

Research and Applications Supporting NOAA's New Strategic and Implementation Plans for Climate Ready Nation, Equity and the New Blue Economy

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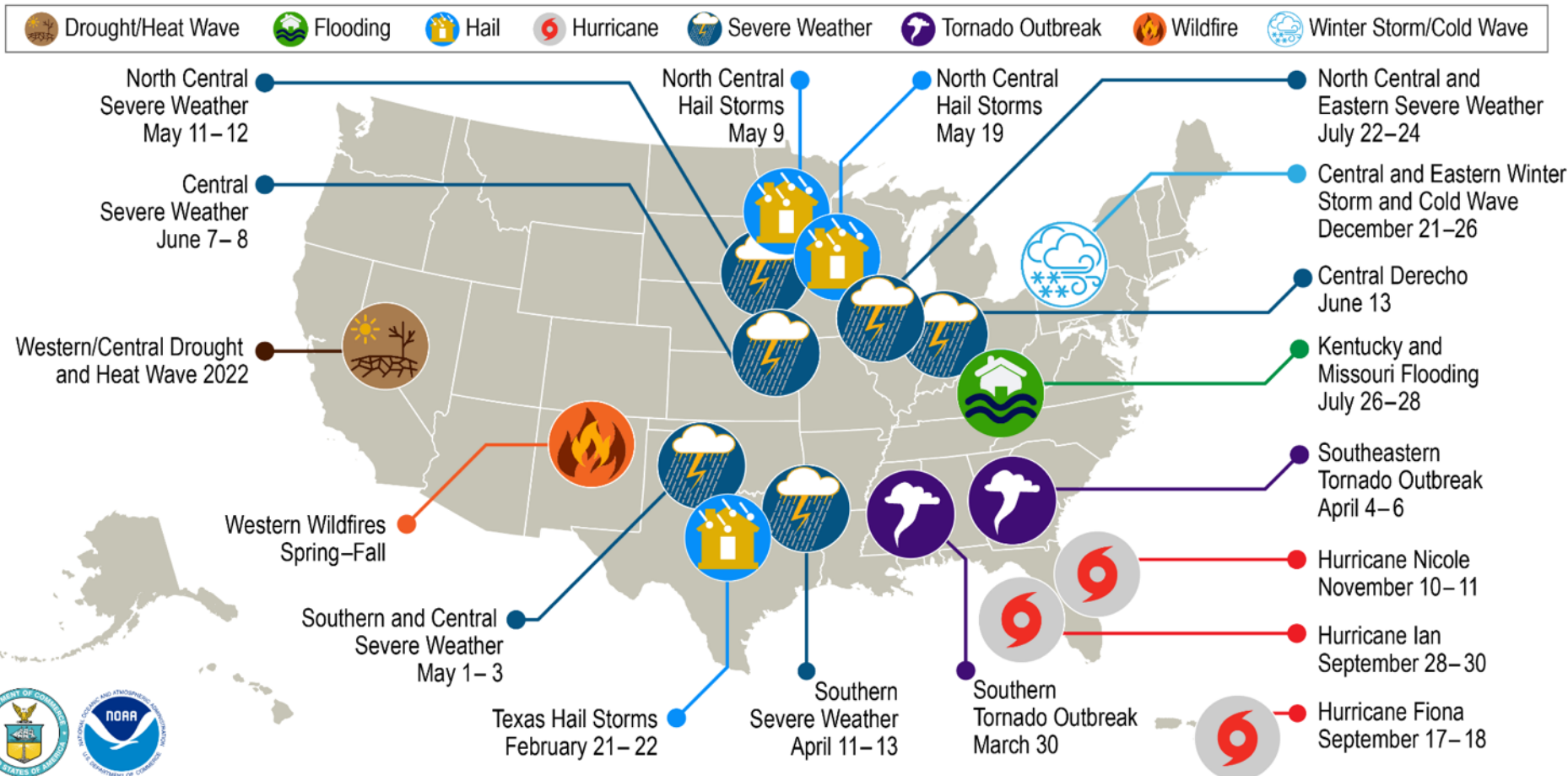
National Environmental Satellite,
Data, and Information Service

July 25, 2023

NOAA Strives to Understand and Predict Our Changing Environment



Billion-Dollar Disasters in U.S. Are Increasing (2022)



All Disasters

Drought

Flooding

Freeze

Severe Storm

Tropical Cyclone

Wildfire

Winter Storm

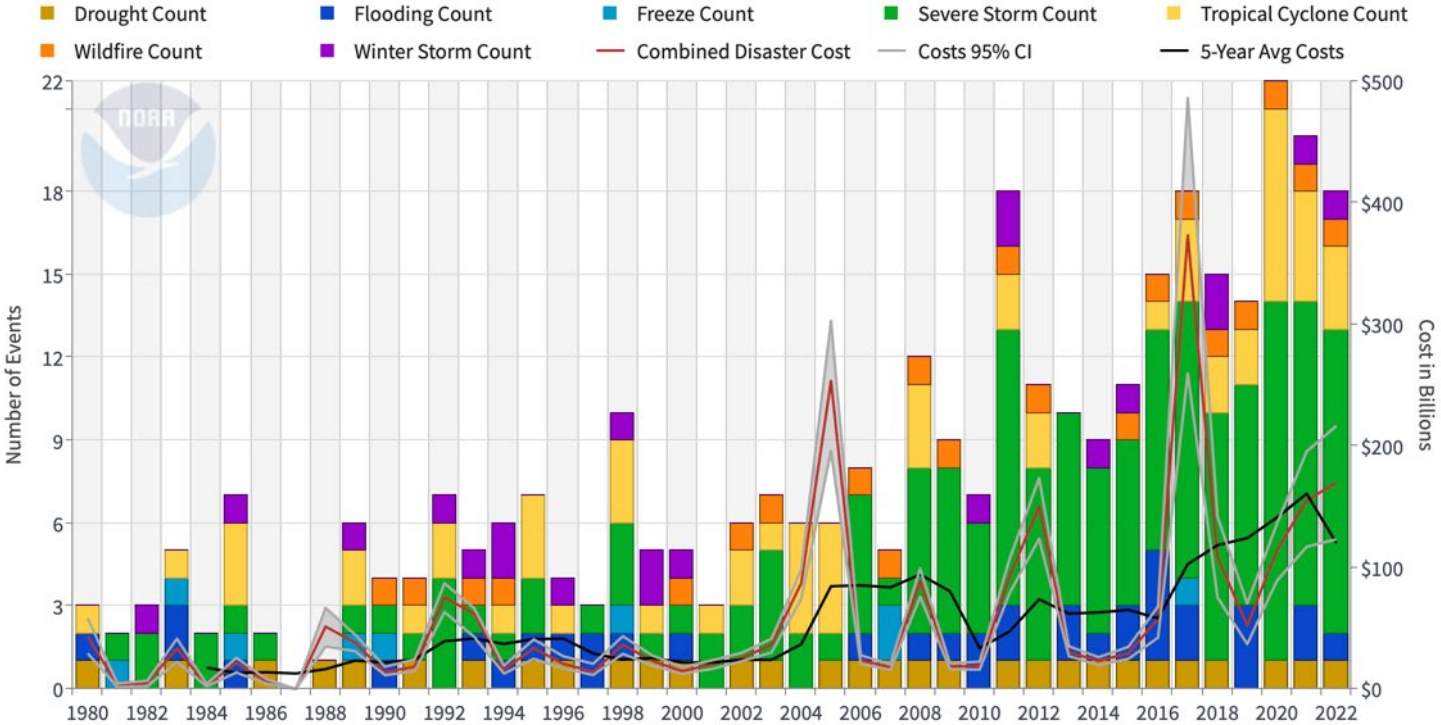
United States

Update

CPI-Adjusted

Unadjusted

United States Billion-Dollar Disaster Events 1980-2022 (CPI-Adjusted)



Updated: January 10, 2023

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NOAA Priorities

Science, Service, and Stewardship



CLIMATE

Establish that NOAA is **the authoritative source** for climate products and services that can be applied to a diverse range of missions.



BALANCE

Advance NOAA's complementary work on **environmental stewardship and economic development** with a particular focus on the New Blue Economy.



EQUITY

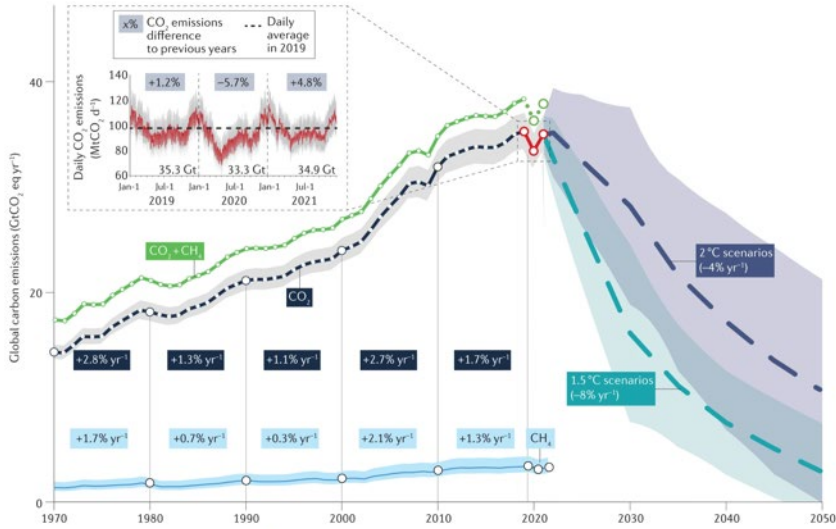
Exhibit equity in how NOAA builds and provides services. Promote diversity, equity, inclusion, and accessibility in the workforce. Provide **equitable access to NOAA products and services**.

WH Executive Orders

- Tackling the Climate Crisis at Home and Abroad
- Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis
- Advancing Racial Equity and Support for Underserved Communities

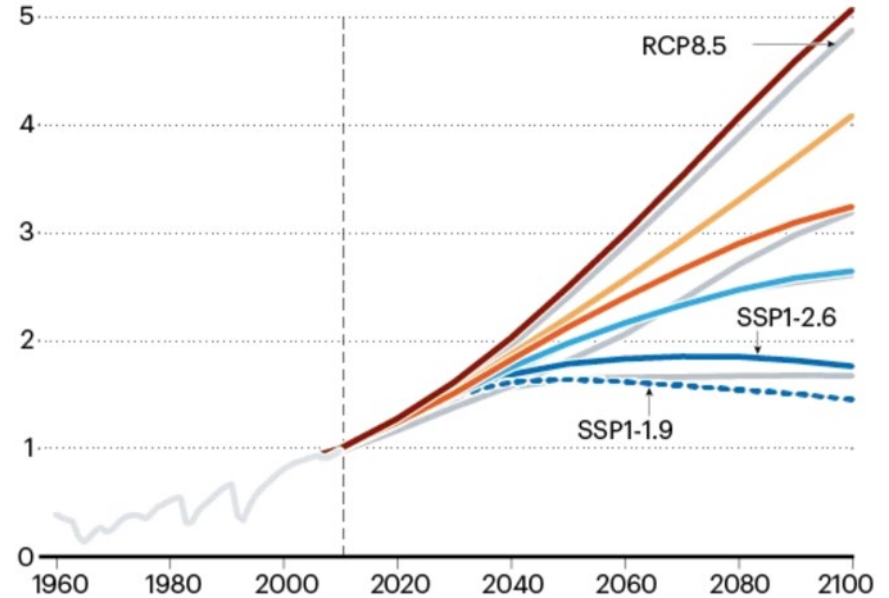


Yes we have a Climate Crisis



Temporal evolution of historical CO₂ emissions⁵ (navy; including emissions from fossil fuel combustion and the process of cement production), near-real-time CO₂ emissions^{3,4} (red), projected CO₂ emission mitigation pathways¹⁰ (dark blue and aqua), and historical fossil CH₄ emissions^{4,1} (light blue; 1970–2018 data from EDGARv6.0, scaled to 2021 with IEA data). Solid/dashed lines and shading represent the median and range, respectively. The inset depicts daily near-real-time CO₂ data over 2019 to 2021, and the corresponding year-on-year changes in annual CO₂ emissions. Current emission trends will use up the allowed future emissions for limiting anthropogenic warming to 1.5 °C (the remaining carbon budgets) within 10 years.

Temperature Increase (°C)



<https://www.nature.com/articles/s43017-022-00285-w>

<https://www.nature.com/articles/d41586-020-01125-x>





Climate-Ready Nation

2030 Vision Statement

A thriving Nation whose prosperity, health, security, and continued growth benefit from and depend upon a shared understanding of, and collective action to reduce, the impacts of climate change



New NOAA Climate Council to enhance delivery of climate science and services

Focus areas: Across NOAA, Climate Topics: NOAA leadership, climate science

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July 21, 2021



A collage of typical climate and weather-related events: heatwaves, drought, hurricanes, wildfires and changes in sea ice coverage. (NOAA) Download Image



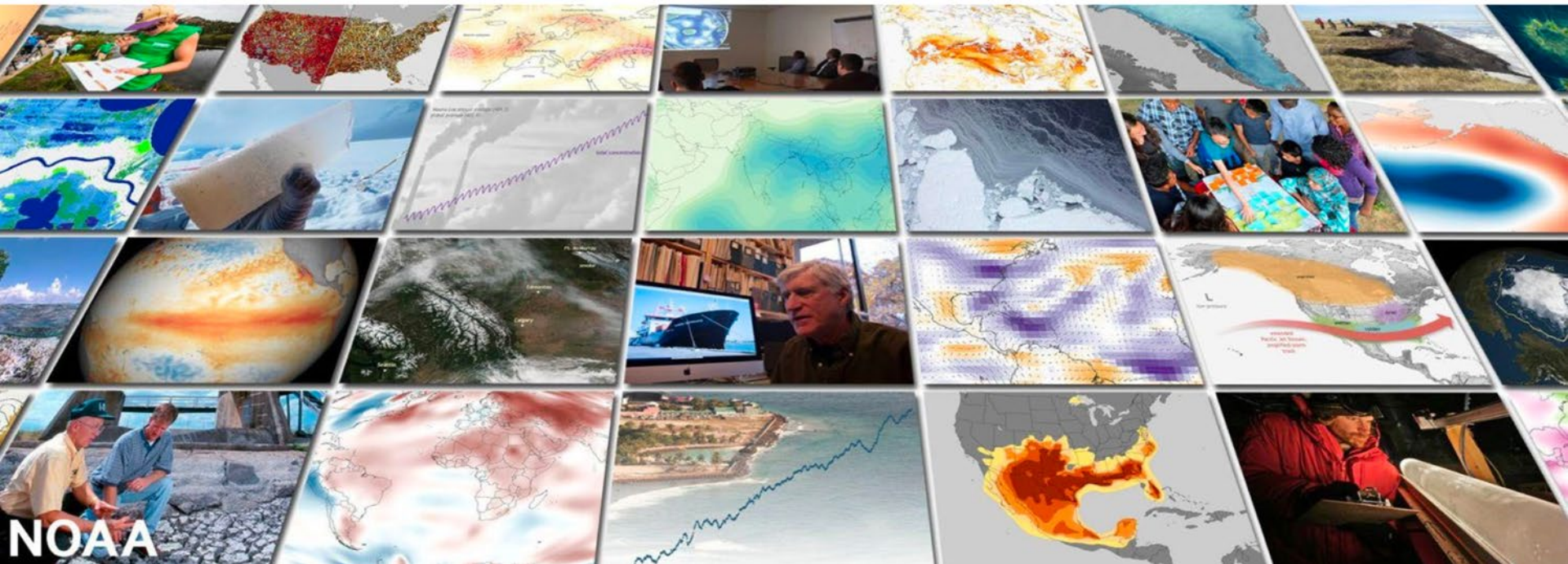
Weather, Water, and Climate Strategy

FY 2023-2027



The Vision for a New Blue Economy

A sustainable and equitable ocean and coastal economy that optimizes advances in science and technology to create value-added, data-driven economic opportunities and solutions to pressing societal needs.



MAKE EQUITY CENTRAL TO NOAA'S MISSION

As NOAA tackles the climate crisis by building a Climate Ready Nation, it will strive to ensure the needs of the nation's underserved and vulnerable communities are met. To meet this challenge, NOAA is making equity central to every facet of its mission delivery services and is working internally to create a model agency that draws from the full diversity of the nation, where everyone is treated with dignity and respect.

2.1 BUILD A MODEL WORKPLACE.

NOAA is firmly committed to increasing the diversity of its workforce and creating a more inclusive work environment where everyone feels valued, is treated fairly and experiences a true sense of belonging. A key outcome of this plan is to fully integrate diversity, equity, inclusion and accessibility (DEIA) into NOAA's business practices and organizational culture and thereby strengthening NOAA's ability to recruit, hire, develop, promote and retain diverse talent and remove barriers to equal opportunities.

2.2 SUPPORT UNDERSERVED AND VULNERABLE COMMUNITIES.

Underserved communities — those that have been systematically denied a full opportunity to participate in aspects of economic, social and civic life — are often disproportionately impacted by increasing extreme weather, water, ocean and climate events. NOAA will expand equity-focused products and tools to address these impacts by leveraging its deep experience in service delivery and regional collaboration and partnerships with underserved communities.



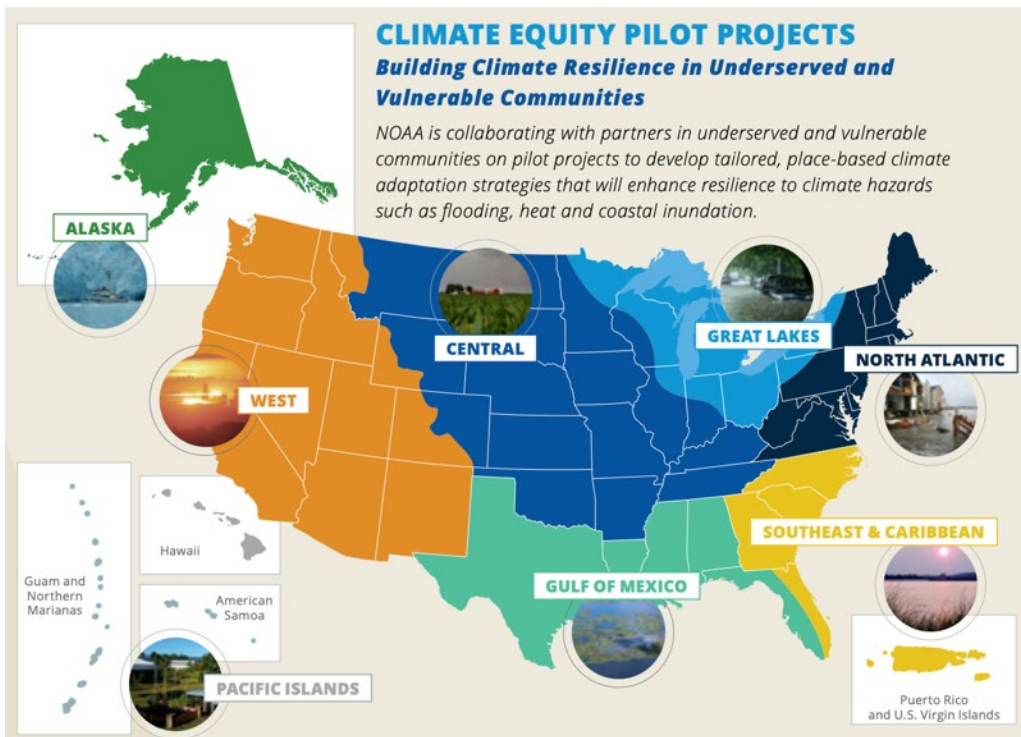
SIGNATURE EQUITY INITIATIVE

NOAA will complete regional pilots to enhance resilience to flooding, heat and coastal inundation, leveraging recommendations from its Climate and Equity Roundtables conducted around the nation. NOAA will work more closely with community partners on these pilots to increase participation from underserved and vulnerable populations for planning and training sessions and to tailor services to place- and community-based needs.

CLIMATE EQUITY PILOT PROJECTS

Building Climate Resilience in Underserved and Vulnerable Communities

NOAA is collaborating with partners in underserved and vulnerable communities on pilot projects to develop tailored, place-based climate adaptation strategies that will enhance resilience to climate hazards such as flooding, heat and coastal inundation.



ALASKA

Expanding and connecting tribal-led climate change capacity to serve indigenous community needs in Alaska

GREAT LAKES

Address urban flooding with Climate Action Plan

PACIFIC ISLANDS

Utilize agroforestry dashboard blending western and traditional knowledge

GULF OF MEXICO

Develop tribal community resilience tools for coastal impacts

SOUTHEAST & CARIBBEAN

Address heat-health risks in vulnerable populations

CENTRAL

Increase flood and drought resilience within the Upper Mississippi River Basin Plan

NORTH ATLANTIC

Enhance community engagement in climate risk communication

WEST

Address heat-health risks in vulnerable populations





DOC Strategic Plan

GOALS:

Drive U.S. Innovation and Global Competitiveness;
Foster Inclusive Capitalism and Equitable Economic Growth;
Address the Climate Crisis Through Mitigation, Adaptation, and Resilience Efforts;
Expand Opportunity and Discovery Through Data;
Provide 21st Century Service with 21st Century Capabilities



NOAA Strategic Plan

GOALS:

Building a Climate Ready Nation: Develop, Deliver and Use Climate Products and Services;
Making Equity Central to NOAA's Mission;
Foster an Information-Based Blue Economy



Weather, Water, and Climate Strategy

CHALLENGES:

Extreme Events and Cascading Hazards; Coastal Resilience;
The Changing Ocean; Water Availability, Quality, and Risk;
Effects of Space Weather;
Monitoring and Modeling for Climate Change Mitigation



CLIMATE VALUE CHAIN

Building a Framework for a Climate Ready Nation

NOAA's climate value chain, around which Goal 1 objectives are organized, illustrates the five key activities necessary to successfully deliver critical services to the agency's customers and partners.

SERVICE DELIVERY & DECISION SUPPORT TOOLS



Comprehensive service delivery and decision support tools are necessary to build a Climate Ready Nation to meet the needs of businesses, federal partners and communities most vulnerable to climate and weather hazards.

MODELING, PREDICTION & PROJECTION



With state-of-the-science modeling, prediction and projection capabilities, NOAA leverages high-performance computing and the use of artificial intelligence.

RESEARCH & DEVELOPMENT



6,000 NOAA scientists and engineers develop cutting-edge applied research and applications to address pressing climate and weather challenges.

DATA & INFORMATION STEWARDSHIP

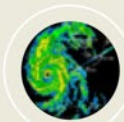


NOAA's world-class data and information stewardship is leveraging cloud infrastructure and working to store and to provide to the public more user friendly and authoritative data sets.

OBSERVATIONAL INFRASTRUCTURE



From the ocean floor to on orbit, NOAA's robust next-generation observational infrastructure and data dissemination observes and collects data 24/7.



Opportunities: Current NOAA Budget Sources

(Enacted or Proposed)

\$345M

Disaster Relief Supplemental Appropriations Act, 2022

- Repair and Replace assets, facilities, and equipment damaged by hurricanes or wildfires
- Recovery efforts in mapping and charting, marine debris removal, coastal resilience, and fisheries disaster assistance
- Improvements to hurricane intensity and track forecasting, precipitation, flood and wildfire prediction and forecasting

\$6.8B

FY23 President's Budget

- **NOAA Program Change Summary Total: \$1.4B**
- Climate Products and Services
- Economic Development
- Equity and Workforce
- Satellites
- Facilities

\$2.96B

Bipartisan Infrastructure Law

- Habitat restoration, marine debris removal, and increased fish passage
- Flood and inundation mapping and forecasting and next generation water modeling
- Wildfire prediction, modeling, and forecasting
- Observing infrastructure for coastal, ocean, and Great Lakes, and wildfire
- Research supercomputing

\$3.3B

Inflation Reduction Act

- Climate services and climate ready coasts
- High performance computing capacity and research
- Planning and permitting
- Replacing aging facilities and construct new ones
- Hurricane Hunter aircraft

Theme I: Coastal Resilience



CENTER FOR EARTH SYSTEM SCIENCES
AND REMOTE SENSING TECHNOLOGIE

Social Science Research Integration

- Task 1: CREST Ocean Observatories in Critical Coastal Regions**
- Task 2: Quantify coastal erosion in the Arctic and impacts on vulnerable coastal ecosystems and communities**
- Task 3: Develop coastal water quality indicators**
- Task 4: Assess resilience to disturbance in tropical coral reefs**
- Task 5: Improved monitoring of HABs and impacts in coastal eutrophic systems**

Theme II: Atmospheric Hazards

- Task 1: Severe Storm Prediction**
- Task 2: Heat Stress and Urban Modeling**
- Task 3: Satellite Validation and Analysis**
- Task 4: CESSRST Earth System Observing Network**

Theme III: Water Prediction and Ecosystem Services

- Task 1: Drought Risk Assessment & Ecosystem Outcomes**
- Task 2: Flood Risk Assessment and Data Products**
- Task 3: Assessment and Application of National Water Model using Remote Sensing Data**
- Task 4: Monitoring land-atmosphere-ocean fluxes**
- Task 5: Use of UAS platforms for environmental intelligence and satellite product validation**





EXTREME EVENTS & CASCADING HAZARDS

CHALLENGE AREA 1

SOCIETAL CHALLENGE

Communities across the U.S., particularly underserved communities, face enduring, compounding risks from extreme, high-impact weather, water, and climate events, which have become more severe and more frequent in recent decades.

SOCIETAL BENEFIT

NOAA addresses this challenge by leading whole-of-government approaches, in partnership with private enterprise, academia, and non-governmental organizations, to prepare communities to mitigate and adapt to extreme events such as drought, extreme heat and cold, fire weather, flooding, atmospheric rivers, tornadoes, marine heat waves, and tropical cyclones.



Cascading Hazards and Tipping Points

As the climate changes, extreme events are becoming more prevalent, and compound extreme events are leading to cascading hazards. Cascading hazards often create a domino effect and although they do not topple along an orderly path, they do have consistent patterns over time. Cascading hazards examples are provided below.

- Extreme heat and drought leads to wildfire, leading to debris flows and impacts on water quality.
- Increased risk of significant winter and spring precipitation can mobilize nutrients and contaminants and create a corresponding enhanced downstream flood risk that can trigger changes in coastal water quality, impacting marine ecosystem productivity.
- Marine heatwaves can cause harmful algal blooms that contaminate crabs with levels of domoic acid unsafe for human consumption, delaying West coast crab fishing activity from winter into spring, disrupting historically offset seasonal patterns of fishing and whale migration, leading potentially to greater incidents of humpback whale entanglements in fishing gear.



FIVE-YEAR OUTPUTS: EXTREME EVENTS & CASCADING HAZARDS

Area	Output
<p>Extreme Heat and Cold</p>	<ol style="list-style-type: none"> <li data-bbox="658 181 1528 241">1. Improve extreme heat and cold forecasts, particularly for improving decision support, and deep engagement with vulnerable and underserved communities. <li data-bbox="658 257 1528 421">2. Develop methods and services that place weather forecasts for heat waves and cold waves in context. These services, developed with demographic and socio-economic data from the Census Bureau, other agencies and end users, will convey the relative magnitude of these events in historical context, based on the social science of the personal, institutional, and societal experience(s) of NOAA stakeholders. <li data-bbox="658 437 1528 497">3. Improve modeling and forecasting of urban heat island effects and its impact on air quality, particularly in underserved communities. <li data-bbox="658 514 1528 596">4. Incorporate climate-change science in operational forecasts of extreme heat and cold, in order to improve understanding of extreme event variability and uncertainty in the prediction of high impact events.
<p>Floods</p>	<ol style="list-style-type: none"> <li data-bbox="658 625 1528 751">5. Deliver a comprehensive real-time and forecast flood inundation mapping (FIM) capability at the street level for all communities nationwide, to better depict when, where, and how deep flood waters will be for improved Emergency Management decision support before, during, and after an event. <li data-bbox="658 767 1528 855">6. Better inform decisions in support of interagency forecast informed reservoir operations (FIRO), e.g., DOI/USGS, DOI/BoR, FEMA, USACE, to more effectively balance flood and drought risk while maximizing water availability for environmental flows and consumptive uses.
<p>Droughts</p>	<ol style="list-style-type: none"> <li data-bbox="658 880 1528 1000">7. Deliver regional drought early warnings and forecasts, covering weather-to-climate timescales, for communities and economies across the country by expanding and enhancing the interagency National Integrated Drought Information System (NIDIS), and the many NOAA activities that support improvements in drought information.



FIVE-YEAR OUTPUTS: EXTREME EVENTS & CASCADING HAZARDS

Area	Output
Wildfire	11. Understand the sources of predictability of fire weather, including associated climate phenomena (e.g., ENSO, MJO, droughts), on seasonal, interannual, and decadal timescales, and provide skillful S2S Probabilistic Fire-Risk forecasts and retrospective summaries so that decision makers can evaluate past decisions about assets and seasonal posture.
	12. Incorporate the impacts of wildfire on snowpack properties/evolution and soil hydraulic behavior, and their associated effects on infiltration, runoff, streamflow prediction, and debris flow formation into the NextGen National Water Model.
	13. Integrate fire behavior observations, modeling, and meteorology to better forecast the spread of fire, providing improved short-range, hourly fire forecasts, and explore extending the range of fire and smoke forecasting through the inclusion of forest and ecosystem features with agency partnerships. Test new concepts and forecast techniques leveraging test bed environments and evaluations..
	14. Utilize artificial intelligence and machine learning algorithms to vastly improve early detection of wildfires from satellite data, meeting a long-standing need by the wildland fire community for timely detection and notification of newly ignited wildfires within critical fire environments that support extreme fire behavior.
	15. Accelerate the research, development, and transition to operations of NWS forecasting capability for impacts of wildfires on air quality to support improved community decisions for resulting hazards, which disproportionately impact underserved and vulnerable communities. The project will accelerate development and transition of a new high-resolution forecast capability enabled by the coupled high-resolution Rapid Refresh Forecast System (RRFS) and Community Multiscale Air Quality Modeling System (CMAQ).



COASTAL RESILIENCE

CHALLENGE AREA 2

SOCIETAL CHALLENGE

U.S. coastal communities, economies, and ecosystems, as well as the natural and built infrastructure on which they depend, are increasingly impacted by accelerating changes at the coast — the continued impacts of severe storms coupled with the impacts of rising seas, variable Great Lakes water levels, the warming ocean, loss of sea ice, changing ecology, reduced water quality, and coastal erosion and shoreline change, among others. Creating resilience to these changes requires risk-informed decision making and adaptation via enhanced emergency response, coastal data collection, and predictive capabilities, as well as equitable service delivery and decision support. A resilient coastal zone is required to reduce the risk of adverse impacts on our coastal and ocean infrastructure, ecosystems, marine transportation, tourism, recreation and other key economic sectors at the coast.

SOCIETAL BENEFIT

NOAA addresses this challenge by providing equitable access to actionable, authoritative information on coastal change that helps communities (state, local, tribal, and territorial) plan for and take actions that increase their resilience and mitigate risks, and by advancing stewardship and planning for the long-term resilience and adaptation of the nation's diverse blue economy in a changing climate.



FIVE-YEAR OUTPUTS: COASTAL RESILIENCE

Area	Output
Coastal Oceanic Modeling	1. Deliver a complementary suite of operational coastal oceanographic modeling, as appropriate, for coastal open ocean and coastal wave and sea state, marine weather (e.g., wind, tides, coastal flood hazards to support port operation, etc.). These include storm surge, sea and freshwater ice extent, nearshore currents, erosion hazards, water temperature and salinity, concentrations of dissolved oxygen and macronutrients (i.e, nitrate and phosphate), and harmful algal blooms.
Observational Infrastructure	2. Define, expand, operate, and maintain the necessary suite of observational infrastructure which are required to support the modeling envisioned above, leveraging regional, state, federal and private sector partnerships as appropriate. This will include high resolution nearshore bathymetry, water level, waves, shoreline change, wetland delineation, modernization and maintenance of the National Spatial Reference System, and observations of meteorology and nearshore ocean circulation (temperature, salinity, currents, turbidity, macronutrients, dissolved oxygen, etc.) using various data collection platforms.
High resolution Topographic and Bathymetric	3. Collect, integrate and disseminate comprehensive, high-resolution topographic and bathymetric information to significantly expand the National Bathymetric Source, the definitive bathymetric digital elevation model for the United States.
Consistent Coastal Water Level Variability Predictions	4. Create nationally consistent, 2-dimensional gridded estimations of the probabilities of coastal water level variability, including integrated monthly-to-annual outlooks of the probabilities of coastal inundation, and national gridded projections of mean and extreme sea level probabilities, and lake level variability, out to 2100. Projections will consider changes in relative and global mean sea level or lake level including satellite measurements of land subsidence. Provide scenarios of coastal hazards compounded by rising sea levels and associated changes in tidal flooding impacts.



FIVE-YEAR OUTPUTS: COASTAL RESILIENCE

Area	Output
<p>Develop Research, observations, and modeling capabilities</p>	<p>5. Develop the research, observations, and modeling needed to skillfully project physical, ecological, and biogeochemical change due to sea level rise, a warming ocean, and other environmental change at the coast, inclusive of possible human made interventions. This will include natural and nature based interventions applicable to specific coastal environments under local conditions (e.g., tropical islands, Great Lakes shorelines, etc.)</p>
<p>Community Based Adaptation Specialist Training</p>	<p>6. Implement a national program, building on existing NOAA programs, to train community-based adaptation specialists and extension agent networks on availability and delivery of NOAA tools, products, training, and services at the coast. When faced with requests for information services, NOAA will explain existing NOAA services, including their uses and limitations, and inform the requester that others in the environmental information enterprise may be able to meet the requester's needs.</p>
<p>Integrated Web-based Dissemination Interface</p>	<p>7. Create an integrated web-based framework and a prototype dissemination interface with necessary backend infrastructure in existing coastal applications. This will leverage existing NOAA equities, including NCEI and the Big Data Program, and represent a uniform and consistent data services framework that meets the needs of both internal and external data users and modelers.</p>
<p>Develop Coastal and Ocean Normals</p>	<p>9. Develop a comprehensive set of coastal and ocean normals and other key indicators of environmental change, similar to those used for terrestrial climate and weather, leveraging its historical records and data as well as its operational tracking, monitoring, and assessments of coastal conditions.</p>





THE CHANGING OCEAN

CHALLENGE AREA 3

SOCIETAL CHALLENGE

The ocean is a dynamic and connected component of the earth system. Ocean warming, decreasing sea-ice, changing currents, rising seas, ocean acidification and deoxygenation are affecting the nation's valuable living marine resources and the many ocean-dependent businesses and communities. These changes impact the nation's security through many sectors from marine navigation, transportation and energy to fisheries, aquaculture and protected resources.

SOCIETAL BENEFIT

NOAA addresses this societal challenge by providing products and services essential to understanding, preparing for and responding to changing ocean and climate conditions. These products and services are part of an end-to-end value chain that spans observations, research, modeling, forecast, tools, training and applications to help society and decision-makers make ocean-informed and climate-informed decisions that increase resilience, adaptation, and sustainability in a changing world.



FIVE-YEAR OUTPUTS: THE CHANGING OCEAN

Area	Output
<p>Nowcasts and Forecasts to Generate Economic Benefit and Improve Safety</p>	<p>1. Supply skillful, comprehensive ocean, sea ice, atmosphere and wave nowcasts and forecasts, to generate economic benefit, improve the safety and cost-effectiveness of the Nation's marine transportation sector, sustainably manage living marine resources, and facilitate decisions in challenging coastal environments, particularly in the Arctic. Nowcast and forecast skill will be maximized through the integration of transformative observational technologies, including uncrewed observational platforms (UxS), non-traditional, low-cost in-situ moored or drifting sensors and advanced satellite-based approaches.</p>
<p>Improved Ocean Physics Models</p>	<p>2. Provide improved ocean physics models that better represent the mass and energy of the global ocean and its integral role in driving Earth, ocean, atmosphere, cryosphere coupled models, resulting in improved weather, ocean, sea ice, and climate forecasting and applications.</p>
<p>Expand Ocean Observations and Improved Data Assimilation</p>	<p>3. Expand observations of the ocean and improved data assimilation into ocean models, specifically for observations of the air-sea interface, including remotely sensed and in-situ observations, particularly for adaptive sampling to optimize the geographic deployment of observing resources over the ocean.</p>
<p>Integrated Satellite Marine and Ice Information</p>	<p>4. Provide integrated satellite marine and ice information in polar regions to enable safer marine transportation and operation in polar waters and to allow for efficient emergency response.</p>
<p>Expand Ocean Remote Sensing and In-situ Monitoring</p>	<p>5. Expanded remote sensing and in-situ monitoring for regionally-optimized ocean ecosystem and biogeochemical observations.</p>



FIVE-YEAR OUTPUTS: THE CHANGING OCEAN

Area	Output
Create Robust Indicators	6. Create a robust set of indicators that track and provide early warnings for changes in the ecological, social and economic sector conditions and value.
Create Robust Statistics	7. Create a robust set of statistics at appropriate scales that depict and value the major sectors of the marine (blue) economy to measure progress and inform investments in the blue economy.
Provide Ocean Normals and Key Change Indicators	8. Provide ocean normals and other key indicators of environmental change, similar to those used for terrestrial climate and weather, leveraging its historical records and data, including consistent long-term time series for satellite data, as well as operational tracking, monitoring, and assessments of ocean conditions. Extend the entire satellite data record over the period 1982 through the present.
Build end-to-end Ocean Modeling and Decision Support System	9. Build an end-to-end ocean modeling and decision-support system to provide living marine resource managers with climate-informed risk assessments and management strategies for effective management of living marine resources in a changing climate (NOAA Climate and Fisheries Initiative).
Create Robust Indicators	10. Create a robust set of indicators that track and provide early warnings for changes in the ecological, social and economic sector conditions and value.



WATER AVAILABILITY, QUALITY, AND RISK

CHALLENGE AREA 4

SOCIETAL CHALLENGE

The U.S. is facing emerging threats to our economic and national security, and ecosystem and habitat health, from competing demands for our increasingly limited and stressed water supply and other water risks nationwide, in the context of aging water infrastructure, degrading water quality, population growth, and climate change.

SOCIETAL BENEFIT

NOAA, in collaboration with partners, addresses this challenge by helping ensure water security, to protect human and ecosystem health and inform water resources decisions, including availability, quality, and risk, while promoting equity and resilience. Water availability, quality, and risk lie at the nexus for food (via irrigated agriculture), energy (via hydropower), ecosystems (especially protected resources) and municipal and industrial water services. NOAA's water predictions and services are and will continue to inform decisions to support the protection of life and property, human and ecosystem health, recreational water use, and the optimal allocation of water supply in the context of competing demand.



FIVE-YEAR OUTPUTS: WATER AVAILABILITY, QUALITY, AND RISK

Area	Output
Equitable Water Service Delivery	<ol style="list-style-type: none"> 1. Define audiences, terminology, and approach for equitable service delivery. Build and sustain relationships in disadvantaged and underserved communities to gather and understand user needs in the context of their decisions; review and translate into the capacities needed to respond; assess and prioritize product and service development; evaluate impacts; and enhance products services.
Comprehensive and Real-Time Flood Inundation Mapping	<ol style="list-style-type: none"> 2. Deliver a comprehensive, real-time and forecast flood inundation mapping (FIM) capability for a wide range of applications, expanding NOAA's FIM services from 300 miles of rivers and streams to over 3.4 million miles, specifically reaching previously underserved communities. These applications will better depict when, where, and how deep flood waters will be for improved Emergency Management decision support before, during, and after an event; and for natural resources management, will address the intersection of aquatic resources (wetlands) and events that connect streams and rivers to these wetlands.
Common Digital Elevation Models to Improve Hydrologic Prediction	<ol style="list-style-type: none"> 3. Collect, and process, integrate, and disseminate comprehensive, high-resolution, topographic and bathymetric, impervious surface, and hydraulically-relevant feature data such as flood walls, structures and embankments, into common digital elevation models to profoundly improve the accuracy of hydrologic prediction, enable hydraulic modeling capabilities, and improve the accuracy of FIM capabilities.
Coastal Modeling Capabilities, Particularly for Underserved Coastal Communities	<ol style="list-style-type: none"> 4. Deliver coastal modeling capabilities, particularly in previously underserved coastal communities, that provide: (1) Total Water Prediction along the coastal boundaries for FIM applications; (2) Coupled riverine and coastal modeling systems (wind, coastal, and ice) that better account for fresh and saltwater contributions to surface and subsurface applications supporting enhanced predictions of coastal and estuarine processes.



FIVE-YEAR OUTPUTS: WATER AVAILABILITY, QUALITY, AND RISK

Area	Output
Coastal Modeling Capabilities, Particularly for Underserved Coastal Communities	<p>4. Deliver coastal modeling capabilities, particularly in previously underserved coastal communities, that provide: (1) Total Water Prediction along the coastal boundaries for FIM applications; (2) Coupled riverine and coastal modeling systems (wind, coastal, and ice) that better account for fresh and saltwater contributions to surface and subsurface applications supporting enhanced predictions of coastal and estuarine processes.</p>
Temperature, Salinity, and Turbidity Initial Water Quality Prediction Capabilities	<p>5. Deliver initial water quality prediction capabilities for water temperature, salinity, and turbidity in rivers, lakes, bays, estuaries, and sounds to (1) better inform decisions related to ecosystem, habitat, and species management and water supply; (2) better represent surficial aquifers that impact streamflow generation; and (3) provide an extended-range ensemble capability to address water temperature prediction.</p>
Hydrological Ensemble Forecast Services	<p>6. Deliver Hydrologic Ensemble Forecast Services (HEFS), leveraging improved seasonal to subseasonal, weather and climate forecasts, at all applicable stream gage locations nationwide. These services will include improved quantification of risk and uncertainty in streamflow forecasts from the NWS River Forecast Centers on scales of hours to seasons and longer, including improved seasonal volumetric water supply forecasts in the West and for previously underserved communities in the Southeast. This will expand the application of HEFS to water supply questions across the nation, and improve skill for critical forecast points necessary to accurately characterize the relationship between streamflow, flood, and drought.</p>
Evolve NextGen National Water Model	<p>7. Evolve the Next Generation of NOAA's National Water Model (NextGen NWM) to improve overall forecast skill. NextGen NWM will include model components that better account for process dominance and land surface variability, as well as the development of a community standards-based software framework that facilitates collaboration, accelerates development, and promotes interoperability of hydrologic, hydraulic, water quality, and coastal hydrodynamic models using an open source software development paradigm.</p>



EFFECTS OF SPACE WEATHER

CHALLENGE AREA 5

SOCIETAL CHALLENGE

The effects of space weather pose significant and increasing societal, economic, national security, and health risks to the United States and nations worldwide. These include risks to the electric power grid; aviation operations; positioning, navigation, and timing (PNT) services; satellites and communications; human space exploration; and other space-based assets.

SOCIETAL BENEFIT

To safeguard national security assets, critical infrastructure and technology, and crewed and uncrewed space assets, NOAA addresses this challenge by providing actionable space weather observations, forecasts, alerts, warnings, and decision support services.

FIVE-YEAR OUTPUTS: EFFECTS OF SPACE WEATHER

Area	Output
Space-base Observational Infrastructure	1. Build, operate, and augment the necessary space-based observational infrastructure required for short-term and long-term predictions of space weather including continuity of solar wind measurements, and new imagery of the solar corona.
Sun-Earth System Coupled Modeling Continuum	2. Build a coupled modeling continuum of the sun-Earth system, that addresses solar wind, impact on Earth's magnetic field, and impacts on the upper atmosphere.
Space Traffic Management Capabilities	3. Develop new, operational observation capabilities for space traffic management, including specifically, measurements of thermospheric density, and the capacity to assimilate those measurements into operational models.



FIVE-YEAR OUTPUTS: EFFECTS OF SPACE WEATHER

Area	Output
Ground-based Geomagnetic Measurements and Neutron Monitoring	4. Build and sustain partnerships with the public and private sector for ground-based geomagnetic measurements and neutron monitoring.
Integration of Commercial Space Weather Data	5. Obtain, validate, and demonstrate the integration of commercial space weather data from commercial sector providers into NOAA's operational space weather models.
Space Weather Prediction Testbed	6. Establish a Space Weather Prediction Testbed and associated community R2O2R Framework to increase coordination of space weather research-to-operations (R2O) and operations-to-research (O2R), and also operations to service delivery –producing applied products that meet societal needs.
Space Weather Products and Services	7. Continue to build and sustain partnerships with end-users to evolve space weather products and services to help in the development of plans and procedures for responding to and recovering from space weather events.
Satellite-based Broadband Internet and GPS Access	8. Increase satellite-based broadband internet and GPS access by strengthening NOAA's investment in new space weather platforms in collaboration with commercial providers.



MONITORING AND MODELING FOR CLIMATE CHANGE MITIGATION

CHALLENGE AREA 6

SOCIETAL CHALLENGE

Worldwide, there is now widespread recognition of the impact of greenhouse gas emissions on the climate system, leading to dangerous, accelerated warming. Within the U.S. and internationally, there is a growing demand for information about current and future greenhouse gas emissions, their impact on the state of the global climate system, and options and effectiveness of climate change mitigation measures at different scales.

SOCIETAL BENEFIT

NOAA addresses this challenge by informing mitigation choices through greenhouse gas and climate system monitoring and modeling. Additionally the agency has modeling capabilities to assess the climate, atmospheric, and oceanic implications of both current and proposed mitigation options, including renewable energy, coastal and oceanic carbon removal, and climate intervention strategies.

FIVE-YEAR OUTPUTS: MONITORING AND MODELING FOR CLIMATE CHANGE MITIGATION

Area	Output
Greenhouse Gas observation and Modeling Capabilities	<ol style="list-style-type: none">1. Develop GHG observation and modeling capabilities with NOAA domestic and international partners to reliably track changes in natural and human-made GHG emissions and sinks over time and at local, regional, continental, and global scales. Ensure the quality and necessary scientific stewardship of in situ and remotely sensed data sets from NOAA and partner observing systems.
Models, Tools, and Products for Climate Mitigation	<ol style="list-style-type: none">2. Be a reliable provider of models, tools and products for decision makers to determine the feasibility of achieving climate mitigation targets, taking into account anthropogenic emissions, ocean fluxes, and feedbacks in the earth system, and to evaluate the broader climate implications of various mitigation measures.
Quantification of Key Emission Sources Products and Services	<ol style="list-style-type: none">3. Deliver products and services that improve quantification of key emission sources to help decision makers at various scales identify important mitigation opportunities. Such sources include GHG emissions from urban sources, from the land-use and agricultural sectors, methane leaks from industry, and small quantities of potent GHG emissions from niche applications.



Summary and Opportunities

- The need for scientists and engineers have never been greater
- CIs and CSCs are the pipelines to NOAA's workforce and our research must be relevant, and we need to work together to maximize our strengths and minimize our individual weaknesses.
- There are opportunities:
 - NESDIS Satellite Programs
 - Other NOAA programs:
 - <https://coast.noaa.gov/funding/ira/resilience-challenge/>
 - <https://cpo.noaa.gov/Funding-Opportunities/NIHHIS-FY2024-IRA>

