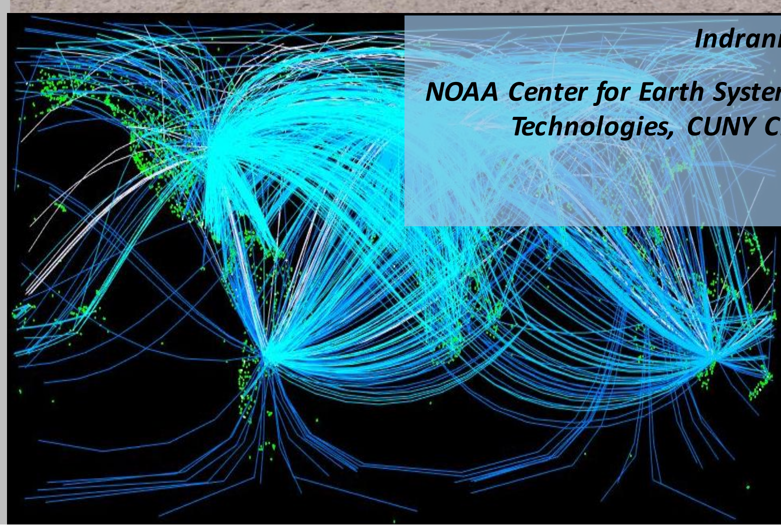
Hydro-climatic extremes and ecosystem services



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Ongoing Research

- **Impacts of meteorological droughts on surface water resources and fish productivity: Diagnostics and Predictability analyses of low flow incidence and fish productivity in the U.S. streams**

- **Characterizing the larger-scale climate connections to concurrent hydro-climatic disasters and crop productivity across the growing regions of the world**

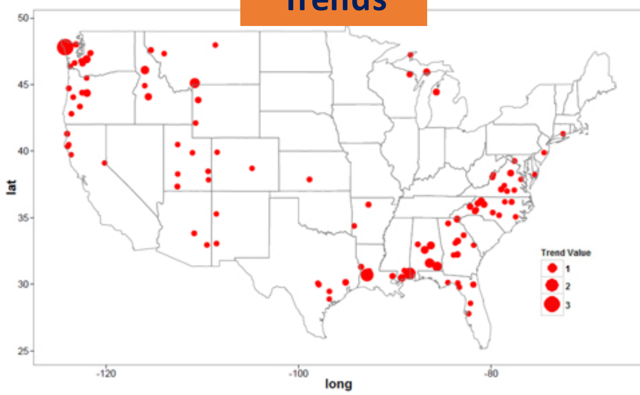
Streamflow Droughts: Low river flow incidence and fish productivity

- Develop indices relevant for ecosystem services (sustaining minimum flow of rivers)
- Assess trends and attribution
- Characterize the larger-scale climate influence (e.g. ENSO, AMO, PDO), vegetation influence, and human influence (e.g. dams, urban vs agricultural watersheds) on low flow incidence in rivers
- Impact analyses on fish productivity

A dead fish on the dry bed of the Rio Grande in Albuquerque, N.M., emphasizes the risks posed by low river flows. Credit: Dagmar Llewellyn

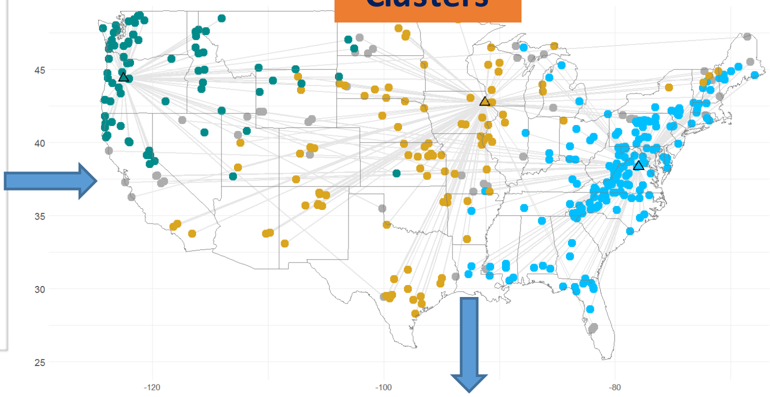
Streamflow Droughts: Low river flow diagnostics and fish productivity

Trends



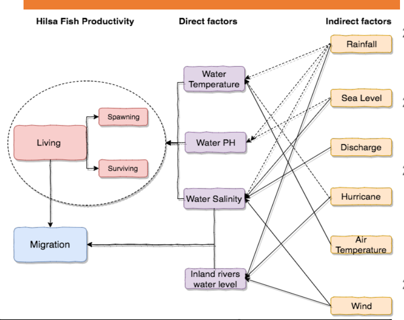
Locations of stream systems that are experiencing significantly low flows. Color bubbles indicate location of the stations and loss-of-flow estimates in cubic feet per second per day per year. The size of the bubble is proportional to the magnitude of trend value.

Clusters

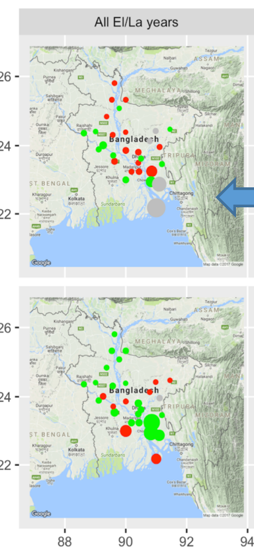


Three clusters where solid triangles display medoid locations. All the stations are attached to their corresponding medoids by light gray lines. Gray circles correspond to the stations those are not well classified for not crossing the 95th percentile significance levels of SCs.

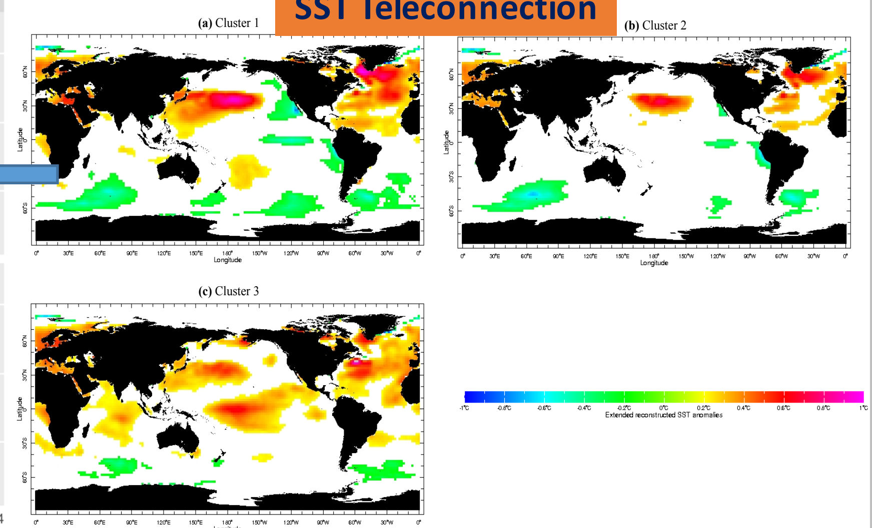
Environmental factors affecting Hilsa fish productivity in Bangladesh (Source: various).



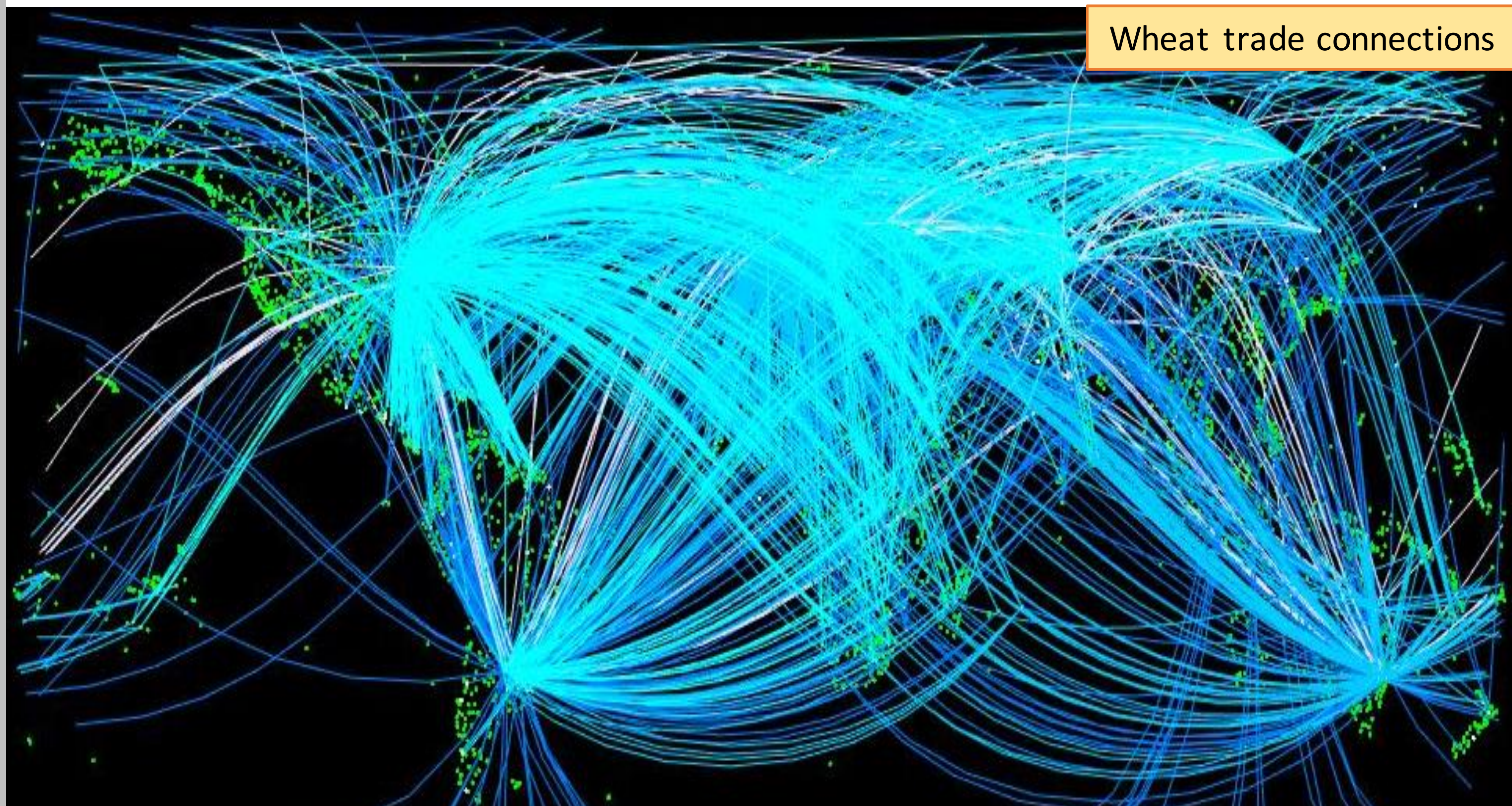
El Year		La Year	
Positive	37.93%	68.97%	
Negative	62.07%	31.03%	



SST Teleconnection



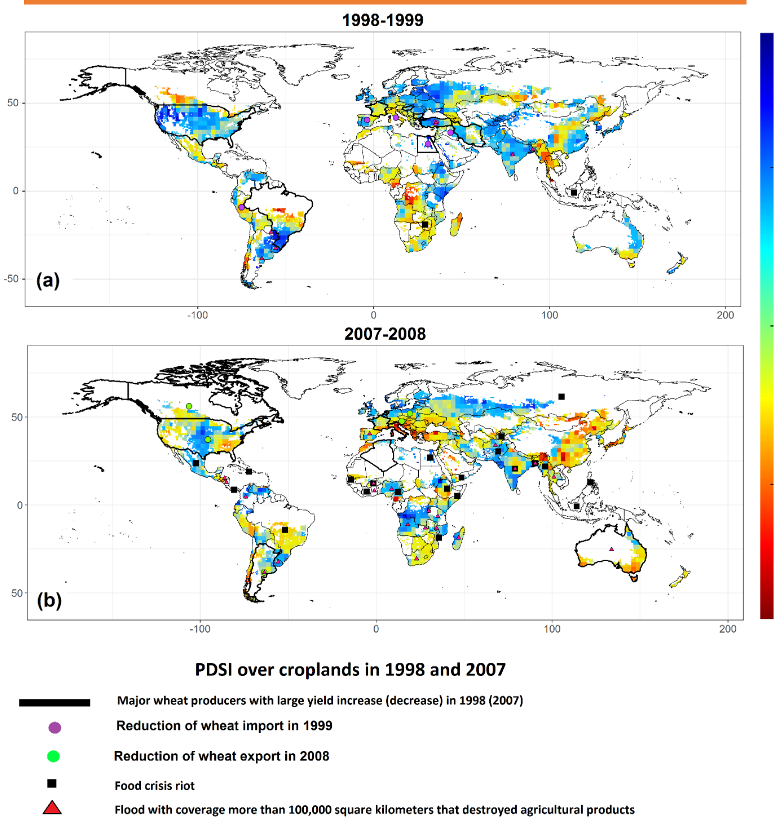
Crop Productivity in a Highly Connected World: Assessing the role of larger-scale climate



- Larger-scale climate connections (e.g. ENSO, AMO, PDO) influencing crop productivity in many regions at a time (via parallel local climate influence)
    - Global and regional crop yield volatility diagnostics
    - Shifts in the growing seasons

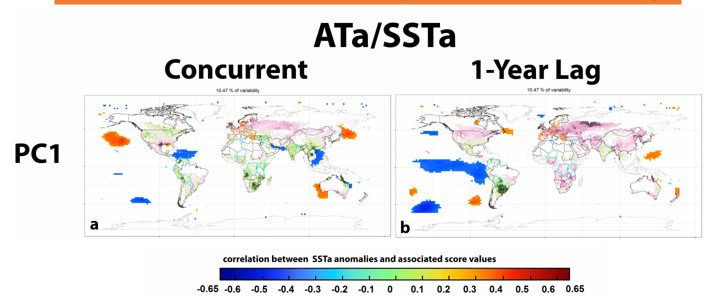
Concurrent extreme events and global crop yield volatility: e.g. Wheat

Crop Yield and Climate Volatility Ex Years

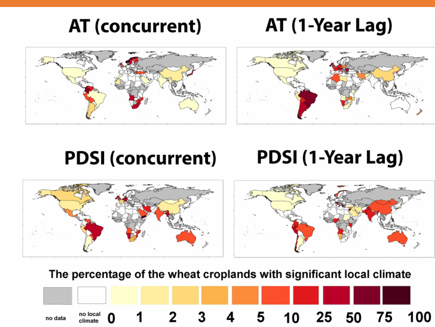


Global wheat grain productivity and trade, local climate status, and occurrence of societal conflicts in two specific years. (a) 1998-1999 is favorable and (b) 2007-2008 is vicious.

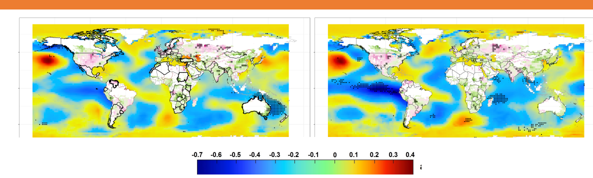
SST Teleconnection (PC1 correlation)



% cropland area impacted by climate in PC1



SST Teleconnection (composites with most yield volatile years – deficit-led)



Shifting Seasons

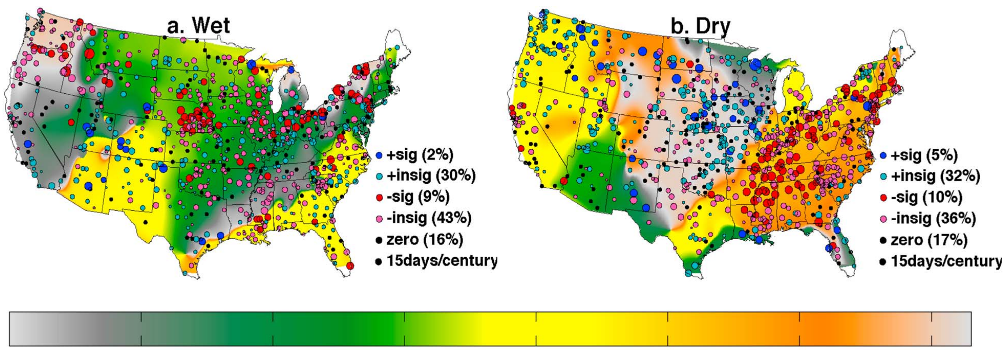


Figure 4. Trends of Julian days count from 1 January to the center of the (a) wettest and (b) driest 91 day period in a given year ("shift in seasons"). Wettest (driest) period is defined as the center of the 91 day period with the maximum (minimum) number of precipitating days, allowing for overlap with the preceding/following year. Color bubbles indicate location of the stations, sign, and significance of the trend estimates. The size (as well as the shading) of the bubble is proportional to the magnitude of the trend. The percentages in parentheses indicate fraction of the total number of stations having such trend category. Background color is the same as in Figure 3. For example, in east New York, there has been a statistically significant negative shift in wet season (red bubble, Figure 4a) of approximately 25 days in 100 years, and the wet season is centered on approximately Julian day 20 (gray background), meaning that the wet season in east New York has shifted from approximately 1 February to 8 January.

Pal I, Anderson BT, Salvucci GD and Gianotti DJ. (2013) Shifting Seasonality and Increasing Frequency of Precipitation Events in Wet and Dry Seasons Across the U.S. Geophysical Research Letters 40 : 4030-4035.

*ElAlem S# and **Pal I**. (2014) Mapping the vulnerability hotspots over Hindu-Kush Himalaya region to flooding disasters. Weather and Climate Extremes 8 (2015) : 46-58 doi:10.1016/j.wace.2014.12.001.*

Flooding Disasters, assessing and mapping vulnerability: Hindu-Kush Himalaya as an e.g.