Temperature variations at Svalbard during the last century

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Only a few meteorological observation series in the high Arctic are available during the last 100 years. Fortunately one of those series is located on Spitsbergen. A wireless telegraph station was established in 1911 at Finneset near the present Barentsburg in Grønfjorden and meteorological observations were carried out by its staff.

The telegraph station at Finneset was closed in 1930, but measurements were continued at other sites so that different series from the island exist up to present. The series reflect different climatic conditions at Spitsbergen. Generally speaking the temperature varies along an axis from southwest to northeast with the coldest pole to the northeast.

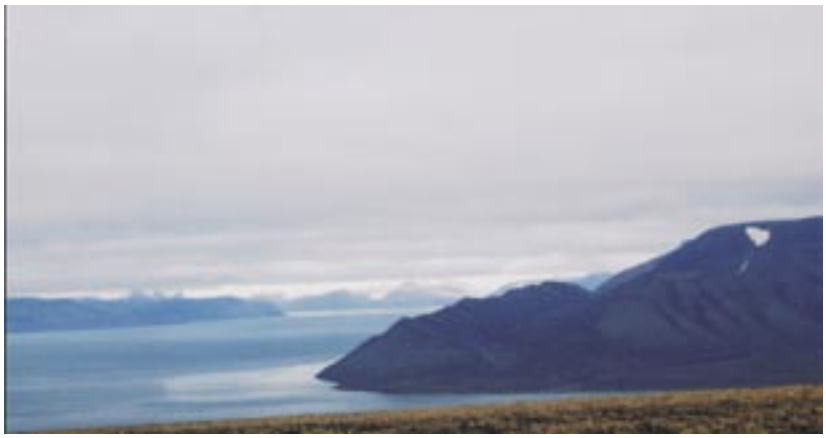
For the study of temporal variations of the Svalbard temperature the many series have to be combined. This is not a simple task if the combined series is to be homogenous and not influenced by different local climates at the individual sites. For the Isfjorden area the homogenisation is done using overlapping series in certain time windows. The whole composite series is made valid for the present site of observation at Isfjorden, i.e. at the Svalbard Airport.

The most marked feature of the temperature evolution on Svalbard is the increase from the start of the series up to the 1930s (Fig. 1). This increase is seen in all season of the year and thus also in the annual mean values. For winter the temperature increase is particularly large, whereas in summer a maximum value is reached already in the 1920s and the trend is weaker. In literature the warming is frequently described and often referred to as the early 20th century warming. In particular it was strong in the European sector of the Arctic where Svalbard is situated (e.g. Overland et al. 2004). The warming was large also in the Norwegian mainland, but was less marked in southern Europe. Atmospheric/ocean models indicate, however, that the temperature increase is within the range of natural variability (Johannessen et al. 2004).

A cold spell in the series is also readily identified in the 1960s in all seasons of the year. On a decadal time scale this minimum is not as low as the one in the start of the series, but it is still the second lowest minimum in all seasons. Those two cold decades, the 1910s and the 1960s, and the warm spell around 1930 are the main characteristics of the Svalbard climate. In addition also the positive trend in the last 40 – 50 years should be recognised. This trend is also present in all seasons.

Atmospheric/ocean models predict a warming in the Arctic due to increased greenhouse gasses. It is therefore of great interest examining whether a warming is seen in the data series. As a tool for detection of trends the non-parametric Mann-Kendall test is chosen with a significance level of 0.05. This means that the probability is less than 1 to 20 for trends being recognised as significant, while they in reality are established merely by chance.

The test detects significant positive trends for the annual temperatures as well as for spring and summer, whereas the positive trend for the autumn is not significant. For the winter season there is practically no trend at all (Table 1). The temperature variability is larger in Arctic than at lower latitudes. This can mask anthropogenic signals in the Arctic temperatures. For example the trend in summer



More mild weather will give less ice in the Icefjord at Svalbard

Øyvind Nordli works as a scientist at the Norwegian Meteorological Institute. His main work is to study long-term climate variations and trends. He also works on proxy data in order to lengthen the time window for this study beyond the instrumental epoch.

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Autumn (SON)
1.6*	0.1	4.2*	0.7*	1.3

*Tabell 1 Svalbard airport. Temperature increase (°C) during 100 years . Statistical significant results are marked by *.*

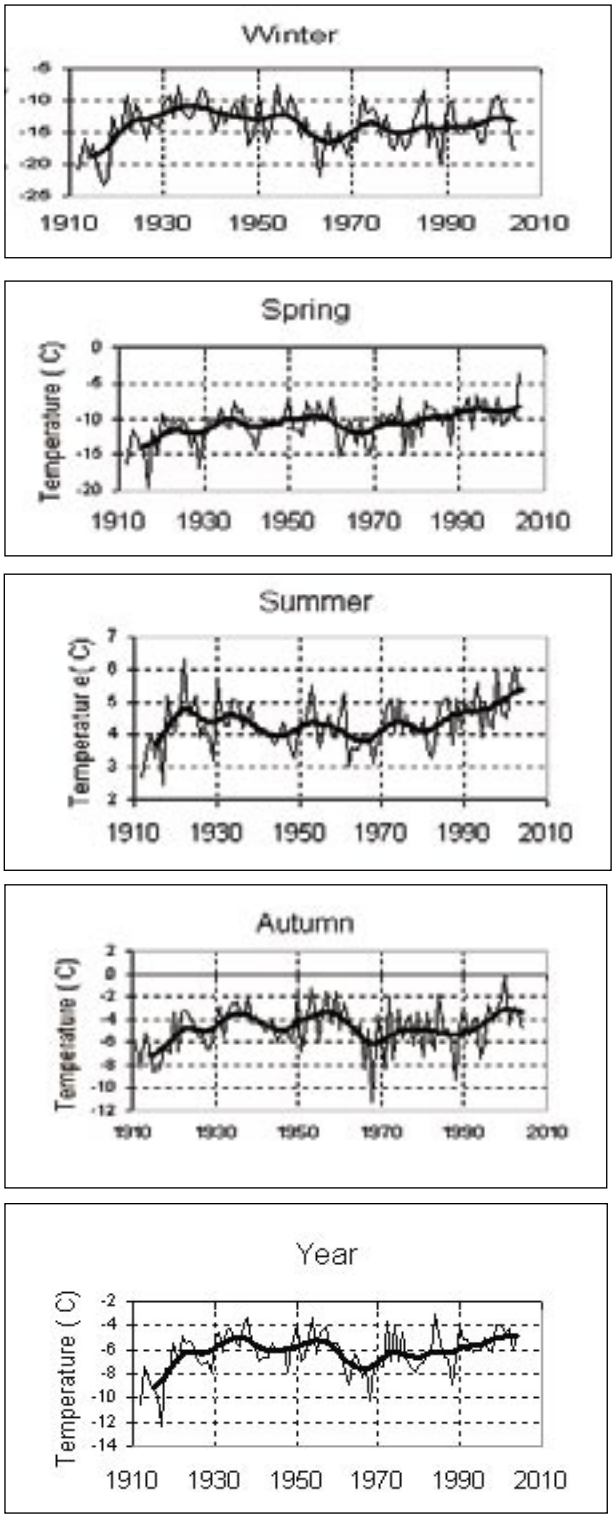


Fig. 1 The Svalbard Airport series analysed for annual values, winter season (DJF), spring (MAM), summer (JJA), and autumn (SON). Individual years are represented as dots in the diagrams connected by lines. The individual years are filtered by a Gaussian low-pass filter with standard deviations of 3 years (Filt.1), corresponding to a rectangular filter of about 10 years.

temperature of 0.7 °C is significant, whereas the almost double as large trend in the autumn temperature is not. This might be due to the much larger variability in autumn than in summer.

Also proxy data for temperature exist for Svalbard. At Lomonosovfonna 1255 m a.s.l. ice cores have been drilled and analysis performed based on stable oxygen isotopes (Isaksson et al. 2003). The agreement with the Svalbard Airport series is generally good, but the temperature series based on the ice cores does not show the early 20th century warming as an abrupt shift in temperature, rather as a long-term positive trend.

References

Isaksson, E., Hermanson, M., Hicks, S., Igarashi, M., Kamiyama, K., Moore, J., Motoyama, H., Muir, D., Pohjala, V., Vaikmäe, R., van de Val, R.S.W., Watanabe, O. 2003. Ice cores from Svalbard - useful archives of past climate and pollution history, *Physics and Chemistry of the Earth*, **28**, 1217–1228.

Johannessen, O.M, L. Bengtsson, M.W. Miles, S.I. Kuzima, V.A. Semenov, G.V. Alekseev, A.P. Nagurnyi, V.F. Zakarov, L.P. Bobylev, L.H. Pettersson, K. Hasselmann, and H.P. Cattle. 2004: Artic climate change: observed and modelled temperature and sea-ice variability. *Tellus*, **56A**, 328-341.

Nordli, Ø. and J. Kohler. 2004: The early 20th century warming. Daily observations at Grønfjorden and Longyearbyen on Spitsbergen (2nd edition). *DNMI/klima*, report No. 12/03.

Overland, J.E, M.C. Spillane, D.B. Percival, M. Wang and H.O. Mofjeld. 2004: Seasonal and Regional Variation of Pan-Arctic Surface Air Temperature over the Instrumental Record. *Journal of Climate*, **17**, 3263–3282.