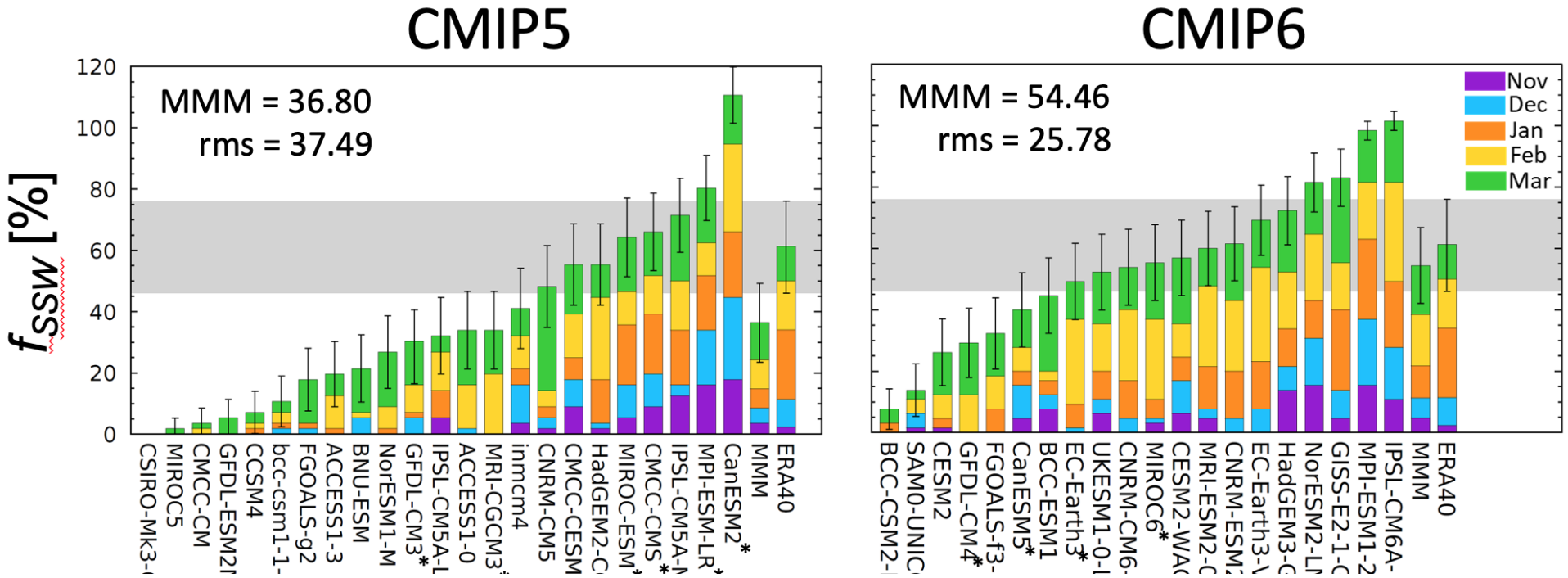
Variations in SSW Frequency in CMIP5 and CMIP6

Zheng Wu[1,2] & Thomas Reichler[1]

(1) U. of Utah (2) ETH Zurich



Motivation: large variations in SSW frequency amongst models

Question: can we identify common underlying causes?

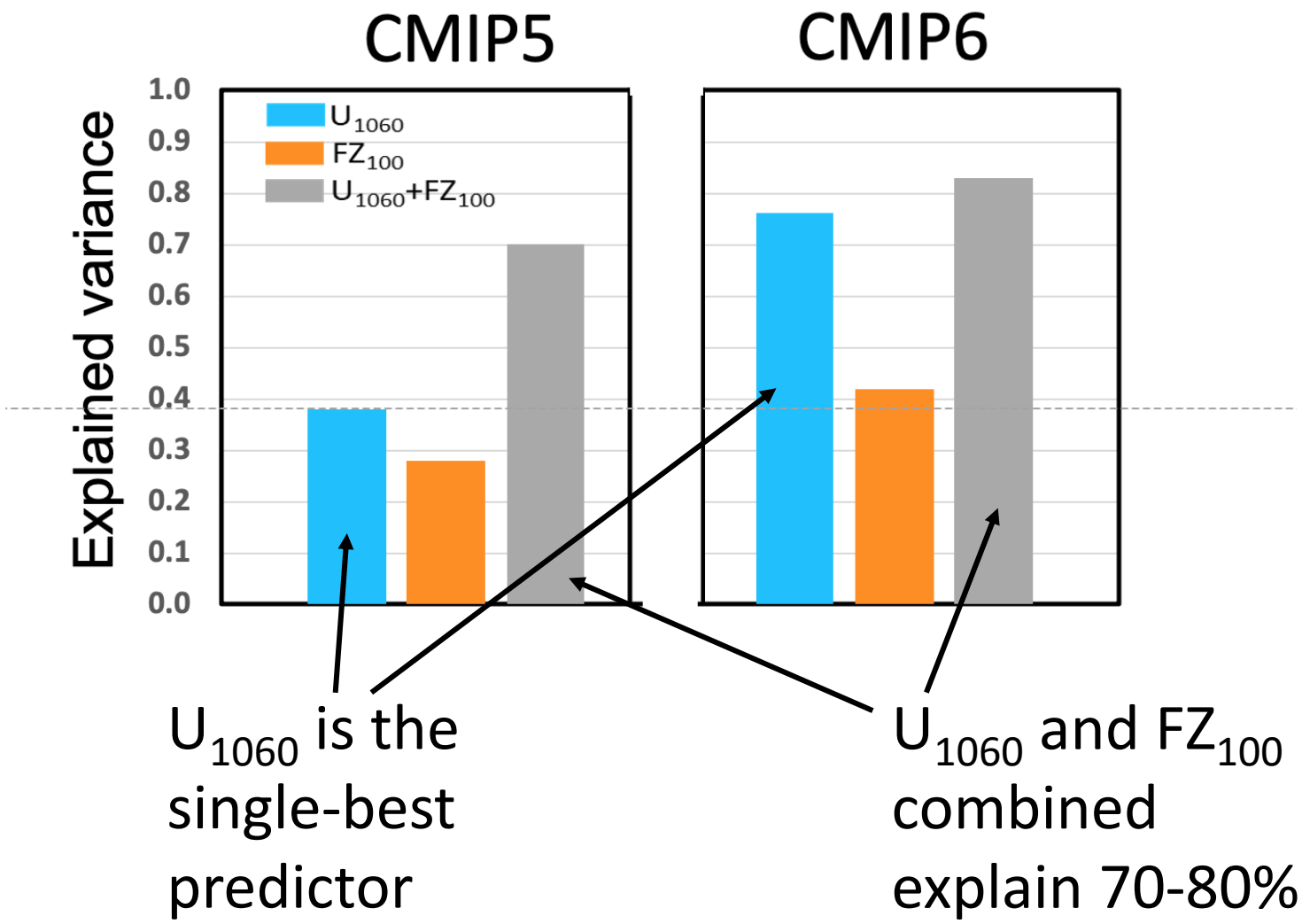
Methodology

- Linear regression to explain variations in SSW frequency
- Aspects of zonal mean climate as predictors:

    1. zonal wind at 10 hPa and 60°N (U_{1060})
    2. upward EP-flux at 100 hPa (FZ_{100})
    3. temperature at extratropical tropopause

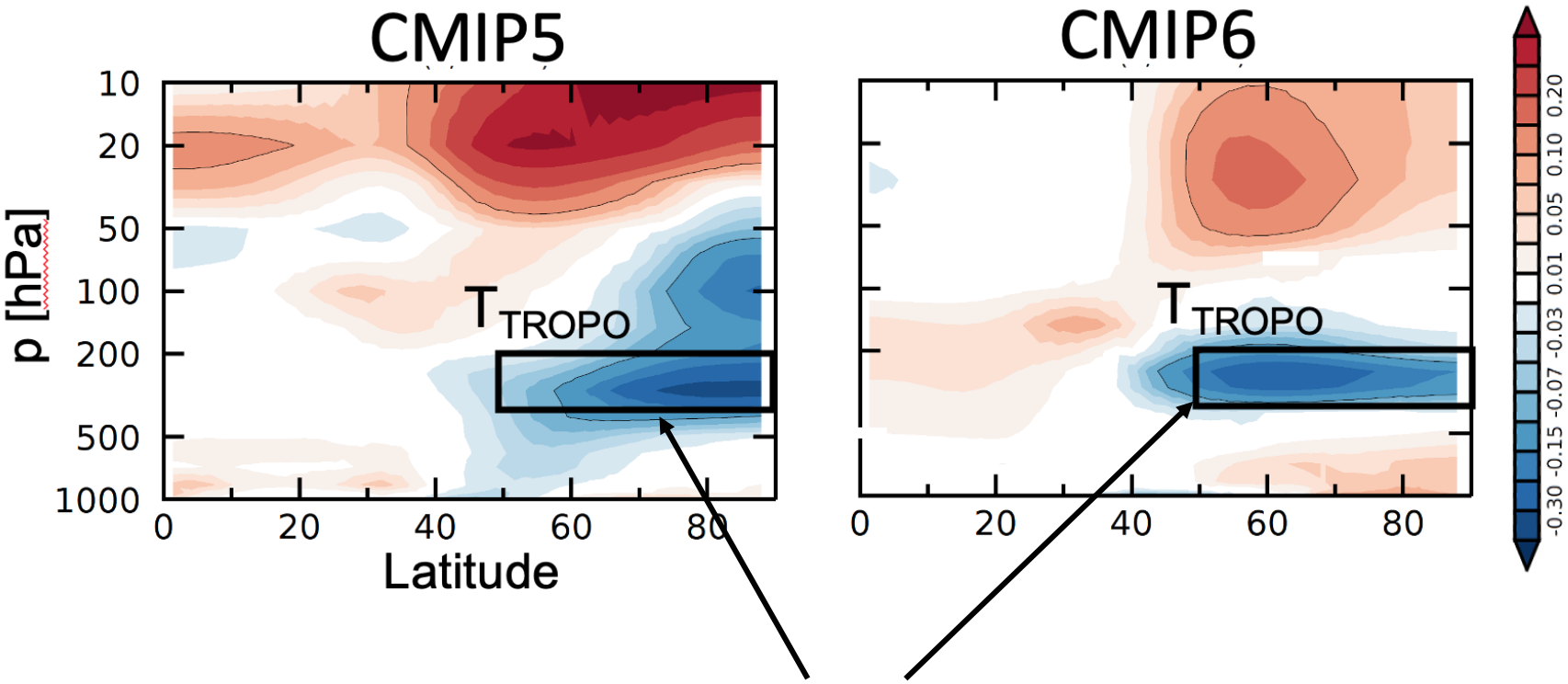
- Role of vertical resolution is also investigated

Explained SSW Variance from U_{1060} and FZ_{100}



Explained SSW Variance from Temperature on Top of U_{1060}

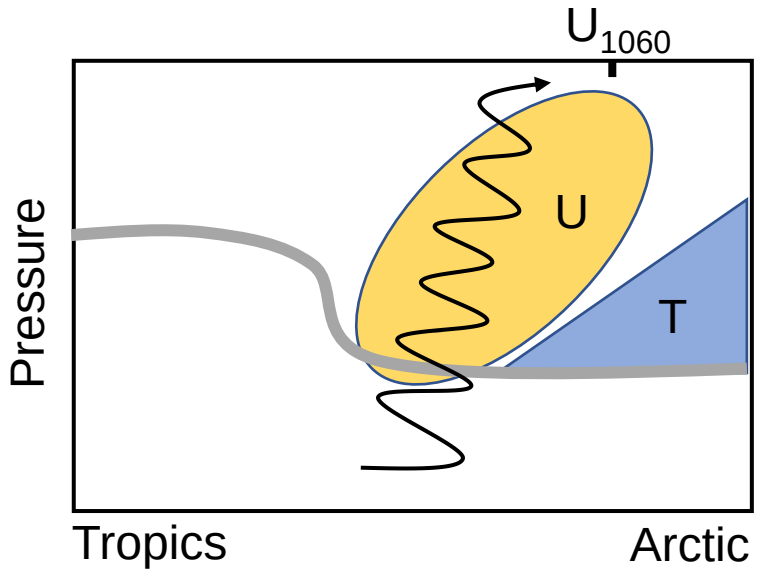
Shading shows how zonal mean temperatures are related to SSW frequency



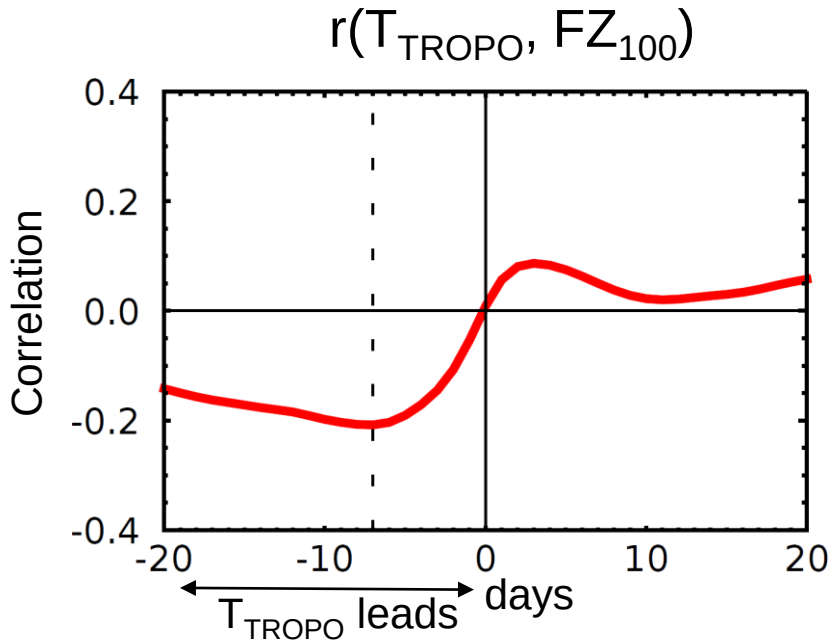
Temperatures at the extratropical tropopause are important!
Cooler temperatures lead to more SSWs.

Role of Extratropical Tropopause Temperatures

- Tropopause temperatures control the upward wave flux through U and the index of refraction:



- Verification with reanalysis



- Lagged correlation using daily ERA-40 suggests that T_{TROPO} tends to lead FZ_{100}

Take-home Messages

- Large variations in SSW frequency in both CMIP5 and CMIP6
- SSW frequency largely determined from polar vortex strength and upward wave activity flux
- Extratropical tropopause temperatures influence wave activity entering the stratosphere from below through the index of refraction
- Tropopause temperature biases are related to coarse vertical model resolution (not shown)

- Questions: zheng.wu@env.ethz.ch

- Work has been submitted to J. Clim.