SMF Day 1 – Tuesday 12 September 2023

SMF 6
12-13 Sept 2023
Toolik, Alaska

10:30-12:00	**Open floor**
12:00-12:15	The unpredictable Arctic
12:15-12:25	Making station data and publications widely available
12:25-12:30	Station outreach
12:30-13:30	**Lunch break**

INTERACT

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SMF Open Floor

Tuesday 11. September 10:30-12:00: SMF Open floor

1. Science Trails - **Kilpisjärvi Biological Station**, Finland (Tanja Lindholm)
2. A new opportunity to study an exceptional region at the center of the Nitassinan and a UNESCO World Biosphere Reserve - **Station Uapishka**, Canada (Charles Gignac and Marianne Valcourt)
3. The Lotic Model, quis magistret ipsos magistros? **Finse Alpine Research Centre**, Norway (Jens Haga)
4. Green Transition, solar energy - **Zackenberg Research Station**, Greenland (Torben R. Christensen)
5. Off grid internet solutions - **Zackenberg Research Station** and **Marine Expedition** (Torben R. Christensen and Morten Rasch)
6. New Actions - **Arctic DTU Sisimiut Research Station**, Greenland (Susanna Hansson and Steffen Bringsøe)
7. Update on Italian Arctic activities - **Dirigibile Italia, Italian Arctic Station**, Svalbard (Nicoletta Ademollo)
8. Test implementing AMAP micro/nano plastic monitoring protocols - **CEN Whapmagoostui-Kuujjuarapik Research Station**, Canada (Lise Millera Ferriz)






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INTERACT

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Elmer Topp-Jørgensen, Susse Wegeberg & Kári Fannar Lárusson





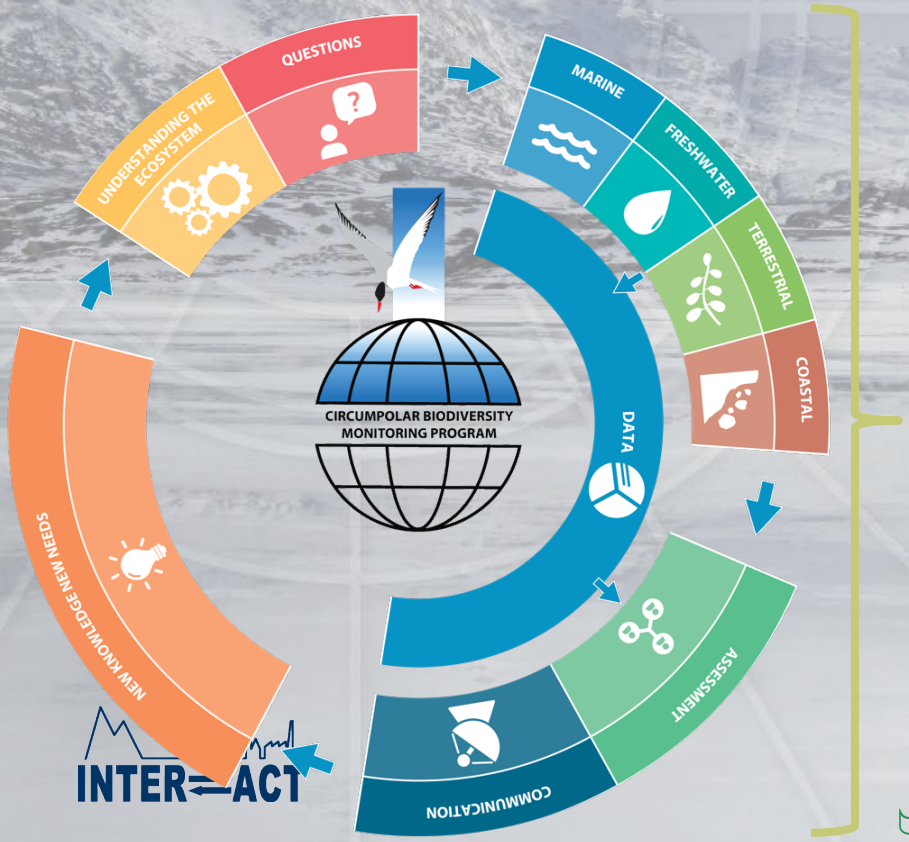

Monitoring framework for integrating extreme event monitoring into existing biodiversity monitoring efforts

Extreme events and rapid biodiversity change

SMF Task 2.1 Unpredictable Arctic

Circumpolar Biodiversity Monitoring Program

An international network to improve detection, understanding, and reporting of Arctic biodiversity trends.

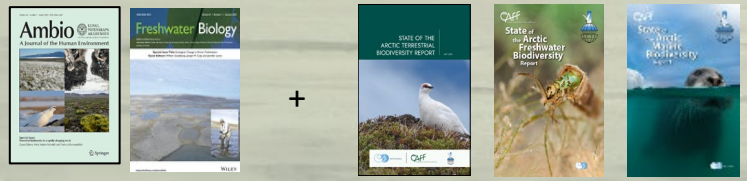


Coordinated circumpolar monitoring plans

Expert consensus on what, where and how to monitor

State of the Arctic Biodiversity Reports

Results on status and trends and advice for monitoring



Global information provider

ARCTIC COUNCIL · OSPAR COMMISSION · UN environment · NAMMCO · GBIF · Convention on Biological Diversity · OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM · GEO GROUP ON EARTH OBSERVATIONS · GEO BON · ICES CIEM International Council for the Exploration of the Sea

Task 2.1 The unpredictable Arctic

Subtask 2.1.1

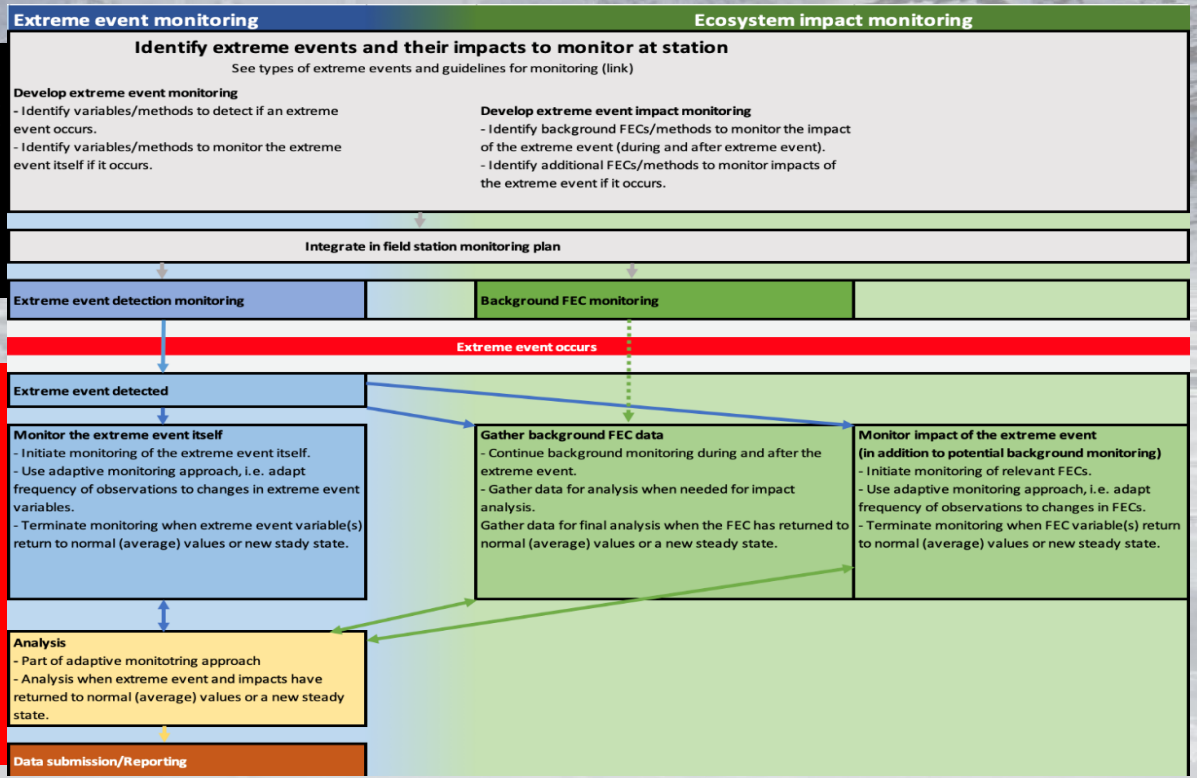
1) **Identify relevant types of extreme events**
2) **Develop monitoring programmes for extreme events and rapid biodiversity change**
3) Test monitoring programmes at four INTERACT stations
4) Disseminate refined protocols
5) Provide observations on extreme events and rapid biodiversity change
6) Develop mechanism for stations and their communities to provide data on unpredicted extreme events to JRA partners, decision makers and other stakeholders

Extreme events and rapid biodiversity change

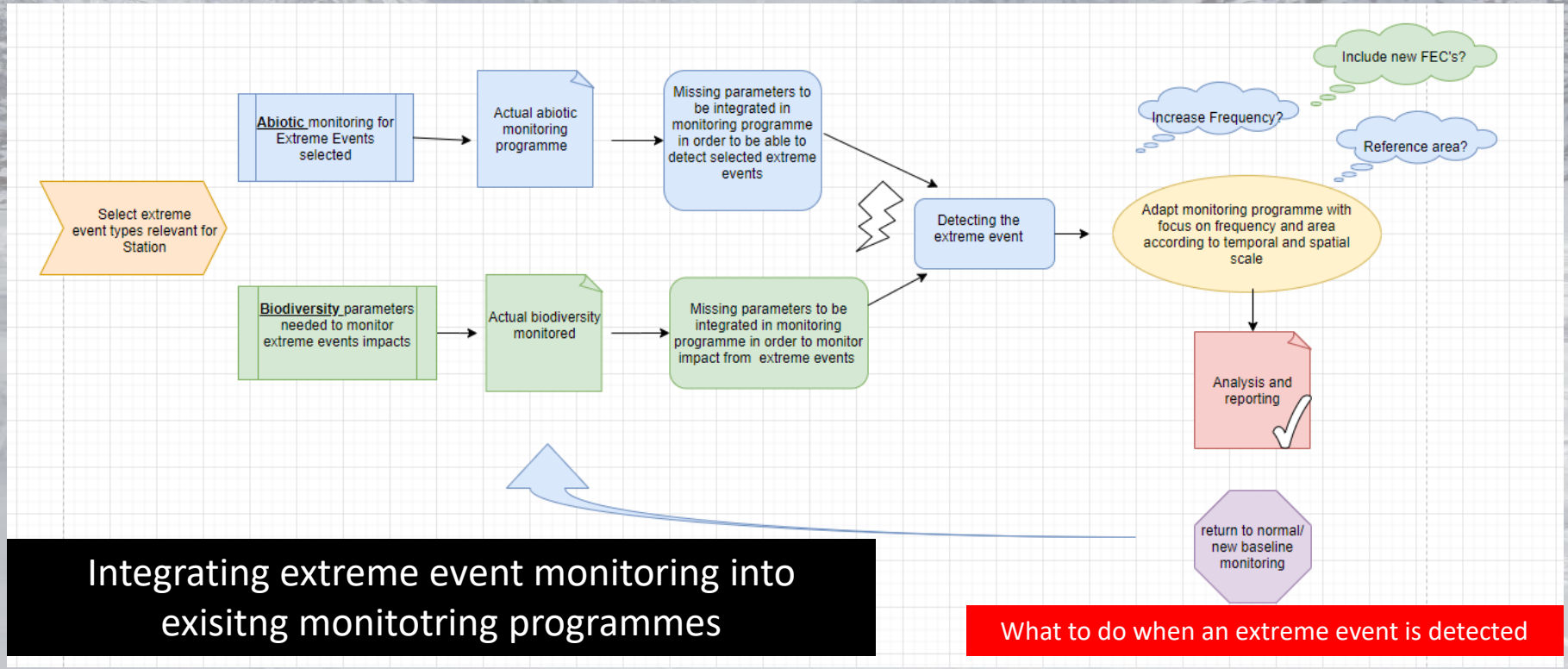
- Monitoring framework

Integrating extreme event monitoring into existing monitoring programmes

What to do when an extreme event is detected



Step-wise tool



Integrating extreme event monitoring into exisitng monitotring programmes

What to do when an extreme event is detected

Definitions

Meteorological
Temperature extremes
Precipitaion extremes:

Physical (derived)
Glaciers: extreme melt events
Extreme runoff

Combined driver
Precipitation
Temperature, runoff

Ecological
Browning
Pest outbreaks/population extremes

References for designation as extreme event
Research stations, van Beest et al. 2022, IPCC 2012
van Beest et al. 2022, Phoenix et al. 2023

References for descriptions and definitions
IPCC 2021, WMO 2016
Pheonix et al. 2023, Treharne et al. 2020

Description
Metrics of snow include both snowfall, snow-on-ground (extent, depth, location), snow density and avalanches
Strong wind events

Definition
Melting temeprature (0C)
Erosion of the land surface by thermal and mechanical processes

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Definitions

Meteorological	Physical (derived)	Combined driver	Ecological	References for designation as extreme event	Description	Definition	References for descriptions and definitions	Tools / methods
Extreme event					In many cases, a weather or climate event with high impact	The occurrence of a value 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	WMO 2016	
Temperature extremes	Heatwaves (summer)			AMAP 2021, IPCC 2021, WMO 2016, van Beest et al. (2022)	A marked unusual hot weather (Max, Min and daily average) over a region persisting at least two consecutive days during the hot period of the year based on local climatological conditions, with thermal conditions recorded above given thresholds (WMO 2016).	Number, percentage, or fraction of days with maximum temperature (Tmax) above the 90th, 95th, or 99th percentile, generally defined for given time frames (days, month, season, annual) with respect to the 1961-1990 reference time period (IPCC 2012). Daily maximum temperature exceeds its 90th percentile from a base period of 1961–1990 (IPCC 2021)	IPCC 2012, 2021, AMAP 2021, WMO 2016	Arctic Passion? ERA5 reanalysis dataset, from ECMWF contains weather/model data for the whole globe. It is a best guess and a combination of observations and a model. It can be plotted for any point in the world (so very useful for defining event thresholds, if you don't have a long observed record at the station of interest). See here for an example: https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/event/related_docs/DraftversionoftheGuidelinesontheDefinitionandMonitoringofExtremeWeatherandClimateEvents.pdf?h2Kr0f7dXp6CXZzocIQYveoEQ9FNoO5r
	Warm spell (winter warming)			WMO 2016	Heat waves differ from warm spells. Similar to heat waves, warm spells are defined as a persistent period of abnormal warm weather. It usually occurs during the cold period of the year, not during the climatologically hot period	Warm spell can be defined in terms of top 5th or 10th percentile of Tmax of the time of year.	WMO 2016	
	Inland flooding:	Precipitation		Research stations, AMAP 2021, WMO 2016	Floods can be defined as the effect of covering by water areas that are not normally underwater	Probability of occurrence of given quantities or on threshold exceedances (Section 3.1.2).	IPCC 2012, Radovic & Inglesias 2019	
	Glaciers: extreme melt events			AMAP 2021	Glacier melt during the warm season can trigger floodings		AMAP 2021	
	Glacier Lake Outburst Flood (GLOF)	*Precipitation*		AMAP 2021, IPCC 2012	Drainage of ice-dammed lakes or glacial outburst floods, occurs when a moraine is breached or an ice-dam fails (AMAP 2021). Glacial lake outburst floods are typically a result of cumulative developments and occur (i) only once (e.g., full breach failure of moraine-dammed lakes), (ii) for the first time (e.g., new formation and outburst of glacial lakes), and/or (iii) repeatedly (e.g., ice-dammed lakes with drainage cycles, or ice fall) (IPCC 2012)	GLOF event	AMAP 2021, IPCC 2012	
	Tsunami			AMAP 2021	Sudden thermafrost thaw, landslides and iceberg calving can cause tsunamis in coastal areas	Induced wave causing flooding	AMAP 2021, e.g., Wolper et al. 2021	
	Cold wave (autumn to spring)			IPCC 2012, WMO 2016	A marked and unusual cold weather characterized by a sharp and significant drop of air temperatures near the surface (Max, Min and daily average) over a large area and persisting below certain thresholds for at least two consecutive days during the cold season (WMO 2016).	Number, percentage, or fraction of days with minimum temperature (Tmin), below the 1st, 5th, or 10th percentile, generally defined for given time frames (days, month, season, annual) with respect to the 1961-1990 reference time period (IPCC 2012)	IPCC 2012, WMO 2016	
	Cold spell (summer)			WMO 2016, van Beest et al. (2022)	During summer the cooling of the air near the surface that can be caused by atypical seasonal temperature conditions and/or winds can lead to cold spells	A period of time during which temperatures drops significantly below the normal conditions	WMO 2016	
Icing / de-icing events	Rapid ice loss event (sea ice) (RILE)			AMAP 2021	E.g., loss of September sea-ice extent over a five-year period exceeding 0.5 millon km2		AMAP 2021, and references herein	
	Thaw/freeze events (rain-on-snow, freezing rain)			Beest et al. (2022)	Threshold is the freezing temeprature (0C), exceedance of which, on shorter timescales, and during winter precipitation events can result in freezing rain or rain-on-snow events	Defined as a minimum of 3 mm of rain falling on a minimum of 5 mm of snow water equivalent(?). Freezing temeprature (0C)	AMAP 2021	
	Permafrost thaw/degradation			AMAP 2021	Permafrost thaw has a clearly defined threshold (0C) but is largely dependent on the underlying (slow-onset) change in climate rather than short-duration warm events or single snowfall	Melting temeprature (0C)	AMAP 2021	
	Thermokarst			AMAP 2021, IPCC 2012	Subsidence of the ground surface and to the formation of uneven topography known as thermokarst, having implications for ecosystems, landscape stability, and infrastructure performance	Erosion of the land surface by thermal and mechanical processes	IPCC 2012	
Precipitaion extremes:				AMAP 2021, van Beest et al. (2022)			IPCC 2012	
Low precipitation	Drought	Temperature, runoff		AMAP 2021, IPCC 2021, WMO 2016	Periods of time with substantially belowaverage moisture conditions, usually covering large areas, during which limitations in water availability result in negative impacts for various components of natural systems and economic sectors (IPCC 2021)	Drought can be numerically defined using indices that integrate temperature, precipitation and other variables that affect evapotranspiration and soil moisture (WMO 2016)	IPCC 2021, WMO 2016	The most commonly used index is the PDSI (Palmer, 1965) that uses precipitation, temperature and local available water content data to assess soil moisture (WMO 2016)
			Browning	Peonix et al. 2023, Pheonix & Trehame 2022, Treharne et al. 2020, Phoenix & Bjerke	Acute and extensive loss of plant biomass at landscape and greater scales, thus large-scale vegetation damage	Browning is a systematic decrease in vegetation growth or the death of vegetation that results in a negative trend in NDVI or productivity and is observed using the same tools and methods used to identify greening	Pheonix et al. 2023, Treharne et al. 2020	Snow depth and air temperature data (two of the main climate variables implicated in browning) explained 63% of the plot-level Normalised Difference Vegetation Index (NDVI)
	Wildfire	Temperature		AMAP 2021, van Beest et al. 2022, IPCC 2021	Concurrent hot and dry conditions amplify conditions that promote wildfires (IPCC 2021), of which lightning may be the major driver (AMAP 2021)	Wildfire event	AMAP 2021, IPCC 2021	
High (heavy) precipitaion				AMAP 2021, IPCC 2012, 2021, WMO 2016	A marked precipitation event occurring during a period of time of 1h, 3h, 462 6h, 12h, **24h** or 48 hours with a total precipitation exceeding a certain threshold defined for a given location	The flexibility to define the percentile level for extremes will also allow users to define a very *rare event*, for instance an event exceeding the 99th percentile, or a *record breaking event* which exceeds the highest percentile (WMO 2016). E.g., number of days exceeding the 95th percentile (AMAP 2021)	AMAP 2021, WMO 2016	
	Extreme runoff	Temperature		IPCC 2021				
	Landslides	Hydroclimatic extreme		Research stations, van Beest et al. 2022, IPCC 2012	Triggered by raised groundwater levels after excess rainfall or active layer detachments in thawing slopes of permafrost (IPCC 2012) or flooding (AMAP 2021, WMO 2016)	Landslide event	IPCC 2012, and references herein	
	Extreme ice/snow cover:	Temperature		AMAP 2021	Metrics of snow include both snowfall, snow-on-ground (extent, depth, location), snow density and avalanches		Bokhorst et al. 2016, table 2	Arctic Passion?
	Thickness *Density?* *Spatial coverage* *Temporal coverage*	*Storms/cyclones*						
	Snow avalanches				Rapid downward movement of snow down a sloped section of land under the influence of gravity	Snow avalange event		
Wind	Storms/cyclones			AMAP 2021, IPCC 2021, van Beest et al. 2022	Strong wind events	Storm from wind velocities of 24.5 m/s (Beaufort scale)	DMI	Arctic Passion?
	Extreme wave heights, flooding			IPCC 2021, AACA 2017, SWIPA 2017	Floods are the effect of covering by water areas that are not normally underwater	Inundation of normally dry land	Radovic & Inglesias 2019, IPCC 2021	
	Coastal errosion	Storms/cyclones		AMAP 2021	Coastal erosion In tha Arctic has an average rate of several meters per year, and rates may exceed 5 m/y (Beaufort Sea coast). Because much of the Arctic coastline is permafrost, thermal as well as dynamic processes impact erosion rates.	Coastal erosion rate, meters per year,	AMAP 2021	
Atmospheric blocking		Storms/cyclones		AMAP 2021	High-latitude blocking often represents persistent, quasi-stationary anticyclonic conditions that divert the zonal path of hte polar jet stream and tend to yield more meridional transport of storms into and out of the Artic. E.g., Greenland Blocking Index (GBI). It measures blocking over Greenland which impacts both climate and weather in the Northern Hemisphere	GBI is the mean 500 hPa geopotential height for the 60-80°N, 20-80°W region.	Hanna et al. 2016. https://psl.noaa.gov/gcos_wgsp/Timeseries/GBI_UL/	
			Pest outbreaks/ population extremes	van Beest et al. 2022, Phoenix et al. 2023	An insect pest outbreak is a large and sporadic population of insect pests	Pest population rises significantly above its general equlibrium level	https://brewerint.com/news-insights/101-guides/managing-insect-	
			Non-native invasive species		Introduction of a non-native species that becomes invasive, i.e., inhabits habitats otherwise inhabited by native species and out-competes them.	1) non-native (or alien) to the ecosystem under consideration and, 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.	https://www.invasivespeciesinfo.gov/	

Description of extreme event				Detecting and monitoring the extreme event itself			Monitoring ecosystem impacts of the extreme event			References/links
	Expected temporal scale of extreme event itself	Expected spatial scale of extreme event itself	Types of impact (and relevant cascading effects)	Define extreme event - Suggested definition	Method to detect extreme event	Method to monitor (risk of) extreme event itself (if different from detection method)	Suggested baseline data needed to assess impact on ecosystem/biodiversity	Suggested method to monitor impacts of extreme event (if different from	Expected temporal scale of impact	
Precipitaion extremes										
Low precipitation (drought)	Medium (< year)	Large scale (Regional, > 100 km2)	Impact on terrestrial ecosystem - coverage/abundance, survival and reproduction of flora and fauna from suboptimal conditions	The lowest 2% of seasonal rainfall totals or less than expected from trend analyses	Precipitation measurements		Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, demographics, temporal cycles and health for	Monitor in affected and comparable reference area	< 5 years	https://www.climate.gov/news-features/understanding-climate/extreme-event-attribution-climate-versus-weather-blame-game
High precipitation (flooding)	Brief (< month)	Medium (Several catchments/ < 10 km	Impact on terrestrial ecosystem - coverage/abundance, survival and reproduction of flora and fauna from suboptimal conditions from loss of substratum, flush and drowning	Days with precipitation in the top 1 percent of all days with precipitation or more than expected from trend analyses	Precipitation measurements Water level measurements	Remote sensing or field measurements of affected area (size of area)	Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles	Monitor in affected and comparable reference area	< 5 years	https://www.globalchange.gov/browse/indicators/heavy-precipitation
Temperature										
Heat waves	Brief (< month)	Large (region/ > 10 km2)	Impact on terrestrial ecosystem - coverage/abundance, survival and reproduction of flora and fauna from suboptimal conditions	Daily temperatures > 10 C above high average or more than expected from trend analyses	Air temperature measurements		Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles		< 5 years	https://www.un-spider.org/extreme-temperature
Cold	Brief (< month)	Large (region/ > 10 km2)	Impact on terrestrial ecosystem - coverage/abundance, survival and reproduction of flora and fauna from suboptimal conditions	Temperatures of - 55 C, including wind chill, issues extreme cold warning or less than expected from trend analyses	Air temperature measurements		Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles		< 5 years	https://en.wikipedia.org/wiki/Extreme_cold_warning
Extreme ice/snow cover										
Thickness	Brief (< month)	Large (region/ > 10 km2)	Delay of snow melt and uncover of vegetation, decreases availability of feed for higher trophic levels and higher risk of mismatch	Snow cover thickness less than 2 % of the long-term average or significantly more than expected from trend analyses	Weekly measurements of snow cover thickness		Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles and health for flora and fauna	Monitor in affected and comparable reference area	< 1 year	Kunkel, K.E., Robinson, D.A., Champion, S. *et al.* Trends and Extremes in Northern Hemisphere Snow Characteristics. *Curr Clim Change Rep* **2**, 65–73 (2016). https://doi.org/10.1007/s40641-016-0036-8 Bokhorst, S., Pedersen, S.H., Brucker, L. et al. Changing Arctic snow cover: A review of recent developments and assessment of future needs for observations, modelling, and impacts. Ambio 45, 516–537 (2016). https://doi.org/10.1007/s13280-016-0770-0, https://link.springer.com/article/10.1007/s13280-016-0770-0
Spatial coverage	Medium (< year)	Large (region/ > 10 km2)	Larger area, with potential decreased availablity of feed for higher trophic levels	Area with snow cover within normal thickness range changed by more than 1% of normal area or significantly more than expected from trend analyses	Weekly measurements of snow cover thickness combined with satelite information on spatial range		Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles	Monitor in affected and comparable reference area	< 1 year	https://www.epa.gov/climate-indicators/snow-ice
Temporal coverage	Medium (< year)	Large (region/ > 10 km2)	Delay in uncover of vegetation, decreases productivity, availability of feed for higher trophic levels and higher risk of mismatch	Season with snow cover within normal thickness range changed by more than 2 weeks or significantly more than expected from trend analyses	Weekly measurements of snow cover thickness		Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles	Monitor in affected and comparable reference area	< 1 year	https://www.epa.gov/climate-indicators/snow-ice
GLOF (glacier-lake-outburst-flood)	Short (< day)	Medium (Several catchments/ < 10 km	Impact on terrain, land organisms, their productivity, biodiversity and habitat composition by loss of substratum, flush and drowning	Flooding from outburst of a glacier lake	Air temperature measurements, satelite observations on glacier retreat and glacier lake size or water level measurements. Observation of outburst	Remote sensing or field measurements of affected area (size of area)	Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles and health for flora and fauna	Monitor in affected and comparable reference area	>5 years	
Icing events										
Icing	Brief (< month)	Large (region/ > 10 km2)	Impact ability of herbivores to reach food source under snow. Affect reproduction and	Formation of ice layer in vegetation or on snow > 10 mm	Observations of precipitation type and temperature	Snow structure measurements	Diversity, abundance, composition, productivity, phenology, spatial structure,	Monitor in affected and comparable reference area	< 5 years	Berger, J., Hartway, C., Gruzdev, A. et al. Climate Degradation and Extreme Icing Events Constrain Life in Cold-Adapted Mammals. Sci Rep 8, 1156

Detecting and monitoring the extreme event itself	Monitoring ecosystem impacts of the extreme event
Example: Extreme event monitoring	Ecosystem impact monitoring: Affect food availability. Affect reproduction and population size. Changes in herbivore population may affect predator populations and plant community composition
Detection: minimum of 3 mm of rain falling on a minimum of 5 mm of snow water equivalent. Freezing temperature (0C)	**Background data needed:** Diversity, abundance, composition, productivity, phenology, spatial structure, ecosystem functions and processes, phenology, demographics, temporal cycles and health for flora and fauna
(ROS) Rain on S **Monitor/assess extreme event:** Preferrably daily measurements of (type of) precipitation and snow layer thickness and temperature	**New monitoring:** Monitor in affected and comparable reference area

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NEXT STEPS

- Approval in CAFF/CBMP
  - incl. identification of prioritised FECs for each type of extreme event
- Finalising guidance documents
- Test implementation 2023 at INTERACT stations
- Integrate in CBMP Interactive online tools

Toolkit-
unpublished Beta

FECS MONITORING

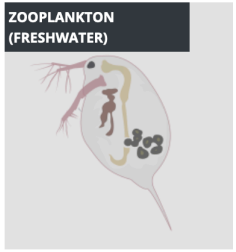
What, where, and how to monitor Arctic biodiversity (and other advice) from the Circumpolar Biodiversity Monitoring Program (CBMP).

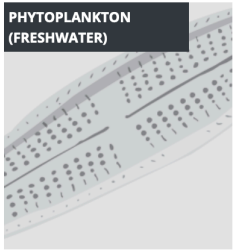
The CBMP has identified targets for monitoring, called Focal Ecosystem Components (FECs). FECs likely indicate changes in the overall environment and have been prioritized for various reasons including importance to Arctic peoples, circumpolar distribution, monitoring feasibility, available data, and more. Here the CBMP provides advice for gathering data and reporting on FECs.

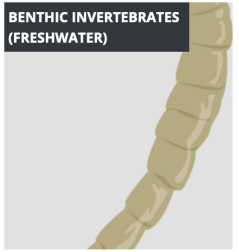
FECs have been identified in ecosystem-based Arctic Biodiversity Monitoring Plans (Marine, Freshwater, Terrestrial, Coastal), and refined via State of the Arctic Biodiversity reporting processes. CBMP products represent agreement across Arctic states on how to coordinate and generate better results from existing monitoring efforts, and identify gaps in knowledge and ongoing monitoring. Arctic Biodiversity Monitoring Plan implementation—including monitoring the FECs below—supports efforts to compile, harmonize and compare results from existing biodiversity and ecosystem monitoring efforts.

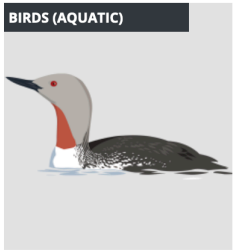
Ecosystem | Species group | Habitat

Freshwater

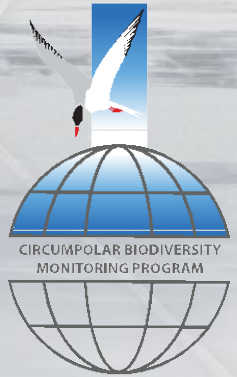








Let’s INTERACT



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INTERACT

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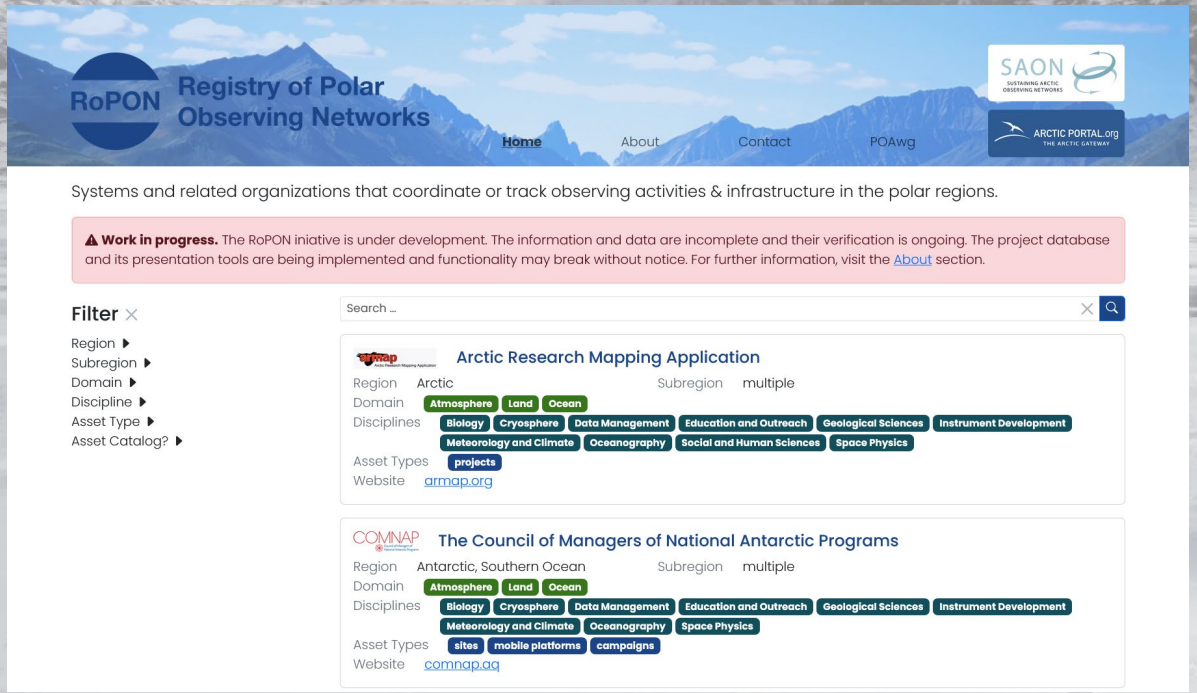
Meet **RoPON**

- Registry of Polar Observing Networks

Developed by POA wg - Polar Observing Assets working group
Under SAON – Sustained Arctic Observing network
An Arctic Council initiative

D2.8 Pocket guide on metadata standards for scientific networks

SMF contributes to development of the system and has provided our INTERACT GIS metadata standard related to stations, networks and projects



http://poawg.arcticportal.org:14200/search



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INTERACT

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M2.19-20 ‘Open House’ thematic days at minimum ten research stations






Open station events arranged at INTERACT stations

Themes:

- Climate Change
- What can you do?

M2.19-20 'Open House' thematic days at minimum ten research stations

Participating stations:
Finse, Nibio Svanhovd, KEVO, Kluane Lake, Arctic Station, DTU Arctic Sisimiut, GINR, Jaerdfengi, Cairngorms






Materials developed

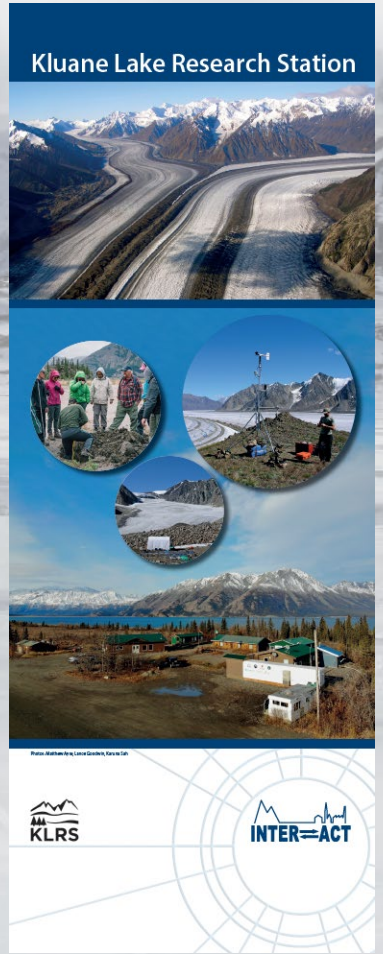
Roll-ups (about INTERACT + individual stations)
Posters (both themes)
PPT (Climate Change theme)

Will soon be available for all on the INTERACT website

Roll-ups

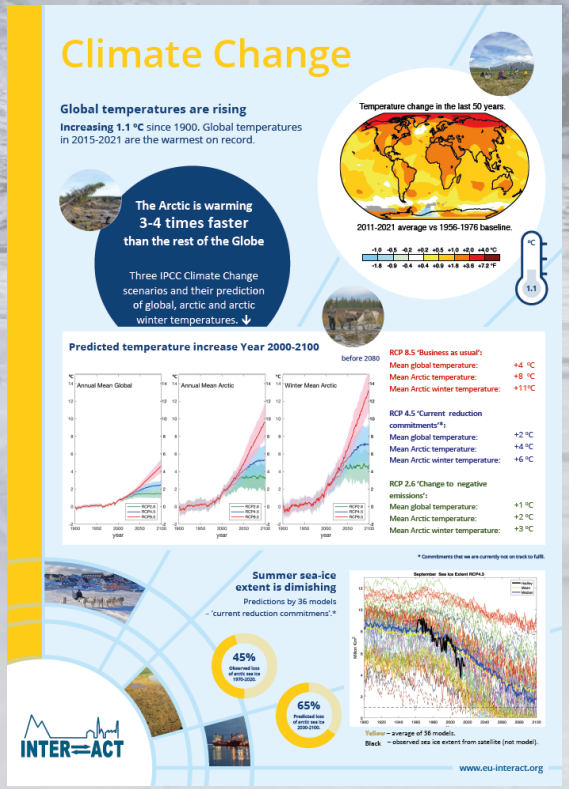
About INTERACT

Individual stations



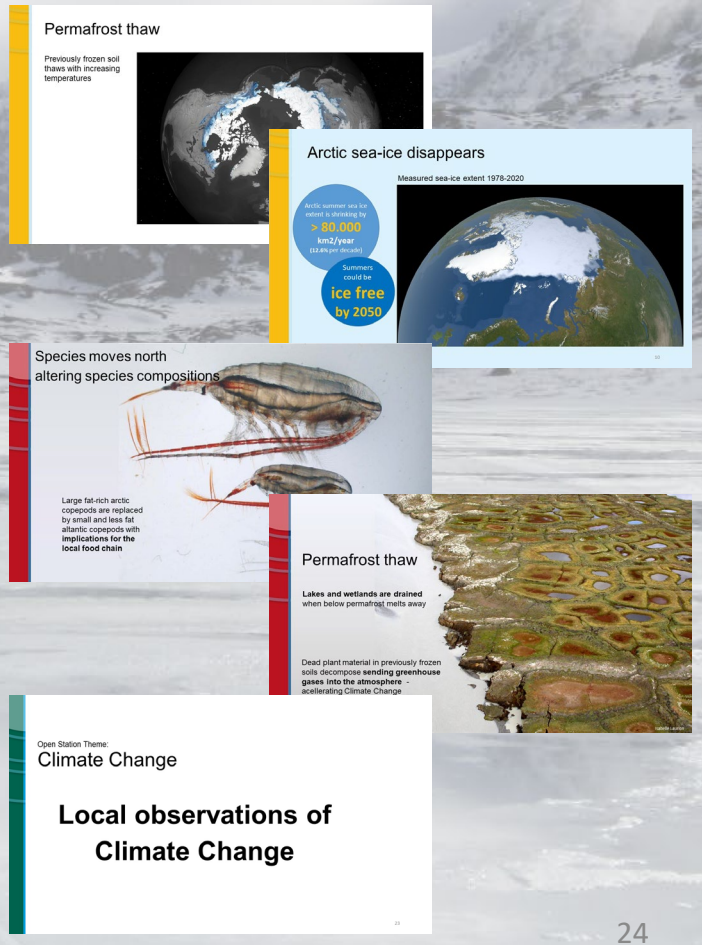
Climate Change theme

Posters



Climate Change theme

Power Point



INTER⇌ACT

What can you do? theme

Posters

On display at Toolik

– take a look during coffee break

There is one blank poster where you can write local changes observed at your station

Lunch break

SMF 6
12-13 Sept 2023
Toolik, Alaska

13:30-13:45	A cleaner Arctic
13:45-15:00	The Future of SMF (1) - workshop on challenges, opportunities and priorities
15:00-15:30	**Coffee break**
15:30-17:30	Tour of Toolik, including nearest experimental sites
18:00	**Dinner at the station**

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