NWS Science and Technology Roadmap

Winter Weather

Team Composition

- **Paul Stokols, NWS/OCWWS/MSD/FPWSB—Team Leader**
- **Robert Kelly, NWS/HPC/FOB—Contributor**
- **David Schultz, OAR/NSSL—Contributor**

Vision/Benefits/Impacts

- **Team Vision:**
  - NWS forecast accuracy, timeliness and form is sufficient to be used by decision makers at all levels to meet the challenges and mitigate the impacts of winter weather hazards—saving lives, property and enhancing the Nation's economy
- **Benefits**
  - Forecasters focus on societal impacts rather than producing products
  - Decision makers: Better, informed decisions to mitigate effects/costs of winter weather hazards
    - Pre-position assets
    - Airports cut back on unneeded delays with timely deicing/runway clearing process
    - DOT can be better prepared to clear /sand roads with the help of longer lead times and more accurate geospatially referenced forecasts.
    - Weather sensitive industries/agriculture change to maximize costs savings based on forecasts
- **Impacts:**
  - Lives, property, and money saved through short term and long term mitigation
    - 100+ lives lost annually in winter weather—exceeds loss due to lightning, hurricanes or tornadoes
    - 70% winter storm deaths due to people abandoning cars; 25% due to snow shoveling/exposure
    - Injuries, loss of life, and property damage cost an average of $42B annually just for snow and ice
  - Improved ice/snow forecasts for airports → saves >$600M/yr*
  - Improved predictions of road ice & fog → saves >$29M/yr in avoiding truck reroutes*
  - Improved temperature/frost forecasts → saves $500M/yr (utilities), $6K/hectare/yr (fruit orchards)*
  - Winter weather impacts a plethora of interests in aviation, surface transportation, power delivery, and infrastructure

* Reference: NOAA report, 2004, The Value of Snow and Snow Information Services

Goals/Targets:
Customer Needs

Goal	Outstanding Issues
Storm-based watches and warnings	Next Generation Warning Tool and additional community outreach needed
Additional training in research to operations, sociological impact, and decision-maker needs	Every forecaster, not just WCMs and IMETs, need a broad knowledge base
Improved performance measures to include impacts on economic sectors	Better understanding of economic impacts and how to measure based on variety of user needs.

Goals/Targets:
Emerging Science & Technology

Goal/Target	Outstanding Issues
Parameters: (3 hourly, unless noted) Snow/Ice Intensity/Accumulation(6 hrly and storm total) to 2 weeks QPF (6 hrly and storm total) to 2 weeks Temperatures/POP/Wind to 2 weeks Watches/Warnings locally defined to 5 days Onset/cessation/intensity of precipitation hourly to 2 weeks Cloud Cover/Ceiling/Visibility to 2 weeks Extreme Temperatures/Wind Chill to 2 weeks Verification: Individual parameters GPRA WSW Accuracy (POD) grid/user-based criteria at 1 km or less GPRA WSW Lead Time 30 hours User Based criteria	Model resolution to 1 km or less to meet geographical and decision maker needs. Development of Next Generation Warning Tool and Decision Support Services Training/Understanding of user based criteria Multilevel Communications GIS and Web 2.0/3.0 applications Maximize public/private partnership

Key Information Gaps

Gap	Solution Alternative	Impact
1. Lack of reliable high resolution data in QPF and Precip Type	1.1 Improvements in remote sensing, modeling, observations	Better analysis and understanding of current and forecast precip amounts, types, and spatial distribution
2. Real-time Snowfall/ Snowpack products not available at spatial, temporal resolution sufficient for situational awareness and to validate forecasts	2.1 Remote sensing options (satellite, radar, ASOS) 2.2 Radar determination of snowfall estimates	Improved modeling validation and real-time situational awareness will lead to more accurate and timely forecasts
3. Better understanding of conditional symmetric instability	3.1 Develop training using latest research findings on forecasting conditional symmetric instability 3.2 Develop algorithms/ applications for forecasting conditional symmetric instability based on model parameters	Improved understanding of physical processes and operational impacts Greater predictability of conditional symmetric instability and impacts

Key Information Gaps

Gap	Solution Alternative	Impact
4. Snow band formation and snow intensity	4.1 Develop training using latest research findings on forecasting snow band formation and intensity 4.2 Develop algorithms/ applications for forecasting snow band formation and intensity based on model parameters.	Improved understanding of physical processes and operational impacts Greater predictability of snow band formation and intensity and impacts.
5. Information flow to external users suffers with widespread power outages. Lack of hardened backup at WFOs	5.1 Make forecasts available under all circumstances through hardened backup operations, multi-redundancy, and public private partnerships	Large segment of population will be made aware of potential hazards even when widespread power is lost
6. Tools available for customized high impact winter weather services	6.1 Develop a set of general decision support tools. 6.2 Customize DSS to meet a variety of users	Provides push/pull capability that allows users tom specify products to meet their needs Provide full range of customizable decision support to partners

Key Information Gaps

Gap	Solution Alternative	Impact
7. Limited knowledge of specific user needs/impacts (and their understanding our capabilities), leaving us irrelevant to some sectors of the market	7.1 Assess local/national user needs 7.2 Enhance collaboration with other agencies such as DOT, NASA, and Regions; and academia 7.3 Develop tools to aid the decision making process 7.4 Provide training for forecasters in understanding users' needs	Forecasters will be able to communicate effectively with and provide pertinent winter weather information to federal, state, and local level decision makers
8. Need for ongoing training and research in societal impacts, and R2O efforts to get the proper message out to the appropriate user, and foster more relevant forecasts and faster adaptation of R2O.	8.1 Assess and enhance effectiveness of societal response to winter weather information 8.2 Develop an approach to move societal research to operations to make our forecasts/ messages more consistent and effective.	Forecasters will understand societal impacts and provide more relevant forecasts to individuals and society in general. R2O process will be shortened

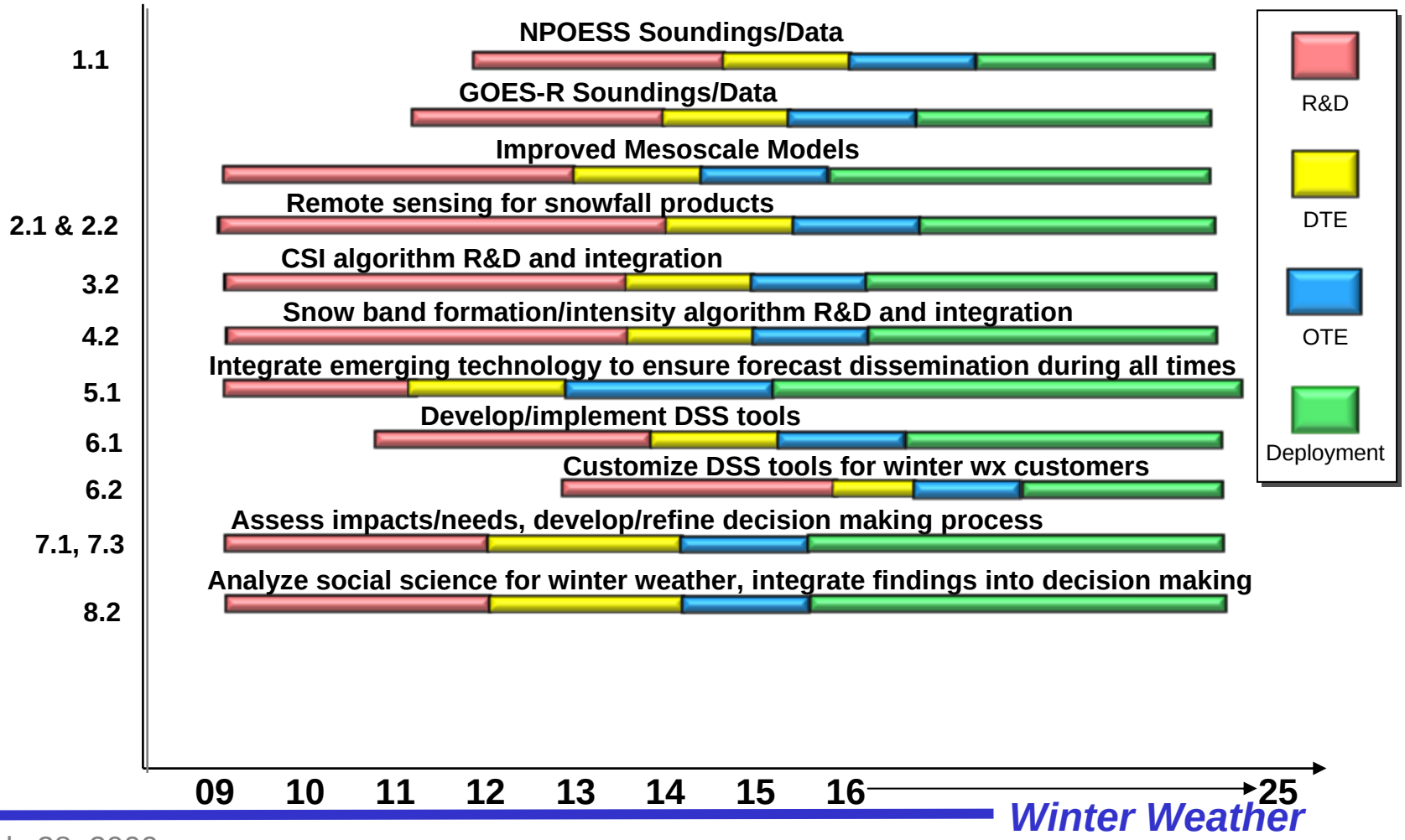
Research Needs and Opportunities

- **Short-term (2010-2016)**
  - Integrate social science and use of technological advances in IT and communications to deliver storm-based Watch/Warning/Advisory and winter weather information in a timely, relevant mode to mitigate societal, energy and transportation impacts and meet the needs of decision makers
  - Develop comparison tools for forecasters to assimilate a multitude of information into decision support tools for a full range of users
  - Expand public private partnership to meet first two research thrusts
  - Improved data assimilation to include new data sets such as TAMDAR, DOT obs., and additional mesonets
  - Additional training for all forecasters in decision support and societal impacts.
  - Better understanding of conditional symmetric instability
  - Snow band formation and snow intensity
  - Radar determination of snowfall estimates
  - Improved Ceiling/visibility parameters

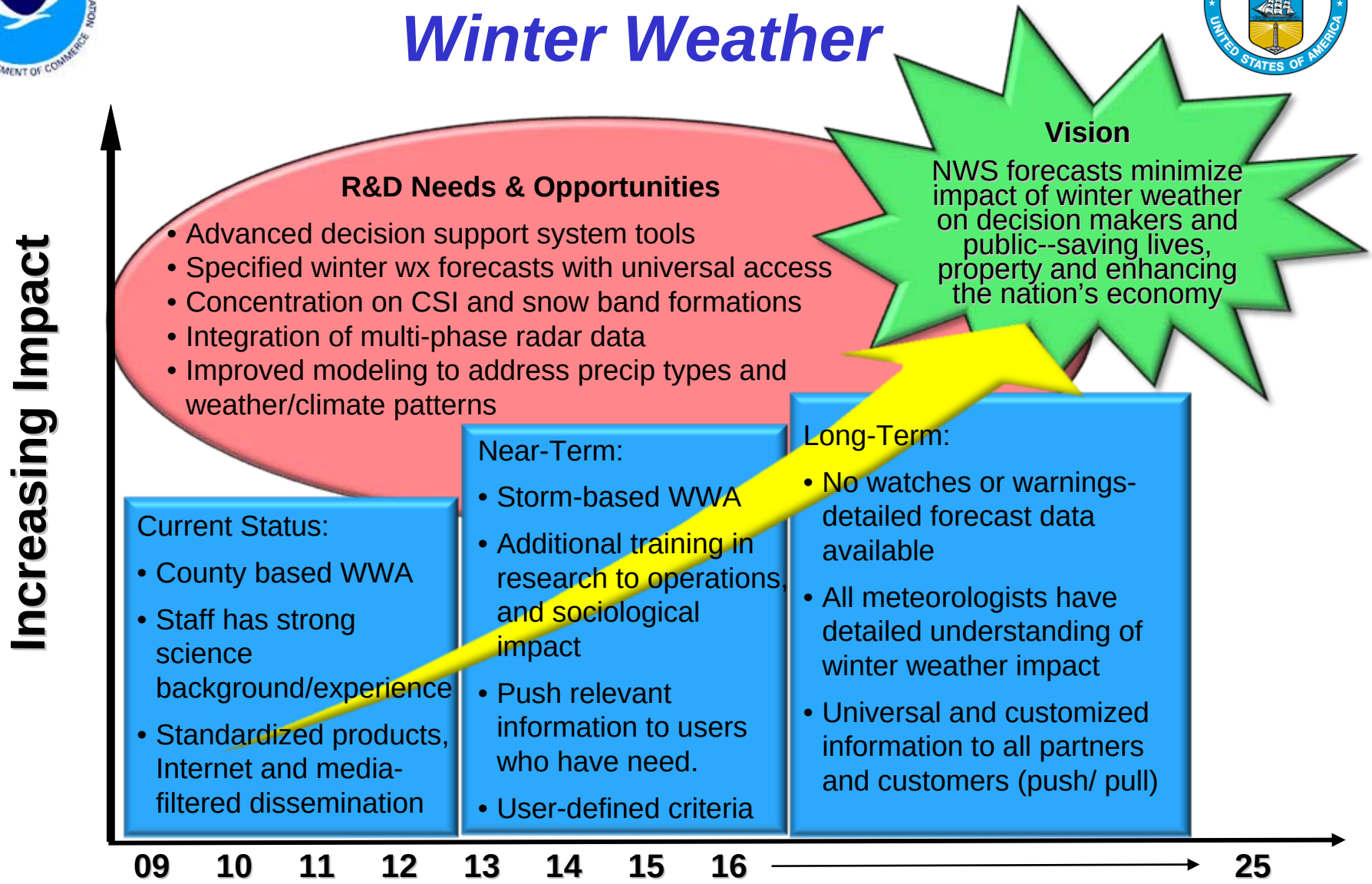
Research Needs and Opportunities

- **Long-term (2017-2025)**
  - Evolution to geospatially based specific forecasts with universal access.
  - Advanced decision support system that allows for integration of probabilistic and uncertainty information, and local needs specific forecasts and warnings.
  - Improved modeling to better understand and forecast precipitation types and amounts at 1 km scale or less.
  - Multi-phase radar to determine snowfall rates and p-types.
  - Automated RTVs for winter parameters
  - Seasonal/climate scale relationships that better define winter weather patterns.
  - How do forecasters interact with and use this data?

Winter Wx Alternative Solutions



Focus Area Team Summary: Winter Weather



Target Performance Measures: Winter Weather

Winter Parameters/Verification	Current (2009)	FY 2016 Target Example	FY 2025 Target Example
Snow and Ice Accumulation	3 days	7 days	14 days
QPF	5 days	7 days	14 days
Temperatures/POP/Wind	7 days	10 days	14 days
Watches/Warnings by county through 72 hours	By county- 3 days	Storm based 3 days	Locally defined 5dys
Onset and cessation of precipitation	6 hrly out to 7 days	Hrly out to 7 days	Hrly 14 days
Cloud Cover	7 days	10 days	14 days
Extreme Temperatures/Wind Chill	7 days	10 days	14 days
Verification			
GPRA WSW Accuracy (POD)	90%	SB-WSW	Grid/User based criteria(1km or less))
GPRA WSW Lead Time	15 hours	20 hours	30 hours
User Based criteria			User based criteria