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HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

Status of the Arctic BSRN Site Ny-Ålesund (78.9°N, 11.9°E)

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Ny-Ålesund
is located on the western fjord coastline of Svalbard, at about 79°N. Although located in the high Arctic, the local climate is affected by North Atlantic influences, both due to oceanic heat advection and the impact of cyclones following the main storm tracks, with particular significance for the atmospheric warming trend in winter.

The **BSRN station** is operated since August 1992, providing the radiation budget components global radiation, reflective radiation, upward thermal radiation and downward longwave radiation, as well as direct and diffuse radiation, and some filtered bandwidth measurements to retrieve photosynthetic active radiation (PAR).

Spring / Summer — Shortwave Radiation

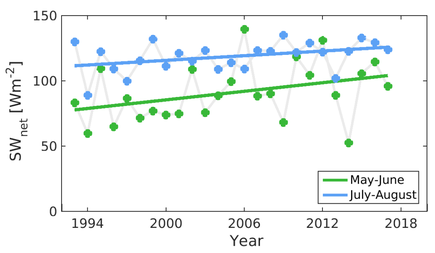
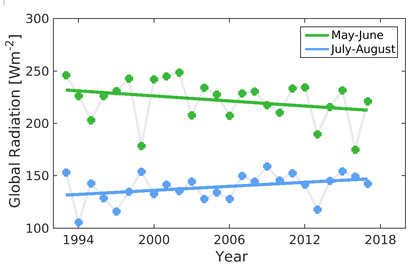
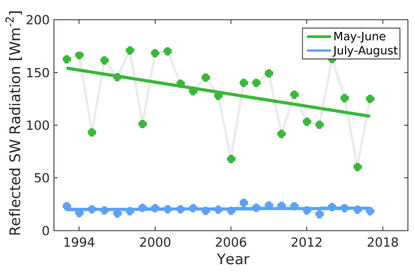


Figure 1: Increase in short-wave net radiation $SW_{net} = SW_{down} – SW_{up}$ (left) for the snow-melt season May-June and the summer months July-August since 1993, due to changes in the single components SW_{down} (lower left panel) and SW_{up} (lower right panel), respectively.



summer: increase in global radiation



spring: decrease in reflected radiation

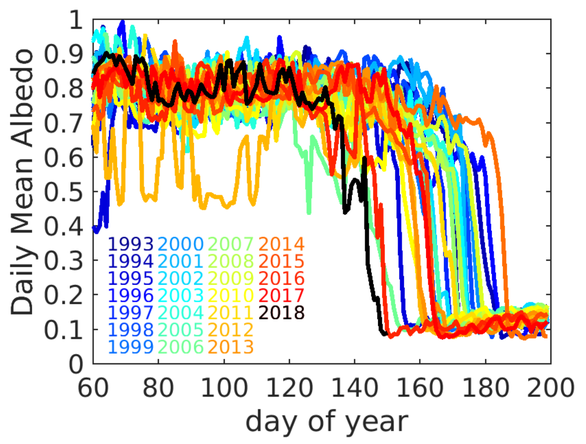


Figure 2: Daily mean albedo SW_{down}/SW_{up} at the Ny-Ålesund BSRN radiation sensor set-up *[update of Maturilli et al., 2015].*

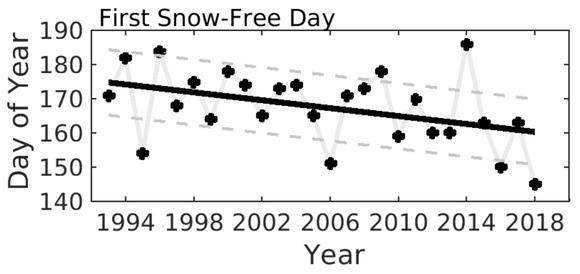


Figure 3: First day of each year assumed to have a predominantly snow-free surface beneath the radiation sensor set-up (= daily mean albedo <0.2), with linear regression +/- 1 standard deviation *[update of Maturilli et al., 2015].*

- shortening of the snow-cover period
- **2018**: year with earliest snow-melt observed so far

Winter — Longwave Radiation

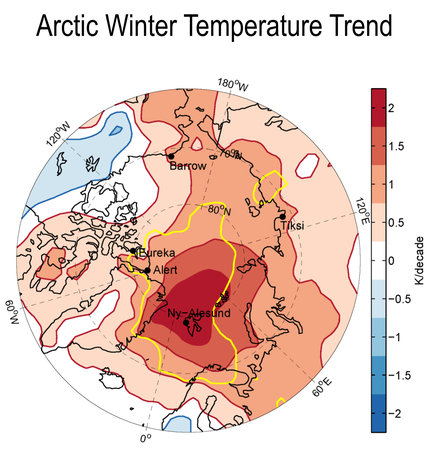


Figure 4:
December-January-February (DJF) mean decadal temperature trend at the 850 hPa level using ERA-Interim 1996–2016. Yellow line = significant trends (95% confidence level). *[Dahlke and Maturilli, 2017]*

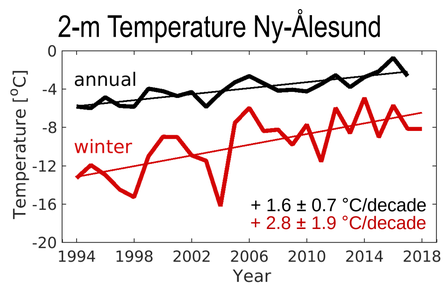


Figure 5:
Surface air temperature increase in Ny-Alesund, for the annual mean (black line) and the dark winter period DJF (red line).

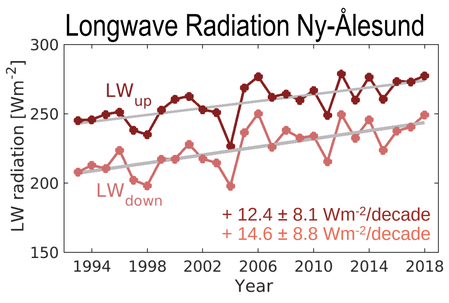


Figure 6:
BSRN measurements of upward (LW_{up}) and downward (LW_{down}) longwave radiation during the winter months DJF, respectively.

- Strong winter surface warming in Svalbard region is related to winter sea ice depletion in the Barents / Kara Seas
- Temperature increase also observed in atmospheric column, along with increase in humidity
- Advection contributes to 25% of this tropospheric warming *[Dahlke and Maturilli, 2017]*
- changes in water vapour + clouds ⟹ radiative impact ?

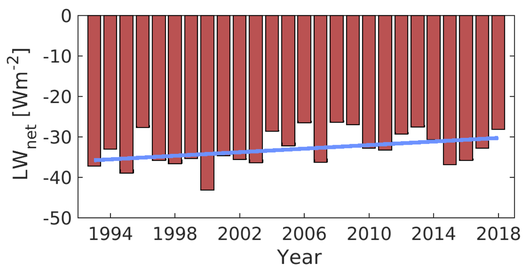


Figure 7:
The longwave net radiation $LW_{net} = LW_{down} - LW_{up}$ for the winters 1992/93 to 2017/18. The slight increase of + 2.2 Wm^{-2} per decade indicates the growing importance of processes in the atmospheric column.

Auxiliary Data: Radiosondes

With the introduction of the new radiosonde type RS41 in April 2017, the upper-air data are no longer submitted in the station-to-archive files (as LR1100).

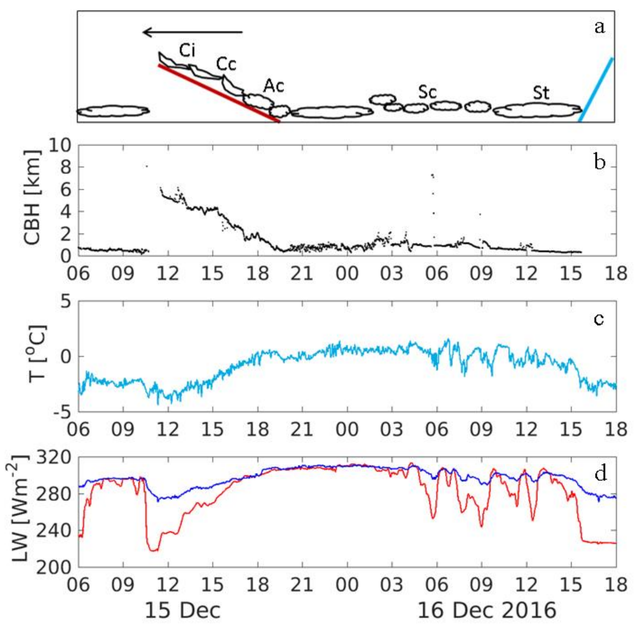
Instead, the radiosonde data in 1-second resolution can be retrieved via the Pangaea database with the search term "*High resolution radiosonde measurements from station Ny-Alesund*".

A direct link is also provided on the BSRN webpage http://bsrn.awi.de/data/data-retrieval-via-pangaea/

GRUAN

The Ny-Ålesund radiosonde program is part of the GCOS Reference Upper-Air Network (GRUAN).
www.gruan.org

Auxiliary Data: Ceilometer



A description of the 25 year data set of cloud base height measurements by ceilometer in Ny-Ålesund has recently been published.
(Maturilli and Ebell, 2018)

Figure 8: A frontal passage on 15 / 16 December 2016 in Ny-Ålesund. a: Schematic diagram of the warm front (red line) and cold front (blue line), their moving direction (black arrow), and associated clouds, respectively. b: Cloud base height (CBH) from ceilometer measurements. c: 2m air temperature from surface meteorological observations. d: Upward and downward longwave radiation (blue and red lines, respectively) from surface radiation measurements.

References:

Maturilli M, and K Ebell (2018) 25 years of cloud base height measurements by ceilometer in Ny-Alesund, Svalbard. Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2018-48, in review

Dahlke S, and M Maturilli (2017) Contribution of atmospheric advection to the amplified winter warming in the Arctic North Atlantic Region. Advances in Meteorology, Vol.2017, Article ID 4928620. doi: 10.1155/2017/4928620

Maturilli M, A Herber, and G König-Langlo (2015) Surface radiation climatology for Ny-Ålesund, Svalbard (78.9° N), basic observations for trend detection. Theor. Appl. Climat. 120(1), 331-404 339. doi: 10.1007/s00704-014-1173-4

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