Environmental Intelligence: Making the Best Use of Publicly Available Data and Information

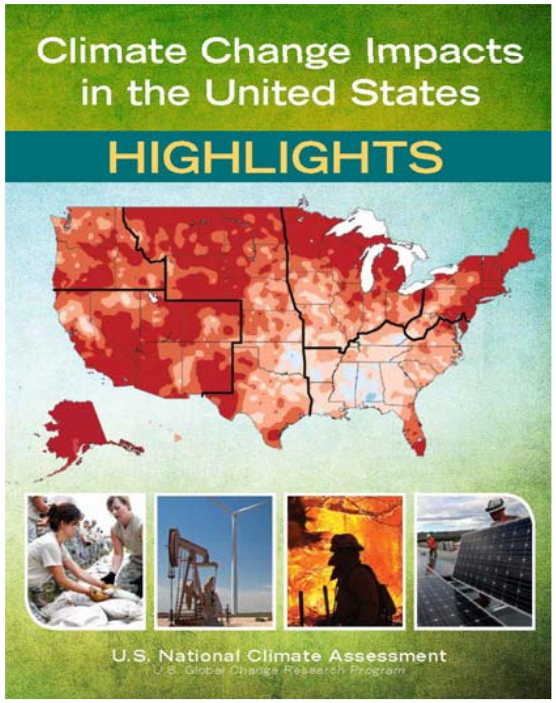
A Workshop at the Casualty Actuarial Society Annual Meeting

Margaret A. Davidson
Senior Advisor for Coastal Inundation and Resilience Science and Services
National Oceanic and Atmospheric Administration

Douglas J. Collins
Retired Actuary, Chair (2014-2015); CAS Climate Change Committee

National Climate Assessment Key Messages

- Climate change is not just a problem for the future – it has moved firmly into the present
- Many Americans are already feeling the effects of the increases in certain types of extreme weather and sea level rise that are fueled by climate change
- This Assessment is the most comprehensive analysis to date of how climate change is affecting our nation now and could affect it in the future
- America has important opportunities to reduce emissions and prepare for the effects of climate change



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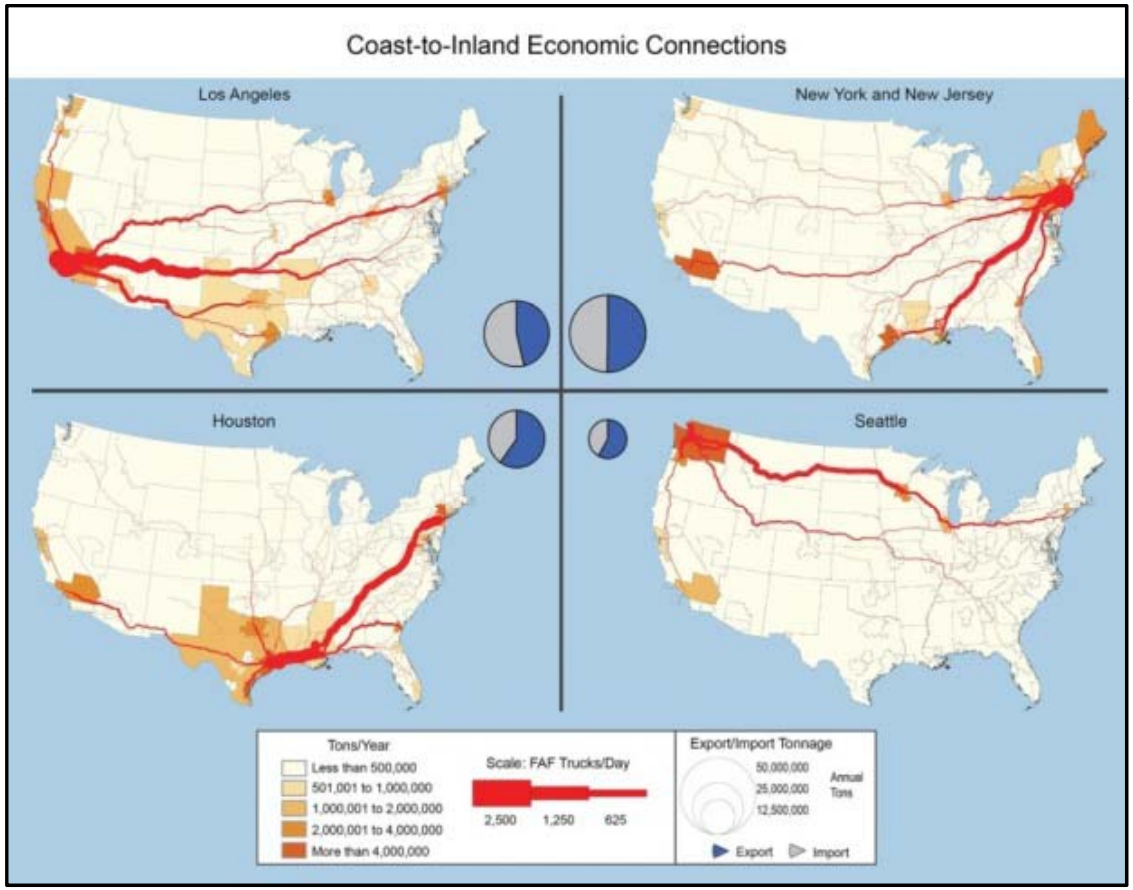
Adapting Coastal Infrastructure to Sea Level Rise and Land Loss

3

ECONOMIC DISRUPTION

Coastal Impacts Cause Far-Reaching Economic Disruptions



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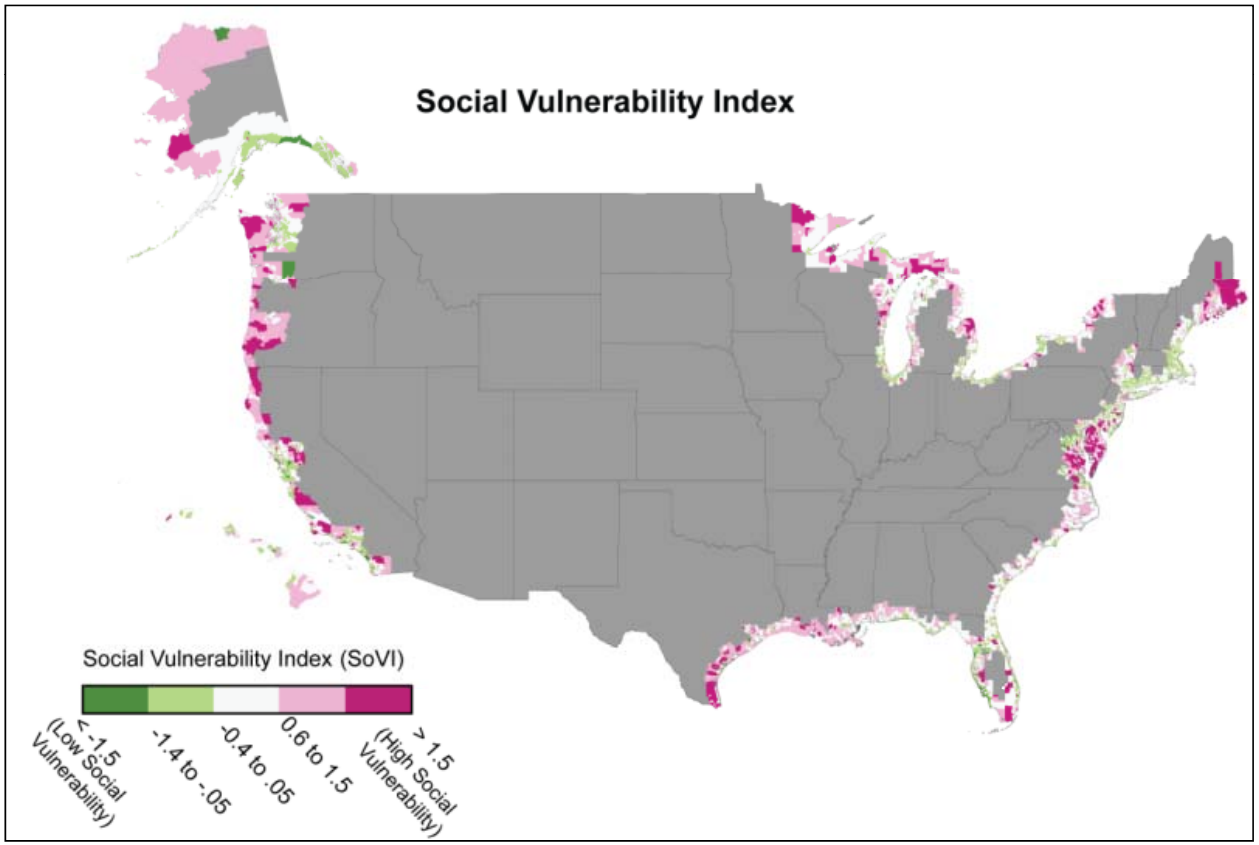
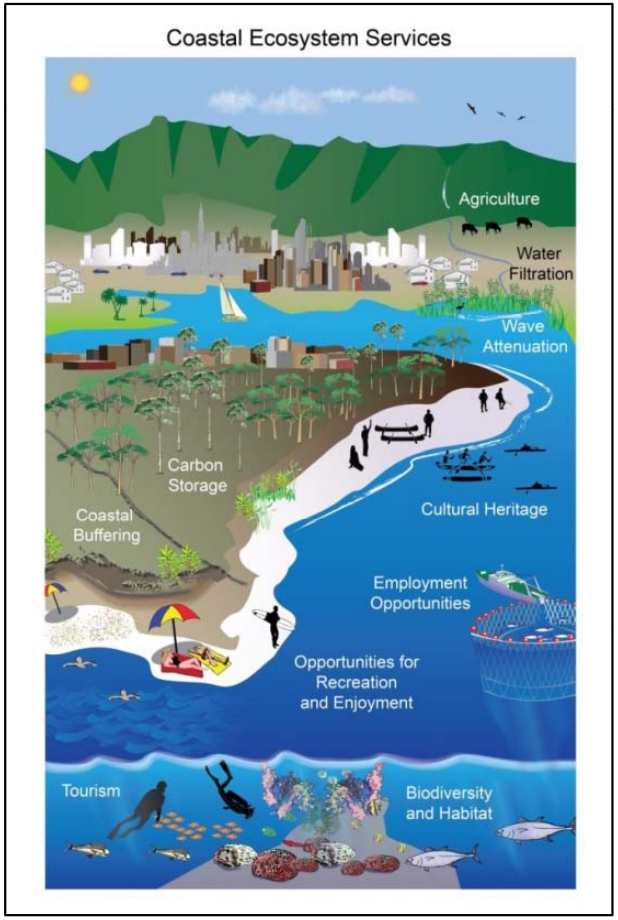
Socioeconomic Disparities Create Uneven Vulnerabilities



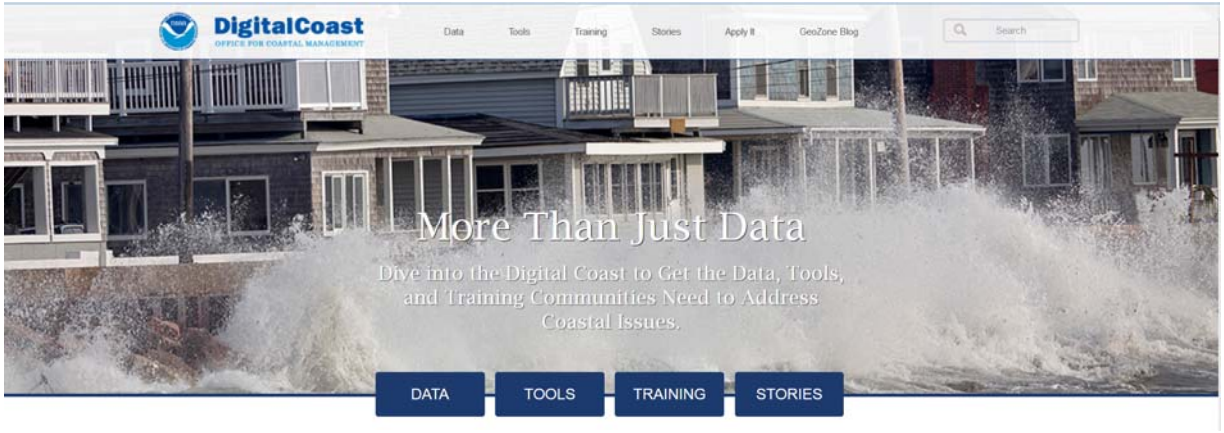
Stressed Ecosystems Nearing Irreversible Losses



Coastal Adaptation is Beginning but it is Incommensurate with Risk

Ecosystem Restoration

ENVIRONMENTAL INTELLIGENCE DATA & TOOLS



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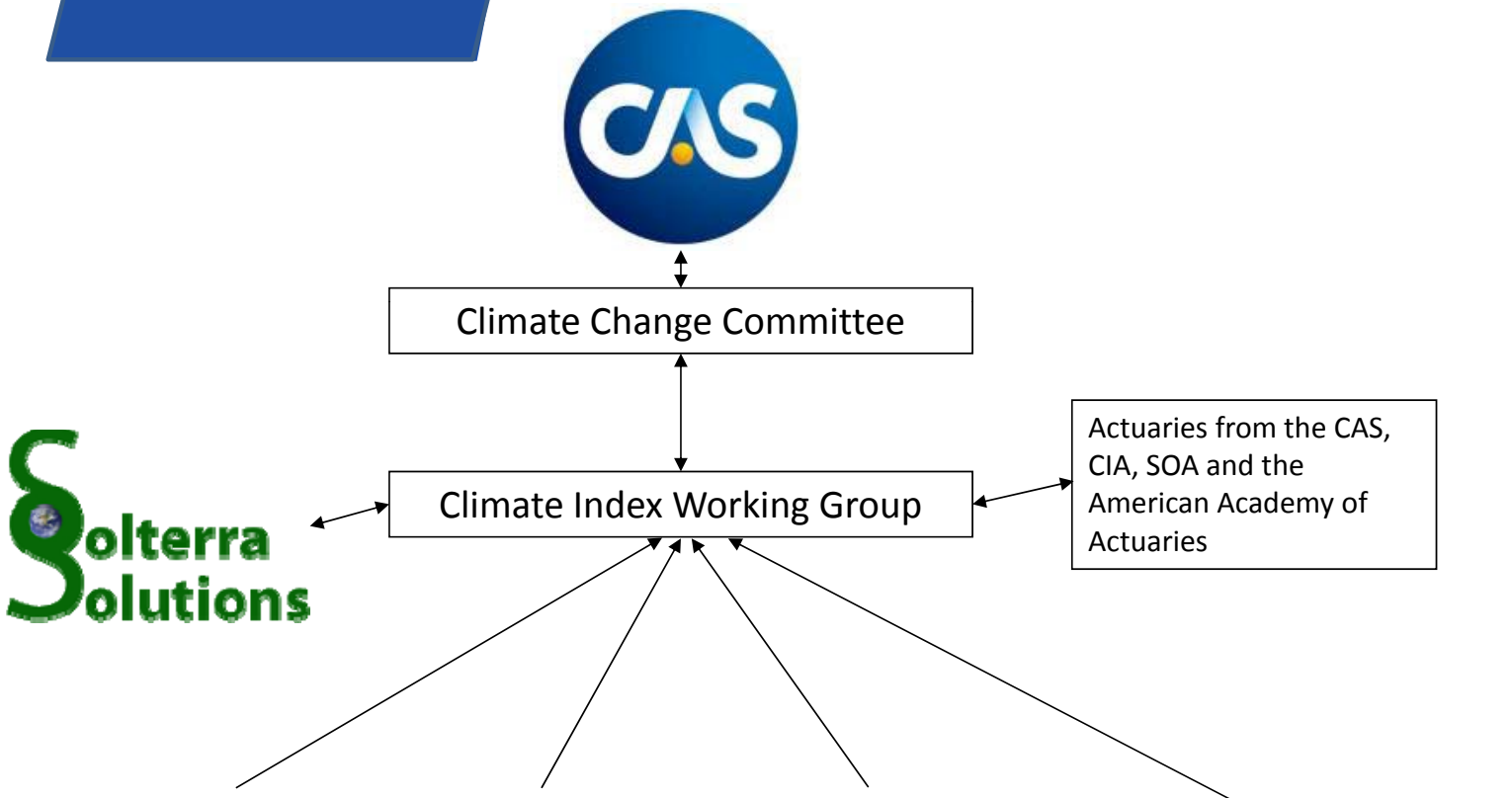
ACI & ACRI


Climate Change Committee
Climate Index Working Group
Actuaries from the CAS, CIA, SOA and the American Academy of Actuaries
Solterra Solutions
American Academy of Actuaries
Society of Actuaries
Canadian Institute of Actuaries
Institut canadien des actuaires

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Actuaries Climate Index

- Resources: Solterra Solutions and CIWG
- Timing: Spring 2015
- Goals:
  - Easy to understand, but not simplistic
  - Compelling
  - Serves and educates the public
  - Promotes our profession

ACI Basics

- Initial focus US and Canada
  - Hope to gradually add other parts of world where good data is available
  - Publish index and related information on web
- Focus on measuring frequency and intensity of extremes rather than averages
- Six variables we are planning to use, all by 2.5° grid (275km x 275km at equator), summarized by 12 regions and by country :
  - Temperature (highs and low separately),
  - Precipitation,
  - Drought,
  - Wind,
  - Sea level
- Working on web site now

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Extreme Temperatures Indices

- Global Historical Climatological Network (GHCN) – global, land station-based, gridded dataset, daily from 1950-present (GHCN-Daily)
- GHCNDEX indices* based on the above:
  - TX90 = 90%ile warm days
  - TN90 = 90%ile warm nights
  - TX10 = 10%ile cold days
  - TN10 = 10%ile cold nights
- The average of % anomalies relative to the 1961-1990 reference period for T90 and T10:
  - Standardized anomaly (T10′ similar): $T90' = \Delta T90 / \sigma_{ref}(T90)$

* Produced as part of the CLIMDEX project by the Climate Change Research Centre, at The University of New South Wales, Australia.

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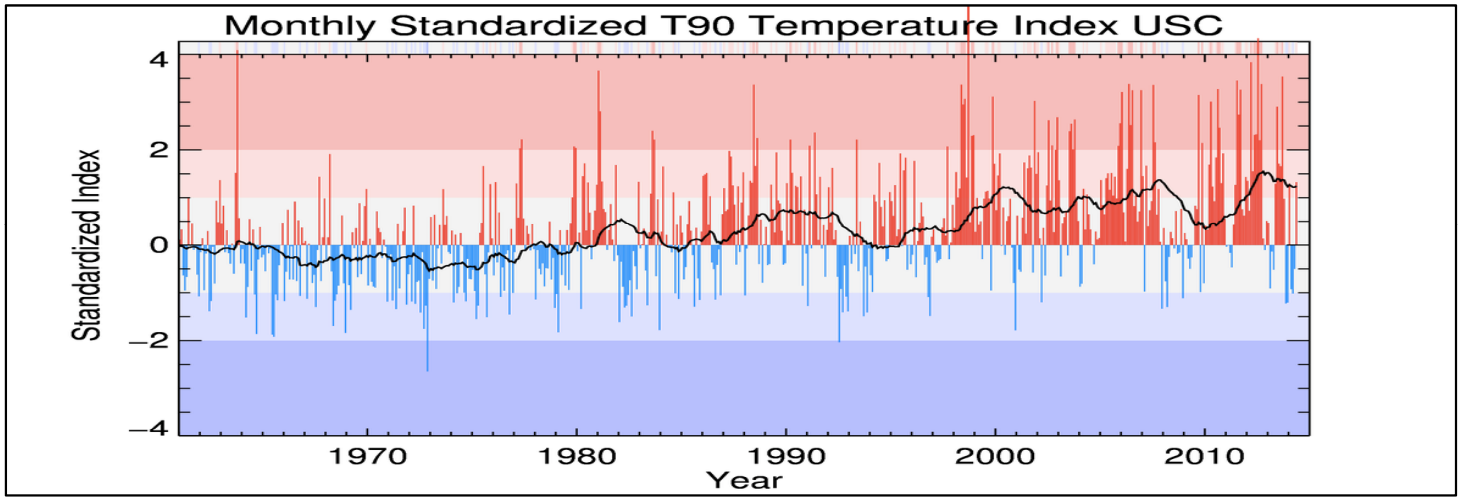
ACI & ACRI


Monthly Standardized T90 Temperature Index USC
Standardized Index
4
2
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−4
1970
1980
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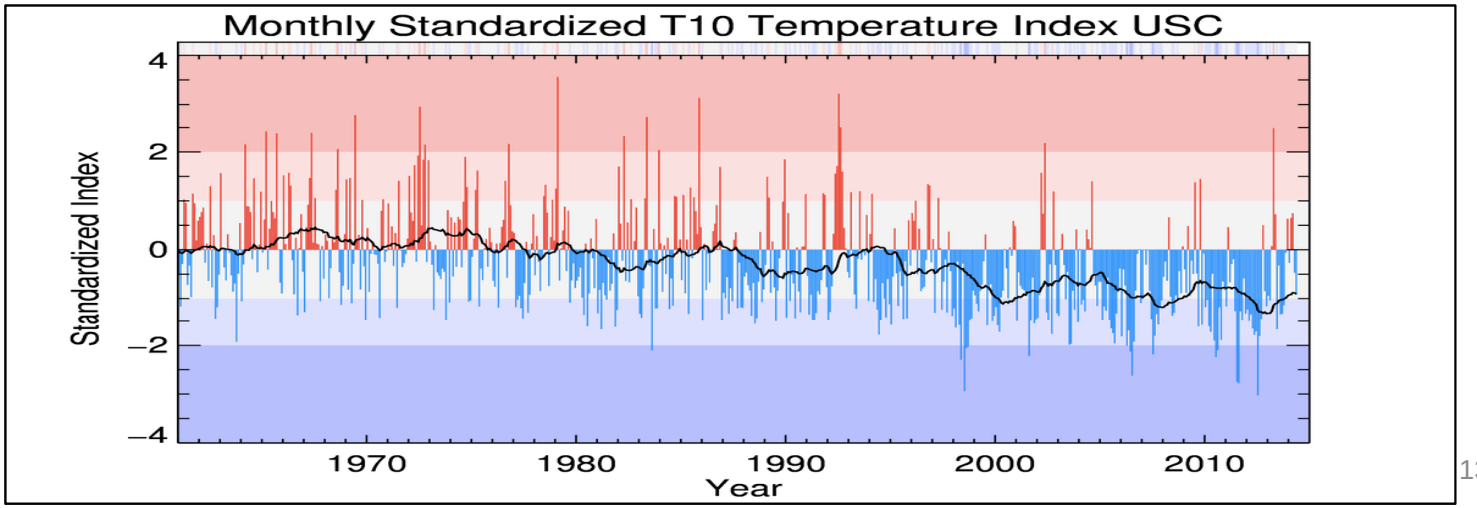
2000
2010
Year


Monthly Standardized T10 Temperature Index USC
Standardized Index
4
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−4
1970
1980
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2000
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Year

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Extreme Precipitation Indices

- GHCNDEX monthly maximum five-day precipitation data
  - Heavy precipitation index, Px = $[(Rx5day - Rx5day_{ref}) / Rx5day_{ref}] \times 100\%$
- GHCNDEX, consecutive dry days (CDD) = Max days/year with <1mm precipitation
  - Drought index = 1 value of CDD/year
  - Linear interpolation to obtain monthly
  - $Dx = 100\% * [(CDD - CDD_{ref})/CDD_{ref}]$

Wind Power Index

- Index derived from NOAA Earth System Research Laboratory data:
  - Daily mean wind speeds
  - $WP = (1/2)*\rho*w^3$
    Where ρ is air density, w is daily mean wind speed
- $Wx = 100\% * [(WP90 - WP90_{ref})/WP90_{ref}]$
  - Where WP90 is the 90th percentile of daily wind power, calculated monthly: W' std $= \Delta Wx / \sigma_{ref}(Wx)$

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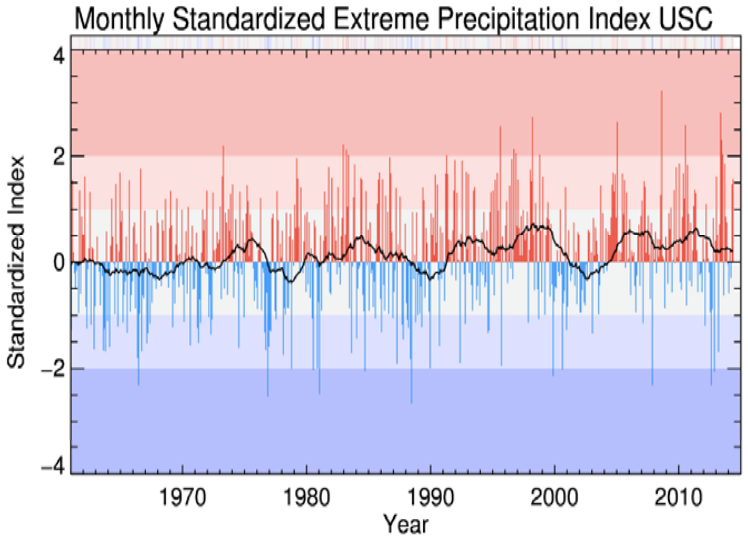
Sea Level Index

- At tide gauge stations along US and Canada coast
  - Data provided by Permanent Service for Mean Sea Level (PSMSL), part of the UK's National Oceanography Center
  - Data will be matched to grids used for other variables
  - S' std = ΔS / $\sigma_{ref}(S)$

ACI & ACRI


Monthly Standardized Extreme Precipitation Index USC
Standardized Index
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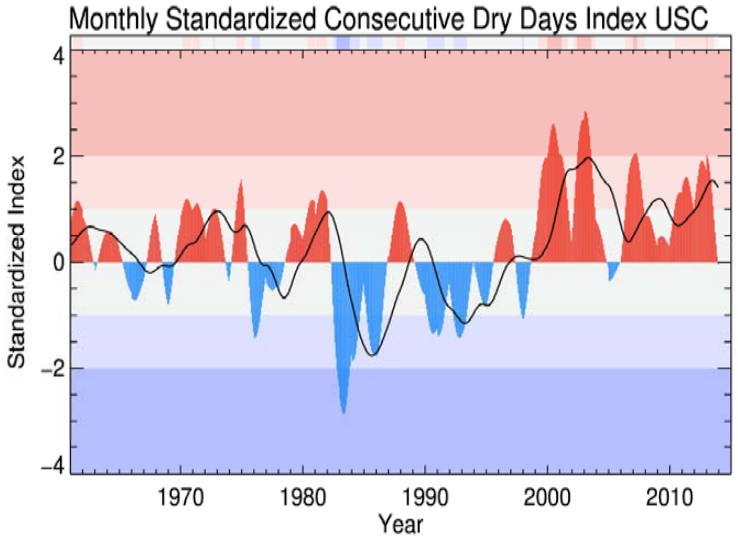
Year


Monthly Standardized Consecutive Dry Days Index USC
Standardized Index
4
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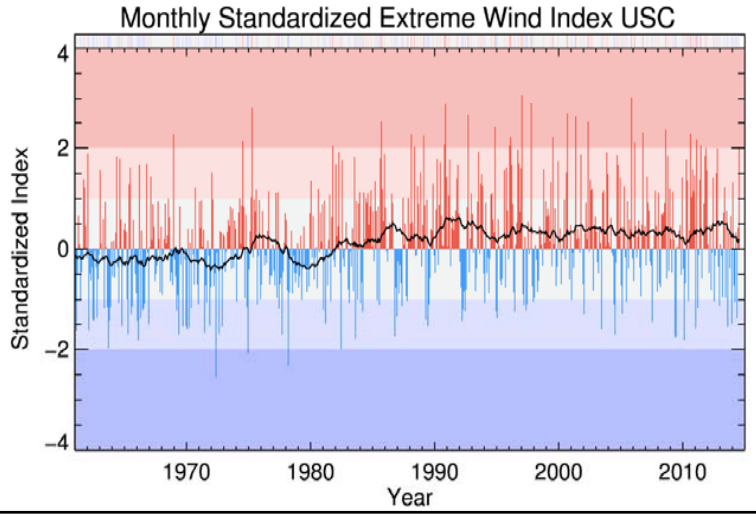
Year


Monthly Standardized Extreme Wind Index USC
Standardized Index
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2
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−4
1970
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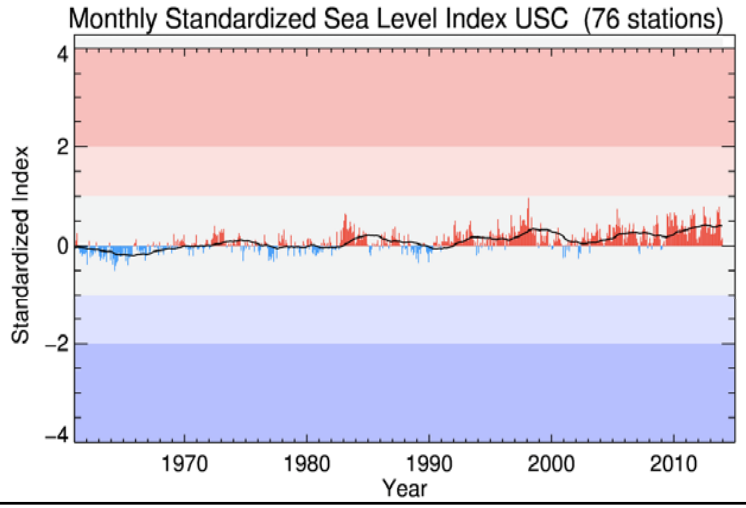
Year


Monthly Standardized Sea Level Index USC (76 stations)
Standardized Index
4
2
0
−2
−4
1970
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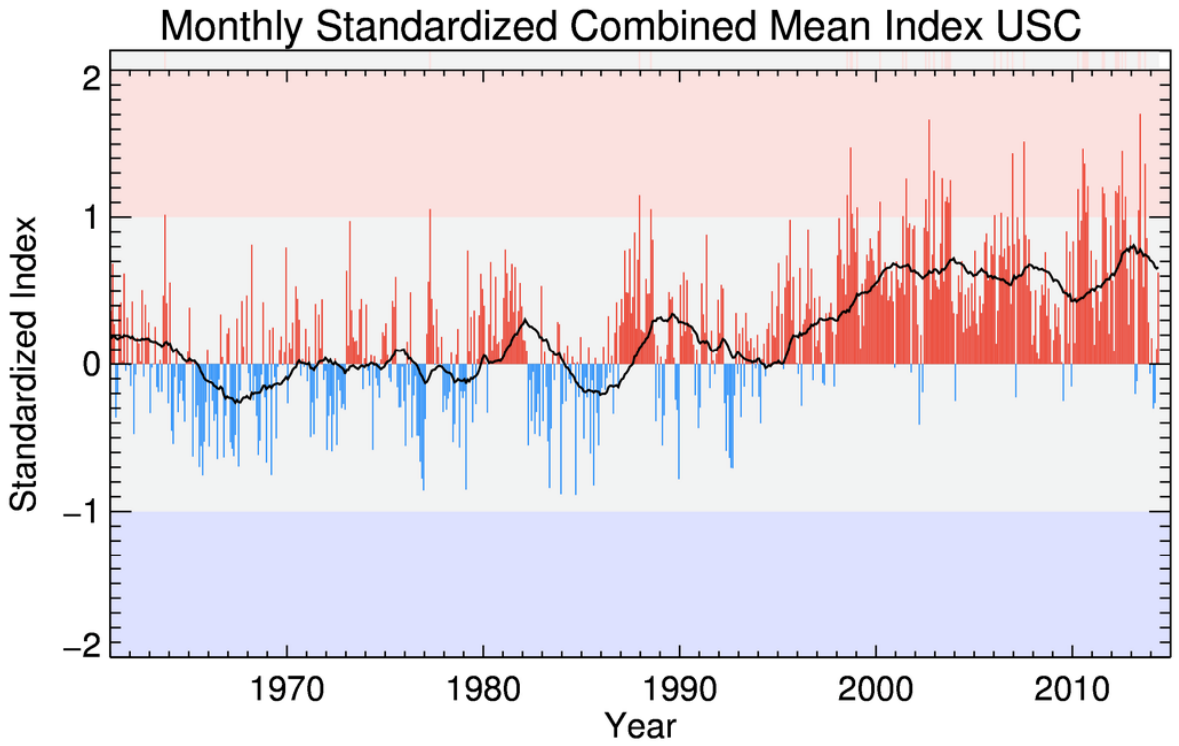
Year

Composite ACI Index

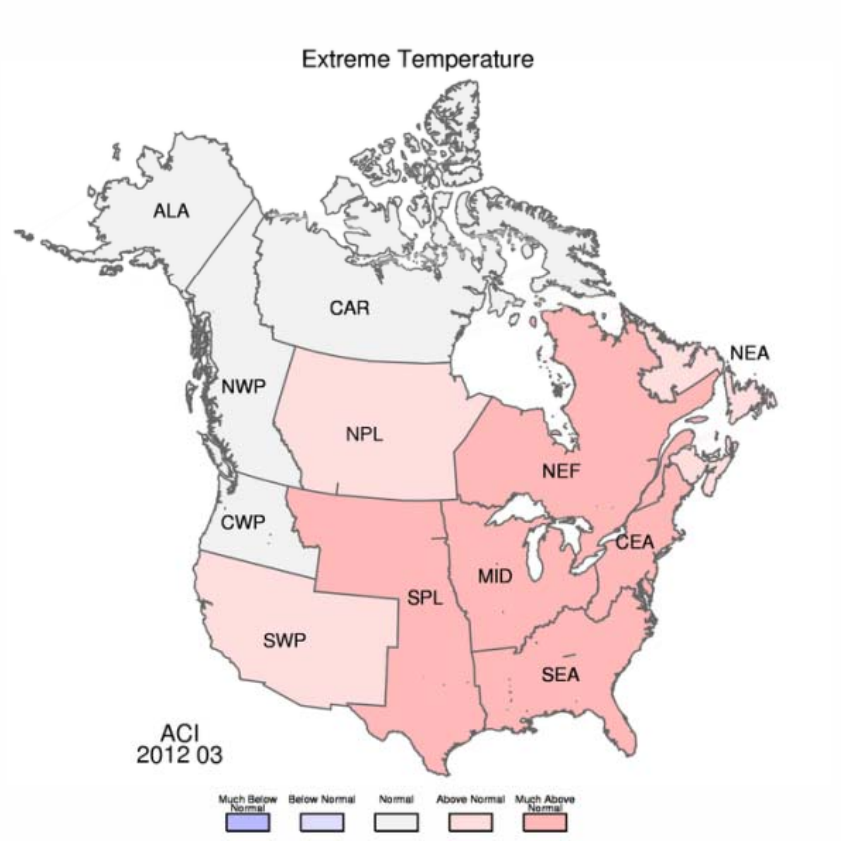
- Unweighted average of standardized anomalies
  - *ACIstd* = (*T90′std* –*T10′*std + *Px′std* + *Dx′std* + *Wx′std* + *S′std*) / 6



ACI Communication

- Quarterly press releases
- Website
  - Charts of index components and composite indices
  - Maps of variation by 12 regions
  - Commentary in English and French
  - Links to related information

Website Prototype Region Map



Actuaries Climate Risk Index

- Combine components of ACI with exposure measures (e.g., population, GNP per capita) to produce "physical exposure"
- Measure correlation of economic losses by peril to the physical exposure
  - Using SHELDUS data for economic losses, mortality and morbidity
  - Economic losses available for flood, wind, fire, crop
- Goal is to produce an index especially useful to the insurance industry
  - ACRI rollout Summer 2015

Index Resources

- Donat, M. G., et al. 2013. Global land-based datasets for monitoring climatic extremes. Bulletin of the American Meteorological Society, July, 997-1006, doi:10.1175/BAMS-D-12-00109.1.

- Hansen J., et al. 1998, A Common Sense Climate Index: Is Climate Changing Noticeably? PNAS, 95, 4113-4120

- Solterra Solutions, Determining the Impact of Climate Change on Insurance Risk and the Global Community, Phase I: Key Climate Indicators, November 2012. Available at: www.casact.org/research/ClimateChangeRpt_Final.pdf

- Data sources:
  - GHCNDEX: www.climdex.org
  - GHCN-Daily: www.ncdc.noaa.gov/oa/climate/ghcn-daily/
  - Soil Moisture: www.esrl.noaa.gov/psd/data/gridded/data.cpcsoil.html
  - Sea Level: www.psmsl.org/data/obtaining/
  - Wind: www.esrl.noaa.gov/psd/data/gridded/datancep.reanalysis.html
  - Economic Losses: http://webra.cas.sc.edu/hvriapps/sheldus_setup/sheldus_login.aspx