Norwegian Meteorological Institute

Monitoring of weather and climate on Svalbard - standardisation, harmonisation and experiences at MET Norway

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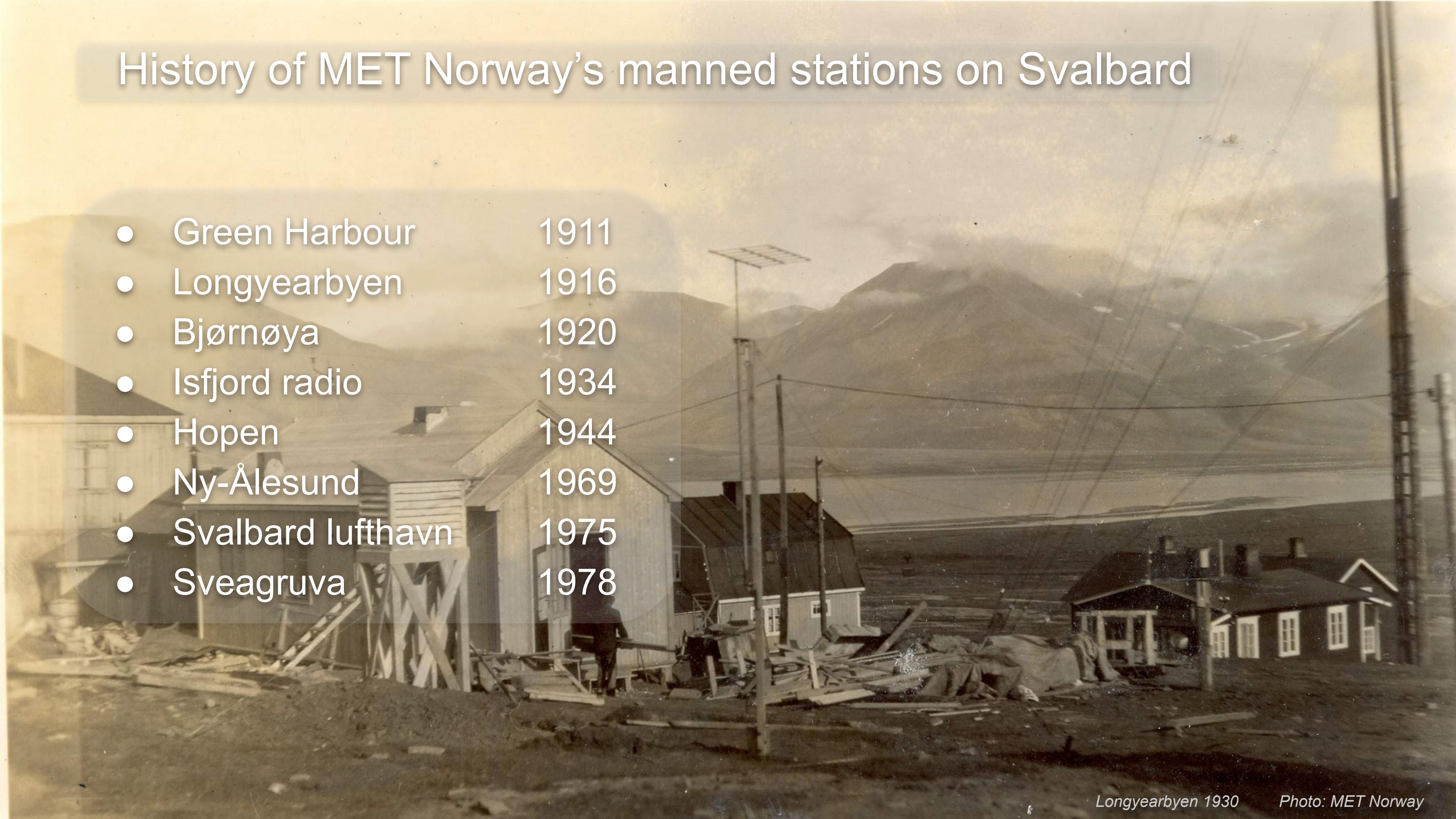
Photo: Ketil Isaksen

History of MET Norway's manned stations on Svalbard

- Green Harbour 1911
- Longyearbyen 1916
- Bjørnøya 1920
- Isfjord radio 1934
- Hopen 1944
- Ny-Ålesund 1969
- Svalbard lufthavn 1975
- Sveagruva 1978



Longyearbyen 1930 *Photo: MET Norway*

Design of observational networks

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(a) The location of each station should be representative of conditions in space and time;

(b) The station spacing and interval between observations should correspond with the desired spatial and temporal resolution of the meteorological variables to be measured or observed;

(c) The total number of stations should, for reasons of economy, be as small as possible but as large as necessary to meet requirements.

WMO-No. 488, 2010 (updated 2017)

Design of observational networks

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- In principle the air-mass properties should be sampled at a station covering the smallest possible area,
- although instruments should be positioned so that they do not affect each other's measurements.
- In selecting station sites, the intention is to obtain data that are representative of a larger area.
- Ideally, all measurements and visual observations at all stations would be made at the same time, that is, at a predetermined synoptic hour/standard time of observation

WMO-No. 488, 2010 (updated 2017)

MET Norway's automatic station network on Svalbard

MET Norway has been operating Automated Weather Stations (AWS) at Svalbard since the early '90s.

- Edgeøya - Kapp Heuglin
- Kongsøya
- Verlegenhuken
- Karl XII-øya
- Kvitøya
- Pyramiden
- Sveagruva
- Akseløya
- Svalbard lufthavn (manned)
- Isfjord radio
- Ny-Ålesund (manned)
- Sørkappøya
- Hopen (manned)
- Janssonhaugen vest (new in 2019)
- Reindalspasset (new in 2019)
- Istjørndalen (new in 2020)

Setup of our new Automatic Weather Stations (AWS) on Svalbard							
Air temp.	Wind speed&dir.	Humidity	Barometric pressure	Snow depth	Radiation	Soil temp.	Soil water cont.

Main challenges regarding service at our AWS on Svalbard

- Avoid becoming a “bear snack”
- Power-> Minimize power consumption
- Weather-> Able to withstand all kinds of weather
- Limited time for service and repair (serviceability)
- Communication
- Logistics

Regular inspections of AWS
Verlegenhuken

Photo: Ole Jørgen Østby

WMO Integrated Global Observing System (WIGOS)

The WMO Integrated Global Observing System (WIGOS) provide the overall observing framework for WMO.

Interoperability of observing systems and compatibility of climate data and products are essential for meeting the needs of diverse users.

WIGOS will achieve interoperability and compatibility through the application of internationally accepted standards and best practices. Data compatibility will also be supported by the use of standardized data representation and formats. WIGOS aims to improve the quality and availability of data and metadata in order to develop capacity and to improve access to data.

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WMO Integrated Global Observing System (WIGOS)

The principal areas of standardization include:

- Instruments and methods of observation across all components, including surface-based and spacebased elements (observations and their metadata);
- WMO Information System (WIS) exchange as well as discovery, access and retrieval services; and
- Data management (data processing, quality control, monitoring and archiving).

Although aimed primarily at improving the WMO observing systems, it will also interface among co-sponsored and non-WMO observing systems, thereby engaging regional and national actors for the successful integration of these systems.

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Metadata

GCOS describes the relevance of metadata as:

> *"The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e., metadata) should be documented and treated with the same care as the data themselves."*

The WIGOS Metadata Standard (WMDS) was developed to support "adequate use of observations".

Observational metadata are routinely submitted to and maintained in OSCAR/Surface; the official repository of metadata on meteorological and climatological observations that are required for international exchange, and are integrated under the WIGOS framework.

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Observation protocols (standards) at MET Norway

Use WMO as benchmark for our own work (as far as possible)

Install our sensors in the field is based on **WMO recommendations** and described as

- Classification (exposure, performance and data quality QC flags)
- Instrument specifications
- Calibration routines

Problem: sensors for different variables have different requirements. Placed within the vicinity of a station gives challenges regarding classification

For handling extremes, harmonise distribution of external stations/sensors MET has introduced a siting method equivalent to WMO. All stations can be good if installation and metadata is sufficient.

Observation protocols at MET Norway

The WMO's Commission for Instruments and Methods of Observation (WMO CIMO) gives suggestions on the siting of e.g. temperature & precipitation sensors and also recommends a siting classification system to classify those stations which are not perfectly located for easier evaluation of the expected quality.

Work in good progress at MET Norway related to naming convention for climate and observation data: use the CF (Climate and Forecast) metadata convention if possible, and we suggest new CF standard names whenever the convention does not cover the observed weather elements.

Observation protocols at MET Norway

Precipitation

- Precipitation is a difficult measurement.
- New developed algorithm for removing noise in data (electrically induced and from wind)
- External station owners use instruments with different measuring methods and is not always comparable.

Photo: Svein Olav Sundal

Real-time data and data transfer

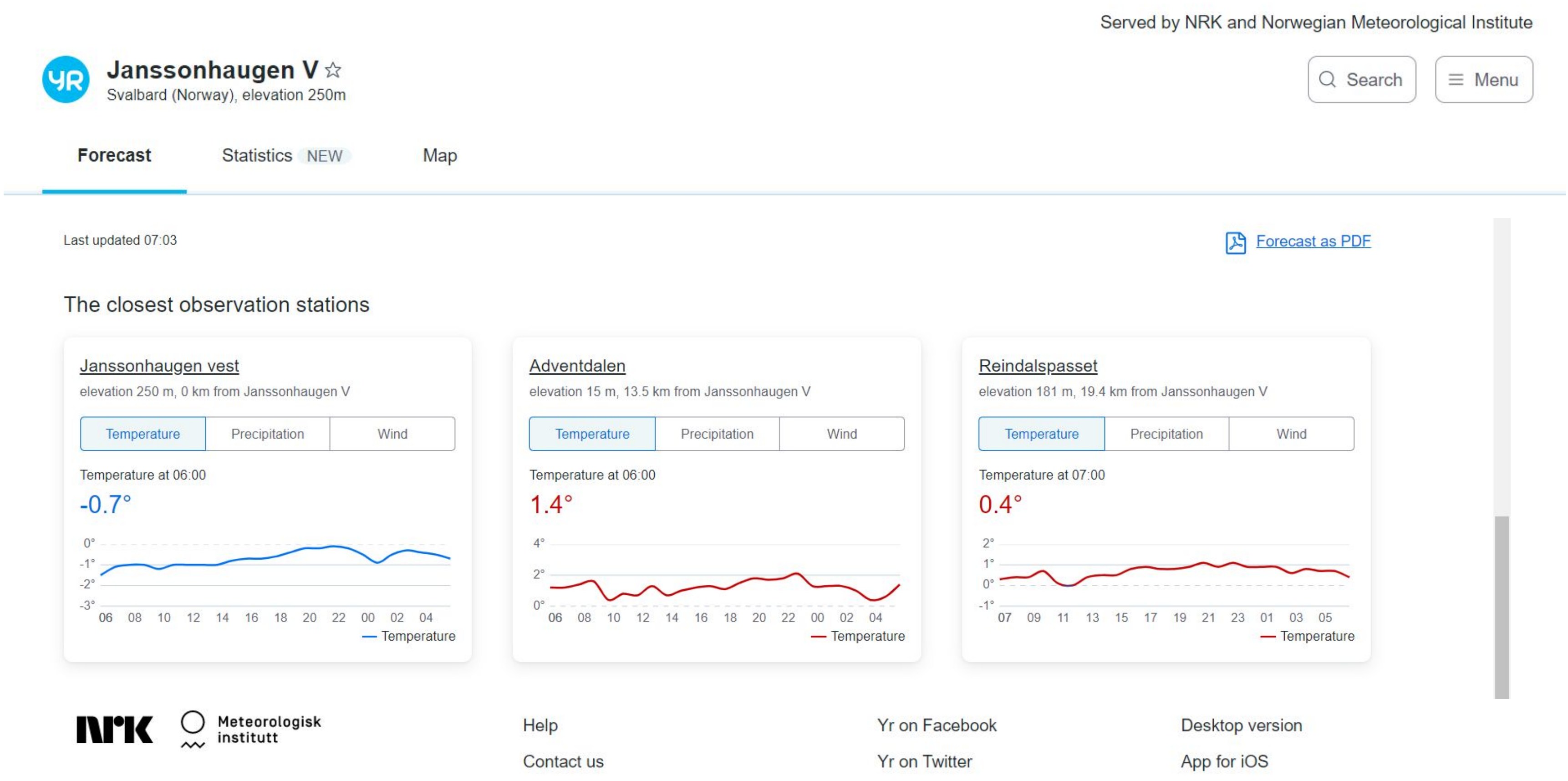
All stations provide real-time data, and data transfer and storage takes place through MET Norway operational systems

Ensure fast data access for

- operational weather- and avalanche forecasting
- local rescue services
- general public
- researchers

The Frost API frost.met.no and seklima.met.no provides free access to MET Norway's archive of historical weather and climate data.

Photo: Ketil Isaksen



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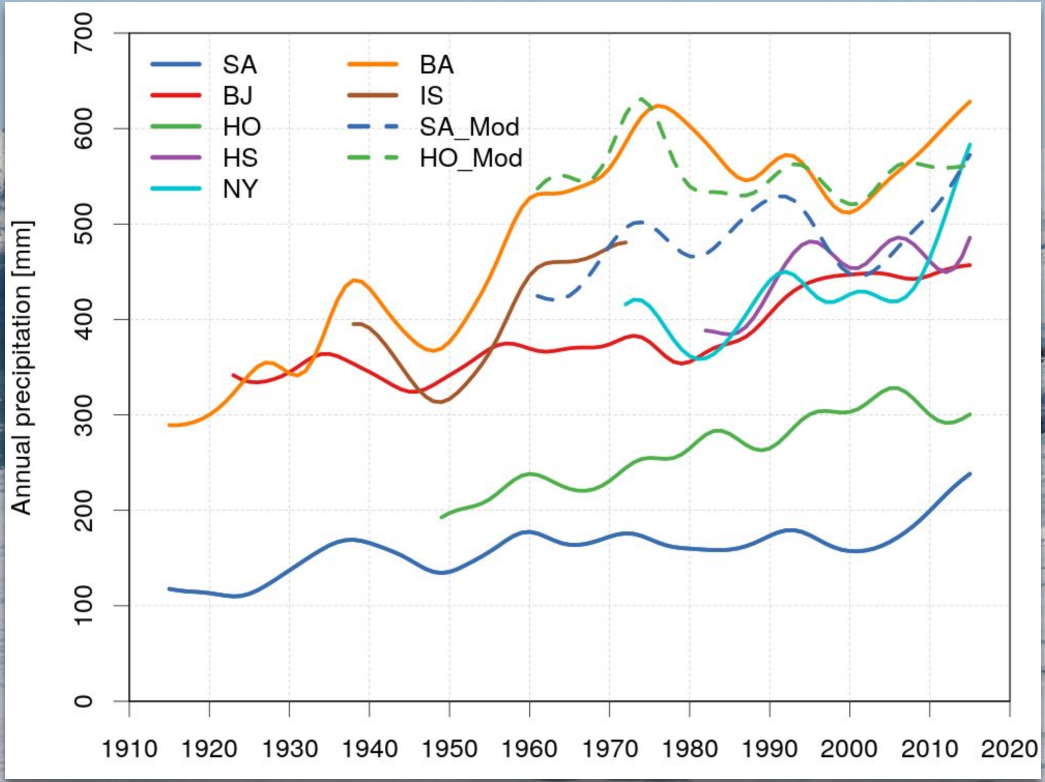
Increasing precipitation on Svalbard



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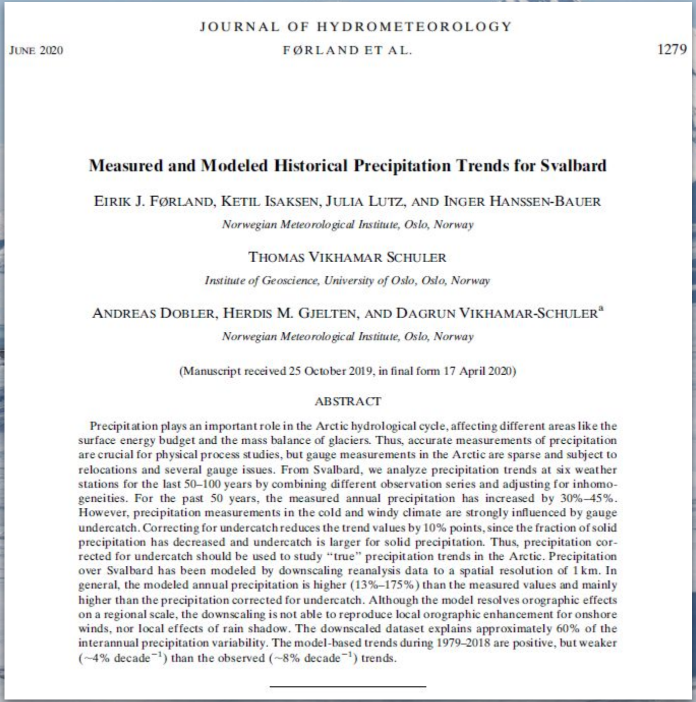

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Measured and Modeled Historical Precipitation Trends for Svalbard

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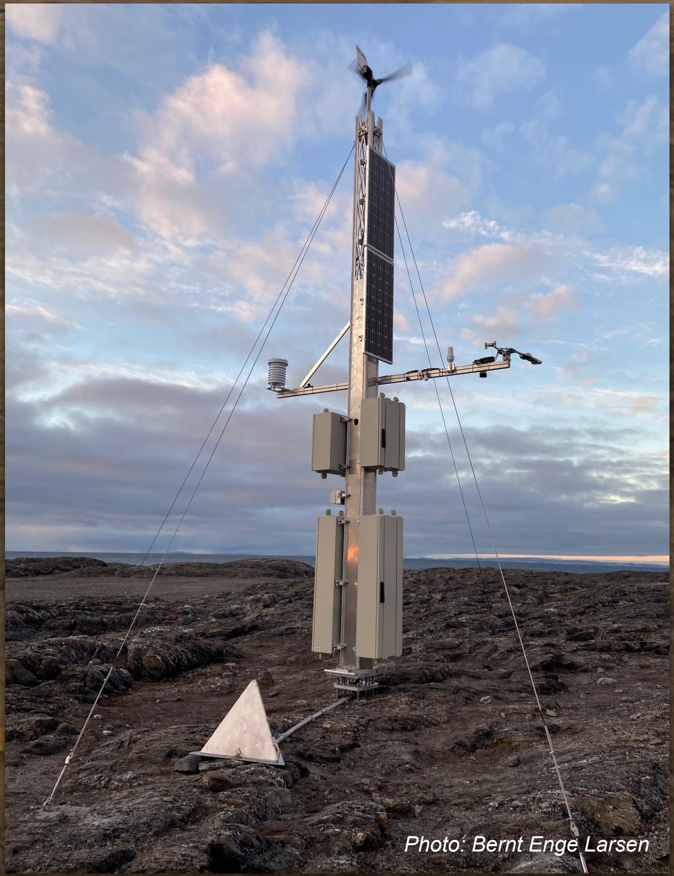
ABSTRACT

Precipitation plays an important role in the Arctic hydrological cycle, affecting different areas like the surface energy budget and the mass balance of glaciers. Thus, accurate measurements of precipitation are crucial for physical process studies, but gauge measurements in the Arctic are sparse and subject to relocations and several gauge issues. From Svalbard, we analyze precipitation trends at six weather stations for the last 50–100 years by combining different observation series and adjusting for inhomogeneities. For the past 50 years, the measured annual precipitation has increased by 30%–45%. However, precipitation measurements in the cold and windy climate are strongly influenced by gauge undercatch. Correcting for undercatch reduces the trend values by 10% points, since the fraction of solid precipitation has decreased and undercatch is larger for solid precipitation. Thus, precipitation corrected for undercatch should be used to study “true” precipitation trends in the Arctic. Precipitation over Svalbard has been modeled by downscaling reanalysis data to a spatial resolution of 1 km. In general, the modeled annual precipitation is higher (13%–175%) than the measured values and mainly higher than the precipitation corrected for undercatch. Although the model resolves orographic effects on a regional scale, the downscaling is not able to reproduce local orographic enhancement for onshore winds, nor local effects of rain shadow. The downscaled dataset explains approximately 60% of the interannual precipitation variability. The model-based trends during 1979–2018 are positive, but weaker (~4% decade^{-1}) than the observed (~8% decade^{-1}) trends.

Photo: Brage B. Hansen

New monitoring efforts coordinated across disciplines



New monitoring efforts coordinated across disciplines

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