INTEGRATED INFORMATION SYSTEMS

Helping decision-makers understand, proactively manage, and build resilience to weather, climate, and water risks with integrated information

An Integrated Information System (IIS) is a proven, whole-of-government organizational approach for enabling and strengthening capabilities to understand, manage, and mitigate societal risks from complex environmental hazards (e.g., heat, drought, floods). These systems work across sectors, timescales, geographies, and disciplines. An IIS is designed to inform and improve the policy and decision-making landscape, connect and amplify existing programs and networks, and respond to emerging priorities in a rapidly changing climate.

Why do we need Integrated Information Systems?

Weather, water, and climate hazards are increasingly responsible for the loss of or damage of life, property, infrastructure, economies, and ecosystem services. However, these hazards often do not have one single coordination entity at federal, state, or local scales—and thus no comprehensive, holistic, and coordinated science-policy framework to address them.

Disasters such as heatwaves in Chicago (1995) and the Pacific Northwest (2021) and drought in the Western US (2003-2004), Central Plains (2021), and Northern Plains (2017) made communities realize action to mitigate risk cannot wait. Events like these require the best available science, advance planning that connects science to action, and the integration of information, perspectives, and expertise across disciplines.

What Integrated Information Systems exist?

The National Integrated Drought Information System (NIDIS) initiated the Integrated Information Systems (IIS) approach in 2006 to address drought (P.L. 109-430). The IIS approach was adopted in 2015 as a model for the National Integrated Heat Health Information System (NIHHIS), and NIHHIS has been the subject of proposed legislation as well (The Preventing Heat Illness and Deaths Act of 2023). The National Integrated Flood Information System (NIFIS) was established by the 2022 FLOODS Act (P.L. 117-316) and is in the early stages of development as an IIS.

NOAA administers these Integrated Information Systems (IIS) and provides core staffing and support functions through congressional appropriations or base funding. NOAA is the the federal entity tasked with understanding and predicting changes and the provision of operational services in climate, weather, ocean, and coasts. Housing these IIS programs within NOAA allows for a strong, science-based foundation that can both build upon and strengthen existing NOAA and federal science and research programs.

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How do Integrated Information Systems work?

Improving decision making and service delivery is at the core of everything that an IIS does. An IIS anticipates and identifies a hazard and its associated compounding drivers and societal impacts, and brings together different perspectives and capabilities from decision-makers, practitioners, and scientists to find solutions to manage impacts and avoid them in the future. An IIS could not function without the extensive investments, activities, and networks that already exist. Where an IIS adds unique value is through the convening, integrating, and strengthening of existing individual efforts —such as a specific data portal, a community of practice or learning network, federal research programs, early warning systems—in the context of a defined problem and hazard. In essence, and IIS serves as a 'network of networks' that connects and amplifies existing work, while also addressing specific gaps identified by partners.

Decision-making depends on a broad range of environmental data, information, tools, and services. An IIS is able to strengthen the delivery of relevant, timely, and actionable information by different entities, including NOAA, by providing a mechanism to enable a continuous process of incorporating user needs and requirements and integrating state of the science advancements. The result is the delivery of information and services that is co-developed and based on mutual trust, in alignment with the NOAA Service Delivery Framework.

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All Integrated Information Systems incorporate and align **five interconnected characteristics** regardless of the environmental hazard and associated problems being addressed. These can be thought of as puzzle pieces, with each piece required to complete the puzzle and provide an efficient implementation of an IIS.

AGILE AND FLEXIBLE APPROACH

Agile and flexible approach to problem solving and new needs. Agility and flexibility are key characteristics of an IIS, where each IIS is able to shift priorities to respond to the most pressing (and sometimes unanticipated) needs, as the hazard itself and the priorities of the users may change over time. Additionally, there is no single best approach for applying knowledge to resolving problems. For example, NIDIS utilizes a regional-based approach because solutions can often be shared between states, while NIHHIS takes a community cohort approach to build heat resilience.

INFORM POLICY AND INVESTMENTS

Inform policy at the national and local levels. Each IIS has a key role in working with decision-makers and practitioners to inform action at all levels of governance. An IIS works to communicate the issues to the public, decision-makers, and other stakeholders in a way that supports action. To do this, the IIS maintains sustained engagement with policy-makers at the national level through Congressional briefings and hearings. At the local level, the IIS works alongside partners to improve current policies to manage risk, such as heat mapping data collection through the NIHHIS urban heat island campaigns that inform cooling solutions.

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Integrated information across all existing elements. An IIS is developed and executed intentionally to bring information and people together, and foster integration of existing efforts and networks to address specific problems. This includes the integration of scientific information and knowledge, such as models and data, into decision support tools. For example, NIDIS collaborated with USDA to convene service providers, decision-makers, and researchers on the issue of drought in a changing climate. The outcomes from this dialogue are resulting in the design of research investments that will inform near-term drought monitoring and long-term risk assessment. An IIS can also collate and curate the breadth of data and tools available in the context of a specific hazard context, such as through heat.gov and drought.gov.

TRUSTED RELATIONSHIPS

Trusted relationships across individuals, organizations, and disciplines. Relationships are critical to each IIS because the system relies on partnerships for its success. While the three existing Integrated Information Systems are NOAA-led, they take an inter-agency, organizational approach focused on working with decision-makers, researchers, stakeholders, and the public to learn from each other to define and address problems and promote resilience. For example, NIHHIS and partners have developed and run Extreme Heat Tabletop Exercises in cities across the US to stress test plans and identify gaps.

SYSTEM MANAGEMENT APPROACH

A Systems Management Approach to coordinate, support, and monitor actions undertaken by the IIS. An IIS builds and maintains partnerships, connects and integrates the existing networks and efforts underway, and provides the science community with user needs. This requires 'care and feeding' at a higher level than just an individual project. Therefore, a 'systems' approach is used by the IIS program offices to oversee the broader IIS strategy and implementation. For example, NIDIS supports a coordinator for each of the regional drought early warning systems (DEWS) who is responsible for convening regional partners and connecting tools and services from federal and state partners.

While each IIS differs in its approaches based on the hazard and problem, there are some **common elements that each Integrated Information System incorporates into its implementation.** This is achieved by working directly with existing entities and networks through focused investments and partnerships, and integration across the functions.

Knowledge Transfer and Communication. Communication is not the end result. An IIS meaningfully helps others do their work by enabling sharing and active learning across different areas of expertise, and building capacity through trust building and knowledge transfer. Frequent IIS partner examples: National Weather Service Weather Forecast Center


◄ **Example:** *The U.S. Drought Portal (www.drought.gov) is the U.S. government's authoritative drought information website. It provides a one-stop shop for data, decision-support products, resources, and information on drought—from drought monitoring and prediction, to planning and preparedness, to applied research.*

◄ **Example:** *Heat.gov serves as the premier source of information regarding heat and health for the nation. The portal seeks to improve federal, state, and local information and capacity to reduce the health, economic, and infrastructural impacts of extreme heat.*

Product Co-Development. Co-development of information, products, and tools is a cornerstone of the IIS approach to provide improved decision support information and services. Each IIS spends a large portion of time in conversation with current and potential users of climate, water, and weather information. Frequent IIS partners: Regional Climate Centers, State Climatologists, National Weather Service and National Centers For Environmental Information, NOAA Regional Climate Service Directors, USDA Climate Hubs, USGS Climate Adaptation Science Centers, private sector, states, and communities
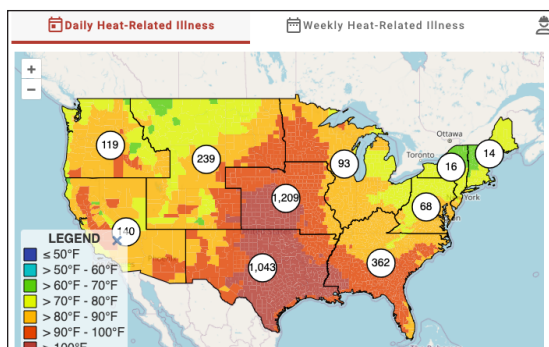
◄ **Example:** *The Heat & Health Tracker provides local heat and health information so communities can better prepare for and respond to extreme heat events by pairing NOAA National Centers for Environmental Information data with health data from the CDC's National Syndromic Surveillance Program.*

Example: *NIDIS is working with the National Weather Service's Climate Prediction Center to improve the reliability and usability of drought outlooks using social science and new research.*

For more information on drought, heat, or flood events, visit drought.gov, heat.gov, or water.noaa.gov.

Applied Research and Assessment. Each IIS is designed to facilitate the connection and coordination between existing research and assessment efforts around specific hazards and problems and jointly develop and implement coherent strategies and priorities. This is a continuous, two-way process, where an IIS can provide guidance on research priorities for federal and academic programs through the identification of on-the-ground needs, and can also take research outcomes from these existing research programs and institutions and incorporate it into products, tools, and communications. Frequent IIS partners: NOAA and other federal labs and programs, academic institutions.

NOAA DROUGHT TASK FORCE REPORT ON THE 2020–2021 SOUTHWESTERN U.S. DROUGHT

◀ **Example:** *NOAA research investments on the extensive Southwest Drought were informed by stakeholder needs identified through NIDIS-led engagement.*

Example: *NIDIS has twice convened the national drought research community and practitioners to identify outstanding information needs for planning and responding to rapid onset (flash) drought, leading to improved products and incorporation of practitioner needs in research efforts.*

Monitoring and Forecasting. An IIS coordinates and integrates federal, state, and tribal efforts to improve observation, monitoring, and forecasting in support of early warning systems, response, and longer-term planning such as observation data and health surveillance.
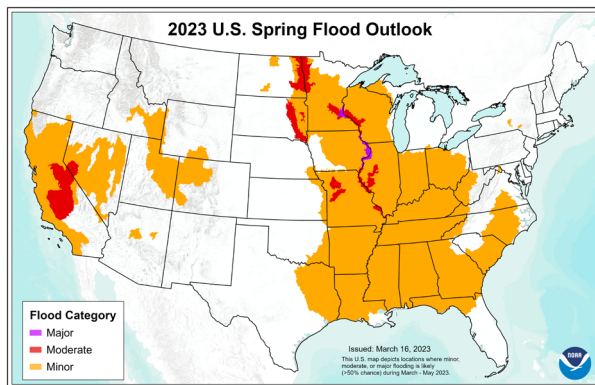
◀ **Example:** *The 2023 National Hydrologic Assessment offers an analysis of flood risk, water supply, and ice break-up and jam flooding. NOAA's network of 122 Weather Forecast Offices, 13 River Forecast Centers, and the National Water Center assess and summarize this risk for the public.*

Example: *As leader of the cross-agency National Coordinated Soil Moisture Monitoring Network, NIDIS is advancing the full range of soil moisture resources, from improved monitoring, to technical assistance, to co-developed decision products.*

Preparedness, Planning, and Resilience. Some decision-makers are primarily focused on a particular timescale (e.g., emergency managers on response, urban planners on resilience), but the IIS model aims to bring these stakeholders together so they can learn from one another and conduct integrated planning across timescales.

◀ **Example:** *Example: NIHHIS has worked with citizen scientists across the country since 2017 to map urban heat islands in over 70 communities. These urban heat maps are used by decision-makers in communities to implement cooling solutions, such as integrating them into heat action plans.*

Example: *Scenario and Tabletop Exercise are utilized by NIHHIS and NIDIS to improve cross-agency coordination for response and planning at local, state, basin/regional and national levels.*