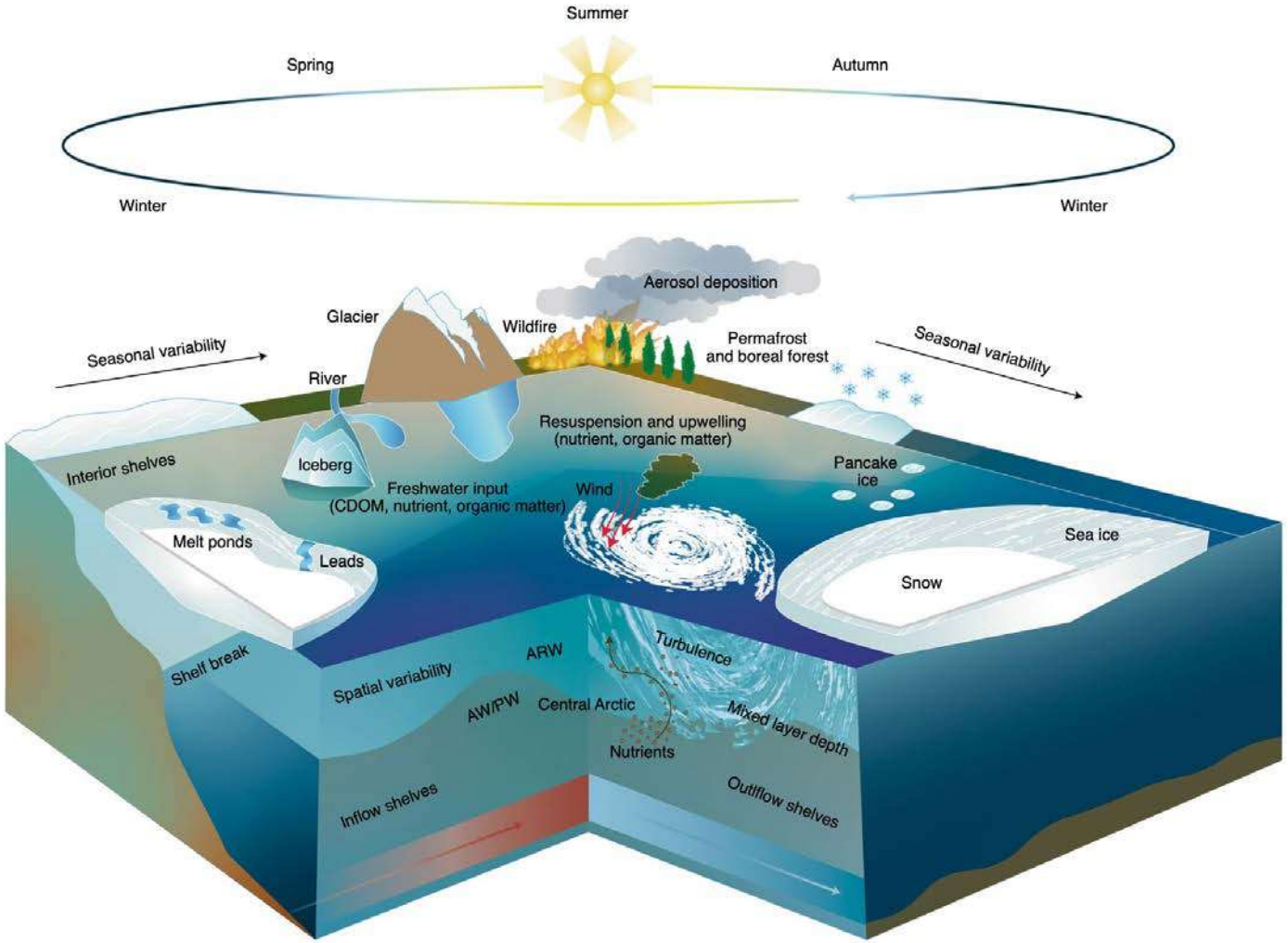
CNES annual meeting, March 2 2023

Alg-o-Nord & Takuvik activites

Algorithmes satellitaires des flux de matières dans les eaux côtières arctiques

M. ARDYNA, M. BABIN, D. DOXARAN, H. CLAUSTRE

CHANGING ARCTIC OCEAN



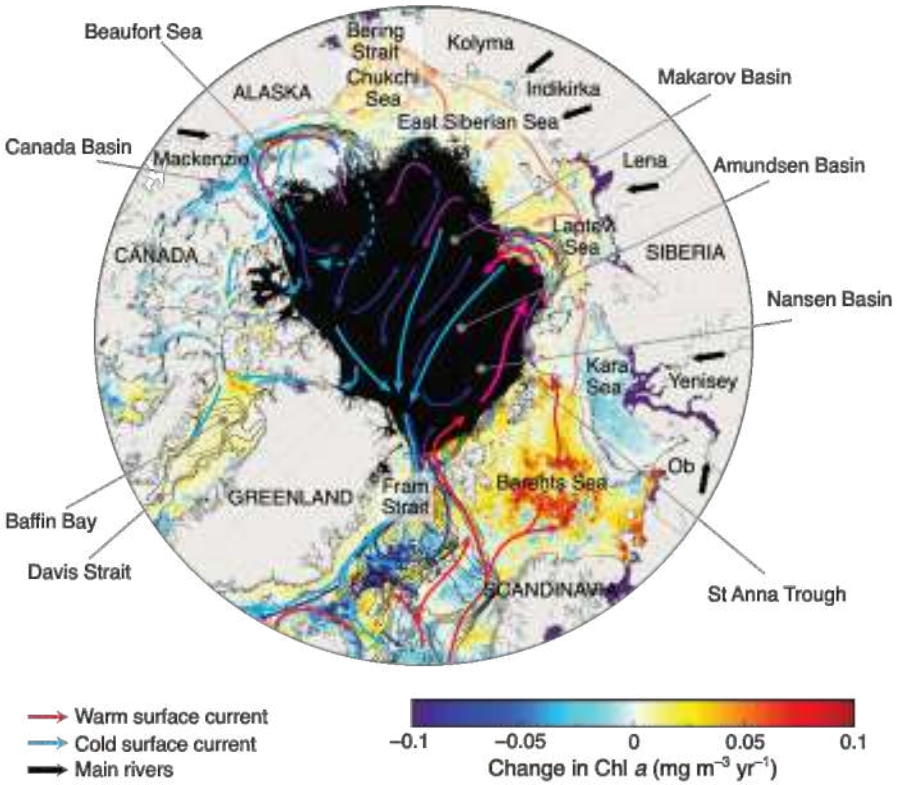
Main key climate-driven changes:

- Sea ice loss and thinning
- Increasing atmosphere-ocean exchange
- Increasing water intrusions at Arctic gateways
- Amplified land-ocean continuum (e.g., glacier and river inputs, wildfire)

Need to improve satellite-derived approaches and time series

Ardyna & Arrigo, *Nature Climate Change*, 2020

Changing Arctic productivity



- 57% NPP increase over 1998-2018
- Increasing inflow waters (Atlantic/Pacific)
- Coastal regions, large uncertainties related to complex waters and small-scale processes.

Ardyna & Arrigo, *Nature Climate Change*, 2020

COASTAL COMPLEXITY

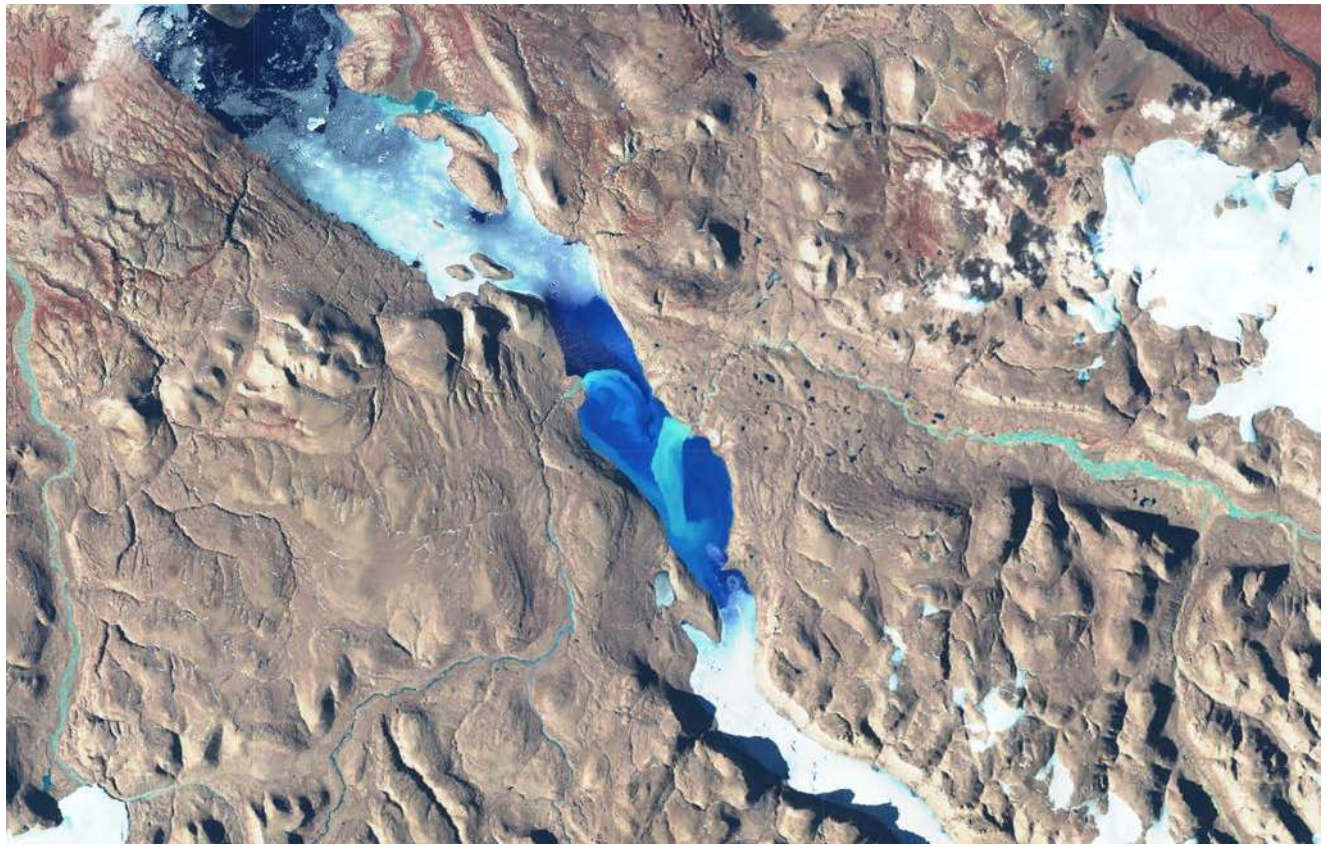
Baie de Rosse avec l'île de Pim (détroit de Nares) (78.72°N -74.30°W; Sentinel2)

4 main processes in coastal Arctic waters

Increase in:

- River/Glacier inputs
- Coastal erosion
- Resuspension episodes
- Shelf-break upwellings

supplying new nutrients to fuel Arctic productivity

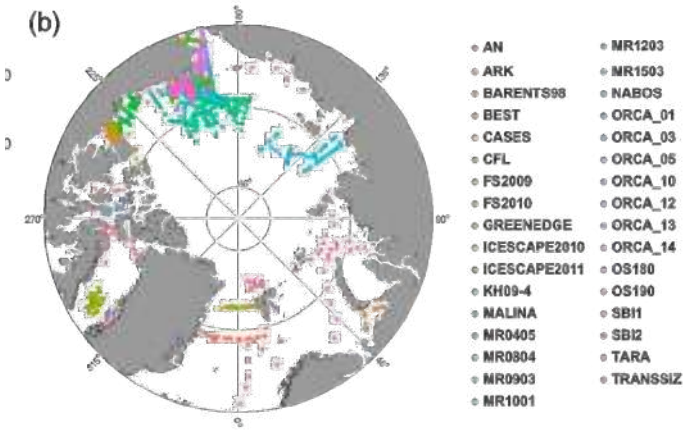


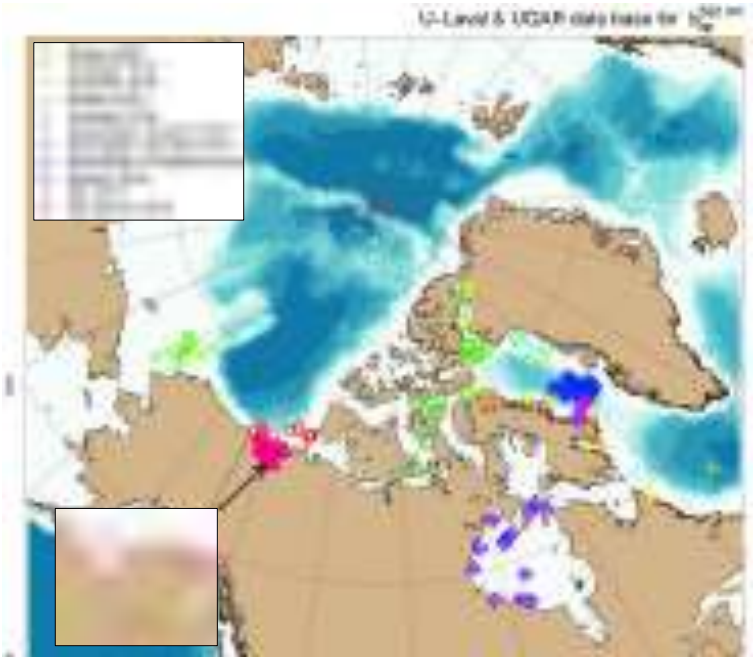
Glacier Peterman et apports de rivière
(80.50°N -59.50°W; ; Sentinel2)

Complexity of Arctic waters

Better constrain CDOM, SPM, chlorophyll a dynamics at high resolution to highlight these climate-driven processes and their impact of primary production

ALG-O-NORD OBJECTIVES





Bécu et al. in prep for ESSD

- Validate and refine the algorithms (CDOM, SPM, Chl *a*) at high resolution (Sentinel2/3) using historical optical data and by participating in an expedition in the Canadian High Arctic (bio-optical data, BGC-Argo floats equipped with a hyperspectral radiometer)

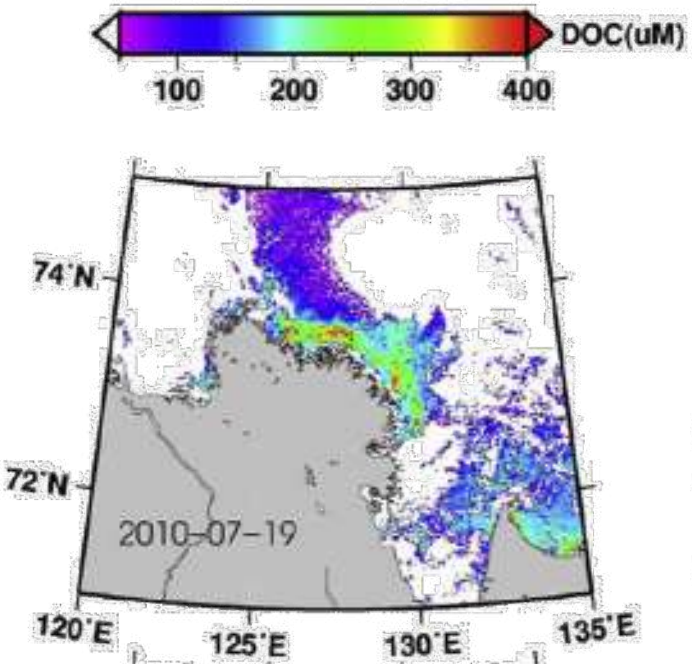
- Infer temporal trends (2016-) in the importance of these processes and their impact on primary production

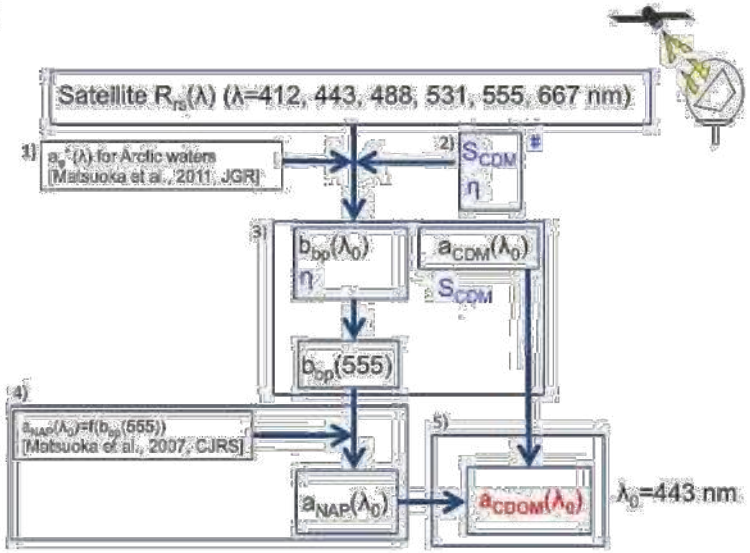
ALGORITHMS

CDOM algorithm

(Matsuoka et al. 2013, 2017)

Semi-analytical algorithm modified Garver–Siegel–Maritorena (GSM) model for estimating CDOM absorption





SPM algorithm

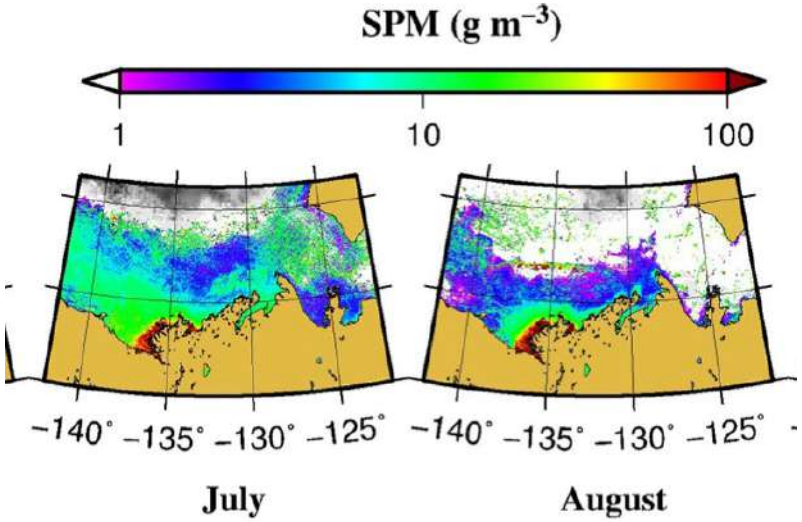
(Doxaran et al. 2012,2015)

$$\mathrm{SPM} = 0.8386 \times R_{\mathrm{RS}}(748 : 555) \quad \text{if } R_{\mathrm{RS}}(748 : 555) < 87\,\%, \tag{1}$$

$$\mathrm{SPM} = 70 + 0.1416 \times R_{\mathrm{RS}}(748 : 555) + 2.9541 \times \exp[0.2092 \times (R_{\mathrm{RS}}(748 : 555) - 87)] \quad \text{if } 87\,\% \le R_{\mathrm{RS}}(748 : 555) \le 94\,\%, \tag{2}$$

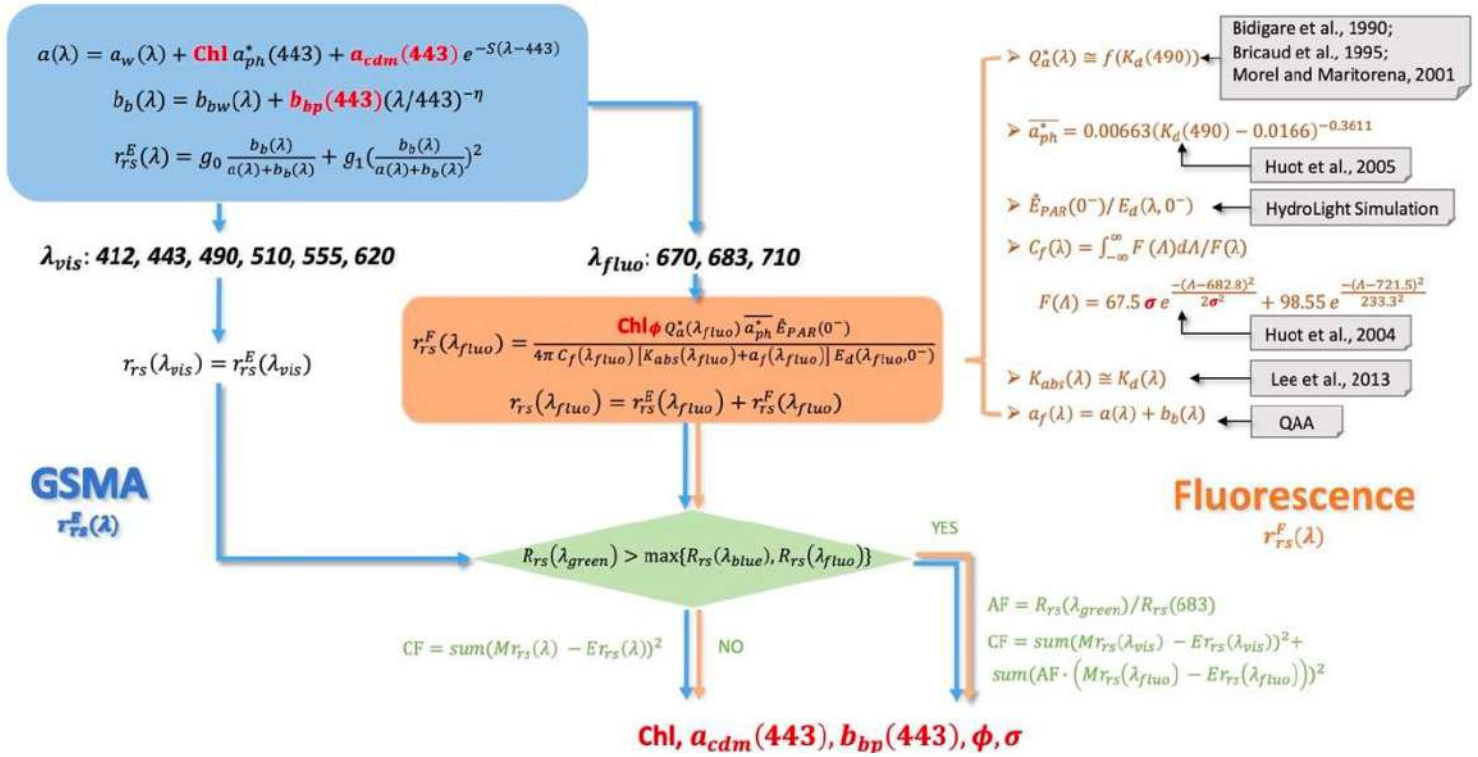
$$\mathrm{SPM} = 3.922 \times R_{\mathrm{RS}}(748 : 555) - 285.4 \quad \text{if } 94\,\% < R_{\mathrm{RS}}(748 : 555), \tag{3}$$

where SPM is the SPM concentration in grams per cubic meter and $R_{\mathrm{RS}}(748:555)$ is the ratio of remote-sensing reflectance at 748 to 555 nm.



ALGORITHMS

Novel semi-Analytical model for retrieving absorption coefficients of phytoplankton (FGSM)



- Fluorescence model combined to a modified Garver-Siegel-Maritorena (GSM) algorithm to retrieve the phytoplankton absorption coefficient ($a\phi$) at 443 nm and the magnitude of the fluorescence

- A two-step analytical inverse optimization procedure was performed by using the measured reflectance over the whole visible spectrum at Ocean and Land Colour Instrument (OLCI) bands (from 412.5 to 708.75 nm).

Li et al, in prep. for RSE

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Questions ???