How do different seagrass species disperse in the Great Barrier Reef?

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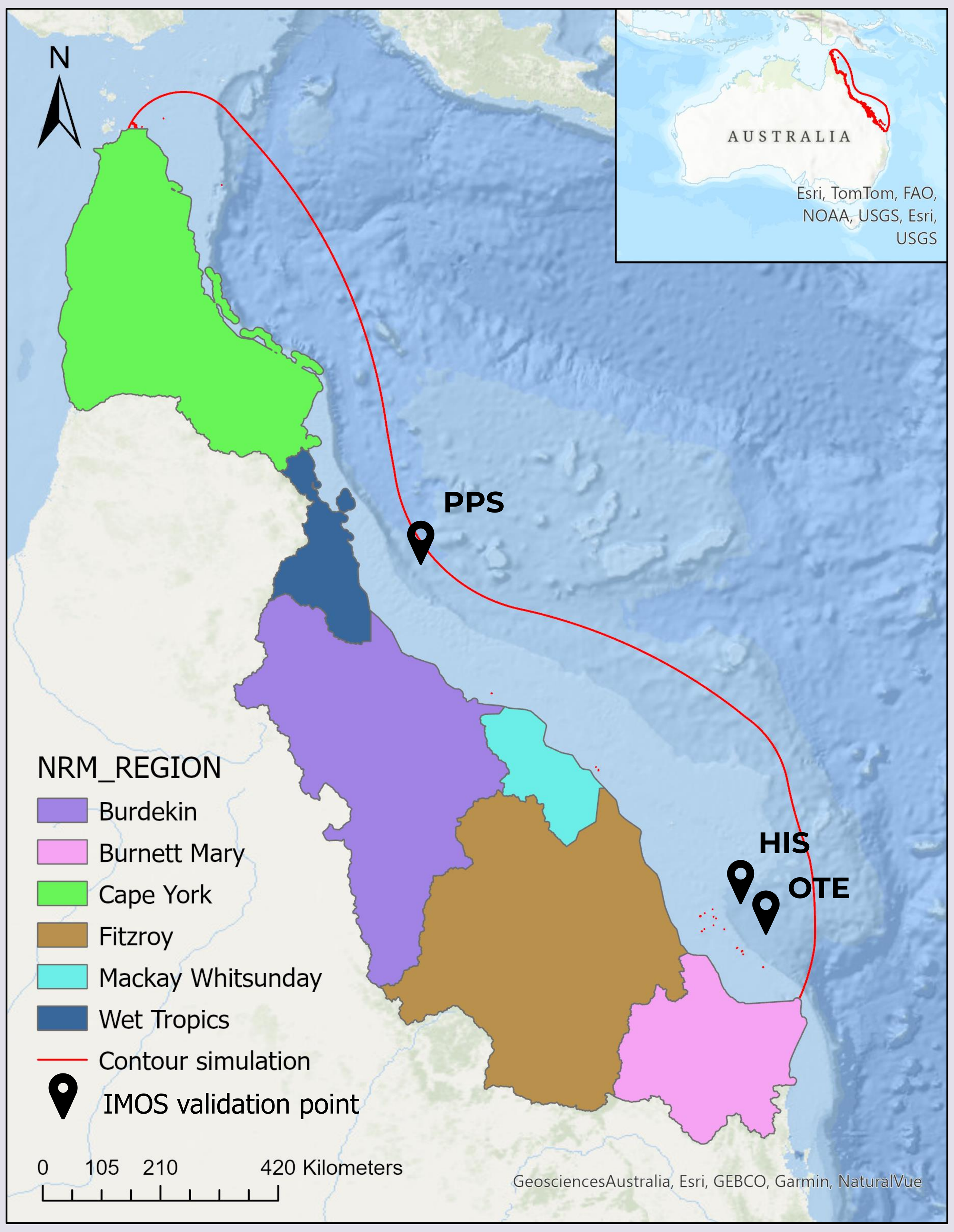
Biophysical modelling: an important tool in marine ecosystem management, but rarely tested

Biophysical modelling is an important tool to understand key **marine dispersal processes**. Applications are numerous, including connectivity & community analysis and estimation of population resilience. Outputs have the potential to inform **ecosystem management** and guide restoration projects.
The sensitivity of biophysical models are rarely tested, particularly for seagrass dispersal. Seagrasses are coastal ecosystems that provide essential services including fisheries habitat, water filtration, coastal protection and carbon sequestration. Seagrasses use multiple reproductive mechanisms including rhizome extension and export of **floating propagules** (fruits, seeds, fragments).

In this study, we tested a biophysical model of seagrass fragment dispersal in the **Great Barrier Reef** (GBR), Australia. 15 seagrass tropical species have been observed in the GBR. We used the multiscale ocean model SLIM to simulate the barotropic ocean circulation, with a resolution reaching 250m over seagrass meadows. We then used a Lagrangian transport model to simulate the dispersal of virtual **seagrass fragments**.
We performed a **sensitivity analysis** with 3 main variables: windage, species behaviour (buoyancy) and time (seasons, interannual variations). The sensitivity analysis was expressed as a function of the travelled distance by propagules.



We assigned seagrass species into 4 groups, based on their leaf morphology:

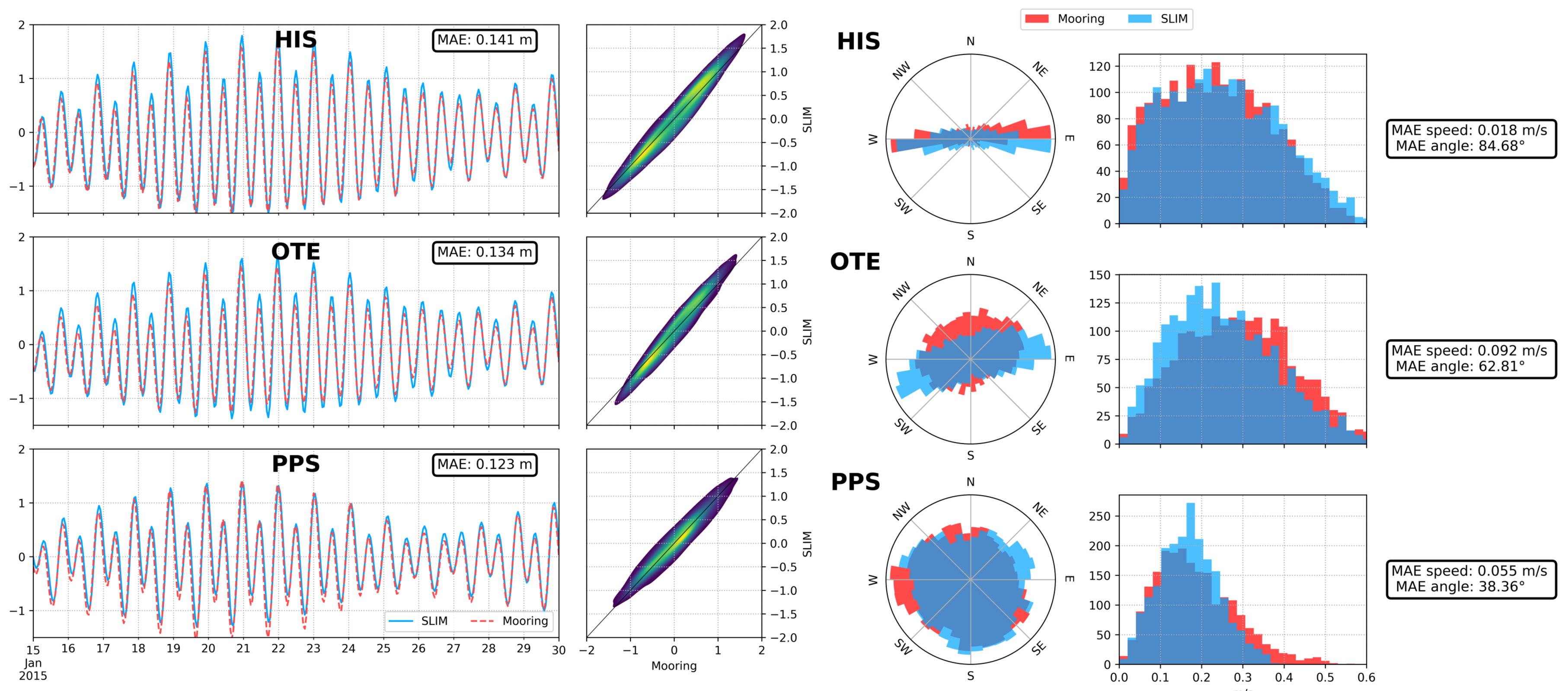
G1 – *Halophila sp. (ovalis, capricorni, decipiens, minor, tricostata)*
windage: 0.21-1.175%

G2 – *Halophila spinulosa*
windage: 0.5-1.5%

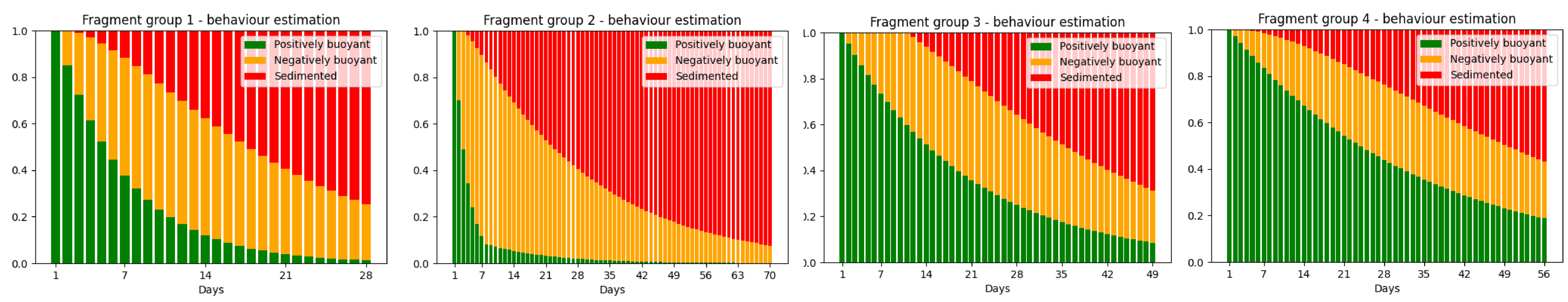
G3 – *Syrringodium isoetifolium*
windage: 1.0-2.0%

G4 – *Zostera mueller & Halodule uninervis*
windage: 0.34-0.96%

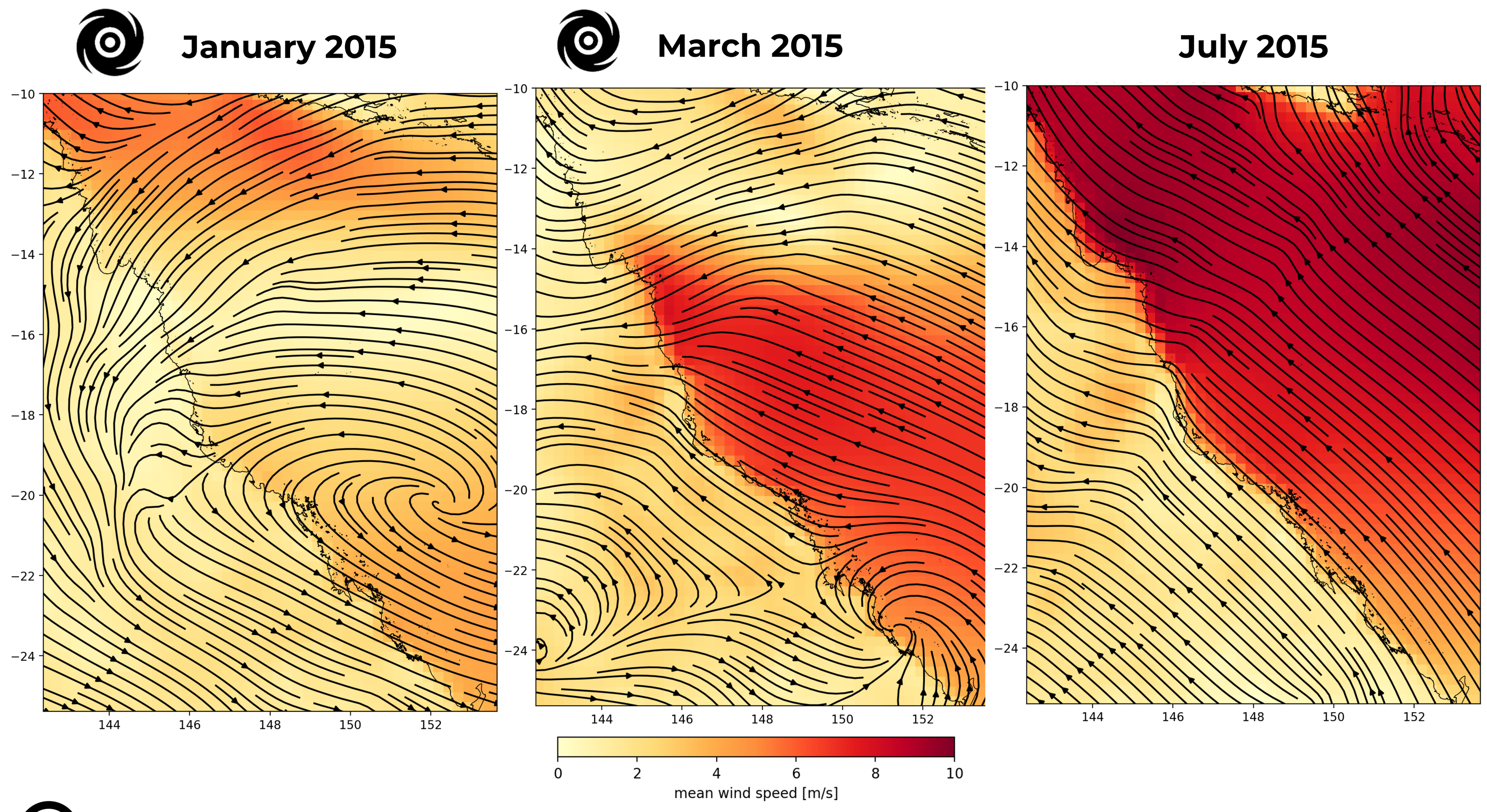
1 We validated the simulated currents and sea surface elevation with IMOS mooring data. Validation was for a 2-month period: 15th January – 15th March 2015.



2 We calibrated the **seagrass fragment dispersal model** by incorporating information on the buoyancy of seagrass species in the four groups over time. Information was obtained from the literature and expert opinion.

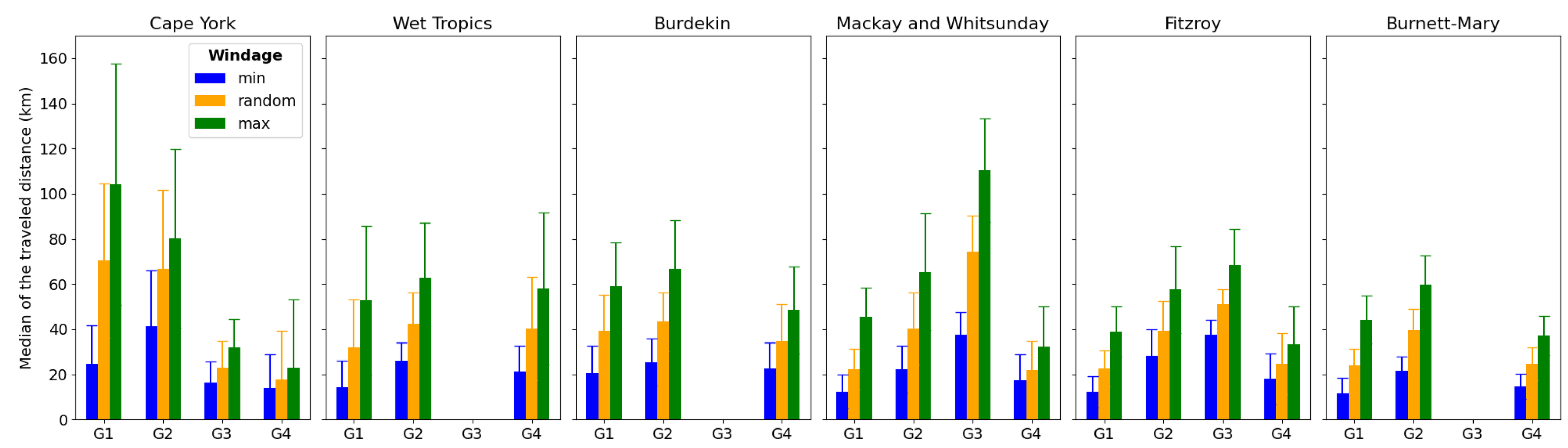


3 The GBR has a **tropical climate**, divided by 2 main seasons: wet (November-March) and dry (April-October). Dry season is windier while during wet season, wind is more variable. In 2015, the GBR was impacted by tropical cyclones in both January and March.

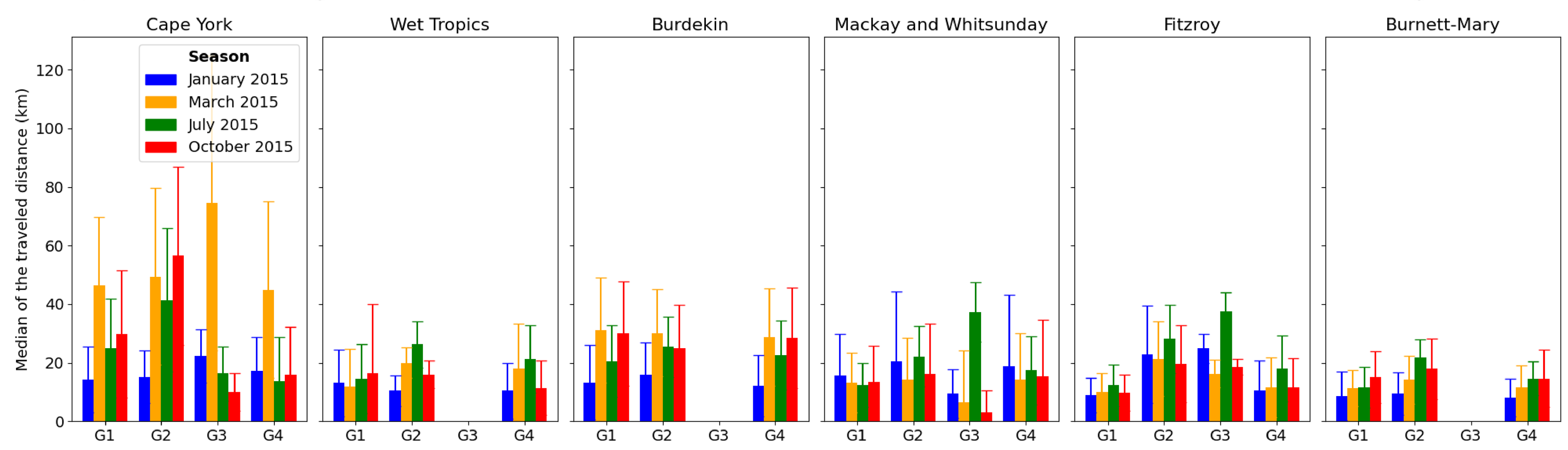


4 **Sensitivity analysis**

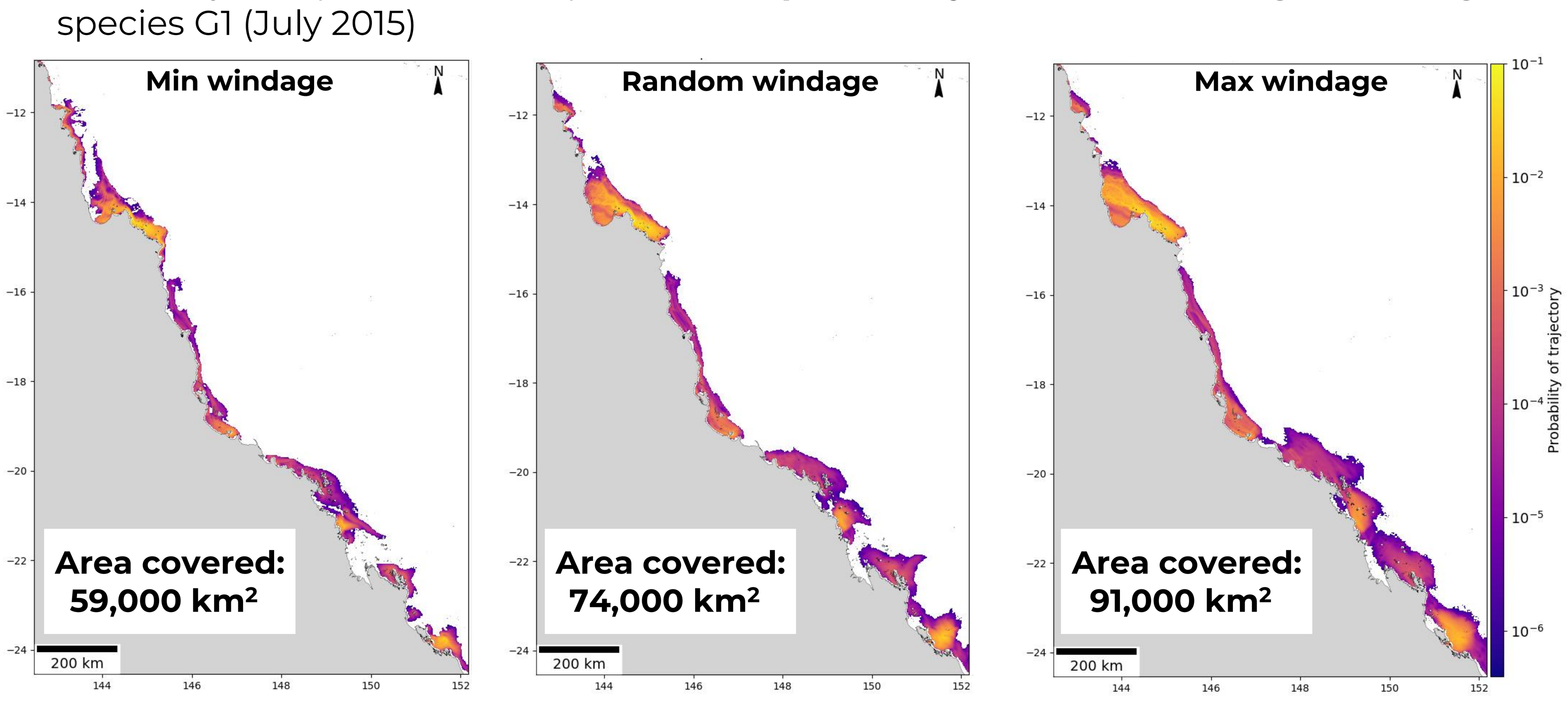
A. We measured variations in dispersal distance with a varying **wind drag**, according to species and regions. Calculations below are for July 2015.



B. We also measured variations in dispersal distance for different **seasons**, according to species and regions. Calculations below were made with a minimum wind drag.



C. We finally computed heatmaps of the **dispersal trajectories** according to windage for species G1 (July 2015)



First results

Different seagrass groups exhibit similar dispersal patterns in terms of traveled distance (see 4A).

Seagrass dispersal varies seasonally and is further influenced by extreme weather events like tropical cyclones (see 4B).

Next steps

Increase the time period considered to assess interannual variability. We currently have hydro simulations for 2007-2017.

Add more species to my results, to increase species variability.