

Brief summary of “Identification of Human-Induced Changes in Atmospheric Moisture Content”, by B.D. Santer *et al.*

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Q1: What is the scientific focus of our PNAS paper?

Our paper looks at the causes of changes in the moisture content of Earth’s atmosphere. Since the start of routine satellite-based measurements of atmospheric water vapor in September 1987, atmospheric moisture content has increased markedly. This increase had been noted in previous scientific papers, and was prominently mentioned in the IPCC’s Fourth Assessment Report. But the causes of the increase were not known. Our investigation was the first to use rigorous statistical “fingerprint” methods to tackle the question of why water vapor has increased.

Q2: What is climate “fingerprinting”?

Basically, “fingerprinting” involves searching for a computer model-predicted pattern of climate change (the “fingerprint”) in observed climate records. Fingerprint techniques allow researchers to examine a change in some property of the climate system and make rigorous statistical tests of the different possible explanations for that change.

Q3: What were the primary findings of our study?

Our key findings were as follows:

- Despite the relatively short length (19 years) of the observed water vapor data, we were able to identify a “fingerprint” of human activities in this observational record.
- Unlike most previous “fingerprint” work, our study used results from virtually all of the world’s major climate models. We showed that our identification of a human “fingerprint” in satellite-based water vapor records was robust to current uncertainties in climate models.
- The model results enabled us to “disentangle” the contributions of different factors to the overall increase in water vapor. We found that in climate models, this increase in water vapor was primarily due to human-caused increases in greenhouse gases.
- Bottom line: our results suggest that there is an emerging signal of human activities in the moisture content of Earth’s atmosphere. The climate system is

telling us a consistent story. The observed changes in temperature, moisture, and atmospheric circulation fit together in an internally- and physically consistent way.

Q4: Does our work have any larger implications?

Yes

One persistent criticism of the “discernible human influence” findings of previous IPCC assessments is that such conclusions were largely based on “fingerprint” studies which relied heavily on surface temperature changes. The thrust of the criticism was this:

“If there really is a signal of human activities lurking in the climate system, it should be manifest in many different climate variables, and not in surface temperature alone”.

Our study helps to refute this criticism, and shows that we have now moved well beyond “temperature only” fingerprint studies.

Q5: Why should we care about the behavior of water vapor?

There are at least three reasons why we should pay attention to water vapor. First, water vapor is itself a potent greenhouse gas, so it is important to have a good understanding of the cause or causes of its recent increase. Second, atmospheric moisture content is one of the large-scale environmental conditions that influences the genesis and development of hurricanes. In the absence of countervailing changes in other factors, an increase in water vapor would favor the development of more intense hurricanes. Finally, the observed increase in water vapor provides independent evidence of the reality of warming of the lower atmosphere. The observed water vapor increase since 1988 is consistent with pronounced warming of the surface and lower atmosphere, but fundamentally inconsistent with claims (still made by some die-hard skeptics!) that the lower atmosphere has cooled over recent decades.

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