NWS Science and Technology Roadmap

Decision Support Services (DSS) Tiers 1-2

Team Composition

Douglas Hilderbrand, OST—Team Leader

David Ruth, OST—DSS Tier 3-5 Team Coordination

Wendy Levine, SPP—Advanced Forecaster Tools and Applications Team Coordination

John Gaynor, OAR—Research

Mark Moran, NCEP—Operations

Joanne Swanson, SPP—Planning

Mike Gerber, OCWWS—Outreach Team Coordination

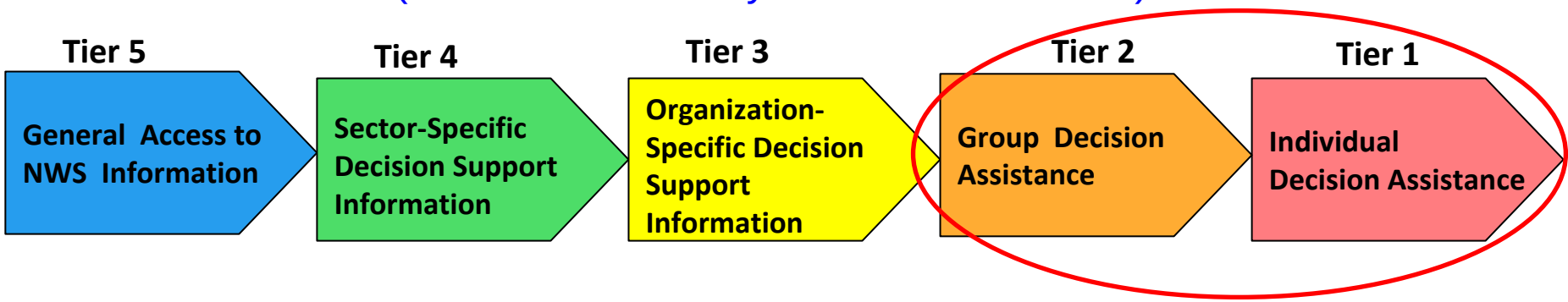
Additional input provided by Pete Browning, Aimee Devaris, Ken Johnson, Eli Jacks, Ken Graham, Andy Edman

DSS Tiers 1-2 – What Is It?

Premise:

The success of NOAA's mission should not *just* be measured by the accuracy of its information but by the effectiveness of its application.

- **NWS interaction with users on-location or remotely with emphasis on high-frequency rapidly updated information, especially during high-impact events**
- **Clear explanations and interpretation assistance**
- **Two-way communication for all levels of sophistication that is:**
  - Impact-based
  - Easily accessible and well articulated
  - Risk-based (includes uncertainty forecast information)



DSS Tier 1-2

DSS Tier 1-2 Vision/Outputs

Focus Area Team Vision: Infusion of science and technology that enables easily accessible, well-articulated interaction with government agencies (federal, state, local) resulting in appropriate actions to mitigate loss of life and property.

Benefits/Outputs

- Increased collaboration and two-way communication (either on-location or remotely) based on strong core partnerships anytime and anywhere
- Translation of weather (including water and climate) information into impact-based actionable decision support
- Improved preparation/risk mitigation, response, and recovery during high-impact events (end-to-end situational awareness)
- Support a culture through technology that ensures high-frequency interactions between government agencies and NWS personnel

"The major problem with communication is the illusion that it has occurred."
- Albert Einstein

Impacts/Outcomes

Impacts/Outcomes: So What?

- Risk mitigation saves lives and protects property
  - More appropriate delays/cancellations due to severe weather, flash flooding, etc.
  - Improved road surface treatment decisions during winter weather (e.g., ~7,400 Americans die annually in weather-related auto accidents)
  - Optimal positioning of firefighters during wildfire saves $Ms in property damage
- Preparedness and mitigation techniques enhance economy
  - More efficient use of resources (e.g., rerouting aircraft saves $100Ms)
  - Better evacuation decisions save lives and reduce costs of inappropriate expenditures (e.g., ~1 mile of coastline evacuated costs $1M)
- Faster response to what customers need
  - Interactive feedback loop ensures appropriate application of information in time to be incorporated into decision-making process
  - High-frequency interactions increase situational awareness during rapidly changing conditions

Goals/Targets: Emerging Science & Technology

Goal/Target	Outstanding Issues
1. Optimize Communication and Effective Interpretation: Well articulated, clear explanations, and interpretation assistance between forecasters and users anytime/anywhere to ensure effective application of information.	1.1 Forecasters need tools* to generate advanced graphics and visualizations taken from gridded forecasts. 1.2 Current dissemination methods** not taking advantage of mobile device technology. 1.3 Current commercial software was not designed for current NWS webinars. 1.4 Consistency needed among products and services. **Link with Advanced Forecast Tools & Applications Team* ***Link with Dissemination Team*

Goals/Targets: Emerging Science & Technology

Goal/Target	Outstanding Issues
2. Intelligent Service Delivery: Deliver information within context of pre-defined user needs and thresholds. Anticipate user needs and requests using "intelligent" delivery of information based on past user behavior.	2.1 AWIPS not integrated with database of pre-defined user needs and risk thresholds. 2.2 Rapid advances in mobile device technology, social networking, web 2.0/3.0* require responsive S&T transitions to operations **Link with Outreach and Feedback Team*
3. Communicate impact-based information: Elicit appropriate action by communicating the impacts that environmental conditions will have on users.	3.1 New AWIPS tools* needed to assist forecasters in generating impact-based information that accesses meteorological and non-meteorological databases (e.g., demographic, geographic, infrastructure). ** Link with Advanced Forecast Tools & Applications Team*

Goals/Targets: Emerging Science & Technology

Goal/Target	Outstanding Issues
4. On-demand Situational Awareness: Deliver immediate, actionable risk-based information (perception of environmental elements, comprehension of their meaning, and projection of their status in the near future).	4.1 Capability needed to provide high frequency rapidly updated forecasts. 4.2 Consistency must be ensured using the Single Authoritative Source (SAS). 4.3 Integrated NOAA and non-NOAA databases.
5. Communicate Forecast Uncertainty: Effective communication of uncertainty/probabilistic information as additional input into decision-making and not just based on most likely scenario. Eliminate "bad forecast → bad decision" syndrome. Decisions based on cost/loss models or risk mitigation.	5.1 Requires significant amount of training for NWS personnel as well as education of users. 5.2 Probabilistic forecasts* must be reliable operating under stable processes. **Link to DSS Tier 3-5 and Post-Processing Teams*

Goals/Targets: Emerging Science & Technology

Goal/Target	Outstanding Issues
6. Institutionalize an integrated, experiential training program: Create a comprehensive educational framework to integrate science, technology, communications, and critical thinking skills.	6.1 Culture shift in workforce toward active communicators and translators of critical, complex information. 6.2 Training of forecasters needed in using appropriate language (build DSS lexicon) to ensure consistency.
7. Integrate social science in DSS: Social science methods ensure the correct interpretation and application of environ-mental information to make better decisions as well as measure socio-economic impacts of forecast information.	7.1 Information must match sophistication of users, including all socio-economic groups*. **Link to Social Science Team*
8. Service metrics and service verification: Track performance measures of NWS decision support services based on customer satisfaction.	Currently no GPRA goals* for DSS. **Link to Verification Team*

Key Information Gaps

Gap	Solution Alternative	Impact
1. Communication inefficiencies lead to users not receiving information when they need it, and in forms that can be misinterpreted.	1.1 Provide on-location assistance using advanced visualizations (e.g., graphics, animation, etc.). 1.2 Two-way mobile device information sharing. 1.3 Interact remotely using advanced collaboration tools (web-2.0/3.0), webinars using advanced audio/visual (e.g., GIS fully integrated, Virtual Reality).	• Faster, more responsive delivery of information, esp. during rapidly evolving high impact events. • Two-way communication anytime/anywhere minimizes chance of misinterpretation of NWS information.

Key Information Gaps

Gap	Solution Alternative	Impact
2 Current DSS capabilities do not incorporate user needs or thresholds and do not anticipate user requests. Current DSS efforts are reactive as opposed to proactive.	2.1 Customer Relationship Management (CRM) System (e.g., centralized IRIS database). 2.2 Automatic Alert System to alert forecasters of user impacts based on weather conditions and defined user thresholds. 2.3 Next-Generation Information Sharing Capabilities (e.g., Web 2.0/3.0, "Artificial Intelligence" concept.	• Users receive real-time environmental information in context with their needs/thresholds.
3. Current NOAA information is not impact-based.	3.1 Integrate user impact information with environmental information (e.g., will two inch snowfall melt on road surfaces or ice over?). 3.2 Forecaster tools to generate creative displays of information based on gridded forecasts in a rapid response capability (e.g., run models on demand).	• User decisions will improve if environmental information is delivered in an impact-based context.

Key Information Gaps

Gap	Solution Alternative	Impact
4. NOAA lacks resource capacity and flexibility to dedicate to impact-based decision support during high-impact events.	4.1 Access to rapidly refreshed environmental information (obs., model runs). 4.2 Integrated NOAA and non-NOAA databases and common interoperability for holistic situational awareness. 4.3 Decision Support Officers (DSO) at local, regional, and national centers.	• Customer support for the WIDB at local, regional, national scales with on-demand high frequency forecast capability.
5 Only limited communication of uncertainty/probabilistic information for DSS purposes. Customers making decisions based only on most likely scenario.	5.1 Training of forecasters on how to communicate uncertainty. 5.2 Education of users on how to apply uncertainty information to improve decisions.	• Decisions based not on incomplete information (i.e., most likely scenario) but on complete range of possible scenarios.

Key Information Gaps

Gap	Solution Alternative	Impact
6. No formal DSS training exists.	6.1 Institutionalize an integrated, experiential training program.	• Improved decisions due to more effective application of NOAA information.
7. No measurement exists on the effectiveness of the application of NOAA information.	7.1 Integrate social science methods into DSS.	• Improved decisions due to more effective application of NOAA information.
8. Service metrics and service verification do not exist.	8.1 Define DSS performance metrics and economic impacts, including GPRA measures.	• Cost/benefit information that will help in budget acquisition.

Research Needs and Opportunities

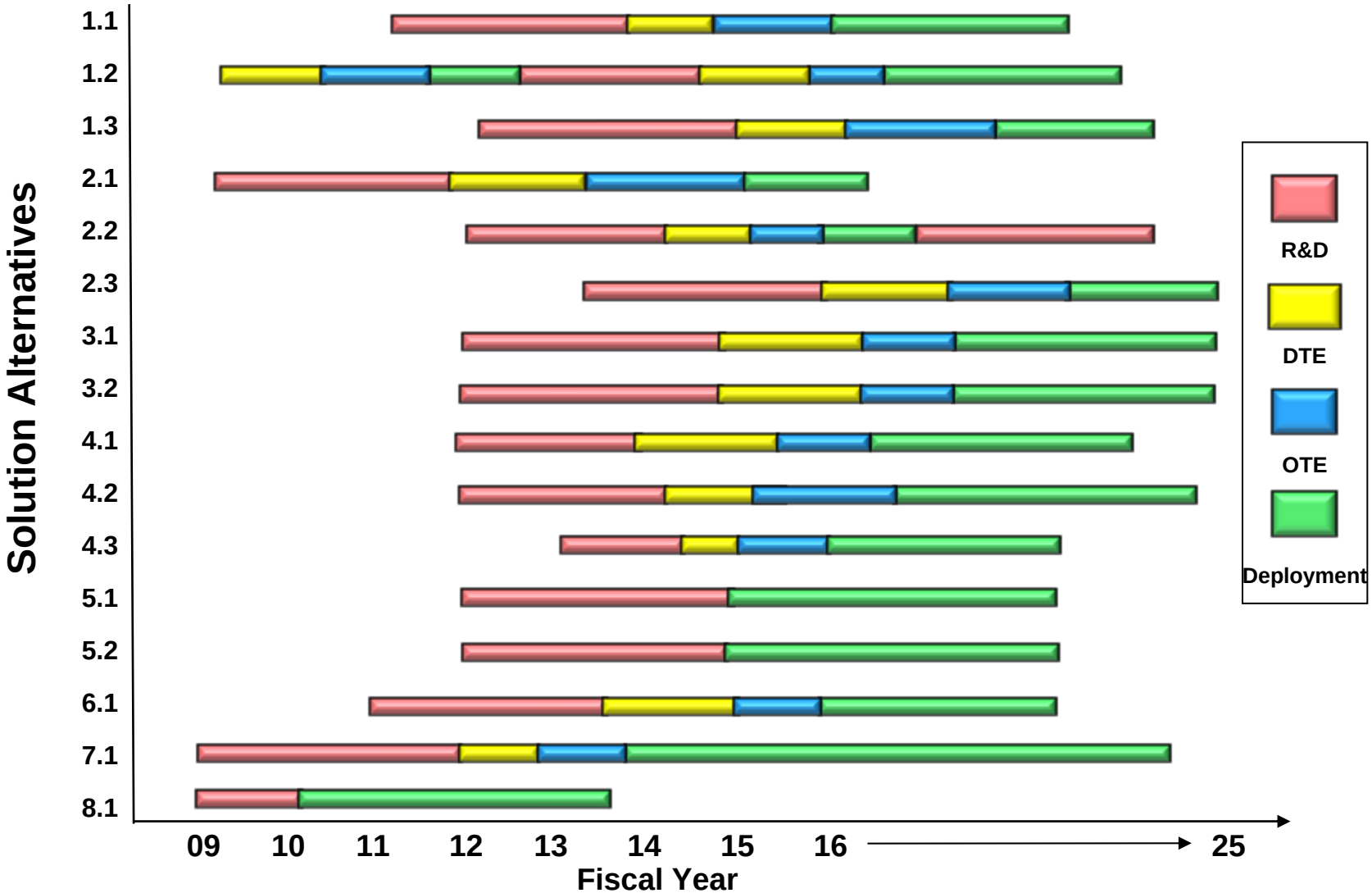
Near-term

- Advanced graphics, animation, and other visualizations (e.g., GIS-based)
- Method for effective communication of forecast uncertainty
- User needs/thresholds database; impact-based information generation
- Two-way communication tools (graphical collaboration; thin client for on-location support and webinar software for remote support)
- Develop social science methods and quantify socio-economic impacts
- Develop service metrics and verification

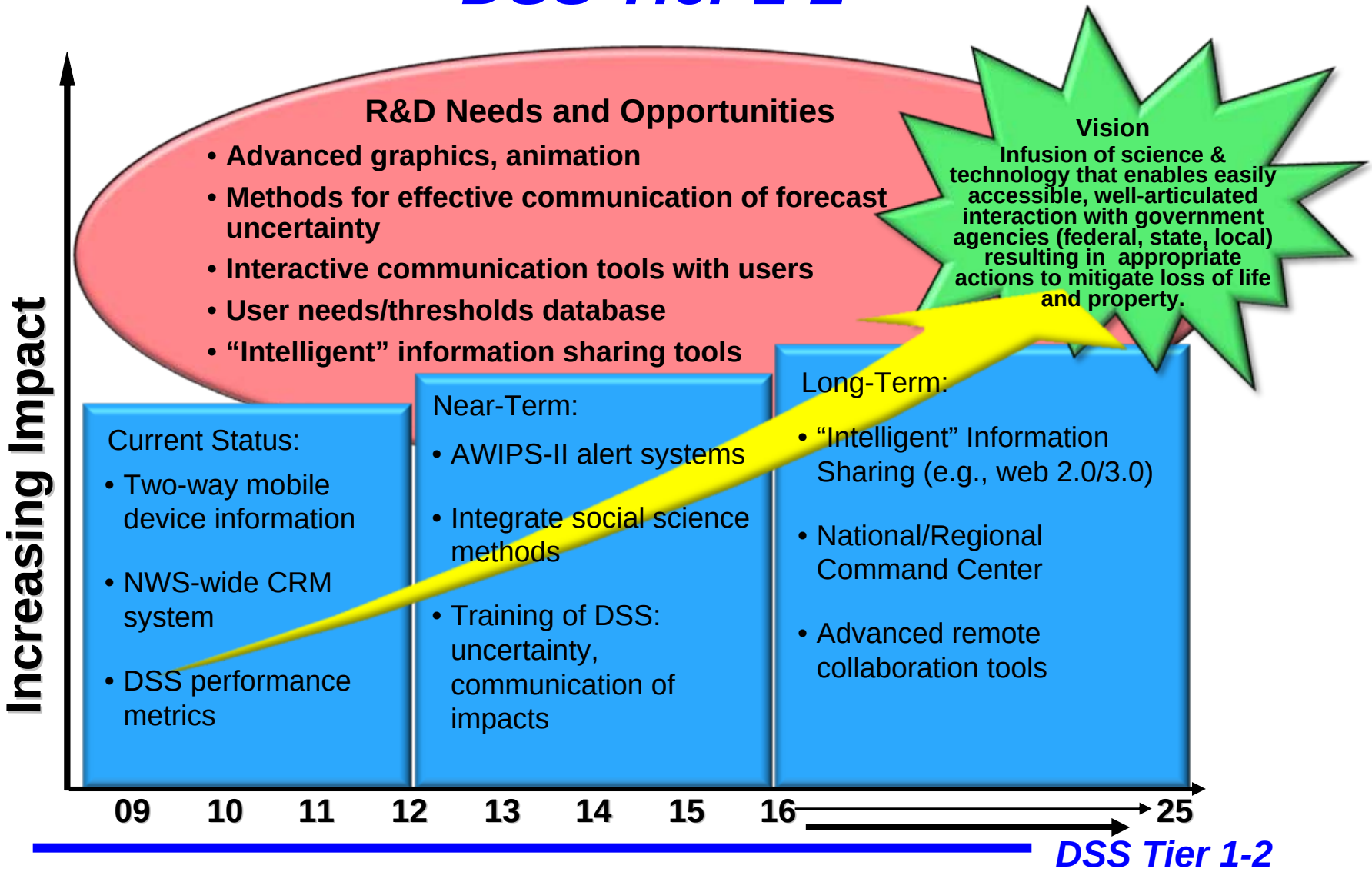
Long-term

- Forecaster assistance tools to ensure consistency (e.g., automatic alerting messages for violating SAS)
- Fully integrated WIDB with other non-NOAA databases (e.g., environmental, geographic, demographic)
- Collaboration tools (advanced display capabilities)
- “Artificial Intelligence” software that anticipates customer needs for specific information

DSS Tier 1-2
Alternative Solutions



Focus Area Team Summary: DSS Tier 1-2



NWS Science and Technology Roadmap

Decision Support Services Tier 1-2 Team

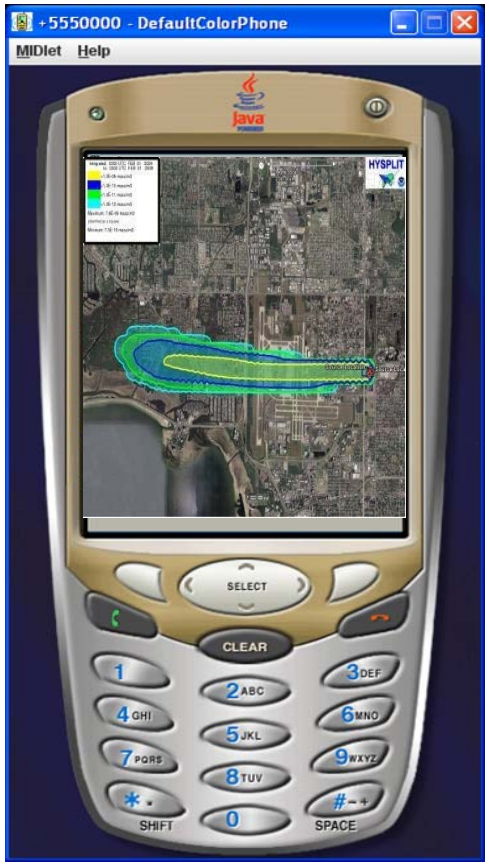
Additional Information

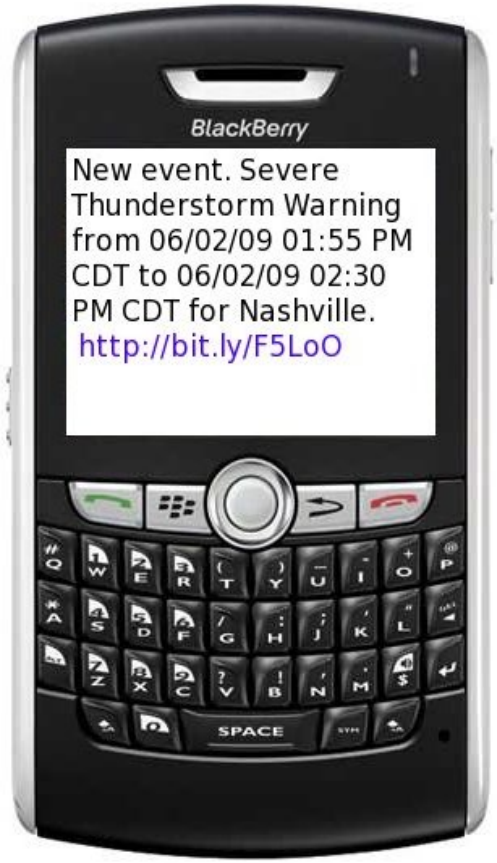
Target Performance Measures: DSS Tier 1-2

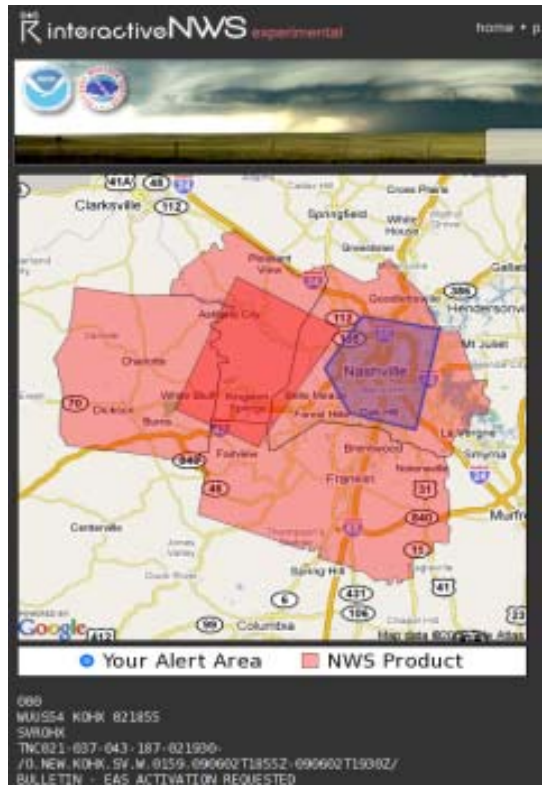
Proposed	Current (2009)	FY 2016 Target Example	FY 2025 Target Example
Response rate (%) of user requests for on-location DSS	<100%	100%	100%
# of mobile subscribers	0	30,000	Potentially millions
# of GIS-based products disseminated	Isolated	Widespread	Widespread
% training at WFOs	0%	100%	100%
# GPRA measures defined	0	>1	>1
DSS Support (Scale)	Ad hoc Local	Local	Local, Regional, National

Examples of DSS Tier 1-2

-Mobile Alerts-

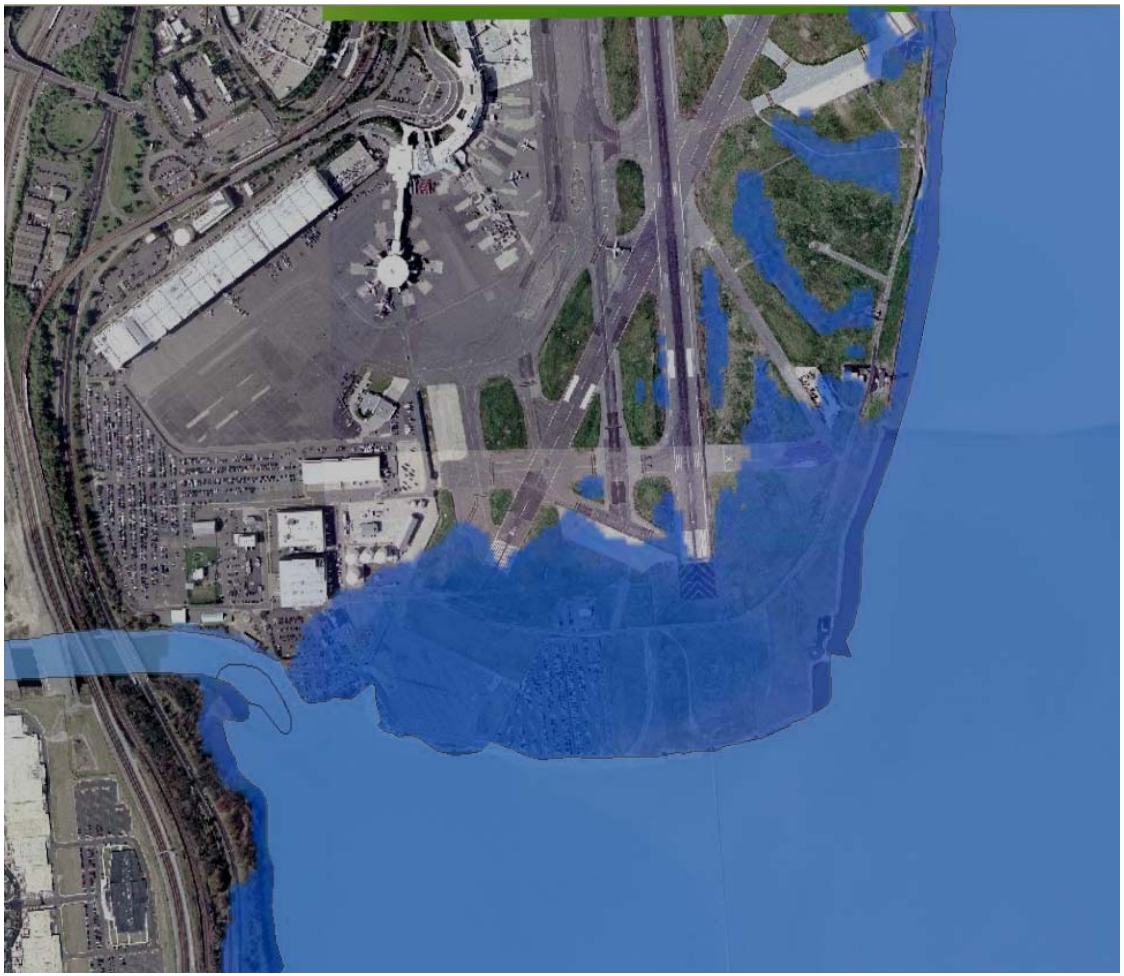






Examples of DSS Tier 1-2

-Innovative Visualization-

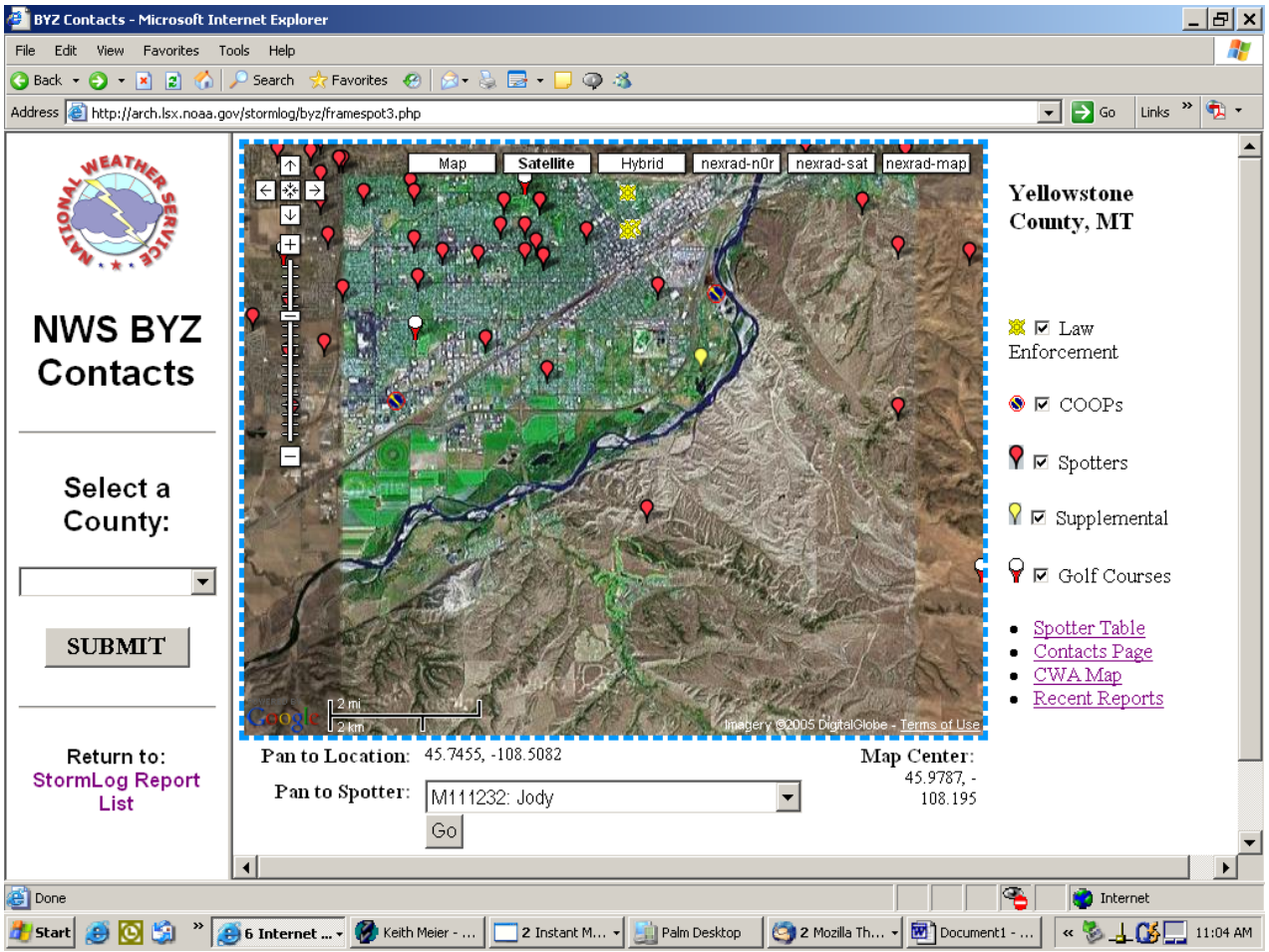


Leverage weather & water modeling expertise with innovative visualization graphics to improve communications between forecasters and users…as expected conditions are “simulated”.

Left: Inundation simulation for Isabel at Washington National Airport (DCA)

Examples of DSS Tier 1-2

-Integrated Databases-



Integration of databases allows for GIS imagery overlays.