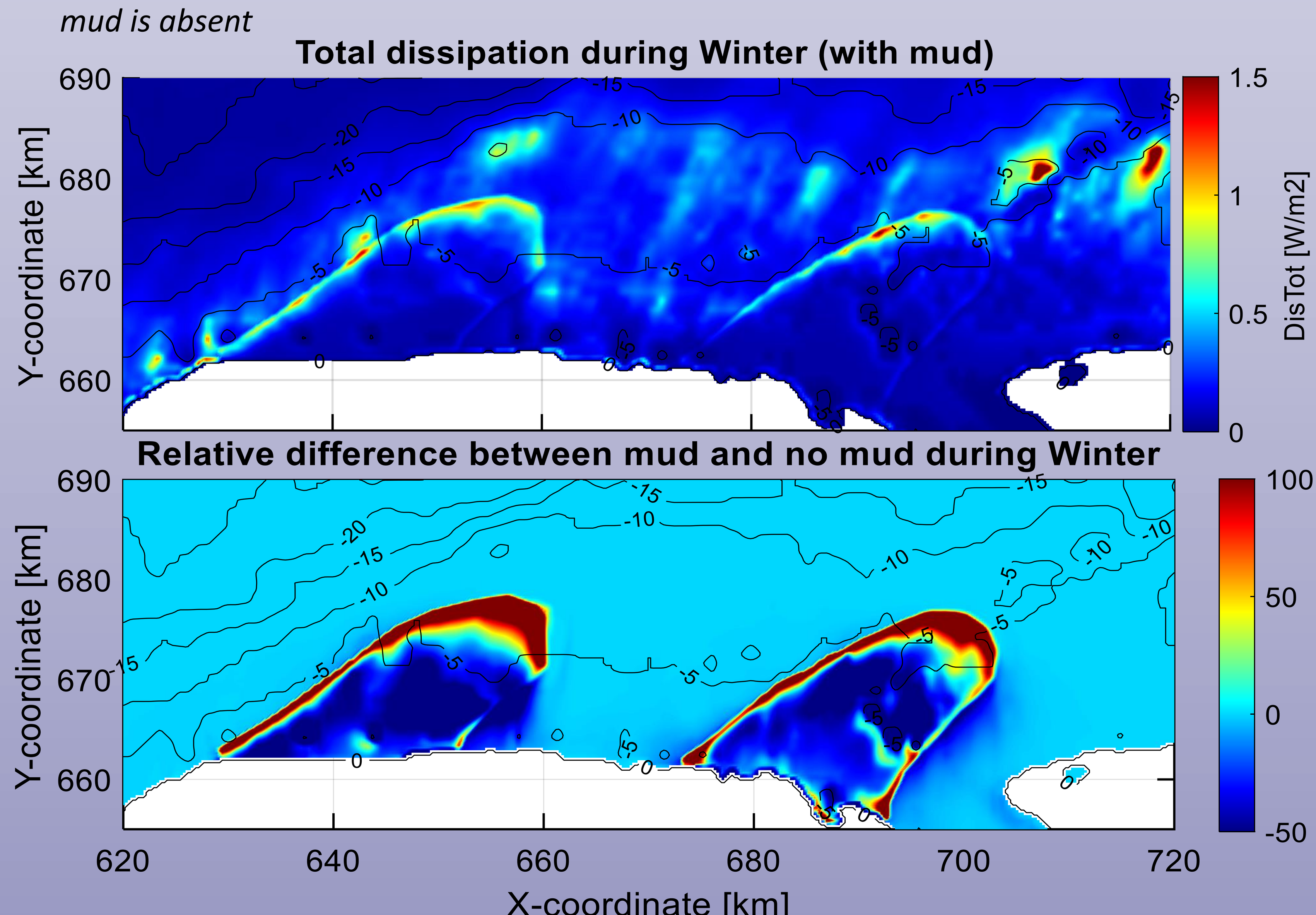
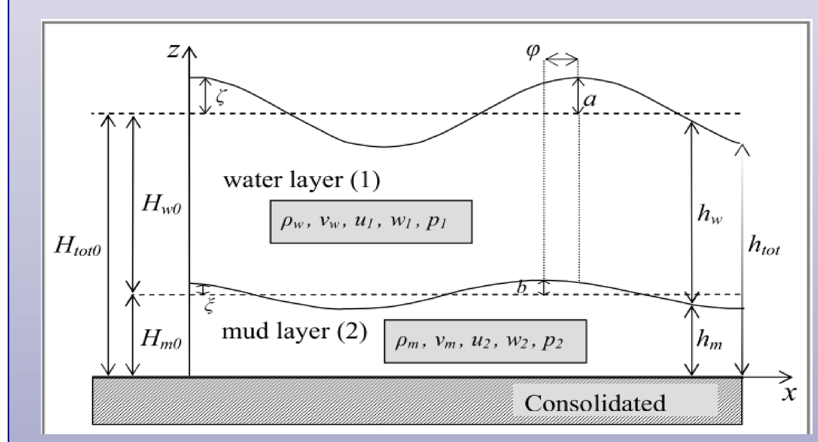


Figure 4: Total dissipation when mud is present and the relative difference when mud is absent

Study area

- The coast of Suriname is investigated, with mudbanks designed for this study (In Delft3D)(Fig.2)
- Large sized mudbanks (45 x 15 km), maximum 2 meters thick
- Low wave energy, higher energetic when trade winds are stronger during winter. Mainly from NE direction, small variation with seasons



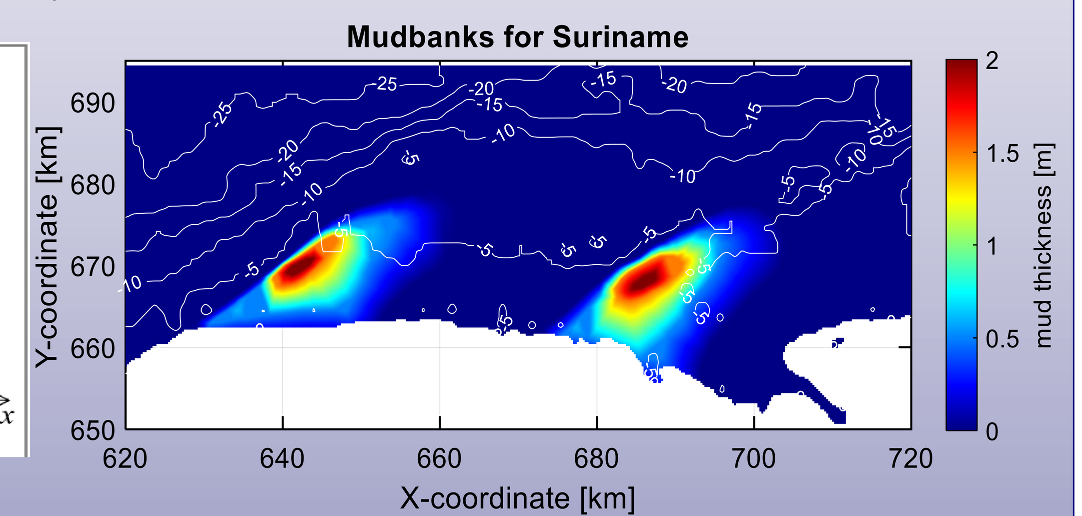
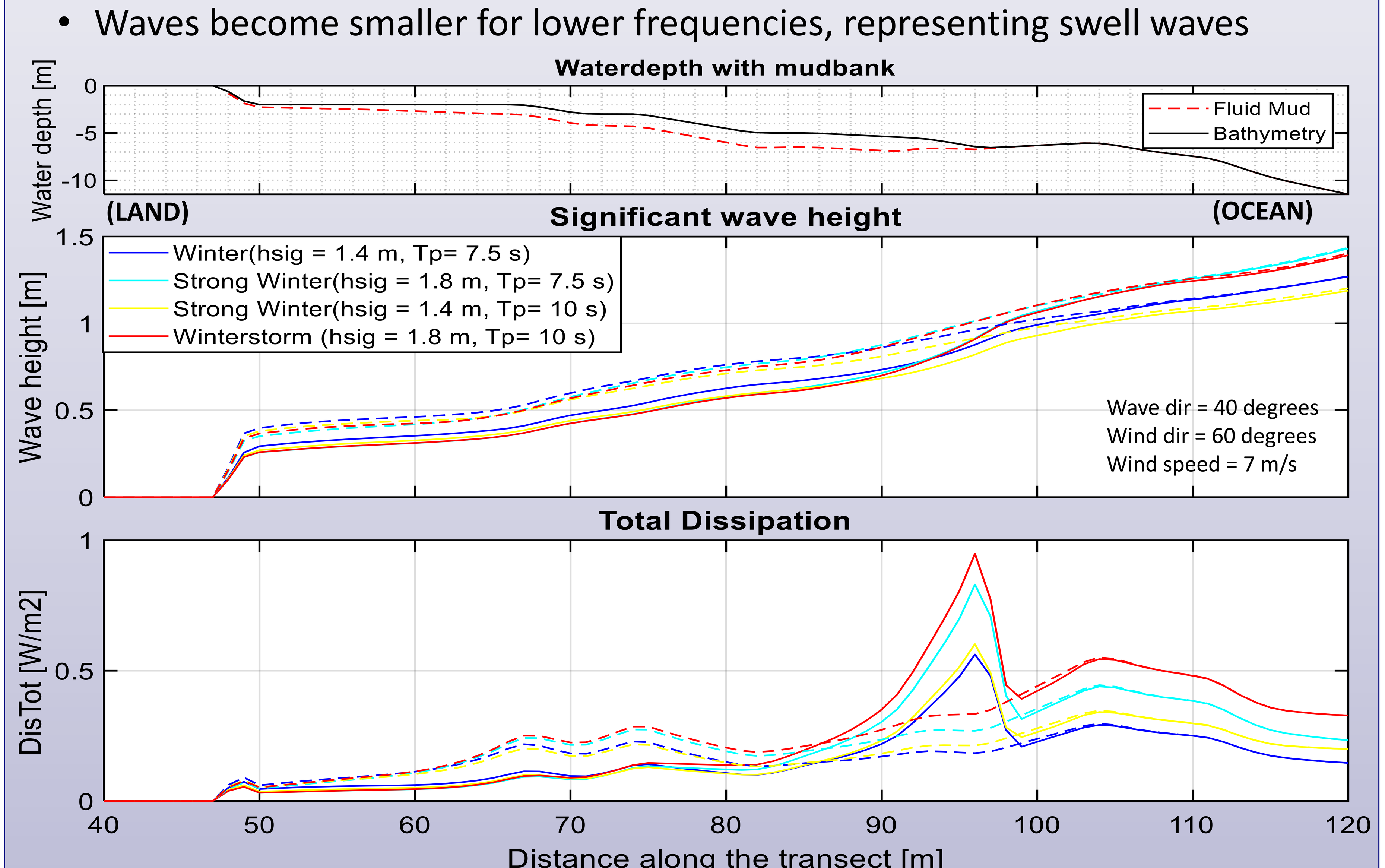


Figure 1 & 2: the two-layered viscous model used in SWAN-Mud (Kranenburg, 2008)(left) & Mud-layer thickness (colors) and depth (contours) in the Suriname coastal area (right)

Result 2 & 3 *(Figure 5 & 6)*

- Situations with the highest waves show the larges peak in total dissipation, this peak represents the mud dissipation
- Storm situations have larger dissipation over the mud but also decline the most in wave height
- Waves become smaller for lower frequencies, representing swell waves



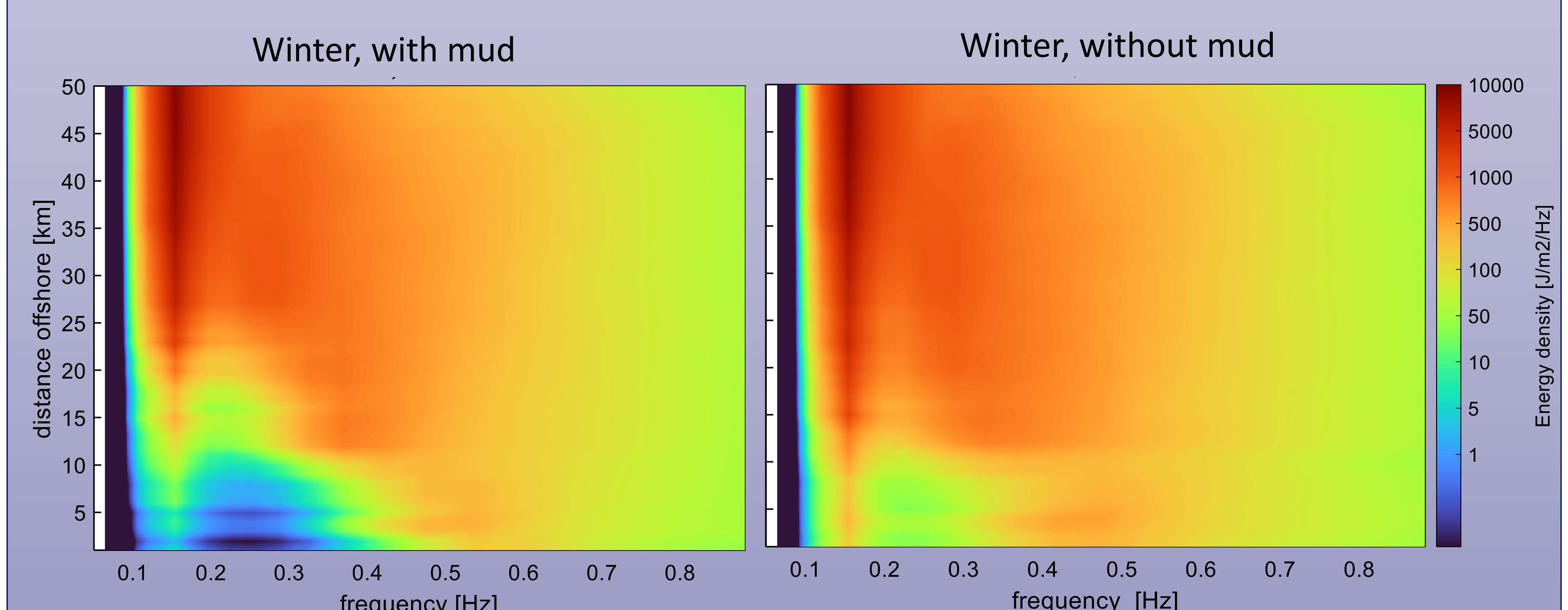


Figure 5 & 6: Wave height and dissipation for a perpendicular transect in the top figures and the wave energy density spectrum for the as function of the distance to the coast (bottom)

Conclusions

1. **The mud causes the dissipation to increase in the beginning of the mud banks which results in a strong decrease in wave height when waves reach the shore when mud is present and hence protect the coast**
2. **The more energetic the wave environment, the higher the dissipation by the mud. Wave height has more influence on the wave energy compared to the wave period**
3. **Waves in higher frequencies (wind waves) are not influences by the mud, while lower frequencies (swell waves) decline strongly in energy density**

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Further details
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Winterwerp, J. C., de Boer, G. J., Greeuw, G., & van Maren, D. S. (2012). Mud-induced wave damping and wave-induced liquefaction. *Coastal engineering*, *64*, 102-112.