

NCDC Extremes Datasets and Recent NCA Analyses



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Extremes Are Relevant

U.S. 2013 Billion-dollar Weather and Climate Disasters



Global Historical Climatology Network-Daily

Variables:

- Precipitation
- Snowfall
- Snow depth
- Temperature
- And 150 others

World's largest collection of daily in situ data

Some Basics

About 30 source datasets

90,000 precipitation stations

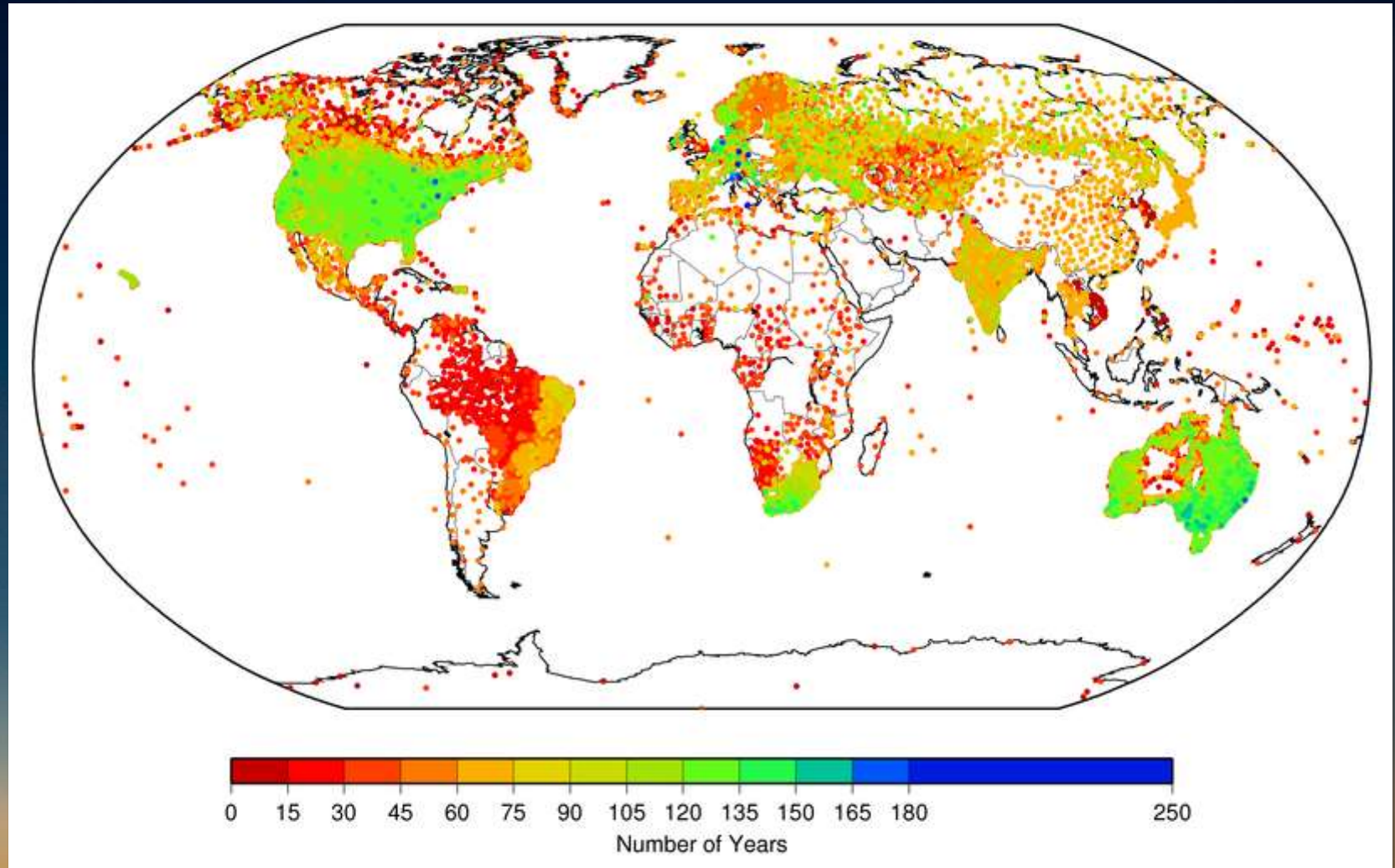
40,000 snowfall and snow depth stations

Good coverage of many global land areas

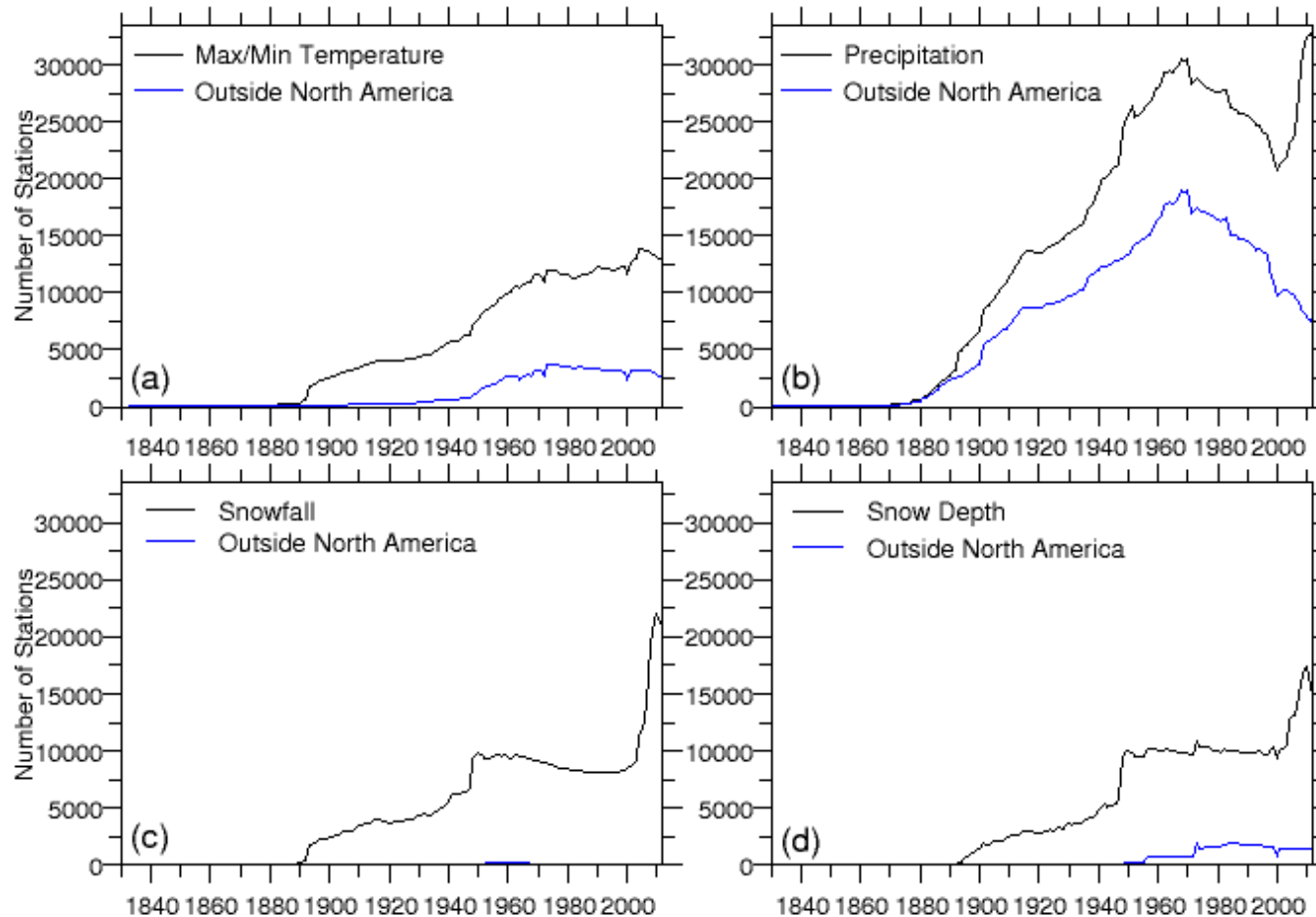
Primary U.S. networks:

- ☑ COOP (Cooperative Observing Network)
- ☑ ASOS (Automated Surface Observing System)
- ☑ CRN (Climate Reference Network)
- ☑ SNOTEL (Snow Telemetry Network)
- ☑ CoCoRaHS (Community Collaborative Rain, Hail, and Snow...)

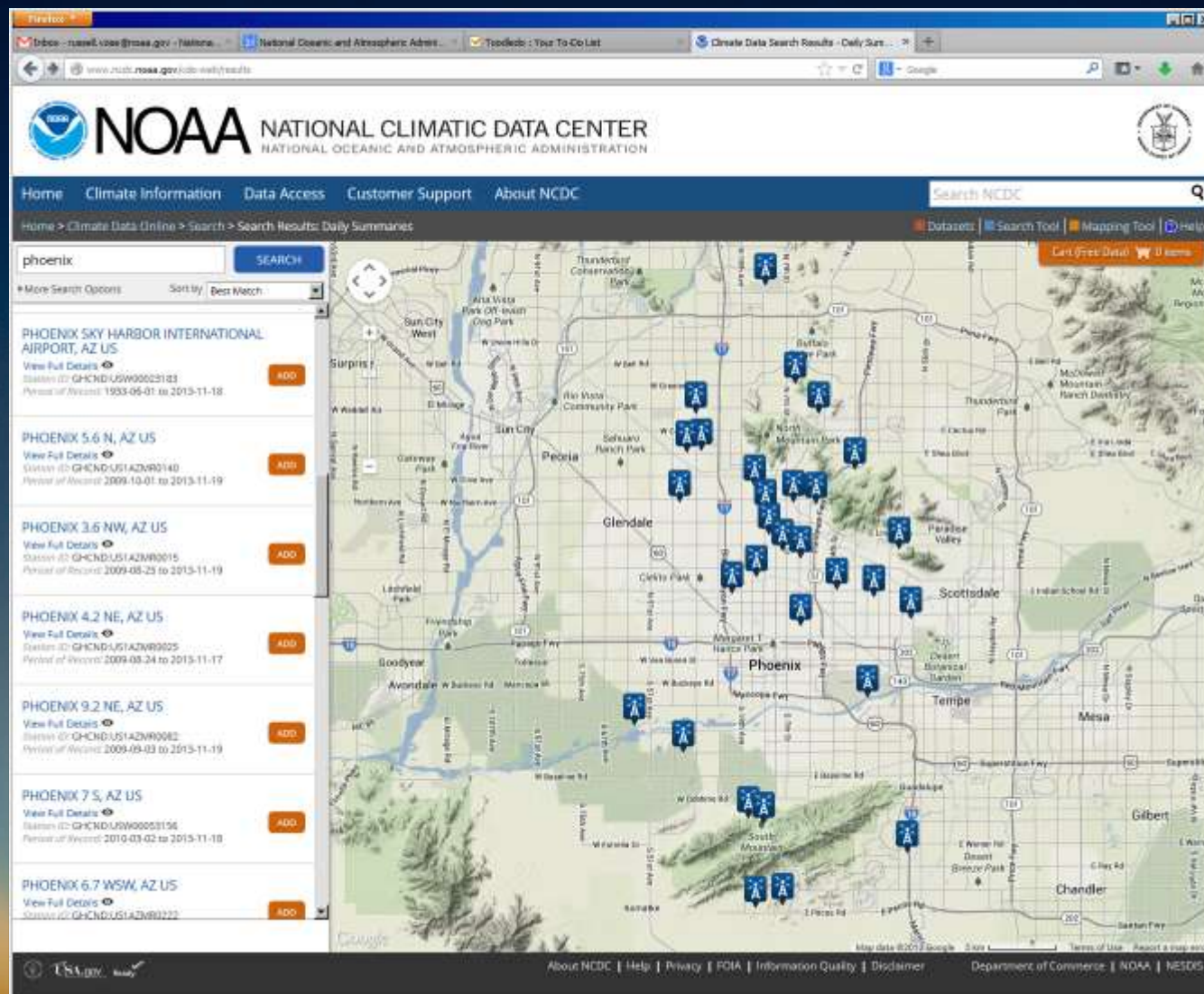
Record Length Varies



Network Increases in Time



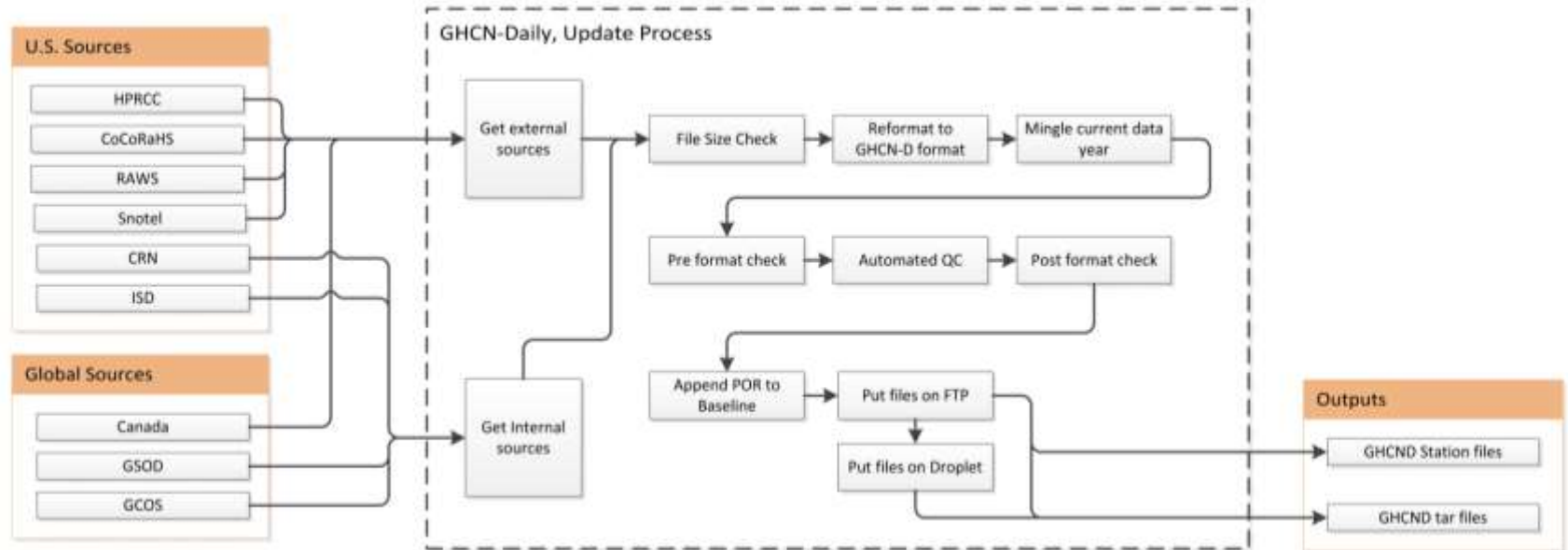
Freely Available to All



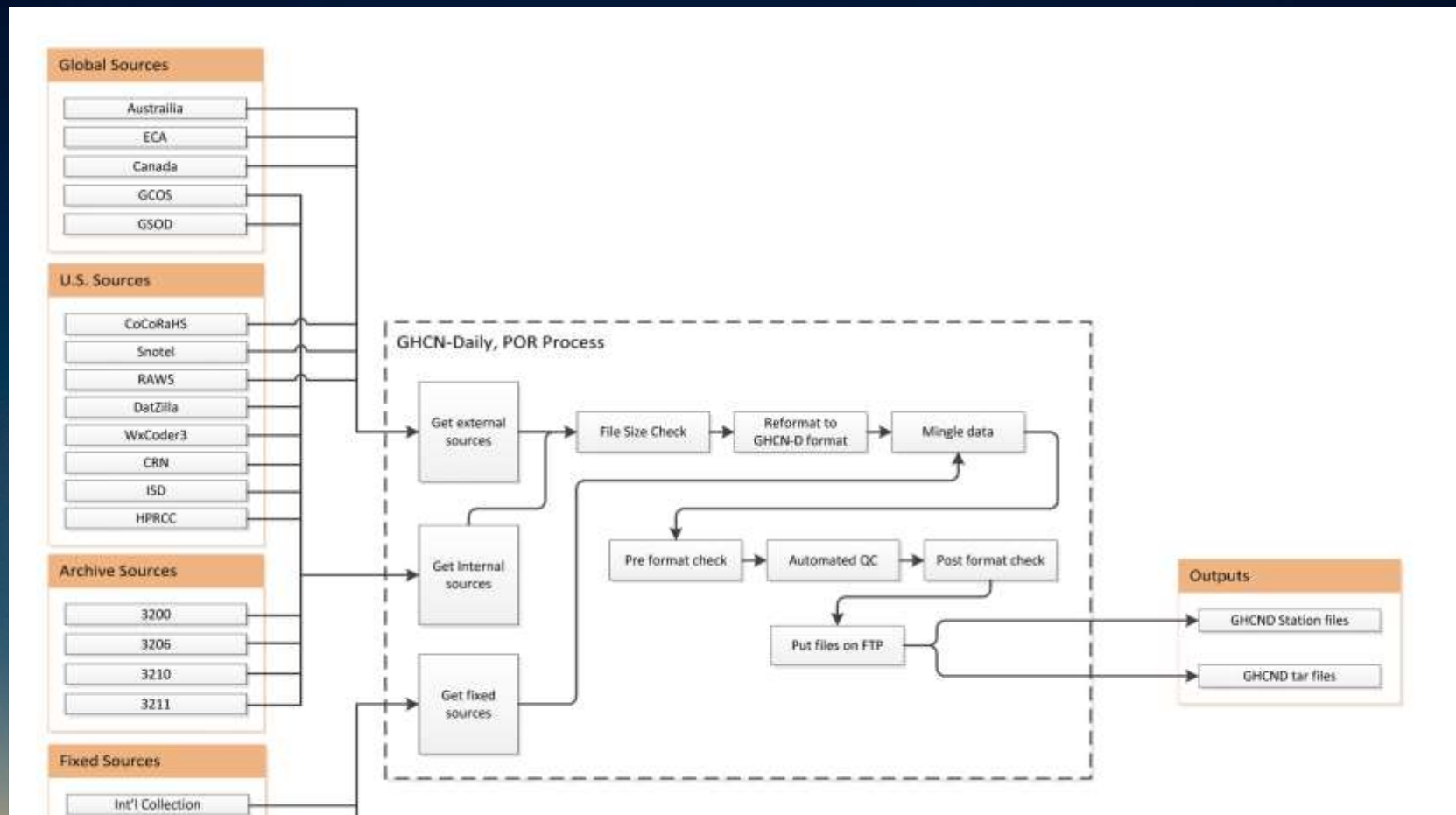
Operations



Daily Updates



Weekly Reprocessing



Sources Added Periodically

- Winter 2008: U.S. Forts (30 new stations)
- Summer 2009: CRN (137 new stations)
- Winter 2010: 13 African countries (129 new stations)
- Summer 2010: CoCoRaHS (~22,000 new stations)
- Fall 2010: Australia (~17,000 new stations)
- Fall 2010: Belarus, Ukraine, Uzbekistan (updates)
- Fall 2011: ECA&D (1270 new stations)
- Summer 2012: Russia (updates and 116 new stations)
- Fall 2012: RAWs (1453 new stations)
- Fall 2012: SNOTEL (668 new stations)
- Summer 2013: China (updates to ~200 stations)

Criteria in Adding a Source

Need for data in a certain place and time

Consistency with NCDC Mission and Strategic Themes

- ☑ 1.2 Sustain Assessments and Monitoring
- ☑ 1.4 Understand Extremes

Request from a specific customer base

- ☑ Sponsor (CPO)
- ☑ Internal and external stakeholders

Expediency of integration

- ☑ Quality, availability, and documentation of data source
- ☑ Personnel resources (< 20% of GHCN-Daily development time)

Quality Assurance

19 checks (most applied to most primary elements)

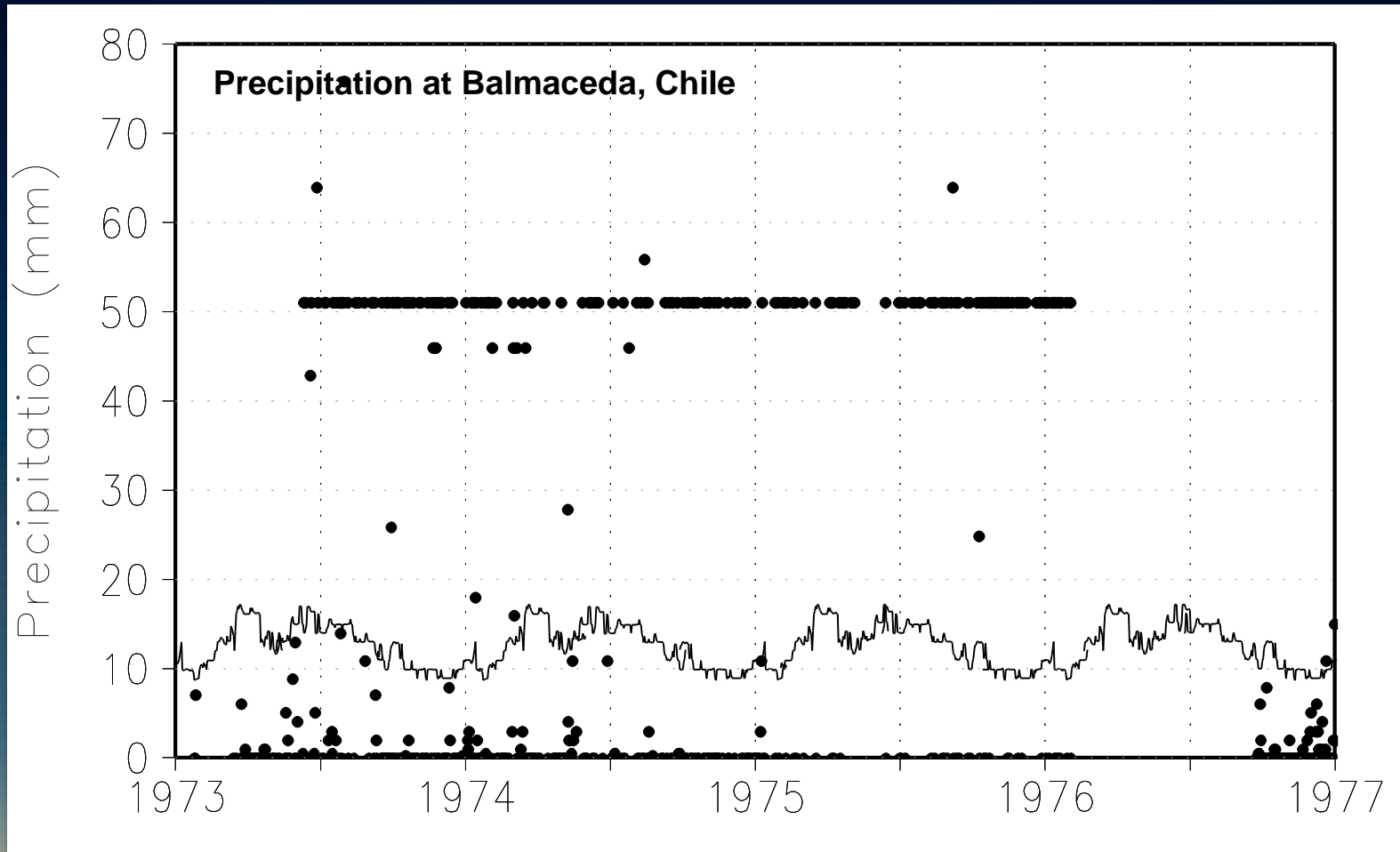
3 general types (integrity, outlier, consistency)

1-2% false positive rate (limits collateral damage)

0.24% total flag rate (higher for snow)

Uniform and automated throughout the period of record

Always a New Problem...



National Climate Assessment

Convened workshops in 2011-2012
to assess the state of knowledge

- ☑ Document changes
- ☑ Assess data suitability
- ☑ Explore potential causes
- ☑ Rate the evidence (strong, moderate, suggestive, inconclusive)



Changes in Extremes

Focusing on three areas:

- ☑ Precipitation
- ☑ Temperature
- ☑ Storms

Emphasizing two attributes of extremes:

- ☑ Uncommon short-term events
- ☑ Defined based on meteorological principles rather than actual damage

Three Papers Published

Monitoring and understanding changes in extreme storm statistics: state of knowledge

Kunkel, K., T.R. Karl, H. Brooks, J. Kossin, J. Lawrimore, D. Arndt, L. Bosart, D. Changnon, S. Cutter, N. Doesken, K. Emanuel, P. Ya. Groisman, R.W. Katz, T. Knutson, J. O'Brien, C.J. Paciorek, T. Peterson, K. Redmond, D. Robinson, J. Trapp, R. Vose, S. Weaver, M. Wehner, K. Wolter, and D. Wuebbles. 2013. *Bulletin of the American Meteorological Society* **94**:499-514, doi:10.1175/BAMS-D-11-00262.1.

Monitoring and understanding changes in heatwaves, coldwaves, floods, and droughts in the United States: state of knowledge

Peterson, T.C., R. Heim, R. Hirsch, D. Kaiser, H. Brooks, N.S. Diffenbaugh, R. Dole, J. Giovannettone, K. Gurguis, T.R. Karl, R.W. Katz, K. Kunkel, D. Lettenmaier, G.J. McCabe, C.J. Paciorek, K. Ryberg, S. Schubert, V.B.S. Silva, B. Stewart, A.V. Vecchia, G. Villarini, R.S. Vose, J. Walsh, D. Wolock, K. Wolter, C.A. Woodhouse, M. Wehner, and D. Wuebbles. 2013. *Bulletin of the American Meteorological Society* **94**:821-834, doi:10.1175/BAMS-D-12-00066.1.

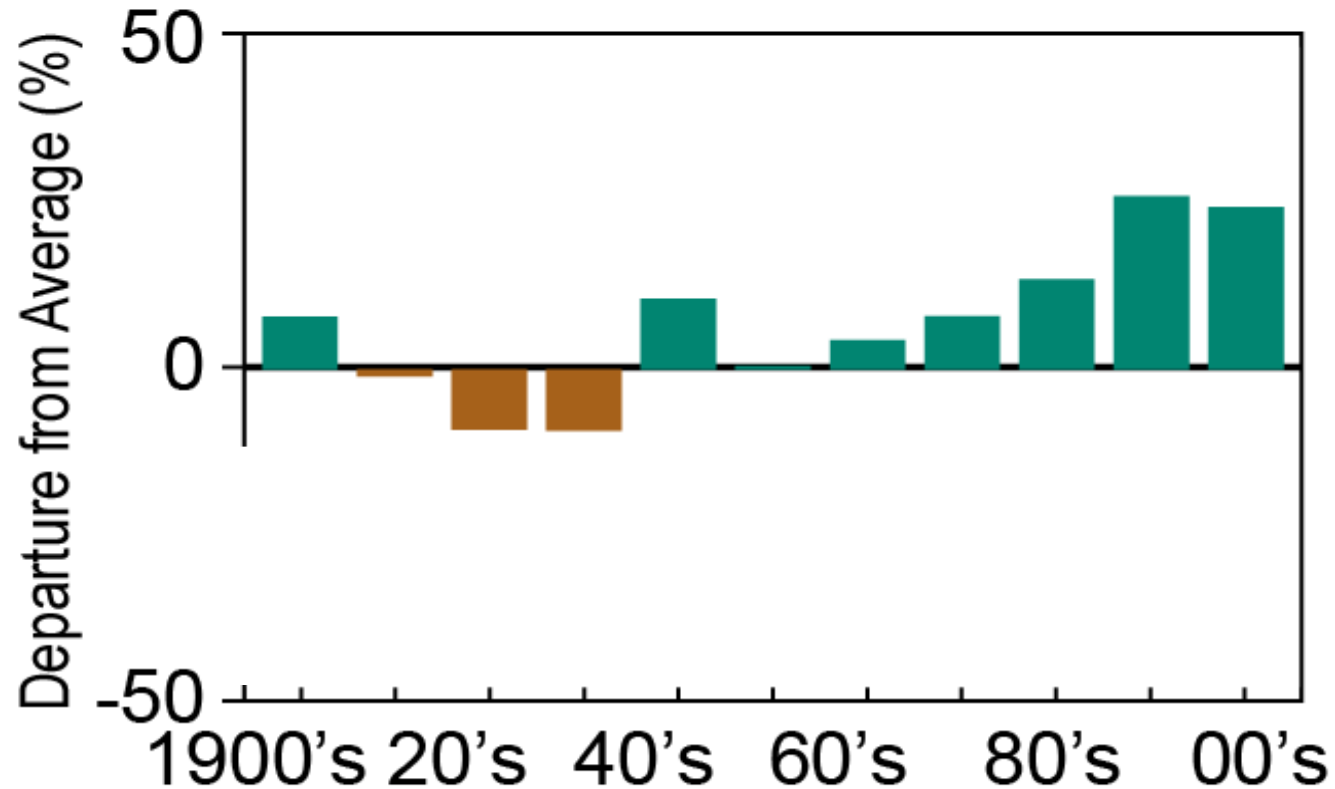
Monitoring and understanding changes in extremes: extratropical storms, winds, and waves

Vose, R.S., S. Applequist, M.A. Bourassa, S.C. Pryor, R.J. Barthelmie, B. Blanton, P.D. Bromirski, H.E. Brooks, A.T. DeGaetano, R.M. Dole, D.R. Easterling, R.E. Jensen, T.R. Karl, R.W. Katz, K. Klink, M.C. Kruk, K.E. Kunkel, M.C. MacCracken, T.C. Peterson, K. Shein, B.R. Thomas, J.E. Walsh, X.L. Wang, M.F. Wehner, D.J. Wuebbles, and R. Young. 2013. *Bulletin of the American Meteorological Society* (early online release).

Precipitation

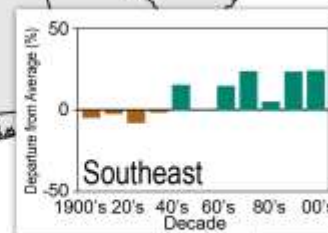
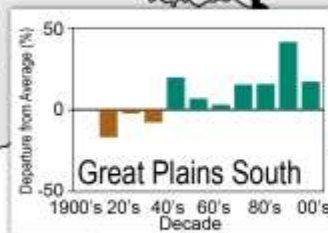
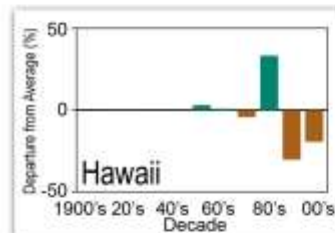
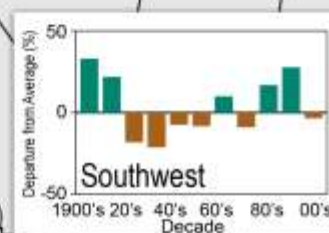
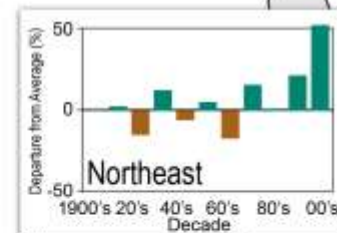
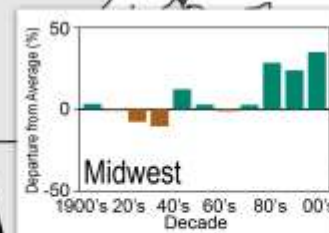
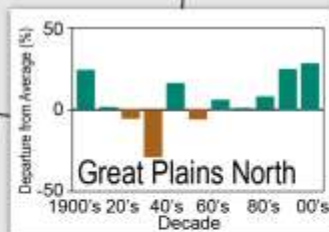
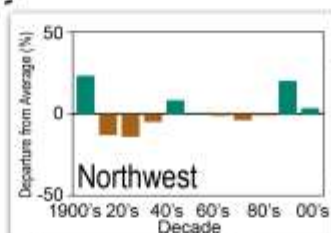
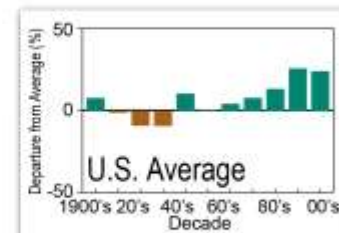


Increase in Very Heavy Precipitation

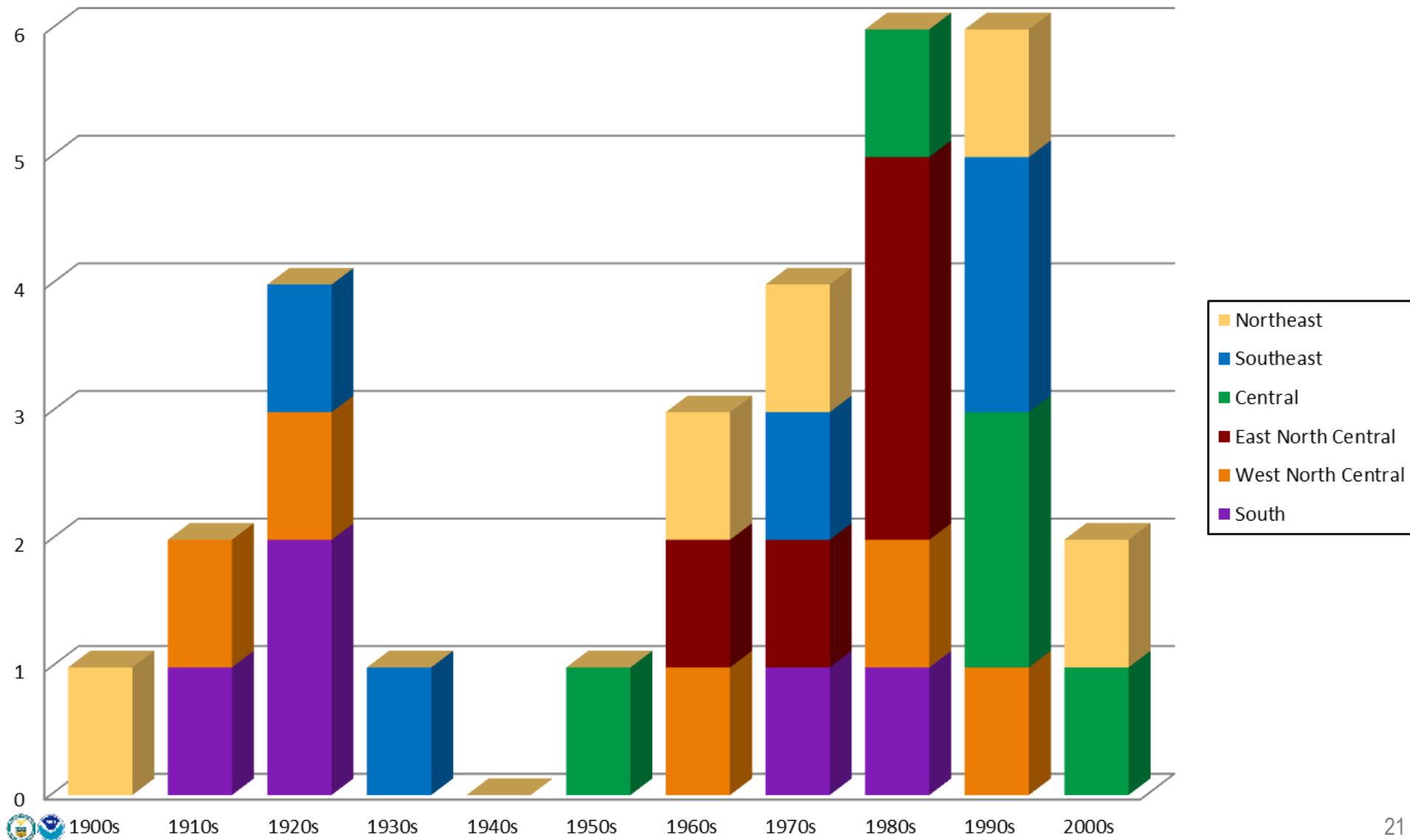


Increase in Very Heavy Precipitation

1901-2012



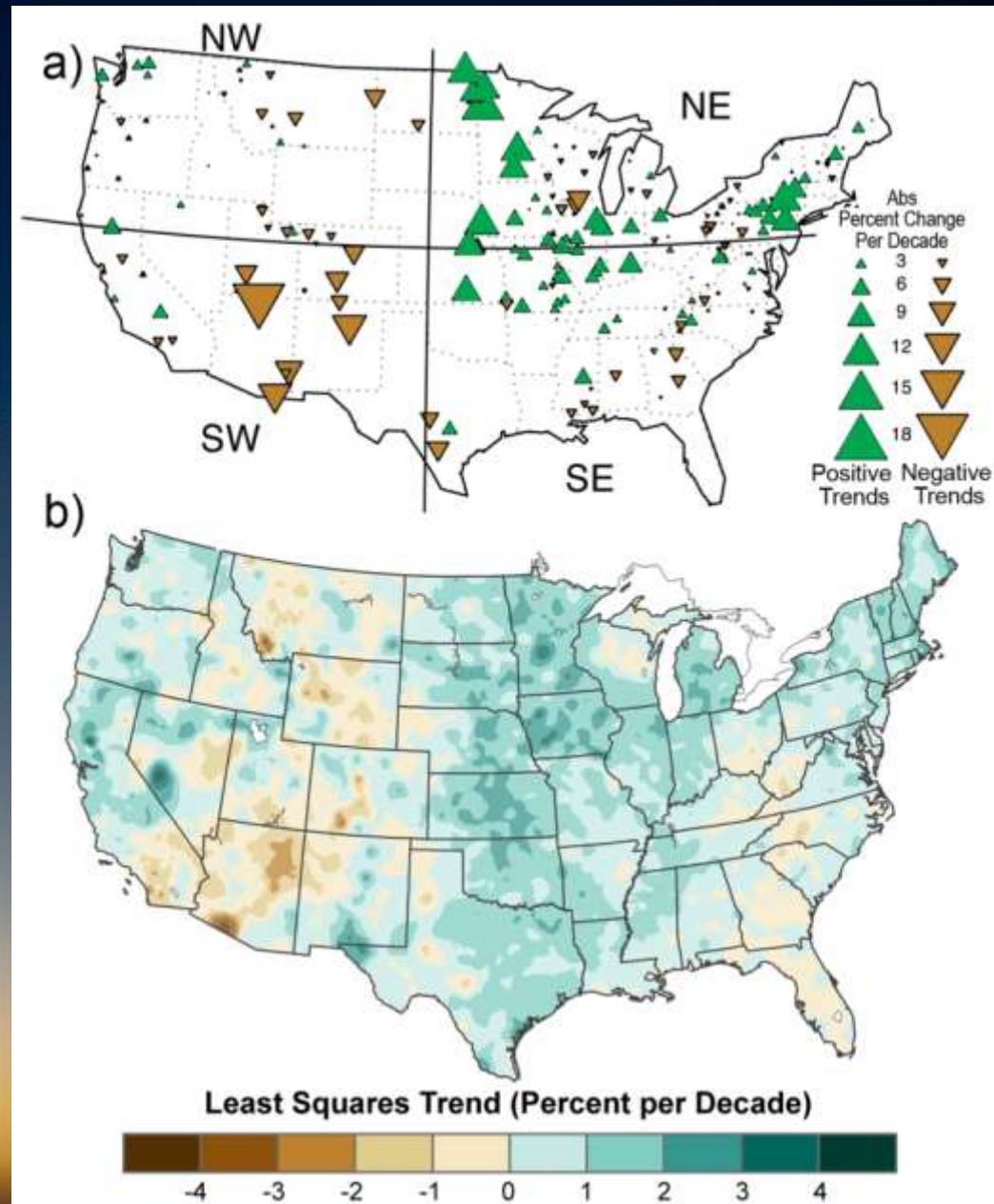
Increase in Extreme Snowstorms



Floods Consistent with Precipitation

Floods

Precipitation

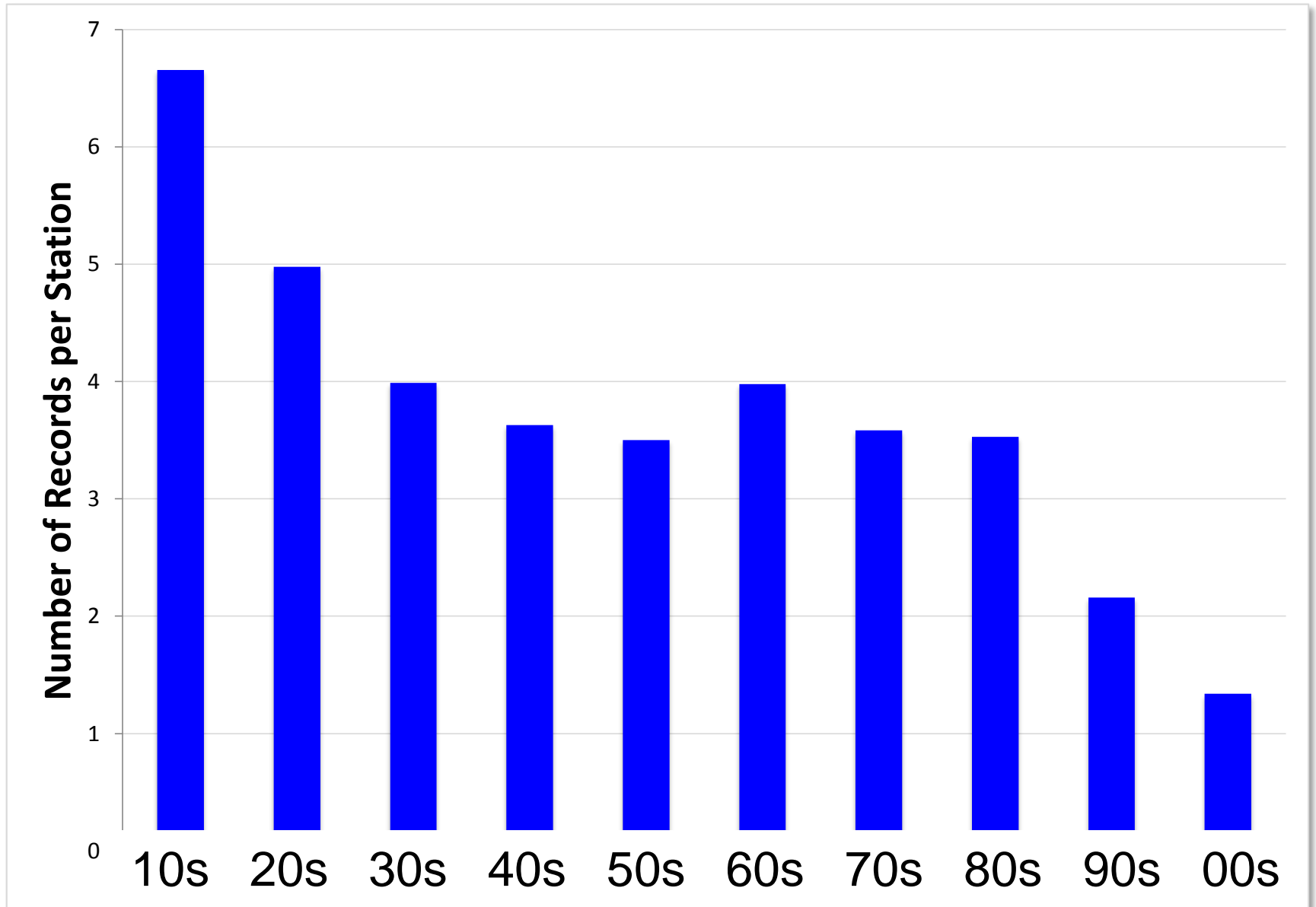


Temperature

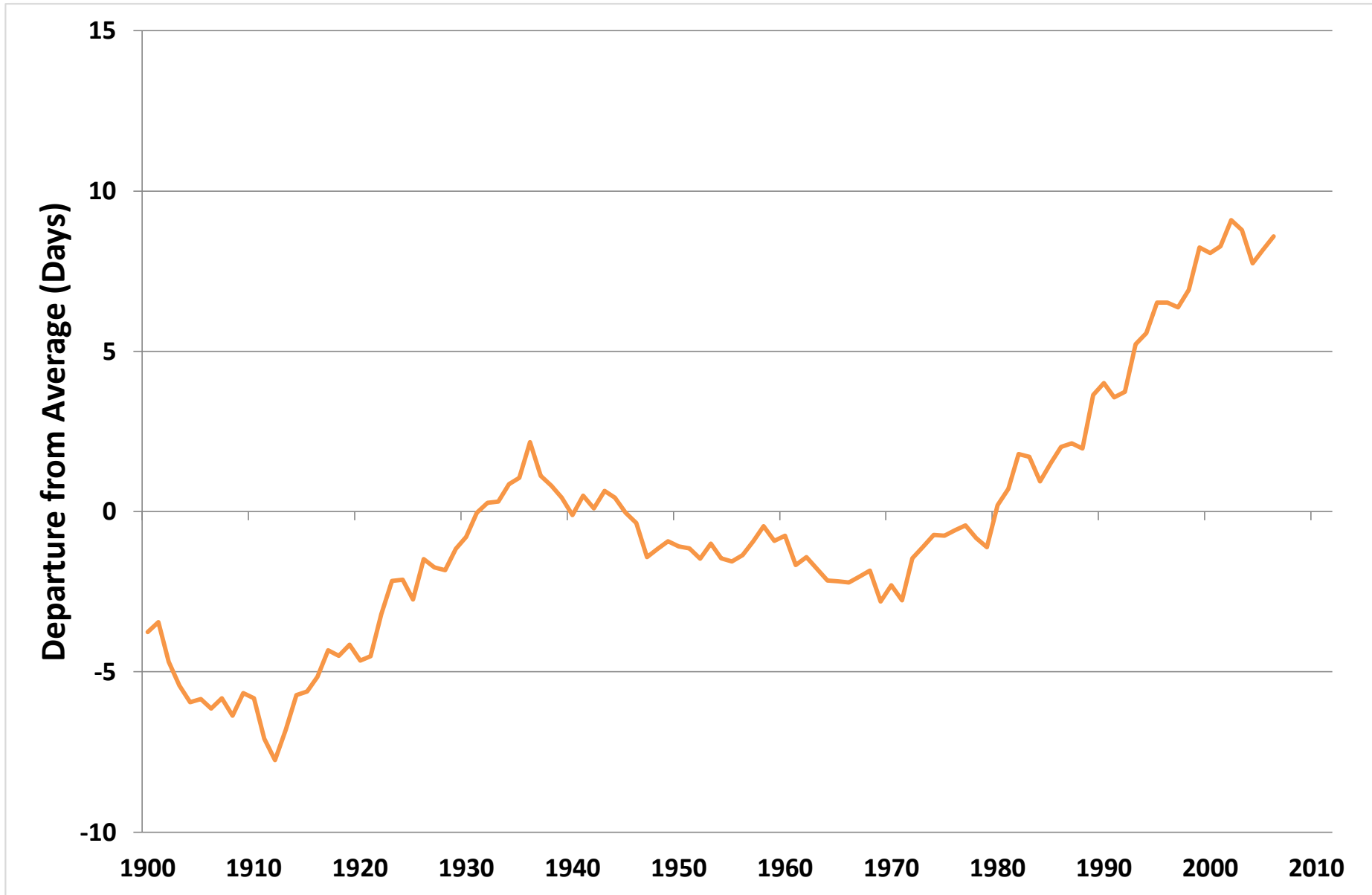


Extreme
Temperature
Experts

Decrease in Record Lows

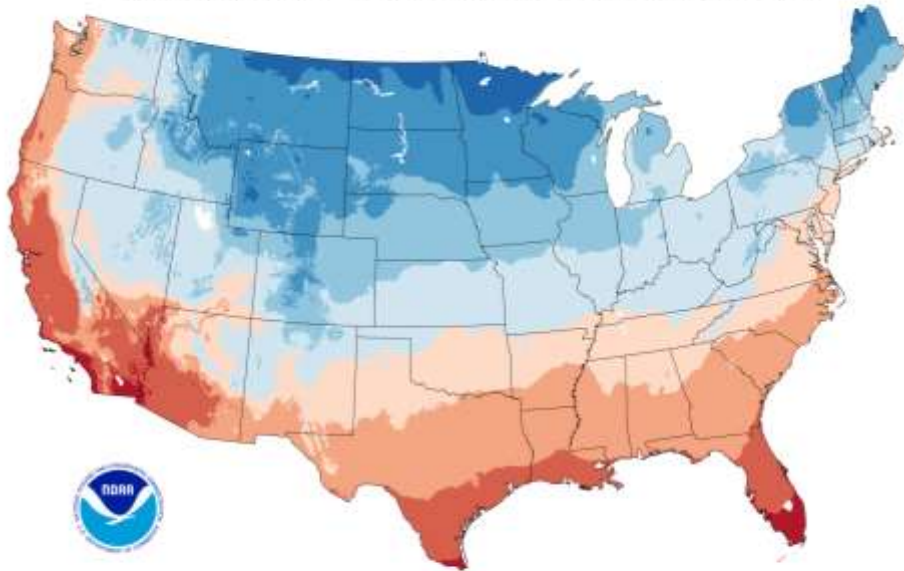


Longer Frost-Free Season



Northward Movement of Planting Zones

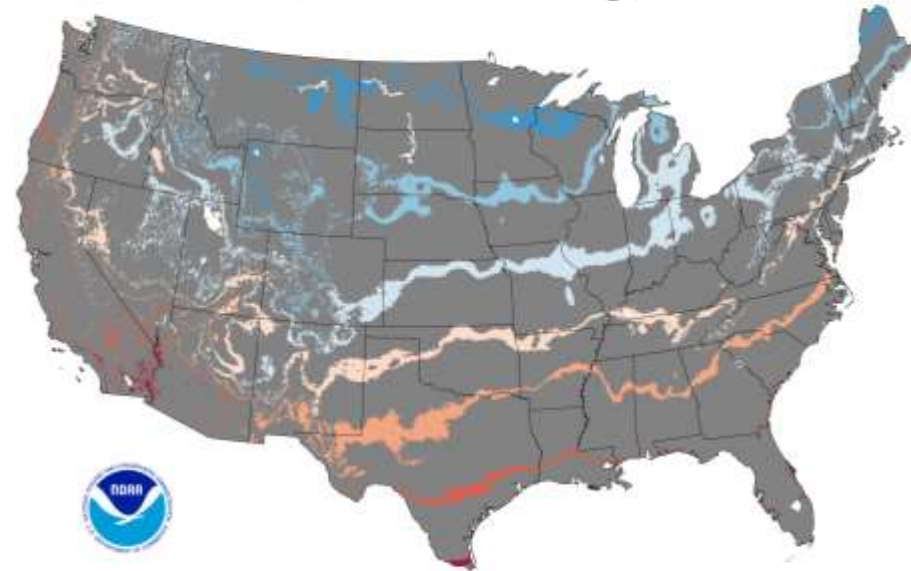
Climate-Related Planting Zones
Based on New 1981-2010 Climate Normals



Average Annual Minimum Temperature by Climate-Related Planting Zone



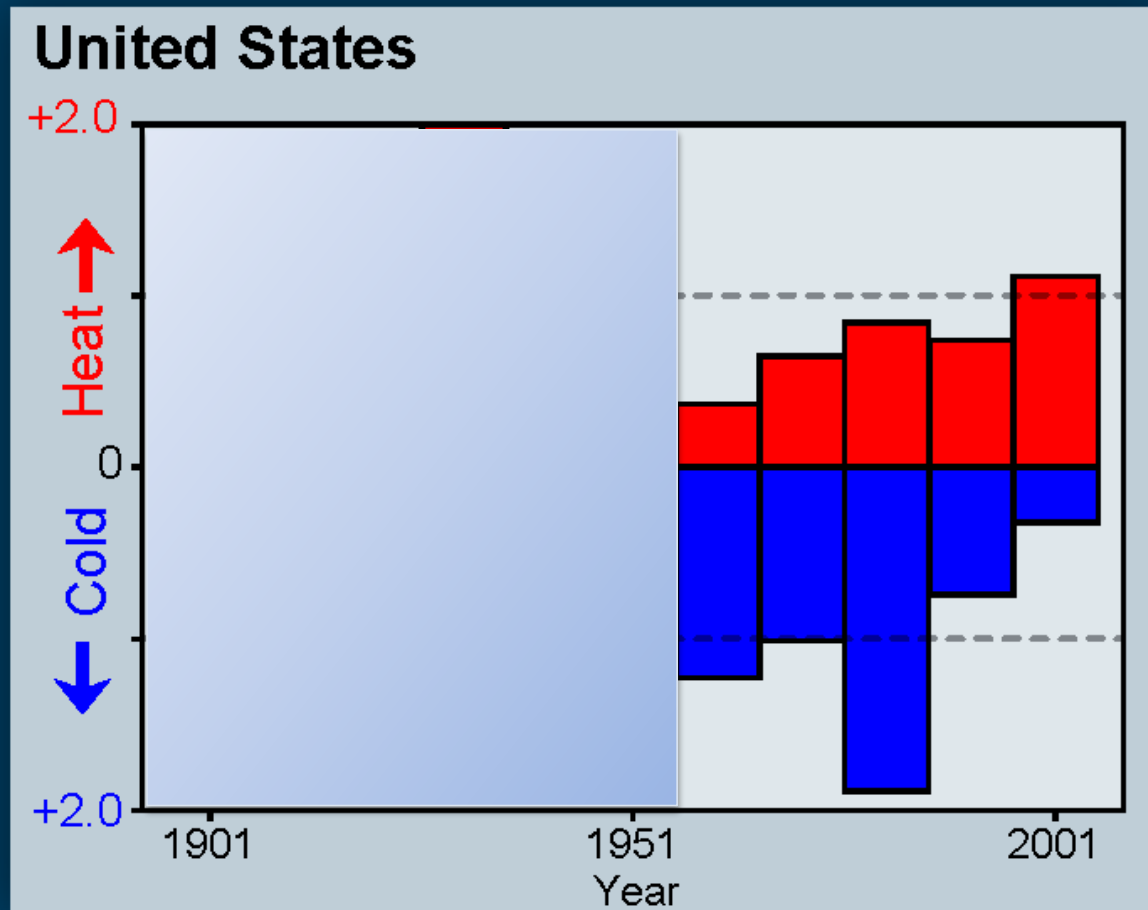
Zone Changes in Past 10 Years
In Color of New Planting Zone



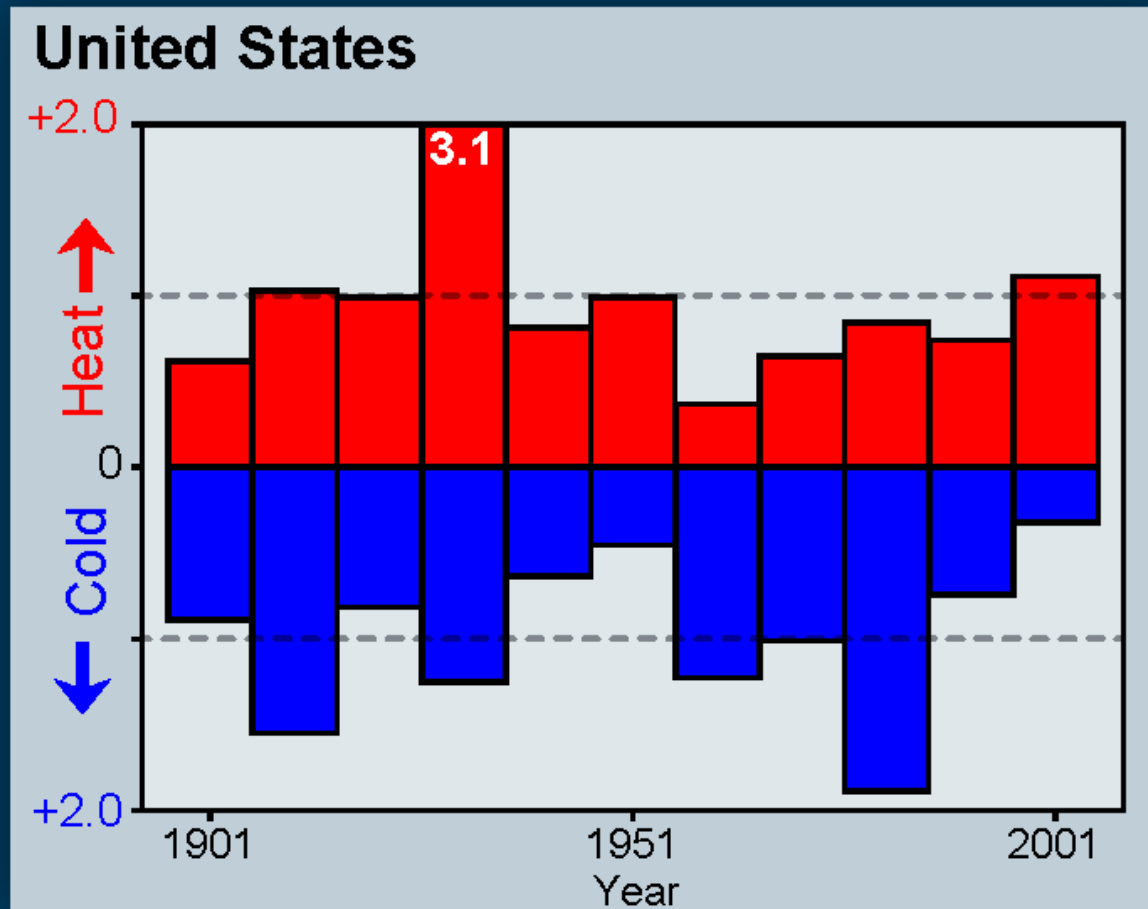
Average Annual Minimum Temperature by Climate-Related Planting Zone



Fewer Cold Waves and More Heat Waves



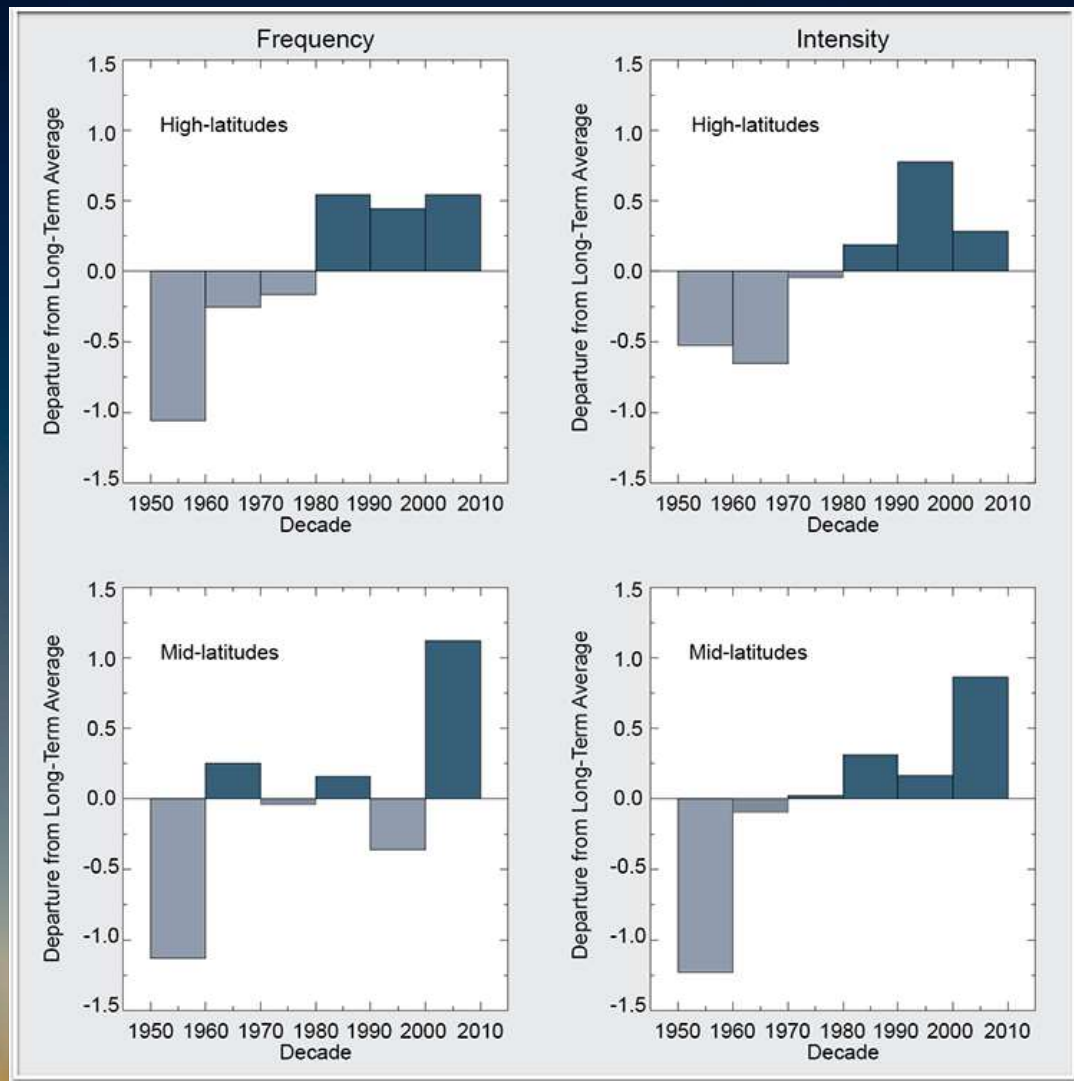
Long-Term Picture More Complex



Storms



More Frequent and Intense Winter Storms

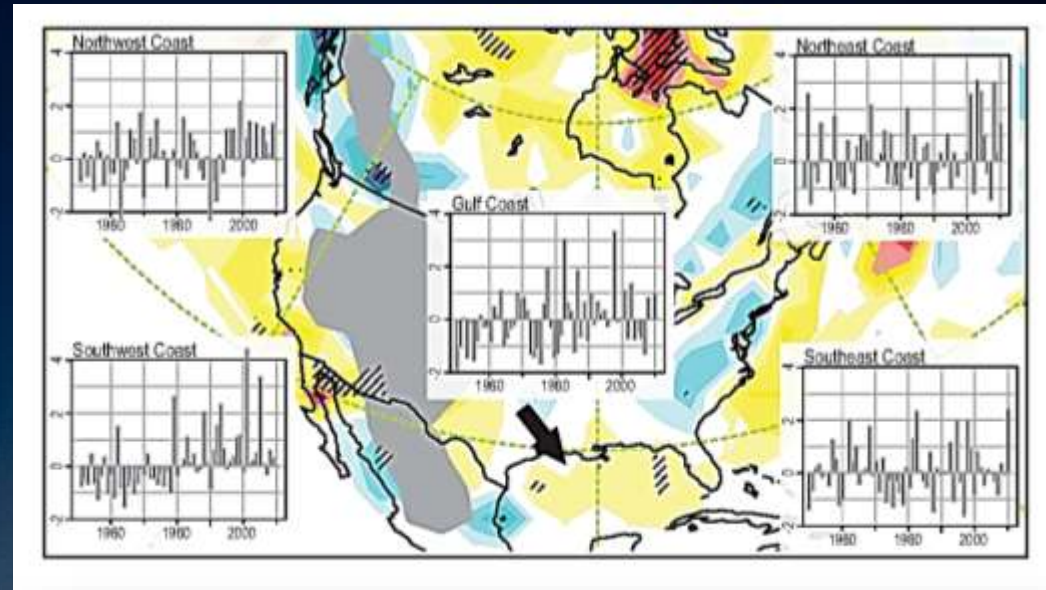


(Northern Hemisphere)

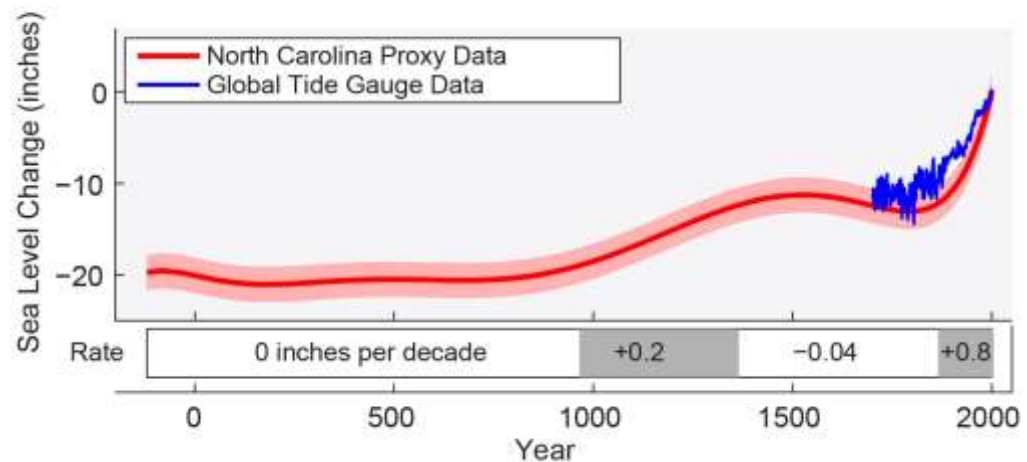
Increasing Coastal Vulnerability

Storms drive winds, which drive waves

- ☉ “Suggestive” evidence
- ☉ Shift toward offshore storm activity (1950s)
- ☉ Increase in extreme offshore winds (1980s)
- ☉ Increase in extreme Pacific waves (1950s)



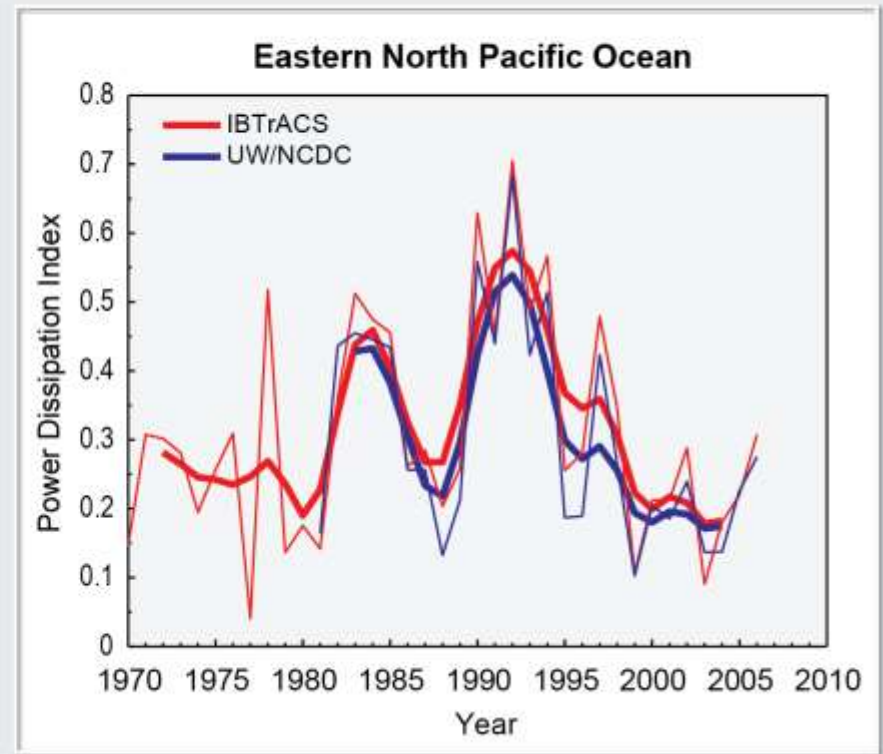
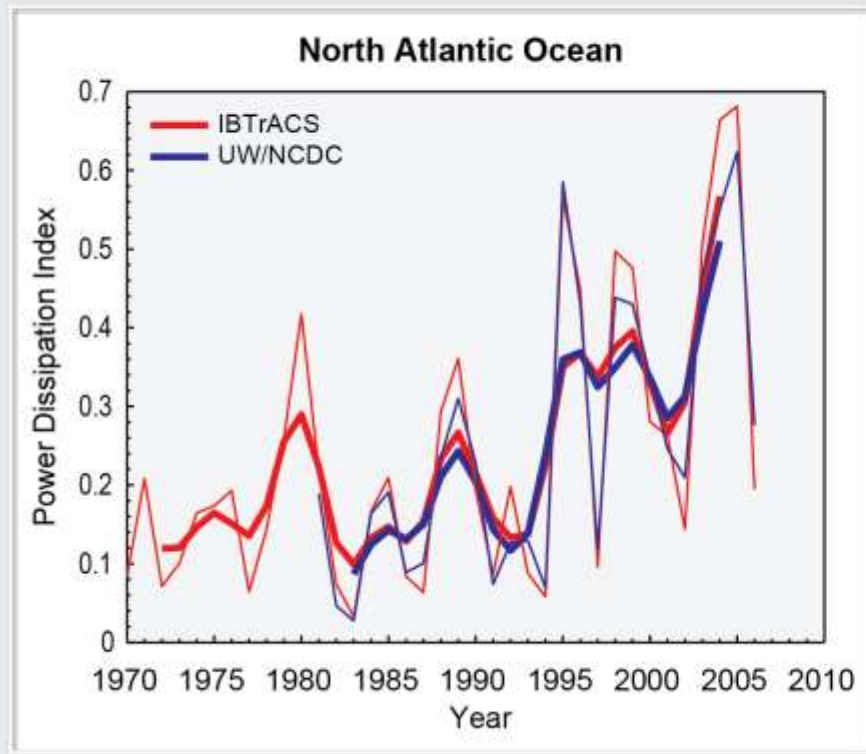
North Atlantic Sea Level Change



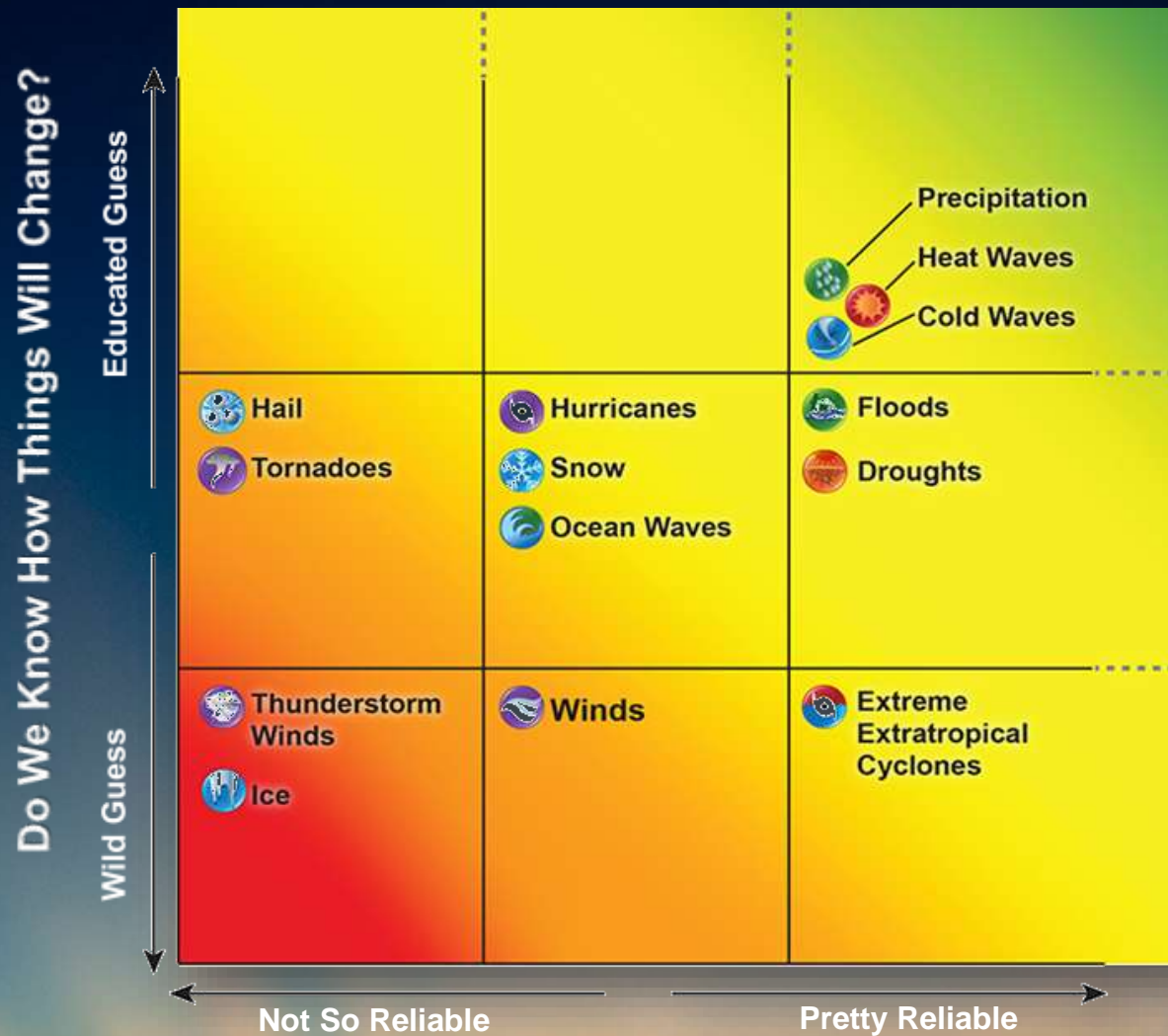
Increase in North Atlantic Hurricanes

Intensity, frequency, and duration have increased since the early 1980s

Observed Trends in Hurricane Power Dissipation



Putting It All Together



Are the Data Reliable for Detecting Change?