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Arctic

EPFL
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Earth Observation
//HACKEON

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

14 LIFE BELOW WATER

Martin Defuns

Hyeongkyun Kim

How’s it going, Arctic?

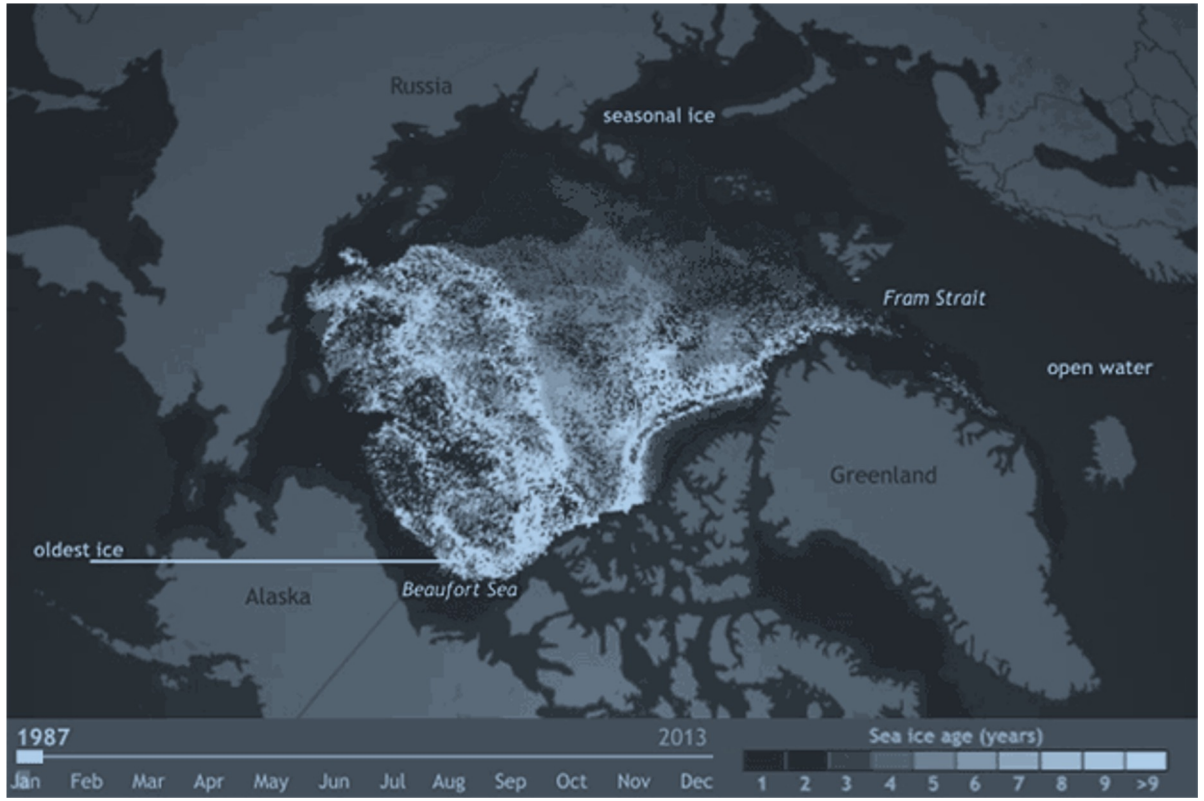
Ice in Arctic is rapidly

breaking and ***melting.***

300 km^3 per year.[2]

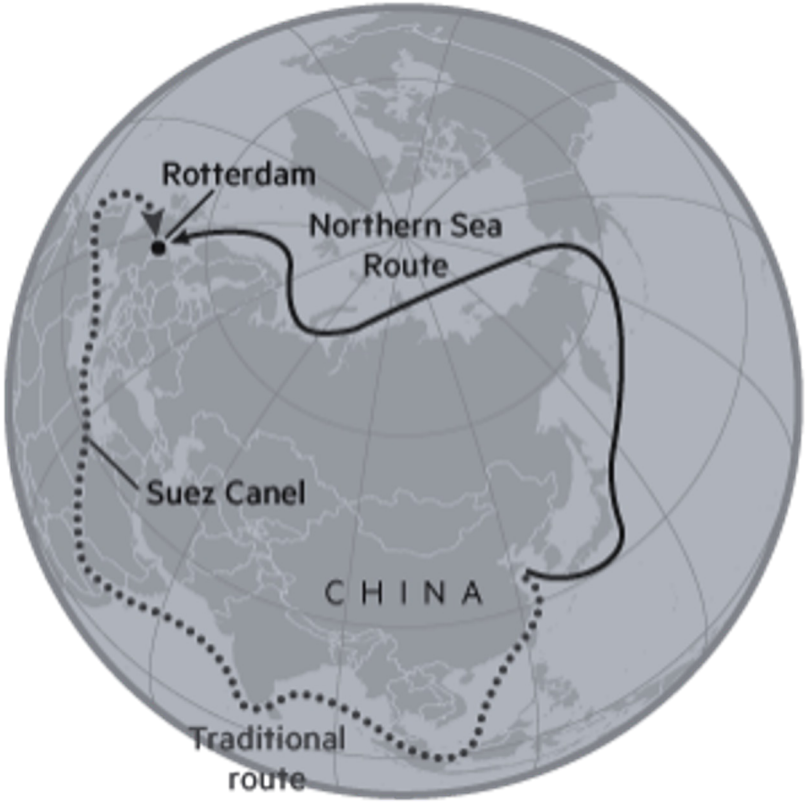
ca. ***3x of Glacier in Alps***

100 km^3 in 2017.



1. GIF: Amount of old ice in Arctic, 1987-2013, NOAAClimate,
2. Future of the sea: implications from opening Arctic Sea routes, Government of Science, UK, 2017
3. “More than 90% of glacier volume in the Alps could be lost by 2100”, EGU, 2019

Revealing new shipping lanes



Source: FT research
© FT

- Arctic route : 12 - 15 days

  → ***40% shorter*** than traditional route.[1]

  20 - 25 days via Suez Canal

- More demands for Arctic shipping.[2]

  → ***1M Tons of Cargo*** in 2020.

  → Y-to-Y Growth ***200%***

1. Image Source : China reveals Arctic ambitions with plan for 'Polar Silk Road', Financial Times, 2018
2. Responding to a changing Arctic, House of Lords, UK, 2014
3. NSR Shipping Traffic – Transit Voyages in 2020, CHML Information Office, 2021

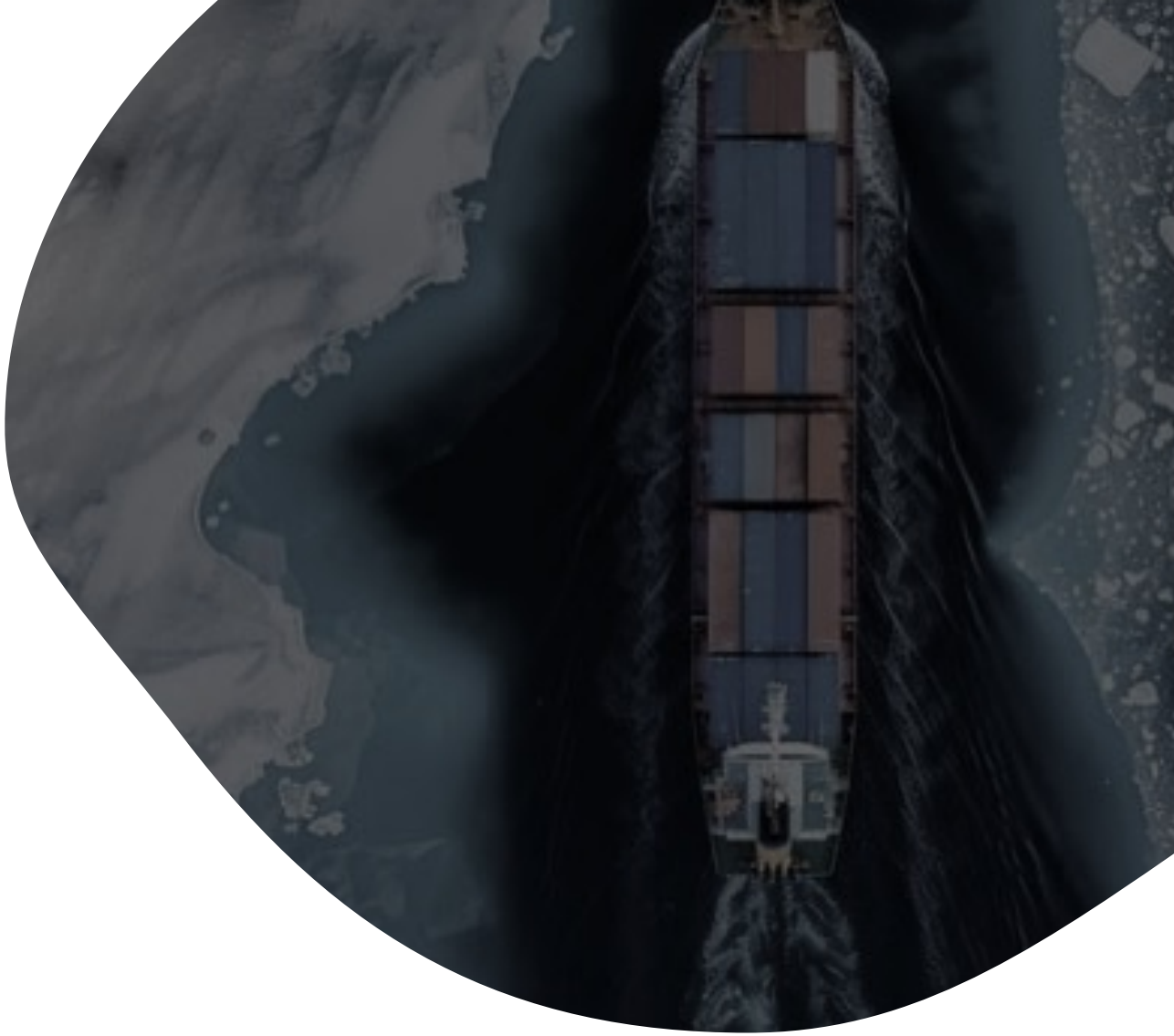
Artic navigation: New opportunities

- **Operational Efficiency:** Reduced fuel consumption and carbon emissions
- **Flexibility and Agility:** Additional route options enhancing supply chain flexibility and adaptability
- **Seasonal Benefits:** During summer month particularly advantageous, especially for bulk shipping

Artic navigation: Challenges

Artic navigation: Economic challenges

- Equipment
- Hull Reinforcement
- Polar Code compliance
- Administration fees



1. L. Xu, Q. Yu. "Performance Analysis: Using the Northern Sea Route as an Alternative to Traditional Routes," in *Journal of Marine Science and Technology*, vol. 30, no. 6, 2022.
2. Y. Zhang, Q. Meng, S. Ng. "Shipping efficiency comparison between Northern Sea Route and the conventional Asia-Europe shipping route via Suez Canal," in *Journal of Transport Geography*, vol. 57, pp. 241–249, 2016.
3. Buixadé Farré, A., et al. "Commercial Arctic shipping through the Northeast Passage: routes, resources, governance, technology, and infrastructure," in *Polar Geography*, vol. 37, no. 4, pp. 298–324, 2014.

Artic navigation: Environmental challenges

- Ecologically protected areas
- Noise and disturbances
- Accidental discharge of oil and toxic chemicals
- Risk of oil spills

1. G. Celik, E. Van Hassel. "The sustainability of the Arctic: A case study analysis of container shipping," in *Transportation Research Procedia*, vol. 72, pp. 3403–3410, 2023.

Artic navigation: Safety hazards

- Incidents caused by weather extremes
- Navigability through difficult ice conditions
- Sparse maritime infrastructure

1. M. Christensen, M. Georgati, J. Arsanjani. "A risk-based approach for determining the future potential of commercial shipping in the Arctic," in *Journal of Marine Engineering & Technology*, vol. 21, no. 2, pp. 82–99, 2022.
2. C. Chang, J. Xu, D. Song. "An analysis of safety and security risks in container shipping operations: A case study of Taiwan," in *Safety Science*, vol. 63, pp. 168–178, 2014.

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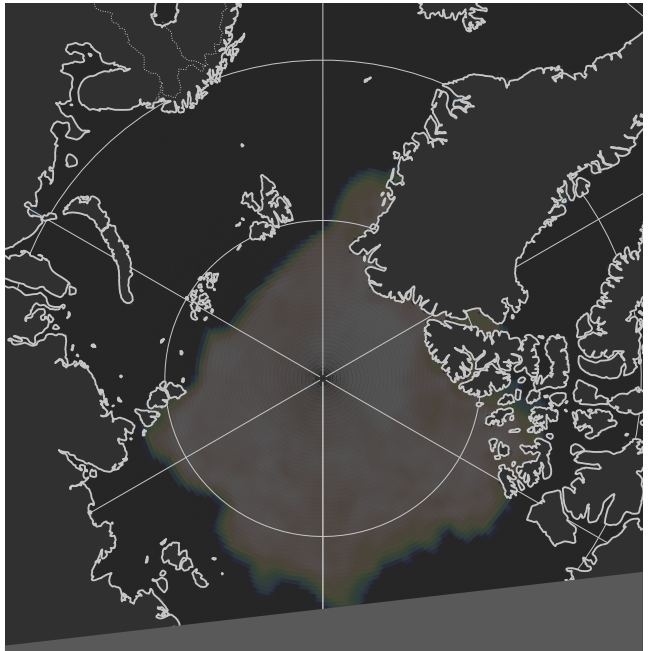
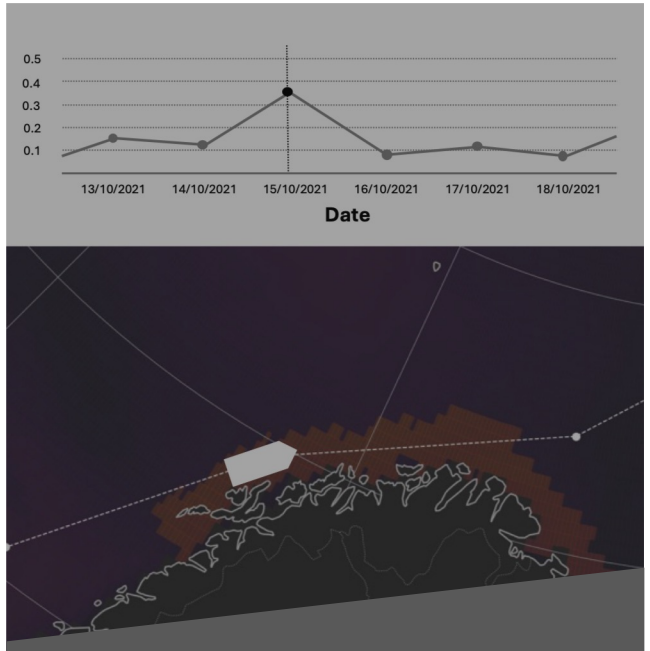


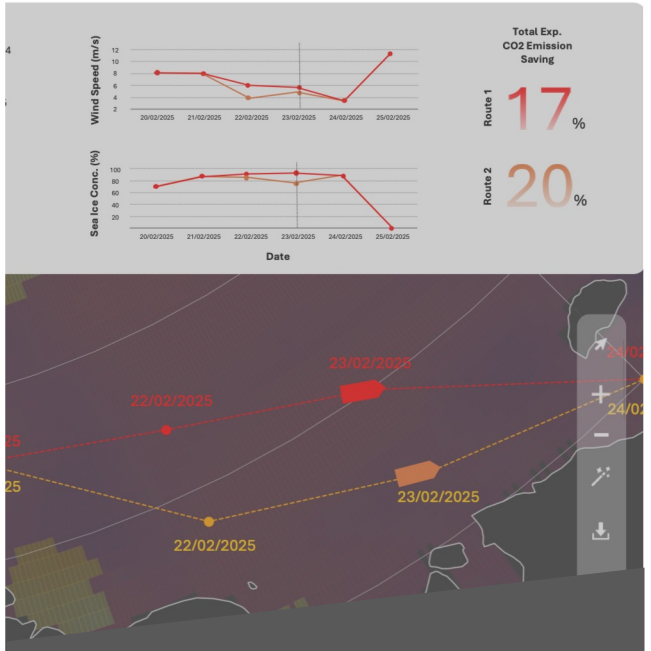
Arctic Condition Monitoring

Making informed decisions based on current and future conditions



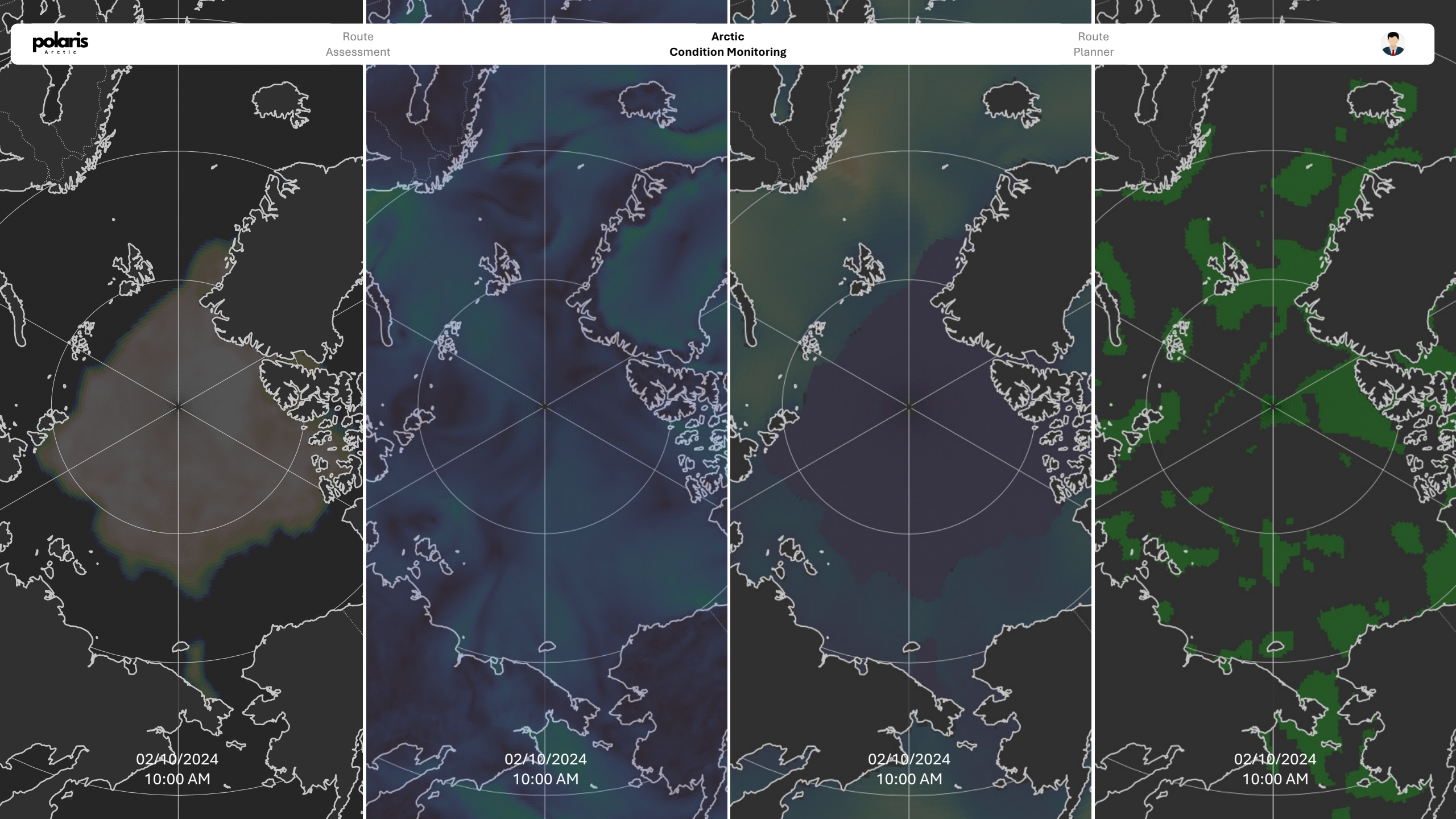
Arctic Route Assessment

Analysis and estimations for pre-defined artic voyages



Arctic Route Planner

Route planning based on multi-objective route optimization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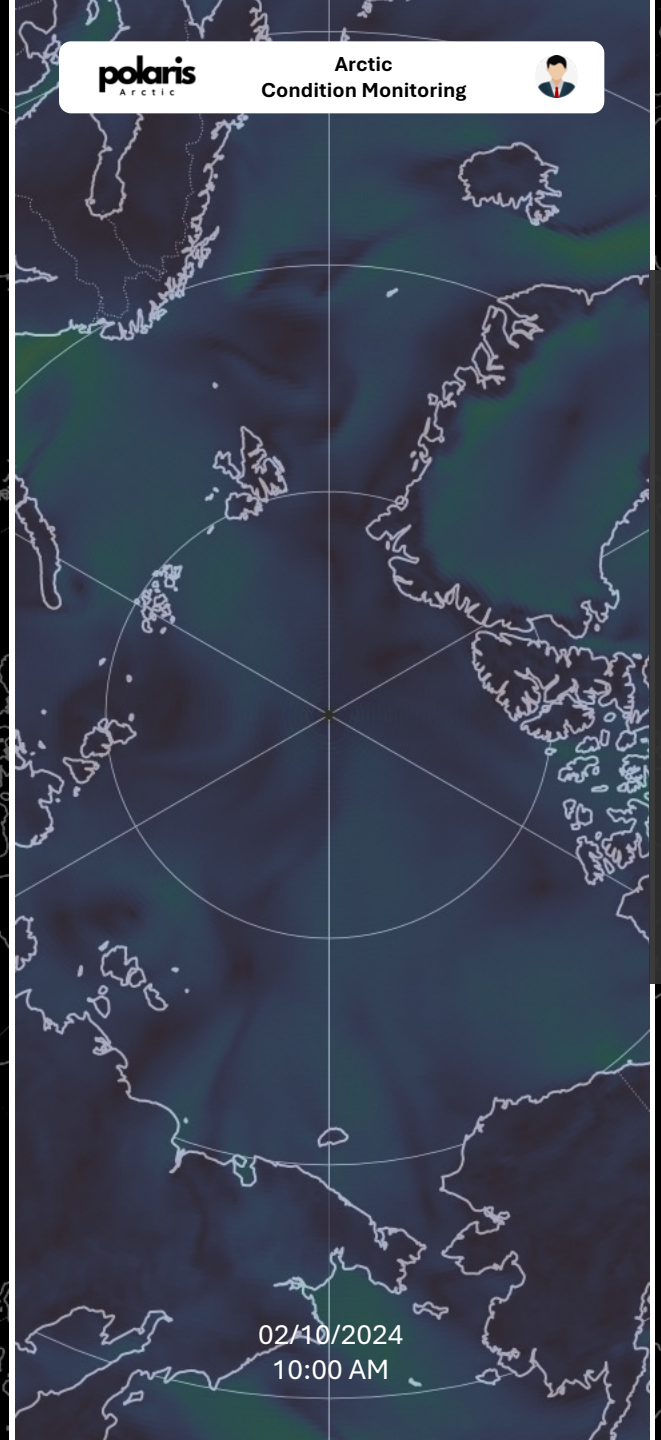
Arctic Condition Monitoring

1 . Sea Ice Concentration

- Obstructs the shipping route
- Vessels can be trapped and damaged
- Fewer ports and limited rescue services increase the risk



Arctic Condition Monitoring

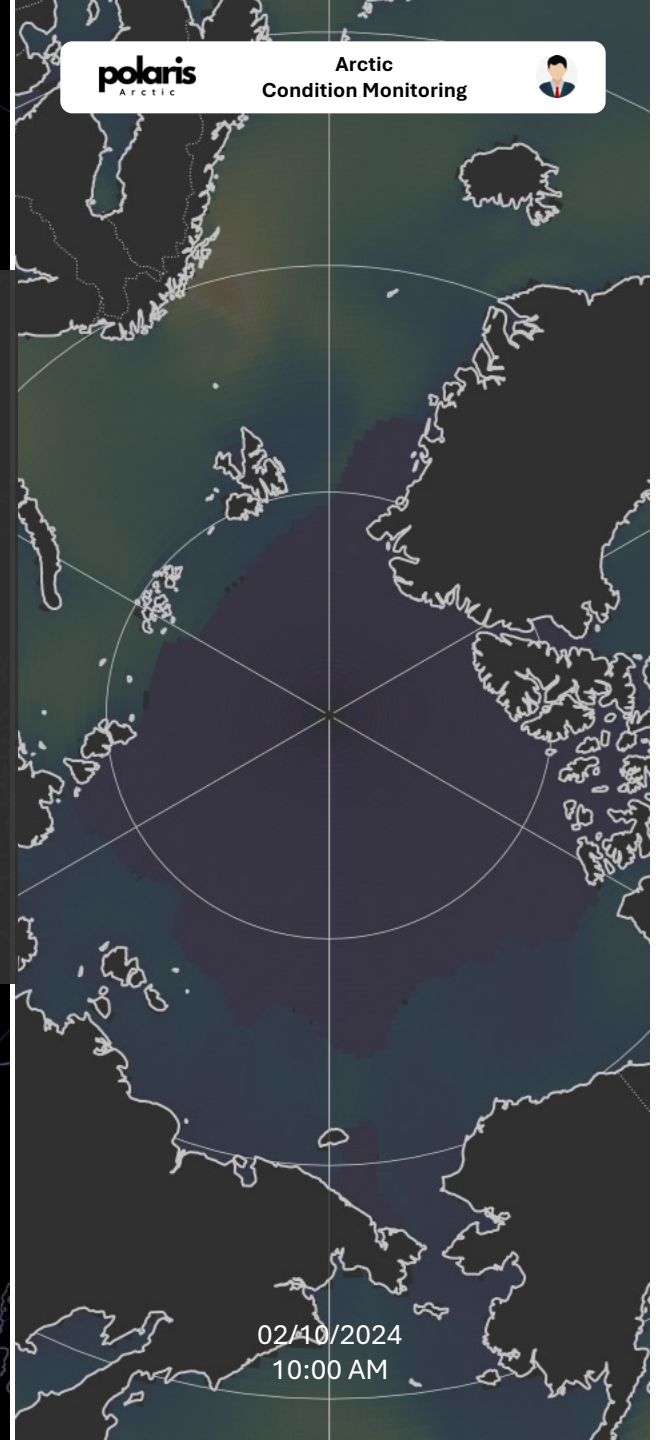
2 . Wind Speed

- Reduces visibility to navigate
- Affects stability and maneuverability
- Moves sea ice on the shipping lane

Arctic Condition Monitoring

3 . Wave Height

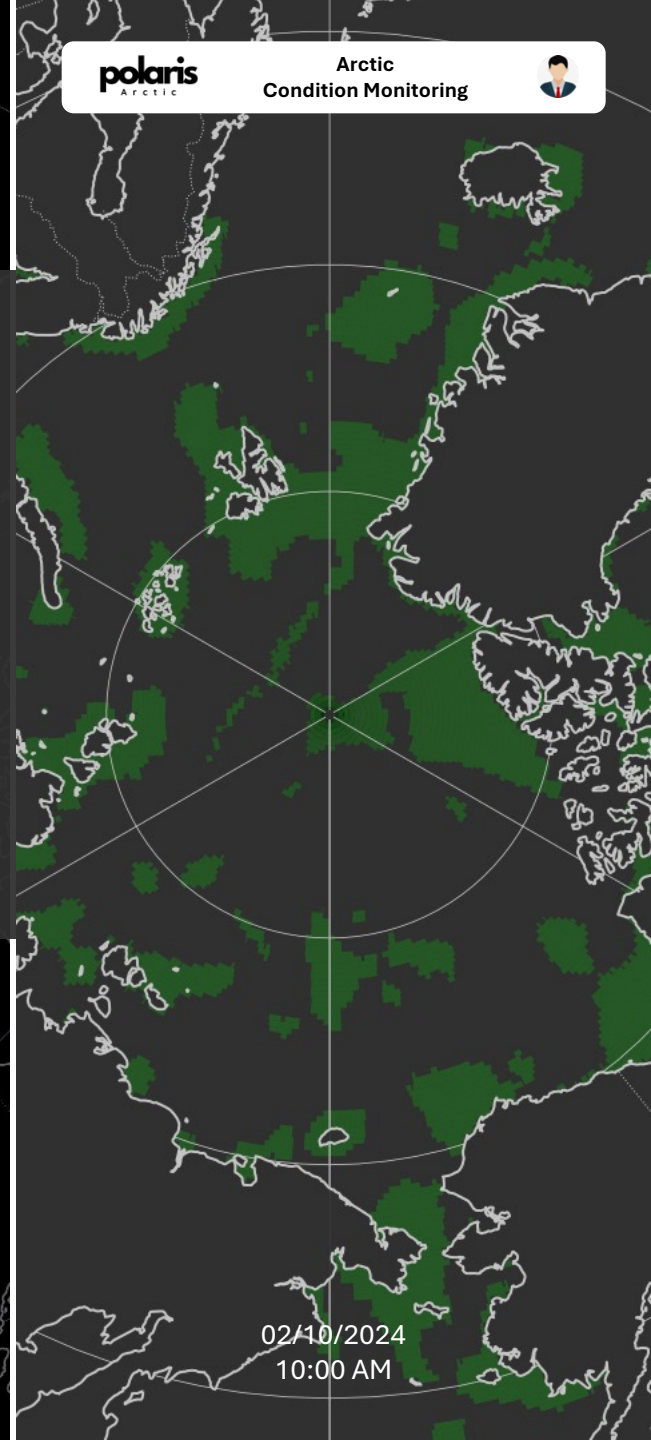
- Resistance on thrust and steering
- Increased fuel consumption



4 . Priority Area for Conservation (PACs)

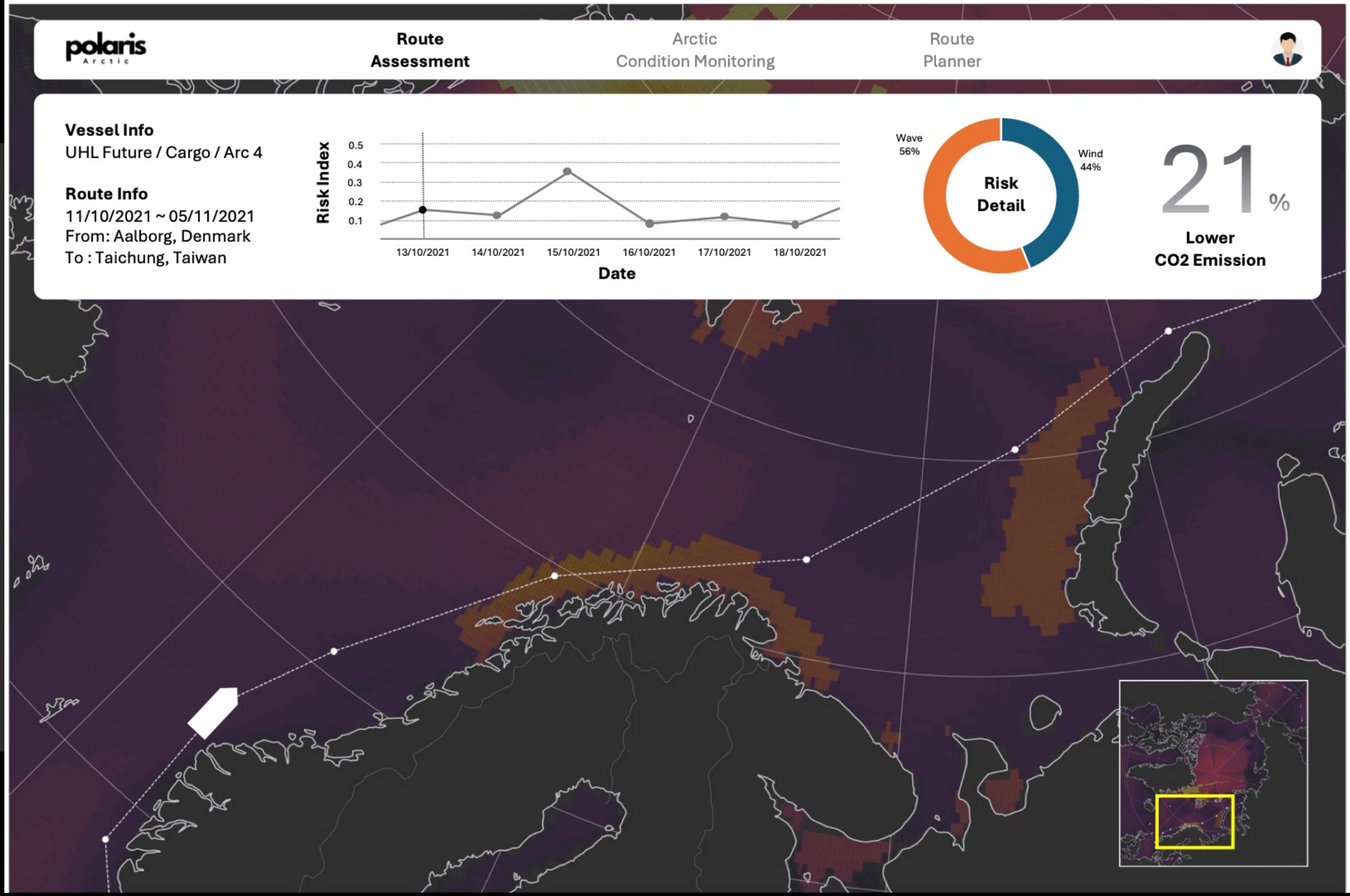
- ArcNet : 83 priority areas to conserve Arctic biodiversity
- Considers marine mammals, sea birds, fish, sea-ice habitats, benthos, and coastal features

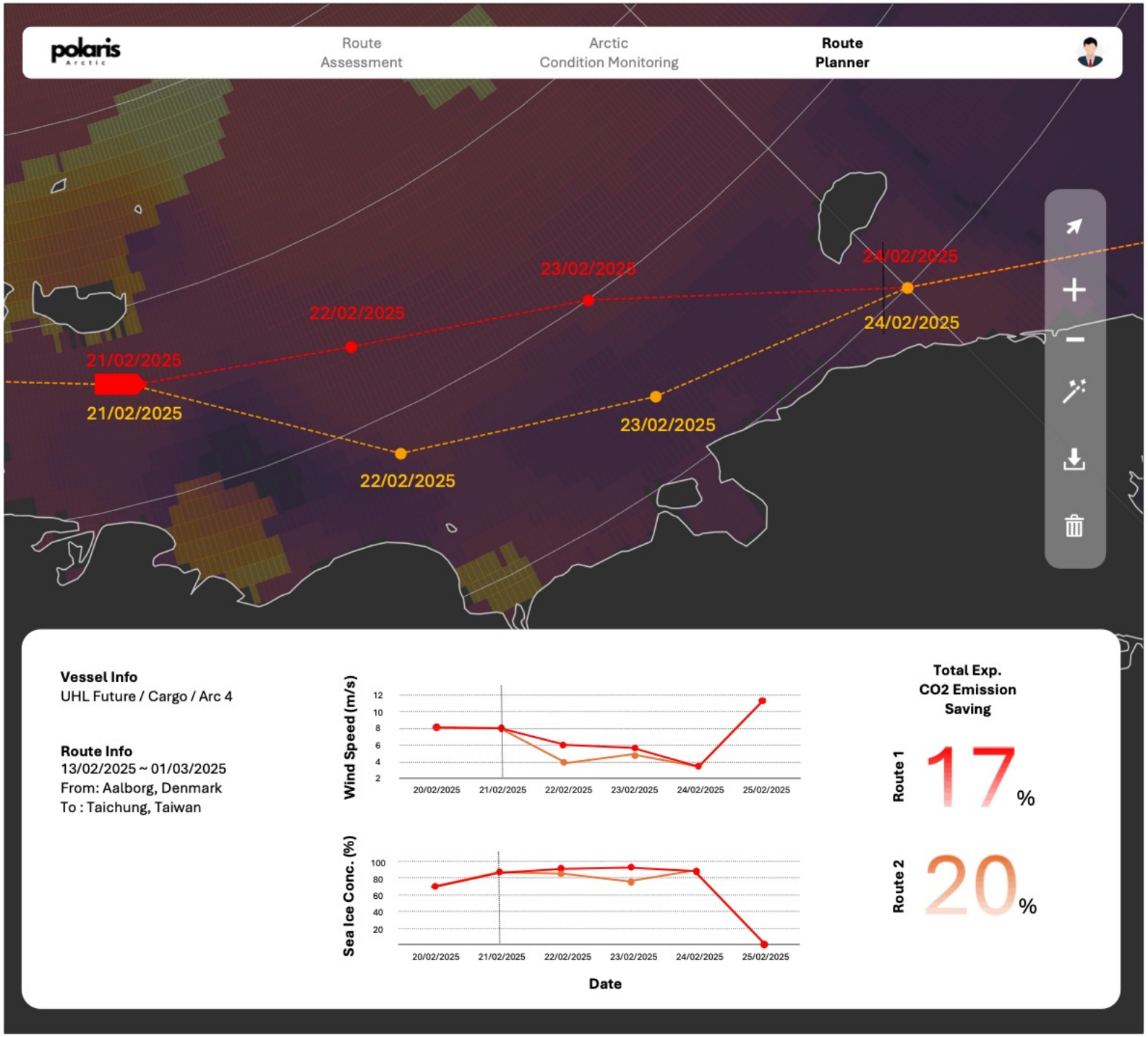
James, Timothy D., et al. "Whole-ocean network design and implementation pathway for Arctic marine conservation." *npj Ocean Sustainability* 3.1 (2024): 25.



Arctic Route Assessment

- Post-sailing route analysis
- Risk analysis based on EO historical data
- Env. impact evaluation

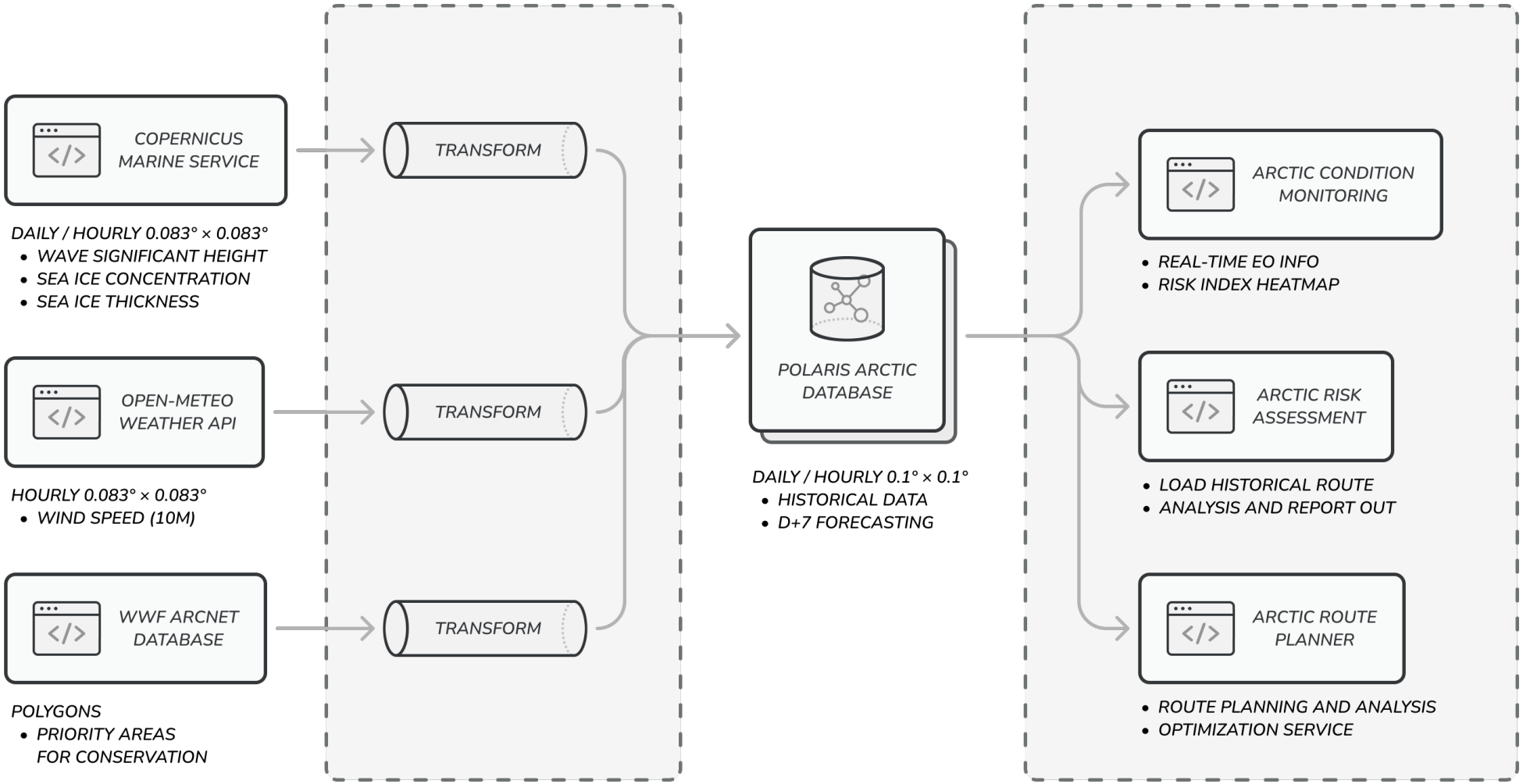




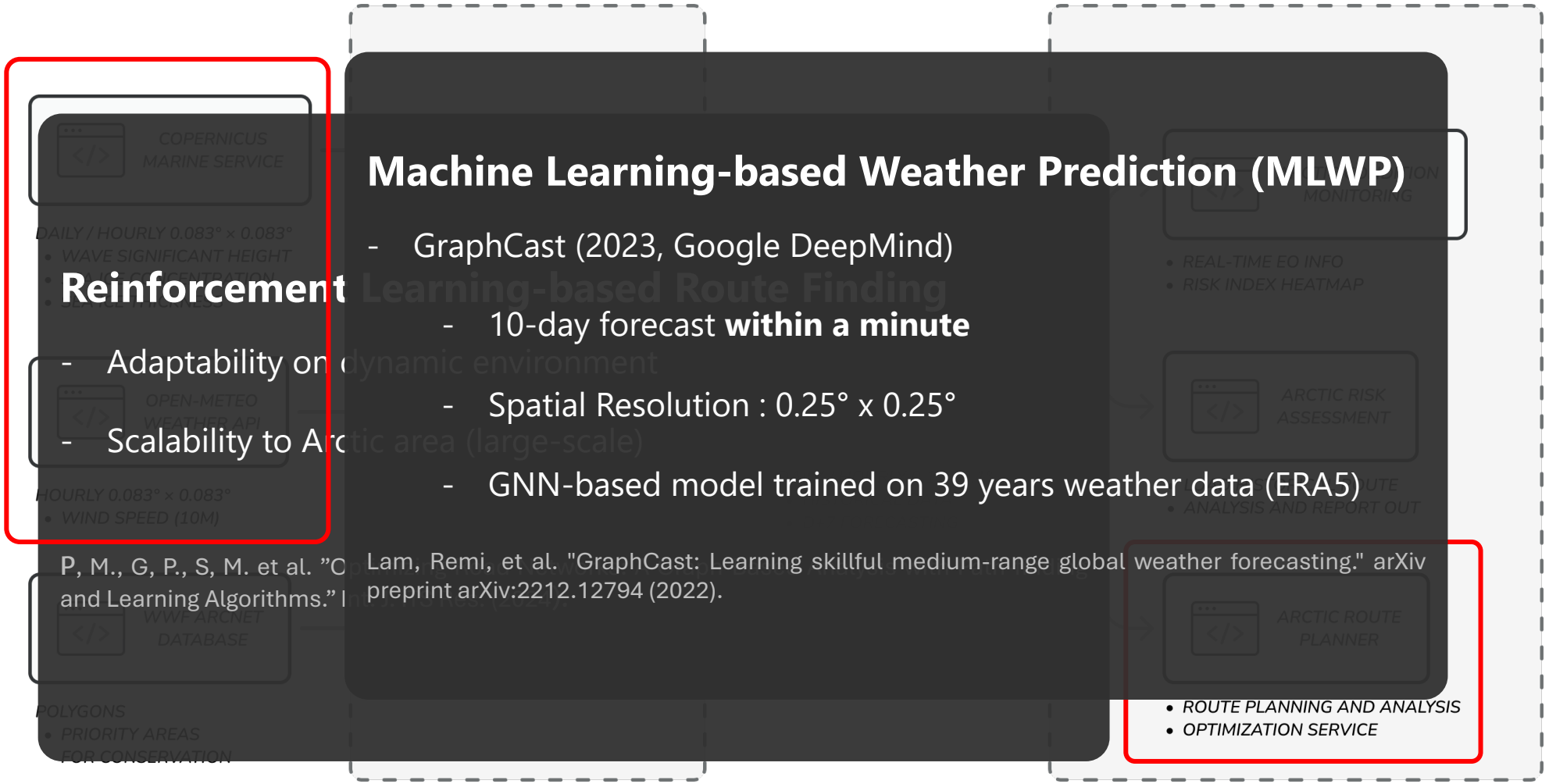
Arctic Route Planner

- Pre-sailing route analysis
- Plan and compare routes based on EO forecasting data
- Support optimal route finding

System Overview



Move forward with AI !



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