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# IceGIS: A near real time ice information system for FS Polarstern

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Introduction

To support ship navigation, station planning, and scientific data evaluation, a new near real time sea-ice information system was installed onboard FS Polarstern during summer 2016. After installation works during PS98 the full product was available on PS101, when all components of the system were tested and used for the first time.
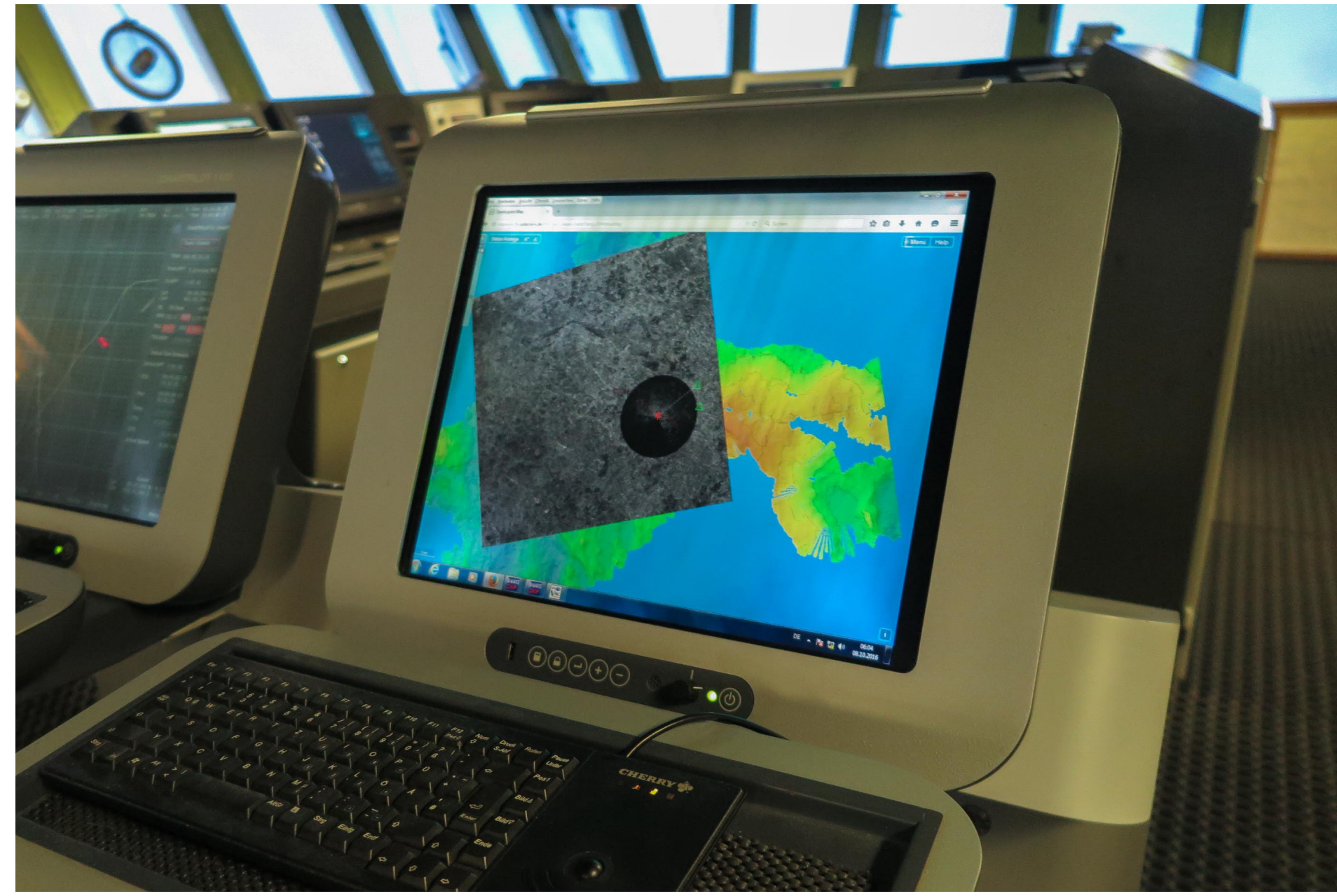

Data transfer
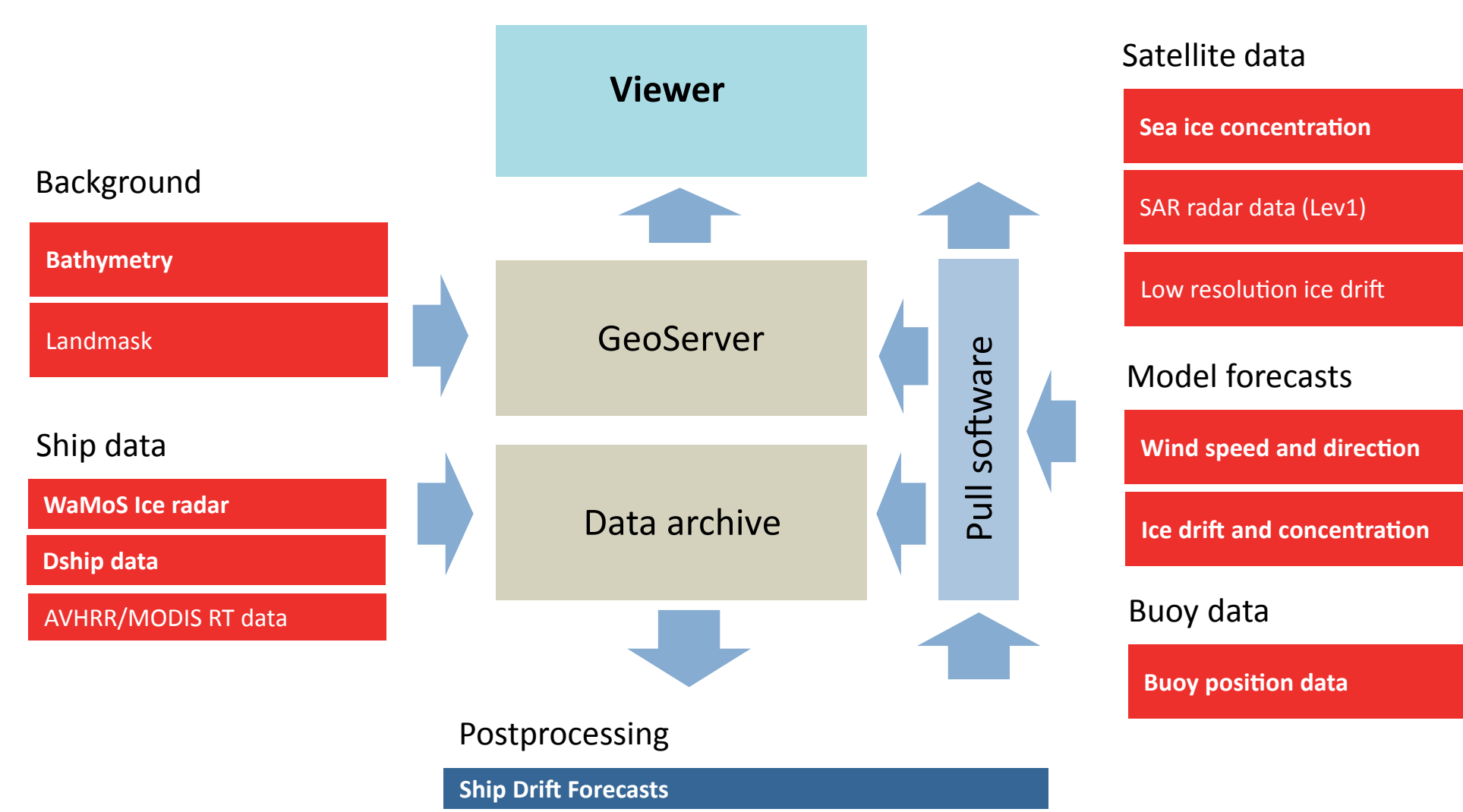
The different datasets are downloaded automatically using FTP from the various data providers. The files are saved on a local directory on board the ship, where they are accessible for postprocessing and import into a GeoServer.
All datasets are presented in a web-based viewer software, both on bridge computers as well as on every network computer on board.

Sentinel-1 SAR image delivery

Sentinel-1 (S1) images are automatically aqcuired from ESA and cropped according to predefined static regions of interest or following dynamic ship and buoy positions.
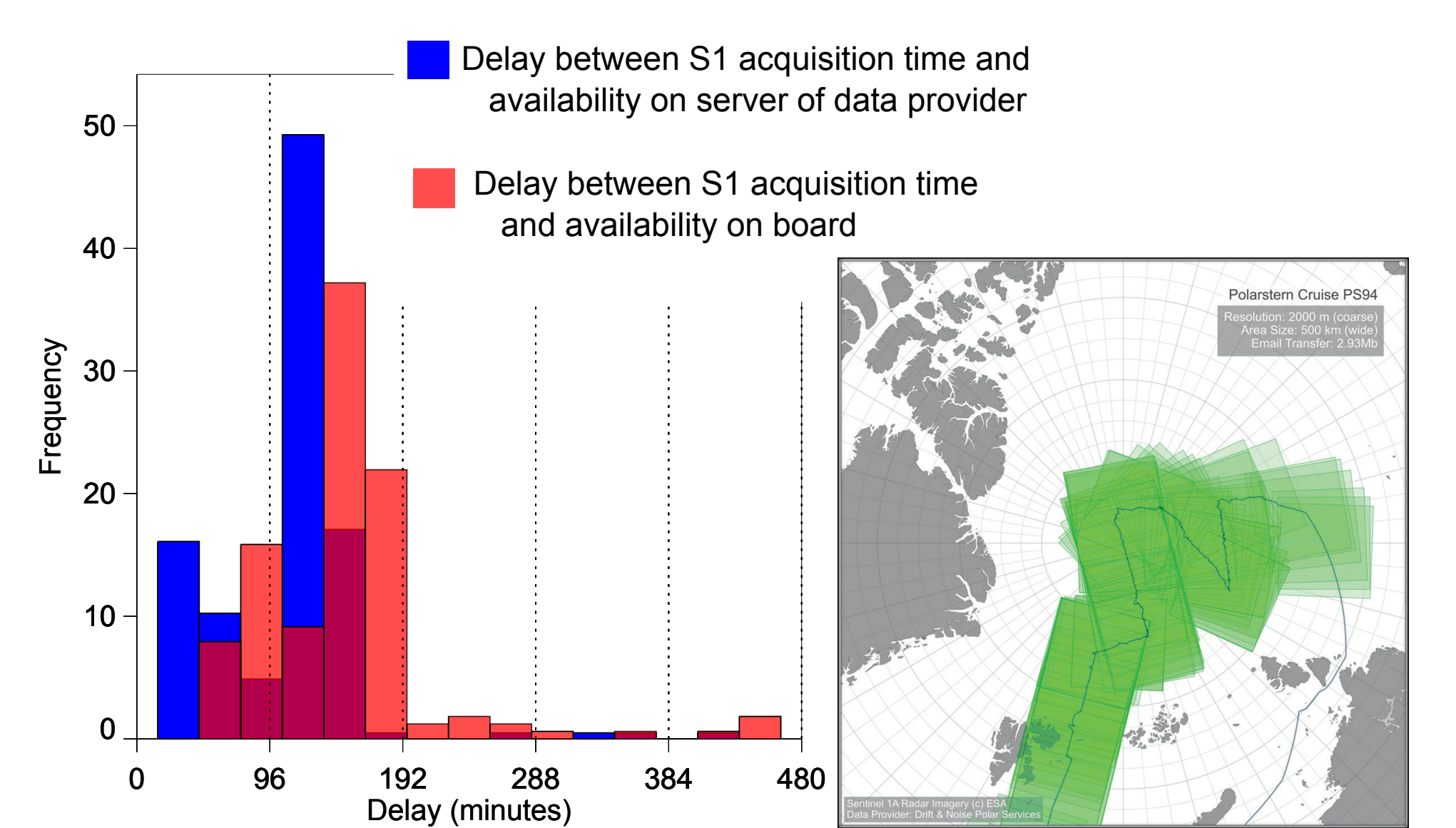
On average, Sentinel-1 images are ready for pickup at the data provider (Drift&Noise) 135 minutes after acquisition. Due to delays mostly caused by the ships internet it takes on average additional 122 minutes until the image is displayed on board. This could be improved down to 30 minutes by better bandwidth management of the iridium connection.

Data visualization
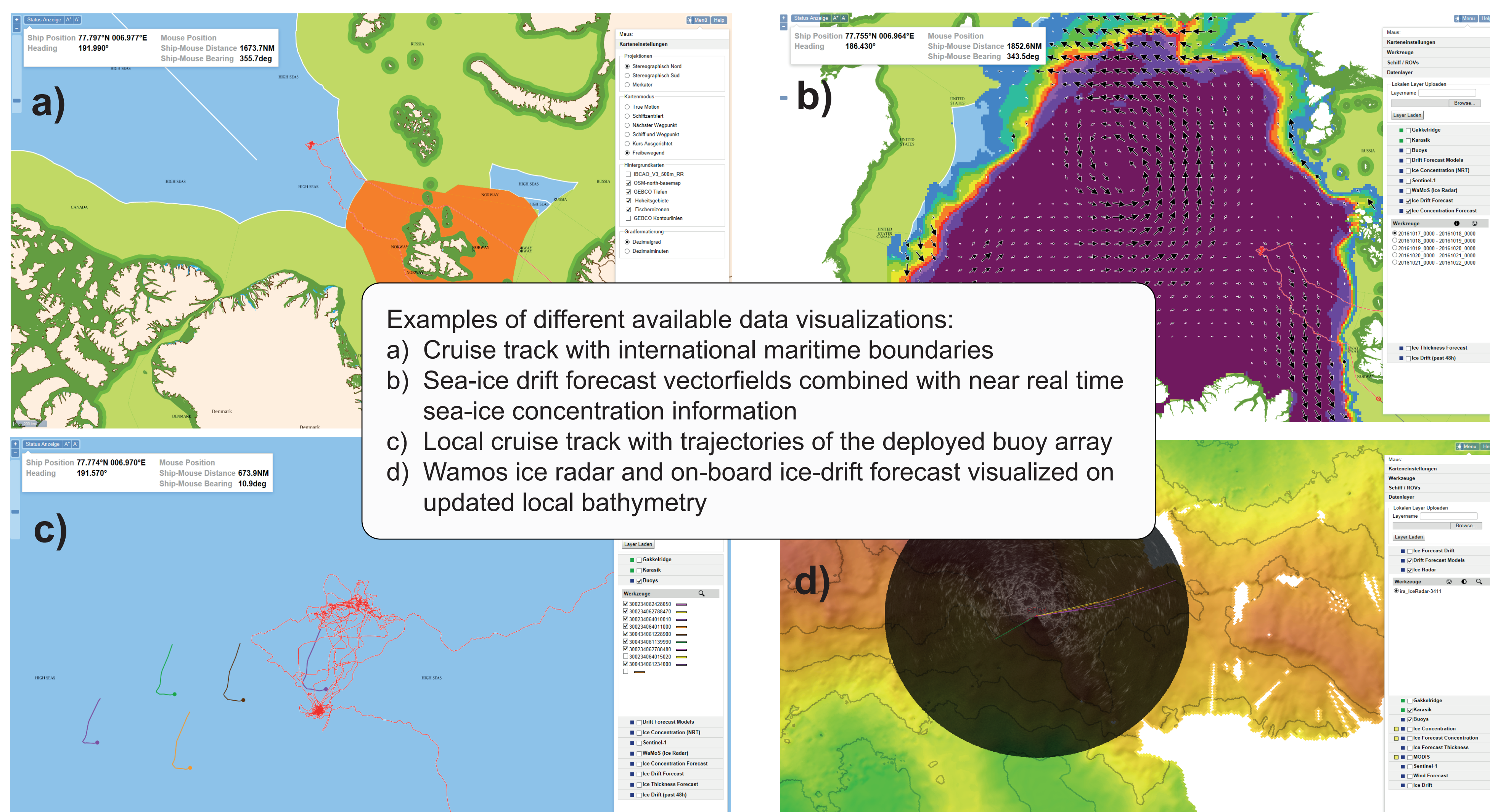
Examples of different available data visualizations:
a) Cruise track with international maritime boundaries
b) Sea-ice drift forecast vectorfields combined with near real time sea-ice concentration information
c) Local cruise track with trajectories of the deployed buoy array
d) Wamos ice radar and on-board ice-drift forecast visualized on updated local bathymetry

Conclusions

- Sentinel-1 radar images are very helpful in identifying fast transit routes through the ice

- The IceGIS package provides helpful additional information for navigational decision making

- Some adaptations are necessary to increase usability for bridge officers

- On ship sea-ice drift-forecasts provide useful information for targeted deployment of deep sea exploration gear

- Dynamic display of current buoy positions improves drift-estimate and enables easy location for recovery operations.

- Data delivery with a delay of less than 15 minutes for buoy data and on average 4 for SAR images.

Route planning

High resolution Sentinel-1 SAR images allow the identification of a fast route out of the ice pack following a track of sequential leads.

Short term Drift-forecast
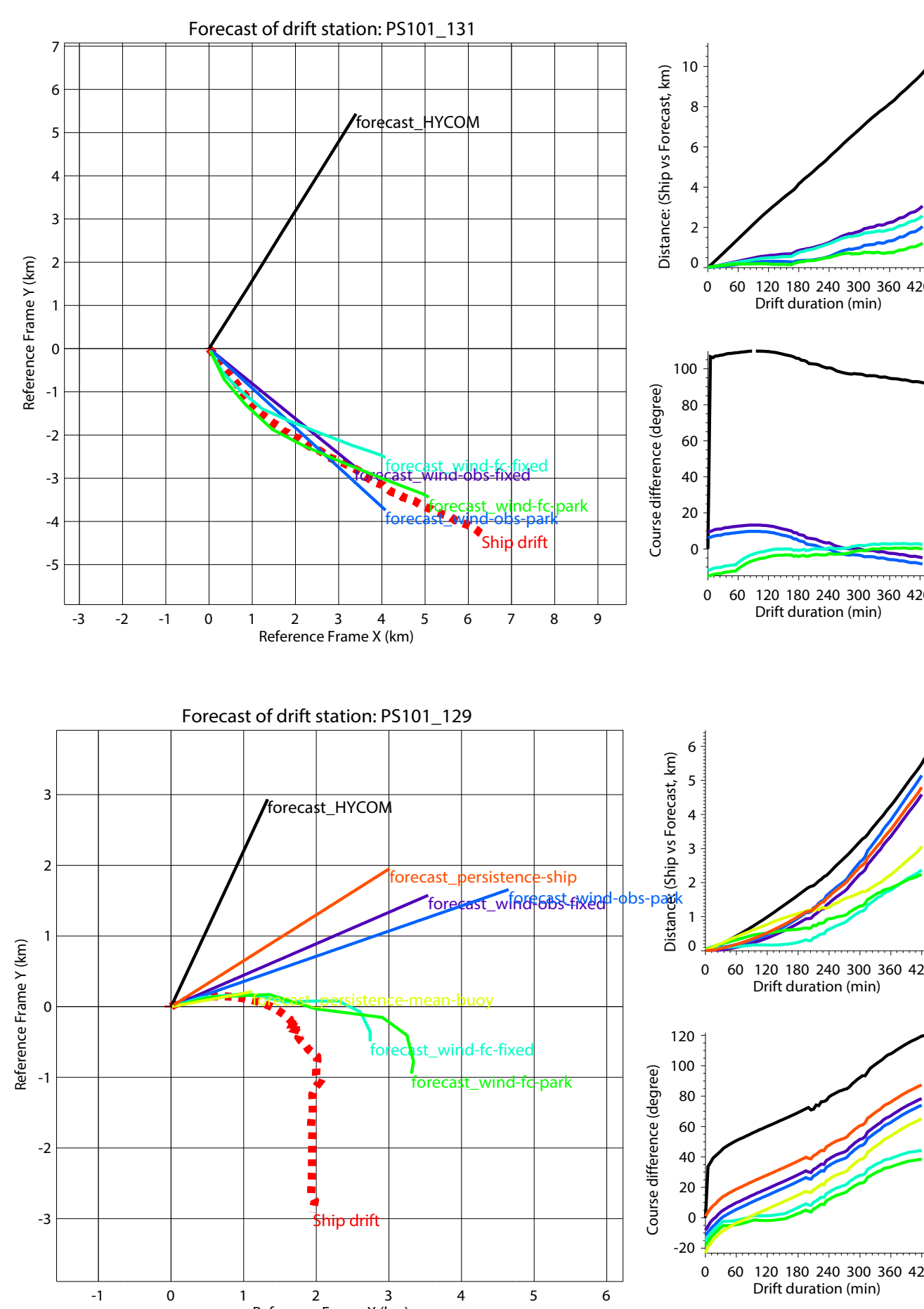
Local short-term drift forecasts were calculated on board every five minutes using DWD wind forecast, wind observations, current ship drift or buoy drift. These models were also compared to the forecast data from the HYCOM-TOPAZ forecast product.
In most occasions, the ensemble of forecasts provided a good estimate of drift direction as well as drift speed. This proved to be very useful to reach areas of the size of a football field in the deep sea while adrift.

Heuristic algorithms using a fixed wind-ice turning angle and speed ratio performed better than explicitly solving the boundary layer problem with the algorithm of Park et al. (2016). Forecasts based on the wind-forecast provide a better representation of drift, in conditions of turning winds. However timing errors of predicted wind direction changes are a frequent issue. While the Arctic wide forecast provided by the HYCOM-TOPAZ system provides a reasonable estimate of drift speed, it suffers from low temporal resolution and large errors in predicted ice drift direction.

References
Park, H.-S. and Stewart A. L.; An analytical model for wind-driven Arctic summer sea ice drift; The Cryosphere, 10, 227-244, 2016, doi:10.5194/tc-10-227-2016