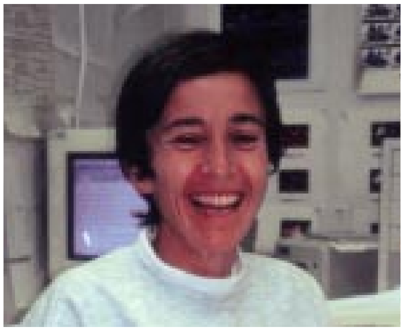
So When Is the Next El Niño Coming?



I'm Claire Perigaud and I work with a team of oceanographers at the Jet Propulsion Laboratory (JPL) in California. Our goal is to understand how the oceans interact with the atmosphere to trigger events such the 1997/98 El Niño. I would like to introduce my team: current members are Frederic Melin, Christophe Cassou, Pierre Garnier, and Pierre Florenchie [Fig. 1]. These graduate students work at JPL for two-year periods. This is a great arrangement because the students always bring fresh ideas. Our team's friendship and our exciting discoveries about the way in which the ocean and the atmosphere interact make this important task a fun one.

Figure 1. Photo of Frederic (left) and Christophe (right) on sand dunes.

I am a physical oceanographer and I am working to understand what the ocean is doing and what is forcing it to move in the way it does. To do this I use sea surface temperature data, ocean wind data, ocean height data collected from satellites and mathematical equations called models. Our team has developed a computer model to understand how ocean winds push the warm surface waters around, and how these displaced, or "pushed around" warm ocean areas, in turn create winds. We are working to use the model to predict what will happen in the next few months.

One of the most interesting examples of this wind-ocean interaction is the El Niño event [Fig. 2]. As you can discover in greater detail in the El Niño section, an El Niño occurs when the trade winds weaken and allow a warm "pool" of surface water to travel across the Pacific. This displaced warm water hits the west coast of Peru and then spreads north and south along the coasts of North and South America. These El Niño events have a large impact on people and happen every few years [Fig. 3], so it is important to understand how they are created.

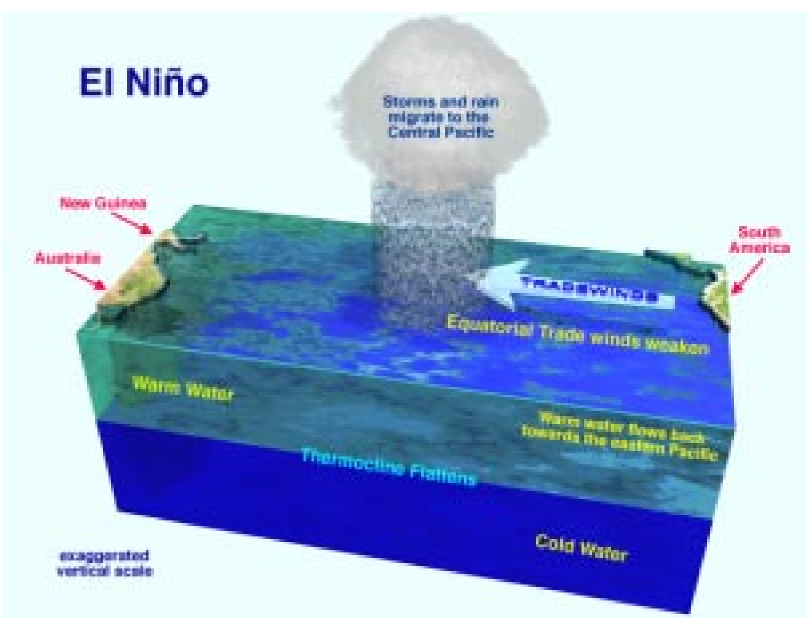


Figure 2. Diagram of El Niño.

The model that we have developed to understand and predict the El Niño is a series of equations that try to describe the major ocean events that affect the movement and temperature of the winds and water in the equatorial Pacific. We use real data in the models and then we let the models 'run by themselves,' which means that they do a lot of repeat calculations on a computer. When the models 'run,' they automatically figure out what the ocean and the winds are going to be like, i.e. where the waters are going to

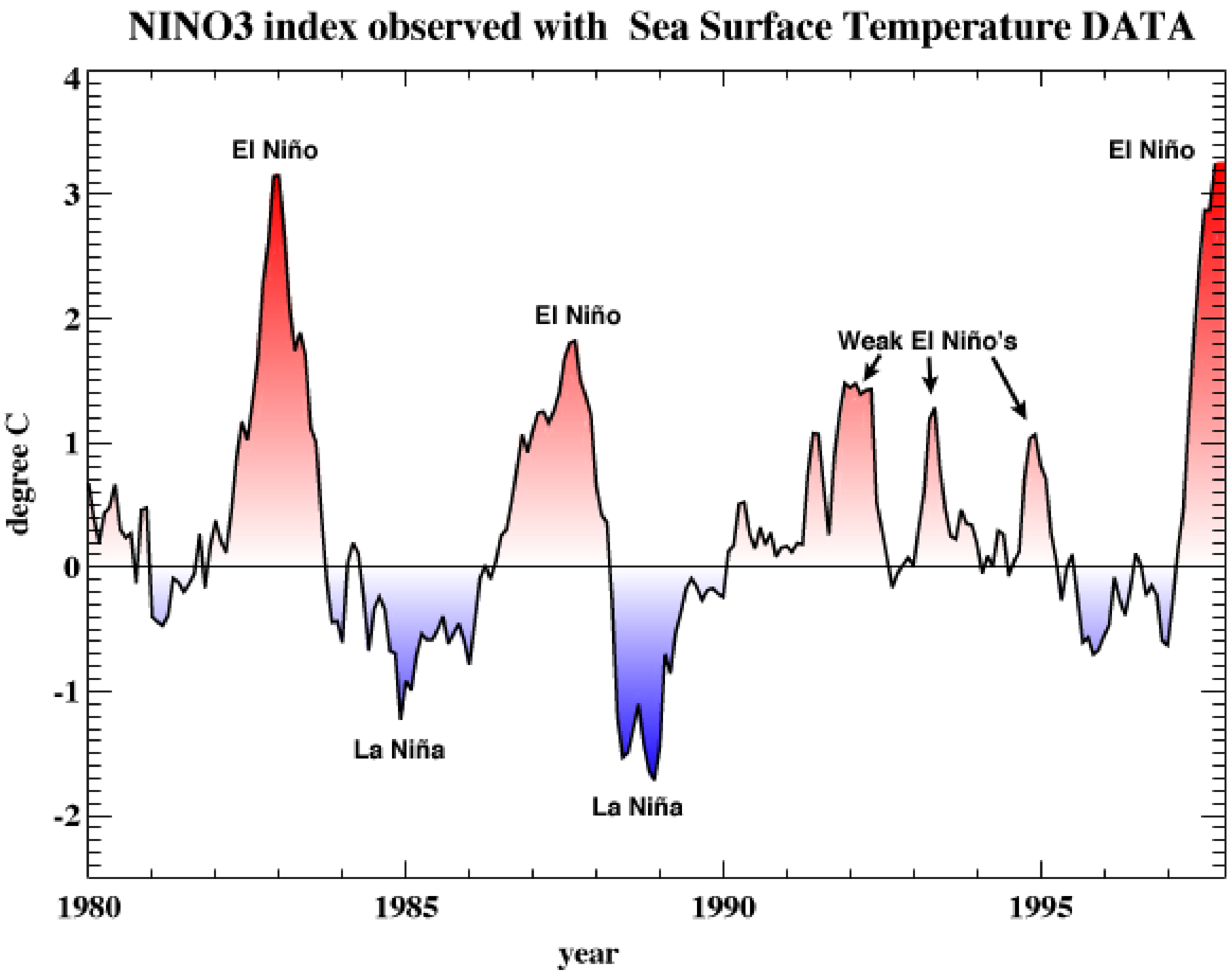
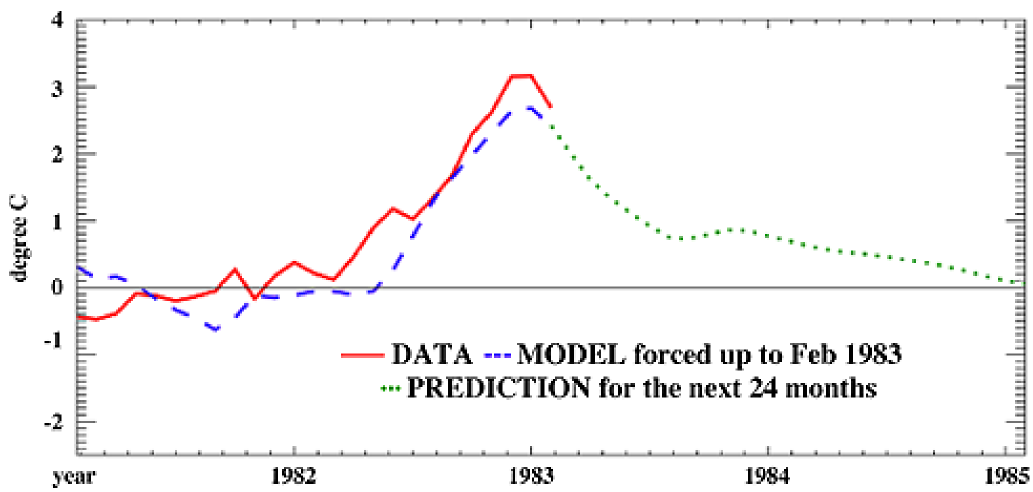


Figure 3. El Niños are a natural deviation in climate conditions. This graph shows the Niño index which is the average of the sea surface temperature in the tropical Pacific Ocean (5°N to 5°S, and 150°W to 90°W) compared to a long-term average temperature. El Niño's can be seen as high peaks, that is when the temperature is much higher than normal. You can see the El Niño's of 1983, 1987, some smaller ones in the 1990's and the very large one of 1997/98. There is a phenomena called La Niña when the sea surface temperature is much cooler than average. A La Niña occurred in 1989, and a weak La Niña occurred in 1985.

be hotter than normal and where they are going to be colder than normal. Then we compare what the model predicts with what actually happens [Figs. 4, 5, & 6]. We are also interested in La Niña events. A La Niña is the opposite of an El Niño. La Niñas occur when the trade winds are very strong so warm water is held against the west side of the Pacific Ocean.

When we first started with the models, the results were not very good, so what they predicted did not happen, but we have improved the models and now they are much better. We are using both satellite and shipboard data to fine-tune our model equations. This is very important because it helps us better understand what connects, or "couples," the ocean to the atmosphere and how they affect each other. We hope that some day we will be able to predict El Niño conditions up to one year before they happen! Predicting an El Niño in advance is still one of the most challenging problems in oceanography.



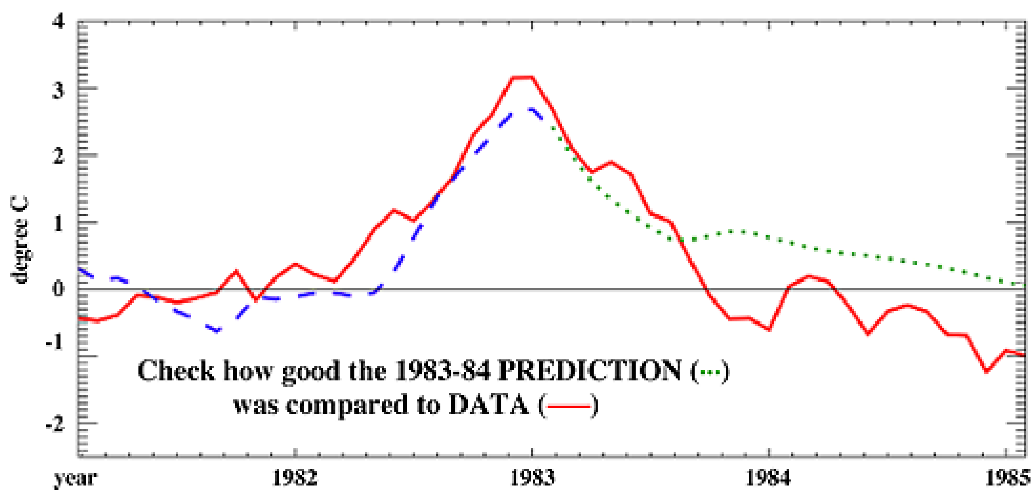


Figure 4. Comparison of model prediction with actual data - 1983. The red line is the actual data, the dashed line is the model when it was using real data, and the dotted line is the prediction.

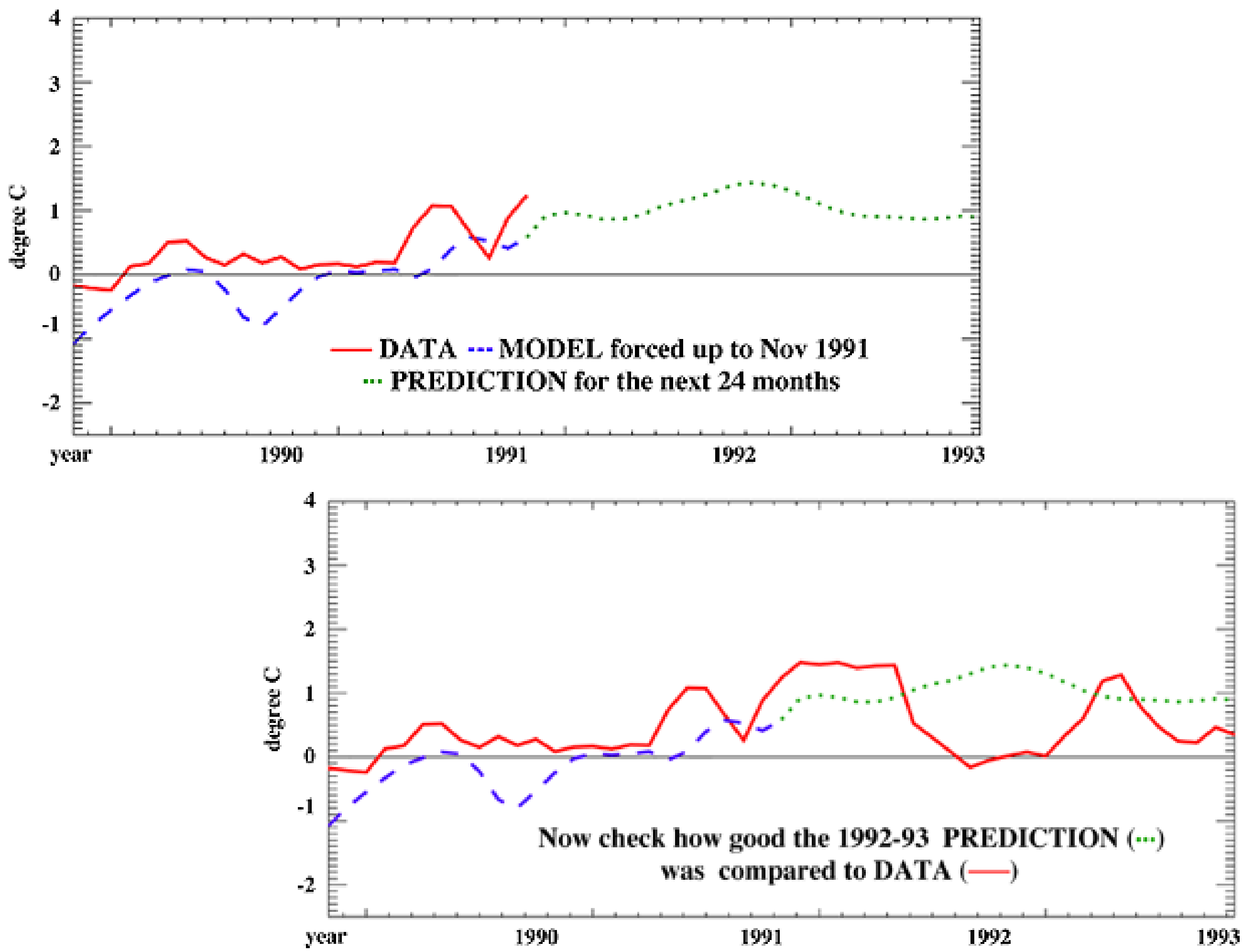


Figure 5. Comparison of model prediction with actual data - 1989. The red line is the actual data, the dashed line is the model when it was using real data, and the dotted line is the prediction.

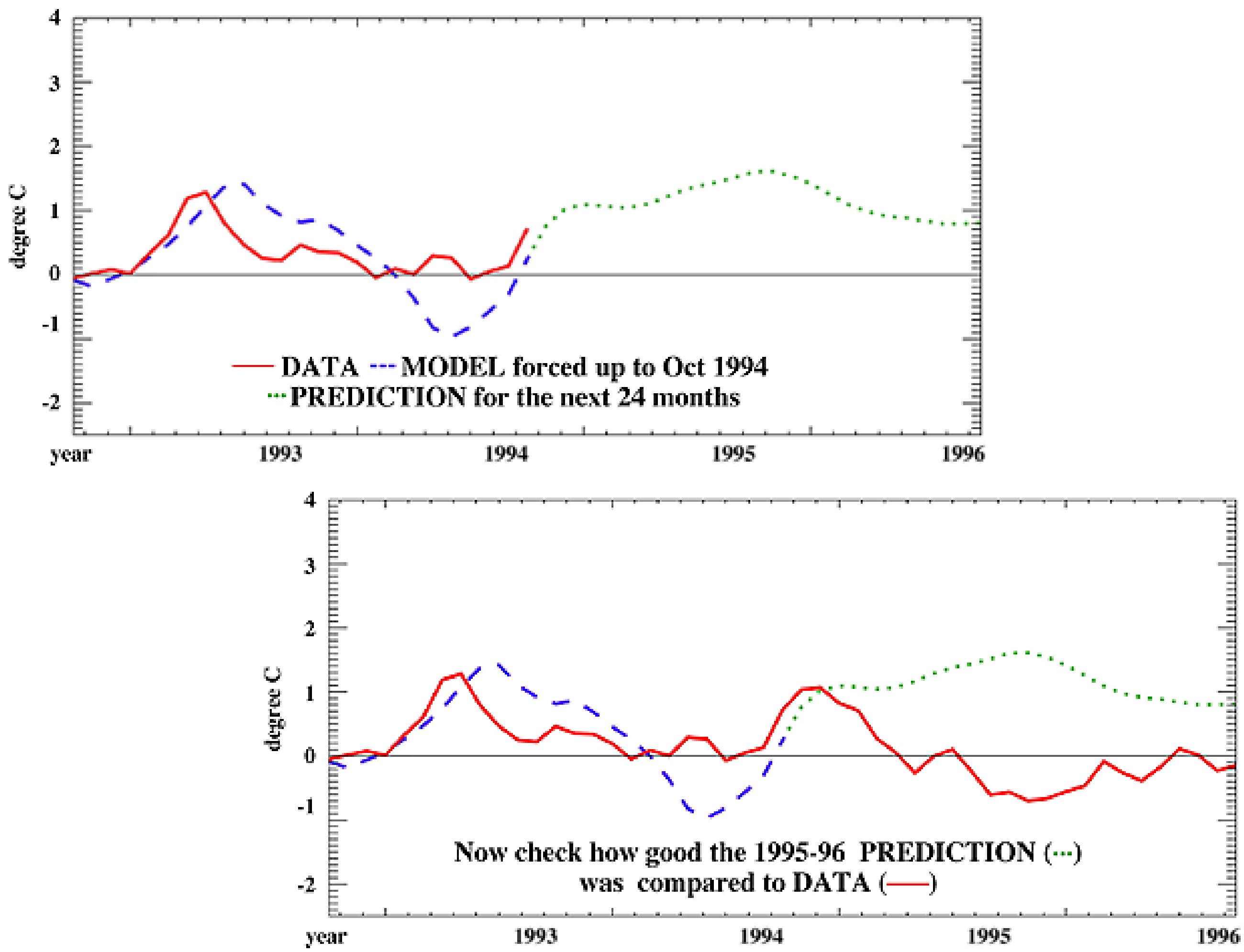


Figure 6. Comparison of model prediction with actual data - 1994. The red line is the actual data, the dashed line is the model when it was using real data, and the dotted line is the prediction.