Climate **R**elevant interactions and feedbacks:
the key role of sea **ice** and **S**now in the polar and global climate system

CRiceS

Bridging Biological Observations and Models in Polar Oceans: Insights from the CRiceS Project

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CRiceS Consortium

CRiceS

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FINNISH METEOROLOGICAL INSTITUTE

cnrs

CICERO
Center for International Climate Research

Stockholm University

NORSK POLARINSTITUTT

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University of Victoria

UNIVERSITY OF CALGARY

university of groningen

NCPOR

20 partners from 14 countries

Full team: https://www.crices-h2020.eu/team

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Project overarching objective

The **overarching objective** of CRiceS is to **deliver improved understanding of the physical, chemical, and biogeochemical interactions within the OIA system, new knowledge of polar and global climate, and enhanced ability of society to respond to climate change.**

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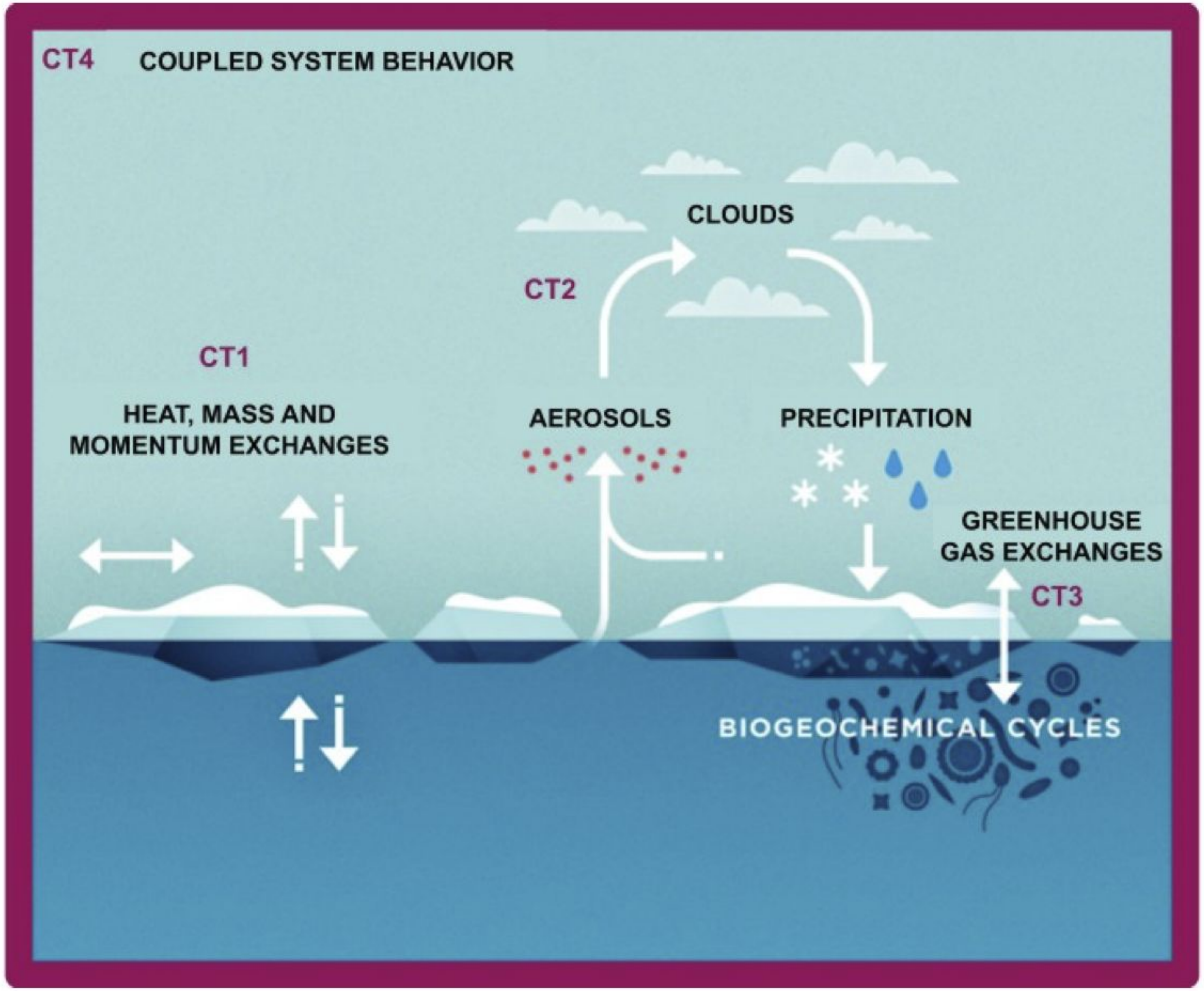

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CT3 Biogeochemistry (BGC) in CRiceS

WP1/T1.4 Improved Knowledge of Polar BGC Processes
- *Comprehensive sea ice and ocean biogeochemical data compiled*
- *Recommendations for improving models provided*

WP2/T2.3 Novel/Improved representation of biogeochemical processes in model
- *Key BGC processes identified in WP1 included in models*
- *New parameterizations tested in process models/revised regional models*

WP3/T3.4 Polar-lower latitude interactions influenced by the inclusion of advanced polar biogeochemical processes
- *The influence of improved descriptions of biogeochemistry in T2.3 evaluated and quantified in large scale models/ESMs*

WP4/T4.3 Quantifying the impacts of new OIA process descriptions on future projections
- *Future projections using improved global/Earth system models or regional climate models evaluated*
- *Recommendations for future model development for MIP and assessments, including CMIP7 and CMIP8*

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A (mainly) modeller perspective on challenges

- Time-series observations of several ecosystem parameters over long period are few
- Spatial variability at the metre-scale for both physical and biogeochemical parameters can be substantial

→ Challenge 1: *To evaluate models with more observations and at several locations*

- Limited understanding of several processes and thus poor confidence in model parameterizations

→ Challenge 2: *To increase the scope of models towards more processes that we think are relevant*

- Lack of understanding between modellers and observationalists

→ Challenge 3: *To increase COMMUNICATION*

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A typical conversation between a bear and a penguin

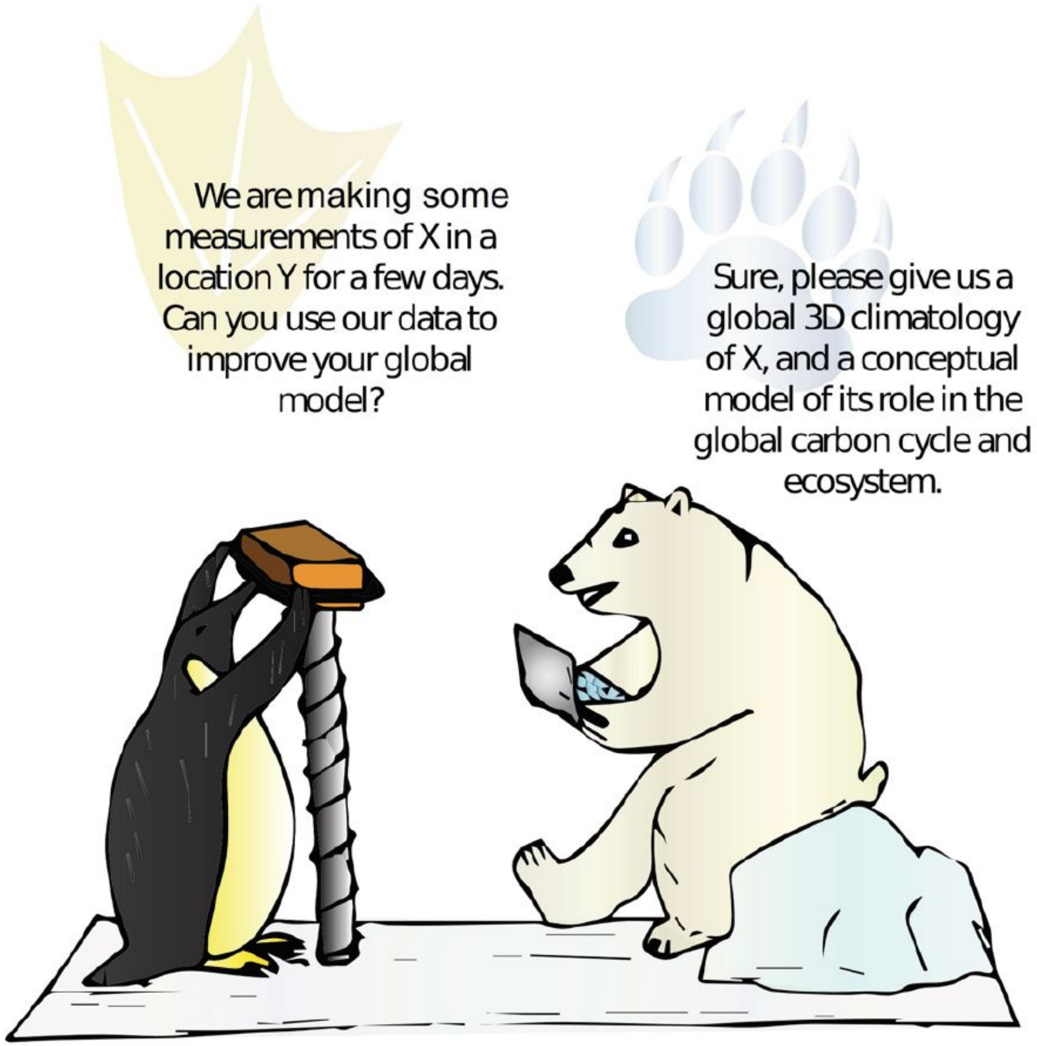

Figure 1

Conversation between a global climate modeller and an observer.

The choice of two polar animals together on one ice floe, when they do not co-occur in nature, is intended to represent the need for modellers and observers to meet at the same table, regardless of background.

doi: 10.12952/journal.elementa.000084.f001

Steiner et al. (Elementa, 2015)

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BIOGEOCHEMICAL EXCHANGE PROCESSES AT SEA ICE INTERFACES

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A modeller's wishlist (Steiner et al, 2015)

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- **Multidisciplinar**, ie physical, biological, and chemical properties measured at the same time and the same place to understand causes, effects, and feedbacks

- **Comprehensive**, ie all of the ecological domains (atmospheric, cryospheric, pelagic, and benthic) measured when possible to link and understand the fluxes between them

- **Extensive**, spatially and temporal, with long time series that span ice formation, ice melt, and the open water season, preferably over a reasonable spatial extent, to gain a holistic understanding

- **Quantitative**, as moving from conceptual to numerical models requires quantification of processes and rates

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A modeller's <u>realistic</u> wishlist (Steiner et al, 2015)

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- Both modellers and observers agree that **sampling in polar regions is difficult, expensive**, and consequently **observations are sparse and heterogeneous**

- Rather than asking ***how my observations can improve your model?***, the aim should be combining even imperfect models with even restricted measurements to improve our understanding of specific processes. Hence, ***How can we derive the most benefit from what measurements we can make?***

→ **No matter how many observations are taken, those should ideally:**

- follow the **best practices** that have been established by the scientific community (e.g., Eicken et al., 2009; Miller et al., 2015)

- use **common measurement data templates** (i.e., http://data.aad.gov.au/aadc/seaice/)

- establish and **maintain coordinated databases** (see www.bepsii.org)

- always provide **ranges of uncertainty and detection limits**

- use **consistent units** and provide the ancillary data necessary to convert between different units

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A modeller's realistic wishlist (Steiner et al, 2015)

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A 5* observer is the one who measures a process of most interest repeatedly in several places and for long time periods and has a good global understanding of the variability that might drive the process being studied.

Figure 4

A five star observer from a modeller's perspective.

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Some final recommendations

Every **observationalist** should keep **numerical modelling** in their toolboxes

&

Every **modeller** should get in **the field**

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