EGU General Assembly 2022

CL5.3.4 – Predictions of climate from seasonal to (multi) decadal timescales (S2D) and their applications

Predictable Patterns of Winter Temperature and Their Predictability Sources

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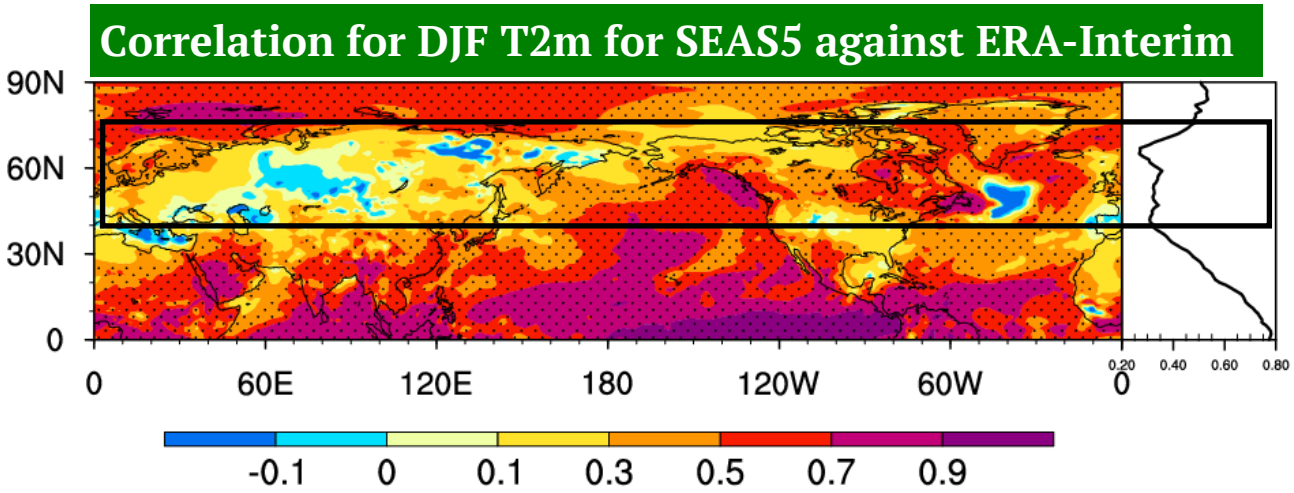
26.05.2022

1. Low Predictability over Mid-latitude Eurasia



➢ **Atmospheric external forcing has been suggested to play a role: ENSO, snow cover and sea ice** *(Ineson and Scaife 2008; Cohen 2014; Zuo 2011)*

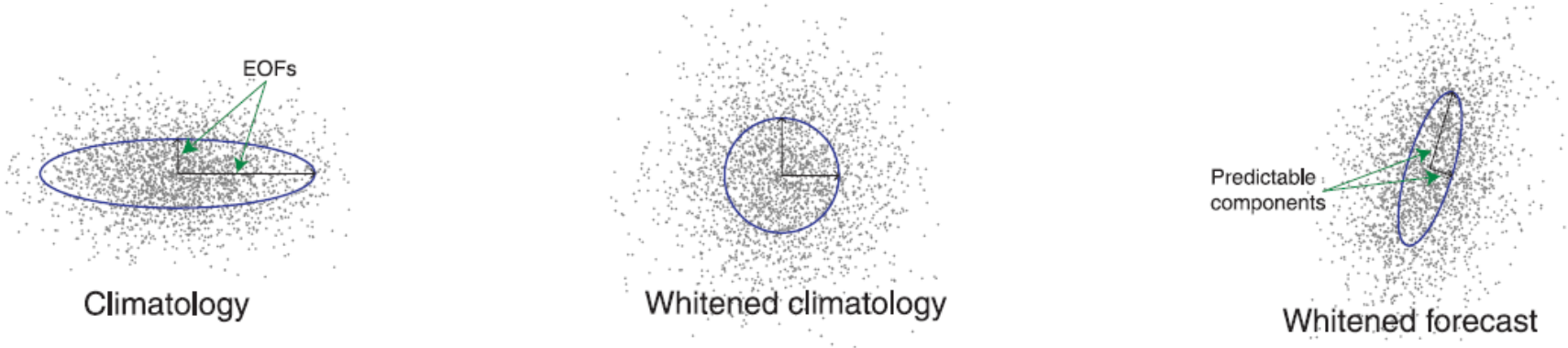
➢ **Question**

Can we improve the prediction of winter temperature (T2m) via predictable patterns?

(Fan 2020)

2. Maximize the Signal-to-noise Ratio to Extract Predictable Patterns

Internal variation → **White noise** → **Predictable patterns**

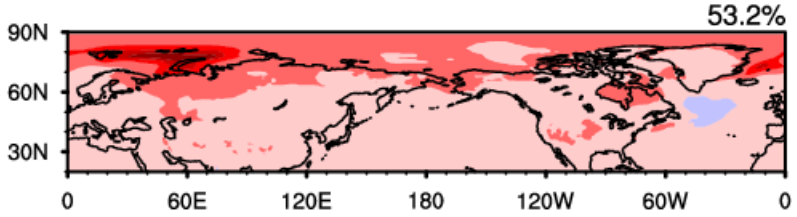


Maximum signal-to-noise EOF analysis (Allen and Smith 1997; Schneider and Griffies 1999; Timothy 2006)

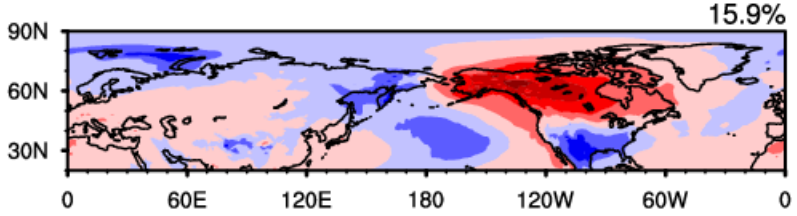
3. Predictable Patterns and Their Possible Atmospheric External Forcing

Predictable patterns

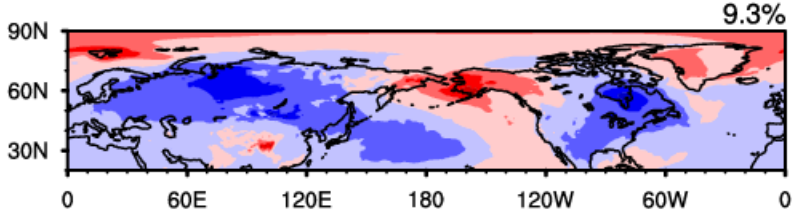
MEOF1



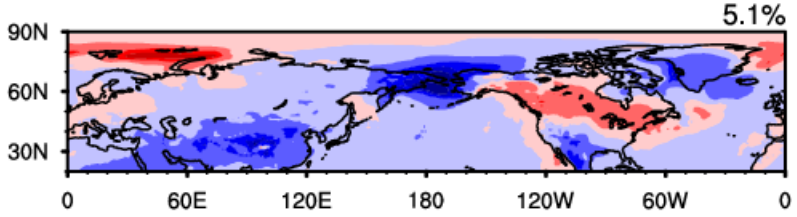
MEOF2

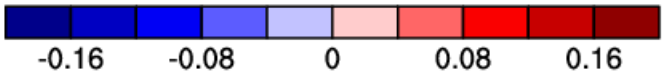


MEOF3



MEOF4



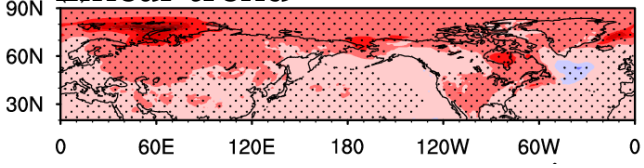


Trend

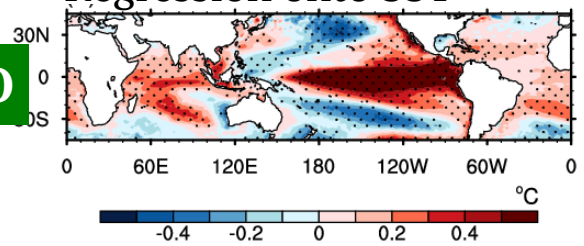
EP ENSO

Predictability sources

Linear trend



Regression onto SST



CP ENSO

Eurasia Snow

Arctic Sea Ice

(Fan 2020)

4. Scheme to Improve the Predictive Skill

Predictable patterns

Projecting

Time series of predictability sources

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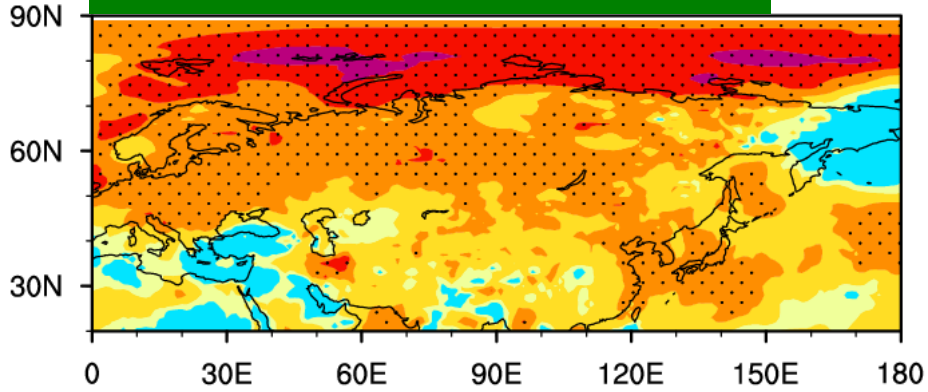
Predictable patterns

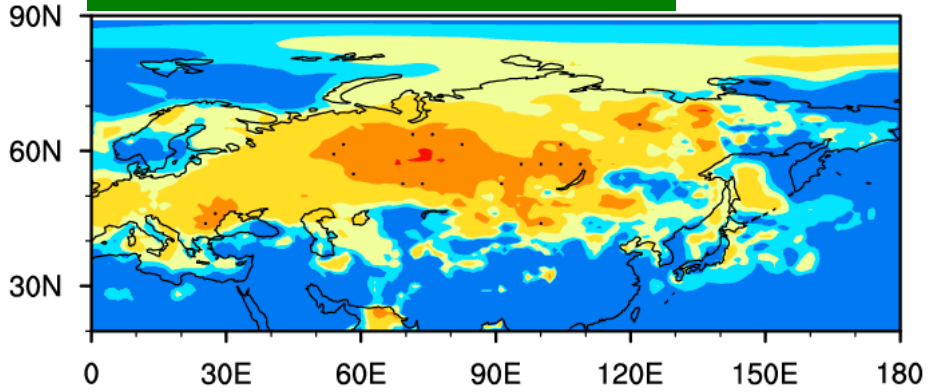
Projecting

Time series of predictability sources

ACC for Reconstructed T2m



Reconstructed – SEAS5



(Fan 2020)

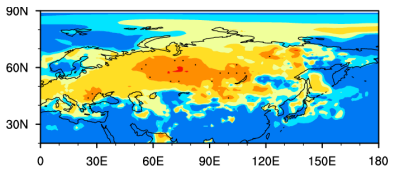
5.Conclusions

Extract Predictable Patterns

- MEOF1 → **Trend**
- MEOF2 → **EP ENSO**
- MEOF3 → **CP ENSO; Eurasia Snow**
- MEOF4 → **Arctic Sea Ice**

Reinforce MEOFs and Predictability Sources

Improved Prediction Skill over Eurasia



This presentation participates in OSPP

EGU

Outstanding Student & PhD candidate Presentation contest

Thanks for listening!

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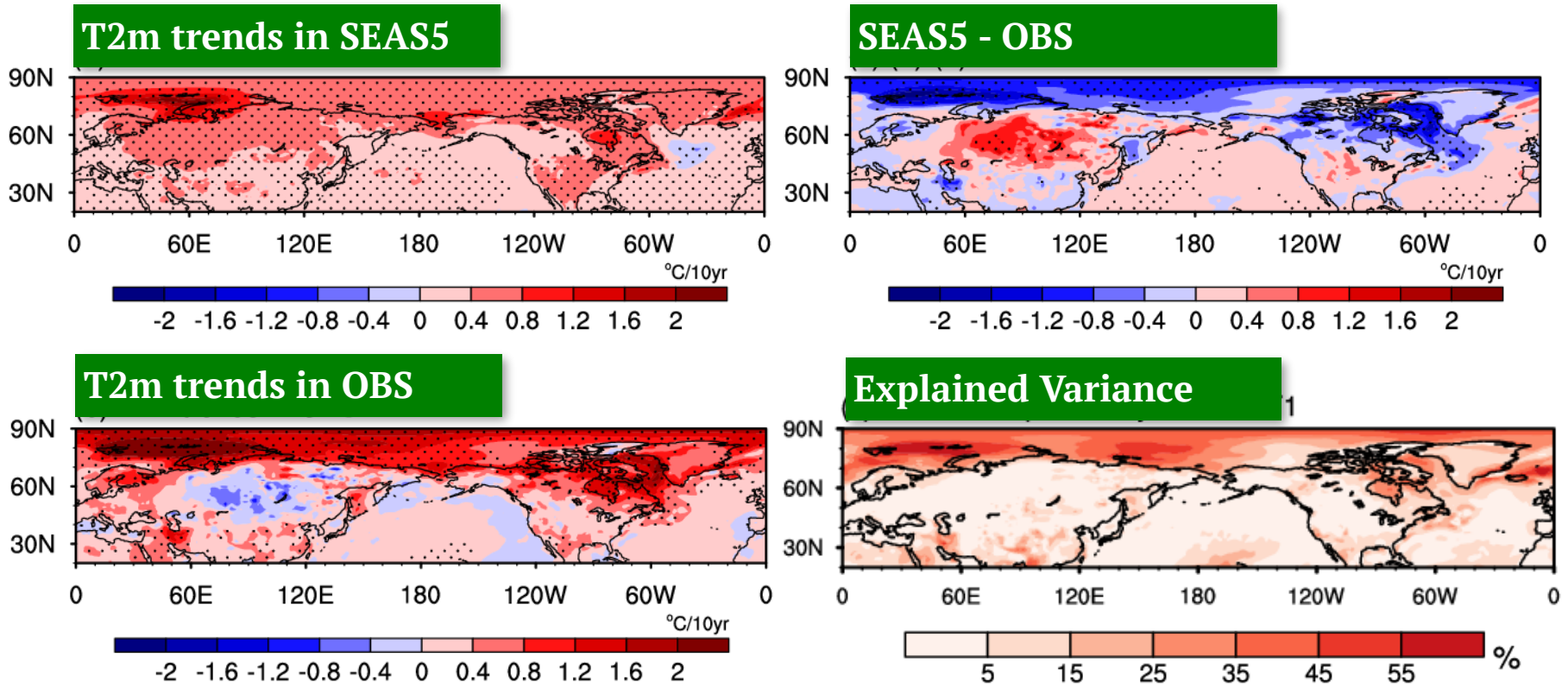
Fan, H. et al., 2020. *J. Clim.*, 33, 10743-10754.

Supplement

3. Predictability sources of the leading predictable patterns

a) MSN EOF1



SEAS5 underestimates the observed magnitude of the warming trend and misses the observed warm Arctic-old continent pattern.

(Fan et al 2020)

b) MSN EOF2

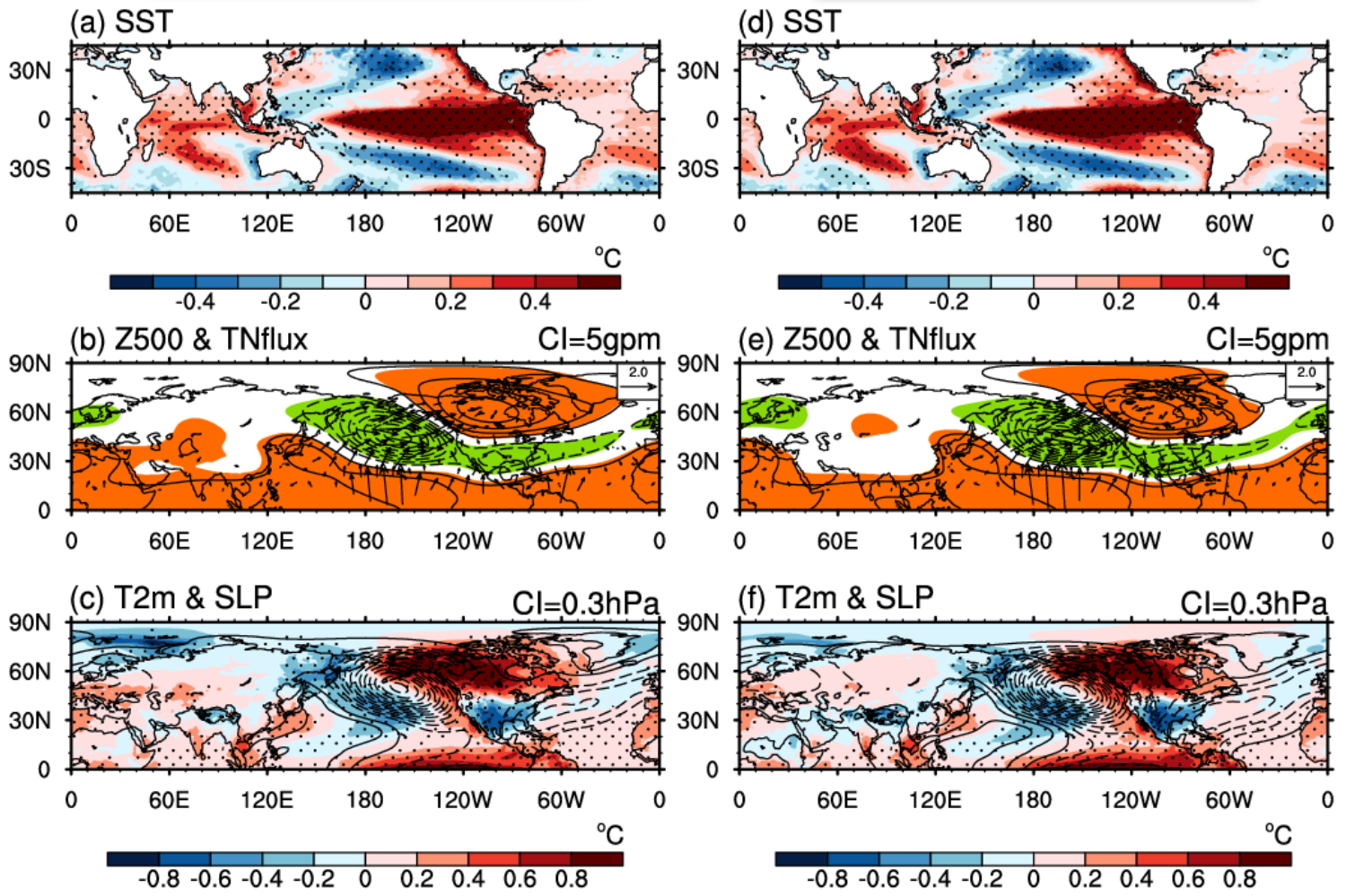
Regression onto MPC2

Regression onto $PC1_{SST}$

SST

Z500&TNflux

T2m & SLP



The MSN EOF2 is rooted in the tropical forcing for the eastern Pacific-type ENSO

c) MSN EOF3

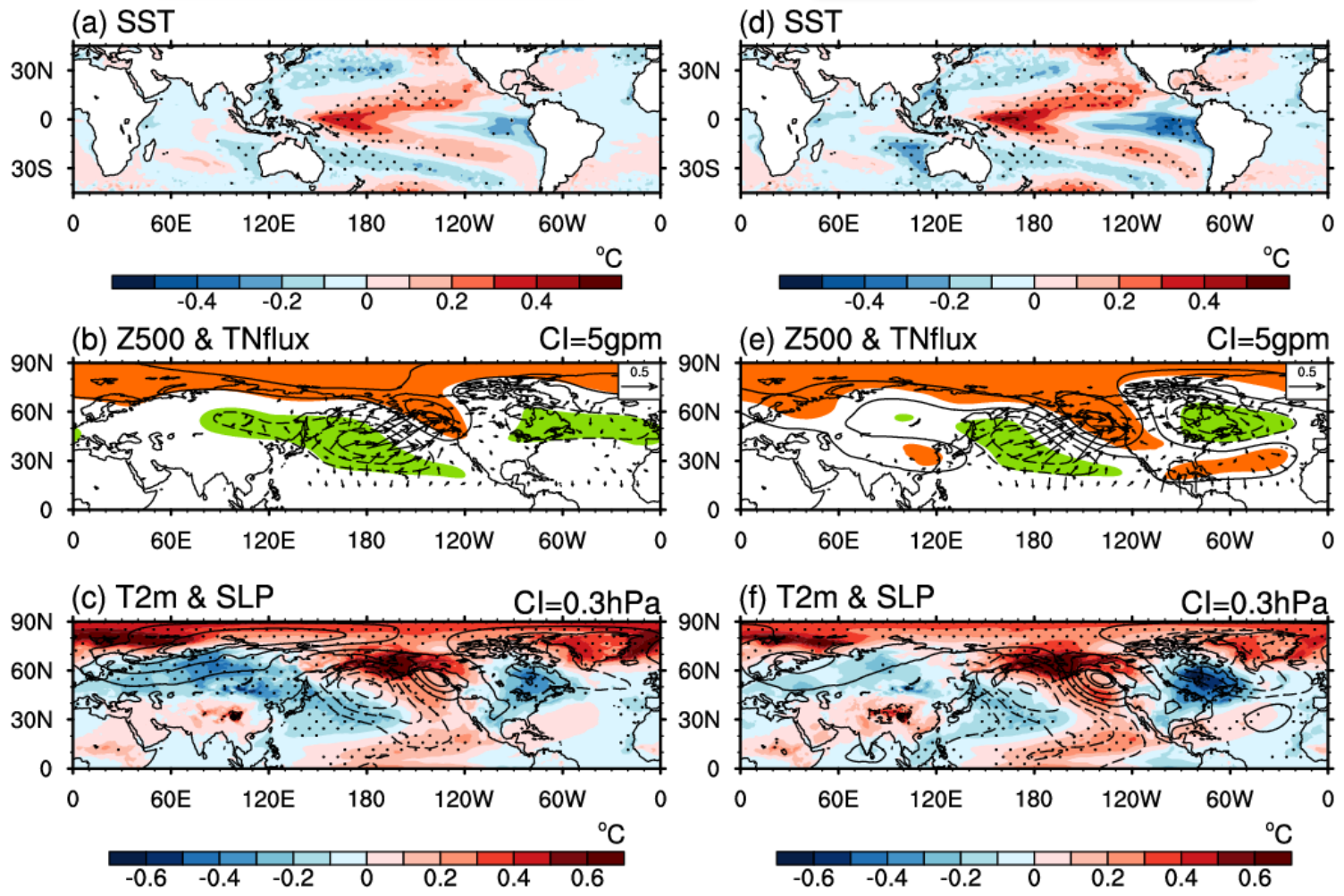
Regression onto MPC3

Regression onto $PC2_{SST}$

SST

Z500&TNflux

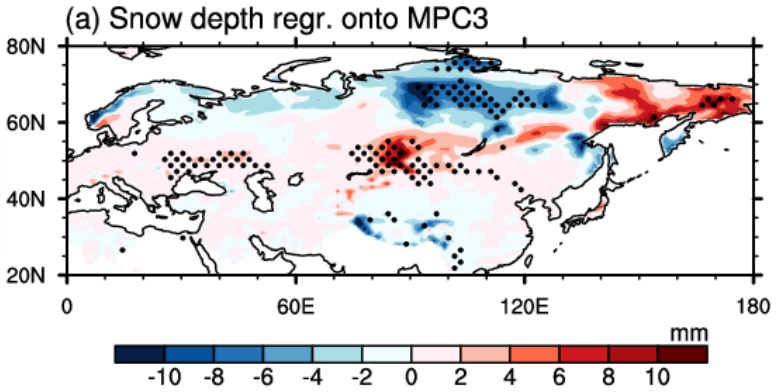
T2m & SLP



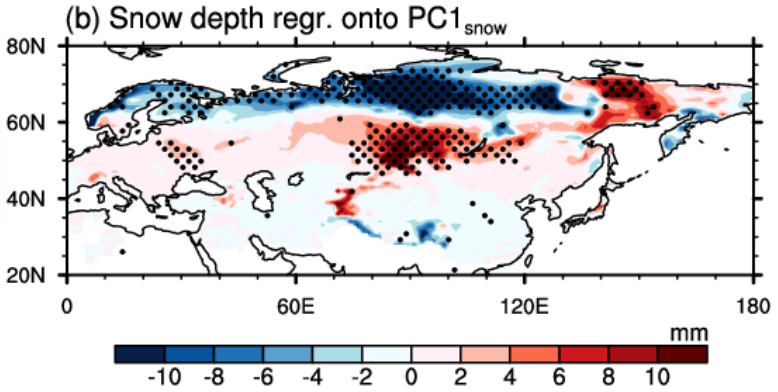
Source of predictability: central Pacific-type ENSO

c) MSN EOF3

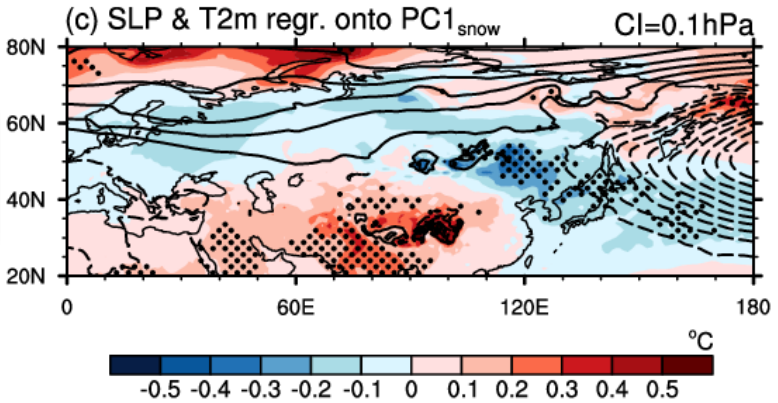
Snow regression onto MPC3



Snow regression onto $PC1_{snow}$



SLP & T2m regression onto $PC1_{snow}$



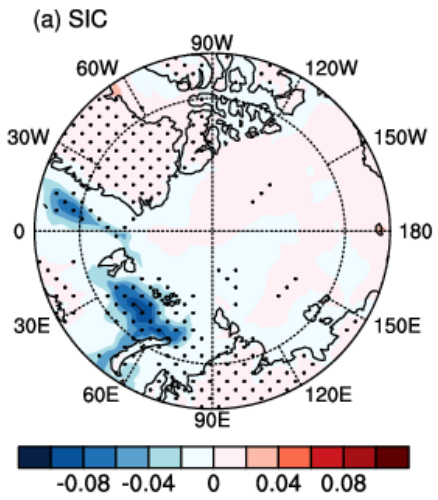
Source of predictability: Eurasian snow depth

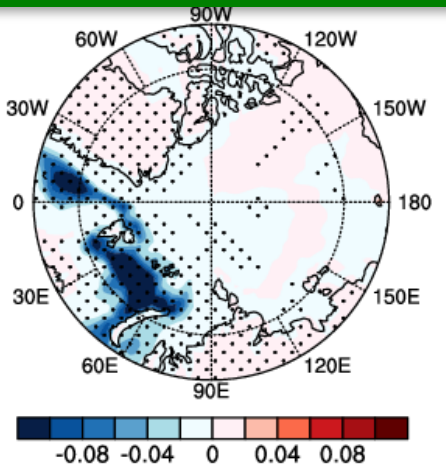
d) MSN EOF4

Regression onto MPC4

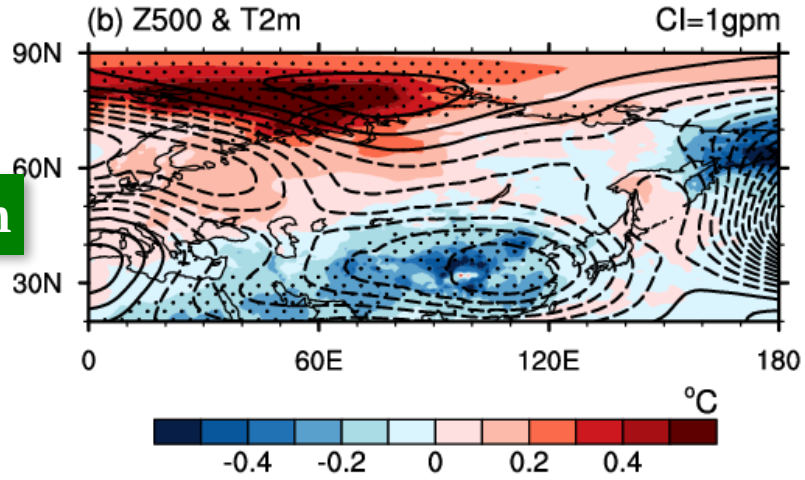
Regression onto $PC1_{SIC}$

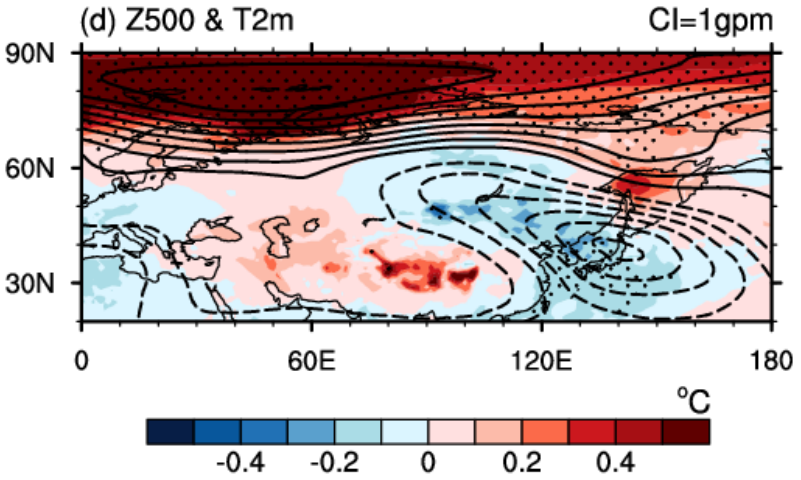
SIC





Z500 & T2m





Partially traced to the Arctic sea ice in the Barents and Norwegian Seas with some uncertainty

3. Predictability sources of the leading predictable patterns

5% and 1% significance levels based on two-tailed Student's *t*-test are denoted by * and **, respectively.

	Trend	$PC1_{SIC}$
MPC1	0.98**	-0.40*

	$PC1_{SST}$	$PC1_{SIC}$
MPC2	0.87**	0.33*

	$PC2_{SST}$	$PC1_{Snow}$	$PC1_{SIC}$
MPC3	0.75**	0.46**	-0.40*

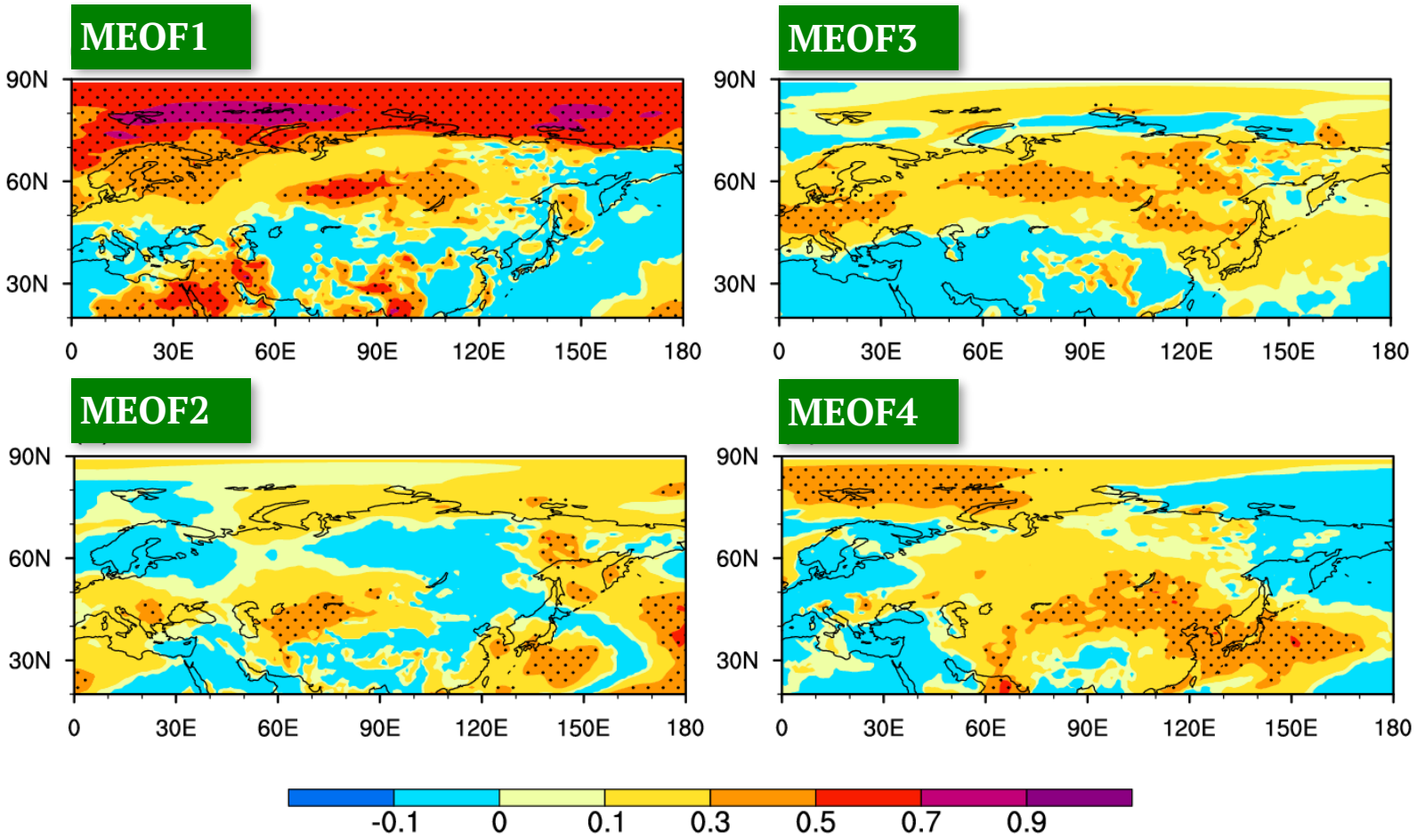
	$PC1_{SIC}$
MPC4	-0.51**

Tropical Pacific sst : 30°S-30°N, 110°E-70°W

Arctic sea sic : 70°N-89°N

Eurasian snow depth: 20°E-130°E, 45°N-75°N

4. Improved predictions over Eurasia by incorporating the predictable patterns



(Fan et al 2020)