Observations that Support a Weather-Ready Nation:



The Role of Frequency Spectrum



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Today's Weather Forecast

Everything you read, see or hear about weather, climate and ocean forecasts is based on numerical prediction models

Four Essential Components of the Prediction Enterprise

- Global Observations
 - Dominated by the global satellite network
- Data Assimilation & Modeling/Science
 - Coupled Earth System model
- Supercomputers
 - Computing: Primary/Backup each @ 2.8PF runs with 99.9% reliability
- Forecaster Skill



Why a Weather Ready Nation?

Our Vulnerability to High-Impact Weather Has Increased





NWS Strategic Outcome -A Weather-Ready Nation:

Becoming a Weather-Ready Nation is about building community resiliency in the face of increasing vulnerability to extreme weather, water & climate events

"Ready, Responsive, Resilient"

- Requires NWS to:
 - Fully integrate our field structure to produce:
 - Better forecasts and warnings
 - Consistent products and services
 - Actionable environmental intelligence



- Address the "last mile" that connects forecast to critical national, state and location decisions
 - Provide Impact-based Decision Support Services (IDSS)
 - Deliver through multiple and reliable dissemination pathways
 - Work with partners, including embedding NWS in Emergency Operations Centers and incorporating Social Sciences, to gain the public's needed response

Involves entire US Weather, Water and Climate Enterprise WORKING TOGETHER to achieve far-reaching national preparedness for weather events



Use of Radio Spectrum in the National Weather Service Forecast Process:



NWS Field Structure:



Observations are Foundational:





Global Constellation of Environmental Satellites:





Global Constellation of Environmental Satellites (continued):

- Geostationary Satellites Approximately 22,240 miles above the Earth's equator. The satellite travels at the same speed as the Earth's rotation so it is always in the same position in relation to the Earth
- **Polar Satellites** circle the globe in a Sun-synchronous orbit approximately 540 miles above the Earth
- Environmental satellite operators share data freely with each other and with other countries. Some countries (such as the USA) distribute all satellite data at no cost, but some charge commercial users



Spectrum Use by Environmental Satellites:

- Active Sensing
- Passive Sensing
- Data Communication Links
 - Command & Control
 - Transmitting Remotely Sensed Data
 - o Data Links for Remote Terrestrial and Ocean Observations
 - Delivering data and products to offices / customers



Polar Satellites: Microwave & Infrared Soundings:

Ascending_orbits: CRIS (900 cm⁻¹) BT (K) Date: 2012-04-29







JPSS-1, JPSS-2





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Geostationary Satellite Imagery:





Superstorm Sandy Animation – Five Days Prior to Landfall:





Spectrum Use by NOAA's Meteorological Radars:

- NEXRAD, the WSR-88D
 - Doppler, measures precipitation and wind velocity over an area hundreds of miles wide
 - Graphics are used throughout the Weather Enterprise
 - Operates **2700-2900 MHz**, and some in 2900–3000 MHz
 - Other met radars operate in 5600 MHz band, and other bands.
- Wind Profilers
 - Doppler, measures wind vector (direction and speed) as a function of height. Performance frequency dependent with operations on 449 MHz
 - Can be equipped to measure temperature versus height



NEXRAD Doppler Radar:





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NOAA Wind Profiler:



Wind Profiler Display:



Spectrum Use by Radiosondes:

- Measures temperature, pressure and relative humidity
 - Can be equipped for other measurements (CO2, etc)
- Instruments are launched by a balloon, or parachuted (dropped from airplane or launched by rocket)
- Launched simultaneously worldwide, at least twicedaily at synoptic hours of 00:00 and 12:00 UTC
- International allocation in 1668.4-1700 MHz and 400.15-406 MHz
 - NOAA currently uses four operational frequencies in the 1675-1683 MHz
 - Currently in process of transitioning to 400MHz band



Radiosonde Launch





Radiosonde Frequency Migration Project (RFMP):

- The RFMP is a NWS project initiated in response to the AWS-3 spectrum auction resulting from a Presidential initiative to repurpose federal radio spectrum for private sector use
- This initiative changed the GOES-R (next generation of GOES satellite) system operational frequencies to be slightly lower in the 1679.7-1695 MHz band, which would use the same frequencies used by radiosonde systems (1675-1683 MHz)
- To avoid interference with GOES-R signals, radiosondes operations in the 1680 MHz band are being transitioned to the 400 MHz band
- Spectrum funding was allocated at the end of 2015, and the transition is expected to be completed in 2022



AWS-3 Spectrum Sharing:





Emerging Technologies -Multifunction Phased Array Radar:





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Radar Spectrum Study:



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Spectrum Efficient Radar Network:

- MOU between multiple agencies being pursued to consider future radar alternatives for surveillance and weather
- Key questions to be answered:
 - Concept of Operations for multi-agency mission sets
 - Science questions (weather-driven)
 - ✓ "Dual-Polarization" performance, volume update rates, planar vs cylindrical, all-digital architecture
 - Can spectrum be reallocated for commercial exclusive or shared use and auctioned for commercial use?
- NOAA is executing a WSR-88D Service Life Extension Program to keep radars operating beyond 2030



Data Dissemination:

- Weather.gov
- NOAA All-Hazards Radio
- Emergency Managers Weather Information Network (EMWIN)
- Integrated Public Alert and Warning System (IPAWS)
 - Emergency Alert System
 - Wireless Emergency Alerts

HazCollect:







NOAA All-Hazards Radio:

Broadcasts are found in the VHF public service band at these seven frequencies (MHz):





EMWIN:











Bottom Line:

- A Weather-Ready Nation depends on foundational environmental observations that support the forecast process and provide actionable information
- Dissemination of Forecasts and Warnings is equally important
- The use of frequency spectrum is a critical component that ensures NOAA can continue to acquire and distribute these environmental observations upon which the Nation depends





QUESTIONS?

