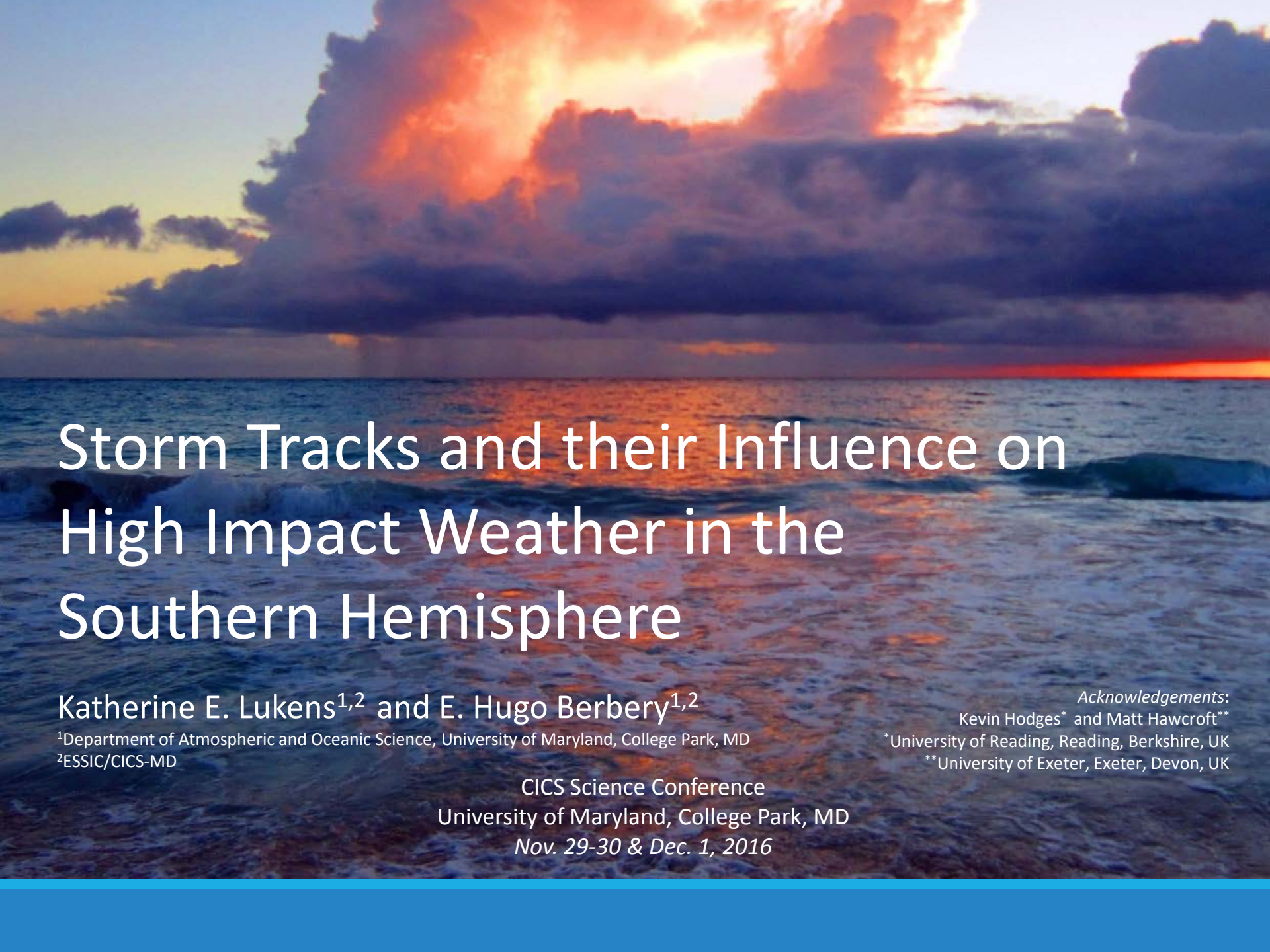




Storm Tracks and their Influence on High Impact Weather in the Southern Hemisphere

Katherine E. Lukens^{1,2} and E. Hugo Berbery^{1,2}

¹Department of Atmospheric and Oceanic Science, University of Maryland, College Park, MD

²ESSIC/CICS-MD

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Kevin Hodges* and Matt Hawcroft**

*University of Reading, Reading, Berkshire, UK

**University of Exeter, Exeter, Devon, UK

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Outline

Background

Objectives and Goal

Dynamics of Storm Tracks

Effects on High Impact Weather

Reanalysis vs. Observations

Background

- **Storm Tracks (STs) are narrow bands of baroclinic instability** along which storms tend to propagate. They exist near regions of large cyclonic shear poleward of the upper tropospheric jet stream that promote the growth and intensification of unstable baroclinic waves and cyclones.
- The jet stream along with other **forcings** like SSTs, land-sea temperature contrasts, and orography **influence the strength and distribution of STs**.
- The **STs in the Southern Hemisphere (SH)** lie coincident with the subtropical and subpolar jets and are maintained year-round in part by the large zonal symmetry resulting from the expansive oceans and overall lack of landmass.

Objectives

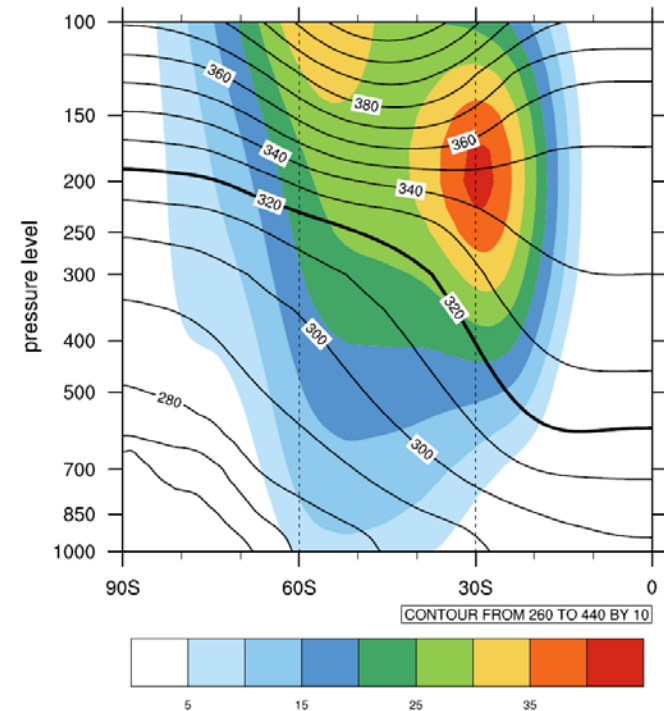
1. To understand the dynamic factors behind the evolution of severe storms in the **Southern Hemisphere winter (JJA)**.
2. To examine how severe storms influence **low-level wind and precipitation** distributions, especially near populous areas.
3. To examine how well the **ingested CFSR represents observed** storm precipitation.

Goal

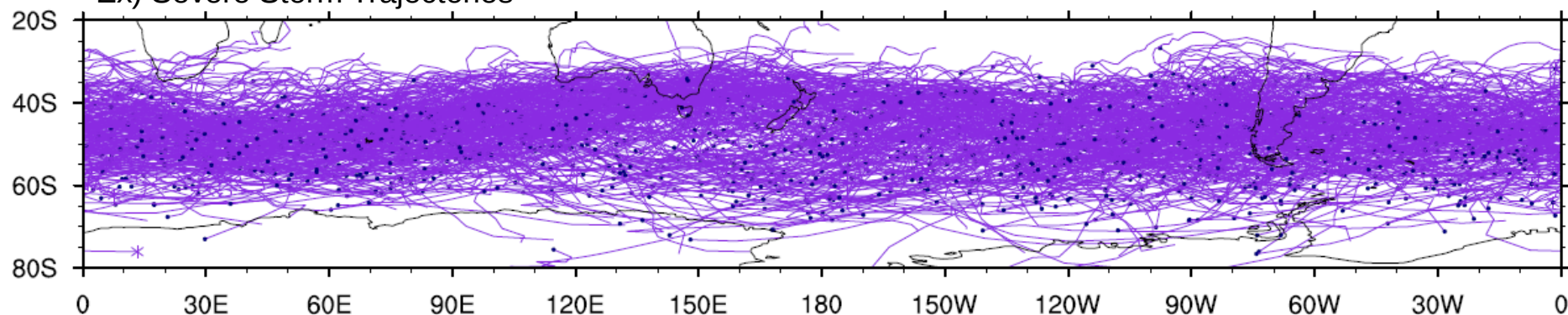
-To provide **guidance in seasonal forecasting** of severe storms and high impact weather in the Southern Hemisphere.

Methodology

- A cyclone-tracking approach is used to identify **isentropic potential vorticity (IPV) minima on the $\theta=320\text{K}$ surface** from CFSR as individual storms and follow their evolutions.
- To be considered a storm, each cyclone must:
 - Have a min intensity less than -0.5 PVU ($1 \text{ PVU} = 10^{-6} \text{ K m}^2 \text{ kg}^{-1} \text{ s}^{-1}$).
 - Last at least 2 days.
 - Travel farther than 1000 km.

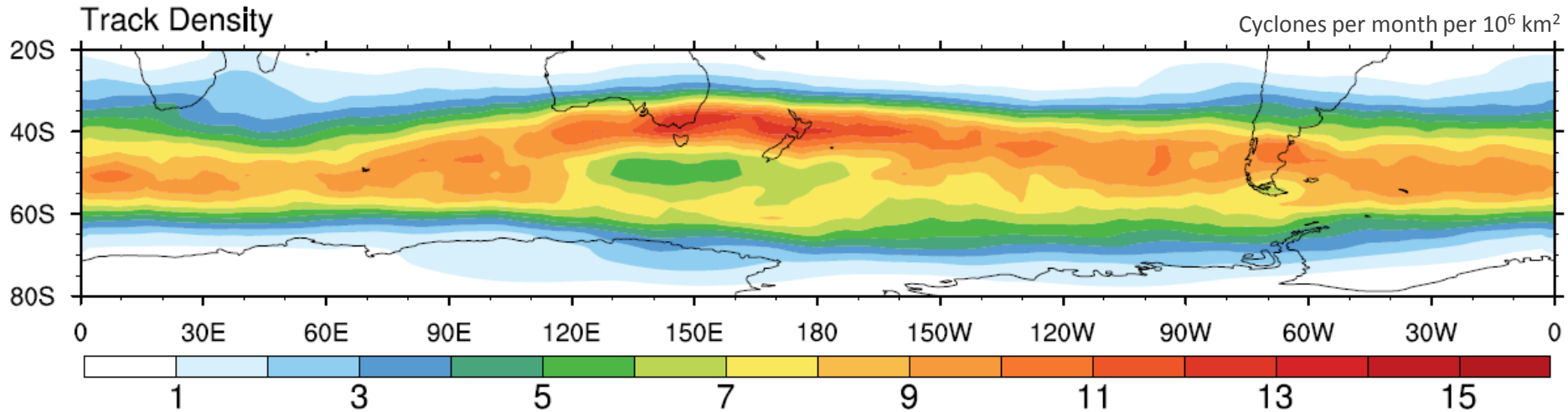


Ex) Severe Storm Trajectories



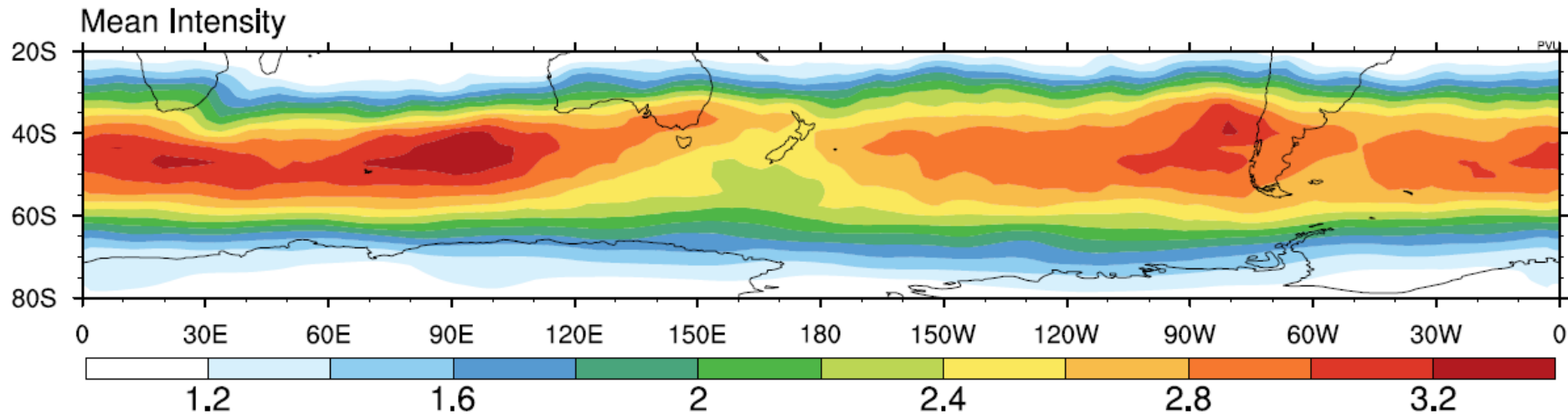
SH Storm Tracks

- The mid-latitude storm track spans all longitudes with a secondary track south of Australia toward the Ross Sea.



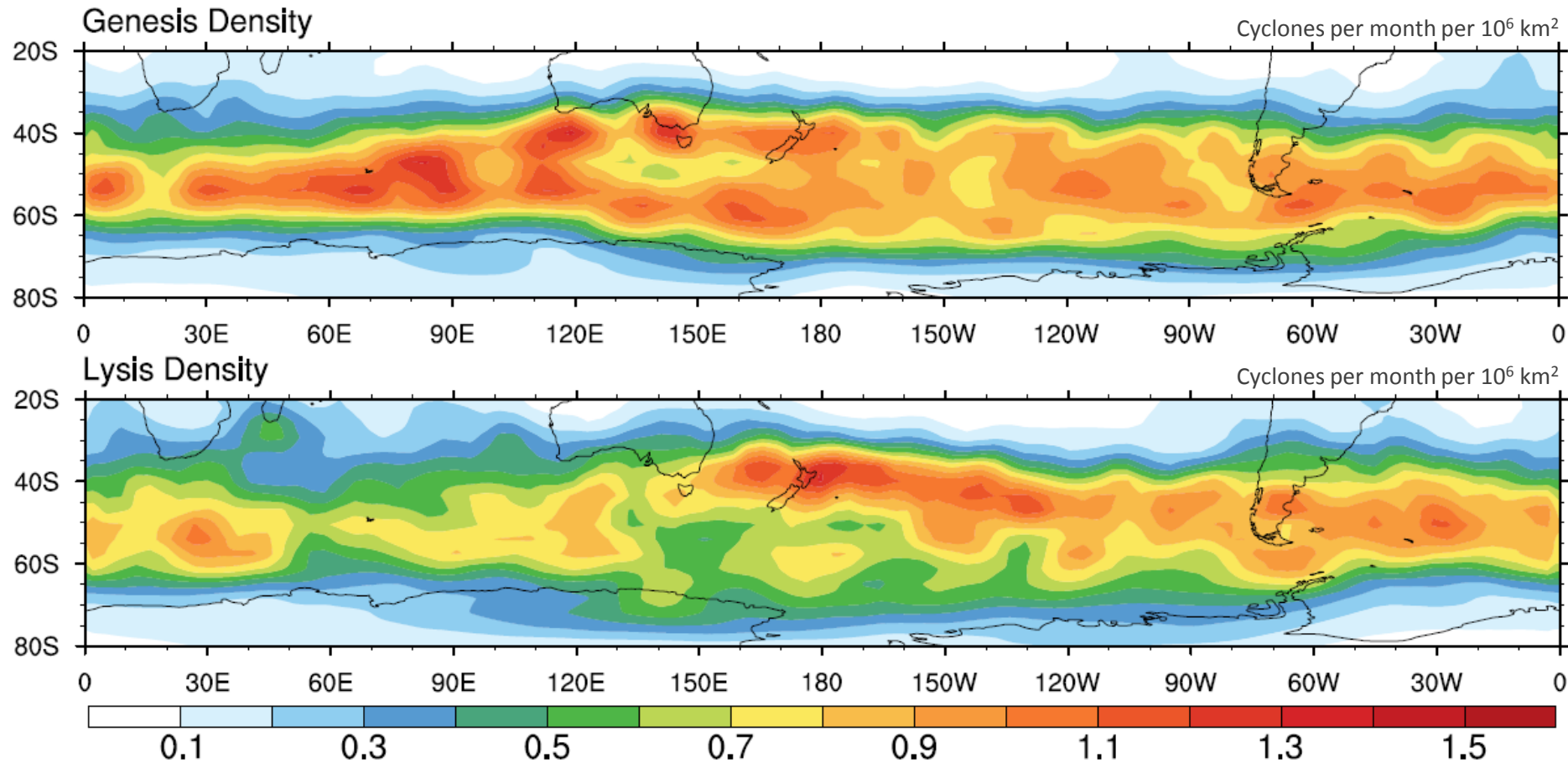
Mean ST Intensity

- STs are strongest over the oceans and upwind of high orography.



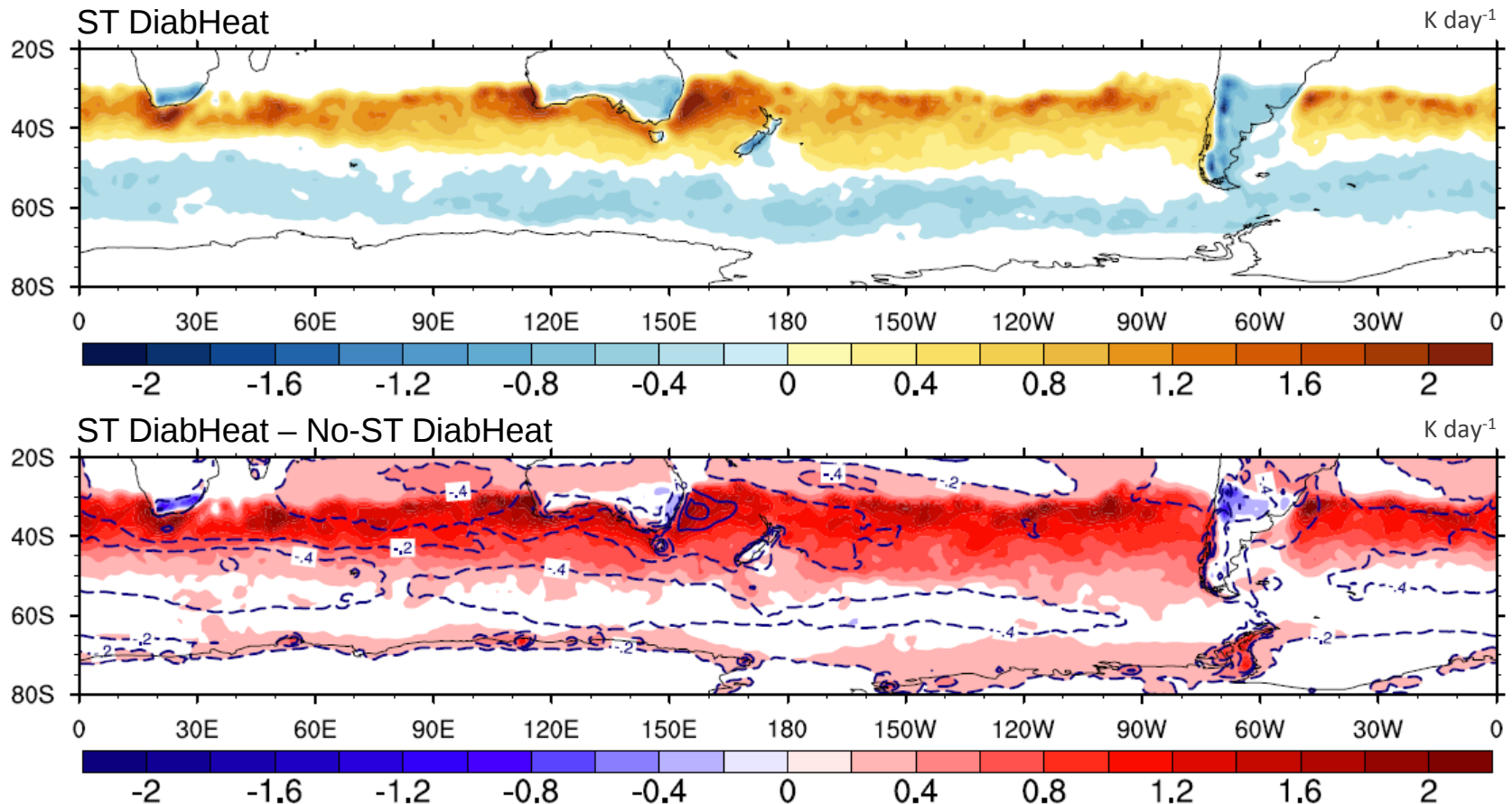
Cyclogenesis & Cyclolysis

- Cyclogenesis and cyclolysis regions are revealed.



Diabatic Heating & Severe STs

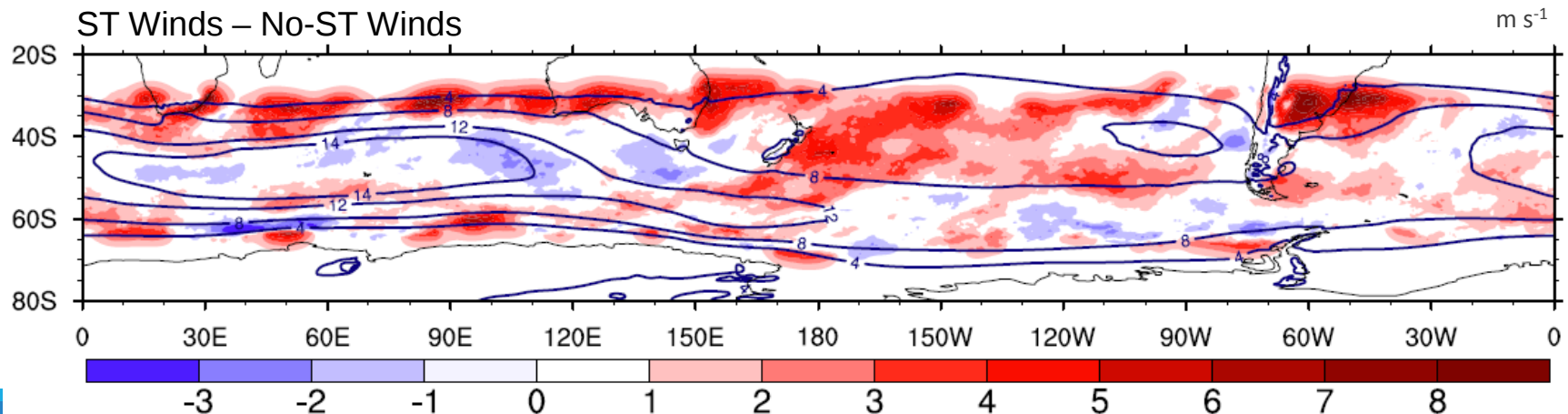
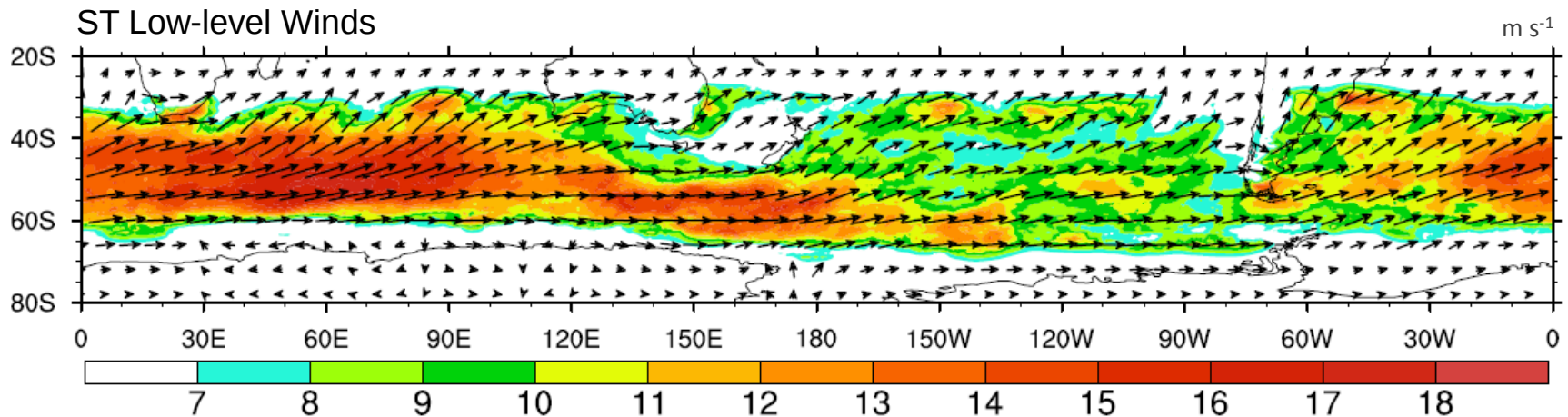
- **Severe storms make up 14%** of all winter cyclones.
- **Net diabatic heating increases** in the storm track regions when severe storms are present.
- **Deep convection dominates** over the oceans where the severe STs are most intense.



High Impact Weather

850hPa Winds

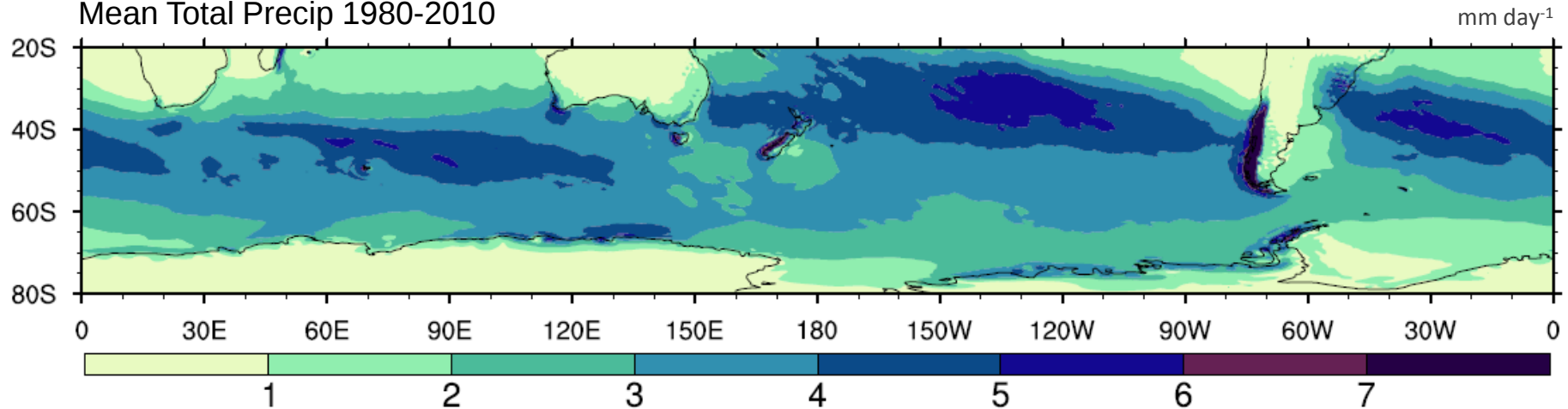
- Severe storms
 - Shift the winds northeastward.
 - Increase low-level wind speeds (a) where deep convection dominates, and (b) leeward of high orography.



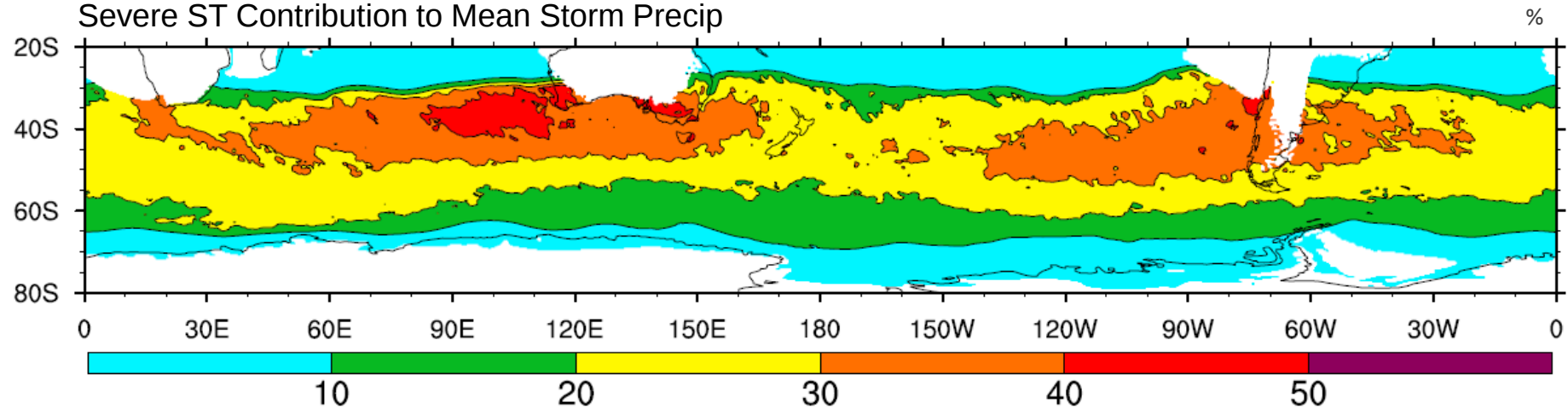
High Impact Weather Precipitation

- Severe STs provide about 40% of the precip contributed by all storms.

Mean Total Precip 1980-2010



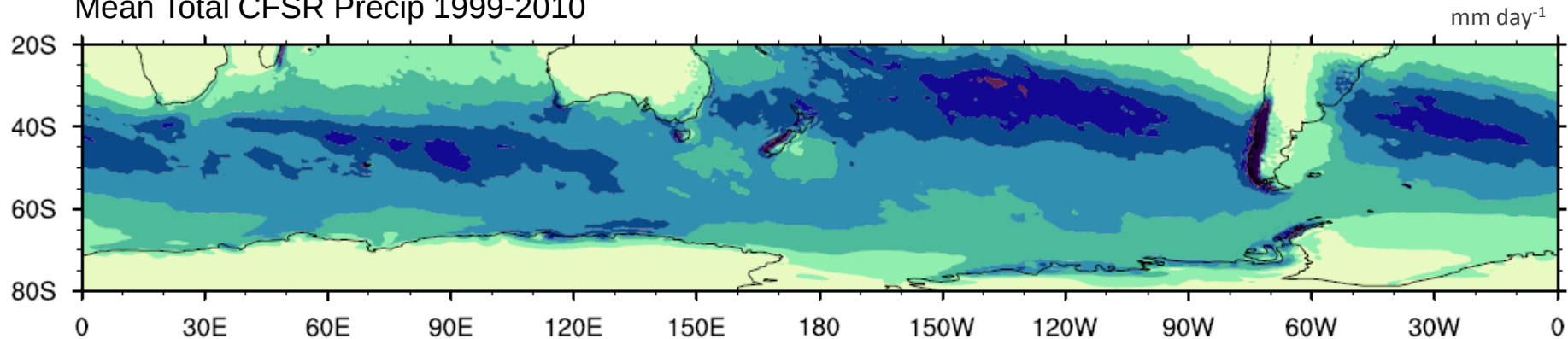
Severe ST Contribution to Mean Storm Precip



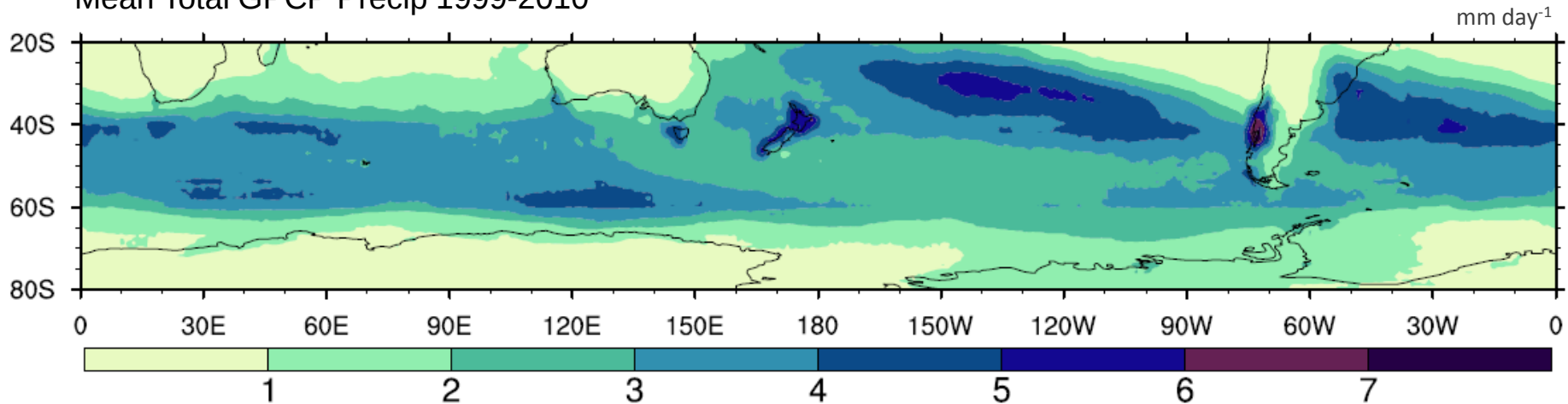
Reanalysis vs. Observations

- The precip structure is consistent between the reanalysis and observations (GPCP, taken as “ground truth”).

Mean Total CFSR Precip 1999-2010



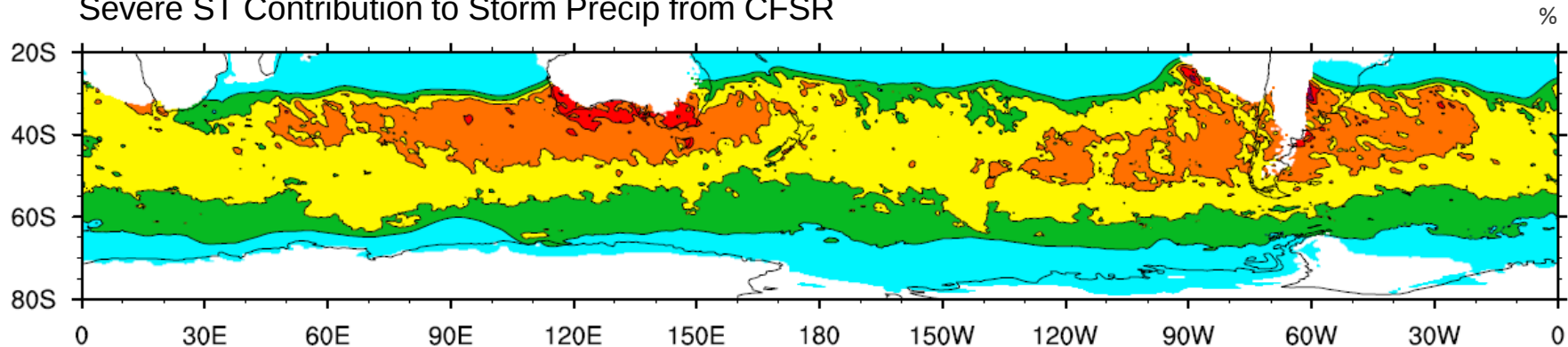
Mean Total GPCP Precip 1999-2010



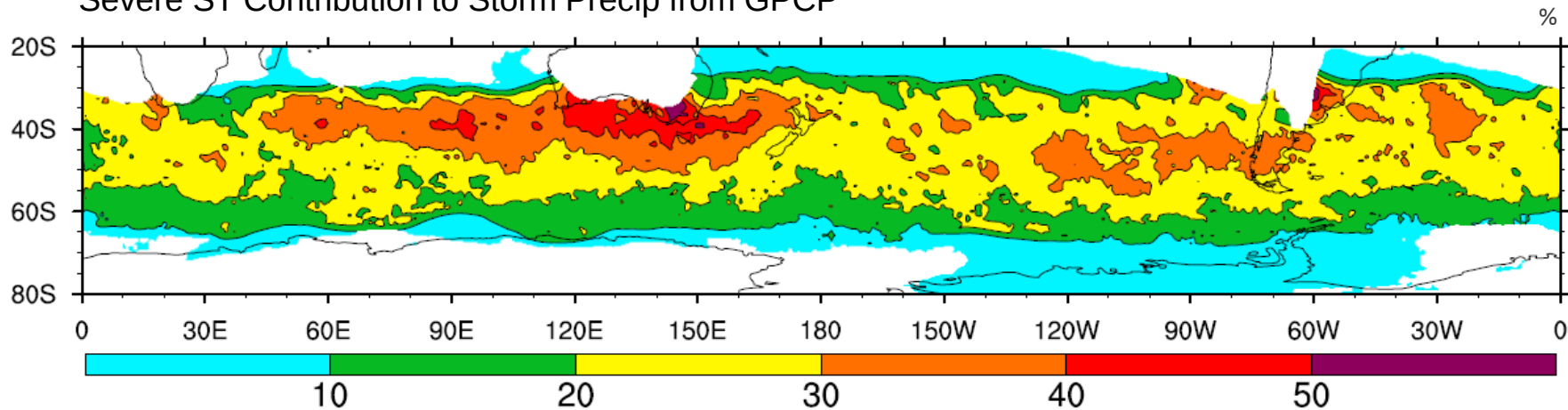
Reanalysis vs. Observations

- Severe STs provide comparable fractions of total precip using both datasets.

Severe ST Contribution to Storm Precip from CFSR



Severe ST Contribution to Storm Precip from GPCP



Conclusions

1. The mid-latitude and subpolar STs on the 320K isentrope are consistent with past studies.
2. STs are most intense over the oceans and upwind of high orography.
3. Severe storms intensify the low-level winds (a) where deep convection dominates and (b) leeward of high orography, particularly east of the Andes Mountains.
4. Severe storms provide almost half of the precip contributed by all storms.
5. Reanalysis precip associated with storms is consistent with observations.

A photograph of a sunset over the ocean. The sun is low on the horizon, partially obscured by large, dark, and dramatic clouds. The sky is a mix of deep blue and orange. The ocean is dark blue with white-capped waves. The sun's reflection is visible on the water's surface. A solid blue horizontal bar is at the bottom of the image.

Thank you!

Questions?

Email: klukens@umd.edu

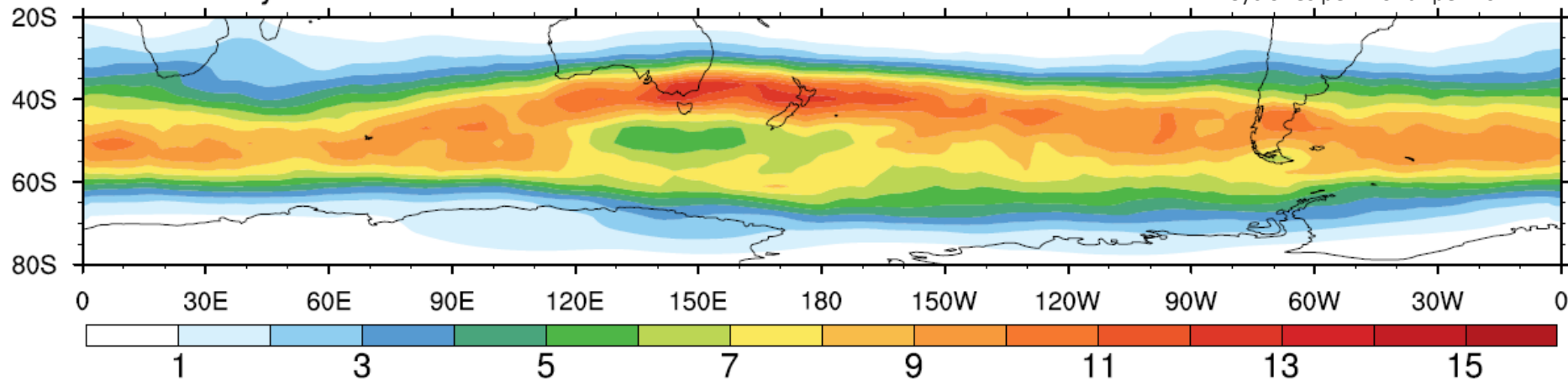
Supplemental

STs and Mean Zonal Wind

1980-2010

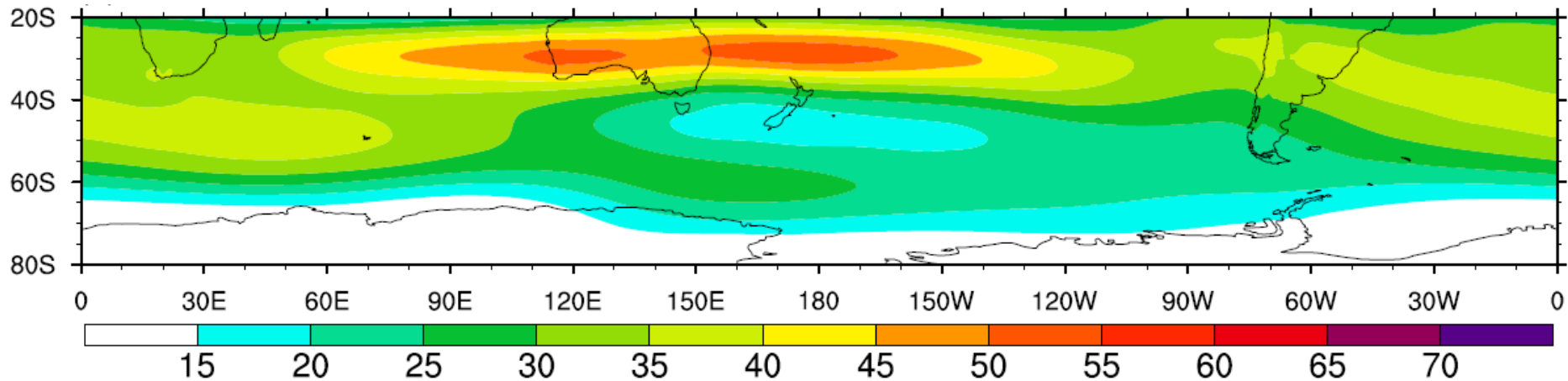
Track Density

Cyclones per month per 10^6 km 2



Mean Zonal Wind at 200mb

m s $^{-1}$

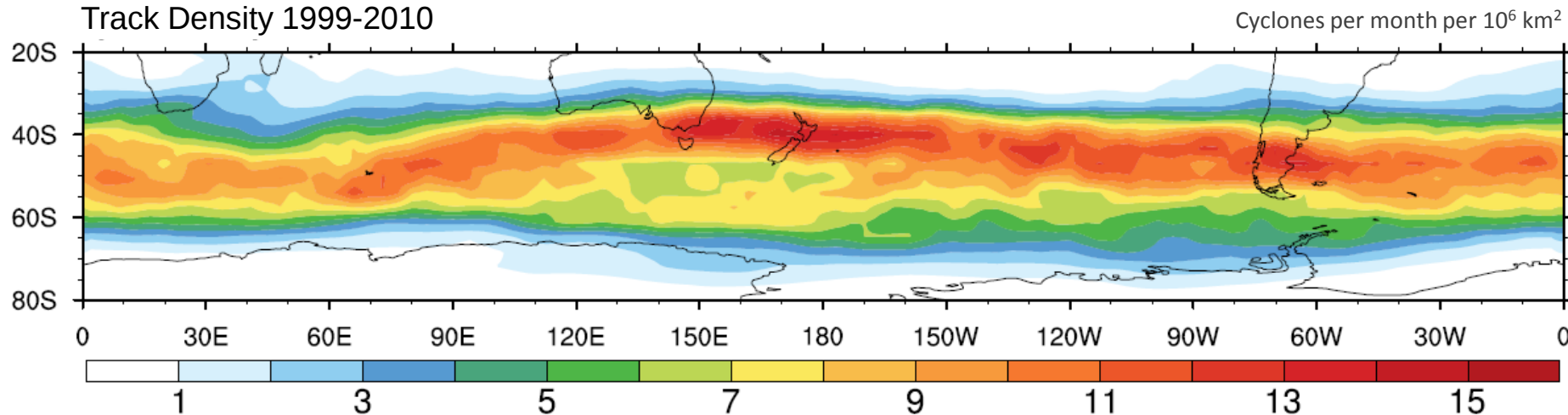




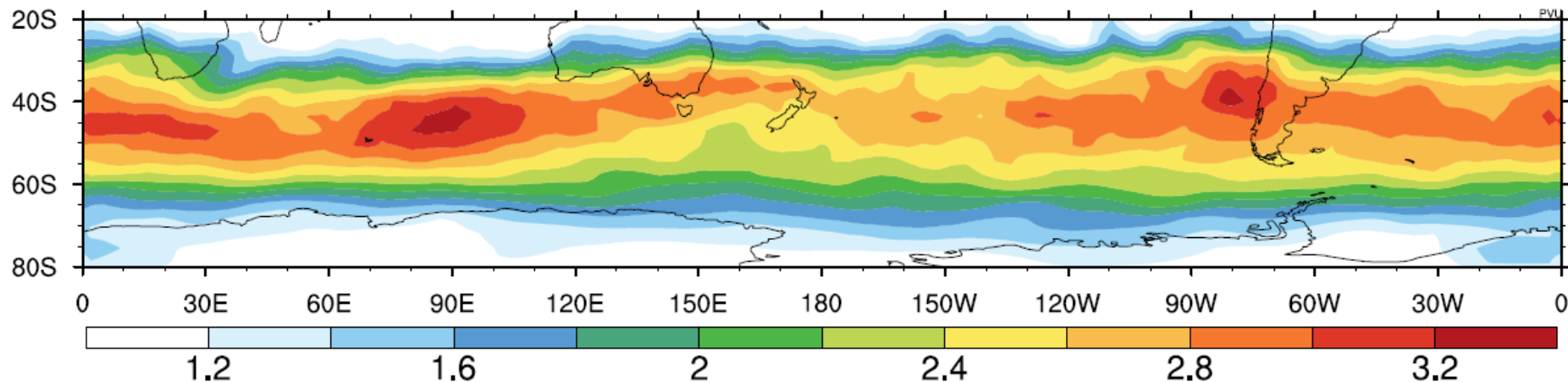
Supplemental

Properties of STs for 1999-2010

Track Density 1999-2010



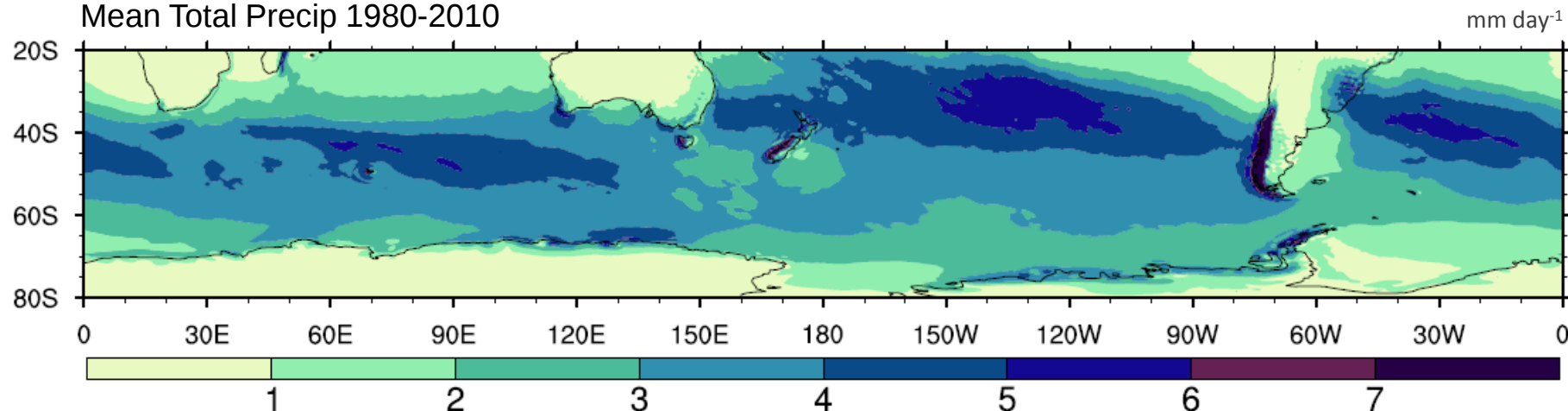
Mean ST Intensity 1999-2010



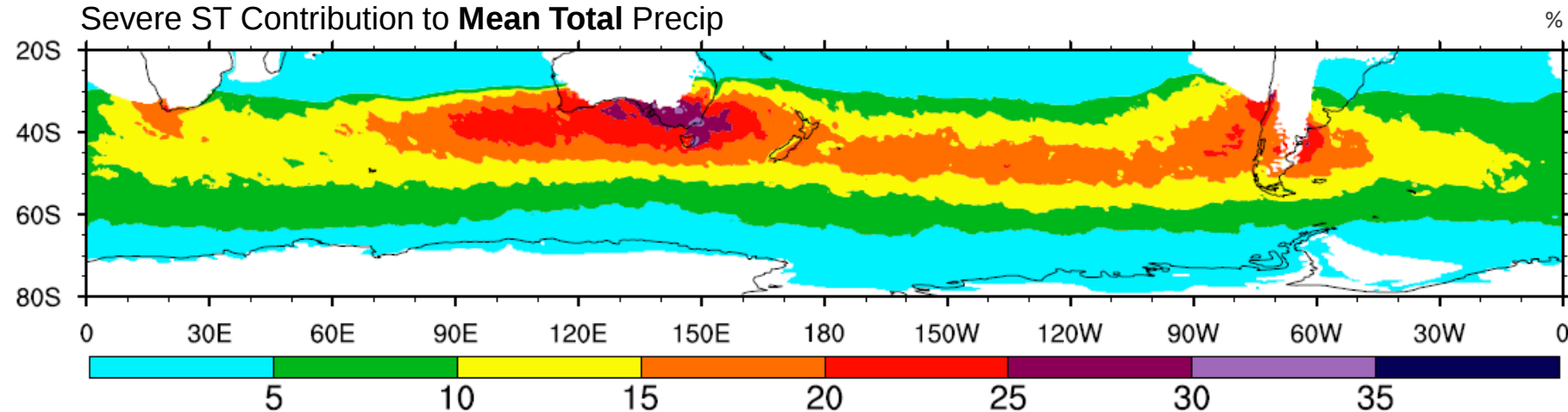
High Impact Weather Precipitation

- Severe STs provide about over 15% of the total mean precip.

Mean Total Precip 1980-2010



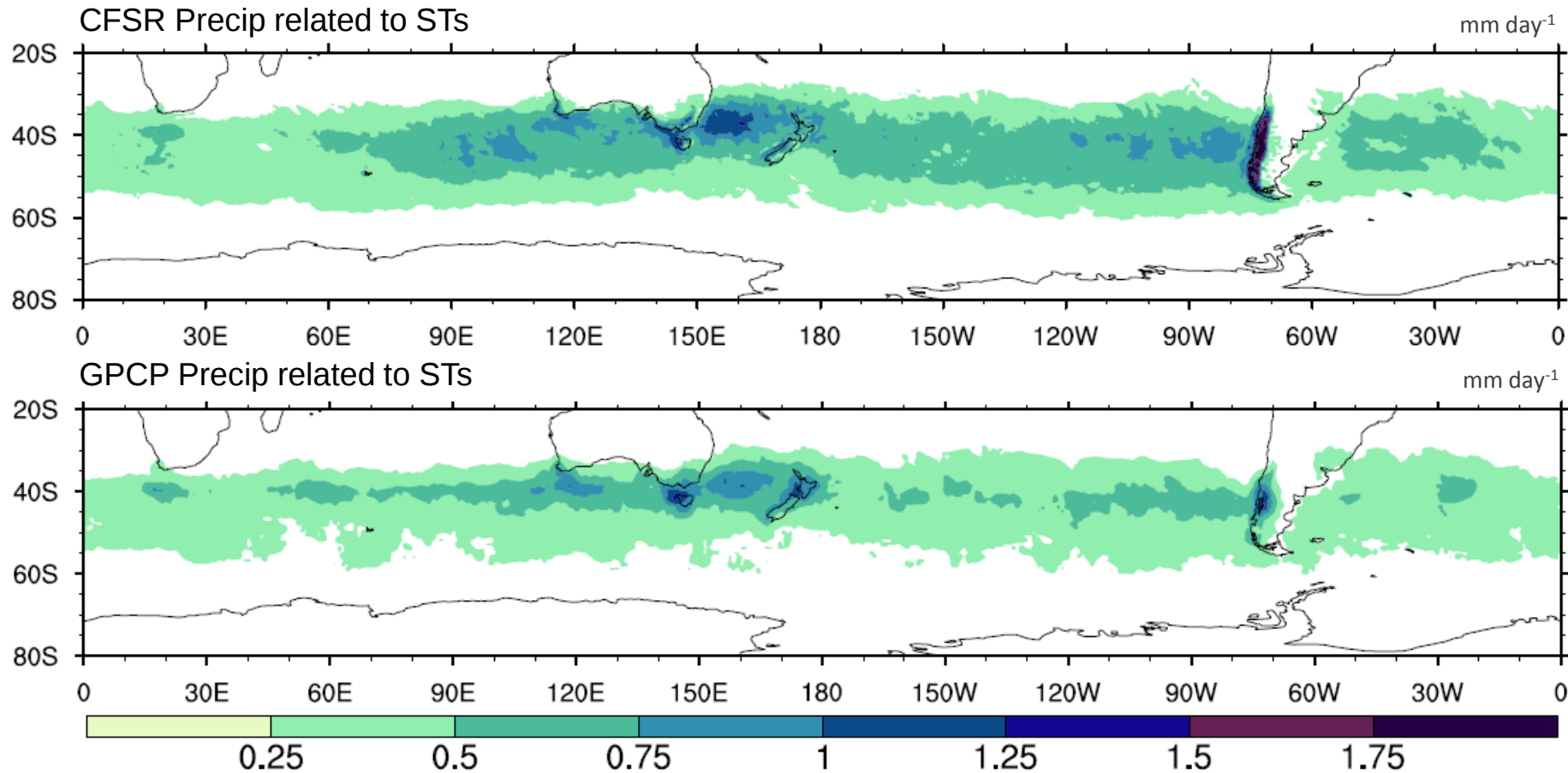
Severe ST Contribution to **Mean Total** Precip



Supplemental

Reanalysis vs. Observations

- Severe STs provide more reanalysis precipitation than is observed, particularly along the southwestern coast of South American.



Reanalysis vs. Observations

- Severe STs provide comparable fractions of total precip using both datasets.

