WP 4: Sea ice

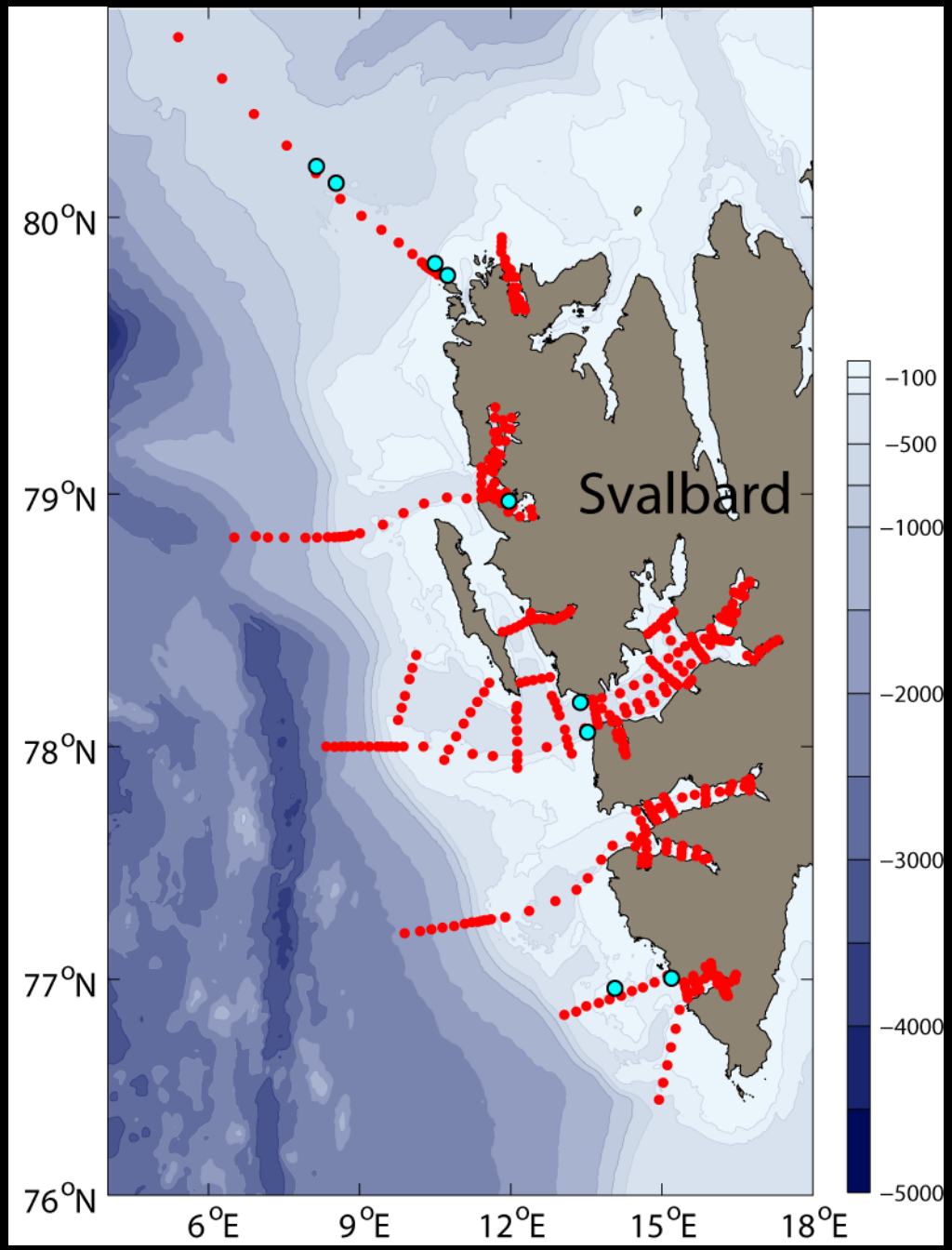
(and WP 2 input)

UNIS, NERSC, met.no

Frank Nilsen (UNIS)

WP 4 Task

- T4.1: Compilation of satellite data from the Svalbard area (NERSC)
- T4.2: To analyse the sea ice data for specific fjords and shelf areas (NERSC)
- T4.3: Air-ice-sea interactions study based on fjord-polynya model (UNIS)
- T4.4: To analyse the response of the sea ice cover to atmospheric and ocean forcing (NERSC, Met.no, UNIS)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79°N
78°N
77°N
76°N
6°E
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12°E
15°E
18°E
Svalbard
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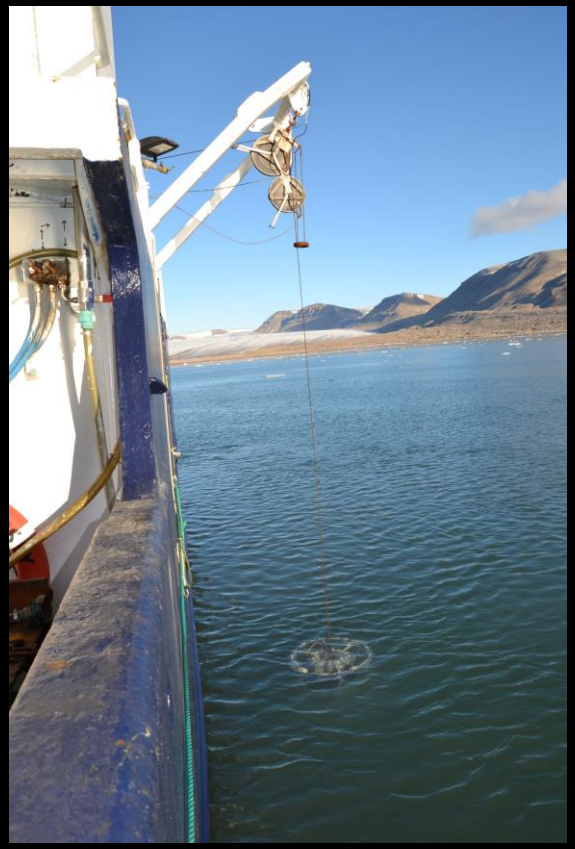
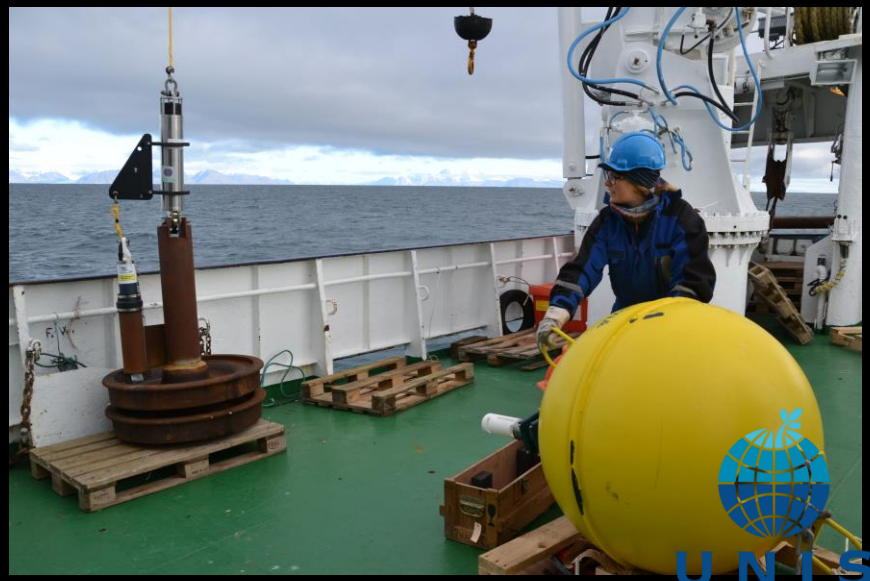
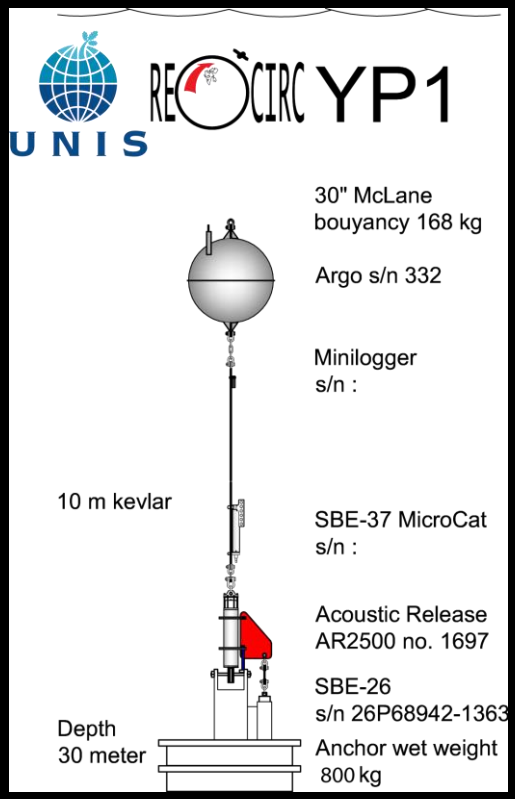
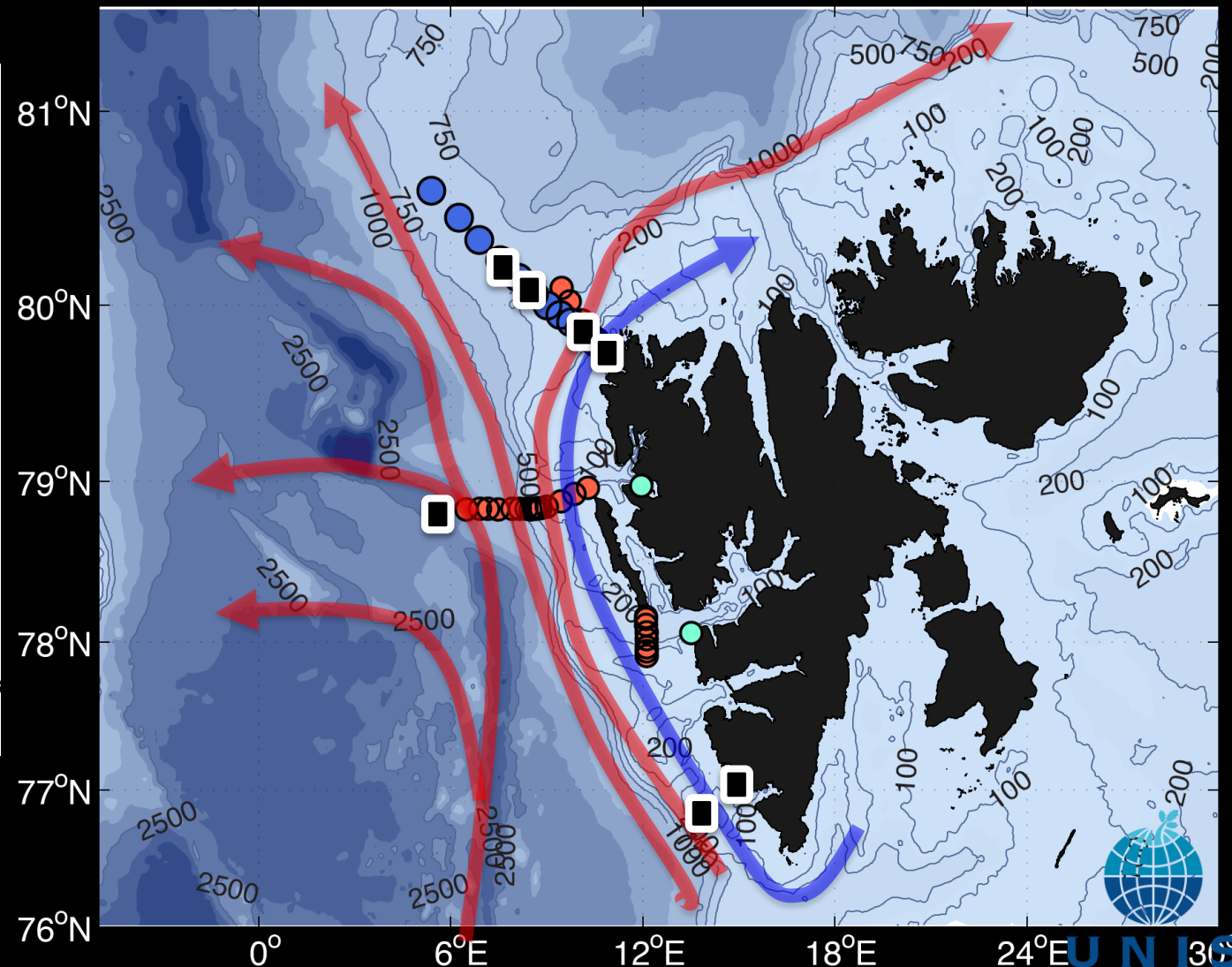
−500
−1000
−2000
−3000
−4000
−5000




UNIS

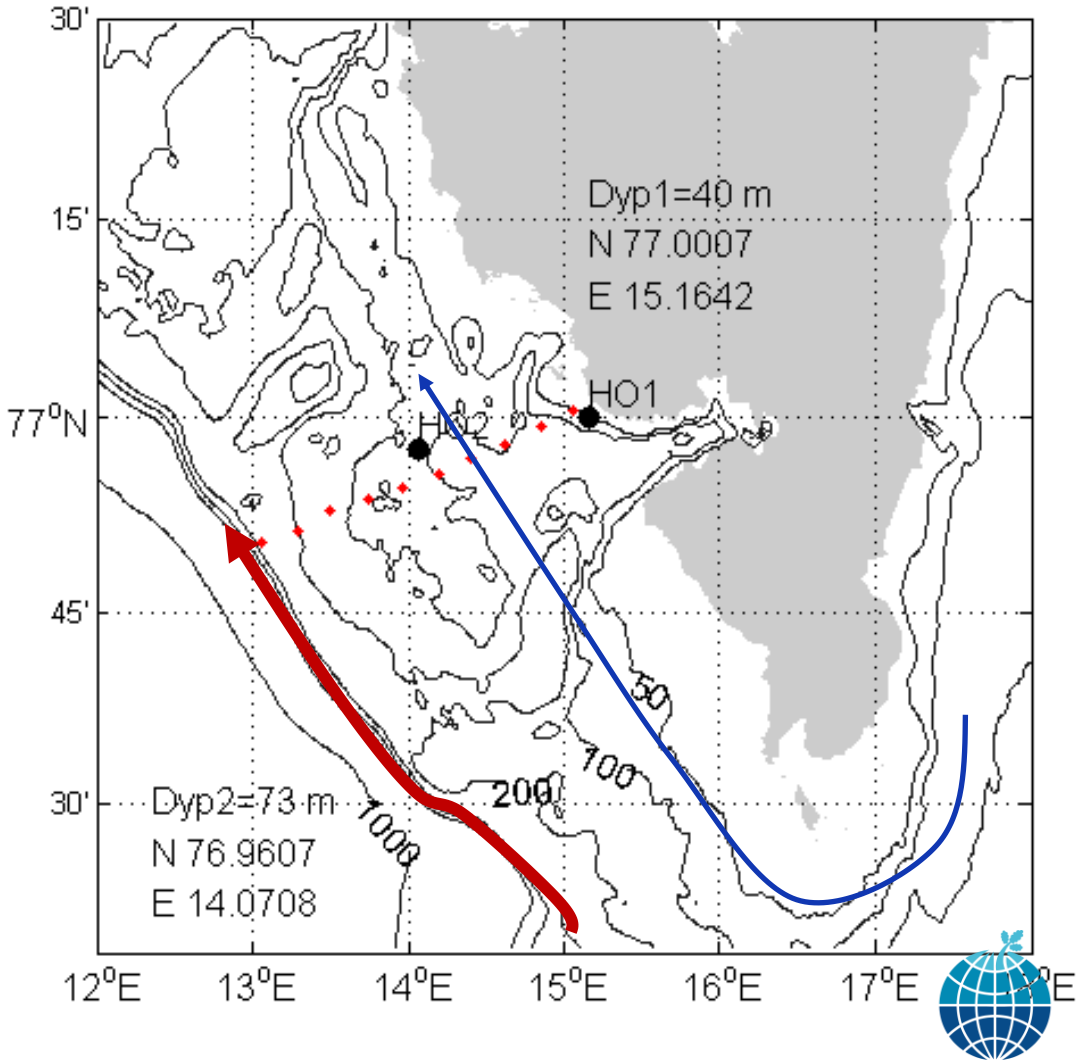
Ocean Circulation and Environmental Mass Changes

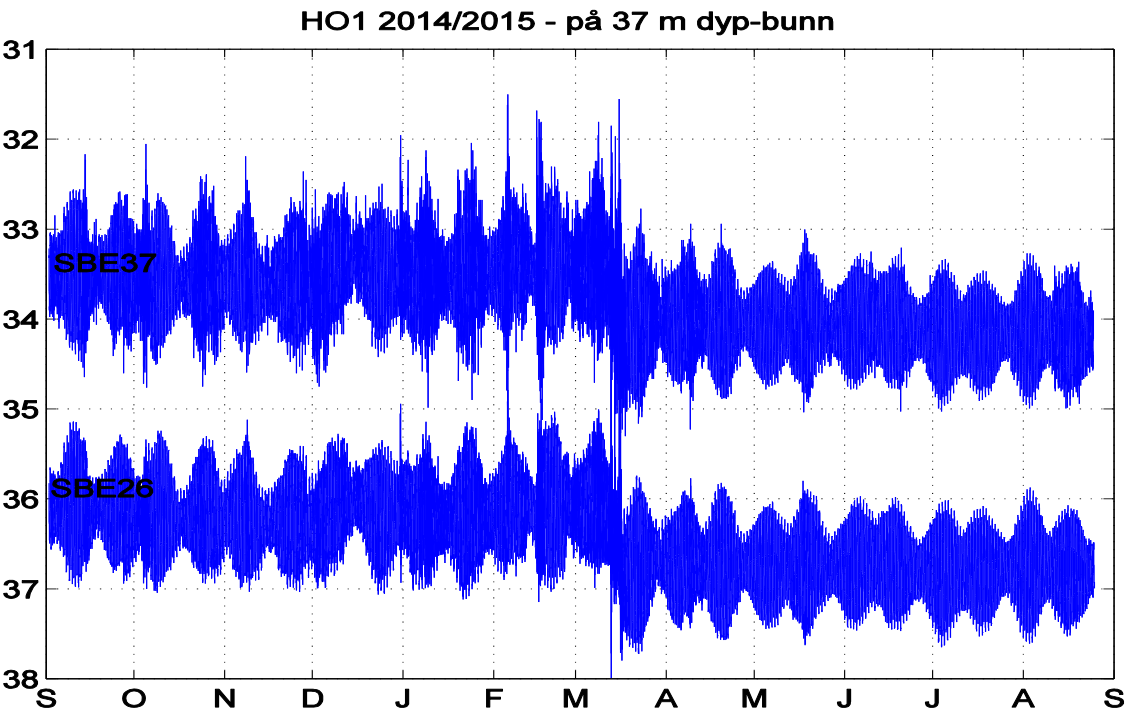




AWAKE-2

OBP moorings at Hornsund

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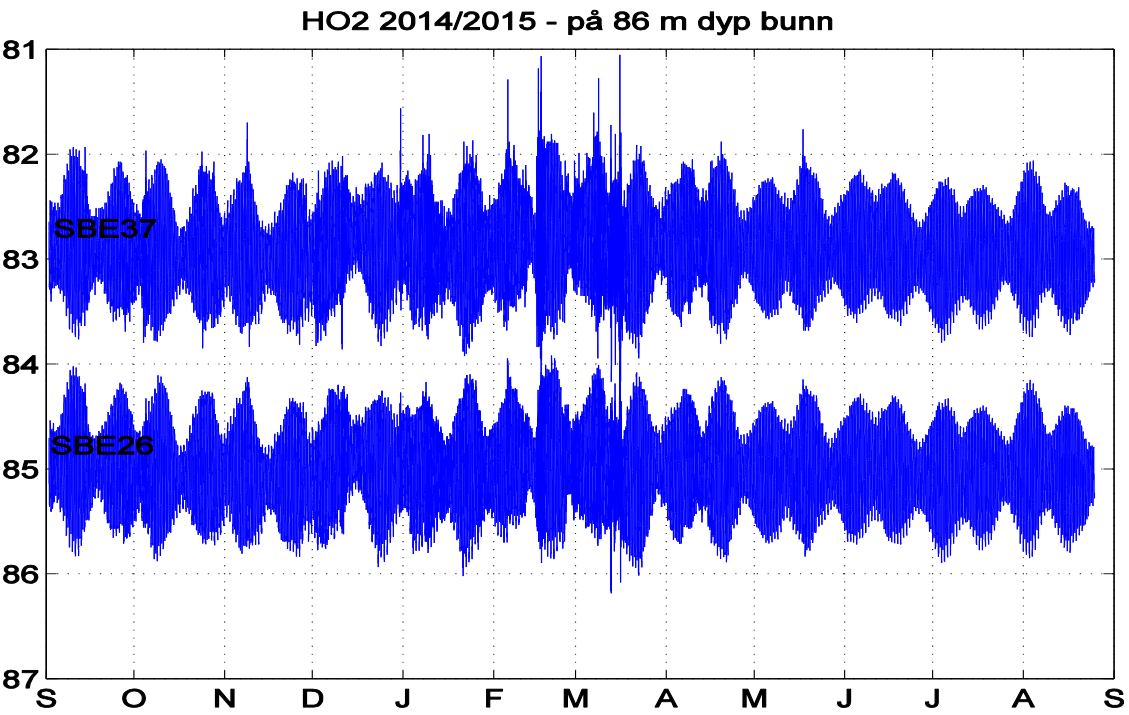
37
38
S O N D J F M A M J J A S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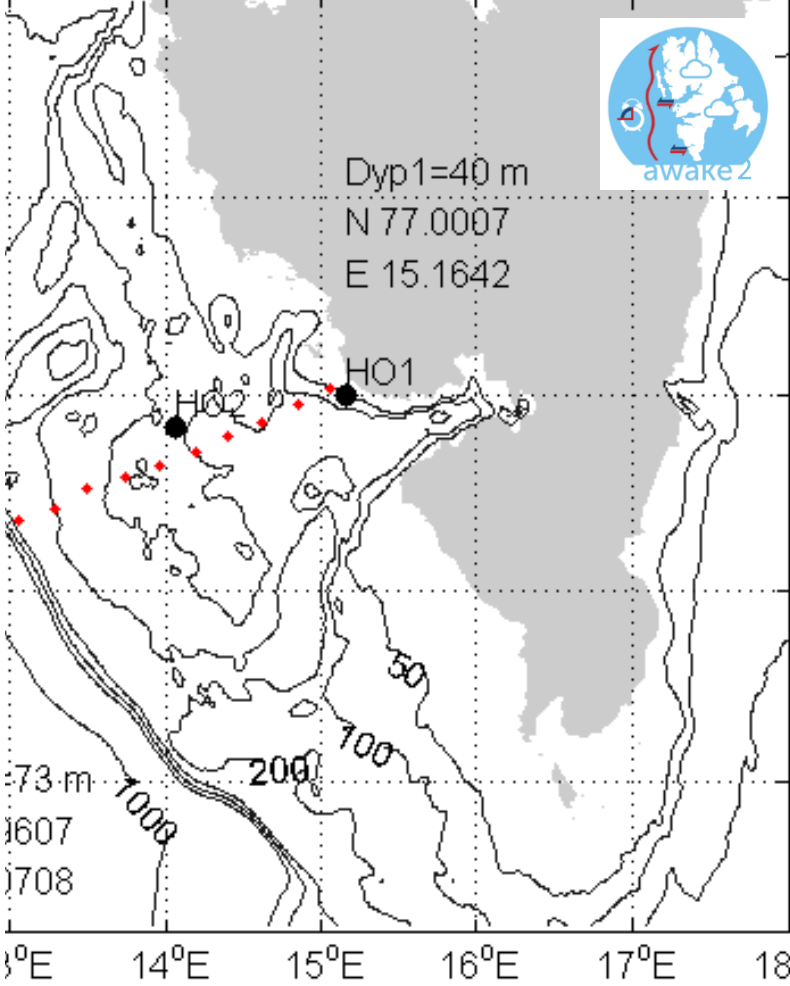
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E 15.1642
HO1
HO2
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100
200
1000
14°E
15°E
16°E
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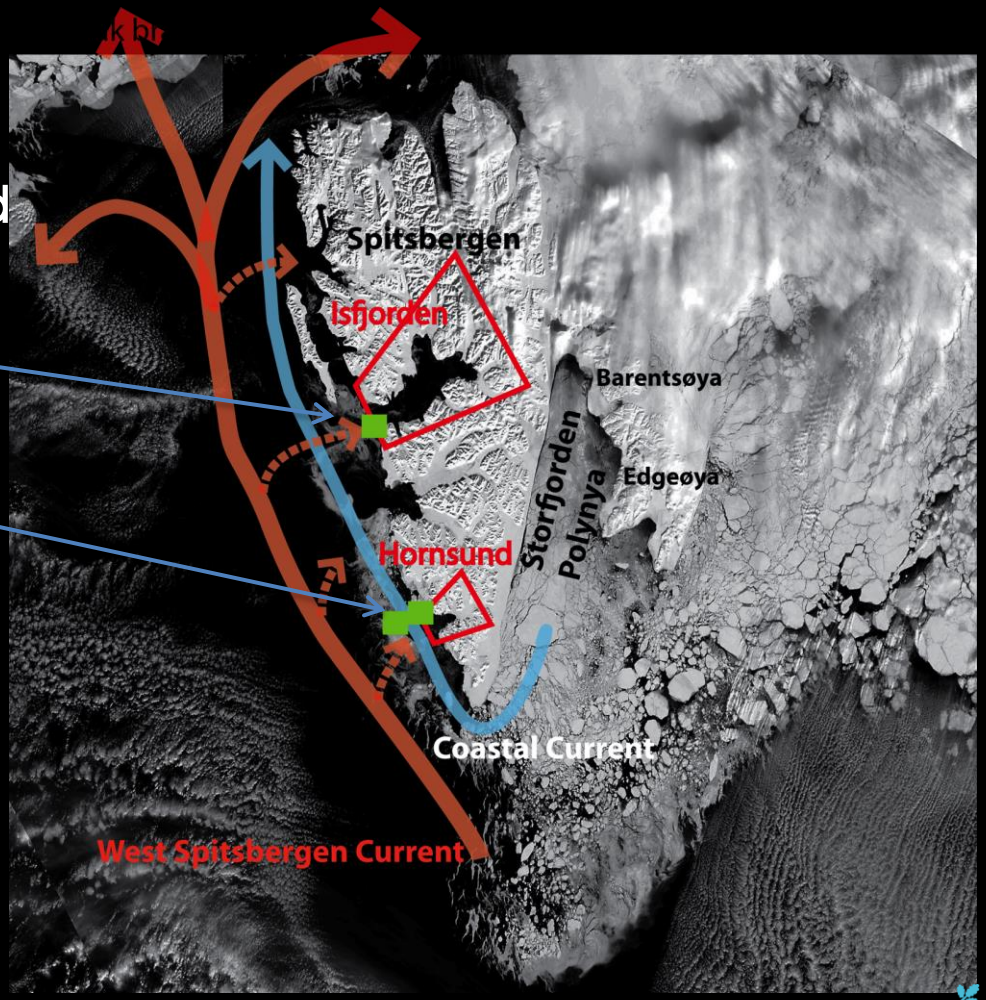
UNIS

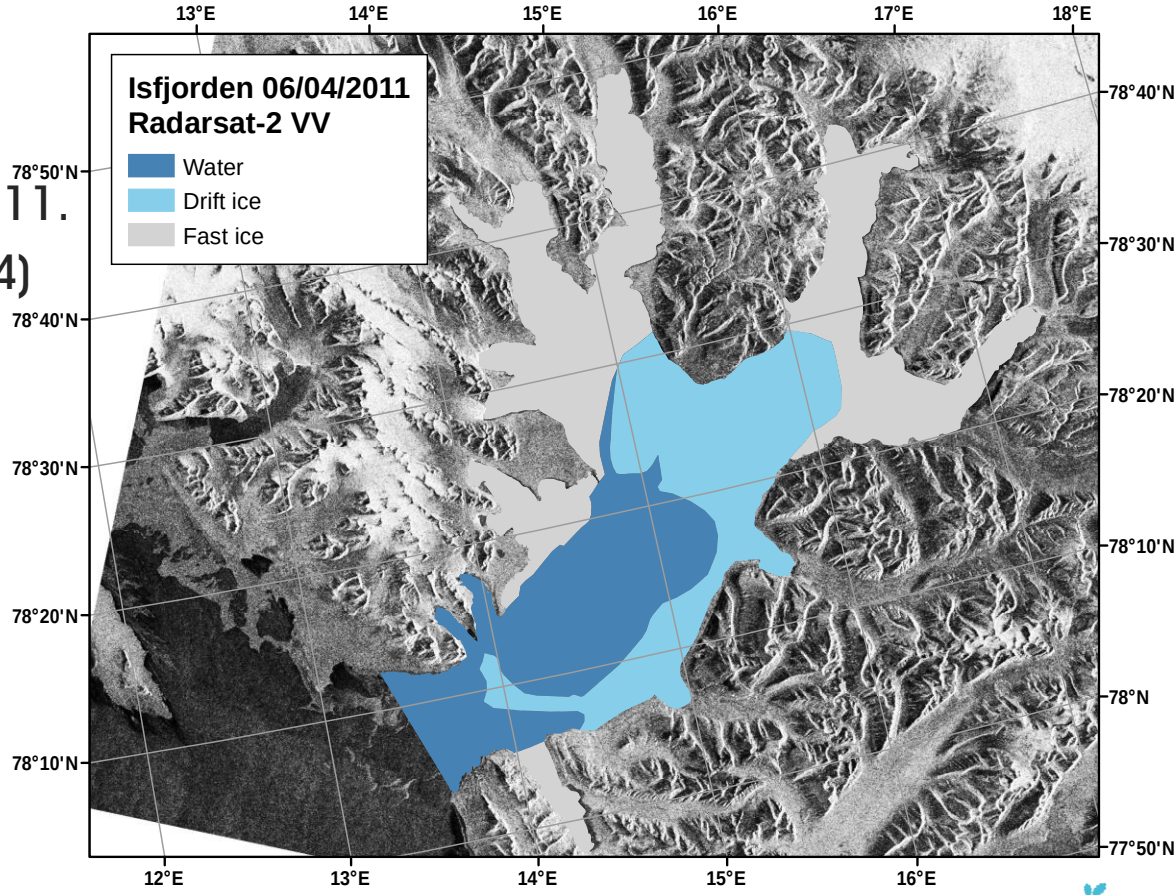
Monitoring Atlantic and Arctic Water circulation

- Atlantic water inflow to Hornsund Isfjorden
- Coastal Current and freshwater fluxes
- Sea ice monitoring of Isfjorden and Hornsund



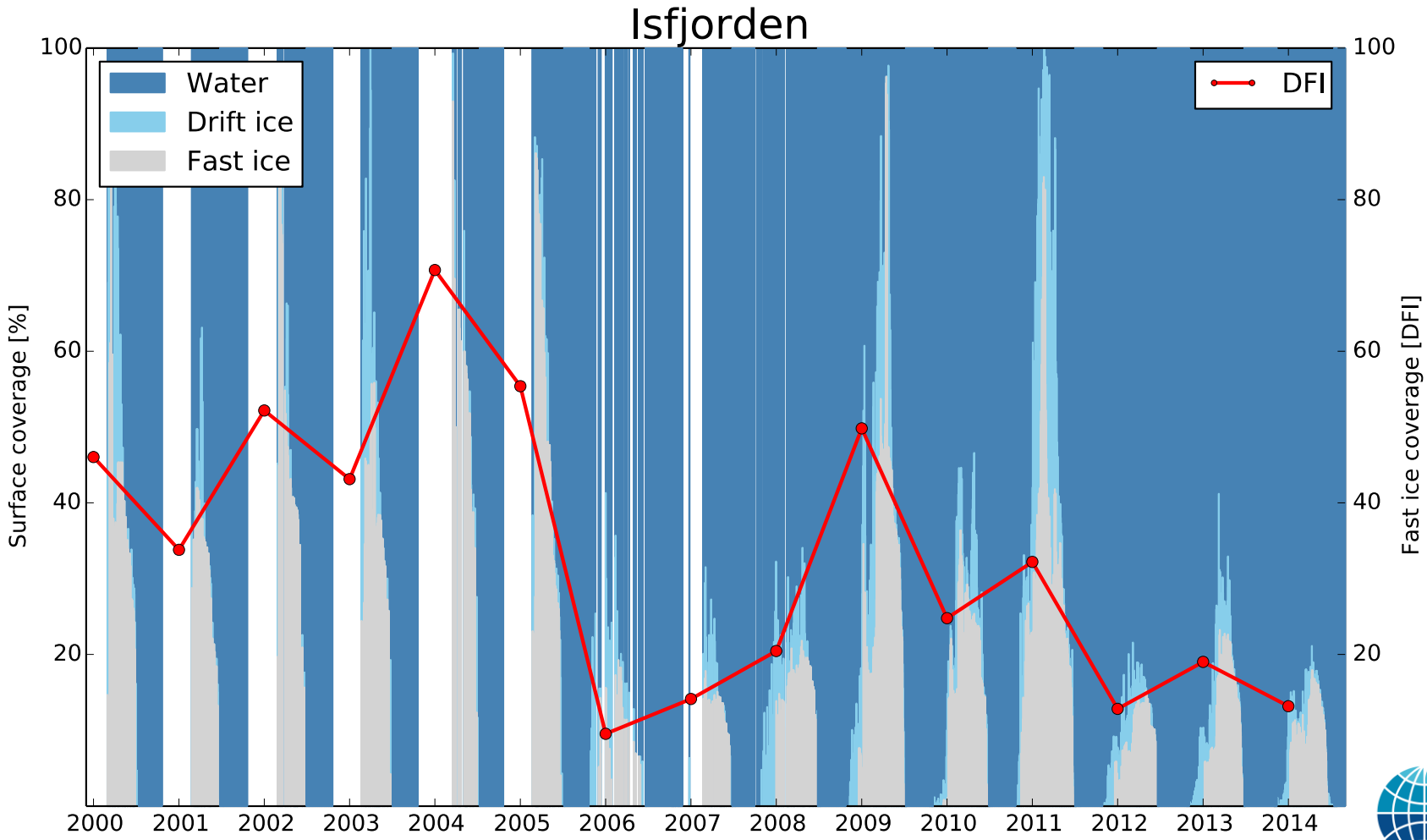
Sea ice cover in Isfjorden and Hornsund

- Radarsat-2 image April 6th 2011.
- Sea ice time series (2000-2014) from remote sensing.
- Sea ice classification in Fast ice and Drift ice.



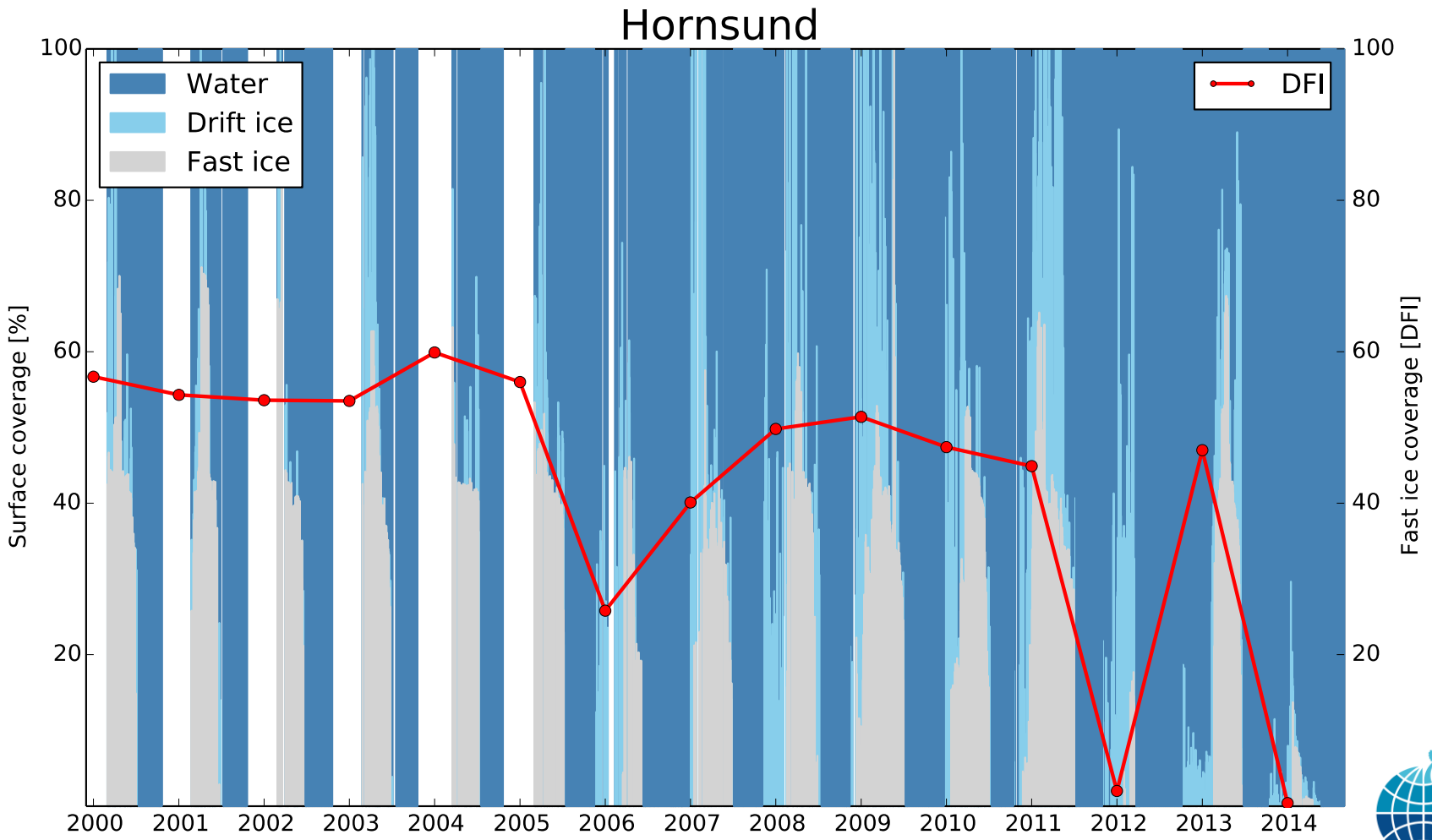
Muckenhuber et al. (2015), TCD

Sea ice coverage of Isfjorden 2000-2014



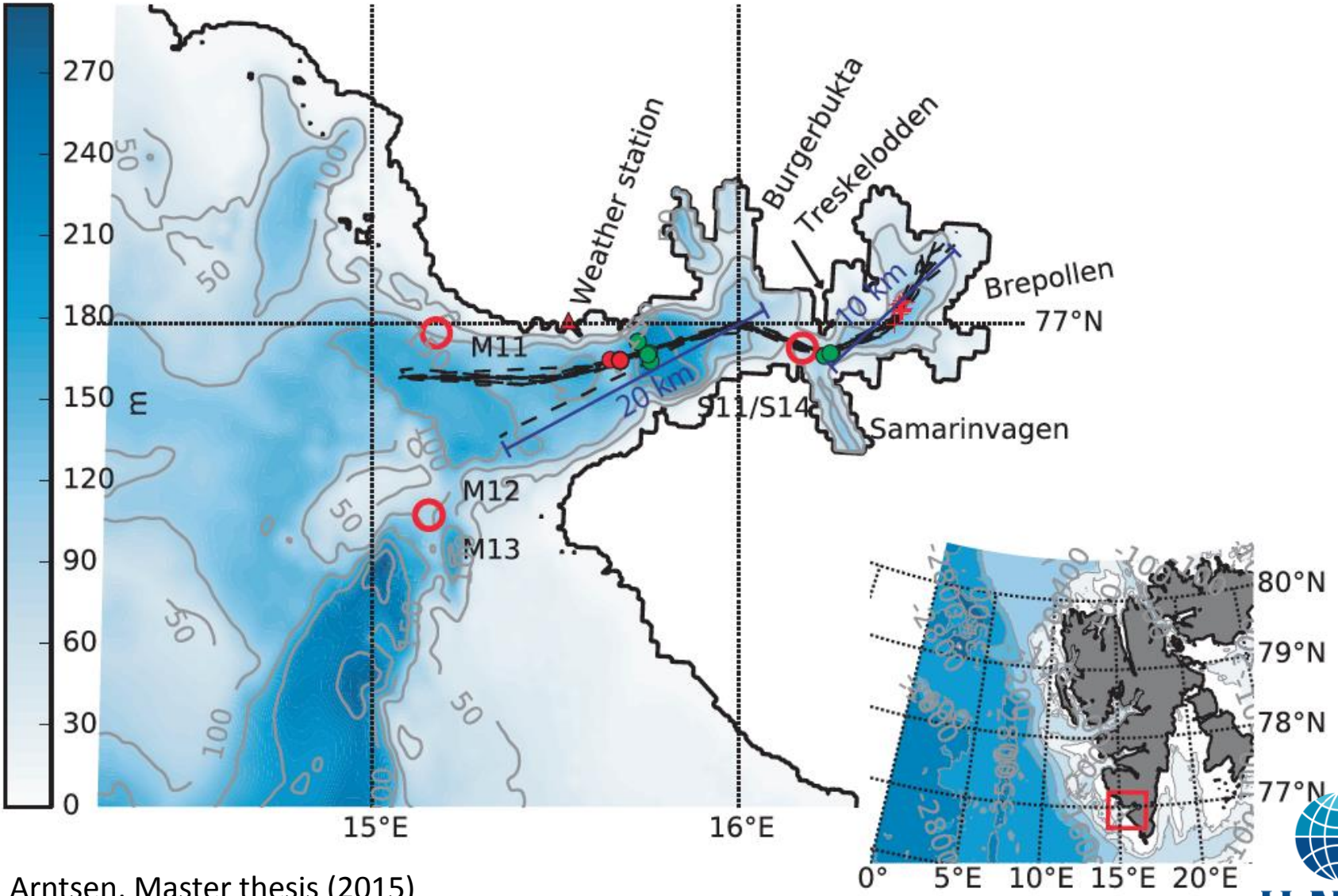
Muckenhuber et al. (2015), TCD

Sea ice coverage of Hornsund 2000-2014



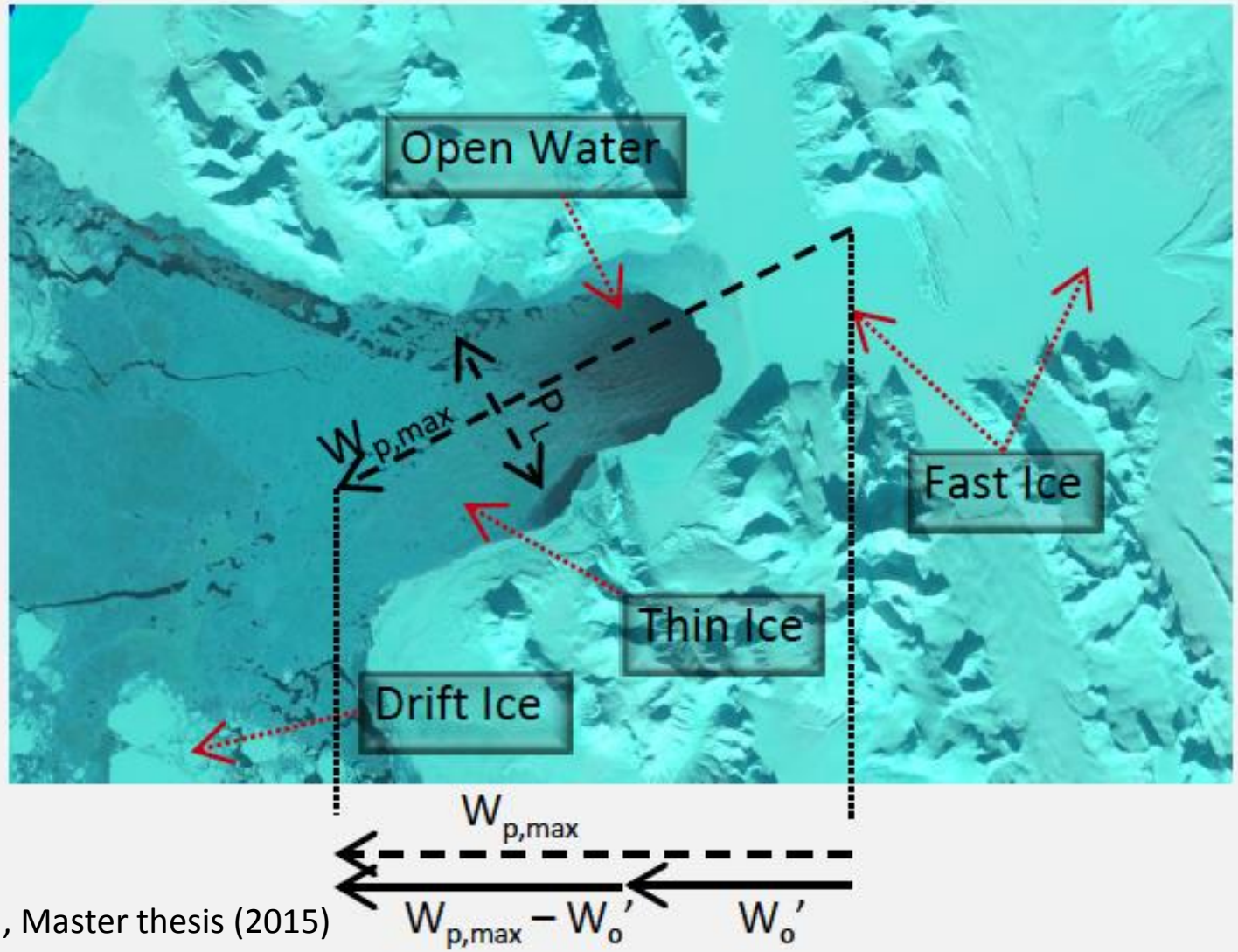
Muckenhuber et al. (2015), TCD

The Hornsund Polynya (T4.3)



Martin Arntsen, Master thesis (2015)

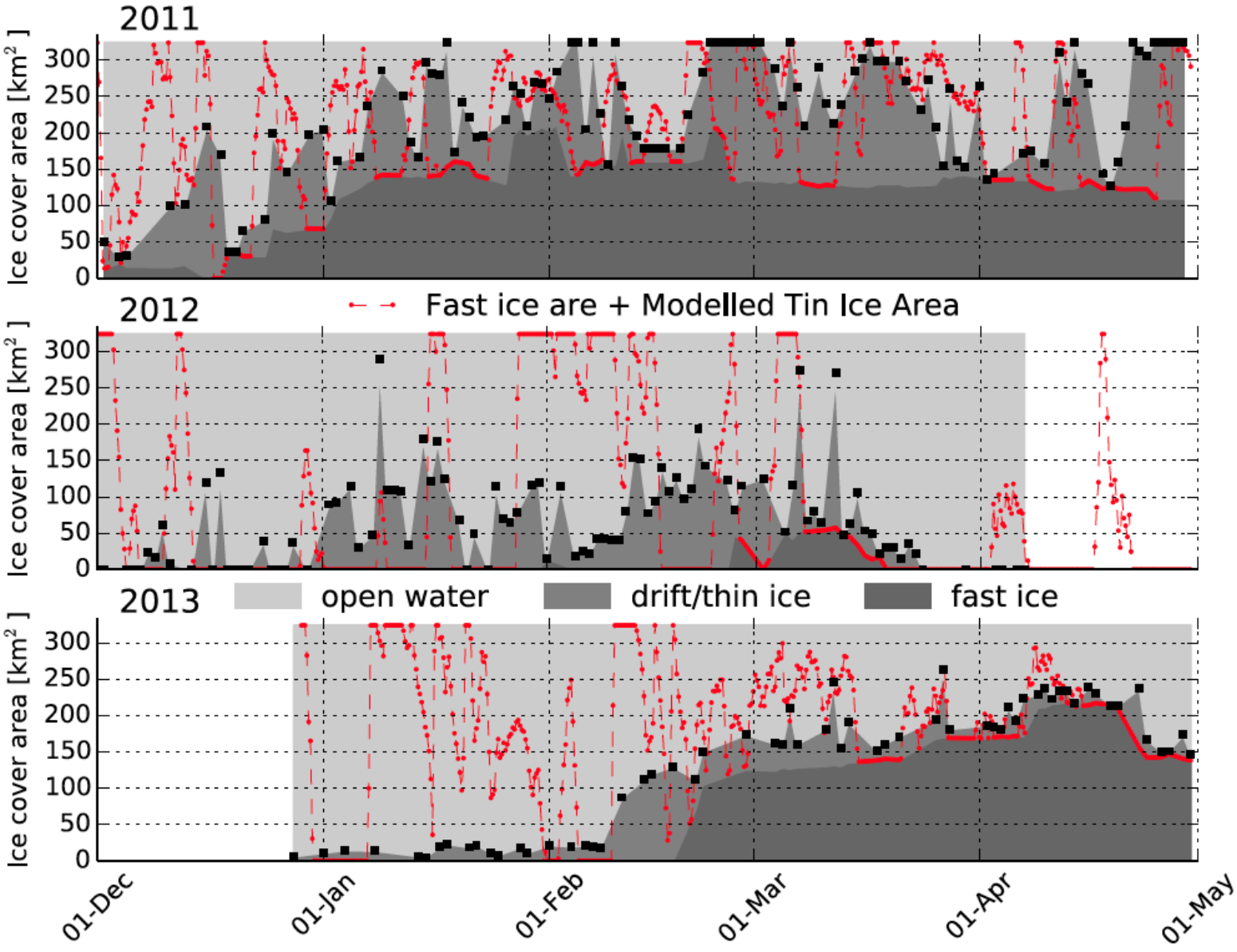
The Hornsund Polynya



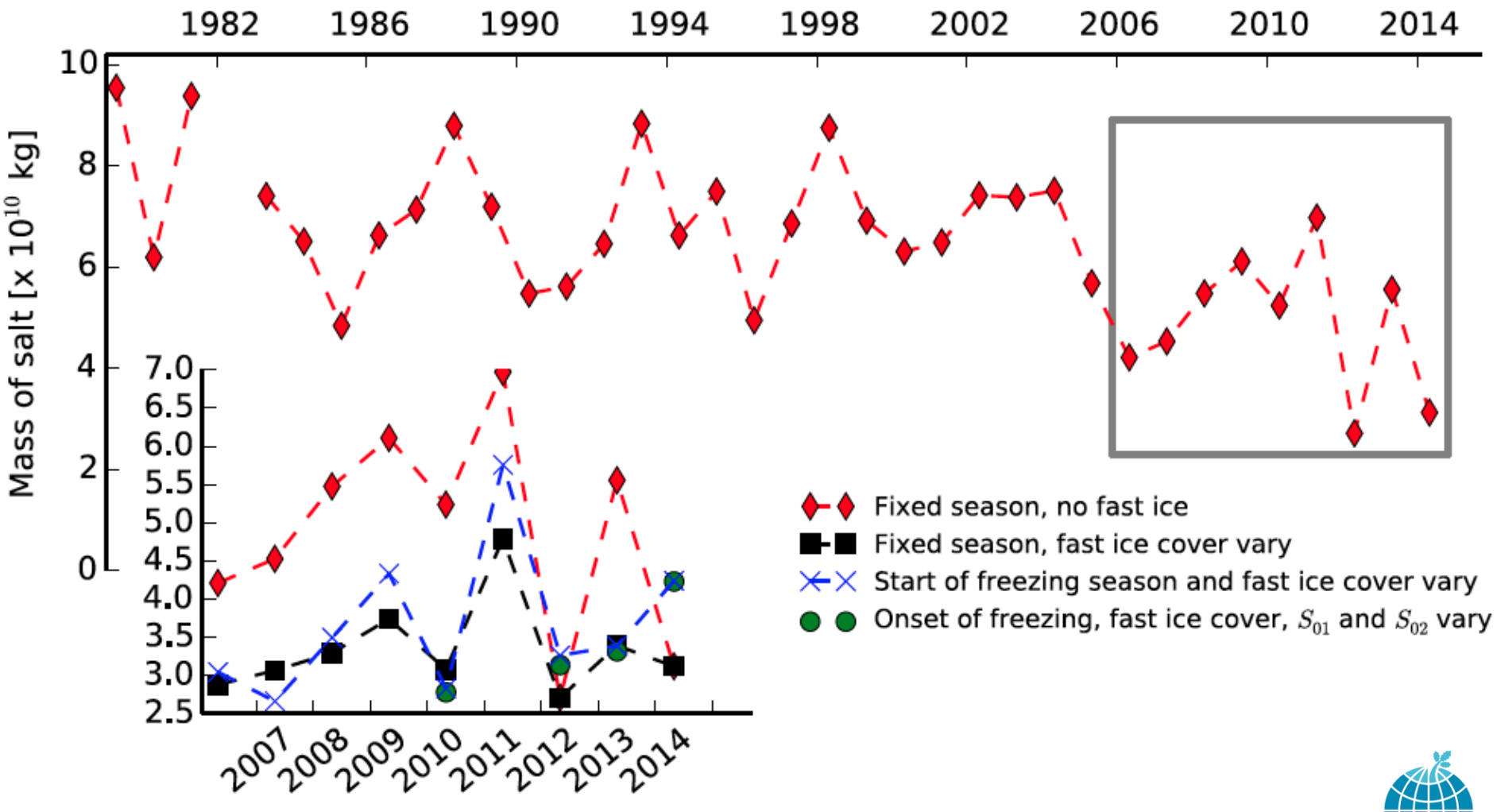
Martin Arntsen, Master thesis (2015)

Year	$\bar{\Theta}_{day}$ day C°	# of days below T_{freeze}	$\bar{U}_{\phi_0}$ m/s	$\bar{F}_{net}$ W/m^2	AST [$\times 10^9$kg]	Fast Ice	TIA km^2	Obs. Drift km^2	DFI
2014	5.9	98	4.2	56.0	30	30	40	8.7	2.5
2013	9.4	103	5.0	164.4	55	33	37	31.9	49.9
2012	5.0	102	3.9	38.3	26	26	35	60.3	2.5
2011	8.8	128	5.0	158.6	68	47	50	101.4	76.1
2010	7.6	114	5.2	115.4	51	30	35	60.1	53.6
2009	9.3	123	4.2	146.4	60	36	50	89.5	71.4
2008	7.6	129	4.1	121.5	53	32	50	88.9	54.2
2007	6.1	125	4.5	93.1	44	30	36	97.9	51.1
2006	7.2	84	4.1	71.7	41	28	43	81.9	28.8
2005	7.6	115	5.2	120.9	55		42		
2004	10.6	124	5.5	193.8	74		52		
2003	11.1	129	3.7	187.3	73		67		
2002	9.9	123	4.9	183.6	73		55		
2001	8.8	132	4.3	157.6	64		51		
2000	9.2	132	5.8	150.3	62		39		
1999	7.8	134	6.3	157.3	68		36		
1998	11.0	136	5.9	232.4	86		47		
1997	11.2	143	4.1	202.4	68		67		
1996	10.2	118	1.7	141.3	49		76		
1995	9.5	129	6.1	176.7	73		40		
1994	9.1	127	5.6	163.0	65		44		
1993	11.3	140	4.6	230.9	87		58		
1992	9.2	133	4.9	166.5	64		50		
1991	8.3	119	3.4	130.3	55		56		
1990	9.0	117	4.9	127.3	54		44		
1989	12.7	135	3.8	208.3	72		67		
1988	12.6	143	4.7	243.0	87		64		
1987	10.6	125	3.9	182.1	70		60		
1986	11.3	133	3.3	179.1	65		70		
1985	8.5	115	2.8	111.6	48		61		
1984	9.4	128	4.2	163.0	64		58		
1983	9.8	131	4.8	180.3	72		51		
1981	13.1	144	5.5	258.6	93		54		
1980	10.5	129	3.7	156.6	61		63		
1979	12.9	140	5.0	258.1	94		64		
Sum ± std	9.5±1.9	125.1±13.1	4.5±1.0	160±51	63±15	47±12	52±11	68±29	43.3±25.2

Ice observations and modeled thin ice cover

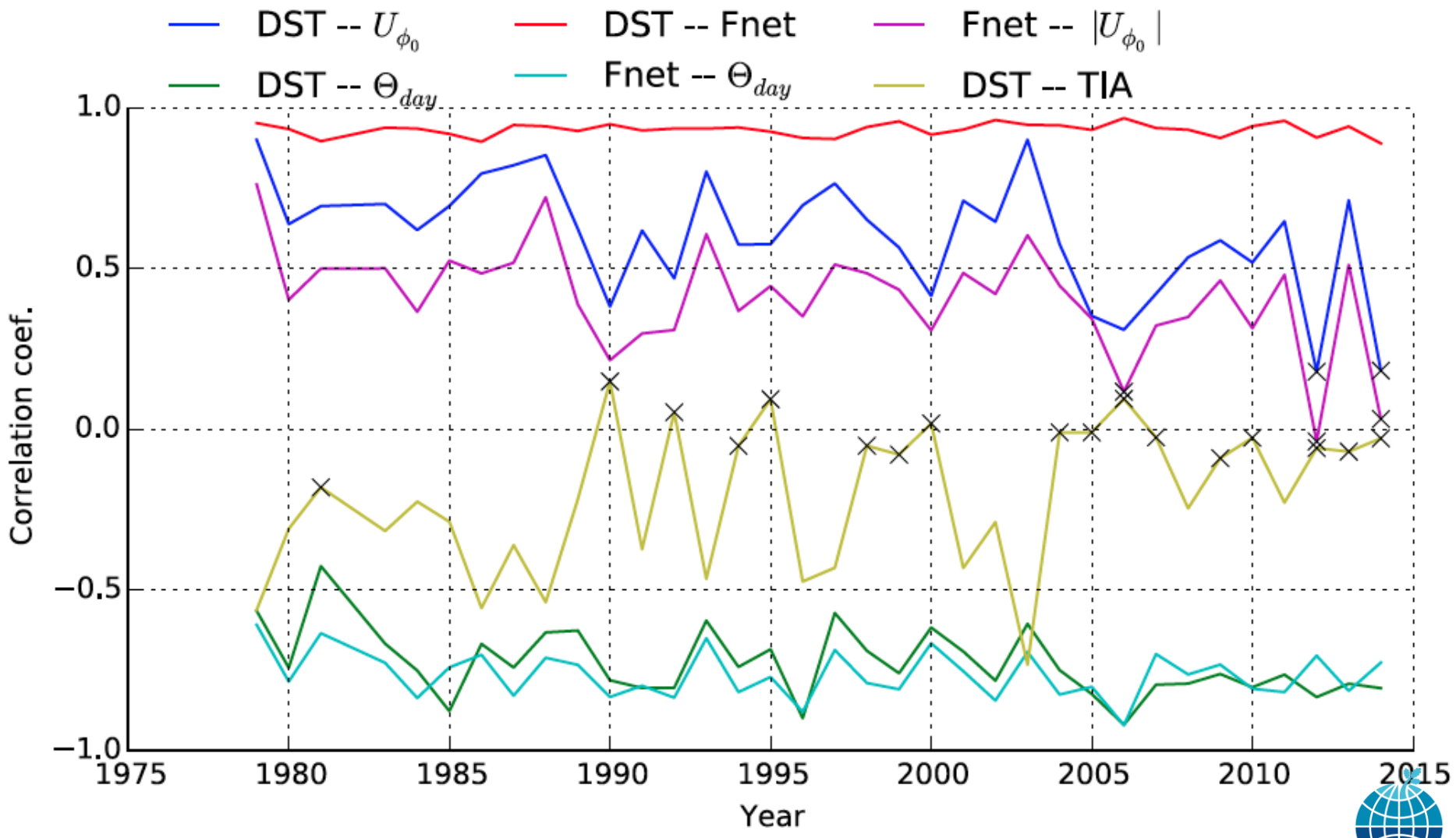


Yearly salt release



Martin Arntsen, Master thesis (2015)

Model results and major forcing parameters



Martin Arntsen, Master thesis (2015)

Air-ice-sea interactions study summary

- Overall the meteorological forcing that governs sea ice production in the fjord has been identified, and hydrographic observations confirm increased salinities for some years with large sea ice production.
- A shift in general conditions for the fjord seems to have occurred in recent years.
- We have shown the importance of including the fast ice cover in the salt release calculations, as years of high fast ice coverage corresponds to years with high salt release. Including the fast ice cover then reduces the relative differences in salt production between the years.

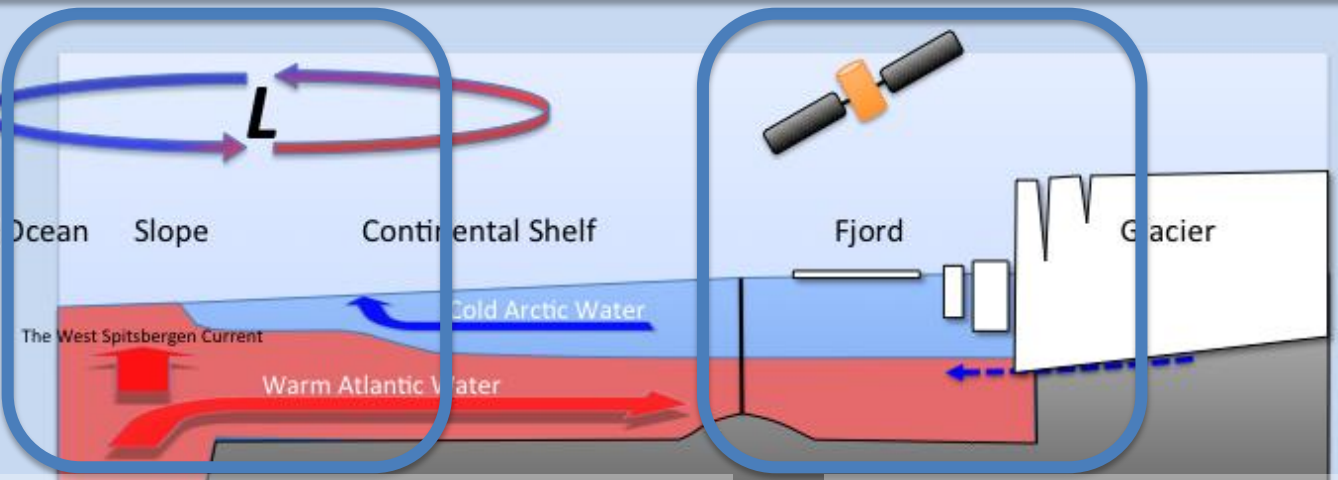
Air-ice-sea interactions study summary

- The salt release is very well correlated with the total net heat flux $F_{net.}$.
- This give rise to a different year to year variability for salt production in Hornsund compared to similar studies in Isfjorden and Storfjorden (Nilsen et al., 2008; Skogseth et al., 2004).

WP 4 Deliverables

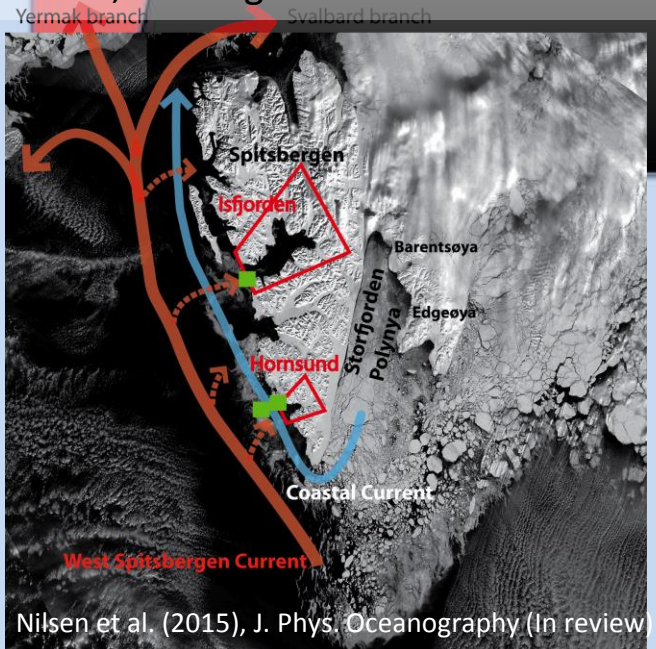
- D4.1: Sea ice database for 2000-2016 (12)
- D4.2: Sea ice area time series (2000-2016) for fjord systems, sea ice type (thickness) classification and ice drift (24)
- D4.3: A time series (2000-2016) of sea ice and dense-water production in Spitsbergen fjords (36)
- D4.4: A qualitative description of the causal relation between sea ice cover, atmosphere and ocean temperature and wind forcing (36)

Interaction and interdisciplinary studies

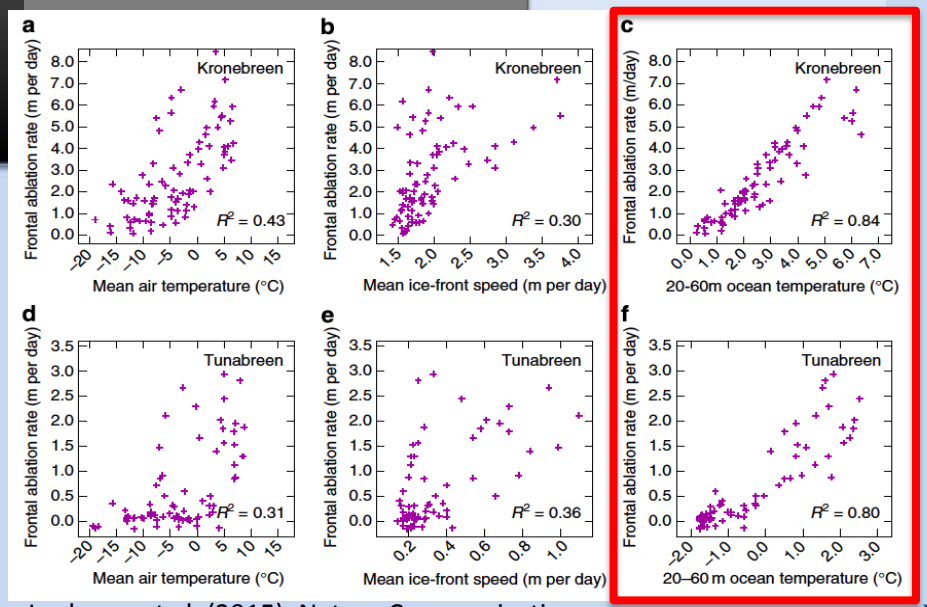


Warm Atlantic Water transport towards the Arctic and flooding of the Arctic shelves, melting sea ice in the Arctic.

Deep fjord temperatures control calving rates at tidewater glaciers. Combining glacier- and ocean dynamics with remote sensed data.



Nilsen et al. (2015), J. Phys. Oceanography (In review)



Luckman et al. (2015), Nature Communication

Thank you for your attention!