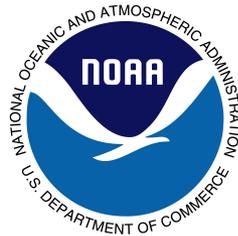


Past and Projected Poleward Migration of Typhoons

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Presentation based on

Kossin, J. P., K. A. Emanuel, and G. A. Vecchi, 2014: The poleward migration of the location of tropical cyclone maximum intensity. *Nature*, **509**, 349-352.

Kossin, J. P., K. A. Emanuel, and S. J. Camargo, 2015: Past and projected changes in western North Pacific tropical cyclone exposure. *In preparation*.



How do tropical cyclones respond to climate change?

IPCC AR5, Expectations based on theory and modeling (depend on patterns and mechanisms of forcing):

Intensity: small increases in mean intensity. Potential for large increases in the strongest storms as thermodynamic potential increases.

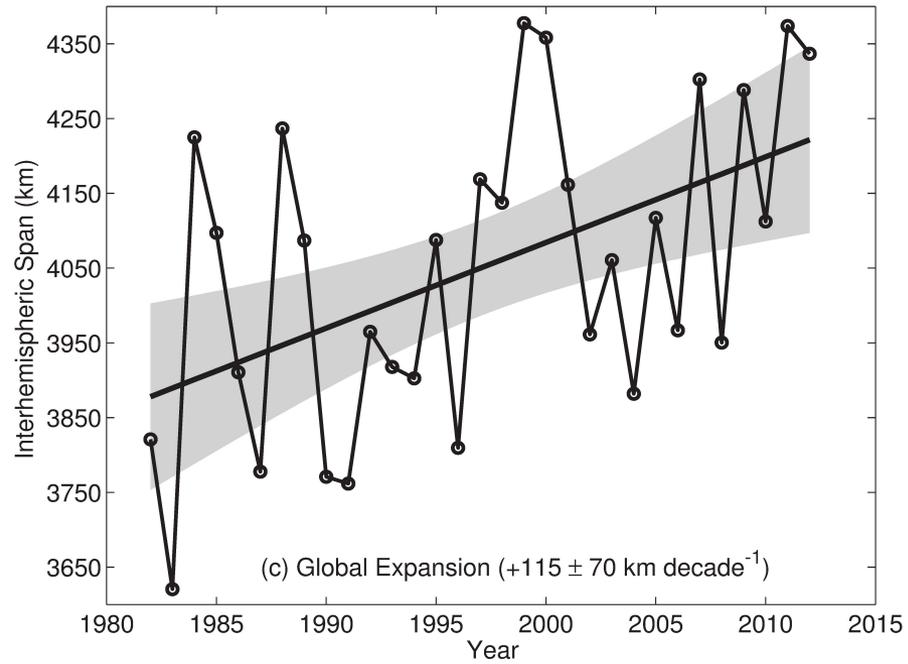
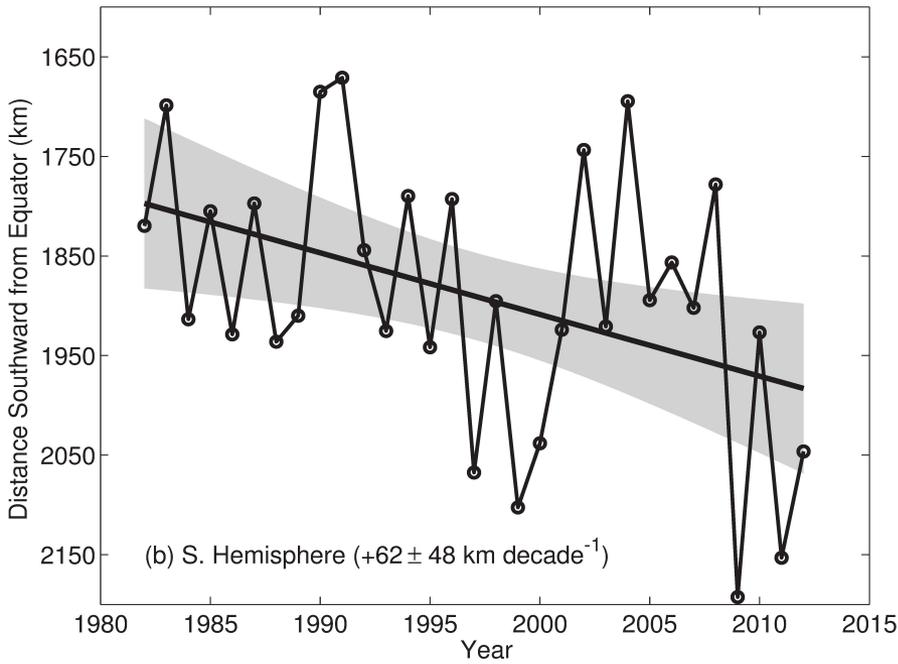
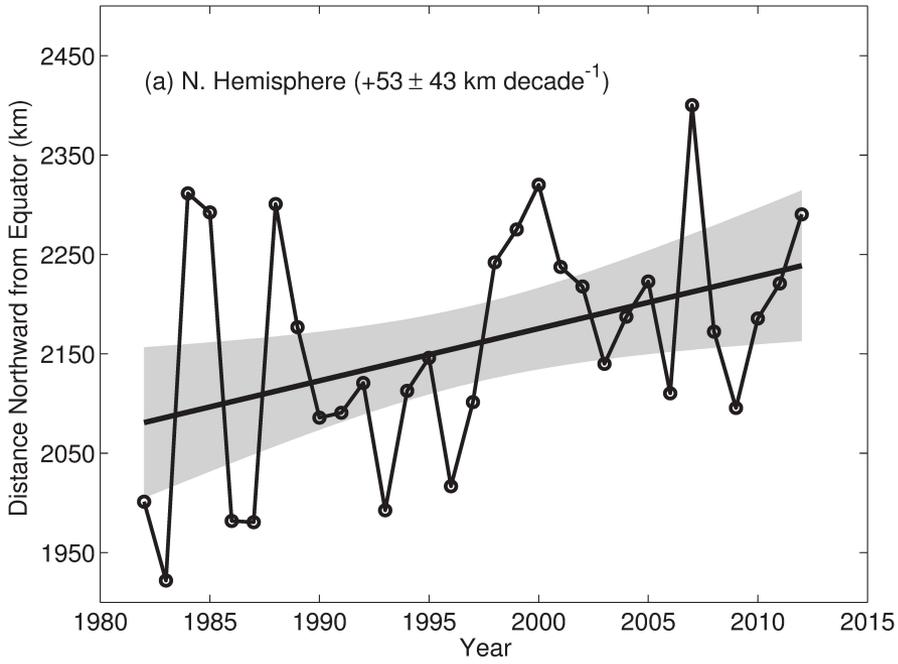
Frequency: no change or a decrease as genesis inhibition increases. Lots of regional uncertainty.

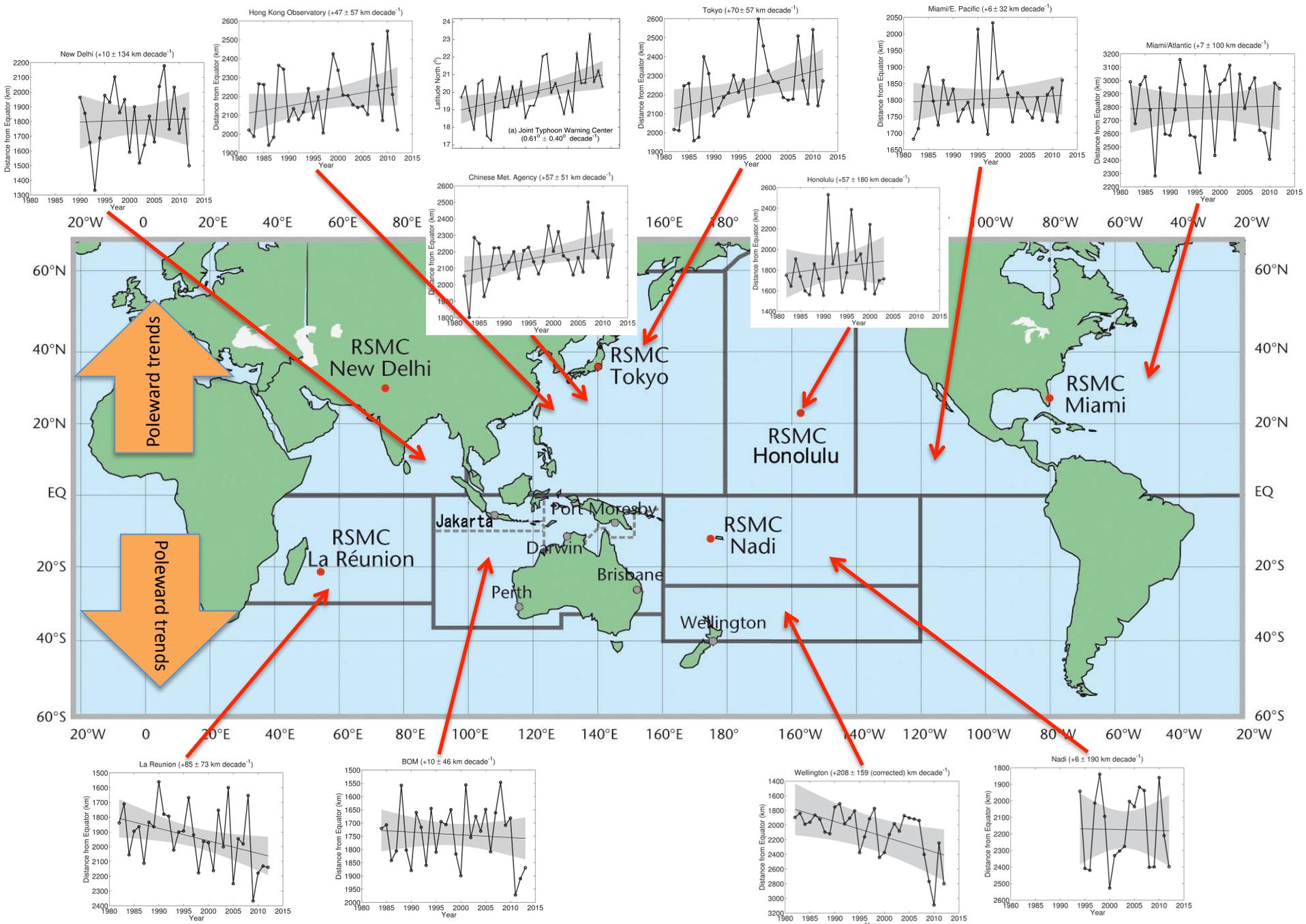
Track? ...Landfall?

Poleward migration of the annual-mean position of LMI

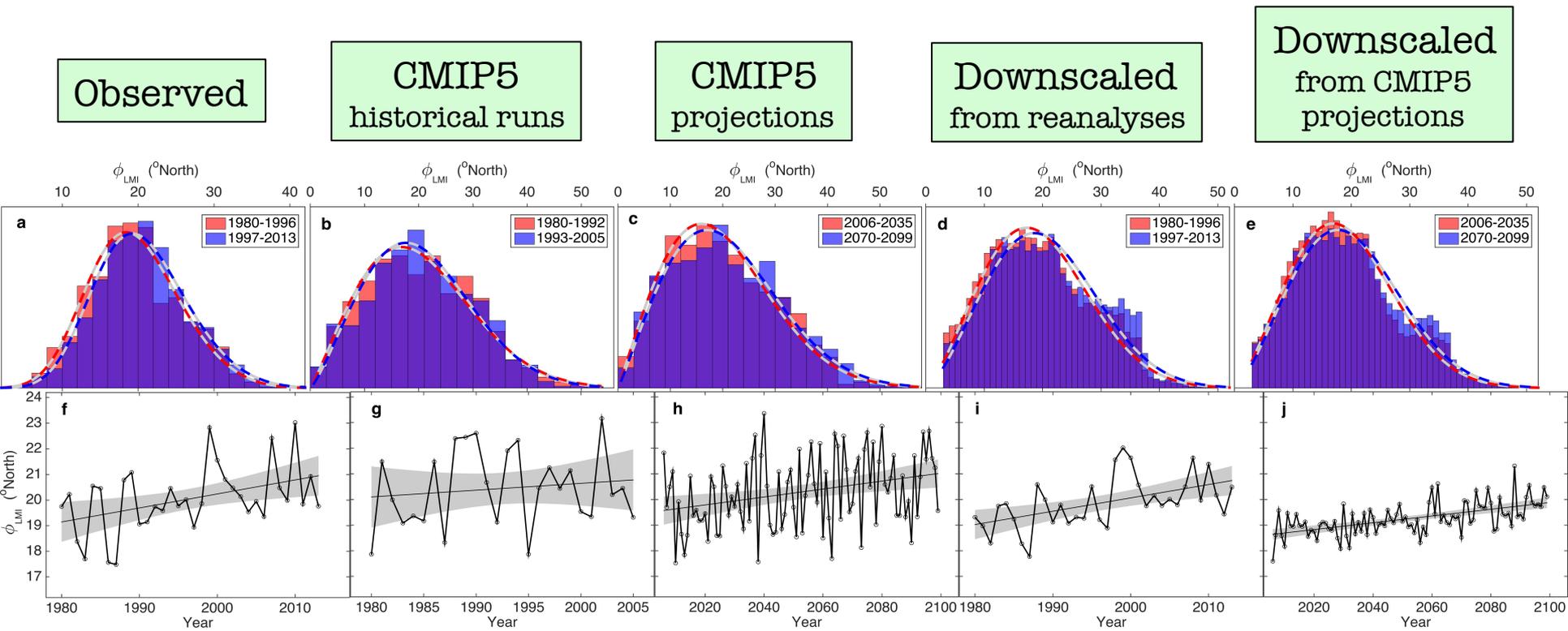
Consistent with independently observed expansion of the tropics.

Tropical expansion has been attributed to greenhouse gas and anthropogenic aerosol forcing.





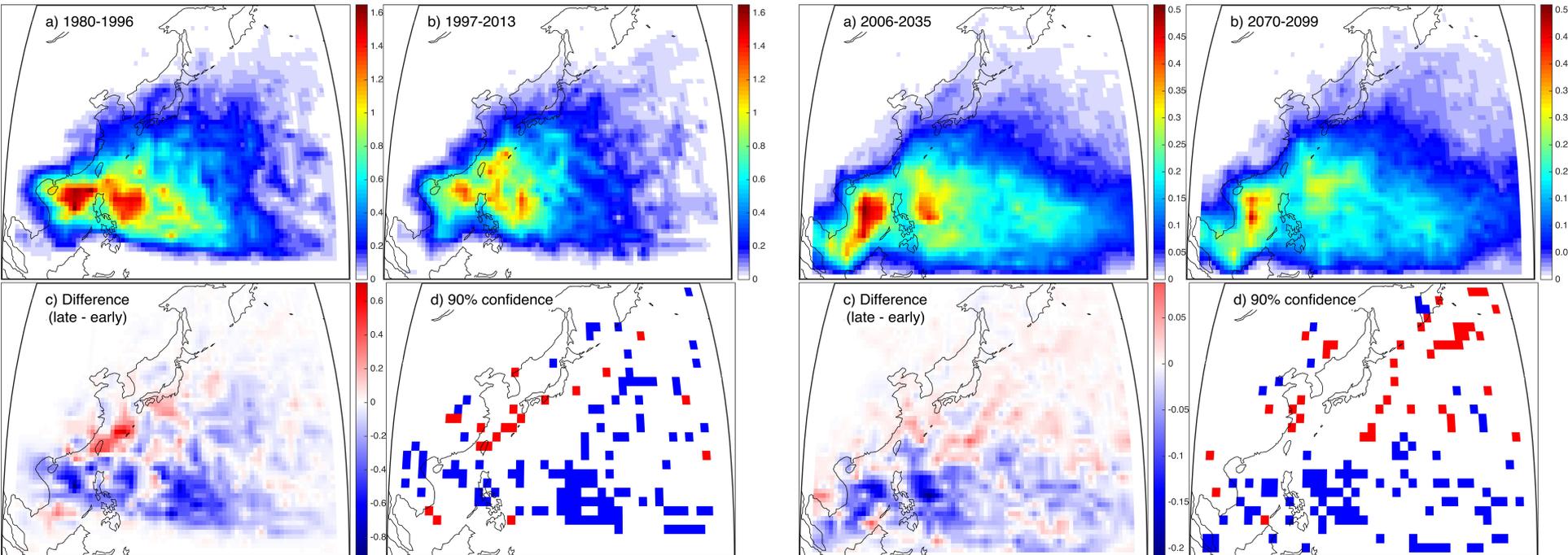
Past and future poleward shift in the western North Pacific



Regional changes in tropical cyclone exposure

Observed
1980-2013

Projected
2006-2099



CMIP5 simulated storms: basin-wide decrease in frequency is compounded or offset by track shifts, depending on region.

Marianas & Philippines: TC exposure roughly cut in half

Japan & Ryukyu Islands: TC exposure roughly doubled

Summary:

In addition to intensity and frequency, tropical cyclone track responds to climate variability and change, which can have substantial effects on tropical cyclone exposure and human mortality risk.

In the western North Pacific, past track changes have caused large and significant changes in tropical cyclone exposure and coastal risk, and CMIP5 models project this behavior to continue under the RCP8.5 (“business as usual”) emissions projection.

Regions of low vulnerability/sensitivity & high resilience (e.g., Guam, where homes are constructed as concrete bunkers) may become less exposed while regions of higher sensitivity & lower resilience (e.g., Japan) may become more exposed.

Questions of attribution remain: Hadley circulation expansion?
”Permanent El Niño”?