

# ERC experience





# Personal story

- MSCA extension to write an ERC proposal
- Last year I could ask for the StG call
- First time I tried
- I had a general idea, but once you start writing the idea grows
- Embrace and Breathe the FEAR, and just trust in the process!





# ERC StG B1/B2 writing

- Don't be afraid, just write!

- You are going to get it!

- Believe in yourself :)

- Ask for help, no one is perfect!



## ERC Starting Grant 2024 Research proposal [Part B1]

Unraveling FRESHwater and ocean Currents changes in the Arctic using REmote sensing

FRESH-CARE

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Proposal duration: 60 months

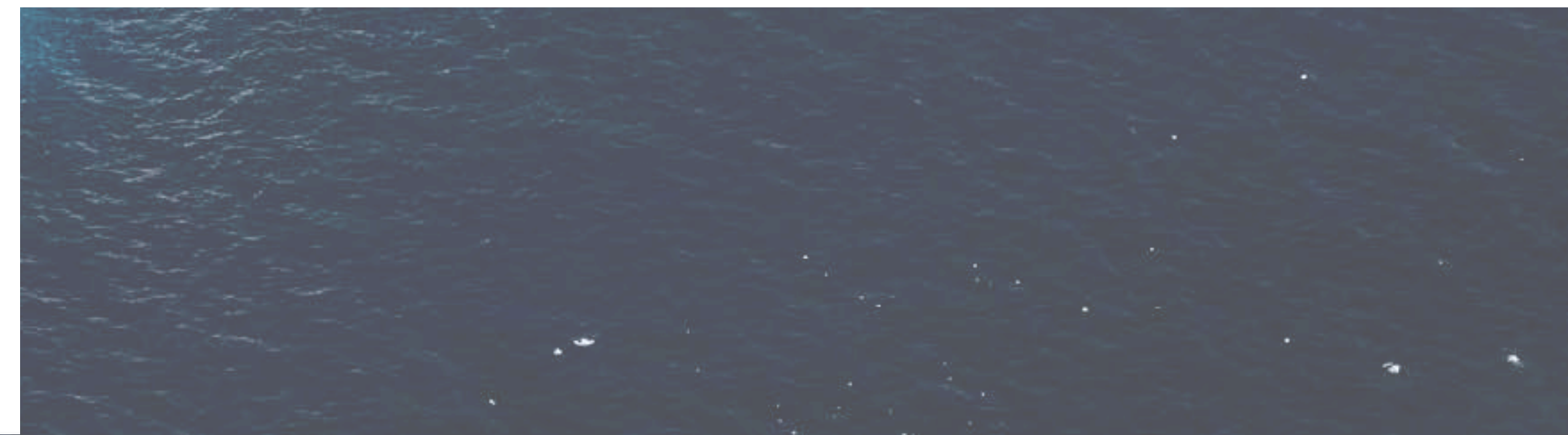


### Proposal summary:

The Arctic is warming rapidly, causing significant hydrographic changes including sea ice retreat, freshwater accumulation, and altered ocean currents. These changes intensify water stratification potentially destabilizing Earth's thermohaline circulation. Despite its key role in global climate system, the ultimate fate of Arctic freshwater remains unconstrained. Current estimates lack the resolution that remote sensing and Artificial Intelligence (AI) can provide. It is crucial to improve freshwater flux uncertainties, to better constrain future projections and understand global climate impacts.

FRESH-CARE aims to transform our understanding of Arctic freshwater dynamics. It will develop innovative methodologies that leverage (radiometric, thermal, and altimetric) satellite data, AI-integrate remote sensing and *in-situ* information, and run model simulations to forecast freshwater transports under various Shared Socioeconomic Pathways. FRESH-CARE will focus on three specific objectives: (1) develop a novel AI-based methodology to characterize four-dimensional ocean currents; (2) quantify freshwater transports through the main Arctic gateways; and (3) perform simulations for future Arctic freshwater scenarios using a coupled ice-ocean model.

Overall, I envision that FRESH-CARE will offer a multidisciplinary view of ocean currents and freshwater fluxes in the Arctic Ocean over three decades, from hindcast in the 2010s to forecasts into the 2040s. FRESH-CARE will provide pan-Arctic estimates of ocean currents and freshwater distribution with high spatiotemporal resolution, benefiting polar oceanographers, earth modelers, and climate scientists, as well as to the society at large. FRESH-CARE findings will enhance the understanding and assimilation of ocean freshwater in future global climate models.





# ERC StG

## B1/B2 writing

- write the MAIN OBJECTIVE (same in B1/B2)
- write the SPECIFIC OBJECTIVES (same in B1/B2)
- think on the MAIN INNOVATION
- write the TITLE OF WORK PACKAGES (same in B1/B2)
- write the TITLE OF PROJECT

Specific objectives: The overarching goal of FRESH-CARE is to **revolutionize** our current understanding of freshwater dynamics in the Arctic Ocean. To reach this goal, I propose to leverage new L-band satellite salinity, SWOT sea-level data, integrate remote sensing and *in-situ* information using AI, and run a coupled ice-ocean model to simulate freshwater transports under various Shared Socioeconomic Pathways (SSP).

Specifically, the following objectives will be addressed:

O1: Develop a novel methodology based on artificial intelligence to characterize the 4D ocean currents.

O2: Quantify freshwater transports through the main Arctic Ocean gateways.

O3: Perform simulations for future freshwater scenarios using a coupled ice-ocean model.

The novelty of my hypothesis is that I will introduce modern methodologies that exploit remote sensing measurements as the main source of information to quantify freshwater transports. This will improve the spatial and temporal resolution of prior estimates by a factor of two. Superior estimates will empower our understanding of the changing freshwater inflows and outflows in the Arctic Ocean.



# Structure

## B1

- Proposal summary (half page)
- Graphical abstract (half page)
- Scientific context (half page)
- Project vision (1/4 page)
- Scientific objectives (1/4 page)
- State of the art (1 and half page)
- Methodology (2 pages)
- Feasibility (1/3 page)
- Risk analysis (1/3 page)

**FRESII-CARE will make a remarkable contribution to Arctic research by integrating remote sensing data, enhancing ocean models, and providing insights into future Arctic hydrography across top-four SSPs (Riahi et al., 2017).** SSPs are a set of scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) in collaboration with the Coupled Model Intercomparison Project (CMIP). The CMIP is a project that gathers outputs from various existing climate models and provides data on temperature and salinity. These can be used in conjunction with historical products (ranging from pre-industrial times to the present) to conduct a hindcast approach. (Hindcasting refers to the technique of assessing the degree to which computer models, such as climate change models, match the historical record by comparing them to the observational data). Future simulations are then run using the outputs of the Scenario Model Intercomparison Project (ScenarioMIP). ScenarioMIP is earth system model simulation driven by different defined futures of socioeconomic developments and their associated land use and emissions. There are five plausible scenarios, of which 4 are considered as top-priority and range from a sustainability pathway to a fossil-fuel development. Recent studies show how existing models need further improvements to fully capture Arctic complexities, highlighting the need for additional Arctic observations to reduce uncertainty (Wang et al., 2023). **FRESH-CARE will use the latest CMIP data to force the FC-model simulations to quantify how freshwater will be distributed and transported under the diverse potential scenarios of the Arctic Ocean.**

**Methodology:** I have developed the proposed three scientific objectives (O1-3 above) into five actionable work packages (WP), as shown in Fig. 2. Specifically, O1 will be addressed in WP1-2, O2 in WP3-4 and O3 in WP5. Whereas the focus of WP1, WP2, WP3, and WP5 is the whole Arctic Ocean, defined as the oceanic area enclosed by the four Arctic gateways, the focus of WP4 is through those Arctic gateways per se. In what follows I describe these WP, and their expected duration in months (M) in turn.

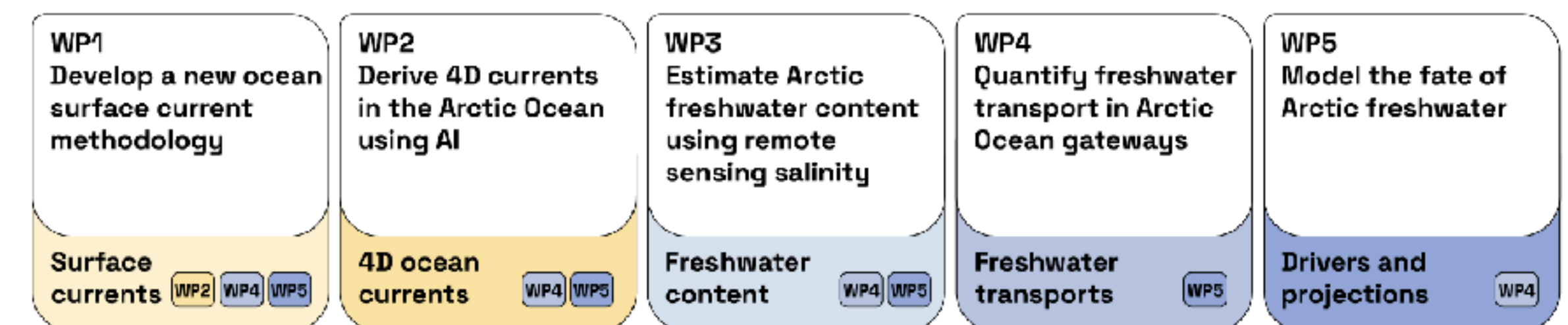
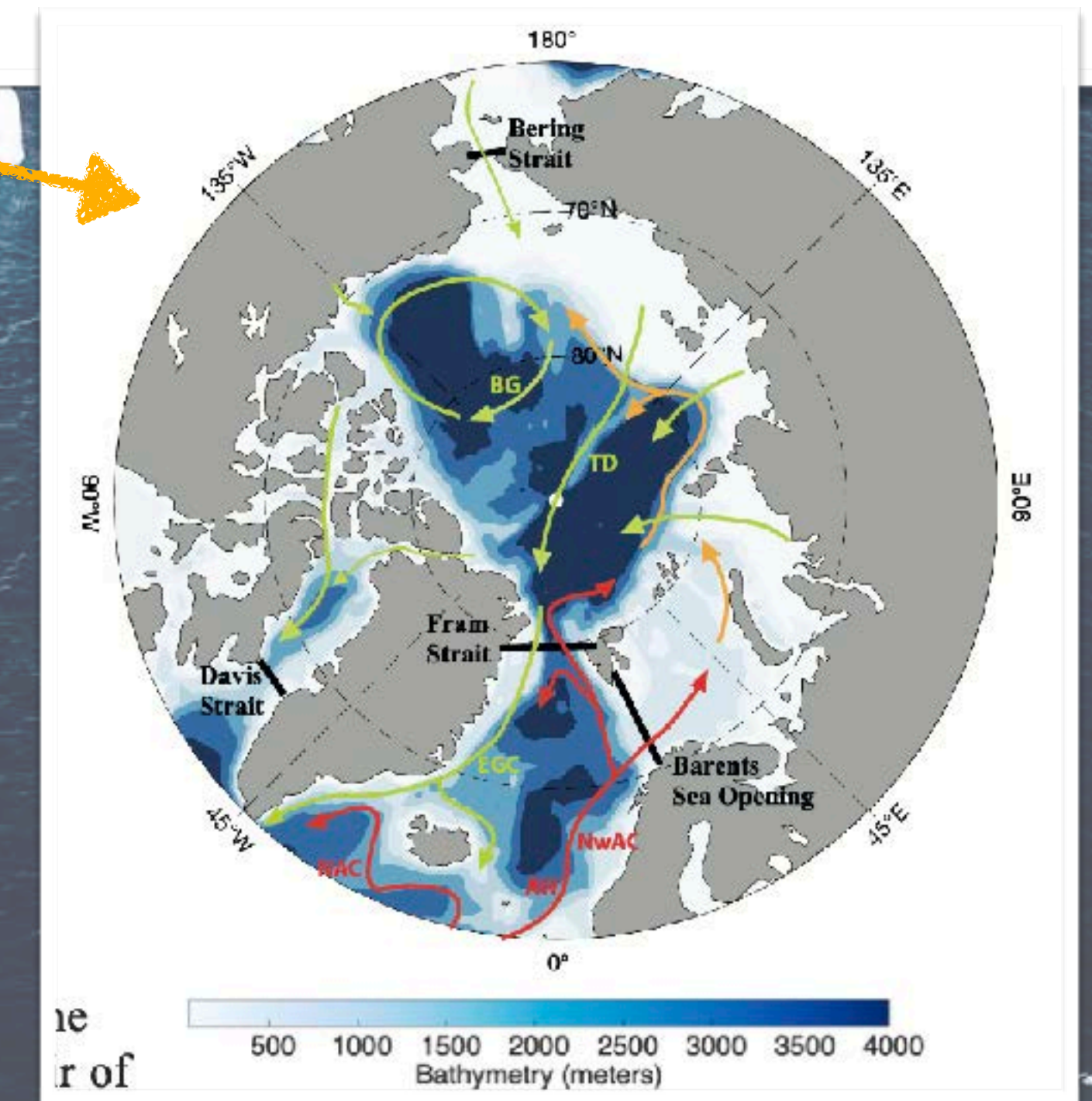
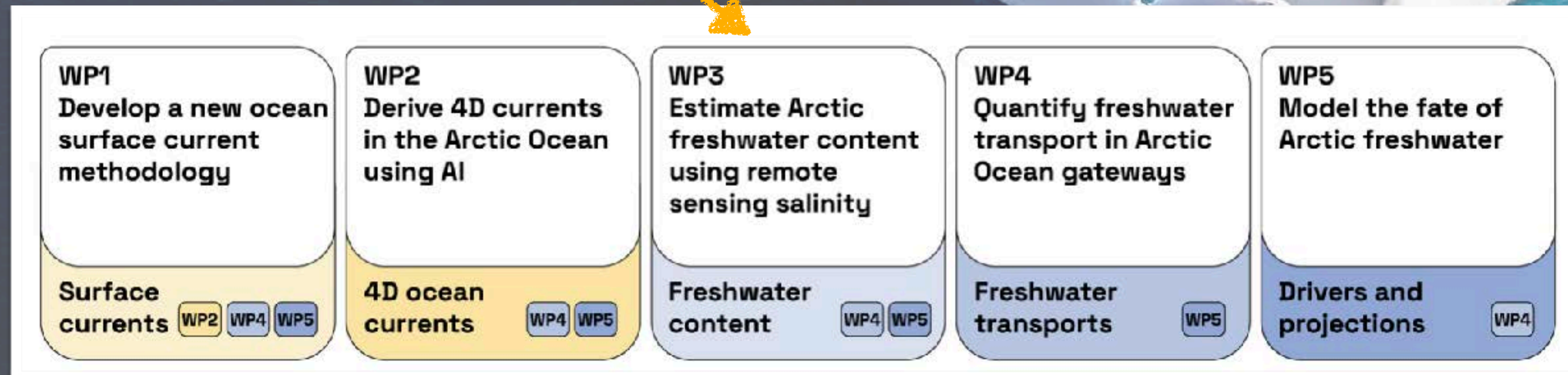
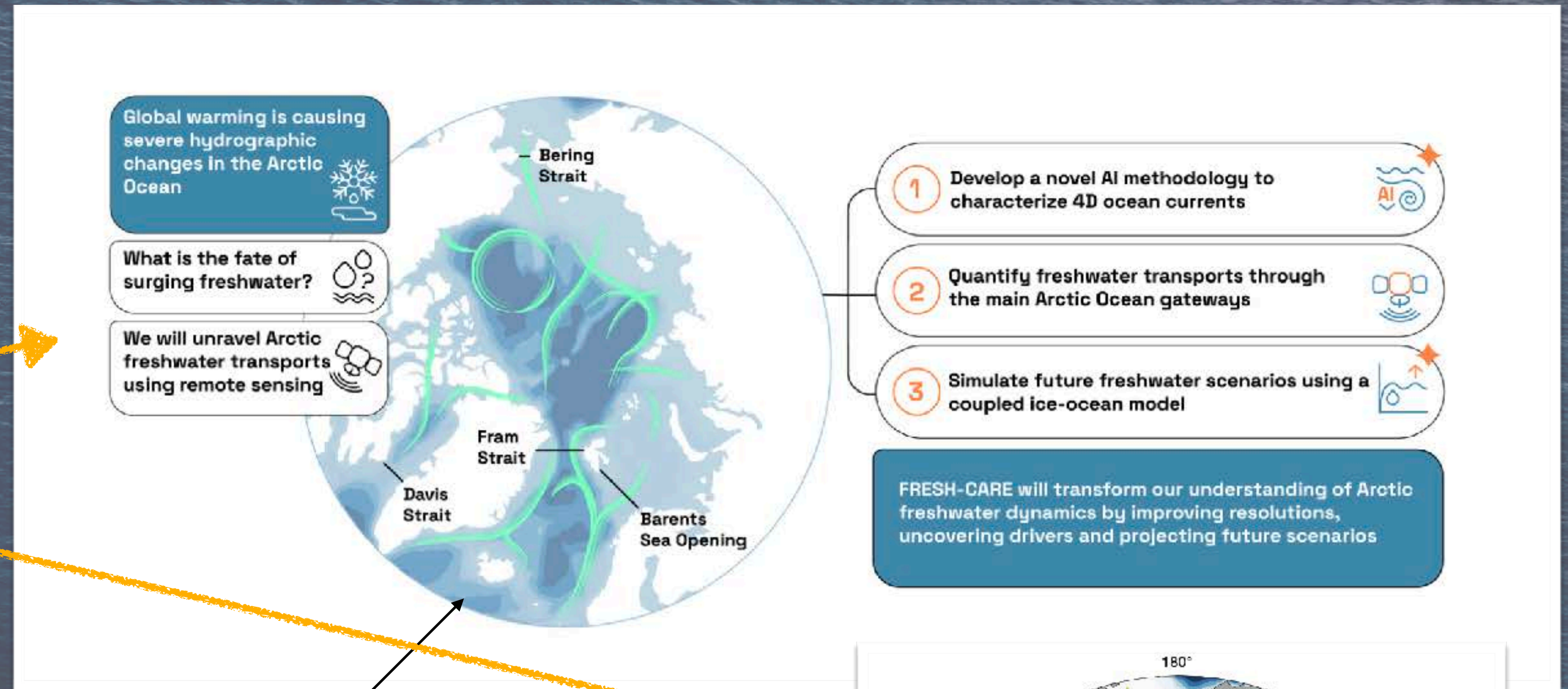


Figure 2: Workflow of the FRESII-CARE project structured in work packages. Find for each WP: title, the main output, and WPs that will employ these outputs.



# Structure B1 figures

- B1 —> 4 figures
- 1. Graphical abstract
- 2. Area of study
- 3. Work packages
- 4. First results



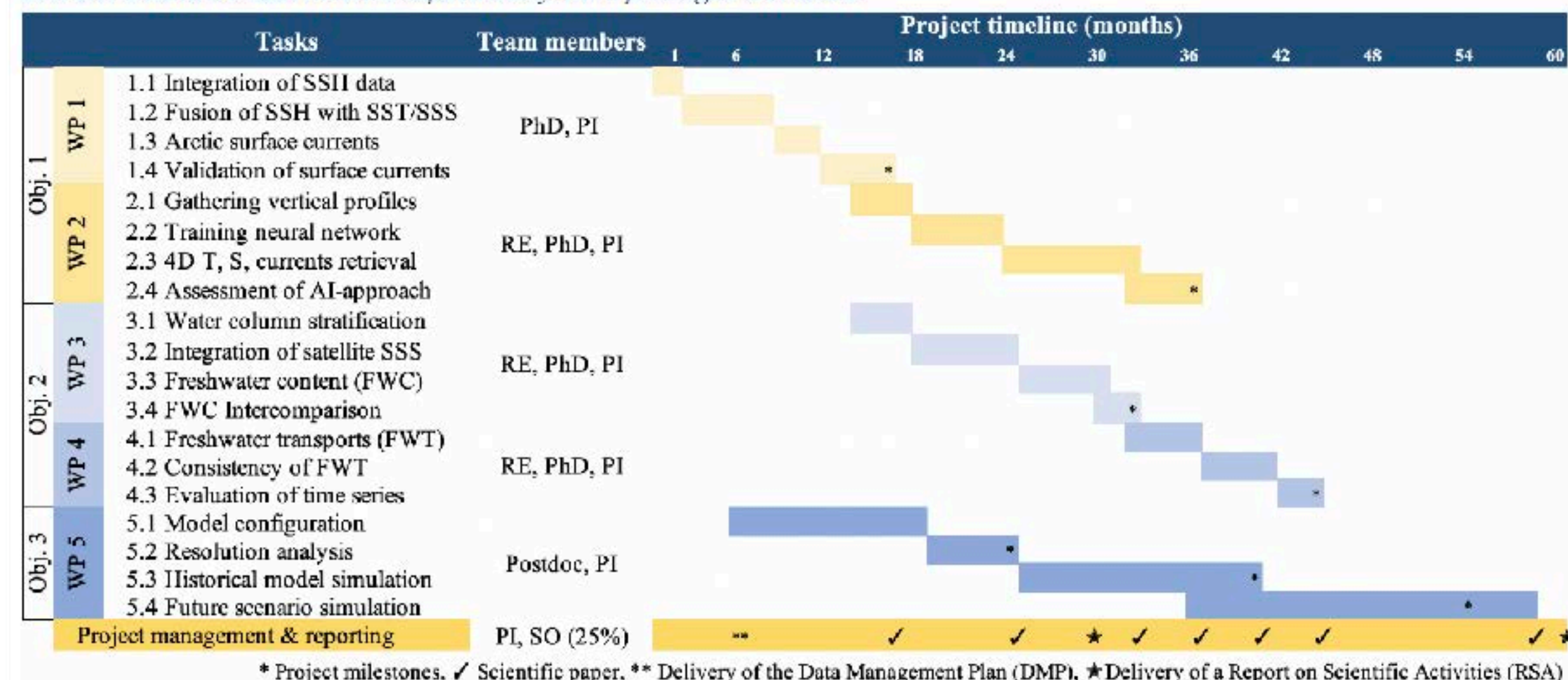


# Structure

## B2 (14 pages)

- Scientific context (2/3 page)
- Project vision (1/2 page)
- Scientific objectives (1/2 page)
- State of the art (4 and half page)
- Methodology (6 pages)
- Feasibility (2/3 page)
- Risk analysis (1/2 page)
- Potential Impact (1/2 page)

Table 1: FRESH-CARE timeline separated by work packages and tasks.



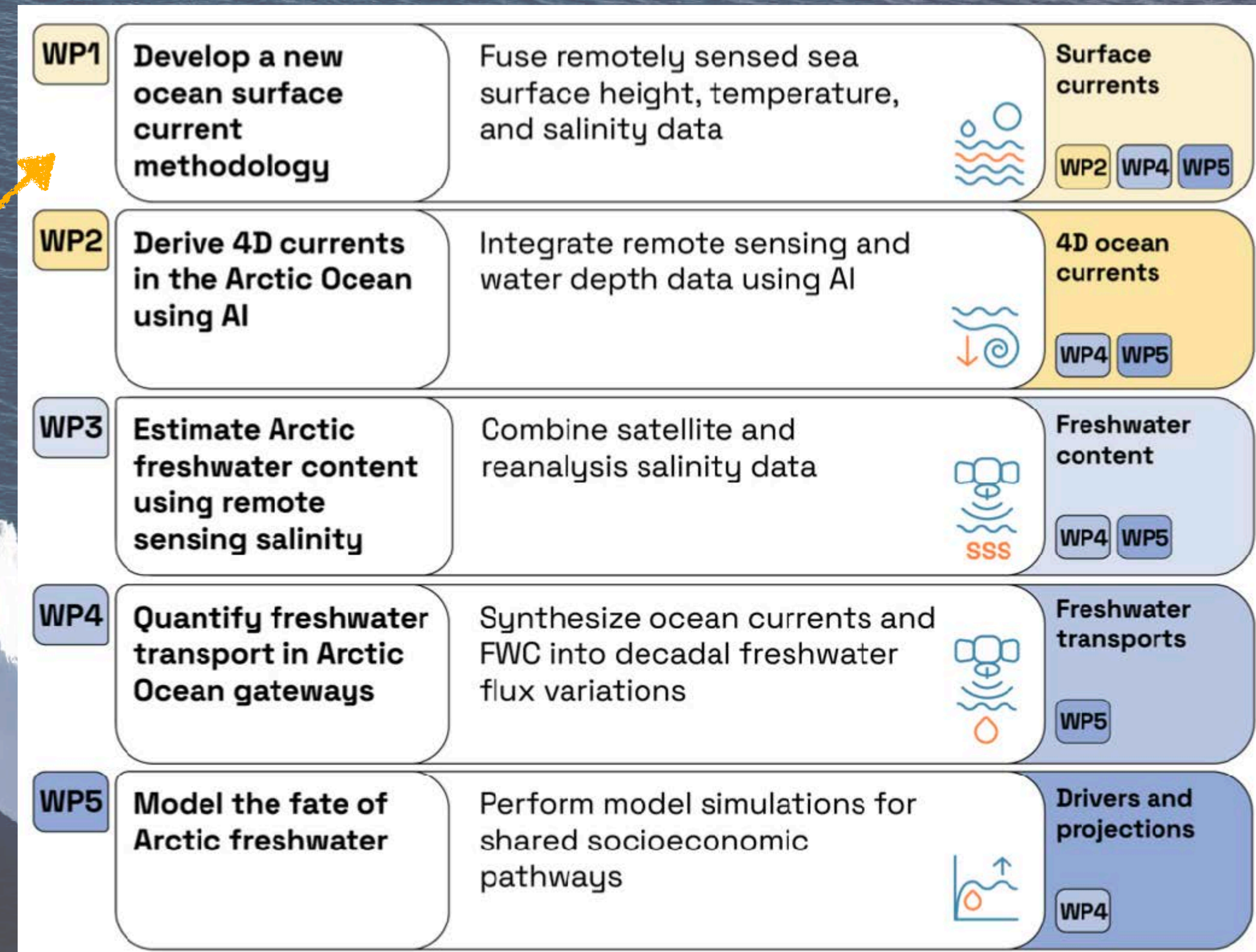
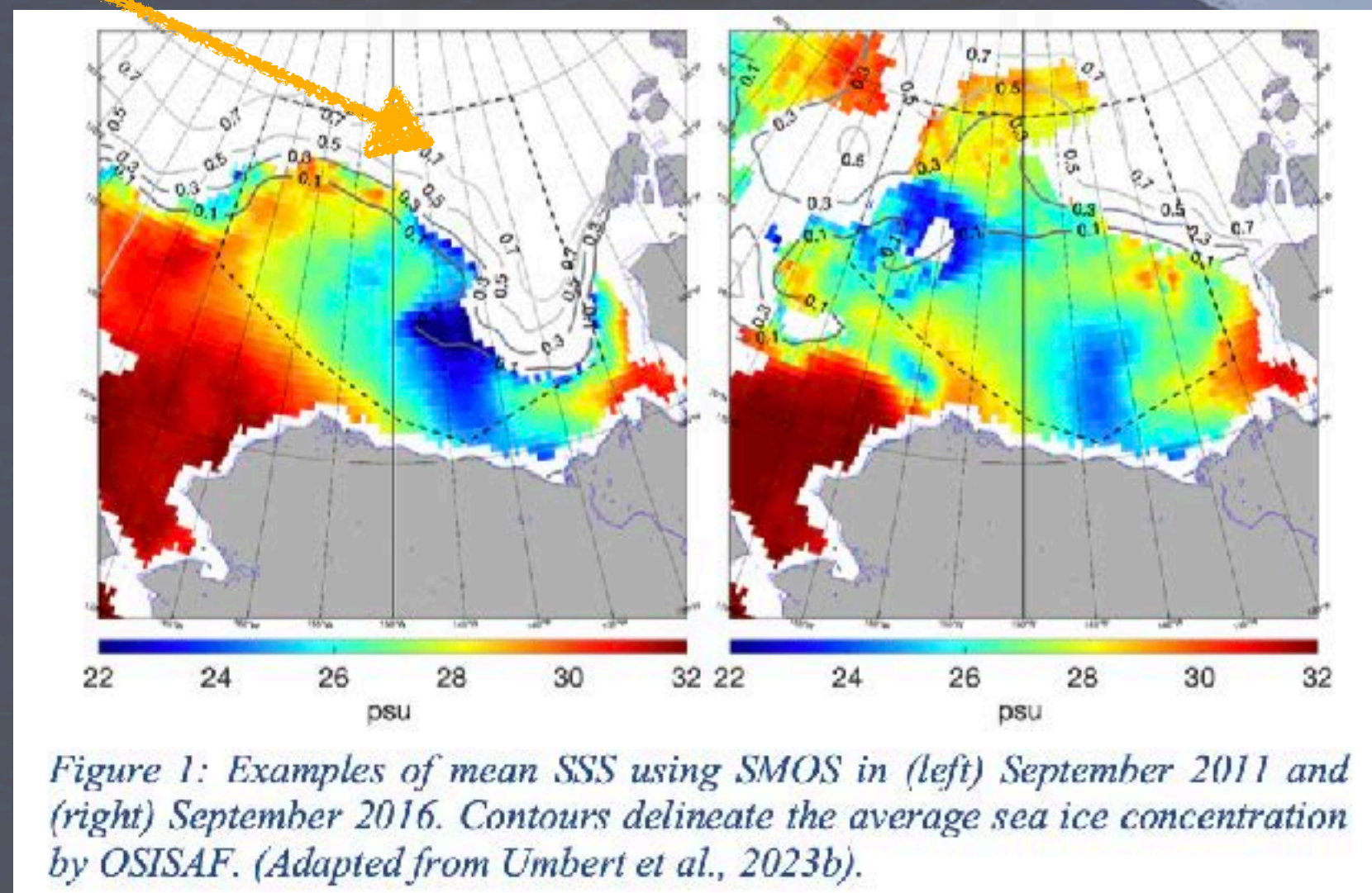
Risks	Probability/Impact	WP	Mitigation/Contingency Plan
Data limitations due to satellite failures	M/M	WP1-WP4	If a mission ends operation, use an alternative mission that can measure the same variable; Collaborate with remote sensing data providers.
Weak integration of freshwater dynamics	M/L	WP1	Change the approach if integration proves ineffective using SSII without data fusion of SST or SSS in WP2.
Insufficient control of AI-based methodology	H/M	WP2	Collaborate with international experts who have worked with the same AI-based approach, (Dr. Bruno Buongiorno, who was an international reviewer of my Ph.D.) to enhance control in the training and validation of LSTM approach. Organize work meetings and invite to come to the III 1 month.
Data fusion effectiveness uncertainty	H/M	WP1-WP4	Conduct testing and validation; Use alternative interpolation approaches; Collaborate with data fusion experts.
Unforeseen delays in models development	H/M	WP2, WP5	Proactive project management to prevent delays; Allocate extra time buffers for unexpected challenges, e.g. WP2 could be extended an extra 8 months. WP5, could be extended until the end of the project and we can prioritize running just the two extreme scenarios to assess the fossil fuel development and sustainability pathways if delays occur.
Complex implementation of FC-model	M/M	WP5	Seek guidance from domain experts (e.g. Dr. Kate Hedström, collaborator of ICM researchers); Allow flexibility to adapt methods if needed.
Computational resource constraints	L/M	WP2, WP5	To secure computational resources, I will use MareNostrum 5 at the Barcelona Supercomputing Center (BSC). To achieve efficient and continuous simulation workflows, I will use the AutoSubmit management tool that will ensure smooth and reproducible simulation workflows.

Table 2: Risk analysis of FRESH-CARE project.



# Structure B2 figures

- B2 —> 4 figures
- 1. First results
- 2. First results
- 3. Work packages
- 4. First results





# Once is written

## Use other's brains

- Ask your colleges to read and make suggestions
- Enrole in all facilities provided by FEYCT, your institution, ERC, etc.
- Ask help for the graphical design
- Fully focus on writing and enjoy the journey!





**Good luck!**

**Any questions?**

