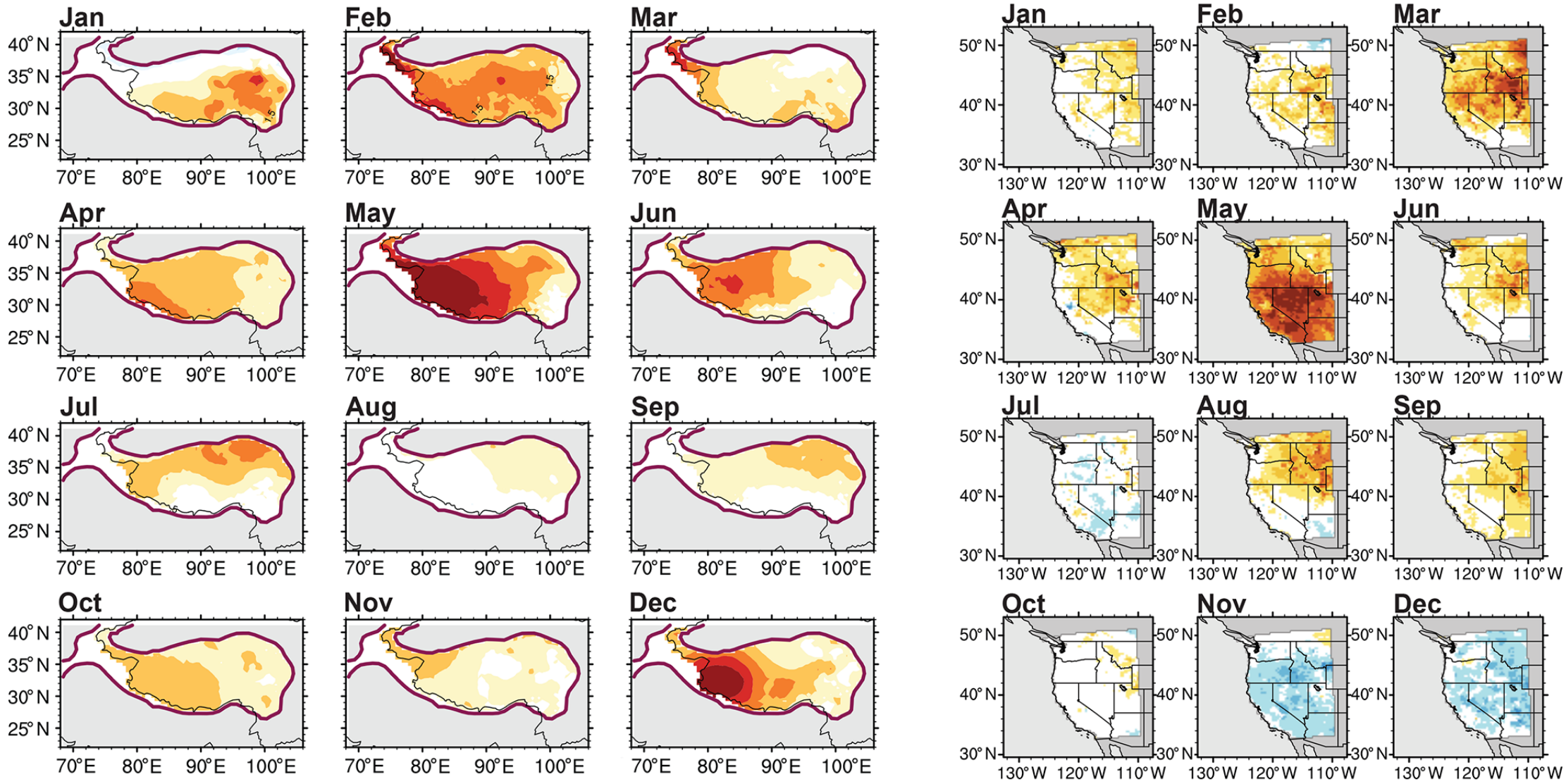
Spring Land Temperature in Tibetan Plateau Enhances Global-Scale Summer Precipitation Prediction ---- The GEWEX/LS4P Phase I Experiment

Yongkang Xue, I. Diallo, A. A. Boone, T. Yao , Y. Zhang , X. Zeng , J. D. Neelin, W. K.M. Lau, P. J. van Oevelen, D. Klocke, H. Nayak, and LS4P Team

LS4P: Impact of initialized **L**and **S**urface temperature and **S**nowpack on **S**ub-seasonal to **S**easonal **P**rediction

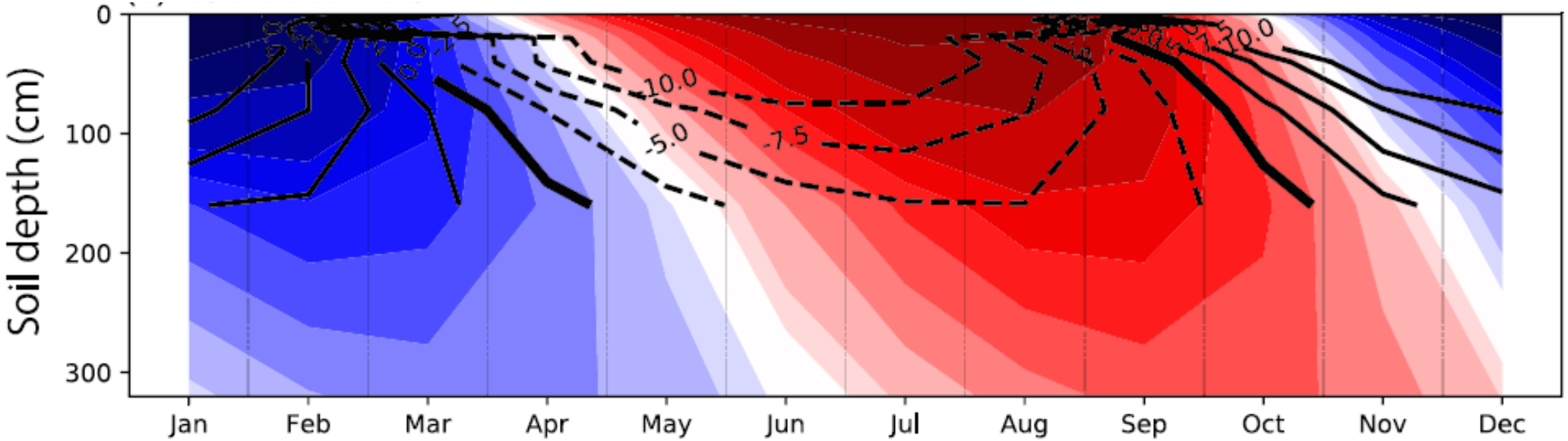
3rd Pan-GASS Meeting: Understanding and Modeling Atmospheric Processes
July 25 - 29, 2022, Monterey, CA, USA

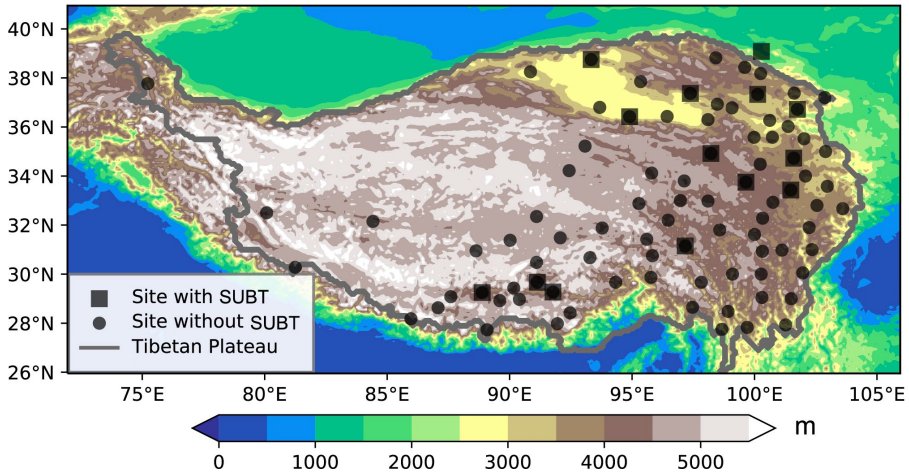
Monthly 2 m temperature difference between warm and cold Mays (◦C) over Tibetan Plateau and West U.S.



Xue et al., 2021, GMD

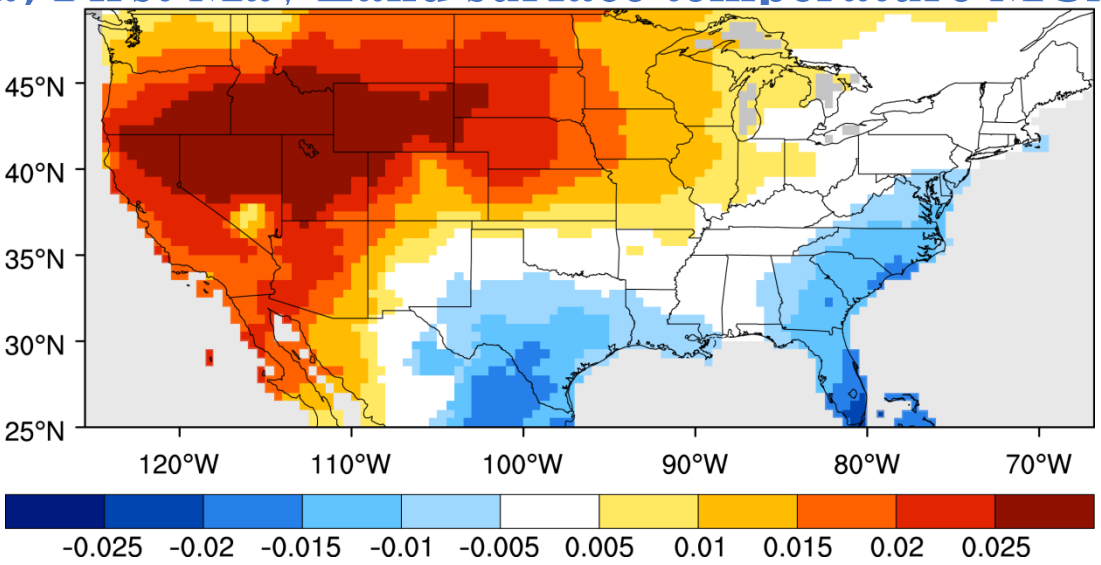
Observed Soil Temperature Climatology (1981-2005) over Tibetan Plateau



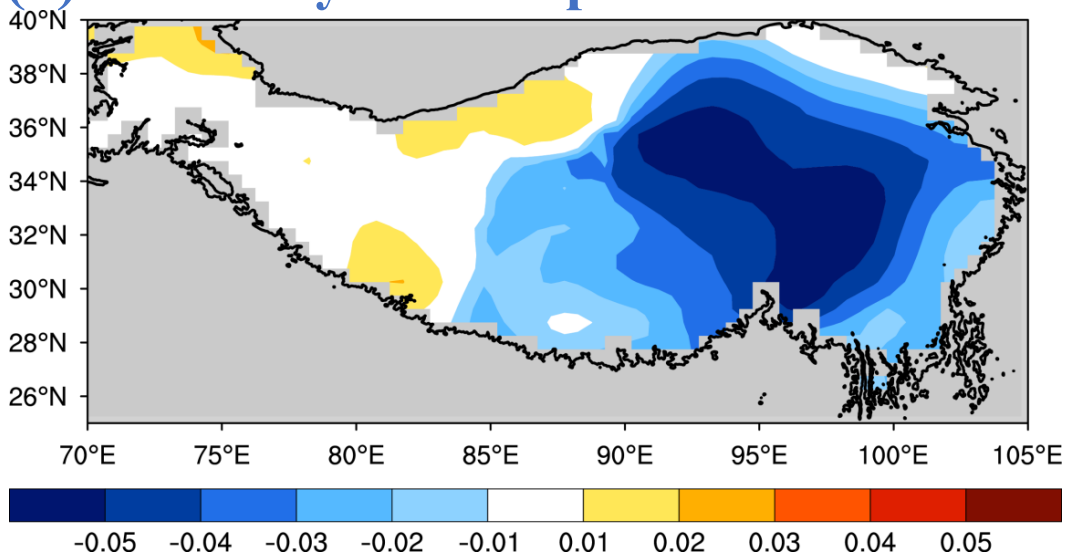


Liu et al., 2020, JGR

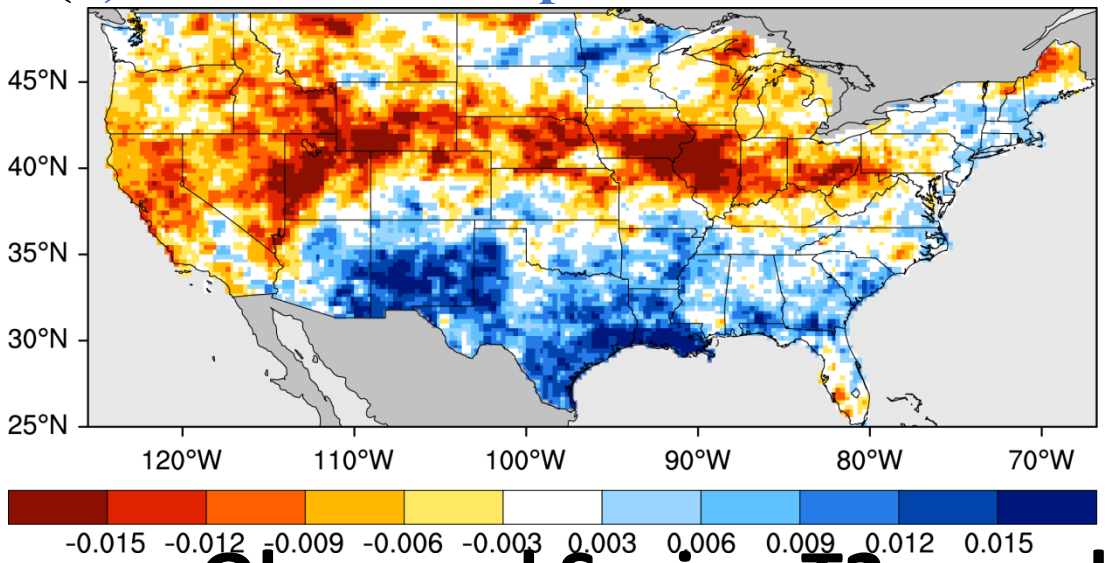
a) First May Land surface temperature MCA Mode



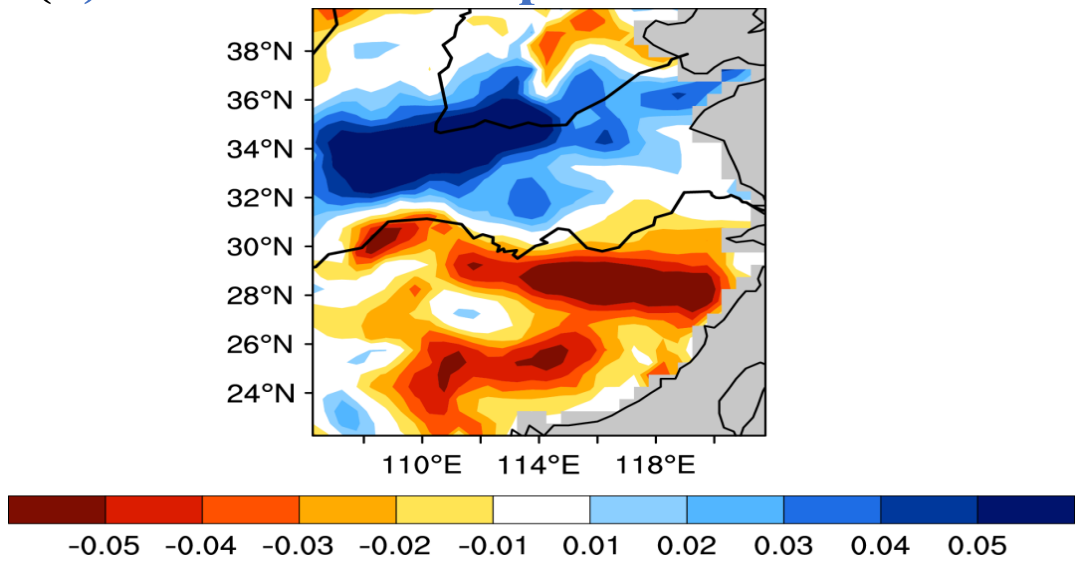
(a) First May 2-m temperature MCA Mode



(b) First June Precipitation MCA Mode



(b) First June Precipitation MCA Mode

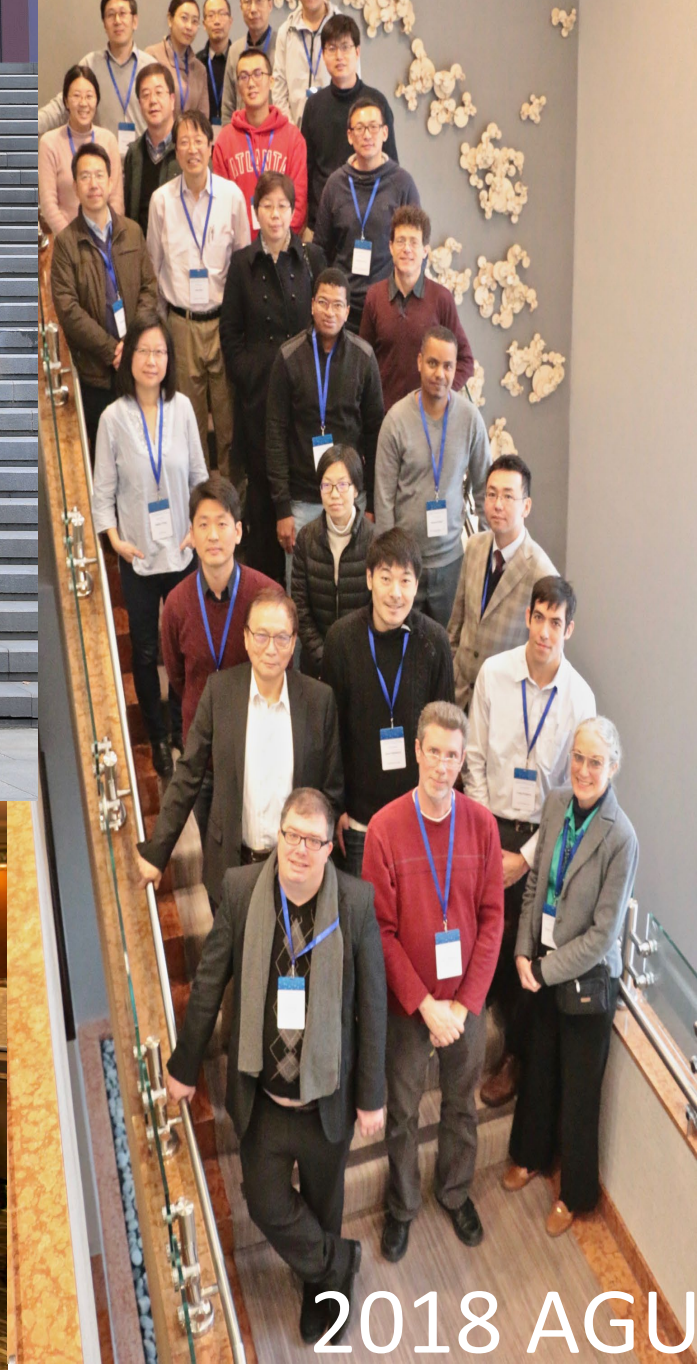


Observed Spring T2m and summer precipitation relationship

MCA: Maximum Covariance Analyses


July 2019 Nanjing


2019 AGU


2018 AGU

Impact of Initialized Land Surface Temperature and Snowpack on Subseasonal to Seasonal Prediction Project, Phase I (LS4P-I): organization and experimental design

Geosci. Model Dev., 14, 4465–4494, 2021
https://doi.org/10.5194/gmd-14-4465-2021

Geoscientific Model Development
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EGU

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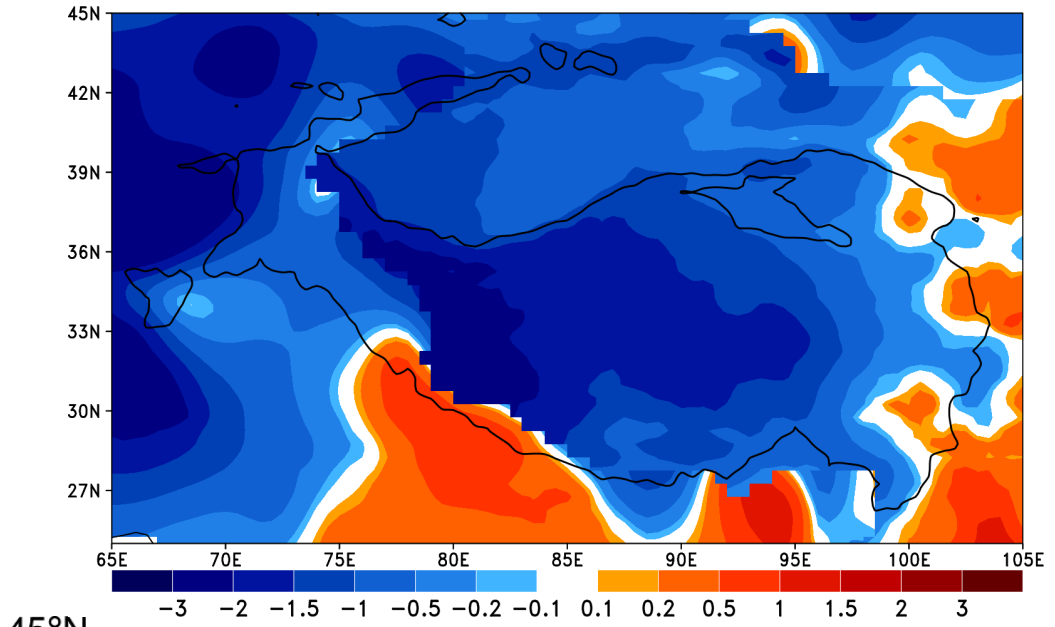
LS4P Phase I

The LS4P Phase I focuses on the first order effects most related to TP land temperature because of the high elevation of the Tibetan Plateau (TP), its significant areal coverage, and the comprehensive field measurements there.

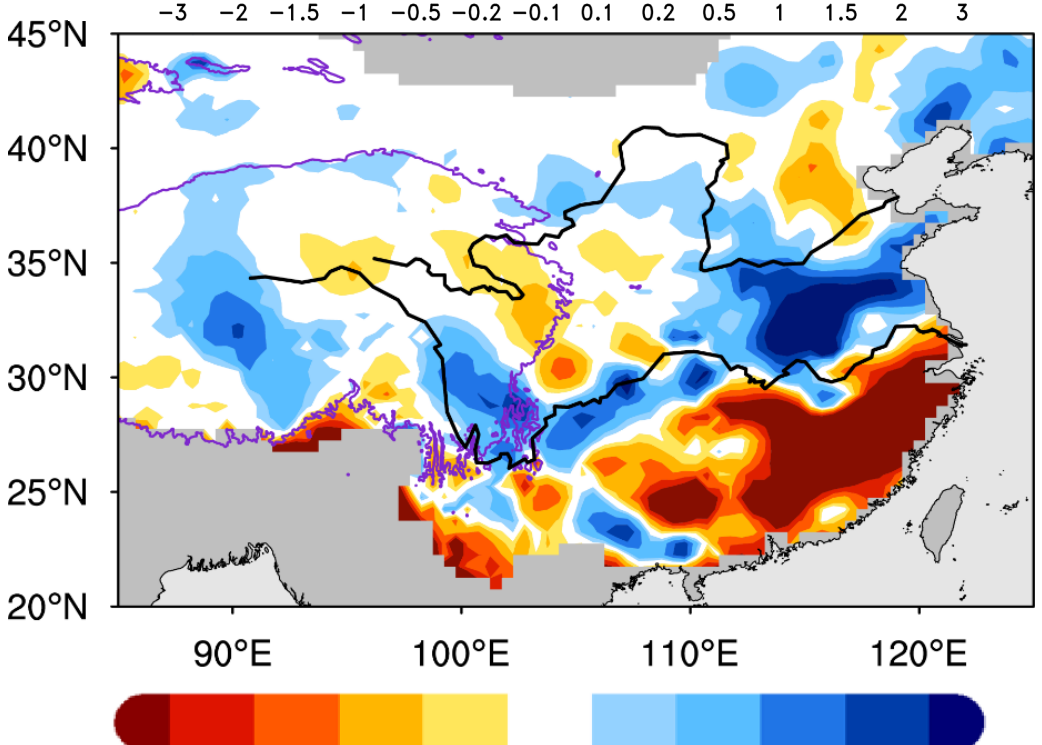
The TP land surface temperature (LST) and Subsurface temperature (SUBT) are used as predictors of spring/summer precipitation events.

May-June 2003 is selected as the 1st case study

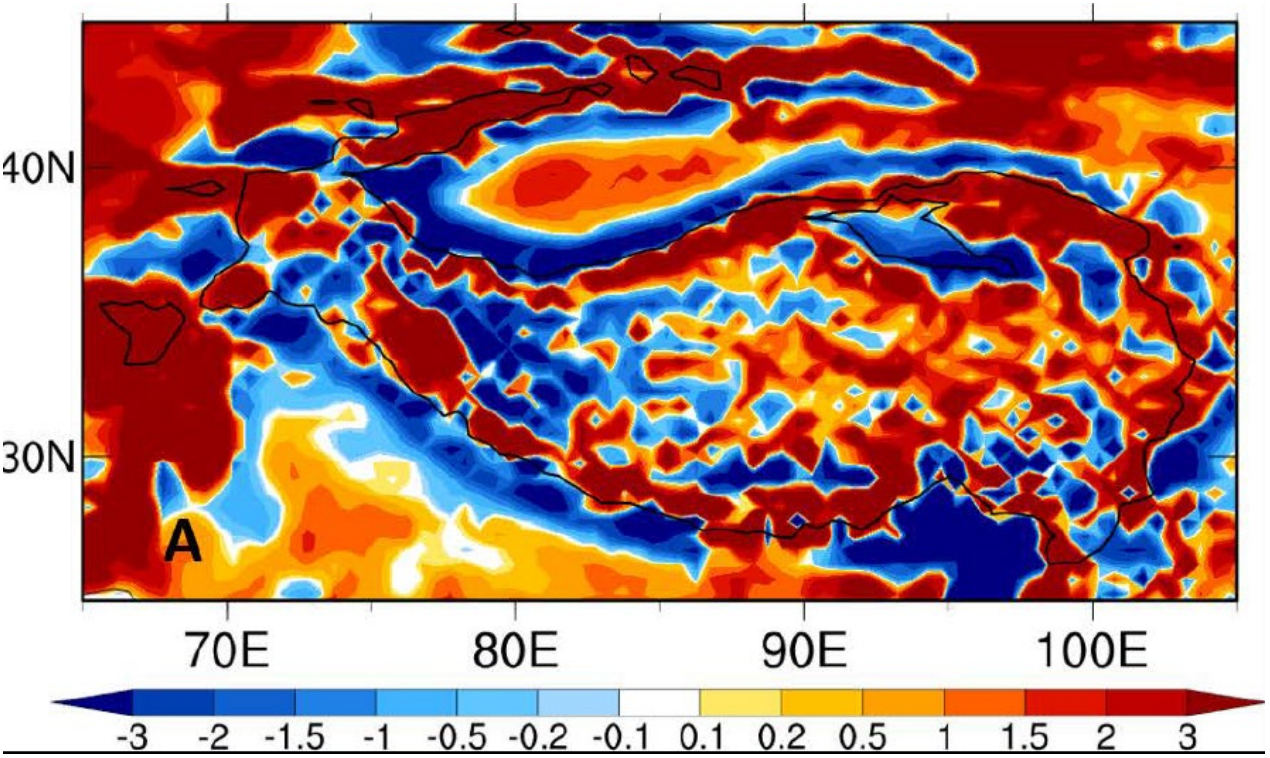
Observed 2003 East Asian Flood/drought



-1.41°C



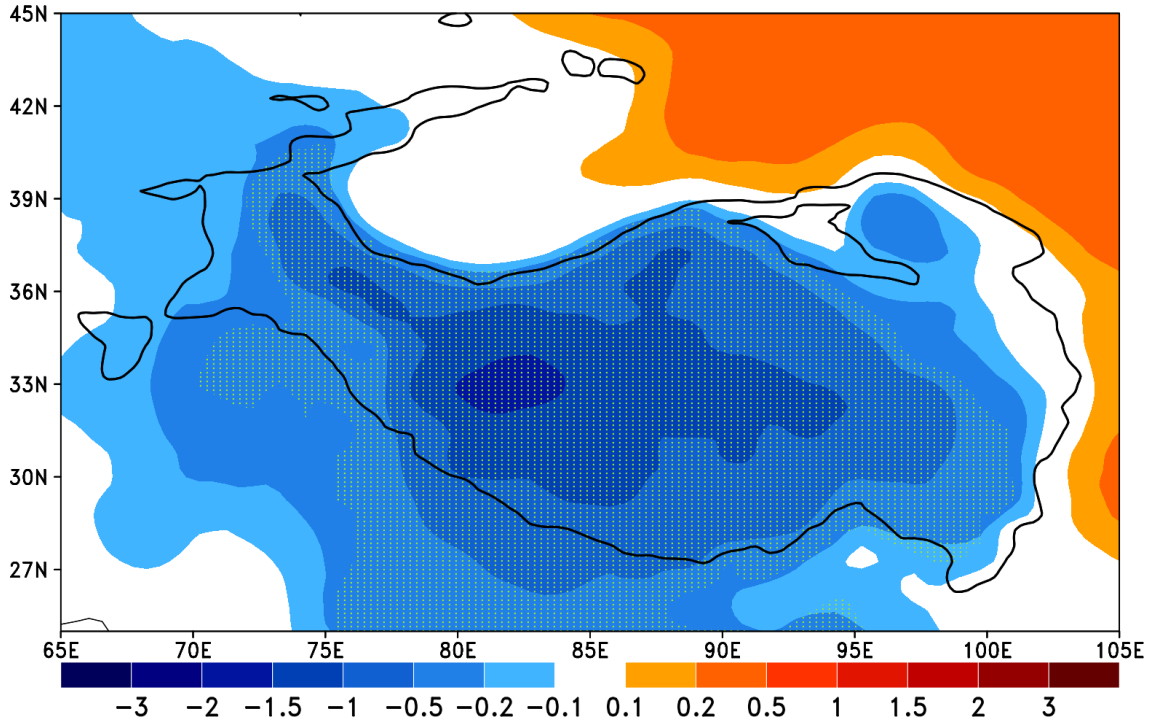
May T2m biases from ensemble mean



12 ESM with + Bias: +1.54 °C

4 ESM with – Bias: -1.07 °C

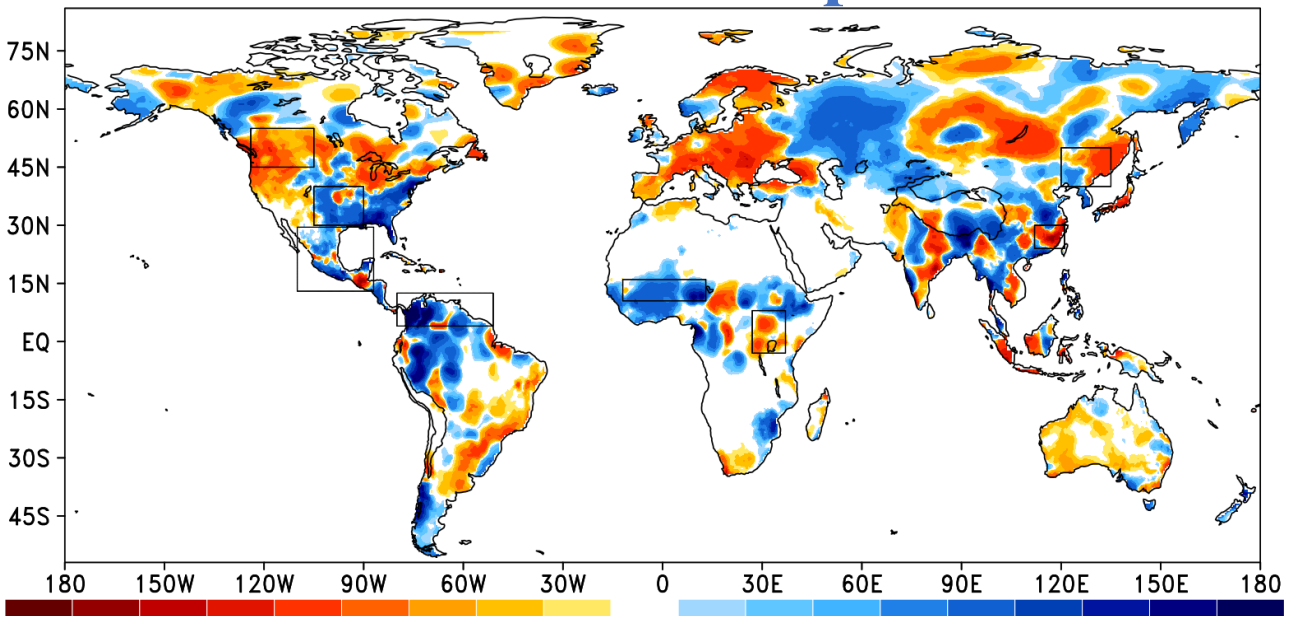
The ensemble mean May T2m difference after imposing a mask for initialization



-0.82 °C

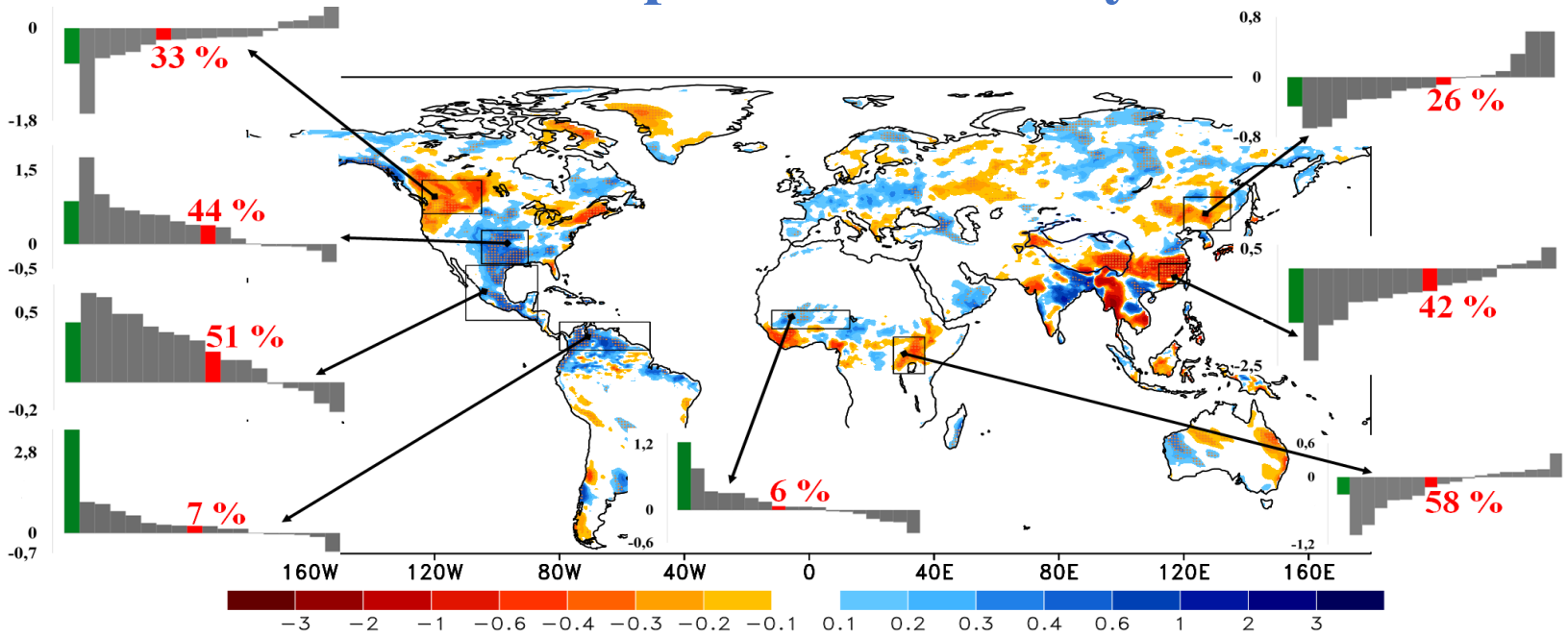
Observed June 2003 Precipitation Anomaly

A

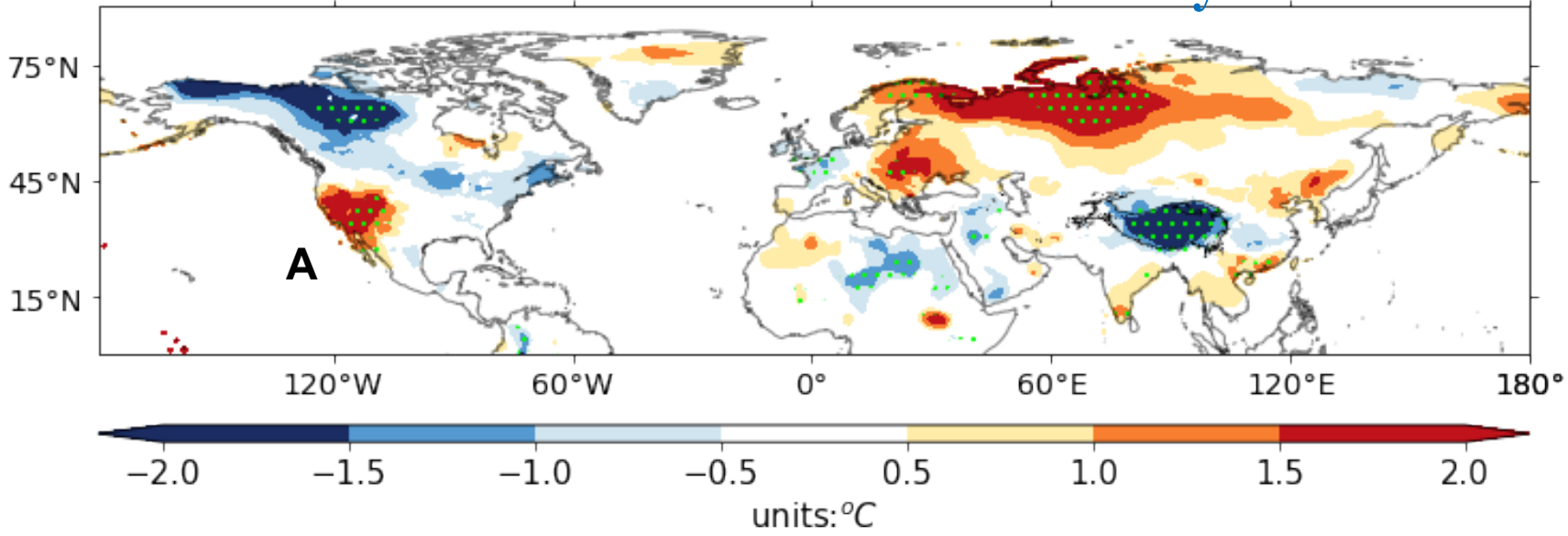


Simulated June 2003 Precipitation Anomaly due to TP LST/SUBT Effect

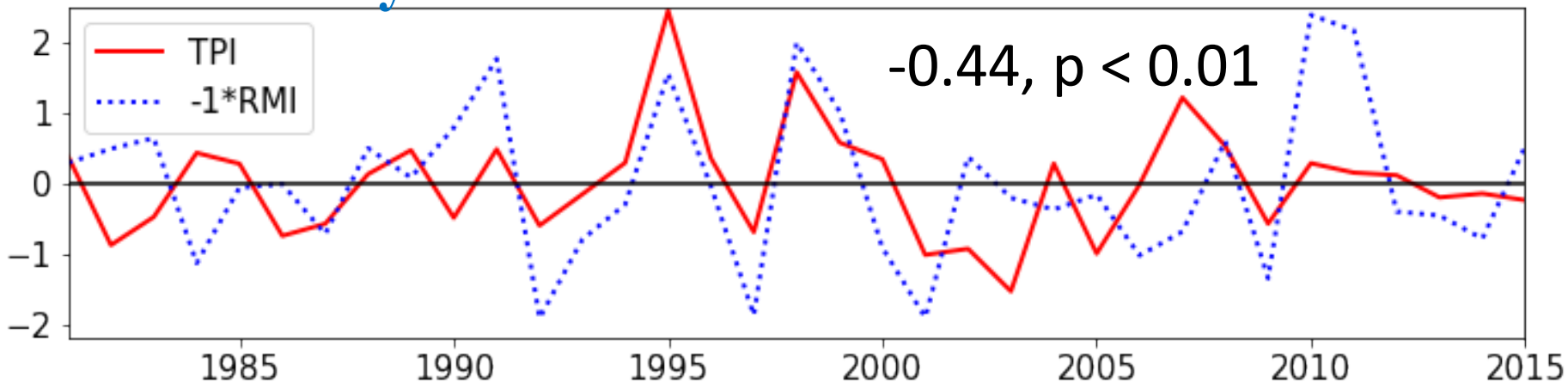
B



Observed differences between five cold and five warm Mays in the Tibetan Plateau

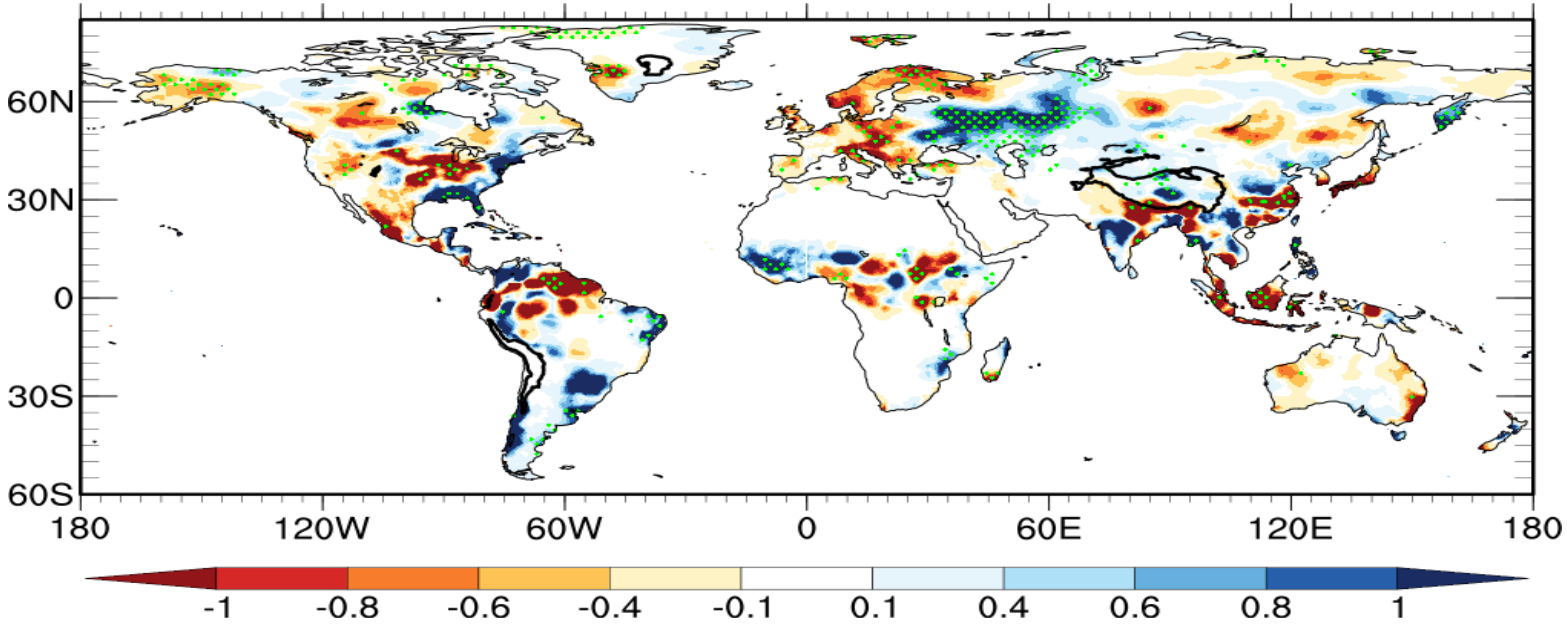


Observed May TPI and RMI time series from 1981-2015

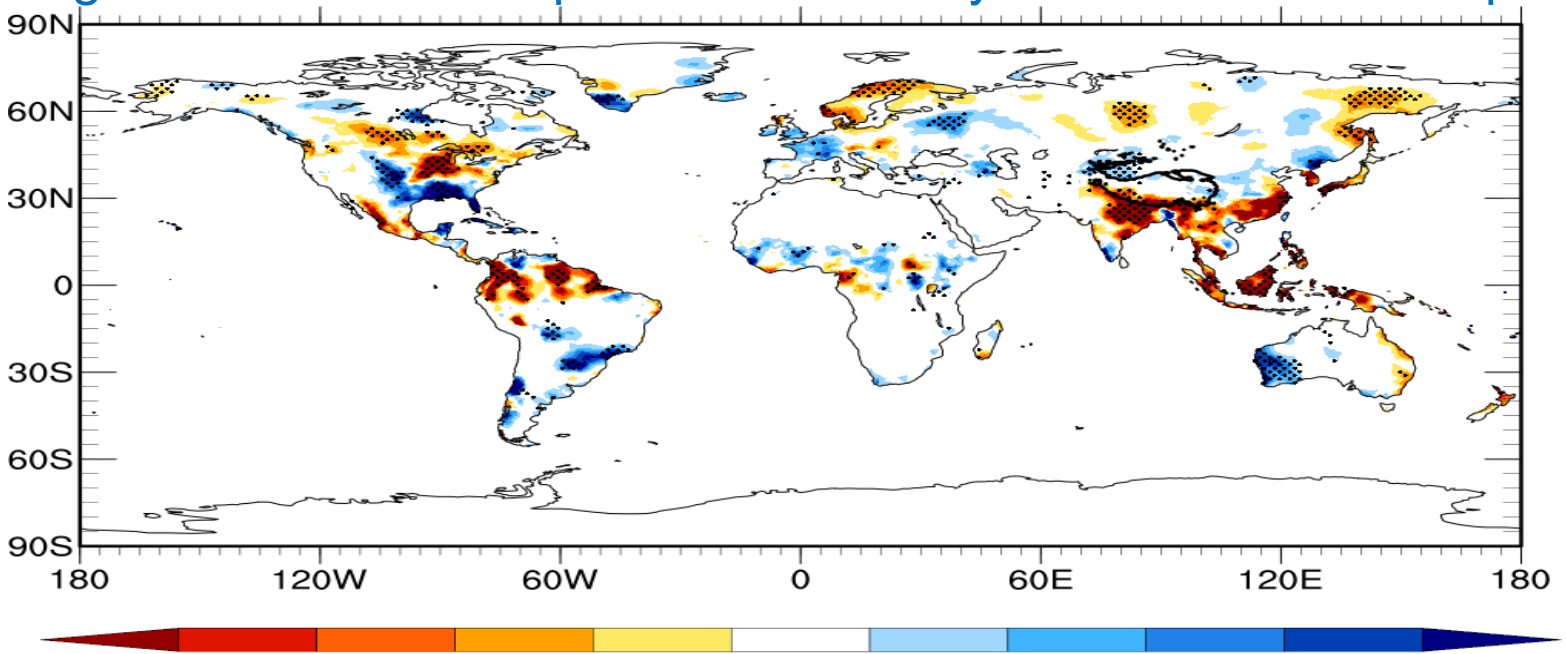


Tibetan Plateau Index (TPI) and Rocky Mountain Index (RMI) are defined as the averaged T2m anomaly over the region bounded by 29°N~37°N and 86°E~98°E and 32°N~45°N and 110°W~125°W, respectively

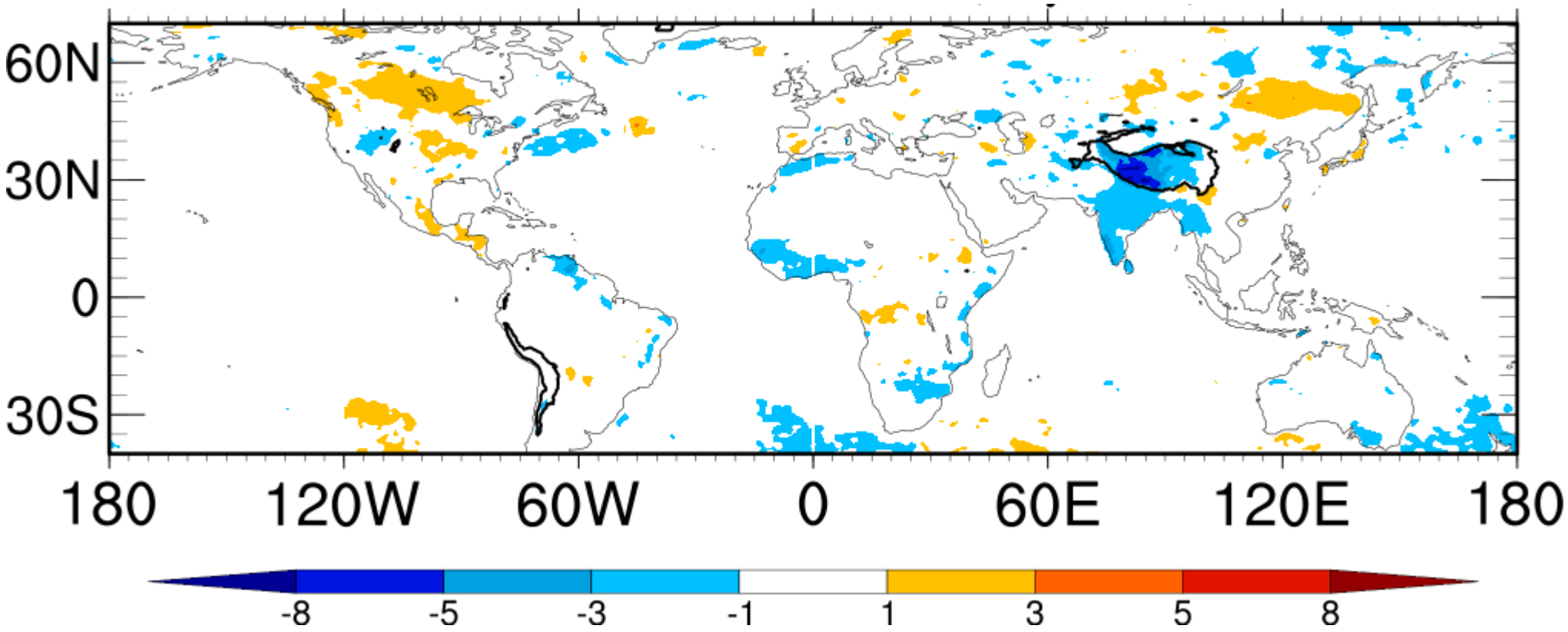
Observed differences between five cold and five warm Mays in the Tibetan Plateau



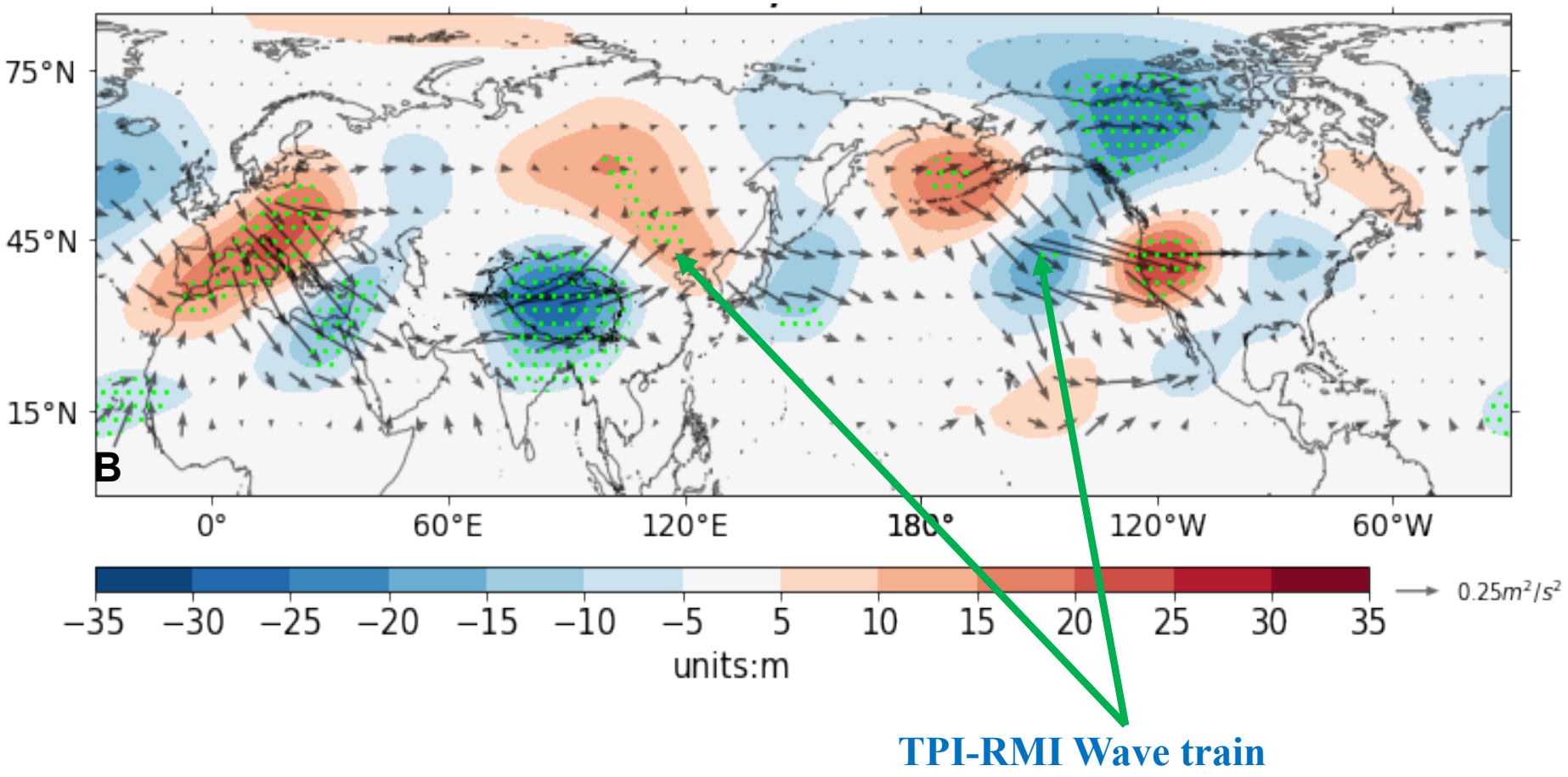
Lag Regression Relationship between TP May T2m and June Precipitation



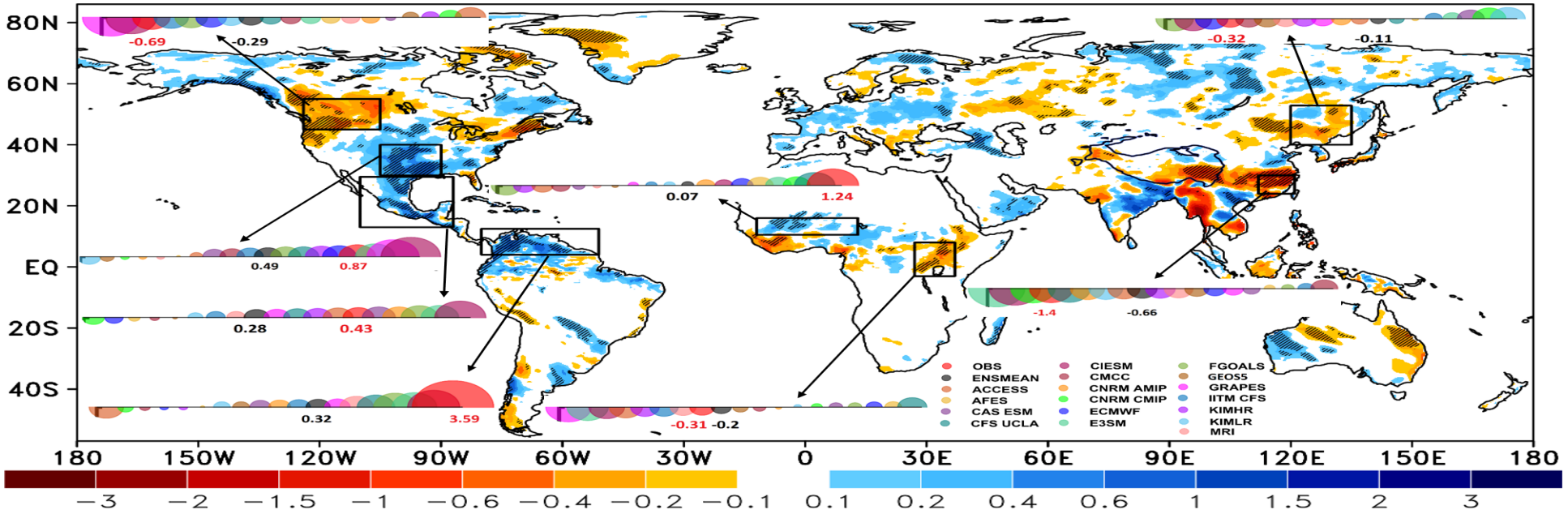
Ensemble mean sensible heat flux difference (W/m2) after Initialization during May 2003.



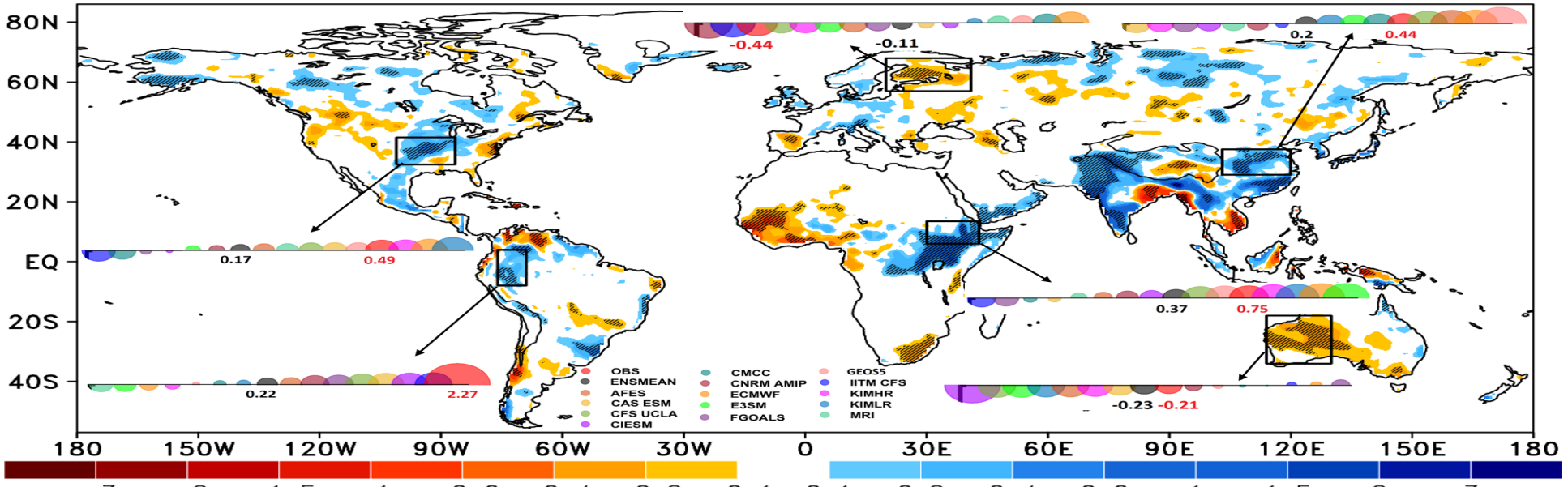
Observed TPI-RMI Wave Train due to TP May T2m anomaly



Simulated June 2003 Precipitation Anomaly due to TP LST/SUBT Effect



Simulated June 2003 Precipitation Anomaly due to Global SST Effect



Phase II

1). When? The LS4P Phase II will kick off late this year.

2). Focus I: Phase II will focus on the LST/SUBT in the Rocky Mountains region and the interactions of LST/SUBT in the Rocky Mountains and Tibetan Plateau.

Climate Assessment for 1998

Gerald D. Bell,* Michael S. Halpert,* Chester F. Ropelewski,+ Vernon E. Kousky,*
Arthur V. Douglas,* Russell C. Schnell,@ and Melvyn E. Gelman*

ABSTRACT

The global climate during 1998 was affected by opposite extremes of the ENSO cycle, with one of the strongest Pacific warm episodes (El Niño) in the historical record continuing during January–early May and Pacific cold episode (La Niña) conditions occurring from July–December. In both periods, regional temperature, rainfall, and atmospheric circulation patterns across the Pacific Ocean and the Americas were generally consistent with those observed during past warm and cold episodes.

The 1998 Oklahoma–Texas Drought: Mechanistic Experiments with NCEP Global and Regional Models

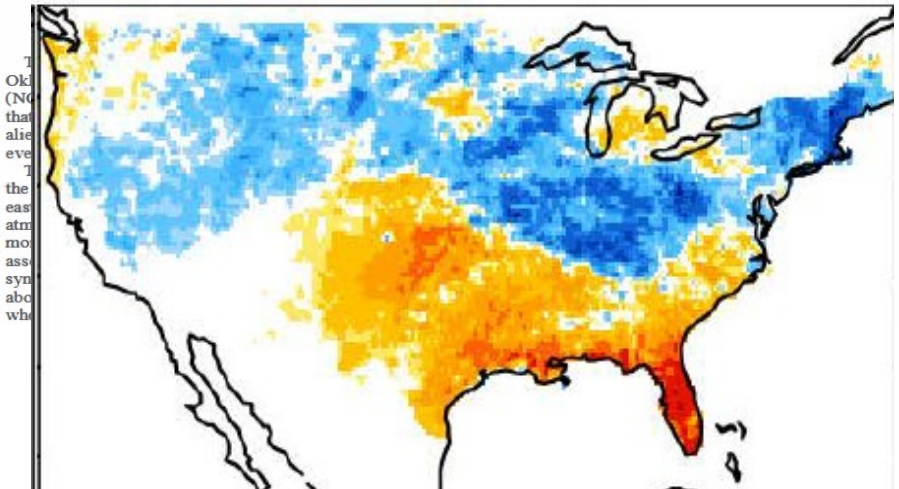
SONG-YOU HONG

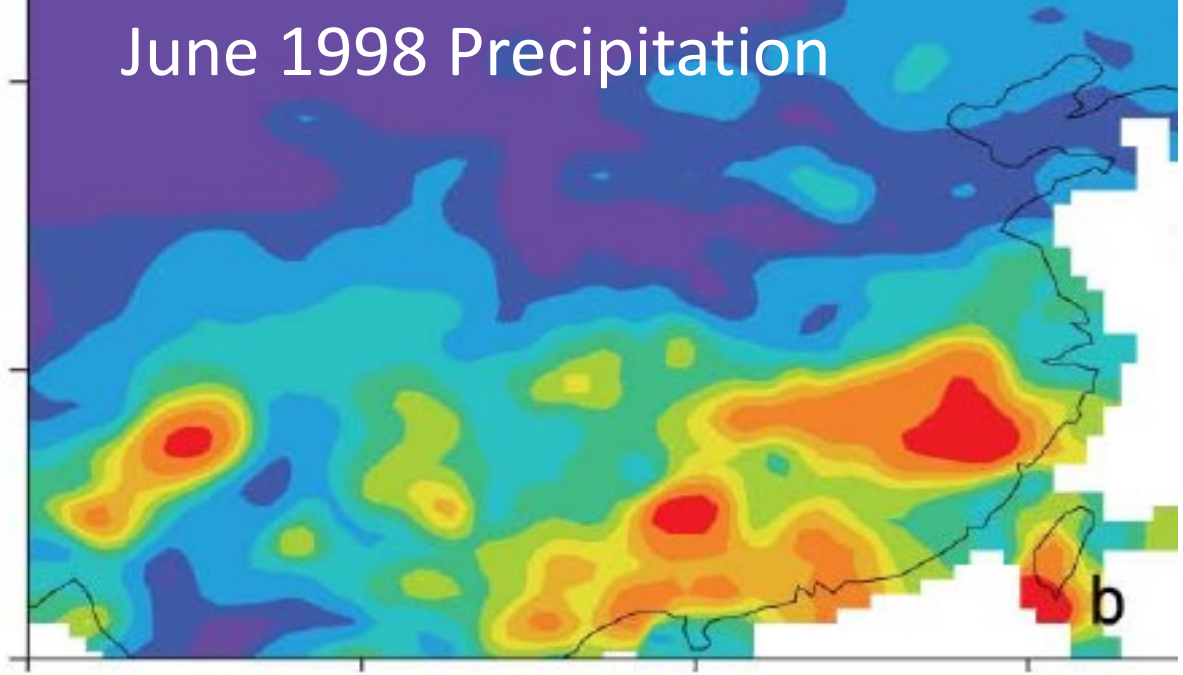
Department of Atmospheric Sciences, Yonsei University, Seoul, Korea

EUGENIA KALNAY

Department of Meteorology, University of Maryland, College Park, College Park, Maryland

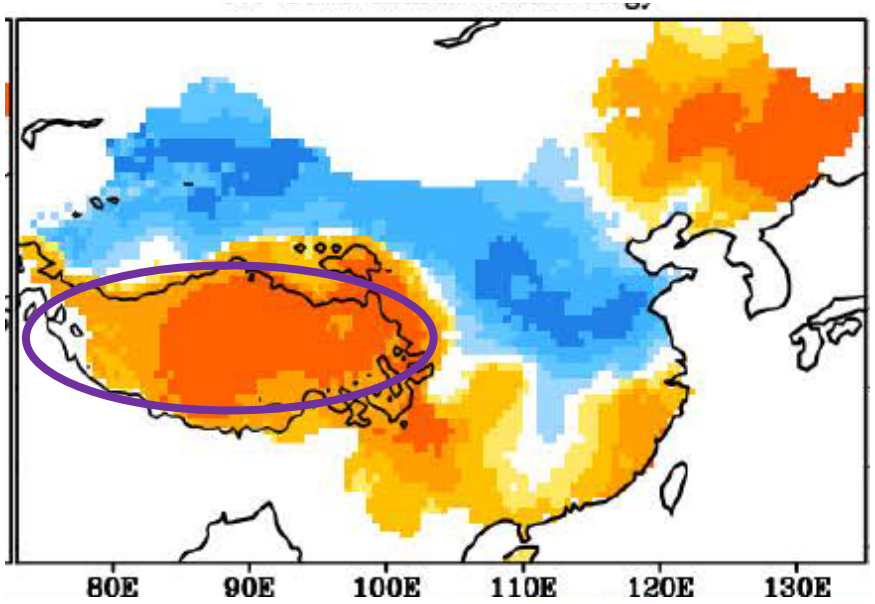
(b) June Precipitation (in mm/day)
for 1998 minus Climatology

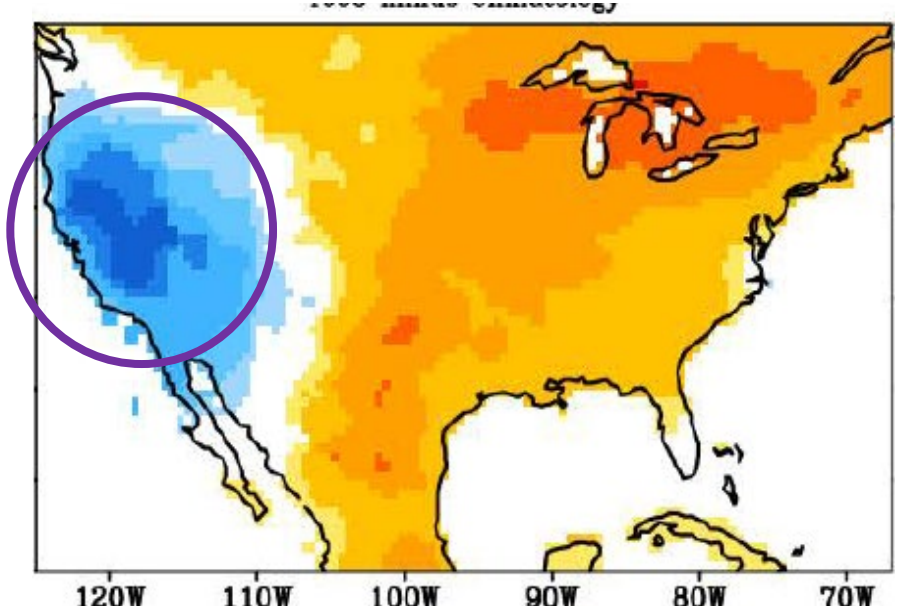




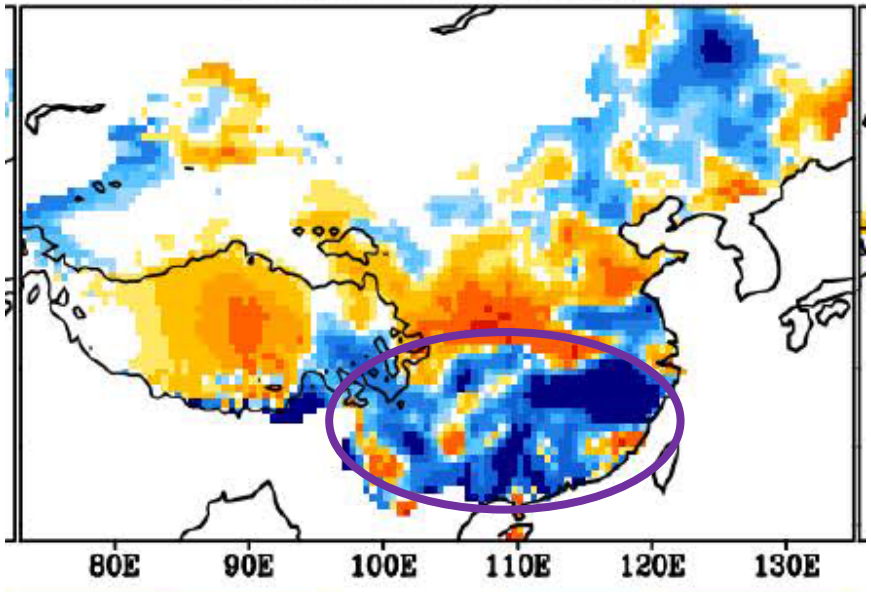
mm/month

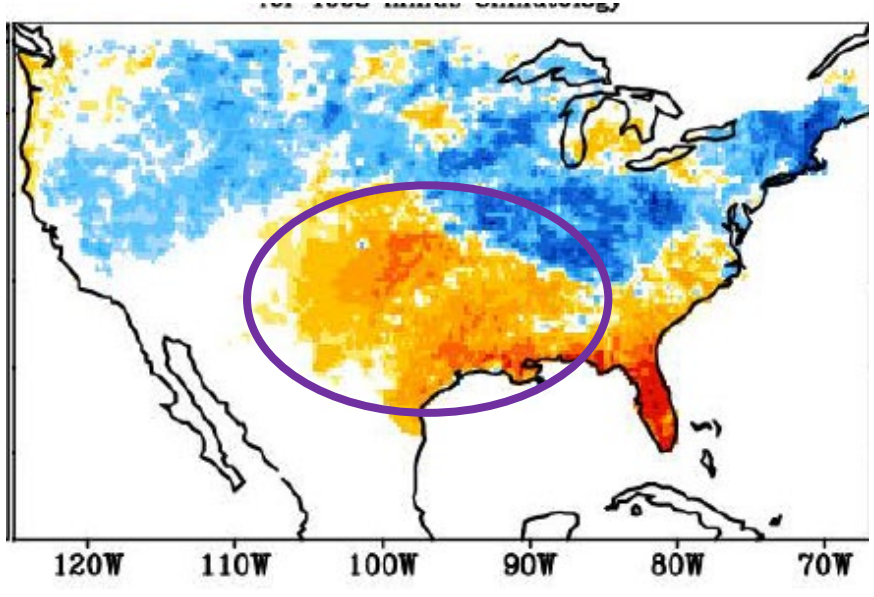
Observed May 1998 T2m anomaly (C°)





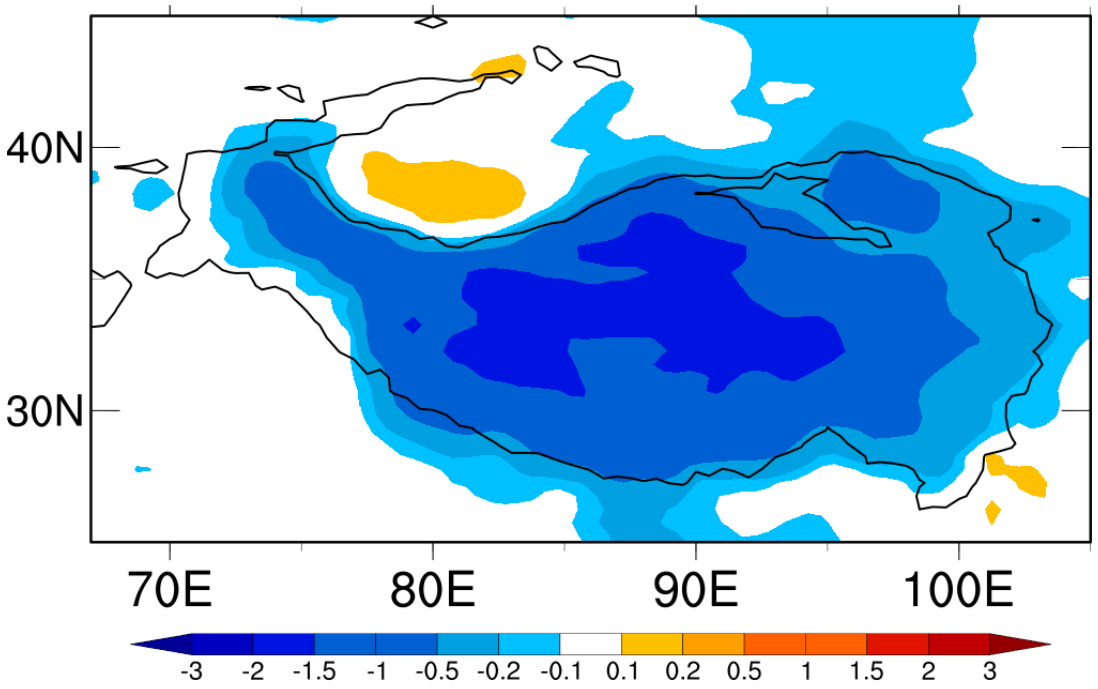
Observed June 1998 Precipitation anomaly (C°)





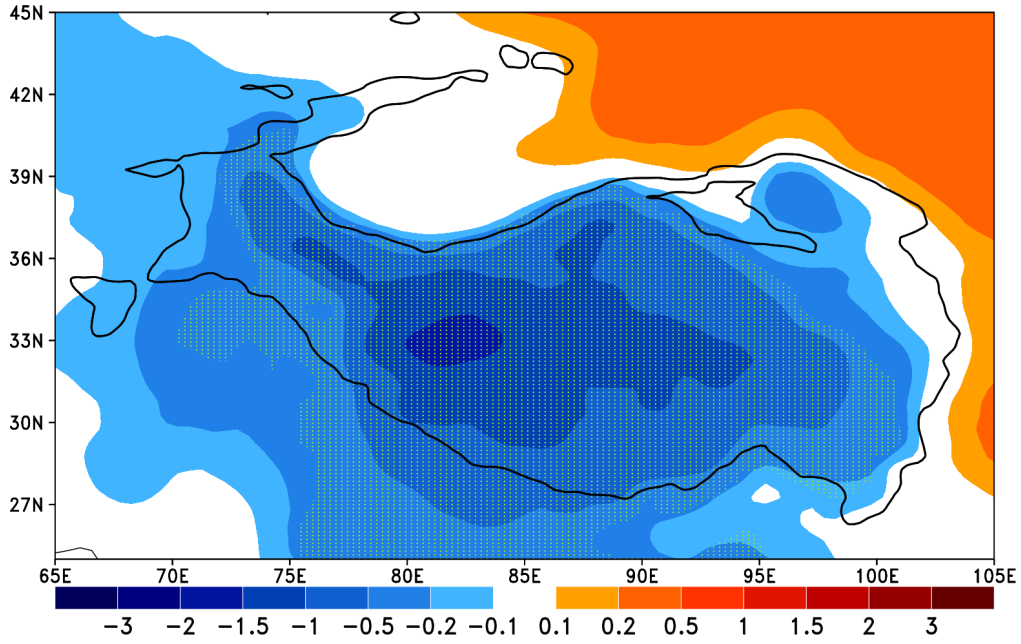
2) Focus II: How to improve the initialization for operational purpose

The ensemble mean **1 May** T2m difference after imposing a mask for initialization



-1.1 °C

The ensemble **mean May** T2m difference after imposing a mask for initialization



-0.84 °C

Summary

1). Observed land surface temperature anomalies can persist for several months, especially during the spring. The land temperature memory could be a substantial source of S2S precipitation predictability.

2). The current ESMs has significant bias in simulated land surface temperature over high mountain regions. The prediction skill for precipitation anomalies in spring and summer months has remained stubbornly low for years. The LS4P is a community efforts focusing on process understanding and predictability, and complements other international projects that focus on the operational S2S prediction.

3). For the first time, after introducing an innovative land temperature initialization in TP, the LS4P results show that the spring land temperature anomaly in the TP has a tele-connected impact on summer precipitation S2S predictability over a number of mid-latitude and tropical hot spots, comparable to those caused by oceanic anomalies.

4). The influence is underscored by an out-of-phase oscillation between the Tibetan Plateau and Rocky Mountain surface temperatures. The impact of TP land surface energy balance on the large-scale climate dynamics manifested as a downstream wave train linking the TP to North America.

5). The LS4P Phase II will kick off late this year. Phase II will focus on the LST/SUBT in the Rocky Mountains region and the interactions of LST/SUBT in the Rocky Mountains and Tibetan Plateau. The LS4P meeting in the Breakout Group session is a prelude for the kickoff of the LS4P Phase II. How to improve the initialization for operational purpose will also be a focus.

http://ls4p.geog.ucla.edu. Email: yxue@geog.ucla.edu