

Noctilucent clouds or polar mesospheric clouds



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Introduction

In 1997, many countries agreed to reduce their greenhouse gas emissions and signed the Kyoto Protocol and have been more aware about climate change since then. It was prompted by global alterations in weather, the oceans, atmosphere and temperature, which are already modifying the natural cycles on the planet.

Climate change has a large impact on the environment. Many natural phenomena are modified and intensified, leading to even more drastic consequences.

Climate change is not simply “global warming” or “the greenhouse effect” – it is a series of massive changes, some of which are not even understood yet. Besides polar ice melting, more powerful hurricanes, warmer temperatures, rising sea levels, the extinction of species, droughts and floods, many other destructive consequences are yet to come. These phenomena will cause more and more disturbances to the planet's ecosystem. In this article, some events possibly connected to climate change are discussed, of which very few people are aware.

Noctilucent Clouds or Polar Mesospheric Clouds

Noctilucent clouds (NLCs) are also called polar mesospheric clouds (PMCs). They mostly appear at latitudes between 50° and 70° north and south of the equator in summer months, and exist at altitudes of about 80 km (50 miles) in the upper atmosphere,^[1]

which is also known as the mesosphere – much higher than any other clouds in the Earth's atmosphere [Figure 1].

NLCs are primarily composed of tiny (about 100 nm in diameter) ice particles. This is quite interesting because the mesosphere is extremely dry. (The Sahara desert has approximately one hundred million more water particles than the mesosphere.) Moreover, very low temperatures are required for ice particles to form. Hence, NLCs are only present in polar regions during the summer, when the temperature in the mesosphere is below 120°C (180°F).^[1]

The presence of an aerosol (airborne liquid or solid particle) is necessary for NLCs to form, so that water can freeze on its surface. In other words, water needs a surface to adhere to so that it can form droplets or ice crystals. This chemical process is called nucleation. If humans emit more and more particles into the atmosphere, more NLCs will be formed in the mesosphere. Furthermore, the greenhouse effect caused by the emission of carbon dioxide, methane, and many other gases is warming the lower atmosphere, which in turn cools the upper atmosphere. If temperature in the mesosphere is lower, it follows that more NLCs will be formed.

NLCs were only recognized in the late 19th century and the phenomenon has been studied by the NASA mission Aeronomy of Ice in the mesosphere (AIM) since 2007. The purpose of this satellite mission is to further understand the causes and consequences of NLCs and their possible connections to climate change – it was the scientists involved in this project who first suggested a link between NLCs and climate change.



Figure 1: Noctilucent clouds (from http://en.wikipedia.org/wiki/File:Helkivad_%C3%B6%C3%B6pilved_Kuresoo_kohal.jpg)

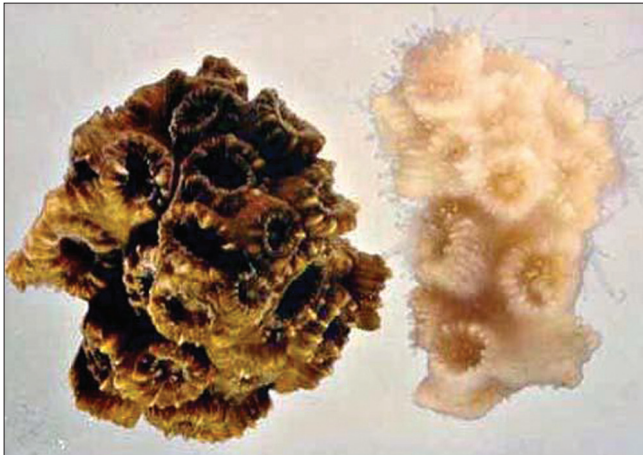


Figure 2: A healthy coral (left) and a 'bleached' coral [from <http://en.wikipedia.org/wiki/File:CoralBleaching.jpg>]

Coral Bleaching

Do you know whether climate change affects the oceans or the atmosphere the most?

In fact, a quarter of globally emitted carbon dioxide gas is absorbed by the oceans.^[2] The world's oceans are being modified on an immense scale by increasing temperatures and the emission of greenhouse gases. When carbon dioxide gas is absorbed by water, under certain conditions, the compounds will react and

produce carbonic acid, changing the water chemistry. This process is called acidification and it causes harm to marine life, especially in the coral reefs especially in the coral reefs, as shown in Figure 2.

Coral reefs are the most abundant ecosystem in the whole biosphere and are an important support for all marine species. They are the habitat of many fish, plants, seaweeds and sponges, which represent the beginning of the ocean food chain. Unfortunately, coral reefs need special environmental conditions to survive. When these conditions are absent, corals become stress-conditioned and die. This process is called coral bleaching because corals whiten when stressed.

Causes of coral bleaching

- Water acidification: This is caused by the reaction of water and carbon dioxide, in which carbonic acid is produced. Since corals are composed of calcium carbonates, the acid will react with these compounds and destroy the corals.
- Increase in water temperature: Most of the heat trapped in the atmosphere is also absorbed by the oceans, modifying global sea temperatures. Coral reefs are very sensitive to temperature changes and most of them live in areas where the temperature ranges between 25°C and 29°C (77°F and 84°F). If they are exposed to

high temperatures, they will be at risk of being damaged or destroyed.^[3]

- Changes in salinity: Melting of the polar glaciers modifies the concentration of salt in water, resulting in coral bleaching.

If corals disappear, thousands of species will vanish and the ocean will become a completely different place. The increasing temperatures and concentration of carbon dioxide in the atmosphere are directly affecting the oceans. From this example, one can see that the effects of global warming are more than just melting polar glaciers.

Conclusion

I had the opportunity to talk with a Nobel Laureate in Chemistry, Dr. Mario Molina, and I asked him what young people could do to make a difference to climate change. He answered, “The solution of climate change depends solely on governments and big companies around the world; all that young people can do is speak up to authorities and demand a change”. I totally agree with him. A single man

cannot do everything. But if 6 billion people on this planet come together to overcome this obstacle – a global issue that involves and affects all of us – we may be close to solving this problem and be able to continue living on Earth, this place we call home.

The whole planet is changing and the Earth is the only place we have for a home. In the words of Al Gore, “That is what is at stake, our ability to live on planet Earth, to a future as a civilization. It is our time to secure our future; that’s the future in which we’re going to live our life”.^[4]

References

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About the Author

Gustavo J. Bonilla participated in the “International Youth Conference on the Environment in Japan” when the city was celebrating the 10th anniversary of the Kyoto Protocol. He has also taken part in some research with the National Aeronautics and Space Administration (NASA) when they studied pollution and new climatic effects, such as noctilucent clouds, the melting of glaciers and coral bleaching. Finally, he has contributed to the promotion of Green Energies by organizing three substantial symposiums about climate change and renewable energy resources.