

Case studies as a tool to co-develop climate services

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APPLICATE.eu
Advanced prediction in
polar regions and beyond



In a nutshell

Develop enhanced predictive capacity for weather and climate in the Arctic and beyond and determine the influence of Arctic climate change on Northern Hemisphere mid-latitudes, **for the benefit of policy makers, businesses and society.**



Participatory framework for climate services

Empowerment

Tailored knowledge

CASE STUDIES

*Adapted from Bojovic et al.
(under review) and
WMO's guidance for good
practices for climate services
user engagement (2018)*



Engagement

Websites and web tools

Involvement

Interactive group activities

Increasingly used in the climate services field to provide descriptions of **particular extreme weather and climate events of interest for stakeholders** (e.g. affecting their businesses and activities) that occurred in the past over a specific location and time.

Wildfires rage in Arctic Circle as Sweden calls for help

Sweden worst hit as hot, dry summer sparks unusual number of fires, with at least 11 in the far north



▲ Firefighters battle a blaze in a forest in western Sweden, the worst-hit country. Photograph: Mats Andersson/EPA

Starvation deaths of 200 reindeer in Arctic caused by climate crisis, say researchers

Comparable death toll has been recorded only once before, says Norwegian Polar Institute



▲ An annual census of wild reindeer by the Norwegian Polar Institute found 200 had started to die over winter due to climate change. Photograph: Geoffrey Reynaud/Getty Images/iStockphoto

Case studies

USER GROUP



BLOG POLAR PREDICTION MATTERS
<https://blogs.helmholtz.de/polarpredictionmatters/>



CONFERENCES



ARCTIC CHANGE – 7-10 December 2020

OTHER PROJECTS



ECS



CASE STUDIES

Case studies

Energy case studies

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ENERGY CASE STUDY

HOW DOES ARCTIC SEA ICE AFFECT ENERGY PRODUCTION IN MID-LATITUDES?



CHAIN OF EVENTS

1. Historical low sea ice concentration in the Barents and Kara (BK) seas.

During November and December 2016, extreme warm temperatures were observed in the Arctic. As a result, the total Arctic sea ice extent experienced a historical low value, with negative anomalies^a in most of the Arctic, but especially strong in the BK seas (Acosta Navarro et al. 2018). According to existing records, a breakpoint in sea ice loss (i.e., an accelerated decline) over the BK seas took place in the early 2000 (Close et al. 2015). In the last decade several studies have found causal links between low Arctic sea ice cover in the late autumn and extreme climate anomalies the following winter in mid-latitudes (Cohen et al. 2014, Screen et al. 2018). In the framework of the APPLICATE project, retrospective forecasts^b with the EC-Earth3 climate model (Doblas-Reyes et al. 2013) were performed to attribute the role of extremely reduced Arctic sea ice conditions (mostly over BK) with regard to the extremely low precipitation event in Europe in winter 2016-2017 (Acosta Navarro et al. 2018; see Fig.1).

- 1** Winter sea ice concentration
Historical low winter sea ice in the Barents and Kara seas
- 2** Cold spell
Atmospheric blocking over Europe responsible for:
• Cold spells
• Lower precipitation
• Lower wind speed
- 3** Energy demand
Increase in energy demand and lower than usual hydro and wind power generation

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ENERGY CASE STUDY 2

HOW DID ARCTIC SEA ICE AFFECT ENERGY PRODUCTION IN EUROPE IN 2018?



Spring 2018 was a warm and dry period in the central and northern part of Europe that some energy producers identified as a relevant event affecting their businesses. This period saw high temperatures with low precipitation and wind speed, which impacted renewable power generation. The aim of this case study is to explore whether these weather conditions were associated with extremely low values in sea ice concentration^a observed in the Arctic a few months earlier. The APPLICATE project aims to improve our understanding of the linkages between Arctic sea ice changes and the mid-latitude climate for the benefit of policy makers, businesses and society. Confirming the link between the extremely low sea ice concentrations in 2018 and the subsequent weather conditions over Europe would open an opportunity for short-term and long term planning of European energy systems if similar events become more frequent in the future.

**THE EVENT:
Hot and dry spring and early summer 2018**

Spring and summer of 2018 in Europe were much warmer than average. During this period, high sea level air pressure conditions were present over the northern half of the continent, which brought clear skies with rather dry and stable weather. This increased the number of sunshine hours typical for this time of the year, but also led to a very small amount of rain in central, western and northern Europe from April to June. A few months earlier, from January to April, the historically lowest sea ice cover in the Bering region of the Arctic was recorded. The almost simultaneous occurrence of these extreme events poses the question of whether the reduction in sea ice had played any role in the development of the high air pressure systems over Europe.

GLOSSARY

A
Sea ice concentration: the amount of sea ice covering an area, usually written as the percentage of the total area covered by sea ice

Contributors:
Sara Oesterjak, Dragana Bojovic, Marta Terrado, Ferran López Martí, Pablo Ortega, Juan Acosta, Markus Donat & Veronica Tomalba (BSC-CNS, Spain), 2019.

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Risk management case studies

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RISK MANAGEMENT CASE STUDY

IS SVALBARD PREPARED FOR EXTREME RAINFALL?



Svalbard is an archipelago in the Arctic Ocean administered by Norway under the Svalbard treaty midway between continental Norway and the North Pole (Fig. 1). For the last 50 years, it has witnessed an annual mean temperature rise of 3.5°C (Hanssen-Bauer et al. 2019), with winter warm spells becoming more frequent (Peeters et al. 2019). The risk of increased frequency of precipitation in form of rain is an important climate change challenge affecting the archipelago during autumn and winter. Adaptations that settlements and the environment would demand, could set the scene for the rest of the globe. In order to make progress, we first need to have a better understanding of extreme weather and climate events in Svalbard, which will lead to better predictions that improve the preparedness of local populations to deal with such events.



Fig. 1 Location of Svalbard in the Arctic Circle. Credit: adapted from the Guardian.

- 1** Warm and moist air moving northwards
Large-scale flow pattern leading to extreme temperatures over Europe and the Arctic
- 2** Extreme rainfall
Extreme precipitation in form of rainfall in Svalbard (up to 60 mm from ground level)
- 3** Landslides/ slash avalanches
• Increased soil production
• Landslides
• Slash avalanches

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RISK MANAGEMENT CASE STUDY 2

IS ALASKA PREPARED FOR EXTREME WILDFIRES?



Wildfires are a natural part of the boreal forest ecosystem, which is largely present in Alaska. However, in recent years, the fires seem to be more frequent and intense due to human-forced warming and an overall lengthening of the fire season, which affects local communities, flora and fauna. Alaskan ecosystems are already significantly exposed to impacts of climate change, not least due to temperature increase, which is almost twice the global average rate, largely due to a phenomenon known as *Arctic amplification*^a (US Global Change Research Program). Summer 2019 recorded some of the highest temperatures and lowest moisture levels since records are kept (1952) (NASA Earth Observatory). This led to an extreme fire season in the northern state, burning an area of over 1 million hectares. This situation additionally contributed to exacerbating climate change, since the CO₂ stored in the soil and permafrost of these ecosystems had been released. Keeping forest fires under control is becoming an urgent and challenging task for the Arctic region. Predicting this type of events could improve preparedness and help to better protect the towns and communities that are at risk of destruction, e.g. help authorities make evacuations in time or allow the relocation of firefighting resources.

GLOSSARY

A
Boreal forest: A forest growing in high latitude environments, characterized by coniferous trees; also known as taiga.

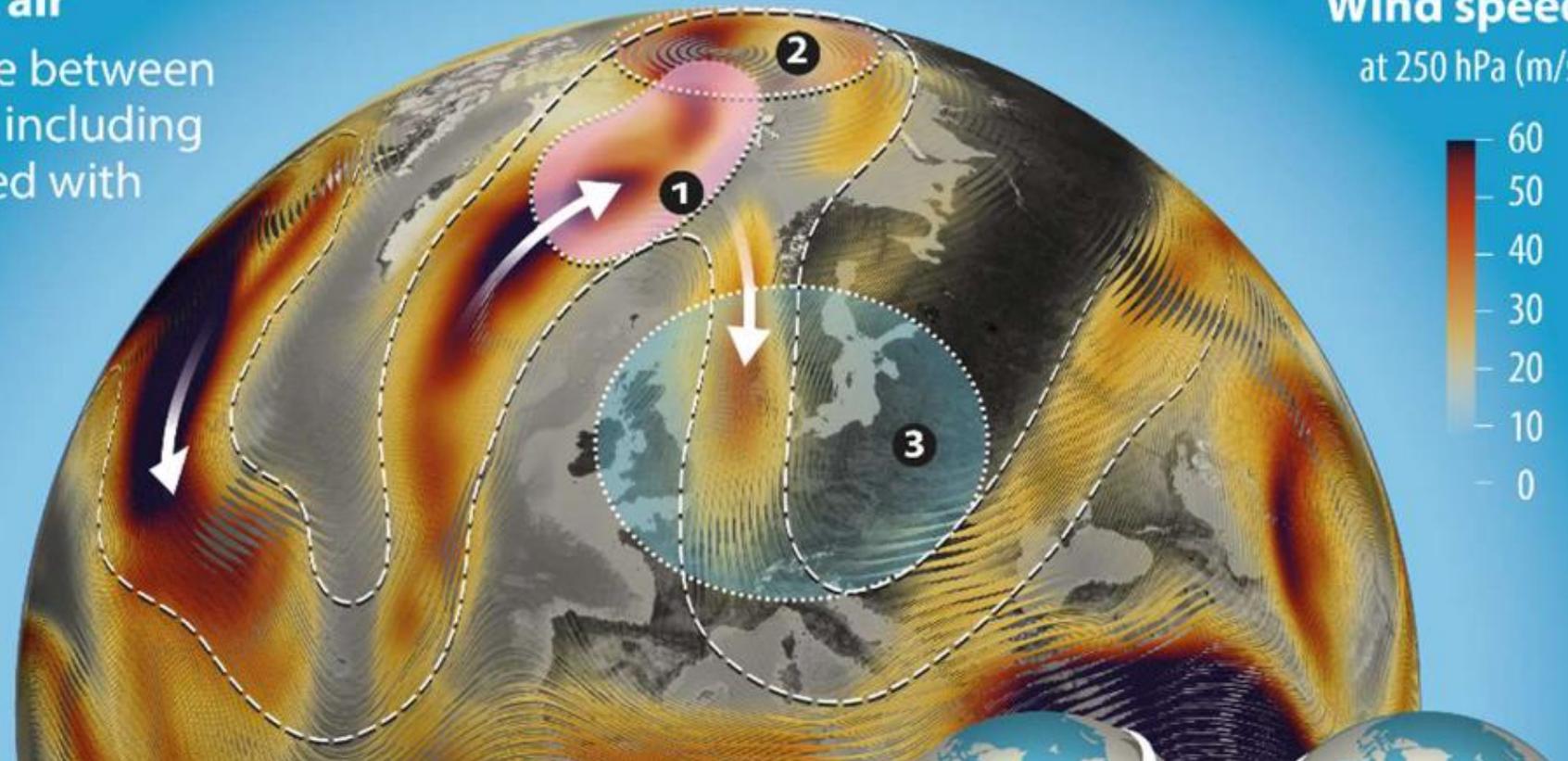
B
Arctic amplification: A phenomenon in which Arctic temperatures increase faster than in the rest of the world. This reduces the temperature difference between the equator and the North Pole, with potential consequences for weather and climate at lower latitudes.

Contributors:
Sara Oesterjak, Dragana Bojovic, Marta Terrado & Inara Ojvanovic (BSC-CNS, Spain), Linus Magnusson & Claudia Vitolo (ECMWF, UK), 2020.

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Extreme events in the Arctic

Wind speed
at 250 hPa (m/s)



1 Intrusion of warm and moist air

Periods of strong direct exchange between polar regions and midlatitudes – including moist air intrusion – are associated with undulation of the jet stream.

Extreme events

Extreme events across the Northern Hemisphere are associated with meandering of the jet stream.

2 Arctic heat wave

3 European cold snap

Case study: Extreme rainfall in Svalbard

Learning from the past



1

Warm and moist air moving northwards

Large-scale flow pattern leading to extreme temperatures over Europe and the Arctic

2

Extreme rainfall

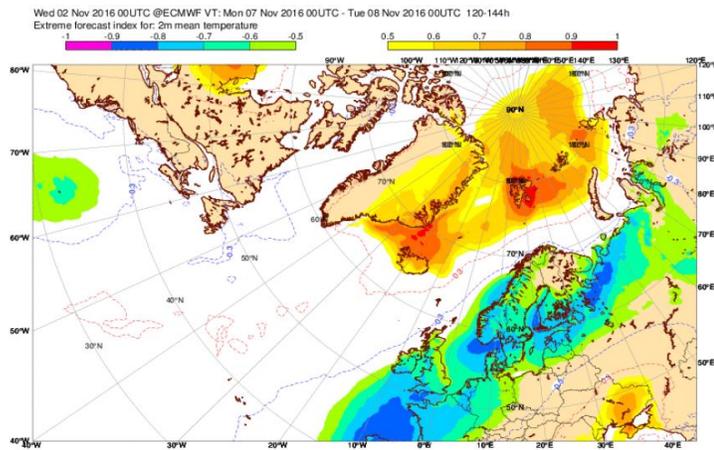
Extreme precipitation in form of rainfall in Svalbard (rain-on-frozen ground event)

3

Landslides/ slush avalanches

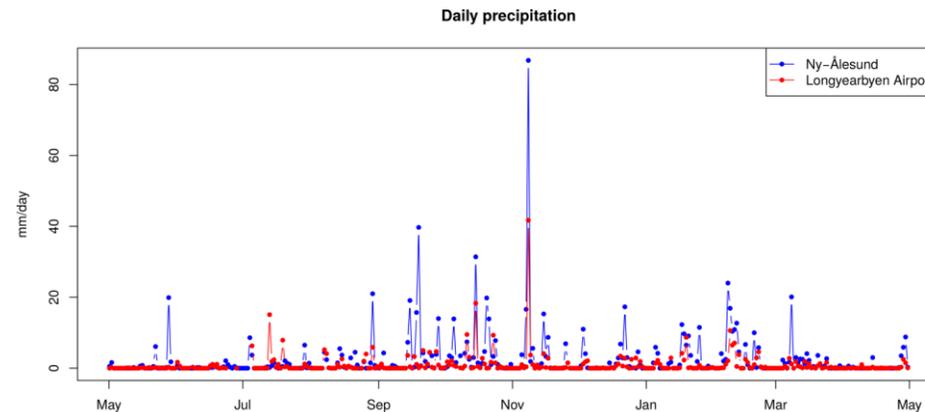
- Ground ice production
- Landslides
- Slush avalanches

Extreme temperatures over the Arctic

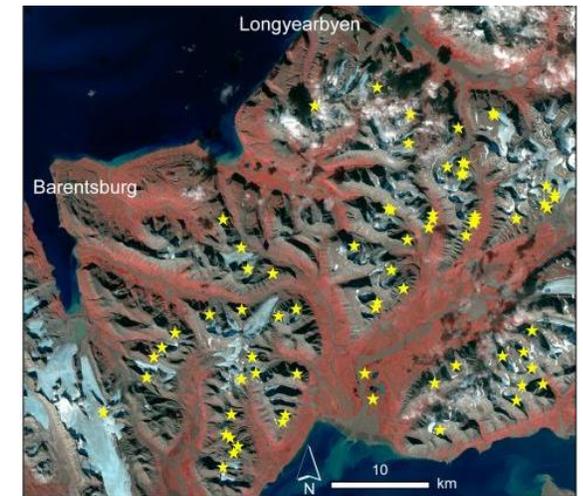


ARCTIC CHANGE – 7-10 December 2020

Observed daily precipitation, 7 November 2016



Landslides and slush avalanches identified by satellite images

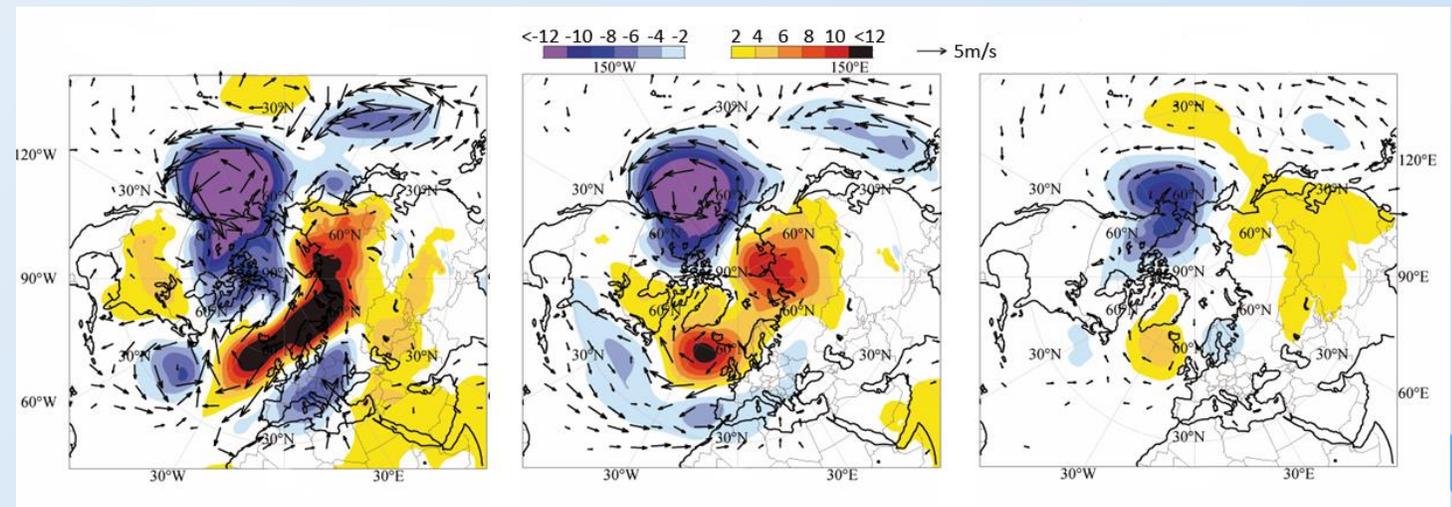


Case study: Extreme rainfall in Svalbard

Preparing for the future

- Understand linkages between the Arctic and mid-latitudes
- Enhanced weather and climate information can support preparedness of local populations to deal with events that can be catastrophic
- Next: explore how these type of events will look like in the future.

Sub-seasonal predictions 1, 2 and 3 weeks in advance
(potential occurrence of rain-on-frozen ground)



Lessons learned

Learning from the past

- Event **identified by stakeholders**. Ask stakeholders to provide feedback and help in the dissemination
- **Physical processes** and underlying causes of the event
- **Impact on society** and the economy
- Explore **event attribution**
- Identify **research gaps**

Preparing for the future

- Assess the **predictability** of the event
- Assess the **added value of climate services** for the affected/benefitted stakeholders
- **Build narratives** of how the event will look like in the future



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Thank You!

You can find the APPLICATE projects case studies here:

<https://applicat.eu/outreach/case-studies>

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