



November 2015

# CLIMATE INFORMATION

## A National System Could Help Federal, State, Local, and Private Sector Decision Makers Use Climate Information

Accessible Version

## Why GAO Did This Study

Over the last decade, the federal government incurred over \$300 billion in costs due to extreme weather and fire, according to the President's 2016 budget request. Costs are expected to grow as rare events become more common and intense due to climate change, according to the National Academies. State, local, and private sector decision makers also drive fiscal exposures, as they are responsible for infrastructure paid for with federal funds or eligible for disaster aid. GAO's 2015 High-Risk update prioritized improving federal efforts to provide the best available climate information and technical assistance to help decision makers use the information to build resilience in up front.

This report examines (1) the extent to which federal efforts meet the climate information needs of decision makers; (2) examples of how other countries organized climate information systems; (3) whether and how federal efforts could be improved; and (4) the strengths and limitations of different options to provide climate information. GAO analyzed reports; reviewed systems in three other countries; and interviewed stakeholders with knowledge of climate information.

## What GAO Recommends

GAO recommends that the Executive Office of the President (EOP) direct a federal entity to develop a set of authoritative climate change projections and observations and create a national climate information system with defined roles for federal agencies and nonfederal entities. Relevant EOP entities provided only technical comments, which GAO incorporated as appropriate.

View [GAO-16-37](#). For more information, contact J. Alfredo Gómez at (202) 512-3841 or [gomezj@gao.gov](mailto:gomezj@gao.gov).

## CLIMATE INFORMATION

### A National System Could Help Federal, State, Local, and Private Sector Decision Makers Use Climate Information

#### What GAO Found

Many federal efforts are under way, but the climate information needs of federal, state, local, and private sector decision makers are not being fully met, according to recent GAO reports, National Academies and other studies, and interviews with stakeholders. The November 2013 Executive Order 13653 on *Preparing the United States for the Impacts of Climate Change* calls on certain federal agencies to work together to provide authoritative information on climate preparedness and resilience. However, the federal government's own climate data—composed of observational records from satellites and weather stations and projections from climate models—are fragmented across individual agencies that use the information in different ways to meet their missions. GAO's February 2015 High-Risk update found that federal, state, local, and private sector decision makers may be unaware that climate information exists or be unable to use what is available.

Germany, the Netherlands, and the United Kingdom have well-established climate information systems, although each country's system is organized somewhat differently. In each, the government provides direction and funding, and entities within and outside the government provide technical assistance to help decision makers understand how to use climate information in planning.

Federal climate information efforts could be improved by incorporating key organizational and data elements, according to GAO reports, studies by the National Academies and other organizations, site visits to three countries with climate information systems, and interviews with stakeholders. Specifically, the key elements are (1) a focused and accountable organization, (2) authoritative data that define the best available information for decision makers, and (3) technical assistance to help decision makers access, translate, and use climate information in planning. Authoritative locally-focused information is crucial because it defines a common starting point for decision makers, and most decisions are made at the local level.

Options to provide climate information and technical assistance to decision makers have strengths and limitations, according to studies, international site visits, and interviews with stakeholders. For example, a new federal agency would have a focused mission but could face turf conflicts with existing programs at other agencies. On the other hand, a national climate information system could be developed that would incorporate the best features and address the limitations of these options. Similar to the programs in Germany, the Netherlands, and the United Kingdom, a national system to provide climate information to U.S. decision makers could have roles for federal and nonfederal entities. Based on GAO's review of systems in other countries, studies, and interviews with stakeholders, a key federal role in a national climate information system would be to provide authoritative data and quality assurance guidelines for how to use the data. A nonfederal entity would be better positioned to provide on-the-ground technical assistance and facilitate connections between decision makers and intermediaries with expertise.

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# Contents

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Letter	1	
	Background	6
	Many Federal Efforts Are Under Way, but the Climate Information Needs of Federal, State, Local, and Private Sector Decision Makers Are Not Being Fully Met	10
	Germany, the Netherlands, and the United Kingdom Have Organized Climate Information Systems	19
	U.S. Federal Climate Information Efforts Could Be Improved by Incorporating Key Organizational and Data Elements	28
	Options to Provide Climate Information to U.S. Decision Makers Have Strengths and Limitations	32
	Conclusions	46
	Recommendations for Executive Action	47
	Agency Comments and Our Evaluation	47

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Appendix I: GAO Contact and Staff Acknowledgements	48
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Table		
	Table 1: The Strengths and Limitations of Options to Provide Climate Information to U.S. Decision Makers	33

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Figures		
	Figure 1: Selected Coordination Mechanisms for Federal Climate Change Activities	14
	Figure 2: Germany's Climate Information System as of February 2015	21
	Figure 3: The Netherlands' Climate Information System as of February 2015	24
	Figure 4: The United Kingdom's Climate Information System for Adaptation as of February 2015	27

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## Abbreviations

CEQ	Council on Environmental Quality
CRS	Congressional Research Service
DEFRA	Department for Environment, Food and Rural Affairs
FFRDC	federally funded research and development center
ISO	International Organization for Standardization
KNMI	Royal Netherlands Meteorological Institute
NOAA	National Oceanic and Atmospheric Administration
OSTP	Office of Science and Technology Policy
SGCR	Subcommittee on Global Change Research
USDA	U.S. Department of Agriculture
USGCRP	United States Global Change Research Program

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November 23, 2015

The Honorable Maria Cantwell  
Ranking Member  
Committee on Energy and Natural Resources  
United States Senate

The Honorable Frank Pallone  
Ranking Member  
Committee on Energy and Commerce  
House of Representatives

The Honorable Matthew Cartwright  
House of Representatives

Over the last decade, the federal government has incurred more than \$300 billion in direct costs due to extreme weather and fire events, including costs to federal programs for domestic disaster response and relief (\$176 billion), flood insurance (\$24 billion), crop insurance (\$61 billion), and wildland fire management (\$34 billion), according to the President's 2016 budget request.<sup>1</sup> Costs are expected to increase as previously rare events become more common and intense due to climate change, according to the National Academies and the United States Global Change Research Program (USGCRP).<sup>2</sup> While it is not possible to identify the portion of these costs incurred as a result of climate change, costs for these federal programs have been increasing and can be

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<sup>1</sup>*Analytical Perspectives, Budget of the United States Government, Fiscal Year 2016* (Washington, D.C.: U.S. Government Printing Office, 2015).

<sup>2</sup>See, for example, Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe, eds., *Climate Change Impacts in the United States: The Third National Climate Assessment*, USGCRP (Washington, D.C.: May 2014). USGCRP coordinates and integrates the activities of 13 federal agencies that conduct research on changes in the global environment and their implications for society. USGCRP began as a presidential initiative in 1989 and was codified in the Global Change Research Act of 1990 (Pub. L. No. 101-606, § 103 (1990)). USGCRP-participating agencies are the Departments of Agriculture, Commerce, Defense, Energy, the Interior, Health and Human Services, State, and Transportation; the U.S. Agency for International Development, the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, and the Smithsonian Institution. See also, for example, National Research Council, Panel on Adapting to the Impacts of Climate Change, *America's Climate Choices: Adapting to the Impacts of Climate Change* (Washington, D.C.: 2010).

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expected to continue to increase as the impacts of climate change intensify, according to the President's 2016 budget request.

State, local, and private sector decision makers can drive federal climate-related fiscal exposures, as they are responsible for planning, constructing, and maintaining certain types of vulnerable infrastructure, such as roads and bridges, paid for partly with federal funds, insured by federal programs, or eligible for federal disaster assistance.<sup>3</sup> For example, the federal government annually provides billions of dollars through various mechanisms for infrastructure projects that state and local governments prioritize, supervise, and own. Specifically, state and local governments control zoning decisions and make decisions about how to build roads and bridges, which are vulnerable to extreme weather events.

As a result of the significant risks posed by climate change and the nation's fiscal condition, in February 2013, we added *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks* to our list of areas at high risk for fraud, waste, abuse, and mismanagement, or most in need of transformation.<sup>4</sup> As a result of the significant long-term impacts of climate change, in our 2015 High-Risk update, we found areas where government-wide improvement is needed to reduce fiscal exposure, including the federal government's role as the provider of data and technical assistance to federal, state, local, and private sector decision makers responsible for managing the impacts of climate change on their activities. Specifically identified under this area for improvement in our 2015 High-Risk update are federal efforts to provide technical assistance to federal, state, local, and private sector decision makers. We reported that these efforts can be addressed by providing (1) the best available climate information for decision makers, such as observed and projected temperatures for a geographic area, and (2)

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<sup>3</sup>Fiscal exposures are responsibilities, programs, and activities that may either legally commit the federal government to future spending or create the expectation for future spending. Fiscal exposures vary widely as to source, extent of the government's legal commitment, and magnitude. See GAO, *Fiscal Exposures: Improving Cost Recognition in the Federal Budget*, [GAO-14-28](#) (Washington, D.C.: Oct. 29, 2013).

<sup>4</sup>GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: Feb. 14, 2013). Click [here](#) for specific information on *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks* available in the 2015 high-risk update—GAO, *High-Risk Series: An Update*, [GAO-15-290](#) (Washington, D.C.: Feb. 11, 2015).

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assistance for translating climate data into what officials need to make decisions.

The federal government recognizes the need to account for climate change risks in its planning and programs and has begun calling on agencies to take certain actions. For example, Executive Order 13653, issued in November 2013, directs certain federal agencies to work together to provide authoritative, easily accessible, and usable information and decision-support tools on climate preparedness and resilience.<sup>5</sup> In addition, USGCRP's 2012-2021 strategic plan for climate change science, released in April 2012, identifies enhanced information management and sharing as a strategic objective.<sup>6</sup>

In this context, you asked us to review federal efforts to provide decision makers with the climate information they need for planning purposes. Specifically, this report examines (1) the extent to which federal efforts meet the climate information needs of federal, state, local, and private sector decision makers; (2) examples of how, if at all, other countries have organized systems to meet the climate information needs of decision makers; (3) whether and how U.S. federal efforts to provide climate information could be improved; and (4) what options exist to provide climate information to U.S. decision makers, and the strengths and limitations of each option.

To address these four objectives, we reviewed reports and studies, interviewed knowledgeable stakeholders, and visited selected sites in the United States and three other countries involved in providing climate information. First, we reviewed our reports related to climate change and reports and studies by the National Research Council, the National Academy of Public Administration, USGCRP, the National Oceanic and Atmospheric Administration (NOAA), the Congressional Research

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<sup>5</sup>The National Academies define resilience as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. See, for example, The National Academies, Committee on Increasing National Resilience to Hazards and Disasters; Committee on Science, Engineering, and Public Policy; *Disaster Resilience: A National Imperative* (Washington, D.C.: 2012). Click [here](#) for more information on the November 2013 Executive Order 13653 on *Preparing the United States for the Impacts of Climate Change*, and other federal climate change resilience efforts.

<sup>6</sup>USGCRP, National Global Change Research Plan 2012-2021: *A Strategic Plan for the U.S. Global Change Research Program* (Washington, D.C.: April 2012).

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Service, and the Congressional Budget Office. We also searched various databases for studies from 2000 to 2014, focusing on peer reviewed journals, trade and industry journals, government reports, and publications from research organizations, advocacy groups, and think tanks. In all, we identified and reviewed over 60 relevant reports and studies.

Second, we interviewed a nonprobability sample of over 40 U.S. stakeholders, including current and former federal officials, local decision makers, researchers, and consultants. We selected this nonprobability sample of stakeholders based on whether they (1) participated in drafting or reviewing National Research Council and other federal reports related to climate information, and thus having relevant knowledge and expertise; (2) were identified by other knowledgeable stakeholders we interviewed; or (3) held positions at Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), USGCRP, or NOAA because these are key federal agencies that provide climate information to decision makers. Because we selected a nonprobability sample of stakeholders to interview, we cannot generalize their views to all stakeholders with relevant knowledge and expertise.

Third, we visited entities in the United States that develop, provide, or archive climate information. These entities were (1) the National Corporation for Atmospheric Research in Boulder, Colorado, which is a federally funded research and development center (FFRDC)<sup>7</sup> that works to enhance research, tools, and assistance in interpreting and using climate-related information; (2) the University Corporation for Atmospheric Research, which operates the National Corporation for Atmospheric Research; (3) the program office of the NOAA National Integrated Drought Information System, also in Boulder, Colorado, which has a goal of improving the nation's capacity to manage drought-related risks by providing those affected with information and tools; and (4) the NOAA National Climatic Data Center in Asheville, North Carolina, which maintains the world's

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<sup>7</sup>FFRDCs are privately owned but government-funded entities that have long-term contractual relationships with one or more federal agencies to perform research and development and related tasks. Click [here](#) to access the National Science Foundation's master government list of FFRDCs.



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largest data archive and provides climatological services and data to various sectors of the U.S. economy.<sup>8</sup>

Fourth, we visited a nonprobability sample of three countries with systems to coordinate the development, archiving, and use of climate information by decision makers—Germany, the Netherlands, and the United Kingdom—to understand how their systems were organized and key characteristics of each.<sup>9</sup> We selected these countries because they were recognized in our literature review and by stakeholders as having well-established systems to coordinate the development, archiving, and use of climate information by decision makers. In the interest of efficiency, we did not review every global example of a country with a well-established system. During our international site visits, we gathered information through interviews with government officials and international stakeholders knowledgeable about the systems, observed some projects that used climate information in planning, and reviewed related documents. Descriptions of the systems in Germany, the Netherlands, and the United Kingdom and graphical depictions of how these systems are organized were reviewed for accuracy and completeness by government officials in these countries. We did not evaluate the effectiveness of these countries' systems.

We conducted this performance audit from June 2014 to November 2015 in accordance with the generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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<sup>8</sup>Click [here](#) for more information about the National Center for Atmospheric Research and the University Corporation for Atmospheric Research. Click [here](#) for more information about the NOAA National Integrated Drought Information System. NOAA's National Climatic Data Center has merged with other NOAA data centers into the National Centers for Environmental Information. Click [here](#) for more information about the NOAA National Centers for Environmental Information.

<sup>9</sup>The findings from these site visits are not generalizable to countries we did not visit.

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## Background

The federal government is using a risk-management strategy for reducing its fiscal exposure to climate change that involves providing technical assistance to state, local, and private sector decision makers. Decision makers from all levels of government and the private sector use different types of climate information in their planning processes to reduce the potential impacts of climate change.

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## Climate-Related Technical Assistance for Adaptation Efforts Is Part of a Risk Management Strategy to Reduce Federal Fiscal Exposure

Climate-related technical assistance for adaptation—adjustments to natural or human systems in response to actual or expected climate change—is a part of a risk-management strategy to help protect vulnerable infrastructure and communities that might be affected by changes in the climate.<sup>10</sup> Such assistance includes, for example, raising river or coastal dikes to protect infrastructure from sea level rise, building higher bridges, and increasing the capacity of storm water systems. One way to reduce the potential impacts of climate change is to build the best available climate information into existing federal, state, local, and private sector planning processes. As discussed in our February 2015 High-Risk update, a key role for the federal government is to provide technical assistance to decision makers to help them translate available climate-related data into the information they need for such planning processes.<sup>11</sup> The President’s June 2013 Climate Action Plan and November 2013 Executive Order 13653 drew attention to the need for improved technical assistance. For example, the executive order directs numerous federal agencies, supported by USGCRP, to work together to develop and provide authoritative, easily accessible, usable, and timely data, information, and decision-support tools on climate preparedness and resilience.<sup>12</sup>

Risk management is not a new concept, and it is used extensively almost anywhere decision makers are faced with incomplete information or unpredictable outcomes that may have negative impacts. Broadly defined, risk management is a strategic process for helping decision makers assess risk, allocate finite resources, and take action under conditions of uncertainty. The International Organization for Standardization standards on risk management recommend that

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<sup>10</sup>When discussing climate change, the term adaptation is synonymous with enhancing resilience.

<sup>11</sup>[GAO-15-290](#). Click [here](#) for specific information on *Limiting the Federal Government’s Fiscal Exposure by Better Managing Climate Change Risks*.

<sup>12</sup>78 Fed. Reg. 66,819 (Nov. 6, 2013).

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organizations such as federal agencies develop, implement, and continuously improve a framework for integrating risk management into their overall planning, management, reporting processes, and policies.<sup>13</sup> For risk management to be effective, these standards state that an organization should comply at all levels with the following principles:

- **Risk management is not a stand-alone activity that is separate from the main activities and processes of the organization.** Risk management is part of the responsibilities of management and is an integral part of all organizational processes, including strategic planning and all project and change management processes.
- **Risk management is part of decision making.** Risk management helps decision makers make informed choices, prioritize actions, and distinguish among alternatives.
- **Risk management explicitly addresses uncertainty.** Risk management explicitly takes account of uncertainty, the nature of that uncertainty, and how it can be addressed.
- **Risk management is based on the best available information.** The inputs to the process of managing risk are based on information sources such as historical data, experience, stakeholder feedback, observation, forecasts, and expert judgment. However, decision makers should inform themselves of, and should take into account, any limitations of the data or modeling used or the possibility of divergence among experts.

As summarized by a 2011 World Meteorological Organization report on climate information, reducing the risks and realizing the opportunities of climate change require making good decisions based on reliable and appropriate information about past, present, and future climate, as well as

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<sup>13</sup>International Organization for Standardization, *ISO 31000 Risk Management—Principles and Guidelines (2009)*. The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies. ISO 31000:2009 *Risk management – Principles and guidelines* is available [here](#). Please also note that the risk assessment standard in GAO, *Standards for Internal Control in the Federal Government* (the “Green Book” AIMD-00-21.3.1) state, among other things, that federal agencies are to assess the risks they face from both external and internal sources and that management should identify, analyze, and respond to relevant risks associated with achieving agency objectives—including changes in external environmental conditions.

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properly integrating that information into the decision-making process.<sup>14</sup> The report also states that appropriate use of climate information can help individuals make more informed short- and medium-term decisions relating to their livelihoods and can help organizations and businesses reduce uncertainty in the long term. Governments also need to choose adaptation measures that reduce vulnerability to climate change, according to the report.

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## Decision Makers Use Different Types of Climate Information

Decision makers from all levels of government and the private sector use different types of climate information in their planning processes to reduce the potential impacts of climate change. The climate information needs of decision makers are diverse, and the effective use of climate information depends on the circumstances of the decision maker, as stated in the 2011 World Meteorological Organization report on climate information.<sup>15</sup> To be useful, climate information must be tailored to meet the needs of each decision maker, such as an engineer responsible for building a bridge in a specific location, a county planner responsible for managing development over a larger region, or a federal official managing a national-scale program. Further complicating matters, decision makers need climate information at different timescales corresponding to the short, medium, or long-term nature of their planning processes. The 2011 World Meteorological Organization report stated that decision makers need access to expert advice and support to help them select and properly apply climate information.

According to a 2010 National Research Council report on making informed decisions about climate change<sup>16</sup> and our October 2009 report on climate change adaptation,<sup>17</sup> most decision makers need a basic set of

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<sup>14</sup>World Meteorological Organization, *Climate Knowledge for Action: A Global Framework for Climate Services*, WMO-No. 1065 (Geneva, Switzerland: 2011).

<sup>15</sup>World Meteorological Organization, *Climate Knowledge for Action: A Global Framework for Climate Services*.

<sup>16</sup>National Research Council, America's Climate Choices: Panel on Informing Effective Decisions and Actions Related to Climate Change, *Informing an Effective Response to Climate Change* (Washington, D.C.: 2010).

<sup>17</sup>GAO, *Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions*, [GAO-10-113](#) (Washington, D.C.: Oct. 7, 2009).

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information to understand and make choices about how to adapt to climate change. This set of information includes the following:

- **Information and analysis about observed climate conditions.** This includes information on, for example, temperature, precipitation, drought, storms, and sea level rise and how they may be changing in the local area. This type of information can be most easily conveyed by graphs and maps with some statistics on trends, variability, and data reliability.
- **Information about observed climate impacts and vulnerabilities.** Decision makers will need site-specific and relevant baselines of environmental, social, and economic impacts and vulnerabilities resulting from observed changes in the climate against which past and current decisions can be monitored, evaluated, and modified over time.
- **Projections of what climate change may mean for the local area.** This includes, for example, projections based on easily understandable best- and worst-case scenarios with confidence and probability estimates and examples of potential climate impacts. The projections may need to be downscaled from complex global-scale climate models to provide climate information at a geographic scale relevant to decision makers.<sup>18</sup> Then, the information would need to be translated into impacts at the local level, such as how increased stream flow for a particular river may increase flooding.
- **Information on the economic and health impacts of climate change.** Observed and projected local impacts must be translated into costs and benefits, since this information is needed for many decision-making processes.

Agencies across the federal government collect and manage many types of climate information, including observational records from satellites and weather monitoring stations on temperature and precipitation, among

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<sup>18</sup>According to a 2012 National Research Council report on climate models, the fundamental science of greenhouse gas-induced climate change is simple and compelling. However, genuine and important uncertainties remain, such as how clouds affect the climate system, and these uncertainties need to be considered in developing scientifically based strategies for societal response to climate change—especially those related to “downscaled” climate information. For more information, see National Research Council, *A National Strategy for Advancing Climate Modeling* (Washington, D.C.: 2012).

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other things; projections from complex climate models; and other tools to make this information more meaningful to decision makers. For example, over 750 federal climate-related datasets were publicly accessible through the [www.data.gov/climate](http://www.data.gov/climate) web portal as of August 2015.<sup>19</sup> The term “climate information system” means a systematic approach for coordinating the development, archiving, and use of such climate information by decision makers, with defined roles for federal agencies and nonfederal entities such as academic institutions. A climate information system coherently organizes different types of climate information and facilitates technical assistance to help decision makers understand how to integrate climate information into their planning processes.

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## Many Federal Efforts Are Under Way, but the Climate Information Needs of Federal, State, Local, and Private Sector Decision Makers Are Not Being Fully Met

Many federal efforts are under way, as the federal government has begun to address the climate information needs of decision makers through various agency activities and government-wide efforts. Coordination is evident, but these efforts are fragmented and do not fully meet the needs of federal, state, local, and private sector decision makers, according to our reports, various studies, and interviews with stakeholders.

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<sup>19</sup>The 2013 [Federal Open Data Policy](#) directs federal agencies to make newly-generated government data available in open, machine-readable formats, while continuing to ensure privacy and security. Data.gov was created to serve this purpose, and [www.data.gov/climate](http://www.data.gov/climate) provides climate data and resources related to coastal flooding, food resilience, water, ecosystem vulnerability, human health, energy infrastructure, and transportation.

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## Many Federal Climate Information Efforts Are Under Way

Many federal climate information efforts are under way, including individual agency activities and government-wide efforts. On February 23, 2015, the Congressional Research Service (CRS) reported that since 2009, federal initiatives have generally increased the priority, number of participants, and specificity of products and actions aimed at climate change adaptation.<sup>20</sup> For example, as of December 2014, almost 40 federal departments and agencies produced climate change adaptation plans and metrics to evaluate adaptation performance, according to this CRS report.<sup>21</sup> Our February 2015 High-Risk update also shows how the President's June 2013 Climate Action Plan and various executive orders, task forces, and strategic planning documents have identified climate change as a priority.<sup>22</sup>

Some agencies have been focusing on how to help their clients understand climate risks and adaptation planning.<sup>23</sup> For example, since 2006, NOAA's National Integrated Drought Information System has incorporated climate information into drought forecasts to help federal, state, local, and private sector decision makers—such as municipal water supply managers—understand the risk and impact of droughts.<sup>24</sup> Other agency efforts, such as the U.S. Department of Agriculture's Climate Hubs, the Department of the Interior's Landscape Conservation Cooperatives and Climate Science Centers, and NOAA's Regional Integrated Sciences and

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<sup>20</sup>CRS, *Climate Change Adaptation by Federal Agencies: An Analysis of Plans and Issues for Congress*, Publ. No. R43915 (Washington, D.C.: Feb. 23, 2015).

<sup>21</sup>In response to the November 2013 Executive Order 13653 on *Preparing the United States for the Impacts of Climate Change*, agencies created or updated climate change adaptation plans that describe how the agency will consider the need to improve climate resilience, including determining whether infrastructure such as roads are built to withstand projected heat extremes. Click [here](#) to access agency climate change adaptation plans submitted in October 2014.

<sup>22</sup>GAO-15-290. Click [here](#) for specific information on *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks*. More information on the June 2013 Climate Action Plan can be found [here](#).

<sup>23</sup>Congressional Research Service, *Climate Change Adaptation by Federal Agencies: An Analysis of Plans and Issues for Congress*, Publ. No. R43915 (Washington, D.C.: Feb. 23, 2015). This report provides detailed descriptions of agency activities related to adaptation and climate information.

<sup>24</sup>Click [here](#) for information on NOAA's National Integrated Drought Information System.

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Assessments program also are designed to help decision makers account for climate information in existing planning processes.<sup>25</sup>

- **USDA Climate Hubs:** The U.S. Department of Agriculture (USDA) established regional Climate Hubs to deliver science-based knowledge and practical information to farmers, ranchers, and forest landowners to support decision making related to climate change.<sup>26</sup>
- **Interior’s Landscape Conservation Cooperatives:** The Department of the Interior developed a network of collaborative Landscape Conservation Cooperatives composed of federal, state, local, and tribal governments; nongovernmental organizations; universities; and interested public and private organizations to, among other things, develop and provide the science and technical expertise needed to apply climate data in natural resources decision making, such as conservation strategies for sensitive habitats.<sup>27</sup>
- **Interior’s Climate Science Centers:** Climate Science Centers partner with natural and cultural resource managers to provide science that helps fish, wildlife, ecosystems, and the communities they support adapt to climate change by, among other things, providing climate, water, and ecosystem modeling to decision makers. National coordination and management for the Climate Science Centers is provided by the U.S. Geological Survey’s National Climate Change and Wildlife Science Center.<sup>28</sup>
- **NOAA’s Regional Integrated Sciences and Assessments program:** NOAA’s Regional Integrated Sciences and Assessments program supports research teams at academic institutions that work

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<sup>25</sup>The 2015 CRS climate adaptation report provides descriptions of programs related to climate information. See Congressional Research Service, *Climate Change Adaptation by Federal Agencies: An Analysis of Plans and Issues for Congress*, Publ. No. R43915. Several recent GAO reports also describe these programs. See, for example, GAO, *Climate Change: USDA’s Ongoing Efforts Can Be Enhanced with Better Metrics and More Relevant Information for Farmers*, [GAO-14-755](#) (Washington, D.C.: Sept. 16, 2014). See also GAO, *Climate Change: Various Adaptation Efforts Are Under Way at Key Natural Resource Management Agencies*, [GAO-13-253](#) (Washington, D.C.: May 31, 2013).

<sup>26</sup>Click [here](#) for more information on USDA Climate Hubs.

<sup>27</sup>Click [here](#) for more information on Landscape Conservation Cooperatives.

<sup>28</sup>Click [here](#) for more information on Climate Science Centers.



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with public and private decision makers—including local, regional, and state governments; federal agencies; tribal governments; and the business community—to among other things, enhance the use of climate information in decision making.<sup>29</sup>

Further, entities within the Executive Office of the President, such as CEQ and OSTP, have led specific government-wide climate information efforts such as the Climate Resilience Toolkit, the Climate Data Initiative, and USGCRP's May 2014 Third National Climate Assessment.<sup>30</sup> These efforts show how federal agencies have made some progress on better organizing within and across agencies. For example—in response to the 2013 President's Climate Action Plan and Executive Order 13653—federal agencies led by OSTP and CEQ created the Climate Resilience Toolkit in 2014, which is a website designed to provide scientific tools, information, and expertise to help people manage their climate-related risks and opportunities and improve their resilience to extreme events. In addition, USGCRP's May 2014 National Climate Assessment summarizes the impacts of climate change on the United States, now and in the future. A team of several hundred experts guided by a 60-member federal advisory committee produced the report, which was extensively reviewed by the public and experts, including federal agencies and a panel of the National Academy of Sciences. In addition, a large stakeholder network was developed in support of the May 2014 National Climate Assessment, and many of the stakeholders involved found the process and product very useful, according to federal officials.

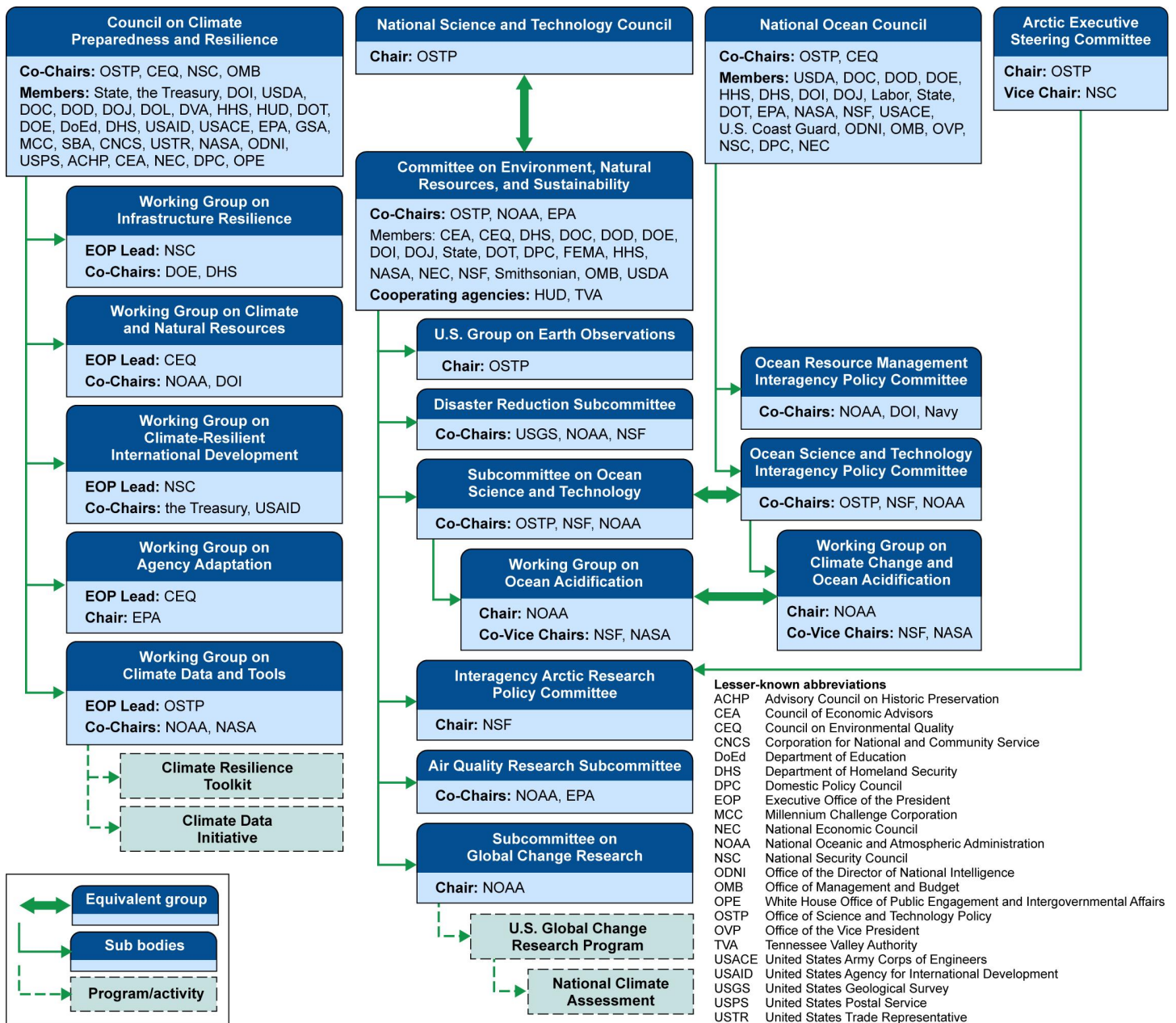
Figure 1 shows selected coordination mechanisms for federal climate change activities, and reflects the complex system of interagency councils, committees, and working groups that currently coordinate the climate-related activities of individual agencies. The dashed boxes in figure 1 reflect government-wide activities related to climate information.

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<sup>29</sup>Click [here](#) to learn about the Regional Integrated Sciences and Assessments program.

<sup>30</sup>CEQ coordinates federal environmental efforts and the development of environmental policies and initiatives. OSTP was established by statute in 1976 to serve as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the federal government, among other things. The Climate Resilience Toolkit is accessible [here](#). Click [here](#) to access the Climate Data Initiative, a web portal that provides access to federal climate-related statistics and information to help companies, communities, and citizens understand and prepare for the impacts of climate change, such as coastal flooding and sea-level rise. Click [here](#) for more information on the Third National Climate Assessment.

**Figure 1: Selected Coordination Mechanisms for Federal Climate Change Activities**



Source: Executive Office of the President. | GAO-16-37

Note: The dashed boxes reflect government-wide programs and activities related to climate information

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## Current Federal Efforts Are Fragmented and Do Not Fully Meet the Climate Information Needs of Federal, State, Local, and Private Sector Decision Makers

Current federal efforts are fragmented and do not fully meet the climate information needs of federal, state, local, and private sector decision makers, according to our recent reports; studies from the National Academies and other organizations; and interviews with knowledgeable stakeholders. According to several officials who coordinate federal climate information efforts, the climate information needs of decision makers are not being fully met because of the lack of a mandate for climate information services.

## Current Federal Climate Information Efforts Are Fragmented

Current federal climate information efforts are fragmented, according to our recent reports, various studies, and interviews with knowledgeable stakeholders. As we reported in our February 2015 High-Risk update, federal climate information efforts have begun to focus on providing technical assistance to federal, state, local, and private sector decision makers so they can make more informed choices about how to manage the risk posed by potential climate impacts.<sup>31</sup> However, our 2015 High-Risk update—based on our recent work—found that climate information exists in an uncoordinated confederation of networks and institutions. The federal government’s climate information—composed of observational records from satellites and weather monitoring stations, projections from complex climate models, and other tools—is fragmented across many individual agencies that use the information in different ways to meet their respective missions. That climate information is found across various agencies is not surprising and is expected given the far-ranging climate information needs of decision makers, according to federal officials. They said that federal agencies are doing exactly what they are supposed to be doing consistent with their missions and, while there is fragmentation, there is also coordination and collaboration within and across agencies.

A November 2014 report by the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience identified “silos” among and within federal agencies as a barrier to climate resilient planning.<sup>32</sup>

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<sup>31</sup>[GAO-15-290](#).

<sup>32</sup>The Task Force on Climate Preparedness and Resilience was established by Executive Order 13653 on *Preparing the United States for the Impacts of Climate Change* and was composed of 26 governors, mayors, county officials, and tribal leaders from across the United States. The task force was created to provide recommendations to the President and an interagency council on how the federal government can support state, local, and tribal resilience to climate change, among other things. Silos among and within federal agencies, as referenced in the task force’s report, include systems and processes that operates in isolation from others. Click [here](#) for more information on the task force.

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Stakeholders we interviewed similarly noted the need to reduce fragmentation of federal climate information efforts. For example, according to stakeholders from the climate modeling community, decision makers are vastly underserved by the current ad hoc collection of federal climate information services. Further, another stakeholder with experience managing federal climate information programs stated that the federal government's current efforts are uncoordinated and inefficient and that federal agencies have created their own climate programs. According to this stakeholder, these programs are uncoordinated, operate as separate information systems, and fail to share information and learn from each other, partly because of turf battles between them. We found in our February 2015 High-Risk update that existing federal actions and strategies do not clearly define the roles, responsibilities, and working relationships among federal, state, local, and private sector entities, or how such efforts will be funded, staffed, and sustained over time.<sup>33</sup>

### The Climate Information Needs of Decision Makers Are Not Being Fully Met

According to our recent reports, other studies, and interviews with knowledgeable stakeholders, the climate information needs of federal, state, local, and private sector decision makers are not being fully met, which hinders their planning efforts. The International Organization for Standardization standards on risk management recommend that organizations such as federal agencies develop, implement, and continuously improve a framework for integrating risk management into their overall planning, management, reporting processes, and policies.<sup>34</sup> They also state that risk management is based on the best available information. However, as we found in our February 2015 High-Risk update, federal, state, local, and private sector decision makers may be unaware that climate information exists or unable to use what is available, making it harder to justify the current costs of incorporating climate change into planning efforts for less certain future benefits.<sup>35</sup> For example, in September

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<sup>33</sup>[GAO-15-290](#).

<sup>34</sup>International Organization for Standardization, *ISO 31000 Risk Management—Principles and Guidelines* (2009).

<sup>35</sup>[GAO-15-290](#). This statement in our February 2015 High-Risk update is supported by many of our climate-related reports focused on topics as varied as federally managed land and water resources ([GAO-13-253](#)); Department of Defense facilities [GAO, *Climate Change Adaptation: DOD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts*, [GAO-14-446](#) (Washington, D.C.: May 30, 2014)]; and infrastructure such as roads and bridges that are primarily managed by state and local officials [GAO, *Climate Change: Future Federal Adaptation Efforts Could Better Support Local Infrastructure Decision Makers*, [GAO-13-242](#) (Washington, D.C.: Apr. 12, 2013)].

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2014, we found that USDA has made few efforts to quantify the costs and returns of actions that could help farmers make both short- and long-term decisions in the face of a changing climate.<sup>36</sup> Without information that is readily accessible to farmers, they may be reluctant to take action to become more resilient to climate change. We recommended that USDA develop and provide readily accessible information to farmers on the farm-level economic costs and returns of taking certain actions in response to climate change. USDA concurred with this recommendation and continues to make progress. For example, in July 2015, USDA announced the Climate Hubs Tool Shed—an online, searchable database of tools designed to assist these farmers and others in adapting their lands to the impacts of climate change and other risks.<sup>37</sup> Further, the participants in our July 21, 2015, *Comptroller General’s Forum on Preparing for Climate-Related Risks: Lessons from the Private Sector* stated that the absence of consistent, authoritative climate information made it hard for private sector entities to consider climate information in planning.<sup>38</sup> For example, one participant stated that there is a climate information gap at the regional level, and businesses should not be responsible for making scientific determinations about what climate information to use.

Various studies we reviewed and stakeholders we interviewed also show how the climate information needs of decision makers are not being met. For example, a 2012 National Research Council study on climate models reported that decision makers need to find and work with someone with the ability to access climate data and interpret it in the context of a specific decision maker’s need.<sup>39</sup> In many cases, according to the 2011 World Meteorological Organization report on climate information, the knowledge exists to help decision makers but is not converted into services they can access and use.<sup>40</sup> For example, according to one stakeholder we

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<sup>36</sup>[GAO-14-755](#).

<sup>37</sup>Click [here](#) to for more information about the Climate Hubs Tool Shed.

<sup>38</sup>GAO, *Highlights of a Forum: Preparing for Climate-Related Risks: Lessons from the Private Sector*, [GAO-16-126SP](#). (Washington, D.C.: Nov. 19, 2015). The forum brought together private sector representatives, federal officials, subject matter experts, and other stakeholders such as a local official.

<sup>39</sup>National Research Council, *A National Strategy for Advancing Climate Modeling* (Washington, D.C.: 2012).

<sup>40</sup>World Meteorological Organization, *Climate Knowledge for Action: A Global Framework for Climate Services*.

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interviewed from academia, the federal government does an excellent job collecting climate observations and archiving quality climate data, but it does not communicate or translate this information in ways useful for decision makers. As a result, according to this stakeholder, decision makers do not understand how climate information is relevant to them and do not know how to incorporate it into their planning efforts. Federal officials responsible for coordinating government-wide climate information efforts told us that the federal government does not know what information decision makers want or need, and decision makers generally do not know what information is available or what information they need to account for climate change in their planning.

According to several officials who coordinate federal climate information efforts, the climate information needs of decision makers are not being fully met because of the lack of a mandate for climate information services. Further, according to certain federal officials, agency climate programs were created to meet individual agency missions and are not necessarily focused on the needs of other decision makers. Federal efforts only recently transitioned to creating government-wide infrastructure for providing climate information to decision makers, according to these officials. They said that, in the current federal structure, the provision of climate information is an inherently interagency activity that relies on the cooperation and shared resources of many agencies, but interagency coordination is weak by design with an inconsistent mandate to use specific climate information in federal decision making. Significant changes to this model would require structural changes in the way that the government operates.



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## Germany, the Netherlands, and the United Kingdom Have Organized Climate Information Systems

Germany, the Netherlands, and the United Kingdom have organized systems to meet the climate information needs of decision makers, according to documents we reviewed and officials we interviewed from these countries.<sup>41</sup> In each climate information system we selected, the government provides direction and funding, and entities within and outside the government help translate climate information to meet decision makers' needs, although each system is organized differently. The following descriptions of the climate information systems in Germany, the Netherlands, and the United Kingdom were based on our review of government documents describing these programs and discussions with government officials.<sup>42</sup>

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### Germany

Germany's climate information system involves entities both within and outside of the German government, according to documents we reviewed and German officials we interviewed in February 2015. Within the German government, the Interministerial Working Group on Adaptation to Climate Change (see fig. 2), headed by the Ministry for the Environment, develops and implements Germany's strategy to adapt to the effects of climate change—known as the German Adaptation Strategy.<sup>43</sup> The strategy describes how the German government is to work with the country's state governments and nongovernment groups to identify both climate risks and appropriate actions to address them. Within the Ministry for the Environment, an office called KomPass advises the German government on climate and adaptation policy.<sup>44</sup> Specifically, KomPass evaluates what is

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<sup>41</sup>We recognize that Germany, the Netherlands, and the United Kingdom (UK) are different from the United States in geographic size, population, ecological diversity, range of climate, and government structure. The United States may be different in many ways, but Germany, the Netherlands, and the United Kingdom provide insight into how to organize climate information systems at a national scale.

<sup>42</sup>The descriptions and accompanying figures were reviewed for accuracy and completeness by officials in these countries. Officials in Germany, the Netherlands, and the United Kingdom told us, however, that some organizational changes have occurred or soon will be taking place. When sufficient information was available, we described changes to these systems in footnotes. In some cases, however, sufficient information was not available before publication of this report.

<sup>43</sup>The full name for the Ministry for the Environment is the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. Click [here](#) for more information about the German Adaptation Strategy.

<sup>44</sup>The full name for KomPass is The Competence Centre on Climate Impacts and Adaptation. Click [here](#) for more information about KomPass.

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known about Germany's vulnerability to climate change, as well as the risks and opportunities climate change presents. KomPass also assists decision makers by evaluating the costs and benefits of potential adaptation strategies in Germany and sharing this information with them. The Ministry of Transport and the Ministry of Research also play key roles, according to German officials.<sup>45</sup> The Ministry of Transport provides funding for the National Meteorological Service of Germany, which operates observation networks and provides climate information and climate projection data to research institutes and those who help decision makers understand the information, according to German officials.<sup>46</sup> In addition, according to documents we reviewed and German officials, the National Meteorological Service's regional climate offices help state governments develop adaptation plans and serve as channels of information to decision makers relevant to the regional offices' area of responsibility.<sup>47</sup>

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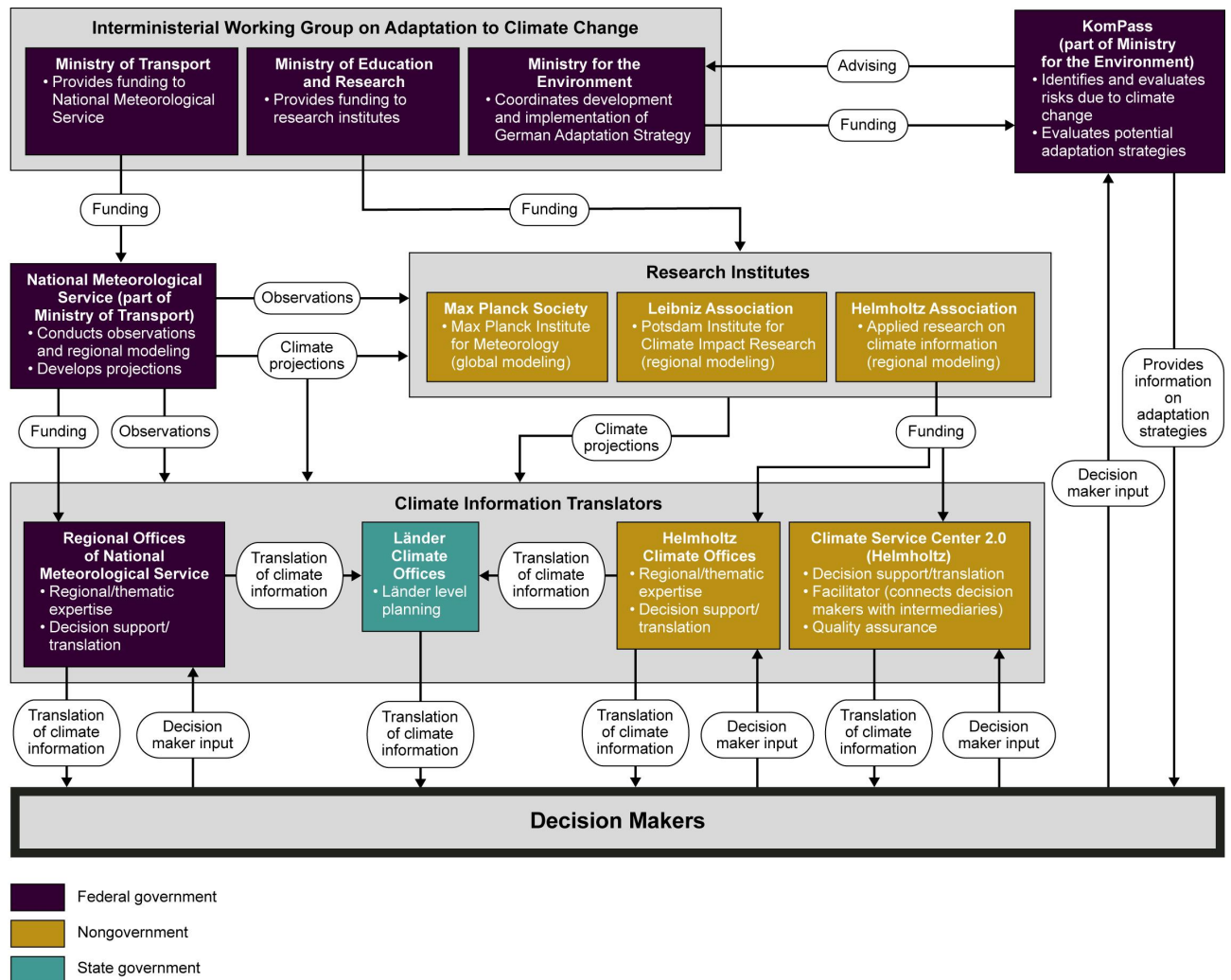
<sup>45</sup>The full names for these ministries are the Federal Ministry of Transport and Digital Infrastructure and the Federal Ministry of Education and Research.

<sup>46</sup>Click [here](#) for more information about the National Meteorological Service of Germany's observation networks and climate information.

<sup>47</sup>German officials told us the National Meteorological Service of Germany plans to announce the National Climate Service Network in late 2015. According to one official, this network will consist of federal agencies and state governments which will provide climate information and services.



**Figure 2: Germany's Climate Information System as of February 2015**



Sources: GAO analysis of German climate-related documents and information; GAO interviews with German officials. | GAO-16-37

Note: Some entity names have been shortened in this figure due to space constraints. For the full names of these entities, see the corresponding text describing Germany's climate information system.

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The Ministry of Research provides funding to nongovernment climate adaptation research institutes, according to documents we reviewed and interviews with German officials. For example, the Max Planck Institute for Meteorology develops global climate models and climate projections that are also used to develop regional-level climate projections, and the Potsdam Institute for Climate Impact Research conducts modeling and data analysis to assess socioeconomic effects of climate change.<sup>48</sup> In addition, the Helmholtz Association of German Research Centres has four regional climate offices that work with decision makers to understand their needs and assist them in using the climate information.<sup>49</sup> Each of the regional climate offices focuses on different regions and specific climate issues or impacts. For example, Helmholtz's North German Climate Office focuses on changes in storms, storm surges, ocean waves, and coastal climate impacts.

In addition, the publicly funded Climate Service Center 2.0—a scientific organization of the Helmholtz Association—conducts applied research and development and offers products and advisory services to decision makers in government and the private sector to address their needs in adapting to climate change, according to documents we reviewed and German officials we interviewed.<sup>50</sup> The center also offers training courses for decision makers on how to use climate information, provides guidelines on modeling, and evaluates climate information portals for reliability and usefulness, according to German officials.

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## The Netherlands

Like Germany, the Netherlands' climate information system involves entities within and outside of the government, but fewer entities are involved, according to documents we reviewed and government officials we interviewed in February 2015. Within the government, the Netherlands Ministry of Infrastructure and the Environment is the lead agency on climate change adaptation (see fig. 3). It develops and implements the

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<sup>48</sup>Click [here](#) for more information about the modeling efforts of the Max Planck Institute for Meteorology. Click [here](#) for more information about the modeling efforts of the Potsdam Institute for Climate Impact Research.

<sup>49</sup>Click [here](#) for more information about the regional climate offices of the Helmholtz Association.

<sup>50</sup>In July 2015, Climate Service Center 2.0 was renamed as Climate Service Center Germany. Click [here](#) for more information about the Climate Service Center Germany.

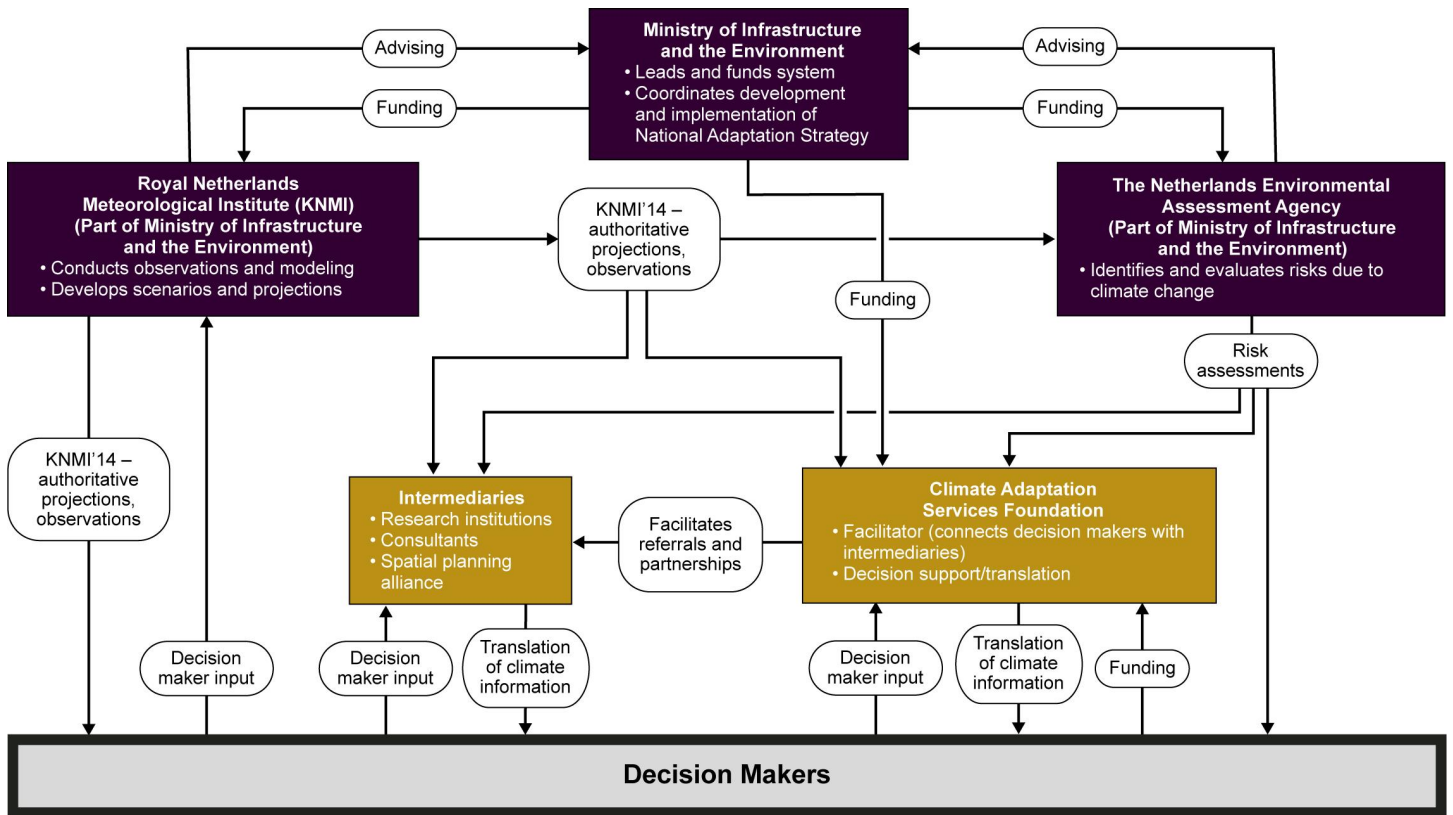
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National Adaptation Strategy, which describes the government's priorities in adapting to the effects of climate change. The ministry provides funding to the Netherlands Environmental Assessment Agency and the Royal Netherlands Meteorological Institute, called KNMI. The Environmental Assessment Agency advises the ministry on climate and adaptation policy by identifying and evaluating risks facing the Netherlands due to climate change. KNMI conducts climate observations and modeling, and develops authoritative projections and scenarios for the climate information system. The most recent version of these scenarios is called KNMI'14.<sup>51</sup> These projections are considered the authoritative source of climate information in the Netherlands, according to documents we reviewed and Dutch officials we interviewed. The projections are also used by other government agencies, by organizations that translate climate information for decision makers, and by decision makers directly, according to these documents and officials. In addition, KNMI operates a help line that decision makers can use to ask questions about climate change, according to Dutch officials.

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<sup>51</sup>Click [here](#) for more information about KNMI'14.

**Figure 3: The Netherlands' Climate Information System as of February 2015**



Government  
 Nongovernment

Sources: GAO analysis of Dutch climate-related documents and information; GAO interviews with Dutch officials. | GAO-16-37

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Outside the government, the Climate Adaptation Services Foundation, a foundation composed of research institutions, consultants, and an alliance of spatial planning organizations, and its predecessor, the Knowledge for Climate Research Programme, have facilitated connections between decision makers and its members, according to documents and officials.<sup>52</sup> Climate Adaptation Services also offers products and services to decision makers, such as the Spatial Adaptation Knowledge Portal, which explains the effects of climate change, describes guiding principles in incorporating climate change into policy development, and showcases how others in the Netherlands are adapting to climate change.<sup>53</sup> Climate Adaptation Services receives some funding from the Ministry of Infrastructure and Environment, as well as funding from decision makers who use its services, although Dutch officials told us that changes to the system are under way.

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## The United Kingdom

The United Kingdom's climate information system involves entities within and outside government, according to documents we reviewed and United Kingdom officials we interviewed in February 2015. The government's Department for Environment, Food and Rural Affairs (DEFRA) in England—together with the devolved administrations in Wales, Scotland, and Northern Ireland—are responsible for leading climate adaptation efforts in the United Kingdom, such as funding the United Kingdom climate information system for adaptation, setting priorities for adaptation, and coordinating with other government and nongovernment partners (see fig.4). As required by statute every 5 years, the department publishes an assessment of climate change impacts across the United Kingdom—the Climate Change Risk Assessment—to help determine the United Kingdom's priorities for climate change

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<sup>52</sup>The Knowledge for Climate Research Programme was established by the Dutch government to operate from 2007 through 2014. The objective of this program was to convert general knowledge about the effects of climate change into specific knowledge relevant to decision makers. Climate Adaptation Services is its successor and, according to government officials, seeks to maintain similar services and networks of intermediaries, but with more limited funding. Click [here](#) for more information about the Knowledge for Climate Research Programme. Click [here](#) for more information about the Climate Adaptation Services Foundation.

<sup>53</sup>Click [here](#) for more information about the Spatial Adaptation Knowledge Portal.

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adaptation, according to these documents and officials.<sup>54</sup> The policies, actions, and timelines to address these priorities are described in the National Adaptation Programme, which is also published every 5 years.<sup>55</sup> In addition, the statute requires the Adaptation Sub-Committee of the Committee on Climate Change to advise the department on the preparation of the Climate Change Risk Assessment, as well as to assess the progress made toward implementing the National Adaptation Programme every two years.<sup>56</sup> As a result, according to United Kingdom officials, the Adaptation Sub-Committee provides independent oversight of the climate information system. Also, the Met Office Hadley Centre—a government-funded climate science and services center—conducts climate observations and modeling, and develops authoritative projections for future climate scenarios.<sup>57</sup> The most recent version of these projections is called the UK Climate Projections 2009 or UKCP09.<sup>58</sup> These projections are considered the authoritative source of climate information in the United Kingdom and are used across the United Kingdom by government agencies, organizations that translate the information to meet decision makers’ needs, and decision makers themselves, according to documents we reviewed and officials we interviewed.

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<sup>54</sup>In 2008, the Parliament of the United Kingdom (UK) enacted the Climate Change Act, which sets up a framework for the UK to ensure steps are taken toward adapting to the impact of climate change, among other things. Click [here](#) for more information on the UK Climate Change Act of 2008. Click [here](#) for more information about the Climate Change Risk Assessment.

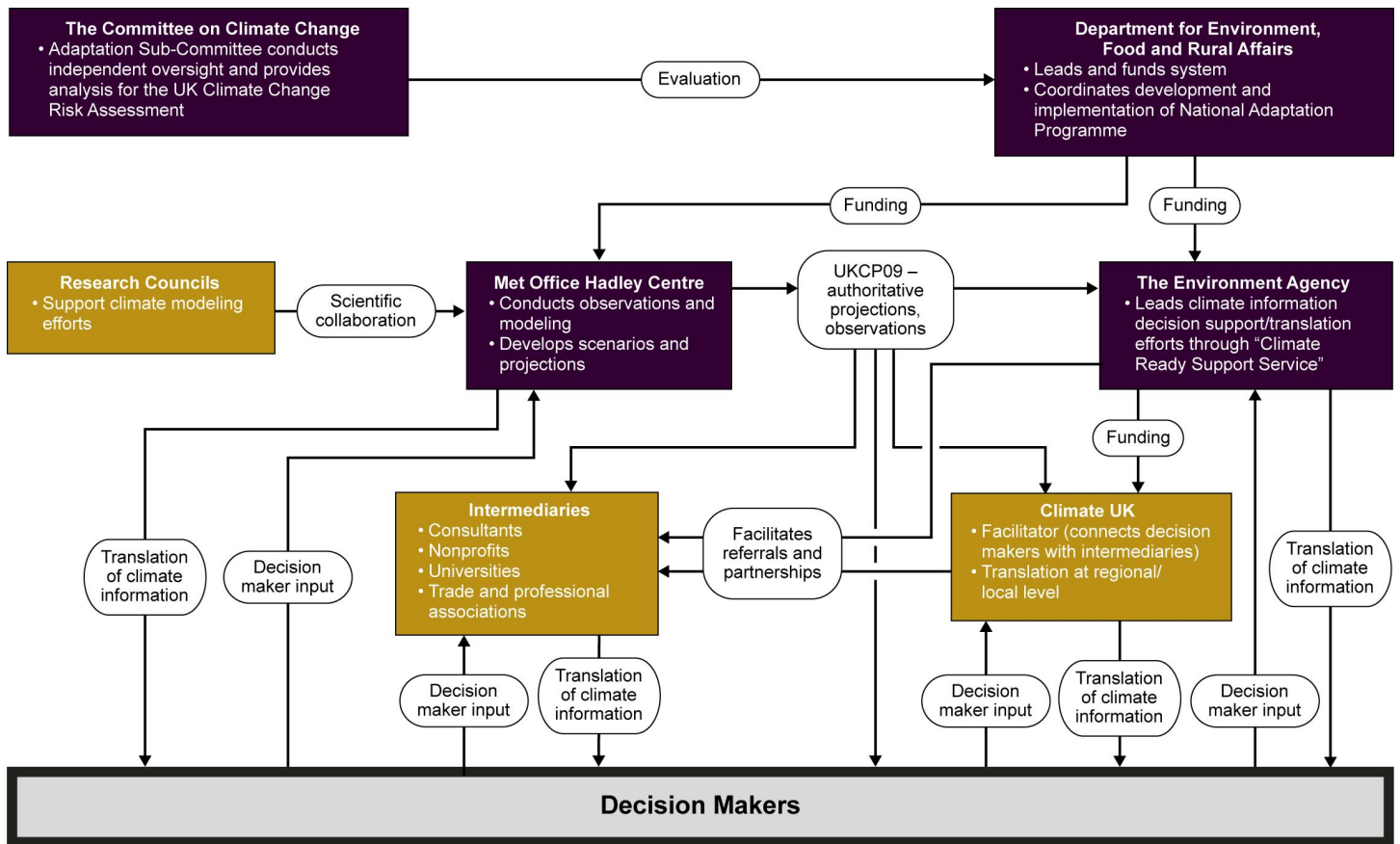
<sup>55</sup>Click [here](#) for more information about the National Adaptation Programme. According to a United Kingdom official, the National Adaptation Programme covers each country of the United Kingdom—England, Scotland, Wales, and Northern Ireland—except where relevant policies are devolved to Scotland, Wales, and Northern Ireland.

<sup>56</sup>Click [here](#) for the Adaptation Sub-Committee’s most recent report to the UK Parliament on progress in addressing the United Kingdom’s priorities for climate change adaptation.

<sup>57</sup>Click [here](#) for more information about the Met Office Hadley Centre.

<sup>58</sup>UKCP09 provides future climate projections for land and marine regions, as well as observed (past) climate data for the UK. It can be used to help decision makers assess their climate risks and plan how to adapt to a changing climate. Click [here](#) for more information about the UKCP09.

**Figure 4: The United Kingdom’s Climate Information System for Adaptation as of February 2015**



Government  
 Nongovernment

Sources: GAO analysis of United Kingdom (UK) climate-related documents and information; GAO interviews with UK officials. | GAO-16-37

Note: The government’s Department for Environment, Food and Rural Affairs in England—together with the devolved administrations in Wales, Scotland, and Northern Ireland—are responsible for leading climate adaptation efforts, such as funding the United Kingdom climate information system for adaptation, setting priorities for adaptation, and coordinating with other government and nongovernment partners. As an entity sponsored by the department, the Environment Agency only covers England; there are similar entities in Wales, Scotland, and Northern Ireland.



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Another government entity—the Environment Agency’s Climate Ready Support Service—leads the efforts to assist decision makers in using climate information to adapt to the effects of climate change in England.<sup>59</sup> It mainly works through intermediaries outside the government, such as nonprofit organizations, consultants, universities, and trade and professional associations to translate climate information for decision makers, according to government officials. For example, the Environment Agency partially funds Climate UK, a network of regionally based nonprofits that help decision makers at the regional and local level incorporate climate information into their planning and connect with intermediaries.<sup>60</sup> In addition, the Climate Ready Support Service supports the Local Government Association, which works with local authorities on adapting to climate change.<sup>61</sup> Also, outside the government are the research councils, such as the Natural Environment Research Council, that support climate modeling efforts by collaborating with the Met Office Hadley Centre.<sup>62</sup>

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## U.S. Federal Climate Information Efforts Could Be Improved by Incorporating Key Organizational and Data Elements

U.S. federal climate information efforts could be improved by incorporating key organizational and data elements, according to our reports on adaptation and interagency collaboration, National Academies and other studies, observations from site visits to other countries with climate information systems, and interviews with U.S. and international stakeholders. Specifically, the key organizational and data elements that could improve federal climate information efforts are (1) a focused and accountable organization, (2) authoritative data, and (3) technical assistance.

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<sup>59</sup>Click [here](#) for more information about the Environment Agency.

<sup>60</sup>Click [here](#) for more information about Climate UK.

<sup>61</sup>Click [here](#) for more information about the Local Government Association’s efforts related to climate change.

<sup>62</sup>There are seven UK research councils. Each receives funding from the government’s science budget, which is administered through the Department for Business, Innovation and Skills. In addition, some research councils also receive funding from other government departments, commercialization of research, and other research funders, according to their website. These councils are responsible for investing the funding they receive in research and training activities in various fields, including engineering and physical sciences and medical and life sciences. Click [here](#) for more information about the research councils.



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## A Focused and Accountable Organization

A focused and accountable organization that engages in key practices of collaboration would improve federal climate information efforts, according to our reports on adaptation and interagency collaboration, National Academies and other studies, observations from site visits to other countries with climate information systems, and interviews with U.S. and international stakeholders. Collaboration between entities is necessary to address complex, high-risk challenges like climate change.<sup>63</sup> In October 2005, we found key practices to enhance and sustain interagency collaboration include agreeing on roles and responsibilities and establishing mutually reinforcing or joint strategies.<sup>64</sup> In addition, in September 2012, we found that such interagency efforts benefit from clearly defined short-term and long-term outcomes, common terminology and definitions, agreement on how the effort will be funded and staffed, and committed leadership.<sup>65</sup> Other reports also cited the importance of collaboration. For example, the President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience stated in 2014 that coordination among and within federal agencies is vital to ensure that decision makers can navigate federal climate information products and resources.<sup>66</sup> In addition, federal officials and stakeholders we interviewed in the United States and the three countries we visited told us that any successful collaboration on climate information between federal and nonfederal entities required well-defined and clear roles and responsibilities.

Further, our October 2005 collaboration report states that agencies must have a clear and compelling rationale to work together to overcome significant differences in agency missions, cultures, and established ways of doing business.<sup>67</sup> According to this report, the compelling rationale for agencies to collaborate can be imposed externally by law or directive or can come from the agencies' own perceptions of the benefits they can

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<sup>63</sup>GAO, *Managing for Results: OMB Should Strengthen Reviews of Cross-Agency Goals*, [GAO-14-526](#) (Washington, D.C.: June 10, 2014).

<sup>64</sup>GAO, *Results-Oriented Government: Practices That Can Help Enhance and Sustain Collaboration among Federal Agencies*, [GAO-06-15](#) (Washington, D.C.: Oct. 21, 2005).

<sup>65</sup>GAO, *Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms*, [GAO-12-1022](#) (Washington, D.C.: Sept. 27, 2012); [GAO-06-15](#).

<sup>66</sup>The State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, *Recommendations to the President* (Washington, D.C.: November 2014).

<sup>67</sup>[GAO-06-15](#).

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obtain from working together. Federal officials we interviewed who are responsible for coordinating federal climate information programs stated that they need a mandate that allows agencies and partner organizations to perform the functions necessary to improve federal efforts. The reason, these officials said, is that agencies have other missions and, in some cases, are precluded from participating in climate change efforts. Some officials in the United Kingdom stated that people will act if they have a specific duty to manage climate change risk. Similarly, government pressure for action is the backbone of Germany's climate information system, according to some German officials.

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## Authoritative Data

Authoritative climate data—a periodically updated set of observed and projected best available climate data for use by decision makers—would improve federal climate information efforts, according to National Research Council studies and other reports, international climate information systems, and interviews with stakeholders. Decision makers need consistent, geographically specific, and accessible information and tools to identify climate risks and support resilience planning in their communities, according to a November 2014 report by the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience.<sup>68</sup> According to domestic and international stakeholders we interviewed, authoritative data are crucial because they define a common starting point for decision makers. However, stakeholders said that a single source of information may not be necessary, as a minimum level of certification, a “seal of approval,” could be applied to multiple data sources that meet certain criteria. Further, according to OSTP staff, centralized data are only part of the answer; there needs to be user demand for such information, and translation of those data for myriad different end users, among other factors. These staff also said that observations and projections are tools, and solely coordinating access to these tools will not, by itself, resolve the issue at hand.

Various reports we reviewed and stakeholders we interviewed also emphasized that improved federal efforts should provide authoritative locally-focused information because most decisions are made at the local level. These reports and stakeholders consistently said that locally-

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<sup>68</sup>The State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, *Recommendations to the President* (Washington, D.C.: November 2014).

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focused information makes climate change real to decision makers where they live and work. For example, one stakeholder said that decision makers want to know about the effects of climate change in their local area, as well as the local area of their businesses and customers. German officials echoed this point, stating that locally-focused information helps the public and political leaders realize what climate change means for them where they live. However, CEQ and OSTP staff and other stakeholders cautioned that locally-focused climate projections need to be presented in the necessary regional, national, and global context. According to OSTP staff, in some cases, it may not be possible to realistically project future conditions at the local scale due to inherent limitations in the ability to understand and simulate global systems at the local level. United Kingdom officials also stated that locally-focused information is not necessary for many decisions, and the appropriate geographic scale varies depending upon the hazard and decision under consideration.

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## Technical Assistance

Clearly organized technical assistance would improve federal climate information efforts by helping different types of decision makers—ranging from those who can define their needs to those who have limited experience using climate information—access, translate, and use climate information, according to one of our recent reports, National Academies studies, other reports, and interviews with stakeholders. In April 2013, we found that local decision makers need assistance from experts to help them translate available climate data into locally relevant information.<sup>69</sup> In addition, the State, Local, and Tribal Leaders Task Force stated that the greatest need is often not the creation of new data or information, but assistance and tools for decision makers to navigate the wide array of resources already available. Federal officials, domestic stakeholders, and officials we interviewed in the three countries we visited told us that expecting decision makers to interpret and use complicated data themselves is insufficient and ineffective. For example, several stakeholders said that decision makers are unable to use climate data without significant translation and support. In addition, federal officials told us that there is no substitute for face-to-face communication with providers of technical assistance. This type of technical assistance is labor- and resource-intensive with a significant formal role for nonfederal

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<sup>69</sup>[GAO-13-242](#).

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institutions, according to federal officials, and is most effective when sustained and iterative in nature—not just scientists handing data and information to decision makers.

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## Options to Provide Climate Information to U.S. Decision Makers Have Strengths and Limitations

Various options exist for providing climate information to U.S. decision makers, and these options have strengths and limitations, according to our reports, other studies, interviews with officials from countries with climate information systems, and interviews with knowledgeable stakeholders. According to a 2010 National Research Council report, successful adaptation to climate change involves federal, state, and local governments; the private sector; nongovernmental organizations and community groups; and others.<sup>70</sup> The report said that the challenge is creating a framework where all of the parties work together, taking advantage of the strengths of each and ensuring that they do not get in each other's way. According to a different National Research Council report, a formal system is critical to longevity and success because such activities are more effective when well-established organizations build trust among information users over time.<sup>71</sup> Studies we reviewed and interviews we conducted with stakeholders identified six options to provide climate information to decision makers: (1) a new federal agency, (2) a single existing agency, (3) a nonprofit or FFRDC, (4) a strengthened USGCRP, (5) a strengthened OSTP or new entity within the Executive Office of the President, and (6) a federally coordinated network of regional organizations. A national climate information system with defined roles for federal agencies and nonfederal entities could emphasize the strengths and deemphasize the limitations of these different options. Table 1 presents a summary of the strengths and limitations of these options, each of which is discussed in more detail below.

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<sup>70</sup>National Research Council, Panel on Adapting to the Impacts of Climate Change, *America's Climate Choices: Adapting to the Impacts of Climate Change* (Washington, D.C.: 2010).

<sup>71</sup>National Research Council, Panel on Strategies and Methods for Climate-Related Decision Support, Committee on the Human Dimensions of Global Change, *Informing Decisions in a Changing Climate* (Washington, D.C.: 2009).

**Table 1: The Strengths and Limitations of Options to Provide Climate Information to U.S. Decision Makers**

Government-wide option	Strengths	Limitations
New federal agency	<ul style="list-style-type: none"> <li>Focused mission</li> <li>Consolidates expertise</li> </ul>	<ul style="list-style-type: none"> <li>Turf conflicts with existing agencies</li> <li>Disrupts existing relationships</li> </ul>
Single existing federal agency	<ul style="list-style-type: none"> <li>Employs existing relationships</li> <li>Uses existing organizational functions</li> </ul>	<ul style="list-style-type: none"> <li>Turf conflicts with other agencies</li> <li>No single agency has all necessary expertise</li> <li>Tension between existing and new mission</li> </ul>
Nonprofit/federally funded research and development center (FFRDC) <sup>a</sup>	<ul style="list-style-type: none"> <li>Nimble and flexible</li> <li>Can obtain funding from federal and nonfederal sources</li> </ul>	<ul style="list-style-type: none"> <li>Inability to coordinate federal activities</li> <li>Information may not be perceived as authoritative</li> <li>Inability to participate in federal budget discussions</li> </ul>
Strengthened United States Global Change Research Program (USGCRP)	<ul style="list-style-type: none"> <li>Employs existing relationships</li> <li>Uses existing coordination mechanisms</li> </ul>	<ul style="list-style-type: none"> <li>Turf conflicts with agencies</li> <li>Few links to on-the-ground decision makers</li> </ul>
Strengthened Office of Science and Technology Policy (OSTP) or new entity within the Executive Office of the President	<ul style="list-style-type: none"> <li>Ability to coordinate federal activities</li> <li>Agencies have short-term incentive to cooperate</li> </ul>	<ul style="list-style-type: none"> <li>Lacks long-term continuity</li> <li>Lacks operational capabilities</li> </ul>
Federally coordinated network of regional organizations	<ul style="list-style-type: none"> <li>Capable of engaging a broad range of decision makers</li> </ul>	<ul style="list-style-type: none"> <li>Inconsistent use of available data and tools</li> <li>Information may not be perceived as authoritative</li> </ul>

Source: GAO review of National Academies and other studies and interviews with knowledgeable stakeholders. | GAO-16-37

<sup>a</sup>FFRDCs are privately owned but government-funded entities, operated by contractors or other nongovernmental organizations, that have long-term contractual relationships with one or more federal agencies to perform research and development and related tasks.

## New Federal Agency

A new federal climate information agency would have strengths and limitations, according various studies, interviews with officials from countries with climate information systems, and interviews with knowledgeable stakeholders. Strengths of a new agency include a focused mission and consolidated expertise gathered from agencies across the federal government. One stakeholder noted that a new agency would have authority, a direct mandate, and clarity of mission. Other stakeholders said a new agency would be less likely to be pulled in multiple directions, could create a unified culture, and would be relatively easy to manage.

Limitations identified by stakeholders include the potential for “turf” conflicts with existing agencies, as many climate information efforts are

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currently under way across the federal government, and consolidated expertise would disrupt existing relationships. First, several stakeholders said that they believed that a new climate information agency would result in serious turf battles with existing agencies. For example, according to one stakeholder, a new agency would not be successful because existing agencies would resist losing their programs. Second, a new climate information agency would disrupt existing relationships, according to various reports reviewed and stakeholders interviewed. According to the 2010 National Research Council report, it is necessary to build upon existing relationships because no single government agency or centralized unit could perform all the functions required of a climate information system.<sup>72</sup> In support of this view, one stakeholder stated that establishing a new federal agency is unrealistic because the new agency would have to develop new relationships with decision makers.

Experiences in other countries with climate information systems provide insight about the merits of developing a new climate information agency. None of the climate information systems we reviewed—that is, those of Germany, the Netherlands, or the United Kingdom—relies upon a single new or existing national agency to provide the entire spectrum of climate information and translation services. For example, in the United Kingdom, climate information activities for adaptation are coordinated among four government entities and a range of nongovernment entities. Similarly, multiple government entities have roles in the climate information systems of Germany and the Netherlands.

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## Single Existing Federal Agency

A federal climate information system led by a single existing agency would also have strengths and limitations, according to various studies, interviews with officials from countries with climate information systems, and interviews with knowledgeable stakeholders. Strengths of this option are similar to those for developing a new federal agency, with one key difference—the ability to build on existing relationships instead of starting over. As with a new agency, relying on an existing agency to provide decision makers with climate information would involve a single point of contact. According to a 2010 National Academy of Public Administration report, it would be extremely valuable to have one federal agency

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<sup>72</sup>National Research Council, America's Climate Choices: Panel on Informing Effective Decisions and Actions Related to Climate Change, *Informing an Effective Response to Climate Change* (Washington, D.C.: National Academies Press, 2010).

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designated to aggregate climate information and provide the best available science to support public policy decision making.<sup>73</sup> One stakeholder with experience coordinating federal climate information efforts stated that a single existing agency would have an established organizational structure, resources, and relationships with federal and nonfederal entities. Another stakeholder said that relying on an existing agency would allow the agency to hit the ground running and start up quickly compared with starting a new agency.

The limitations of having an existing agency lead a federal climate information system are similar to the limitations of developing a new agency—especially turf conflicts with existing agencies. In addition, no single agency has all the necessary expertise. For example, according to a stakeholder with experience coordinating federal climate information efforts, a single agency would not have the breadth of expertise and knowledge needed for a functional climate information system. Further complicating matters, according to this stakeholder, every agency wants to lead, and no agency wants to support. A related limitation is that an existing agency would already have a mandate to do other tasks. It would have to balance its old mandate with its new one—which probably would not go well, according to certain federal officials who coordinate federal climate information programs.

Experiences in other countries and a recent attempt by NOAA to establish a climate information system provide insights into the feasibility of having a single agency lead U.S. efforts. None of the climate information systems we reviewed in other countries relies on a single new or existing government agency to provide the entire spectrum of climate information and technical assistance. And, in 2011, NOAA attempted, through the budget process, to organize a Climate Service to coordinate federal climate information functions. Stakeholders we spoke with generally cited this effort as illustrative of the limitations of relying on a single existing federal agency to lead a climate information system in the United States.<sup>74</sup>

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<sup>73</sup>Panel of the National Academy of Public Administration, *Building Strong for Tomorrow: NOAA Climate Service*, a report prepared for Congress, the Department of Commerce, and NOAA (Sept. 13, 2010).

<sup>74</sup>Click [here](#) for more information about NOAA's 2011 effort to develop a Climate Service.

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## Nonprofit or FFRDC

The option of having a nonprofit or FFRDC lead a federal climate information system would also have strengths and limitations, according to various studies, interviews with officials from countries with climate information systems, and interviews with knowledgeable stakeholders. For example, a strength identified by a NOAA report describing options to organize federal climate information was that a nonprofit could operate without the burden of complex rules and regulations.<sup>75</sup> A stakeholder with experience coordinating federal climate information programs said that getting this activity out of the federal government would allow a climate information system to be nimble and efficient. Another strength identified by stakeholders is that nonprofits can be funded with both federal and nonfederal dollars. Specifically, according to one stakeholder, a nonprofit would be able to spend federal and nonfederal funds and address new challenges as they arise, while the federal government has limited flexibility for spending its funds.

The nonprofit option also has limitations, according to stakeholders we interviewed, including its inability to coordinate federal activities and the inability to participate in federal budget discussions.<sup>76</sup> According to staff from the Executive Office of the President, a nonprofit option may not have adequate authority to deliver climate information in an authoritative and coordinated way to decision makers. For example, it would lose the “federal government stamp,” which means it would be seen as less authoritative, according to these staff. Further, one stakeholder noted that a nonprofit would struggle to get federal agencies and other organizations to cooperate because it would lack the authority to require them to do so. Also, several stakeholders said nonprofit staff would be excluded from federal budget discussions, meaning agencies would not have an incentive to work with them, and they would not be able to advocate for federal funding.

Climate information systems in Germany, the Netherlands, and the United Kingdom have components similar to U.S. nonprofits or FFRDCs. However, nonprofits in these countries do not play a lead role in any of these systems and primarily perform a technical assistance or facilitator

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<sup>75</sup>NOAA Science Advisory Board, *Options for Developing a National Climate Service* (Washington, D.C.: June 5, 2009).

<sup>76</sup>Federal officials cautioned that funding from private nonfederal entities could influence the priorities and emphasis of an FFRDC.



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role within a larger system. For example, Climate UK—a network of regionally based nonprofits—helps decision makers at the regional and local level incorporate climate information into their planning and connect with intermediaries such as private sector contractors with climate information expertise. Climate UK is partially supported by the UK Environment Agency and partially supported by other, nongovernment funds, but it does not play a lead role in the United Kingdom’s climate information system.

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## Strengthened USGCRP

A strengthened USGCRP—the interagency body that coordinates the climate science activities of 13 agencies—with independent funding and additional authority for its National Coordination Office to lead a U.S. climate information system would have strengths and limitations, according to various studies, interviews with officials from countries with climate information systems, and interviews with knowledgeable stakeholders.<sup>77</sup> The strengths are that it employs existing relationships with other federal agencies and nonfederal entities and uses established federal coordination mechanisms. As stated by one stakeholder with extensive experience coordinating federal climate information efforts, having a strengthened USGCRP lead a climate information system is by far the easiest option to implement because the program has experience and existing networks with state and other nonfederal stakeholders. Other stakeholders noted that USGCRP has a history of convening agencies, has close connections with the Executive Office of the President, and can participate in budget discussions.

A strengthened USGCRP National Coordination Office would also have limitations, primarily related to turf conflicts with agencies and few links to decision makers. For example, according to several stakeholders, some agencies see USGCRP as an operation they do not own, and strengthening USGCRP would be very difficult because of funding and territorial conflicts between member agencies. In addition, USGCRP has historically been a research—not operational—organization, according to stakeholders we interviewed. For example, according to one agency

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<sup>77</sup>USGCRP is steered by the Subcommittee on Global Change Research (SGCR) of the National Science and Technology Council’s Committee on Environment, Natural Resources, and Sustainability, and overseen by the White House Office of Science and Technology Policy. The SGCR coordinates interagency activities through the USGCRP National Coordination Office and interagency working groups.

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official, it is difficult for the USGCRP National Coordination Office to be the main point of contact for a climate information system because it has not historically focused on providing information directly to decision makers.

Climate information systems in other countries provide few insights as to whether a strengthened USGCRP could lead a U.S. climate information system. Germany has an interministerial working group composed of several federal ministries, but none of the international systems we reviewed supports an organization like USGCRP.

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### Strengthened OSTP or New Entity within the Executive Office of the President

Strengthening OSTP or creating a new entity within the Executive Office of the President to lead a U.S. climate information system would have strengths and limitations, according to various studies, interviews with officials from countries with climate information systems, and interviews with knowledgeable stakeholders. The primary strength of this option is that it is housed within the Executive Office of the President. For example, according to one academic stakeholder, a strengthened OSTP would provide political power and authority to a climate information system.<sup>78</sup> Other stakeholders said this option would be directly connected to the President, would provide a strategic vision, and could ensure the vision's implementation.

Key limitations of a strengthened OSTP or new entity within the Executive Office of the President are the lack of long-term continuity and operational capabilities, according to stakeholders we interviewed. One stakeholder with extensive experience coordinating federal climate information activities said a strengthened OSTP is the worst option because it is too political, and changes in administrations could disrupt the continuity needed to build a sustainable system. A stakeholder from academia said this is the most worrisome option because it could lack long-term continuity and be vulnerable to disruption or dismantlement. A strengthened OSTP or new entity within the Executive Office of the President also would lack operational capabilities, according to several

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<sup>78</sup>According to federal officials, it is not clear why an entity within the Executive Office of the President would automatically confer greater authority on a set of scientific information products than an institution with a scientific mission rather than policy-focused one. They said that scientific authority may be lost in such an arrangement due to perceptions of political influence.

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stakeholders. For example, one private sector stakeholder stated that OSTP staff are not with the office long enough to be effective at running long-term projects. Another stakeholder also cited low staff numbers and high turnover that make an Executive Office of the President option unsuitable for a large effort like a climate information system.

Climate information systems in other countries provide few insights as to whether a strengthened OSTP or new Executive Office of the President entity could lead a U.S. climate information system. Climate information systems in Germany, the Netherlands, and the United Kingdom generally divide tasks among specific agencies or nongovernment entities and do not consolidate power in a single executive-level entity.

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## Federally Coordinated Network of Regional Organizations

Using the federal government to periodically convene and finance a network of nonfederal regional organizations to provide climate information to decision makers also would have strengths and limitations, according to various studies, interviews with officials from countries with climate information systems, and interviews with knowledgeable stakeholders. This option, according to the 2010 National Research Council report, is an intermediate approach, with decentralized planning and actions, but a significant role for the federal government as a catalyst and coordinator, providing information and technical resources at a national level.<sup>79</sup> A key strength of this approach is the ability to connect and actively engage a broad range of decision makers, according to a 2009 report by the NOAA Science Advisory Board.<sup>80</sup> For example, according to one stakeholder, this option could more easily present climate information in an appropriate context for decision makers because providers of technical assistance at the regional level would be more aware of and responsive to decision makers' needs.

Limitations of the federally coordinated network of regional organizations option include potentially inconsistent use of climate information. Specifically, decision makers in different regions may use climate information of varying quality because of the decentralized nature of this

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<sup>79</sup>National Research Council, Panel on Adapting to the Impacts of Climate Change, *America's Climate Choices: Adapting to the Impacts of Climate Change* (Washington, D.C.: 2010).

<sup>80</sup>NOAA Science Advisory Board, *Options for Developing a National Climate Service* (Washington, D.C.: June 5, 2009).

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type of system, according to various documents and stakeholders we interviewed. For example, according to the 2009 NOAA Science Advisory Board report, the voice and vision of a federally coordinated network may not be coherent if regionally distributed.<sup>81</sup> Further, according to this report, climate information provided through distributed partners may not be viewed as authoritative.

Climate information systems in Germany, the Netherlands, and the United Kingdom all rely on some elements of a federally coordinated network of regional organizations, employing multiple entities to provide and translate climate information to different decision makers. However, Germany's climate information system most closely resembles the federated option described here because of the sheer number of regional climate information providers. As described by one German official, the best description of the German system is a confederation of partners designed to convince decision makers to take action and facilitate implementation. Germany's system is very decentralized with a national framework and heterogeneous local implementation, according to this official. Several German officials stated that Germany's decentralized structure enhances the ability for scientists to communicate with local decision makers, and another said that the resulting competition is often positive, but others said it resulted in overlapping roles, coordination problems, competition, and decision-maker confusion.

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## A National Climate Information System Could Incorporate the Best Features and Address the Limitations of Different Options

A national climate information system with defined roles for federal agencies and nonfederal entities could incorporate the best features and address the limitations of different options to provide climate information to decision makers, according to various studies we reviewed and interviews we conducted with knowledgeable stakeholders. These studies and stakeholders generally recognized the need to combine elements of the different options to provide climate information to decision makers—as each has relative advantages—and they called for a national climate information system with (1) federal leadership, (2) authoritative federal data and federal quality assurance guidelines, and (3) nonfederal technical assistance.

### Federal Leadership

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<sup>81</sup>NOAA Science Advisory Board, *Options for Developing a National Climate Service*.

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Federal leadership for climate information could emphasize the ability of the strengthened OSTP option to coordinate federal activities while deemphasizing the lack of such ability and potential for turf conflicts evident in many of the other options. Based on our review of studies, international climate information systems, and interviews with stakeholders, the main approaches for motivating decision makers to use climate information are statutory requirements and strategic plans—distinctly federal actions. With respect to statutory requirements, officials within the Executive Office of the President said that a mandate is necessary for a climate information system to be successful because certain agencies would not otherwise be able to participate in climate information activities due to laws authorizing or funding their work. Likewise, some German and United Kingdom officials said that strong leadership and a mandate are necessary to make a climate information system happen. A specific law requiring various actions related to climate change—the Climate Change Act of 2008—facilitated the creation of the United Kingdom’s climate information system and provided the justification to sustain it over time, according to United Kingdom officials.

Strategic plans can motivate decision makers to use climate information. In 2009, we recommended that the appropriate entities within the Executive Office of the President, in consultation with relevant federal agencies, state and local governments, and key congressional committees of jurisdiction, develop a strategic plan to guide the nation’s efforts to adapt to climate change.<sup>82</sup> This plan would include the establishment of clear roles, responsibilities, and working relationships among federal, state, and local governments. Similarly, in 2010, the National Research Council recommended that the Executive Branch initiate development of a collaborative national adaptation strategy, which might take the form of a national adaptation plan.<sup>83</sup> As of October 2015, the federal government had yet to develop a strategic plan for adaptation or a national adaptation strategy. In comparison, the climate information systems in Germany, the Netherlands, and the United Kingdom all have national climate adaptation plans that describe government-wide climate information for adaptation priorities. For example, according to certain German officials, the German National Adaptation Strategy provides a

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<sup>82</sup>GAO-10-113.

<sup>83</sup>National Research Council, Panel on Adapting to the Impacts of Climate Change, *America’s Climate Choices: Adapting to the Impacts of Climate Change* (Washington, D.C.: 2010).

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Authoritative Federal Data and  
Federal Quality Assurance  
Guidelines

framework and clear forward-looking goals for the German climate information system. The German National Adaptation Strategy emphasizes how using climate information in planning processes makes sense and saves money. According to German officials, this encourages decision makers to adapt by showing them why an action makes sense, instead of focusing solely on required actions.

Paired together, authoritative federal data and federal quality assurance guidelines emphasize the strengths of the New Federal Agency, Single Existing Agency, and Strengthened USGCRP and OSTP options by using existing coordination mechanisms and organizational functions and focusing on a specific mission while deemphasizing the limitations of inconsistent use of available data inherent in the Federally Coordinated Network of Regional Organizations option. The federal government should be responsible for maintaining the nation's official climate records as part of a climate information system, according to the National Research Council.<sup>84</sup> Certain federal, nonprofit, academic, and private sector stakeholders also identified this role for the federal government. For example, one stakeholder we interviewed said that the federal government is the only entity with sufficient resources to ensure the provision of a full suite of forecasting, modeling, observations, and other information. In addition, a federal role would increase the certainty that decision makers are using the best available information and eliminate a disincentive for action, according to stakeholders from a nonprofit entity that produces climate information. A stakeholder from academia noted that the federal government is good at developing and providing access to various types of climate information but does not do nearly as well integrating information into decision making. A private sector stakeholder was more specific, stating that the federal government should provide a range of acceptable scenarios—defined high, low, and medium scenarios—so decision makers can prepare accordingly depending upon their risk tolerance.

In 2009, we recommended that the federal government develop a national strategic plan to guide the nation's effort to adapt to a changing climate that, among other things, identified mechanisms to incorporate climate information into federal, state, local, and private sector decision

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<sup>84</sup>National Research Council, *A Climate Services Vision: First Steps Toward the Future* (Washington, D.C.: 2001).

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making.<sup>85</sup> Further, in 2013, we recommended that a federal entity designated by the Executive Office of the President work with agencies to identify the best available climate-related information for infrastructure planning and to update this information over time for local infrastructure decision makers.<sup>86</sup> Although the federal government has made progress, as of October 2015, the Executive Office of the President had not fully addressed these recommendations.<sup>87</sup>

The climate information systems in the Netherlands and United Kingdom rely on authoritative climate data provided by national-level agencies. For example, in the Netherlands, KNMI develops authoritative national, regional, and local-scale projections and scenarios that are used across the country, by other government agencies, and by organizations that translate climate information to something more useful for decision makers. Similarly, within the UK government, the Met Office Hadley Centre—a government-funded climate research center—develops authoritative national, regional, and local-scale projections and scenarios for the UK climate information system. Through UKCP09, the Met Office provides a single set of projections with High, Medium, and Low emissions scenarios so decision makers have the flexibility to use any scenario based on risk tolerance. Germany relies on several different regional models, reflecting its federated structure.

Federal quality assurance guidelines are also important to preserve the integrity of federal data in a national climate information system. To inform and be effective, a climate information system needs a clear set of principles to guide products and activities, according to the 2010 National Research Council report.<sup>88</sup> The federal government should make developing quality assurance standards a priority to ensure that data used for providing climate services are reliable and that contractors and agencies are playing by the same rules, according to officials at a nonprofit entity that produces and translates climate information. Another stakeholder stated

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<sup>85</sup>[GAO-10-113](#).

<sup>86</sup>[GAO-13-242](#).

<sup>87</sup>[GAO-15-290](#).

<sup>88</sup>National Research Council, America's Climate Choices: Panel on Informing Effective Decisions and Actions Related to Climate Change, *Informing an Effective Response to Climate Change* (Washington, D.C.: 2010).

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that the primary climate information role of the federal government should be to develop observation systems to meet basic foundational research needs while maintaining rigorous data quality so nonfederal actors can provide services with more flexible mechanisms.

The climate information systems we reviewed in other countries generally do not have quality assurance guidelines for how decision makers use their authoritative climate data. However, officials we interviewed in the United Kingdom and Germany told us that they recognize the need to produce such guidelines. For example, United Kingdom officials said they recognized the need to develop a quality assurance process because the government could be blamed if a contractor misuses government data. Guidelines would help protect the integrity of government data by clearly stating acceptable procedures and methods for using government climate data. Another United Kingdom official noted that if you are to have a one-stop-shop for climate services, quality assurance and quality control will have to be a key part of the system. German officials similarly noted the need to move toward standardized quality assurance and quality control processes to ensure the quality and consistency of climate information for decision makers.

#### Nonfederal Technical Assistance

A nonfederal entity would be better positioned to provide technical assistance in a national climate information system, according to various studies we reviewed and interviews we conducted with knowledgeable stakeholders. Nonfederal technical assistance would emphasize the strengths of many of the options by being nimble and flexible, employing existing relationships, and engaging a broad range of stakeholders. Nonfederal technical assistance would also minimize the limitations of no single agency having all necessary expertise, few links to on-the-ground decision makers, and turf battles between existing agencies.

The federal government cannot take on the climate services role, according to officials within the Executive Office of the President, because it does not have the resources to do the task, and there is no way that the federal government can work with every decision maker. The federal government also does not have the presence at the local level, or trust of communities, to play this direct role, according to these officials. Similarly, a stakeholder with experience coordinating federal climate information issues stated that the federal government has to be a part of whatever system is put in place—particularly from a leadership perspective—but there is a false assumption that the federal government should do it all and be all things to all people. It cannot, according to this stakeholder, because it is too hard to match the rigor required of the federal



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government with the flexibility needed to make the information relevant to decision makers.

A nonfederal entity would be better positioned to interact with existing networks of decision makers and to facilitate connections between decision makers and intermediaries with specialized expertise, according to various stakeholders. For example, according to some federal officials who manage climate information programs, a nonfederal organization to teach, promote, and transfer climate information would likely be more effective than government agencies. Officials within the Executive Office of the President made a similar point, noting that there needs to be an intermediary or intermediaries—for example, nonprofits, the private sector, or academic institutions—to perform the technical assistance role for the federal government. A nonfederal entity could facilitate connections between decision makers and intermediaries while employing existing networks of climate information expertise.

Opinions varied on how a nonfederal entity or entities could provide the technical assistance component of a U.S. national climate information system, but certain stakeholders we interviewed called for a central hub where decision makers could access technical assistance. Two of the other countries with climate information systems have central hubs. For example, the United Kingdom's Climate Ready Support Service leads efforts to assist decision makers in using climate information. This service provides tools, information, and practical advice to help businesses and other organizations adapt to the effects of climate change and operates a help desk to answer questions from the public or decision makers about how to use climate information. A similar entity exists in the Netherlands with more of a role for academia. Germany's system has multiple points of contact for decision makers, reflecting its federated structure. While climate information systems in the United Kingdom and the Netherlands have central hubs, these systems also interact with decision makers at multiple points by reflecting the value of existing networks and established decision-making processes.

Even if a nonfederal entity acts as the central hub for a national system, this does not preclude the federal government from providing technical assistance to decision makers. Programs like NOAA's National Integrated Drought Information System already serve existing networks of decision makers and will provide key information resources however a national system is organized. Even if a nonfederal entity was designated as the central hub in a national system, federal efforts would remain part of the larger network providing technical assistance to decision makers. In

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addition, according to several stakeholders, federal adaptation science programs could continue to provide support to federal and nonfederal technical assistance efforts, focusing on problems that affect all climate information users and providers such as how to evaluate the effectiveness of adaptation actions.

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## Conclusions

The federal government has begun to address its large and growing fiscal exposure to changes in the climate. These exposures are partly driven by state, local, and private sector decision makers responsible for planning, constructing, and maintaining certain types of vulnerable infrastructure paid for with federal funds, insured by federal programs, or eligible for federal disaster assistance. However, because federal climate information efforts are fragmented, these decision makers generally do not understand how to access and use the best available authoritative information they need to account for climate risk in planning processes, according to principles of risk management. Germany, the Netherlands, and the United Kingdom provide examples of how national climate information systems can be structured with defined roles for federal and nonfederal entities. Options to provide climate information to U.S. decision makers have strengths and limitations, according to various studies we reviewed and interviews we conducted with knowledgeable stakeholders. A national climate information system with defined roles for federal agencies and nonfederal entities could incorporate the best features and address the limitations of different options to provide climate information to decision makers. Specifically, a national climate information system with federal leadership, authoritative federal data and quality assurance guidelines, and a nonfederal provider of technical assistance may make it easier for federal, state, local, and private sector decision makers to justify the costs of incorporating climate change information into planning efforts, thereby reducing long-term federal fiscal exposure.

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## Recommendations for Executive Action

To help federal, state, local, and private sector decision makers access and use the best available climate information, we recommend that the Executive Office of the President designate a federal entity to take the following two actions:

- develop and periodically update a set of authoritative climate change observations and projections for use in federal decision making, which state, local, and private sector decision makers could also access to obtain the best available climate information; and
- create a national climate information system with defined roles for federal agencies and nonfederal entities with existing statutory authority.

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## Agency Comments and Our Evaluation

We provided a draft of this report for review and comment to the Director of the Office of Science and Technology Policy and the Managing Director (Acting Chair) of the Council on Environmental Quality. They did not provide official written comments, but did provide technical comments, which we incorporated as appropriate.

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As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of the report to the appropriate congressional committees; the Director of OSTP and the Managing Director (Acting Chair) of CEQ; and other interested parties. In addition, this report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff members have questions about this report, please contact me at (202) 512-3841 or [gomezj@gao.gov](mailto:gomezj@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made contributions to this report are listed in appendix I.



J. Alfredo Gómez  
Director, Natural Resources and Environment

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# Appendix I: GAO Contact and Staff Acknowledgements

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## GAO Contact

J. Alfredo Gomez, (202) 512-3841 or [gomezj@gao.gov](mailto:gomezj@gao.gov)

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## Staff Acknowledgements

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## Public Affairs

Chuck Young, Managing Director, [youngc1@gao.gov](mailto:youngc1@gao.gov), (202) 512-4800  
U.S. Government Accountability Office, 441 G Street NW, Room 7149  
Washington, DC 20548