How Does Atmospheric Circulation Affect Rainfall? Transcription

How does the atmosphere affect land? We can exchange heat and freshwater between the atmosphere and the land surface, as you can see here. I'm going to give a couple of examples. This will be a nice animation of rainfall over the season. You can see the how the patterns of rainfall, which I indicated by red colors, progress over the season. You can see that there are areas with a lot of rainfall, especially around the maritime continents and generally in the tropics you have the highest rainfall. I'll explain later how that happens.

The land surface reacts to this input of freshwater. The input of freshwater is very important for humankind, since we are largely dependent on that for agriculture and to just live in a habitable area. As you can see here, the vegetation changes over the season, especially in the northern hemisphere. Green indicates large vegetation, and grayish areas as you can see here in the Sahara, there's basically no vegetation at all; we all know that this is a desert area.

That brings me to my next point. In climates where you lose freshwater on average you will form a desert region. The Sahara is the best example I think. This is a schematic that helps explain these large scale phenomena. Basically the atmosphere as well as the ocean moves in three dimensions. You can set this up. Generally you have very hot and moist air in the tropics that tends to rise. While it rises it rains heavily. This is what is called the Intertropical Convergence Zone which will lead to this band of high precipitation that we saw earlier.

Once that air rains out all the moisture, it gets transported to the north and the south respectively. Right where the Sahara is in the subtropics this air subsides slowly. But it is so dry that there is almost no rainfall in these areas. Still, we are rather close to the equator, closer than the mid-latitudes, and that leads to a lot of evaporation, but due to the evaporation of the precipitation we lose a lot of freshwater in these areas, causing the desert regions as you see here in the Sahara.

So the same thing occurs in the ocean. Obviously the ocean will not show this as nicely as with the vegetation pattern. So you cannot really see it with the bare eye. This shows a map of sea surface salinity. When you constantly remove freshwater from the sea surface, the salt stays behind, which enhances your sea surface salinity as is seen here.

This is a picture composed of I believe Aquarius data. There are two satellites out there that have been measuring salinity for I think one or two years. I think Aquarius just turned two. Also shown here are the cruises that were part of the SPURS program. There were two cruises from the New England area to the study site, and there was one Spanish cruise that I was also a part of that went from the Canary Islands to the Azores.

This is a little schematic that explains the SPURS program. The SPURS program aims at understanding the freshwater cycle in a process study. So we basically focus an immense amount of measurement in a relatively confined area which is the sea surface salinity maximum which is in the North Atlantic, which is the highest sea surface salinity in all of the world's ocean basins. You can see

here the various amounts of measurements that we did. There are shipboard measurements which I'm mainly working with. There are autonomous measurements like floats and gliders. Steve Riser is going to talk about the floats in the next series. As I mentioned there is also observations from space. There's an American satellite, Aquarius, and there's a European satellite SMOS. There's also anchored buoys that observe the area at a fixed point and with depth for the 4 quarters of the year. Tom Farrar will hopefully give you some great info on these measurements in the last talk of this series.

As I said I'm mainly involved with shipboard measurements. What I am going to show today is what was mostly collected with the Spanish ship, the Sarmiento de Gamboa. I am going to talk about the measurements a little later.