

# Could the historical storm tides in the German Bight have been higher than they occurred?

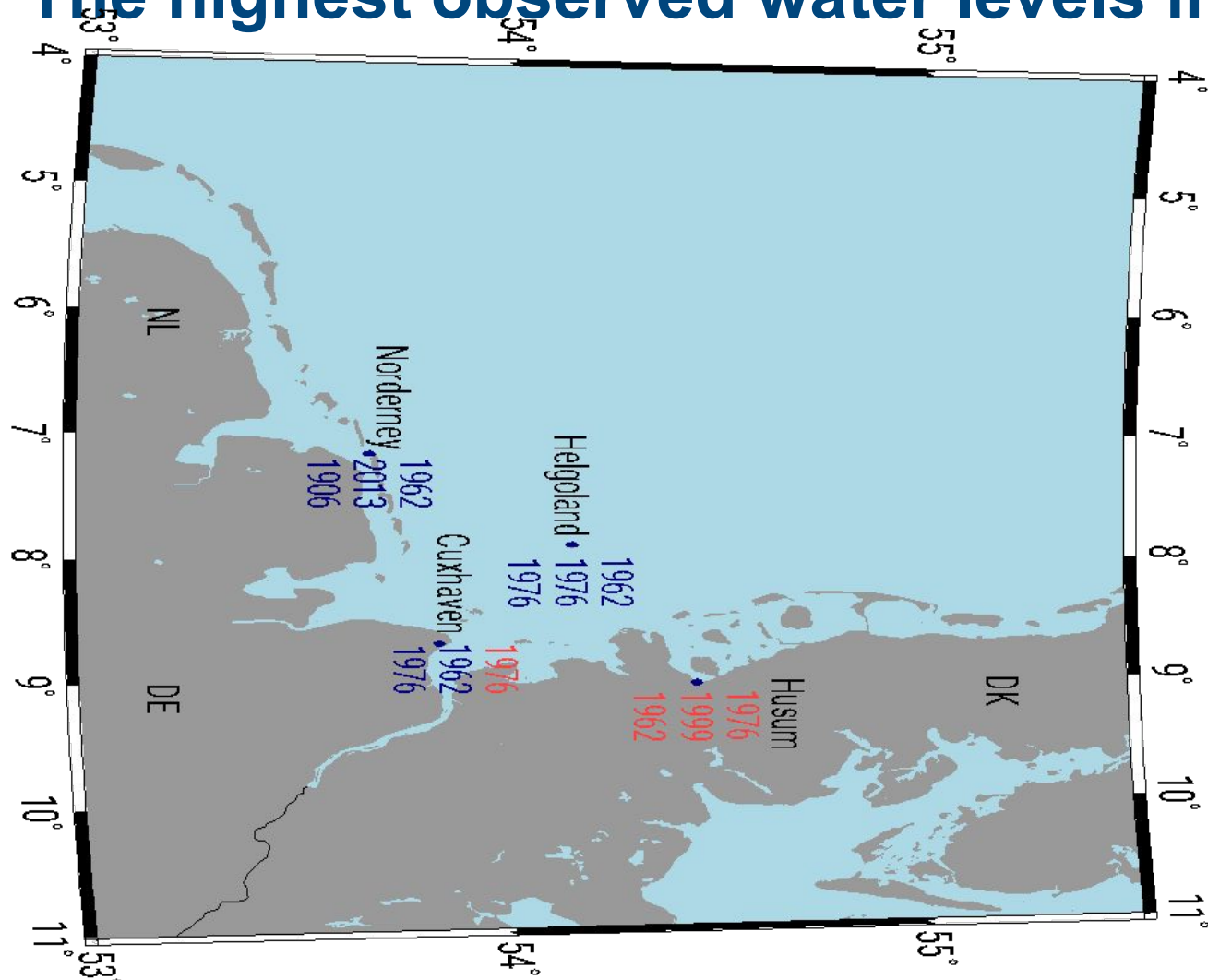
**Dr. Elke M. I. Meyer**

Hereon Institute of Coastal Systems

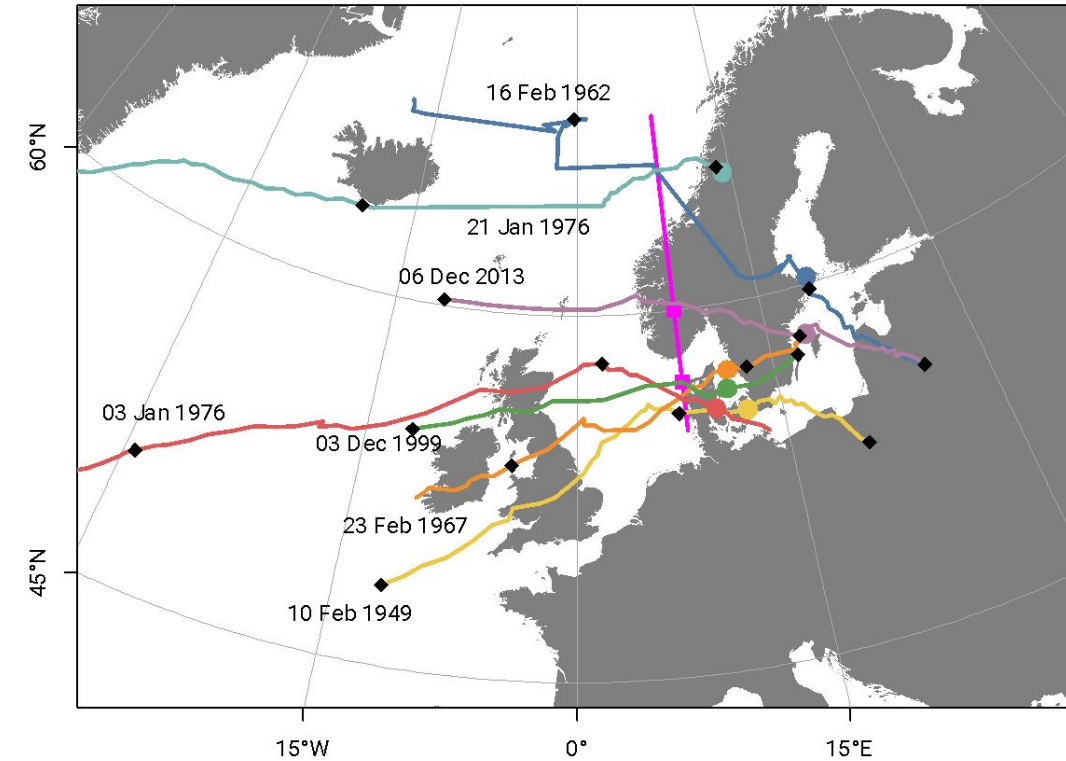
04 October 2023  
Notre Dame, IN



# The highest observed water levels in the German Bight



Storm tracks based on ERA5 data



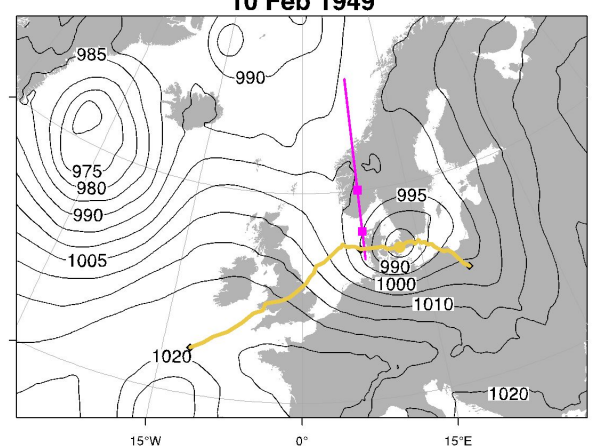
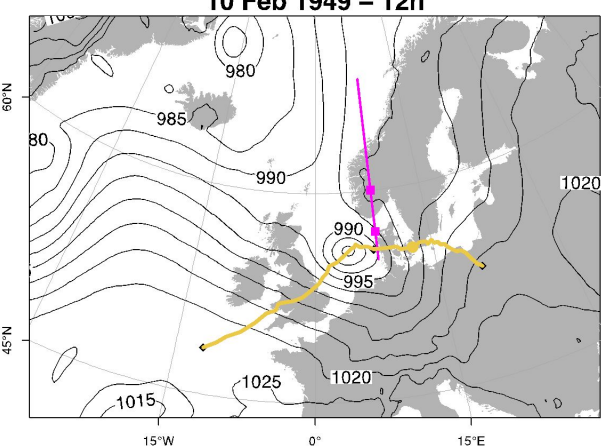
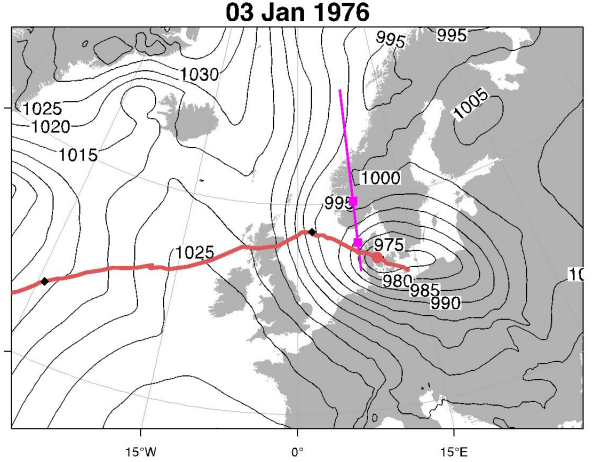
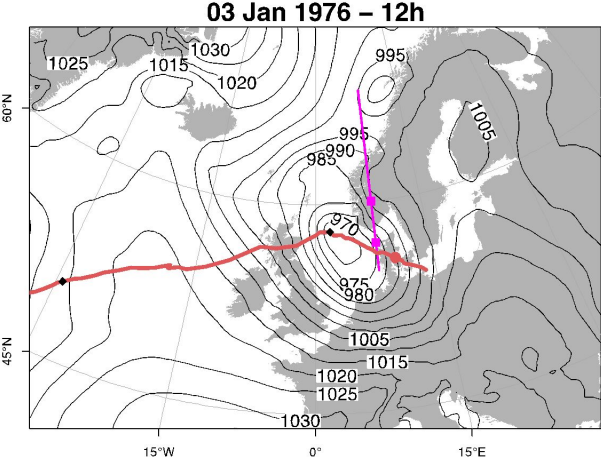
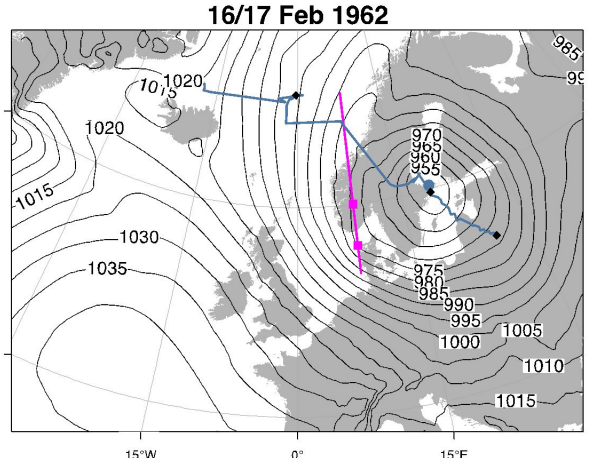
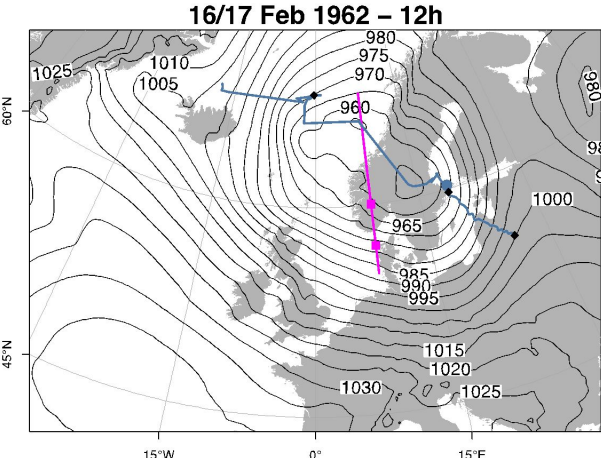
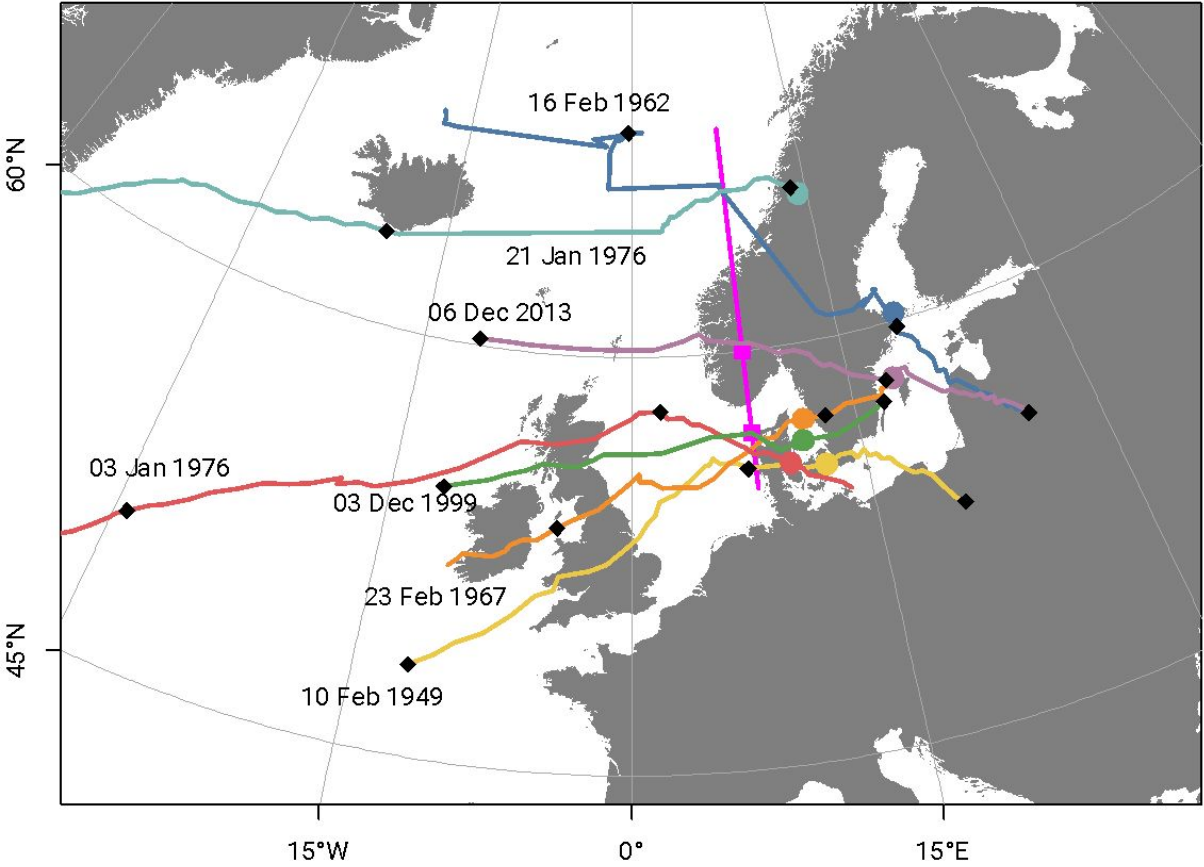
Storm tide criteria by the Federal Maritime and Hydrographic Agency (BSH):

**Very severe storm tide: > 3.5m above mean high tide**

Severe storm tide: 2.5 - 3.5m above mean high tide

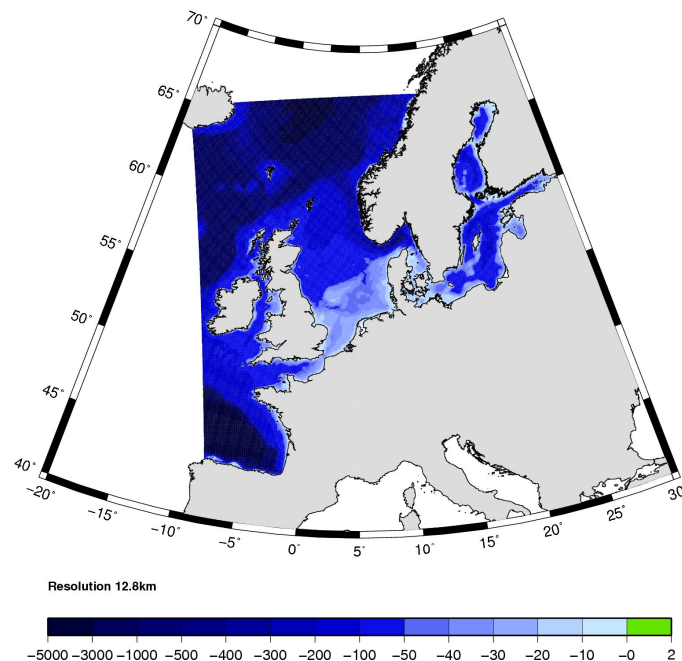
# Mean Sea-Level Pressure charts

## Storm tracks based on ERA5 data



# Atmospheric Forcing

Reanalysis	Short form	Ensemble member	Starting year	Spatial resolution	Temporal resolution
20 <sup>th</sup> Century Reanalysis Project version 2c	20CRv2c	56	1851	2° x 2°	6-/3-hourly
20 <sup>th</sup> Century Reanalysis Project version 3	20CRv3	80	1836	1° x 1°	3-hourly
ECMWF ERA5	ERA5	1	1940	0.25° x 0.25°	1-hourly
ECMWF UERRA-HARMONIE	UERRA	1	1961	11 km x 11 km	1-hourly
DWD OptempS	OPTEMPS	1	1962	0.06° x 0.06°	1-hourly



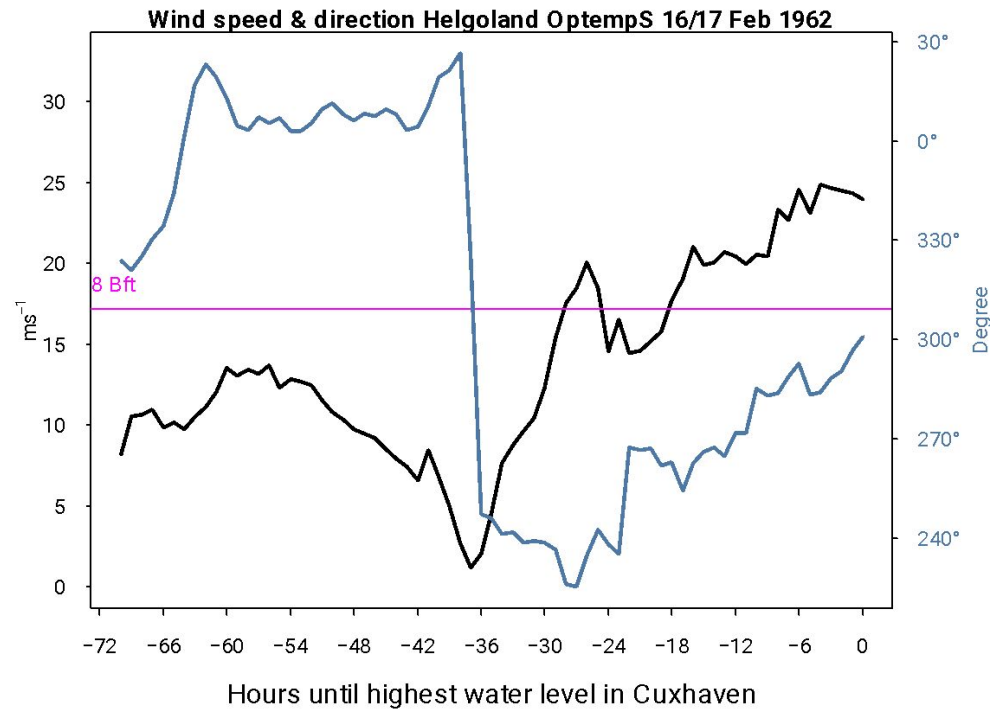
Trim-NP Tidal Residual and Intertidal Mudflat model –  
Nested and Parallelized

Grid1    Grid2    Grid3    Grid4  
12.8km   6.4km   3.2km   1.6km

Hourly output of model data

(Tide)-data from FES2004 are used at lateral boundaries

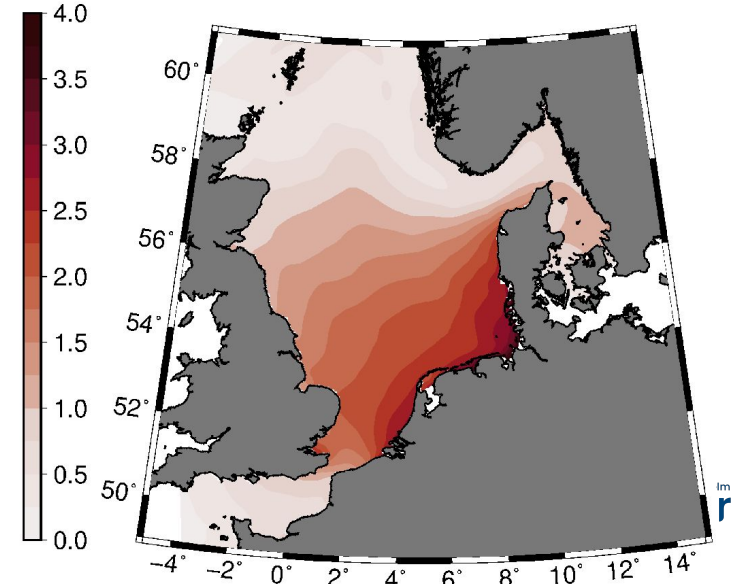
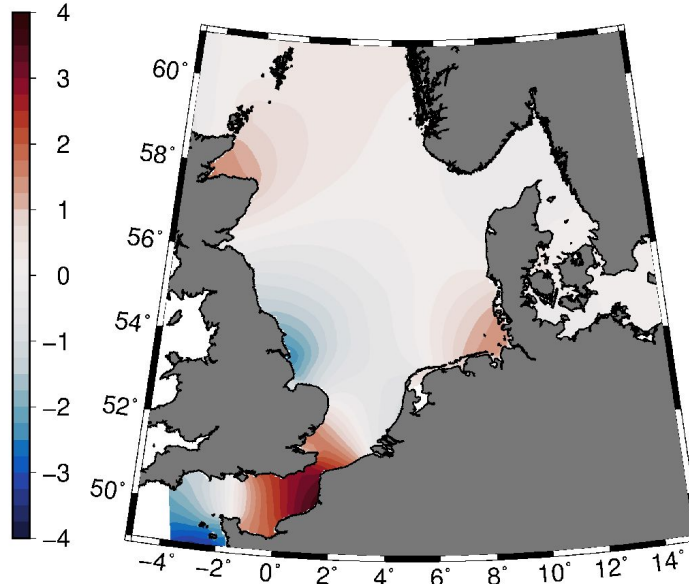
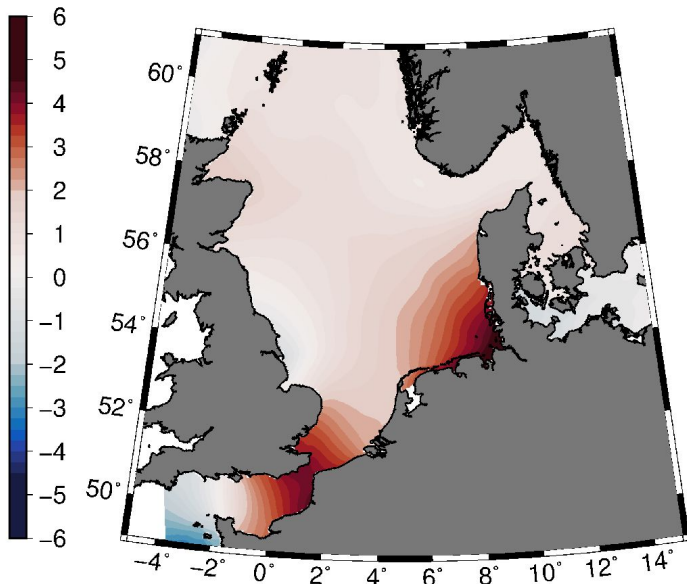
# 16 Feb 1962



Water Level [m]

Tides [m]

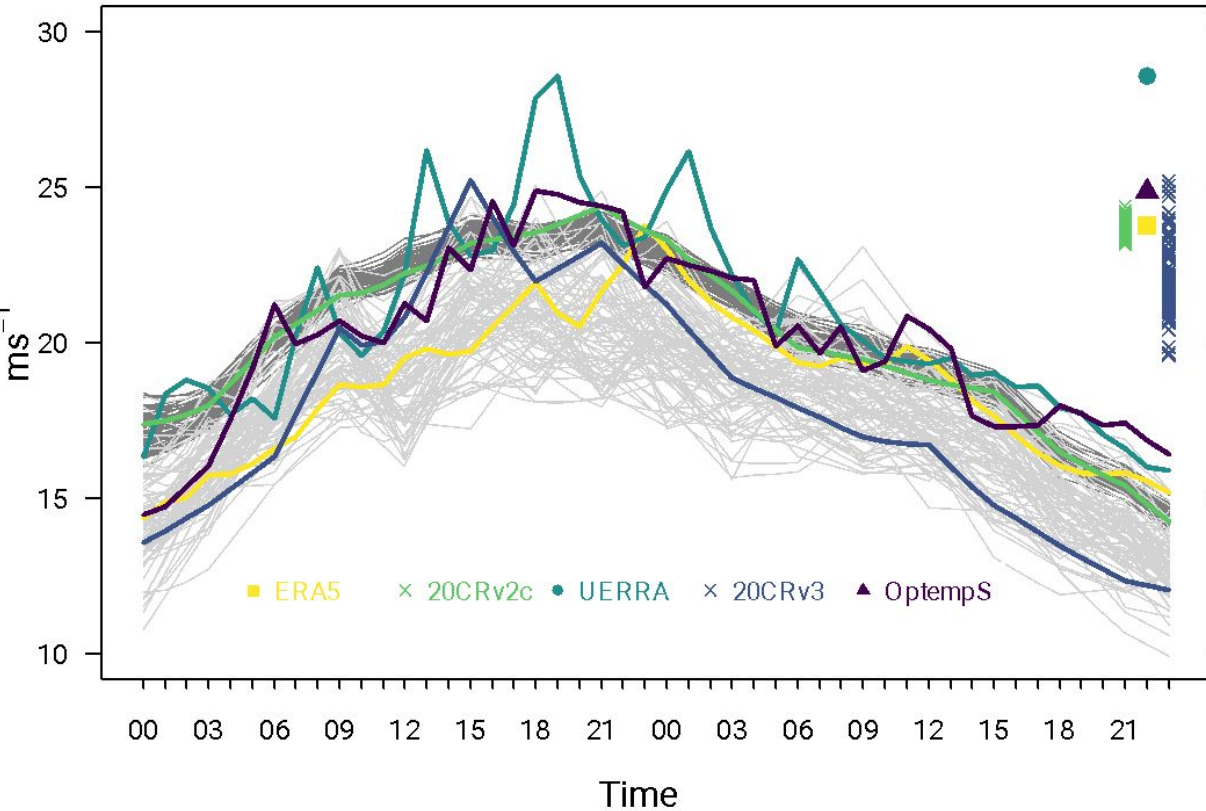
Surge [m]



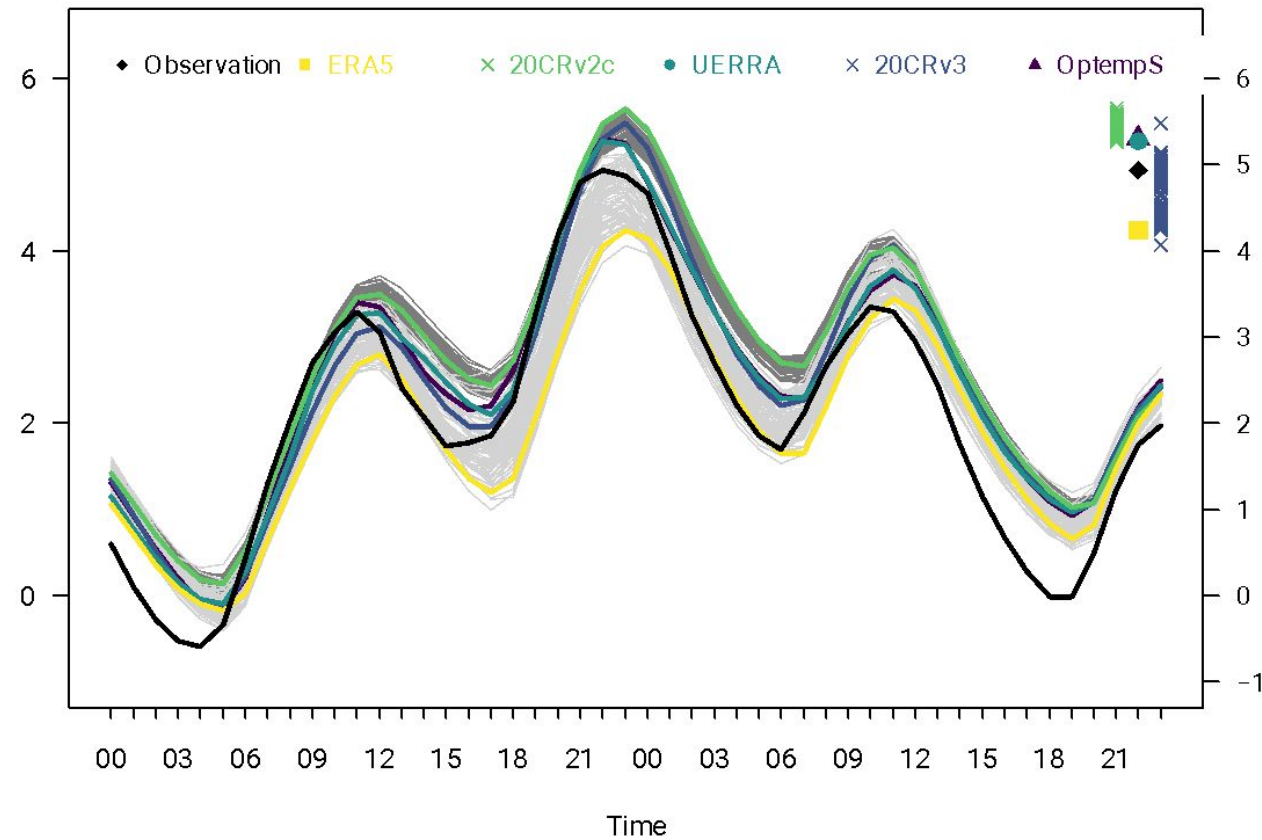
16 Feb 1962; 22:00 UTC

# Wind speed and water level for 16-17 February 1962

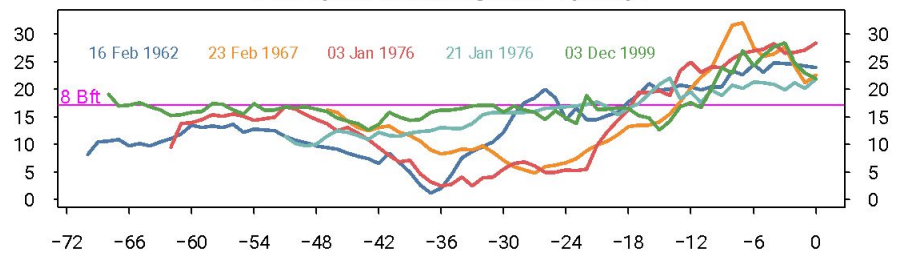
## Wind speed Helgoland 16 - 17 Feb 1962 [UTC]



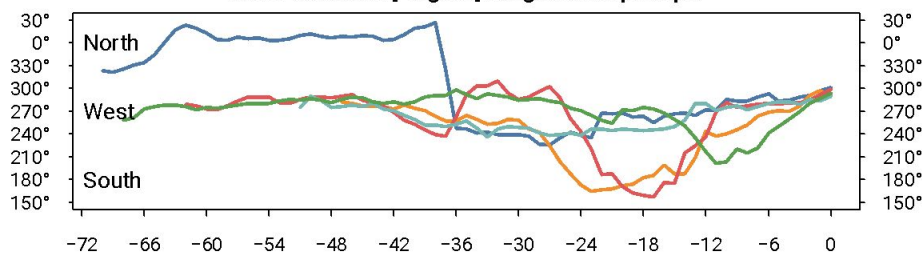
## Cuxhaven, 16-17 Feb 1962



Wind speed [m/s] Helgoland Optemps

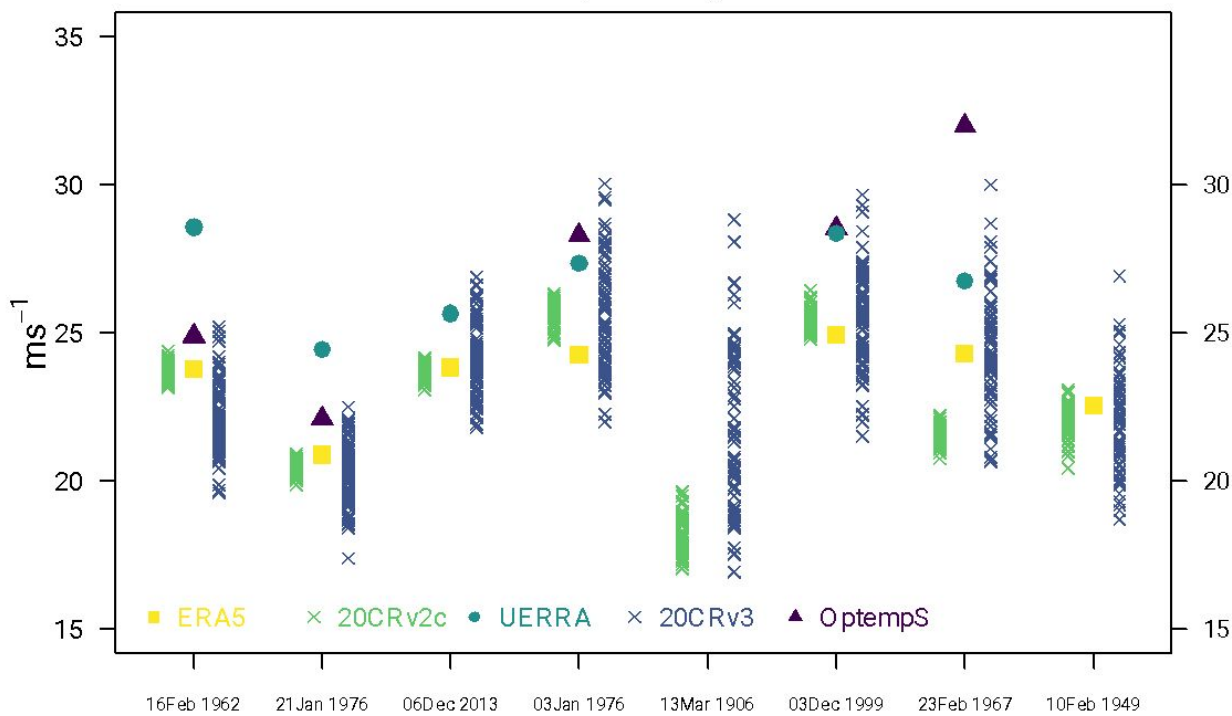


Wind direction [Degree] Helgoland Optemps

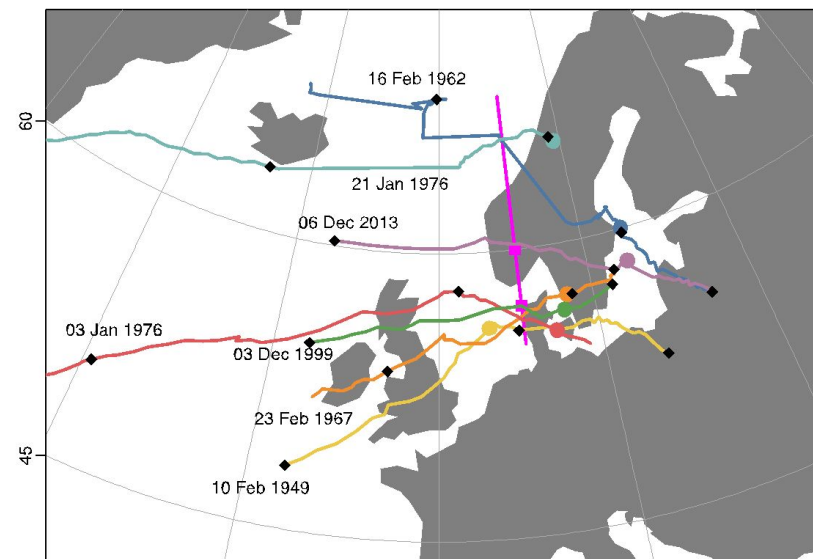


Hours until highest water level in Cuxhaven

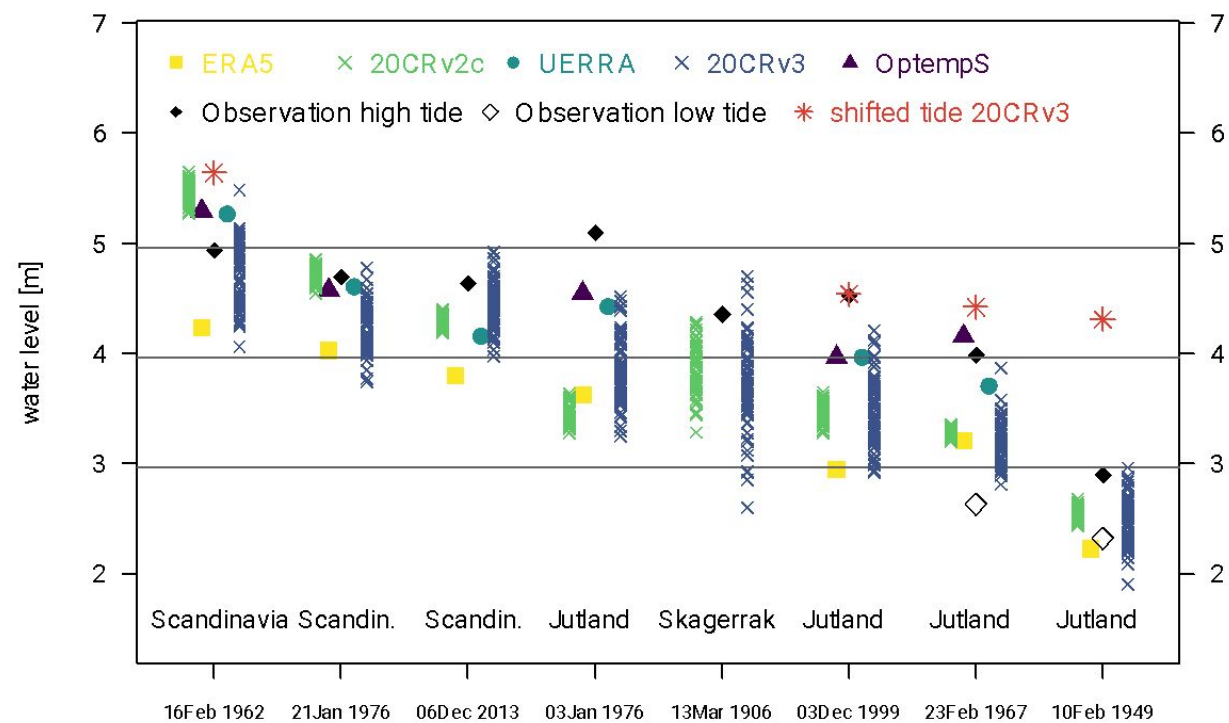
Wind speed Helgoland



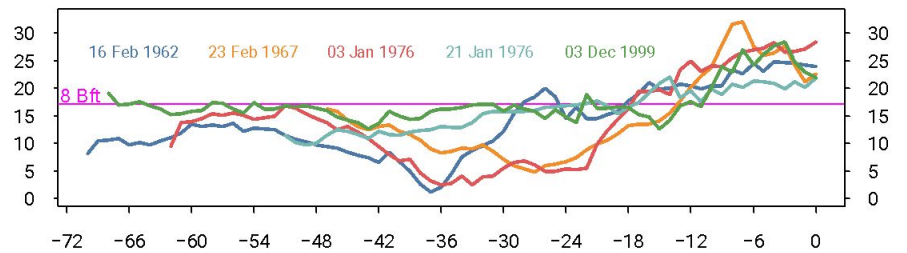
Storm tracks based on ERA5 data



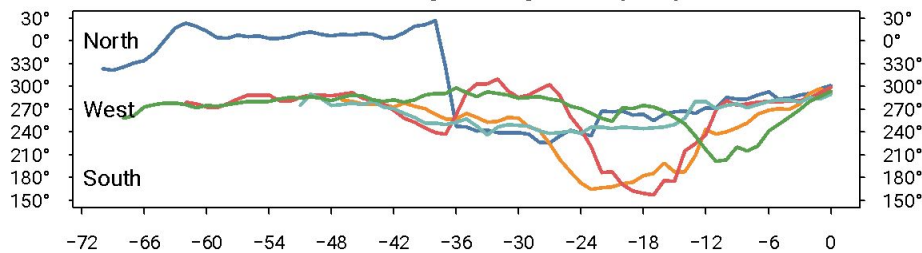
Cuxhaven



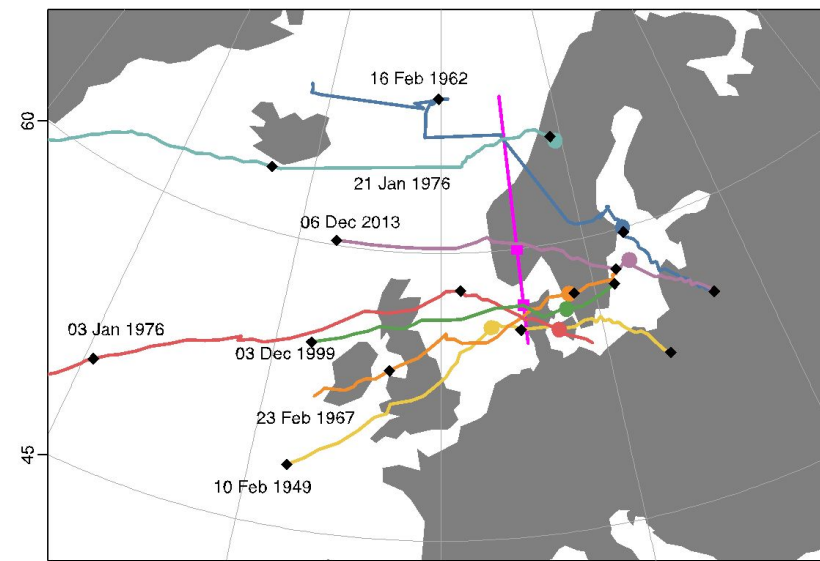
**Wind speed [m/s] Helgoland Optemps**



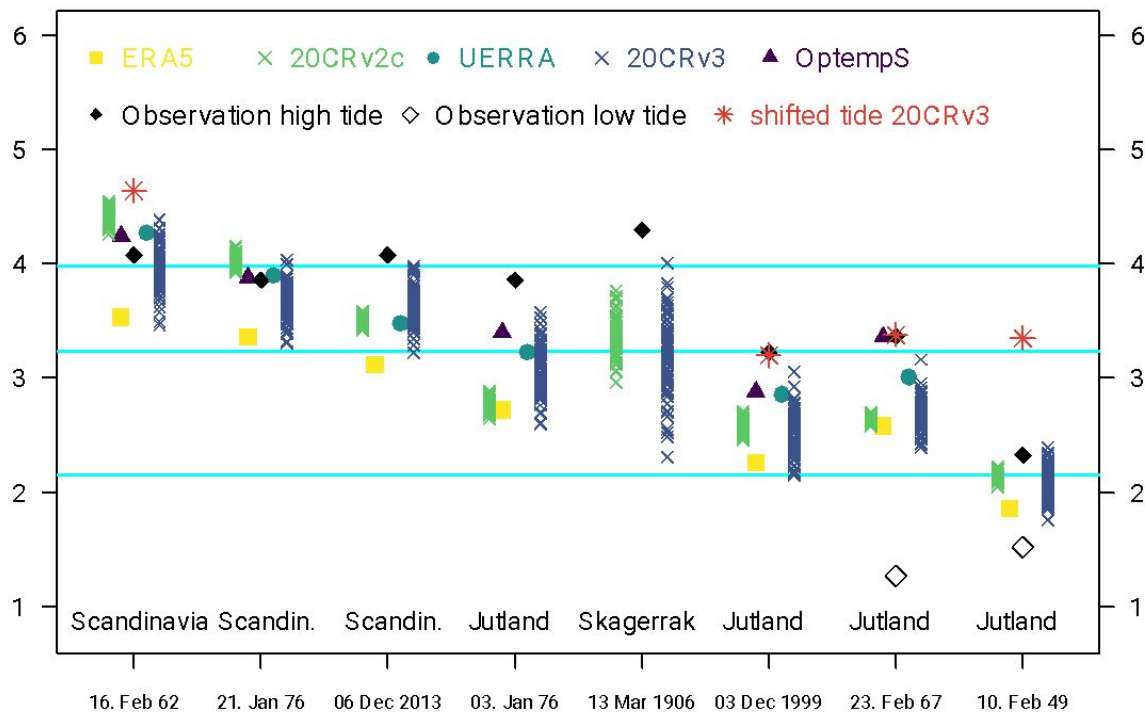
**Wind direction [Degree] Helgoland Optemps**



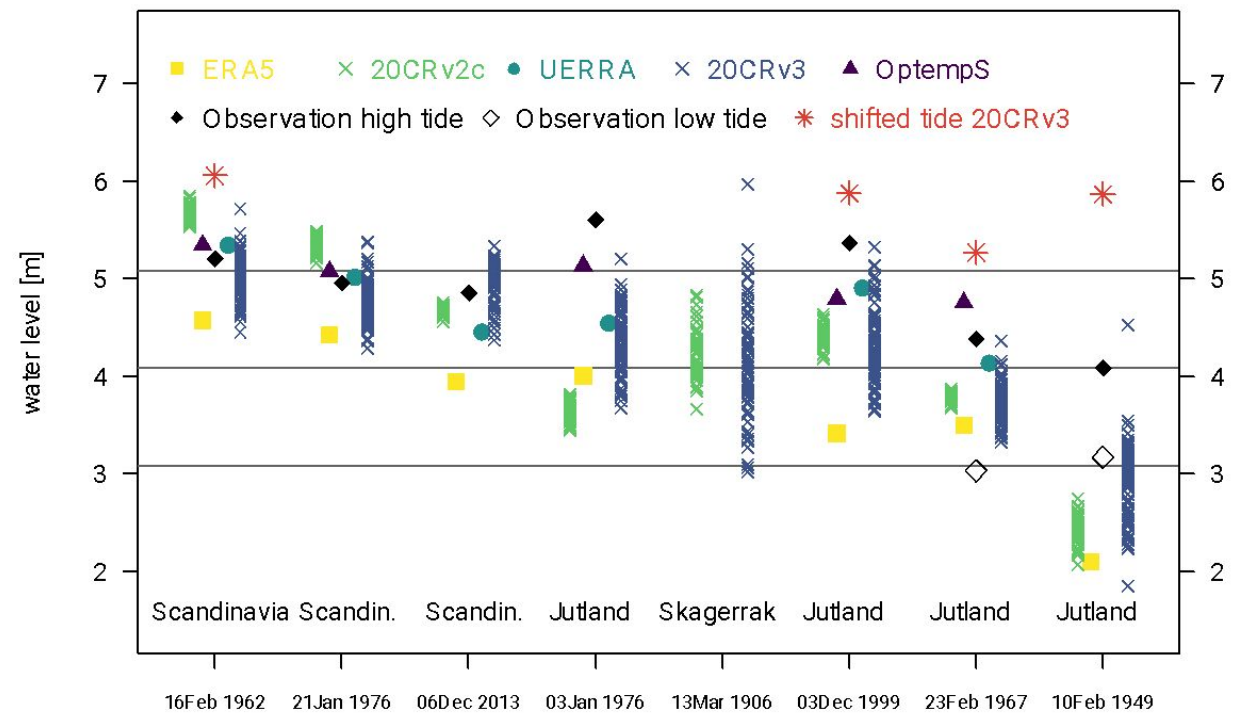
**Storm tracks based on ERA5 data**



**Norderney**

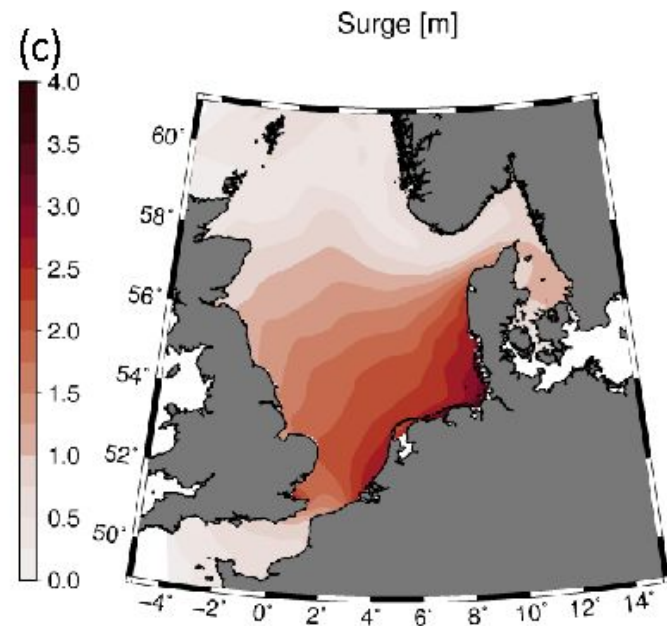
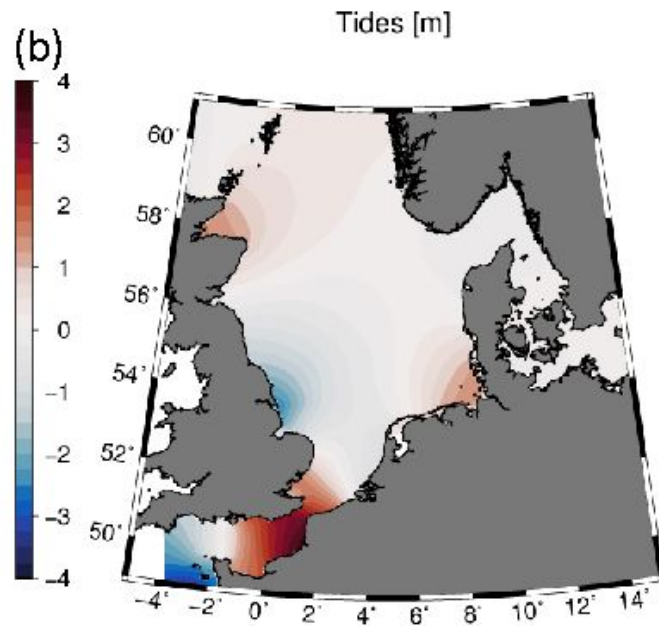
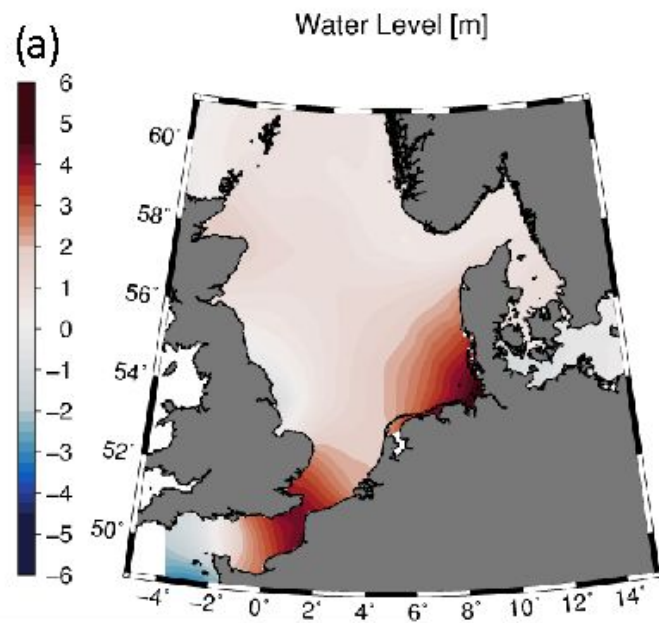


**Husum**

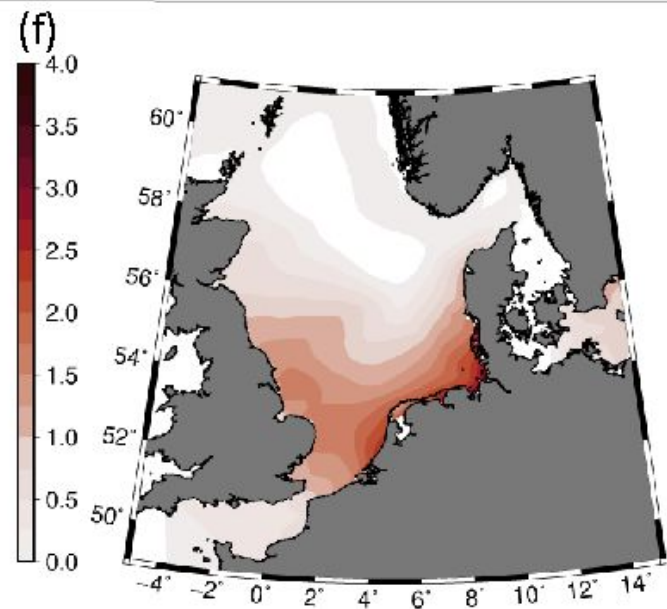
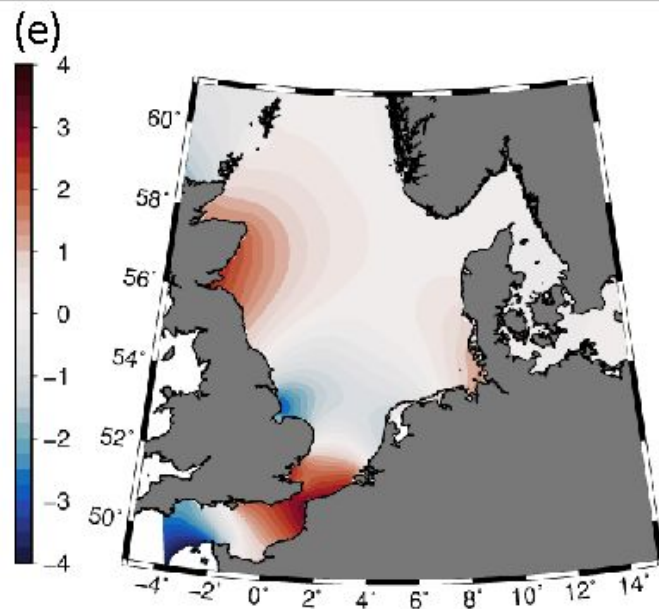
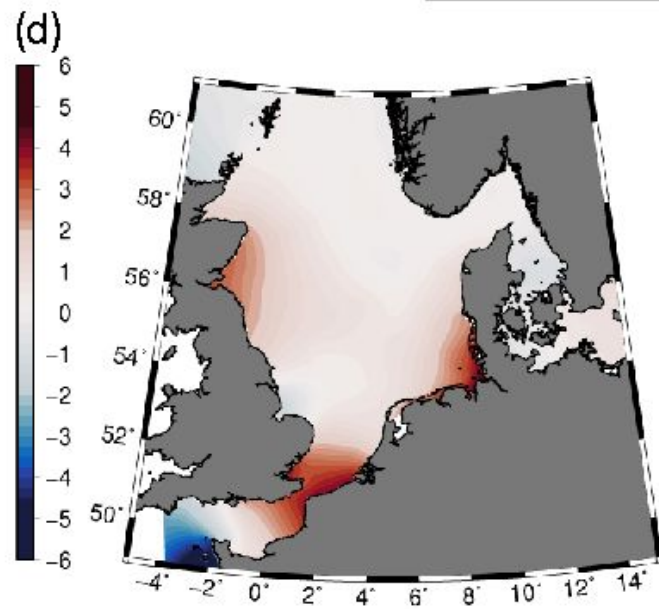




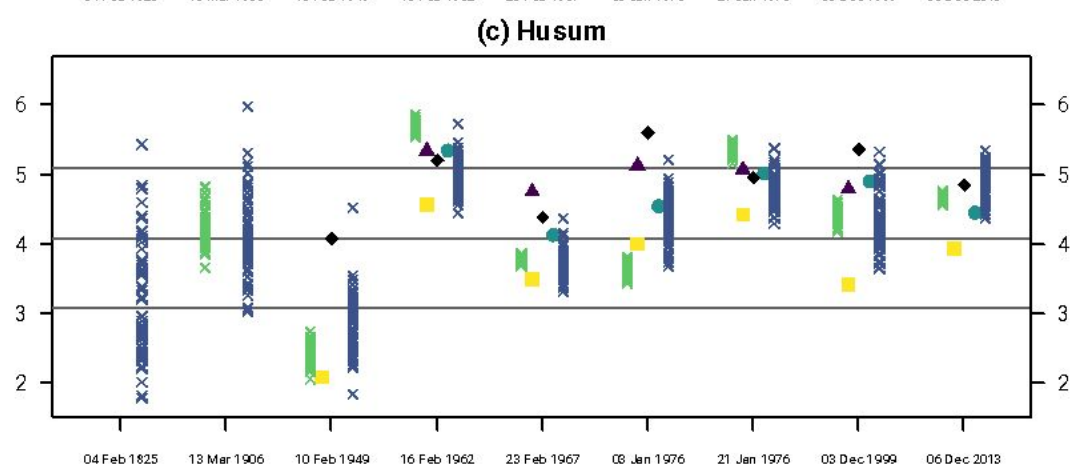
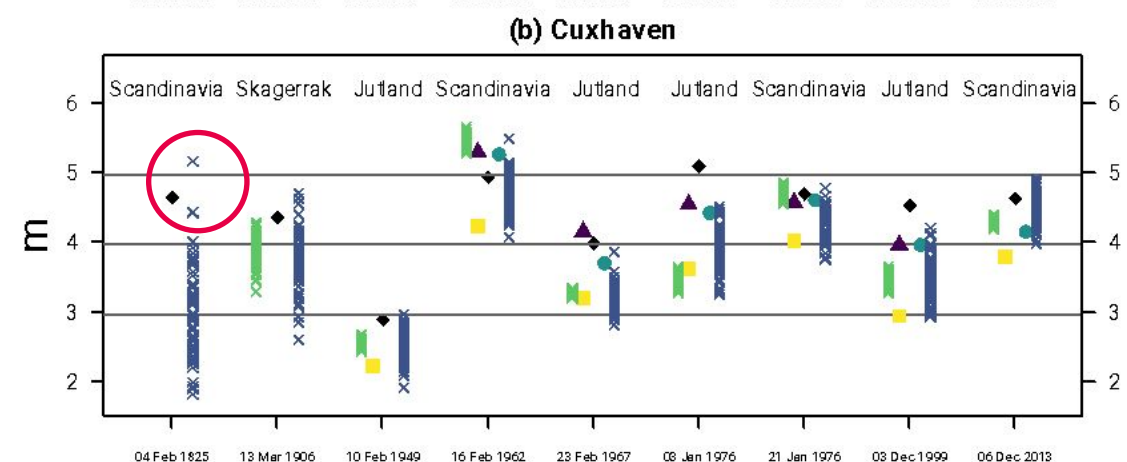
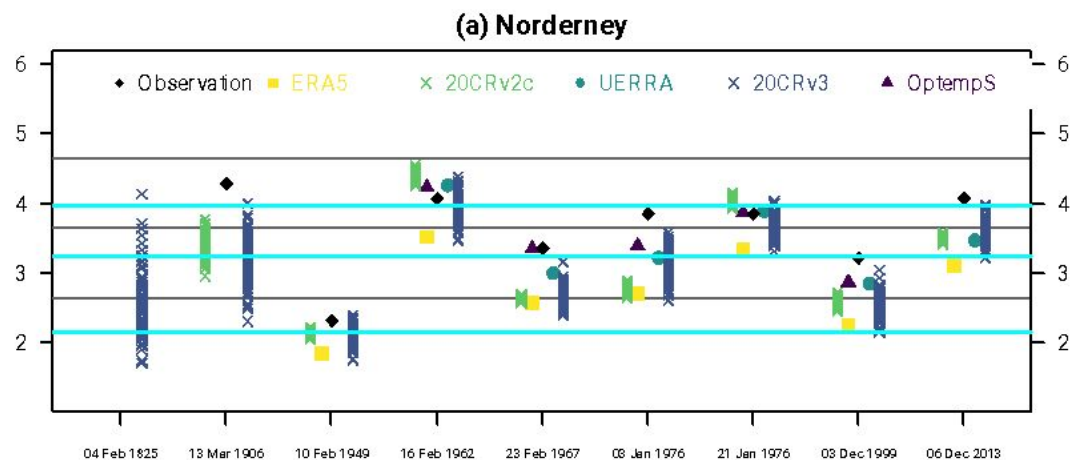
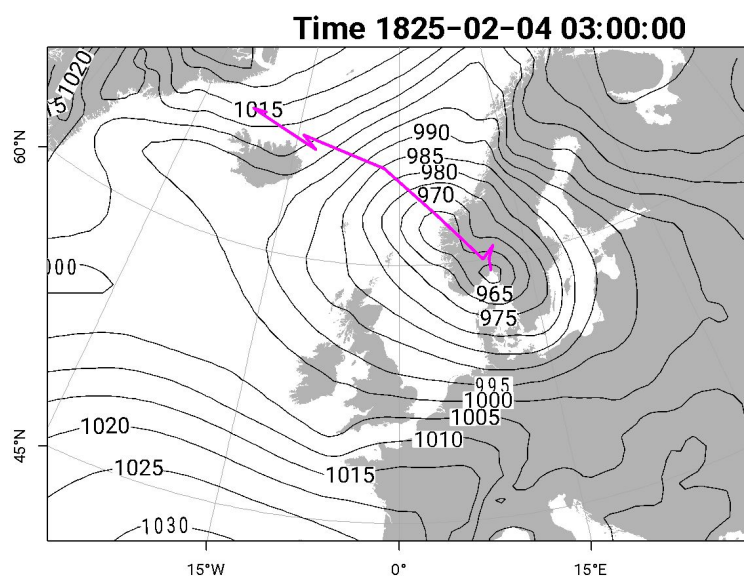
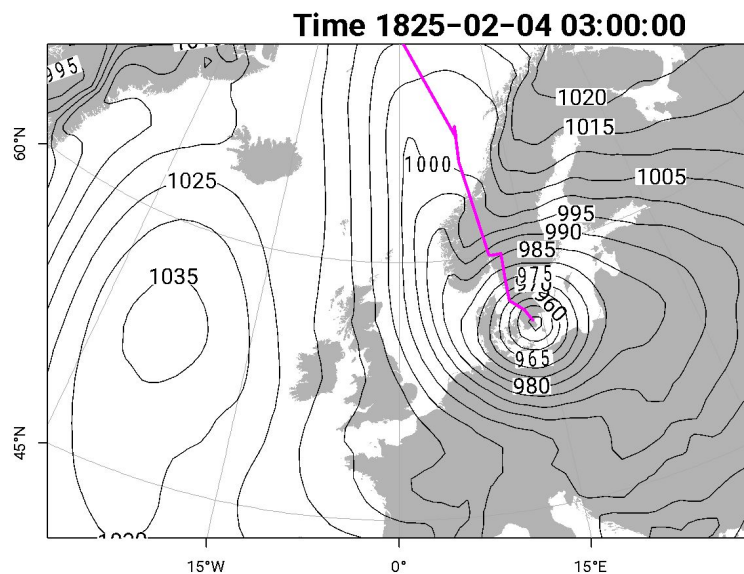
16 Feb 1962; 22:00 UTC



03 Jan 1976; 14:00 UTC



# Storm tide event 03/04 Feb 1825

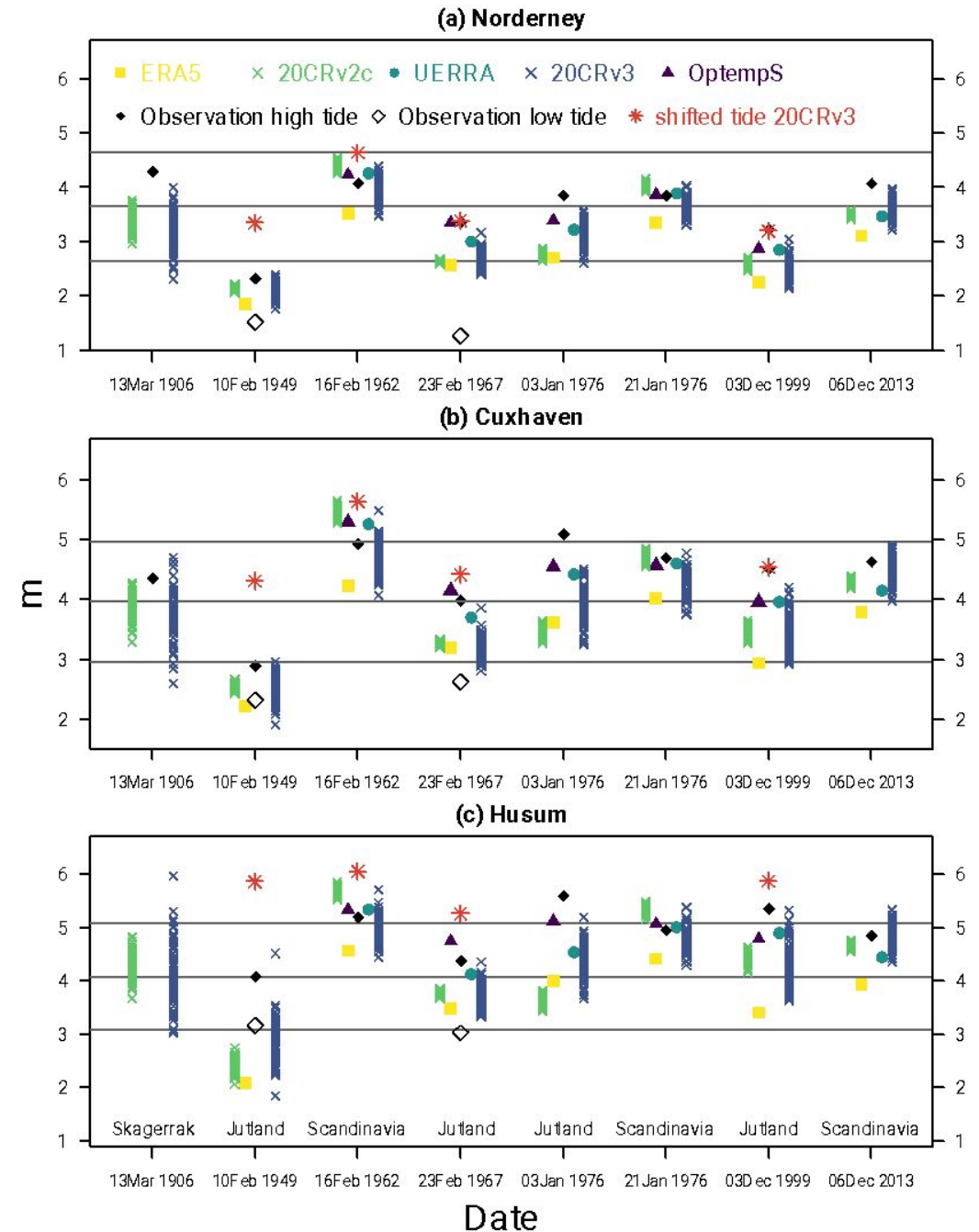


Date

# Summary

- Forced by single ensemble members of 20CR and UERRA, the hydrodynamic model can simulate higher water levels than observed.
- The model runs forced by ERA5 resulted in lower water levels than observations.
- Shifting the tides to spring tides increases the water levels by several decimetres.
- The observed water level of the severe storm tide of 03 January 1976 could not be simulated.

## Maximum water level



Meyer, E. M. I. and Gaslikova, L.: Investigation of historical severe storms and storm tides in the German Bight with century reanalysis data, EGU sphere [preprint], <https://doi.org/10.5194/egusphere-2023-2068>, 2023.

# Vielen Dank

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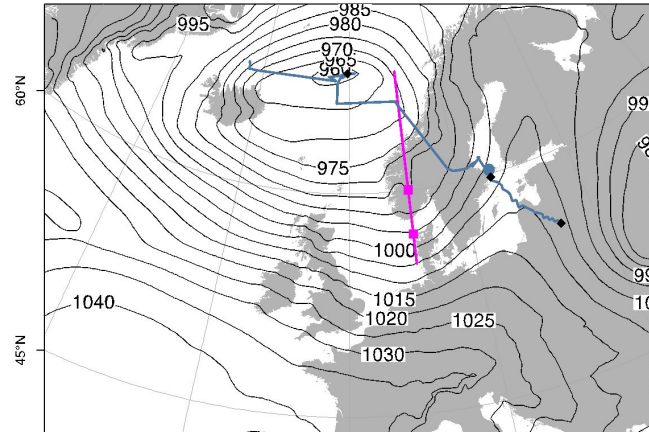
[elke.meyer@hereon.de](mailto:elke.meyer@hereon.de)

[www.hereon.de/coastalsystems](http://www.hereon.de/coastalsystems)

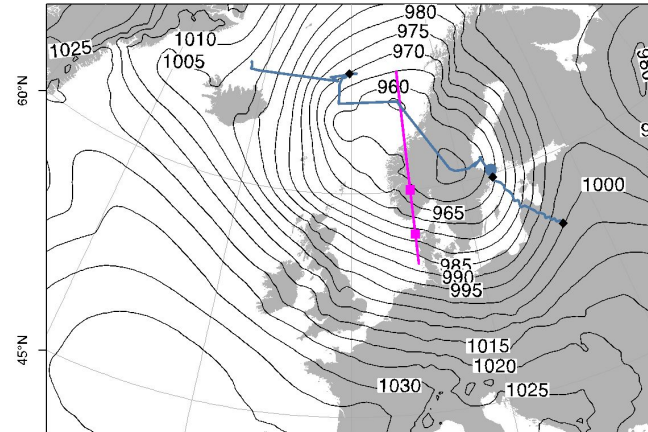


Helmholtz-Zentrum  
**hereon**

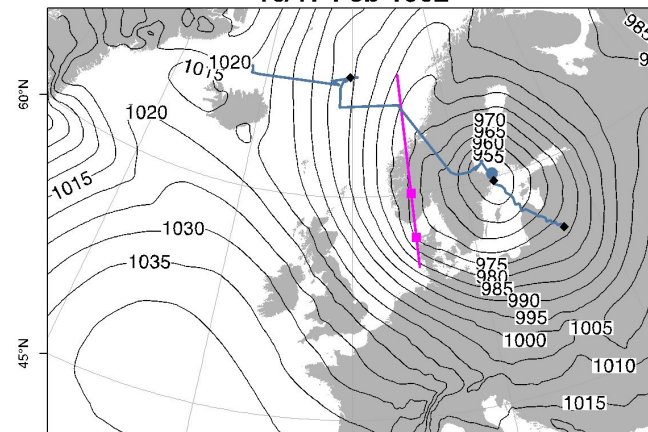
16/17 Feb 1962 – 24h



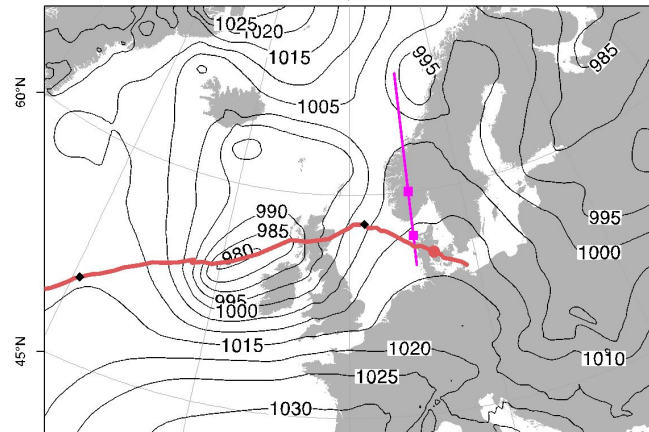
16/17 Feb 1962 – 12h



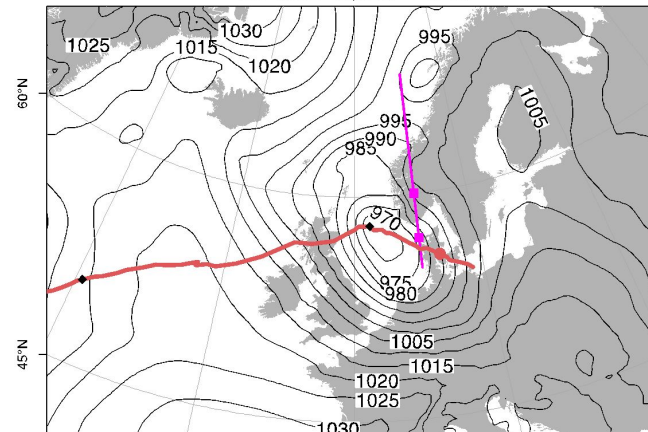
16/17 Feb 1962



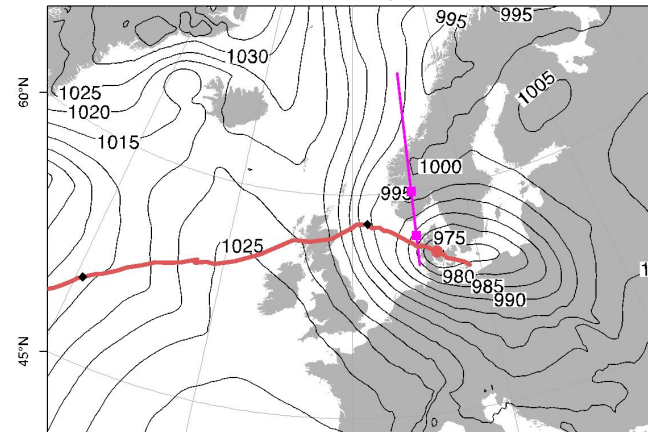
03 Jan 1976 – 24h



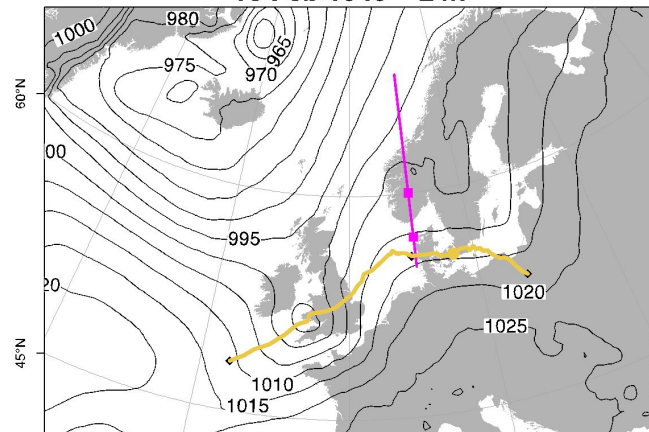
03 Jan 1976 – 12h



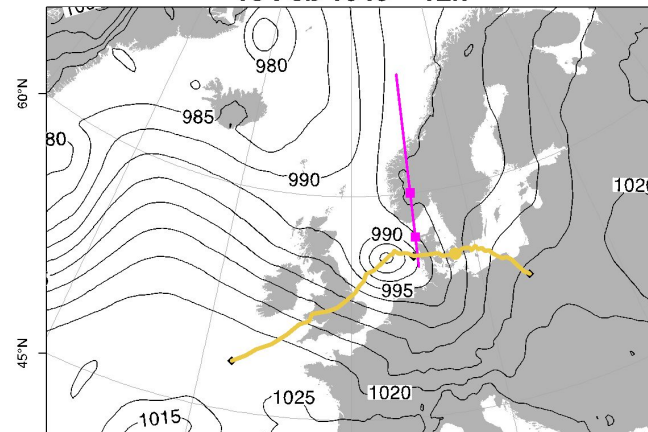
03 Jan 1976



10 Feb 1949 – 24h



10 Feb 1949 – 12h



10 Feb 1949

