ships4sst

shipborne radiometers for sea surface temperature

High latitude Radiometer activities at DMI

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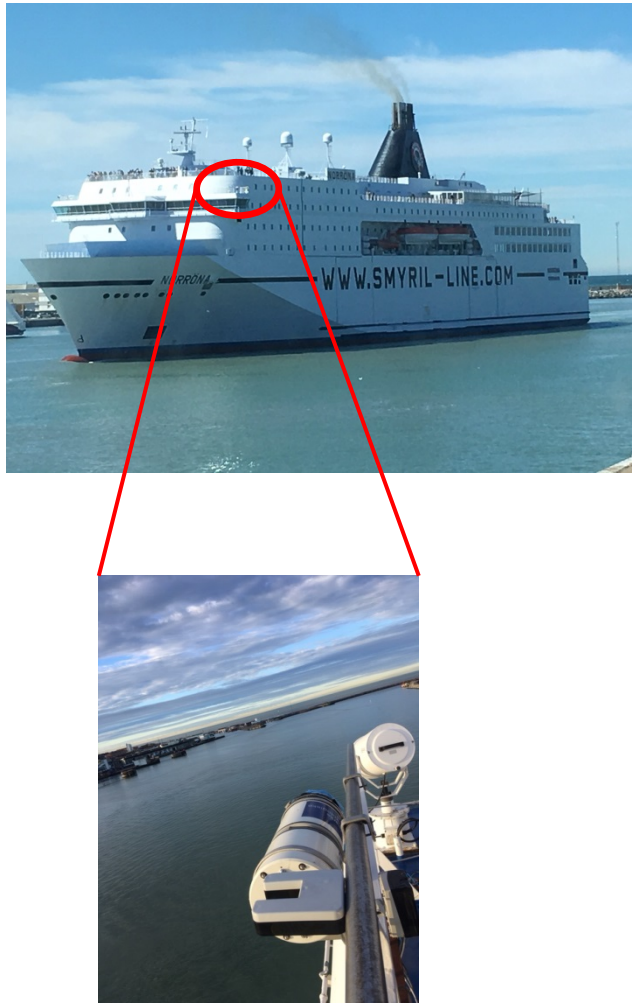
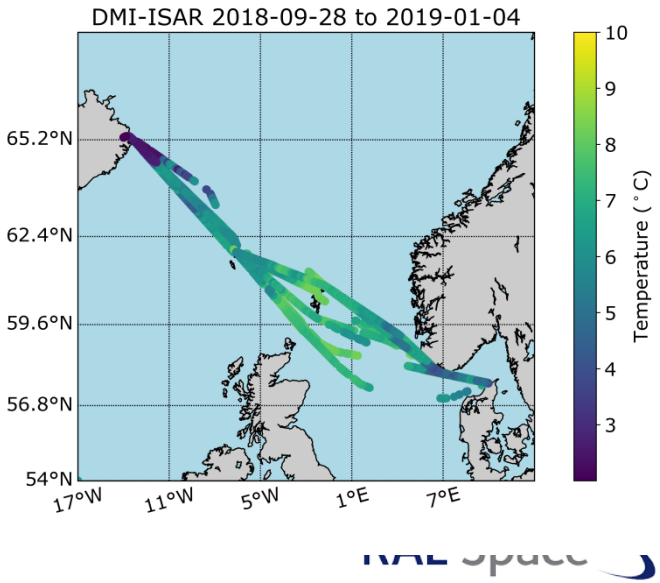
Outline

- DMI routine deployments
  - Data coverage
  - Performance and calibration
- Spatial SST variability using thermal 2-D camera
- IR and MW radiometer intercomparisons
- IST radiometer campaigns
- Future work

Routine Deployments

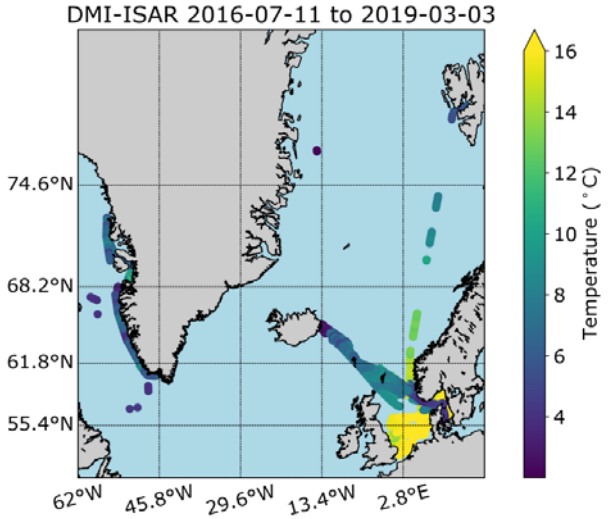
- DMI ISAR installed on Smyril line ferry Norrøna, December 2017
- Incidence angle: 25 degrees
- Routine operations between Denmark, Faroes and Iceland
- Round time: 1 week
- Year round service
- Servicing and calibration: every 2-3 months



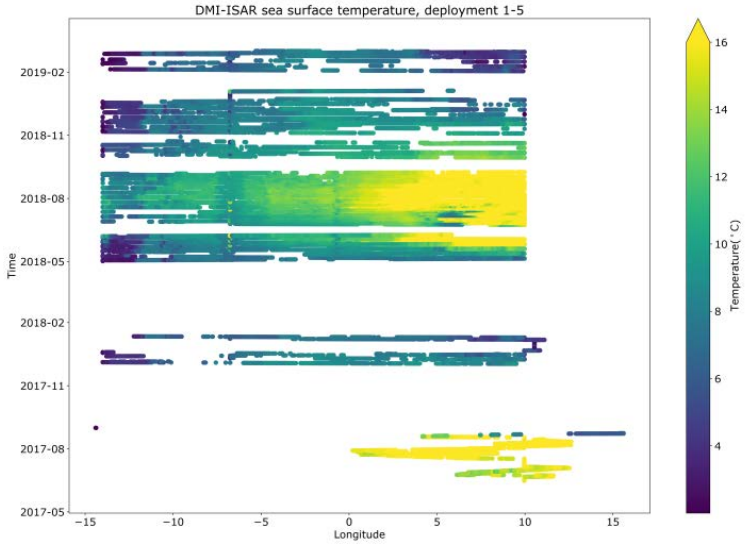


Processing and Deployments

- All data available from SHIPS4SST

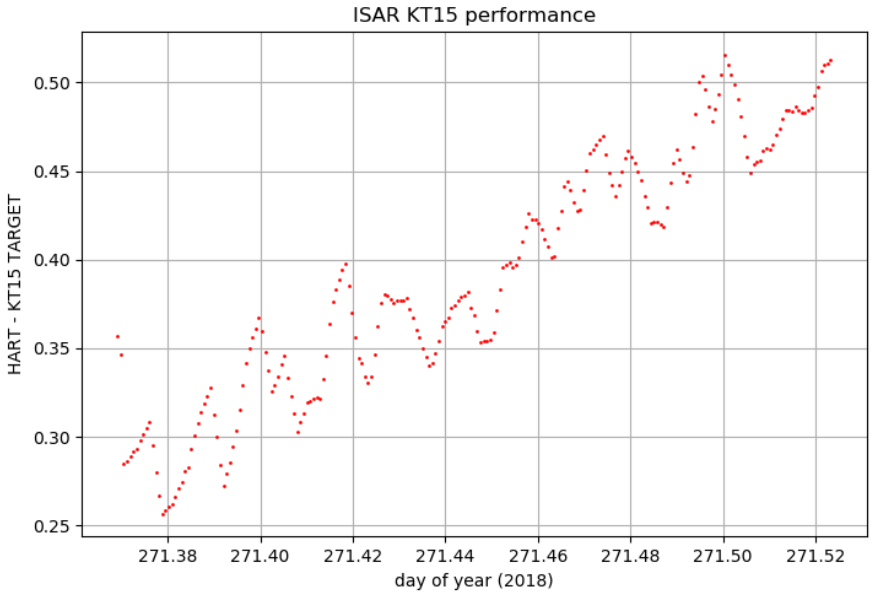


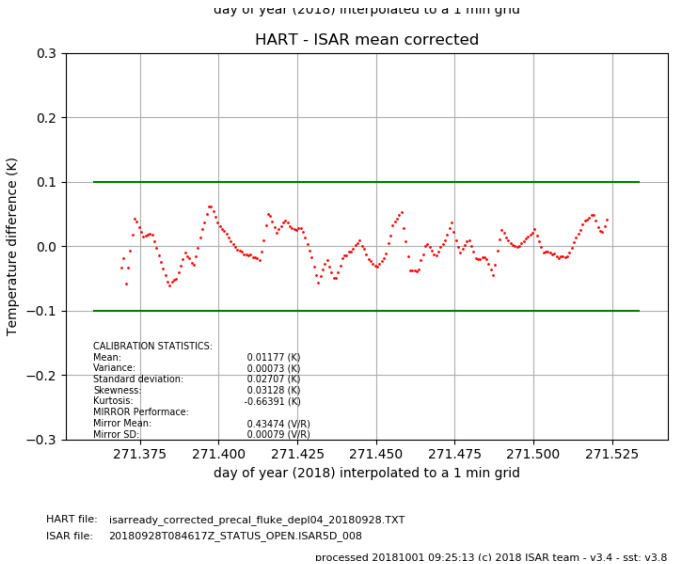
Deployment	Ship	ISAR	Start	End	Days
1	Norrøna	8	02-12-2017	31-03-2018	119
2	Norrøna	8	21-04-2018	09-06-2018	49
3	Norrøna	8	23-06-2018	08-09-2018	78
4	Norrøna	8	29-09-2018	05-01-2019	99
5	Norrøna	8	02-02-2019	30-03-2019	57
6	Norrøna	8	27-04-2019	10-07-2019	75
7	Norrøna	8	23-07-2019	12-10-2019	82
8	Norrøna	8	09-11-2019	18-01-2020	71
9	Norrøna	8	07-02-2020	23-05-2020	107
10	Norrøna	8	06-06-2020	05-09-2020	92

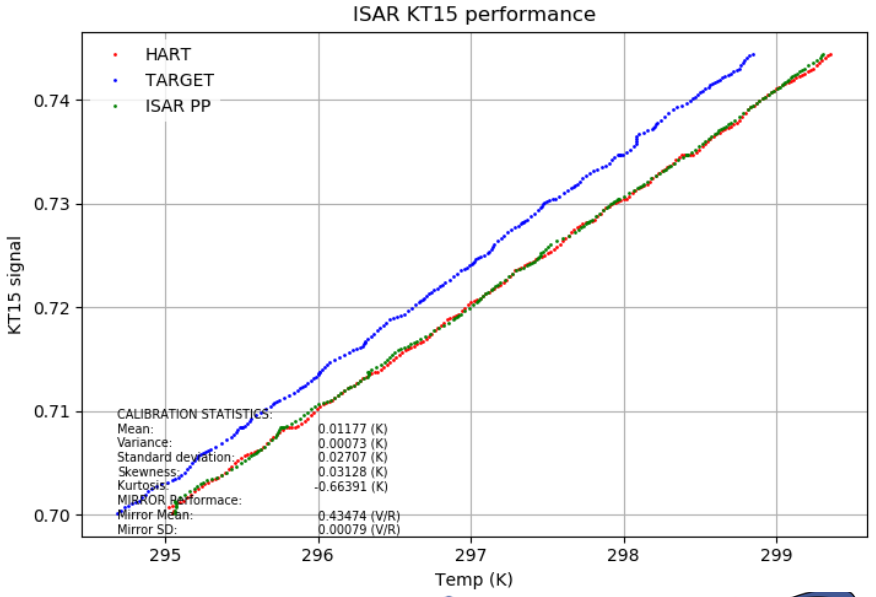


Routine Calibration

- Pre and Post deployment calibration
- Internal calibration targets
- Can correct several degrees
  - Largest correction when mirror is dirty







Spatial SST variability

- Use Thermal Camera to assess spatial variability of SST

Measurement program:

- Measure the SST field around the ISAR for 10 minutes, during clear sky and cloudy conditions
- Measure the SST field in other locations around the ship with broken water.
- Assess SST variability (spatial and temporal) for the measurement lokations.

- Thermal camera: Zenmuse XT2, (8-14μm), 17x13^{o} aperture, 0,05 accuracy, 9 FPS.

MW and IR radiometer intercomparison

- IR and MW measure fundamentally different temperatures (Skin vs. subskin)
- Different error characteristics
- Simultaneous deployment of MW and IR radiometers can link IR and MW observations
- Important for existing CDRs and for homogenisation of future reference missions (e.g. SLSTR vs CIMR)
- Special focus upon cold waters

MW + IR plans within Ships4SST

- Refurbish DTU MW radiometer
  - C and X-Band
  - Internal calibration targets
  - Performance < 0.1 K for 1 sec integration.
- Calibrate and characterize MW radiometers
- Perform a static deployment, MW + IR for a test site
- Update the FRM procedures and protocols to include the MW radiometer component
- Provide recommendations to constructions of future MW radiometer
- Next year (pending funding)
  - Deploy MW + IR radiometers on Norrøna from Hirtshals to Iceland

fiducial reference temperature measurements

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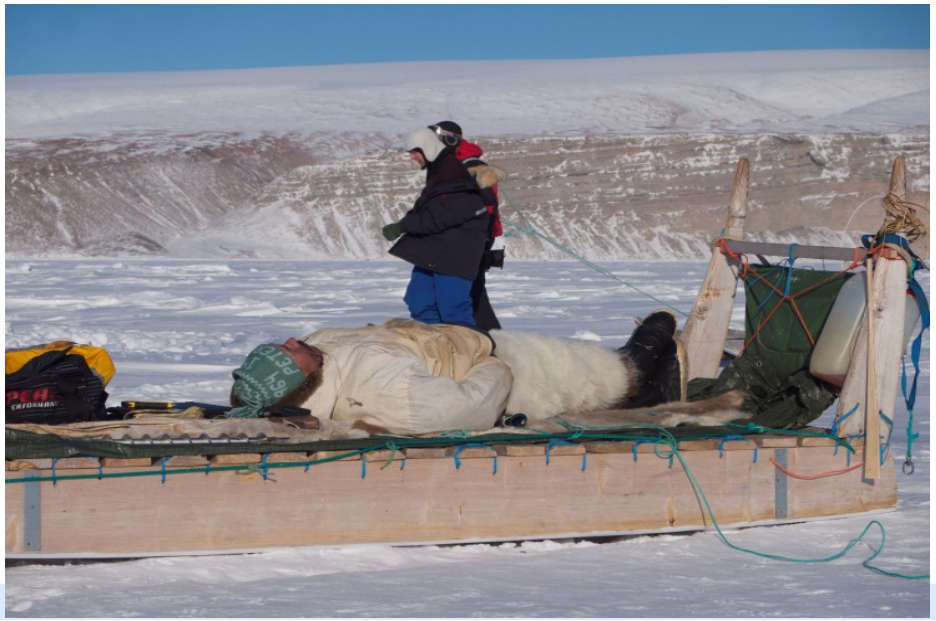
Ice radiometer inter-comparison



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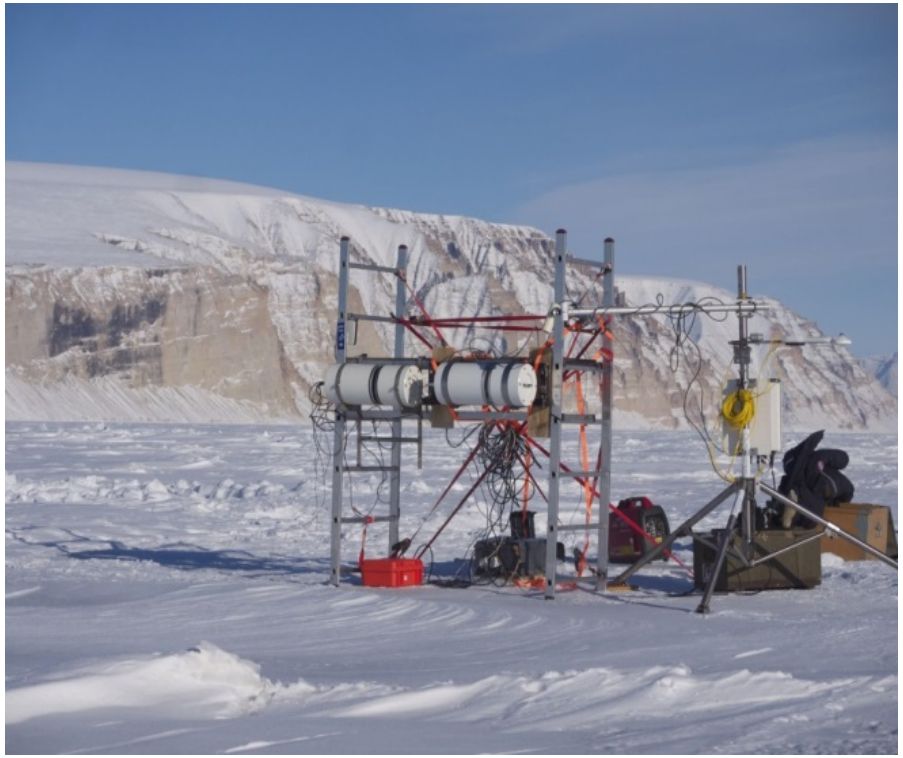
Space ConneXions

IST FICE

- FRM4STS Field campaign:
- Successfull campaign conducted with 3 research teams and 6 TIR radiometers
- All instruments mounted on sea ice for intercomparisons
- Other instruments:
  - Automatic Weather stations
  - Ice Mass balance buoys
  - Ocean buoys (T,S, Currents)
- Additional experiments:
  - Freeze up experiment
  - Angular emissivity experiment



Results in: *Høyer et al., 2017*

Future plans

- Continue operational deployments on Norrøna
- 2 more ISARs expected within a month
  - Minimize gaps in Norrøna record
  - Spare ISAR for campaigns
- Conduct MW + IR ship inter-comparison (if funded)
- Conduct basic ice campaign (March 2020)
- Calibrate Thermal IR camera and use UAV for spatial temperature variability assessments