

# Linking weather types to tense dewatering situations of the Kiel Canal (NOK)

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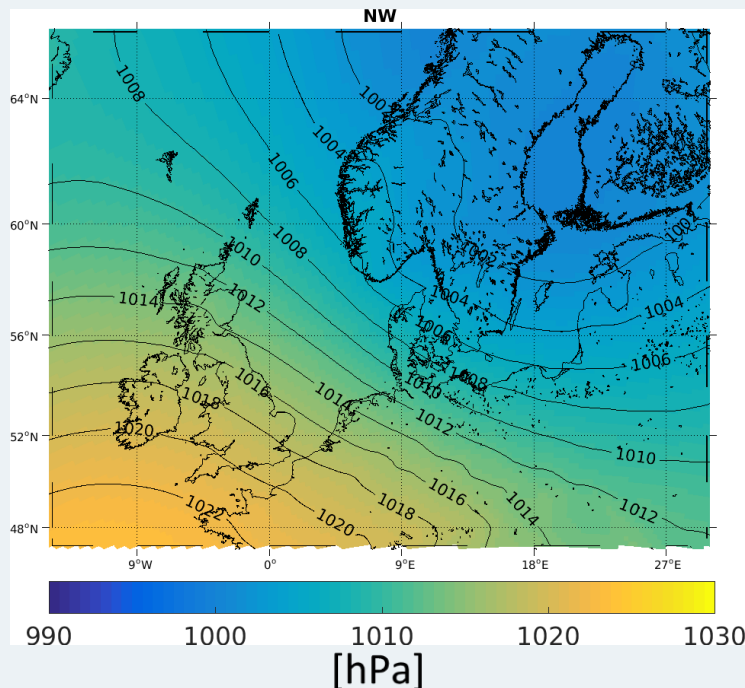
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The Kiel Canal (Nord-Ostsee-Kanal) is one of the world's busiest man-made waterways navigable by seagoing ships. It connects the North Sea to the Baltic Sea and can save ships hundreds of kilometers of distance. The Kiel Canal also drains a catchment area of about 1500 km<sup>2</sup>. As the Canal can be operated only within a certain water-level range, shipping may be hampered in tense dewatering situations. The questions to be answered in the following are:

1. Are tense dewatering situations of the Kiel Canal associated with certain weather types?
2. How will the frequencies of these weather types change until the end of the century?

For this investigation water levels at a model grid point close to Cuxhaven as well as sea level pressure fields from two regionally coupled models were used.



- **Water levels** near Cuxhaven serve as proxy for the dewatering situation of Kiel Canal.
- **Sea level pressure** fields were used to derive daily weather types. (Lamb, 1950)

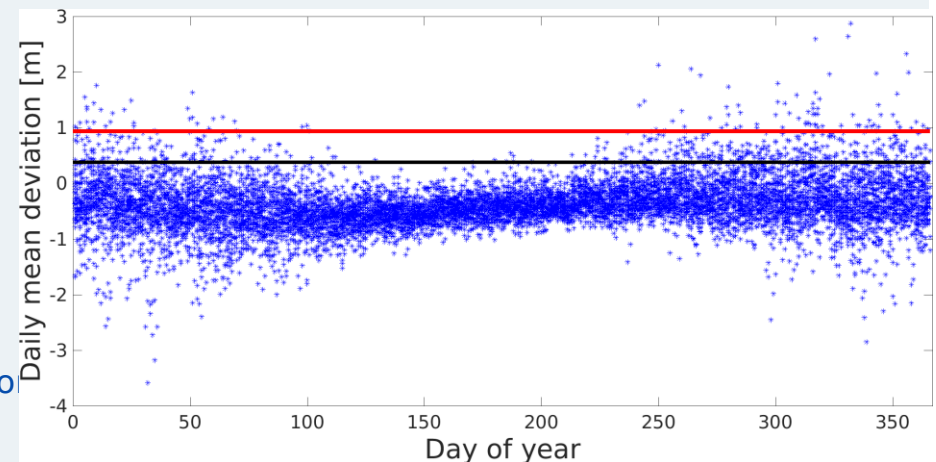
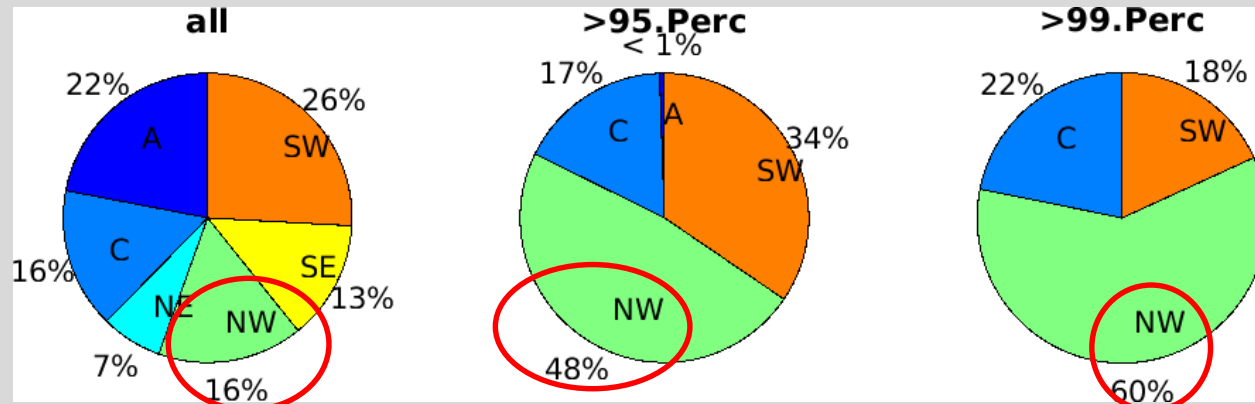


Fig.1: **Top:** Mean sea level pressure field [hPa] for North-West weather types in 1971 - 2000;  
**Right:** Daily mean deviation from long-term mean water level [m] at a grid point close to Cuxhaven for 1971-2000. Horizontal lines show the 95. (black) and 99. percentile (red) for the period of analysis. Results concern the realization MPI-M/REMO run 3.

- The weather types were classified using Lamb (1950). All six possible types are: A (Anticyclonic), C (Cyclonic), NE (North-East), NW (North-West), SE (South-East), SW (South-West)
- The distribution of weather types for all days was compared to the distribution for days with water levels above the 95. and 99. percentile.

## Distributions of weather types

Change with  
high  
percentiles



Change over  
time

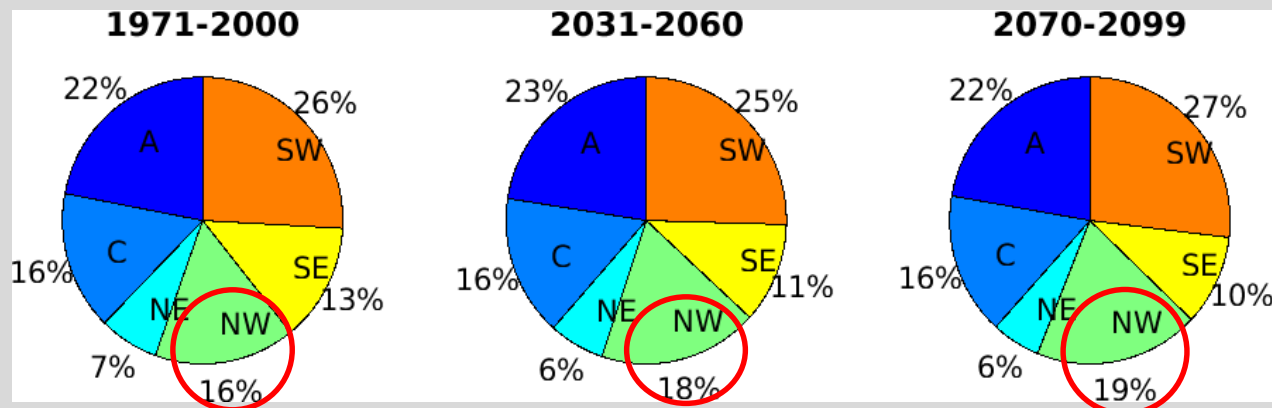


Fig.2: **Top:** Relative frequency distributions [%] of 6 Lamb weather types for 1971-2000. Unconditional distribution (all days, top left) and distributions on the condition that mean water levels near Cuxhaven exceed the 95. (middle) and the 99. percentile (right). **Bottom:** Unconditional relative frequency distributions of weather types for 1971-2000 (left, same as top left), 2031-2050 (middle) and 2070-2099 (right) for the RCP 8.5 scenario („business as usual”). Results pertain to the realization MPI-OM/REMO run 3.

*Are tense dewatering situations of the NOK associated with certain weather types?*

- 55-85 % (ensemble spread of 8 members) of high water level situations (above 99. percentile) are associated with **North-West weather types (NW)**.
- Conversely, 7-22 % of all NW weather types are associated with high water levels (not shown).

*How will the frequencies of these weather types change until the end of the century?*

- The annual relative frequency of the NW weather type increases significantly towards the end of the century.
- At the same time, Easterly weather types (NE & SE) decrease significantly. However, high water levels do not occur with these types.

- Higher frequencies in North-West weather types may lead to more frequent tense dewatering situations in the Kiel Canal.
- This adds to the already rising sea level, which also leads to a lower dewatering potential in the Kiel Canal.
- More detailed information can be found in Jensen (2019).

- *Jensen, C. (2019): Wetterlagen über der Nordsee, Bericht zu Meilenstein M108b-2 im SP-108 des BMVI Expertennetzwerks (in german). Doi pending.*
- *Lamb, H. H. (1950). Types and spells of weather around the year in the British Isles: annual trends, seasonal structure of the year, singularities. Quarterly Journal of the Royal Meteorological Society, 76(330), 393-429. <https://doi.org/10.1002/qj.49707633005>*

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