Background on CO_2 and ocean pH

A great deal of carbon flows back and forth between the ocean's surface and the atmosphere. Carbon enters the ocean reservoir from the atmosphere by absorption, where it dissolves because of diffusion (moving from places of higher to places of lower concentration). The difference between the concentration of CO_2 in the ocean and the atmosphere causes CO_2 to move rapidly between the two in order to equalize concentrations. Once in the ocean, some of the CO_2 dissolves and forms carbonic acid (H_2CO_3), which in turn generates bicarbonate (HCO3-), carbonate (CO_3^{2-}), and hydrogen (H+) ions. This means that the concentration of CO_2 in the ocean has decreased, so more CO_2 diffuses into the ocean. This process is affected by water temperature—colder water absorbs more CO_2, warmer water absorbs less. Therefore, polar regions are seeing bigger and faster changes than other parts of the world. Another influence is surface winds; they agitate ocean surface water and speed up the process of absorption.

As the ocean takes in more and more CO_2 from the atmosphere, the H+ ion concentration increases, thereby making the ocean increasingly acidic (pH is a measure of hydrogen ion concentration). The ocean has already taken in so much CO_2 over the past 200 or so years that it has become about 30 percent more acidic (a -0.11 drop in average surface ocean pH). When the ocean becomes more acidic (really, less basic, as the ocean will most likely never be acidic), it is called ocean acidification. Since the start of the Industrial Revolution, atmospheric CO_2 has increased by nearly 40 percent. The ocean has absorbed a little more than a quarter of that CO_2 (IPCC 2013). Evidence shows that the rate of human-driven ocean acidification is about 100 times faster in the surface ocean than that experienced by marine ecosystems globally for tens of millions of years.