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IPCC Sixth Assessment Report: about the Cycle, The Physical Science Basis, and upcoming reports of WGII and WGIII

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ИНСТИТУТ ГЕОГРАФИИ
Российской академии наук

основан в 1918 году

The Intergovernmental Panel on Climate Change (IPCC) was organized as an international scientific non-political organization in view of the need of countries to have reliable information on climatic issues for decision making, in particular, in connection with UNFCCC development and implementation.

Established jointly by the World Meteorological Organization and the United Nations Environment Programme in 1987-1988. UN GA (September 6, 1988, 70th Plenary Session, paragraph 5) assigned the IPCC to prepare scientific assessments of: - the magnitude and timing of climate changes, their possible impacts on the environment and socio-economic system; - realistic response strategies.

Target audience: international climate negotiations, government climate advisers, academia, interested public.

The IPCC presents the results of its work in the form of publications, namely, scientific reports. IPCC does not conduct scientific research itself, but only generalizes and summarizes in its reports the information presented in scientific publications.

Periodically (once every 5-7 years), the most extensive assessment reports (AR) are prepared. Five IPCC Assessment Reports were issued in 1990, 1995, 2001, 2007 and 2013-2014. Other publications are prepared, in particular, upon request of member-states or international organizations (special reports, methodological reports, technical papers, etc.). The publications can be found at http://www.ipcc.ch/.

The IPCC Assessment Reports consist of contributions from its three Working Groups: Working Group I 'Physical Science Basis', Working Group II 'Impacts, Adaptation and Vulnerability', and Working Group III 'Mitigation of Climate Change'.

WGI assesses past, current and future climate change.

WGII describes associated impacts on various natural and human systems, their vulnerability and adaptation options, aa well as climate resilient pathways.

WGIII characterizes opportunities for mitigation of anthropogenic impact on the Earth's climate, including reduction of greenhouse gases emissions.

The IPCC does not make any recommendations, but only describes current situation and futures corresponding to various scenarios of anthropogenic impact on the Earth's climate system.

The Sixth IPCC assessment cycle is ongoing. It started in 2015 and will end up in 2022. Only contribution of WGI has been yet completed (approved on August 6, 2021).

Contribution of WGII Is currently under consideration by the 12th session of WGII, and the approval is expected next week.

The approval of WGIII contribution is scheduled for March, 2022.

WGI contribution presents an assessment of past and future climate changes under some scenarios of global anthropogenic emissions of climatically active substances (greenhouse gases and aerosols). These topics are traditional for WGI reports.

However, there are important new elements in the document this time. First, the authors of the report considered the global temperature goals presented in the Paris Agreement (not exceeding the average global air temperature in the near-surface layer of 2°C and 1.5°C relative to pre-industrial values). Secondly, the possibility of achieving those goals under different scenarios of global anthropogenic emissions of climatically active substances are assessed using climate models.

In the assessment, the new family of scenarios were employed, so-called shared socio-economic pathways – SSPs.

The new scenario set structure met two main requirements (Gidden et al., 2019):
- commonality of socio-economic assumptions (including in relation to the population size, gross domestic product, poverty level) used in different model implementations of the scenario;
- the possibility of studying many ways of world development, within the framework of which the given climate parameters can be achieved over time (usually by the end of the 21st century).

Five SSP scenarios have received the greatest use in applied research (they are shown in Figure 1):

SSP1 : (van Vuuren et al., 2017); "green" development;
SSP2 : (Fricko et al., 2017); intermediate scenario;
SSP3 : (Fujimori et al., 2017); inequality between countries;
SSP4: (Calvin et al., 20); inequality within countries;
SSP5 : (Kriegler et al., 2017); use of fossil fuels.

Under these scenarios, different levels of radiative forcing can be achieved depending on the applied climate policy.

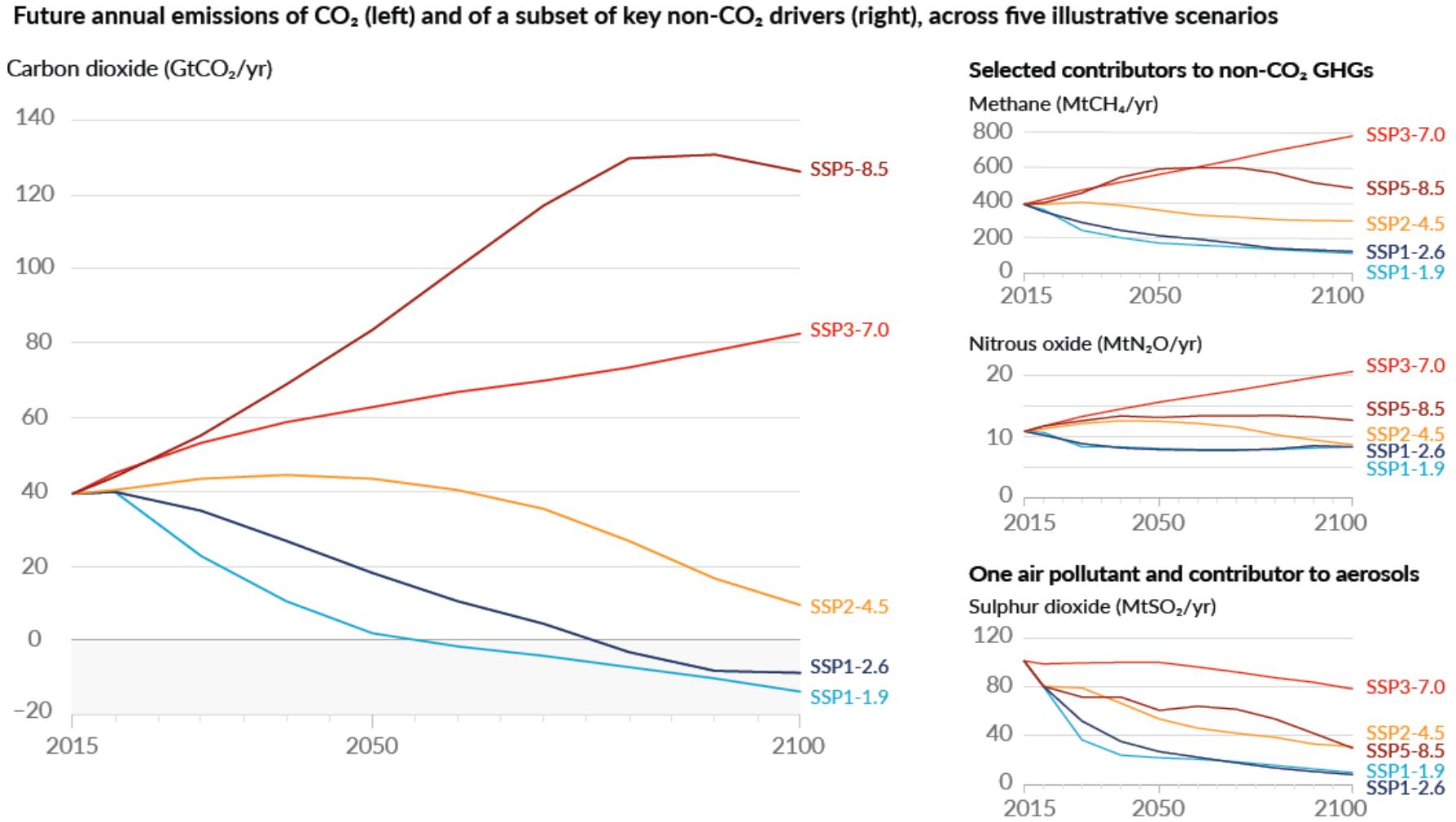


Figure 1. Future global anthropogenic annual emissions of carbon dioxide CO_2 (net emissions), methane CH_4, nitrous oxide N_2O and sulfur dioxide SO_2 under five illustrative scenarios: SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5 (IPCC, 2021a, p. 13)

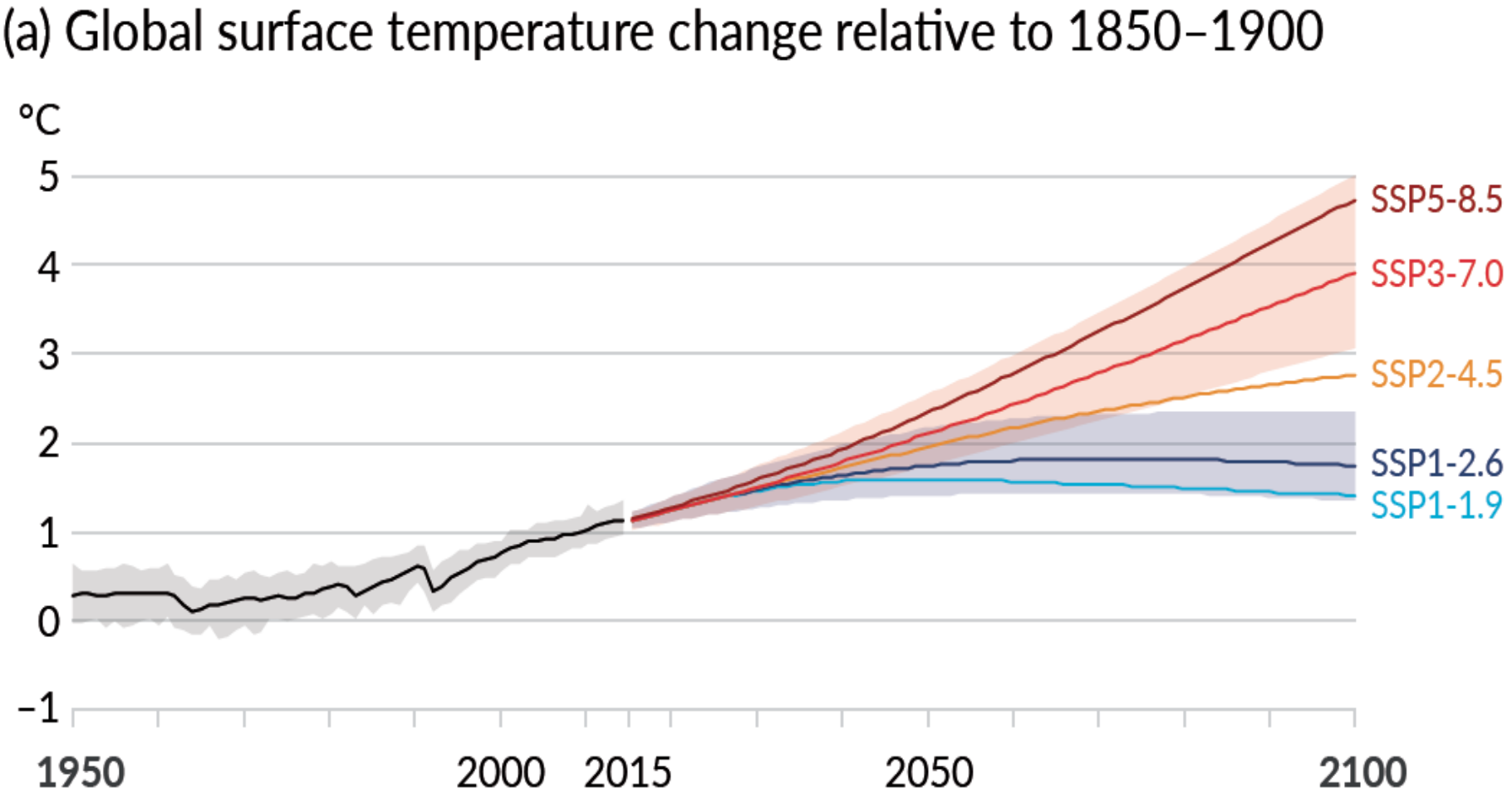


Figure 2. Changes in global mean surface temperature (°C) from 1850–1900 levels. Ranges corresponding to the *very likely* category are shown for SSP1-2.6 and SSP3-7.0 as shaded areas (IPCC, 2021, p. 22-23)

As clear from Figure 2, under low-emission scenarios SSP1-1.9 and SSP1-2.6 it is possible to keep the temperature within the limits described in the Paris Agreement (even if exceeded for a short period of time - overshoot), while under other scenarios it is impossible.

However, low-emission scenarios SSP1-1.9 and SSP1-2.6 require a rapid and very significant limitation of the global anthropogenic CO_2 net-emission, tending then to zero and further to negative levels by the middle of the 21st century, as well as a very significant limitation of global anthropogenic emissions of other greenhouse gases.

In its report, IPCC WGI has pointed out the increase in some climate-related hazards when the temperature thresholds (of 2°C and 1.5°C relative to pre-industrial values) are exceeded, for example, the increase in frequency and magnitude of some extreme weather events (heat waves, droughts, tropical cyclones).

However, their danger can be objectively assessed only taking into account the details of the spatial distribution of the hazards and the vulnerable systems and sectors (economic, natural, social) and their ability to adapt. These topics along with consideration of climate resilient pathways and possibilities to achieve sustainable development goals (SDGs) are within the mandate of IPCC Working Group II. It has just finalized its contribution to the IPCC Sixth Assessment Report, and the approval process is currently ongoing.

The issues of technological and financial feasibility of different scenarios of world economic development and, respectively, different trajectories of global anthropogenic emissions of climatically active substances (greenhouse gases and aerosols) will be presented only in the contribution of the IPCC Working Group III to the Sixth Assessment Report. The approval is planned for March, 2022.

Since the information about Contribution of WGII to AR6 is still embargoed (the approval session is ongoing), only a couple of methodological points can be made here.

A. RISK is one of the basic concepts of AR6. It occurs when hazards from climate change (including extremes and trends) interact with the exposure and vulnerability of recipients. Changes in the climate system and socio-economic processes, including mitigation adaptation, cause changes in hazards, exposure and vulnerability.

Such risk assessments have so far been synthesized by the IPCC mainly at the global level and partly at the regional level, since in some cases there are no enough relevant published observational data or model calculations for regional assessments. However, intensive studies in this direction are being conducted by various research teams.

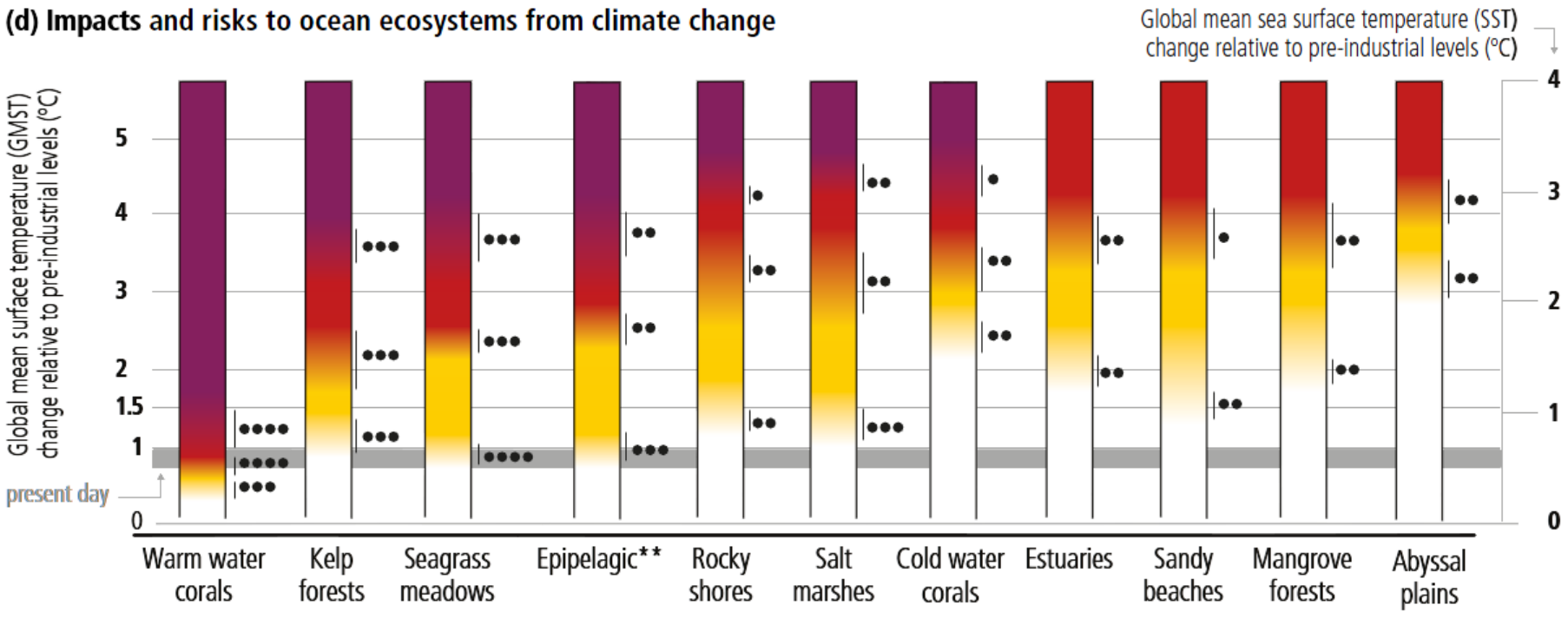
B. QUANTIFICATION OF RISK

A_0, A_1, A_2, …, A_N are events of various intensity in which a climate-related hazard manifests itself. A_0 means no impact (zero intensity); P_0, P_1, P_2, …, P_N are the probabilities of these events in a certain period of time (say, summer season). We will assume that in this period of time only one of these events can occur and that one of them necessarily occurs, i.e. the sum of these probabilities is 1. D_0, D_1, D_2, …, D_N are damage values ($D_0 = 0$, the damage is absent) in certain units arising due to the occurrence of respective events A_0, A_1, A_2, …, A_N .

The risk value *R* is calculated as follows:

$$R = P_0 D_0 + P_1 D_1 + P_2 D_2 + \ldots + P_N D_N .$$

AR6 WGII authors often assess impacts and risks in the form of burning ember diagrams. It is a colloquial term for the diagrams that show the levels of concern assessed for the risks from climate change and the change in risk with global warming levels. For example, the following Figure 3 shows the risk assessment for coastal and open ocean ecosystems based on observed and predicted climate impacts on ecosystem structure, function and biodiversity (a part of Figure SPM.3 from The IPCC Special report on Ocean and Cryosphere (2019)).



CONCLUDING REMARKS

The contribution of Working Group I, in particular, considered the temperature goals contained in the Paris Agreement (not exceeding the average global air temperature in the near-surface layer of 2°C and 1.5°C relative to pre-industrial values) and, using climate models, assessed the possibility of achieving these goals under different scenarios of global anthropogenic emissions of climatically active substances. At the same time, it was found that under some scenarios with low global emissions, it is possible to keep the temperature within the limits described in the Paris Agreement (even if with exceedance for a short period of time), while under other scenarios this is impossible. At the same time, low-emission scenarios require very radical and rapid reductions in global greenhouse gas emissions.

We are enthusiastically awaiting the assessment of risks to natural and socio-economic systems associated with climate change, which will soon be presented by Working Group II. Its mandate also includes assessing the adaptive capacity of systems and sectors to climate change, as well as the global development pathways that are resilient to climate change.

Finally, Working Group III, in particular, will evaluate the technological aspects and financial implications of measures needed to radically limit the anthropogenic impact on the climate system that are critical to decision-making at both global and country levels.

We all are looking forward to upcoming findings and conclusions with great interest !


THANK YOU FOR ATTENTION!!