A native Washingtonian, Jason Samenow has been a weather enthusiast since 1987, the year of the “double whammy” snow storms that shut schools down seven straight days in the Washington, D.C., area. He was 10.

Before graduating from high school, Jason interned for NBC4’s chief meteorologist Bob Ryan. At the University of Virginia, he earned a degree in environmental science with a focus in atmospheric science. He went on to earn a master’s degree in atmospheric science at the University of Wisconsin-Madison in 2000.

Jason is currently The Washington Post’s weather editor. From 2000 to September 2010, he worked as a climate change analyst for the federal government, monitoring, analyzing, and communicating the science of climate change. He founded CapitalWeather.com in early 2004, the first professional weather blog on the Internet, which was absorbed by The Washington Post in 2008.

Jason is a past chairman of the D.C. chapter of the American Meteorological Society and a Weather and Society Integrated Studies fellow. Jason lives with his wife, Deborah, and son, Evan, in Washington, D.C.
Three Session Ideas
Tools or tips you learned from this session and can apply back at the office.

1. 

2. 

3. 

Wild Weather Trends: Climate Change and Extreme Events in the Past, Present, and Future.

Jason Samenow
Weather editor, The Washington Post

About me
- Lifelong weather enthusiast
- Atmospheric science degrees
  - B.A. University of Virginia
  - M.S. University of Wisconsin
- Climate change analyst, U.S. EPA, 2001-2010
- Washington Post weather editor since 2010
About the Capital Weather Gang

• Washington Post’s weather team
• Blog, social media, radio voice for NPR affiliate, print, video
• 2 full-time meteorologists
  – 20 contributing freelance writers
• Broad mix: Local → National → International Weather
• Weather adjacent topics: Climate change, space weather, astronomy
• Commitment to reader engagement, communicating uncertainty

Talk outline

• The climate is changing: the evidence
• The near term forecast
• The long term forecast
• Questions and answers
Climate change evidence: Inexorable rise in CO2 concentrations

Global Atmospheric Concentrations of Carbon Dioxide Over Time

![Graph showing CO2 concentrations over time](chart)

Data source: Compilation of 19 underlying datasets. See [www.epa.gov/climatechange/indicators/ghg/ghg-concentrations.html](http://www.epa.gov/climatechange/indicators/ghg/ghg-concentrations.html) for specific information.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climatechange/indicators](http://www.epa.gov/climatechange/indicators).

Climate change evidence: Global temperatures are rising

Temperatures Worldwide, 1901–2014

![Graph showing temperature anomalies](chart)


For more information, visit U.S. EPA’s "Climate Change Indicators in the United States" at [www.epa.gov/climatechange/indicators](http://www.epa.gov/climatechange/indicators).
Climate change evidence: U.S. temperatures are rising

Rate of Temperature Change in the United States, 1901–2014

-3.5 to -1°F
-1 to 0°F
1 to 2°F
2 to 3.5°F
3.5°F


For more information, visit U.S. EPA “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.

Climate change evidence: Increasing warm weather extremes

Area of the Contiguous 48 States with Unusually Hot Summer Temperatures, 1910–2014

- Hot daily highs
- Hot daily high (smoothed)
- Hot daily lows
- Hot daily low (smoothed)


For more information, visit U.S. EPA “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.
Climate change evidence: Record high temperatures outpacing record low temperatures

Record Daily High and Low Temperatures in the Contiguous 48 States, 1950–2009


For more information, visit U.S. EPA’s “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.

Climate change evidence: More heavy rain and snow

Extreme One-Day Precipitation Events in the Contiguous 48 States, 1910–2014


For more information, visit U.S. EPA’s "Climate Change Indicators in the United States" at www.epa.gov/climatechange/indicators.
Climate change evidence: More heavy rain and snow

Climate change evidence: More precipitation falling as rain than snow
Climate change evidence: Declining western snowpack

Climate change evidence: Little trend in drought


For more information, visit U.S. EPA’s “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.
Climate change evidence: Little trend in Atlantic hurricane activity (1/2)

Number of Hurricanes in the North Atlantic, 1878–2014

- Total hurricanes (adjusted)
- Total hurricanes (unadjusted)
- Hurricanes reaching the United States

Data sources:

For more information, visit U.S. EPA’s “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.

For more information, visit U.S. EPA’s “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.
Climate change evidence: Little trend in Atlantic hurricane activity (2/2)

- North Atlantic Tropical Cyclone Activity According to the Accumulated Cyclone Energy Index, 1950-2014


For more information, visit U.S. EPA’s “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.

Major hurricane drought: Longest on record

- Last major hurricane to strike U.S.: Wilma, 2005
- Florida has not been hit since
- Vulnerability increasing? Complacency, coastal population increase and development boom
- Category can be misleading: Sandy (Cat 1) and Ike (Cat 2) very destructive but not major
- (This is not evidence for or against climate change)
Tornadoes increasingly coming in packs

- 2014 studies (Elsner et al. and Brooks et al.): Big tornado days featuring densely concentrated tornado outbreaks on the rise

Data sources:
- For more information, visit U.S. EPA “Climate Change Indicators in the United States” at www.epa.gov/climatechange/indicators.

Climate change evidence: Rising seas
Climate change evidence: Rising seas (2/2)

Climate change evidence: Billion dollar weather disasters in the U.S.
Climate change evidence: Insured and uninsured disaster losses

![Graph showing insured and uninsured disaster losses over time.](http://www.iii.org/fact-statistic/catastrophes-global)

Weather disaster losses going down as product of GDP

![Bar chart showing global weather-related disaster losses as a proportion of global GDP from 1995 to 2015.](http://www.iii.org/fact-statistic/catastrophes-global)
Observed evidence conclusions

- Warming signal consistent across indicators
- Increasing warm weather extremes (and fewer cold weather extremes)
- Increasing heavy precipitation
- No apparent trend in hurricanes and drought in U.S. (“Other trends in severe storms, including the intensity & frequency of tornadoes, hail, and damaging thunderstorm winds, are uncertain” – U.S. Climate Assessment, 2014)
- Climate signal in disaster losses inconclusive and controversial; exposure the biggest driver

The near term forecast: Through the winter

- El Nino looms large
- Arctic Oscillation wild card for east
  - Implications for the polar vortex
- The ‘blob’ wild card for West
El Nino: One of the strongest on record?

Strong El Nino: Top 5 impacts

1) Substantially increases odds of heavy rain/snow in California
2) Reduced Atlantic hurricane activity
3) Milder than average winter northern U.S.
4) Stormier/cooler than normal in the South
5) Boosts global temperatures

- LA Times: “a relentless string of storms caused havoc, washing away roads and railroad tracks, overflowing flood control channels, causing 17 deaths and more than half a billion dollars in damage in California.”
- “Mobile home parks in Huntington Beach flooded. Rescuers were forced to use inflatable boats and a catamaran to scoop up residents. Mudslides destroyed hillside homes. Major roads were made impassable by debris.”
- February: 13.68 inches of rain in downtown Los Angeles

The ‘blob’: The wild card in the West

- Blob = persistent area of warm areas off Pacific Northwest and West coast
- Has been in place past two winters, favoring a storm track that favors “ridiculously resilient ridge”, deflecting Pacific storms, feeding into drought
- It’s still there. How will it interface with El Nino?
The Arctic Oscillation: Wild card for the Eastern U.S.

- Northern U.S. usually mild during El Nino, but a negative Arctic Oscillation could mean a third straight cold, snowy winter
- July AO was strongly negative
- 10/10 Julys w/ -AO had winters with - AO

AO would favor more “polar vortex events”
A low confidence forecast for this winter

• Wet in southern California
• Mild, dry Pacific Northwest to Upper Midwest
• Stormy, colder than average in Mid-Atlantic and Northeast
• Chilly, damp across the South

The long-term outlook

• A warmer world
• A wetter world
• A more extreme world?
U.S. Temperatures: Substantial warming, especially for high emissions

Projected Temperature Change

Lower Emissions (B1)  Higher Emissions (A2)

Temperature Change (°F)

3  4  5  6  7  8  9  10  15

Increases in hot weather extremes

Projected Temperature Change of Hottest Days

Rapid Emissions Reductions (RCP 2.6)  Continued Emissions Increases (RCP 8.5)

Temperature Change (°F)

3  4  5  6  7  8  9  10  15
U.S. Precipitation: Wetter north, drier south

Projected Precipitation Change by Season

Warmer climate increases drought, wildfire potential

- August 2015 study on California drought: “Precipitation is the primary driver of drought variability but anthropogenic warming is estimated to have accounted for 8–27% of the observed drought anomaly in 2012–2014 and 5–18% in 2014.”


- EPA 2015 report: “Without global GHG mitigation efforts, climate change is projected to dramatically increase the area burned by wildfires across most of the contiguous U.S., especially in the West.”

http://www2.epa.gov/cira/climate-action-benefits-wildfire
Increases in extreme precipitation

Projected Change in Heavy Precipitation Events

Tornadoes and thunderstorms: Uncertainty on future changes

• 2013 study (Diffenbaugh et al.): Modeling experiment shows increase in number of days with favorable tornado ingredients in warmer world
Hurricanes: Gradual increase in intensity projected to emerge

• Anthropogenic warming by the end of the 21st century will likely cause hurricanes globally to be more intense on average (by 2 to 11% according to model projections for an IPCC A1B scenario). This change would imply an even larger percentage increase in the destructive potential per storm, assuming no reduction in storm size.

• There are better than even odds that anthropogenic warming over the next century will lead to an increase in the numbers of very intense hurricanes in some basins—an increase that would be substantially larger in percentage terms than the 2-11% increase in the average storm intensity.

• Anthropogenic warming by the end of the 21st century will likely cause hurricanes to have substantially higher rainfall rates than present-day hurricanes, with a model-projected increase of about 20% for rainfall rates averaged within about 100 km of the storm center.


Rising seas, potentially substantially

Past and Projected Changes in Global Sea Level

- Proxy Records
- Tide Gauge Data
- Satellite Data

Sea Level Change (feet)

1800 1850 1900 1950 2000 2050 2100

Year

6.6 ft
4 ft
1 ft
0.66 ft

-1 0 1 2 3 4 5 6 7
More erratic jet stream and “stuck” extreme weather?

• “Drunk Arctic” hypothesis
• Reduction in Arctic sea ice decreases temperature contrast between poles and mid-latitudes → slower, wavier, more erratic jet stream
• Jet stream more prone to getting stuck in extreme positions

General conclusions

Prediction is hard, especially about the future

• What’s virtually certain:
  – Earth continues to become warmer
  – Heavier rain storms
  – More hot weather extremes, fewer cold weather extremes
  – Seas rise
• What’s likely:
  – Droughts are more intense and longer lasting
  – Wildfires become worse
  – Hurricanes gradually become more intense
• What’s possible:
  – Extreme weather patterns are more persistent due to wavier jet stream
  – Tornadoes, severe thunderstorms become more intense, especially during transition seasons
Contact

Jason Samenow
Jason.samenow@washpost.com
202.334.9937

Twitter: @capitalweather
FB: facebook.com/capitalweather