Met Office
Hadley Centre

Predictability of European winter 2020/21: Influence of a mid-winter stratospheric warming

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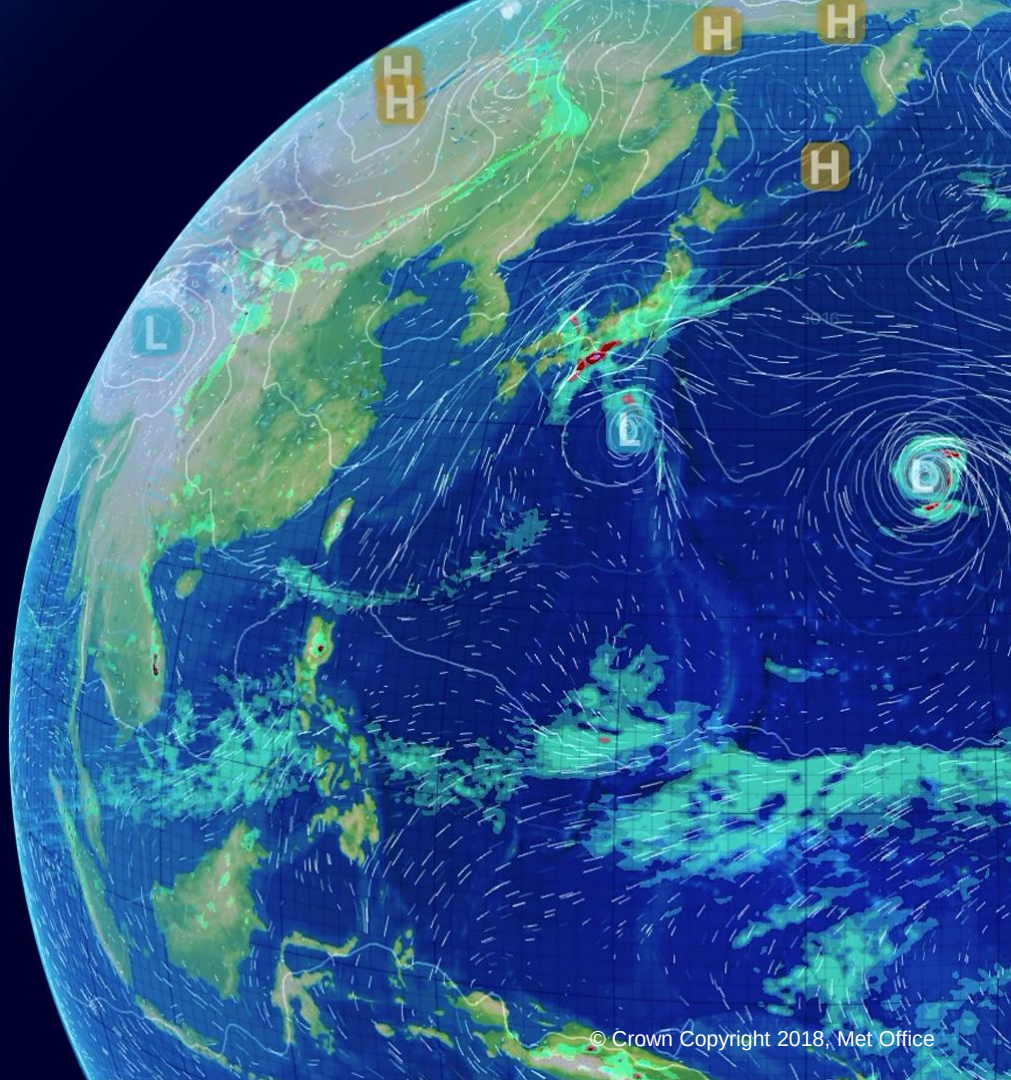
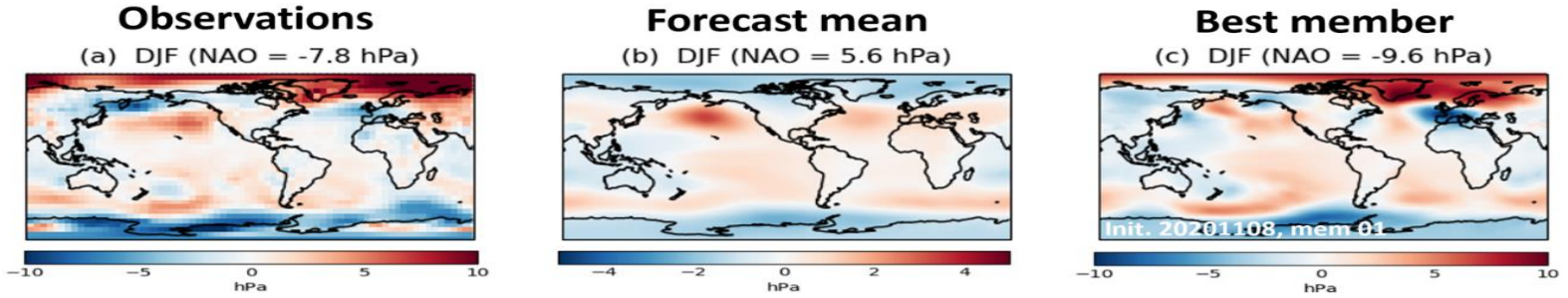
EGU 2022



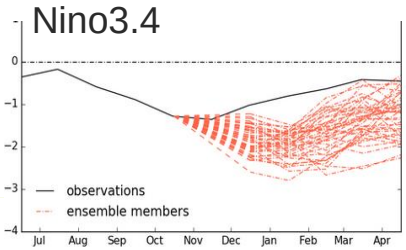
Winter (DJF) 2020/21 - Forecast

Winter 2020/21 was characterised by a negative North Atlantic Oscillation. In common with other leading forecast systems, the Met Office forecast ensemble mean indicated the positive phase more likely. The observed outcome *was* captured within ensemble spread.

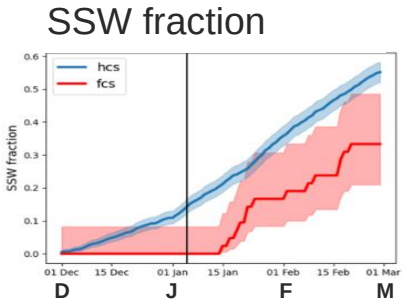


Was observed outcome a low probability event, or due to model error?

The forecast indicated a overly strong La Niña …

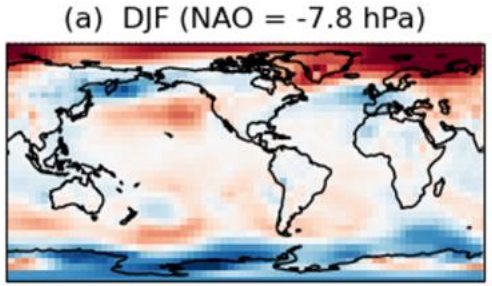


… and a strong polar vortex (consistent with La Niña and westerly QBO)
Low probability of SSW



Winter 2020/21: observed timeline

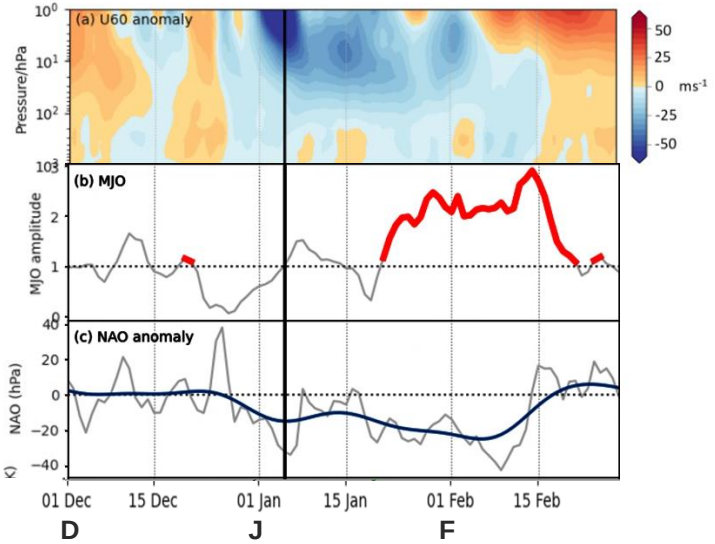
MSLP



U60

MJO

NAO



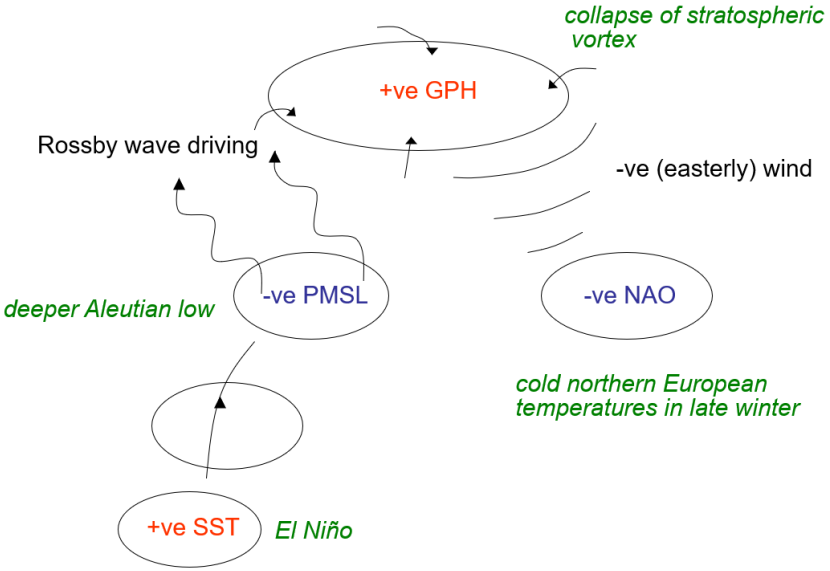
Likely influences:

A mid-winter SSW (5th Jan 2021). Winds remained easterly until mid-Feb

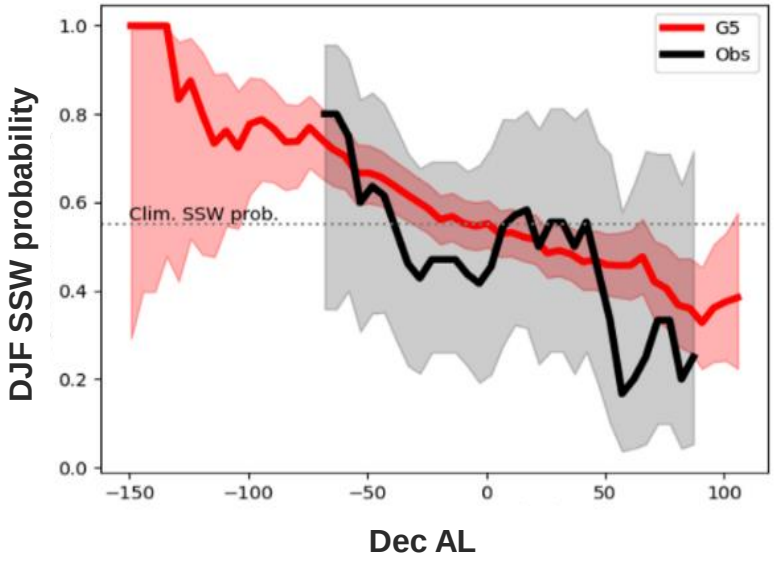
A prolonged MJO in phase 6/7 (mid-Jan to mid-Feb) may have amplified and extended the –ve NAO (cf Cassou, 2008)

ENSO – Aleutian Low (AL) – SSW pathway

Schematic for El Niño

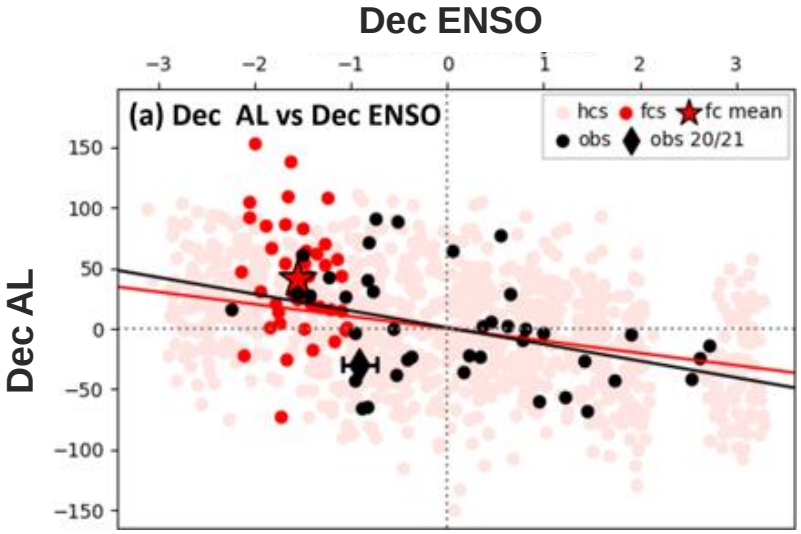


AL to SSW



Strong negative linear relationship between AL and SSW probability

ENSO to AL teleconnection



Similar negative correlation for hindcasts and observations, but note large scatter

Obs (-30m) show deeper AL in Dec (and Jan), rather than weaker as expected during La Niña (cf Garfinkel et al., 2012, Butler and Polvani, 2011)

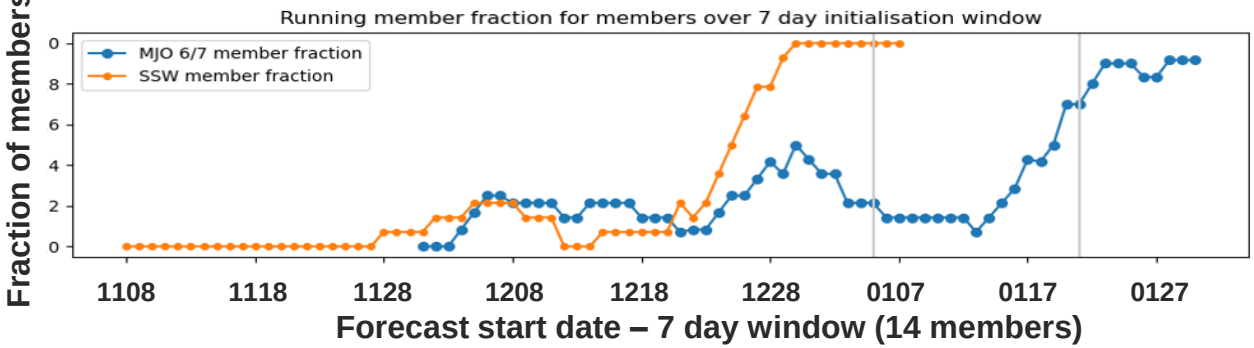
Obs are within range of 2020/21 forecast

(C.1) Unpredictable variability in the AL may disrupt the stratospheric pathway

(C.2) Error from over-prediction of La Niña may have contributed to a ~10% decrease in SSW probability, much smaller than the sampling uncertainty in SSW probability

(C.3) Our analysis has not found any evidence for a systematic error in the model ENSO – SSW relationship. Further investigations are ongoing.

Daily updated ensembles



By 25 Dec the SSW is predicted by >50% members

2 days before onset ‘long’ MJO is predicted > 50% members

The exact timing of the SSW and phase 6/7 MJO are not predictable at a 1-m lead
If an SSW occurs, but with low forecast probability, it can lead to observed conditions very different to the forecast mean

(C.4) Continuously updated lagged ensembles enable changes in the forecast due to phenomena with sub-seasonal predictability, such as SSW and MJO, to be promptly communicated to users

Summary

Winter 2020/21 was characterised by a negative NAO.

Ensemble mean forecast indicated the positive phase more likely.

However, the observed outcome *was* captured within ensemble spread.

(C.1) Unpredictable variability in the AL may disrupt the stratospheric pathway

(C.2) Error from over-prediction of La Niña may have contributed to a ~10% decrease in SSW probability, much smaller than the sampling uncertainty in SSW probability

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Lockwood et al., 2022, Predictability of European winter 2020/21. Atmospheric Science Letters – in revision