

Connecting the Global Water Cycle with Climate Change Transcription

We know that the earth is warming. These are the temperature changes from probably about the 1850s to 2005 or so. These are carefully constructed from temperatures on land and on the ocean. The dots represent the annual average, and then the red line represents the 5 year average. It has been especially strong since about the 70s. We're in a period of pretty strong warming of about ½ a degree centigrade since the 70s.

The important thing for us is that we expect that to have a consequence of really intensifying the global water cycle. This plot shows the vapor pressure of water as a function of temperature. This is just derived from the thermodynamic properties of the water molecule; it's dictated by the physics of the water molecule.

The important thing to note is that the average temperature of the globe right now, the average surface temperature of the planet is around 15 degrees C. At that temperature the rate of increase is about 7% increase in vapor pressure per degree C. You'll notice this curve is not a straight line, it's an exponential curve. The fact that you could get 7% increase for one degree change suggests we could be in for a wild ride in the climate system in the future. You can see that if the temperature is just a little bit warmer we can hold a lot more water vapor in the atmosphere. That will intensify the water cycle.

Now this is a point of some controversy in models. The meteorologists believe that there are certain feedbacks in the climate system in the atmosphere that cause the reaction, the intensification of the water cycle, to be less than the 7% per degree. They think it is only about 2% per degree. But if we look at the oceanographic data which I think is a better indicator of the water cycle, we come to a different conclusion.

This comes from looking at the changes in salinity over the global ocean. Again here's another map of the global ocean salinity. The salty Atlantic is redder. The Pacific is bluer. If you look at the change in salinity over 50 years, going back 50 years our data weren't so complete. For the last decade or so we've gotten really good data on ocean salinity. What we're seeing is some remarkably strong trends. The salty areas are getting saltier, and the fresh areas are getting fresher. This is a change of 0.2 in salinity. Those are pretty large changes for an oceanographer. That change over the 50 years is in pretty good agreement with that basic idea of the intensification of the water cycle corresponding to 7% per degree. It's in not such good agreement with the meteorologist claim that it's only going to be 2% per degree.

I'm going to have another slide showing that. Here's the sea surface salinity in the top panel, the change in salinity over the 50 years. Again, the red areas are getting redder, and the blue areas are getting bluer. And here's the distribution of the evaporation and precipitation. My main point is most of the water cycle is over the ocean, and when we look at ocean salinities which are a direct indicator of the intensity of the water cycle, we see a strong intensification of salinity contrasts, which has to be tied to a rapidly strengthening global water cycle.