NOAA'S NATIONAL WEATHER SERVICE STRATEGIC PLAN 2011 - 2020

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Mission

Provide weather, water and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy

Vision

Keep Americans safe, healthy, and productive by delivering weather, water, and climate information

Goals

- Improve weather decision services for events that threaten safety, health, the environment, economic productivity, or homeland security
- Deliver a broader suite of improved water services to support management of Nation's water supply
- Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks
- Improve sector-relevant information in support of economic productivity
- Enable integrated environmental services supporting healthy communities and ecosystems

NOTE TO THE READER

The NWS Strategic Plan 2011 - 2020 responds to society's changing needs and strengthens NWS operations. The Plan derives from NOAA's Next Generation Strategic Plan and is the result of a collaborative endeavor among our employees, NOAA and NWS management, and our private sector, research and operations partners.

To guide the implementation of the Plan, NWS is developing two supporting roadmaps for services and science and technology that describe in more detail how we will achieve the vision and goals described in this Plan. The Services Roadmap, being developed by a NWS-wide team and managed by the NWS Office of Climate, Water and Weather Services (OCWWS), will define NWS operational changes and improvements to achieve the Strategic Plan vision and goals. The Services Roadmap will be supported by the Science and Technology (S&T) Roadmap, being developed by a NWS-wide team and managed by the NWS Office of Science and Technology. The S&T Roadmap will enable enterprise solutions and allow for continuous improvements across the NWS science service areas.

We encourage the reader to view the NWS Strategic Plan as the overarching framework for all NWS planning activities. Taken collectively, the Plan and Roadmaps along with implementation and program plans, budgets, operating plans, and even individual performance plans will guide the agency's decision-making and investment choices. Specific details such as resource requirements will be defined in program plans and budget submissions.

INTRODUCTION

The National Weather Service (NWS) has played a key role in protecting American lives and properties for over a century. The timely provision of reliable weather, water, climate, and environmental information has supported the Nation's social and economic development. NWS offices in communities across the U.S. and its territories, supported by regional and national centers, provide the authoritative information needed by Americans, including national, regional, state, tribal and local authorities, to plan, prepare, mitigate, and respond to natural and human-caused events.

The NWS is part of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), an agency with a diverse mission to understand and communicate changing conditions in the weather, climate, oceans, and coasts and use that understanding to manage natural resources, including managing the Nation's fisheries and supporting healthy coastal habitats and species. NWS expertise in weather, water, and climate prediction, contributes to NOAA-wide initiatives such as air and water quality forecasts and ecological prediction and monitoring. NOAA's commitment to science, service, and stewardship informs society to respond and adapt to environmental conditions within a changing and uncertain world.

As the world has changed, so too has the NWS, advancing our scientific and technical capabilities to better meet the needs of Americans. During the 1980s and 1990s, NWS deployed state-of-the-art observing and computing systems, re-aligned the organization to better deliver services, and made substantial investments in training and recruitment. The result was an organization with a greater capacity to help saves lives and avert disaster.

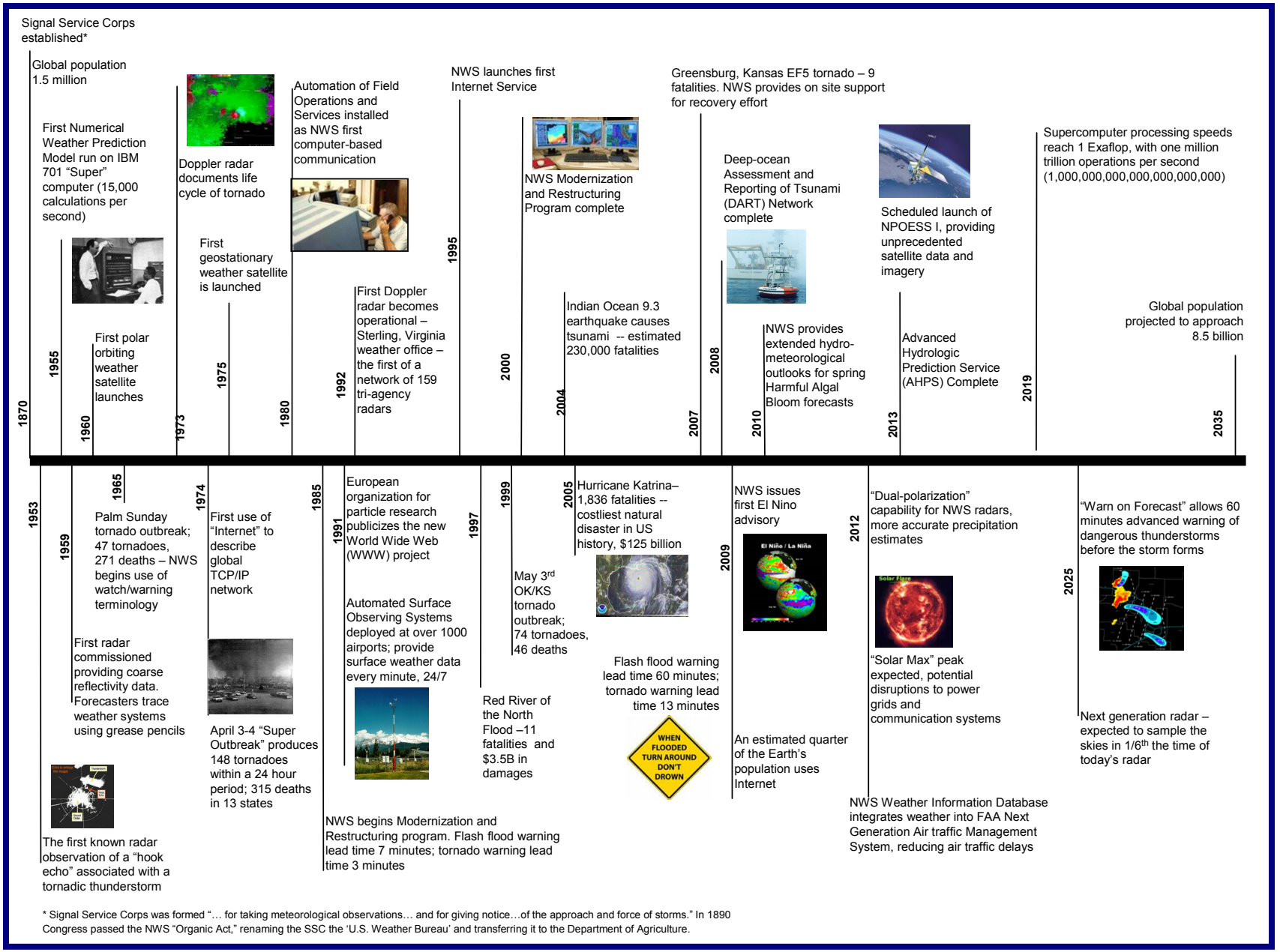
> In 1950, an F5 tornado devastated the town of Udall, Kansas, killing 68 percent of the town's residents. In 2007 an F5 tornado similar in makeup to Udall ripped through Greenburg, Kansas decimating the town. Emergency managers on the scene expected a death toll in the hundreds. Unlike Udall, Greenburg residents were prepared as a result of advances in the NWS warning system, radar improvements, and a strong partnership among NWS, emergency responders, media, and private sector. The number of fatalities in Greenburg was nine - a casualty rate less than 7 percent of that in Udall fifty-seven years earlier.

Today our services continue to evolve and improve to meet emerging needs. For example, NWS forecasters are working more closely with emergency responders to prepare for and avoid the impacts of natural and human-caused events; space weather forecasts and warnings are helping protect our Nation's infrastructure, and climate outlooks are contributing to the management of the Nation's water resources, energy supply and food security. We are also responding to the changing ways people communicate, network, and share information, and we are using new technologies to make information more accessible and interoperable.

Over the next ten years, weather, water, climate, and environmental information will play a greater role in the significant decision's we make as individuals and as a society – from the quantity and quality of water we need and the air we breathe, to the generation and distribution of renewable energy, the safe passage of our country's highways, railways, seas, and airways – making everyday life safer, healthier, and more productive.

The timeline on the next page encapsulates the evolution of NWS from its inception to the future, including the significant events and advancements that have shaped or will influence our services to the country.

NWS EVOLUTION AND INNOVATION: PAST TO FUTURE



* Signal Service Corps was formed "… for taking meteorological observations… and for giving notice…of the approach and force of storms." In 1890 Congress passed the NWS "Organic Act," renaming the SSC the 'U.S. Weather Bureau' and transferring it to the Department of Agriculture.

THE PLAN

> ***NWS Vision:*** *Keep Americans safe, healthy, and productive by delivering weather, water, and climate information*

Our vision calls for a new way of observing, forecasting and warning. We must move beyond just the forecast to providing information that eliminates or reduces the likely human and economic impacts of weather-related events on the public, sectors, and ecosystems. Our goal is to provide information that allows decision makers to take preventative actions so fewer lives are lost or displaced and less damage is done to communities, businesses, and the environment. Impact-based decision support services means:

- Producing highly accurate and specific forecasts on multiple time scales that integrate human, economic, cultural, risk and uncertainty criteria;
- Communicating information in ways people can assess direct and indirect impacts in useful and relevant ways so benefits are realized;
- Rethinking how and what we warn to target those at risk;
- Integrating immediate feedback on the impacts of our forecasts and services;
- Reaching out to sectors whose safety, health, productivity, or security is at-risk: transportation and public health officials; water resource and environmental managers;
- Empowering America's entrepreneurs and businesses to gain full value from our information
- Applying prediction capabilities to alert for broader ecological and health impacts;
- Integrating user thresholds and impacts into the forecast process to communicate risks and uncertainty; enhancing visualization and collaboration to facilitate communication.

Impact-Based Decision Support – What Is It?

Forecast
+ Social and Economic Impacts & Risks

Impact-Based Forecast

Targets the individuals and economic sectors at-risk

Requires knowledge of user needs

Why? Minimize the Human and Economic Impacts

It is no longer sufficient to produce an accurate forecast of severe weather and issue a timely warning. Our users must be able to properly use NWS information to realize safety, health, and productivity benefits. We envision forecasters focusing less on improving increasingly accurate model output and more on maintaining continuous situational awareness, interpreting information and providing decision support for high impact events with an understanding of user decision thresholds. We envision local and regional offices as decision support hubs delivering integrated environmental information for NOAA and other agencies, in partnership with the private sector. Delivery of decision support will be based on user needs: pushed by the forecaster or pulled by the user. It will be for the general public, sectors,

organizations, or public officials. We envision our national centers continuing to serve as the operational foundation for NWS – and supporting NOAA to provide weather, water, climate, and other environmental predictions within an Earth system framework. Critical to our success will be the ability to work closely with public and private sector partners to enable our users to exploit accurate, timely and impact-focused information.

Scientific and technical advancements are essential enablers for providing impact-based decision support. Most notably, the planned four-dimensional environmental database, or 4D Cube, and associated forecaster tools will transform operations by integrating weather, water, climate, and environmental observations, forecasts, and decision-making into a network-enabled, continuously updated "virtual" repository. The result will be a common, nationally-consistent, real-time weather picture, allowing forecasters to easily analyze forecast challenges, monitor uncertainty, and make prognoses. The forecast team will be at the center of the information system producing and delivering information to enable human decisions that affect outcomes. Next generation observations, Earth system models at all possible spatial and temporal scales, and advanced technologies will be enablers, extending capabilities to warn-on forecast and to quantify forecast uncertainty. A critical component will be the linking of social and physical science to produce information and deliver services.

Training, recruiting, and partnering are critical to the success of impact-based decision support. NWS will develop strategies and commit resources to train our workforce beyond weather, water, and climate sciences to be better communicators and interpreters of NWS information, and to understand the risks and impacts of our forecasts. We want to recruit world-class scientists, meteorologists and hydrologists who have communication, social science, and information technology skills. We want to recruit and partner with people from other disciplines: economists, behavioral scientists, ecologists, engineers, health experts, and the like.

What is a High Impact Event?

No standard, nationwide criteria define a high impact event. It could last minutes or months. It may impact millions of people or one sector, and it may vary in timing or location.

It is any weather, water, or climate event that significantly impacts safety, health, the environment, economic productivity, or homeland security, such as:

- Persistent drought
- Convection over a congested air space
- Heavy rains that trigger flooding and harmful algal blooms
- Geomagnetic storms that threaten energy grids and communication systems
- Snow squall at rush hour
- An above average hot day

Our vision for the future maximizes the use of weather, water, climate, and environmental information to contribute to outcomes for society. These are outcomes we cannot control alone but ones where our capabilities can have a positive impact on the world and the many challenges we face as a nation. Specifically, our strategic plan focuses on five societal outcomes important to all Americans:

- Society is better prepared for environmental events to prevent adverse impacts and maximize social and economic benefits from environmental information
- Necessary actions to manage and respond to a changing climate are proactively taken
- Clean usable water is available for homes, industry, agriculture, ecosystems, and recreation
- Smart growth and economic productivity is fueled by trusted and available environmental information

- Natural habitats, biodiversity, and human well-being are restored and preserved in healthy ecosystems and communities

The next section, "Achieving Outcomes and Goals," outlines our goals, objectives, measures of success, and strategies. Following that section are the overarching people and infrastructure strategies which support all goals and are essential to our success.

WHAT IS THE 4D CUBE?

The 4D Cube is part of the NWS component of the Next Generation Air Transportation System, known as NextGen.

By 2020 the 4D Cube will include NWS information beyond aviation to serve the needs of anyone needing weather, water, climate, or environmental information. The 4D Cube will support decision support systems, offering consistent information at high temporal resolutions. Information will be available and useable in real-time, enabling push/pull data capabilities and two-way information sharing. Information will be rapidly updated, disseminated in seconds, and available in flexible formats.

The 4D cube will transform how the public and decision makers access information. It will also transform NWS operations. NWS forecasters will be at the center of the information hub, using tools and decision support applications to interact with the 4D Cube. It will enable forecasters to better maintain situational awareness, focus on scientific interpretation, and monitor forecast challenges with the goal of providing impact-based decision support.

NWS will deliver the aviation component of the 4D Cube to the Federal Aviation Administration (FAA) in 2013. It will contain continuously updated weather observations and high-resolution analysis and forecast information, including impact parameters for turbulence, icing, convection, winds, ceiling, and visibility. Users will include members of the Air Transportation System, such as Department of Transportation, FAA, Department of Defense, and airlines. The role of NWS will be to serve as the experts of the science and the 4D Cube contents, since multiple data sources will populate it.

The goals of NextGen are to:

- Increase capacity and reliability of the National Airspace System (NAS)
- Improve safety and security of the NAS
- Minimize the environmental impact on aviation

NextGen will stress adaptability by enabling air traffic to adjust immediately to ever-changing factors such as: weather, traffic congestion, aircraft position via GPS, flight trajectory patterns, and security issues. By 2025, all aircraft and airports in the national air space will connect to the NextGen network, continually sharing information in real-time to improve efficiency, safety, and absorb the predicted increase in air transportation.

ACHIEVING OUTCOMES AND GOALS

This section describes the long-term, mutually supportive goals, measurable objectives, and high-level strategies for achieving the NWS vision. Many of the strategies support the achievement of multiple goals even if listed once under one goal. Objectives and strategies mostly focus on service delivery, science and technology. Strategies for a productive and dedicated workforce and state-of-the-art infrastructure enable the achievement of all goals and are therefore included in their own section, beginning on page 17. Measures of Success are defined for each objective and serve as indicators in achieving each objective. Additional details describing how the objectives and strategies will be implemented will be contained in the Services and Science & Technology Roadmaps (see "Note to the Reader" on page 2).

GOAL 1: IMPROVE WEATHER DECISION SERVICES FOR EVENTS THAT THREATEN SAFETY, HEALTH, THE ENVIRONMENT, ECONOMIC PRODUCTIVITY, OR HOMELAND SECURITY

Urbanization and a growing population are increasingly putting society in harm's way of weather, water and climate events. For a growing number of people living in coastal communities, hurricanes, typhoons, and tsunamis take lives and cause major damage to property and infrastructure. People who live along rivers and other inland waterways face increasing disruption because of more frequent and devastating flooding. Winter storms paralyze cities and regions for days and cost billions in cleanup and lost productivity. Tornadoes can take lives and destroy entire communities within a matter of seconds, while wildfires can burn for months threatening homes and natural habitats. The indirect impacts of these events, such as infrastructure failures, illness, and emotional trauma, can be just as significant. This goal seeks to prevent the human and economic impact of such events.

Objective: Provide demand-driven, impact-based weather services

Measures of Success: Fewer fatalities resulting from high impact weather events; less economic losses from unnecessary evacuations and property damage; at-risk communities certified as TsunamiReady™ or StormReady®; increased service satisfaction from partners and users

Strategies for Achieving

- *Impact-Focused Services:*
  - Provide impact-based forecasts that integrate user-defined thresholds, risks and uncertainty to communicate human, economic, and environmental impacts
  - Redefine warnings to focus on a broad range of high impact events specifically targeting those at-risk
- *Decision Support:*
  - Increase direct, interpretive support to public sector officials and emergency responders for incidents of national, regional, or local significance
  - Improve and expand use of emerging technologies to communicate with partners, users and across NWS. Examples of such technologies include advanced visualization tools, collaboration, mobile, video, and voice
- *Dissemination:* Leverage emerging dissemination methods to and warn those groups specifically impacted by weather, water, climate events

- *Outreach & Education:* Improve the preparedness and resiliency of those vulnerable to the impacts of weather, water and climate events on health and well-being. Continue to promote community preparedness programs, such as TsunamiReady™ and StormReady®
- *Partnerships:* Enhance intra and interagency leadership role in national and international issues; continue to engage in regional collaboration; promote the NWS and NOAA missions; and continue effective partnership with America's weather industry

Objective: Utilize emerging science and technology to improve weather prediction and service delivery

Measures of success: Improved forecast accuracy, specificity, and lead time for the science service areas listed below; integration of user-defined thresholds, socioeconomic criteria, and uncertainty into forecasts; deployment of new forecaster tools

Strategies for Achieving

- *Severe Weather*: Develop impact-based neighborhood-scale forecasts and warnings achieved by advancing warn-on forecast for convective weather, improving quantitative precipitation forecasts, improving tornado forecast skill, and integrating social science to improve public response
- *Hurricanes and Cyclones*: Develop impact-based, finer-scale and more accurate track, intensity and inundation forecasts, dependent upon better observations, high resolution modeling for multiple scales, forecast uncertainty, social science, and transition of research to operations
- *Winter Weather:* Deliver storm-based winter weather watches, warnings, and advisories by integrating social science and implementing advances in science, technology, and communication
- *Fire Weather*: Advance and deploy forecast improvements, including better observations, fire-scale modeling, and forecaster and decision support tools to reduce losses and damages caused by wild fires
- *Tsunami:* Improve tsunami detection, forecasting, and impact-based information that elicits appropriate public response, based on better understanding of tsunami factors, upgraded observations, higher resolution models, and improved data assimilation
- *Marine:* Provide accurate, timely, impact-based coastal and ocean data, forecasts, and warnings, based on coastal wave modeling research; new and integrated observations; global and regional coupled modeling; and integration of social science
- *Forecast Uncertainty:* Develop and implement steps toward quantifying and communicating hydrometeorological forecast uncertainty achieved through physical and social science research, modeling improvements, and modifications to forecast and dissemination systems
- *Observations*: Advance and deploy next generation integrated observing systems to address Nation's need for real-time weather and climate data, in partnership with NOAA, other agencies, and private sector

- *Earth System Modeling:* Implement high-resolution Earth system models, including land, atmosphere, ocean, and cryosphere components for multiple time and space scales
- *Forecaster Tools:* Implement forecaster tools that support enhanced visualization, smart decision assistance, and forecaster coordination and collaboration.
- *Data Access & Interoperability:* Extend access to and interoperability of weather, water, climate, and environmental data using national and international systems and standards, such as mesonets, 4D Cube, and Global Earth Observation System of Systems (GEOSS)
- *Partnerships:* Invest in new partnerships and strengthen existing ones to find and influence emerging technologies and define requirements to accelerate transition of research into operations
- *Transition of Research:* Use common modeling and operating infrastructures, testbeds and national partnerships to accelerate the transition of research into operations

GOAL 2: DELIVER A BROADER SUITE OF IMPROVED WATER SERVICES TO SUPPORT MANAGEMENT OF NATION'S WATER SUPPLY

Today, water for homes, agriculture, energy, and industry is already in short supply. In 2007, Atlanta, GA, came within three months of running out of water. Lake Superior, the Earth's largest freshwater body by surface area, was too shallow to float fully loaded cargo ships; and a lack of water led regulators in Idaho, Arizona, and Montana to deny permits for new coal-fired power plants. A growing population and more frequent, persistent drought will only make the availability of water all the more challenging. Clean, safe water is also a growing challenge for communities and ecosystems. Water quality is being affected by changing water temperatures and an increase in salinity, nutrients, and other pollutants. This goal seeks to integrate and extend NWS water prediction capabilities to provide information and forecasts for a full suite of water services to better enable water resource managers to make preventative, proactive decisions in a changing and uncertain environment.

Objective: Develop cross-government, integrated water resource services

Measures of Success: Less economic loss and property damage from flooding as a result of impact-based decision support; More efficient management of municipal water supplies using integrated water forecasts and information; positive economic, ecological, agricultural impacts realized from forecasting water temperature, soil moisture and other parameters;

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Decision Support*: Develop and deliver, with partners, decision support tools for water resource managers, focusing on climate-related impacts for arid and coastal watersheds. Tools will be based on interoperable high resolution summit-to-sea water resources data and information from multiple government partners
- *Water Resource Services:* Expand services to provide forecasts for such parameters as water flow, temperature, quality, dissolved oxygen content, and soil moisture conditions for inland and coastal watersheds

- *Partnerships:* Advance hydrologic services by leveraging the science and technology of partners within NOAA, other agencies, the private sector, and academia

Objective: Advance science and technology to improve and expand water forecasting

Measures of Success: Reduction of river forecast errors; improved probabilistic forecasts; increased number of water resource observations

Achieving this objective will require many of the science and technology strategies from other goals, along with the following:

- *Research & Development:* Advance understanding of precipitation, temperature, evaporation processes in an Earth system framework
- *Observations*: Leverage and expand river, surface, and remote observations for hard-to-observe and emerging service areas
- *Modeling & Prediction*:
  - Improve quantification of hydrologic forecast uncertainty
  - Integrate long-range weather forecasting into hydrologic modeling
  - Advance hydrologic and hydraulic modeling capabilities, including inundation mapping
  - Implement higher resolution coupled models for rivers, lakes and estuaries

GOAL 3: ENHANCE CLIMATE SERVICES TO HELP COMMUNITIES, BUSINESSES, AND GOVERNMENTS UNDERSTAND AND ADAPT TO CLIMATE-RELATED RISKS

Our changing climate is a real and major challenge facing Americans and the world. A changing climate is contributing to increasing average temperatures, melting sea ice, rising sea levels, and ocean acidification. Precipitation patterns are changing and weather-related events may increase in intensity and even frequency – from extreme temperatures, drought, and flooding, to wildfires and severe storms. The impacts are vast, affecting all aspects of our ecosystems, society, and economy. A changing climate is likely to negatively impact our Nation's water resources, including municipal water supplies and marine ecosystems. Along our coastlines, sea level rise will have a mostly negative impact on housing and development, transportation, commerce, and the economy. In the Arctic, melting sea ice is already impacting natural habitats while providing opportunities for oil and gas development and opening new sea routes for commerce and tourism. This goal supports the efforts of NOAA to deepen scientific understanding of climate, deliver climate services from global to local scales, and improve public knowledge of the impacts of a changing climate.

Objective: Enhance NWS workforce and infrastructure to support development and delivery of NOAA climate services

Measures of Success: Reduced economic losses in areas such as agriculture, water, and energy as a result of impact-based climate services; improved preparation and response to weather-related events based on climate forecasts; better management of fisheries based on climate forecasts

Achieving this objective will require many of the strategies from other goals, along with the following:

- *Training*: Train NWS workforce in climate science, adaptation and mitigation strategies, and climate decision support services
- *Impact Forecasts:* Create seamless suite of impact-based forecasts across multiple time and space scales, with emphasis on regional to local products
- *Decision Support:* Enhance decision support through integration of social and economic factors, better communication of risk and uncertainty, and by using visualization, web, and other technologies
- *Observations, Modeling, & Prediction:* Provide climate-caliber network of observations, modeling and prediction capabilities, contributing to a strong scientific foundation for adaptation and mitigation strategies and minimizing gaps in our understanding of climate variability and change
- *Partnerships:* Better understand climate needs by strengthening local, state, and regional partnerships across various sectors; foster growth of an emerging climate service industry to serve diverse needs of America's economy
- *Infrastructure:* Expand, in collaboration with NOAA, physical and IT infrastructure to accommodate national, regional, and local climate services, assessments, science, and outreach

Objective: Improve and expand climate modeling for time scales from weeks and seasons to years

Measures of Success: Improved prediction of the intensity and frequency of weather and climate extremes on all time scales; skillful climate forecasts from weeks to years

Achieving this objective will require many of the strategies from other goals, along with the following:

- *Research & Development*:
  - Improve weather to climate understanding and prediction through analysis and modeling activities coordinated with NOAA, public and private partners
  - Support a NOAA-wide research effort on the potential for routine decadal prediction
- *Impact forecasting*: Integrate human and economic impacts into climate forecasting and decision support tools to better understand how climate variability affects human well-being, economic productivity, and resilience in a changing climate

- *Modeling & Prediction*:
  - Improve the capability, with NOAA and partners, to simulate and predict climate on multiple time scales within an Earth system framework
  - Develop, with NOAA and partners, forecast-downscaling techniques that add value to climate forecasts at regional and local scales
  - Improve forecast skill for weeks 2-4, in collaboration with the external research community, including generation of related data sets, multi-model ensemble prediction system, improved data assimilation, test beds, and model test facility
- *Transition of Research*: Use common modeling and operating infrastructure, testbeds and partnerships to accelerate research to operations

GOAL 4: IMPROVE SECTOR-RELEVANT INFORMATION IN SUPPORT OF ECONOMIC PRODUCTIVITY

Minimizing economic impacts on U.S. business and industry from weather-related events is critical to maintaining global competitiveness and keeping our national infrastructure secure. Transportation is disrupted by storms, hurricanes, and flooding causing delays, loss of cargo, and lives. Within aviation, weather accounts for 70 percent of all air traffic delays, costing billions of dollars to the economy. In the energy sector, many renewable and alternative energy forms are weather and water-driven, requiring accurate, reliable forecasts to make critical production and management decisions. Extreme weather, like hurricanes, can disrupt oil and gas production, while the transmission of energy is vulnerable to extreme temperatures and weather, including geomagnetic storms. In addition, space weather activity can interfere with communications and transportation systems cause disruption and major economic loss. In the agriculture sector, global food supplies are highly sensitive to weather, water, and climate, impacting everything from crop yields to the health of livestock. This goal seeks to provide trusted, timely environmental information as a key input into planning, decision making, and risk management to grow the economy and protect lives and livelihoods.

Objective: Maximize use of weather-related information for informed decision-making and risk management

> Measures of success: Gains in efficient renewable energy production; fewer weather-related aviation delays; fewer fatalities from weather-related transportation accidents; mitigated economic loss in the agriculture sector; greater reliability in navigation services due to space weather forecasts and warnings

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Sector Knowledge & User Needs:* Expand workforce knowledge – through collaboration with the private sector and other agencies – of weather, water, and climate needs of weather-sensitive sectors, such as transportation, energy, agriculture, and telecommunications

- *Sector-relevant Data:* Make accessible, via the 4D Cube, data and information based on sector-relevant thresholds, impacts, and parameters
- *Decision Support:* Explore opportunities to increase weather, water, and climate interpretive support to other government agencies supporting energy, agriculture, transportation, emergency management, or homeland security
- *Renewable Energy:* Engage the renewable energy sector and other agencies to obtain, share and expand observations, improve forecasts, and promote technical exchange and research, benefitting renewable energy production and transmission
- *Aviation:* Continue to evolve aviation and space weather decision support in partnership with FAA to improve safety and reduce air traffic delays
- *Agriculture:* Participate in national and international efforts to tackle global food supply and water resource challenges by contributing modeling and prediction capabilities
- *Partnerships*: Foster growth of America's weather industry through collaboration on information services and decision tools
- *Policy:* Ensure policies and practices support the evolution of science and technology, such as the 4D Cube, including data access and intellectual property rights with U.S. and international partners; and global and national frameworks to obtain and quality control data

Objective: Improve forecast skill to accuracy and confidence levels required for decision-making and risk management

Measures of Success: Increased forecast accuracy, specificity and precision for aviation, space weather, and energy sector at confidence levels needed for decision-making; increased lead time for space weather warnings; completed integration of 4D Cube into FAA air traffic systems

Achieving this objective will require many of the science & technology strategies from other goals, along with the following:

- *Observations*: Expand observations for roadways, marine, and aircraft; polar, planetary boundary layer, and space
- *Modeling & Prediction:* Extend temporal scales of weather prediction, from hours to weeks, with improved accuracy and confidence to support decision-making and mitigate economic loss
- *Space Weather*: Improve forecasting at global and regional scales for geomagnetic storms, solar flares, and other particles. Dependent on extended observations; Earth system models coupling atmosphere, ionosphere, and magnetosphere; and data assimilation improvements for application in energy, transportation, telecommunications, and other industries
- *Energy*: Provide weather, water, ocean, and climate information to meet energy sector needs. Dependent upon expanded observations in the planetary boundary layer, model improvements at needed temporal and spatial scales, and quantification of forecast uncertainty
- *Aviation*: Improve the accuracy, precision, timeliness, and consistency of weather information by extending satellite and radar observations; improving modeling and

predictions for aviation parameters; developing new forecaster tools; and integrating the 4D Cube to support a weather-safe national airspace

GOAL 5: ENABLE INTEGRATED ENVIRONMENTAL SERVICES SUPPORTING HEALTHY COMMUNITIES AND ECOSYSTEMS

High impact weather-related events, such as extreme temperatures, poor air quality, and the transmission of air and water-borne diseases, pose significant risks to the health of individuals and their communities. As of 2008, approximately 127 million U.S. residents live in counties where air pollution exceeds national standards, causing decreases in lung function, more frequent asthma-related hospital visits and even premature death. Temperature, precipitation, and humidity affect the timing and intensity of disease outbreaks from pathogens, and changes in climate may alter the geographic range and evolution of such diseases. More frequent heavy rains and flooding can trigger sewage overflows, spilling raw sewage into drinking water supplies, lakes and waterways, and beaches. Other pollutants in our inland and coastal waterways cause harmful algal blooms, dead zones, human illnesses, and concerns about the safety of seafood harvests. This goal seeks to support NOAA and other partners by linking weather, water, and climate with biological, chemical, ecological, and other processes to reduce the impact of health and environmental hazards on our communities and ecosystems.

Objective: Extend weather, water, and climate services to provide ecological and health-based forecasts and services

Measures of Success: Hospitals prepared for patients with weather and climate-sensitive illnesses, including air pollution and extreme temperatures, due to health-based forecasts; decreased occurrence of water-borne illnesses due to improved water and beach quality forecasts

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Ecological Forecasts:* Contribute, with NOAA and partners, the operational backbone for a defined suite of integrated ocean and coastal ecological forecasts and services, based on NOAA priority forecast areas of beach quality, species progression, dead zones, harmful algal blooms, and disease pathogen progression
- *Health-Based Forecasts:* Deliver, with NOAA and partners, information integrated to meet regional forecast needs, including: high resolution ozone, smoke, dust, and particulate matter forecasts; extreme heat; and the progression of insect and water-borne diseases
- *Decision Support:* Expand outreach and decision support services in collaboration with our partners for persistent events, such as extreme heat or cold; seasonal flooding; drought
- *Partnerships:* Expand and build partnerships with local, regional, and national health, water and environmental managers to better meet weather, water, and climate needs and explore new opportunities for collaboration

Objective: Advance capabilities in support of ecological prediction

Measures of Success: Demonstrate predictive skill in key, measureable components of ecosystem health; demonstrate predictive skill in health-based forecasting for specific weather and climate-sensitive diseases

Achieving this objective will require many of the science & technology strategies from other goals, along with the following:

- *Research & Development:*
  - Research and develop, with NOAA and partners, ecological predictions, what-if scenarios, and projections
  - Improve climate, water, and weather forecasts for multiple time and space scales relevant to health risks and disease control impacting communities and ecosystems
- *Observations:* Expand weather, climate, and air quality observations to support environmental surveillance relevant to, and in partnership with, public health agencies
- *Modeling:*
  - Integrate long-range weather into ecological modeling within an Earth system framework
  - Contribute to improving regional ocean, estuary, and coastal circulation models, including biogeochemistry and ecosystem processes
- *Air Quality:* Expand air quality predictions for ozone, smoke, dust, and particulate matter, including research and development of airborne particulate matter, chemical data assimilation, and coupled meteorological and air quality predictions
- *Ecological Forecasting:* Initiate development of an ecological forecasting system, coupling air, land, water, and sea with biological, geological, chemical, and ecosystem processes
- *Research to Operations:* Implement testbed framework to accelerate transition of ecosystem & health prototypes into operations and services

CRITICAL TO OUR SUCCESS

Critical to the success of the NWS mission and vision is our people. We are committed to the continued growth and development of our people to sustain a skilled, professional, and creative workforce. We are committed to cultivating an organization that embraces change, strives for excellence, and places service over self. We are committed to providing our people with the best possible tools, technology, and facilities. The following objectives and strategies are essential to achieving all of our goals.

Objective: Enhance knowledge and skills of our dedicated workforce

Measures of success: Increased knowledge of NWS user needs; increased mix of interdisciplinary skills across workforce; improved employee satisfaction

Strategies for Achieving

- *Training:*
  - Increase and apply knowledge – through partnering, collaboration, and learning opportunities – of the missions and needs of NWS users across sectors, such as emergency management, transportation, energy, health, and others
  - Enhance development and training programs to improve and expand core competencies of all NWS employees, including expanding workforce skills to be more interdisciplinary, drawing from social sciences and economics, communication, information technology, leadership, and management
  - Implement new and enhanced methods and technologies for training delivery, such as simulations and on-demand training integrated into forecaster applications and other systems
- *Recruiting:* Improve recruitment strategies to ensure future workforce skills align with NWS vision, including hiring university-trained hydrologists and space weather forecasters, and recruiting people with multidisciplinary skills
- *Succession Planning:* Partner with universities on adapting curricula to emerging national and NWS needs
- *Regional Collaboration:* Continue to take lead role in building and sustaining regional partnerships to better serve and adapt to changing needs
- *International Collaboration:* Continue to provide global leadership to advance NWS mission and vision by working with other countries and international organizations

Objective: Provide state-of-the-art, reliable, secure, and extensible infrastructure

Measures of success: Increased high performance computing capacity; expanded and sustained facilities and infrastructure; expanded availability and interoperability of environmental data; operational collaboration and knowledge-sharing tools for NWS workforce

Strategies for Achieving

- *IT & Communications:* Transform information technology and communication infrastructure to accommodate increasing data
- *Internal Communication & Collaboration*: Use emerging technologies and other tools to improve internal communication, collaboration, and knowledge sharing across NWS and NOAA
- *Computing:* Expand and sustain state-of-the-art computing architectures and high performance computing to achieve modeling and prediction improvements
- *Observing Systems:* Seek new approaches and opportunities to ensure the integration and sustainment of NWS operational observing and dissemination systems
- *Facilities:*
  - Expand opportunities to co-locate NWS facilities with key partners, as well as sustaining existing facilities through “green” improvements

    - Ensure NWS facilities portfolio is appropriately aligned to support a reliable and secure work and living environment

- *Equipment:* Develop the next generation forecast and decision support system, to include data mining tools, advanced visualization, and interoperability with partner systems