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Report to Congressional Requesters

September 2021

NATIONAL WEATHER SERVICE

Additional Actions Needed to Improve the Agency's Reform Efforts

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GAO-21-103792

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Highlights

Highlights of GAO-21-103792, a report to congressional requesters

September 2021

NATIONAL WEATHER SERVICE

Additional Actions Needed to Improve the Agency's Reform Efforts

Why GAO Did This Study

Extreme weather events, such as tornadoes and hurricanes, have caused major damage and loss of life in the United States. NWS is responsible for developing weather forecasts and issuing warnings to help protect life and property from such events. NWS has determined that it needs to reform its operations and workforce to effectively carry out this responsibility and to improve its provision of services to emergency managers and other partners.

GAO was asked to review NWS's reform efforts under the Evolve Program. This report examines, among other things, the actions NWS has taken under the Evolve Program and the extent to which it has followed selected leading practices for effective agency reforms. GAO reviewed relevant NWS documents, interviewed officials, and assessed the Evolve reform efforts against selected leading practices.

What GAO Recommends

GAO is making three recommendations to NWS: (1) incorporate key attributes of successful performance measures as it develops measures for the Evolve Program, (2) develop a two-way communications strategy for the program that outlines how the agency will listen and respond to employee concerns, and (3) revise its approach to staffing the program to improve leadership and staff continuity. The Department of Commerce agreed with GAO's recommendations.

View GAO-21-103792. For more information, contact Cardell D. Johnson at (202) 512-3841 or JohnsonCD1@gao.gov.

What GAO Found

The Department of Commerce's National Weather Service (NWS) initiated the Evolve Program in 2017 to carry out a series of agency reforms to help it achieve its strategic vision of strengthening the nation's readiness and responsiveness to extreme weather events. The program has 20 reform initiatives that are in varying stages of completeness and are intended to free up staff time and improve service to the agency's partners, among other things.

NWS has substantially followed five of eight leading reform practices.

Extent to Which NWS Has Followed Selected Leading Practices for Effective Agency Reforms

Practice	Extent followed
Establishing goals and outcomes	◒
Involving employees and key stakeholders	◒
Using data and evidence	●
Addressing fragmentation, overlap, and duplication	●
Leadership focus and attention	◒
Managing and monitoring	●
Strategic workforce planning	●
Employee performance management	●

Legend:

● **Substantially followed**—NWS took actions that addressed most or all aspects of the selected key questions GAO examined for the practice.

◒ **Partially followed**—NWS took actions that addressed some, but not most, aspects of the selected key questions GAO examined for the practice.

Source: GAO analysis of National Weather Service (NWS) documents and interviews with NWS officials. | GAO-21-103792

However, the agency has only partially followed the other three practices, resulting in gaps.

- **Establishing goals and outcomes.** NWS has established goals for the Evolve Program but has not established performance measures for key elements of the program's reform efforts.
- **Involving employees and key stakeholders.** NWS has engaged its employees in a number of ways in developing the Evolve reforms, including by sending quarterly email updates to all employees. However, the agency has not developed a two-way communications strategy for the program that listens and responds to employee concerns about the proposed reforms.
- **Leadership focus and attention.** NWS has designated three leadership positions as having primary responsibility for leading the implementation of the reforms. However, the agency has not established a dedicated implementation team that has the capacity to manage the reform process. Instead, the agency has primarily relied on rotating leaders and part-time staff for the Evolve Program, an approach that has not provided adequate leadership and staff continuity for the program.

By addressing gaps in these areas, NWS would have better assurance that its Evolve reform efforts will succeed.

Contents

Abbreviations

AWIPS	Advanced Weather Interactive Processing System
CFP	Collaborative Forecast Process
COVID-19	Coronavirus Disease 2019
GS	General Schedule
IDSS	Impact-based Decision Support Services
N-AWIPS	National Advanced Weather Interactive Processing System
NBM	National Blend of Models
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PMI	Project Management Institute
PMO	Program Management Office
URMA	UnRestricted Mesoscale Analysis

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September 29, 2021

The Honorable Eddie Bernice Johnson
Chairwoman
Committee on Science, Space, and Technology
House of Representatives

The Honorable Suzanne Bonamici
House of Representatives

The Honorable Charlie Crist
House of Representatives

The Honorable Paul Tonko
House of Representatives

Accurate and timely weather forecasts can provide important information to help individuals, communities, and businesses prepare for and minimize damage from extreme weather events. Extreme weather events—including tornadoes, hurricanes, winter storms, and flooding—can have major economic, health, and safety impacts and the potential to devastate communities. From 1980 through 2020, the United States experienced 285 extreme weather events in which damage costs for an individual event reached or exceeded $1 billion, collectively resulting in more than $1.8 trillion in damage. In addition, these events were responsible for the deaths of more than 14,000 people, according to the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA).[1]

The National Weather Service (NWS), an agency within NOAA, is responsible for developing weather forecasts and issuing warnings when weather conditions pose a threat to life and property. NWS offices, including local weather forecast offices and national centers such as the National Hurricane Center, also provide other weather-related services to help the agency's core partners and other stakeholders prepare for and

[1]NOAA National Centers for Environmental Information, *U.S. Billion-Dollar Weather and Climate Disasters*, accessed January 11, 2021, https://www.ncdc.noaa.gov/billions/.

respond to extreme weather events.[2] Known as Impact-based Decision Support Services (IDSS), these services include providing specialized briefings to core partners and deploying agency staff to state emergency operations centers in anticipation of major storm events. NWS has reported that it expects the demand for these types of services to grow as the number of extreme weather events that result in significant damage increases.[3]

However, over the past decade, reports by the National Academy of Sciences and the National Academy of Public Administration, as well as our previous work, have identified challenges facing NWS that may hamper the agency's ability to deliver its services.[4] Partially in response to these reports, the agency implemented an Operations and Workforce Analysis project from 2015 to 2017 to, among other things, assess the baseline state of its operations and workforce and evaluate its provision of IDSS.[5]

NWS subsequently launched the Evolve Program in 2017 to implement a series of reform initiatives based on the results of its Operations and

[2]NWS Policy Directive 10-24 defines NWS core partners as government and nongovernment entities that are directly involved in the preparation; dissemination; and discussion of weather, water, or climate-related NWS information that supports decision-making for routine or episodic high-impact events. Core partners include members of the emergency management community, such as state and local emergency management agencies; members of the water resources management community; government partners with missions that require close coordination with NWS, such as the Federal Aviation Administration; and media outlets. Other stakeholders include entities such as utility companies, research councils, and the private weather industry.

[3]National Weather Service, *Operations and Workforce Analysis Catalog*, September 2017, accessed August 9, 2021, https://www.weather.gov/owa-catalog.

[4]See National Academy of Sciences, Committee on the Assessment of the National Weather Service's Modernization Program, *Weather Services for the Nation: Becoming Second to None* (Washington, D.C.: National Academies Press, 2012); National Academy of Public Administration, *Forecast for the Future: Assuring the Capacity of the National Weather Service* (Washington, D.C.: May 2013); and GAO, *National Weather Service: Actions Have Been Taken to Fill Increasing Vacancies, but Opportunities Exist to Improve and Evaluate Hiring*, GAO-17-364 (Washington, D.C.: May 24, 2017).

[5]For more information, see GAO, *National Weather Service: Information on Contractor Selection and Work Performed for Its Operations and Workforce Analysis Project*, GAO-20-271R (Washington, D.C.: Jan. 30, 2020).

Workforce Analysis project. NWS established a program management office (PMO) to lead the Evolve Program and guide its reform efforts.[6]

Previously, in 2013, NWS had initiated a separate project to develop a new weather modeling tool known as the National Blend of Models (NBM). The agency intends for NBM to enhance its weather forecasts by providing a common starting point for the forecast process to help reduce forecast inconsistencies across offices, which in turn could help it improve the quality of IDSS. In addition, the agency expects NBM to reduce the time it takes to develop forecasts, which could help weather forecast offices provide more IDSS to their partners. After establishing the Evolve Program, NWS included the NBM development effort as one of the Evolve reform initiatives, giving the Evolve PMO a role in overseeing the project.

You asked us to review NWS's reform efforts under the Evolve Program and its management of the NBM project. This report examines (1) the actions NWS has taken under the Evolve Program and the extent to which NWS has followed selected leading practices for effective agency reforms, and (2) the development and use of NBM and the extent to which NWS has followed selected leading practices in managing the project.

To examine the actions NWS has taken under the Evolve Program and the extent to which NWS has followed selected leading practices for effective agency reforms, we reviewed NWS documents related to the program. For example, we reviewed the Evolve Program Management Plan to obtain information on the processes used to manage and implement the program, and we reviewed the project charters for the Evolve initiatives to obtain information on the initiatives' purpose, scope, and key deliverables. We also interviewed NWS headquarters officials as well as current and past leaders of the Evolve PMO to obtain their perspectives on the Evolve reform efforts. In addition, we interviewed senior officials from all six regional offices and four of the agency's nine national centers, which we selected to represent varied levels of

[6]According to NWS officials, NWS initially setup the PMO in late 2016 but did not formally establish the PMO until July 2017 with the signing of the Evolve PMO Charter.

involvement in the Evolve Program and different users of NBM.[7] We also held separate interviews with managers and forecasters from seven of the 122 weather forecast offices. We selected these offices to represent the six NWS regions, different types of terrain (such as mountains and coasts), and a range of weather conditions (such as winter weather, tropical weather, and severe weather).[8] The results from these interviews cannot be generalized to other offices and employees we did not interview. To obtain additional perspectives on the Evolve reform efforts, we interviewed representatives from the NWS Employees Organization and two external organizations that represent meteorologists (the American Meteorological Society and the National Weather Association).[9]

We then assessed NWS's Evolve reform efforts against selected leading reform practices from our June 2018 report that identified leading practices and associated key questions for assessing agency reforms.[10] We focused our assessment on the eight leading reform practices and selected key questions for those practices that we determined were most relevant to the Evolve reform efforts based on our review of Evolve

[7]Specifically, we interviewed officials from the following national centers: (1) Aviation Weather Center, (2) Environmental Modeling Center, (3) Storm Prediction Center, and (4) Weather Prediction Center. According to agency officials, other national centers, such as the Space Weather Prediction Center, are not likely to use NBM in their work.

[8]We interviewed managers and forecasters from the following weather forecast offices: (1) Anchorage, Alaska; (2) Brownsville, Texas; (3) Charleston, West Virginia; (4) Portland, Maine; (5) Honolulu, Hawaii; (6) Kansas City, Missouri; and (7) Los Angeles, California. As part of our visit to the Kansas City weather forecast office, we also interviewed officials from the Missouri Basin River Forecast Center, which is co-located with the forecast office, as well as local emergency management officials that the forecast office supports.

[9]The NWS Employees Organization is the labor organization representing NWS employees, including forecasters, technicians, and support personnel.

[10]GAO, *Government Reorganization: Key Questions to Assess Agency Reform Efforts*, GAO-18-427 (Washington, D.C.: June 13, 2018). In that report, we defined the term "reforms" broadly, to include any organizational changes—such as major transformations, mergers, consolidations, and other reorganizations—and efforts to streamline and improve the efficiency and effectiveness of government operations. The leading practices that report presented were based on our previous work that found the success of agency reforms hinges on the agencies' adherence to key practices for organizational transformations. Such practices include establishing clear outcome-oriented goals and performance measures, as well as involving federal employees and other key stakeholders to develop the proposed reforms.

Program documents and interviews with NWS officials.[11] A senior analyst and a supervisor reviewed the evidence related to each practice drawn from the documents and interviews described above, and independently rated NWS as having either substantially followed, partially followed, or not followed each practice.[12] The senior analyst and supervisor then met to reconcile their ratings, and they resolved differences through discussion to reach agreement on the final determinations.

To examine the development and use of NBM and the extent to which NWS has followed selected leading practices in managing the project, we reviewed agency documents related to the project, such as the project charter, training materials, and regional agreements regarding the use of NBM in the forecast process. In addition, we used the interviews with NWS officials and external organizations described above to obtain perspectives on the agency's management of the NBM project and the use of the modeling tool in the forecast process. We then assessed NWS's management of the NBM project against six project management leading practices based on the Project Management Institute's (PMI) standards for project management presented in *A Guide to the Project*

[11]We did not include four leading reform practices from our June 2018 report that we determined were less relevant for the purpose of our assessment of the Evolve Program. For example, one of these practices focuses on workforce reduction strategies, but NWS has not undertaken workforce reductions as part of its Evolve reforms. For the full list of leading reform practices and their associated key questions, see GAO-18-427.

[12]We determined that NWS substantially followed a reform practice if the evidence showed that NWS took actions that addressed most or all aspects of the selected key questions we examined for the practice. We determined that NWS partially followed a reform practice if the evidence showed that NWS took actions that addressed some, but not most, aspects of the selected key questions we examined for the practice. We would have determined that NWS had not followed a reform practice if the evidence showed that NWS took no actions that addressed the selected key questions we examined for the practice. However, we found that NWS at least partially followed all of the reform practices.

Management Body of Knowledge (PMBOK® Guide), Sixth Edition.[13] We focused on leading practices related to areas of project management that we determined were most relevant for the purposes of our review of the NBM project, such as measuring project performance and managing and monitoring communications. A senior analyst and a supervisor reviewed the evidence related to each practice drawn from the documents and interviews described above, and independently rated NWS as having either substantially followed, partially followed, or not followed each practice.[14] The senior analyst and supervisor then met to reconcile their ratings, and they resolved differences through discussion to reach agreement on the final determinations.

We conducted this performance audit from September 2019 to September 2021 in accordance with 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.

Background

NWS headquarters, led by the Director of NWS, is responsible for overall management of the agency, including overseeing operations and

[13]Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition, 2017. *PMBOK* is a trademark of Project Management Institute, Inc. The *PMBOK® Guide* presents a broad description of project management-related knowledge and practices, which can be tailored to fit the needs of different projects. We worked with PMI representatives to refine and validate the wording of the six leading practices for the purposes of our review and incorporated their feedback, as appropriate. PMI representatives agreed with the way we present these leading practices and noted that the practices represent only a small portion of the knowledge, skills, tools, and techniques identified by consensus as good practice on most projects most of the time. There are many additional project management principles in other areas, such as procurement management, which were not related to our review and thus not included.

[14]We determined that NWS substantially followed a leading practice if the evidence showed that NWS took actions that addressed most or all aspects of the practice. We determined that NWS partially followed a leading practice if the evidence showed that NWS took actions that addressed some, but not most, aspects of the practice. We would have determined that NWS had not followed a leading practice if the evidence showed that NWS took no actions that addressed the aspects of the practice. However, we found that NWS at least partially followed all of the project management leading practices.

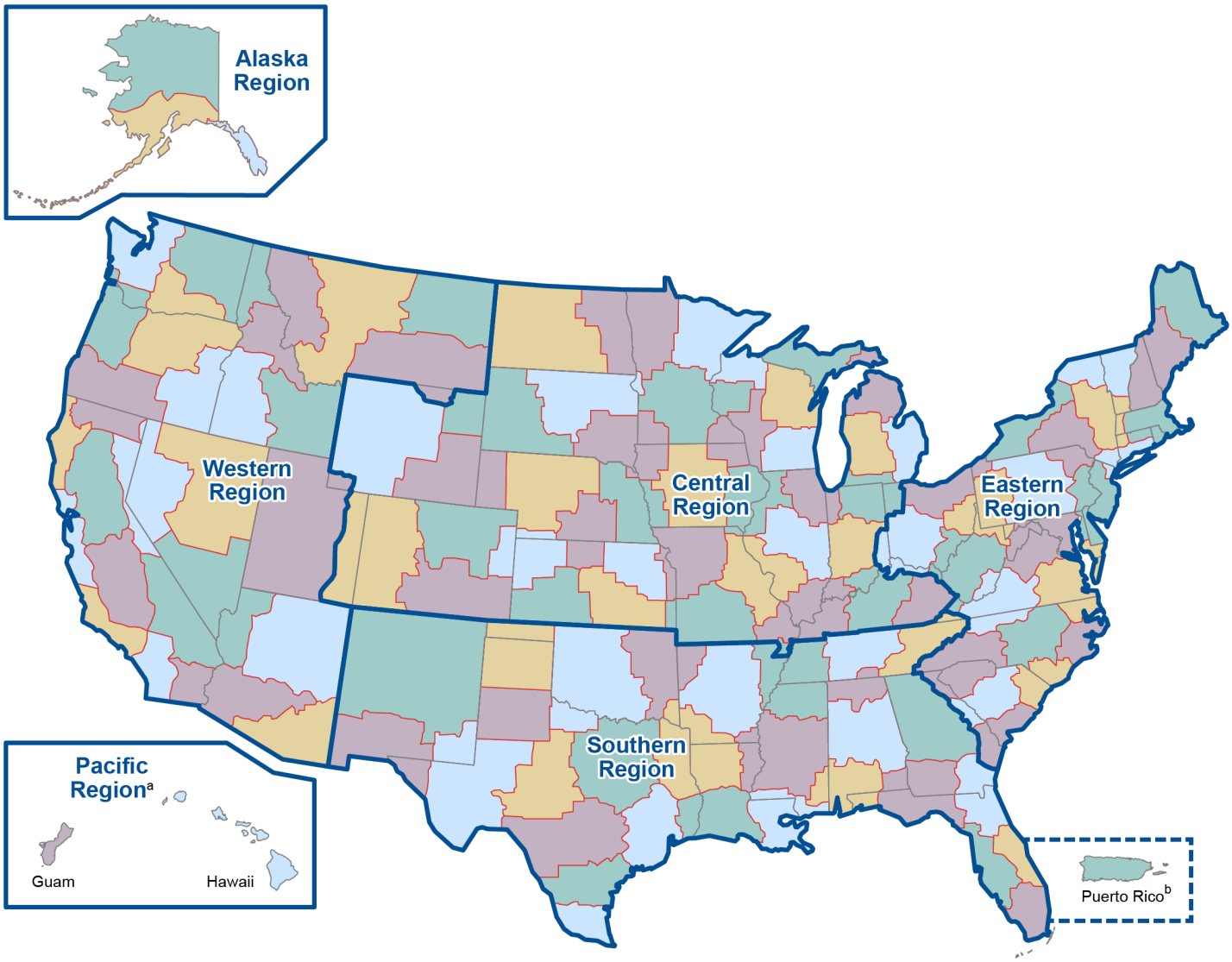
conducting budgetary formulation, analysis, and reporting.[15] The agency's field structure includes nine National Centers for Environmental Prediction, the National Water Center, and six regional offices—referred to as regional headquarters—that in turn oversee a variety of local offices.[16] These local offices include 122 weather forecast offices, which collect observations on local weather conditions and issue local forecasts and warnings, among other things.[17] Figure 1 shows the boundaries of NWS's six regions and 122 weather forecast offices.

[15]The Director of NWS is also known as the NOAA Assistant Administrator for Weather Services. In fiscal year 2020, NWS's budget was approximately $1.17 billion, according to NOAA documentation.

[16]The National Centers for Environmental Prediction generate products and services to support other NWS offices, as well as private sector partners, other governmental agencies, and the public. Some national centers also issue forecasts and warnings related to a particular area of focus (e.g., the National Hurricane Center issues forecasts and warnings for hurricanes and other tropical weather). The nine centers are the (1) Aviation Weather Center, (2) Climate Prediction Center, (3) Environmental Modeling Center, (4) National Centers for Environmental Prediction Central Operations, (5) National Hurricane Center, (6) Ocean Prediction Center, (7) Space Weather Prediction Center, (8) Storm Prediction Center, and (9) Weather Prediction Center.

[17]Other types of local offices include (a) 13 river forecast centers that monitor major river systems and aquifers to produce river and flood forecasts, and (b) 21 center weather service units that provide aviation weather forecast support to the Federal Aviation Administration.

Figure 1: NWS Regions and Weather Forecast Office Boundaries



Sources: GAO analysis of National Weather Service (NWS) documents and information provided by NWS officials; Map Resources (map). | GAO-21-103792

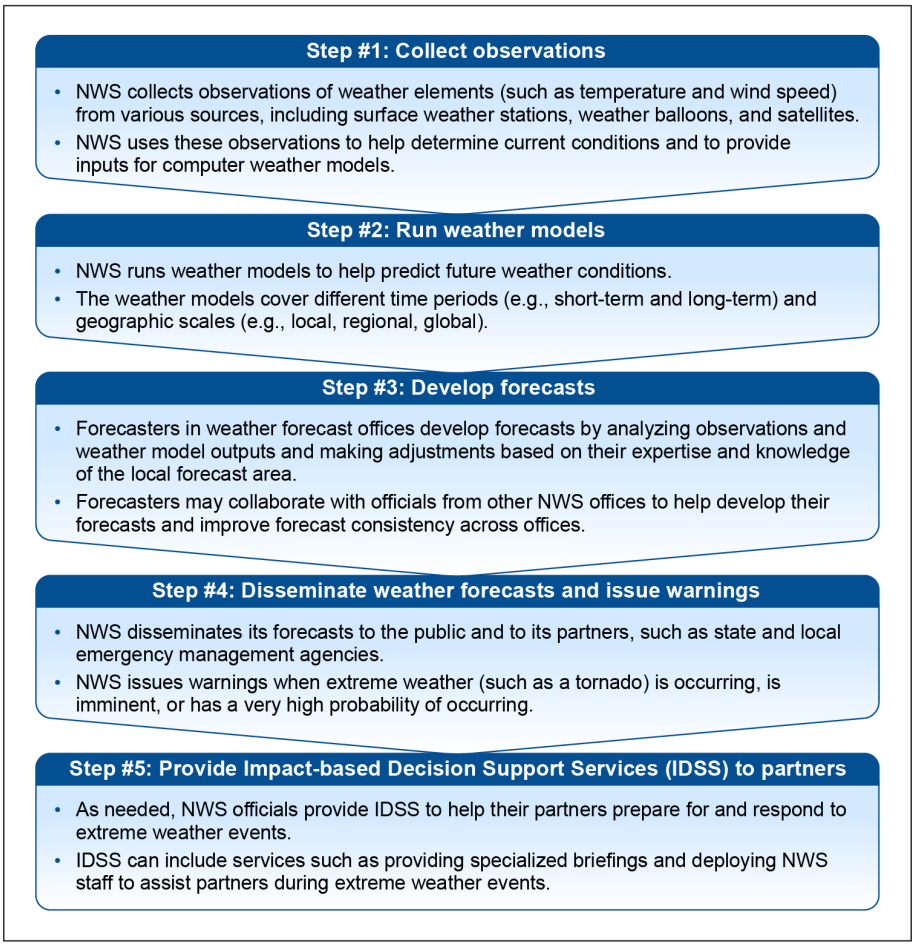
[a]The Pacific Region also covers other areas not shown on the map, such as American Samoa and the Commonwealth of the Northern Mariana Islands.

[b]The Puerto Rico weather forecast office also covers the U.S. Virgin Islands.

Through its offices nationwide, NWS issues approximately 1.5 million forecasts and 50,000 warnings annually. The agency also collects billions of weather and climate observations annually, which it feeds into its computer weather models as part of the forecast process. Figure 2

presents an overview of NWS's weather forecast process, from the collection of observations through the provision of IDSS to the agency's partners.

Figure 2: Overview of NWS's Weather Forecast Process



Source: GAO analysis of National Weather Service (NWS) documents. | GAO-21-103792

In 2011, NWS established a strategic vision for the agency to help build a "weather-ready nation" in which society is ready, responsive, and resilient to extreme weather events. The National Academy of Public Administration reported in 2013 that this vision was not an entirely new concept for NWS, as the agency had historically worked with emergency

managers and decision makers responding to extreme weather events.[18] However, the National Academy of Public Administration explained that this vision presented a shift from a more narrow performance focus on the products and services NWS produces, such as weather forecasts, to a broader focus on how these products and services translate into desired public actions and societal outcomes.

A key feature in this shift is the emphasis on providing IDSS, which NWS leaders have described as the linchpin for achieving the vision of a weather-ready nation by connecting the agency's weather observations, forecasts, and warnings with the partners and actions required to prepare for and respond to extreme weather events.[19] According to these officials, successful provisioning of IDSS is an ongoing process that begins before weather events occur with the development of trusted relationships between agency officials and their partners through activities such as tabletop planning exercises. Services provided during an event are then rooted in the relationships established previously, and may be delivered through various mechanisms, including phone calls, videoconferences, webinars, or on-site support.

The Operations and Workforce Analysis project produced ideas to help NWS improve its provision of IDSS and agency management more broadly, including developing IDSS metrics, establishing standard service levels for IDSS, and developing additional IDSS-specific training. The project's results provided a general foundation for the agency's subsequent reform efforts and helped to prompt the establishment of the Evolve Program, including forming the basis for some of the reform initiatives established under the program.[20]

[18]National Academy of Public Administration, *Forecast for the Future*, 2013.

[19]L. W. Uccellini and J. E. Ten Hoeve, "Evolving the National Weather Service to Build a Weather-Ready Nation," *Bulletin of the American Meteorological Society*, vol. 100, no. 10 (2019): 1923-1942.

[20]For more information about the findings and ideas developed under the Operations and Workforce Analysis project, see GAO-20-271R.

NWS Has Established 20 Evolve Initiatives and Substantially Followed Many Selected Leading Reform Practices, but Gaps Exist

NWS has established five objectives and 20 reform initiatives under the Evolve Program and has substantially followed many of the selected leading practices we have identified as critical to the success of agency reforms. The Evolve reform initiatives are in varying stages of completeness and are intended to free up staff time and improve service to the agency's partners, among other things. In carrying out the Evolve Program, NWS has substantially or partially followed the eight leading practices for effective agency reforms that we examined. However, gaps exist in the areas of performance measures, communications with employees, and staffing of the Evolve PMO's leadership and staff positions.

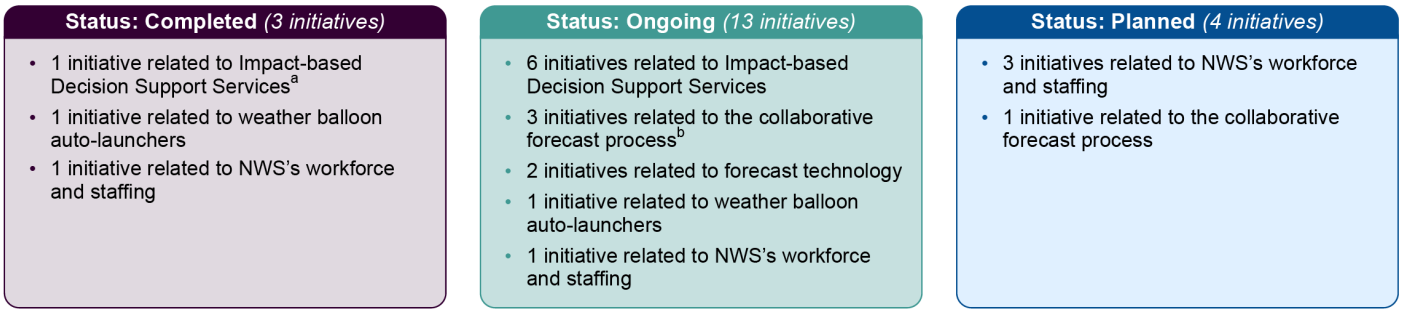
NWS Has Established 20 Evolve Initiatives that Are in Varying Stages of Completeness

NWS has established five objectives and 20 reform initiatives under the Evolve Program. The program's objectives are to

- **Enhance IDSS**. Improve the quality and consistency of IDSS.
- **Improve workforce opportunities**. Build the workforce that NWS needs to deliver its services.
- **Develop a collaborative forecast process**. Improve the effectiveness of forecasting through a collaborative process.
- **Match workforce to workload**. Match workforce to workload across the agency and build a stronger organizational structure.
- **Support innovation, science, and technology**. Support the innovation, science, technology, and culture required for NWS to continue improving over time.

NWS has established 20 reform initiatives under these objectives that are intended to help free up staff time and improve the provision of IDSS to its partners, among other things. Appendix I provides descriptions of the initiatives and outlines how NWS has organized them under the objectives. As shown in figure 3, the 20 reform initiatives are in varying stages of completeness.

Figure 3: Status of the Evolve Program's Reform Initiatives, as of August 2021



Source: GAO analysis of National Weather Service (NWS) documents and information provided by NWS officials. | GAO-21-103792

[a]Impact-based Decision Support Services are services, such as specialized briefings and on-site support, that NWS provides to help its partners, including state and local emergency management agencies, prepare for and respond to extreme weather events.

[b]NWS is developing a new collaborative forecast process intended to help reduce forecast inconsistencies and unnecessary duplication of effort across NWS offices.

Key examples of the reforms NWS has implemented or is pursuing through the Evolve initiatives include

- **New career progression for forecasters**. In 2020, NWS completed its implementation of the General Schedule (GS)-5 through GS-12 (GS 5-12) career progression initiative.[21] This initiative established a new career track for the agency's forecasters that allows them to progress non-competitively from the GS-5 level to the GS-12 level, based on demonstrating competencies at each level.[22] According to officials we interviewed from NWS regional offices and selected weather forecast offices, the new career progression has produced several benefits but may also present some challenges. For example, officials said that the career progression has improved opportunities for newer staff to obtain forecasting experience and provides greater flexibility for weather forecast offices in using their staff, which can enhance NWS's ability to provide IDSS to partners. However, officials from one regional office and five weather forecast offices raised concerns that the new career progression may make it harder for

[21]The GS is the federal government's primary pay and classification system for professional, technical, administrative, and clerical positions. The GS system has 15 grades: GS-1 (lowest) to GS-15 (highest).

[22]Under the new career progression, forecasters progress through the following GS levels: GS-5, GS-7, GS-9, GS-11, and GS-12.

forecasters to transfer between offices, which could lead to difficulty filling positions in remote areas.[23]

- **Weather balloon auto-launchers**. NWS is working to implement new technology to automate the process of launching weather balloons to collect observations of atmospheric conditions, such as temperature and wind speed (see fig. 4). The agency's forecasters have traditionally launched weather balloons manually at least two times daily from 92 sites. NWS officials said that each launch can be a time-intensive process lasting multiple hours at some sites. The agency has installed auto-launchers at 20 sites as of August 2021, 13 of which are located in Alaska, and it plans to install an auto-launcher at one additional site in the future.[24] By automating the launch of weather balloons at those sites, NWS aims to free up time for forecasters to focus on other responsibilities, such as developing forecasts and providing IDSS. In September 2020, the Evolve PMO issued a report analyzing the use of auto-launchers in Alaska. The report found that the auto-launchers reduced the amount of staff time needed per launch to 15 minutes, resulting in time savings at all of the Alaska sites and allowing two weather forecast offices to adjust their shift schedules to better meet the IDSS needs of their partners.

[23]In the past, forecasters would often need to change offices to get promoted, according to NWS documentation. Under the new career progression, forecasters have the opportunity for promotion through the GS-12 level within the same office, which may reduce the movement of staff between offices. Some officials said that, as a result, staff might be less inclined to accept positions in remote locations in the future.

[24]According to agency officials, NWS selected sites for auto-launchers based on several factors, including the potential for auto-launchers to reduce costs and address safety concerns and staffing challenges, such as at some remote launch sites in Alaska.

Figure 4: Weather Balloon Auto-launcher in Fairbanks, Alaska

Auto-launchers automate the process of launching weather balloons to collect data on atmospheric conditions, such as wind speed.

Source: National Weather Service. | GAO-21-103792

- **Collaborative forecast process**. Several ongoing Evolve initiatives focus on the agency's effort to reform its forecast process. NWS forecasters currently use a diverse array of weather models and approaches to developing forecasts that can vary across offices and among individual forecasters. According to agency officials, forecasters generally have flexibility to determine which weather models to use based on their expertise and local knowledge about which models perform best under different circumstances. However, one problem with this approach is that it can result in inconsistent forecasts across offices and forecasters, according to agency officials and documentation. To help address this issue, NWS is seeking to develop a new collaborative forecast process that uses NBM as a common starting point and establishes common procedures for developing forecasts. However, the agency may face challenges in implementing the collaborative forecast process, according to officials we interviewed from NWS headquarters, two regional offices, and two weather forecast offices. For example, the officials said that the

agency might face resistance from some forecasters who do not want to change their approach to forecasting. It also may face logistical challenges to creating a common process that works effectively across different time zones, shift schedules, and the many local and national offices involved in developing forecasts. According to NWS officials, the agency expects to begin an initial collaborative forecast process demonstration for forecasting precipitation amounts in 2022. Following this initial demonstration, NWS plans to develop additional demonstrations of the collaborative forecast process for other types of forecasts, including winter weather and severe weather, according to agency documentation.

NWS Has Substantially Followed Many Selected Leading Reform Practices, but Gaps Exist in Performance Measures, Communications, and Staffing

Based on our analysis of agency documents and information provided by officials, we found that NWS has substantially followed five of the eight leading practices for effective agency reforms that we examined and has partially followed three other practices (see table 1). We identified gaps related to these practices in the areas of performance measures (part of the establishing goals and outcomes practice), communications with employees (part of the involving employees and key stakeholders practice), and staffing of the Evolve PMO's leadership and staff positions (part of the leadership focus and attention practice).

Table 1: Assessment of the Extent to Which NWS Has Followed Selected Leading Practices for Effective Agency Reforms

Selected leading practice	Selected key questions associated with the practice	Extent followed
Establishing goals and outcomes	• To what extent has the agency established clear outcome-oriented goals and performance measures for the proposed reforms? • To what extent has the agency shown that the proposed reforms align with the agency's mission and strategic plan?	◒
Involving employees and key stakeholders	• How and to what extent has the agency engaged employees and employee unions in developing the reforms (e.g., through surveys or focus groups) to gain their ownership for the proposed changes? • How and to what extent has the agency involved other stakeholders, as well as its customers and other agencies serving similar customers or supporting similar goals, in the development of the proposed reforms to ensure the reflection of their views? • Is there a two-way continuing communications strategy that listens and responds to concerns of employees regarding the effects of potential reforms?	◒
Using data and evidence	• What data and evidence has the agency used to develop and justify its proposed reforms? • How, if at all, were the results of the agency's enterprise risk management process used to help guide the proposed reforms?	●
Addressing fragmentation, overlap, and duplication	• To what extent has the agency identified cost savings or efficiencies that could result from reducing or better managing areas of fragmentation, overlap, and duplication? • To what extent has the agency addressed areas of fragmentation, overlap, and duplication in developing its reform proposals?	●

Selected leading practice	Selected key questions associated with the practice	Extent followed
Leadership focus and attention	• Has agency leadership defined and articulated a succinct and compelling reason for the reforms (i.e., a case for change)? • Has the agency designated a leader or leaders to be responsible for the implementation of the proposed reforms? • Has the agency established a dedicated implementation team that has the capacity, including staffing, resources, and change management, to manage the reform process?	◒
Managing and monitoring	• Has the agency developed an implementation plan with key milestones and deliverables to track implementation progress? • Has the agency put processes in place to collect the needed data and evidence that will effectively measure the reforms' outcome-oriented goals?	●
Strategic workforce planning	• To what extent has the agency conducted strategic workforce planning to determine whether it will have the needed resources and capacity, including the skills and competencies, in place for the proposed reforms or reorganization? • How has the agency assessed the effects of the proposed agency reforms on the current and future workforce, and what does that assessment show?	●
Employee performance management	• To what extent has the agency aligned its employee performance management system with its planned reform goals? • How has the agency included accountability for proposed change implementation in the performance expectations and assessments of leadership and staff at all levels?	●

Legend:

● **Substantially followed**—NWS took actions that addressed most or all aspects of the selected key questions we examined for the practice.

◒ **Partially followed**—NWS took actions that addressed some, but not most, aspects of the selected key questions we examined for the practice.

○ **Not followed**—NWS took no actions that addressed the selected key questions we examined for the practice.

Source: GAO analysis of National Weather Service (NWS) documents and interviews with NWS officials. | GAO-21-103792

Establishing Goals and Outcomes

We found that NWS has partially followed the leading reform practice related to establishing goals and outcomes. Our previous work has shown that agencies should establish clear outcome-oriented goals to help identify what they are trying to achieve with their reform efforts and should establish performance measures to assess the extent to which they meet their goals.[25] NWS has established five clear outcome-oriented objectives that serve as the overarching goals for the Evolve Program's reform efforts, such as enhancing the quality and consistency of IDSS and improving the effectiveness of forecasting through a collaborative process. In addition, NWS has explicitly aligned the Evolve Program's reform efforts with the agency's mission and strategic plan by, for example, citing the effort to reform NWS as one of the key drivers for its strategic plan, including describing the linkage between the Evolve

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Program's five objectives and the content of the strategic plan. Moreover, NWS documents and the agency's leadership have described the Evolve Program's reform efforts as critical to the agency's ability to achieve its vision of a weather-ready nation.

However, NWS has not established performance measures for key elements of the Evolve Program's reform efforts, such as improving the provision of IDSS. The Evolve PMO has an initiative underway to develop performance measures related to IDSS, but it has not yet completed this effort because the agency is still working to collect and analyze information that will help to inform the potential measures. NWS officials said that they aim to have an initial proposal for at least some of the IDSS measures by the end of fiscal year 2021. We have previously identified key attributes of successful performance measures, such as measurable targets, which help organizations track the progress they are making and assess whether performance is meeting expectations (see app. II).[26] As NWS continues its efforts to develop performance measures for the Evolve Program reforms, incorporating these key attributes, as appropriate, could help ensure that the agency can effectively assess the Evolve Program's performance and the extent to which the reform efforts are achieving their objectives.

Involving Employees and Key Stakeholders

We found that NWS has partially followed the leading reform practice related to involving employees and key stakeholders. Our previous work has shown that it is important for agencies to directly and continuously involve their employees and other key stakeholders in the development of major reforms, and that failure to adequately address issues related to people and culture can lead to reform efforts being unsuccessful.[27] Moreover, our previous work has identified several actions that agencies should take to help in this area, such as engaging employees and employee unions in developing the reforms to gain their ownership for the proposed changes. According to agency documents and officials, NWS has engaged its employees and the agency's employees union (known as the NWS Employees Organization) in a number of ways in developing the reforms under the Evolve Program. For example, the Evolve PMO sends a quarterly email update to all NWS employees on the status of the Evolve Program's initiatives, and the PMO has included some regional officials and weather forecast office employees on the teams responsible

[26]GAO, *Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures,* GAO-03-143 (Washington, D.C.: Nov. 22, 2002).

[27]GAO-18-427.

for implementing the initiatives. NWS has also involved the NWS Employees Organization in certain Evolve initiatives, such as when it negotiated with the organization to reach an agreement on implementing the GS 5-12 career progression.

Our previous work has also shown that it is important to involve other stakeholders and customers in the development of proposed reforms to ensure the reflection of their views. According to agency documents and officials, NWS has involved other stakeholders in its reform efforts in several ways, including by presenting information about the Evolve reforms at meetings for outside groups, such as the American Meteorological Society. NWS has also developed surveys to collect information from external partners that serve as the customers of the agency's IDSS efforts to help inform the ongoing development of IDSS-related performance measures.

In addition, our previous work has found that having a two-way continuing communications strategy that listens and responds to employee concerns regarding the effects of potential reforms is important.[28] However, NWS does not have a communications strategy for the Evolve Program. The agency developed a partial draft of an Evolve communications strategy in 2019, but it has not yet completed this strategy, in part because it has focused on developing initiative-specific communications plans for certain Evolve initiatives, such as the GS 5-12 career progression.

In the absence of a communications strategy for the Evolve Program, we found that NWS's efforts to communicate with employees about the program's reforms have produced mixed results. For example, officials we interviewed from four weather forecast offices spoke positively about the agency's communications related to certain Evolve initiatives, such as the GS 5-12 career progression. However, officials we interviewed from six weather forecast offices raised general concerns about the agency's Evolve-related communications, including that NWS has not sufficiently engaged and communicated with forecast office employees about the Evolve Program overall. The forecasters we interviewed had varied levels of awareness about the program and the Evolve PMO, with four forecast offices having at least one forecaster that had never heard of the PMO prior to our interviews. NWS officials told us that some employees are reluctant to embrace the Evolve initiatives and are concerned about the potential effects of the proposed reforms, including in some cases fears

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that the reforms could lead to office closures or job losses. Moreover, NWS Employees Organization representatives we interviewed said that they do not feel the agency has been transparent about its vision for the Evolve Program and that sending occasional emails and updating the agency's website about Evolve are not sufficient steps to obtain employee buy-in for the reform efforts.

Such concerns were consistent with what the Evolve PMO found in October 2019 when it asked NWS employees about their understanding of the Evolve Program. Among other things, the PMO found that employees had varied levels of understanding and mixed feelings about Evolve, with some employees reporting that they did not understand Evolve very well and had negative feelings about the program. For example, according to the Evolve PMO, one employee said that while there were many positive aspects of Evolve, there was also a lot of mistrust and concern that field employees were not getting the full story about NWS's anticipated future changes.

According to NWS officials, the agency plans to complete the communications strategy for the Evolve Program by the end of fiscal year 2021. As NWS completes development of this strategy, ensuring that it represents a two-way communications strategy that outlines how the agency will listen and respond to employee concerns could help position NWS to better involve its employees in the Evolve Program and to increase employee understanding and ownership of the reform efforts.

Using Data and Evidence

We found that NWS has substantially followed the leading reform practice related to using data and evidence. Our previous work has shown that agencies are better equipped to address management and performance challenges when managers effectively use data and evidence, such as from program evaluations and performance data that provide information on how well a program or agency is achieving its goals.[29] NWS has used data and evidence from previous assessments to inform its development of the Evolve Program. For example, the agency used the results of the Operations and Workforce Analysis to help develop and justify the reforms it is pursuing under the Evolve Program.[30] This analysis produced 14 key findings and 28 ideas to help address gaps in NWS's operations

[29]GAO-18-427.

[30]For the results of the Operations and Workforce Analysis, see National Weather Service, *Operations and Workforce Analysis Catalog*, September 2017, accessed August 9, 2021, https://www.weather.gov/owa-catalog.

and workforce, including ideas for improving IDSS and the agency's management of its workforce. As discussed previously, NWS subsequently used these findings and ideas as a basis for developing the Evolve reform initiatives. In addition, the agency used previous reports from the National Academy of Sciences and the National Academy of Public Administration as further support and evidence for the need for reform.[31]

NWS has also used the results of its risk management process to help guide and improve the management and implementation of the Evolve initiatives. The agency has developed a plan that describes how it will manage and control risks and issues for the Evolve Program, including defining roles and responsibilities and outlining steps to identify, assess, and monitor risks and issues.[32] In addition, NWS tracks information about risks and issues related to the Evolve Program in records known as a risk register and an issue log, in which the agency describes the identified risks and issues and documents actions that it has taken or plans to take in response.

Addressing Fragmentation, Overlap, and Duplication

We found that NWS has substantially followed the leading reform practice related to addressing fragmentation, overlap, and duplication. Our previous work has shown that agencies can improve the efficiency and effectiveness of federal programs, and in some cases achieve financial savings, by reducing or better managing programmatic fragmentation, overlap, and duplication.[33] NWS has identified duplication in parts of its forecast process that, if reduced, could result in efficiencies in the agency's operations. For example, the Operations and Workforce Analysis found that local weather forecast offices, river forecast centers, and the national Weather Prediction Center duplicate efforts related to forecasting precipitation. Specifically, these entities produce separate forecasts that predict the amount of precipitation expected to fall.

[31]See National Academy of Sciences, *Weather Services for the Nation,* 2012, and National Academy of Public Administration*, Forecast for the Future*, 2013.

[32]The plan states that NWS based its approach to managing risks and issues for the Evolve Program on the Department of Commerce's Enterprise Risk Management process. According to the plan, risks are uncertain events or conditions that, if they occur, could affect a project's objectives, whereas issues refer to current conditions or situations that have already been realized and may affect a project's objectives.

[33]See GAO, *2021 Annual Report: New Opportunities to Reduce Fragmentation, Overlap, and Duplication and Achieve Billions in Financial Benefits*, GAO-21-455SP (Washington, D.C.: May 12, 2021).

According to agency officials, in addition to creating inefficiencies in the forecast process, this duplication of effort results in the production of multiple, and sometimes inconsistent, precipitation forecasts that can cause confusion for NWS's partners and hamper the agency's provision of IDSS.

Our previous work has shown that it is also important for agencies to address areas of duplication in developing their reform proposals.[34] We found that in developing its Evolve reform proposals, NWS addressed the duplication it had identified in its forecast process by establishing initiatives to create a collaborative forecast process. According to agency officials, under the collaborative forecast process, the multiple entities within the agency that currently produce their own precipitation forecasts will instead work together to produce one common forecast.

Leadership Focus and Attention

We found that NWS has partially followed the leading reform practice related to leadership focus and attention. Our previous work has shown that providing leadership focus and attention for agency reform efforts involves several things, including having agency leadership define and articulate a succinct and compelling reason for the reforms.[35] NWS has defined and articulated its reasons for pursuing the Evolve Program's reforms in its strategic plan and other agency documents. As noted previously, the agency has described the reform efforts as critical to achieving its vision of a weather-ready nation.

Our previous work has also shown that agencies should designate leaders to be responsible for the implementation of the reforms.[36] NWS has designated three leadership positions as having primary responsibility for leading the overall implementation of the Evolve reform efforts, according to agency documentation. At the highest level, a member of the agency's executive council serves as the Evolve Executive Sponsor and has ultimate authority over the program. Below the Executive Sponsor, NWS has established a PMO Director position that has overall responsibility for the planning and implementation of the Evolve Program. Finally, the agency has established a PMO Deputy Director position to

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[35]GAO-18-427.

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assist the Director in the implementation and oversight of the Evolve initiatives and the management of the PMO's day-to-day activities.

In addition, our previous work has shown that establishing a dedicated implementation team that has the capacity, including staffing and resources, to manage the reform process is important. NWS has established the Evolve PMO to serve as the entity responsible for managing the reform process.

However, we found that the agency's approach to staffing the PMO's leadership and staff positions has hampered the PMO from functioning as a dedicated implementation team. According to agency officials and documentation, NWS has primarily relied on rotating staff to fill the various PMO leadership and staff positions.[37] For example, the agency has used senior leaders drawn from other NWS offices for rotations designed to last approximately 1 year to fill the PMO Director position. From the time the agency first set up the Evolve PMO in late 2016 through June 2021, seven officials served as Director. According to NWS officials, the PMO Deputy Director generally rotates every 3 years, with two officials having served in the role as of June 2021. The agency has also followed a rotational approach to staffing other key PMO positions, including the staff leads for the five Evolve objectives and the staff leads for some of the teams that the PMO has established for managing the implementation of the Evolve initiatives.[38] The staff leads for the Evolve objectives and members of the initiative teams consist of agency staff from various headquarters and field offices that mostly serve on a part-time rotational basis in addition to their regular duties.

Officials we interviewed from different levels within NWS expressed mixed views on how well the agency's approach to staffing the Evolve PMO's leadership and staff positions has worked. We interviewed six of the seven officials who have served as PMO Director, and they cited benefits of rotating the PMO Directors, explaining that it has brought a range of perspectives, skills, and experiences to the leadership of the Evolve Program. Similarly, officials we interviewed from one regional office, two national centers, and one weather forecast office said that rotating staff through the other PMO positions, such as the initiative

[37]According to NWS officials, an exception to this is the Evolve Executive Sponsor, who has remained the same official since the start of the program.

[38]The Evolve objective leads provide guidance to and oversight of the initiatives under each Evolve objective, among other things.

teams, can help to bring fresh perspectives into the Evolve Program, including from forecasters working in the field.

However, officials we interviewed from NWS headquarters, regional offices, and selected national centers and local weather forecast offices, as well as the officials who have served as Evolve PMO Director, said that the agency's approach to staffing the PMO's leadership and staff positions presents challenges. For example, officials we interviewed from four regional offices and two national centers stated that the agency's approach to staffing the PMO has made it difficult to maintain momentum and focus on Evolve. The officials explained that the frequent turnover in PMO staff results in more time being spent educating new staff about the initiatives, and in some cases, new staff have redone work completed by their predecessors, slowing progress on the reforms. Several officials also said that it is difficult for staff to balance their Evolve duties with their regular responsibilities, and providing greater stability in the staffing of the Evolve PMO would be helpful. According to one senior regional official, Evolve is one of the "most important things [NWS] is doing, but no one is assigned to do it." Moreover, the official said that assigning permanent staff to the PMO would help to improve the Evolve Program, as it is difficult for the PMO to maintain continuity when its leaders and staff are frequently changing.

The PMO's Evolve Program issue log identified similar concerns, stating that the "existing number of PMO staffing resources are not adequate to lead an effort of this size and importance. Current Evolve NWS PMO personnel are part-time, detailed, and rotating, resulting in increased transition overhead, disruption to continuity of projects, and increased risk of overall failure to evolve NWS." NWS headquarters officials said that resource limitations led the agency to follow this approach to staffing the PMO, and the issue log states that the PMO is working to try to secure funding for permanent staffing in the future. According to the officials, NWS has so far implemented the Evolve Program using available resources as part of a "build to budget" approach that largely relies on shared resources and personnel from other NWS offices.[39]

Looking forward, NWS headquarters officials said that the agency has begun initial planning for the next phase of its reforms, an effort that the officials referred to as Evolve 2.0. The officials said that, unlike the current

[39]According to NWS officials, the Evolve Program maintains a yearly budget of approximately $1.0 to $1.3 million, which primarily supports staff travel and contractor support for project management activities.

Evolve efforts, this next phase of the Evolve Program will require additional resources to implement, but NWS has not yet defined the scope of activities it plans to pursue as part of Evolve 2.0 or their associated costs. According to NWS officials, the Coronavirus Disease 2019 pandemic has hampered Evolve 2.0 planning efforts by decreasing the amount of time some personnel have available to support the Evolve Program. The officials stated that NWS hopes to resume planning for Evolve 2.0 by the end of fiscal year 2021.

Agencies are responsible for prioritizing their resources to meet their needs, and NWS's work to define the scope of its future reform efforts and the resources needed to implement them provides an opportunity for the agency to revisit how it staffs the Evolve PMO's leadership and staff positions. By revising its approach to staffing the PMO to improve leadership continuity, staff continuity, and the sufficiency of staff resources, NWS would have better assurance that its reform efforts will succeed.

Managing and Monitoring

We found that NWS has substantially followed the leading reform practice related to managing and monitoring. We have previously reported that organizational transformations must be carefully and closely managed by developing an implementation plan with key milestones and deliverables to track implementation progress, among other actions.[40] As part of its management of the Evolve reforms, the PMO developed charters and schedules for the individual Evolve initiatives, which together serve as general implementation plans for these efforts. In particular, the charters identify key deliverables that each initiative will produce, and the schedules provide a timeline of key milestones and activities. In addition, the agency highlights key Evolve-related deliverables and milestones that it plans to complete each year in the NWS Annual Operating Plan. The PMO and NWS leadership also track implementation progress for the Evolve reforms through various mechanisms. For example, the agency formally tracks the progress of Evolve-related deliverables and milestones listed in the Annual Operating Plan through quarterly program review meetings, and the PMO holds monthly meetings with NWS senior leaders to provide updates on the program's activities and milestones, according to agency documents and officials.

As part of its monitoring of the Evolve Program, NWS has put processes in place to collect data and evidence related to the goals of the reform

[40]GAO-18-427.

efforts. For example, NWS has begun to collect and analyze data about the GS 5-12 career progression to determine how the implementation of this initiative has helped the agency advance its goal of improving workforce opportunities and building a flexible workforce. In addition, the agency has collected and analyzed data to help determine how the use of weather balloon auto-launchers in Alaska has freed up staff time, which is an important element of its ability to achieve its reform goals.

Strategic Workforce Planning

We found that NWS has substantially followed the leading reform practice related to strategic workforce planning. We have previously reported that strategic workforce planning is an essential activity for ensuring that an agency's human capital program aligns with its current and emerging mission and programmatic goals, and that the agency is able to meet its future needs.[41] Our previous work has also shown that strategic workforce planning should precede any staff realignments or downsizing, so that changed staff levels do not inadvertently produce skills gaps or other adverse effects.[42] We found that NWS has conducted strategic workforce planning to help determine whether it will have the needed resources and capacity, including the skills and competencies, in place for its proposed reforms. For example, the agency released a Strategic Human Capital Plan in 2019 that, among other things, outlines human capital-related changes it will need to make to help its workforce fulfill the vision of a weather-ready nation.[43] In addition, the plan highlights several Evolve initiatives that are intended to help reform the agency's workforce, including the GS 5-12 career progression and efforts to improve training to enhance IDSS-related skills and competencies.

The Strategic Human Capital Plan also discusses challenges facing NWS related to staffing levels, vacancies, and hiring that could affect the resources and capacity the agency has in place for its proposed reforms. Officials we interviewed from one NWS national center, one regional office, and five weather forecast offices similarly identified challenges related to staff shortages and vacancies. According to NWS Employees Organization representatives we interviewed, staff shortages and vacancies may make it difficult for some offices to take on new work as part of the Evolve reform efforts, and the representatives called for the

[41]GAO, *U.S. Secret Service: Action Needed to Address Gaps in IT Workforce Planning and Management Practices*, GAO-19-60 (Washington, D.C.: Nov. 15, 2018).

[42]GAO-18-427.

[43]National Weather Service, *National Weather Service Workforce for the Future Strategic Human Capital Plan 2019-2022* (2019).

agency to conduct a staffing analysis to determine its staffing needs. Similarly, the Strategic Human Capital Plan states that enhancing IDSS—a key objective of the Evolve Program—would require a workforce analysis to determine the optimal staffing profiles for NWS's offices. According to NWS headquarters officials, the agency is working with the NOAA Chief Financial Officer to review and analyze current and future staffing requirements to help inform future budget requests.

NWS has also taken steps to assess how Evolve reforms such as the GS 5-12 career progression and the implementation of weather balloon auto-launchers have affected its workforce. For example, as discussed previously, the Evolve PMO issued a report in September 2020 that examined how the implementation of weather balloon auto-launchers has affected the agency's workforce in Alaska. According to this report, the use of auto-launchers has saved time for staff at all of the balloon launching sites in Alaska, which, among other things, has allowed two weather forecast offices to adjust their shift schedules to better meet their partners' IDSS needs.

Employee Performance Management

We found that NWS has substantially followed the leading reform practice related to employee performance management. Our previous work has shown that performance management systems can help organizations manage employees on a daily basis, provide supervisors and employees with the tools they need to improve performance, and help employees understand the connection between their performance and organizational results.[44] We found that NWS has aligned its employee performance management system with its reform goals under the Evolve Program through the implementation of the GS 5-12 career progression initiative. This initiative overhauled much of the performance management system for forecasters, including the agency's process for assessing and promoting these employees. For example, as part of this initiative, NWS developed checklists that identify a variety of competencies that forecasters must demonstrate to advance to the next level in the career progression. Several of these competencies focus on IDSS and help to align the agency's employee performance management system with its broader reform goals under the Evolve Program.

NWS has also taken steps to include accountability for implementing the Evolve Program's reforms in its performance expectations and assessments of leadership and staff. For example, according to NWS

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officials, the agency often sets annual performance goals that align with achieving initiative-level milestones for employees that are directly involved in the Evolve Program. Similarly, the officials said that the agency aligns the performance goals for members of the Evolve leadership with program-level goals for the Evolve Program.

NWS Has Substantially Followed Most Selected Project Management Leading Practices for NBM, but Communications Gaps Exist

NWS has continued to refine NBM since initially developing the modeling tool in 2016, and three regions have established regional requirements to use NBM as the starting point for portions of the forecast process. NWS has substantially followed five of the six selected project management leading practices that we examined for the NBM project and has partially followed the other practice, but gaps exist related to the agency's communications with employees about NBM.

NWS Continues to Refine NBM, and Many Forecasters Use It as the Starting Point for Portions of their Forecasts

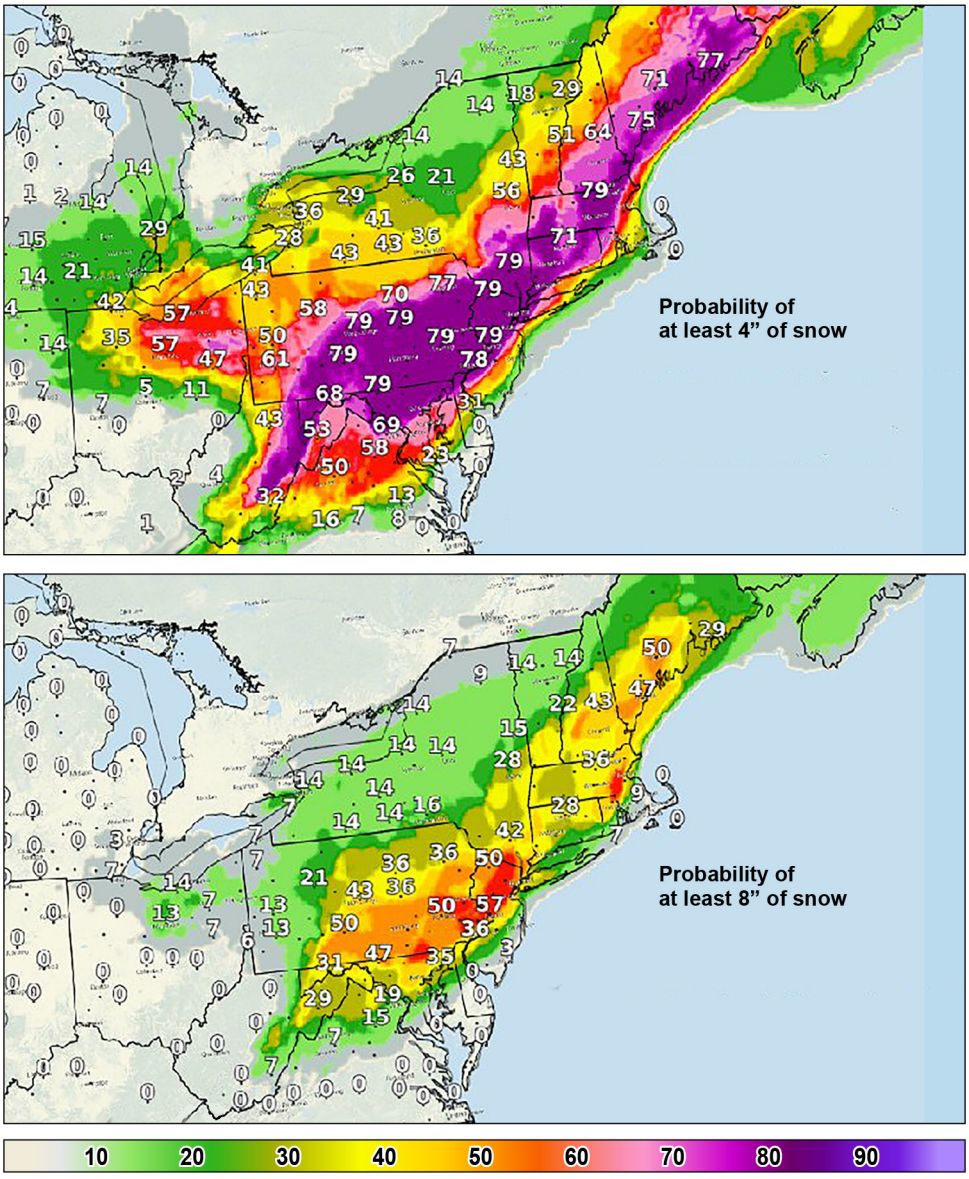
NWS released the first NBM version in January 2016 and has continued to refine the tool by periodically releasing new versions that incorporate additional model inputs and expand its outputs (such as by adding new weather elements or new geographic areas). In total, the agency has released six versions of NBM, the most recent of which came out in September 2020. Going forward, the agency plans to release new NBM versions approximately every 2 years to allow time to assess each version's performance and identify needed improvements, among other things. According to a senior NWS official, the agency estimates that it will release the next NBM version in 2023.

The current version of NBM blends information from nearly 30 NWS and non-NWS weather models to produce a weighted average for more than 100 weather elements, according to agency officials.[45] These elements include parameters commonly seen in general weather forecasts, such as temperature, wind, precipitation, and humidity. They also include more specialized elements, such as sky cover and sea ice concentration that are included in aviation, marine, and fire weather forecasts. In addition, whereas the initial versions of NBM primarily supported deterministic

[45]According to NWS officials, the weights for the NBM model inputs change over time based on each model's performance during recent verification periods.

forecasts, the two most recent versions (released in February 2020 and September 2020) have also begun to include some probabilistic forecast information. Deterministic forecasts produce a single value for each weather element (e.g., a forecasted high of 65 degrees); probabilistic forecasts present a range of potential outcomes and the likelihood of each outcome occurring (e.g., a 75 percent chance of 4 inches of snow, a 50 percent chance of 6 inches of snow, and a 25 percent chance of 8 inches of snow). According to NWS documents and officials, the agency intends to expand its use of probabilistic forecast information in the future to help it better support its partners' decision-making needs. Figure 5 shows a NWS probabilistic snow forecast developed using NBM.

Figure 5: Probabilistic Snow Forecast Developed Using the National Blend of Models



Source: National Weather Service Eastern Region. | GAO-21-103792

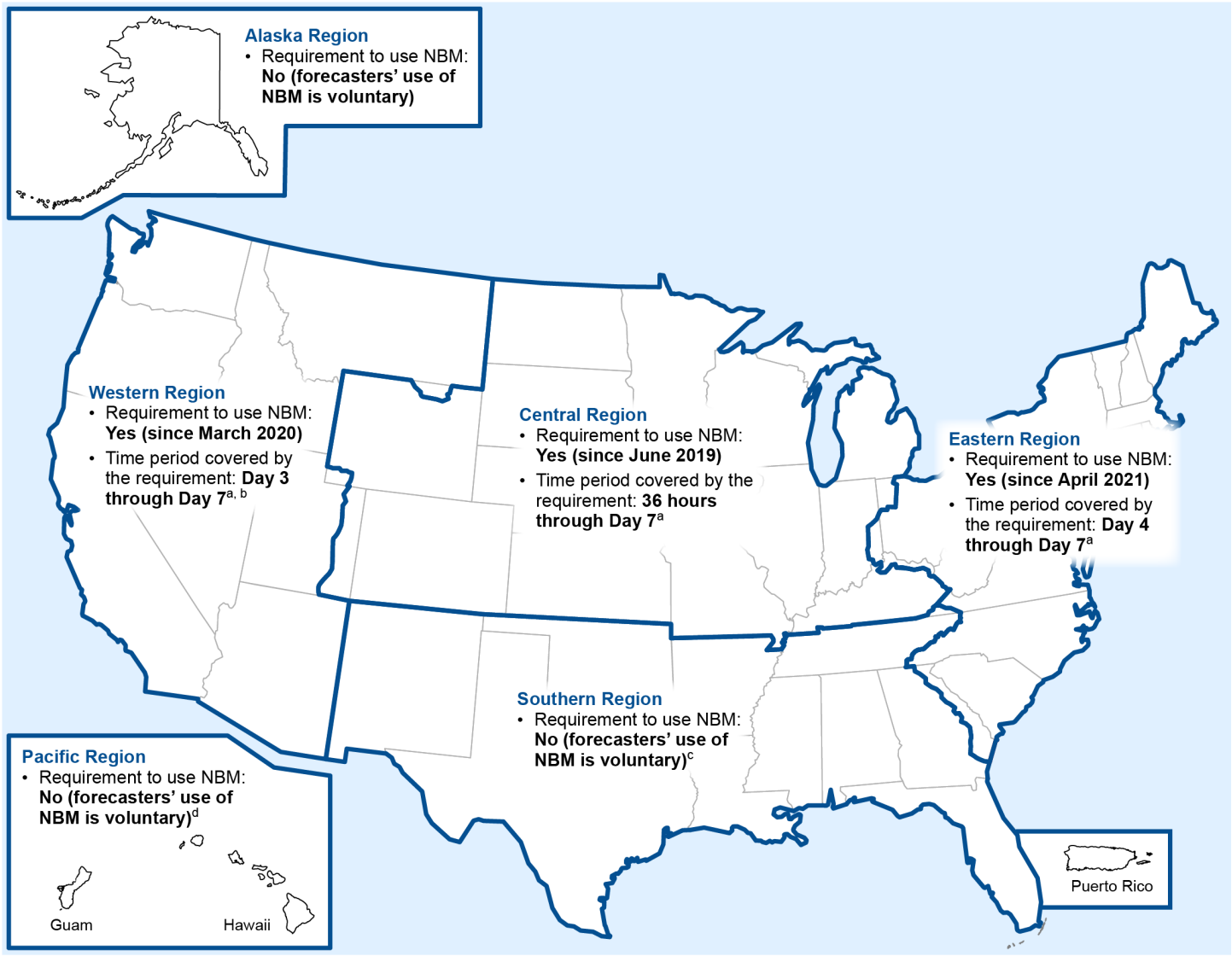
Note: The numbers in the figure represent the percent chance of an outcome occurring.

According to agency officials, NBM is available for forecasters to use in all weather forecast offices as well as several national centers. The officials said that NWS plans for NBM to eventually serve as the common starting

point for forecasts across the agency as part of the collaborative forecast process, but it has not yet established any agency-wide requirements regarding its use. Instead, the six NWS regions have had flexibility to determine when and how their weather forecast offices should use NBM based on the circumstances in each region (see fig. 6). As of April 2021, three regions (Central, Eastern, and Western) required forecasters to use NBM as the starting point for portions of the forecast process, according to agency officials and documentation. These three regions include approximately 70 percent of all weather forecast offices. In addition, in March 2021, the Southern Region completed a 1-year demonstration during which forecasters used NBM as the starting point for Day 4 through Day 7 of the forecast process, according to regional officials. The officials said that the Southern Region may establish new NBM requirements in the future after the region has assessed the results from this demonstration. In the meantime, the officials estimated that around 90 percent of the weather forecast offices in the Southern Region continue to regularly use the modeling tool. The Alaska and Pacific regions have not established any requirements for the use of NBM, but officials in both regions said they have encouraged their forecast offices to examine its performance in their local areas and to use it when appropriate.[46]

[46]Officials from the Alaska and Pacific regions said that they have not required their forecast offices to use NBM because of limitations with the modeling tool in their regions that can affect the quality of its results. The officials explained that their remote locations present unique challenges compared to the contiguous United States, and they said that other weather models face limitations in their regions as well.

Figure 6: NWS Regional Requirements for Using the National Blend of Models (NBM) as the Starting Point for Portions of the Forecast Process, as of April 2021



Sources: GAO analysis of National Weather Service (NWS) documents and information provided by NWS officials; Map Resources (map). | GAO-21-103792

[a]Forecasters may voluntarily use NBM for time periods not covered by the regional requirement.

[b]According to a Western Region official, some weather forecast offices go beyond the regional requirement and use NBM as the starting point for all forecast time periods.

[c]In March 2021, the Southern Region completed a 1-year demonstration during which forecasters were required to use NBM as the starting point for Day 4 through Day 7 of the forecast process. Regional officials estimated that around 90 percent of the weather forecast offices in the Southern Region continue to regularly use NBM, and the officials said that the region may establish new NBM requirements in the future after it has assessed the results from the demonstration.

[d]According to Pacific Region officials, the forecast office in Hawaii has a limited local requirement to use NBM as the starting point for one weather element (thunderstorm probabilities) in the high seas domain covering portions of the Pacific Ocean.

Based on their experiences, the forecasters we interviewed said that NBM has done a better job forecasting some weather elements and conditions than others in their respective offices. For example, forecasters from two weather forecast offices cited temperature as an element that they have found NBM generally handles well in their offices, and forecasters from three offices said that it does a good job with forecasting benign weather conditions (e.g., sunny and warm). However, the forecasters also identified weather elements and conditions that NBM has struggled with in their offices, including marine winds, locations with complex terrain (such as mountains), and some extreme weather events.

NWS Has Substantially Followed Most Selected Project Management Leading Practices for the NBM Project, but Communications Gaps Exist

Based on our analysis of NWS documents and information provided by agency officials, we found that NWS has substantially followed five of the six project management leading practices that we examined for the NBM project and has partially followed the other practice (see table 2).[47]

Table 2: Assessment of the Extent to Which NWS Has Followed Selected Project Management Leading Practices for the National Blend of Models Project

Selected project management leading practice	Extent followed
Clearly and completely define the scope of the project so that its performance can be measured.	●
Conduct monitoring and controlling activities to measure performance at regular intervals.	●
Identify and document quality requirements for the project and its deliverables and conduct testing and other quality assurance activities throughout the life cycle of the project to verify that the quality requirements are met.	●
Conduct risk assessments throughout the life cycle of the project, prioritize risks in a risk register, and develop risk mitigation strategies.	●
Identify project stakeholders and develop and implement strategies to effectively engage stakeholders in project decisions and execution.	●
Manage and monitor communications to ensure that relevant project information is collected, created, and distributed to stakeholders in a timely and appropriate manner.	◒

Legend:

● **Substantially followed**—NWS took actions that addressed most or all aspects of the practice.

[47]As discussed previously, these leading practices are based on PMI's standards for project management presented in *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition.

◒ **Partially followed**—NWS took actions that addressed some, but not most, aspects of the practice.

○ **Not followed**—NWS took no actions that addressed the aspects of the practice.

Source: GAO analysis of National Weather Service (NWS) documents and interviews with NWS officials. | GAO-21-103792

Clearly and Completely Define the Scope of the Project so that Its Performance Can Be Measured

We found that NWS has substantially followed the leading practice related to defining project scope. PMI has reported that defining scope is the process of developing a detailed description of the project and product.[48] NWS has taken several steps to define and manage the scope of the NBM project over time. The agency initially defined the scope in the project's original documentation, and it has subsequently updated the scope as the project has advanced under the auspices of the Evolve Program. In particular, the NBM Development Initiative charter defines the project's purpose and scope now that it is under the Evolve Program, including explicitly identifying activities considered within the scope of the project. In addition, NWS has created a work breakdown structure for the project to help outline the discrete steps and work required to complete the project's key deliverables (such as developing a new NBM version).[49]

Conduct Monitoring and Controlling Activities to Measure Performance at Regular Intervals

We found that NWS has substantially followed the leading practice related to monitoring and controlling project performance. PMI has reported that monitoring provides insights into the health of a project and identifies any areas that may require special attention, and controlling includes determining corrective or preventive actions to address performance issues.[50] According to NWS officials, the agency monitors and controls the performance of the NBM project through the Evolve PMO and the overall NWS governance process. The officials told us that the PMO monitors the performance of the NBM project weekly, and NWS senior leadership monitors its performance through quarterly review meetings. As shown in agency documents, the quarterly reviews focus on the project's schedule performance, its finances, and ongoing risks and issues facing the project, among other things. According to NWS officials, the NBM project has not experienced any cost overruns but has encountered schedule delays, such as when technical issues and staffing

[48]Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition, 2017.

[49]According to PMI's standards, a work breakdown structure is a hierarchical decomposition of the total scope of work the project team is to carry out to accomplish the project objectives and create the required deliverables.

[50]Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition, 2017.

shortages delayed the release of the fifth version of the modeling tool by several months.[51] The officials said that the agency has implemented a series of process improvements to address such performance issues and to improve overall project control, such as by having the NBM developers use new software to make it easier to diagnose and fix technical problems.

In addition, some NWS regions have also taken steps to monitor and evaluate NBM's performance in their local weather forecast offices. For example, officials from the Central and Southern regions said that they have surveyed forecasters in their regions about their experiences using NBM to help monitor the tool's performance. According to regional officials and documents, these survey results can help the regions monitor how using NBM affects forecaster workloads, collaboration, and the provision of IDSS, among other things.

Identify Quality Requirements and Conduct Testing and Other Quality Assurance Activities

We found that NWS has substantially followed the leading practice related to managing project quality. PMI has reported that failure to meet a project's quality requirements can have serious negative consequences for the project's stakeholders.[52] According to NWS officials, the agency has established three core quality requirements for the NBM project. The first requirement specifies a baseline set of weather elements that NBM is to include, and agency officials stated that the current version of the modeling tool meets this requirement. The second requirement states that the runtime and dissemination of NBM should take no more than 60 minutes, on average. In February 2021, NWS officials said that the agency was not meeting this requirement for NBM overall, but the officials said that the agency is working to improve its timeliness, particularly related to supporting the upcoming collaborative forecast process demonstration.

The third quality requirement focuses on verifying NBM's accuracy to ensure that it does not result in any degradation in forecast accuracy. To assess this requirement, the agency has established a national process for verifying NBM's accuracy monthly using a combination of data from observations and results from an analytical modeling tool known as the

[51]According to NWS officials, the agency spent nearly $7 million on the NBM project from fiscal year 2014 through fiscal year 2020.

[52]Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition, 2017.

UnRestricted Mesoscale Analysis (URMA), according to NWS headquarters officials.[53] In addition, the officials said that some weather forecast offices, regional offices, and national centers have conducted their own independent verification work to assess NBM's accuracy in their respective areas. According to these officials, the national verification results have shown that NBM has generally performed well with regard to accuracy. However, officials from six of the seven weather forecast offices, representatives from the NWS Employees Organization, and representatives from one external organization that we interviewed raised concerns about the agency's national process for verifying NBM's accuracy. In particular, these concerns focused on (1) the use of URMA in the verification process given perceived shortcomings in the quality of URMA, and (2) the lack of a systematic effort at the national level to verify NBM's accuracy and performance related to high-impact weather, such as extreme weather events.[54] NWS has begun to take steps to address these concerns. For example, the agency has designated concerns about URMA's quality as a high priority issue in the Evolve issue log and has reported that it plans to evaluate URMA's performance as part of its Fiscal Year 2021 Annual Operating Plan. In addition, the agency has reported that it plans to expand its national NBM verification process to include information about the modeling tool's performance during high-impact weather by the end of fiscal year 2021.

Conduct Risk Assessments and Develop Risk Mitigation Strategies

We found that NWS has substantially followed the leading practice related to managing project risks. PMI has reported that a project's success is directly related to the effectiveness of risk management, as unmanaged risks have the potential to cause projects to fail to achieve their objectives.[55] As an initiative under the Evolve Program, the NBM project follows the risk management processes outlined in the Evolve risk management plan, according to agency officials. For example, the officials told us that the Evolve PMO assesses NBM-related risks at least monthly, and the agency's senior leadership addresses significant NBM-

[53]Officials we interviewed from NWS regional offices and weather forecast offices said that observation data (i.e., data on actual conditions that occurred) are limited. In places where no observation data are available, URMA seeks to provide an estimate of the conditions that occurred by performing an analysis to interpolate what the conditions were based on nearby observations.

[54]In addition, some officials said that it might be misleading to use URMA to verify NBM's output because NWS also uses URMA to help calibrate some of the model inputs that feed into NBM.

[55]Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition, 2017.

related risks and issues as part of their quarterly review meetings. In addition, NWS has documented and prioritized NBM-related risks and issues in the Evolve risk register and issue log discussed previously. Among other things, the risk register and issue log describe the identified risks and issues and outline the agency's plans to address them, including through risk mitigation strategies.

Identify Project Stakeholders and Implement Strategies to Effectively Engage Stakeholders

We found that NWS has substantially followed the leading practice related to identifying and engaging project stakeholders. PMI has reported that the ability to correctly identify and engage stakeholders in an appropriate way can mean the difference between project success and failure.[56] NWS has identified its primary internal stakeholders for NBM as the employees at its weather forecast offices and national centers, as well as the NWS Employees Organization. The agency has identified its primary external stakeholders as its core partners, such as state and local emergency management agencies.

NWS's stakeholder engagement strategy has featured a number of actions to engage stakeholders in NBM project decisions and execution. For example, the agency collects and documents internal stakeholder requirements for the project to help guide its development efforts and ensure that new versions of NBM address the needs of the forecasters who will be using the tool.[57] According to officials we interviewed from NWS regional offices and selected weather forecast offices, forecasters have various options for providing feedback on NBM, and in some cases the NBM developers have used this feedback to help guide improvements to the model. For example, the agency solicits feedback and collects lessons learned from forecasters and other internal stakeholders through the NBM Virtual Lab forum, which contains more than 640 discussion threads and more than 160 case studies submitted by employees. NWS Employees Organization representatives we interviewed expressed concerns that the agency has not sufficiently engaged with their organization at the national level regarding NBM, but they said that it has done a better job of engaging with them at the regional level. In particular, NWS regional leaders have negotiated with their respective NWS Employees Organization regional groups to reach agreement on the use

[56]Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition, 2017.

[57]PMI defines requirements as the conditions or capabilities that are necessary to be present in a product, service, or result to satisfy a business need. With regard to NBM, requirements documented by NWS include additional weather elements that stakeholders would like to have added to future versions of the modeling tool.

of NBM as the common forecast starting point in the regions that have implemented such requirements. In addition, although NWS primarily intends for NBM to support its internal forecast process, the agency has taken steps to engage external stakeholders, including by making NBM output available to external stakeholders and soliciting public comments on its plans to implement new versions of the modeling tool.

Manage and Monitor Communications

We found that NWS has partially followed the leading practice related to managing and monitoring communications. PMI has reported that communication develops the relationships necessary for successful project outcomes and is vital to maintaining effective relationships with stakeholders.[58] NWS has taken a multi-faceted approach to communicating information about NBM to its internal and external stakeholders, according to agency officials. At the national level, the officials said this approach has included communicating through email updates, the agency's internal and external websites, quarterly discussions with NBM developers for agency employees, and presentations at professional conferences. According to NWS regional officials and documents, some regional offices have also taken steps to communicate with their local weather forecast office employees about NBM, including hosting webinars and conference calls and, in one region, developing a "Frequently Asked Questions" document to help address common questions.

Officials we interviewed from NWS regional offices and selected national centers and weather forecast offices expressed mixed views on the effectiveness of the agency's communications regarding NBM. Officials from four regional offices and three weather forecast offices praised some aspects of the agency's communications about NBM, such as the updates provided by the Meteorological Development Laboratory.[59] However, the officials we interviewed also identified gaps in the agency's communications about NBM. According to officials we interviewed in three regions and four weather forecast offices, NWS's communications have not sufficiently addressed the cultural challenges associated with implementing NBM, including some forecasters' resistance to using the new modeling tool and concerns among some forecasters that it could

[58]Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Sixth Edition, 2017.

[59]NWS's Meteorological Development Laboratory leads the technical development of NBM, with overall oversight of the NBM project provided by the Evolve PMO as part of the Evolve Program.

lead to job losses. In addition, officials we interviewed from one national center, one regional office, and two weather forecast offices stated that some forecasters view NBM as a "black box" because the agency has not communicated enough about what goes into the modeling tool and how it produces its results. Consequently, the officials said that this shortcoming has contributed to a lack of trust and confidence in NBM among some forecasters.[60] According to officials from one regional office, it would be beneficial if NWS leadership communicated more with employees in the field about their expectations and vision for NBM, as doing so could help those who have struggled to embrace the new modeling tool.

As discussed previously, the agency is developing a communications strategy for the Evolve Program as a whole, of which the NBM project is a part. As NWS completes development of this strategy, ensuring that it incorporates approaches to listen and respond to employee concerns about NBM would better position the agency to provide employees with the relevant project information they need in a timely and appropriate manner.

Conclusions

NWS is responsible for developing weather forecasts and issuing warnings to help protect life and property, and the agency's leadership has determined that reforming its operations and workforce is critical to achieving its strategic vision of building a weather-ready nation. In developing and implementing its reform efforts under the Evolve Program, NWS has substantially followed many of the selected leading practices for effective agency reforms. Moreover, the agency has also substantially followed most selected leading practices for project management in carrying out the NBM project.

However, NWS has not substantially followed leading reform practices in the areas of establishing performance measures, communicating with employees, and staffing the Evolve PMO's leadership and staff positions. Communication is also an important leading practice for project management, and the agency has fallen short in its communications with employees regarding the NBM project. Taking additional actions in these areas could help NWS improve its Evolve Program reform efforts and its implementation of the NBM project. By incorporating our key attributes of successful performance measures; developing a two-way

[60]As part of its Fiscal Year 2021 Annual Operating Plan, NWS has developed plans to provide forecasters with more information about the inputs into NBM, with the stated aim of reducing the sense of NBM as a "black box" and increasing forecasters' acceptance of and confidence in the modeling tool.

communications strategy that outlines how the agency will listen and respond to employee concerns about the Evolve reforms, including those related to NBM; and revising its approach to staffing the PMO, NWS would have better assurance that its reform efforts will succeed.

Recommendations for Executive Action

We are making the following three recommendations to NWS:

The Director of NWS should ensure that as NWS continues its efforts to develop performance measures for the Evolve Program's reform efforts, it incorporates GAO's key attributes of successful performance measures to the extent appropriate for the program. (Recommendation 1)

The Director of NWS should ensure that the final communications strategy developed by the Evolve Program is a two-way communications strategy that outlines how NWS will listen and respond to employee concerns about the agency's reform efforts, including NBM. (Recommendation 2)

The Director of NWS should revise NWS's approach to staffing the Evolve PMO to improve leadership continuity, staff continuity, and the sufficiency of staff resources to effectively implement the Evolve Program's reform efforts. (Recommendation 3)

Agency Comments

We provided a draft of this report to the Department of Commerce for review and comment. In its written comments, reproduced in appendix III, Commerce agreed with our recommendations. Regarding the staffing of the Evolve PMO, Commerce noted that rotating leadership had provided benefits, such as growth opportunities for staff. However, Commerce also said that it appreciates the importance of continuity and ensuring sufficient staff, and it stated that NWS will evaluate and adjust the staffing model for the Evolve PMO as part of the ongoing planning associated with Evolve 2.0.

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 to the appropriate congressional committees, the Secretary of Commerce, and other interested parties. In addition, the report will be available at no charge on the GAO website at https://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or JohnsonCD1@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 key contributions to this report are listed in appendix IV.

Cardell D. Johnson
Acting Director, Natural Resources and Environment

Appendix I: Overview of Evolve Program Objectives and Initiatives

Table 3 provides an overview of the National Weather Service's (NWS) Evolve Program's five objectives and 20 initiatives, including the status of the initiatives as of August 2021, as reported by NWS.

Table 3: Overview of the National Weather Service's (NWS) Evolve Program Objectives and Initiatives

Initiative	NWS description	Status
	Objective 1: Enhance Impact-based Decision Support Services (IDSS)	
	This objective focuses on improving the quality and consistency of IDSS.	
1. IDSS Policy Guidance	• The goal of this initiative was to issue IDSS-related policy. NWS completed this initiative in 2019. • This initiative produced two key items: (1) a guidance document that, among other things, established formal definitions of IDSS and NWS's core partners; and (2) a policy directive that, among other things, defined IDSS-related roles and responsibilities of various NWS entities and specified the nature and scope of the agency's IDSS work.	Completed
2. IDSS Impact Measurement	• This initiative aims to implement internal and external performance measures that effectively evaluate and communicate the quality and consistency of IDSS to partners. • As part of this initiative, NWS has tested surveys for its partners to assess the agency's performance in providing IDSS, focusing on topics such as accessibility, consistency, and timeliness. In addition, the initiative team has begun a multi-year effort to develop a process to measure the economic value of IDSS.	Ongoing
3. IDSS Instructions Development	• This initiative intends to review and refine a core set of IDSS-related instruction directives. NWS has estimated that it will publish these directives in 2022. • The initiative team began its work by drafting an instruction directive focused on the delivery of IDSS, including documenting a standard IDSS operating model for the agency.	Ongoing
4. IDSS Management System Requirements and Validation	• This initiative focuses on defining, verifying, and validating requirements for the IDSS management system that can be used for future development, acquisition, and implementation efforts. • As part of this initiative, the initiative team has developed workflow strategies needed to develop a successful IDSS management system and has gathered input from stakeholders on how the system could work under different operational scenarios.	Ongoing
5. IDSS Planning and Core Service Level	• Among other things, this initiative aims to (1) develop strategies to communicate what IDSS is, when it is provided, who receives it, and how it is delivered; (2) establish IDSS communities of practice; and (3) develop tools and templates for IDSS reporting, accountability, coaching, roles and responsibilities, timelines, and workflows to help implement minimum IDSS service level standards. • As part of this initiative, IDSS communities of practice have met to collect best practices, findings, and recommendations related to providing IDSS during the Coronavirus Disease 2019 (COVID-19) pandemic. In addition, the initiative team has begun to develop templates and user guides to support IDSS, such as hazardous weather briefing graphics and slides.	Ongoing

Initiative	NWS description	Status
6. IDSS Training Development	• This initiative intends to (1) identify and manage new IDSS training requirements to build a consistent set of baseline IDSS-related skills and (2) identify and manage new training requirements based on updated IDSS policies and tools. • The initiative team has completed its review of the IDSS Professional Development Series trainings and provided feedback to the Office of the Chief Learning Officer. The team also plans to perform a more holistic review of IDSS-related trainings within NWS to develop a coordinated strategy for future IDSS training needs.	Ongoing
Objective 2: Improve workforce opportunities *This objective focuses on building the workforce that NWS needs to deliver its services.*		
7. General Schedule (GS) 5-12 Career Progression	• This initiative implemented a non-competitive, competency-based career path for current and future forecasters at NWS weather forecast offices and applicable national centers. NWS completed this initiative in 2020. • NWS has transitioned forecasters to the new career progression and has developed new competency checklists to guide forecaster promotions through the GS-12 level.	Completed
Objective 3: Develop a collaborative forecast process (CFP) *This objective focuses on improving the effectiveness of forecasting through a collaborative process.*		
8. CFP Planning	• Among other things, this initiative intends to (1) develop CFP demonstration plans, (2) provide oversight of the demonstrations, (3) evaluate results of the demonstrations to make recommendations for future CFP models and adopt new processes for future forecasts, and (4) develop a communications strategy to provide consistent messaging throughout the demonstrations. • The initiative team has developed a plan for the first CFP demonstration focused on precipitation and NWS expects to begin implementing the demonstration in 2022.	Ongoing
9. CFP Requirements and Validation	• This initiative aims to (1) collect, validate, and document CFP and National Blend of Models (NBM) requirements as well as CFP tools and training capabilities; (2) provide NBM performance verification information; and (3) facilitate communications with internal and external stakeholders on the status of CFP and NBM requirements. • The initiative team has worked with different NWS offices to document current collaborative processes and will assist in defining a future CFP focused on winter weather. In addition, the team has worked with the NBM developers to identify requirements and changes needed for future NBM versions.	Ongoing
Objective 4: Match workforce to workload *This objective focuses on matching workforce to workload across the agency and building a stronger organizational structure.*		
10. Evaluate Auto-launcher Staff Time Savings	• This initiative evaluated the results of installing weather balloon auto-launchers in the Alaska Region. In particular, the initiative analyzed the amount of staff time saved by using weather balloon auto-launchers and any resulting increase in staff capacity to provide IDSS in the region. NWS completed this initiative in 2020. • In September 2020, the initiative team completed its report evaluating the use of auto-launchers in the Alaska Region. Among other things, the report estimated that the 13 auto-launchers installed in Alaska save nearly 14,800 hours of staff time per year.	Completed

Initiative	NWS description	Status
11. Regional Operations Center Roles and Stand-up	• This initiative focuses on establishing a Regional Operations Center in each of NWS's six regions to help improve service to regional partners and provide consistent support to field offices. • As part of this initiative, NWS has fully staffed Regional Operations Centers in five regions (Alaska, Central, Eastern, Southern, and Western) and is working to increase staffing at the center in the Pacific Region.	Ongoing
12. Aviation Strategic Staffing	• This initiative will focus on better serving NWS's aviation partners by adjusting staffing at relevant NWS offices. • According to NWS officials, NWS has not begun to implement this initiative because of other priorities, limited resources, and the need to manage the amount of simultaneous change occurring throughout the agency.	Planned
13. Future Operating Model Demonstration/Consider Future Operating Approaches	• This initiative will aim to demonstrate the value of using flexible staffing approaches at weather forecast offices to provide IDSS. • According to NWS officials, NWS has not begun to implement this initiative because of other priorities, limited resources, and the need to manage the amount of simultaneous change occurring throughout the agency.	Planned
14. Regional and Local Staff Time Savings Tests	• This initiative will focus on testing ways to produce staff time savings in a sample of NWS regions. • According to NWS officials, NWS has not begun to implement this initiative because of other priorities, limited resources, and the need to manage the amount of simultaneous change occurring throughout the agency.	Planned
Objective 5: Support innovation, science, and technology *This objective focuses on supporting the innovation, science, technology, and culture required for NWS to continue improving over time.*		
15. Auto-launchers to Automate Upper Air Balloon Launches	• This initiative aims to install weather balloon auto-launchers at some NWS balloon launching sites. • NWS has installed 20 out of 21 planned weather balloon auto-launchers and plans to complete the installation of the final auto-launcher by the end of fiscal year 2021. The NWS Observations Portfolio manages the installation of the auto-launchers under this initiative.	Ongoing
16. CFP Test and Evaluation	• This initiative intends to (1) collect data to support CFP demonstrations at the regional and national levels; (2) develop a feedback process for forecasters to submit comments, concerns, and suggestions on the CFP demonstrations; and (3) evaluate data and identify ways to improve the CFP. • As part of this initiative, the initiative team has prepared a test and evaluation plan to guide how NWS will assess and measure the first CFP demonstration, which will focus on precipitation.	Ongoing
17. IDSS Information Technology Support	• This initiative focuses on coordinating the development, procurement, and operation of IDSS tools and technologies. • As part of this initiative, the initiative team will help to develop the initial operating capabilities for the IDSS management system, including determining technical requirements for the system and documenting recommendations for NWS senior leadership to consider.	Ongoing

Initiative	NWS description	Status
18. National Advanced Weather Interactive Processing System (N-AWIPS) / Advanced Weather Interactive Processing System (AWIPS) Integration	• This initiative focuses on converting forecaster workstations at NWS's national centers from the N-AWIPS operating platform to the AWIPS operating platform currently used at weather forecast offices. According to NWS documents, ensuring that all national centers and forecast offices use a common operating platform will support collaboration on forecasts and will inform planning of other Evolve efforts, such as the CFP. • After experiencing delays because of the COVID-19 pandemic, the initiative team has worked with the national centers to convert some forecaster workstations to AWIPS in fiscal year 2021 and plans to convert additional workstations in fiscal years 2022 and 2023.	Ongoing
19. NBM Development	• This initiative focuses on creating a new source of nationally consistent forecast guidance to serve as the starting point for weather forecast offices and national centers to use when producing their forecasts. • NWS implemented NBM version 4.0 in September 2020. NWS has estimated that it will implement the next version of NBM in 2023.	Ongoing
20. CFP Information Technology Support	• This initiative will focus on providing technical support in the implementation of NBM and AWIPS to help prepare NWS for developing and implementing new collaborative forecast processes. • According to NWS officials, NWS plans to form a team to lead this initiative by the end of fiscal year 2021.	Planned

Source: GAO analysis of NWS documents and information provided by NWS officials. | GAO-21-103792

Appendix II: Key Attributes of Successful Performance Measures

Measuring performance allows organizations to track the progress they are making toward their goals and gives managers critical information on which to base decisions for improving their programs. Table 4 summarizes nine key attributes of successful performance measures we have previously identified and the adverse consequences that may occur if they are missing.[1] All attributes are not equal, and failure to have a particular attribute does not necessarily indicate that there is a weakness in that area or that the measure is not useful; rather, it may indicate an opportunity for further refinement.

Table 4: Key Attributes of Successful Performance Measures

Attribute	Definition	Potentially adverse consequences of not meeting attribute
Linkage	Measure is aligned with division and agency-wide goals and mission and clearly communicated throughout the organization.	Behaviors and incentives created by measures do not support achieving division or agency-wide goals or mission.
Clarity	Measure is clearly stated and the name and definition are consistent with the methodology used to calculate it.	Data could be confusing and misleading to others.
Measureable target	Measure has a numerical goal.	Cannot tell whether performance is meeting expectations.
Objectivity	Measure is reasonably free from significant bias or manipulation.	Performance assessments may be systematically over- or understated.
Reliability	Measure produces the same result under similar conditions.	Reported performance data is inconsistent and adds uncertainty.
Core program activities	Measures cover the activities that an entity is expected to perform to support the intent of the program.	Not enough information available in core program areas to managers and stakeholders.
Limited overlap	Measure should provide new information beyond that provided by other measures.	Managers may have to sort through redundant, costly information that does not add value.
Balance	Balance exists when a suite of measures ensures that an organizations various priorities are covered.	Lack of balance could create skewed incentives when measures over-emphasize some goals.
Government-wide priorities	Each measure should cover a priority such as quality, timeliness, and cost of service.	A program's overall success is at risk if all priorities are not addressed.

Source: GAO | GAO-21-103792

Note: The information in this table was drawn from GAO, *Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures*, GAO-03-143 (Washington, D.C.: Nov. 22, 2002).

[1]For more information on these attributes, see GAO, *Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures,* GAO-03-143 (Washington, D.C.: Nov. 22, 2002).

Appendix III: Comments from the Department of Commerce

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Acting Chief Financial Officer and
Assistant Secretary for Administration
Washington, D.C. 20230

Mr. Cardell D. Johnson
Acting Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Johnson:

Thank you for the opportunity to review and comment on the Government Accountability Office's (GAO) draft report, *NATIONAL WEATHER SERVICE: Additional Actions Needed to Improve the Agency's Reform Efforts* (GAO-21-103792). The Department of Commerce agrees with GAO's recommendations, and I have enclosed our comments.

If you have any questions, please contact MaryAnn Mausser, Commerce Audit Liaison, at (202) 482-8120.

Sincerely,

WYNN COGGINS Digitally signed by WYNN COGGINS Date: 2021.09.14 12:57:35 -04'00'

Wynn W. Coggins
Acting Chief Financial Officer and
Assistant Secretary for Administration

Enclosure

Department of Commerce's Comments on GAO Draft Report entitled *NATIONAL WEATHER SERVICE: Additional Actions Needed to Improve the Agency's Reform Efforts* (GAO-21-103792)

The Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), has reviewed the Government Accountability Office (GAO) draft report, and we offer the following comments for GAO's consideration.

General Comments

NOAA appreciates the opportunity to review the draft report on the National Weather Service (NWS) Evolve Program and National Blend of Models (NBM). The report does a fair and thorough job outlining reform practices. NWS appreciates the recommendations and will continue to enhance its metrics, communications, and leadership oversight.

Comments on Recommendations

The Government Accountability Office (GAO) made three recommendations to the Department of Commerce in the report.

- **Recommendation 1:** The Director of NWS should ensure that as NWS continues its efforts to develop performance measures for the Evolve Program's reform efforts, it incorporates GAO's key attributes of successful performance measures to the extent appropriate for the program.

  Commerce Response: The Department of Commerce agrees with this recommendation.

  NWS will continue to enhance its metrics and strengthen performance measures and incorporate GAO's key attributes of performance measures, as appropriate.

- **Recommendation 2:** The Director of NWS should ensure that the final communications strategy developed by the Evolve Program is a two-way communications strategy that outlines how NWS will listen and respond to employee concerns about the agency's reform efforts, including NBM.

  Commerce Response: The Department of Commerce agrees with this recommendation.

  NWS agrees communication is key to successful change management. NWS will complete its communication strategy and ensure it addresses how NWS will listen to and respond to employee concerns related to reform efforts. This is particularly important as NWS continues to develop and implement the NBM, initiated through congressional direction and appropriation beginning in 2012 with the Sandy Supplemental, Public Law 113-2.

1

- **Recommendation 3:** The Director of NWS should revise NWS' approach to staffing the Evolve Program Management Office to improve leadership continuity, staff continuity, and the sufficiency of staff resources to effectively implement the Evolve Program's reform efforts.

  Commerce Response: The Department of Commerce agrees with this recommendation.

  NWS appreciates the input regarding project oversight. We note that the success of several Evolve initiatives demonstrates the value of the constant NWS Executive Council and executive sponsor oversight and rotational leadership. Rotating leadership has provided growth opportunities for subject matter experts and senior executives from the field; helped inform the successful path forward for the Evolve efforts that have already been completed; and increased the buy-in and support across the agency. We understand and appreciate the importance of continuity and ensuring sufficient staff. As such, NWS will continue to evaluate and adjust the staffing model as a part of the ongoing planning and work associated with Evolve 2.0 to improve the leadership continuity, staff continuity, and sufficiency of staff resources, as recommended.

Recommended Changes for Factual/Technical Information

None

2

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

Cardell D. Johnson, (202) 512-3841 or JohnsonCD1@gao.gov.

Staff Acknowledgments

In addition to the contact named above, Anne-Marie Fennell (Director), Jonathan Dent (Assistant Director), Alyssa M. Hundrup (Assistant Director), Joshua Wiener (Analyst in Charge), Grace Haskin, and Shylene Mata made key contributions to this report. Also contributing to the report were Peter Beck, Kendall Childers, Ellen Fried, Cindy Gilbert, Douglas G. Hunker, Dan C. Royer, Jeanette M. Soares, Sarah E. Veale, and Jessica Waselkow.