New Polar CORDEX model intercomparison initiatives related to MOSAiC

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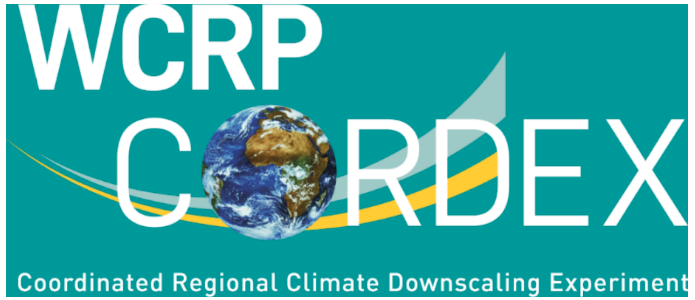
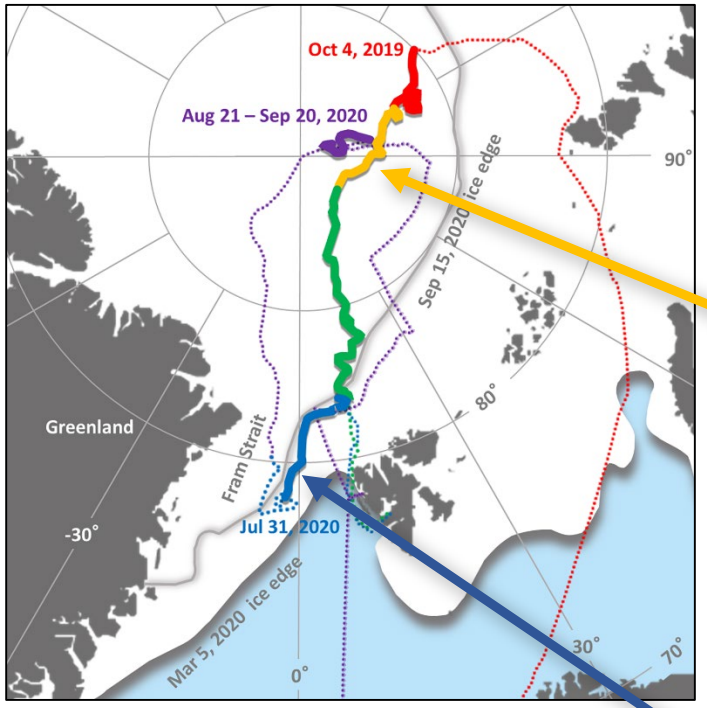
on behalf of the PolarCORDEX & PolarRES WP4 teams

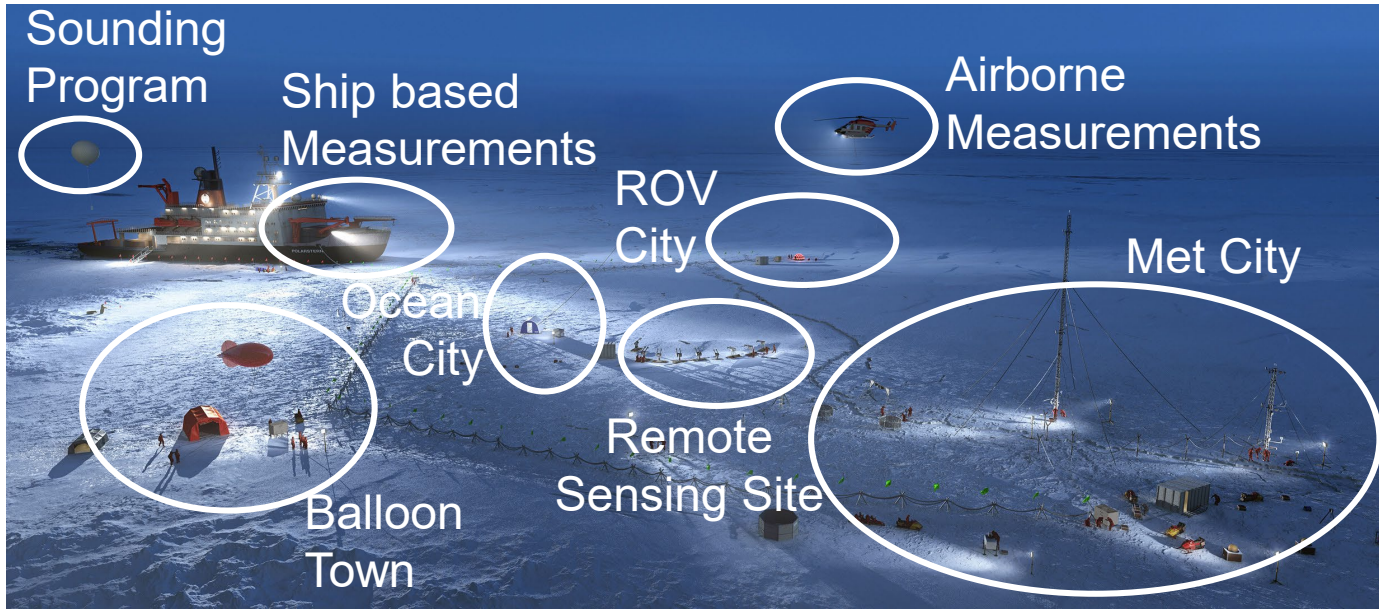


MOSAiC
International Arctic Drift Expedition

→ **Year-round** (Sep.2019 - Sep.2020) measurements of key parameters of ATMO, ICE, OCEAN, BGC, ECO in central Arctic Ocean



Photos: AWI



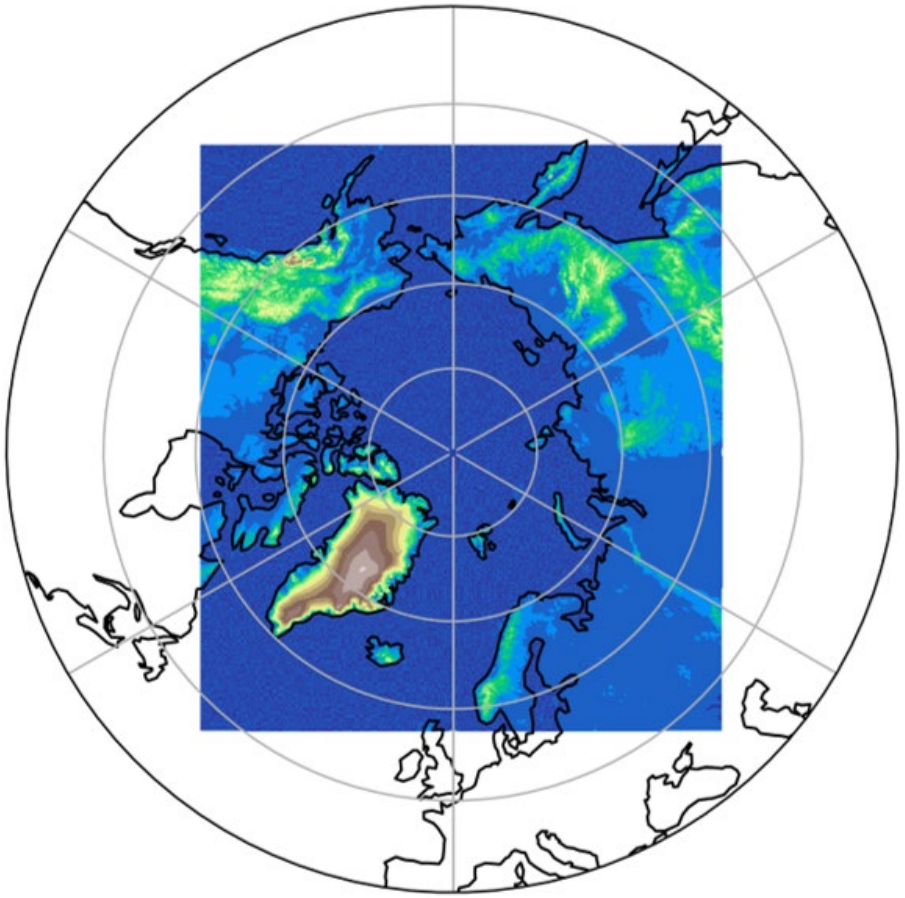
→ Selection of well-observed, interesting cases for **process-oriented model evaluation**

Circum-Arctic domain @ 0.1 deg. resol.

Horizon2020
European Union Funding
for Research & Innovation

PolarRES
Exploring future polar climates

Atmospheric & Coupled Regional Models



577x582 grid points

Model	Institute
HARMONIE Climate (HCLIM) HCLIM-NEMO	met.no, DMI, Univ. Utrecht
ICON, HIRHAM-NAOSIM	AWI
MAR, MAR-NEMO	Univ. de Liege
MetUM-UKCA	BAS
RACMO	Univ. Utrecht
WRF	CU/CIRES, NORCE, UAF
CAFS	NOAA
RASM	CU/CIRES, NPS
JMA/MRI (NHM-SMAP)	NIPR
WRF-Chem	CNRS
CCLM	Univ. Trier

CRiceS

Research interests:

(1) Atmospheric boundary layer (ABL) processes

Can models represent observed occurrence of different stability regimes?
And the associated radiative and mechanical forcing (wind speed)?

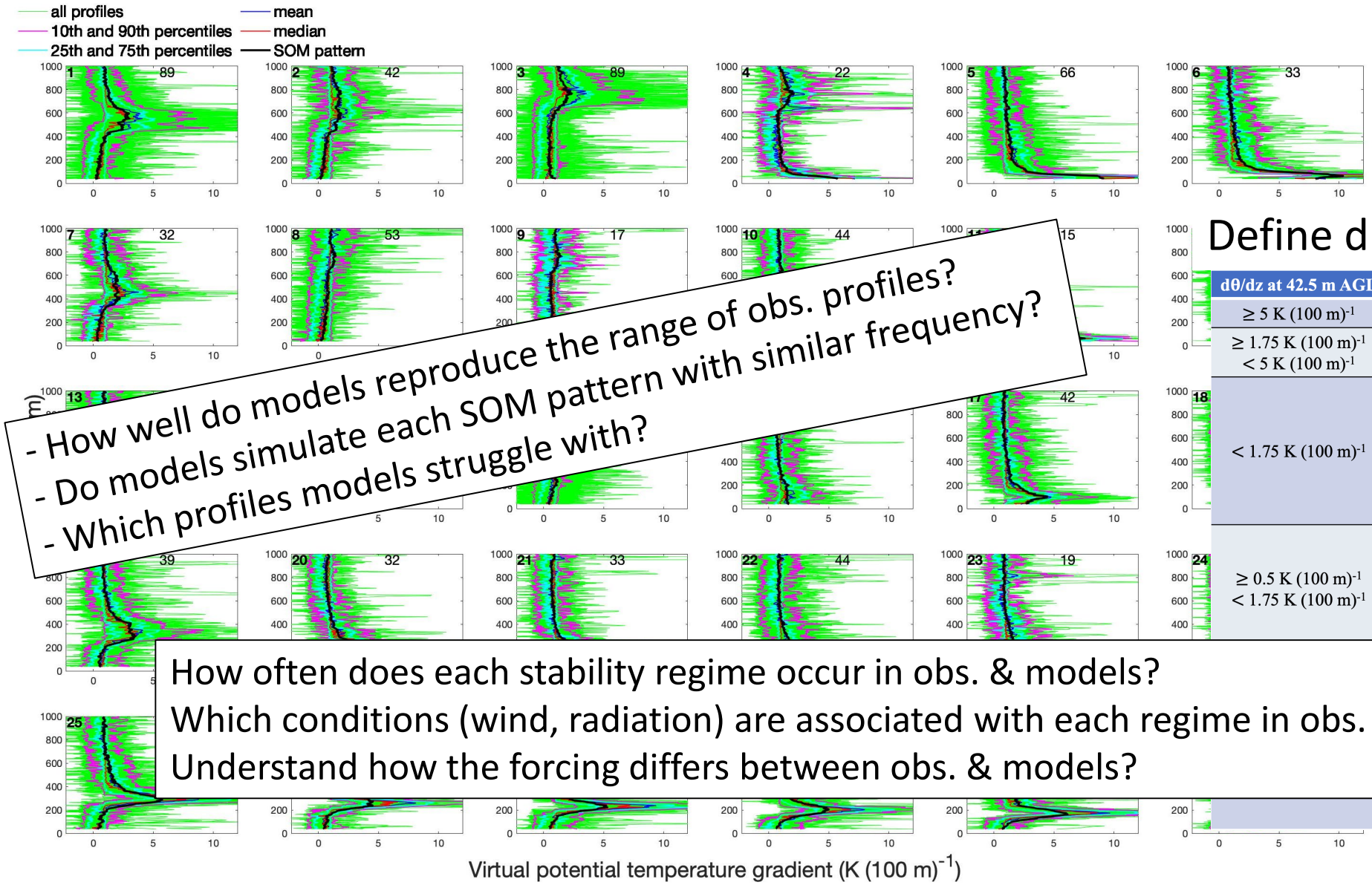
→ *Led by John Cassano & team (Univ. Colorado):*

Self-organizing maps (SOMs) to identify 30 potential temperature profiles that span the range of boundary layer stability profiles observed in MOSAiC radiosonde observations. SOM classification based on $\partial\theta_v/\partial z$ up to 1 km. MOSAiC year.

→ *Initial results for CAFS model*

→ *Other models submitted data (call to receive data is by end of September 2023)*

Potential temperature gradient SOM, based on 1.400 MOSAiC radiosonde $\partial\theta_v/\partial z$ profiles



- How well do models reproduce the range of obs. profiles?
- Do models simulate each SOM pattern with similar frequency?
- Which profiles models struggle with?

Define different stability regimes

dθ/dz at 42.5 m AGL	ABL Height	Max. dθ/dz above ABL	Stability Regime
≥ 5 K (100 m)$^{-1}$	-	-	Strongly Stable
≥ 1.75 K (100 m)$^{-1}$ < 5 K (100 m)$^{-1}$	-	-	Moderately Stable
< 1.75 K (100 m)$^{-1}$	< 125 m	≥ 5 K (100 m)$^{-1}$	Very Shallow Mixed – Strongly Stable Aloft
		≥ 1.75 K (100 m)$^{-1}$ < 5 K (100 m)$^{-1}$	Very Shallow Mixed – Moderately Stable Aloft
		< 1.75 K (100 m)$^{-1}$	Very Shallow Mixed – Weakly Stable Aloft
≥ 0.5 K (100 m)$^{-1}$ < 1.75 K (100 m)$^{-1}$		≥ 5 K (100 m)$^{-1}$	Weakly Stable – Strongly Stable Aloft
		≥ 1.75 K (100 m)$^{-1}$ < 5 K (100 m)$^{-1}$	Weakly Stable – Moderately Stable Aloft
		< 1.75 K (100 m)$^{-1}$	Weakly Stable
		(100 m)$^{-1}$	Near-Neutral – Strongly Stable Aloft
		K (100 m)$^{-1}$ (100 m)$^{-1}$	Near-Neutral – Moderately Stable Aloft
		(100 m)$^{-1}$ K (100 m)$^{-1}$	Near-Neutral – Weakly Stable Aloft
		< 0.5 K (100 m)$^{-1}$	Near-Neutral

How often does each stability regime occur in obs. & models?
Which conditions (wind, radiation) are associated with each regime in obs. & models?
Understand how the forcing differs between obs. & models?

Jozef & Cassano, 2023

Research interests:

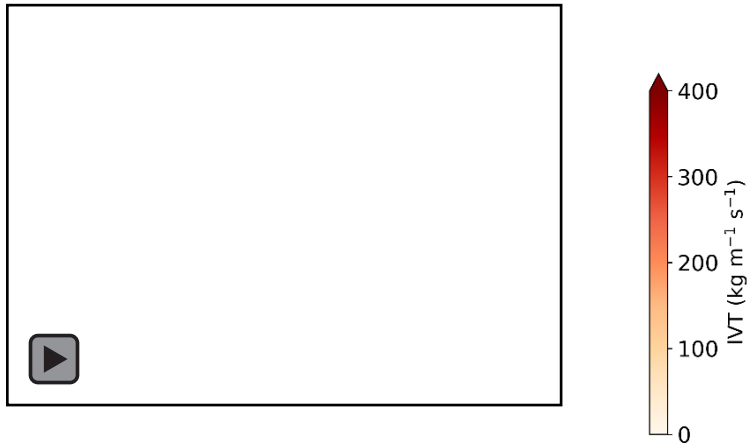
(2) Surface impacts and associated mechanisms of moisture intrusion events

Can models represent observed airmass transformation processes?
And related development of thermodynamic profile and moisture cycling via clouds-precipitation? Impact of aerosol-cloud-radiation processes, and ABL?

→ *Led by Oskar Landgren (met.no), Andrew Orr/Ruth Price (BAS):* PolarRES Exploring future polar climates

What are sensitive parameter? Sensitivity studies with respect to interactive aerosol, complexity of cloud microphysics scheme, resolution,…
Moisture & aerosol intrusion event in mid-April 2020

→ *Nudged simulations @ 1-10 km*

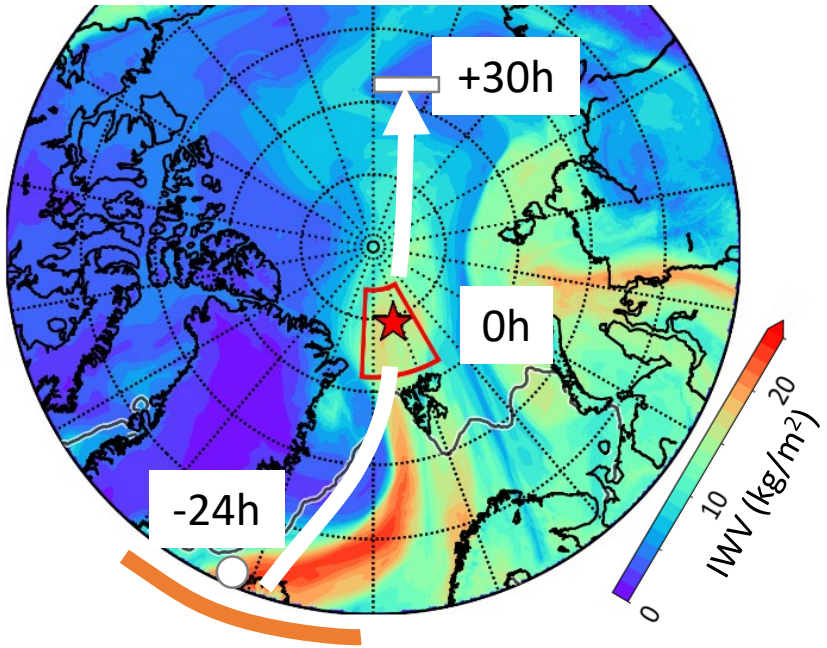


Impact of moisture intrusions: What are the mechanisms?

→ Model sensitivity experiments can help!

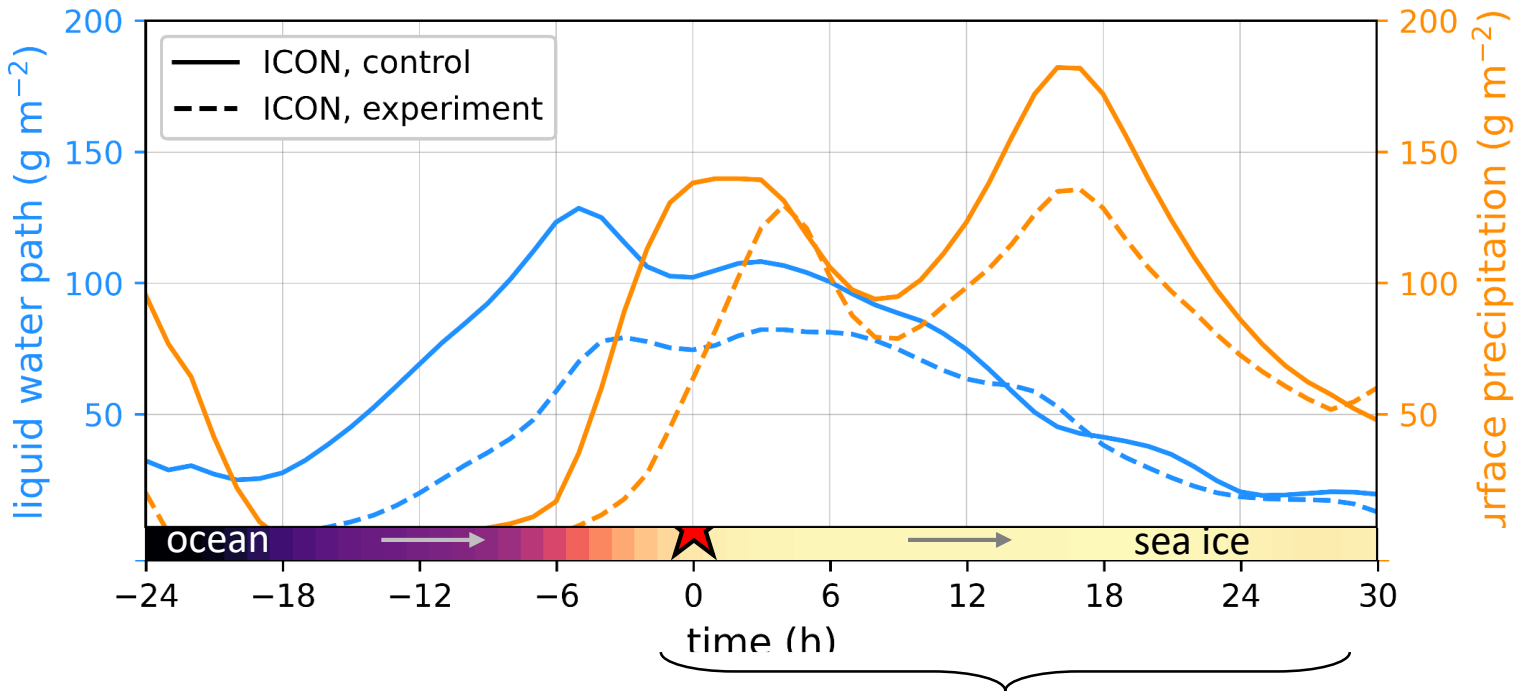
Mid-April 2020 event (MOSAiC)

Moisture inflow



-30% q experiment

Cloud formation & precipitation along trajectory



= similar SEB in control & exp!

SEB effect ~ air mass transform. (**moisture recycling via clouds, precip.**)

Kirbus et al. (2023)

Polar-CORDEX model intercomparison initiatives (driven by PolarRES & MOSAiC):

- Process-oriented evaluation
- Selection of cases & regime approach
  (dynamic active vs. calm, regimes of wind & stability, cyclone & atmospheric river events)
- Eulerian & Lagrangian views

→ Participation & active involvement are welcome!