

Building a Weather-Ready Nation Through Science-Based Service

[A Vision for a Modernized Forecast Operations Concept]

Last Update: 6-Jan-2022



NOAA | National Weather Service
Science & Technology Integration

GOAL // [where we want to go]

Revolutionize our ability to protect life and property, enhance the economy of the United States, and build a Weather-Ready Nation

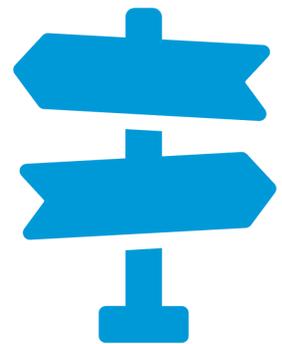


Our goal as meteorologists and hydrologists is to provide useful information, not just good forecasts. This means retooling our operations around producing actionable information, not just ‘getting it right’. There are thousands of decisions made every day in our CWAs that could benefit from the knowledge that we have as experts. We can’t provide information to every one of those decisions with a finite staff and finite time. But if **we fully leverage probabilistic information, focus on the things that humans do well, embrace change, and learn what questions our partners really need answers to, we can revolutionize our ability to protect life and property, enhance the economy of the United States and build a Weather-Ready Nation.**

JUSTIFICATION // [why we want to go there]

*Nearly all of the studies ... indicate that people make **better decisions**, have higher **trust** in information, and/or display a greater **understanding** of forecast information when shown a [tailored] probabilistic forecast instead of a deterministic one*

The NWS recently commissioned [researchers at OU](#) to review 300+ papers pertaining to forecast communication. What did they find? Users, whether it be partners or the public, understand the forecast and make better decisions when given clear probabilistic information - and that **communication** is just as important as accuracy. It’s difficult to hear that simply “getting it right” isn’t the most useful, it is only one aspect of a “good” forecast. But the social, behavioral and economic science (SBES) and meteorological literature are both very clear that producing a single, deterministic forecast is not the best way to fulfill our mission or provide equitable service. A focus on achieving the NWS mission through an emphasis on communicating probabilistic information is supported by almost 50 years of science as well as the [2019-2022 NWS Strategic Plan](#), [NOAA’s 2020-2026 Vision](#), [WMO’s Vision 2030](#), [WMO Guidelines for Impact-based Forecasts and Warnings](#), the [NWS Operational Workforce Analysis](#) and the [NWS Building a Weather-Ready Nation](#) BAMS paper. This goal is designed to be the foundation of NWS [Evolve 2.0](#) and the fulfillment of the promise of FACETs: Consistent, collaborated and effective science-based IDSS for a WRN using probabilistic information.



PATH FORWARD // [how we get there]



The changes necessary to reach the goal are not easy. But incremental changes can be made now to start us down the road. There will be growing pains as we use more probabilistic information while also maintaining legacy deterministic products and dissemination methods. The following pages will describe the steps we are taking, why we are taking them, and what the destination will look like.

THE FIRST STEPS

In the year 2021 we are in a period of transition. Our toolsets are not complete, we and our partners need education, and our forecast process is evolving. We are laying the groundwork for our future.

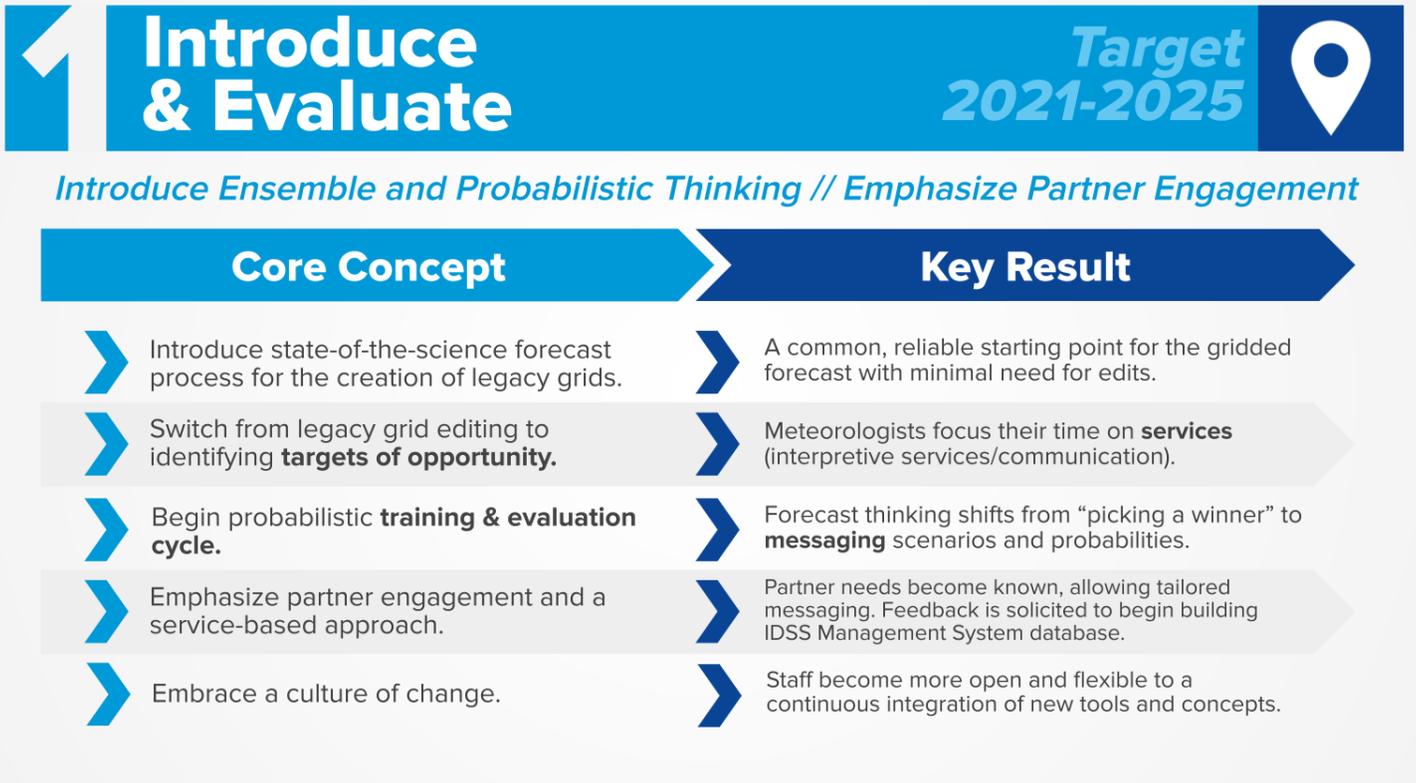


Fig 1 ([top - click for larger](#)) - The first step to a modernized operations concept - Introduce and Evaluate. The core concepts are the key components being introduced and the key results that will fall out and allow us to move forward.

TARGET OF OPPORTUNITY

One of the core concepts is *Target of Opportunity*. But what does it mean? It is much bigger than grid edits. It’s anywhere we can add value to the Collaborative Forecast Process, which includes partner interactions and messaging strategies more often than not, resulting in improved decision making!

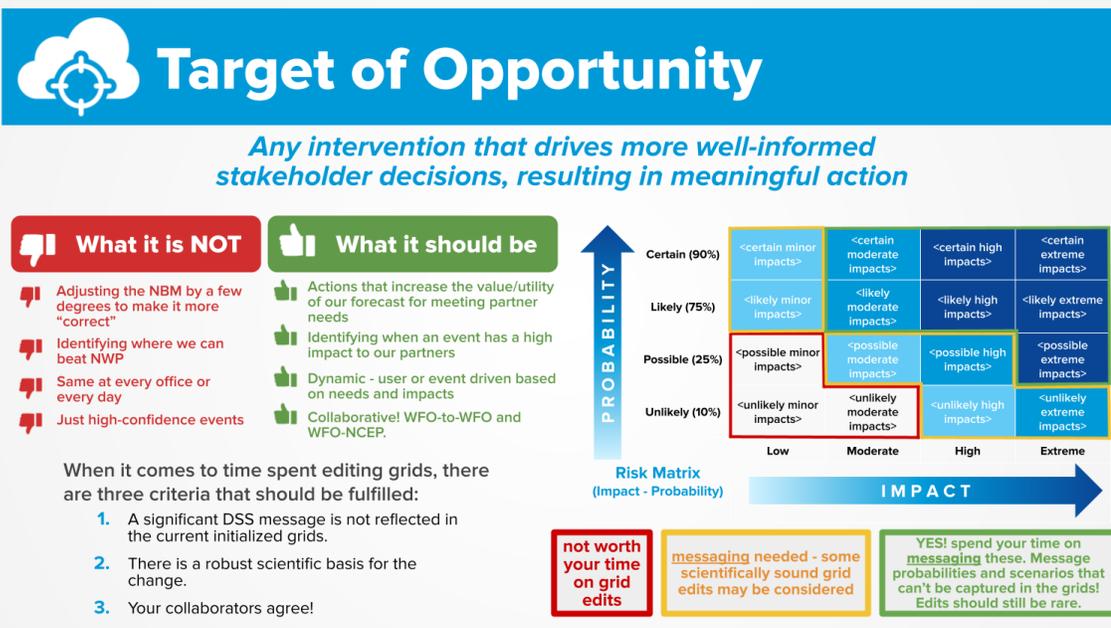


Fig 2 (left - [click for larger](#)) - Target of Opportunity. It goes far beyond grid edits. “Targets of opportunity” are opportunities to add value and utility to our forecast and yield improved decisions by our partners.

THE FUTURE ROLE OF THE METEOROLOGIST AND HYDROLOGIST

The core concepts above will continue to change the role of the meteorologist and hydrologist. Will there still be a need for humans? Yes! Communication of forecast information requires a deep understanding of both the atmosphere and human behavior - something only humans can provide, even with a perfect NBM or national center forecast product. As for hydrometeorological analysis skill, there will always be a requirement for scientific expertise, especially in the short term period and at the mesoscale. But our definitions of “meteorologist” and “hydrologist” will need to broaden to include translating forecast elements and impacts into actionable IDSS. The forecast process ends in the brain of the decision-maker. We will need to attend to the *value* and *consistency* of the forecast as much as to its quality.

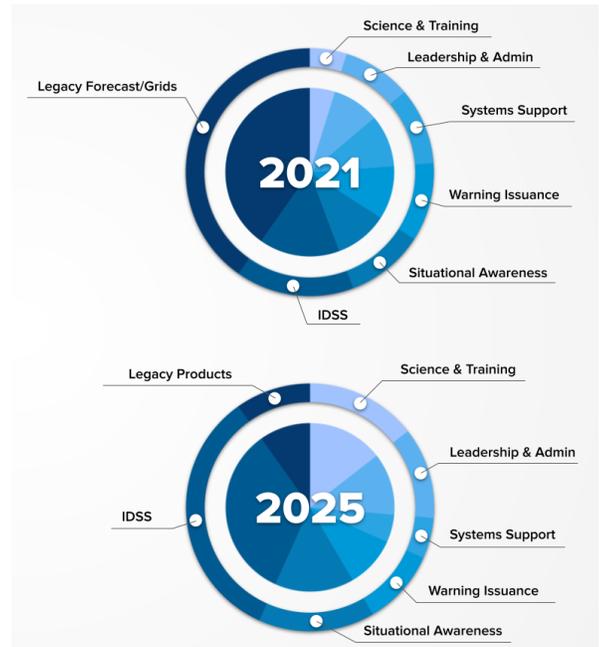
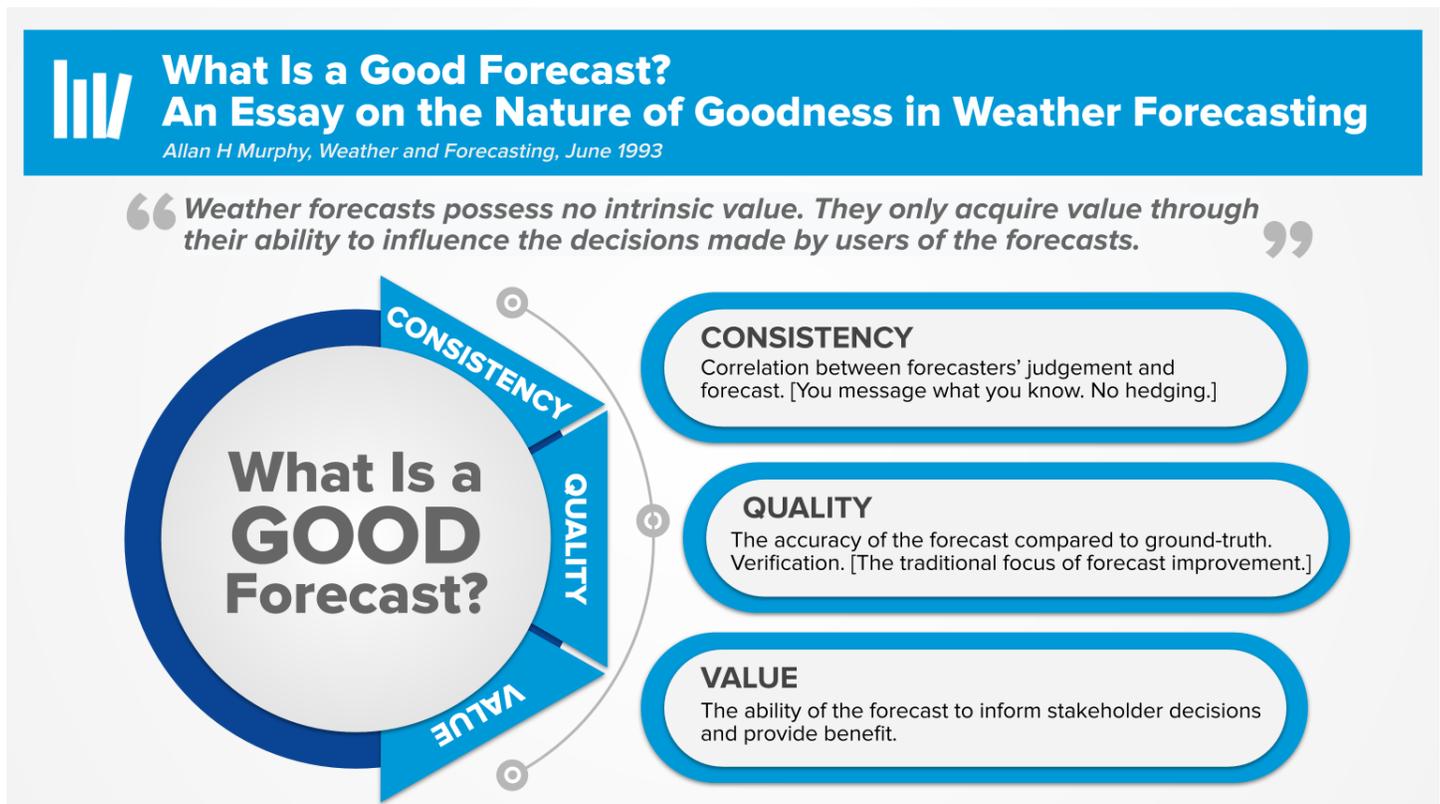


Fig 3 (right - [click for larger](#)) - Where We Spend Our Time - adapted from the [OWA White Paper/NWS Evolve](#)

WHAT IS A GOOD FORECAST?

What are consistency, quality, and value? They are the three essential measures of what constitutes a “good” forecast. For the most part, the NWS has been focused on “quality” - improving verification. Forecast quality, or accuracy, is merely a means to an end. It is not an end in itself. By also focusing on value and consistency (“One forecast, One message”), we maximize our ability to provide actionable IDSS.

Fig 4 (bottom - [click for larger](#)) - What Is a “Good” Forecast? - adapted from Murphy 1993.



INCORPORATING CORE CONCEPTS INTO EXISTING FORECAST PROCESS

Even while our legacy products and structure are still in place we must work the core concepts from [Figure 1](#) into our operations framework. Figure 5 shows how we can work the desired core concepts into the current operational paradigm to begin achieving the key results. Today we can evolve from making small changes to the forecast to a focus on turning the forecast into actionable information.

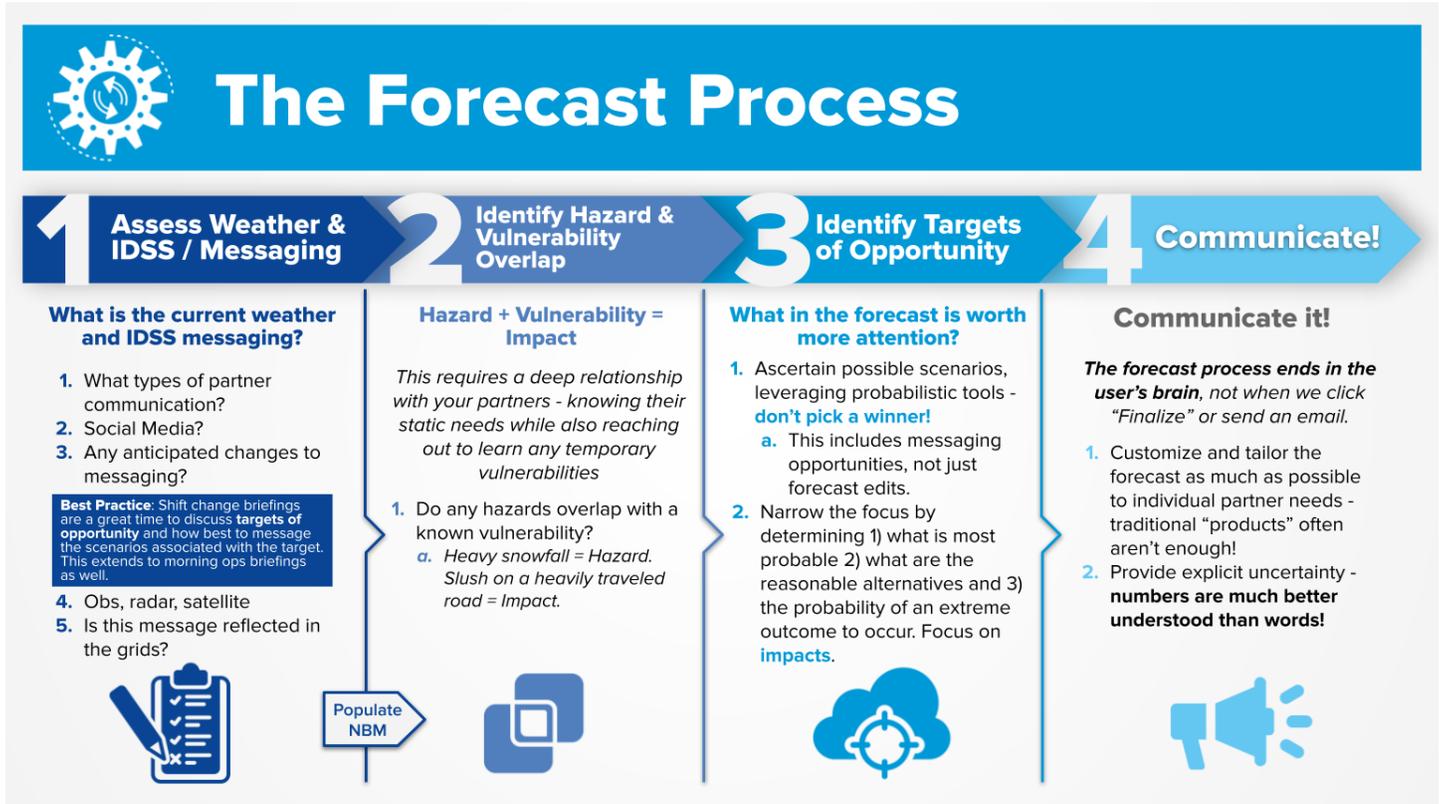


Fig 5 (top - [click for larger](#)) - The Forecast Process. Advancements in science have allowed us to spend more time assessing our messaging, learning where hazards and vulnerabilities overlap, and identifying targets of opportunity in order to better communicate the forecast.

Of course, the forecast process is just one link in the continuous cycle of our operations, where stakeholder engagement and action drive forecast decisions.

Fig 6 (right - [click for larger](#)) - The Modernized Operations Cycle. The forecast process begins and ends with partner engagement, not merely hitting send on operational products



BEYOND 2025

In 2021 the NBM is still a teenager and we are taking steps toward a new paradigm. By 2025 we are hopeful that the NBM will be a mature probabilistic forecast database supporting a Collaborative Forecast and Messaging Process, cloud technology will allow interrogation of that database from anywhere, and our partner relationships will allow us to maximize the decision-making value of that information.

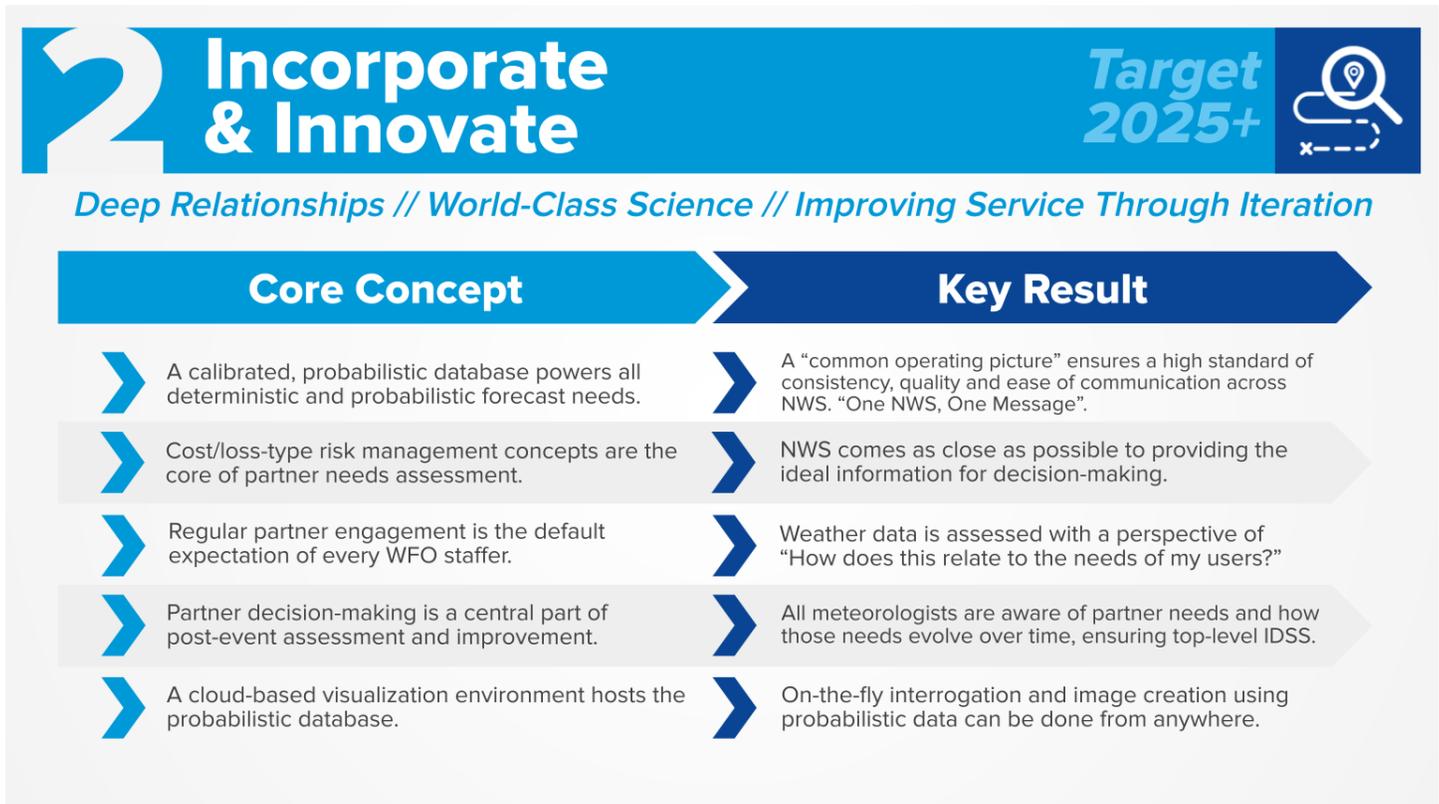


Fig 7 (top - [click for larger](#)) - The Next Step - Incorporate & Innovate. Building deep relationships and an iterative operations process allows us to provide world-class service to our stakeholders.

SUMMARY // [in precis]



Since at least 1974, countless studies have demonstrated that the best way to provide valuable information to the users of weather forecasts is to effectively communicate probabilistic information. To ensure that we can perform the mission of the NWS at a world class level in 10 years, we will need to do several things. First, we will need to leverage probabilistic information from a single calibrated database in the cloud. We will need to go deeper with our partners than we have ever gone before. We will need to embrace change, including in how we think about targets of opportunity. We will need to think about forecast value, consistency, and equity, not just quality. And we will always need to remember that the forecast process ends in the brain of the decision maker. These things will make us the world’s best meteorologists and hydrologists. We are the weather and water experts. Let’s do everything we can to **protect life and property, enhance the economy of the United States, and build a Weather-Ready Nation.**

LITERATURE // [further reading]

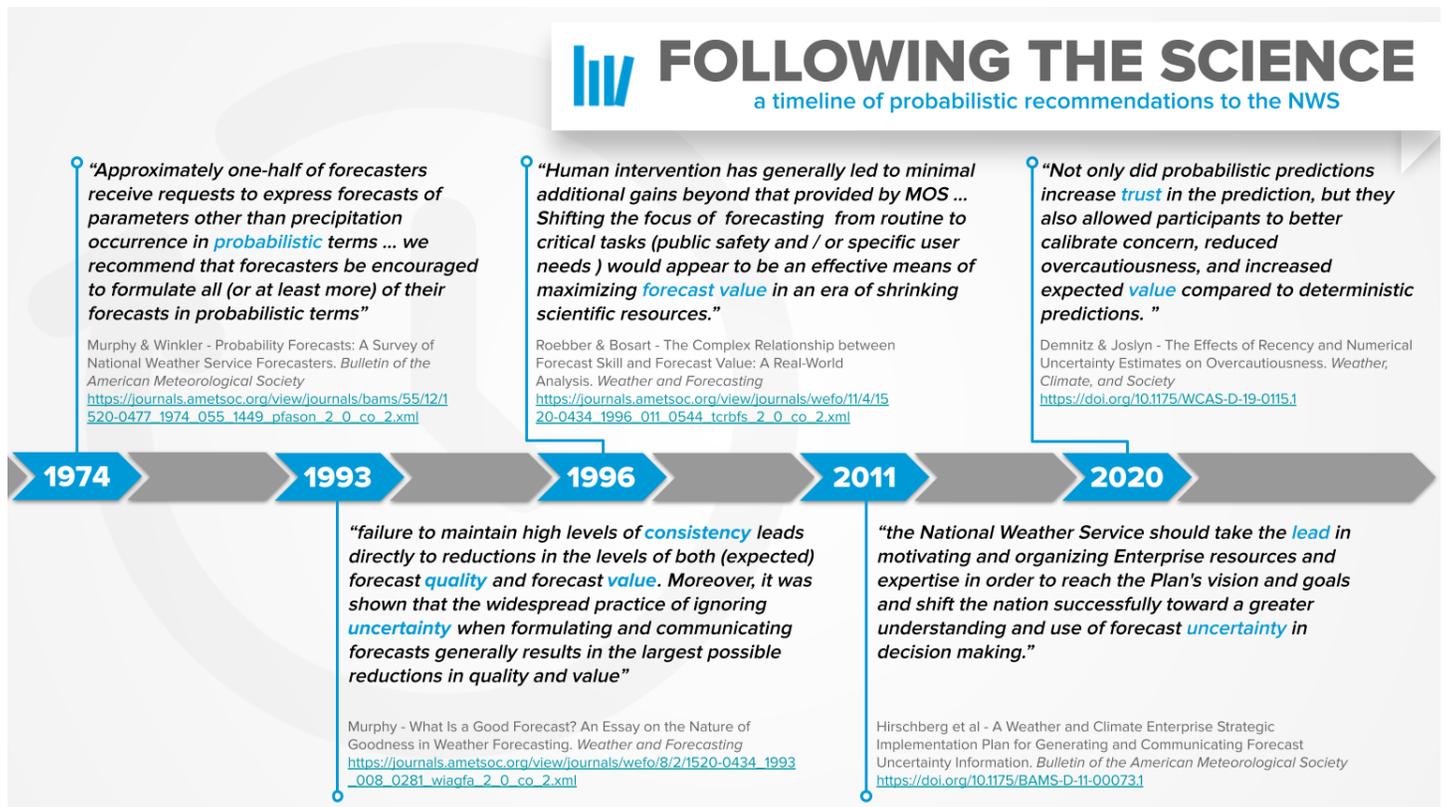


Fig 8 ([click for larger](#)) - Nothing New: A Timeline of Probabilistic Recommendations to the NWS.

[1974 - Probability Forecasts : A Survey of National Weather Service Meteorologists](#)

[1993 - What Is a Good Forecast? An Essay on the Nature of Goodness in Weather Forecasting](#)

[1996 - The Complex Relationship between Forecast Skill and Forecast Value: A Real-World Analysis](#)

[2003 - IFPS and the Future of the National Weather Service](#)

[2011 - A Weather and Climate Enterprise Strategic Implementation Plan for Generating and Communicating Forecast Uncertainty Information](#)

[2020 - The Effects of Recency and Numerical Uncertainty Estimates on Overcautiousness](#)

