Mechanisms Behind the 2020 Extreme Heat Across Siberia

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Background

- During the first half of 2020, extreme heat persisted in Siberia; wildfires developed in the region as a result.
- Heat waves in this region have been linked with summertime stationary Rossby waves (Schubert et al. 2011; 2014), but specific mechanisms driving the 2020 event are unclear.

Characterizing the 2020 heat events

- Using the Modern Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2)
- Strong positive T2m anomalies from January-June (Fig. 1), with variations in spatial extent. May (June) T2m anomalies were focused in Western (Eastern) Siberia
- In June, there was a mid-month breakdown of the heat wave (Fig. 2)

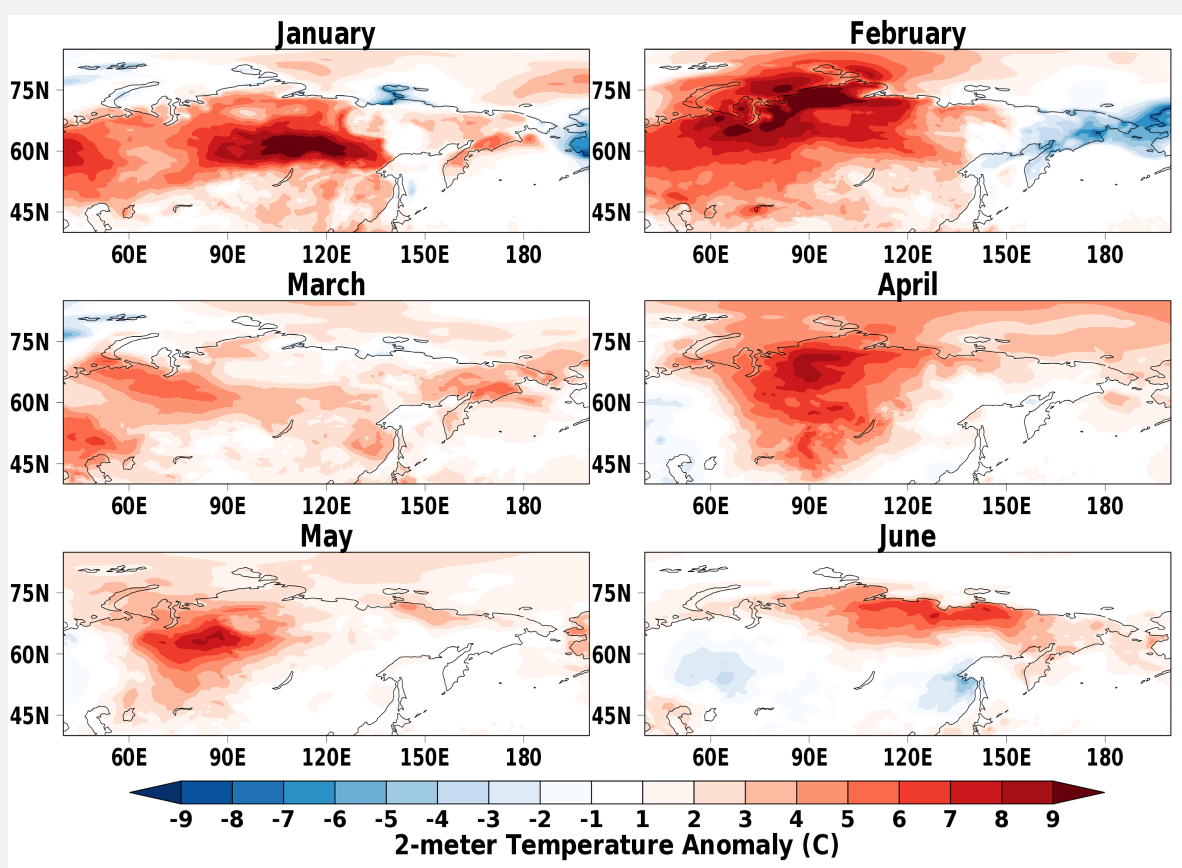

Fig. 1. Monthly 2-meter temperature anomalies from MERRA-2.

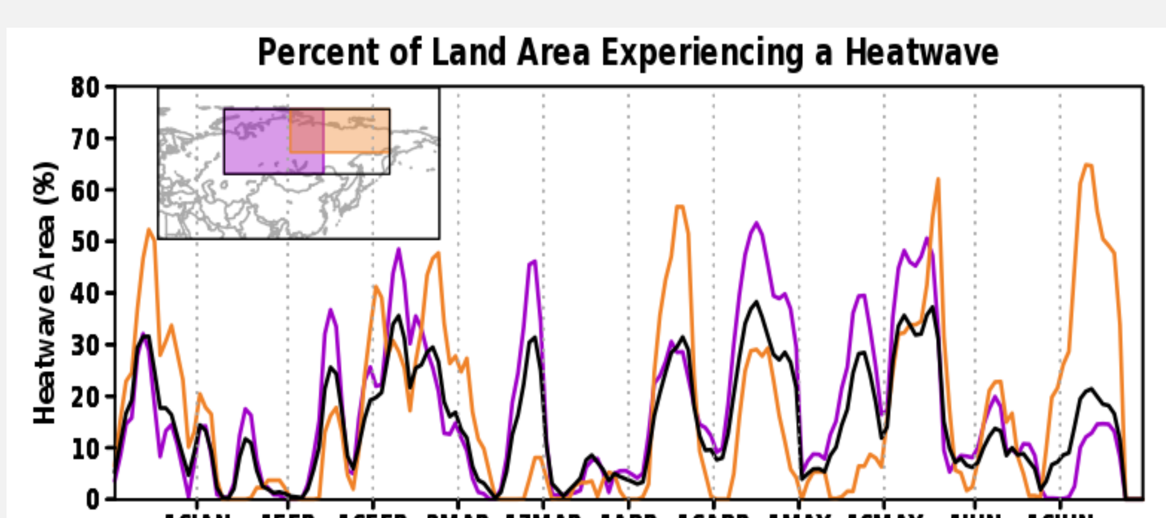

Fig. 2. Daily percent of the region experiencing a heat wave for January-June 2020. Three regions are used; see boxes in the map inset.

Related conditions

- The heat wave of 2020 is associated with a Rossby wave train (Fig. 3), strongest in January-April; weaker but still present in May and June.
- Precipitation anomalies (Fig. 4) are strongly negative in June, in the same region as the T2m anomalies.

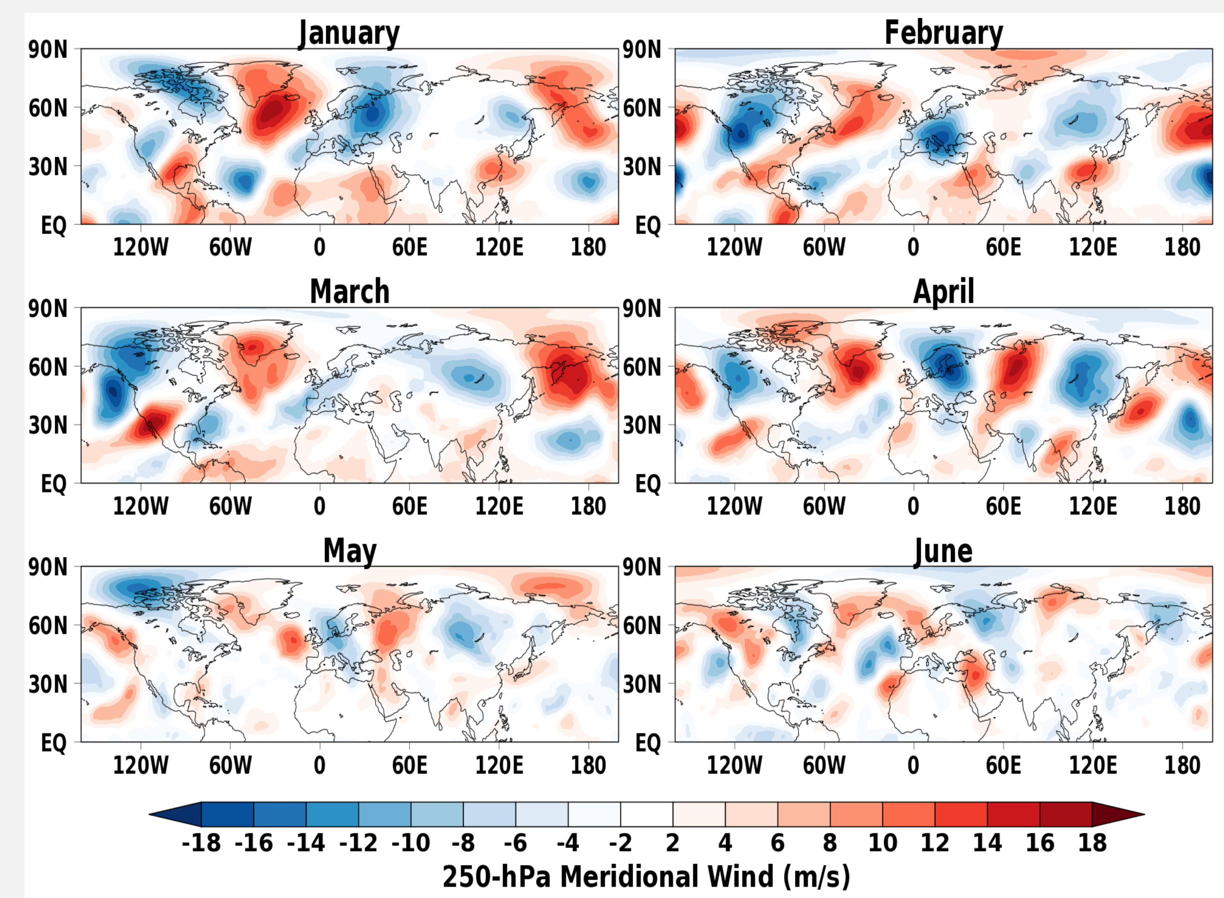

Fig. 3. Monthly 250-hPa meridional winds from MERRA-2

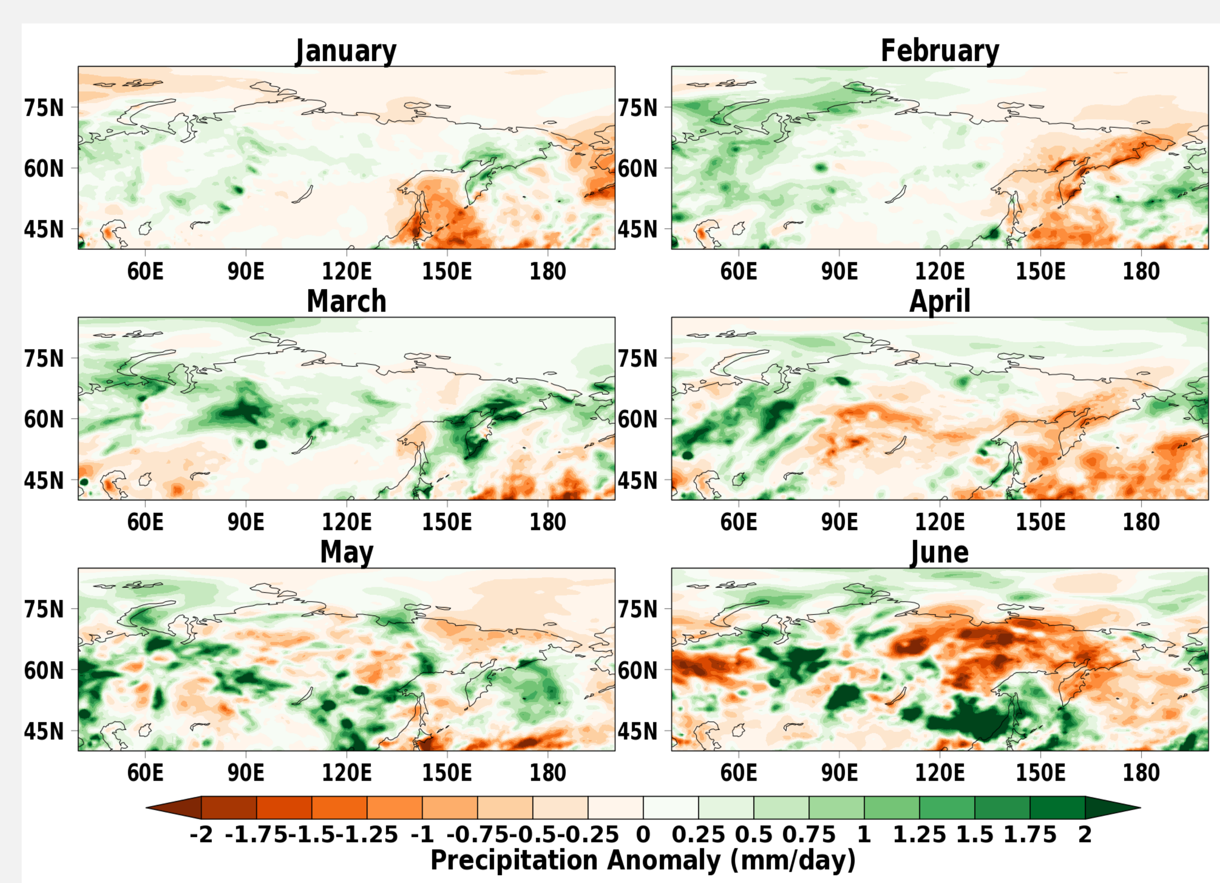

Fig. 4. Monthly precipitation anomalies from MERRA-2.

AGCM Experiments

- Experiments using a version of the Goddard Earth Observing System (GEOS) AGCM that includes updates since MERRA-2.
- Control run: 16-member ensemble run from December 2019 through July 2020 with actual SST and SIC and predicted soil moisture.
- Ensemble-mean T2m anomalies (Fig. 5) are muted compared to observations (Fig. 1), but in the correct location for January and June
- High variance among the ensemble for T2m (Fig. 6) in the regions of observed large T2m anomalies.
- Ensemble-mean V250 (Fig. 7) matches well with observations (Fig. 3) for January-March; less so for April-June

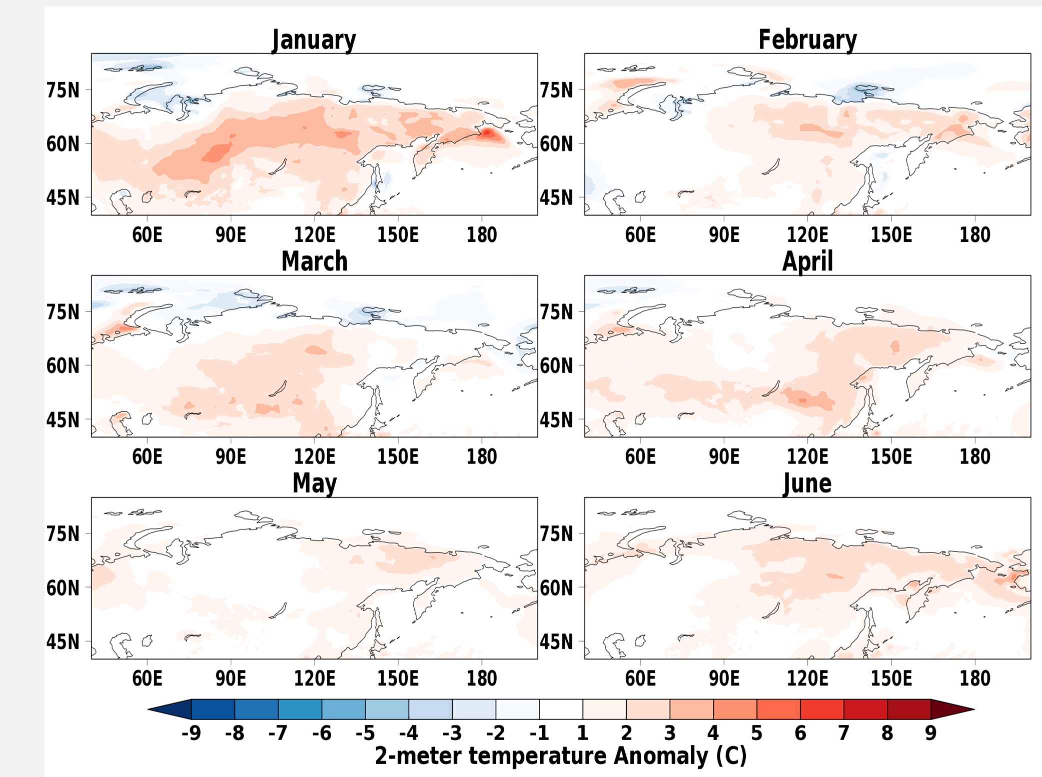

Fig. 5. Monthly 2-meter temperature anomalies from the 16-member ensemble mean control run.

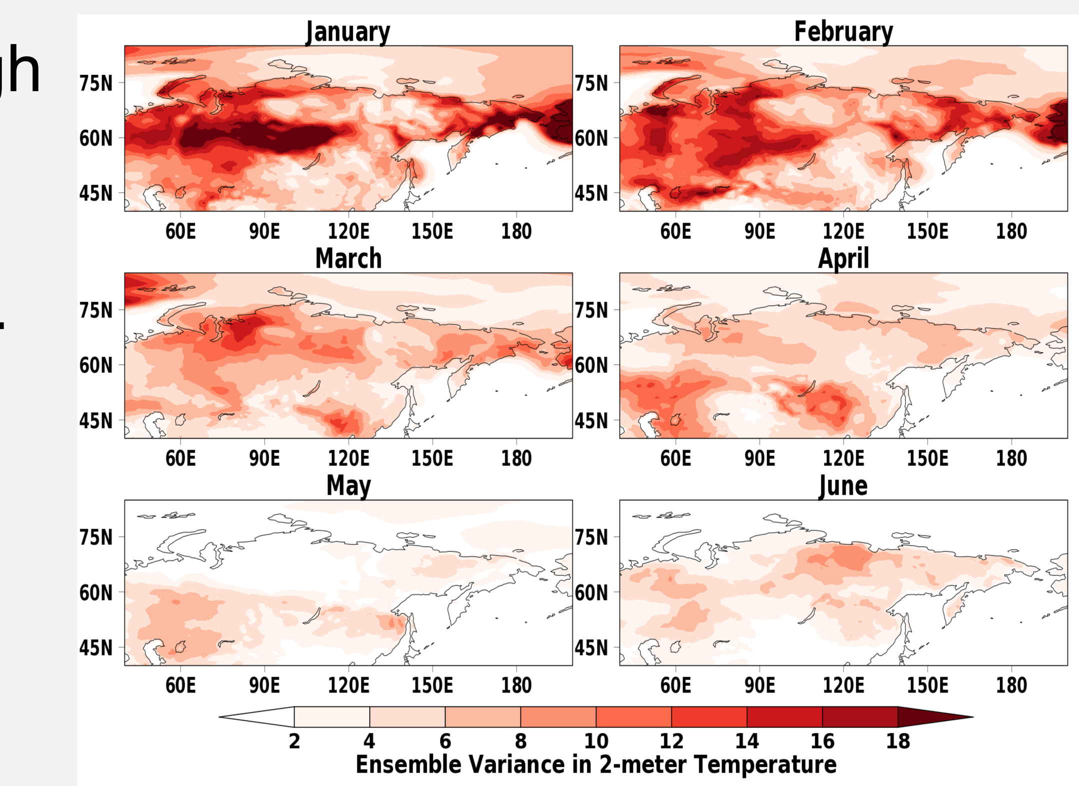

Fig. 6. Variance among the 16-member ensemble for 2-meter temperature.

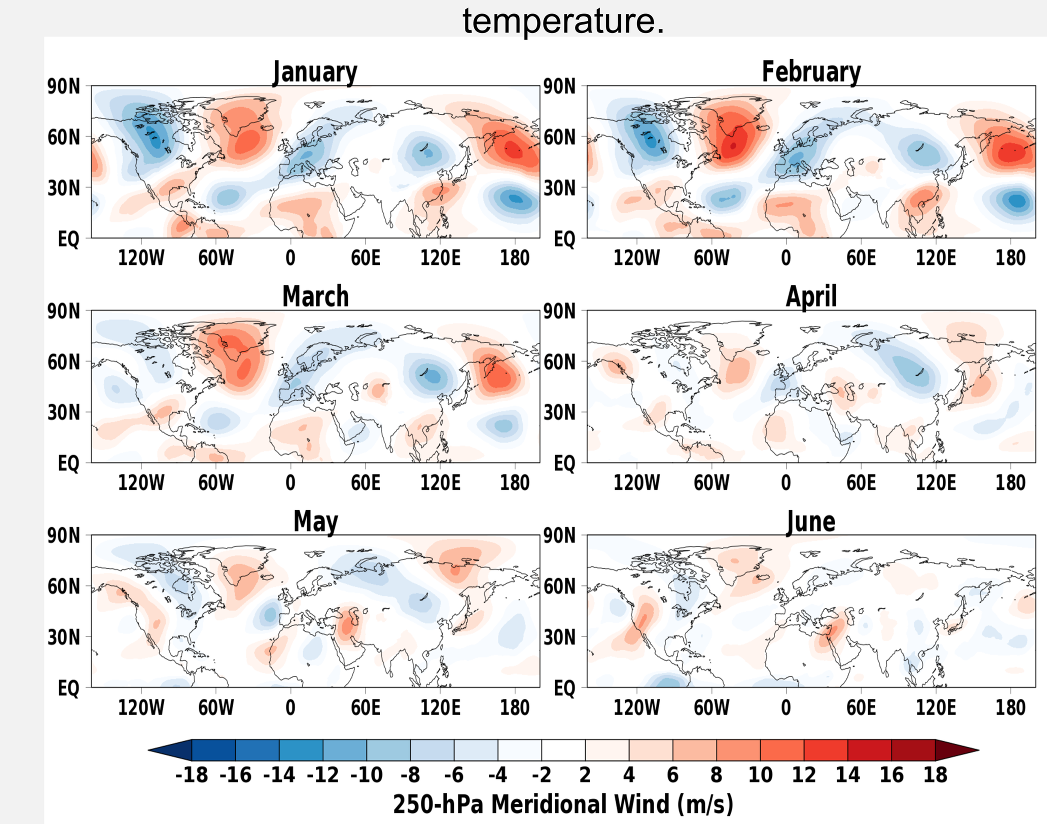

Fig. 7. Monthly 250-hPa meridional wind from the 16-member ensemble mean control run.

Preliminary Conclusions

- Different mechanisms at play for individual heat events occurring during January-June 2020
- Processes driving the Rossby wave train in 2020 remain to be understood

Future Work

- Future work will involve additional AGCM idealized experiments to further understand the contributions of sea ice concentration, SSTs, soil moisture and/or internal variability

References

- Schubert, S., H. Wang, and M. Suarez, 2011: Warm Season Subseasonal Variability and Climate Extremes in the Northern Hemisphere: The Role of Stationary Rossby Waves. *J. Climate*, **24**, 4773–4792.
- Schubert, S. D., H. Wang, R. D. Koster, M. J. Suarez, and P. Y. Groisman, 2014: Northern Eurasian Heat Waves and Droughts. *J. Climate*, **27**, 3169–3207

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