The State of the Earth's Climate in 2018-2019

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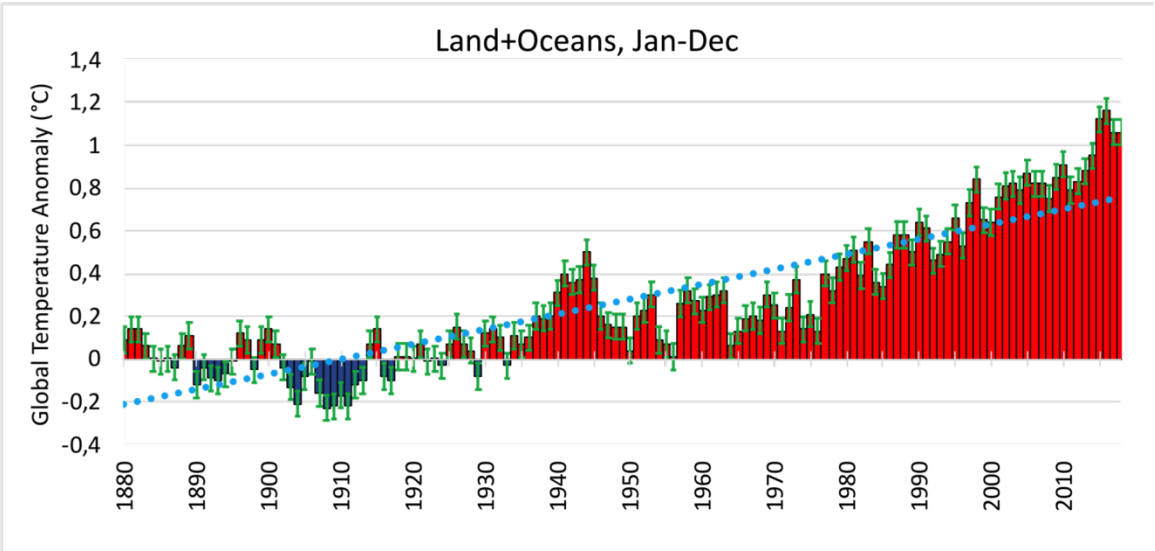
The years 2015 - 2018 have been the four warmest ever recorded in the instrumental period, which confirms the continuity of long-term climate change caused by the atmospheric concentrations of greenhouse gases. It should be remembered that the energy that flows on the earth is energy from the sun which the earth absorbs and then re-emits back out into the space to keep the earth cool and reach a balance. Greenhouse gases naturally act like a blanket that retains some of the energy emitted by the earth, causing it to cool much less than, say, the moon. That is why the average temperatures on the earth are more temperate and suitable for life than on the moon (the average moon temperature is -18°C). But the human activities of burning fossil fuels (oil, natural gas and coal) make the blanket of these gases thicken year by year, causing an increase in the energy that flows in the Earth of about 1% each year. This increase in energy causes the so-called climate change, or also, global warming.



The consolidated analysis of the five of the best international data sets reveals that the global average surface temperature in 2018 exceeded approximately 1.0 ° Celsius (with a margin of error of ± 0.13 ° C) to that of the pre-industrial (before 1750). It is the fourth warmest year ever recorded.

The year 2016, which was influenced by an intense episode of El Niño, continues to be the warmest record (1.2°C above the pre-industrial era, used as a reference).

Both in 2015 and in 2017, global average temperatures exceeded the pre-industrial levels by 1.1°C. It is practically impossible to establish a distinction between both years at thermal level since the difference in temperature is less than one hundredth of a degree, which is less than the margin of statistical error. Since energy flows within the climate system, there are years in which it is concentrated in the air, others in the ice of the poles and most of the years in the interior of the oceans. Therefore, the trend of long-term air temperature is much more important than the temperature of a particular year, and that trend is on the rise. The 20 warmest years for which data are available have been recorded in the last 22 years. The rate of warming in the last four years has been exceptional, both on the land surface and in the oceans.

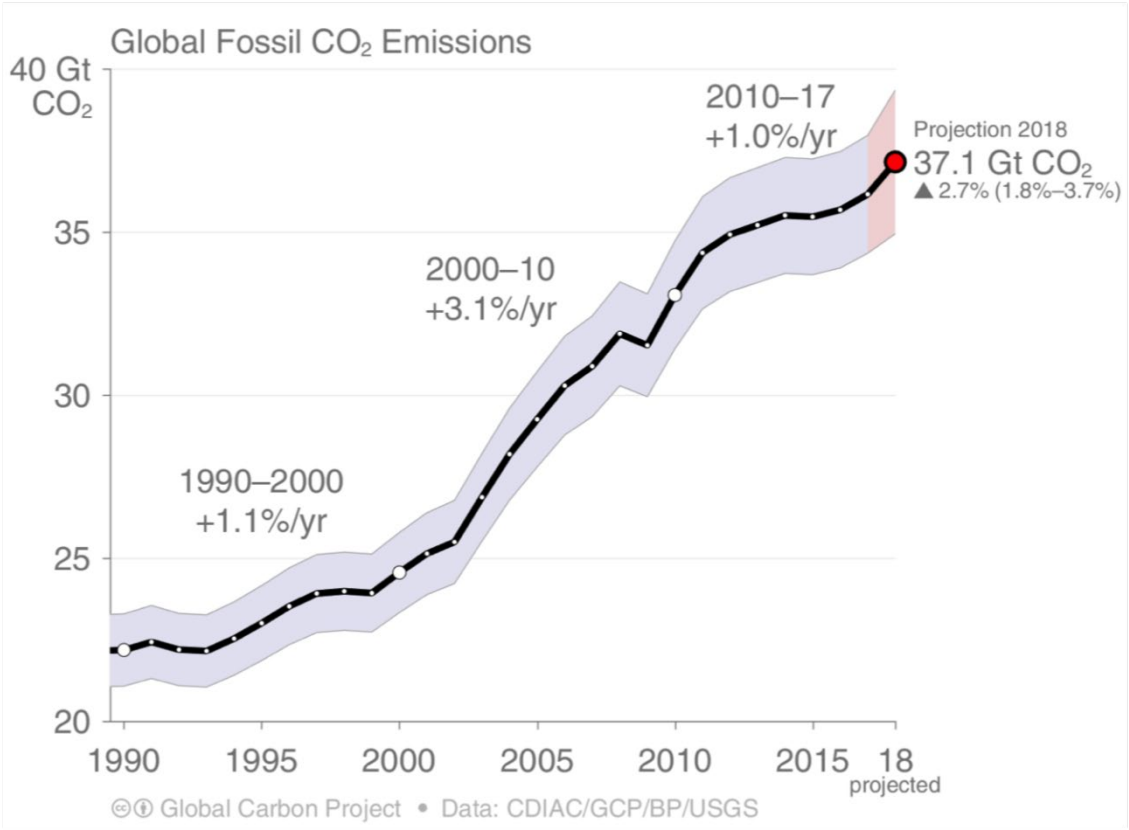
However, temperatures are only part of the problem. In 2018, extreme weather events and devastating effects affected many countries and millions of people and had devastating impacts on economies and ecosystems. The year 2019 has also begun with the same severity. January and February 2019 are already 0.4°C warmer than 2018. Many of the extreme weather events correspond fully to the foreseeable in a situation of climate warming. It is a reality that we have to face. The reduction of greenhouse gas emissions and climate adaptation measures should enjoy the highest priority worldwide.

In Australia the month of January 2019 has been the hottest since data are available, and there have been unprecedented heat waves because of its breadth and duration. It was also the driest month of January ever recorded in Tasmania, where destructive brush fires occurred. In vast regions of Australia the extreme phenomena that cause fires are becoming more frequent and the fire season lasts longer, according to the Office of Meteorology of that country. Intense heat waves are becoming more frequent as a result of climate change. In January, while in the Southern Hemisphere there was extreme heat, as in the Argentine Patagonia, some areas of North America were subjected to extreme cold. The cold weather of the eastern United States of America does not contradict climate change. Arctic warming occurs at a rate twice as fast as the global average and a large part of the region's ice has melted. These changes affect weather patterns, not only in the region but also outside, in the northern hemisphere in general. Part of these anomalous cold temperatures at lower latitudes could be due to drastic changes in the Arctic. The atmosphere tends to dilute the excess polar heat by amplifying the exchange of air masses, through a greater intensity of the jet streams. What happens at the poles is not confined to the poles but it influences the meteorological and climatic conditions of lower latitudes, where hundreds of millions of people live.

CO2 increase

In 2017, the dominant greenhouse gases released into the earth's atmosphere (carbon dioxide, methane and nitrous oxide) reached new record levels. The global

average annual concentration of carbon dioxide on the surface of the earth for 2017 was 405.0 ± 0.1 ppm, 2.2 ppm more than in 2016 and the highest in the record of modern atmospheric measurements and in the records of ice cores that they go back more than 800,000 years ago. The global CO2 growth rate has almost quadrupled since the early 1960s. This value constitutes 146% of pre-industrial levels (before 1750).



The global average figures for 2018 will not be available until the end of 2019, but real-time data from several specific locations, including Mauna Loa (Hawaii) and Cape Grim (Tasmania) indicate that CO2 levels continued to rise in 2018. The report The IPCC's 1.5°C special found that limiting warming to 1.5 ° C above the pre-industrial line means reaching zero net CO2 emissions worldwide by 2050 and deep simultaneous reductions in emissions from other non-CO2 drivers, in particular methane.

Predictions for decades suggest an increasing risk of temporary exceedance of 1.5°C above pre-industrial conditions. Although the Paris Agreement refers to a long-term raise of 1.5°C and not to months or individual years, such short-term exceedances will become more common as the threshold approaches, highlighting the importance of following closely the goals of the Paris Agreement.

Oceans warming, sea level rise and acidification

More than 90% of the energy trapped by greenhouse gases goes to the oceans. The heat content of the ocean provides a direct measure of the energy that

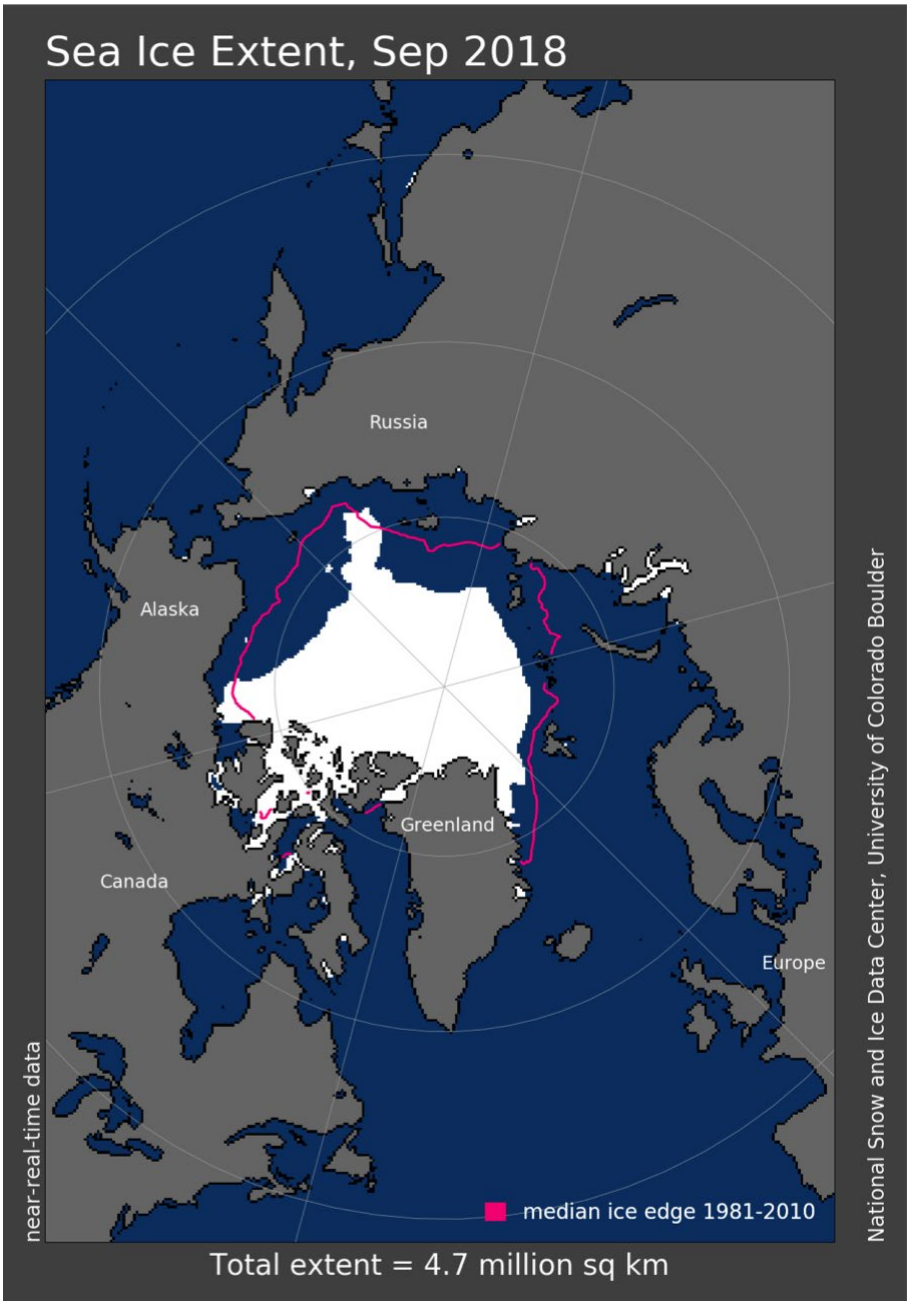
accumulates in the upper layers of the ocean. For each three-month period in 2018 (until July-September 2018), the ocean heat content in the upper 700 m (data since 1955) and the upper 2000 m (data since 2005) was the highest or the second highest registered. In each case, where 2018 was the second highest, the highest was registered in 2017.

The global mean sea level for the period from January to July 2018 has been around 2 to 3mm higher than for the equivalent period in 2017. The changes in sea level from year to year must be due to changes in the loss of the ice sheet, the storage in the earth of the water, as well as the variations in the temperature of the ocean (thermal expansion). The sea level in 2018 has been close to the long-term trend after a rapid increase.

In the last decade, the oceans absorbed around 25% of anthropogenic CO2 emissions. The absorbed CO2 reacts with seawater and changes the pH of the ocean. This process is known as ocean acidification. Observations in the open ocean during the past 30 years have shown a clear tendency to lower the pH. The 5th IPCC Report found that there was a decrease in the pH of the ocean surface of 0.1 units since the beginning of the industrial revolution (1750). Changes in pH are related to changes in oceanic carbonate chemistry that can affect the ability of marine organisms, such as molluscs and reef-building corals, to build and maintain shells and skeletal material. This makes it particularly important to fully characterize the changes in oceanic carbonate chemistry.

Sea ice extent

The extent of sea ice in the Arctic was well below the average throughout 2018, with record levels in the first two months of the year. The annual maximum occurred in mid-March and the monthly extension in March was 14.48 million square kilometres, the third lowest recorded and approximately 7% below the 1981-2010 average (15.64 million square kilometres). The Arctic sea ice extent reached its minimum in mid-September. The monthly extension of sea ice in September was 4.62 million square kilometres, approximately 28% below the average (6.40 million square kilometres). This was classified as the sixth smallest extension registered in September. The 12 smallest extensions in September occurred in the 12 years since 2007. The volume of sea ice, estimated from a new analysis in 2018, was slightly higher than in 2017 and, nominally, the sixth lowest in the record.



The extent of sea ice in Antarctica was also well below the average throughout 2018. For the months of February to August, the monthly extension was among the 10 smallest recorded. The extent of Antarctic sea ice reached its maximum annual extension in late September and early October. The average monthly extension of September was 17.82 million square kilometres, 5% below the average (18.72 million square kilometres) and was among the five smallest.

The challenge of urgency

The next few years are crucial. We are the last generation that could and should act to avoid crossing crucial turning points and avoid irreversible damage to our common home, the earth, the abode of humanity and the rest of God's creatures (see LS 1).

The urgency of the situation requires immediate, holistic and unified responses at all levels, local, regional, national and international. In line with the endeavors of the Church, we feel the need to work together, in alliance of all people of good will, for the care of creation.

Laudato Si' in fact offers us an ethical and religious compass for this common journey ahead. Pope Francis says that “the climate is a common good, that belongs to everyone and that it is meant to all”. The ways to contribute to these drastic reductions of harmful gas emissions are through “energy efficiency” and the disinvestment of fossil fuels and investment in new alternative energies, such as solar, wind and others (see LS 26). As Pope Francis says: "we must be even more aware of the importance of accelerating and adapting our actions to adequately respond to *both the cry of the earth and the cry of the poor*, because they are connected" (LS 49).