Atmospheric circulations affecting the springtime thermal state of Tibet Plateau

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Causes of the spring TP temperature anomaly

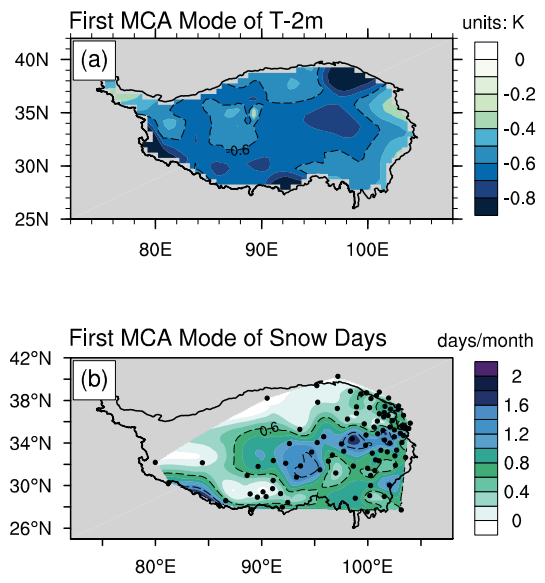
Motivation

- LS4P Phase I experiments suggest that the **spring TP surface temperate** can be a source of subseasonal-to-seasonal prediction;
- One question left is the **cause** of such large-scale TP surface temperature anomaly.

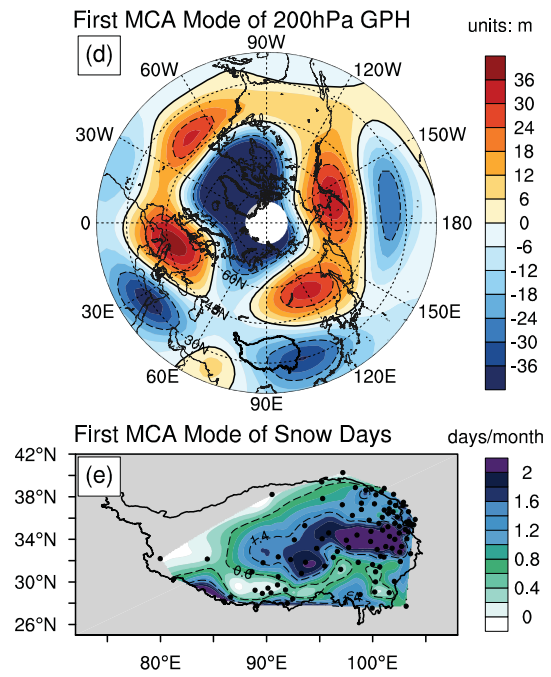
MCA results

T-2m and Snow days

Spring (AM) land surface temp and **Snow cover days in FMA**



Z200 and Snow Days



Winter (Feb) circulation and **Snow cover days in FMA**

(Zhang et al., 2019)

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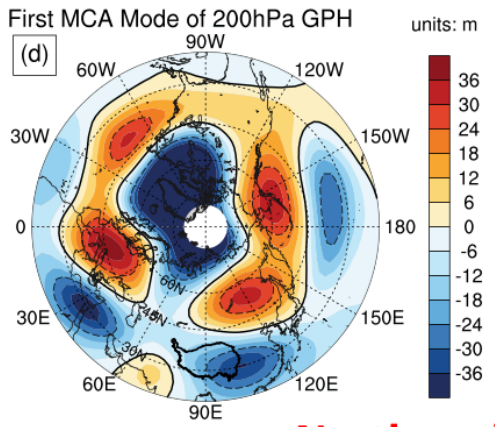
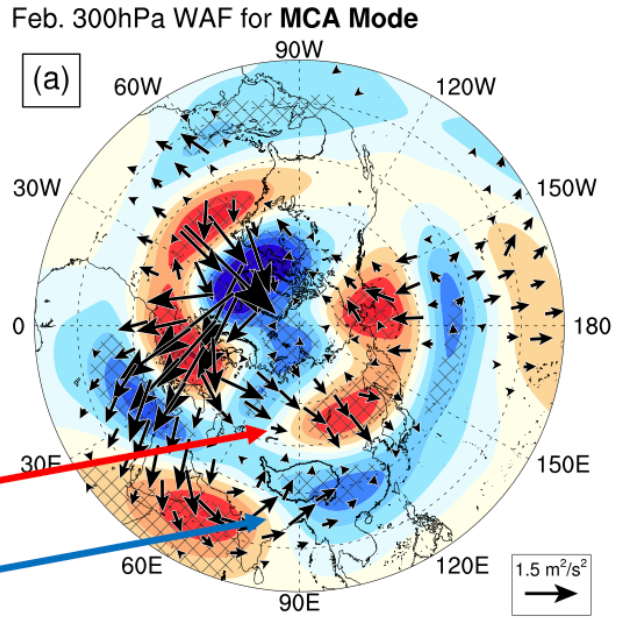
Winter (Feb.) circulation



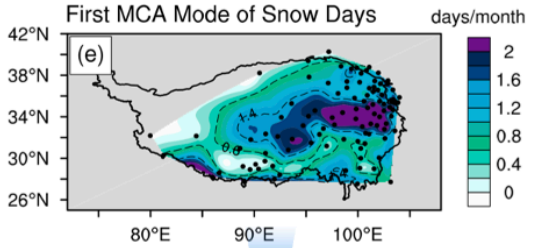
Winter (Feb.) wave activity flux



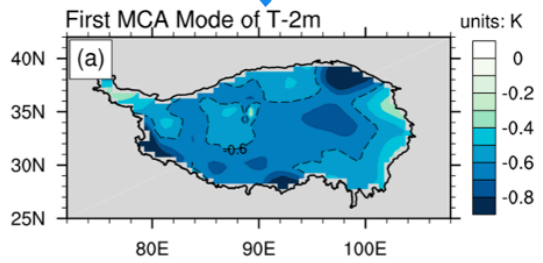
Northern branch
(cold air)

Southern branch
(warm moist air)

Winter-spring (FMA) snow cover days



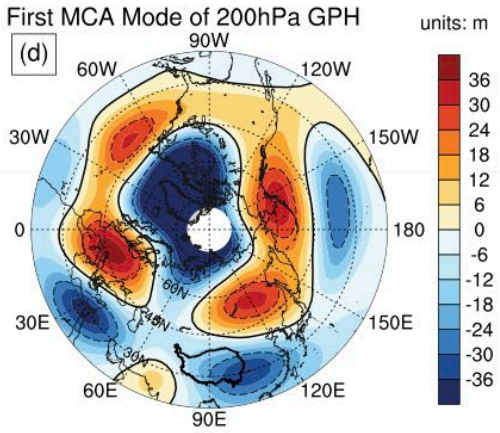
Spring (AM) surface temperature



(Zhang et al., 2019)

Winter circulations affecting the spring TP temperature

Winter (Feb) circulation



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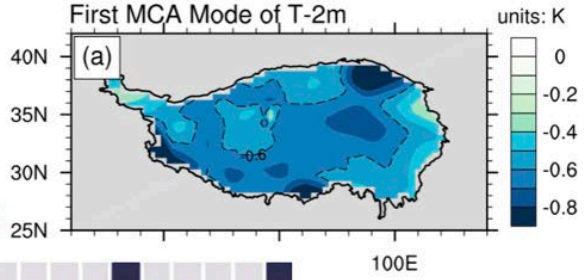
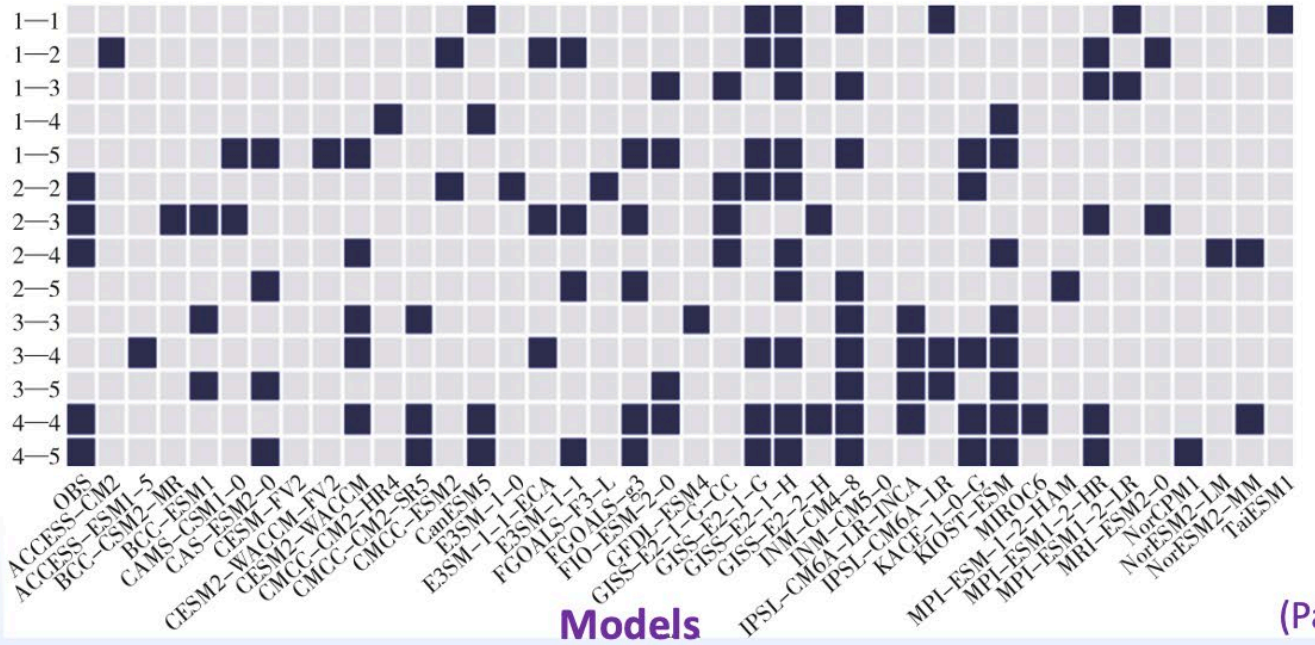


MCA results between winter circulation and Spring TP surface temperature in CMIP6 models



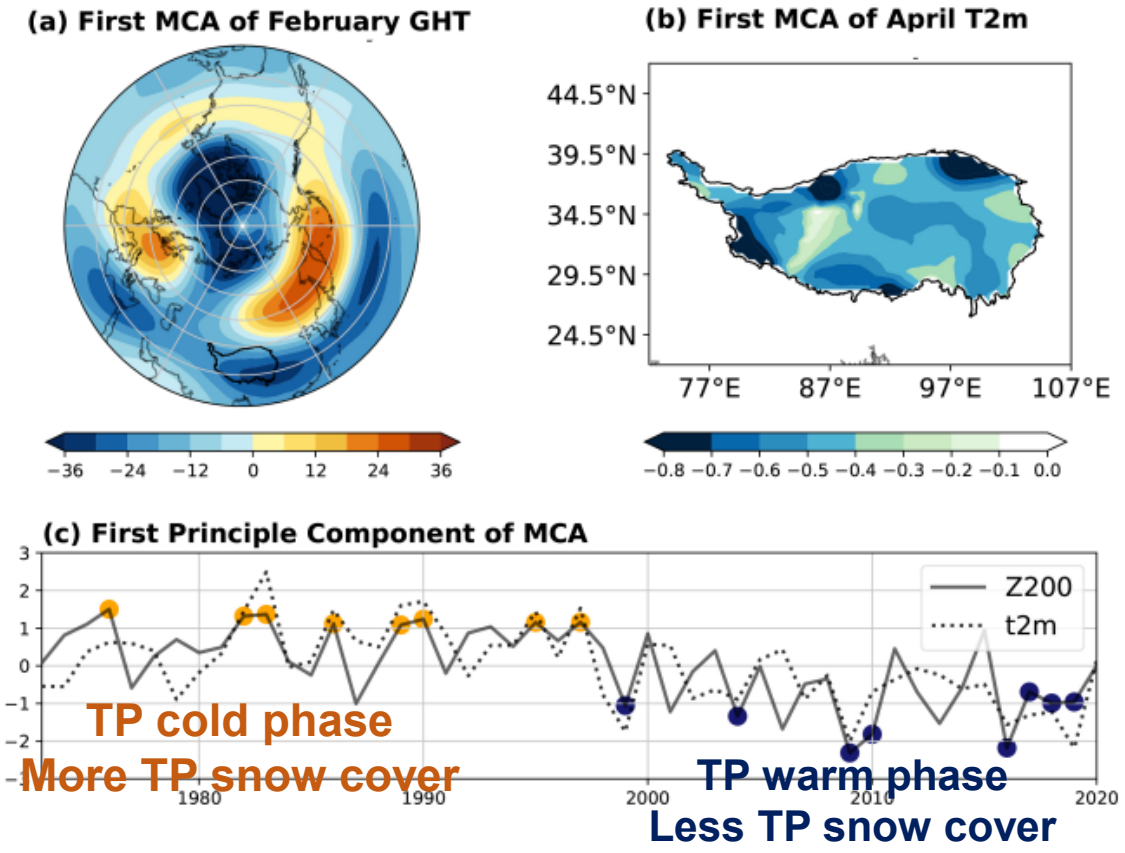
Most CMIP6 models can simulate such winter circulation-spring TP temperature connection

(blue square means significant connection)

(Pan et al., 2022)

Long-time change of the TP related winter circulation

After late 1990s, warm TP temperature anomalies and associated winter circulation occur more frequently



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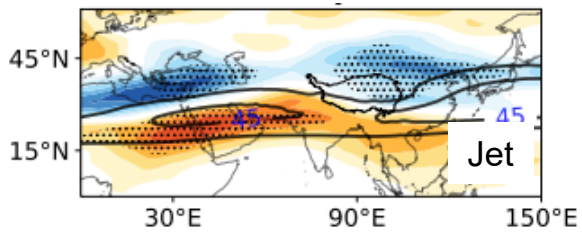
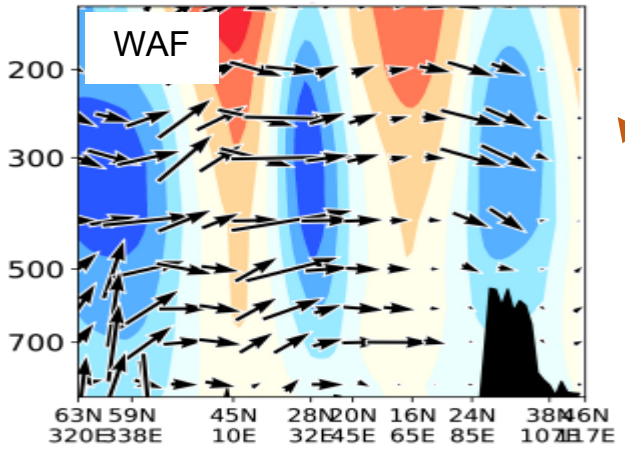
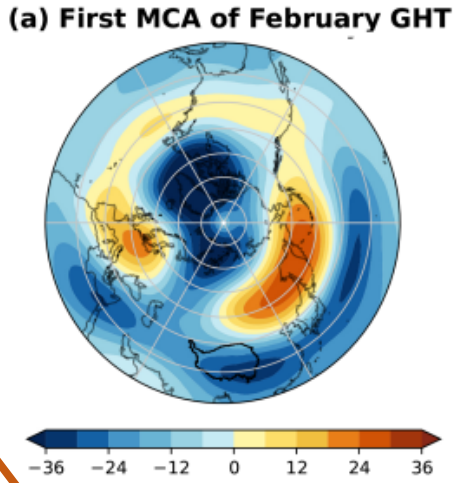
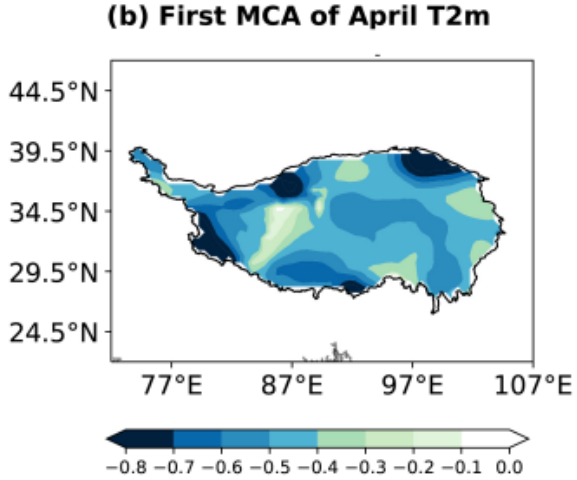
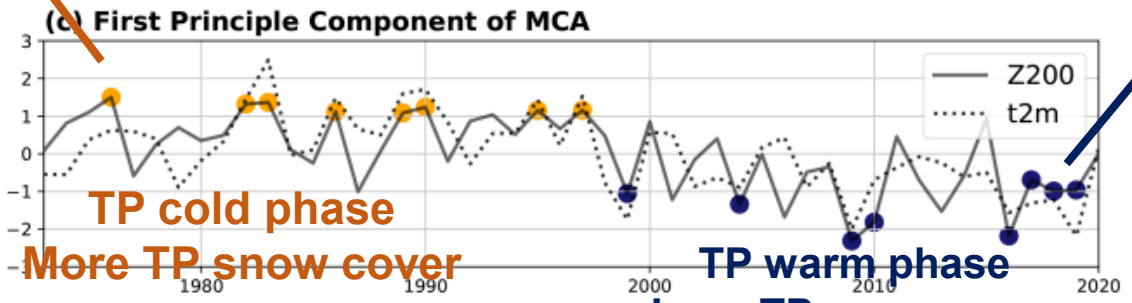
TP cold phase







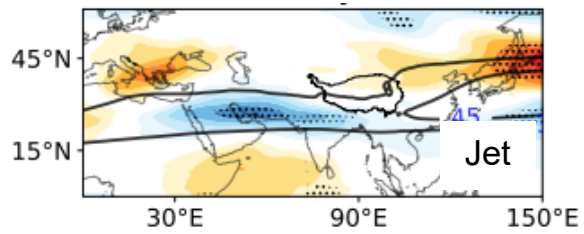


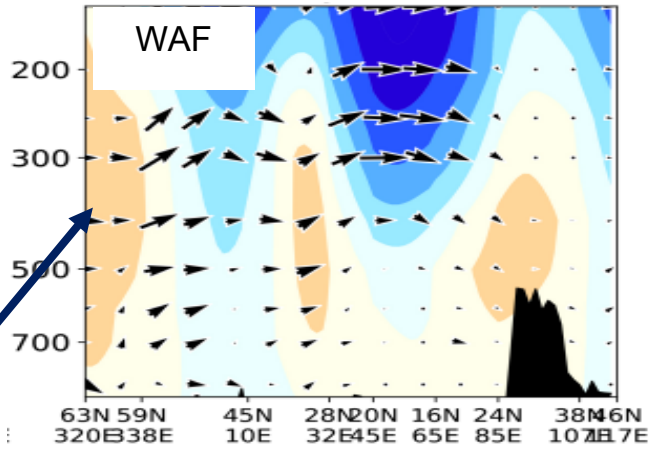


TP cold phase
More TP snow cover

TP warm phase
Less TP snow cover

TP warm phase





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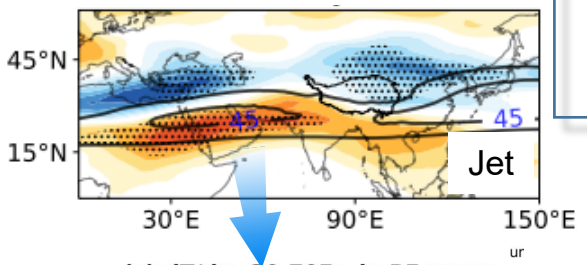

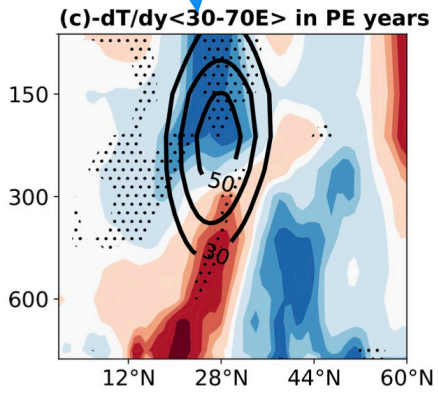

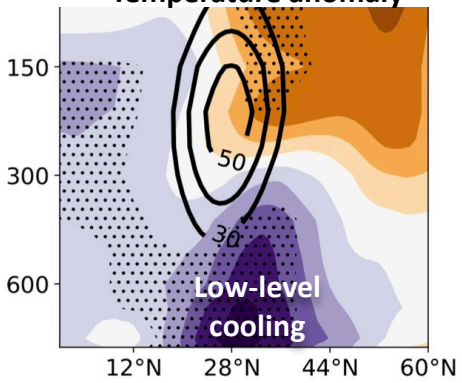

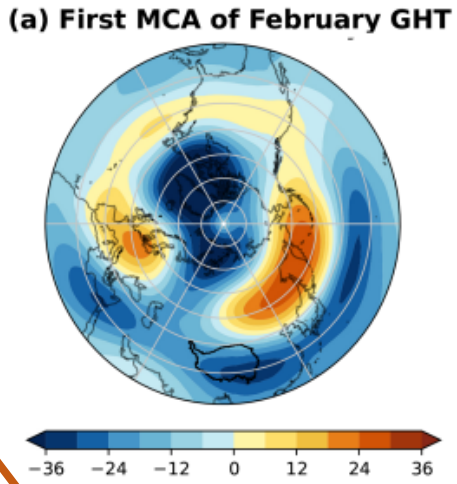

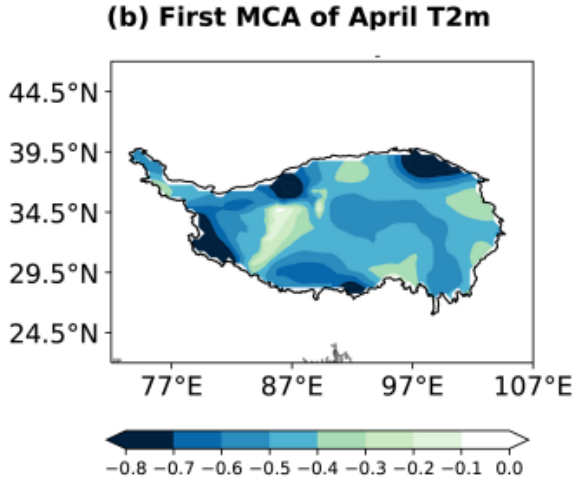

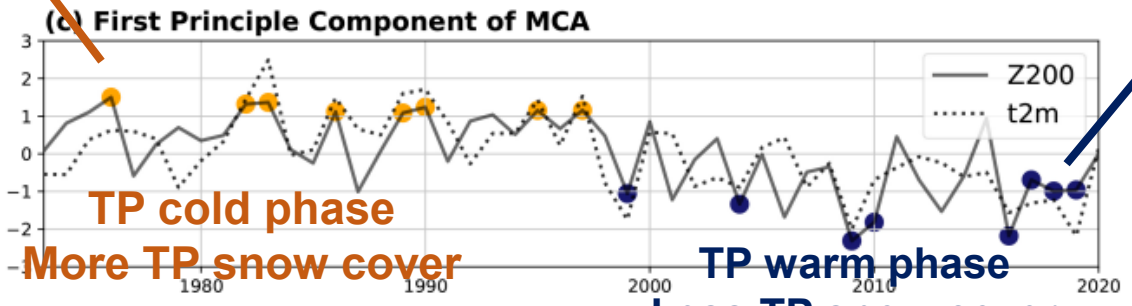

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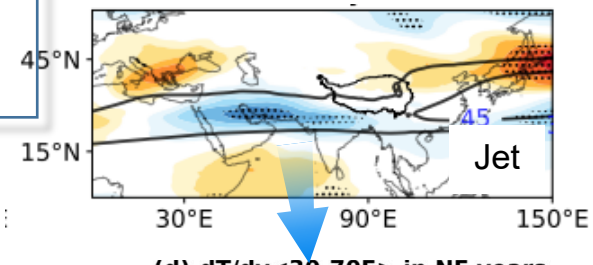

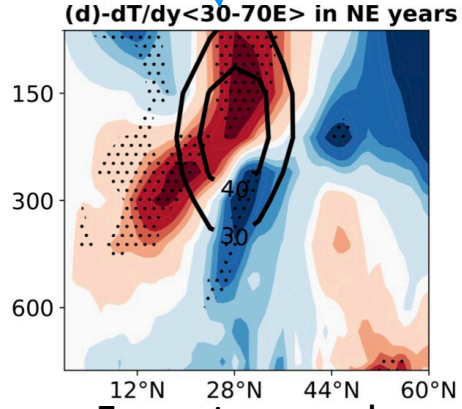

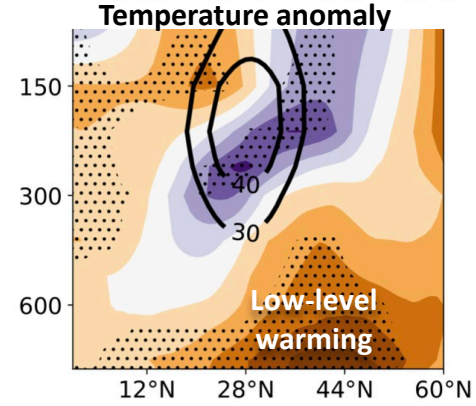

Challenges for understanding the causes of TP anomalies

- **The relative contribution of large-scale circulation vs. local physical process?**
- **Causes for the change of large-scale circulations? (inland warming vs. SST/sea ice change)**

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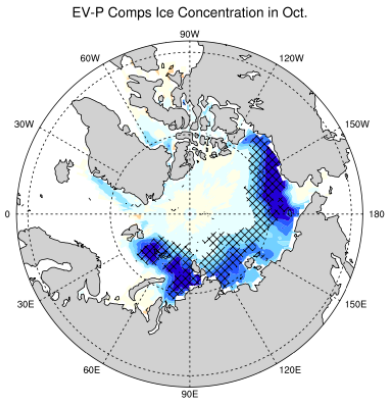
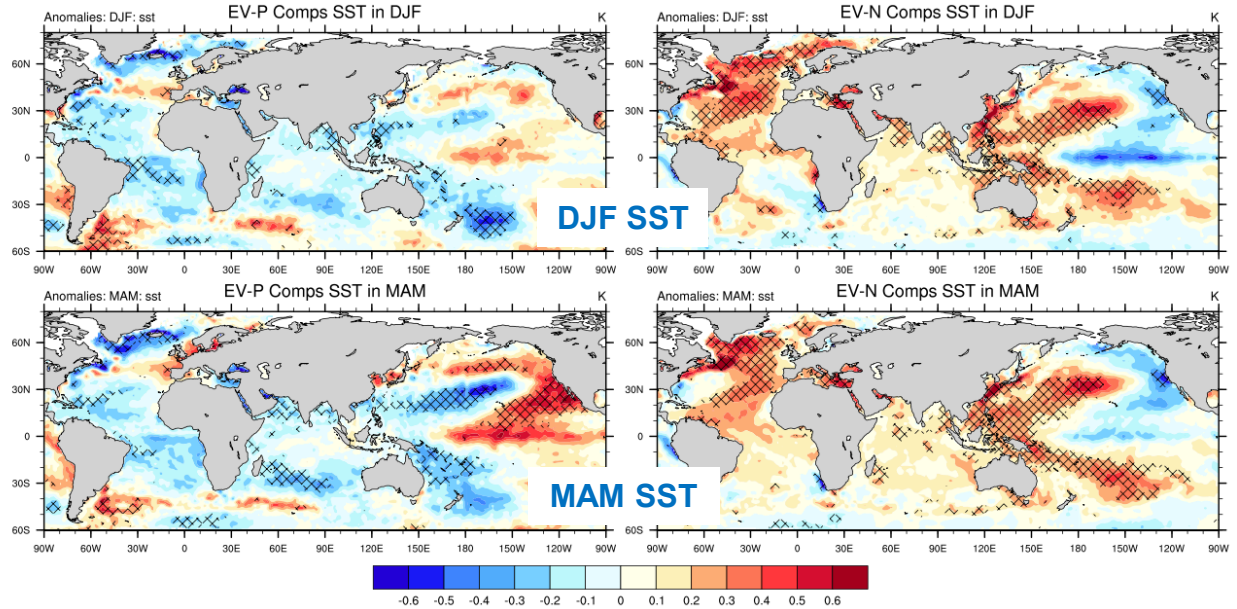


Oct. Sea ice



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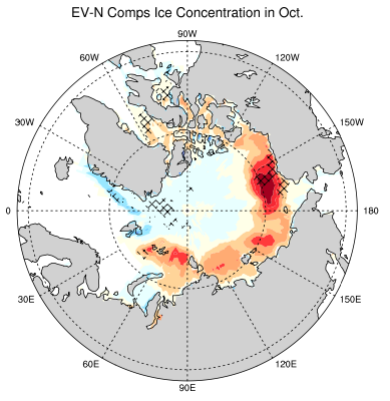

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Thanks !

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December 11, Chicago

Long-time change of the TP related winter circulation

ACC spatial pattern

Time series correlation

trend

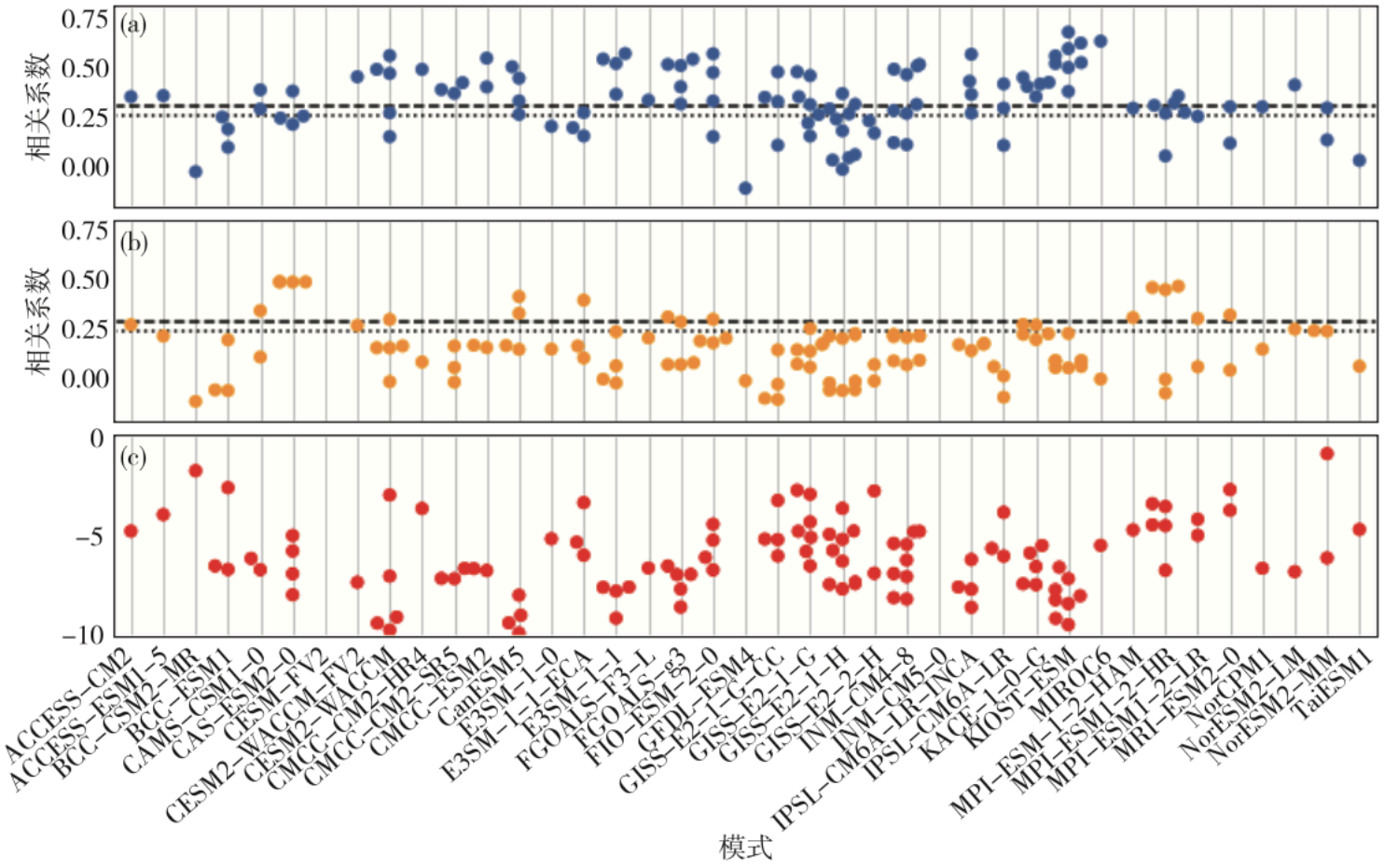
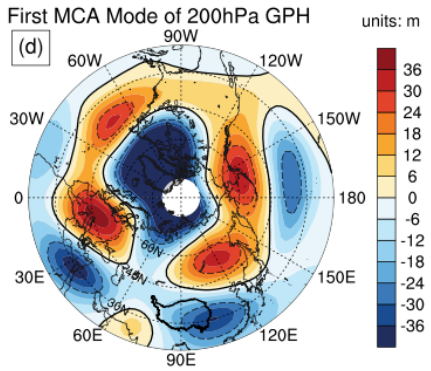


图 6　同图 5,但为 39 个 CMIP6 模式模拟结果

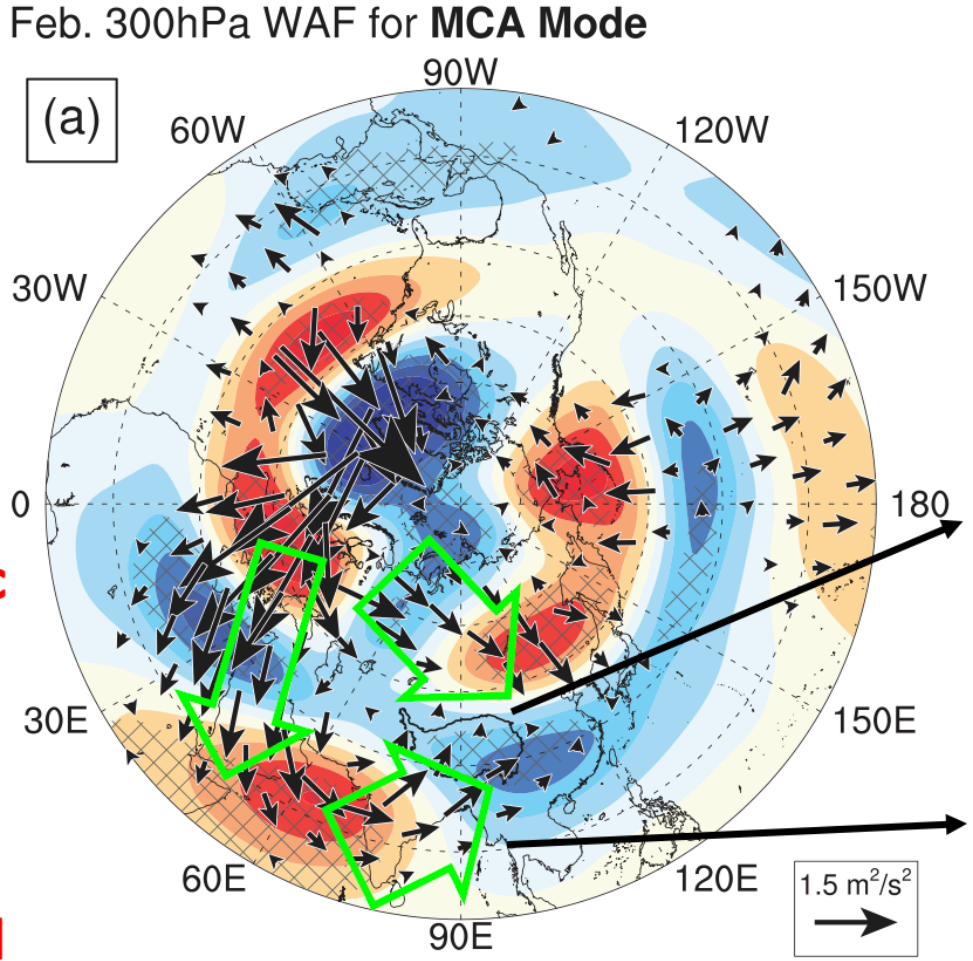
Fig.6　Same as fig. 5, but for CMIP6 models

Mechanism (I): Arctic-Tibet connection



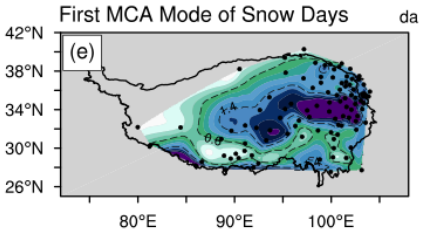
Winter circulation

Wave trains from Arctic can reach Tibet via northern and southern pathways, bringing dynamic and moisture conditions for snow fall



Dynamical condition

Moisture supply



Snow cover days