

## Final Problem 2 – Coral Reef Bleaching

We have looked at a lot of sea level rise from climate change but a far more immediate threat is that of the loss of the coral and other reef ecosystems that are huge carbon sinks and primary producers that much of the world relies upon.

Coral reefs sequester carbon through the growth of coral in calcium carbonate and the photosynthetic ability of the symbiotic plankton.

Increasing temperature from CO<sub>2</sub> causes the coral to expel their plankton and eventually die.

But this also works through increased CO<sub>2</sub> causing carbonic acid to form decreasing the pH of the ocean. This causes coral to die if it gets too high.

There is also an interaction here in that higher temperatures cause less CO<sub>2</sub> to be dissolved in water reducing the acidity of the ocean.

Coral bleaching events are generally quantified in percentage of the reef. Reefs cannot rebound if they lose too high a percentage of the coral.

Coral reefs provide a large amount of carbon sequestration. Every reef that dies is going to mean less carbon sequestration, more carbon in the atmosphere and then more dead reefs.

We need to find the carbon limit in the atmosphere that means we maintain 40% of coral reefs.

Global carbon output is about 10 billion tonnes of carbon per year, currently increasing by about 0.1 per year. This amounts to an increase of about 2ppm carbon in the atmosphere per year. As of 2013 the world reached 400ppm of carbon in the atmosphere.

30 – 40% of carbon put out by humans is absorbed into rivers, lakes and oceans increasing their acidity. An increase of 1ppm of CO<sub>2</sub> in the atmosphere causes a 0.17% increase in ocean acidity.

100ppm increase of CO<sub>2</sub> will cause an approximately 1 degree rise in temperature.

An increase of 1 degree would cause about 50% of coral to die off. The next degree would be 50% of the remaining coral.

If ocean acidity increases by 10% then this will cause 5% of coral to die off.

If coral reefs pass 85% death the reef is irreparably damaged and will eventually die. Death of a reef will increase carbon output by about 0.2ppm per year

The 5 largest reefs in the world account for almost 80% of all the coral. The largest one is the great barrier reef, then the Mesoamerican, the new Caledonian reef, Bahamas and finally the Red sea.

They have all already experienced some level of coral death. The great barrier reef is already at 16%. Mesoamerican at 11%, Caledonian at 4%, Bahamas at 19% and the Red sea at 24%.

Find out under current scenarios how quickly we will lose all the reefs. Is there a level of carbon we can curtail our emissions too that will prevent us losing 50% of our reefs? How about all of the reefs?