Of the carbon reservoirs on land, atmosphere and ocean, the ocean's carbon store is by far the largest, so it is largely the ocean that controls the atmospheric concentration of CO2 on time scales of centuries and millennia, and most of the CO2 that we humans emit will end up in it. It is important therefore for predictions of future climate that we understand the processes at work. Ocean uptake of CO2 is complex however, closely coupled to climate, both in the undisturbed pre-industrial world and in the modern day. To illustrate these two aspects, I will describe two areas of ongoing research; (1) Recent advance in our understanding of how changes in the Southern Ocean caused atmospheric CO2 to change between glacial and interglacial climates, and 2) Recent observations that show that ocean uptake has varied over the last few decades in ways not captured by the Earth system models used in climate studies, indicating that we still do not understand the processes well enough to predict the course of future climate change