APPLICATE Climate Services:

Sharing knowledge through the co-production of case studies

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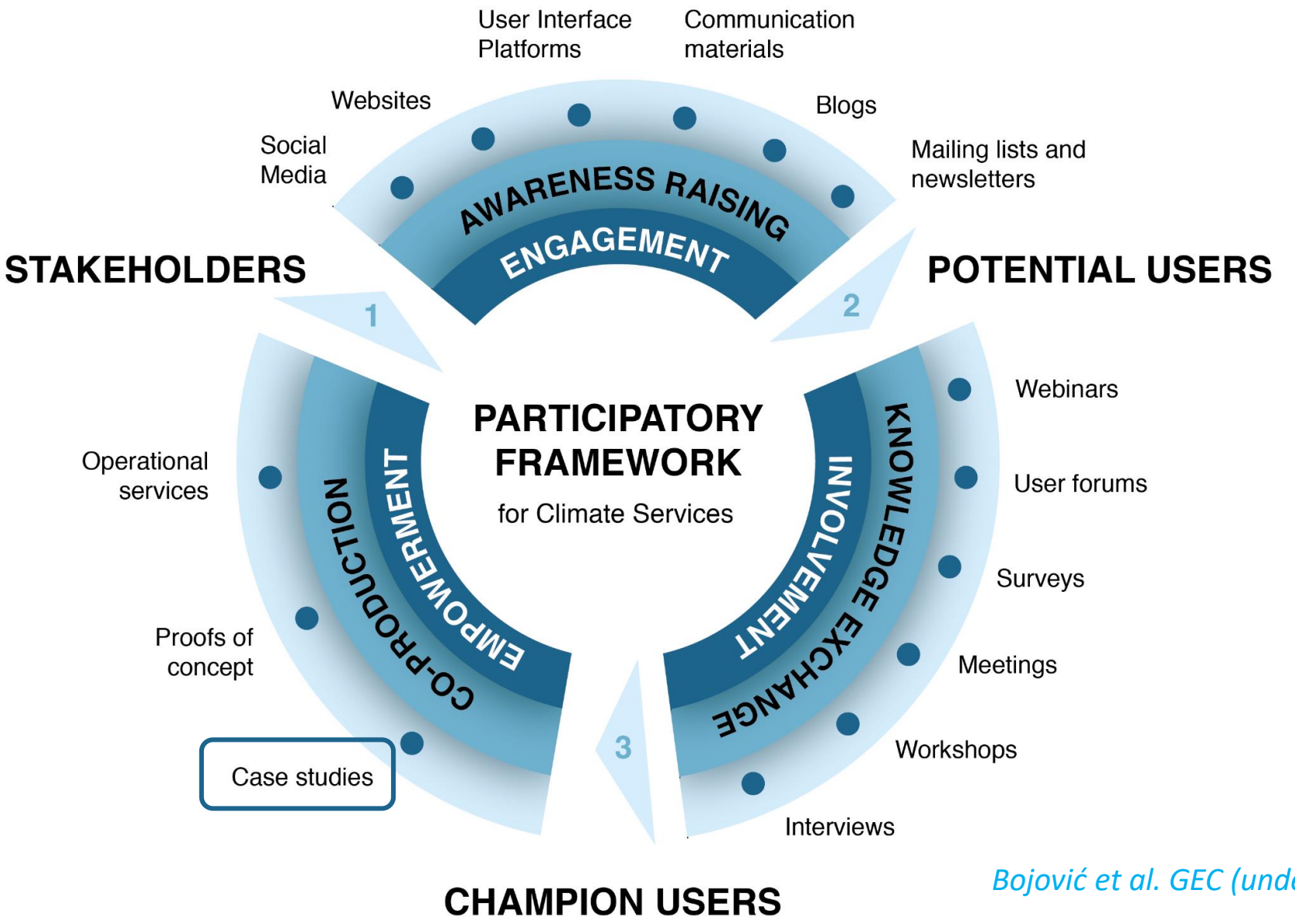
KNOWLEDGE CO-PRODUCTION



Bojović et al. GEC (under review)

INPUT FOR CASE STUDIES

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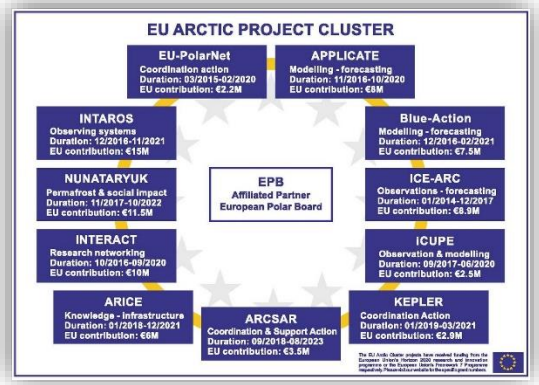
USER GROUP

BLOG Polar Prediction Matters

CASE STUDIES

WORKSHOPS

EU-POLAR CLUSTER/ OTHER PROJECTS



ECS

WHAT ARE CASE STUDIES?

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Particular EXTREME events of Arctic weather and climate with an IMPACT on specific aspects of the society or the economy of Arctic regions and beyond

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 death over winter due to climate change. Photograph: Geoffrey Reynaud/Getty Images/iStockphoto

- **Connect project outputs with particular past extreme events** to see if/how APPLICATE results would have been useful
- See how they can be useful for **future situations of this kind**

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CASE STUDIES

https://applicate.eu/outreach/case-studies

ENERGY CASE STUDY 1

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ENERGY CASE STUDY

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

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 spell
- Lower precipitation
- Lower wind speed

3 Energy demand — Increase in energy demand and lower than usual hydro and wind power generation

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 in 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).

GLOSSARY

A

Anomaly: difference between the sea ice extent, area or concentration at a given time and the long-term average. When it is negative, an anomaly indicates there is less ice than average for a given month.

B

Retrospective forecast: refers to a forecast made for a period of the past using only information available before the beginning of the forecast.

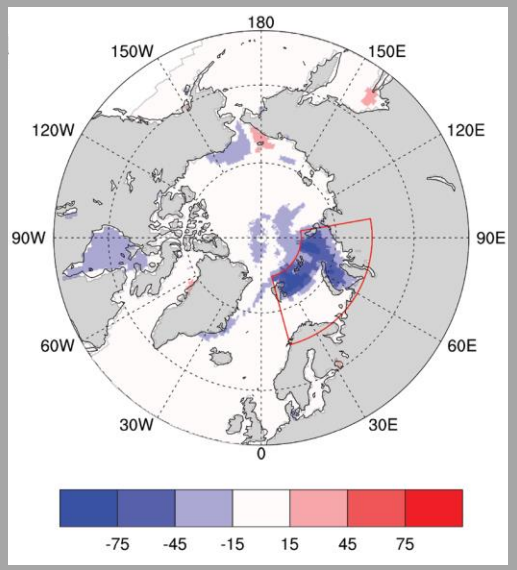
Contributors:

Marta Terrado, Dragana Bojovic, Isadora Christel, Juan Acosta, Pablo Ortega, Markus Donat, Llorenç Lledó (BSC-CNS, Spain), Halldór Johannsson (AP, Iceland), Thomas Jung (AWI, Germany); 2019.

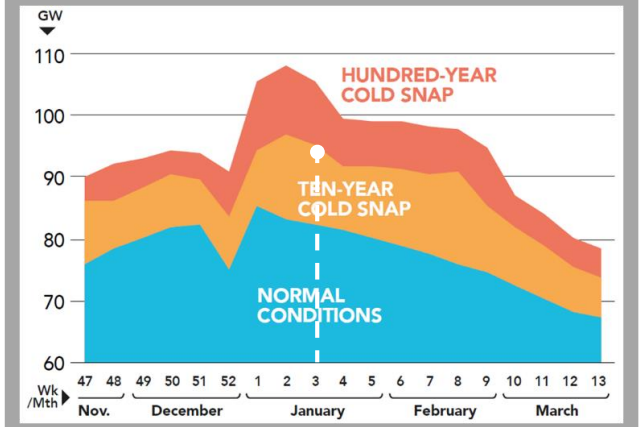
1

- Importance to understand **linkages**
- Value of climate and sea ice forecasts for adaptation and **assessing the risk for EU energy systems**

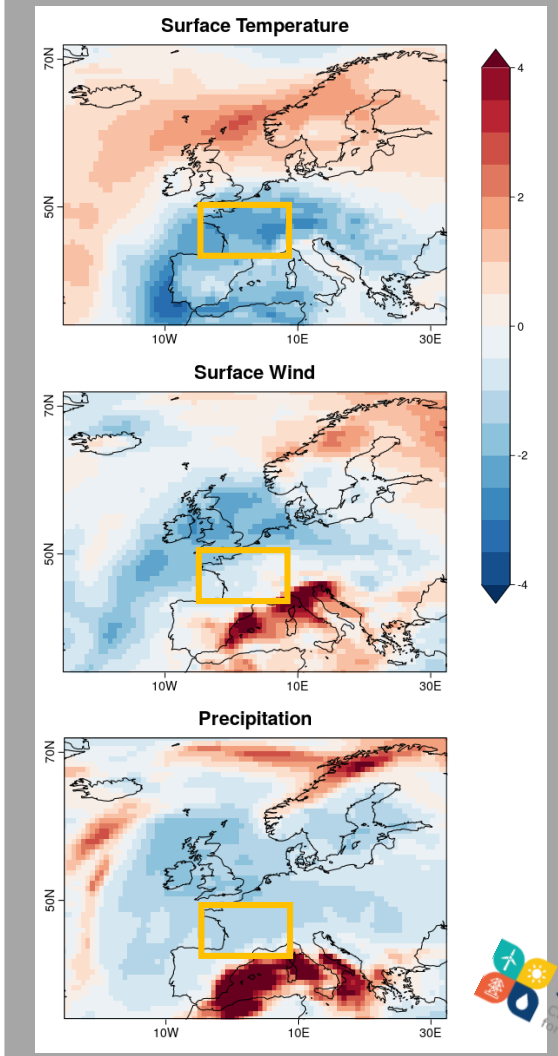
Sea ice concentration anomaly Barents and Kara Seas Nov-Dec 2016



Peak energy demand - France winter 2016-17



Cold spell + Lower-than-normal resources for renewable energy production France third week Jan 2017



S2S4E Climate Services for Clean Energy

ENERGY CASE STUDY 2

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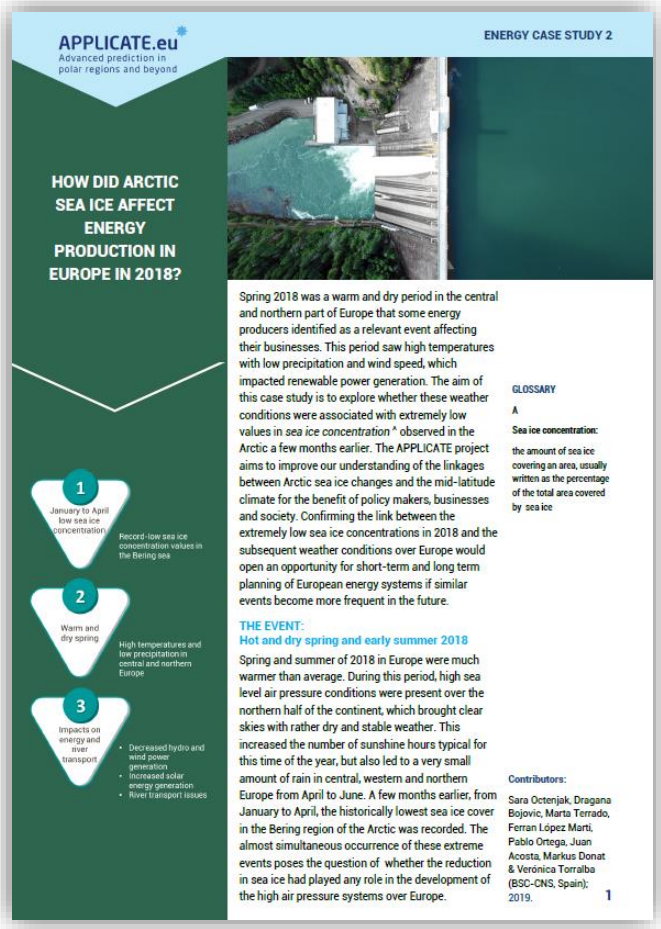

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ENERGY CASE STUDY 2

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

1 January to April low sea ice concentration — Record-low sea ice concentration values in the Bering sea

2 Warm and dry spring — High temperatures and low precipitation in central and northern Europe

3 Impacts on energy and river transport
- Decreased hydro and wind power generation
- Increased solar energy generation
- River transport issues

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* ^ 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.

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

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.

Contributors:

Sara Ocenjak, Dragana Bojovic, Marta Terrado, Ferran López Martí, Pablo Ortega, Juan Acosta, Markus Donat & Verónica Torralba (BSC-CNS, Spain); 2019.

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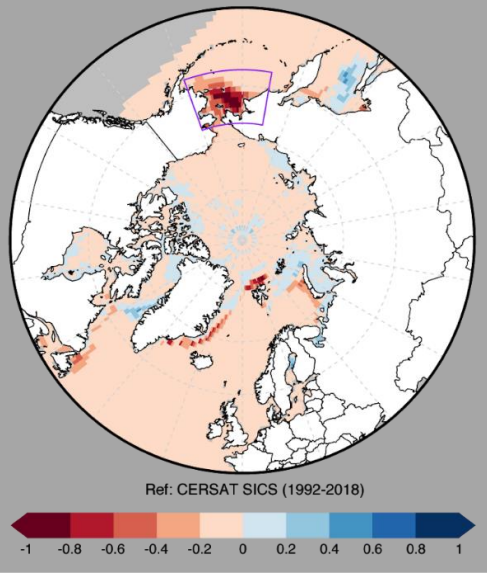
- Importance to understand **linkages**
- Value forecasts for adaptation and assessing the risk for **EU energy systems and transport of shipped commodities**

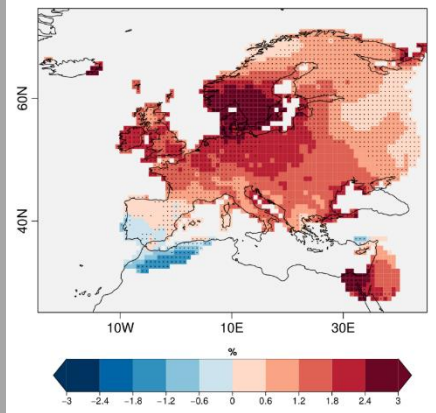
Sea ice concentration anomaly
Bering Sea Jan-Apr 2018



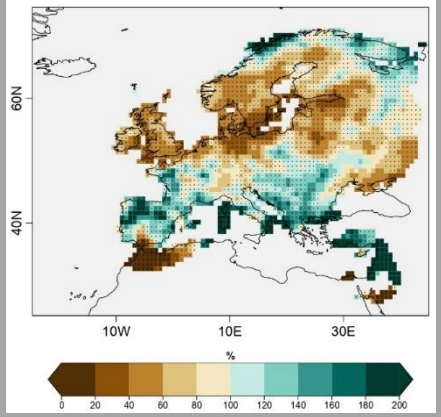
Rhine river transport
Impact companies supply and production

Increase cooling demand +
Lower-than-normal hydropower generation
Sweden & Germany May/June 2018

Surface Temperature



Precipitation



S2S4E
Climate Services for Clean Energy

RISK MANAGEMENT CASE STUDY

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RISK MANAGEMENT CASE STUDY

IS SVALBARD PREPARED FOR EXTREME RAINFALL?

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

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*[A] in Svalbard, which will lead to better predictions that improve the preparedness of local populations to deal with such events.

Arctic Circle
Russia
North pole
Svalbard

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

Upper photo: Landslide in mountainside above Longyearbyen, Svalbard, Thomas Nilsen, The Barents Observer

GLOSSARY

A

Extreme weather and climate events: The occurrence of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable at a particular location.

Contributors:
Marta Terrado, Dragana Bojovic & Juan Acosta (BSC-CNS, Spain), Linus Magnusson (ECMWF, UK), Morten Køltzow (MetNorway, Norway), Thomas Jung (AWI, Germany; 2019.

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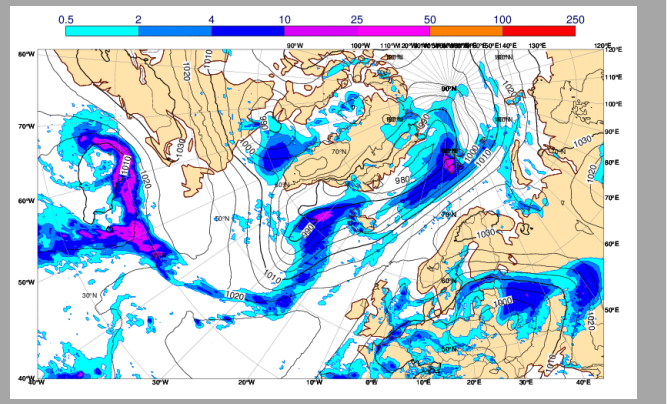
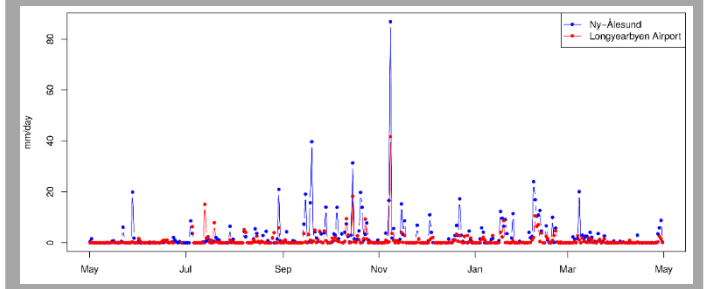
- Importance to understand **linkages**
- Model topography in **HRES for local variations in P**
- How forecasts can **help preparedness of local populations** to deal with catastrophic events

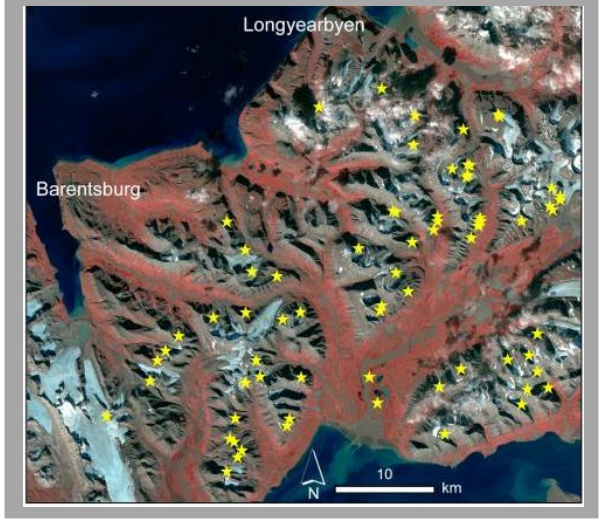
Warm and moist air moving northwards
November 2018
Extreme temperature over Europe and Arctic



Peak of extreme daily precipitation in Svalbard
7 November 2018 (rain on frozen ground)
P values > 100y return period



Landslides and slush avalanches identified by satellite images



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ONGOING WORK

WILDFIRES CASE STUDY

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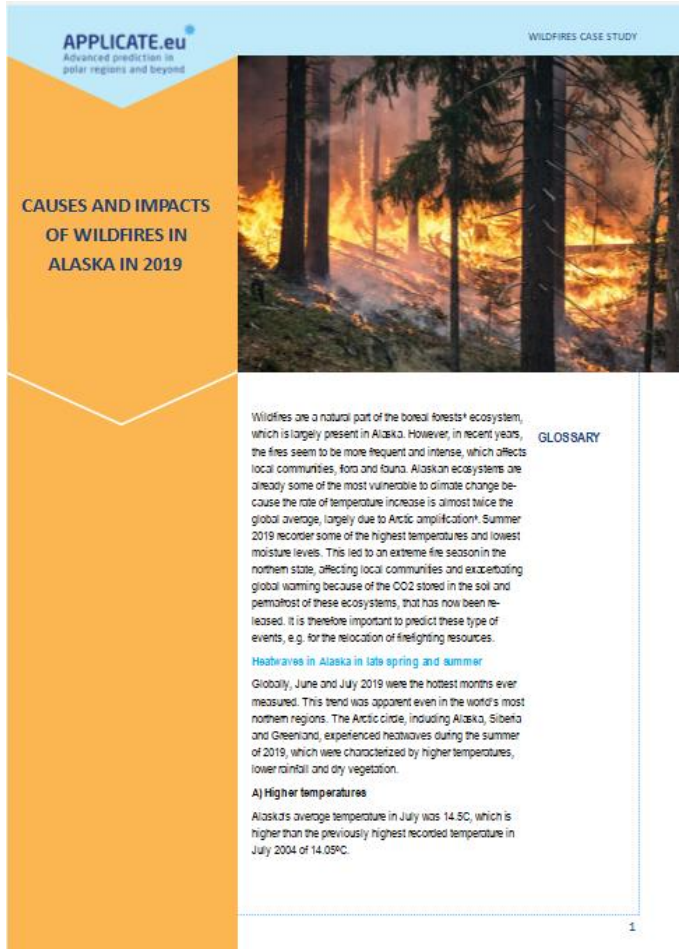
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WILDFIRES CASE STUDY

CAUSES AND IMPACTS OF WILDFIRES IN ALASKA IN 2019

Wildfires are a natural part of the boreal forests' ecosystem, which is largely present in Alaska. However, in recent years, the fires seem to be more frequent and intense, which affects local communities, flora and fauna. Alaskan ecosystems are already some of the most vulnerable to climate change because the rate of temperature increase is almost twice the global average, largely due to Arctic amplification². Summer 2019 recorded some of the highest temperatures and lowest moisture levels. This led to an extreme fire season in the northern state, affecting local communities and exacerbating global warming because of the CO2 stored in the soil and permafrost of these ecosystems, that has now been released. It is therefore important to predict these type of events, e.g. for the relocation of firefighting resources.

GLOSSARY

Heatwaves in Alaska in late spring and summer

Globally, June and July 2019 were the hottest months ever measured. This trend was apparent even in the world's most northern regions. The Arctic circle, including Alaska, Siberia and Greenland, experienced heatwaves during the summer of 2019, which were characterized by higher temperatures, lower rainfall and dry vegetation.

A) Higher temperatures

Alaska's average temperature in July was 14.5C, which is higher than the previously highest recorded temperature in July 2004 of 14.05ºC.

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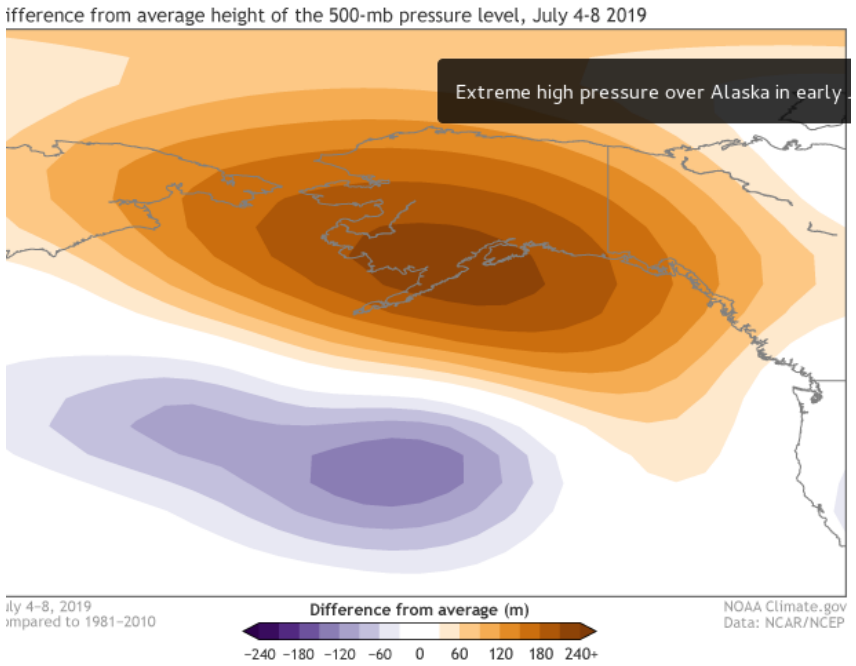

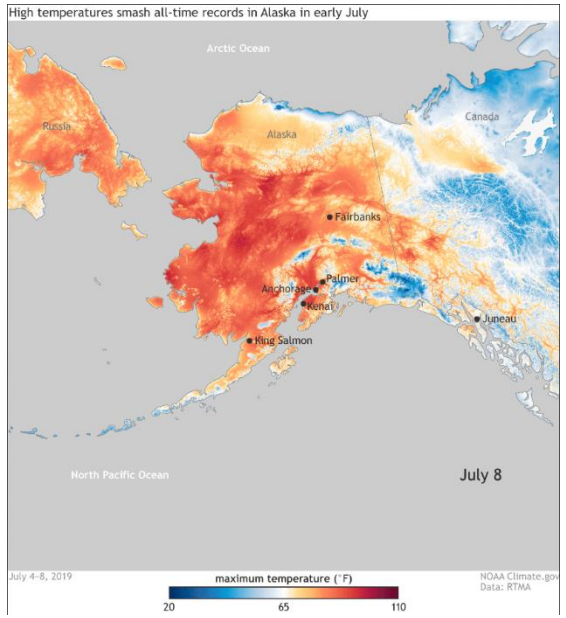

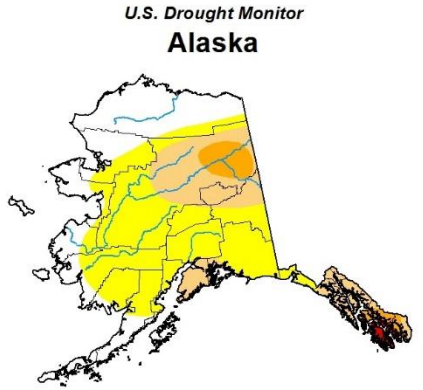

July 23, 2019
(Released Thursday, Jul. 25, 2019)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	30.37	69.63	24.47	5.79	0.88	0.00
Last Week 07-16-2019	30.69	69.31	24.10	2.00	0.88	0.00
3 Months Ago 04-23-2019	94.17	5.83	3.74	1.93	0.00	0.00
Start of Calendar Year 01-01-2019	94.17	5.83	2.35	1.02	0.00	0.00
Start of Water Year 09-25-2018	95.65	4.35	2.34	2.06	0.00	0.00
One Year Ago 07-24-2018	93.75	6.25	2.34	0.00	0.00	0.00

Intensity:
None
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

- Related to additional **carbon emission** from permafrost thaw
- Increased frequency of **lightning strikes**
- Smoke and **air pollution,** houses under-insured for **fire loss**
- **Firefighting resources** compete

OTHER CASE STUDY IDEAS

- Energy case study in the Arctic
- Reindeer husbandry
- Wildfires in Scandinavia
- Biodiversity & nature conservation, shipping (in collaboration with other projects)
- Insurance (e.g. start of catastrophic activity in the Arctic)

POLICY BRIEFS

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Arctic sea ice loss affects weather in mid latitudes

ISSUE

- 69 % of cubic kilometers of September Arctic sea ice has been lost since 1980, and this loss is starting to affect weather in midlatitudes.
- The scientific studies demonstrating the link between sea ice and weather in lower latitudes are already very advanced, while the political reaction still seems rather weak.

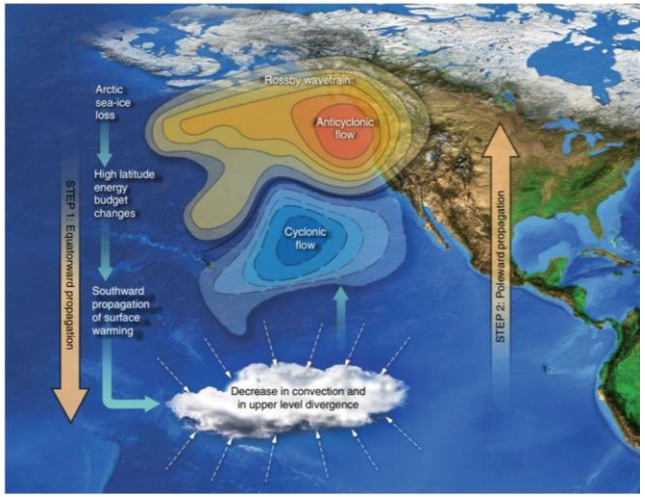
POLICY APPROACHES

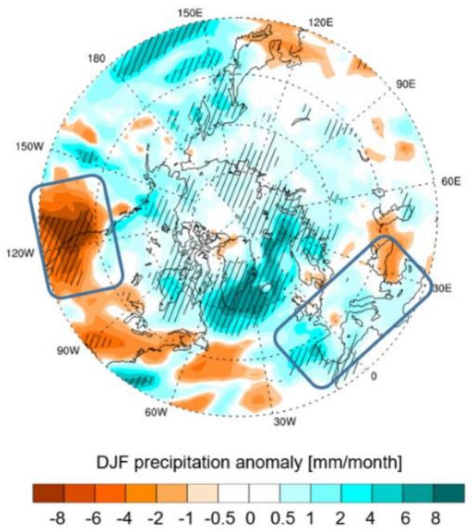
- Continue expanding climate change mitigation and adaptation strategies, with linkages between the Arctic and midlatitudes in mind.
- Make sure that all European sustainable development efforts in the Arctic are in line with the rights and concerns of indigenous peoples of the Arctic.
- Call for an international Arctic treaty, modelled after the Antarctic Treaty System, in order to make the Arctic a zone used exclusively for peaceful purposes.

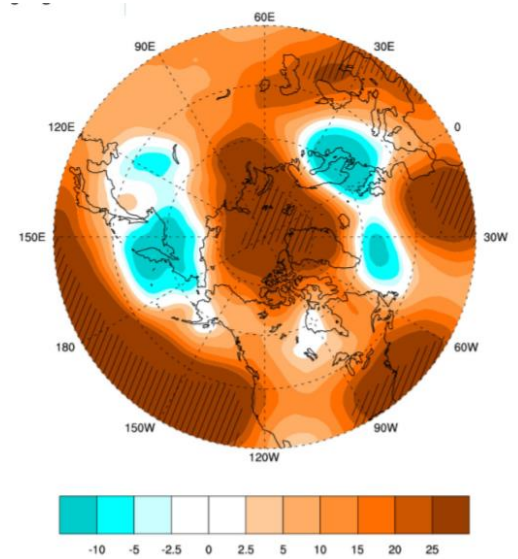
Context and scope of the problem - What is the issue?

Arctic sea ice loss

Future loss of Arctic sea-ice cover could drive substantial changes in weather in mid latitudes.

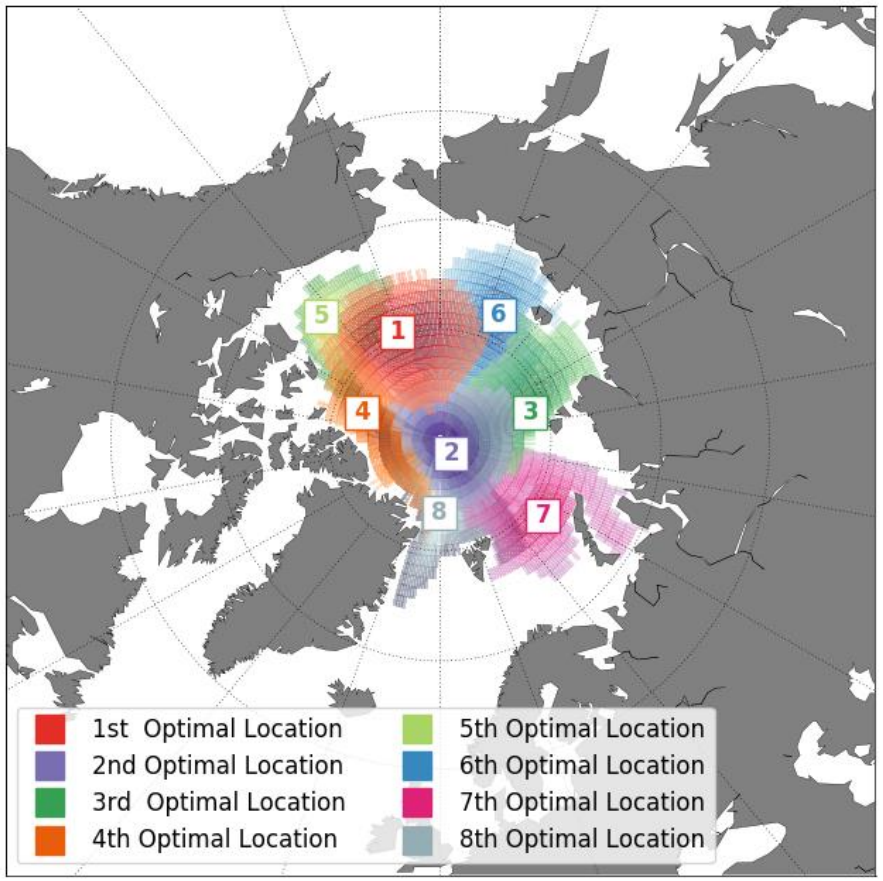






Policy Brief 2:

STRATEGIC PLACEMENT OF IN-SITU SAMPLING SITES TO INFORM POLAR OBSERVATIONAL NETWORKS



Statistical predictability of the Arctic sea ice volume anomaly: identifying predictors and optimal sampling locations

Leandro Ponsoni, François Massonnet, David Docquier, Guillian Van Achter, and Thierry Fichefet
Georges Lemaître Centre for Earth and Climate Research (TECLIM), Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium

Thank you!

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