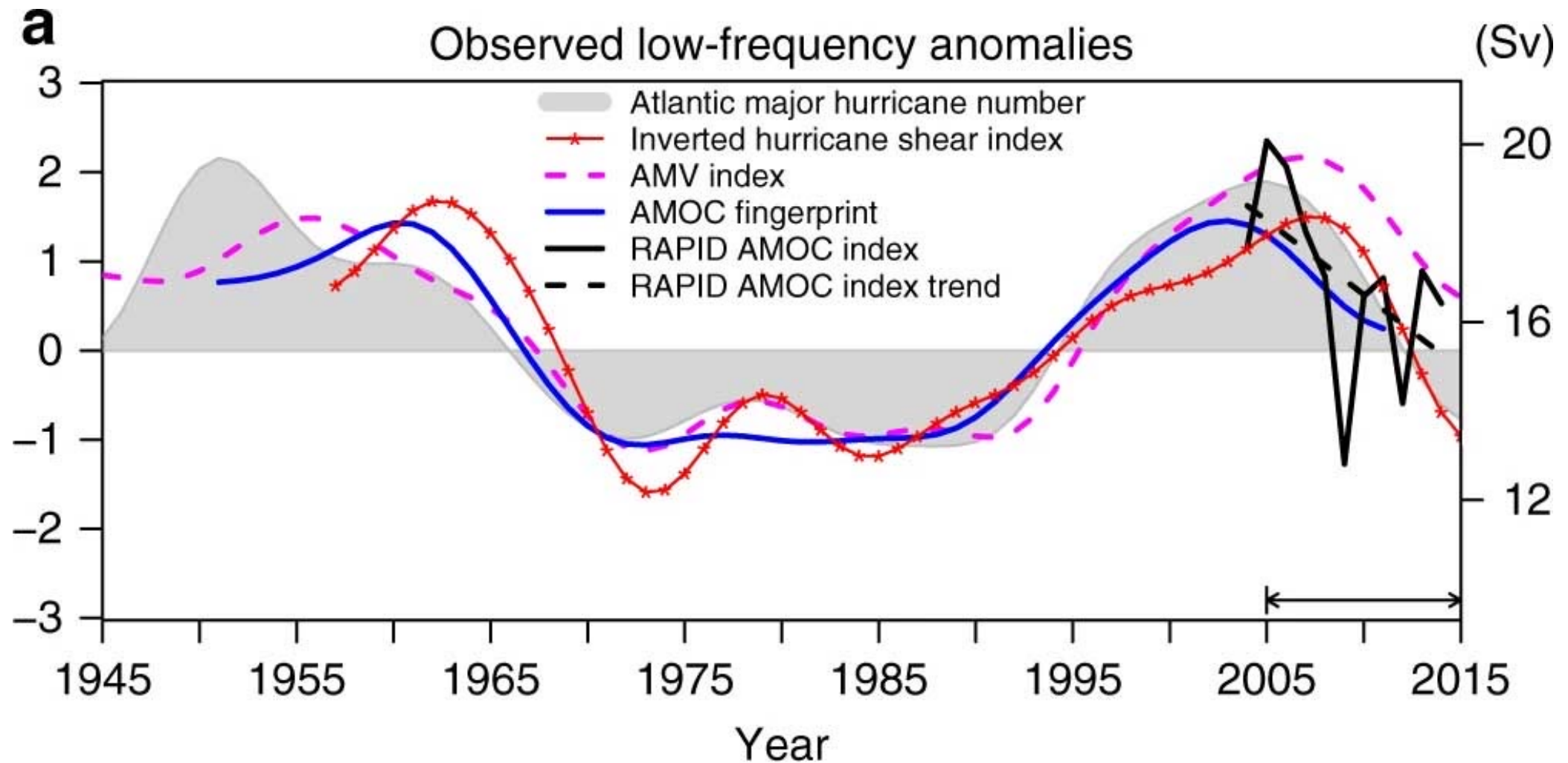


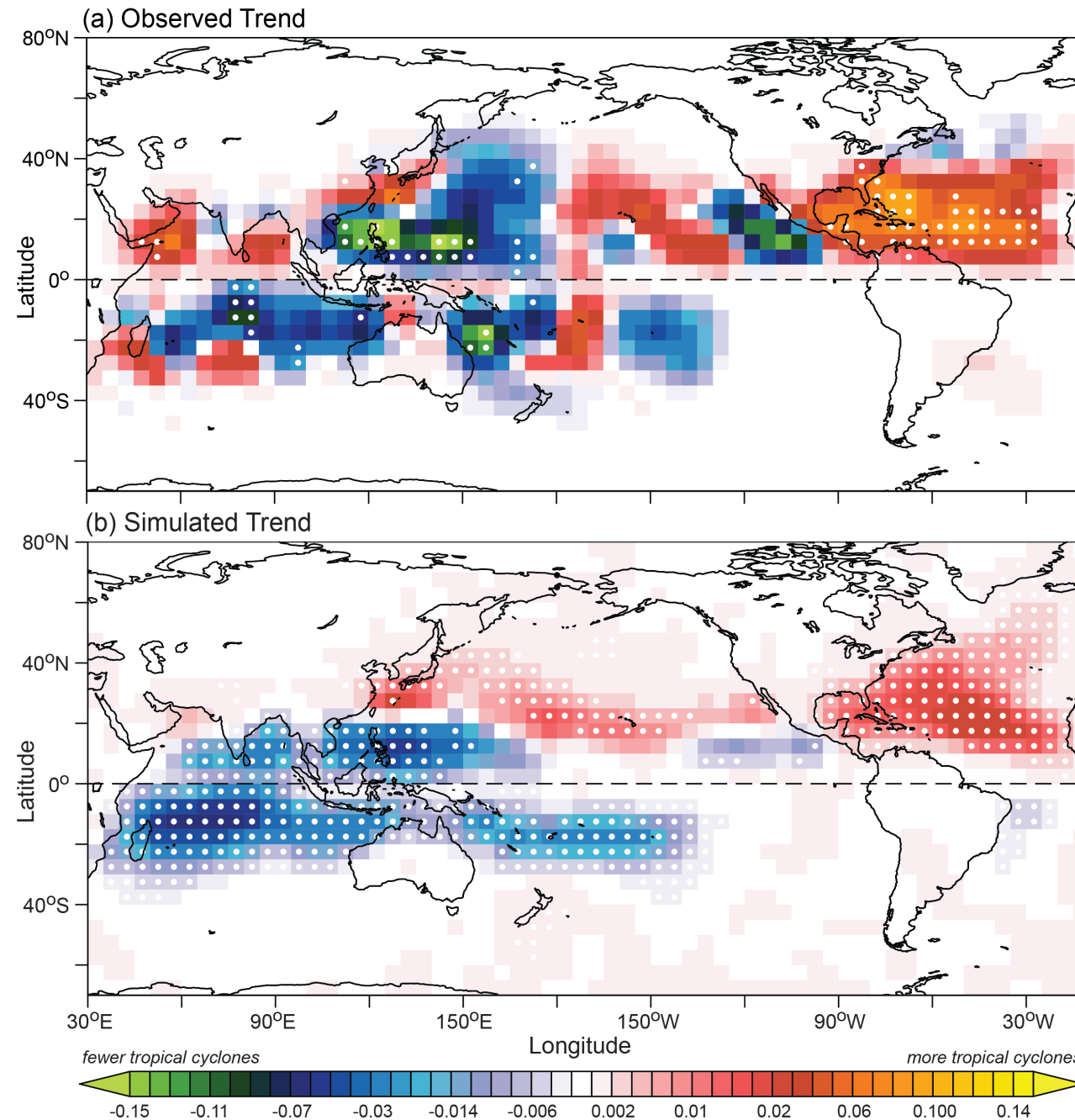
Knutson, Tom.  
 "Global Warming and  
 Hurricanes." *Geophysical Fluid Dynamics  
 Laboratory*,  
[www.gfdl.noaa.gov/global-warming-and-hurricanes/](http://www.gfdl.noaa.gov/global-warming-and-hurricanes/).

This graph shows the number of hurricanes that formed in the North Atlantic Ocean each year from 1878 to 2022, along with the number that made landfall in the United States. The orange curve shows how the total count in the green curve can be adjusted to attempt to account for the lack of aircraft and satellite observations in early years. All three curves have been smoothed using a five-year average, plotted at the middle year. The most recent average (2018–2022) is plotted at 2020. Data source: NOAA, 2023; Vecchi and Knutson, 2011

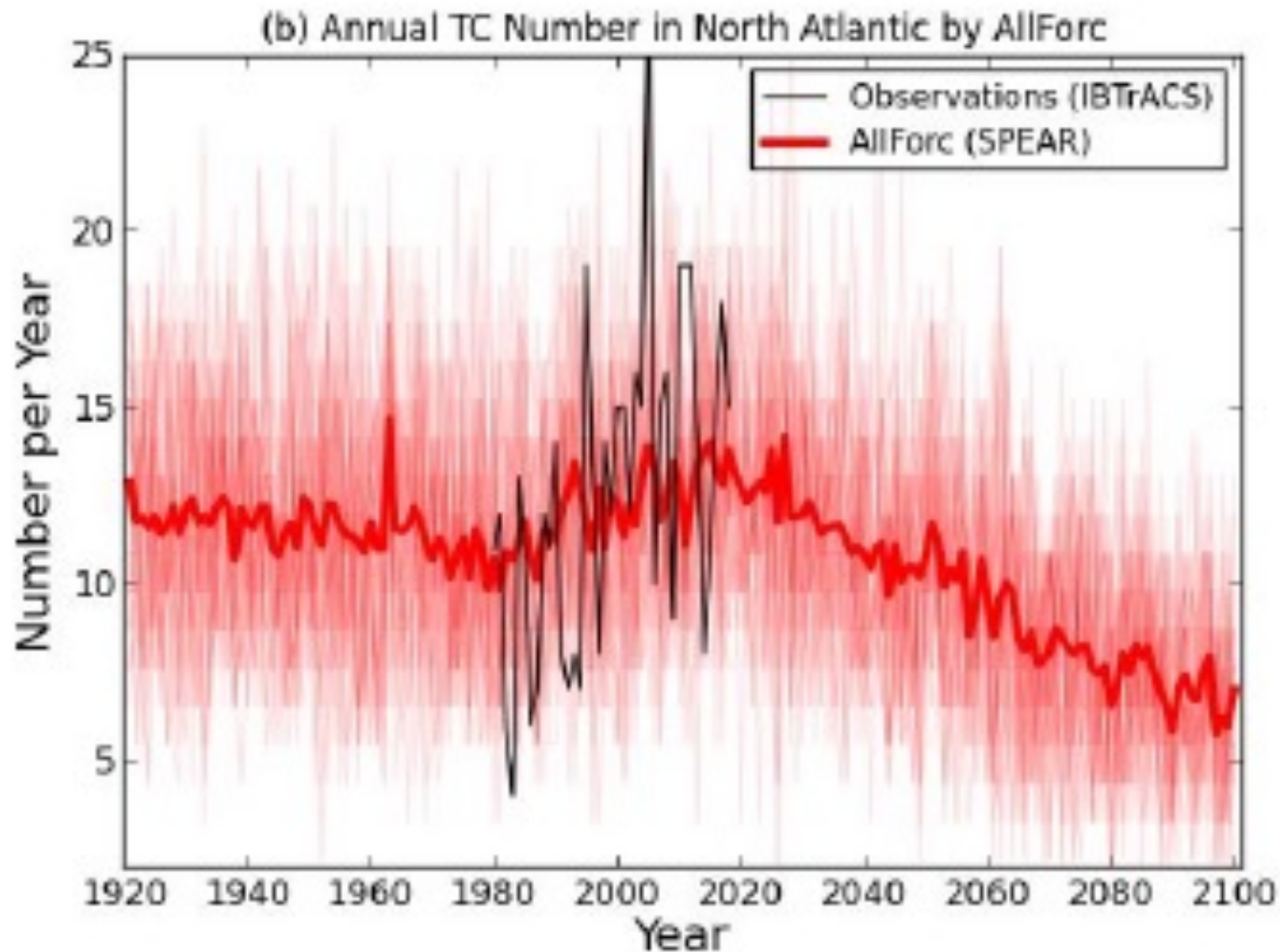


Indices of observed Atlantic low-frequency variability of major hurricanes, tropical wind shear, sea surface temperatures (AMV) and inferred Atlantic Meridional Overturning Circulation (AMOC). RAPID timeseries denote observed AMOC measurements. From [Yan et al. \(2017\)](#).

# Linear Trend in Frequency of Tropical Cyclones from 1980 to 2018



Comparison of observed (top) and modeled (bottom) linear trends of tropical cyclone occurrence (1980-2018). From [Murakami et al. \(2020\)](#).



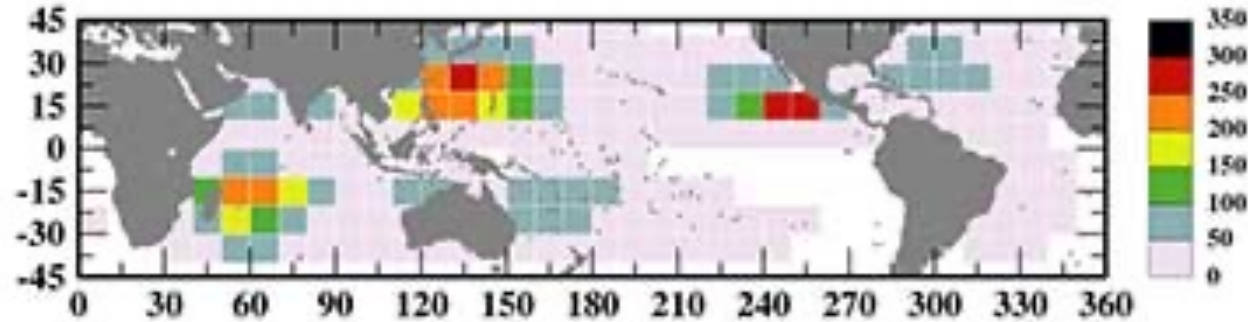
Murakami et al., Dunstone et al. and Wang et al. project, for the Atlantic, a decrease in tropical storm frequency over the coming century, as greenhouse gas influences dominate over projected aerosol influences.

Comparison of observed (black) and modeled (red) Atlantic tropical cyclone frequency. The model simulations were forced by historical estimates of greenhouse gases, anthropogenic aerosols, and volcanic aerosols. From [Murakami et al. \(2020\)](#).

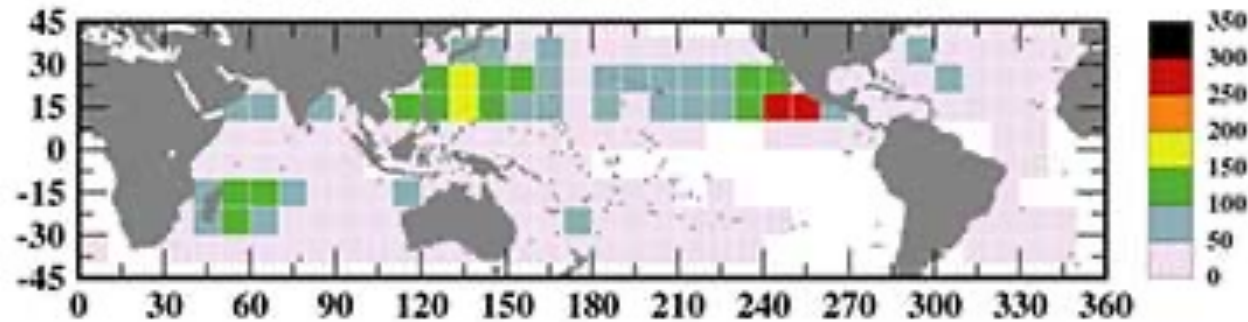


# Late 21st Century Projections for Tropical Storms

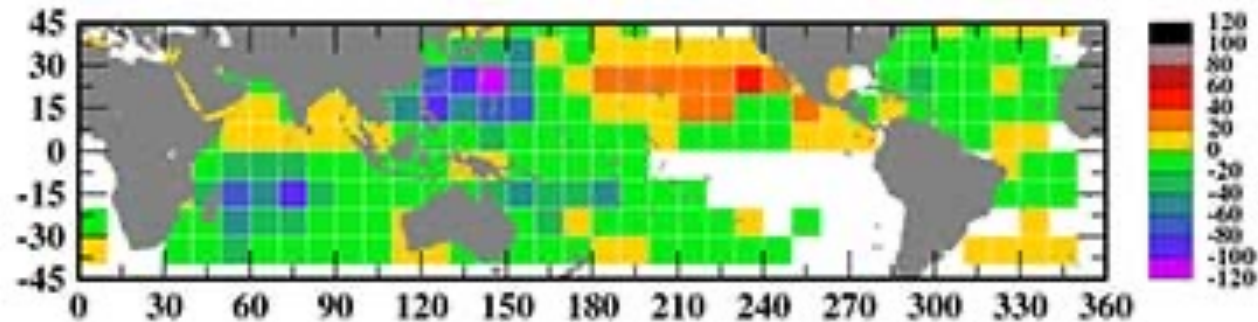
Present-Day Simulated Occurrence



Late 21st Century Simulated Occurrence



Difference: Late 21st Century minus Present-Day



Unit: Number of days per 20 years

Simulated present day (top), projected late 21st century (middle), and difference (bottom) in tropical storm frequency. From [Knutson et al. \(2015\)](#).

## NOAA Summary for Atlantic Hurricanes and Global Warming

Neither our model projections for the 21st century nor our analyses of trends in Atlantic hurricane and tropical storm activity support the notion that greenhouse gas-induced warming leads to large increases in either tropical storm or overall hurricane numbers in the Atlantic.

# Tropical Cyclone Projections (2°C Global Warming)

