The Coalition of Finance Ministers for Climate Action

Data sources for the macro-modeling of climate change impacts and policies

World Bank

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Topic: Specific analytical tools and approaches relevant to Ministries of Finance

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Access the full Compendium at www.greenandresilienteconomics.org

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Climate data for development

The Climate Change Knowledge Portal (CCKP)[1] is the World Bank's climate data service. It is used to study current climate and climate projections through operational data products that enable intercomparable work across countries.

Besides the essential climate variables of temperature (mean, minimum, and maximum) and precipitation (sum), the CCKP presents over 70 related variables and Extreme Precipitation Events. The climate data covers each country in the world and is both global-gridded and spatially aggregated per World Bank national, sub-national, watershed, and Exclusive Economic Zone (EEZ) scales. Climate projection data is from Coupled Model Intercomparison Project Phase 6 (CMIP6), presented at a 0.25° × 0.25° (25 km × 25 km) resolution. Future climate scenarios and projected physical climate risks can be explored for different shared socioeconomic pathways (SSPs), and across future 20-year intervals to 2100. Data is presented as annual and seasonal climatologies, and as either mean or anomaly (change).

As an example of use case for CCKP, a Ministry of Finance assessing climate risks can extract data on average rainfall, rainfall variation, and extreme heat days specific to their country across multiple climate scenarios and over 30 Global Climate Models for each scenario. Projections under SSP 2-4.5 and SSP 5-8.5 would, for instance, allow the Ministry services to compare and prepare for medium- and high-emission futures, evaluating how these risk factors might impact agricultural productivity, and by extension, farmer livelihood, food security, and corresponding ripple effects.

As another use case, an MoF might combine rainfall variation and average rainfall under different scenarios with additional water data to identify potential risks to water resources and infrastructure. If the data shows a significant decrease in average rainfall combined with increased rainfall variability due to climate change, the MoF might prioritize investments in water conservation projects and resilient infrastructure to mitigate the impact of droughts and floods.

The option to download gridded data provides detailed spatial resolution to analyze specific areas of interest. This granularity allows the MoF to tailor financial policies and allocate resources more effectively, ensuring targeted interventions in areas most vulnerable to climate impacts. All the data is freely accessible and available for download.[2]

Energy and emissions data

Ministries of Finance can assess the macroeconomic impact of climate change and of energy transition policies on their economies by incorporating climate components such as energy production and consumption and related emissions into their models using supplemental climate-related data. The following data sources can be used for this purpose:

World Bank Databases. The World Bank offers a wide range of climate-related data, including information on renewable energy, emissions, and climate change adaptation and mitigation projects. Ministries of Finance can utilize this data to understand the impact of climate-related projects and policies on their economies. (https://data.worldbank.org/)

Sources of data

1. World Bank Group's own databases: The World Bank aggregates and curates data from its own projects and research, offering a rich repository of climate-related information.
2. International organizations: The World Bank also sources data from reputable international organizations such as the Intergovernmental Panel on Climate Change (IPCC), the International Energy Agency (IEA), and the United Nations Framework Convention on Climate

1 https://climateknowledgeportal.worldbank.org/.
2 The complete metadata can be found at https://climateknowledgeportal.worldbank.org/media/document/metatag.pdf.

Change (UNFCCC). These organizations provide standardized and globally recognized data on climate and energy.

3. National Governments and Agencies: Data is collected from national statistics offices, Ministries, and Environmental Agencies. This includes country-specific data on emissions, energy use, and climate impacts.
4. Academic and research institutions: Data from scientific research and climate studies conducted by universities and research institutions is also included.

Types of variables available

1. Emissions data:
    - Greenhouse gas emissions: Levels of CO_2, methane (CH_4), nitrous oxide (N_2O), and other greenhouse gases. This includes data on emissions by sector (energy, industry, agriculture) and country.
    - Carbon Intensity: Emissions per unit of GDP or per capita, which can indicate how efficiently an economy is reducing emissions relative to economic growth.
2. Energy data:
    - Renewable energy: Information on the share of renewable energy in the energy mix, including sources such as wind, solar, hydro, and geothermal power.
    - Energy consumption: Data on total energy consumption, energy production, and energy imports and exports.
3. Mitigation measures:
    - Mitigation projects: Reports on projects aimed at reducing greenhouse gas emissions, including their type, scale, and outcomes.
    - Carbon pricing: Information on carbon pricing mechanisms, such as carbon taxes and cap-and-trade systems.

IEA World Energy Statistics and Balances:[3] This dataset covers 150 countries and provides structured datasets on trade, supply, and consumption of energy, categorized by product, such as coal, peat, oil, gas, and renewables. MoFs can use this data to understand the energy consumption patterns and trade dynamics of their countries.

Our World in Data: This source provides data for over 200 countries on CO_2 and other greenhouse gas emissions compiled for modeling purposes. It offers CO_2 emissions by fuel (cement, coal, gas, and oil) in millions of tons, which can be useful for understanding emissions trends and formulating climate policies. Additionally, electricity production categorized by source is available (Ritchie et al., 2023).

IRENA:[4] The International Renewable Energy Agency provides data on the costs of renewable power generation and other climate-related variables for over 220 countries. This information can help MoFs assess the economic feasibility and potential impact of renewable energy investments.

CAIT—Climate Analysis Indicators Tool:[5] The CAIT dataset provides a comprehensive and comparable database of greenhouse gas emissions data (including all major sources and sinks) and other climate-relevant indicators. The data covers all countries (except West Bank, Gaza, and Kosovo) until 2021, with additional energy intensity of GDP data from the IEA database. Emissions are classified

3 IEA, World Energy Balances, IEA, Paris https://www.iea.org/data-and-statistics/data-product/world-energy-balances, License: Terms of Use for Non-CC Material.
4 https://www.irena.org/Energy-Transition/Technology/Power-generation-costs.
5 https://globalclimateactionpartnership.org/resource/climate-analysis-indicators-tool/

according to the 2006 IPCC guidelines and measured in kilotons of carbon dioxide equivalent ($ktCO_2e$), excluding international bunkers as per the guidelines.

ClimateScan:[6] an Excel-based tool and database summarizes publicly available and other WB data sources on climate change and fiscal into an easily digestible dashboard. The tool includes key indicators, whether various climate-fiscal policies are present, and assessment of the level of climate-related taxation and expenditures. Time series of key indicators are compared with region-income group averages and international guidelines. The tool is based on data from the IMF climate database (itself an aggregate of data from other sources such as INFORM for climate risks, NDGain for adaptation, UN and other sources for emissions), the United Nations DP Global Public Finance Review (climate change policies and strategies), and the World Bank (Total Carbon Price dataset, giving data on explicit carbon pricing, fuel excises, and fuel subsidies, and BOOST, giving data on public expenditure). This tool may be available on request from 2025.

In addition to international sources, it is important to recognize that countries have diverse climate agendas and issues. Therefore, nationally gathered statistics often supplement international sources to ensure country-specific factors are appropriately studied for the formulation of policy suggestions. While national sources may be preferred, and more detailed for country-specific work, cross-country comparisons may be better served by international data sets, where an effort has been made to impose some degree of cross-country consistency in data.

Understanding the impacts of climate change

There are several datasets and resources that provide data for estimating the impacts of climate change. There are different approaches to estimating impacts depending on the drivers (e.g., storms, temperature changes, sea-level rise, etc.). Generally, models employ analytical and/or empirical data and approaches to estimate the economic costs of climate impacts as a function of climate variables. Sources of data to complete bespoke modeling are listed below, as well as references to completed risk profiles for certain types of events.

General climate impacts

Rosen & Sartori Climate Damages Dataset: This dataset, presented in a study by Roson and Sartori (2016), provides an empirical analysis of the economic damages from climate change. It includes a cross-country dataset on the economic damages of climate change, allowing for an assessment of the impact on countries' economies.

Intergovernmental Panel on Climate Change (IPCC) reports:[7] The IPCC reports include assessments of the economic impacts of climate change on a global scale, which can be extrapolated to individual countries.

International Monetary Fund (IMF)—Climate Change Indicators Dashboard:[8] This dashboard provides an array of indicators to assess the economic impact of climate change.

Climate Econometrics:[9] This project aims to use econometric methods to study the impact of climate change on economic outcomes.

Risk profiles

CCRIF Country Risk Profiles:[10] The CCRIF SPC (formerly the Caribbean Catastrophe Risk Insurance Facility) provides risk profiles for Central American and Caribbean member countries that offer insights into the economic impact of disasters, including those exacerbated by climate change. These profiles can help understand the financial implications of climate-related risks for member countries.

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6 This database is not publicly available, but further information is available from Stephen John Stretton on request.
7 (https://www.ipcc.ch/reports/.
8 https://climatedata.imf.org/.
9 (https://www.climateeconometrics.org/paris-impacts/.
10 https://www.ccrif.org/ccrifs-country-risk-profiles.

The PCRAFI risk profiles:[11] The Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) risk profiles provide valuable insights into how climate change can affect the economies of Pacific countries by offering detailed assessments of potential disasters, such as cyclones, earthquakes, and droughts, which can have significant economic impacts on this vulnerable region.

GAR-15 (Global Assessment Report on Disaster Risk Reduction 2015): The GAR-15 report provides an in-depth global assessment of disaster risk reduction and offers valuable data and analysis that can be used to understand the impact of disasters, including those related to climate change, on countries and their economies (United Nations, 2015).

World Bank Risk Profiles:[12] Disaster Risk Profiles are completed by the World Bank to support country operations. Profiles for over 60 countries across all regions of the world are available for download.

Exploring risk data

Risk Data Library:[13] The Risk Data Library is a collection of risk datasets to enable disaster and climate risk modeling.

GRI Risk Viewer:[14] This resource is still under development but provides risk data to enable disaster and climate risk modeling.

World Bank Risk Viewer: [15] This database and analysis for Latin American and Caribbean countries provides an overview of different available risk data sources and analysis on how to use them. ()

Fathom:[16] Fathom is a commercial global flood model that estimates flooding extents and depths under different climate change projections. A third version of Fathom global flood hazard maps is currently available, providing hazard data used in national and regional analyses to assess current and future risks from coastal, pluvial, and fluvial flooding.

Global Infrastructure Resilience Index (GIRI):[17] The Coalition for Disaster Resilient Infrastructure provides disaster and climate risk related information for infrastructure sectors by hazard and climate impacts.

Exposure model from the Global Earthquake Model: The GEM datasets provide detailed exposure models and data that could help in climate modeling processes (Yepes-Estrada et al., 2023).

Gaps in the data

The global climate data space has made significant progress, but there are still several gaps and areas where improvements are needed to better inform climate action and policymaking.

1. Granular and localized data: Many climate datasets are aggregated at the national or regional level, which may not capture local variations and nuances. More granular, localized data on climate impacts, such as at the city or community level, would help decision-makers to tailor adaptation and mitigation strategies.

2. Integrated economic and climate data: There is often a lack of integration between economic data and climate data, making it challenging to understand the economic impacts of climate change and policies. Datasets could combine climate data with economic indicators, such as sectoral impacts, job creation, and financial flows, to provide a comprehensive view of climate-related economic outcomes.

3. Long-term and historical data: Long-term historical climate data is often sparse or inconsistent, particularly in developing regions. This could be addressed through enhanced efforts to collect and standardize historical climate data to understand long-term trends and improve future projections.

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11 https://pcric.org/where-we-work/country-risk-profiles/.
12 https://www.gfdrr.org/en/disaster-risk-profiles.
13 https://riskdatalibrary.org/.
14 https://global.infrastructureresilience.org/.
15 https://riskviewer.worldbank.org/.
16 https://www.fathom.global/.
17 https://giri.unepgrid.ch/facts-figures/multi-hazards.

4. Data on climate resilience and adaptation: There is limited data on the effectiveness of adaptation measures and resilience-building initiatives. More detailed and consistent data on the outcomes of adaptation projects, including metrics on resilience improvements and vulnerability reductions, would aid future decision-making and analysis.

5. Sector-specific emissions data: Emissions data is often aggregated at a high level, without detailed breakdowns by specific sectors or activities. More detailed sector-specific emissions data, including insights into emissions from agriculture, transportation, and industry, would support better targeted mitigation efforts.

6. Financial flows and investments: Tracking climate finance and investments can be fragmented, with limited data on private sector contributions and the effectiveness of financial mechanisms. There is a need for more comprehensive data on climate finance flows, including private sector investments, public spending, and the effectiveness of financial instruments such as green bonds and carbon pricing.

7. Data on non-greenhouse gas climate pollutants: Most climate data focuses on greenhouse gases, with less emphasis on other pollutants such as particulate matter and ozone-depleting substances. Expanded datasets on non-greenhouse gas pollutants and their interactions with climate systems would help analysts to better understand their impact on health and climate.

8. Real-time and high-resolution data: Many datasets are not available in real time or at high resolutions, which limits their usefulness for immediate decision-making. Increased availability of real-time, high-resolution data on climate variables and extreme events could improve response times and decision-making.

9. Data accessibility and usability: Access to climate data can be limited by technical barriers, cost, or lack of user-friendly interfaces. Improved accessibility and usability of climate data, including better tools for data visualization and analysis, would make data open and accessible to all stakeholders.

References

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