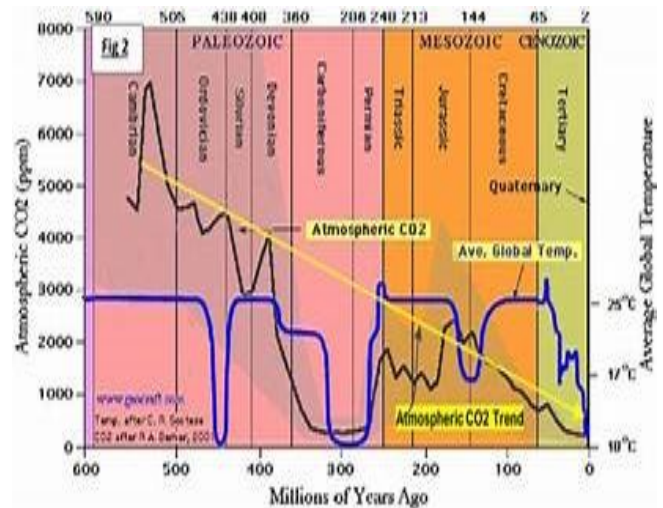


Climate Science and Policy for Nonscientists

Good policy must be based on good science.

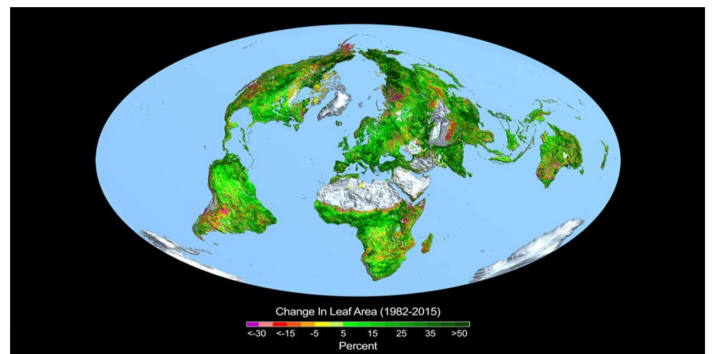
The Benefits of Rising CO2 and 1 C Warming

As discussed last month, the IPCC AR6 concludes that over the last century the world has warmed about 1 C. (Fn.1) This rate of warming has significant benefits. For the last 600 million years the world has been much, much warmer than today, and CO2 levels have been much, much higher. But the oceans never turned acidic and the climate never hit any sort of tipping point. The maximum CO2 level was about 7,000 ppm occurring about 540 million years ago and has been declining steadily ever since. CO2's present level is only 420 ppm, which is 6% of the 7,000 maximum

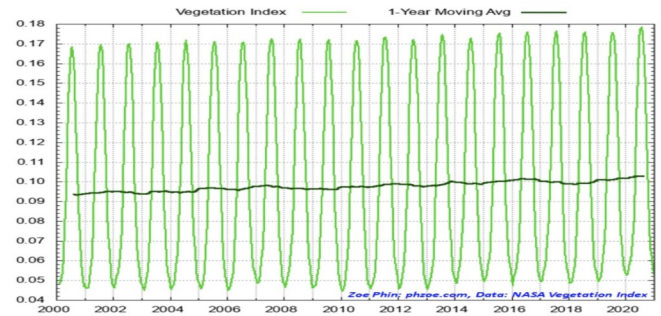


CO2 is plant food. Without CO2 plants starve to death. 420 ppm is an uncomfortably low level of CO2 for plants, which is the reason plants grow faster as CO2 rises. This is known as the CO2 Fertilization Effect and is well documented in published papers. Greenhouse operators install CO2 generators to raise the CO2 level to 800-1,200 ppm, resulting in 20-50% greater growth.

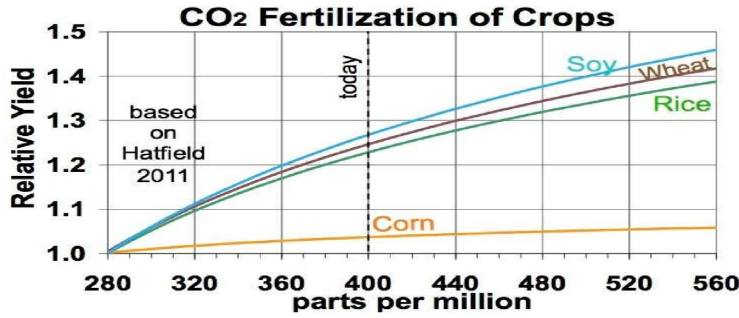
As a result of rising CO2 and rising temperatures satellite data shows that the world significantly greened from 1982 to 2015. Scientists have attributed this greening 70% to the rising CO2 and 30% to the rising temperature



The NASA Vegetation Index increased 10% from 2000 to 2020. As CO2 levels rise plants can grow with less water, and hence can grow in drier areas, which also contributes to global greening.



NASA's Vegetation Index has risen from 0.0936 to 0.1029, which is a 9.94% increase. Chart by [Zoe Phin](#)



Rising CO2 also causes crop yields per acre to increase. There are hundreds of published papers documenting increased yields for a wide variety of crops with rising CO2 levels.

Global average crop yields have risen dramatically over the period 1961-2019. The IPCC in AR6 (2021) agrees: (1) that the growing season has lengthened, (2) that there has been increasing productivity of the land biosphere with the increasing atmospheric CO2 concentration as the main driver, (3) that global-scale vegetation greenness has increased since the 1980s, and (4) that there was a 7% rise in global tree cover from 1982 to 2016. (Fn.2)

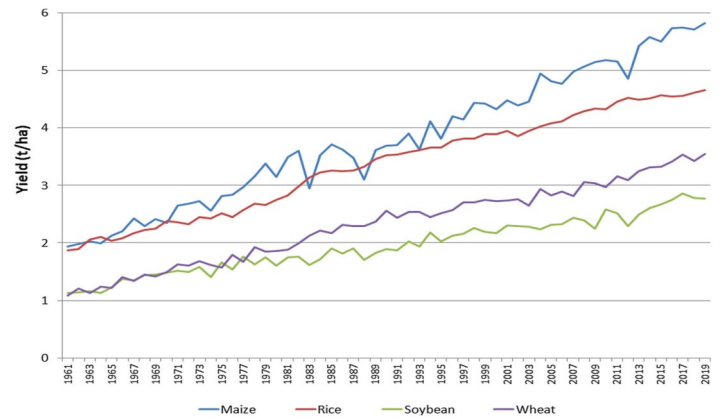
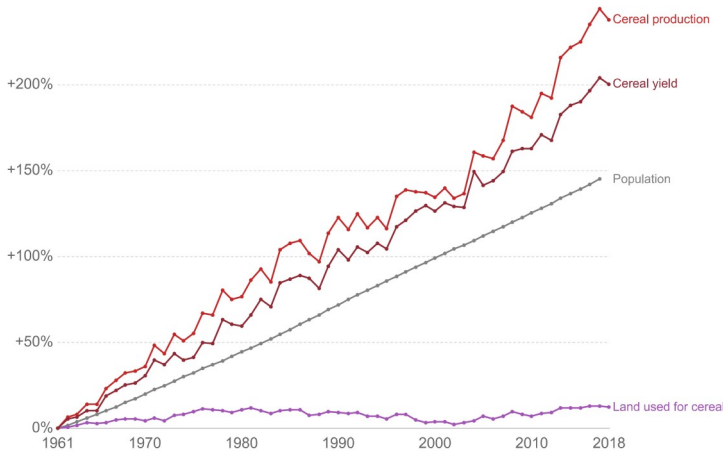


Fig. 7 1961–2019 time series of global average yields (t/ha) for maize, rice, soybean and wheat (source of

Change in cereal production, yield and land use, World

Population and cereal production, yield and land use figures are indexed to the year 1961 (i.e. 1961 = 0).



Source: OWID based on World Bank; and UN FAO

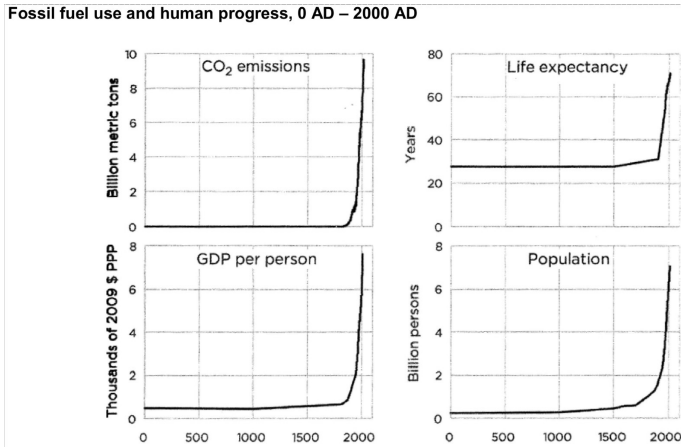
OurWorldInData.org/crop-yields • CC BY

Food production around the world has increased dramatically from 1961 to 2018 and has risen faster than the population, enabling the rapidly growing world population to be fed.

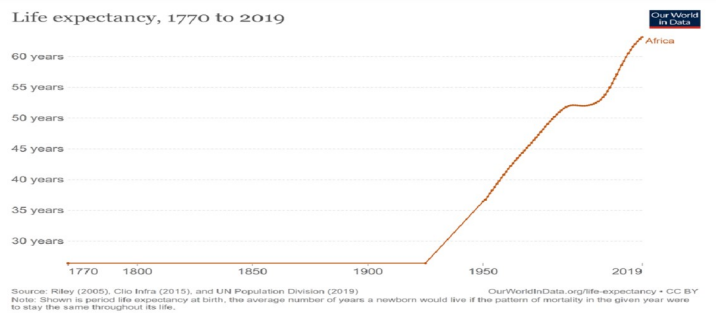
The global risk of death from famine has declined tremendously since 1870.



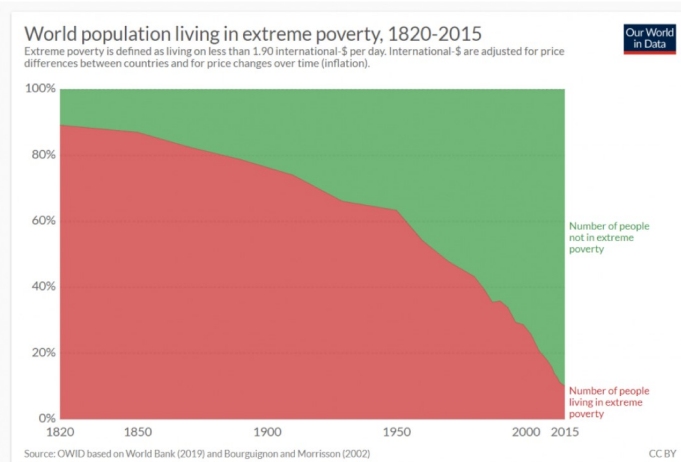
Over the last century while temperatures have risen 1 C and while CO2 emissions have been rising dramatically, life expectancy, population, and per capita GDP have also been rising dramatically.



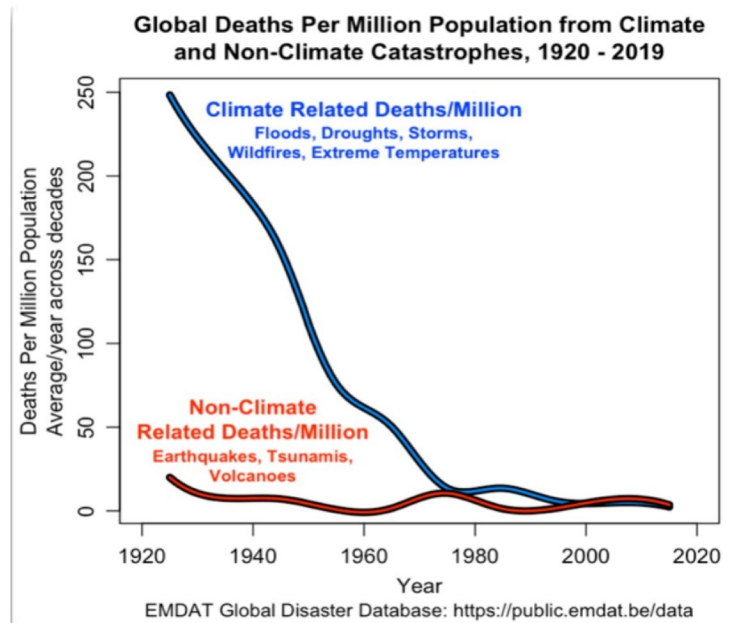
It is not just the rich and First World countries that are benefitting. Life expectancy has risen greatly in third world areas, such as in Africa.



The number of people living in extreme poverty has significantly declined since 1820.

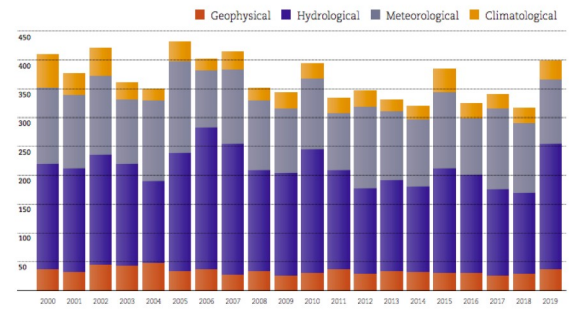


The risk of death from climate disaster has fallen dramatically since 1920.



According to the United Nations, the number of climate disasters per year declined slightly from 2000 to 2019.

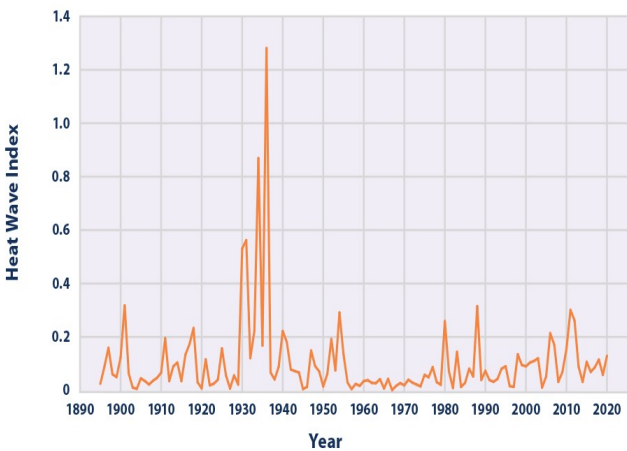
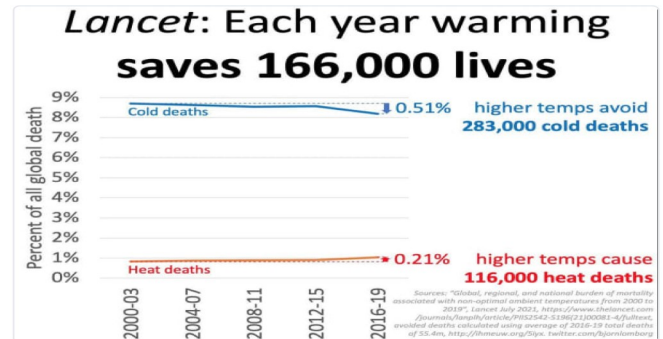
The number of disasters by disaster sub-groups per year (2000-2019)



The above chart, published in the United Nations report, "The Human Cost of Disasters," shows declining disasters by type in this century.

Heat Waves and Cold Waves

Warming obviously means more heat waves, but this also means fewer cold waves. AR6 concluded that heat extremes have increased since 1950 and that cold extremes have decreased. (Fn.3) Is this net good or net bad? Many studies conclude that more people die from cold waves than from heat waves. People have much more difficulty living with cold than with heat. New Englanders retire to Florida, not to Canada.



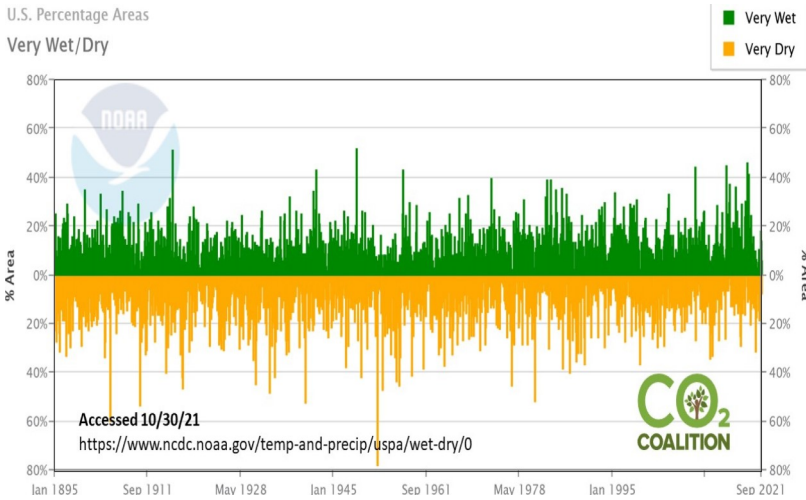
The effect of a particular heat wave depends on how hot it is. The US heat wave index peaked in the 1930s and has barely risen over the last 60 years. AR6 states that the intensity of temperature extremes in most regions will be proportional to the amount of warming (Fn.4). So 1 C warming over a century will result in the temperature of heat waves rising only by roughly the same amount. Regions at higher latitudes, such as the Northern parts of the US and Canada, will welcome some warming.

Rain and Drought

AR6 concludes that the frequency and intensity of heavy precipitation events has "likely" increased over a majority of land regions with good observational coverage. (Fn.5) This is a net benefit. The world needs more fresh water. AR6 observes that currently around four billion people (half the world's population) live under conditions of severe freshwater scarcity for at least one month of the year with half a billion people facing severe water scarcity all year round. (Fn.6)

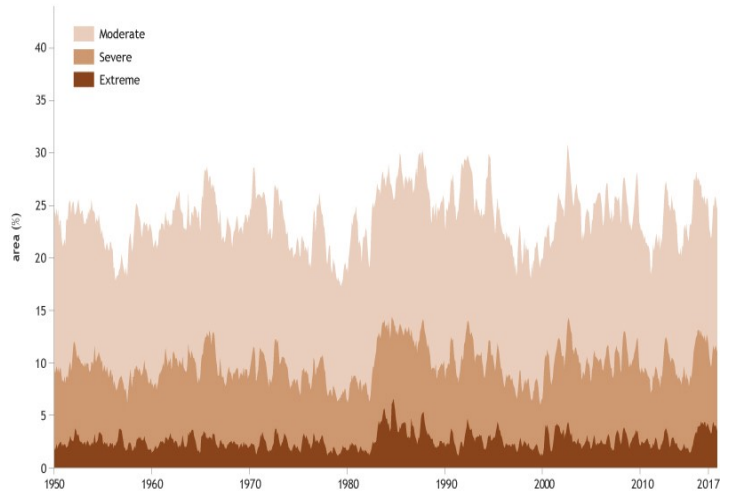


Fig. 4 Global yearly precipitation anomaly (difference in mm from the 1961–1990 average). Processing carried out on data from Hadex3 dataset [29]—figure S27 of supplementary materials



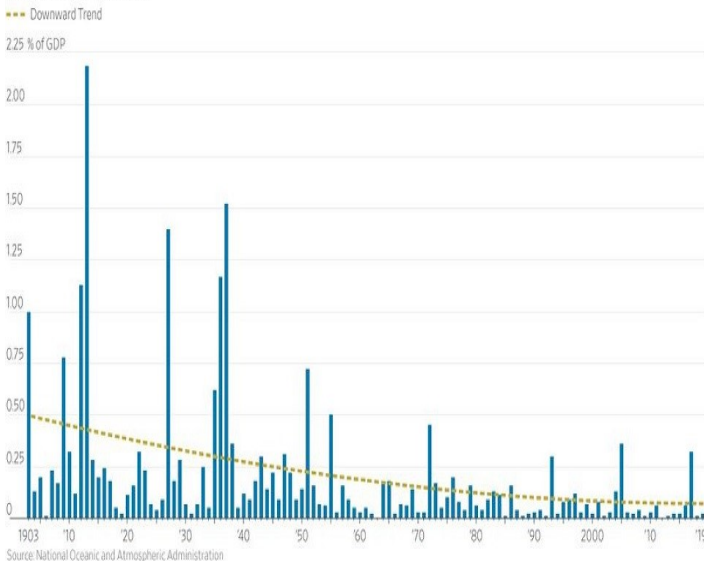
The US data for 1895-2021 shows very little change in area per year that is either very wet or very dry. It also shows significant variability from year to year. Rain tends to move around a lot, so there will always be places that are experiencing more rain than usual and other places that are experiencing less rain (more drought) than usual, such as the US South-West at present.

Rising temperatures cause increased amounts of water to evaporate into the air, which leads to increased precipitation. AR6 observes that lack of precipitation is generally the main factor controlling drought onset. (Fn.7) It is difficult to see how rising temperatures can cause both more rain and more drought at the same time while the world, in general, is getting greener. This NOAA dataset shows virtually no change since 1950 in the amount of drought in the world. AR6 says that there has been some increase in agricultural and ecological droughts in some regions due to increased land evapotranspiration (Fn.8), but the detailed discussion in the body of the report fails to make any finding that would undercut the NOAA data at right. (Fn.9)



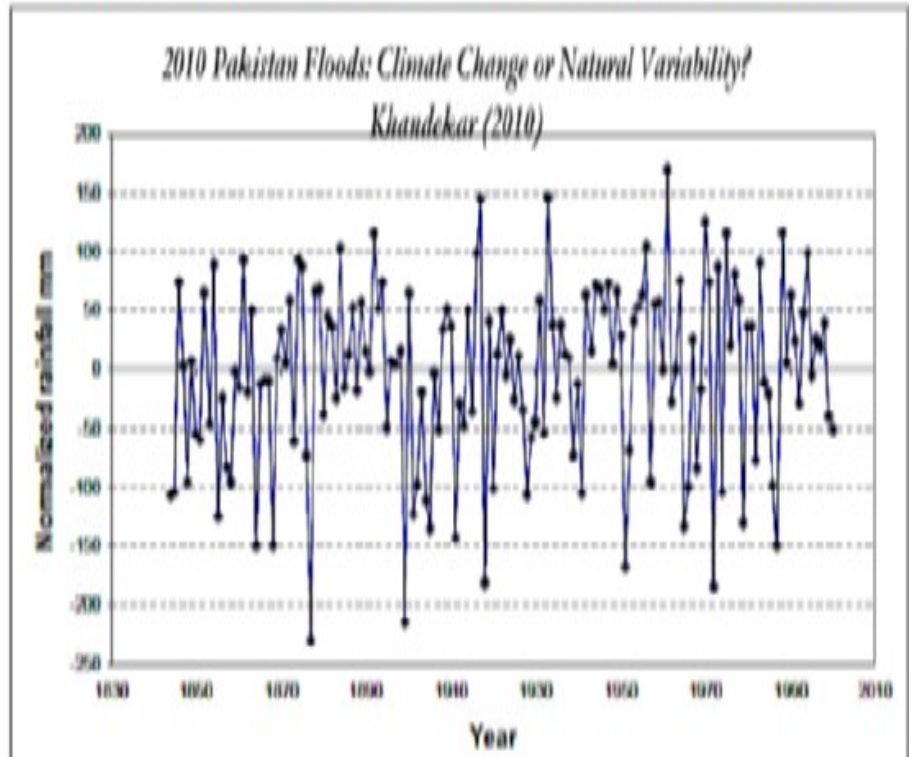
Flooding

Cost of U.S. flooding, 1903-2019



The negative side of more rain is flooding, but AR6 estimates that precipitation will increase only around 1-3% per 1 C of warming (Fn.10), which is not much if the world warms only 1 C over a century. Flooding costs as a percentage of GDP are down in the US 1900-2019. Civil engineers are very good at water management to prevent heavy rainfall from causing floods. AR6 cites a study estimating that projected flood damage can be reduced to 5% in absolute value with adequate adaptation. (Fn.11) And AR6 states that peak flow trends with respect to floods are characterized by high regional variability and lack overall statistical significance of a decrease or an increase over the globe as a whole. (Fn.12)

This past summer Pakistan suffered horrific floods, but Pakistan is part of the Asian monsoon system. Since 1850 Pakistan has experienced 7 major droughts and 6 major floods. It is commonly known in Pakistan that summer monsoons always cause flooding in some rivers somewhere in the country. As shown, Pakistan suffers from a very high variability of rainfall from year to year without any trend. This is driven by the El Nino/La Nina cycles in the Eastern Pacific Ocean, which affect the amount of Monsoon rain in countries such as Pakistan.



Conclusion

There are clear benefits to rising CO₂ levels and 1 C temperature rise per century. These benefits are commonly ignored by the media. Most parts of the world at higher latitudes (such as the Northern US, Canada, Northern Europe, and Russia in the Northern Hemisphere) will benefit, in general, from rising temperatures. In general, the benefit of reduced cold waves offsets the detriment of increased heat waves, and the benefits of increased rain offsets the detriments of increased droughts and flooding.

But there are other potential detriments to rising CO₂ levels and 1 C temperature rise that remain to be discussed, such as sea level rise. They will be addressed in future newsletters



All footnote citations are to the United Nations' Intergovernmental Panel on Climate Change's Sixth Assessment Report (AR6). WGI is the report of Working Group I, Climate Change 2021 The Physical Science Basis. WGII is the report of Working Group II, Climate Change 2022: Impacts, Adaptation and Vulnerability.

- | | | |
|-----------------|-------------------|---------------------|
| 1. WGI at 5 | 2. WGI at 82, 365 | 3. WGI at 1517 |
| 4. WGI at 1518 | 5. WGI at 1518 | 6. WGI at 1060 |
| 7. WGI at 1570 | 8. WGI at 8, 1519 | 9. WGI at 1570-1575 |
| 10. WGI at 1057 | 11. WGII at 607 | 12. WGI 1568 |



To subscribe or unsubscribe email cliscipol@gmail.com