NWS Office of Observations

NOAA

National Weather Service

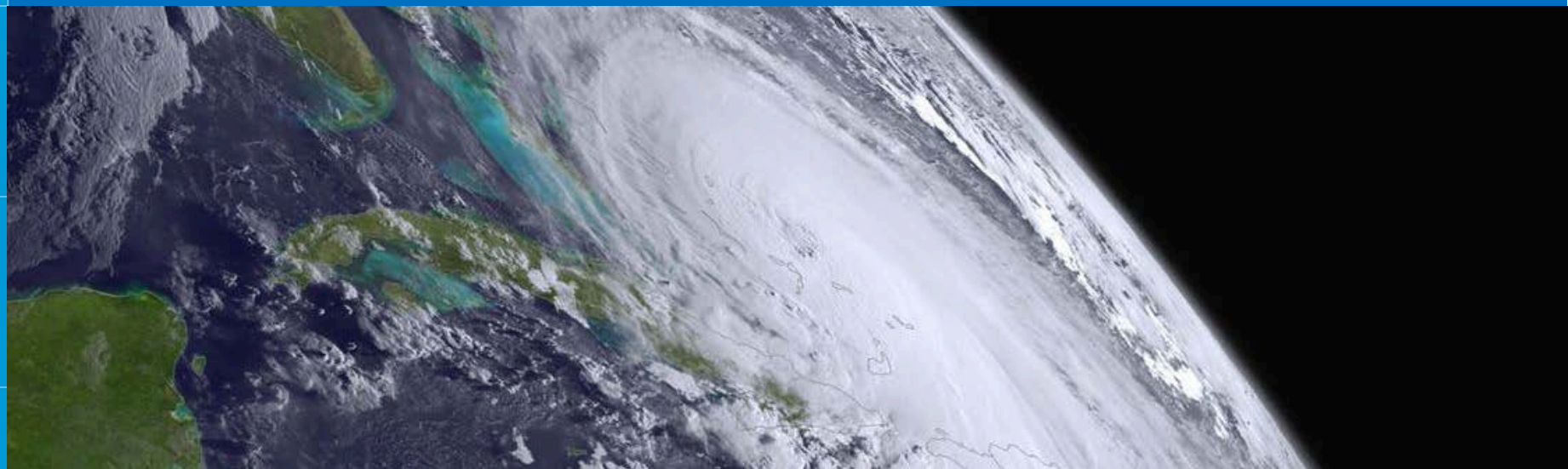
May 22, 2018

at

The 2nd National Operational Processing Centers Observational Data Workshop

Kevin J. Schrab

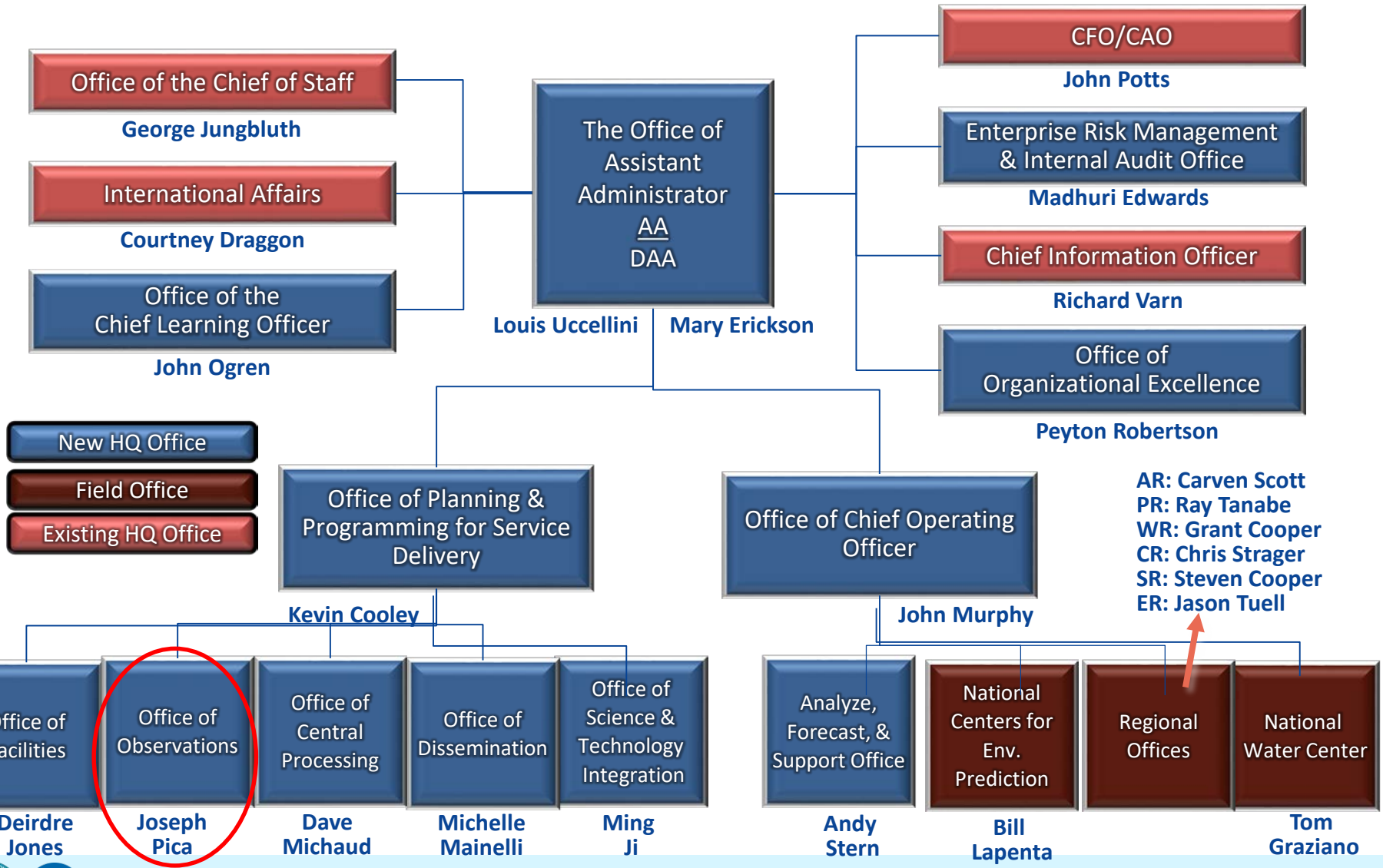
Portfolio Manager



Overview

- NWS Organization
- Office of Observations – Portfolio Organization
- Portfolio Management
- WIGOS Update
- Discussion / Questions

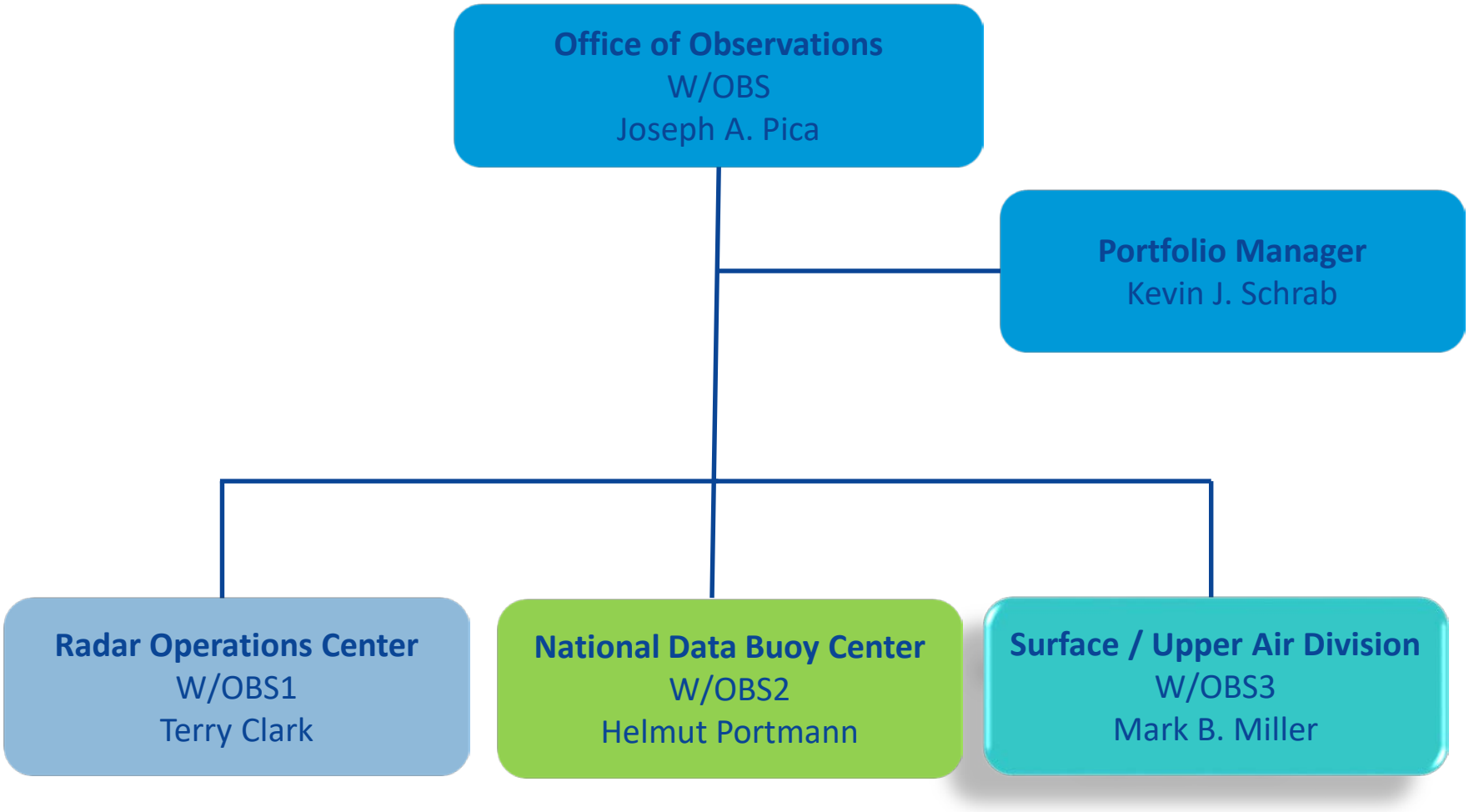
NWS Organization



Office of Observations

Responsible for the collection of space, atmosphere, water, and climate observational data owned or leveraged by the NWS to support the mission of providing weather, water, and climate data forecasts for the protection of life and property; and for the enhancement of the National economy

Portfolio Organization



Portfolio Organization
Front Office

Portfolio Manager - Kevin Schrab

Location

Silver Spring, MD

Primary Duties

Provide portfolio planning and management, and budget support

Portfolio Organization
Radar Operations Center

Director – Terry Clark

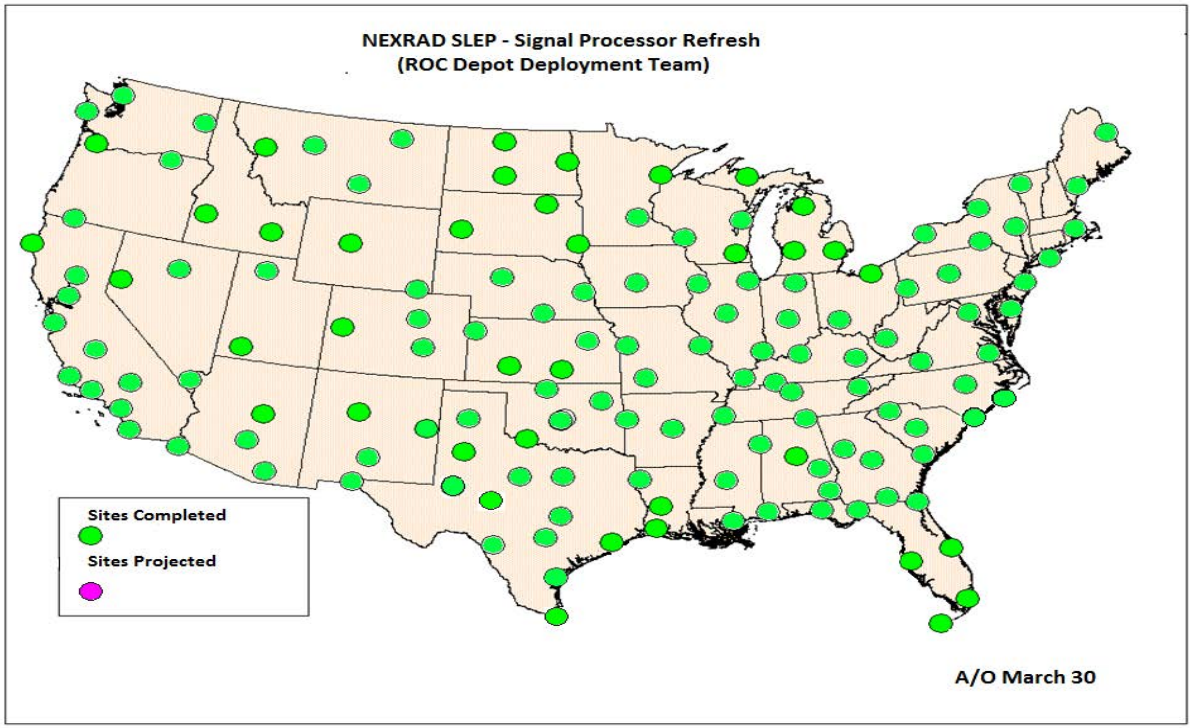
Location

Norman, OK

Primary Duties

Provides life-cycle support for the tri-agency Next Generation Weather Radar (NEXRAD) network, supports hardware and software for Terminal Doppler Weather Radar (TDWR), and wind profiler

Investing in Observation Infrastructure – NEXRAD SLEP



- **NEXRAD Service Life Extension Program (SLEP)** aims for viability through at least 2030
- Signal Processor Technology Refresh completed
- Transmitter, Pedestal, and Shelter Refurbishment ongoing

Spectrum Efficient National Surveillance Radar (SENSR)

Long Range
(1.215-1.390 GHz)
- CARSR
- ARSR4

Terminal
(2.7-2.9 GHz)
- ASR-8 / GPN-20
- ASR-9 / GPN-27
- ASR-11 / GPN-30

Weather
- TDWR (5.5-5.65 GHz)
- NEXRAD (2.7-3.0 GHz)

- Objective is to vacate the 1300-1350 MHz spectrum by potentially consolidating long-range, short-range, and weather radar requirements (with no degradation of mission)
- Feasibility study is funded through the Spectrum Reallocation Fund (SRF), via the SENSR Pipeline Plan approved by the Technical Panel (FCC, OMB, NTIA)

Portfolio Organization
National Data Buoy Center

Director – Helmut Portmann

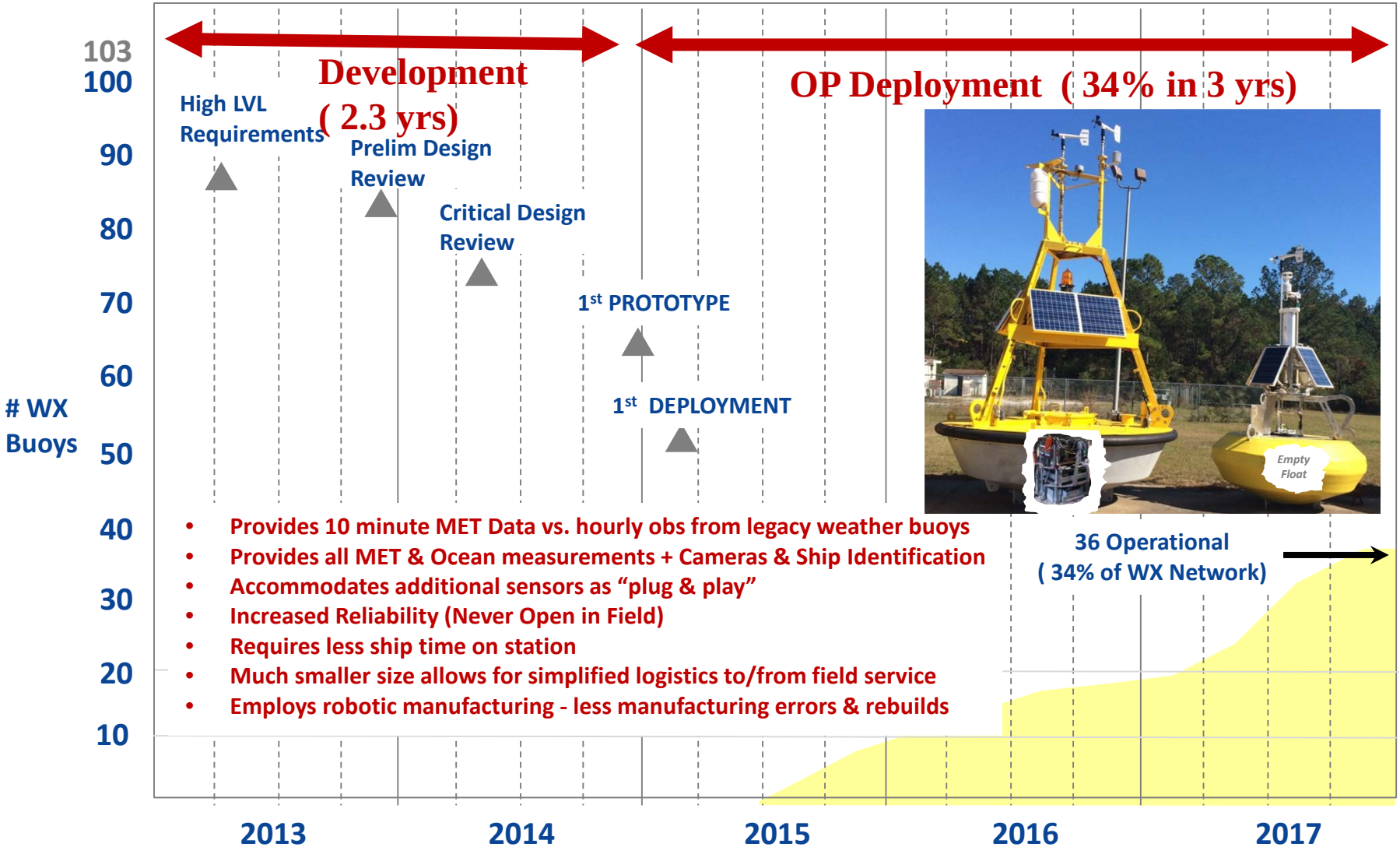
Location

Stennis Space Center, MS

Primary Duties

Manages the deployment, operations, and maintenance of the national data buoy network, coordination with coastal and marine stakeholders, provide maintenance support as a WMO Regional Instrument Maintenance site

Investing in Observation Infrastructure – Weather Buoy: SCOOP (Self-Contained Ocean Observing Platform)



Portfolio Organization
Surface/Upper Air Division

Director - Mark B. Miller

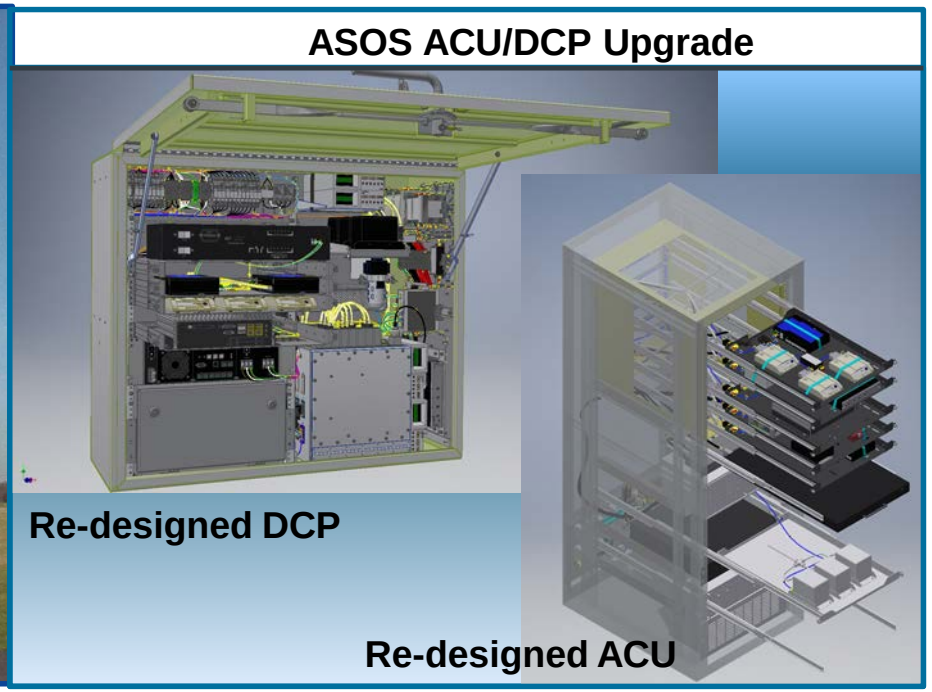
Locations

Silver Spring, MD; Sterling, VA; and Kansas City, MO

Primary Duties

Manages the development, operations, and maintenance of the extensive network of surface and upper air systems

Investing in Observation Infrastructure – ASOS SLEP

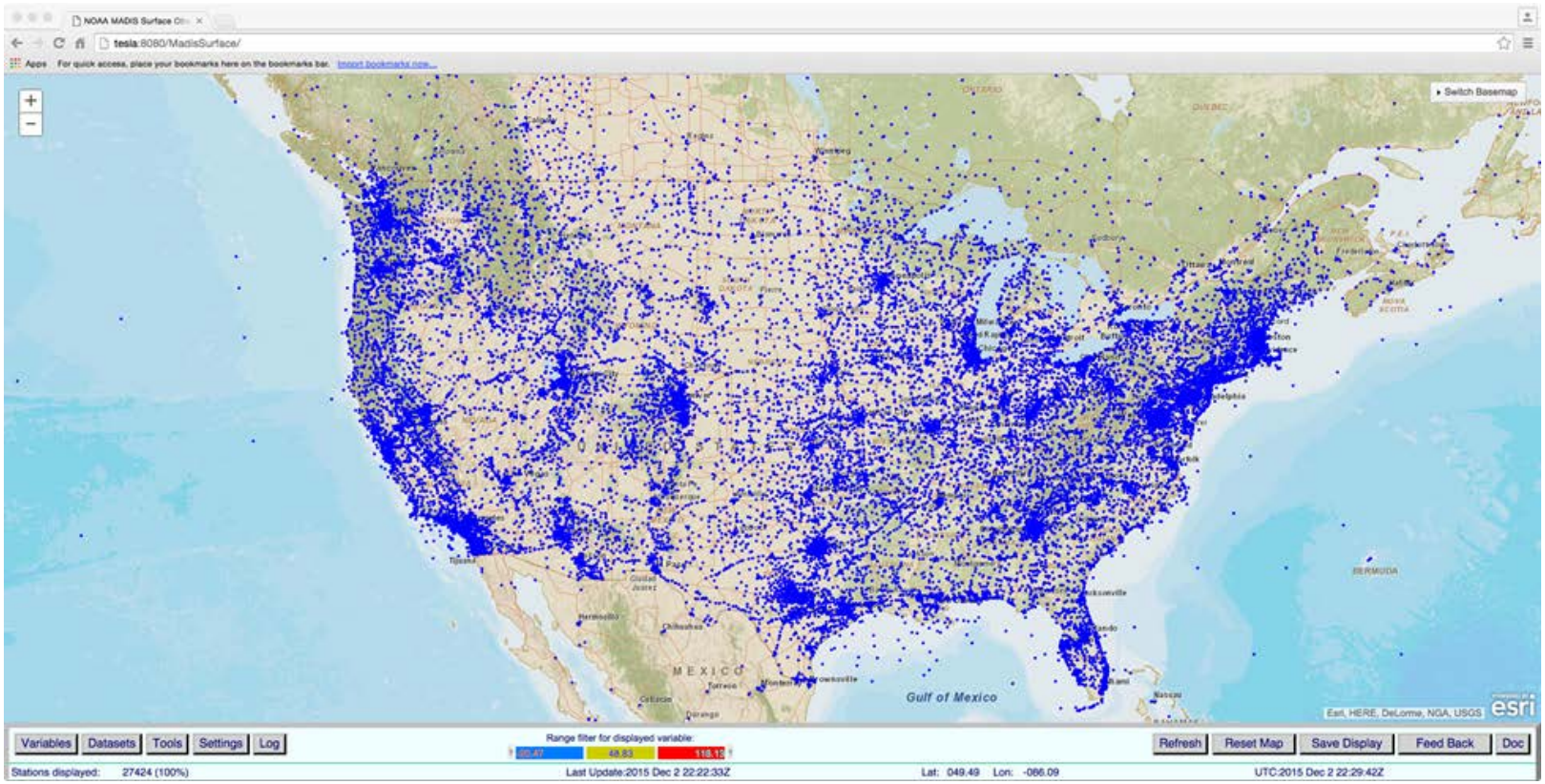


- **Automated Surface Observing System (ASOS) SLEP** aims to extend system viability through 2040
- Most critical components:
  - Acquisition Control Unit / Data Collection Platform (ACU/DCP) replacement
  - Telecommunications upgrade
- Will facilitate cost-effective Commercial-Off-The-Shelf meteorological sensor solutions, increased data flow, improved system security posture, and remote maintenance capabilities

Investing in Observation Infrastructure – Radiosonde Network

- Funded by the sale of “spectrum”, the entire radiosonde network will move frequencies from the 1680 MHz band to the 403 MHz band.
- An updated and approved Transition Plan migrates ~25% of the network to automated launching technology, while the rest of the network is recapitalized with new manual systems.
- An Alaska Demonstration Project (all automated systems to be installed) is underway.

Leveraging Smart Data Buys

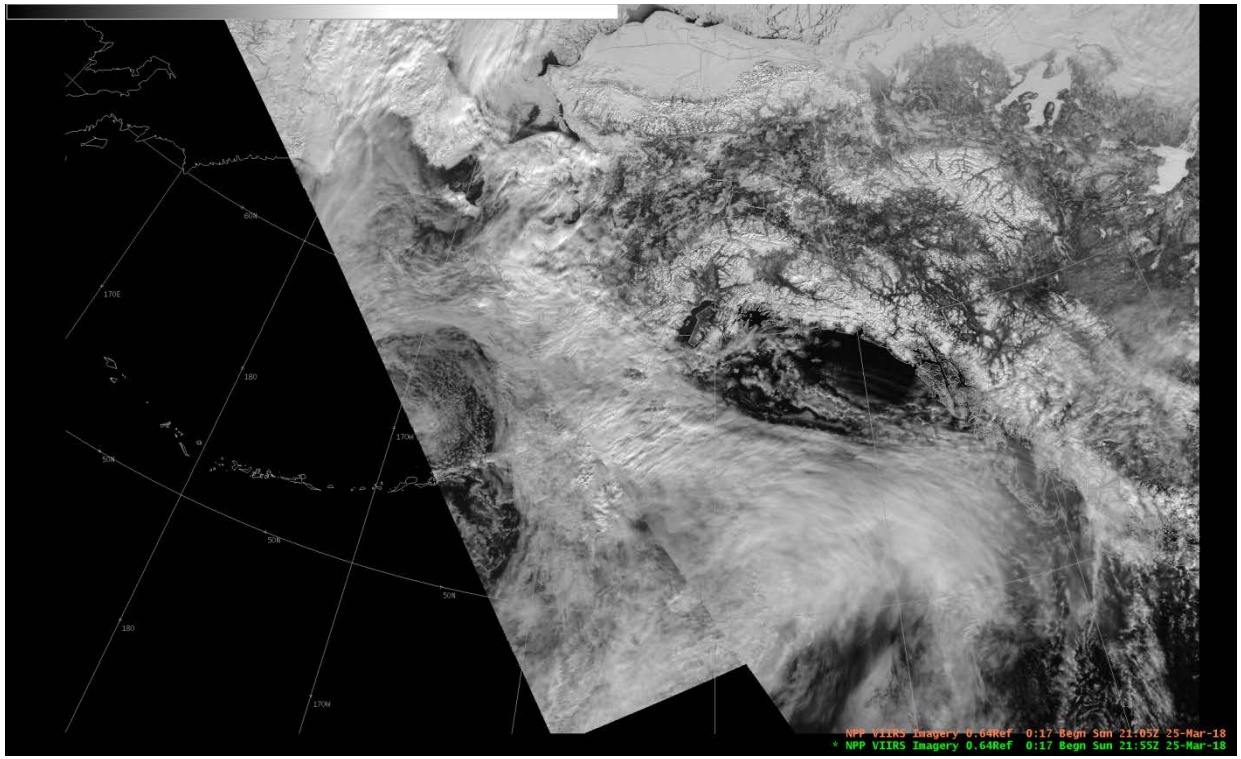


- National Mesonet Program
- Aircraft Based Observations (MDCRS, WVSS)
- Lightning Data
- GPS-Met
- Commercial Weather Data Pilot

Office of Observations
Key Points of Contact

- Kevin Schrab (kevin.schrab@noaa.gov)
- Terry Clark (terrance.j.clark@noaa.gov)
- Helmut Portmann (helmut.portmann@noaa.gov)
- Mark Miller (mark.b.miller@noaa.gov)

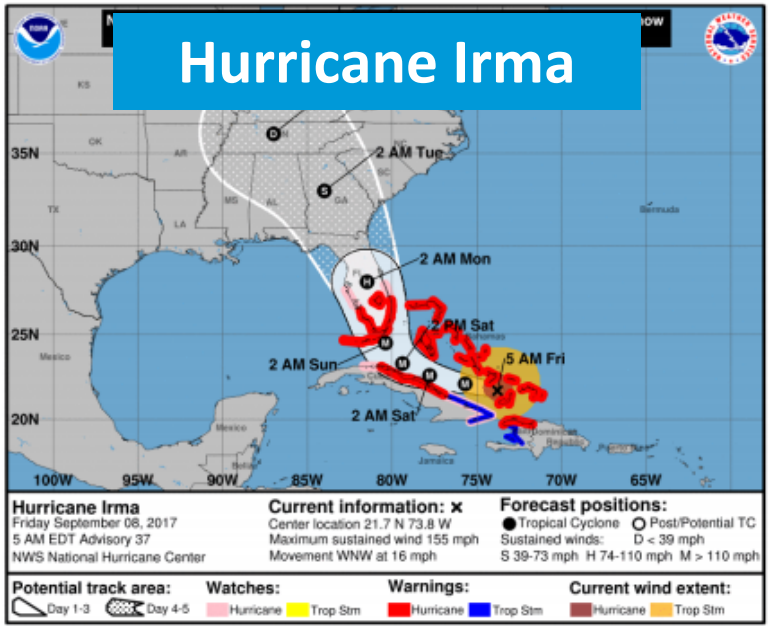
Investing in Observation Infrastructure – Satellites

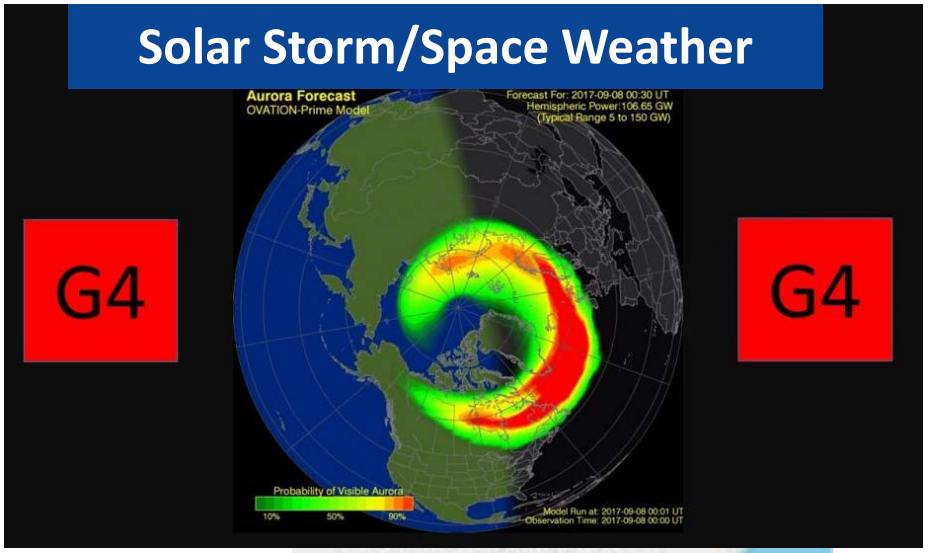


- GOES-16 operating as GOES-East
- GOES-17 at its checkout location…to GOES-West later in 2018
- NOAA-20 in engineering checkout (*image above is an AWIPS screen shot in Alaska of VIIRS imagery from NOAA-20 and SNPP during OT&E*)
- COSMIC-2A – prepping for launch later in the year

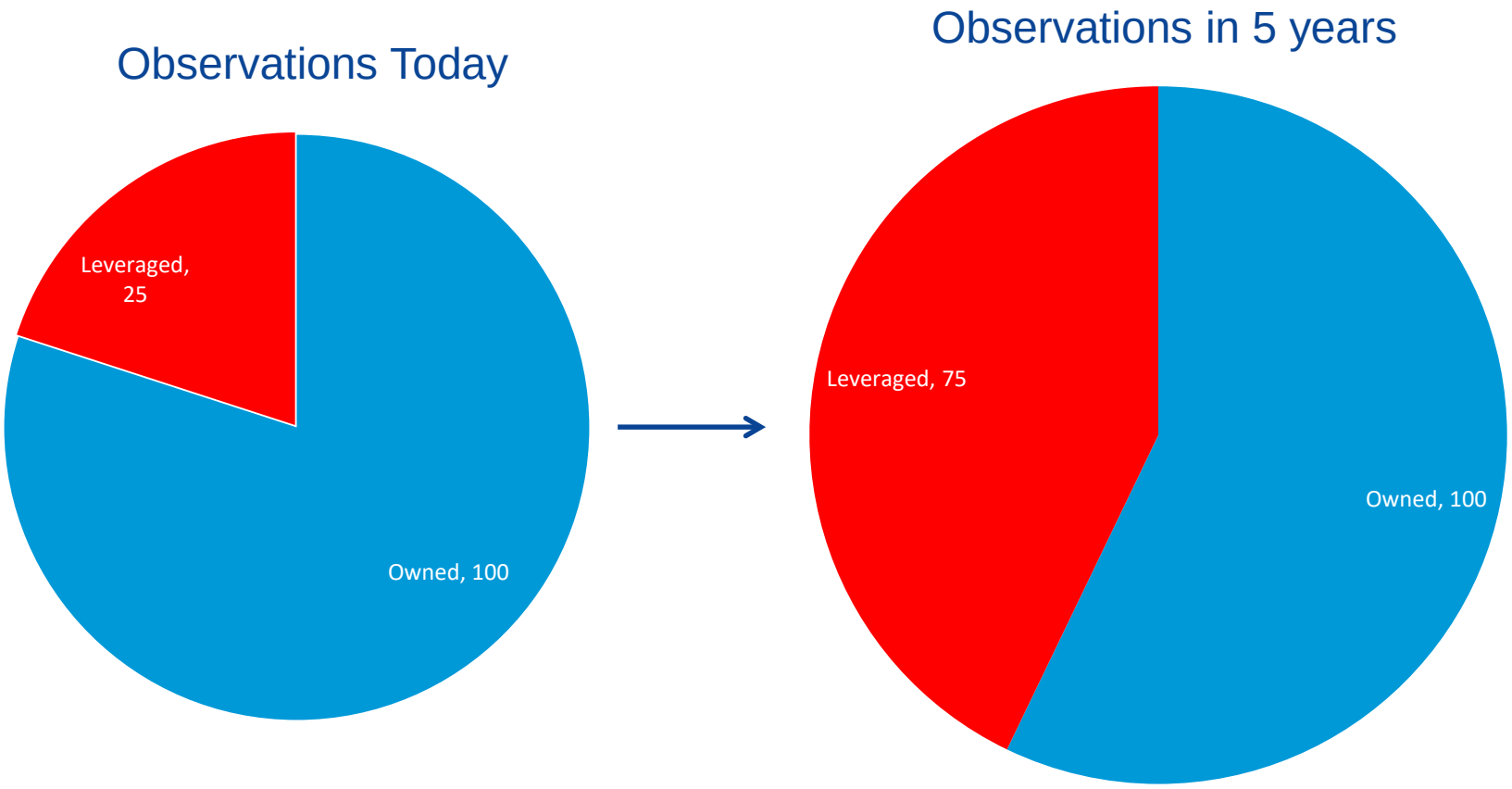
Breadth & Importance of Observations

Friday, 9/8/2017





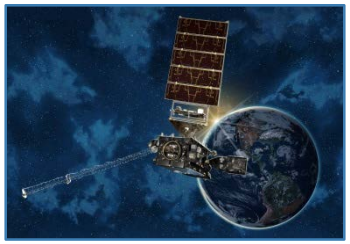
Future Scenario:
Growth in Leveraged Observations

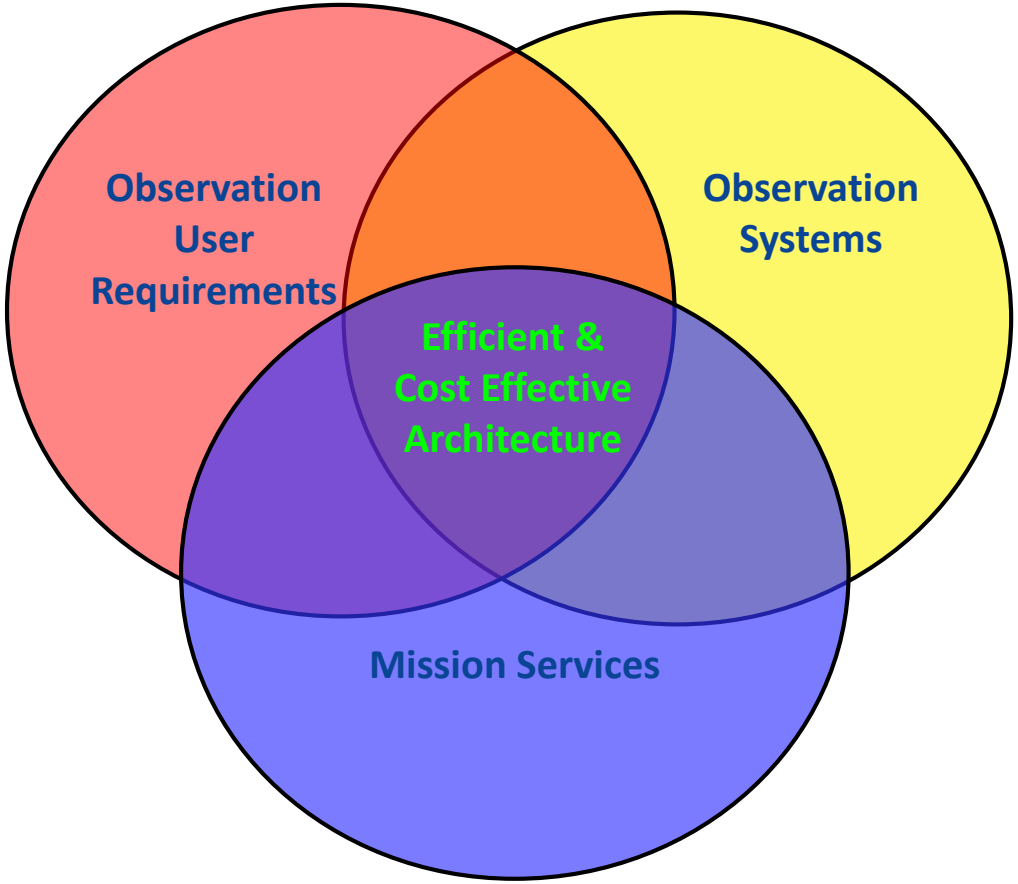


Conceptual representation only, not based on actual numbers.

Goal of Portfolio Management

- Utilize thoroughly vetted information and analyses to make informed decisions about the portfolio
- Efficiently fund and leverage observing assets to support NWS and NOAA strategic goals and objectives





Observing Portfolio Management – Guiding Principles

- **Vision**: NOAA's vision is to achieve and sustain an observing system portfolio that is ***mission-effective, integrated, adaptable,*** and ***affordable***.
- Superior Service and Reputation
- Adaptability
- Cost-Effectiveness, Affordability & Sustainability
- Integration
- Global Context and Commitments *(Data Sharing)*
- In-House Expertise
- *Well-governed, Understood & Trusted*

Ref. NOAA Administrative Order 212-6, Effective 11/1/2016

Portfolio Management

Two cross-Line Office boards provide guidelines and input into the Portfolio Management process:

- **NOAA Observing Systems Council** (NOSC) - Principal advisory body to the NOAA Administrator

- **Observing Systems Committee** (OSC) –
  a NOSC sub-committee

NOAA Observing Systems Council (NOSC)

- Principal advisory body to the NOAA Administrator
- Lead council for managing the agency's observing system architecture
  - Members from all NOAA Line Offices
  - NOAA's Technology, Planning, and Integration for Observations (TPIO) staffs the NOSC to accomplish its mission within its corporate mandate
- NOSC was charged with creating tools for assessing all of NOAA's observing requirements and systems in the context of the agency goals, in order to link observed data to the value it provides

Observing Systems Committee (OSC)

- Subcommittee of the NOSC
- OSC proposes the optimum observing systems configuration necessary to meet NOAA's current and future missions
- The OSC provides:
  - holistic, on-going assessment and analysis of the observing system portfolio
  - specific recommendations to the NOSC for changes to the configuration of NOAA's observing systems and overall portfolio to maximize the benefit to NOAA and its constituents

Portfolio Management Tools

- **COURL and OURD**: Consolidated Observation User Requirements List and Observation User Requirements Document, respectively – documented requirements Mission Service Area (MSA) and associated validations and performance measure mapping
- **SoR**: Systems of Record - a database of over 180 observing system summaries
- **CASrt**: CasaNOSA Analysis System Requirements Tool – data analysis tool to measure how well any observing capability satisfies any given observational requirement
- **NOSIA-II**: NOAA Observing Systems Integrated Analysis – capability used to document and analyze relationship(s) between/among observing systems and their impacts on the Agency's diverse services and scientific objectives
- **QOSAP**: Quantitative Observing Systems Assessment Program – inform major decisions on the design and implementation of optimal observing systems

Mission Service Areas

- Mission Service Areas (MSAs) classify Goals into topical/application areas encompassing major agency functions

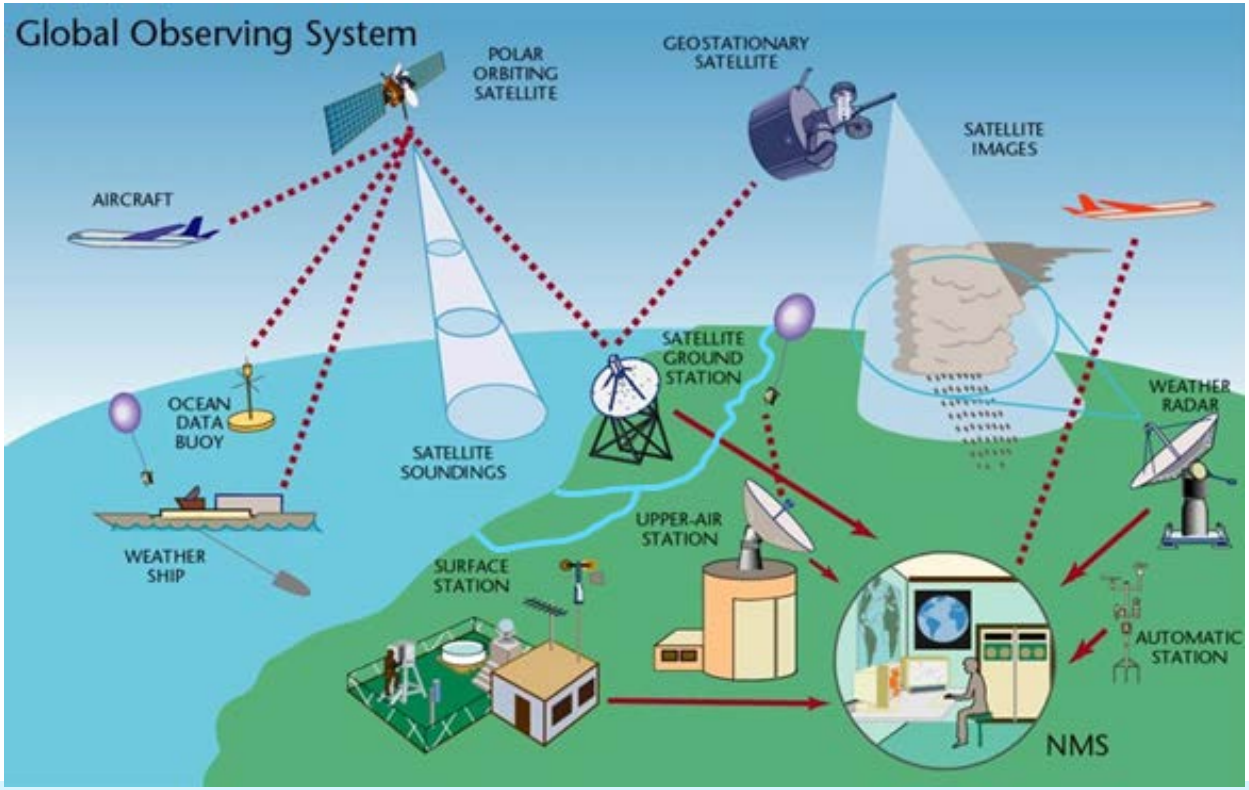
- The observation user requirements supporting the Weather-Ready Nation Goal span 12 MSAs

MSAs and Observing Requirements

Requirements are a reflection of the Mission Service Area (MSA)

Analysis Capabilities

- The Office of Observations uses tools, developed by TPIO, a group within NOAA, to assist in managing the vast array of NWS-owned and leveraged observing systems.
- These tools catalog and analyze observation systems, user requirements, and system requirements.



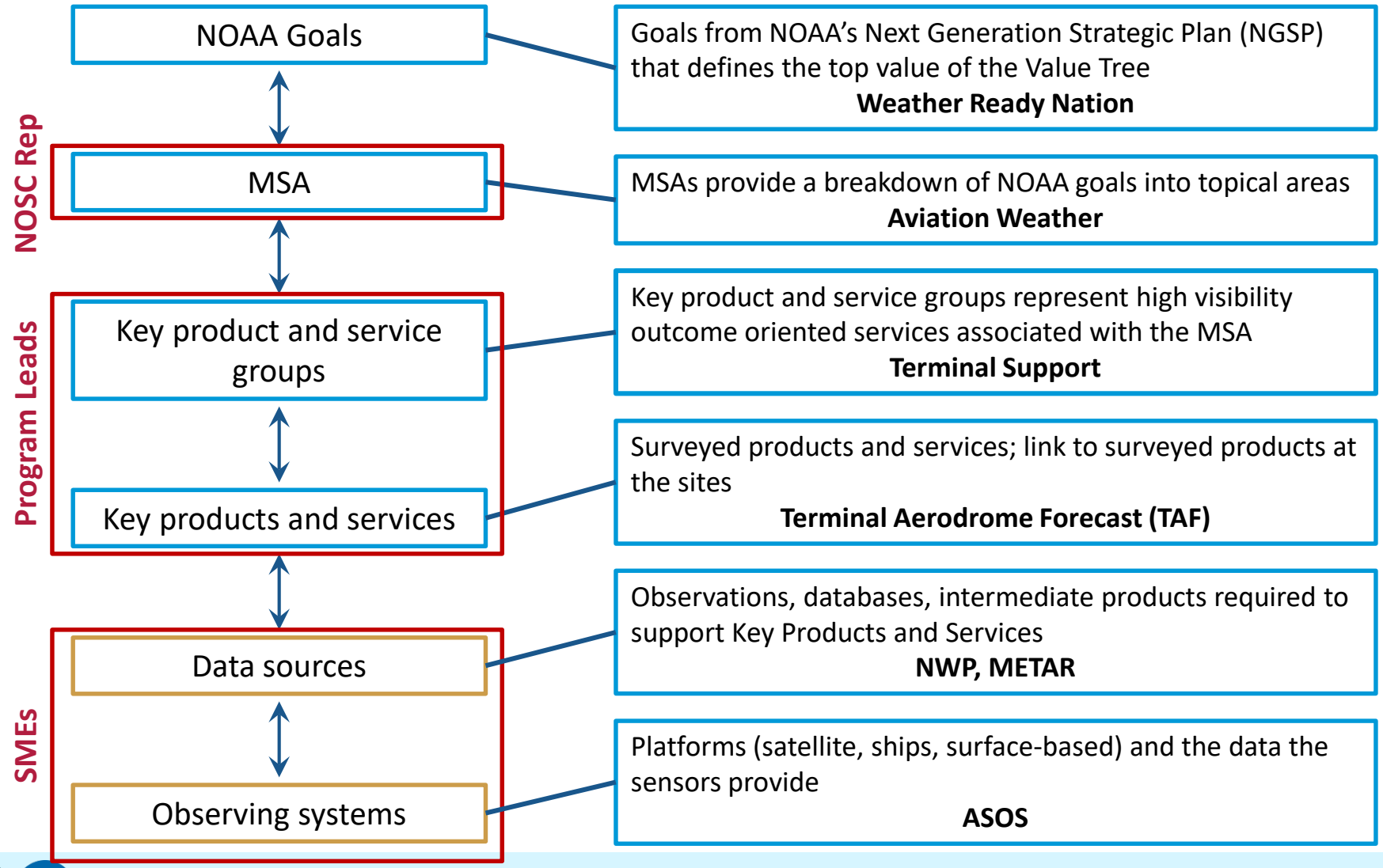
User Requirements

- Documenting user requirements helps NOAA leadership set priorities based on mission needs and stakeholder input
- TPIO, NOAA Mission Service Areas, and SMEs document observation user requirements documented in the Consolidated Observation User Requirements List (COURL) database
- COURL is input to the Observation User Requirements Document (OURD), a summary of a Mission Service Area's requirements, requirement validation, and performance measure mapping
- Validated requirements form the base for justification and gap analysis of NOAA observing systems
- NWS Office of Observations currently coordinating in the review of user requirements with SMEs

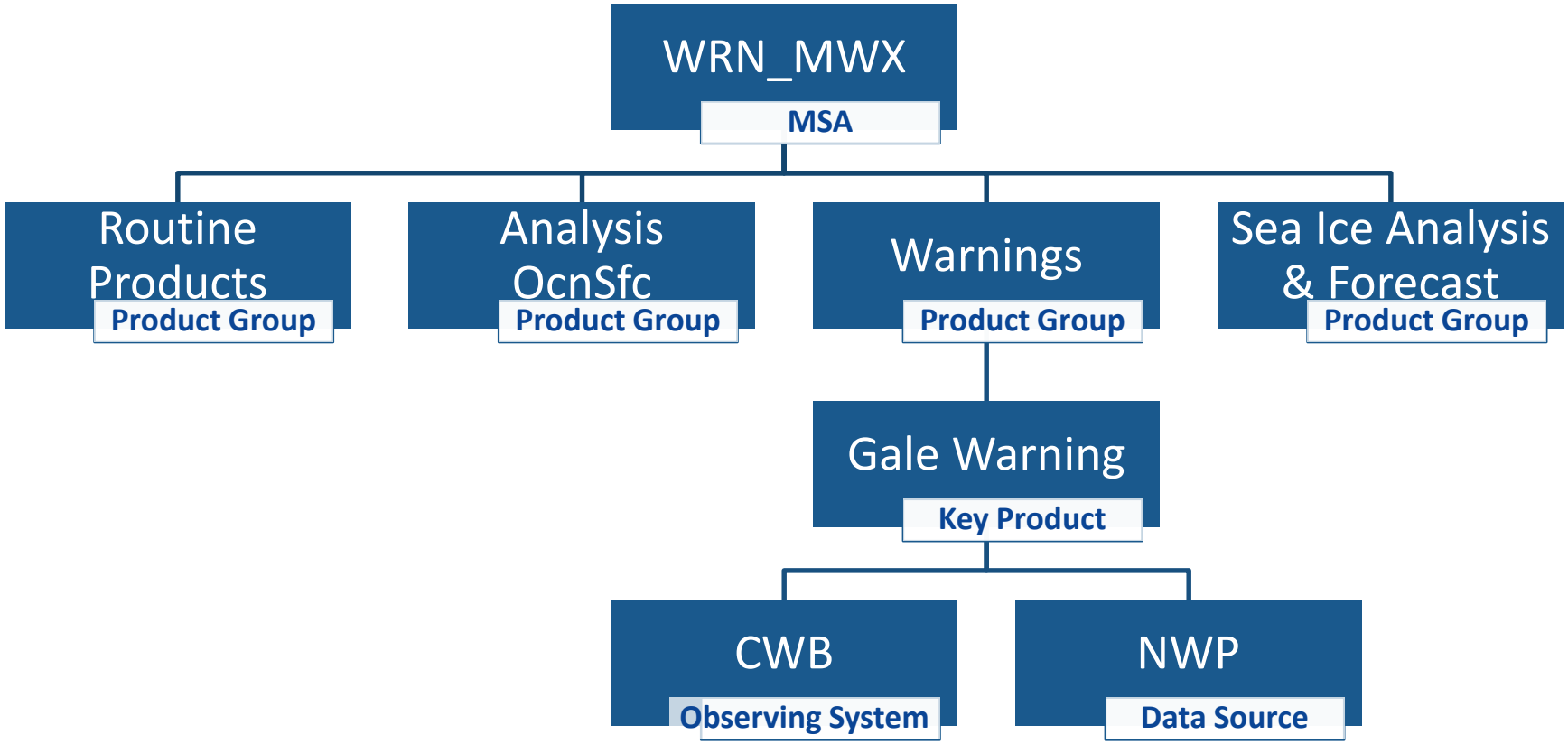
Sfc Temp: Requirements Example

Line Office	MSA	Geographic Coverage	Horizontal Resolution	Measurement Accuracy	Sampling Interval	Sampling Interval Units
NWS	WRN_IWF	North America+US Territories	1 km	1 K	15	min
NWS	WRN_AWX	CONUS+AK+HI	4 km	0.1 K	5	min
NWS	WRN_EMP	Hemi US	20 km	0.794 K	6	hr
NWS	WRN_MWX	North America+US Territories	20 km	1 K	1	hr
NWS	WRN_WWX, WRN_RWX	CONUS+AK+HI+US Territories	25 km	0.1 K	1	min
NWS	WRN_HUR	TC/Marine/Surface Analysis AOR	25 km	1 K	1	hr
NWS	WRN_AWX	Global	50 km	1 K	6	hr
NOS	RC_PAM	US Coral Reefs	64 km	1 K	3	hr
NWS	WRN_EMP	Global	250 km	1 K	6	hr

Observing System Impact: Value Tree



Value Tree Example



Observation Systems Impact: Marine Weather

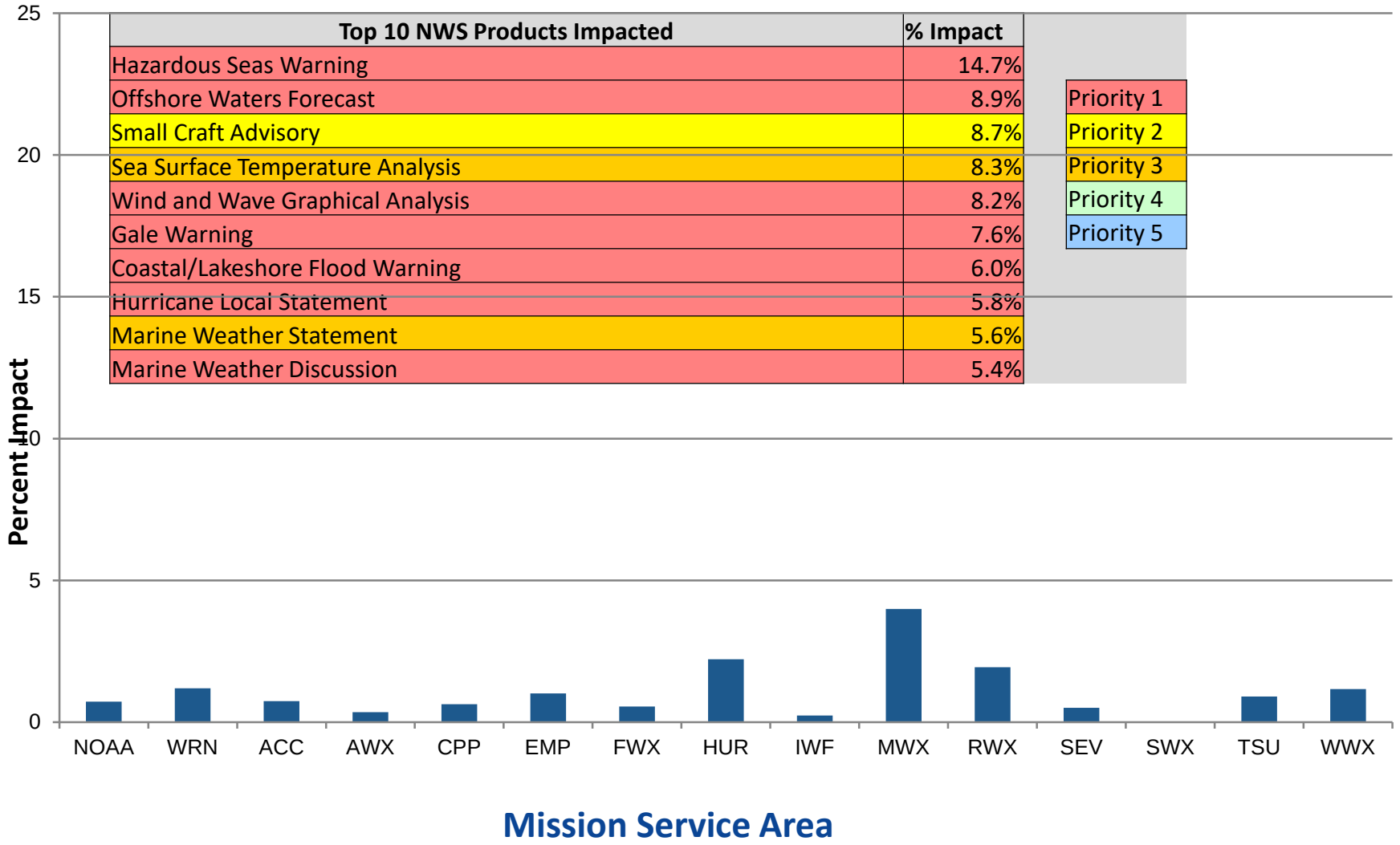
Marine Weather and Coastal Events		
Data Source	% Impact	SQ Score 73.63
Metop-A and -B	8.53%	6.28
GOES	7.53%	5.55
POES	5.93%	4.37
NWLON	5.32%	3.91
NEXRAD	5.31%	3.91
Radarsat Series	4.63%	3.41
Coastal Weather Buoys	3.99%	2.94
SNPP	3.61%	2.66
AQUA	3.21%	2.36
IOOS Regional Ocean Observing System	2.75%	2.03
Global Drifter Program	2.72%	2.00
ASOS/AWOS	2.53%	1.87
Spotter/Skywarn Volunteer Program	2.53%	1.87
RAOB	2.35%	1.73
DMSP	2.26%	1.66
MTS Satellite	1.85%	1.36
GOS Regional Basic Surface Synoptic Network	1.74%	1.28
GOS Upper Air Network	1.61%	1.19
C-MAN	1.60%	1.18
JASON-2,3,CS	1.60%	1.18
USAF Hurricane Hunters	1.59%	1.17
TERRA	1.52%	1.12
Meteosat	1.40%	1.03
Oceansat-2/3	1.29%	0.95
COSMIC	1.27%	0.94

- Sustain critical NWS observing systems
  - NEXRAD
    - Maintain network availability ≥ at 96%
    - Continue SLEP
  - Coastal Weather Buoys
    - Maintain network availability ≥ 80%
  - ASOS
    - Begin SLEP
  - Spotter Program
  - RAOBs
    - Radiosonde Frequency Migration
- Leverage NOAA systems
  - GOES – GOES-R launch Oct 2016
  - Polar Satellites – JPSS launch Q2FY17
  - NWLON – NOS water level network
  - Global Drifter Buoys
- Leverage non-NOAA systems
  - Metop
  - Radarsat
  - IOOS
  - DMSP

Percent Impact of CWB on Multiple MSAs

Top 10 NWS Products Impacted	% Impact
Hazardous Seas Warning	14.7%
Offshore Waters Forecast	8.9%
Small Craft Advisory	8.7%
Sea Surface Temperature Analysis	8.3%
Wind and Wave Graphical Analysis	8.2%
Gale Warning	7.6%
Coastal/Lakeshore Flood Warning	6.0%
Hurricane Local Statement	5.8%
Marine Weather Statement	5.6%
Marine Weather Discussion	5.4%

Priority 1
Priority 2
Priority 3
Priority 4
Priority 5



What is the WMO Integrated Global Observing System (WIGOS)?

- WMO foundational activity addressing all observing needs of the weather, climate, water and environmental services of its Members.
- A framework for integrating all WMO observing systems and WMO contributions to co-sponsored observing systems under a common regulatory and management framework in order to improve effectiveness and efficiency.
- WIGOS is not replacing or taking over existing observing systems, which will continue to be owned and operated by a diverse array of organizations and programs, national as well as international.

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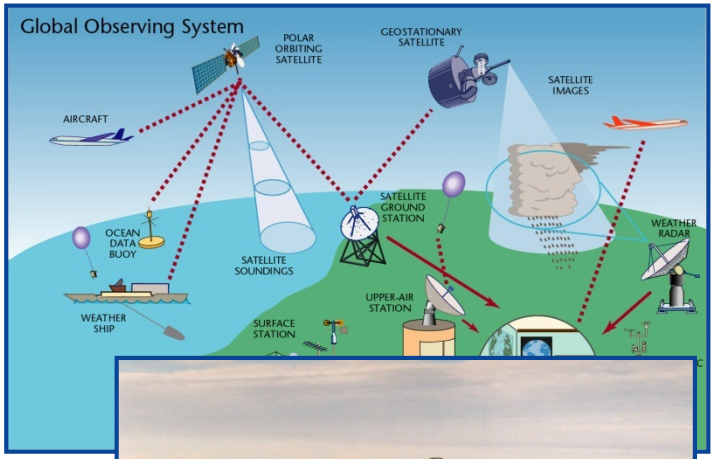
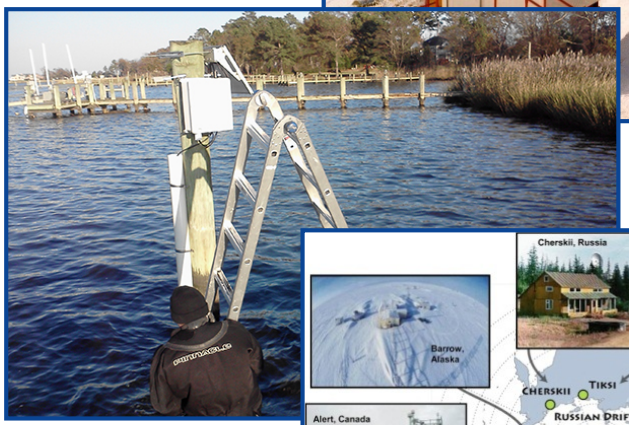
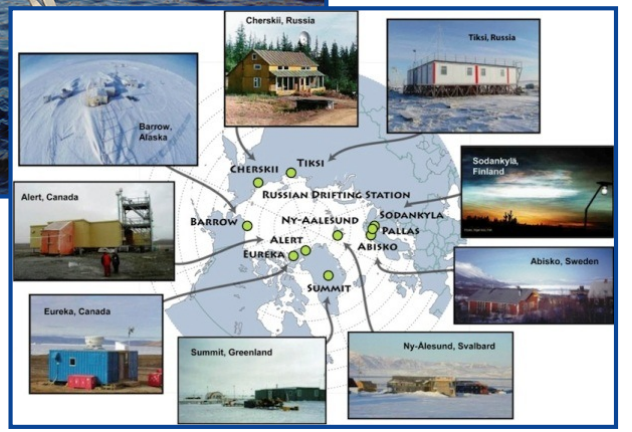
WIGOS Component Systems

- **G**lobal **O**bserving **S**ystem (WWW/**GOS**)
- Observing component of **G**lobal **A**tmospheric **W**atch (**GAW**)
- **W**MO **H**ydrological **O**bservations (including **WHOS**)
- Observing component of **G**lobal **C**ryosphere **W**atch (**GCW**)







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The WIGOS Pre-Operational Phase (2016-2019) decided by Cg-17 in 2015

- Increased emphasis on regional and national activities
- Five main priority areas:
  I. WIGOS Regulatory Material, supplemented with necessary guidance material
  II. WIGOS Information Resource, including the Observing Systems Capabilities analysis and Review tool (OSCAR), especially OSCAR/Surface
  III. WIGOS Data Quality Monitoring System (WDQMS)
  IV. Regional Structure; *Regional WIGOS Centers*
  V. National WIGOS Implementation, coordination and governance mechanisms

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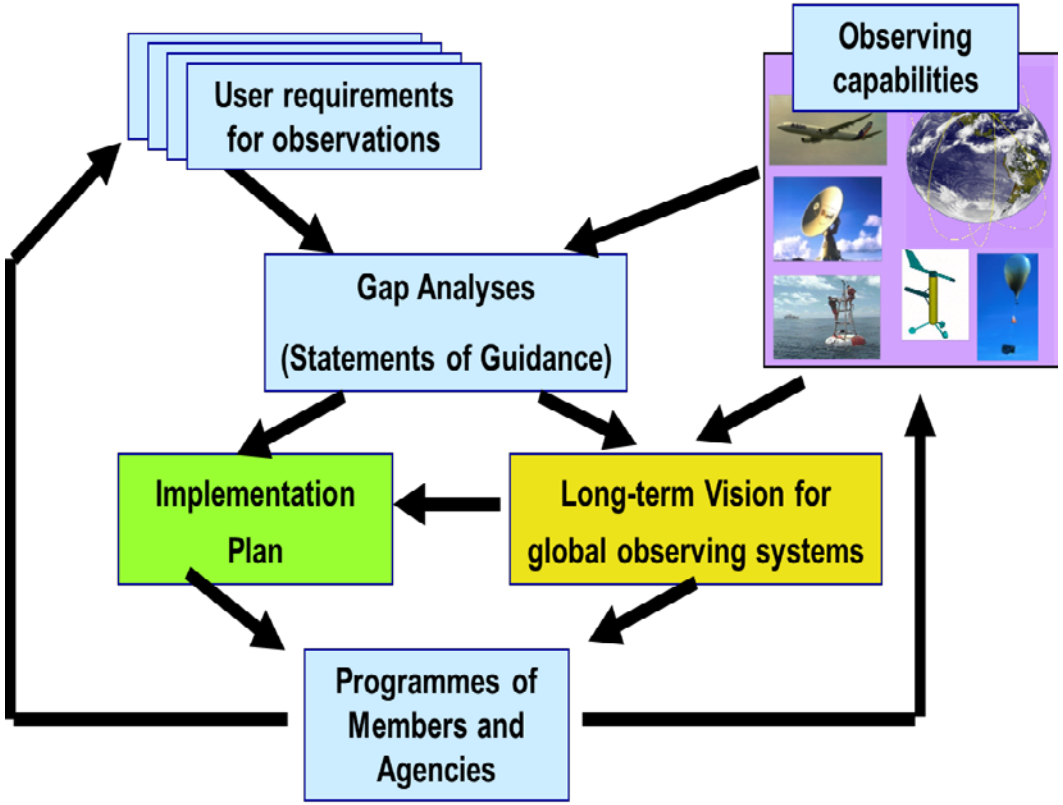
Rolling Review of Requirements (RRR)

- WMO Congress: All WMO and WMO co-sponsored observing systems shall use the RRR to design networks, plan evolution and assess performance.

- The RRR is the process used by WMO to collect, vet and record user requirements for all WMO application areas and match them against observational capabilities.



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WIGOS Information Resource (OSCAR)

- The RRR is supported by three key databases of **OSCAR**, the *Observation Systems Capabilities and Review* tool :
  - **OSCAR/Requirements**, in which “technology free” requirements are provided for each application area, expressed in units of geophysical variables (260 in total currently);
  - **OSCAR/Space,** listing the capabilities of all satellite sensors, whether historical, operational or planned
  - **OSCAR/Surface,** list surface-based capabilities; developed by MeteoSwiss for WMO, operational since May 2016

OSCAR/Requirements

- The following requirements are listed for each of the (currently 14 application) areas and for all relevant geophysical variables:
  - Spatial (horizontal and vertical) and temporal resolution, uncertainty, data latency, required coverage area, source, and level of confidence

- Each requirement is expressed in terms of three separate values:
  - Threshold (observations not useful unless this is met)
  - Break-through (optimum cost-benefit ratio)
  - Goal (exceeding this provides no additional benefit)

- OSCAR/Requirements information content is assembled by CBS and other WMO Inter-Program Expert Teams and Task Teams and is informed by the broader scientific community, e.g. via WMO Impact Workshops

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WMO Application Areas listed in the RRR (January 2017)

1. **Global numerical weather prediction**
2. High-resolution numerical weather prediction
3. Nowcasting and very short range forecasting
4. Seasonal and inter-annual forecasting
5. Aeronautical meteorology
6. Forecasting atmospheric composition
7. Monitoring atmospheric composition
8. Atmospheric composition for urban applications
9. Ocean applications
10. Agricultural meteorology
11. Hydrology
12. Climate monitoring *(currently under revision by GCOS and WCRP)*
13. Climate applications *(currently under revision by GCOS and WCRP)*
14. Space weather

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Why focus on application area 1: Global NWP?

Global Numerical Weather Prediction is a foundational activity for nearly all weather and climate applications

- Global NWP is a pre-requisite for all higher resolution NWP and related quantitative methods used for nowcasting and short-range prediction, also for hurricanes
- Global NWP shares many of its requirements with high resolution NWP, except the latter are even more stringent
- Global NWP requires global observational data and is as such fully dependent on international data exchanged coordinated by WMO

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Which of the many observed variables used for global NWP should we focus on?

- **Surface pressure and upper air wind!**
- They are two of the fundamental predicted variables for NWP (the other two are temperature and humidity)
  - They provide driving requirements for surface-based observing systems, since (as opposed to temperature or humidity) neither is currently well measured from space
    - Surface pressure is derived in experimental mode from total CO2 column measurements
    - Satellite imagers provide horizontal wind components by feature tracking, but only for a single layer (no vertical resolution) and limited height information
  - **Both theory and practice show that vertically resolved wind observations are particularly important in the tropics**
  - **RAOBs, aircraft observations and surface pressure measurements consistently have the highest impact on skill per observation**

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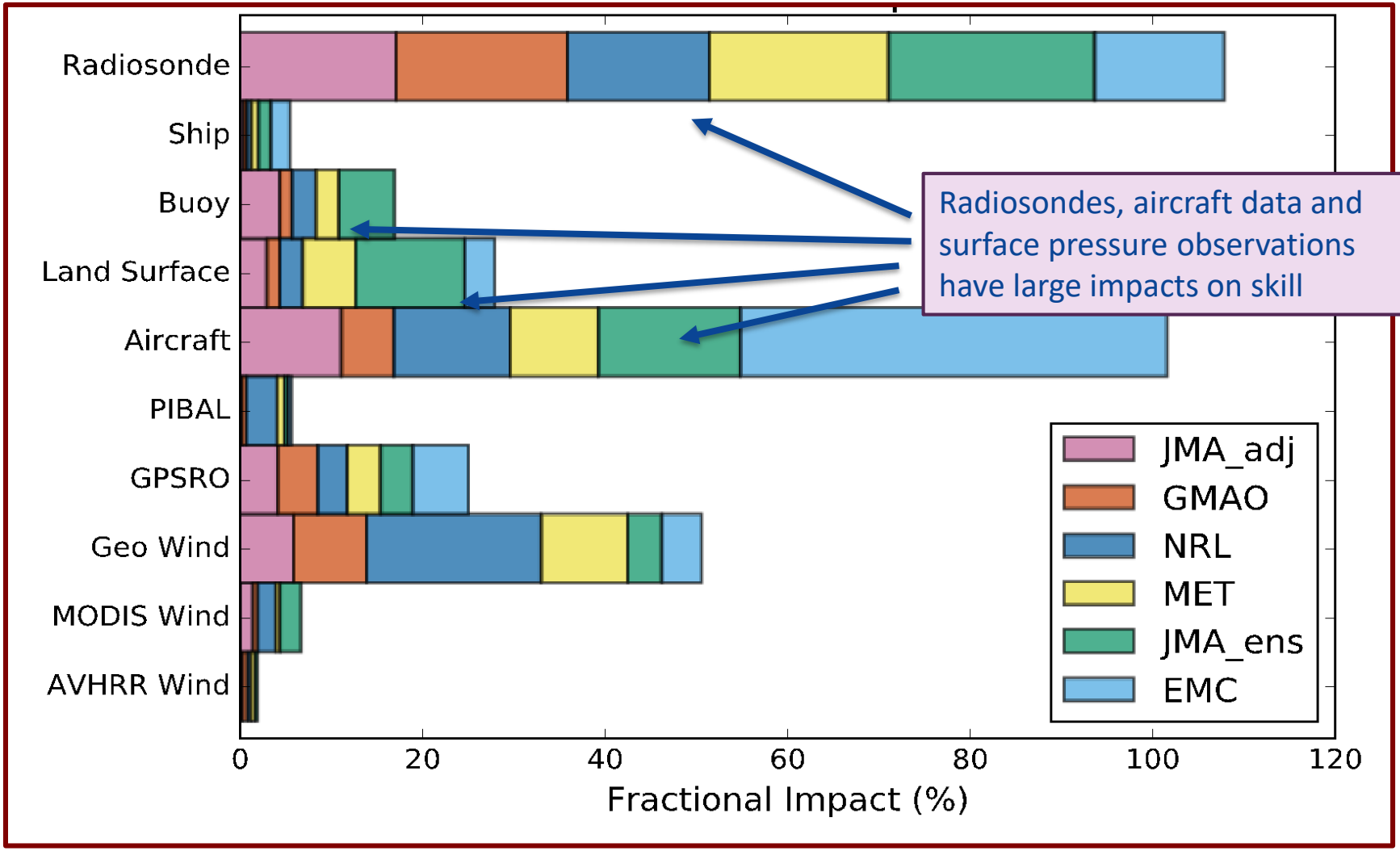
Fractional Impact at 00UTC:
Other Observations

Auligne et al.; from 6th WMO Impact Workshop, Shanghai 2016



OSCAR/Surface *("What is WIGOS?")*

- Implementation layer of the *WIGOS Metadata Standard*: **Modern, electronic, searchable inventory of metadata for all observing stations/platforms under WIGOS**
  - OSCAR/Surface has replaced *WMO Pub. 9, Volume A*, but in addition it includes information from similar inventories for other (non-GOS) components of WIGOS
  - Developed jointly by WMO and MeteoSwiss, with the Swiss government providing the major part of the funding
  - Operational since May 2016
  - Education and training Members in populating, editing and using OSCAR/Surface is a major priority for 2016-2019 financial period
  - Machine to machine interface for automated import/export of OSCAR/Surface and national databases in testing; to be released 3rd Q 2018

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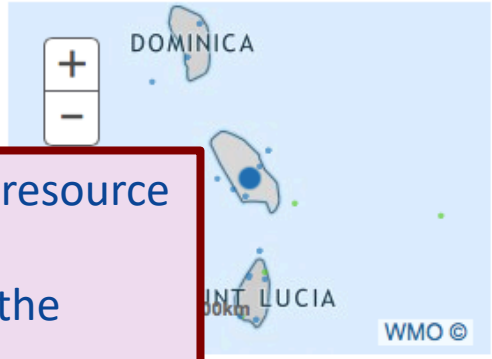
LAMENTIN-AERO (France)

in WMO Region IV - North America, Central America and the Caribbean

Last updated: 2016-04-28

Station characteristics

Station name:	LAMENTIN-AERO
Station alias:	
Date established:	
Station type:	Land (fixed)
Station class	
WIGOS Stati	
WMO region	
Country / Ter	
Coordinates:	> 14.5952777778°N, 60.9955555556°W, 5m
Time zone:	
Climate zone:	
Station URL:	
Other link (URL):	
Predominant surface cover:	
Surface roughness:	
Topography or bathymetry:	
Population in 10km / 50km (in thousands):	
Supervising organization:	> MF
Site information:	> The station was originally registered based on WMO Pub 9 Vol A information containing these observation remarks: A;AUT;CLIMAT(C);METAR;RAD;RBCN;RBSN(S);SOILTEMP;SUNDUR (see code table A for explanations). These remarks imply the following additional observations that could not be registered automatically: Radiation measurements.
Event at station / platform:	



OSCAR/Surface is (or will be) a very powerful resource for WMO Members, **but**

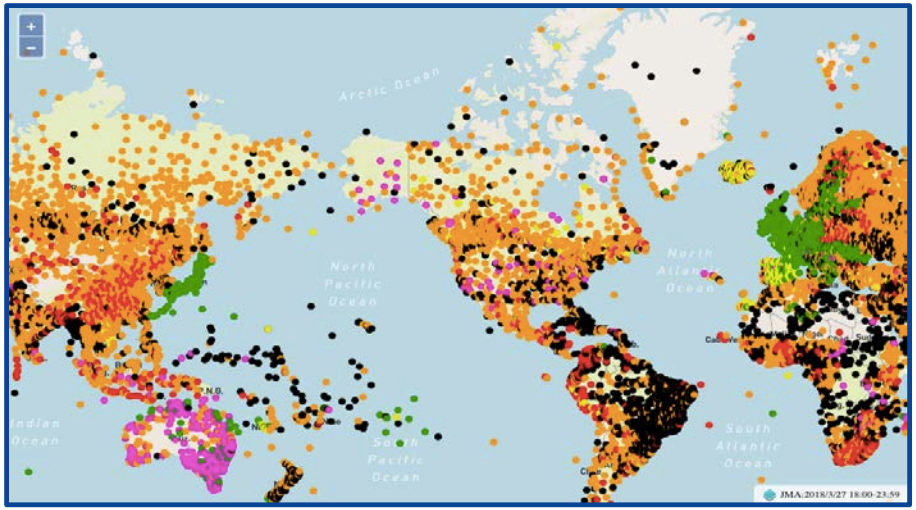
- Not all stations are properly registered in the system
- Station metadata are missing/incomplete for many stations

WHOS

GCW

Co-sponsored co

WIGOS Data Quality Monitoring System (WDQMS)



- Real-time monitoring of performance (data availability and data quality) of all WIGOS components, searchable by region, country, station type, period, etc.

Delayed mode monitoring of data quality as measured against reference sources of information will be included for non-real time observations

Incident management component for mitigation of performance issues

- **The WDQMS will provide a complete description of how well WIGOS is functioning**

Current activities

- **Pilot project on NWP-based monitoring; ECMWF, NCEP, DWD, JMA**
- RA-I Demonstration Project of monitoring and incident management involving Kenya and Tanzania running through 2018

Dr. Lars Peter Riishojgaard, RA-IV Hurricane Committee Meeting, Martinique, April 10 2018

Summary and Conclusions

- WIGOS 60% through its pre-operational phase; main technical systems implemented/under implementation

- Already providing powerful diagnostics of the workings of WIGOS/WIS and the compliance of WMO Members with WMO regulatory and guidance material
  - Room for very substantial improvement!
  - This is a limiting factor in the quality of monitoring, forecast and warning products, also for hurricanes

Discussion / Questions?