The WOC and marine carbon trading

Indonesia's Maritime Affairs and Fisheries Ministry showed a strong desire to propose marine carbon trading as an additional component in the Clean Development Mechanism (CDM) during the just concluded World Ocean Conference (WOC) in Manado, North Sulawesi. In other words, beside forests, the Indonesian delegation wants the Indonesian seas to be considered in carbon trading.

Will this proposal benefit the country?

Before finding out the proper answer, it is better to understand air-sea carbon exchange and its controlling factors. There are four main parameters: Partial pressure of CO2 (pCO2), dissolved inorganic carbon (DIC), total alkalinity and pH. Although they interrelate in the ocean, the reference parameter is pCO2. If pCO2 at the ocean's surface (SSpCO2) is lower than pCO2 in the atmosphere, the surface of the ocean absorbs atmospheric CO2, and vice versa. SSpCO2 itself is controlled by the sea surface temperature (SST), so it varies from low to high latitudes. SSpCO2 in tropical oceans is in general higher than in temperate ocean.

The mechanism of how the SST affects SSpCO2 can be illustrated with a cup of Coke. Gas concentration in the Coke tends to disappear when the cup is put under the Sun, compared to when it is put in a fridge. This is what happens in dissolving CO2 in the ocean. Gas solubility in temperate oceans is much higher, resulting in lower gas partial pressure than in tropical oceans. This mechanism is known as the solubility pump.
On the other hand, photosynthesis by phytoplankton will reduce dissolved CO2 in seawater. Organic matter production during photosynthesis will sink to deeper layers (at depths of more than 1,000 meters) and will be buried in the bottom sediment. This is called the biological pump. However, the deposition of organic matter in shallow seas cannot be categorized as a biological pump since the deposited sediment at the bottom can be eroded by strong tidal currents. In this case, the organic carbon can be released back into the water column.

Takahasi, a researcher at Columbia University's Lamont-Doherty Earth Observatory, deals with the global SSpCO2 in several publications dealing with carbon sources and sinks in tropical and temperate oceans.

Some regions, like middle-latitude oceans, are influenced by the combination of solubility and biological pumps, depending on season and ocean characteristics. Therefore, it should be noted that marine photosynthesis will not directly uptake atmospheric CO2. The air-sea gas exchange is determined by the four parameters, known as the marine carbonate system.

The previous explanation clearly shows Indonesian seas tend to be a carbon source. My research on the Java Sea and cruise data from the Meteorological Research Institute of Japan along the Makassar Strait to the Celebes Sea also reached a similar conclusion.

Regarding the carbon cycle and future climate system, the ocean in general may play an important role. Sabine, a researcher at the National Oceanic and Atmospheric Administration's (NOAA) Pacific Marine Environmental Laboratory, reported in a publication in 2004 that from the 1800s until 1994, the ocean removed about 118 Pg C (1 Pg=1015 grams). This is equal to about half of the CO2 released into the atmosphere from the burning of fossil fuels. The carbon cycle during the pre-industrial era is then determined by scientists as a natural cycle. On the other hand, the emission of CO2 after the industrial era is categorized as anthropogenic carbon. Concentrations of atmospheric CO2 during the pre-industrial era and now are about 280 ppm (parts per million) and 380 ppm, respectively.

A decade ago, it was not clear what the fate of anthropogenic carbon in the ocean was, particularly its spatial distribution. There was no accurate method to determine
the concentration of anthropogenic carbon in the ocean. However, the method improved year by year. Then, a recent paper by Gruber and his colleagues (published in February 2009) reported a synthesis of oceanic sources, sinks and transport of atmospheric CO2, including natural and anthropogenic carbon in the ocean. They concluded the world's oceans now act as sinks for anthropogenic atmospheric CO2. Their findings agree well with Sabine (2004). So the ocean in general naturally acted as a carbon source during the pre-industrial era, but changed into a sink due to anthropogenic perturbation.

Concerning marine carbon trading, one of the difficulties is related to boundaries and transboundary currents. In addition, if the carbon trading deals with the anthropogenic carbon cycle, then all marine countries will benefit, because the entire oceans work as sinks.

However, it's not certain marine countries will benefit, since the ocean becoming a carbon sink has a negative impact on marine organisms (through marine acidification).

On the other hand, if carbon trading deal with the natural carbon cycle, then countries located in tropical oceans, including Indonesia, will have to pay the tax. However, this is impossible since the natural carbon cycle occurred during the pre-industrial era.

Alan F. Koropitan, PhD., is a postdoctoral fellow at the Biogeochemical cycle group, University of Minnesota, and lecturer (currently on sabbatical) at the Bogor Agricultural Institute's (IPB) School of Marine Science and Technology. The article is his personal opinion and does not necessarily reflect the positions of either institution.