



# NCEP

## STRATEGIC IMPLEMENTATION PLAN

2022-2027+

Delivering National-level, Impactful Science-Based Products and Services to Save Lives and Property and Enhance the National Economy



# Strategic Implementation Plan

## 2022-2027+

### NCEP Vision

The trusted source for environmental predictions from the sun to the sea, when it matters most

### NCEP Mission

NCEP delivers national and global operational weather, water, and climate products and impact-based decision support services essential to protecting life, property, and economic well-being



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# Introduction from NCEP Director

Since its establishment in 1954 as the Joint Numerical Weather Prediction Unit, NCEP has been at the forefront of model predictions at the weather to seasonal scales and associated national-level weather operations, providing the foundation for the NWS mission of protecting life and property and enhancing the national economy. As the NWS has evolved to place greater emphasis on Impact-based Decision Support Services (IDSS), NCEP has evolved with it to improve our direct IDSS support to national-level partners, as well as improved partnerships with local NWS offices through new and enhanced Collaborative Forecast Processes. NCEP is also rising to meet the challenge of a changing climate and its impact on the national economy, national security, and the well being of our citizens (especially on vulnerable populations). Altogether, this document reflects the priorities and approach of NCEP to identify implementation pathways to meet the challenges set forth in the NOAA and NWS strategic plans.

While this Strategic Implementation Plan reflects my vision for the future direction of NCEP, it is not a top-down view – instead, this plan was orchestrated and led by the amazing men and women of NCEP, so we all take ownership in the identified strategies and implementation actions. I'd like to express my respect and gratitude to all NCEP members involved, as represented by Dr. Stephen Bieda (Project Lead), Lara Pagano (People & Culture Lead), Jim Clark (Operations Lead), Dr. Alicia Bentley (Science Lead), Doug Fenderson (Technology Lead), and Dr. Wasilla Thiaw (Global Partnerships Lead). With their dedication and expertise, along with the rest of the NCEP workforce, the future of NCEP and the NWS is in good hands!



A handwritten signature in blue ink that reads "Michael Farrar". The signature is written in a cursive, flowing style.

**Dr. Michael R. Farrar**

Director, National Centers for Environmental Prediction (NCEP), National Weather Service (NWS)



NCEP Strategic Planning Team alongside NCEP Leadership at the Strategic Planning Conference, held at the National Center for Weather and Climate Prediction (NCWCP) in October, 2021.

# Strategic Vision

For over sixty years, NCEP has been a national and global leader in analyzing and understanding the earth system and providing national-level guidance and forecasts for high-impact weather that enable the NWS mission to protect lives and property and to enhance the national economy. With the advent of the Weather Ready Nation (WRN) vision in 2011, along with the recent NWS Strategic Plan (2019-22) that further expanded on the impact-based decision support services (IDSS) vision, NCEP's role in providing timely and accurate weather, water and climate forecasts, warnings and IDSS has evolved and grown.

As our environment continues to change and the human, economic, and national security impacts of extreme weather and climate events continue to grow, our nation depends upon the development and delivery of NCEP's authoritative water, weather, and climate products and services now more than ever. In support of the strategic plans of [NOAA](#) and [NWS](#), NCEP strives to advance NWS' three new strategic goals of transforming services, harmonizing science and technology, and investing in people and partnerships. Through this Strategic Implementation Plan, NCEP builds upon its legacy and takes its people, science and technology capabilities, operational processes, and partnerships to the next level of world-class products and services. The NCEP Strategic Implementation Plan has been developed to meet several objectives:

- Communicate NCEP's strategic priorities and goals to the NCEP workforce, across NWS and NOAA, and to our external stakeholders and partners.
  - Inspire the NCEP workforce and grow the next generation of NCEP leaders.
- Identify short-, medium-, and long-term activities for NCEP and its nine centers to undertake in order to meet NCEP goals in support of NOAA and NWS strategy.
- Establish a proactive approach within NCEP to take the initiative and seize opportunities towards achieving our strategic goals.
- Articulate key NCEP requirements and gaps that are essential to supporting higher level NOAA and NWS in order to identify resource needs.
  - NCEP is the foundation for NWS operations and the U.S. weather enterprise; the NWS cannot achieve its mission without a fully-capable, healthy NCEP.
- Identify the most important, unique, and foundational roles for NCEP in support of NWS' Vision for a Weather-Ready Nation and implementation of the NWS Strategic Plan, particularly NCEP capabilities essential for:
  - Collaborative Forecast Process, in partnership with regional/local offices
  - Impact-based Decision Support Services (IDSS)
  - Development and evolution of the Unified Forecast System (UFS)

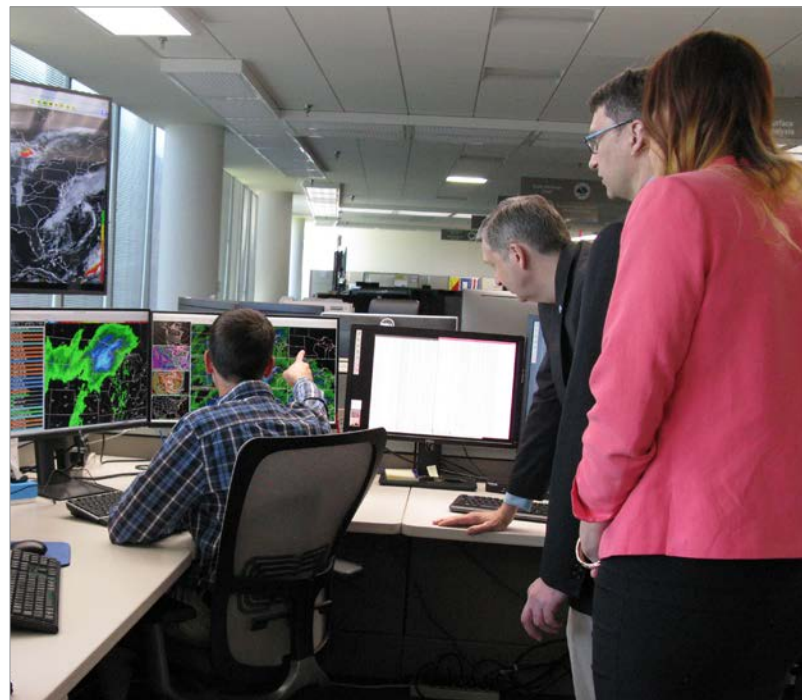
With the increased prevalence of high-impact weather, water, and climate extremes and the Weather-Ready Nation strategy of societal preparation for and response to these events, NCEP

## NWS Vision

“A Weather-Ready Nation: Society is prepared for and responds to weather, water, and climate-dependent events.”

## NWS Mission

“Provide weather, water, and climate data, forecasts, warnings, and impact-based decision support services for the protection of life and property and enhancement of the national economy.”



and the NWS at large must evolve to meet these challenges. In developing this strategic vision, NCEP has identified several actionable goals and objectives, along with candidate implementation actions, that are detailed in the NCEP Strategic Implementation Plan. These goals and associated activities fall under the following four Focus Areas:

## Focus Area 1: People & Culture

In order to meet these challenges, NCEP must develop the next generation workforce and our future leaders. We will do this by directly investing in our people as they drive our success. We will build an unmatched, talented workforce by hiring, developing, and retaining employees from diverse

backgrounds. Our leaders will model consistent and authentic behaviors, driving a culture of equity and inclusion.

## Focus Area 2: Operations

Optimizing innovative solutions into operations requires a healthy and robust NCEP who provides foundational IDSS both nationally and internationally. As weather and climate services evolve, the NWS must respond with agility in order to provide the most accurate, consistent, and actionable forecast products we can achieve in service to the nation. A highly-capable and resource-healthy NCEP is essential to enabling the Collaborative Forecast Process with our partners at local weather forecast offices, as well as key for optimizing IDSS at the local, state, regional, and national levels.

## Focus Area 3: Science & Technology

With its world class workforce, NCEP positions itself to create innovative solutions utilizing the most advanced science and technology. As climate and extreme weather impact national and global security, NCEP will leverage advanced methods to enhance national resilience from global environmental hazards. NCEP will build upon its numerical modeling, post-processing, and forecasting suite, along with its supporting infrastructure, to enhance and solidify its role as a global leader. NCEP will also drive the agency towards probabilistic guidance and enterprise processes/solutions to meet the largest technical challenges facing NWS, ensuring technical capability enables scientific advances.



## Did You Know?

The **Weather Prediction Center** serves as the nation's premier center for forecasting rain storms, winter storms, and synthesizing the nation's big-picture weather story.

## Focus Area 4: Global Partnerships

Together, the NCEP workforce, working in tandem with our partners, will create innovative science-based and technical solutions to the world's most challenging climate and extreme weather challenges while solidifying itself as the operational foundation for national and global decision support services. NCEP is also uniquely positioned to advance U.S. national interests abroad by employing environmental diplomacy to include building on our legacy of capacity development in less developed countries.

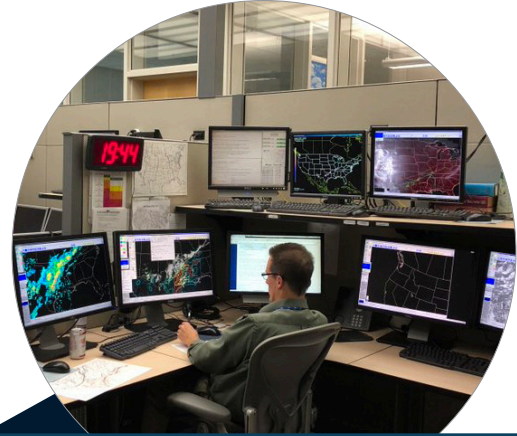
Together, our next generation workforce collaborating with our partners, NCEP will create innovative science-based and technical solutions to the world's most challenging climate and extreme weather challenges while solidifying itself as the operational foundation for national and global decision support services. Executing this common vision reinforces NCEP as the essential foundation necessary for NWS to achieve its mission of protecting lives and property and enhancing the national economy. NCEP is ready to take on new challenges to achieve this vision for the future ... so let's get to work!

# Our Focus

Our strategic implementation plan is organized around four focus areas that provide a logical framework for moving our centers forward towards a shared vision. These focus areas provide an umbrella that captures what is important for meeting our mission to deliver national-level products and services that save lives and property and enhance the national economy.



**People & Culture**



**Operations**



**Science & Technology**



**Global Partnerships**

# Our Actions

Within our four focus areas, we have identified 11 goals with 34 supporting objectives that will drive future implementation actions. They describe the key short- to medium-term activities that will be critical in setting up our future success. Some are aspirational and serve as future guiding points that will allow us to strive towards efforts that prioritize our future vision for our centers.

# Focus Area 1: People & Culture

The success of NCEP is through its people. Our people are inspired by and dedicated to the mission of saving lives and property and enhancing the national economy. In an effort to achieve our mission, it is our people who develop and utilize NCEP resources, tools, and procedures without which NCEP would cease to exist. Therefore, it is imperative that NCEP puts its people first. Focus Area 1 is the foundation by which NCEP will strive to create an environment where all its people are comfortable to be themselves, feel valued, are motivated to contribute, and have opportunities to grow. In addition, to better understand, serve, and engage with all the communities in our nation, NCEP will ensure its people represent the diversity of our nation and attract experts from across the world. Based on the first NWS core principle that articulates the basis for a healthy organization and culture, there needs to be a direct investment in the NCEP workforce since its people drive the agency's success. The goals below align with the initiatives highlighted within the NWS Strategic Plan<sup>1</sup>, Strategic Human Capital Plan<sup>2</sup>, and Organizational Health Action Plan (OHAP)<sup>3</sup>.

## Goal 1: Build Connections & Trust

A diverse and inclusive environment where employees feel psychologically and physically safe to work effectively across organizational boundaries by eliminating silos and promoting actions that maximize the potential of all individuals in achieving our mission.

### Objective 1.1: Improve Organizational Health and Culture

To complement the ongoing NWS and NOAA efforts to routinely measure organizational health and culture, such as the Organizational Health Index (OHI) and Federal Employee Viewpoint Survey (FEVS), NCEP will leverage the OHAP while also distilling employee feedback to determine where and how to best improve culture and the overall employee experience within the workplace. Through this process, the NWS core principles will become evident, woven into the fabric of the organization and accounted for through leadership actions and behaviors. These principles should be reflected through consistent employee engagement, valuing employee learning, and transparent leadership actions that highlight the importance of creating a healthy work environment through cultural awareness, work-life balance, and mental health. Culture training should also emphasize interpersonal communication, with strategies that promote healthy relationships between all employees, as well as combating racism, bullying, and microaggression within the workplace<sup>4</sup>.

### Objective 1.2: Ensure a Diverse and Inclusive Environment

Diversity within the workplace allows an organization to offer a broader and more adaptable range of products and services. Therefore, it is imperative to create a workforce that

## NWS Core Principles

1. **Our people drive our success.** We are dedicated to our science-based service to the nation.
2. **We provide the best forecasts possible,** connecting them to decisions that reduce impacts.
3. **We cannot do it alone.** Teamwork and partnerships are essential for success.
4. **We strive for excellence,** continuously improving our science and engineering for mission performance.

## Healthy Work Environment

- Consistent employee engagement
- Training and learning
- Transparent leadership
- Cultural awareness
- Work-life balance (personal and professional life)
- Mental Health is a priority
- Healthy relationships exist between management, staff, and partners
- Zero tolerance for racism, bullying, and microaggressions.

reflects the communities we serve while also inspiring all within NCEP to see diversity as a necessity for success. Based on 2021 demographics, women represent just over 22% of NCEP's workforce, as compared to 29% of the atmospheric and space sciences workforce, 27% of the STEM workforce, and 48% of the overall civilian labor force. Employees who identify as Black, Indigenous, and People of Color (BIPOC) make up a little over 25% of the NCEP workforce, as compared to 13% of the atmospheric and space sciences workforce, 29% of the STEM workforce, and 33% of the overall civilian labor force.<sup>5</sup> To address these disparities, NCEP

<sup>1</sup> National Weather Service Strategic Plan 2019-2022

<sup>2</sup> National Weather Service Workforce for the Future: Strategic Human Capital Plan 2019-2022

<sup>3</sup> National Weather Service Organizational Health Action Plan

<sup>4</sup> 2020 OHI Results for NCEP

<sup>5</sup> 2019 Census Data



will strive to promote a diverse and inclusive environment at all levels while also empowering employees to perform to their maximum potential while also providing meaningful changes that lead to increased inclusiveness, belonging, and opportunities. Inclusivity should also involve maximizing the integration of all staff members, including federal employees, contractors, Cooperative Institute associates, visitors, and interns in order to amplify the effectiveness of diverse teams and to affirm appreciation for all contributors.

### Objective 1.3: Increase Employee Engagement

By engaging with employees, there is an increased sense of purpose within an organization and thus the organization becomes more effective and innovative. The first step to achieve this initiative is to ensure a physically and psychologically safe work environment where all employees (feds and contractors alike) feel secure in the workplace to share ideas without fear of retribution while also being their complete, true self. These practices will promote openness and optimize employee trust, helping to build a sense of belonging and allyship. Furthermore, leaders should illustrate how employee engagement has positively shaped their respective centers' vision, mission, and operations. As a result, employees will feel valued and thus invest more energy into their respective centers.

## Goal 2: Improve Employee Recruitment & Retention

Meeting the mission of NCEP depends on proper recruitment and retention of talent and expertise within the organization. To this end, there are strategic efforts to achieve a workforce that is qualified, agile, and diverse that will support retention through sustaining a culture of flexibility, recognition, and high performance.

### Objective 2.1: Enhance Hiring Practices

To assist in obtaining and retaining the best and most diverse talent, NCEP will leverage all hiring authorities, use objective and competency-based assessment practices, and continue transparent standardized hiring practices across all centers as referenced in the NCEP Hiring Guidance.<sup>6</sup> The objective is to improve all aspects of the hiring process by reducing barriers and promoting the use of diverse interview panels. As a result, this will support the highest quality hiring decisions based on qualifications and the ability to help grow the NCEP workforce while also ensuring recruitment mirrors the communities we serve. Another key initiative is to expand interdisciplinary hiring practices (e.g., expanding some job opportunities beyond the 1340 Meteorologist job series) which will help broaden the scope of talent required to adapt to the evolving needs within NCEP and the communities it serves.

### Objective 2.2: Expand Outreach Opportunities

Increasing outreach opportunities within the STEM community, including Historically Black Colleges and Universities (HBCU) and Minority Serving Institutions (MSI), will both help educate and expand our talent pool in the long term through recruitment of



## Did You Know?



The **National Hurricane Center's (NHC)** vision is to be America's calm, clear, and trusted voice in the eye of the storm and, with its partners, to enable communities to be safe from tropical weather threats.

a more diverse workforce. NCEP will continue to engage with existing NOAA- and NWS-wide educational programs helping to connect with individuals across the STEM community, thereby broadening and deepening the pool of talent from which the future workforce will be drawn. In addition, NCEP will strive to expand its outreach opportunities within HBCU and MSI which help foster partnerships while also opening the pipeline of well-educated and trained individuals ready to become involved in environmental prediction.

### Objective 2.3: Support Flexible Work Arrangements

NCEP commits to supporting flexible work arrangements that help employees to optimize productivity while achieving work-life balance, thereby aiding to recruit and retain a talented and highly-motivated workforce. Strategic practices to reach this objective include development of flexible scheduling across all roles while maintaining surge support capacity for high-impact weather events and expanded telework and remote work opportunities.

<sup>6</sup> NCEP Hiring Guidance



### **Objective 2.4: Build a Culture of Recognition**

Timely recognition of employees increases workplace morale and thus retains talent. To this end, NCEP will support a more consistent and cohesive awards program that is fair and transparent, specifically highlighting the achievements of employees across all centers through an NCEP-level awards program similar to that established by the NWS Director. This initiative includes finding alternate ways to increase recognition to NCEP contract and cooperative institute employees.

### **Objective 2.5: Improve Performance Management**

Enhancing the current appraisal process across all centers cultivates a high-performing culture through increased accountability and effective professional development, as well as awareness of individual performance. To this end, NCEP will support an assessment process that provides more meaningful feedback for all staff within NCEP.

## **Goal 3: Develop an Agile Workforce**

Enhancing development and training opportunities within the workforce allows employee growth and agility, as well as increased organizational productivity and effectiveness which permits NCEP to lead the world in environmental prediction and service.

### **Objective 3.1: Grow More Effective Leaders**

Leadership is one of the most important factors to organizational success, especially when considering the rapid change within the field of science and technology and the needs of core partners. Therefore, in an effort to build the next generation of effective leaders, NCEP will evaluate current leadership development opportunities, leverage existing regional leadership programs, and create leadership programs to account for any deficiencies. Such an approach will better prepare employees for success within the organization with an emphasis on effectively communicating and emulating NCEPs goals, vision, and core principles including diversity, inclusion, belonging, accessibility, and equality. Leadership training should be a priority at all levels within NCEP to ensure every employee receives the necessary career growth opportunities that also aligns with current and future needs of NCEP. This includes equipping managers with the necessary tools

## **Did You Know?**



The **Ocean Prediction Center (OPC)** originates and issues marine warnings and forecasts, continually monitors and analyzes maritime data, and provides guidance of marine atmospheric variables.

to handle conflict resolution to optimize organizational health and culture. In addition, building future leaders while also ensuring NCEP prospers will involve succession planning. As such, this will require a systematic assessment of the knowledge, skills, and abilities needed to perform certain functions within the workforce, and a resultant strategy to prepare the next generation to perform those functions in the years ahead.

### **Objective 3.2: Expand Professional Development and Technical Training**

Investments must be made in the professional development of NCEPs current and future workforce to strengthen the capabilities for meeting new requirements and emerging technologies, while also improving individual performance and employee experience. Achieving such an objective will start with an assessment of both the skills we lack to meet our future needs and the current state of development and training across all levels of NCEP to identify deficiencies. A strategy will then be developed based on the gap analysis to ensure employees receive the necessary support for professional development and technical training that align with career growth opportunities as well as with the evolving needs within NCEP. This can be accomplished by either utilizing existing NOAA/NWS programs or developing new and innovative ways to enhance employee skills and knowledge. Furthermore, by capitalizing on performance management practices through expanding mentorship and coaching opportunities, these initiatives can be achieved.



## Focus Area 2: Operations

Operations within NCEP provide the foundation for Impact-based Decision Support Services (IDSS) through the data, information, and services utilized at the local, regional, national, and international levels. This includes direct IDSS with national decision makers [e.g., Federal Emergency Management Agency (FEMA), Federal Aviation Administration (FAA), US Coast Guard, among others], and collaborative engagement with Regional Operations Centers (ROCs) to support regional IDSS. The data, information, and services produced and disseminated by NCEP also provide the foundation upon which NWS IDSS relies at the local, regional, national, and international levels. Watches, warnings, forecasts, and outlooks are often the first items utilized or assessed in making actionable decisions.

In addition, NCEP's operational workflows and processes support the timely execution and distribution of NOAA's operational numerical model guidance suite, manage the flow of data and products to partners and stakeholders, and carry out the R&D, transition, and implementation to improve NOAA's operational models. As the impacts and frequency of extreme weather events increase, NCEP must continue to evolve our operations to improve our products and services to enable better decisions that save lives and property and enhance the national economy.



### Did You Know?

The **Storm Prediction Center (SPC)** is tasked with forecasting the risk of severe thunderstorms and tornadoes in the contiguous United States.

### Goal 4: Enhance NCEP's Collaborative Capabilities for Operations

As the leader of environmental prediction, NCEP leverages the expertise within each center to seamlessly provide high-quality products and services in order to enable the NWS to execute our operational mission. NCEP will evolve towards a more collaborative, agile, and interconnected operational model that combines our centers of expertise with our local knowledge of partners and geography. This expansion of collaboration includes National Centers, Weather Forecast Offices, River Forecast Centers, other federal agencies (both within and outside of NOAA), and international partners.

## Objective 4.1: Enhance Collaborative Operational Efforts with NOAA/NWS Offices

Based on the “one agency” approach, NCEP capitalizes on its unique position to collaborate operations utilizing the extensive operational expertise spread across the various National Centers and finding routine opportunities to ensure a collaborative exchange of operational ideas and innovation across all NCEP Centers. In addition, NCEP will expand and improve operational collaborations with NWS field offices and other NOAA/NWS entities, which will in turn improve overall performance, products, and services.

## Objective 4.2: Increase Collaborative Efforts with Key Stakeholders and Partners

NCEP should enhance relationships across the Weather, Water, and Climate Enterprise that align with each Center’s mission and vision. In support of the [NWS Partnership Strategy](#), NCEP will actively seek opportunities to grow new collaborations with stakeholders and partners, as well as deepen and improve existing collaborations such as those with FEMA, FAA, and other external groups.

## Goal 5: Optimize NCEP’s Operational Forecasts

In order to accomplish the NWS mission of saving lives and property, NCEP must provide world-class IDSS to its stakeholders. Optimizing NCEP’s operational forecasts facilitates the expansion and enhancement of IDSS. Three strategies aimed at optimizing NCEP’s operational forecasts include evaluating and solidifying NCEP’s roles and responsibilities, improving NCEP forecasts of high-impact events, and refining NCEP’s forecast communication.

### Objective 5.1: Evaluate and Solidify NCEP’s Roles and Responsibilities

In service to its stakeholders, NCEP has assumed countless new roles and responsibilities over the past three decades. Optimizing NCEP’s operational forecasts necessitates evaluating and solidifying NCEP’s roles and responsibilities in order to maximize the effective and efficient use of our people and computational resources. Since this process will lead to changes in the roles and responsibilities at NCEP Centers, it could also change the relationships in how we collaborate with NWS Weather Forecast Offices and our external partners, so this will transcend just NCEP alone. While use of existing resources in new or better ways can help NCEP accomplish our mission more effectively, additional resources will also be necessary to meet our expanding needs.

### Objective 5.2: Lead Forecasts of High-Impact Events

Societally-disruptive and climatologically-infrequent high-impact events present an ongoing challenge for operational forecasters tasked with their prediction. Such high-impact events (which can be atmospheric, oceanic, or solar) occur across a variety of



## Did You Know?



The **Aviation Weather Center (AWC)** is one of only two World Area Forecast Centers (the other being the UKMET office) delivering global forecasts to the aviation community world wide.

temporal and spatial scales, ranging from nowcasts of tornadic supercells to the subseasonal-to-seasonal (S2S) prediction of extreme drought conditions. Due to their detrimental impact on lives and property, NCEP Centers must forecast high-impact events early and accurately. Special attention should be given to improving NCEP forecasts of high-impact events at operational centers, particularly events for which NCEP provides IDSS.

### Objective 5.3: Refine NCEP’s Forecast Communication

NCEP Centers communicate their forecasts to a variety of stakeholders to facilitate regional, national, and international IDSS. The ability of individual stakeholders to understand NCEP’s guidance and forecasts varies widely—from an expert local forecaster to a casual public user. NCEP webpages and forecast graphics should strive to have a consistent, social science-informed “look-and-feel” across centers which will make graphics easier to understand when viewed as standalone products (particularly in the age of social media). NCEP’s messaging, specifically the terminology used in its products, should also be revisited to ensure its intended interpretation by all users. Spanish-language products should be made available when possible.



## Did You Know?



The **Climate Prediction Center (CPC)** delivers real-time products and information that predict and describe climate variations on timescales from weeks to years, promoting effective management of climate risk and a climate-resilient society.

### Goal 6: Improve Accessibility of NCEP Data and Products

With the NWS evolving towards a partner and customer-centric service delivery model and transforming the way people receive, understand, and act on information, NCEP should make the foundational data, forecasts, warnings, and services it provides more accessible to all users. NCEP will accomplish this through streamlining the process to create new or improved products and services, improving the 'ease of use' for new and existing products, and developing a strategy to realize and focus on the needs of vulnerable and underserved communities.

#### Objective 6.1: Optimize Products and Services

NCEP Centers should take steps to provide its users and core partners with improved products and services that are relevant and useful. The first step to achieving this is through continuous collaboration and engaging with users and core partners in order to gain a better understanding of their evolving needs. Based on this collaboration, NCEP should incorporate more probabilistic information into its products, allowing users and partners to be better informed in making critical decisions.

#### Objective 6.2: Improve Communication and Outreach to Vulnerable Communities

Extreme weather and climate change have been demonstrated to have a disproportionate impact on vulnerable groups, where "vulnerable" groups have been defined based on income,

educational attainment, race and ethnicity, and age (see EPA report, Sep 2021<sup>7</sup>). In partnership with NWS Regional and National Operations Centers, NCEP will learn from the 2021 NWS Service Equity Assessment and implement strategies to enhance outreach and more effective communication with communities and populations who exhibit socioeconomic vulnerability, and will begin investing in an operational forecast and service delivery model that exhibits service equity and mitigates the disproportionate impact on these vulnerable groups.

### Goal 7: Enhance NCEP's IDSS & Education/Outreach

Achieving the NWS mission requires a robust mechanism for interacting with the variety of stakeholders who

<sup>7</sup> EPA, 2021: *Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts*



need the information NCEP provides to make effective decisions. Through IDSS, NWS works with local, state, and federal partners to deliver critical information for impact-based decisions; as such, NCEP has a leading role in enhancing IDSS, education, and outreach with NWS partners and stakeholders. Particular attention must be paid to communities that are underserved and historically marginalized to accelerate service equity.

### **Objective 7.1: Improve Delivery of Foundational Data**

IDSS begins with foundational data from NCEP (e.g. guidance, observations, forecasts, and warnings) that remain trustworthy, quality-controlled, and science-based. It is therefore essential that NCEP provide data and information tailored to IDSS needs in an effective and comprehensive way. Furthermore, those data must be in a format that public safety officials, emergency managers, water resource managers, and the general public can use to take protective action against weather, water, and climate events.

### **Objective 7.2: Provide Data Interpretation Services**

The utility of the foundational data that NCEP provides depends on people's ability to understand the information. NCEP must provide interpretive services to users so they understand how to use the data and information to make decisions. This requires NCEP to leverage expertise across the agency because communicating the data to all end users is beyond the scope of what NCEP alone can do.

### **Objective 7.3: Expand Education and Outreach**

In order for people to take action to avoid the loss of lives and livelihoods when threatened by an extreme event, society must understand weather, water, and climate information. NCEP proactively strives to expand education and outreach initiatives to the general public and core partners, which serve as an excellent mechanism for building trust and fostering relationships. Increased education efforts lead to better understanding of NCEP's products and services. Better outreach also helps NCEP improve current products and services, identify needs for and develop new ones, and retire those that are no longer needed. All of NCEP must work together to develop and implement education and outreach activities. Collaboration with others in the NWS, NOAA, and beyond will also be necessary to develop effective strategies.

### **Objective 7.4: Spearhead the Provision of Quantitative IDSS**

IDSS is built on both environmental data and subjective personal relationships. Quantitative IDSS takes IDSS to the next level by objectively linking environmental forecast data to forecast impacts. It combines the probability of a weather hazard with critical user thresholds to objectively define the probability of an impact. NCEP will work with partners to understand their weather-sensitive costs and decisions and develop analytics to anticipate the quantifiable expected damages and economic impact of the weather event. For example, what is the probability that extreme winds will cause damages exceeding \$1M? NCEP is uniquely positioned to lead this frontier, given the combined expertise of meteorology, physics, and data analytics.

# Focus Area 3: Science & Technology

NCEP has positioned itself as a world-class leader in numerical modeling and forecasting. In order to continue to provide the products and services that its stakeholders expect and depend upon, NCEP must ensure that the science and technology used to create, refine, and disseminate its products and services are state-of-the-art. The movement of the NWS toward probabilistic forecasting necessitates upgrades to NCEP's numerical models, post-processing techniques, and products, as well as additional computational and dissemination resources. Science and technology must advance in tandem in order for NCEP to meet its evolving needs.

## Goal 8: Enhance the Science Underpinning NCEP's Forecasts and Products

As the NWS expands and strengthens its Impact-Based Decision Support Services (IDSS) and matures the Collaborative Forecast Process (CFP), improving the value of NCEP forecasts and products becomes increasingly essential to the success of the NWS mission. Improving the value of NCEP forecasts and products can be achieved by enhancing the science used in their creation. This involves advancing NCEP's modeling, post-processing, and data assimilation capabilities, as well as maintaining and expanding dialogues with NCEP's stakeholders.

### Objective 8.1: Improve NCEP's Operational Model Forecast Skill in Critical Areas

Improving NCEP's operational model forecast skill in critical areas is necessary to improve the value of NCEP's forecasts and products. These critical areas (e.g., sensible weather) are vital to IDSS across NCEP Centers, including forecasts of the atmosphere, ocean, and space. In order to improve NCEP's operational model forecast skill in critical areas, NCEP needs to collaborate with external partners contributing to NOAA's Unified Forecast System (UFS) and reconsider the rationale for making operational model upgrades. For example, rather than upgrading NCEP models on a set temporal cadence, NCEP models should be upgraded based on demonstrable improvements in areas that are vital to IDSS or advancements in science or technology that will lead to demonstrable improvements in the near future. Future model upgrades could be more or less frequent than the current temporal cadence, as well as responsive to targets for innovation.

### Objective 8.2: Develop and Enhance NCEP's Post-Processing Techniques

Post-processing techniques enable NCEP Centers to extract as much information as possible from observational data and model forecasts. The use of machine learning and artificial intelligence should be utilized more effectively to provide NCEP's stakeholders with the best possible initial conditions, forecasts, and products. To become a world-class leader in



post-processing (particularly of ensemble forecasts), NCEP Centers must expand their phenomena-specific post-processing techniques. Post-processing efforts should be discussed across NCEP Centers and NOAA labs to avoid the duplication of effort and to share expertise.

### Objective 8.3: Strengthen and Prioritize NCEP's Use of Observations

Environmental measurements are the foundation for all NCEP forecasts and products. In the future, NCEP will have expanding and evolving opportunities to acquire real-time and retrospective observations throughout all environmental domains. In addition to traditional observations, new observations could be available from proliferating low-cost satellites, high-inclination orbits, and new solar-orbiting platforms from government and commercial partners. With these rapidly expanding observing capabilities, NCEP has the opportunity to fully leverage non-NOAA and non-U.S. observations to improve NCEP model data assimilation and forecaster visualization. By identifying gaps in its products and services, NCEP can also help inform the design of future observing systems used to improve data assimilation and forecast skill.



#### **Objective 8.4: Utilize Testbeds at NCEP Centers to Facilitate R2O2R**

Each operational NCEP Center has specific modeling and technical needs that must be met in order to improve the value of their forecasts and products. In order to facilitate the R2O2R needed to meet their specific modeling and technical needs, some NCEP Centers have developed testbeds based on the phenomena that they forecast. These testbeds provide a proving ground for new forecast tools and products/services that are beneficial to both model developers and operational forecasters. Testbeds also help foster, maintain, and strengthen relationships with the broader community (e.g., emergency managers and broadcasters), whether through one-time or recurring experiments [e.g., the annual Hazardous Weather Testbed (HWT) Spring Experiment at NCEP's Storm Prediction Center]. Utilizing testbeds, whether existing or new, will help facilitate the R2O2R needed to meet each NCEP Center's specific modeling and technical needs.

#### **Objective 8.5: Maintain and Expand Dialogues with NCEP's Stakeholders**

Improving the value of NCEP's forecasts and products depends upon identifying and resolving operational modeling issues. NCEP's stakeholders, who use its forecasts and products on a routine basis, are an invaluable source of information about NCEP's operational models and products. Maintaining and expanding dialogues between NCEP's stakeholders and developers will allow for a greater exchange of information between the two groups and the earlier identification and resolution of operational modeling issues.

## **Did You Know?**



**The Space Weather Prediction Center (SWPC)** safeguards society with actionable space weather information and serves as the nation's official civilian source of space weather warnings, watches, and alerts.

### **Goal 9: Prioritize NCEP's Evolving Technological Needs**

In order to elevate its standing as a world-class leader in numerical modeling, post-processed guidance, and other products, NCEP must continue to increase and effectively utilize its computational resources. Increasing and effectively utilizing NCEP's computation resources can be achieved by prioritizing NCEP's evolving technological needs. This involves increasing development and operational processing capabilities across NCEP (from supercomputers to personal laptops), as well as improving NCEP's dissemination capabilities and web services.



## **Objective 9.1: Increase Development and Operational Processing Capabilities**

Proportionately increasing development and operational processing capabilities (e.g., obtaining larger/faster supercomputers) is critical to ensuring that NCEP remains a world-class leader in numerical modeling and post-processed guidance. The current goal outlined by the NOAA Science Advisory Board is a 100x increase in HPC resources by 2031.<sup>8</sup> Increasing NCEP's development processing capabilities (e.g., compute farms) allows for the creation of the reanalysis/ reforecast datasets required to produce model-specific post-processing techniques prior to model upgrades. Increasing NCEP's development processing capabilities also allows for the testing needed to demonstrate required improvements prior to future model upgrades. An increase in operational processing capabilities supports the implementation of NCEP's growing global/regional ensembles, which are the cornerstone of probabilistic forecasts. An Architecture Plan for NCEP's supercomputers and ancillary systems, as well as its resources in the Cloud, should be constructed to ensure the effective use of NCEP's computational resources.

## **Objective 9.2: Increase Flexibility and Resiliency of IT Capabilities**

NCEP should drive towards enterprise solutions, where appropriate, while balancing the needs and requirements of individual NCEP Centers. This allows NCEP to be more agile and quickly respond to issues that arise (via resourced and effective Help Desks), while also allowing NCEP Centers to focus and grow in their individual areas of expertise. Resourcing IT solutions that facilitate the flexibility needed for on-site and remote operations will enable employees to react more efficiently to changing landscapes. For example, NCEP must continue to improve, harden, and support short-term backup capabilities and Continuity of Operations (COOP) infrastructure at all NCEP Centers in order to ensure essential services and critical products can be provided to customers in the event that NWS personnel, facilities, equipment, or systems are unable to provide them. The transition of COOP solutions to AWIPS2 will be challenging, and time and resources must be allocated to make the transition.

## **Objective 9.3: Improve the Dissemination of NCEP Products and Services**

Critical products and services produced around the world depend upon the efficient and effective dissemination of NCEP forecasts and data, both within the NWS and to its external partners. NCEP must ensure that the forecasts and data produced by an individual NCEP Center can be easily incorporated into the forecast decision processes and IDSS tools at other NCEP Centers and NWS field offices, as well as used by its external partners. In order to accomplish this, NCEP should reimagine the ways in which forecasters and stakeholders obtain and view their forecasts and data. For the NWS, this includes consolidating to a single platform to visualize data and create/send products (e.g., the convergence of NAWIPS and AWIPS2) while ensuring that the performance needs of NCEP Centers and NWS field offices are met prior to

any transition. For external partners, this includes prioritizing reliable, resilient, redundant, and accessible external dissemination capabilities that meet stakeholder needs.

## **Objective 9.4: Modernize Web Services to Meet Users' Evolving Needs**

Meeting the NWS's IDSS initiatives requires NCEP to be a leader in web-based visualization tools for comprehensive forecast/ data discovery. It is critical for NCEP to provide web services that allow stakeholders and decision-makers to easily access the information they are seeking, whether they are in the office or the field. This includes making operational NCEP web pages "mobile friendly" in order to improve user experience on cell phones and tablets and maximize NCEP's reach. NCEP web pages and graphics should all have a consistent "look-and-feel" that exemplifies the high-quality and consistent standards expected of NCEP products and services.

<sup>8</sup> [A Report on Priorities for Weather Research \(PWR\)](#)

# Focus Area 4: Global Partnerships

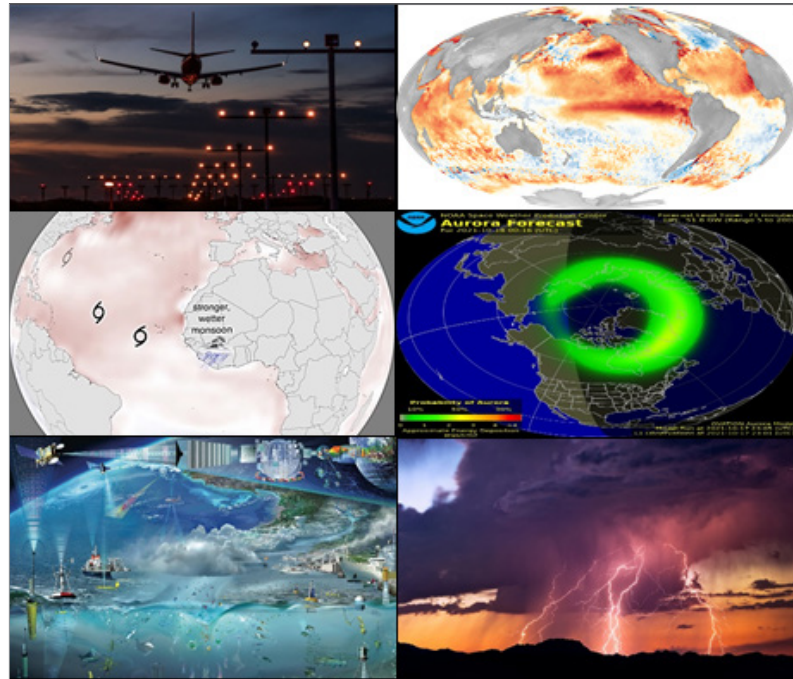
Over the past several decades, NCEP has taken advantage of advances in science and technology to support U.S. national interests abroad, as well as a wide range of international weather, water and climate services. NCEP continues to work collaboratively with national and international agencies to provide global actionable environmental information, helping reduce risks associated with extreme weather events. NCEP contributes tremendously to developing the capacity of meteorological services around the world, providing governments with tools to cope with natural disasters. NCEP will build on its success as a lead global center for weather, water, and climate predictions to expand international collaboration, improve forecasts and services, and advance early actions and early planning for the benefit of society.

## Goal 10: Expand Global IDSS Partnerships for Environmental Prediction Services

The need for actionable weather, water, and climate forecasts to meet societal demand has never been greater as the world grapples with threats caused by frequent extreme weather events and their impacts on global societies. NCEP has established a sustained, leading role in providing weather, water, and climate services through international engagements that support broad U.S. national interests, such as through the U.S. contribution to the mission of the United Nations (U.N.). NCEP strives to coordinate and consolidate its cross-center international activities and expand its core partners, both domestic and international, to bolster weather, water, and climate services around the world.

### Objective 10.1: Expand Global Engagements in Support of U.S. National Interests

In response to growing global needs for actionable weather, water, and climate information, NCEP will capitalize on its recognition by federal development agencies to advance and expand the use of science to improve strategy development and decision-making with interagency and international partners. NCEP will work to develop new and strengthen existing interagency partnerships to develop U.S. capacity to apply weather, water, and climate information to foreign policy, national security, and other U.S. interests. NCEP will also engage with multilateral partners in global science diplomacy to build competency in communication with diplomats and policy makers to convey effective science advice. Furthermore, NCEP will build a culture of cooperation to enhance interagency collaboration for advancing actionable weather and climate information and improving early warning systems. Altogether, this will lead to NCEP enhancing our existing partnerships (e.g., with USAID for international development) and establishing new ones to support other areas of U.S. national interests.



### Objective 10.2: Enhance Partnerships to Improve Global Weather, Water, and Climate Services

NCEP provides world-leading weather, climate, water, and data services across the globe as part of the U.S. contribution to the U.N., particularly through the World Meteorological Organization (WMO). NCEP will enhance our partnerships with WMO global centers in advanced countries and continue to significantly contribute to capacity building in developing countries to aid them in improving their environmental services needed to fulfill their own missions to save lives and property. Examples in this area include engagement with WMO Regional Associations and National Meteorological and Hydrological Services. NCEP will coordinate and consolidate its international interests across all National Centers wherever possible to leverage our collective strengths to carry out designated international responsibilities and commitments more effectively.



## Goal 11: Enhance Global Science and Technology Collaborations to Deliver the Best Forecasts and Warnings

NCEP will promote international collaboration to increase access to global data necessary to advance forecasts and warnings, as well as foster interdisciplinary research and transition to operations to improve forecasts and warnings.

### Objective 11.1: Strengthen Global Collaborations to Improve Operational Forecasts

NCEP has a long history of promoting the use of our global products in forecast decisions around the world. NCEP will strengthen and expand the International Desks across all centers to fill in gaps in the provision of forecasting tools and products which address strategic foreign policy goals of the United States Government, especially as it relates to the U.S. contribution to WMO. To ensure that international partnerships are effective, NCEP will establish metrics to measure success and to sustain and transition research to operations. In addition, NCEP will fully engage and assume leadership roles in emerging international science projects and initiatives.

### Objective 11.2: Expand NCEP Participation in Global Science Initiatives

International and interagency science collaborations have proven to be vital for advancing science and forecasting at all time-scales and also complement broader national science goals. As such, NCEP will promote and engage in multilateral global science partnerships for enhancing the observational network and improving models and forecasts. NCEP will advocate for the benefit of incorporating social, behavioral, and economic science, outreach and communication into multilateral science projects to forge effective interdisciplinary collaboration, and a holistic approach to developing research that meet societal needs. In addition, NCEP will encourage its scientists to seek opportunities to participate in WMO committees and international scientific forums to gain advanced knowledge of the world's priorities in data and in weather, water, and climate research to advance global forecasts.



# Candidate Implementation Activities

The goals and objectives of the 2022 NCEP Strategic Implementation Plan are intended to drive implementation activities at each of the nine NCEP National Centers, many in collaboration with each other as well as other parts of NWS, NOAA, and national and international partners. While detailed implementation plans will be developed later in response to this plan, the following high-level candidate implementation activities serve as a starting point:

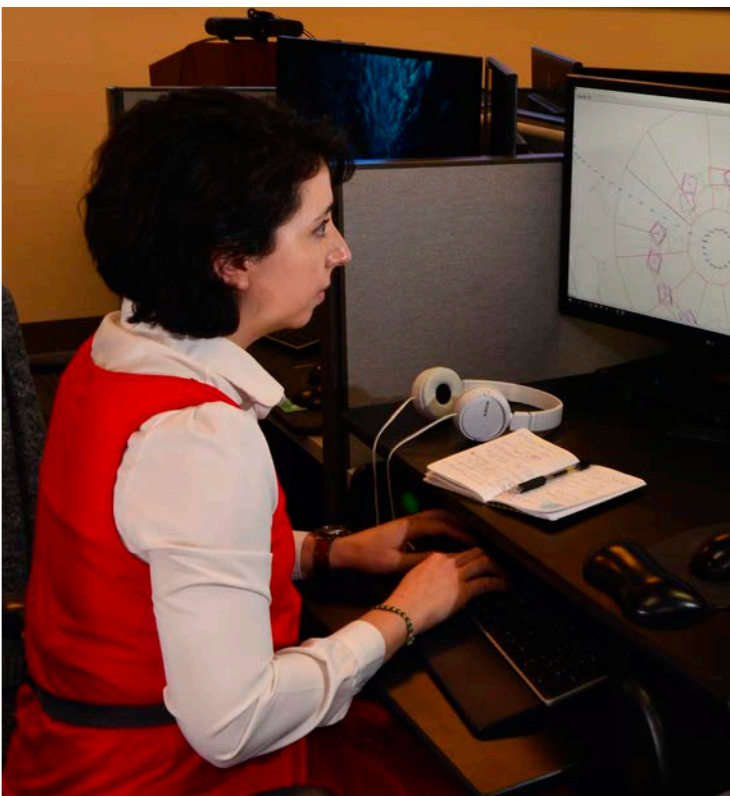
## Focus Area #1: People & Culture

- Develop NCEP leadership development programs consistent across all centers to grow leaders at the supervisor, manager and director levels
- Develop/pilot improved work models to improve employee health and retention
- Develop collaborative NCEP working groups/teams that cross-cut various 'People and Culture' themes



## Focus Area #2: Operations

- Address staffing, service and functional gaps across all NCEP Centers
- Pilot collaborative Center desk staffing model together with local forecast offices
- Improve the accuracy, consistency, and accessibility of NCEP analysis and forecast products and services
- Deepen the CFP approach across Centers and with other NOAA/NWS partners
- Be a leader in probabilistic forecast methods and social science in communication of products and services to customers



## Focus Area #3: Science and Technology

- Establish IT Architecture Team to develop NCEP needs for future architecture
- Modernization of NCEP websites: consistency between Centers, efficiency for hosting, and better accessibility (includes mobile friendly, etc.)
- Build towards full backup capability for all operational systems
- Improve infrastructure, processes and science-based decision making to maximize cost-benefit payoff for environmental modeling investments
- Evaluate requirements for optimal level of world-class IT services for employees conducting world-class science and services
- Leverage testbeds/proving grounds to improve collaboration with R&D partners and accelerate R2O



## Focus Area #4: Global Partnerships

- Increase engagement with Congressional and Administration stakeholders
- Improve and grow science and operation partnerships with internal NOAA offices, U.S. interagency organizations, and with international bilateral and multilateral entities
- Grow partnerships (e.g., DOS, USAID, etc.) for environmental diplomacy and to enhance national security