U.S. Global Change Research Program General Decisions Regarding Climate-Related Scenarios for Framing the Fourth National Climate Assessment

USGCRP Scenarios and Interpretive Science Coordinating Group

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Executive Summary:

Consistent with previous National Climate Assessments (NCAs) under U.S. Global Change Research Program (USGCRP), the Fourth National Climate Assessment (NCA4) will rely heavily on climate-related scenarios generated for the assessments of the Intergovernmental Panel on Climate Change (IPCC). The IPCC's Fifth Assessment Report (AR5), completed in 2013–2014, used model-derived products from the Coupled Model Intercomparison Project Phase 5 (CMIP5) based on four "representative concentration pathways" (RCPs). These RCPs capture a range of plausible emission futures that drive the climate models. CMIP5 climate data are widely available now, whereas products from the next phase of the project (CMIP6) are not envisioned to be available in time to support NCA4.

For physical climate science analyses, NCA4 will use the full range of IPCC RCPs and CMIP5 products. For assessments of impacts, vulnerability, and adaptation responses, NCA4 will focus on RCP 8.5 as a high-end scenario and RCP 4.5 as a low-end scenario. Other scenarios (e.g., RCP 2.6) may be used in addition where instructive, such as in analyses of mitigation issues. The use of RCPs 8.5 and RCP 4.5 as core scenarios is generally consistent with the range of emission scenarios used in the Third National Climate Assessment (NCA3). In addition, using a low-end and a high-end scenario will facilitate communications of assessment findings. A USGCRP Climate Scenarios Task Force will use these decisions to provide recommendations about the development and use of additional climate scenario products for NCA4 (e.g., downscaled climate datasets).

USGCRP is announcing these decisions to provide (1) the research community as much lead time as possible to include these scenarios in studies that may inform NCA4, and (2) user groups, including Federal agencies, an early signal of the direction of NCA4.

General Background:

The use of a range of future scenarios has become common in studies of the long-term implications of climate outcomes that result from different emission pathways. Previous NCAs under USGCRP have focused on low versus high future warming (and associated climate change) scenarios that were generated at the global scale by the IPCC. The IPCC completed its Fifth Assessment Report (AR5) in 2013-14 and more recent climate-related scenarios associated with that report are now available.

The IPCC's AR5 focused on four global RCP scenarios for the 21st century (and in some cases beyond). The RCPs are identified by their approximate *total radiative forcing* (not emissions) in the year 2100, relative to 1750: 2.6 W/m^2 (RCP 2.6), 4.5 W/m^2 (RCP 4.5), 6.0 W/m^2 (RCP 6.0), and 8.5 W/m^2 (RCP 8.5). RCP 8.5 implies a future with continued high emissions growth, whereas the other RCPs represent mitigation pathways of varying stringency. In this sense, the RCPs are a departure from the "no climate

policy" scenarios[1] that were used in the IPCC's Third and Fourth Assessment Reports, as well as the Second National Climate Assessment (NCA2) and NCA3.

NCA2 and NCA3 focused on B1 and A2 scenarios from the IPCC's Special Report on Emission Scenarios (SRES) as the low- and high-end scenarios, respectively. In terms of carbon dioxide (CO_2) concentrations over the course of the 21st century, RCP 4.5 and B1 are very similar. RCP 8.5 is higher in CO_2 concentrations than A2 but reflects the higher range found in the scientific literature surveyed by the IPCC, although there were higher SRES emissions scenarios in the past, e.g. A1FI[2].

Criteria Considered:

A number of criteria were considered in the decisions to (1) use CMIP5 products and scenario-based information, especially the RCPs, and (2) focus on RCPs 8.5 and 4.5 for framing purposes in NCA4, while also considering other scenario information (e.g., RCP 2.6).

Maintaining continuity and consistency with other major assessments: The IPCC assessments—including the future scenarios associated with those assessments—have become standard reference materials for virtually all work in the United States and internationally concerning climate change science, impacts, vulnerability, adaptation, and mitigation. It is therefore reasonable, practical, and in line with the expectations of the research community for NCA4 to leverage the most recent available scenarios from the IPCC—namely, the RCPs.

RCP 8.5 is the high-end scenario in the IPCC's AR5 and will likewise serve as the high-end scenario for NCA4. RCP 4.5 is not the lowest scenario in AR5; however, RCP 4.5 is similar to the low-end B1 scenario used in SRES. RCP 2.6 represents the low end of the range considered by AR5, but it also represents a significant departure—in terms of the assumed stringency of mitigation, even for current and near-term emissions—from previous low-end scenarios used by the IPCC.

Maintaining continuity and consistency with previous NCAs: Leveraging IPCC scenarios is consistent with the approach of previous NCAs. Similar to NCA3, NCA4 will use a high-end IPCC scenario (for NCA3, this was A2; for NCA4, it will be RCP 8.5). On the lower end, RCP 4.5 is consistent with the B1 scenario used in NCA3, whereas RCP 2.6 would represent a significant departure. The range represented by RCPs 8.5 and 4.5 provides the most continuity and consistency with the IPCC scenarios used for framing purposes by NCA3.

Framing for impacts, adaptation, and vulnerability: All of the RCPs demonstrate similar global temperature and sea level rise outcomes for the next few decades. However, by mid-century and beyond, differences between RCPs and their implied emission pathways have a substantial effect on the climate and impact outcomes. The choice to focus on RCPs 8.5 and 4.5 for impacts, adaptation, and vulnerability analyses will allow for an evaluation of near-term concerns for the Nation, as well as a robust and wide range of longer-term outcomes relative to the present.

Framing for mitigation issues: Comparing outcomes under RCP 8.5 with those of RCP 4.5 (and RCP 2.6 in some cases) will not only capture a range of uncertainties and plausible futures—it also will provide

[1] IPCC (2000) Special Report on Emission Scenarios, http://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf
[2] A figure comparing the radiative forcing and temperature projections for the SRES scenarios and the RCPs is available from the IPCC AR5 WGII, Figure 1-4: http://ipcc-wg2.gov/AR5/images/uploads/WGII_AR5_Fig1-4.jpg

information about the potential benefits of mitigation. In addition, this approach will demonstrate the need for adaptation, especially in the near term. In other words, outcomes under RCP 4.5 may show the degree to which significant emissions mitigation (at the global scale) can *avoid* risks and impacts that are expected under RCP 8.5. RCP 4.5 will still inform adaptation choices to the extent that this scenario reduces, but does not completely eliminate, risks associated with a future under RCP 8.5. This choice allows an assessment of impacts at a variety of temperature thresholds, including a 2°C rise. It should be noted that the range of RCP 4.5 simulations includes some with warming of less than 2°C[3].

Facilitating consistency for non-climate inputs to NCA4: A goal for NCA4 is to improve consistency across technical inputs to the assessment—including non-climate inputs (e.g., population, land use). It would be advantageous for sectoral and regional impact studies included in NCA4 to be framed by consistent low- and high-end scenarios. Non-climate inputs could be more readily assembled for the range represented by RCPs 8.5 and 4.5.

USGCRP Process:

The decisions described above were made by USGCRP's 's leadership and Principals within the Subcommittee on Global Change Research (SGCR). Two USGCRP interagency working groups, the Scenarios and Interpretative Science Coordinating Group (SISCG) and Interagency National Climate Assessment (INCA) Working Group, discussed these scenario issues and made the recommendations on which SGCR concurred. The SISCG prepared this document to provide the rationale behind the SGCR decisions.

[3] A figure showing the range of temperature projections for the RCP simulations is available from IPCC AR5 WG1 Summary for Policymakers, Figure TS-15: http://www.climatechange2013.org/images/figures/WGI_AR5_FigTS-15.jpg

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