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5TH IPCC REPORT. THE CERTAINTY OF AN INHERITANCE, GLOBAL WARMING

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Abstract:

On Friday, September 27, 2013, it was announced in Stockholm (Sweden), the Summary for Policymakers of the contribution of Working Group I "Climate Change 2013: The Phisical Science Basis", to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)[1].

In this paper we analyze its key findings and the significant differences in relation to the 4th report, published in 2007, which was considered as a little rigorous in some data analysis and certain conclusions.

Keywords:

Climate Change, IPCC, Assessment Report, Global Warming, Greenhouse Gases, Sea Level Rise, Meltdown, Severe Weather.

[1] GARCIA SANCHEZ, Ignacio. "*El IPCC en la cuenta atrás para el 5º informe de evaluación*". January 2013. www.ieee.es

INTRODUCTION

The three issues that I consider most important, among which can be inferred from the published document are:

The certainty that there is a global warming taking place and, since 1950 the observed changes have no precedent: the atmosphere and the oceans are warming up, the masses of snow and ice are decreasing, the sea level is rising and the concentration of greenhouse gases is increasing.

Most of the effects of climate change will persist for centuries, even if CO_2 emissions were reduced to zero. Its accumulation over the past, present and those that will accumulate in the future is the main factor of this trend and its duration.

Evidence of human influence in the following areas: global warming, change in precipitations patterns, decrease of snow and ice, rise of sea level and changes in extreme weather events, have increased since the 4th Report publication in 2007.

OBSERVED CHANGES IN CLIMATE

The atmosphere

The report warns about the high data variability, not only when referring to the average values when comparing years, but even when referring to decades, therefore trying to extrapolate trends with little data is very dangerous, especially because the data is greatly affected by the time intervals examined.

However, the report concludes that last three decades have been successively warmer than any other since 1850 and probably, the northern hemisphere has experienced over the last 30 years the warmest period in the last 1400 years.

For the above figure, the 1901-2012 period has been taken into account, as the one in which there is enough data available for calculating regional trends. This reconstruction by continent also notes during medieval period—950-1250— there were regions with average temperatures similar to the existing at the present time, but these temperatures were not as widespread and with a global character, as it is happening now.

With regard to the different projections according to the new scenarios[2] used for the first time in this study, the range of values by the end of the century is very large (0.3ºC - 4.8ºC),

[2] In this study was used for the first time four new scenarios (RCP, Representative Concentration Pathway) which are identified by the amount of radiant energy accumulated in 2100 compared to 1750. These scenarios cover a range ranging from 2.6 wm-2 (RCP2.6) to 8.5 wm-2 (RCP8.5). These scenarios are moved in a range of

although it is stressed, with great confidence: the Arctic region will have an increase of warming above average, that will be higher on the continents than at the oceans, and also higher in the tropical and subtropical regions than in mid-latitudes.

Precipitationpatterns

If confidence in the studies of changes in the global precipitations patterns is low, the report considers tighter the verification of an increase in precipitations in mid-latitudes of the Northern Hemisphere since 1951.

Regarding the expected patterns throughout this century, variability is emphasized, and that the difference between regions and wet and dry seasons will increase, although there may be exceptions. It is also likely that torrential rains will persist in mid-latitude landmass and humid tropics, as well as more downpours caused by the monsoon rains. However, the associated wind with this meteorological phenomenon will tend to decrease. In the same way, El Niño will remain and intensify as the predominant factor in regional precipitation patterns.

Extreme weather phenomena

Since 1950, the increase of the following events is clear: the decrease of the number of cold days and nights, the increase of hot days and nights, heat waves in many parts of Europe, Asia and Australia, and the number of torrential rains, especially in North America and Europe. With regard to their projection throughout the century, their intensification is certain, especially regarding heat waves.

Air quality

It is important to recall the relevance of this factor, the scenario envisaged by the OECD for 2050, on premature deaths, places this factor as the major cause of deaths[3].

The report considers that the scope and impact of air quality[4] is mainly due to emissions, rather than to the physical effects of climate change. Projections show that high temperatures in regions with high levels of pollution in the atmosphere can trigger the concentration ozone levels and PM2.5. With regard to the latter, climate change may alter aerosols natural sources and their removal by precipitations, but is not considered demonstrated that there is any relationship to its distribution.

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molecules of CO2 (ppm, number of gas molecules in a million molecules of dry air) from 421ppm to 936ppm; when considering other waste pollutants such as methane (CH4) and nitrous oxide (N2O), the values used would be 475ppm and 1313ppm.

[3] In the projection and in relation to deaths due to poor water quality, only have been taken into account in children ages.

[4] The study refers to ozone and aerosols with a diameter greater than 2.5 microns (PM2.5-Particulate Matter-)

The ocean

Ocean warming accounts for 90% of the energy accumulated between 1971 and 2010 as a result of climate change. 60% of this increase is concentrated in the upper layers, between the surface and 700 meters deep. Also confirmed, with further evidence from the 4th report, that the edges are extended and more saline areas increase their salinity, while less saline areas are becoming sweeter.

Projections for the rest of the century suggest a large increase in surface temperature in the tropics and subtropics of the northern hemisphere, while in the southern hemisphere this increase is distributed towards the deeper layers.

Regarding the tidal current of the southern Atlantic, after a decade of data collection, no evidence is drawn about any change in trend, though it is very likely that, as the century progresses, it will slow down. A sudden transition or a collapse is unlikely to happen in the twenty-first century, but its collapse in the next century cannot be ruled out.

There is also evidence of its acidification, due to the 30% CO^2 absorption. This situation will globally increase due to a progressive carbon dioxide concentration.

Sea level

The data produced by scientists indicate that in the last interglacial age[5], the sea level rose between 5 and 10 meters, and that the melting of Greenland contributed to this increase in 1.4 to 4.3 meters. This situation occurred with a temperature higher by 2ºC to the current one and for several thousand years.

The sea level rise is accelerating, with values between 1901 and 2010 of 1.7 mm/ year to 3.2 mm/ year in the last 17 years. It is considered tat 75% of this increase is due to the loss of mass from glaciers and the expansion of seawater as a result of warming ocean temperatures.

This boom will continue throughout this century, as evidenced by the progress of scientific knowledge since the last report, ranging between 0.26 and 0.28 meters at the end of the century, although it will not be uniform. Of this increase, 30-50% will be due to thermal expansion and 15-35% to the glaciers, while the melting would be responsible for 0.02-0.3 meters of elevation.

Higher increases are not discarded, which could even double the figures presented, but there is enough confidence in that they are going to occur. One reason for this increase could be caused by a collapse of the Antarctic ice.

[5] 129.000-116.000 years ago.

It is certain that the sea level rise will continue beyond this century. The models show that in 2300, the increase would be less than 1m if the CO^2 concentration was maintained below 500ppm. But if they move between 700 and 1500ppm, levels may range from 1 to more than 3 meters. Although, in the case of an almost complete loss of the Greenland ice mass, an increase in sea level of up to 7 meters would occur. The temperature threshold for such an event to happen could range between 1 (low confidence) and 4ºC (medium confidence).

The cryosphere

It is noted that in the last two decades, Greenland[6] and Antarctic land[7]-especially north of the Antarctic Peninsula and the Amundsen Sea- have lost ice mass, glaciers have been reduced almost all over the world[8], excluding the peripheral of the Antarctic lands, the extent of the ice in the Arctic has decreased during the summer months, the so-called perennial ice, between 9.4 and 13.6% while evidences of its substantial warming multiply, the permafrost has increased its temperature 3ºC in northern Alaska and 2ºC in some parts of Siberia, and the extent of northern Hemisphere snow has been reduced an average of 11.7% per decade, measured in June, in the 1971-2010 period.

While projections for Antarctic lands do not show a reduction of the body of ice water, in the Arctic it is just the opposite: the range in which the decline of its ice area stands, measured in September, fluctuates from 43% to 94%. For one of the scenarios used, earlier than mid-century could be considered almost free of ice[9]. Note that the other three scenarios do not end in a clear way that this condition could happen this century.

Reducing the volume of the glaciers ranges in an angle between 15% and 85%, although the reliability is medium, as well as seasonal snow, that ranges between 7-25%, and permafrost area close to the surface, 3.5 meters, with a reduction of its size in the northern hemisphere between 37-81%.

THE CAUSES OF CLIMATE CHANGE

The final result of the increases and decreases of radiant energy in the climate system is positive, and the factor that contributes the most to its progressive increase since 1750 are CO_2 emissions.

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[6] Ice loss in Greenland has increased forma n average of 34 Gt/year in the period 1992-2001, to 215 Gt/year in the period 2001-2011.
[7] Ice mass loss in Antarctica is estimated at 30Gt/year on average in the period 1992-2001 to 147 Gt/year from 2011-2011.
[8] Ice loss in glaciers is estimated at 226 Gt/year on average over the period 1971 to 2009, and if we take the period from 1993 to 2009 would increase to 275 Gt/year.
[9] It is considered ice free when the extension has been reduced below one million km2 five consecutive years.

Since the 4th report, collecting data has increased and improved, as well as the simulation models, which has allowed increasing the evidence of human influence as the dominant element in the global warming observed since the mid-twentieth century, due to the continued emission of greenhouse gases.

The concentration of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have increased to unprecedented levels in the last 800,000 years. Its concentration in 2011 was: 391ppm, 1.803ppb[10], 324ppb, and its increase from pre-industrial values is evaluated as: 40%, 150% and 20% respectively. NASA, which maintains on its website: http://climate.nasa.gov/ the so-called vital signs of the planet with a continuous measurement of the CO_2, places it in 397ppm at present.

This increase is mainly due to emissions of fossil fuels and cement production, with an average emission of 8.3 GtC[11] per year between 2002 and 2011, 9.5 GtC in 2011, a 54% increase over the 1990 value. The emissions due to land use were 0.9 GtC/year over the same period. Since 1750, average CO_2 accumulation has been 545 GtC spread over: 240 to the atmosphere, 155to the ocean, and 150 to terrestrial ecosystems.

Emission projections, as a result of integrating the four RCP scenarios and 15 earth system models, show a positive feedback between emissions and the atmosphere, so that the latter retains an increasing proportion of gases. The range of this CO_2 accumulation in the atmosphere changes between 140GtC and 1.910GtC.

CONCLUSIONS

The total accumulation of CO_2 emissions and global warming has an almost linear relationship. Any given level of warming is associated with a range of CO_2 concentration in the atmosphere.

Limiting warming caused by CO_2 emissions to less than 2ºC with probabilities between 33% and 66% would mean to reduce these between 0-1.560GtC, and 0-1.000GtC respectively.

The climate change effects resulting from CO_2 emissions are irreversible for centuries and even millennia, except in the case of a removal, gas capture of the atmosphere for a continued period.

The International Energy Agency recently presented in Bon a special report “Redrawing the energy-climate map” reflecting that climate change had lost weight on the political agenda, despite the accumulation of scientific evidence supporting stronger action.

[10] The trillion in this study is seen as equivalent to one billion.
[11] 1GtC is equivalent to 1015 grams of carbon.

And it presented as key messages:

Nations must act preventively, while negotiating the terms of a global deal in Paris in 2015, which would take effect in 2020.

Four measures can stop the steady growth of emissions in 2020 and therefore keep the goal of global warming not exceeding 2ºC without jeopardizing economic growth: specific measures must be taken for energy efficiency, limit the inefficient use of coal in electricity generation, minimize emissions of methane in gas and oil production, and remove fossil fuels subsidies.

Coordinated action is needed to develop critical technologies at scale in 2020 in order to develop energy policies with low emissions, among which is included carbon capture and storage (CCS).

The energy sector must be adapted to climate change, both in relation to the measures that exist today, and in future investment decisions.

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