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IPCC : Recent changes in the climate are widespread, rapid, and intensifying, and unprecedented in thousands of years.

Dr. Minh Hà Dương[1]
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In 1990, scientists of the Intergovernmental Panel of Climate Change (IPCC) warned that the global mean surface temperature had increased by 0.3 to 0.6 °C over the previous 100 years. The IPCC predicted that global warming would reach 1°C by 2025 and 20 cm of sea-level rise by 2030 (IPCC First Assessment Report, SPM Executive Summary). Thirty years later, the situation is worse than announced.

The recently released IPCC Working Group I Sixth Assessment Report finds that emissions of greenhouse gases from human activities caused approximately 1.1°C of warming since 1850-1900 (SPM A.1.2). Each of the last four decades has been successively warmer than any decade that preceded it since 1850. Compared to its 1901 level, the global mean sea level increased by 20 cm in 2018 already. The average rate of sea-level rise increased to 3.7 mm yr^{-1} between 2006 and 2018 (SPM A.1.7). More generally, the scientists now see that *« Recent changes in the climate are widespread, rapid, and intensifying, and unprecedented in thousands of years. »*.

Like every other region in the world, South-East Asia has observed an increase in hot weather extremes since the 1950s. The area also observed an increase in heavy precipitation. The jury is still out regarding agricultural and ecological drought (figure SPM.3). Mean precipitation trends are not spatially coherent or consistent across datasets and seasons. Although there is no significant long-term trend in the number of tropical cyclones over Southeast Asia, fewer but more extreme tropical cyclones have affected the Philippines during 1951-2013 (TS 4.3.2.2).

At this point, there is no going back from some changes in the climate system. It is virtually certain that the global mean sea level will continue to rise over the 21st century. Relative to 1995-2014, the likely global mean sea level rise by 2100 is 32-62 cm under the low greenhouse gases emissions scenario. In the longer term, the sea level is committed to rising for centuries to millennia due to continuing deep ocean warming and ice sheet melt. It will remain elevated for thousands of years (SPM B.5.3).

However, limiting warming can slow some changes and stop others. To explore possible futures, climate change scientists defined five illustrative scenarios, the three central ones being :

- The low greenhouse gases emissions scenario is named *SSP1-2.6*. Emissions start to decline before 2025, reach zero before 2075, and become negative hereafter.
- The intermediate greenhouse gases emissions scenario is named *SSP2-4.5*. Emissions levels slow down today, stop increasing by 2035, and start to decline by 2055, to reach about 25 % of current levels at the end of the 21st century.

1 Directeur de recherche au CIRED/CNRS. haduong@centre-cired.fr

- The high greenhouse gases emissions scenario is named *SSP3-7.0*. In that case, CO_2 emissions roughly double from the current level by 2100.

Under all emissions scenarios considered, global surface temperature will continue to increase until mid-century (SPM B.1). The global temperature averaged over the next 20 years is expected to reach or exceed 1.5°C of warming. However, the best estimate long term 2081-2100 global warming is 1.8°C in the low emissions scenario, while it is 2.7°C in the intermediate emissions scenario and 3.6°C in the high emissions scenario (Table SPM.1).

The current trend is the *SSP3-7.0* high emissions scenario. There is no detectable decrease in the observed CO_2 concentration growth rate, despite emissions reductions in 2020 associated with measures against COVID-19. These measures did reduce air pollution, decreasing the cooling caused by anthropogenic aerosols. That led to a temporary increase in total radiative forcing. Still, that effect was too small to be detected above natural variability (SPM D.2.1).

Climate scientists estimate with high confidence that future warming in Southeast Asia will be slightly less than the global average. Still, compound impacts of climate change, land subsidence, and local human activities will lead to higher flood levels and prolonged inundation in the Mekong Delta (IPCC AR6 WG I Regional Fact sheet: Asia).

They also note with very high confidence that despite having a negligible impact on global annual mean surface-air warming, urbanization has exacerbated global warming in cities. For example, the urban heat island effect increased the temperature in Ho Chi Minh City by +0.41°C on top of the warming in the surrounding area. The annual-mean daily minimum temperature is more affected by urbanization than the annual mean daily maximum temperature. The nighttime extremes are particularly impacted (IPCC AR6 WG I Regional Fact sheet: Urban Areas).

The IPCC provides access to the observations and simulations underlying the report online through an Interactive Atlas for the first time. The atlas gives access to detailed regional climate change assessments. For example, Figure 1 displays the total number of days per year with maximum temperature exceeding 35°C (bias-adjusted TX35 days according to the CMIP6 ensemble of models) under three different cases. The top panel shows that in the past (1961-1990), few areas in Vietnam experienced more than 30 days per year above 35°C. The middle panel, showing the simulations for 2021-2040, show that the situation has become much more common already. The bottom panel shows that under the high emissions scenarios, in the 2081-2010 period, most ASEAN areas will experience more than 130 days per year above 35°C.

The report shows that humanity can still avoid this worst-case scenario. IPCC will publish the other two volumes of its sixth assessment in February and March 2022. Working Group II's report will review the science of Impacts, Adaptation, and Vulnerability. In other words, provide the grim details about the worst-case scenario that the world is going to. Working Group III's report will focus on climate change mitigation, assessing methods for reducing greenhouse gas emissions, and removing greenhouse gases from the atmosphere. It will evaluate if the changes towards a carbon-neutral society started everywhere are rapid enough (they are not) and discuss technological and socio-economic options to accelerate them.

The science is unequivocal. There is no time to wait for more and more reports. Ngo Duc Thanh, a Lead Author on the IPCC report, stresses that « *Unless there are immediate, rapid, and large-scale reductions in greenhouse gas emissions, limiting warming to 1.5°C will be beyond reach.* »

The goal of the Paris Agreement is to limit global warming to well below 2ºC, preferably to 1.5ºC, compared to pre-industrial levels. Yet under the *SSP2-4.5* scenario, there is more than a 50 % chance of crossing the 2°C global warming level around 2050 (SPM B.1.2). Only *SSP1-2.6* works. By the laws of Physics, the Paris Agreement goal can only happen if global greenhouse gases emissions start to decline before 2025.

According to IEA's Global Energy Review 2021, global CO_2 emissions declined by 5.8% in 2020, or almost 2 Gt CO_2 – the largest ever decline and nearly five times greater than the 2009 decline that followed the global financial crisis. Unfortunately, IEA also estimates that in 2021 the rebound in coal, oil and gas demand could drive global CO_2 emissions back up by 4.8 %. « *Not only is clean energy investment still far from what's needed to put the world on a path to reaching net-zero emissions by mid-century. It is not even enough to prevent global emissions from surging to a new record.* » said Fatih Birol, IEA Executive Director.

The IEA 2020 Sustainable Recovery Plan estimates that if governments mobilised USD 1 trillion in clean energy investments each year from 2021-2023, they would boost the global economy, create millions of jobs and put emissions onto a Paris-compliant trajectory: net-zero emissions by 2050. Governments need to triple their current level of spending for clean energy and electricity networks.

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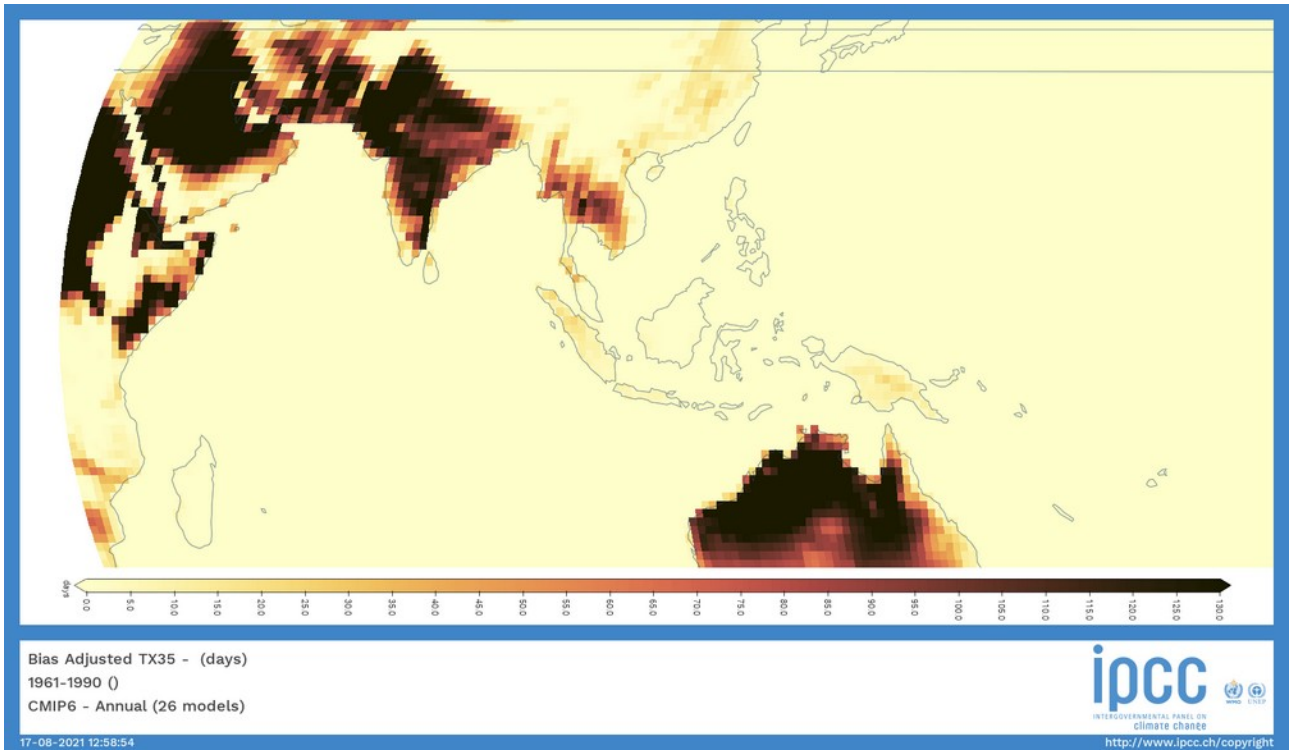
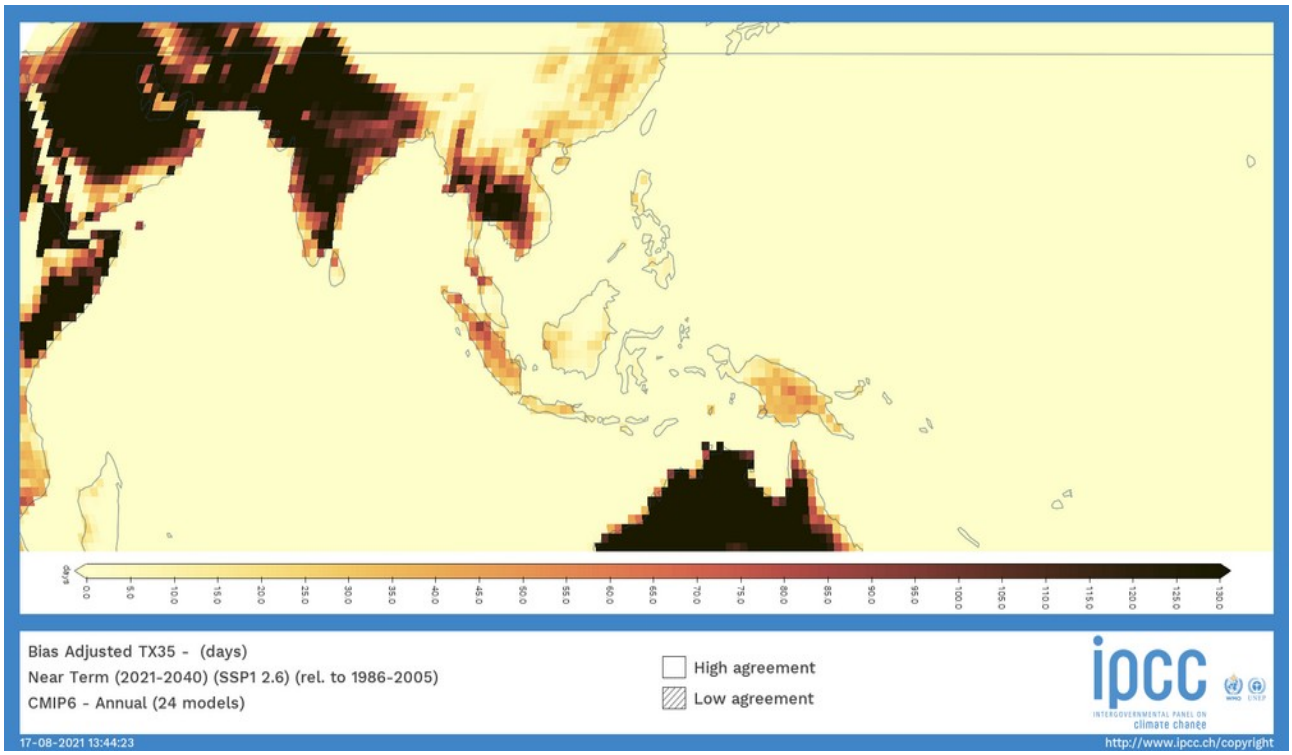
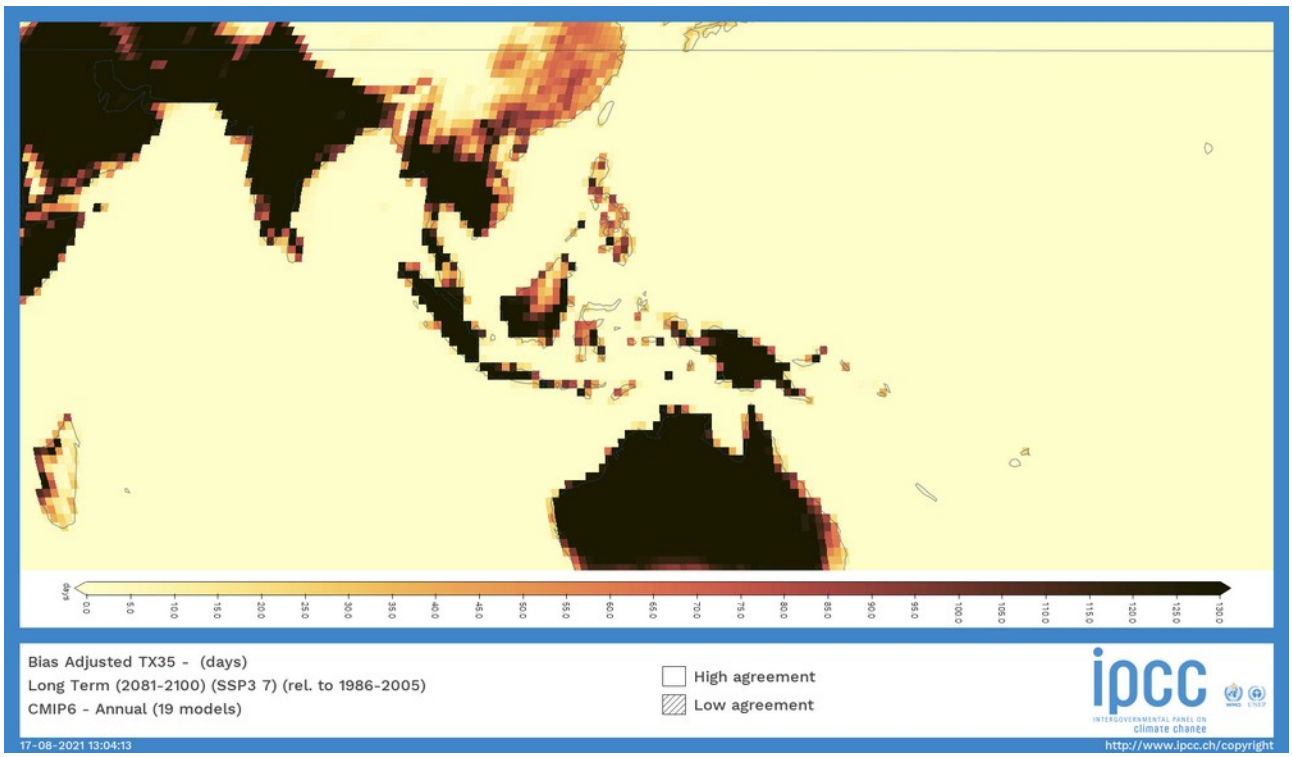
Figure 1. Total number of days per year with maximum temperature exceeding 35°C. Scale : black pixels means 130 days or more. First panel, 1961-1990. Second panel, 2021-2040 under the low emissions scenario. Third panel, 2081-2020 under the high emissions scenario.



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Bias Adjusted TX35 - (days)
Long Term (2081-2100) (SSP3 7) (rel. to 1986-2005)
CMIP6 - Annual (19 models)
High agreement
Low agreement
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