

Sea-ice cover in Isfjorden and Hornsund

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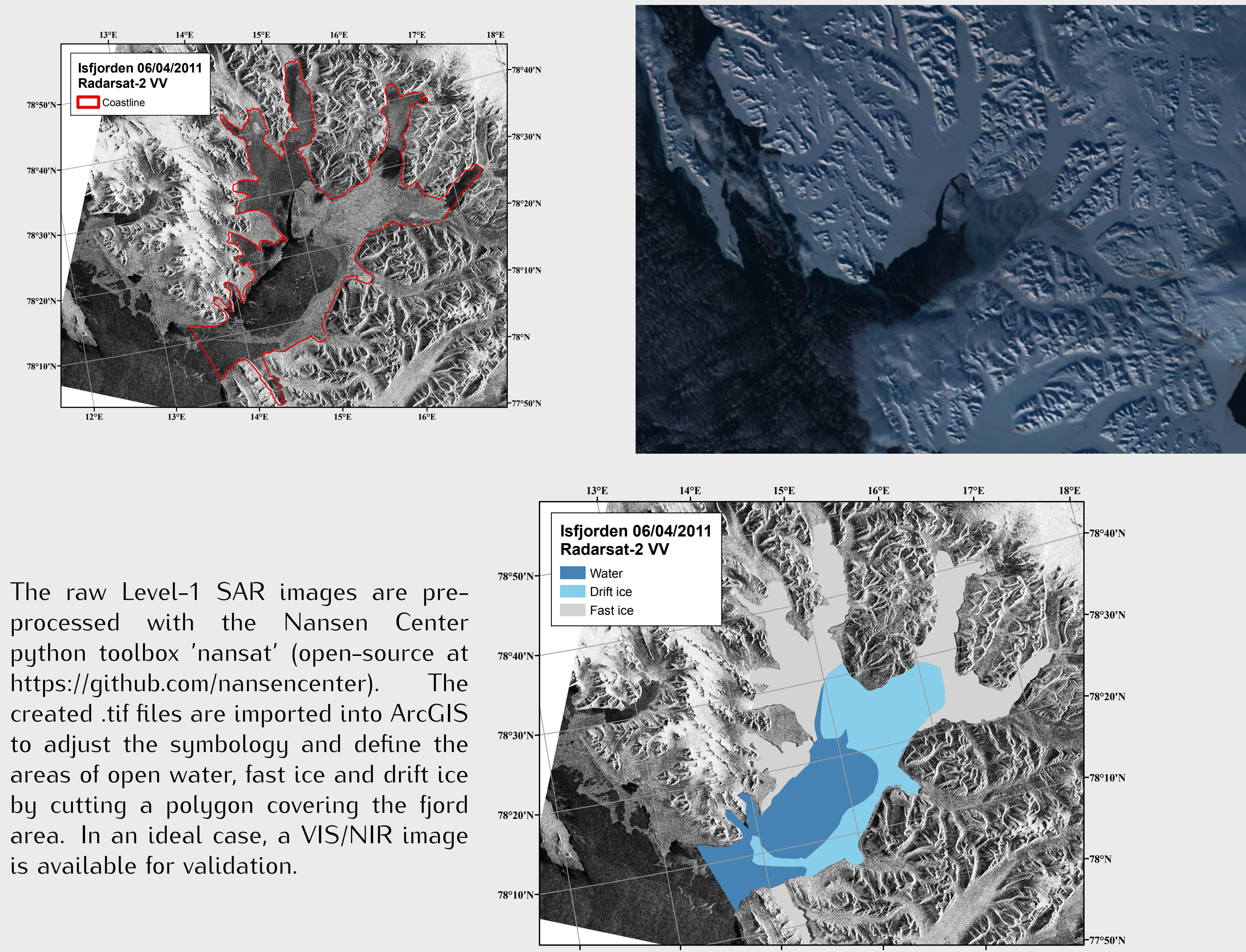
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Abstract As part of the AWAKE-2 project, a sea-ice database was built up for two fjords in Svalbard (Isfjorden and Hornsund) using in-situ observations and high-resolution satellite images from SAR and optical sensors. 16 555 satellite images have been collected and used for manual interpretation to analyse sea-ice coverage in Isfjorden and Hornsund for the time period 2000–2014. The result is a time series with an almost daily resolution defining the fjord area into fast ice, open water and drift ice. The error estimation of the daily values vary between several 1% up to more than 10% depending on sun light, cloud cover, availability and quality of the satellite data. To quantify an ice season in a fjord and for comparison with atmosphere and ocean data, a new index called 'days of fast ice coverage' (DFI) has been developed. The DFI represent the sum of the fast ice area relative to the entire fjord area from all days during a certain period of time (e.g. one season). A distinct shift to lower DFI values is observed in 2006. Calculating a mean before and after 2006 yields a decrease from 50 to 22 DFI for Isfjorden and from 56 to 34 DFI for Hornsund. Fast ice coverage generally correlates well with remote-sensing sea surface temperature and in-situ air temperature. An increase of autumn ocean heat content is observed during the last few years when the DFI values decrease. The presented sea ice time series can be utilised for various climate effect studies linked to e.g. glacier dynamics, ocean chemistry and marine biology.

Publication and time series: <http://www.the-cryosphere.net/10/149/2016/>

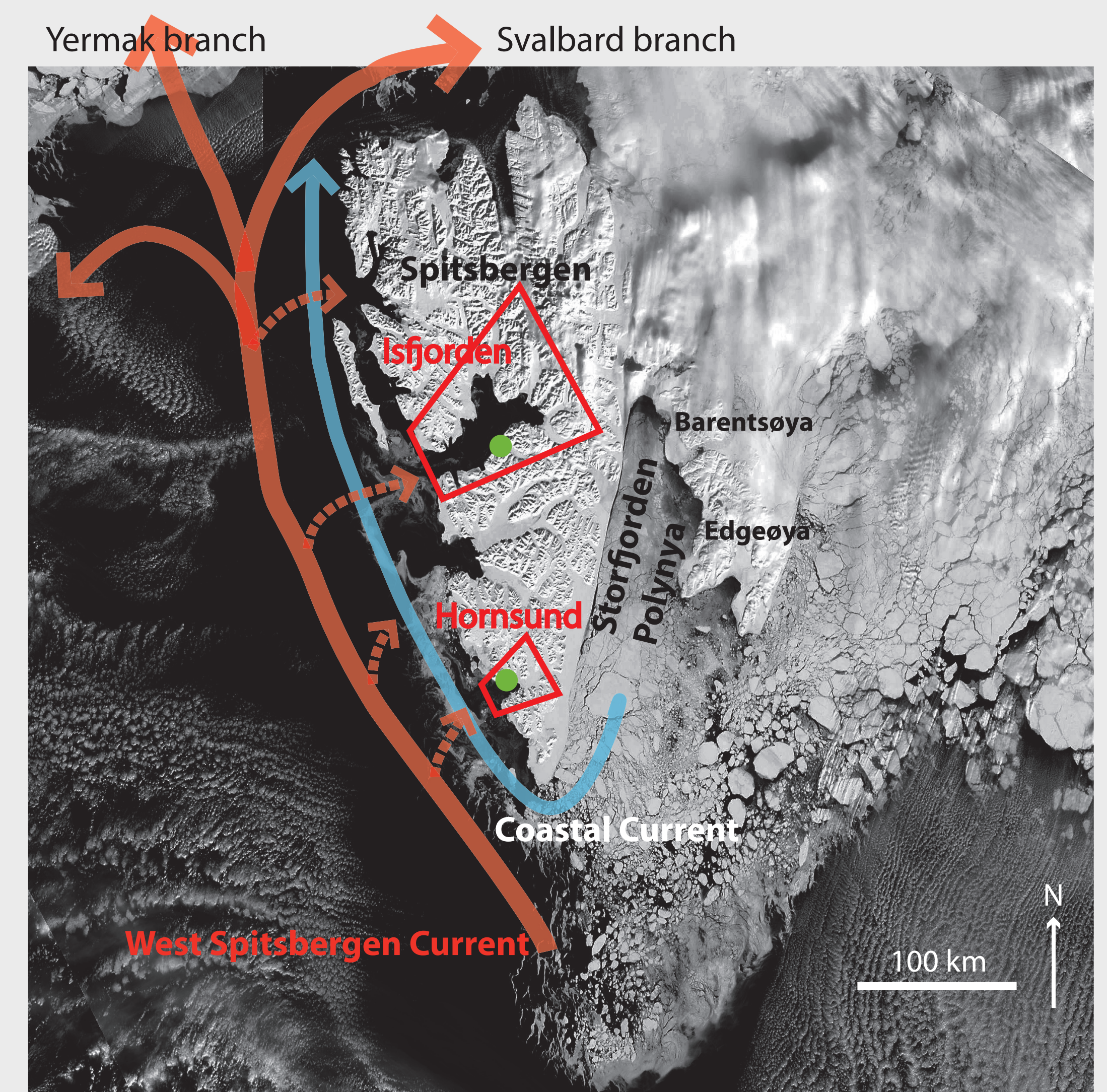
Method



The raw Level-1 SAR images are pre-processed with the Nansen Center python toolbox 'nansat' (open-source at <https://github.com/nanscenter>). The created .tif files are imported into ArcGIS to adjust the symbology and define the areas of open water, fast ice and drift ice by cutting a polygon covering the fjord area. In an ideal case, a VIS/NIR image is available for validation.

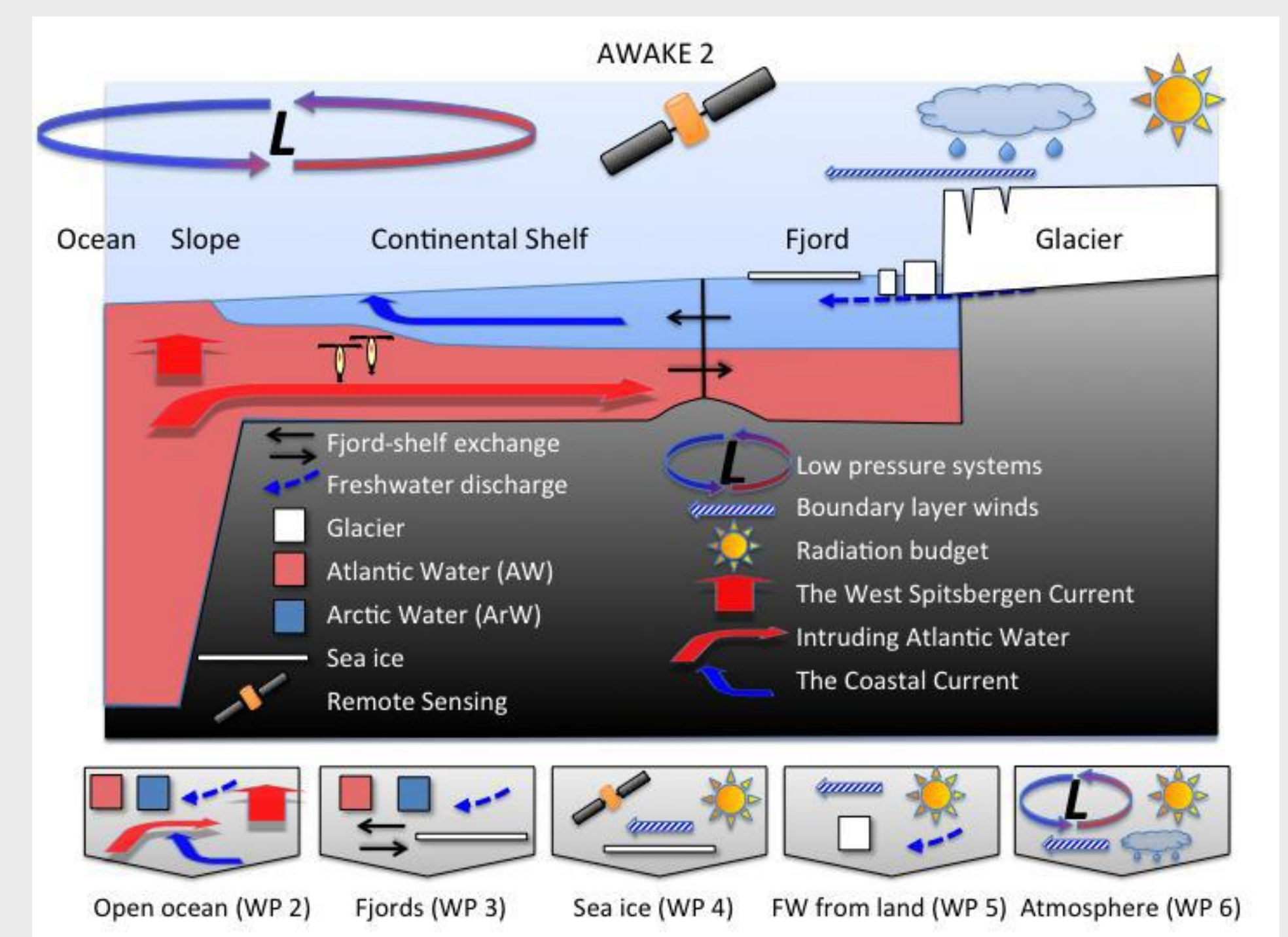
Study area

Svalbard's climate is strongly affected by the West Spitzbergen Current, which transports warm and salty Atlantic Water northwards and causes eastern Fram Strait containing the northernmost permanently ice free ocean. The Coastal Current transports colder, fresher water along the shelf and favours the seasonal sea-ice growth in Isfjorden and Hornsund. Atlantic water inflows into the fjords can alter the sea-ice conditions during the following winter season significantly with major impacts on the local climate and fauna.



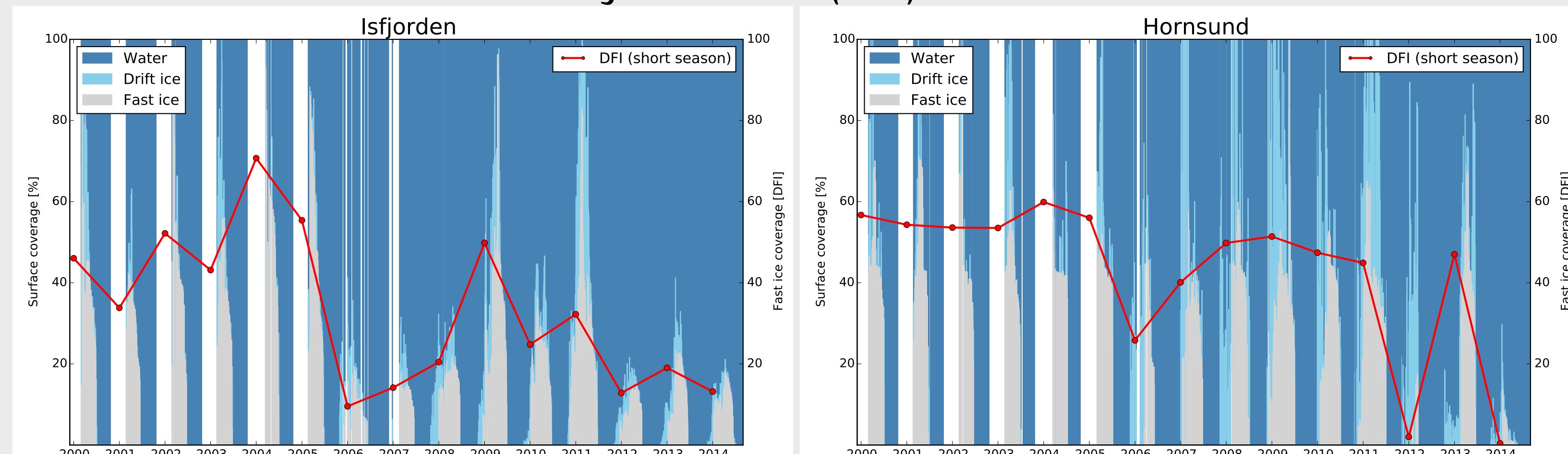
AWAKE-2 Hypothesis

Atlantic Water inflows over the Svalbard shelf and into the fjords have become more frequent during the last decades due to changes in the ocean and atmosphere. The integrated effect of these events results in new regimes and changes in atmosphere, ocean, sea-ice and glaciers in Svalbard.



Results

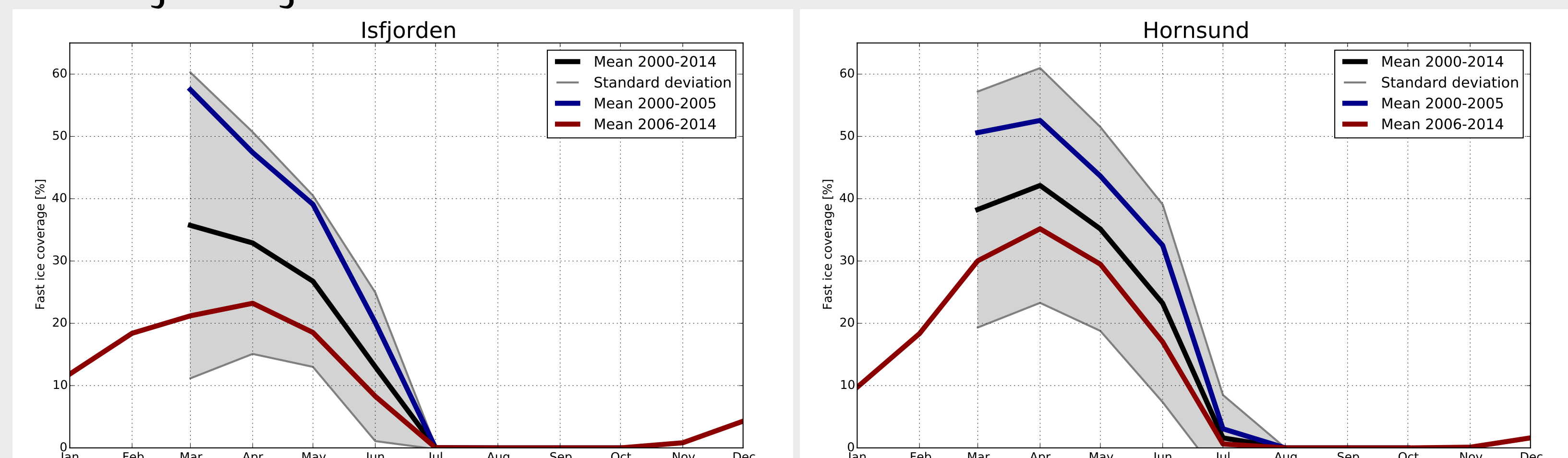
Sea-ice cover time series and days of fast ice (DFI)



$$DFI = \sum \frac{\text{fast ice area}}{\text{fjord area}} \text{ days}$$

- Index for quantifying fast ice season in fjord
- Includes temporal and spatial extent
- Intercomparable between different fjords

Monthly averaged fast ice cover



Discussion

Comparison to T, SST and ocean heat content

