Emergencia climática: la adaptación como herramienta eficaz frente al cambio climático

Introducción y conceptos generales

21 septiembre 2022
de 18:00 a 20:00h

Cambio climático como fenómeno global y regional ¿Qué observamos en Navarra?
Peio Oria, Delegación Navarra de la Agencia Estatal de Meteorología (AEMET).

Atribución de las altas temperaturas en la Antártida al cambio climático antropogénico.
Sergi González, Instituto para la Investigación de la Nieve y las Avalanchas (SLF).

El trabajo del IPCC, la modelización climática y los gemelos digitales del Sistema Tierra.
Francisco Doblas, Barcelona Supercomputing Center (BSC).
Institución Catalana de Investigación y Estudios Avanzados (ICREA).

La mitigación frente al cambio climático: La visión desde Navarra.
Itziar Almarcegui y Miguel Ángel González, LIFE-IP NAdapta-CC
Servicio de Economía Circular y Cambio Climático de Gobierno de Navarra.

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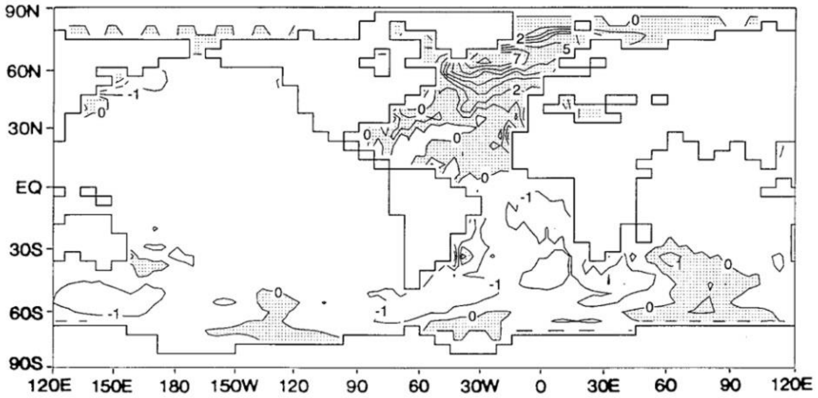
Mostró por primera vez que pasaría si se doblara la concentración de CO_2 en la atmósfera: Cambios en la temperatura media global del aire: 4-5°C **(2 - 4.5°C, según el IPCC 100 años después !).**

La combustión de carbón podría inducir un "considerable incremento" del CO_2 atmosférico durante los siguientes años.



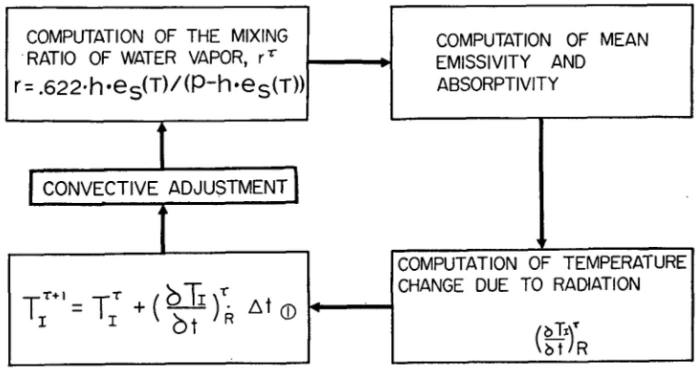
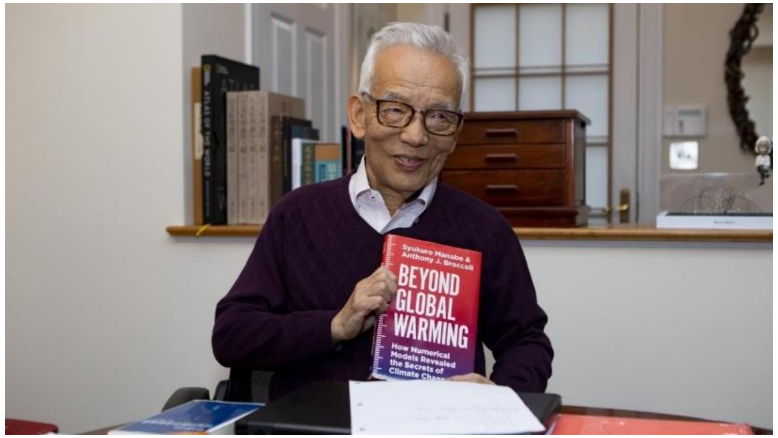
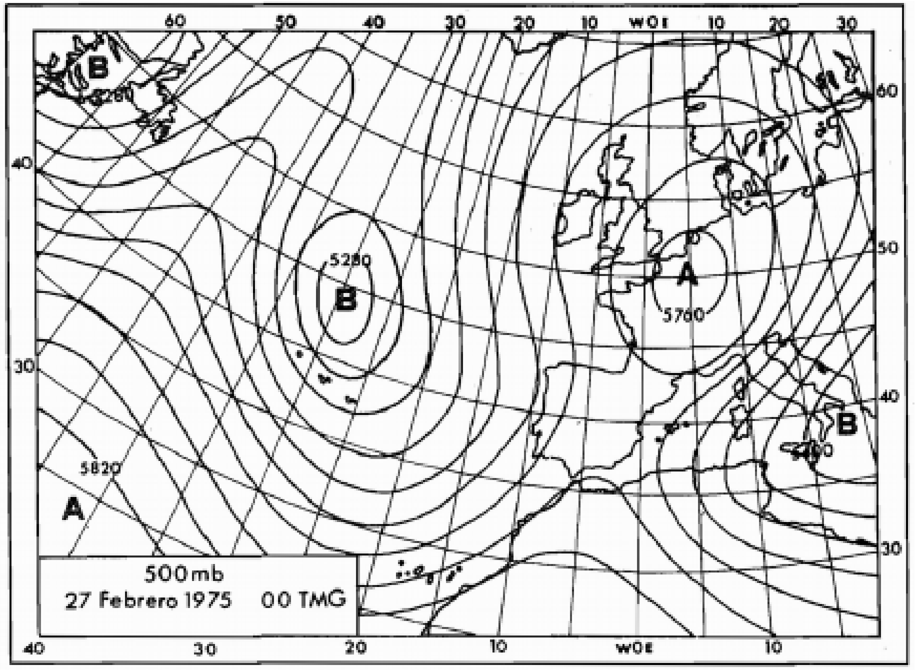


FIG. 2. Flow chart for the numerical time integration.

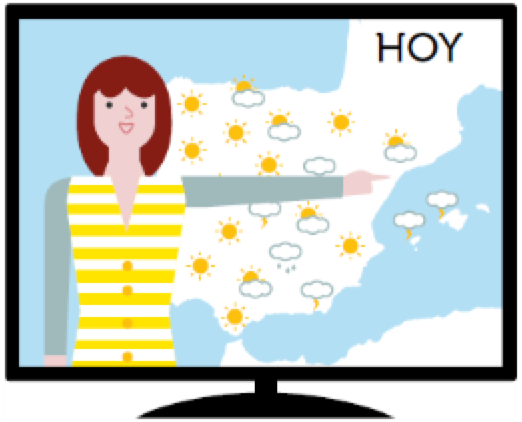
Syukuro Manabe and Ronald J Stouffer (1999). Are two modes of thermohaline circulation stable? *Tellus*

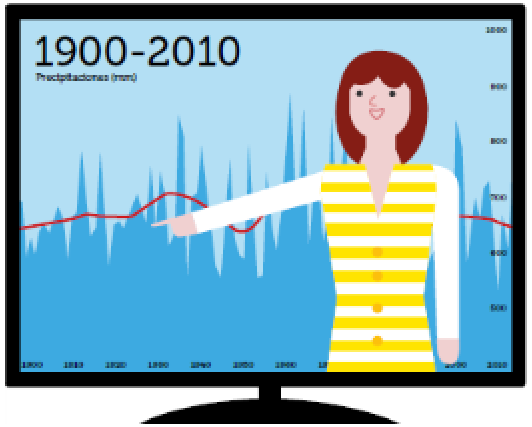


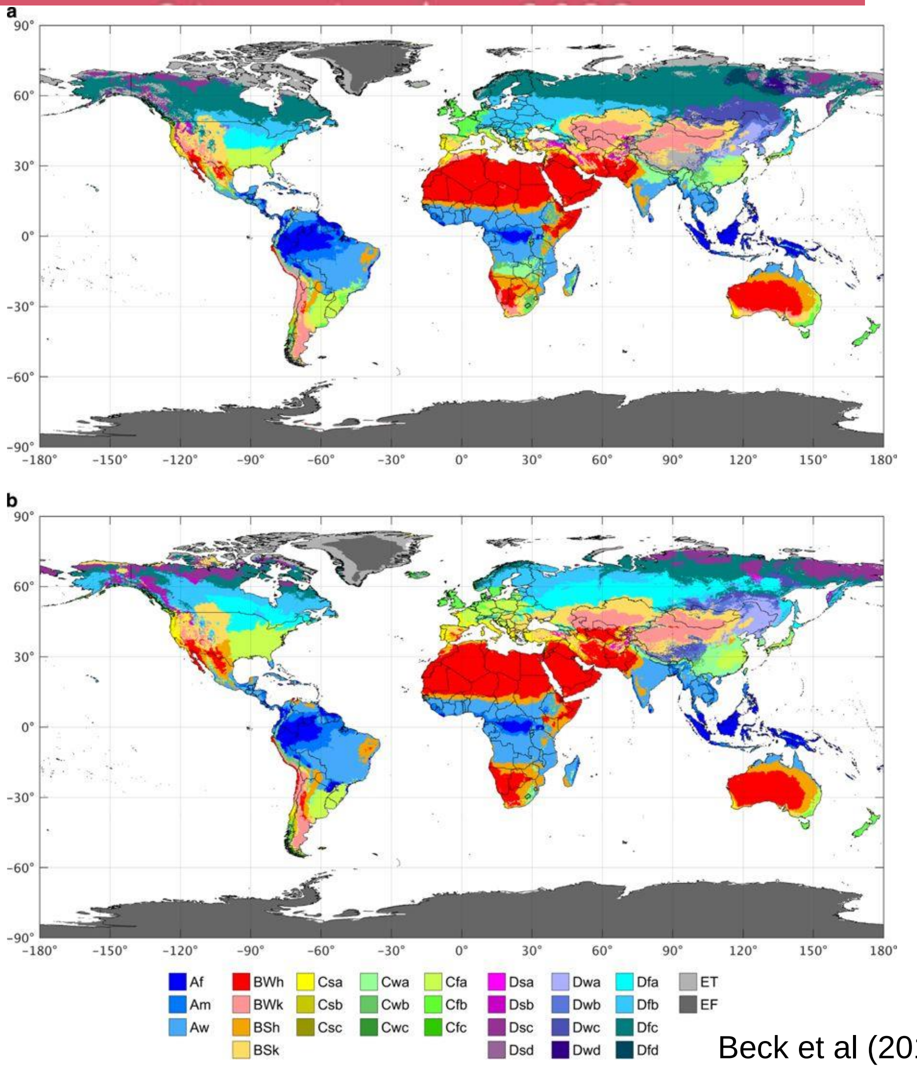
Tiempo y clima, ¿es lo mismo?



Font (2000)



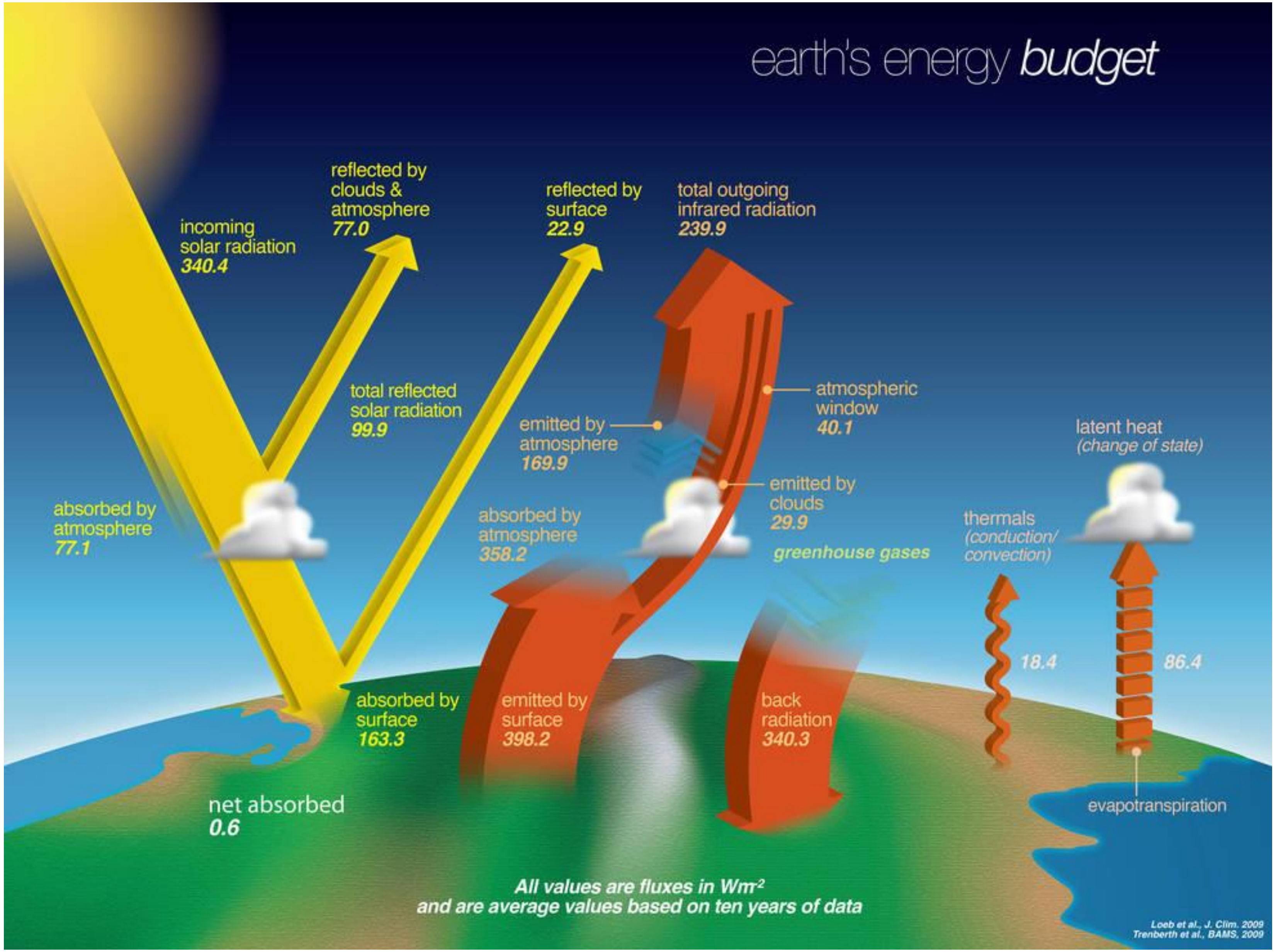


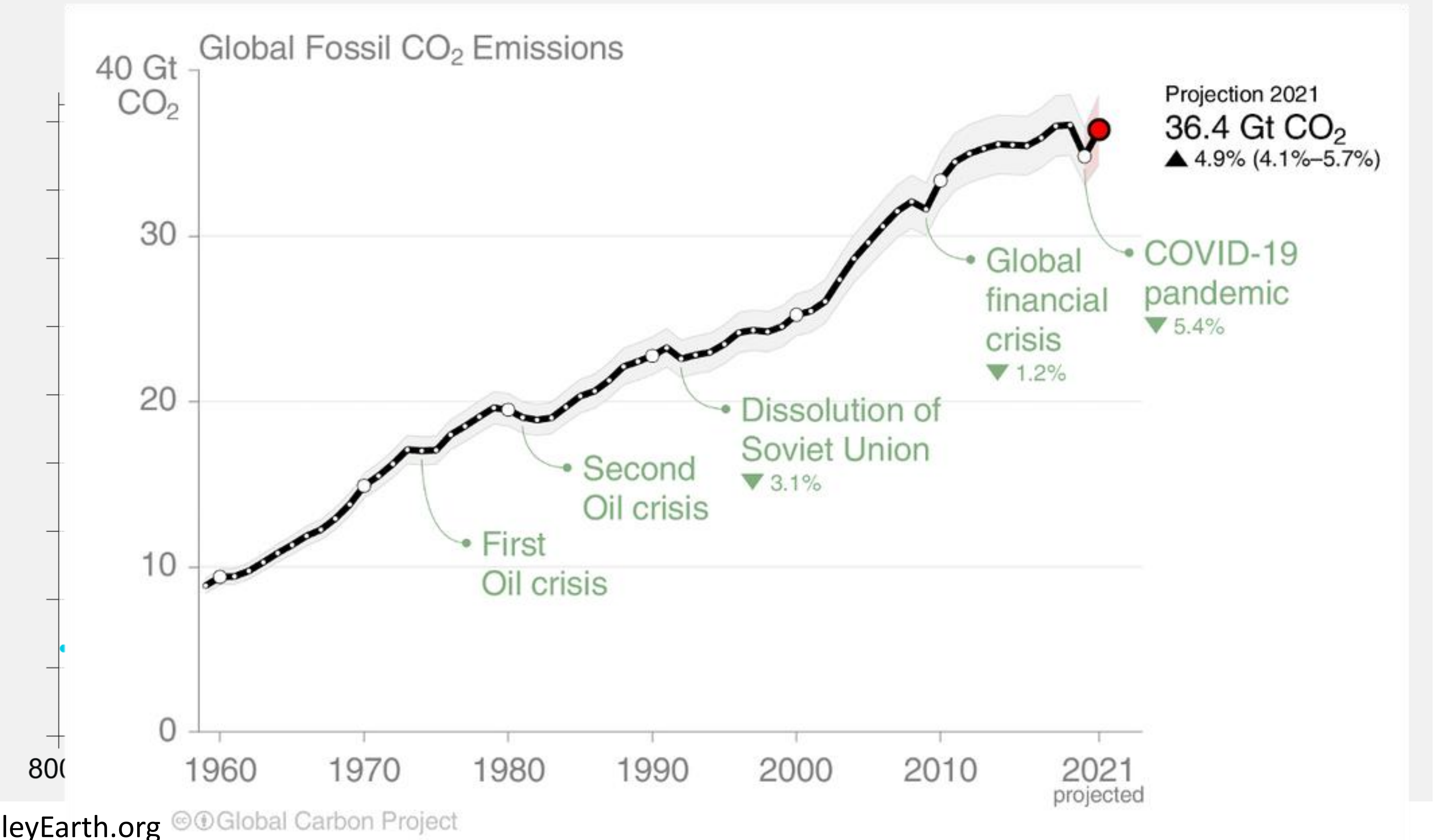


Beck et al (2018)

Tiempo atmosférico se refiere al conjunto de las condiciones meteorológicas, en un momento dado y en un lugar concreto.

El clima se refiere a las "condiciones medias del tiempo" y más concretamente, a la descripción estadística en términos cuantitativos de la media y de la variabilidad de las magnitudes relevantes relativas a periodos de tiempo suficientemente largos.


earth's energy budget
incoming solar radiation 340.4
reflected by clouds & atmosphere 77.0
reflected by surface 22.9
total outgoing infrared radiation 239.9
total reflected solar radiation 99.9
atmospheric window 40.1
emitted by atmosphere 169.9
latent heat (change of state)
emitted by clouds 29.9
absorbed by atmosphere 77.1
absorbed by atmosphere 358.2
greenhouse gases
thermals (conduction/ convection)
18.4
86.4
absorbed by surface 163.3
emitted by surface 398.2
back radiation 340.3
evapotranspiration
net absorbed 0.6
All values are fluxes in Wm^{-2} and are average values based on ten years of data
Loeb et al., J. Clim. 2009
Trenberth et al., BAMS, 2009



Fuente: BerkeleyEarth.org

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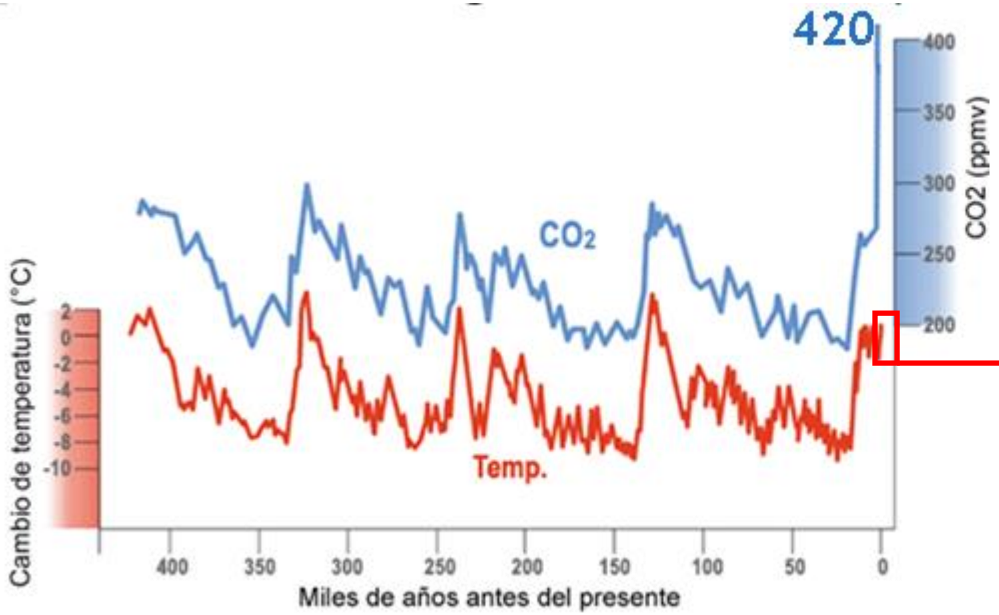
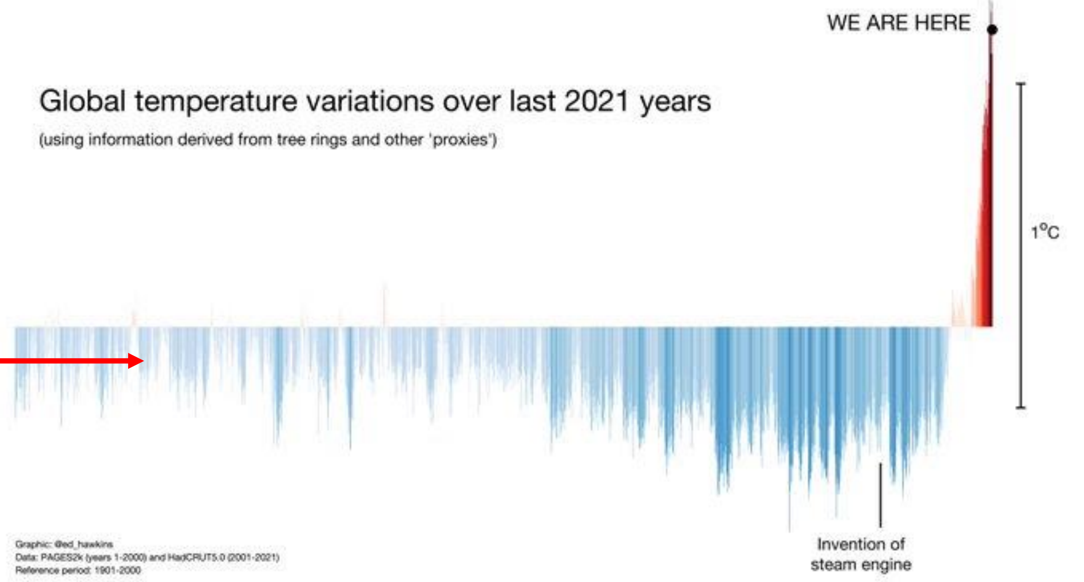
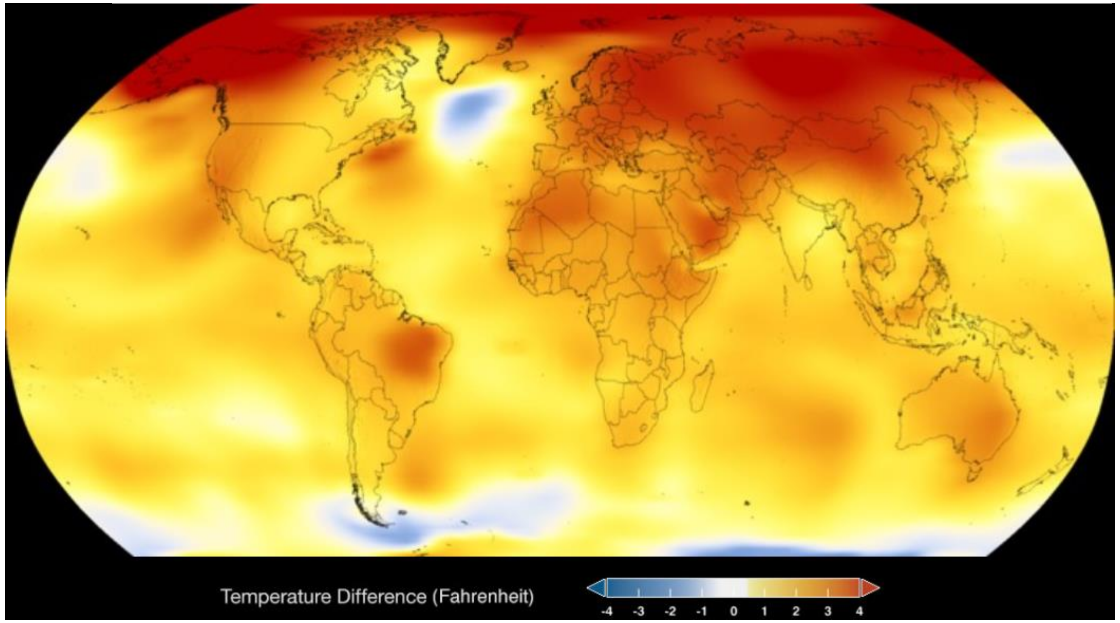
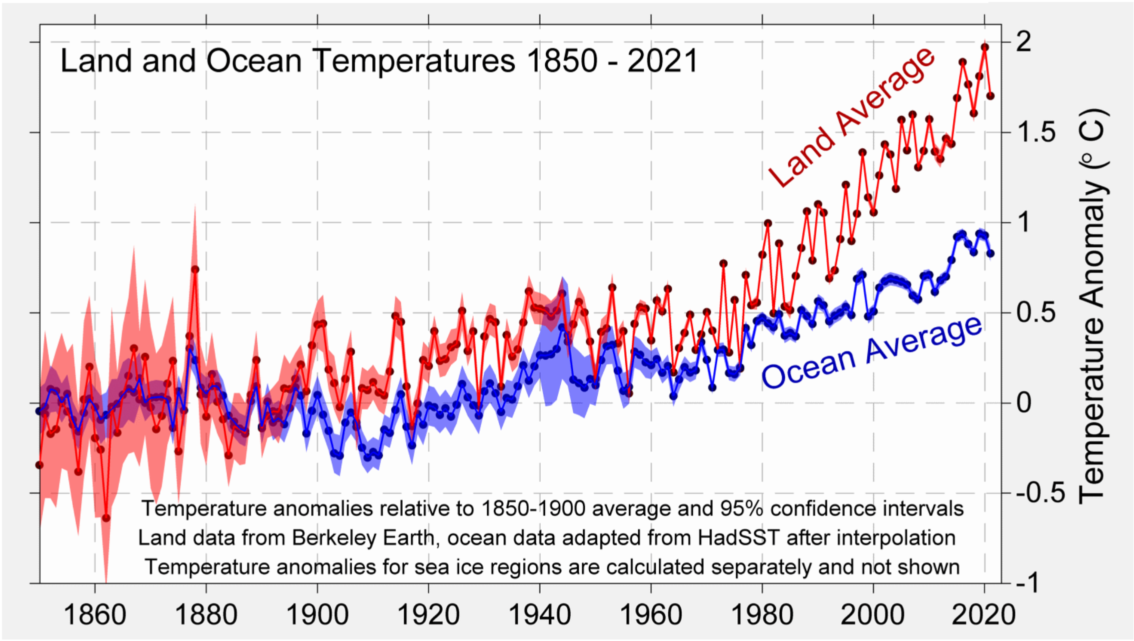
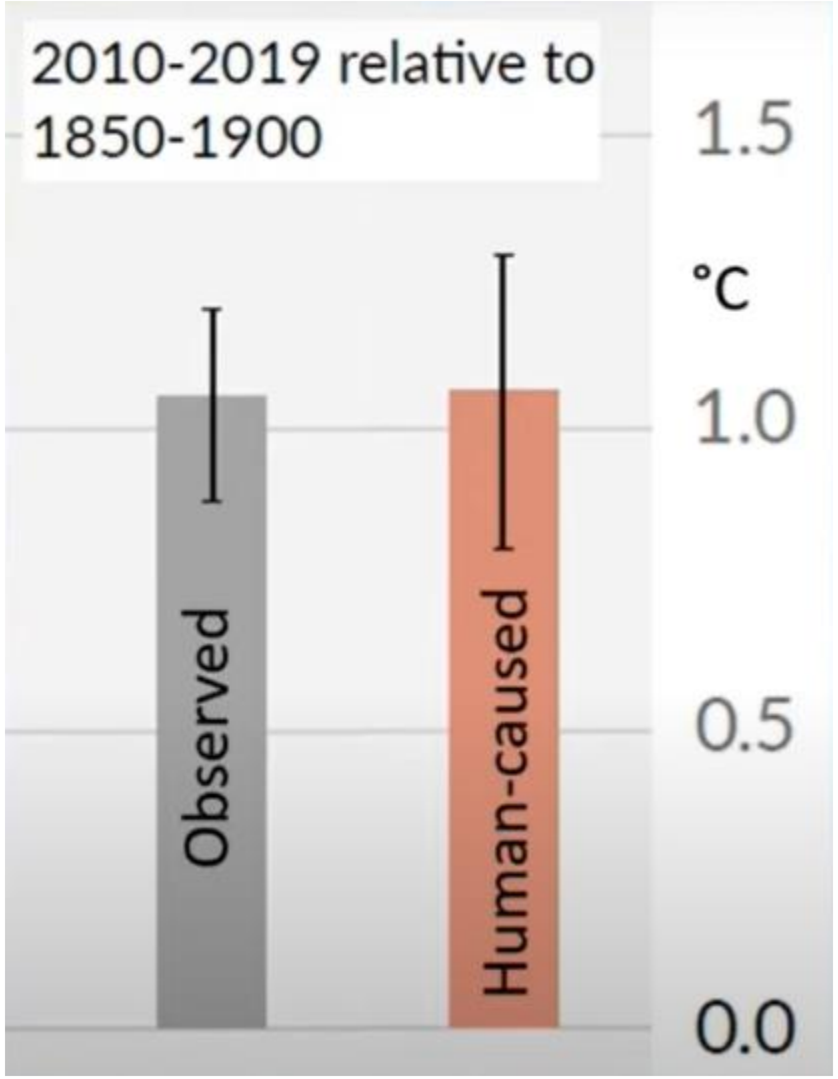
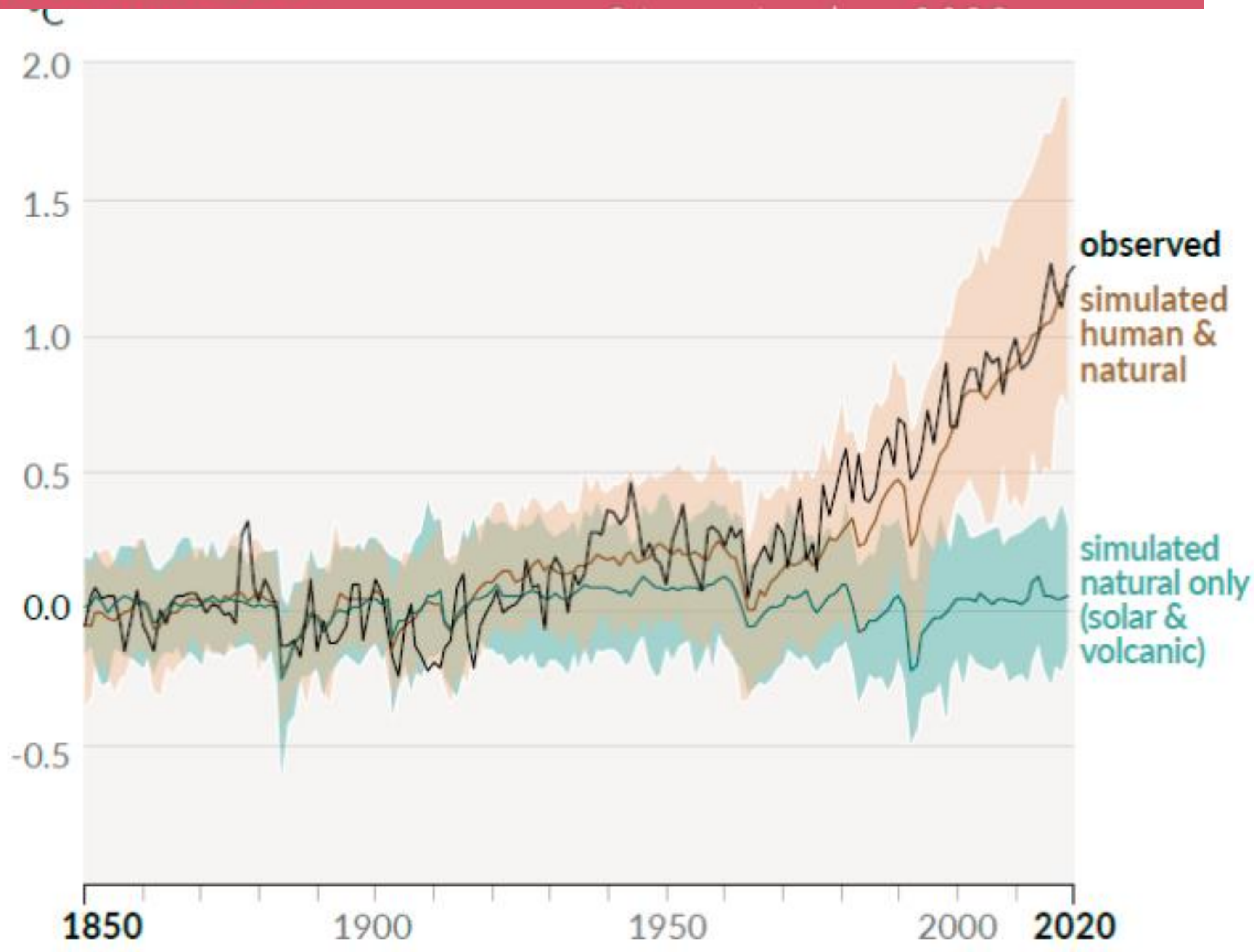










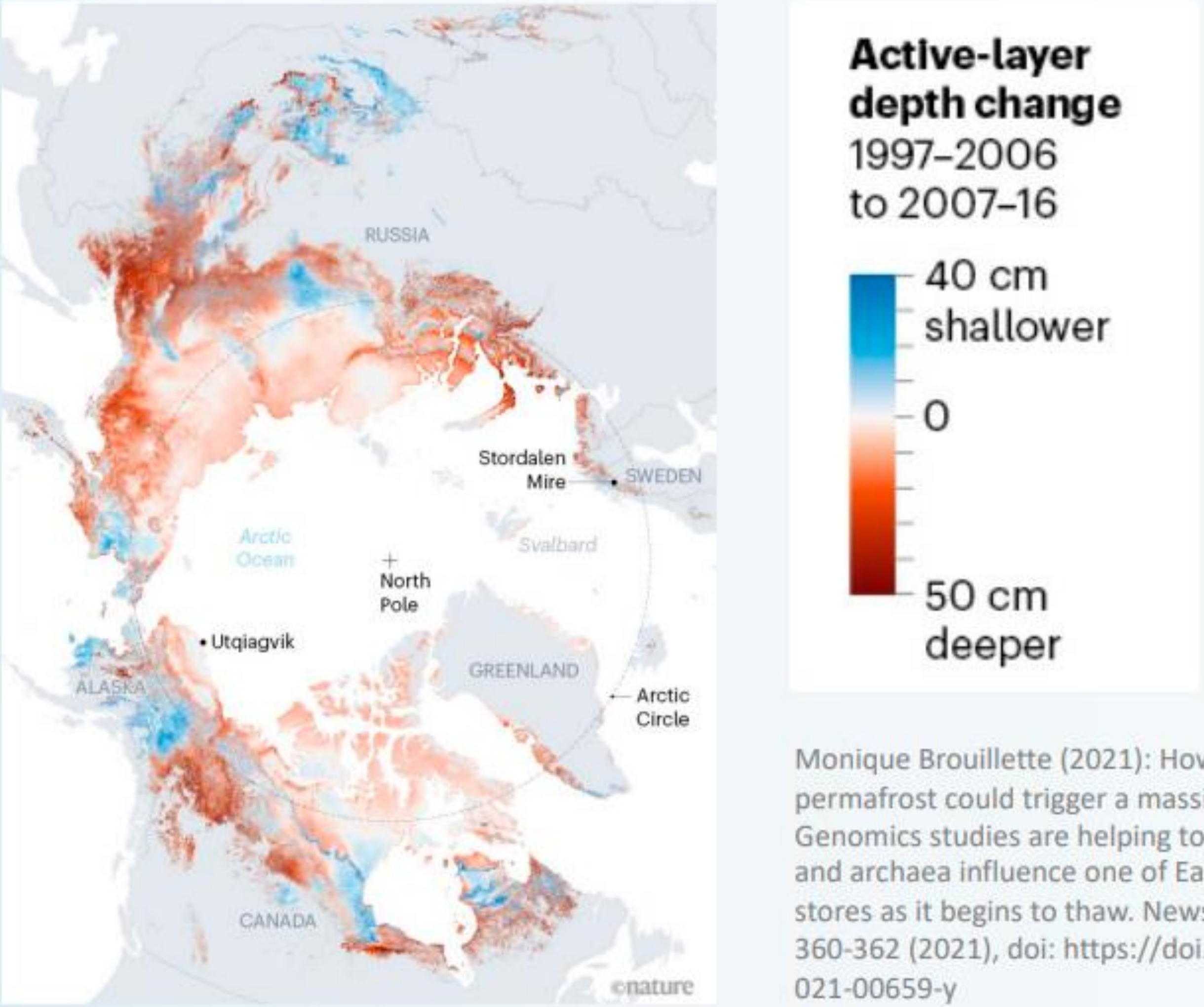


Fuente: IPCC, 6th report

THE BIG THAW

Scientists can track the loss of permafrost using satellite data. The active layer, the soil that thaws and refreezes seasonally, deepened by an average of 2.5 cm across the Northern Hemisphere during 2007–16 compared with the previous decade. For about 5% of the area, the active layer has deepened by more than 30 cm. The deepening active layer destabilizes the landscape and makes more carbon available to microbes in the soil.

derived based on Obu et al. 2018 (CEDA archive) permafrost cci



Monique Brouillette (2021): How microbes in permafrost could trigger a massive carbon bomb Genomics studies are helping to reveal how bacteria and archaea influence one of Earth's largest carbon stores as it begins to thaw. News Feature. Nature 591, 360-362 (2021), doi: https://doi.org/10.1038/d41586-021-00659-y

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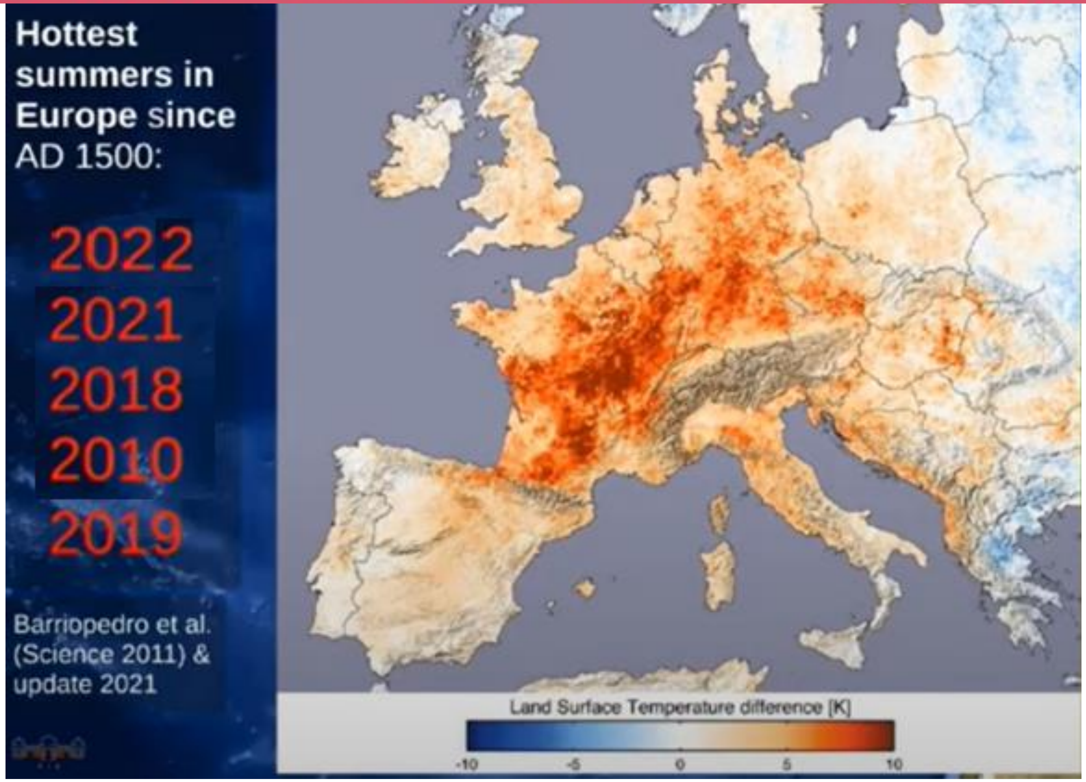
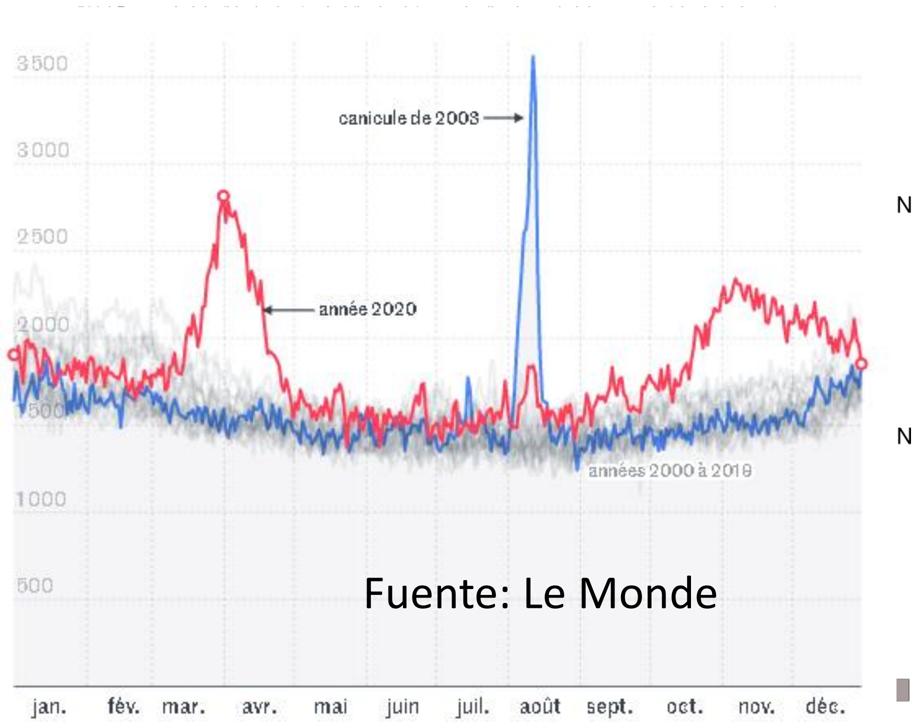
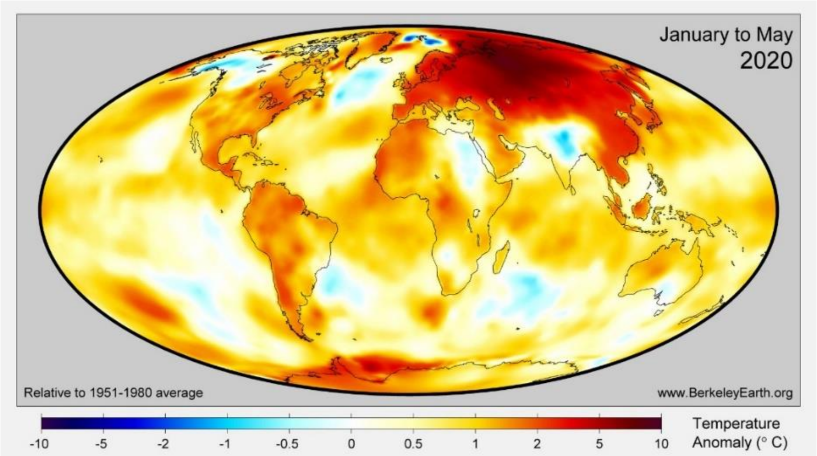
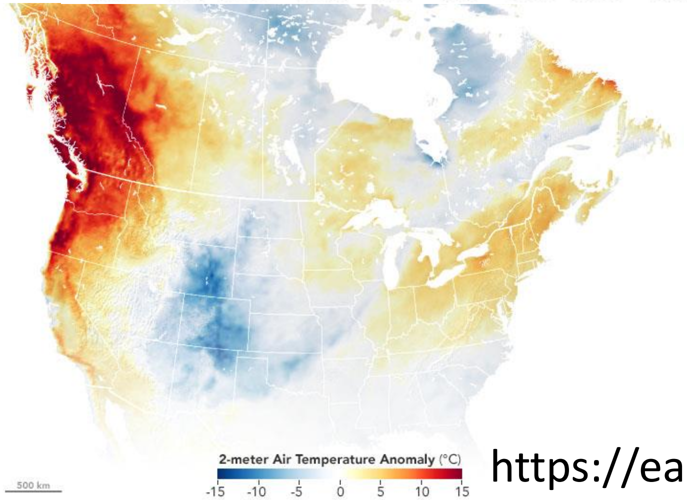


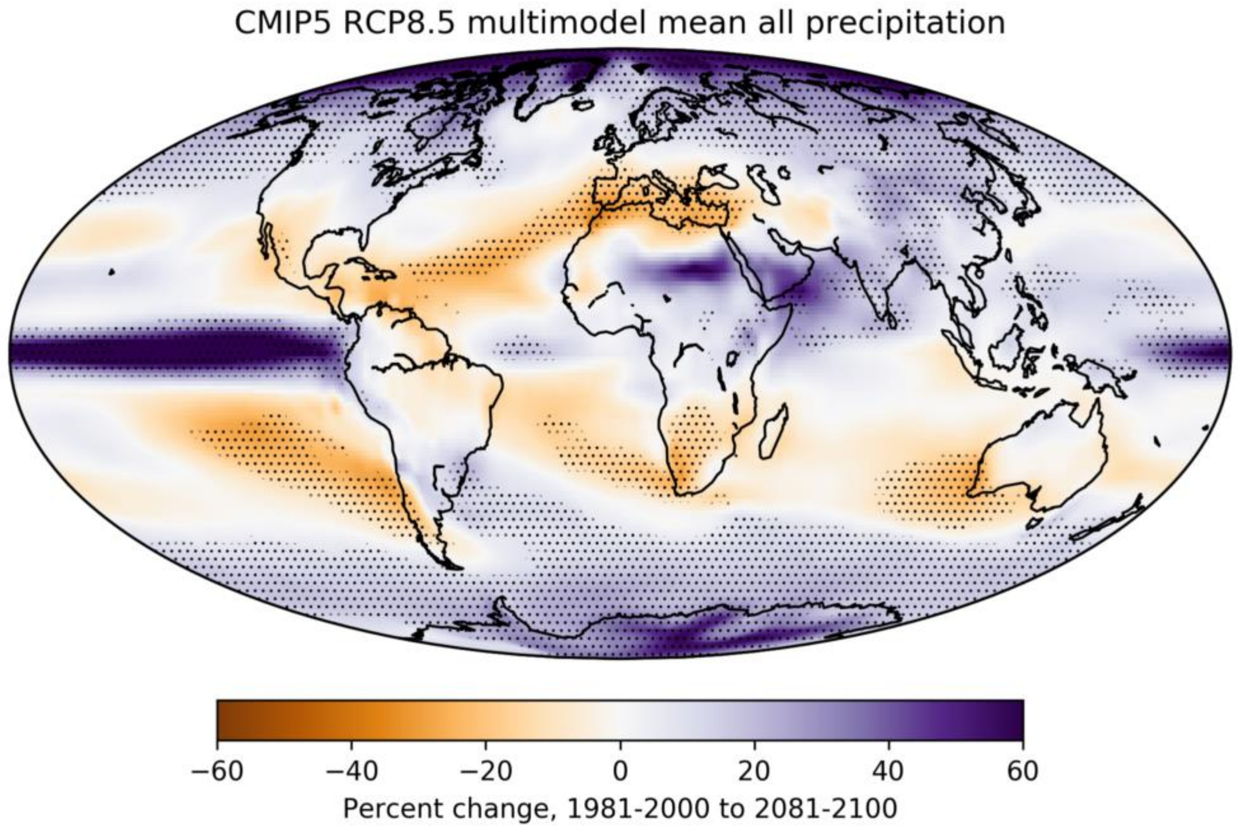


Fuente: Le Monde

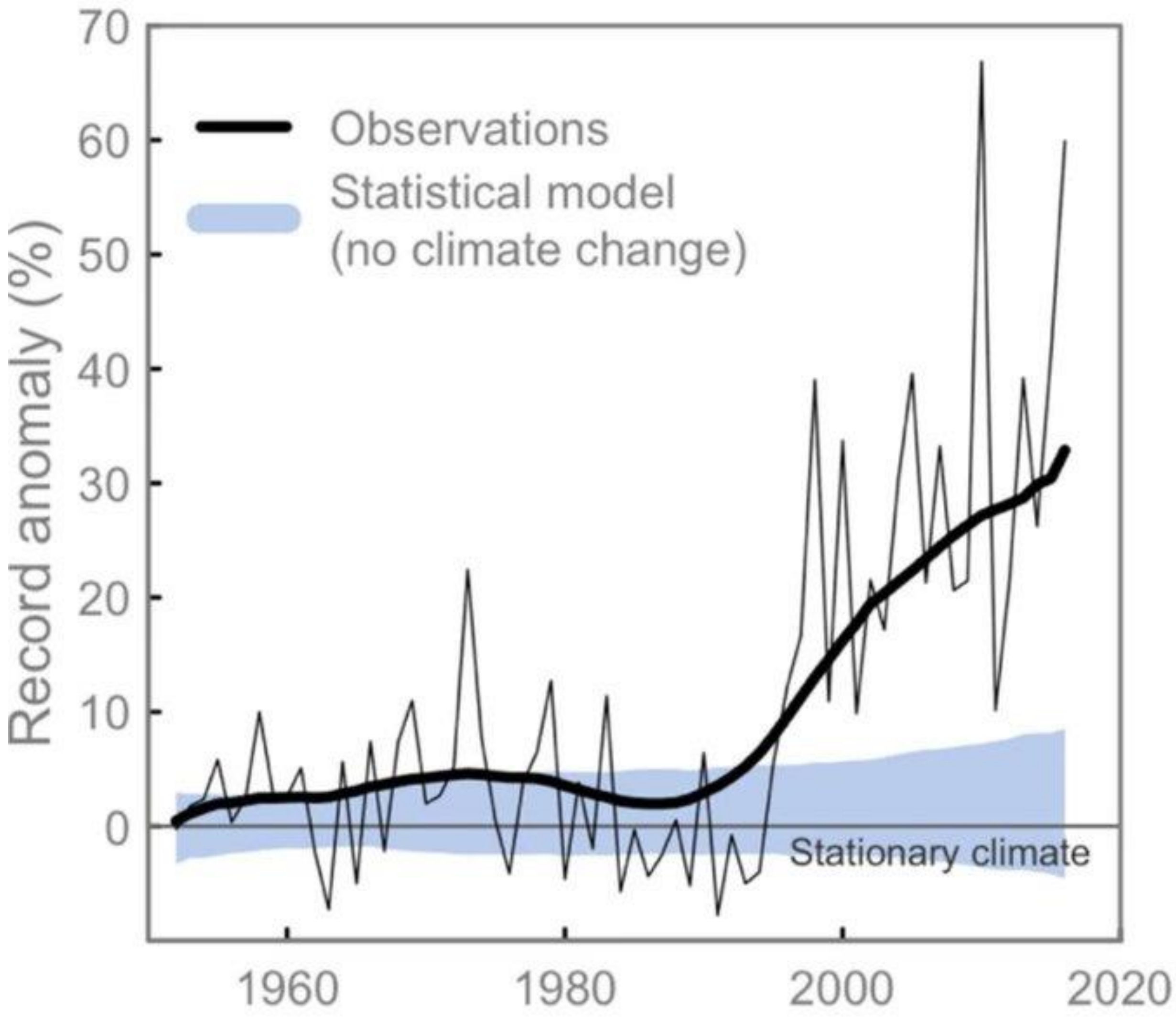




https://earthobservatory.nasa.gov/



IPCC, 2021



Robinson et al 2021.

Fenómenos extremos que aumentan muy preocupantemente su probabilidad de ocurrencia: 2020, 2021 y… 2022

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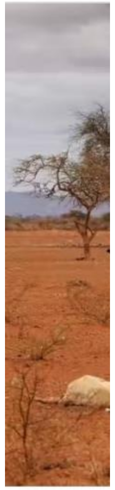

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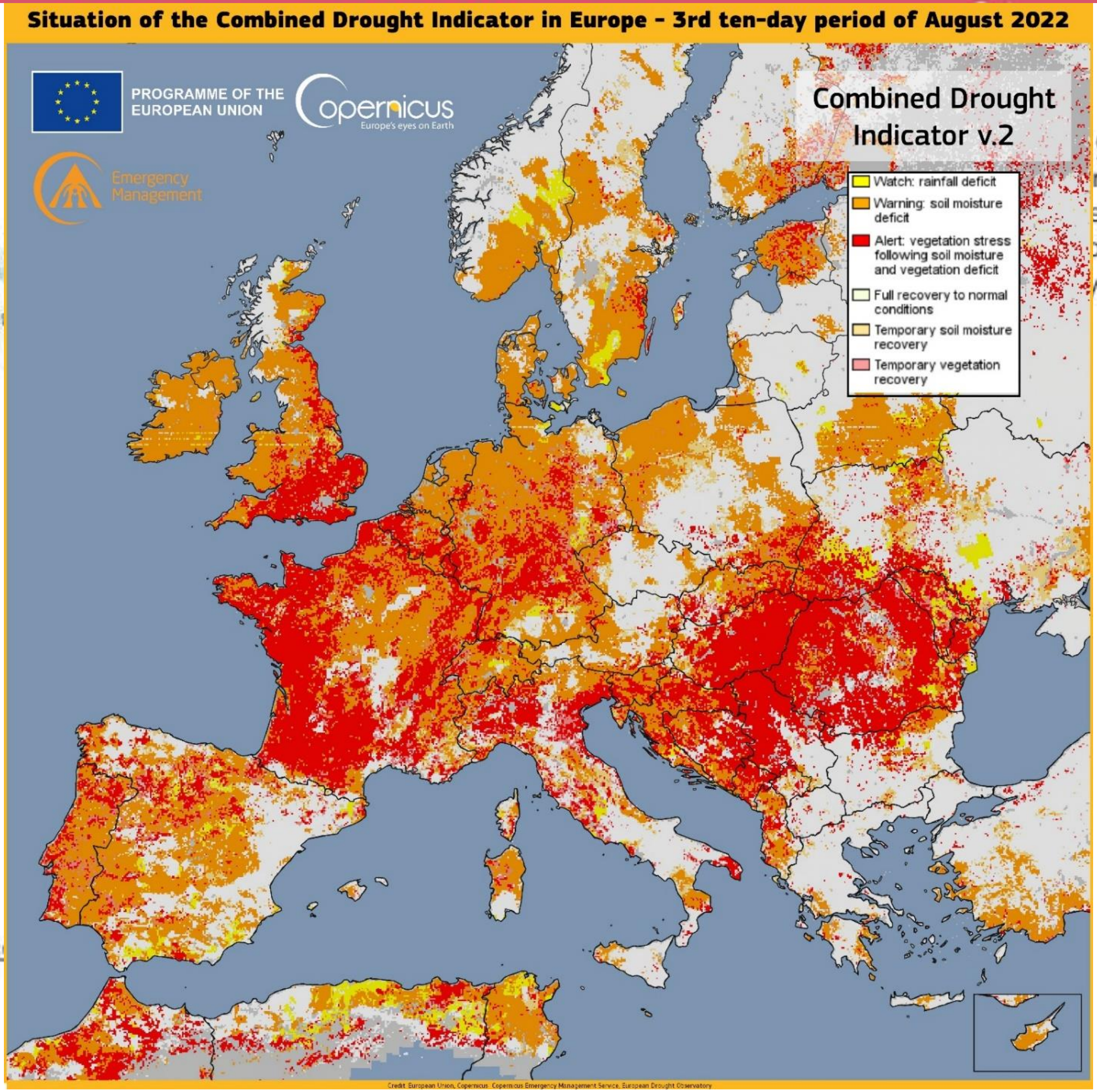

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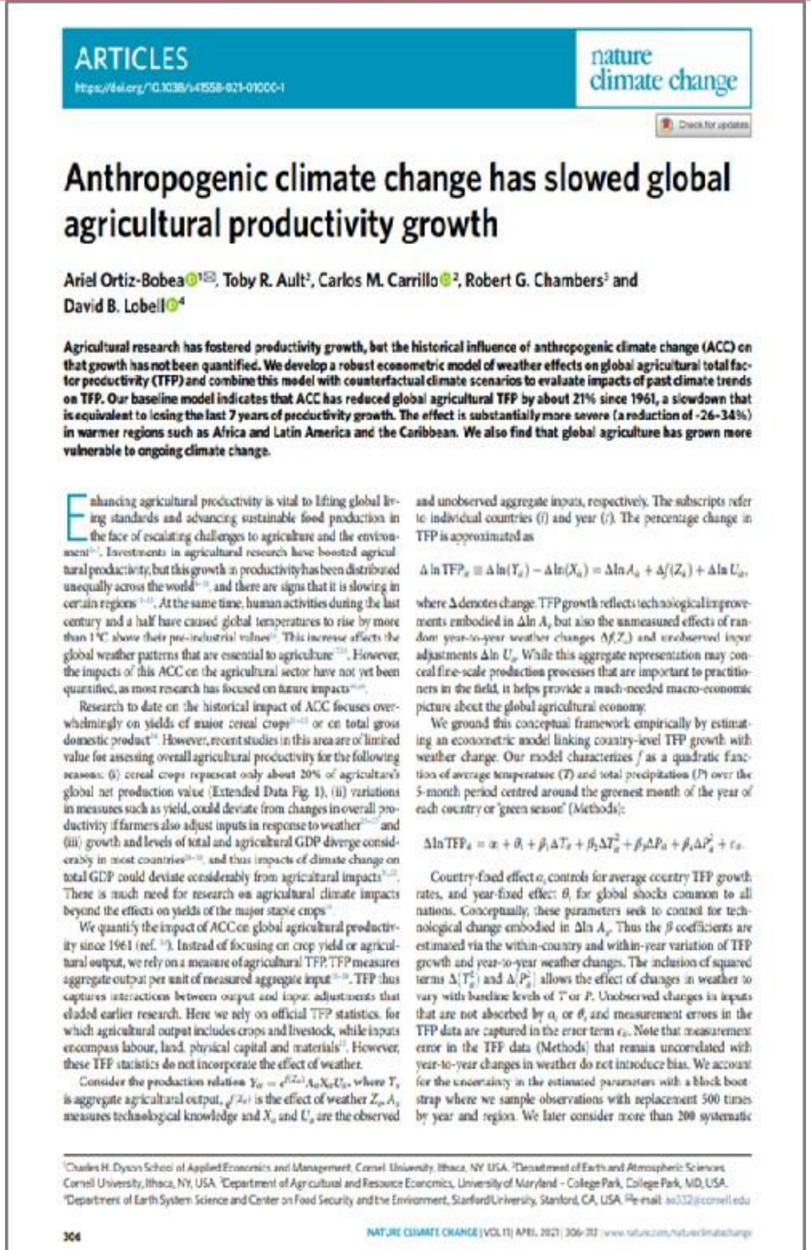

ARTICLES
https://doi.org/10.1038/s41558-021-01000-1
nature climate change
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Anthropogenic climate change has slowed global agricultural productivity growth

Ariel Ortiz-Bobea[1], Toby R. Ault[2], Carlos M. Carrillo[2], Robert G. Chambers[3] and David B. Lobell[4]

Agricultural research has fostered productivity growth, but the historical influence of anthropogenic climate change (ACC) on that growth has not been quantified. We develop a robust econometric model of weather effects on global agricultural total factor productivity (TFP) and combine this model with counterfactual climate scenarios to evaluate impacts of past climate trends on TFP. Our baseline model indicates that ACC has reduced global agricultural TFP by about 21% since 1961, a slowdown that is equivalent to losing the last 7 years of productivity growth. The effect is substantially more severe (a reduction of -26–34%) in warmer regions such as Africa and Latin America and the Caribbean. We also find that global agriculture has grown more vulnerable to ongoing climate change.

Enhancing agricultural productivity is vital to lifting global living standards and advancing sustainable food production in the face of escalating challenges to agriculture and the environment. Investments in agricultural research have boosted agricultural productivity, but this growth in productivity has been distributed unequally across the world, and there are signs that it is slowing in certain regions. At the same time, human activities during the last century and a half have caused global temperatures to rise by more than 1 °C above their pre-industrial values. This increase affects the global weather patterns that are essential to agriculture. However, the impacts of this ACC on the agricultural sector have not yet been quantified, as most research has focused on future impacts.

Research to date on the historical impact of ACC focuses overwhelmingly on yields of major cereal crops or on total gross domestic product. However, recent studies in this area are of limited value for assessing overall agricultural productivity for the following reasons: (i) cereal crops represent only about 20% of agriculture's global net production value (Extended Data Fig. 1), (ii) variations in measures such as yield, could deviate from changes in overall productivity if farmers also adjust inputs in response to weather and (iii) growth and levels of total and agricultural GDP diverge considerably in most countries, and thus impacts of climate change on total GDP could deviate considerably from agricultural impacts. There is much need for research on agricultural climate impacts beyond the effects on yields of the major staple crops.

We quantify the impact of ACC on global agricultural productivity since 1961 (ref.). Instead of focusing on crop yield or agricultural output, we rely on a measure of agricultural TFP. TFP measures aggregate output per unit of measured aggregate input. TFP thus captures interactions between output and input adjustments that eluded earlier research. Here we rely on official TFP statistics, for which agricultural output includes crops and livestock, while inputs encompass labour, land, physical capital and materials. However, these TFP statistics do not incorporate the effect of weather.

Consider the production relation $Y_{it} = e^{f(Z_{it})} A_{it} X_{it} U_{it}$, where Y_{it} is aggregate agricultural output, $e^{f(Z_{it})}$ is the effect of weather Z_{it}, A_{it} measures technological knowledge and X_{it} and U_{it} are the observed and unobserved aggregate inputs, respectively. The subscripts refer to individual countries (i) and year (t). The percentage change in TFP is approximated as

$$\Delta \ln TFP_{it} \equiv \Delta \ln(Y_{it}) - \Delta \ln(X_{it}) = \Delta \ln A_{it} + \Delta f(Z_{it}) + \Delta \ln U_{it},$$

where Δ denotes change. TFP growth reflects technological improvements embodied in $\Delta \ln A_{it}$ but also the unmeasured effects of random year-to-year weather changes $\Delta f(Z_{it})$ and unobserved input adjustments $\Delta \ln U_{it}$. While this aggregate representation may conceal fine-scale production processes that are important to practitioners in the field, it helps provide a much-needed macro-economic picture about the global agricultural economy.

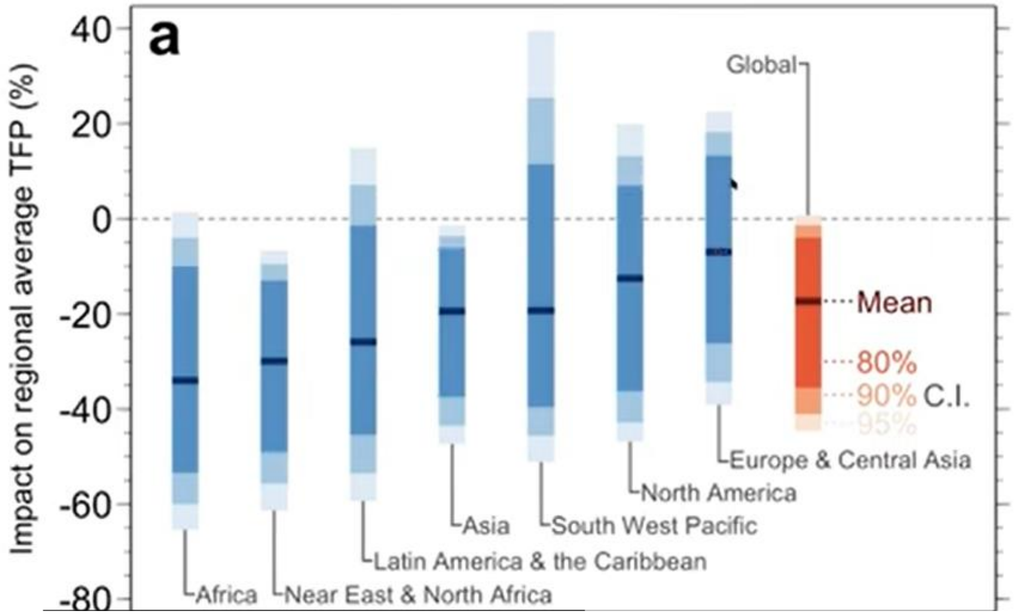
We ground this conceptual framework empirically by estimating an econometric model linking country-level TFP growth with weather change. Our model characterizes f as a quadratic function of average temperature (T) and total precipitation (P) over the 5-month period centred around the greenest month of the year of each country or 'green season' (Methods):

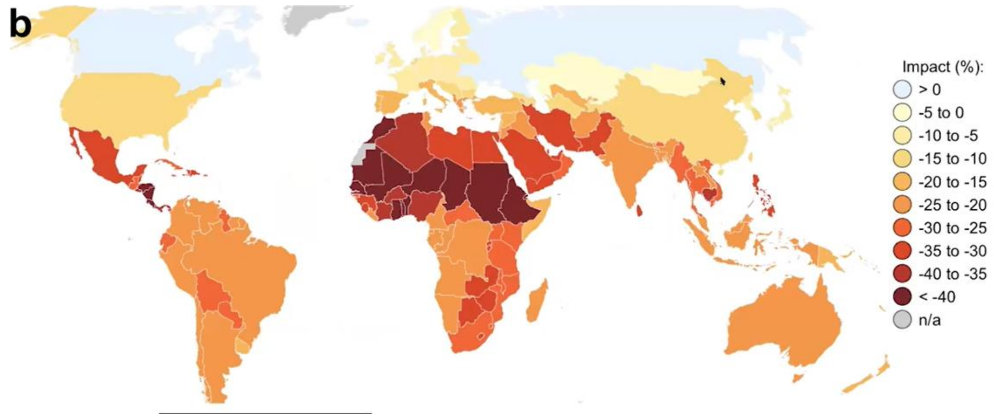
$$\Delta \ln TFP_{it} = \alpha_i + \theta_t + \beta_1 \Delta T_{it} + \beta_2 \Delta T_{it}^2 + \beta_3 \Delta P_{it} + \beta_4 \Delta P_{it}^2 + \varepsilon_{it}.$$

Country-fixed effect α_i controls for average country TFP growth rates, and year-fixed effect θ_t for global shocks common to all nations. Conceptually, these parameters seek to control for technological change embodied in $\Delta \ln A_{it}$. Thus the β coefficients are estimated via the within-country and within-year variation of TFP growth and year-to-year weather changes. The inclusion of squared terms $\Delta(T_{it}^2)$ and $\Delta(P_{it}^2)$ allows the effect of changes in weather to vary with baseline levels of T or P. Unobserved changes in inputs that are not absorbed by α_i or θ_t and measurement errors in the TFP data are captured in the error term ε_{it}. Note that measurement error in the TFP data (Methods) that remain uncorrelated with year-to-year changes in weather do not introduce bias. We account for the uncertainty in the estimated parameters with a block bootstrap where we sample observations with replacement 500 times by year and region. We later consider more than 200 systematic

[1]Charles H. Dyson School of Applied Economics and Management, Cornell University, Ithaca, NY, USA. [2]Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, NY, USA. [3]Department of Agricultural and Resource Economics, University of Maryland - College Park, College Park, MD, USA. [4]Department of Earth System Science and Center on Food Security and the Environment, Stanford University, Stanford, CA, USA. e-mail: ao332@cornell.edu

Afección a la agricultura





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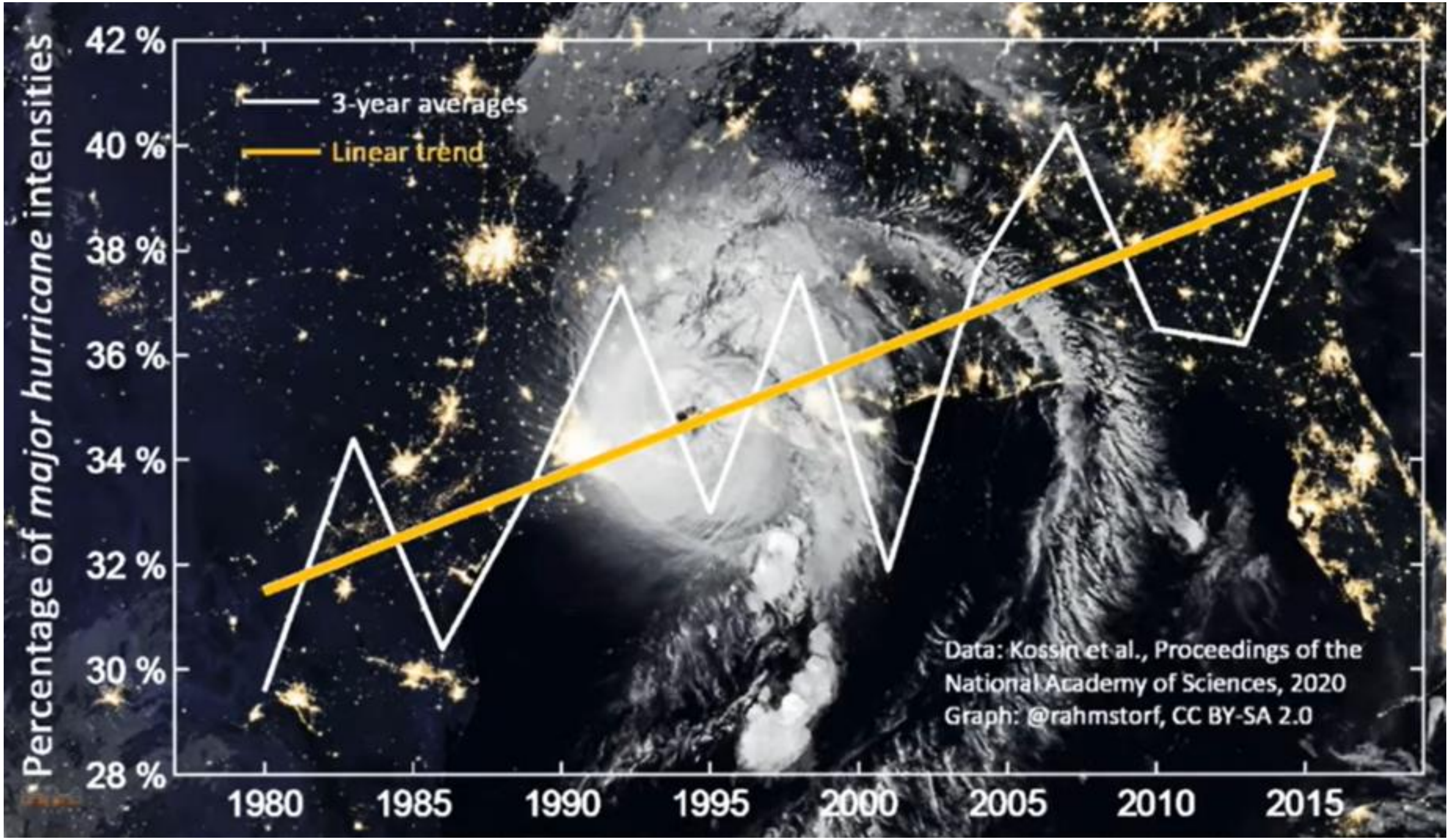

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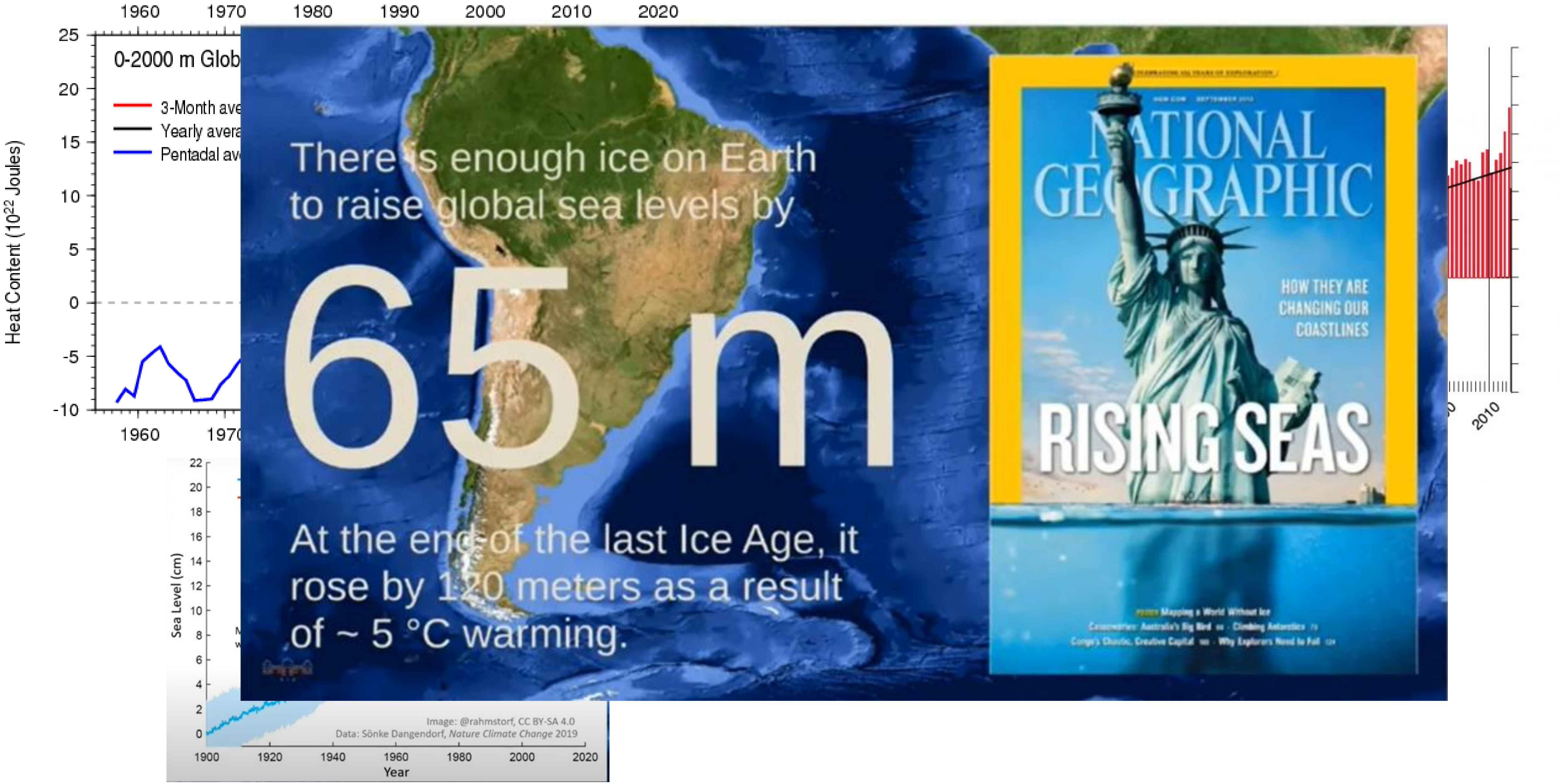
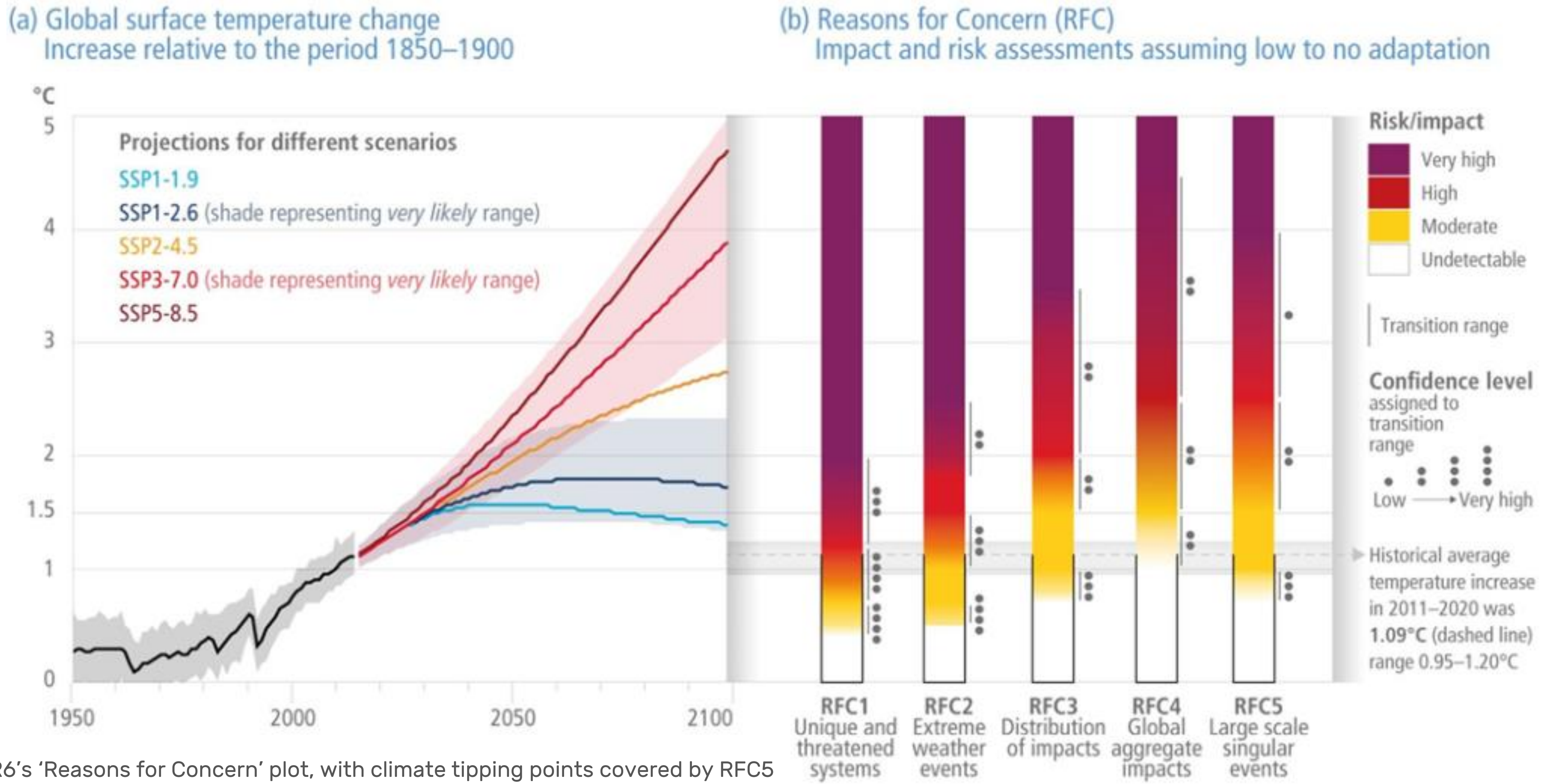
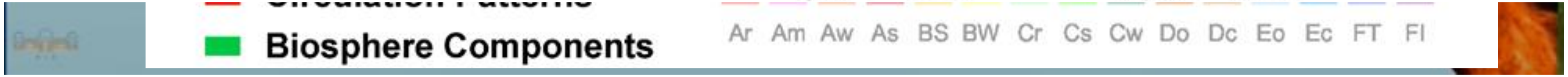




IPCC AR6's 'Reasons for Concern' plot, with climate tipping points covered by RFC5



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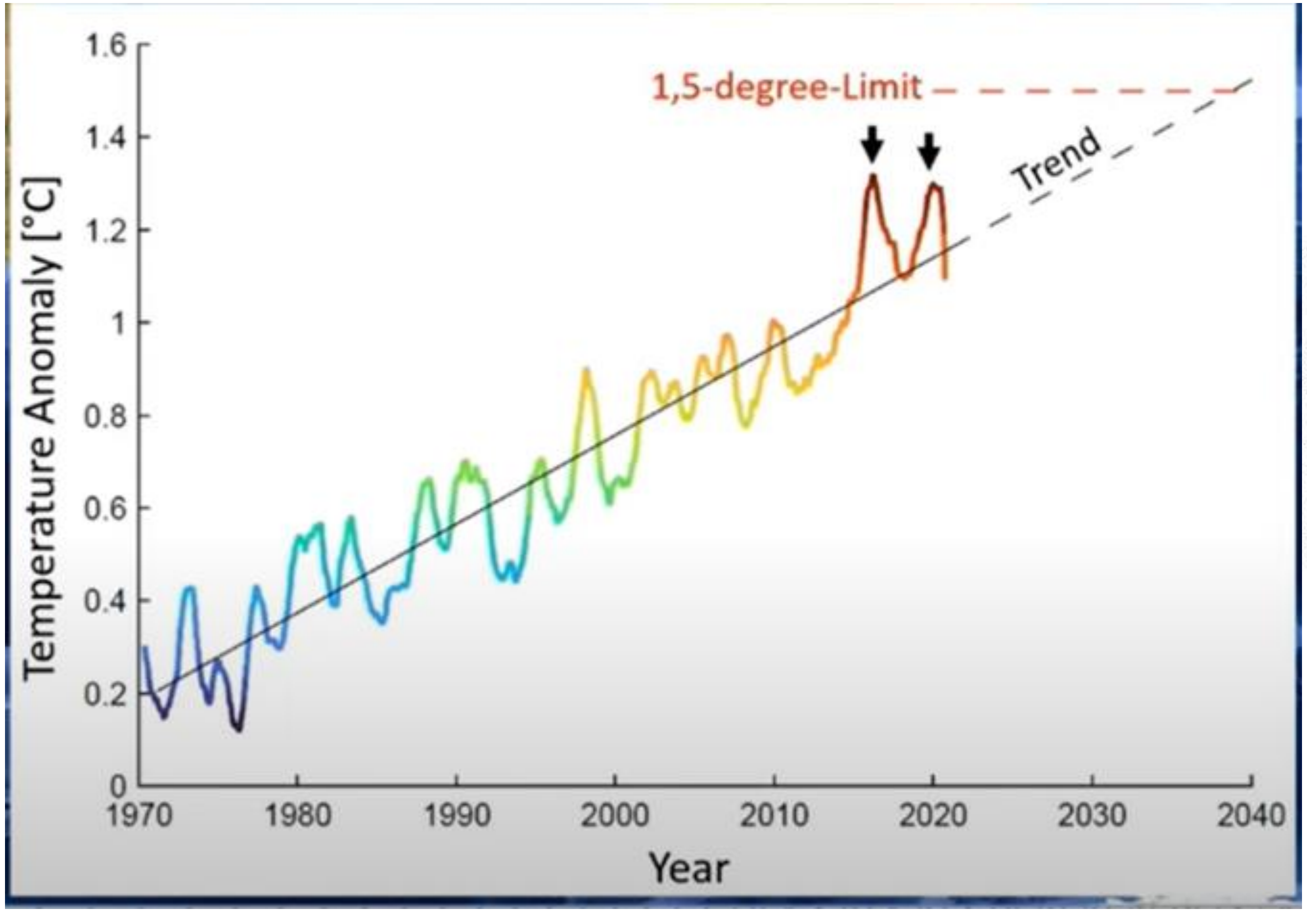
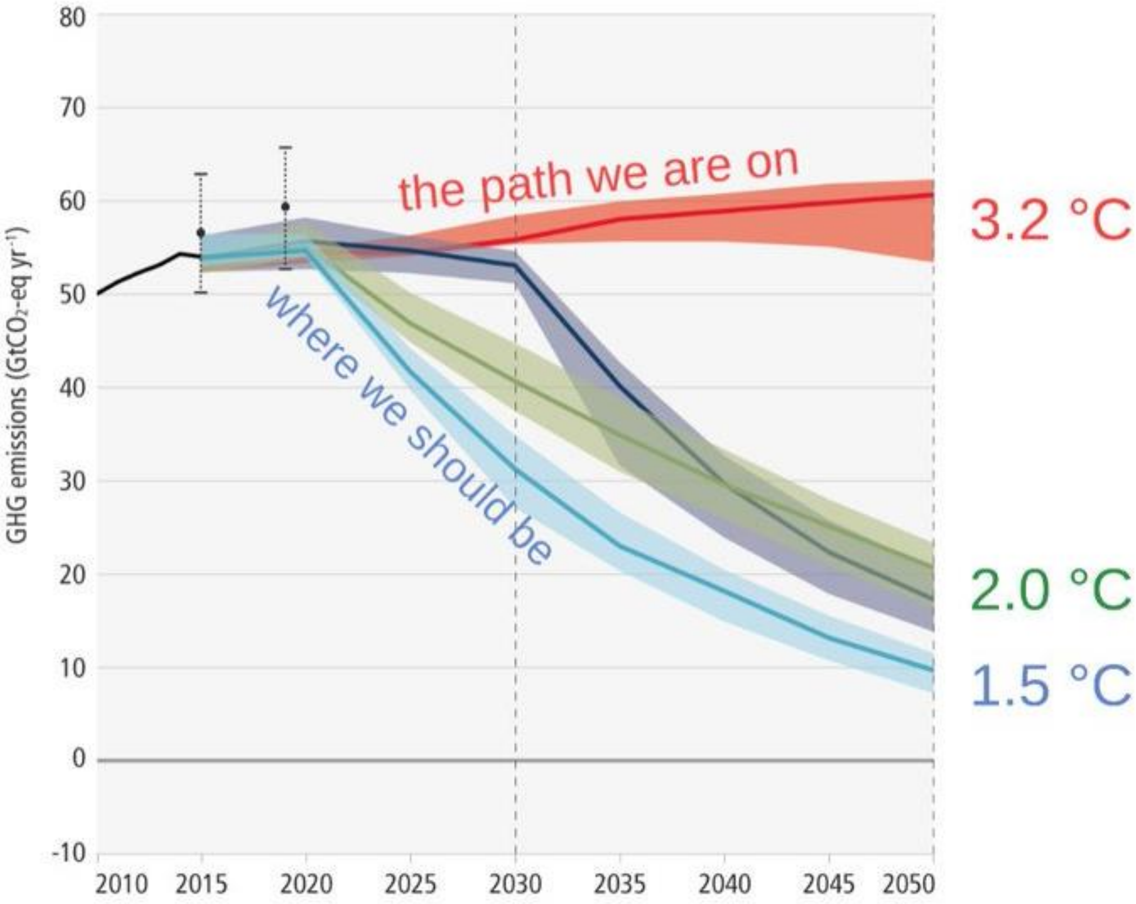
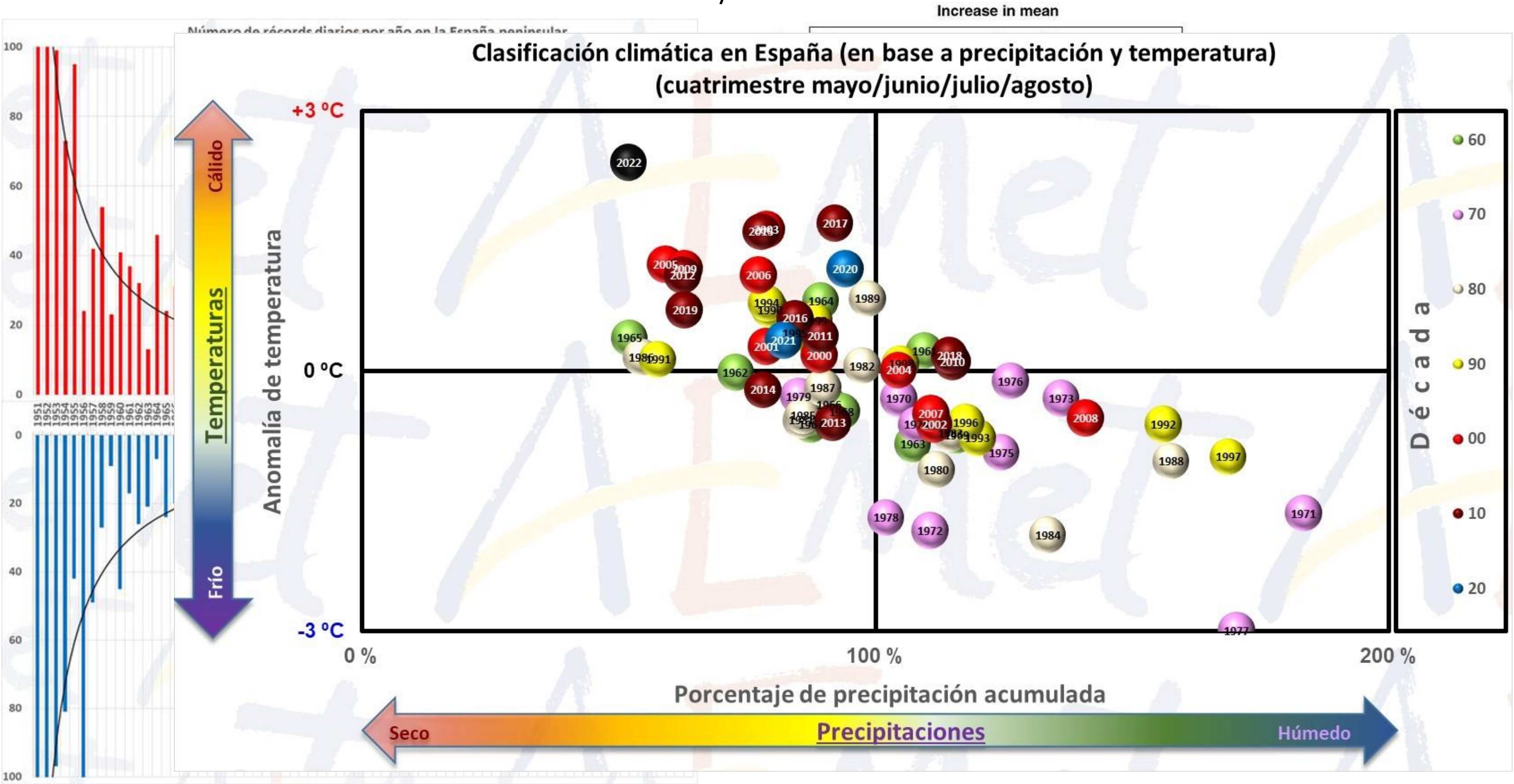




Robbie Andrews, based on data from the Global Carbon Project

A nivel estatal ya observamos un claro aumento en el número de días de las situaciones que dan lugar a olas de calor y la intensidad de las mismas



¿Y qué observamos en Navarra?

¿Qué cambios observamos ya en Navarra en referencia al clima?

Temperatura (desde 1950)	↑ +1.3 °C
Número de días por encima de 30 °C	↑ ~200 %
Adelanto de la fecha en la que se registran los primeros 10 días con 30 °C en la Ribera	↑ 1 mes (2 meses en 2022)
Aumento de días de precipitación extrema (desde 1980)	↑ 7/10 días en 2011-2021 (norte) 6/10 días en 2011-2021 (sur)
Días de helada (desde 1950 en Pamplona)	↓ ~ -30 %
Disminución de la precipitación invernal en vertiente cantábrica	↓ - 20 %

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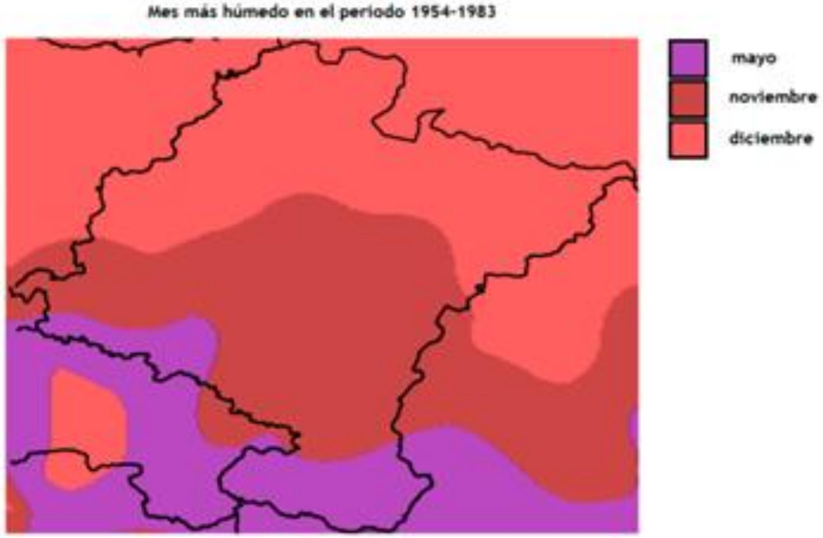
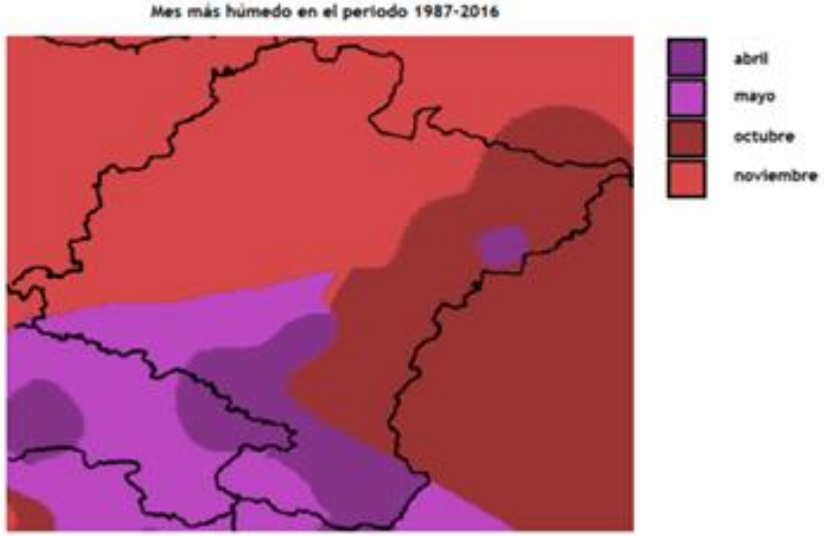
Cambio en el régimen de precipitaciones

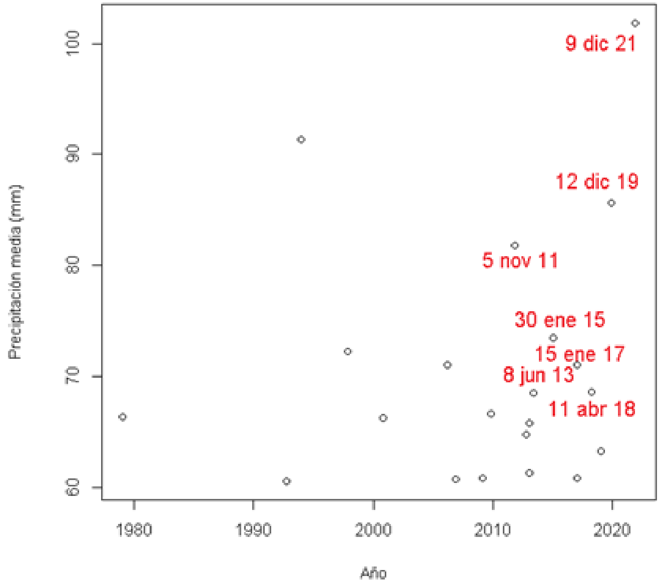




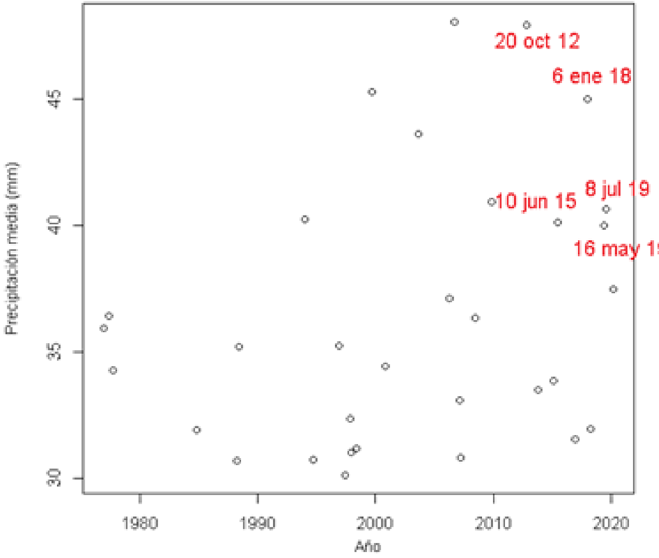
Precipitación más extrema

Días de mayor precipitación desde finales de los 70 en el conjunto de Navarra

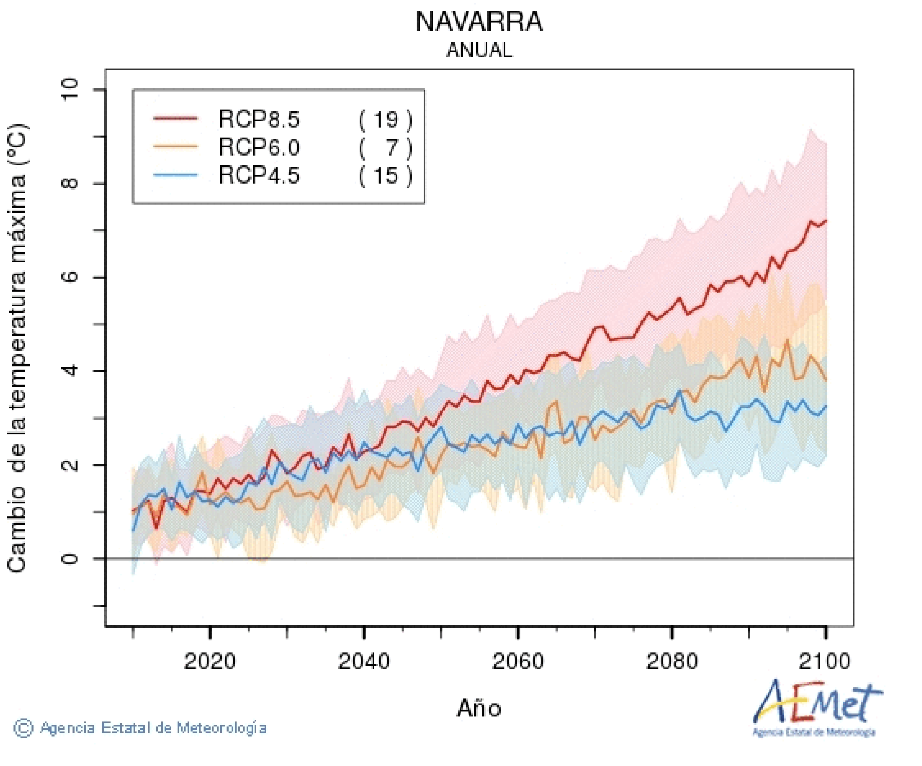
Norte Navarra

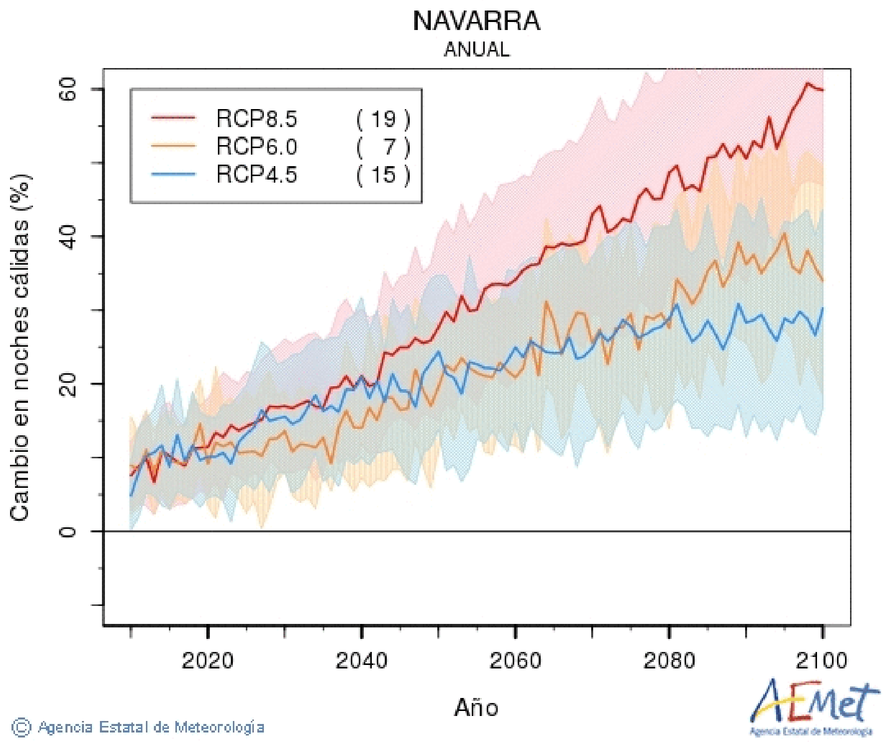


Sur Navarra



Proyecciones: esperamos que las temperaturas continúen aumentando en Navarra.





Conclusiones

El Cambio Climático es inequívoco, continúa y continuará operando y sus efectos se irán incrementando.

Los impactos son generalizados y profundos, en todas las partes del sistema Tierra aunque especialmente en la criosfera y algunos ecosistemas de las altas latitudes de nuestro hemisferio.

Detener el calentamiento global en 1.5-2°C exige llevar a una carrera contrarreloj y de alcance global para alcanzar el cero neto de emisiones a la atmósfera. Los esfuerzos actuales son claramente insuficientes.

Se considera fundamental ahondar en el conocimiento de los procesos de retroalimentación que puedan amplificar cambios a gran escala en el planeta.

En Navarra, igual que en otras zonas de la Península y Europa, los efectos en las alteraciones en el clima son muy claros, especialmente en forma de un incremento del número e intensidad de las olas de calor y de días de precipitación extrema.