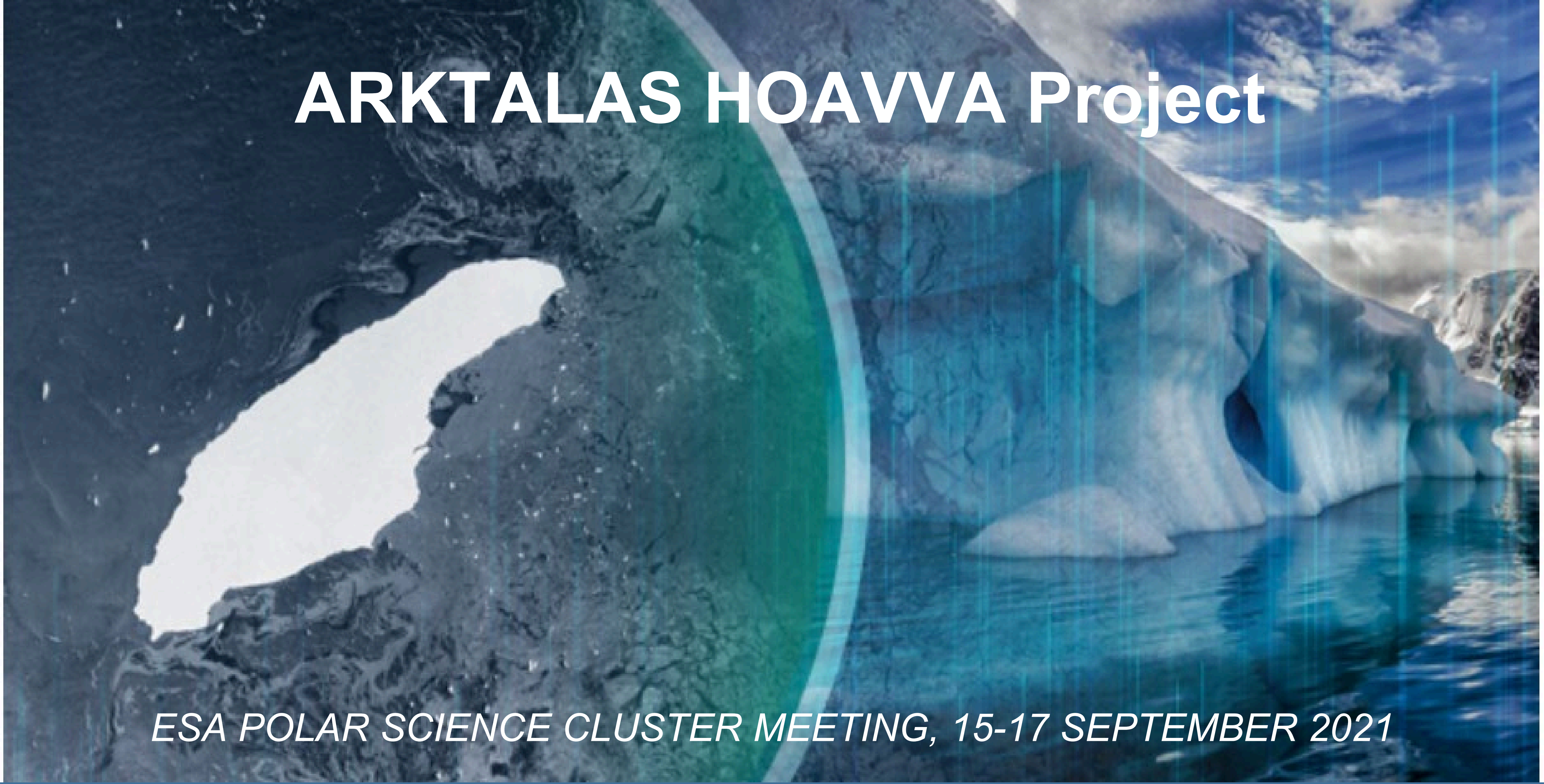
ARKTALAS HOAVVA Project



ESA POLAR SCIENCE CLUSTER MEETING, 15-17 SEPTEMBER 2021

NERSC

Partner in:

BJERKNES CENTRE
for Climate Research

SFI Smart Ocean
SFI Climate Futures

MERCATOR OCEAN INTERNATIONAL

opernicus
Europe's eyes on Earth

ARKTALAS HOAVVA Project Team

ESA Contract No. 4000127401/19/NL/LF – September 2019 to April 2022

NERSC: Johnny A. Johannessen, Anton Korosov, Igor Esau, Adrien Perrin, Timothy Williams, Einar Olason, Jonathan Rheinlænder, Lasse Pettersen

Ifremer: Bertrand Chapron, Camille Lique, Fabrice Ardhuin, Jean-Francois Piollé

OceanDataLab: Fabrice Collard, Sylvain Herlédan

NOVELTIS: Mathilde Cancet, Sylvain Lucas

ESA Scientific and Technical Officers: Craig Donlon and Diego Fernandez

Overall Objective of the Arktalas Hoavva Proje

Use satellite measurements in synergy with in-situ data and mo ols to visualize, characterize and quantify the key processes drivi es in the Artic sea ice and Arctic Ocean.

TO DO SO

ADVANCES IN PROCESS UNDERSTANDING IS A KEY

The following interlinked and cross-disciplinary **ntific Challenges (ASC)** are investigated:

ASC-1: Characterize & predict c ocean spin-up.

ASC-2: Characterize i larger area of open water on sea ice dynamics.

ASC-3: Cha & predict impact of extreme event storms on sea-ice condition

AS aracterize Arctic Amplification and its impact.

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Main Deliverables: Scientific Papers addressing these 4 ASC

ASC-1: Characterize & predict the Arctic ocean spin-up.

*Paper by Regan et al, JPO, 2020 (*Response of Total and Eddy Kinetic Energy to the recent spin up of the Beaufort Gyre)

ASC-2: Characterize impact of larger area of open water on sea ice dynamics.

*Paper by Cassianides et al., GRL, 2020 (*Observational evidences of eddy-sea ice interactions in the pack-ice and in the MIZ)

*Paper by Ardhuin et al in preparation (*Waves & currents in the MIZ: Exploring mechanical effects and feedback)

*Paper by Cancet et al to be submitted early 2022 (*Impact of sea-ice friction on tidal modelling in Arctic Ocean)

ASC-3: Characterize & predict impact of extreme event storms on sea-ice conditions.

*Paper by Rheinlænder et al., to be submitted to Nat. Geo by Sept. 2021 (*Assessment of Arctic storm effects on sea ice)

ASC-4: Characterize Arctic Amplification and its impact.

*Paper by Esau et al, to be submitted to RSE, October 2021 (*Arctic Amplification and its impact: Attribution through remote-sensing data)

Synthesis paper: Gap analyses and future missions

Paper by S. Lucas et al to be submitted in early 2022 (Impact of future satellite missions for understanding changes in the Arctic)

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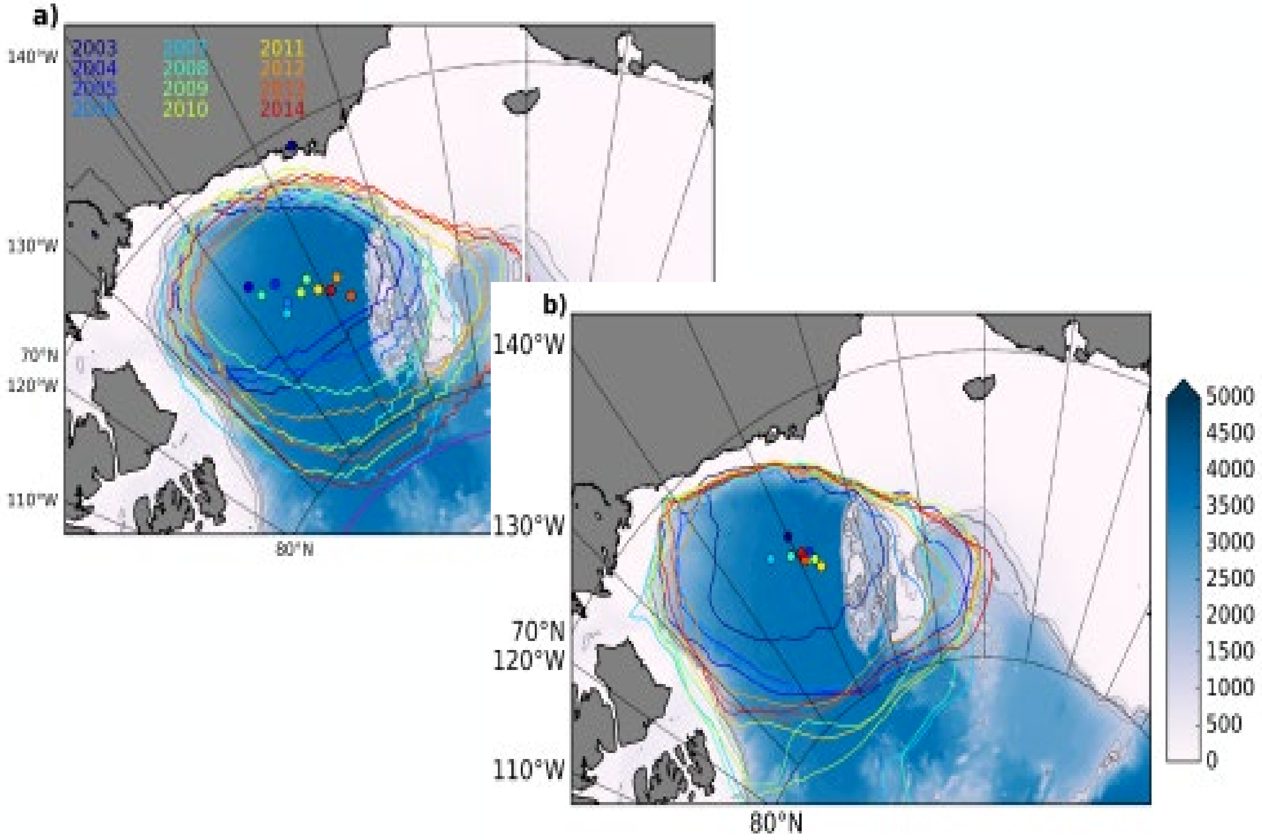
Paper by Regan et al, JPO, 2020

Arctic Ocean spin-up 2003-2014 (ASC 1)

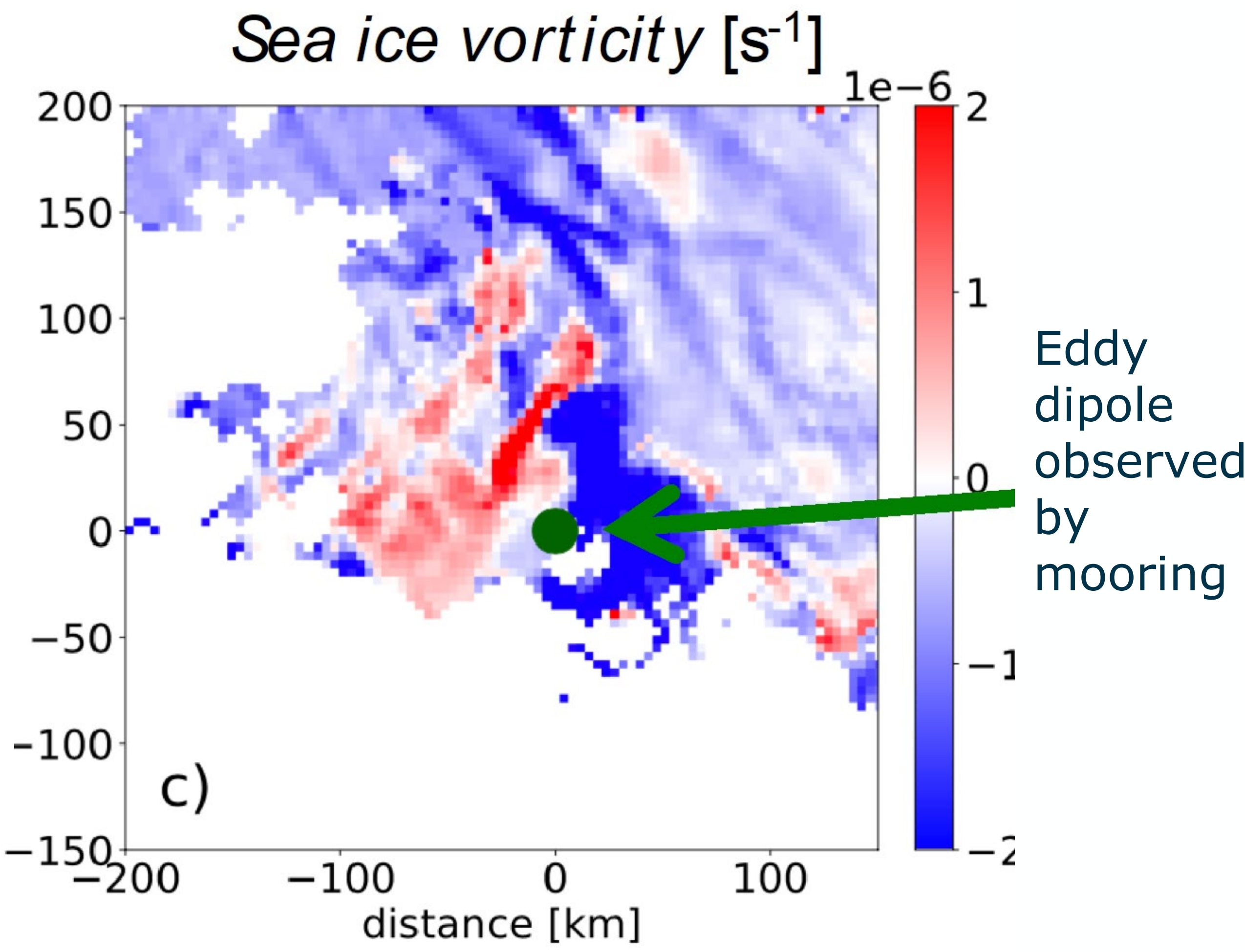


Annual-mean gyre extent from 2003–2014 in (a) DOT observations (Armitage et al. 2016, 2017 and (b) in high res model simulation (bathymetry in color).

The gyre has spun-up and sustained a higher level of mean kinetic energy that is generally not accompanied by higher levels of EKE.

Paper by Cassianides et al., GRL, 2020

Observational evidences of eddy-sea ice interactions (ASC-2)



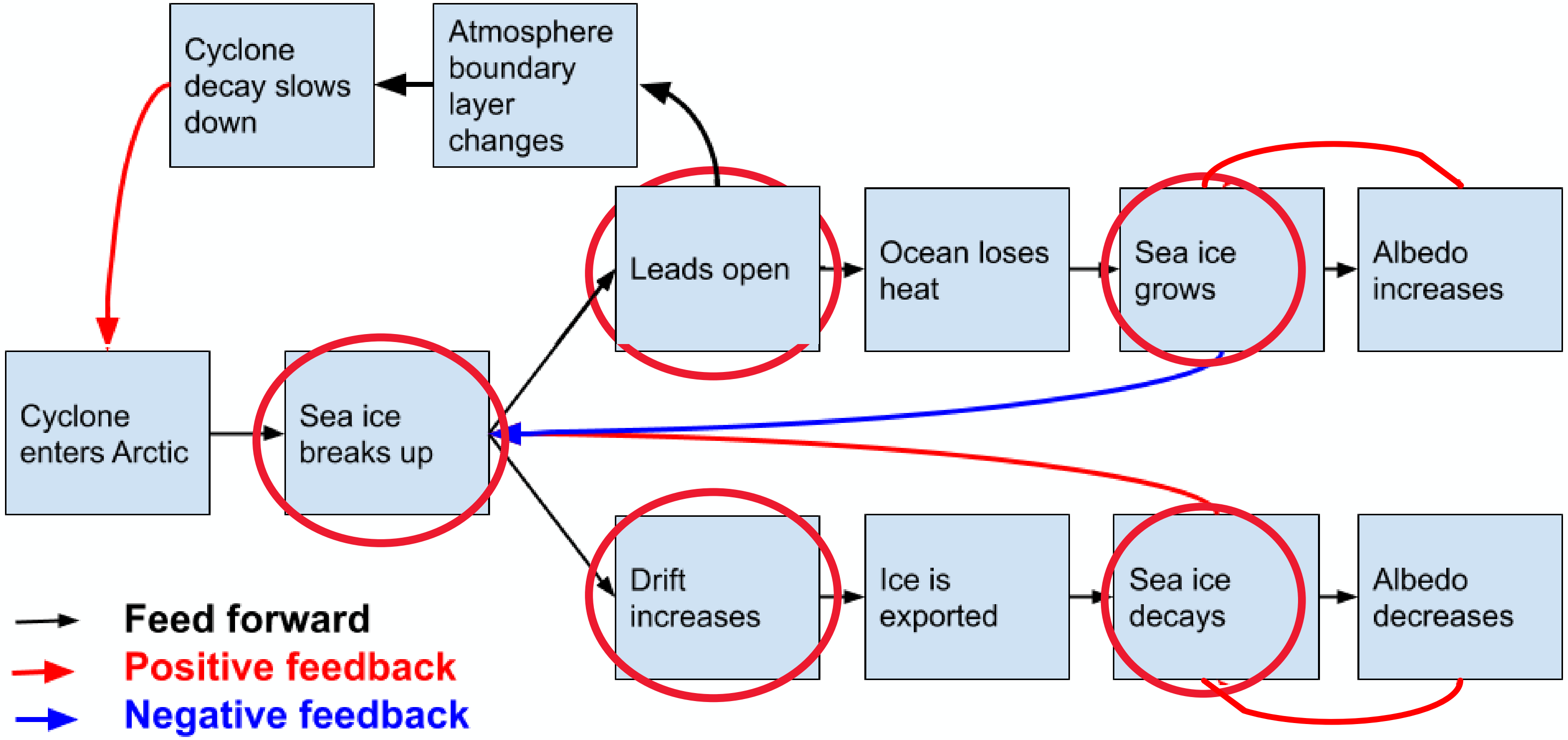
Eddies from mooring data in the Canadian Basin colocated with SAR images of sea ice drift and vorticity. Example from October 2017.

Storm effects on sea ice – Processes and Feedback

ASC-3: Impact of extreme event storms on sea-ice conditions

J. Rheinlænder et. al, to be submitted to Nature Geoscience, end of September 2021

Satellite observations from:
- SAR
- RA
- visible imaging



A negative feedback:
In winter ice breakup opens leads, intensifies heat exchange and enhances ice growth

What if sea ice thickness decrease even further?
- Will early ice breakup events increase in number?
- Will ice growth increase and slow down ice thinning?
- Will ice export increase and compensate the ice growth?

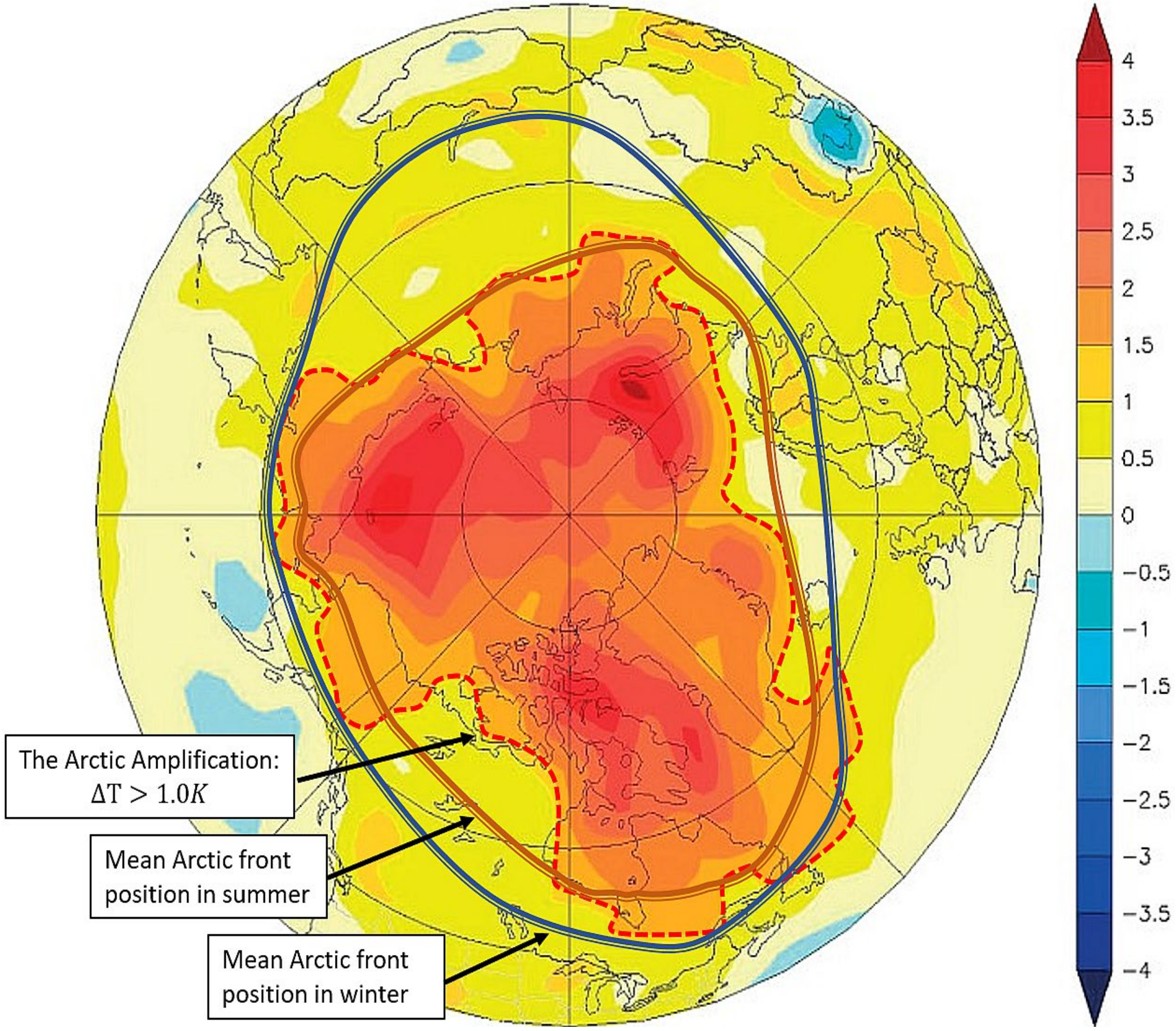
What-if scenario:
- Change of initialization
- Change of Model resolution
- Change of wind forcing
- Change in SIC

CASE STUDY: Storm effects on sea ice – Processes and Feedback

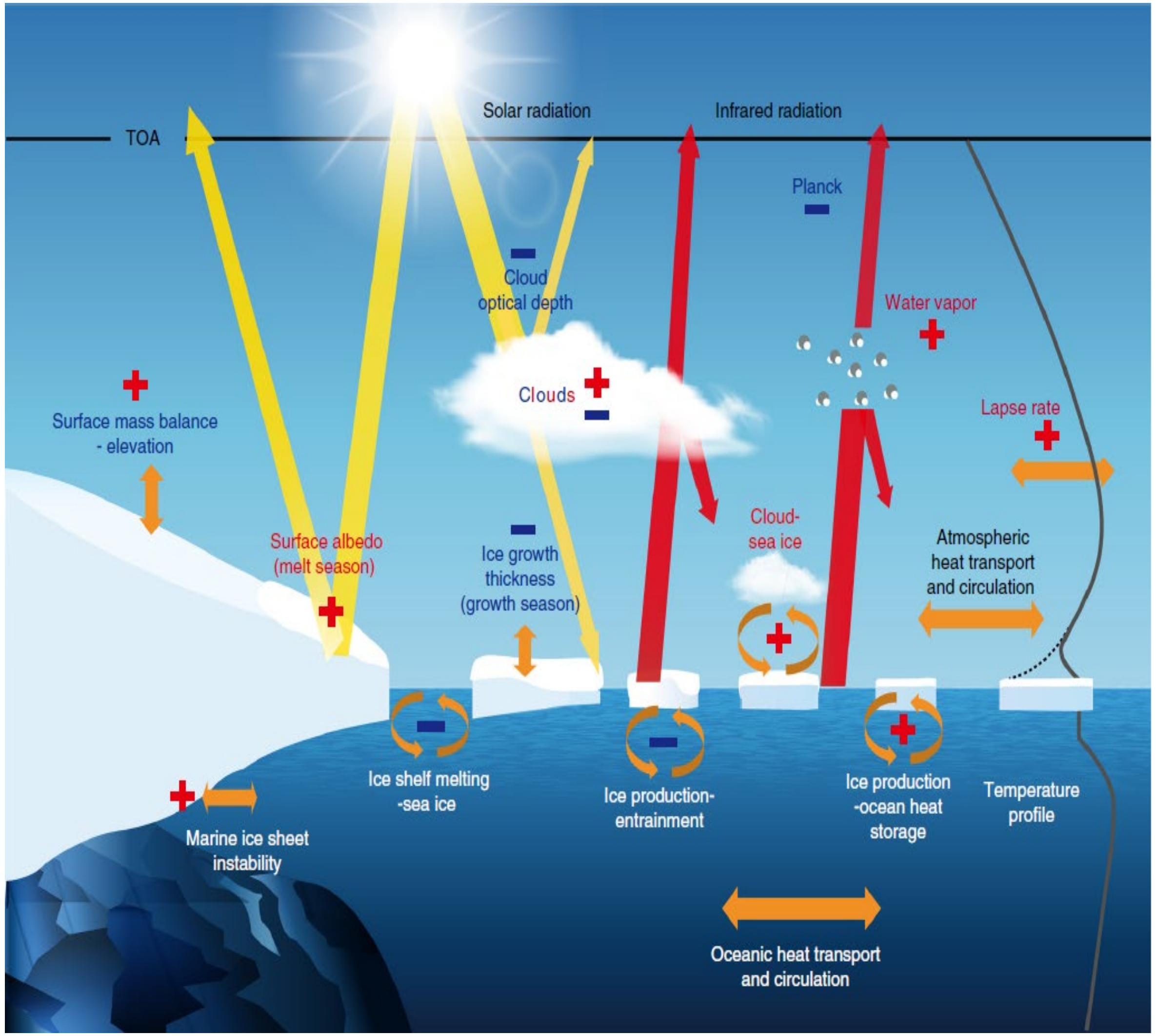

- neXtSIM is used to simulate sea ice breakup in 2013 (see above thickness animation)
- Simulations of ice drift and deformation are statistically close to observations (Rampal et al, 2019)
- Exact location of cracks and opened leads can be improved
- Feedback: In winter, sea ice breakup intensifies heat exchange and enhances sea ice growth in leads.

The Arctic Amplification domain (ASC-4)

(Esau et al)



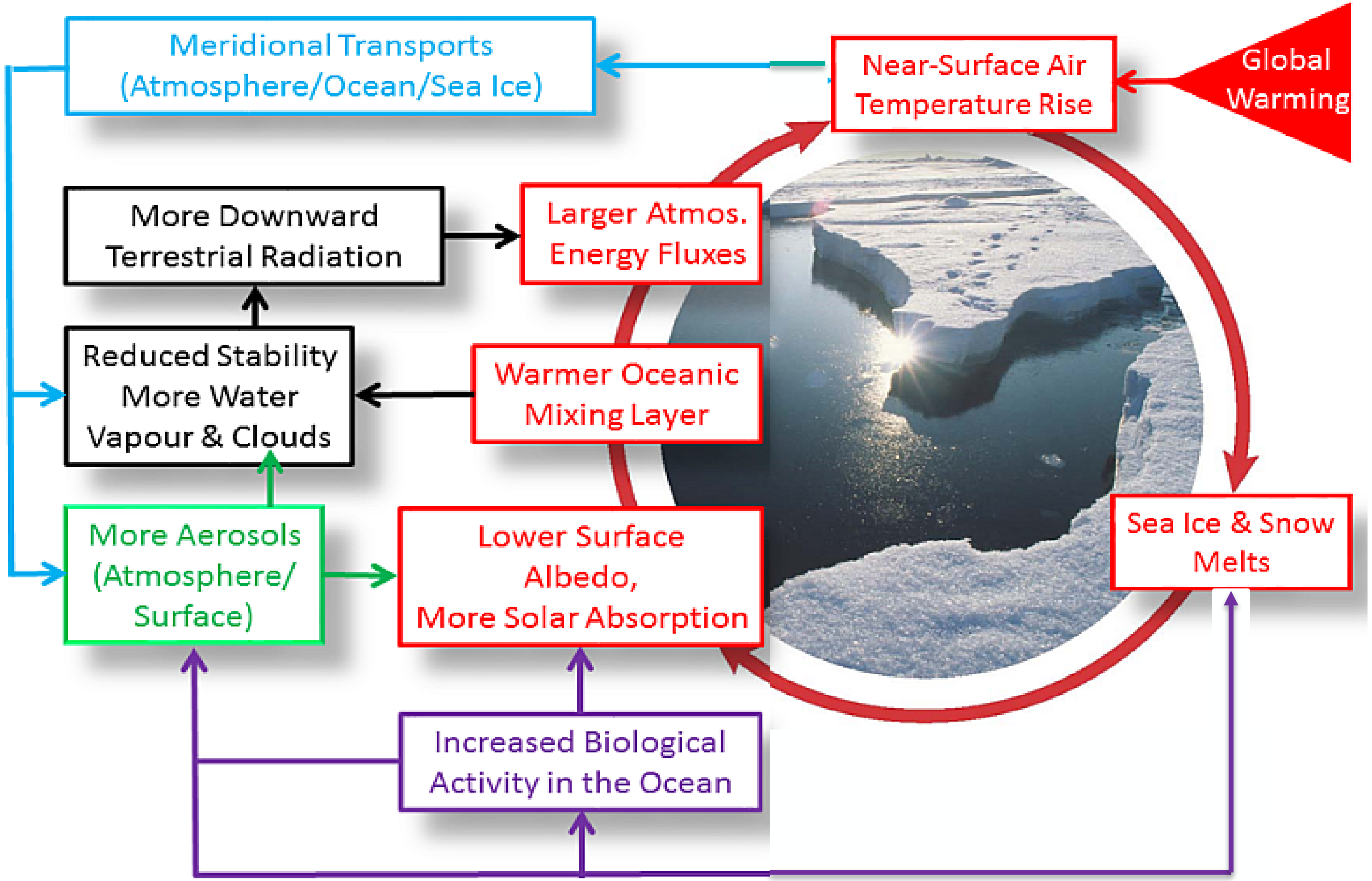
Radiative and non-radiative feedbacks



Goosse, H., et al 2018. Quantifying climate feedbacks in polar regions. Nat. Commun. https://doi.org/10.1038/s41467-018-04173-0

Arctic Amplification and its impact: Attribution through remote-sensing data

Igor Esau, et al , to be submitted to GRL in October 2021



Red: Surface-albedo feedbacks

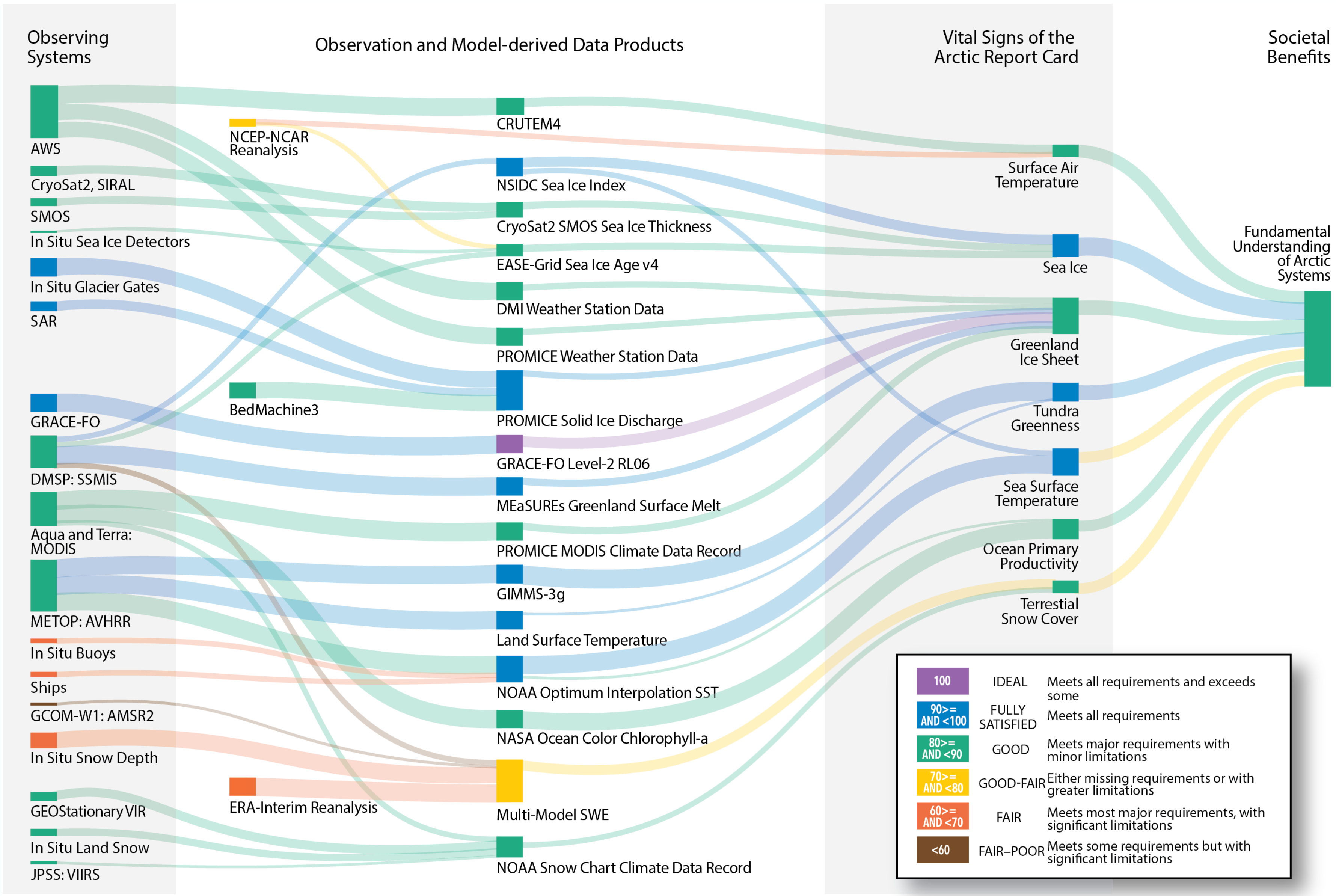
Blue: Amplification Drivers

Black: Water vapour, cloud, and lapse rate feedbacks

Green: Aerosol effect on clouds

Pink: Biological and oceanic particle emission effects

Assessing Arctic Observing System, Data Products & Benefit: PRESENT & FUTURE



Source:

15-Year Retrospective Analysis on AON

The Observational Foundation of the Arctic Report Card - a 15-Year Retrospective Analysis on the Arctic Observing Network (AON) and Insights for the Future System

DOI: 10.25923/ahj5-z336

S. Starkweather, H. Shapiro, S. Vakhutinsky, and M. Druckenmiller

OUTLOOK

Polar Ocean and Sea Ice Scientific Workshop planned to be held at Longyearbyen, Svalbard.

Tentative dates: End of March 2022

Announcement to be released in early October 2021

https://arktalas.nersc.no/

https://eo4society.esa.int/projects/arktalas-hoavva-project/

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Thank You

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