

NYTEFOX 2020 documentation



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Setup (78.9°N, 11.9 °E)

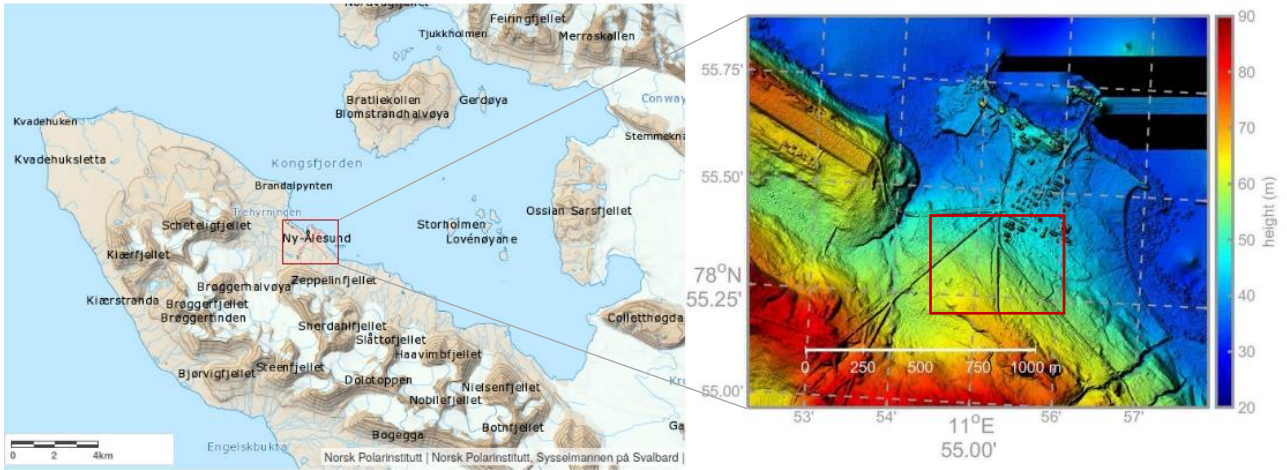


Figure 1. Left: Location Ny-Ålesund in the Kongsfjord from toposvalbard.npolar.no. Right: visualization of a digital elevation model published by Boike et al. (2018) around the location of the setup. The red frame marks the margins of Figure 2.



Figure 2. Setup south of Ny-Ålesund. The labels are the section names of the fiber optic Array (see *File overview*). The letters a-i mark crucial points with their coordinates listed in table 1. The map source is Svalbardkartet (geokart.npolar.no/Html5Viewer/index.html?viewer=Svalbardkartet).

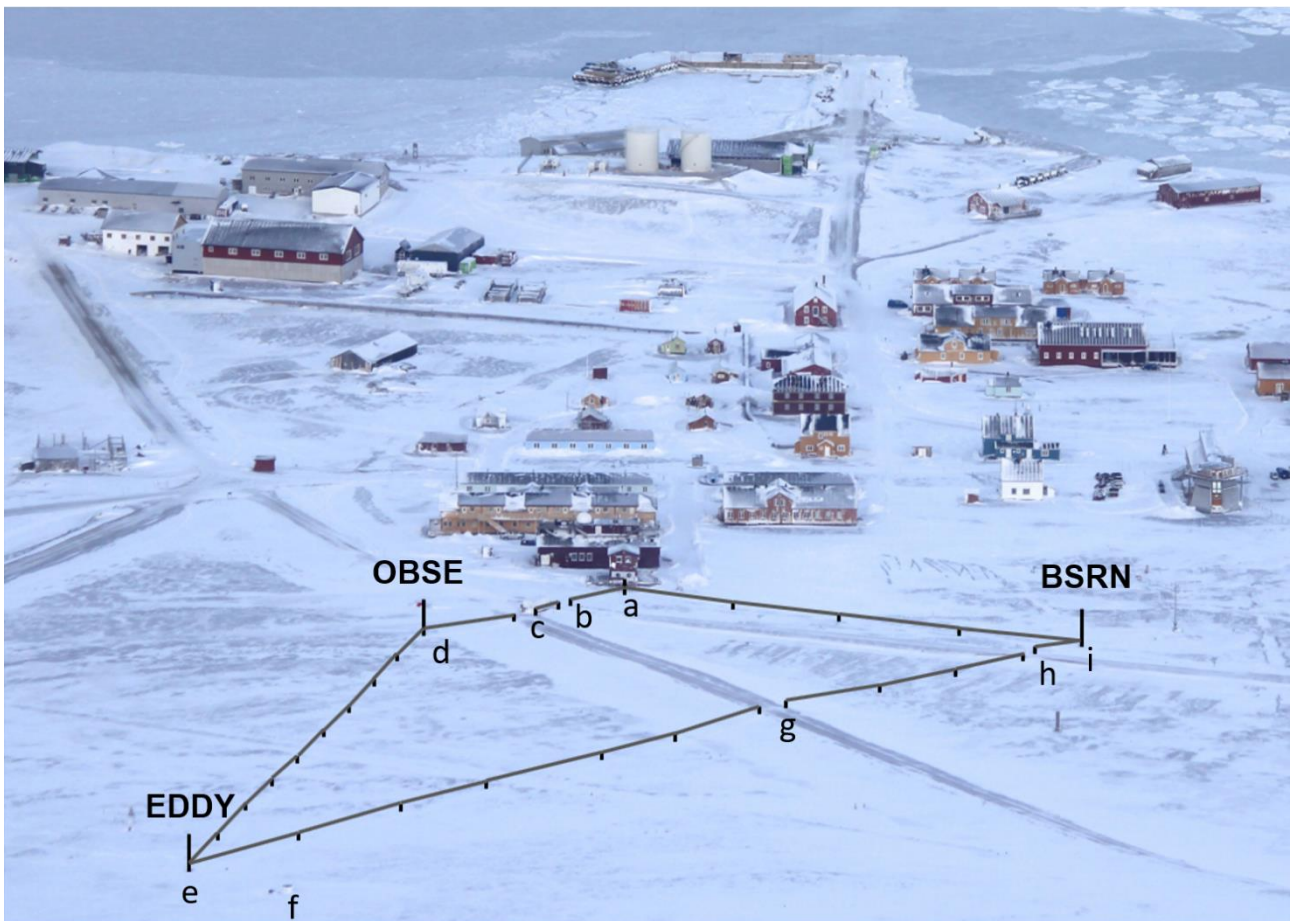
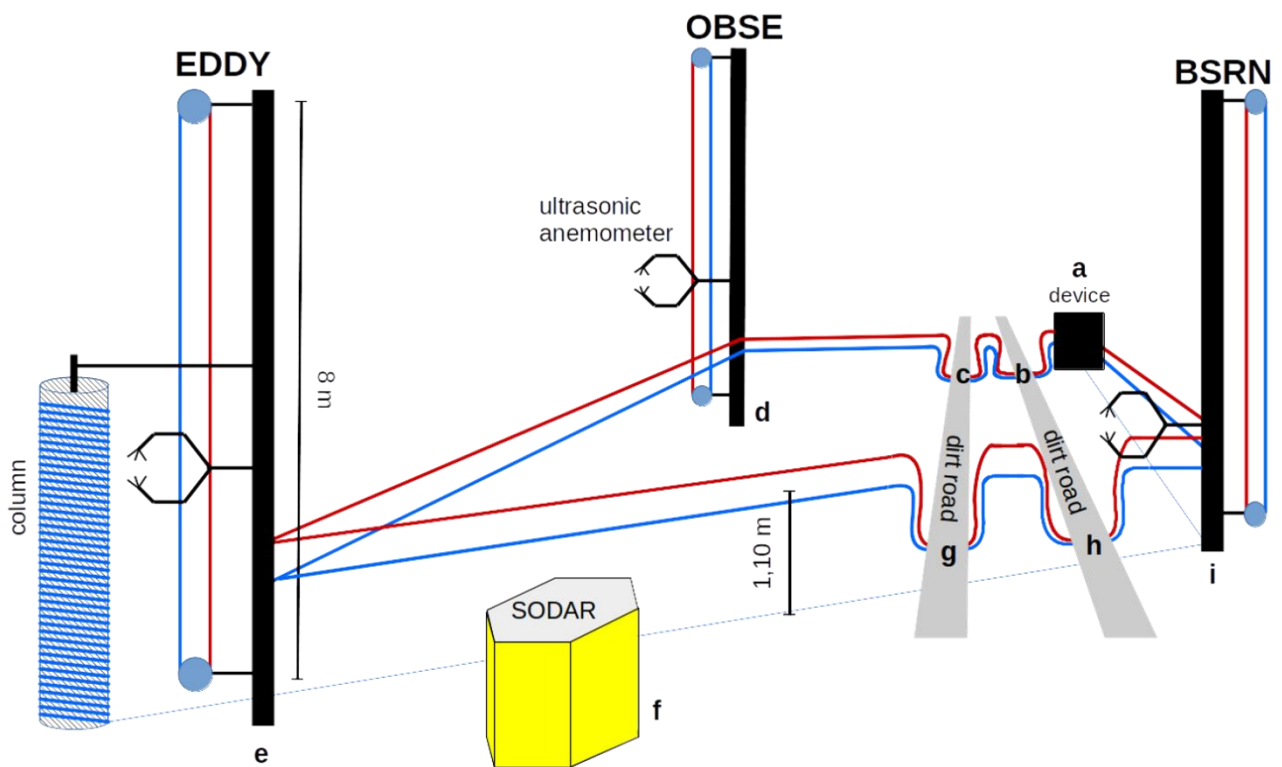


Figure 3. Schematic setup and picture of the setup from the Zeppelin mountain from south. The fiber-optic array has a length of 700 m. The coordinates of the characteristic points a-i of the schematic setup can be found in the Table 1. Photo credit: Harald Sodemann (UBergen, Norway).

Table 1. Setup locations, referenced in Figure 2 and 3, with corresponding coordinates. The uncertainty of the coordinates amounts 4 m.

location name	location on map	latitude (°)	longitude (°)
Device in Ballon House	a	78.92310	11.91811
Crossing 1	b	78.92280	11.92122
Crossing 2	c	78.92273	11.92063
OBSE tower	d	78.92266	11.91936
EDDY tower	e	78.92098	11.91382
miniSODAR	f	78.92082	11.91415
Crossing 3	g	78.92171	11.92090
Crossing 4	h	78.92207	11.92440
BSRN tower	i	78.92214	11.92508

File overview

- Fiber Optic Distributed Sensing (FODS) data, all data were processed using the pyfocs library (Lapo & Freundorfer, 2020):
 - Horizontal and vertical fiber optic temperature measurements of unheated and heated fiber optic cables with a resolution of 0.127 m and 9 s
 - NF_steel_[yyyymmdd]_cold.nc (unheated measurements)
 - NF_steel_[yyyymmdd]_warm.nc (heated measurements)
 - daily netcdf files, containing the following variables:

variable	Explanation	unit	dimension
LAF	Length along the fiber	m	xyz
x	Easting in UTM 33X	m	xyz
y	Northing in UTM 33X	m	xyz
z	Height above surface	m	xyz
cold/warm	String with names of the various fiber sections (named 'cold' for unheated, 'warm' for heated fiber)	-	xyz
time	Start time of aggregation interval (UTC)	seconds since first reading of the file	time
cal_temp	Calibrated temperatures	°C	time, xyz

- Vertical high-resolution fiber optic temperature measurements from 0 to 2.5 m agl. with a temporal resolution of 9 s and a spatial resolution along the fiber of 0.25 m. Note that the effective vertical resolution ranges from 0.0025 to 0.02 m due to helically coil-wrapping the fiber optic cable (see Sigmund et al., 2017):
 - `NF_column.rar`
 - RAR-archive, containing 14 netcdf files of one day each
 - `NF_column_eddy_[yyyymmdd].nc`
variables: same as above

- Ultrasonic anemometers

- Turbulence measurements with ultrasonic anemometers, mounted at three towers (OBSE, EDDY, BSRN), raw (20 Hz) data were processed using the bmmflux software (see Thomas et al., 2009, Appendix for processing)
 - `NF_sonic_OBSE.rar`
 - `NF_sonic_EDDY.rar`
 - `NF_sonic_BSRN.rar`
 - mounting parameters:

	azimuth (°)	height (m)	distance from mast (m)
OBSE	203	1.48	0.77
EDDY	201	1.35	0.80
BSRN	208	1.50	0.91

- RAR-archives, containing ‘results’ and ‘qaqc’ files as CSV for two perturbation time scales (30 s and 2 min, example for OBSE tower):
 - `Nytefox2020_OBSE-EC_results_1p57m_30s_rot_frc.csv`
 - `Nytefox2020_OBSE-EC_qaqc_1p57m_30s_rot_frc.csv`
 - `Nytefox2020_OBSE-EC_results_1p57m_2min_rot_frc_tom.csv`
 - `Nytefox2020_OBSE-EC_qaqc_1p57m_2min_rot_frc_tom.csv`
 - third order moments are only computed for the 2 min perturbation time scale
 - a list of output statistics is given in:
`NF_sonic_output_explanation.pdf`

- miniSodar

- ground-based acoustic remote sensing measurements, using SOund Detection And Ranging (SODAR): vertical measurements of horizontal wind speed and direction, vertical velocity variance, backscatter intensity, and turbulence kinetic energy from 10 up to 300 m agl. with a resolution of 5 m vertically and averaged over 10 min.
 - `NF_miniSODAR.rar`
 - RAR-archive, containing daily netcdf files:
 - `NYTEFOX2020_MiniSodar_ProcessedData_[yyyy-mm-dd].nc`
 - azimuth: 356°

- variables:

variable	explanation	unit	aggregation	dimension
z	Center height of vertical gate	m agl.	5 m	height
SPD	Horizontal wind speed	m s ⁻¹	5 m and 10 min	time, height
DIR	Horizontal wind direction	°	5 m and 10 min	time, height
u	Meridional wind speed component (positive from West to East)	m s ⁻¹	5 m and 10 min	time, height
v	Zonal wind speed component (positive from South to North)	m s ⁻¹	5 m and 10 min	time, height
w	Vertical wind speed component (positive for updrafts, negative for downdrafts)	m s ⁻¹	5 m and 10 min	time, height
sigmaw	Standard deviation of the vertical wind speed component	m s ⁻¹	5 m and 10 min	time, height
r	Acoustic reflectivity (Raw Backscatter Intensity)	dB	5 m and 10 min	time, height
TKE	Turbulence Kinetic Energy	m ² s ⁻²	5 m and 10 min	time, height
time	Start time of aggregation intervals	Matlab serial format: days since Jan 00, 0000		time

Data availability

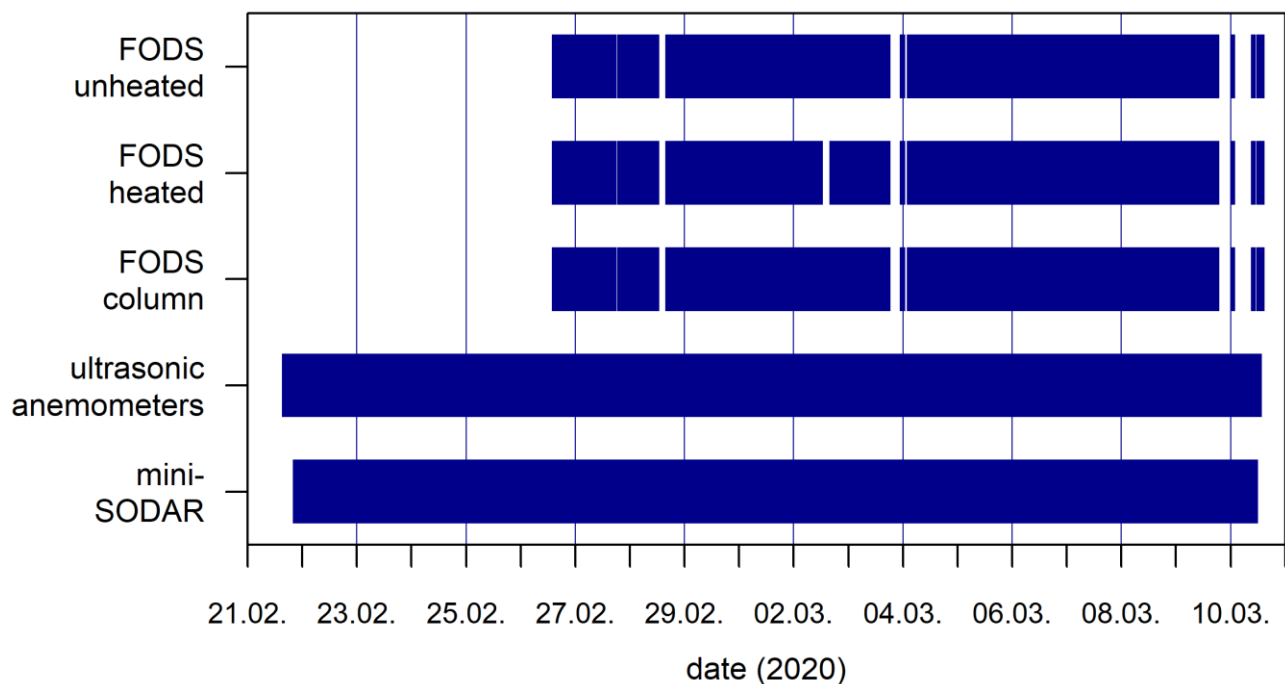


Figure 4: Data availability of the different data sets of NYTEFOX for the campaign period in February and March 2020. Gaps in the FODS data sets occur due to instrument and calibration failures.

References

Boike, J., Juszak, I., Lange, S., Chadburn, S., Burke, E. J., Overduin, P. P., Roth, K., Ippisch, O., Bornemann, N., Stern, L., Gouttevin, I., Hauber, E., and Westermann, S.: HRSC-AX data products (DEM and multi channel) from aerial overflights in 2008 over Bayelva (Brøggerhalvøya peninsula, Spitsbergen), PANGAEA, <https://doi.org/10.1594/PANGAEA.884730>, in supplement to: Boike, J et al. (2018): A 20-year record (1998-2017) of permafrost, active layer and meteorological conditions at a high Arctic permafrost research site (Bayelva, Spitsbergen). *Earth System Science Data*, 10(1), 355-390, <https://doi.org/10.5194/essd-10-355-2018>, 2018.

Lapo, K. and Freundorfer, A.: pyfocs v0.5, Zenodo, <https://doi.org/10.5281/zenodo.4292491>, <https://github.com/klapo/pyfocs>, 2020.

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Thomas, C., Law, B., Irvine, J., Martin, J., Pettijohn, J., and Davis, K.: Seasonal hydrology explains interannual and seasonal variation in carbon and water exchange in a semiarid mature ponderosa pine forest in central Oregon, *Journal of Geophysical Research: Biogeosciences*, 114, <https://doi.org/10.1029/2009JG001010>, 2009.