A New View on the Water Cycle Transcription

We're putting all of this heat into the ocean from the sun's radiation. The important thing that we'll be concerned with today is how that fuels the global water cycle. Let me start out with one of the movies here. This is just a fairly simple straightforward explanation of the water cycle. It's a very traditional picture. We see the sun providing energy to the earth. A lot of that energy of course is going into warming the ocean. It causes the water to evaporate. It gets transported—in this case—over land, and even up into the mountains where it is going to snow. This whole cycle of precipitation contributing to groundwater transport we are showing here. As the snow melts and enters the system here we're showing runoff, as the water flows into the rivers and goes back into the ocean. That whole cycle of evaporating from the ocean, transporting onto land, and raining out or snowing out and flowing back into the ocean is what's traditionally called the water cycle.

But I have a problem with this picture as an oceanographer. That problem really comes up from that view of the globe we saw. There's just a little bitty ocean here, just this small chunk of ocean, when in fact we know that the planet is mostly ocean. In fact there was that quote that I didn't mention at the time, but Arthur C. Clarke said, "We should have called this planet Ocean instead of Earth."

If we can look at some of the slides, this one is spread in quantitative, but it shows the global reservoirs and fluxes. These reservoirs are thousands of cubic kilometers of water. So there's a huge number here. Let's just do percentages. 97% of the water on the planet is in the oceans. Only .001% is in the atmosphere, and about 3% is tied up on land, mostly in the Greenland and Antarctica ice caps.

Then the other numbers next to the arrows here show the flow between these reservoirs. The largest one is evaporation, evaporation from the surface of the ocean—the number we oceanographers like to use called the sverdrup (Sv), named for a famous oceanographer from Scripps—so 13.5 Sv of water evaporating from surface of the ocean. A Sverdrup is a million cubic meters per second.

The flow of the Amazon River which is the world's largest river amounts to two tenths of a sverdrup. The flow of all rivers over the whole globe only amounts to 1.3 Sv. The flow of the Gulf Stream in the Straits of Florida is about 30 Sv. So it's a big number, but it's the number we have to use in oceanography to measure currents, like I mentioned the Gulf Stream at 30 Sv, and further downstream it builds up to about a 100 Sv. You get similar numbers for the Antarctic Circumpolar Current and the Kuroshio in the Pacific.

Of the 13 Sv evaporating from the ocean about 12 are raining right back down on the ocean. What's left for land, and on land of course you have evapotranspiration; the land has its own small water cycle. You see the flow of all the rivers is only about 10% of the evaporation from the surface of the ocean. The ocean really dominates the global water cycle.

If we go and sum up all our estimates of atmospheric transport and ocean evaporation and precipitation, we can make a figure like this which shows the north-south transports of water on the planet by the atmosphere in the dashed line, and by the ocean in the solid line. These are rough numbers. There's lots of things we don't know about the exact numbers yet. That's why we are putting up all of these satellites and sensors. I just want to point out that the flow of rivers--here is the Mississippi, a large north-south river—makes a very small contribution when viewed in terms of the global water cycle.