Selection Process for Downscaled Climate Projection Data in the Fifth National Climate Assessment

This document describes the general process that informed the selection and use of downscaled data in the Fifth National Climate Assessment (NCA5). Downscaled climate data provide more localized and higher resolution climate information than global models to support assessments of impacts for decision-making. In 2020, USGCRP convened a group of federal climate experts (NASA, NOAA, USGS, DOD, DOE) to identify and recommend to NCA5 leadership appropriate downscaled products for use in NCA5 that derived from the latest international global modeling experiments. As part of the NCA5 development process, this set of downscaled climate data products were made available to authors to inform their chapter analyses and were publically available after release of the report.

Background

The Global Change Research Act of 1990 requires that the USGCRP produce and submit a quadrennial assessment (i.e., the National Climate Assessment) to the President and to Congress that broadly interprets the state of climate science, analyzes the effects of global change on the Nation's resources, and analyzes projected trends in global change. The development of a National Climate Assessment is a multi-year process involving participation of all 14 of USGCRP's member agencies along with multiple opportunities for stakeholder and public engagement.

In developing NCA5, USGCRP encouraged the integration of model projections from the Coupled Model Intercomparison Project Phase 6 (CMIP6). The CMIP6 model data started becoming publicly available in 2019 to support the Sixth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC AR6; working group reports were published in 2021 and 2022) and reflected scientific advances and knowledge gained over the last decade. The full release of CMIP6 global data was delayed, which hindered the production of proposed downscaled datasets. Despite the delays in CMIP6 global data and downscaled products, the NCA5 development timeline remained unchanged, which limited the availability, selection, and evaluation of downscaled products to support the analysis in NCA5.

NCA5 development also aligned with laws and policies that impact federal data provision, including:

- The Information Quality Act, which includes data standards related to utility, transparency, objectivity, integrity, and reasonable reproducibility.
- The Foundations for Evidence-Based Policymaking Act (Evidence Act), which expands on prior Open Government policy initiatives and public access to agency data assets.

Required and Recommended Attributes for NCA5-relevant Downscaled Datasets

The expert group developed a set of ideal attributes to apply to downscaled datasets for use in NCA5. These attributes were created in part to fulfill federal requirements as well as to support more advanced climate impact analysis for the United States. However, the group recognized that the substantial overlap in the timelines of NCA5 and the production of CMIP6 data carried some risk that the availability and processing of downscaled datasets would not fully satisfy these ideal attributes.

Required Attributes for downscaled climate data in NCA5:

- Publicly-available algorithms and source code for the downscaling models
- Methodology and technical documentation, including the final datasets, are available in peer-reviewed scientific publications

- Downscaled datasets are derived from CMIP6 global projections
- Downscaled datasets were available to the NCA5 author teams during the NCA5 writing window
- The dataset producers granted permission to the NCA5 Technical Support Unit from NOAA (TSU) to analyze the downscaled data prior to publication
- Derived data from the downscaled models used in NCA5 are available without restrictions on a free and public platform by NCA5 publication

Recommended Attributes for NCA5 downscaled data:

- All four "Tier 1" CMIP6 scenarios are downscaled to sub-global grid spacing
- The size of the downscaled model ensemble is sufficiently large to capture differences in output that stem from differences in how each global model was constructed
- Downscaled variables are relevant to climate impacts at multiple spatial/temporal scales
- The spatial and temporal resolutions of the data are appropriate to create derived variables relevant to climate impacts (e.g., days with temperature > 95°F, days with precipitation > 1 inch)
- Data coverage for nationally affiliated geographies outside of the contiguous U.S.

The expert group recommended two statistically-downscaled datasets for use in NCA5:

1. Localized Constructed Analogs Version 2 (LOCA2)
2. Seasonal Trends and Analysis of Residuals, Empirical-Statistical Downscaling Model (STAR-ESDM)

Downscaled data are not readily available for U.S. regions outside of the contiguous United States. Where applicable for Alaska, Hawai'i, the U.S.-Affiliated Pacific Islands, and the U.S. Caribbean, the expert group recommended use of the STAR-ESDM downscaled weather station data (separate from the gridded dataset). Dynamically-downscaled North American CORDEX data, based on CMIP5, was also suggested for select precipitation variables where available.

Lessons Learned

There was a substantial overlap in the timelines of NCA5 and the production of CMIP6 data and derivative downscaled products. The concurrent development of the CMIP6-based downscaled datasets and NCA5 therefore created notable challenges for satisfying all of the ideal attributes for the downscaled climate data, such as for data availability, ensemble size, and scenarios. Notably, no CMIP6 downscaled products were available to the NCA5 author teams for all U.S. regions outside of the contiguous United States, which reflects persistent gaps in data coverage. This data gap leaves portions of the U.S. population without access to downscaled information for decision-making. It was a major challenge and limitation to ensure that downscaled datasets align with the requisite attributes, timelines, and spatial coverage that were appropriate for NCA5. This challenge carried over to the calculation of derived variables and model-weighting strategies.

Ideally, the selection criteria should also include metrics that promote confidence in data quality, including the strengths and limitations of the two selected datasets using metrics for average climate conditions, climate extremes, temporal and spatial patterns (e.g., trends and gradients) for both datasets, as well as a comparison of the different historical products used for the downscaling.