Impact of Marine Heatwaves on Cyclones

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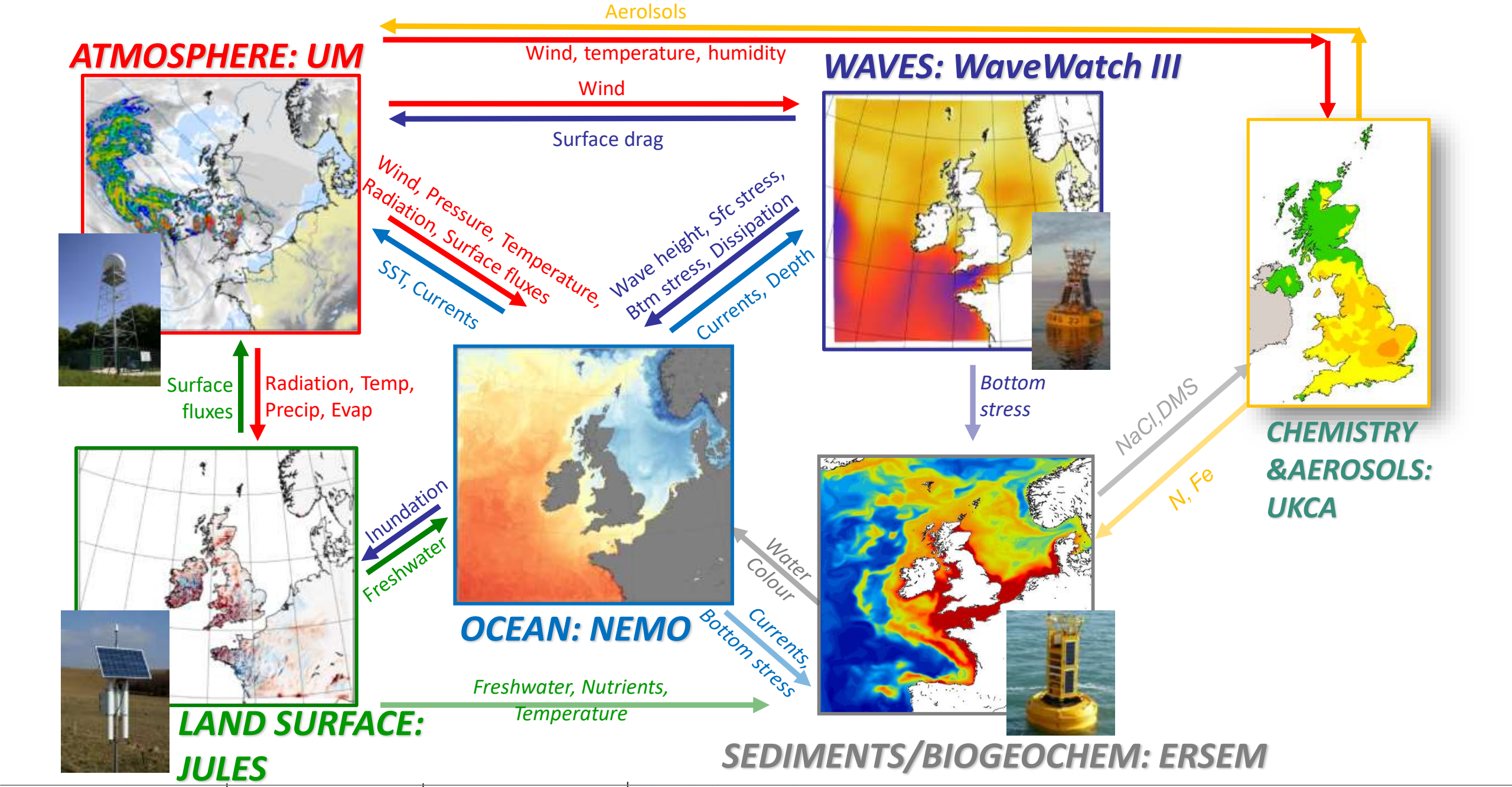
Ségolène Berthou, Piyali Goswami, Akhilesh Mishra, Roxy Mattew Koll, Alex Arnold, JuanMa Castillo, Huw Lewis, Claudio Sanchez & regional ocean / wave / atmosphere/ land modellers in Met Office and NERC centres

Outline

Marine Heatwaves in Regional Environmental Prediction

Impact of Marine Heatwave on Storm Babet (mid-latitude storm)

Impact of Marine Heatwave on Tropical Cyclone Fanni

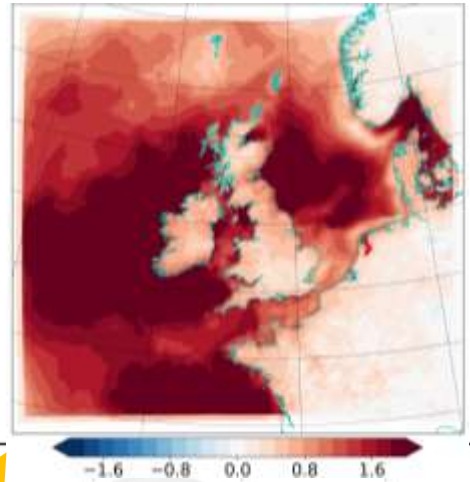


Met Office | Centre for Ecology & Hydrology, Natural Environment Research Council | National Oceanography Centre, Natural Environment Research Council | PML Plymouth Marine Laboratory

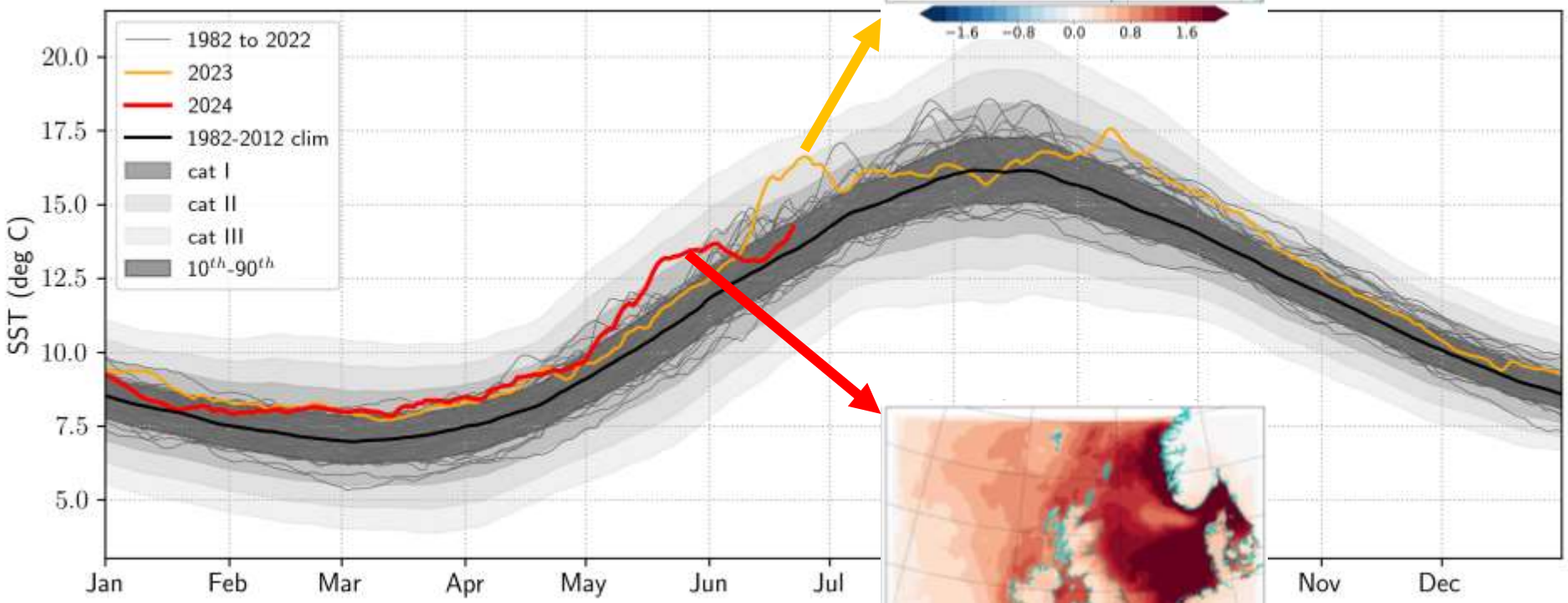
UK Environmental Prediction research

UK Marine Heat Waves

REP & Regional marine heatwaves (MHW)

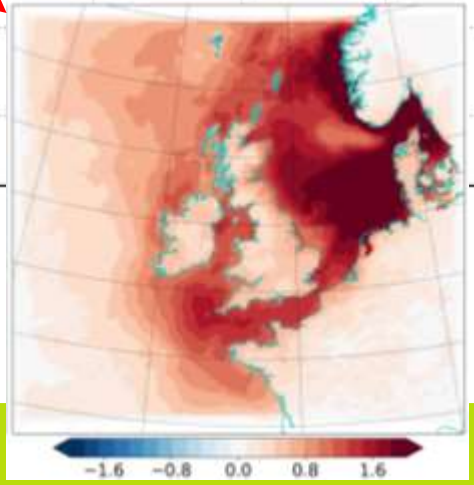


June 2023:
UK monthly mean temperature broken by 0.9°C
Marine heatwave contributed to 0.6°C



Local marine heatwaves amplify margin by which land record are broken

The May 2024 MHW was less intense, but impacted land temperatures similarly: models indicate marine heatwave impact on land depends on boundary layer height ratio between land and sea: a sunny land is less impacted by a MHW than cloudy land



May 2024:
UK monthly mean temperature broken by 1.0°C
Marine heatwave contributed to 0.5°C

[Berthou et al. (2024)]
[Berthou & extremes team report on May 2024]

How do Marine Heat Waves feedback on the weather in the UK – Storm Babet

Met Office

Ministry of Earth Sciences

Storm Babet: intense extratropical cyclone which affected large parts of northern and western Europe.

Formed: 15 Oct 2023

Dissipated: 22 Oct 2023

Highest gusts: 185km/hr (115mph) at Cairn Gorm, Scotland,

cumulated precipitation ~150-200mm in Angus

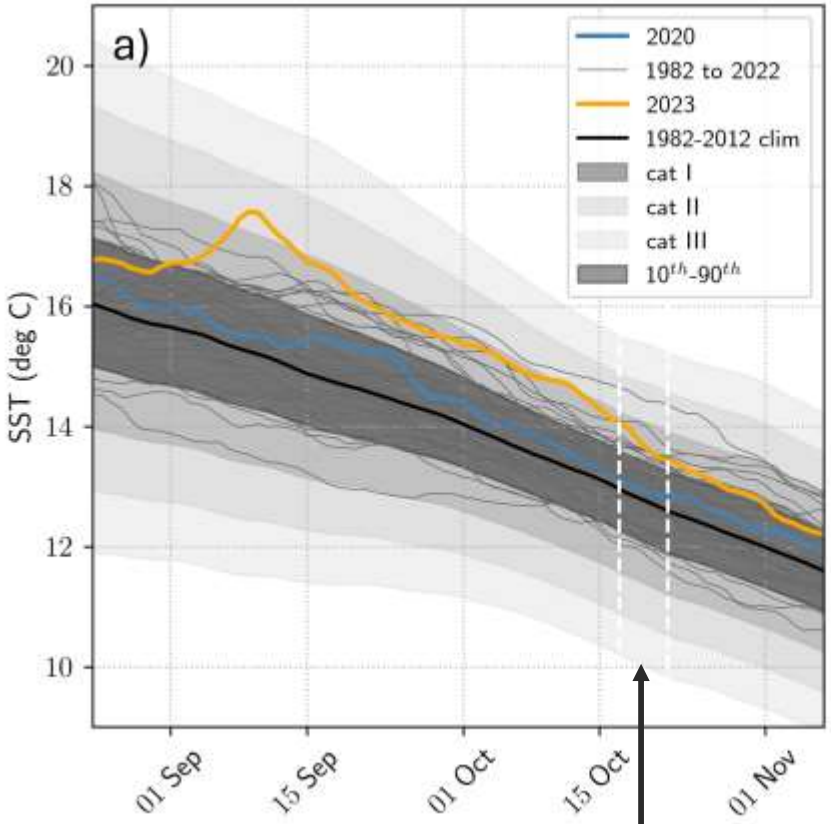
Red warning

Mahmood, Berthou, Goswami (in prep)

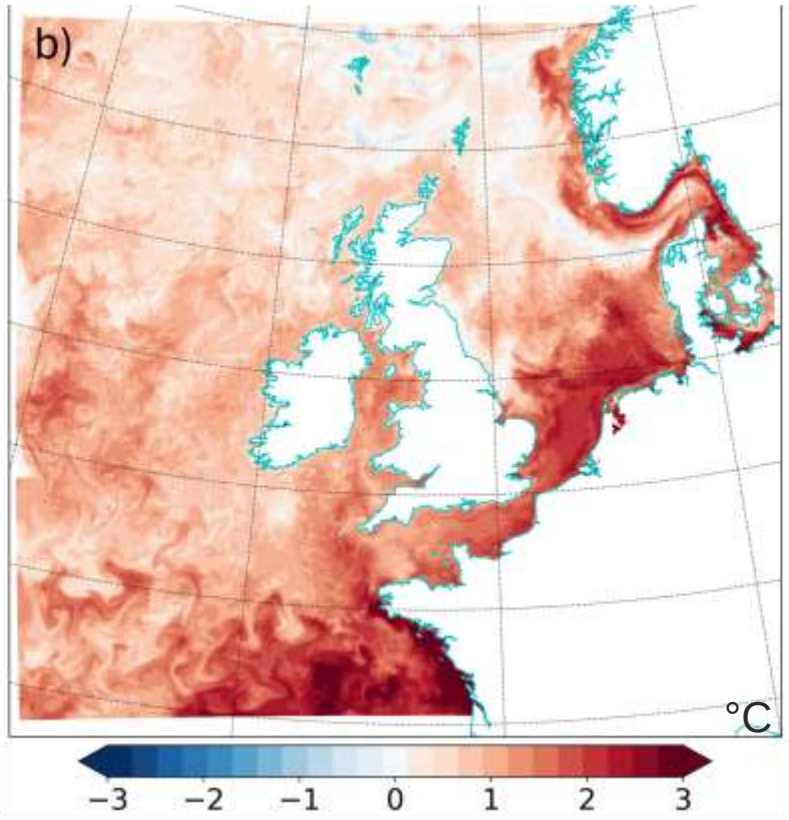
Storm Babet's impacts exacerbated by autumn MHW

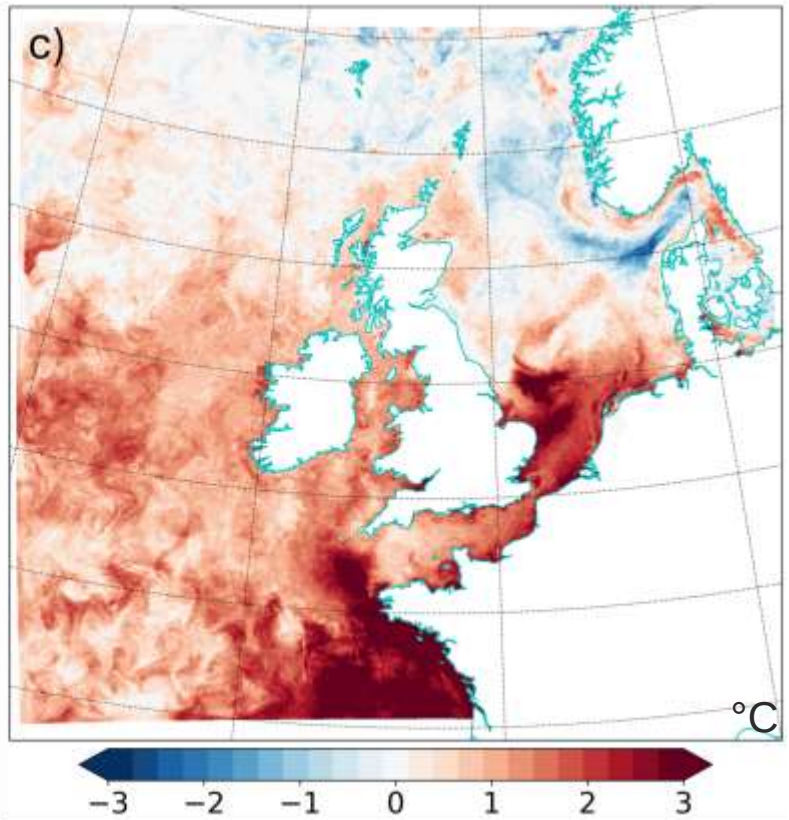
Sea surface temperature anomaly from climatology before storm Babet

Sea surface temperature anomaly: 2023 versus 2020, anomaly used in coupled system



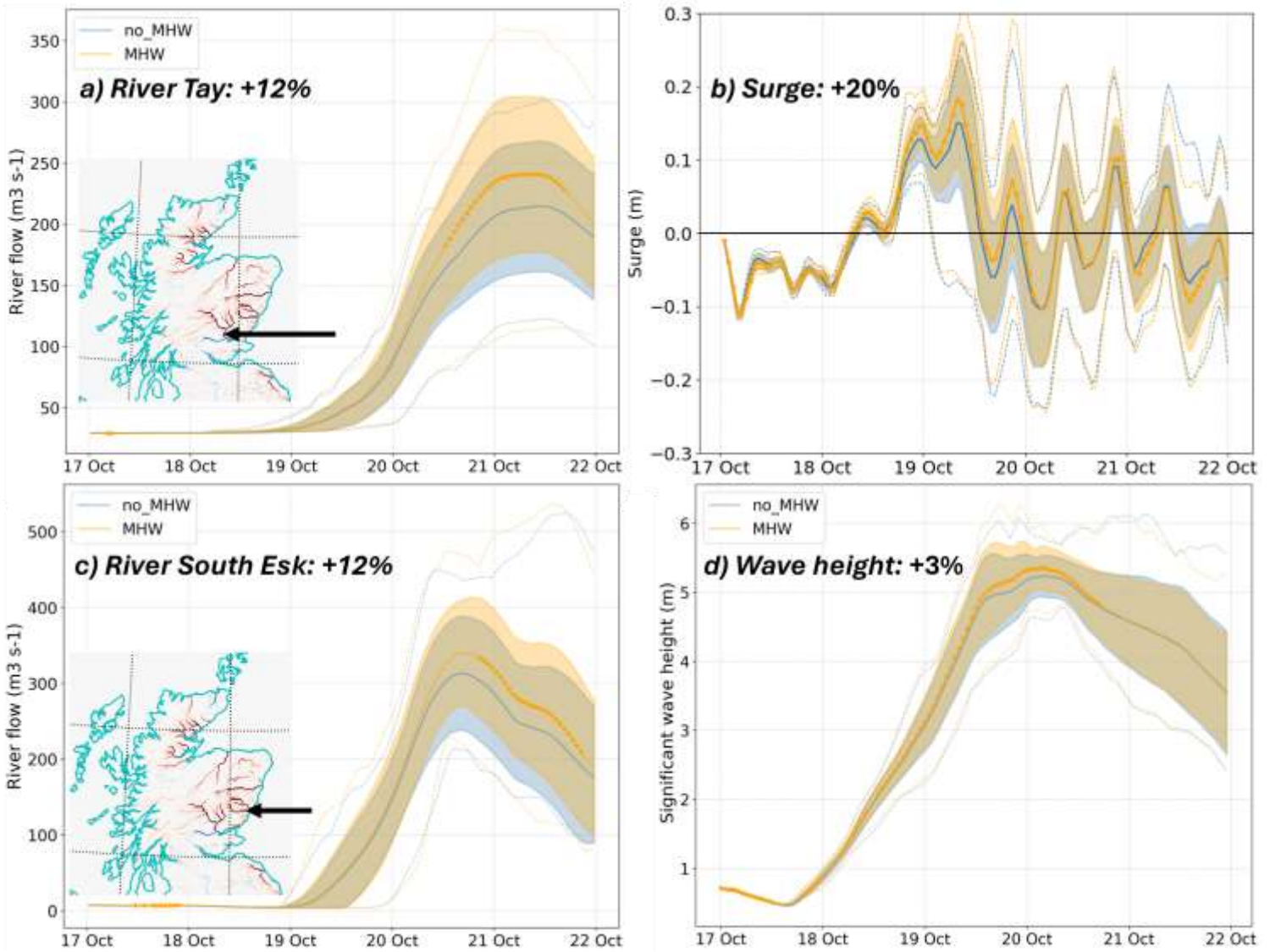
Storm Babet

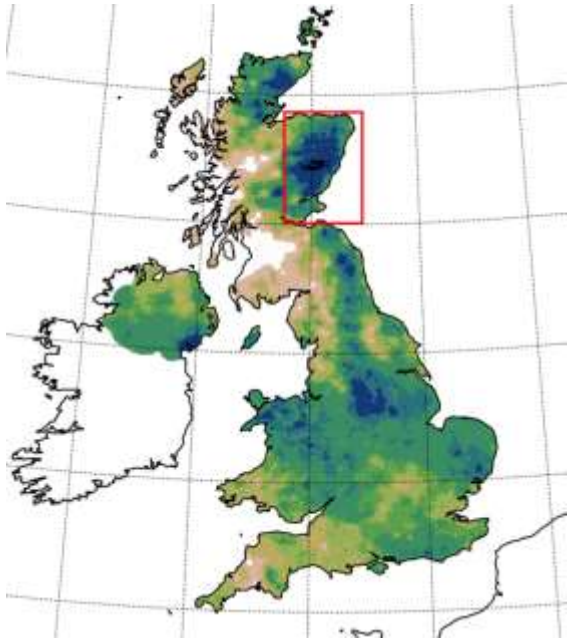




Using 17/10/**2020** as "near-climatological year" to start the ocean for the "no MHW" run, compared with a run starting from 17/10/2023 ("MHW" run)

Storm Babet's impacts exacerbated by autumn MHW





Regional coupled ensemble shows increased river flow, surge and wave height on the eastern coast of Scotland with the marine heatwave.

Tropical Cyclone Fani

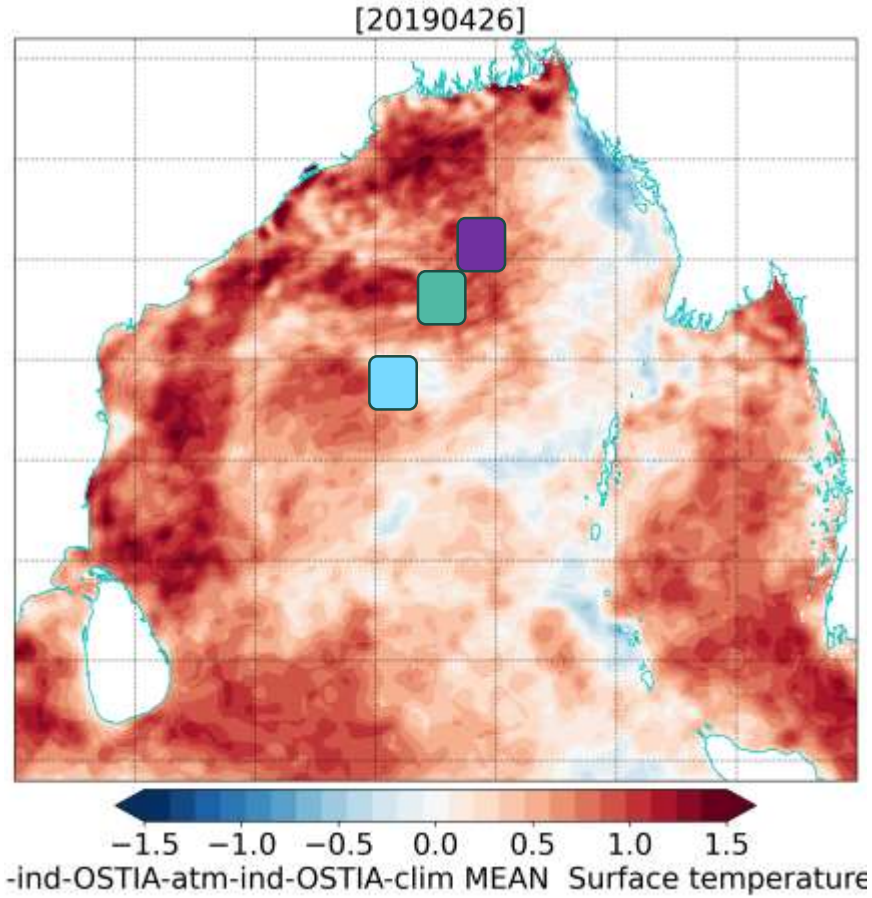
Tropical cyclone Fani was a long-lived storm, forming on 26 April 2019, but did not reach landfall in Odisha until 02:30 UTC on 3 May 2019 and dissipated on 5 May 2019, 9 d after first forming.

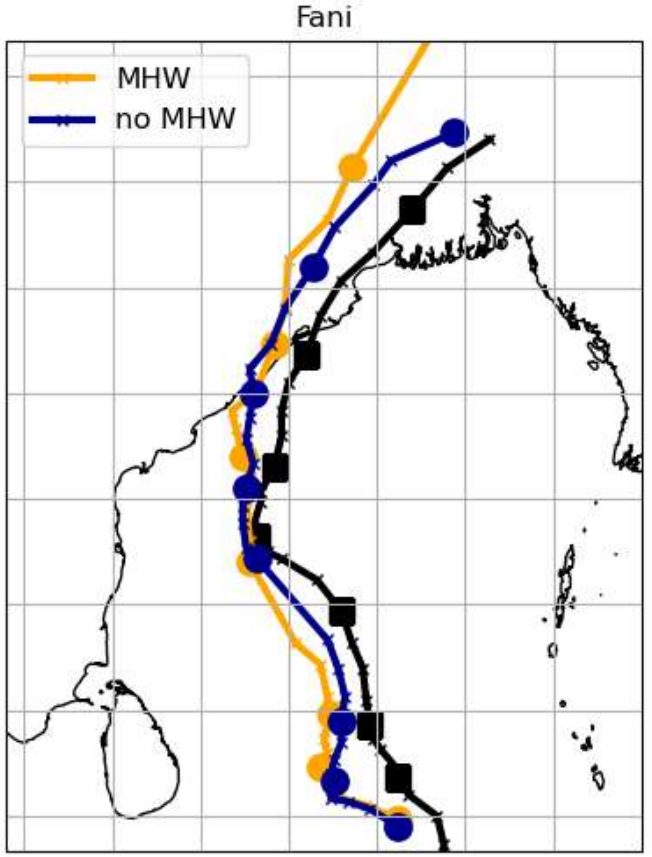
Case initialised on: **26-04-2019**

9-day forecast

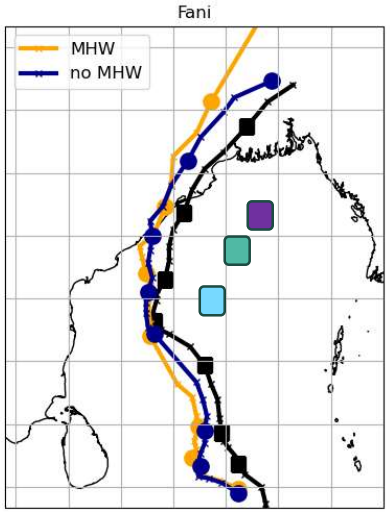
atm-OSTIA	MHW	Atmosphere only with daily updated SST
atm-OSTIA-clim	No MHW	Atmosphere only with daily climatological SST

Castillo et al., 2022 - paper looking at effects of coupling on tropical cyclones
https://doi.org/10.5194/gmd-15-4193-2022

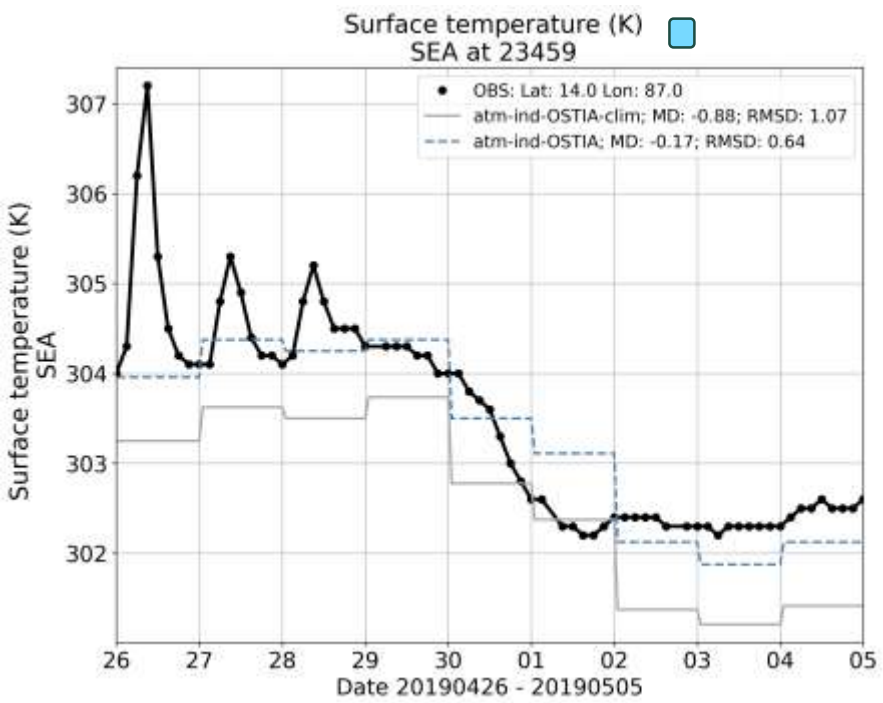


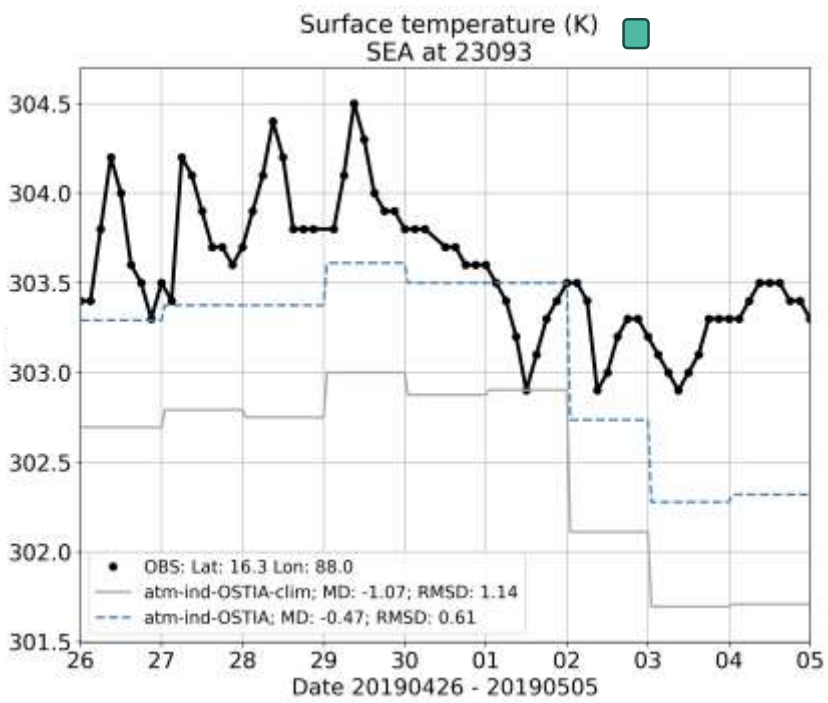


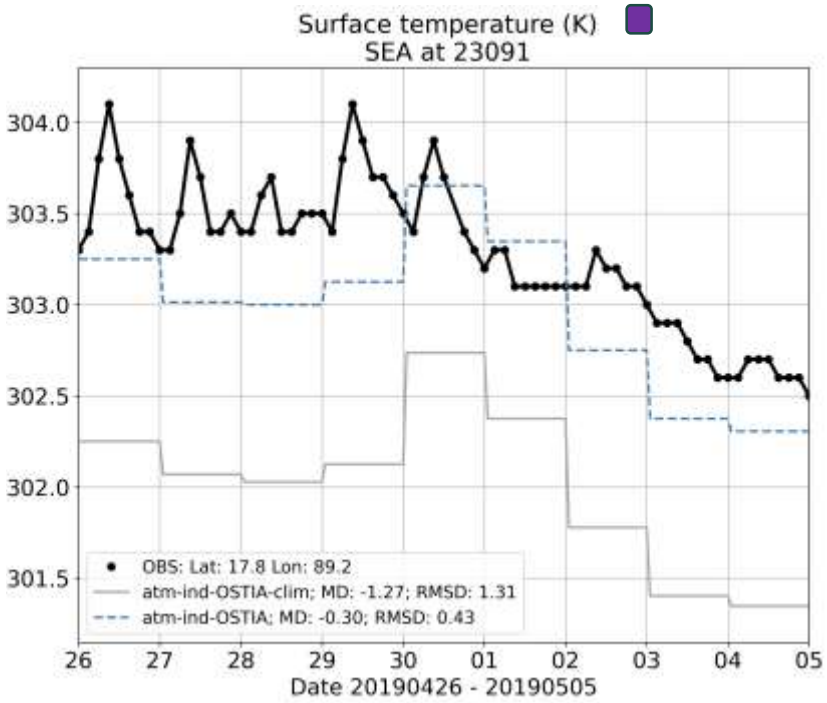
MHW – no MHW (SST)

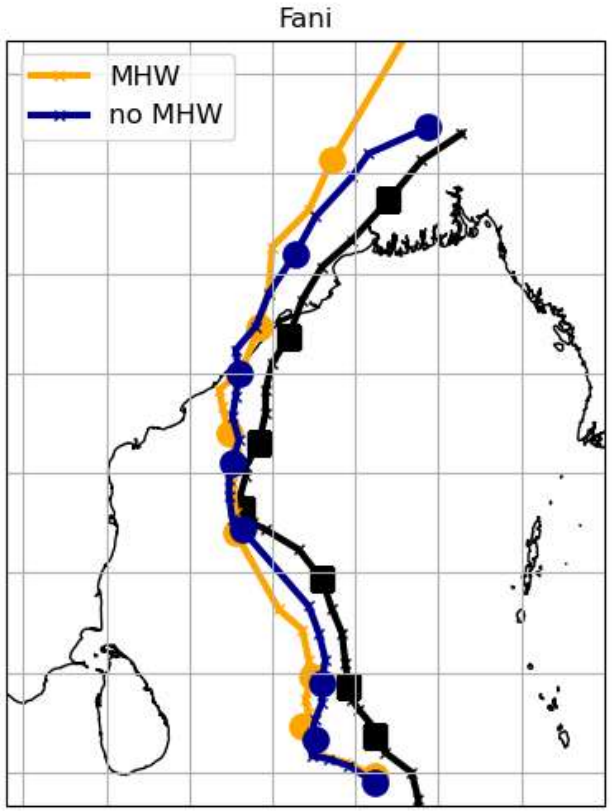


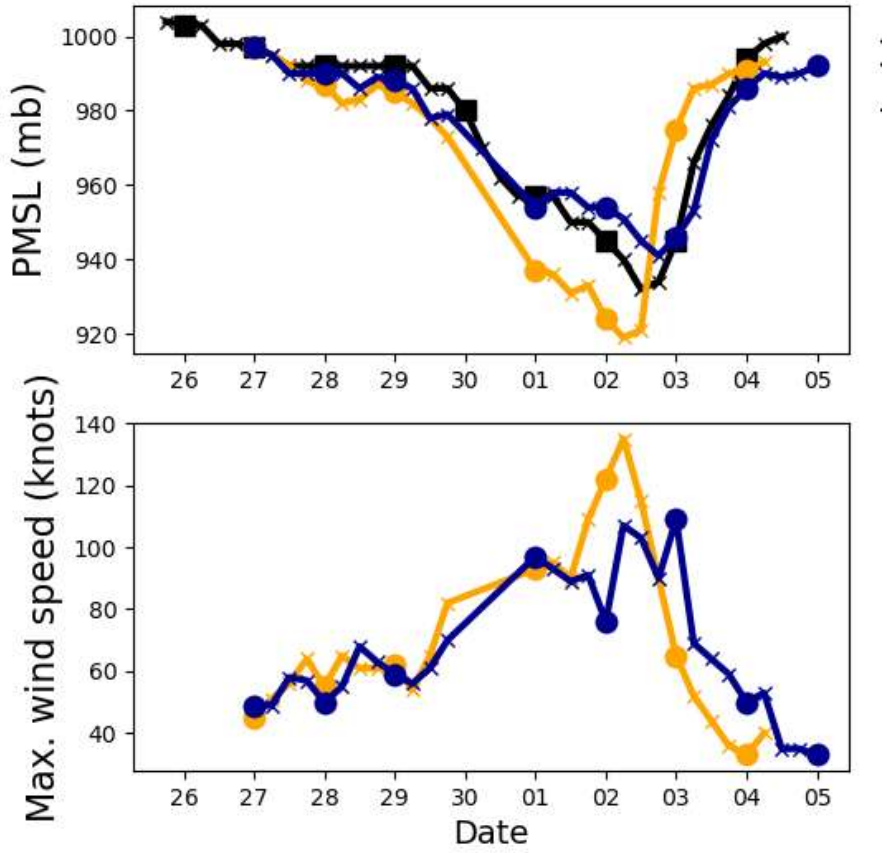
SST shows good agreement with observations,
But observations are not in the cyclone path





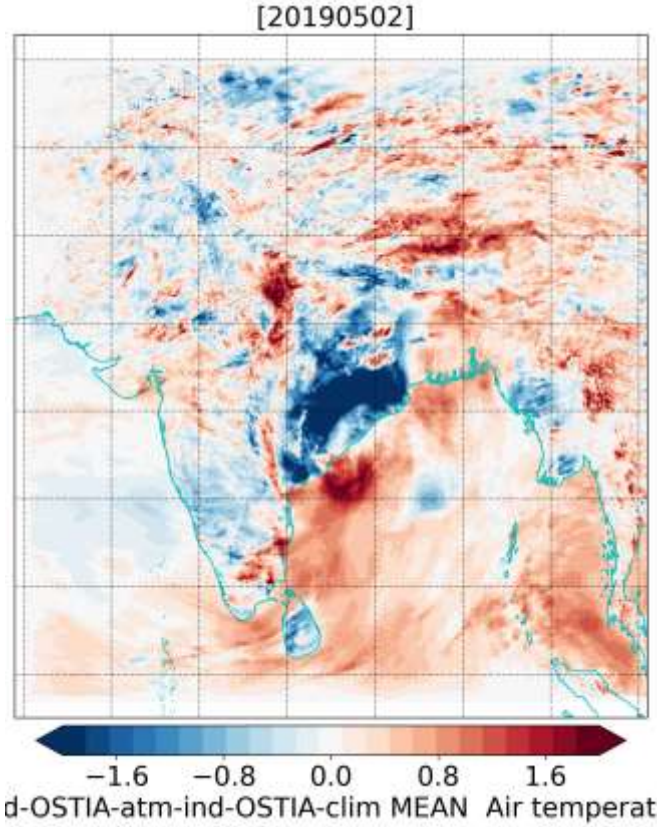




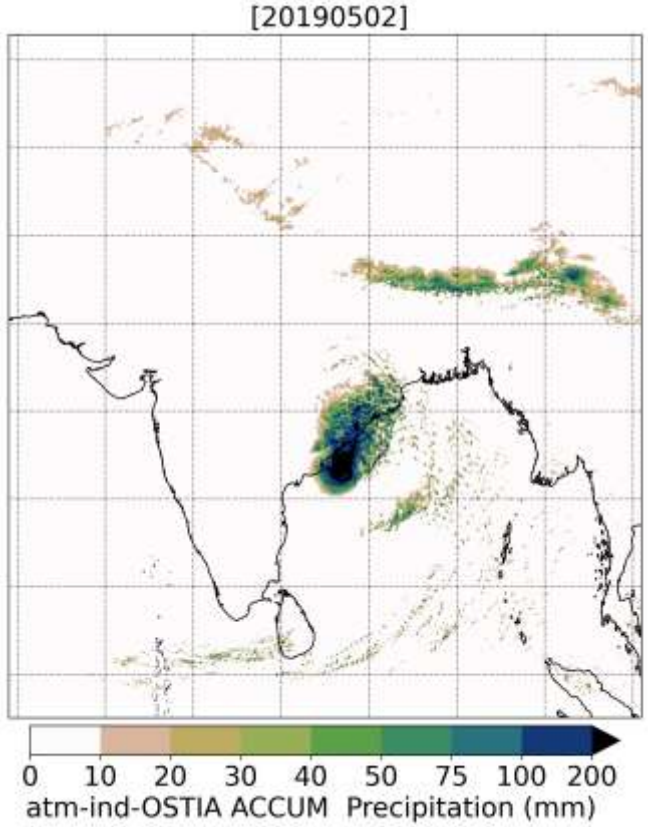


Cyclone tracks are similar between the two simulations

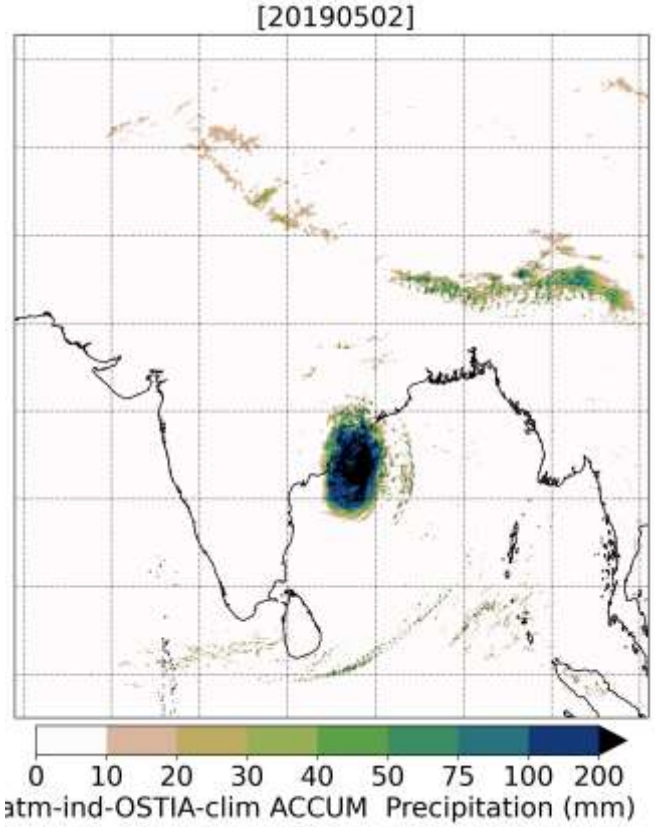
Climatological SST run (no MHW) closer to observations for PMSL



Air temp. difference MHW – no MHW



Precipitation (MHW)



Precipitation (no MHW)

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Thank you!