NOAA Observing Systems Integrated Analysis II (NOSIA-II)

A Presentation to the NOAA Science Advisory Board

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Outline

- Background
- Approach / Process
- NOSIA II Capabilities
  - Key Product Performance
  - Data Sources
  - Goal and MSA Performance
  - Observing System Impacts
  - Efficient Frontier (Portfolio)
- Way Ahead Steps
- Back-up slides

Purpose

Informational briefing to provide an overview of the NOAA Observing Systems Council (NOSC) observing system assessment tools, analysis capabilities and portfolio management activities

Issue

- With over 50% (approximately $2B) of NOAA's budget dedicated to observing systems, NOAA needs a persistent, flexible, and extensible analysis capability to support observing system assessments
- Observing system assessments need to include linkages from NOAA missions, their required activities, products and objectives to specific impacts and costs of each observing system
- Assessment capability must also include a comprehensive and robust analysis tool that can interactively answer leadership's questions to help inform their decision-making process in terms of current observing system impacts and future observing system investments

NOSIA-II

BACKGROUND

Introduction

- NOAA relies on Earth observations from hundreds of observing systems and sensors to accomplish it's mission and to fulfill international commitments. It is estimated about 50% (approximately $2B) of NOAA's budget is dedicated to observing systems.
- The NOAA Observing Systems Council (NOSC) has directed the Observing Systems Committee (OSC), supported by the Technology, Planning and Integration for Observations (TPIO) Program, to work with all NOAA Line Offices (LO) to complete the build out of NOAA's Observing System Integrated Analysis (NOSIA) process to all four NOAA Goals to develop an integrated approach to assess its observation requirements across the agency.
- NOAA's goal in this endeavor is to improve understanding of the impact that observations have on a broad range of NOAA key products and services (KPS).

NOSIA History

March 2010: FY 12-16 PDM Action to NOSC

"… form a NOAA-wide team to evaluate all systems (space, air and ground based) measuring atmospheric moisture and temperature … develop a comprehensive plan to capture these measurements in a more integrated fashion and include recommendations for improvement"

October 2010: NOAA Annual Guidance Memorandum

"[NOAA] must strengthen and integrate NOAA's upper air observing capability through analysis of atmospheric profiles of air temperature, water vapor, and wind vectors."

March 2011: Corporate Portfolio Analysis Decision Memorandum

Recommend cross-NOAA observing system efficiency gains using observing system experiments and other analysis techniques and involving the external community as appropriate, identifying implementation opportunities for FY 12 and plans for further work in FY 13

December 2011: TPIO Completes NOSIA-I Pilot Study *(2 Goals / 3 Parameters)*

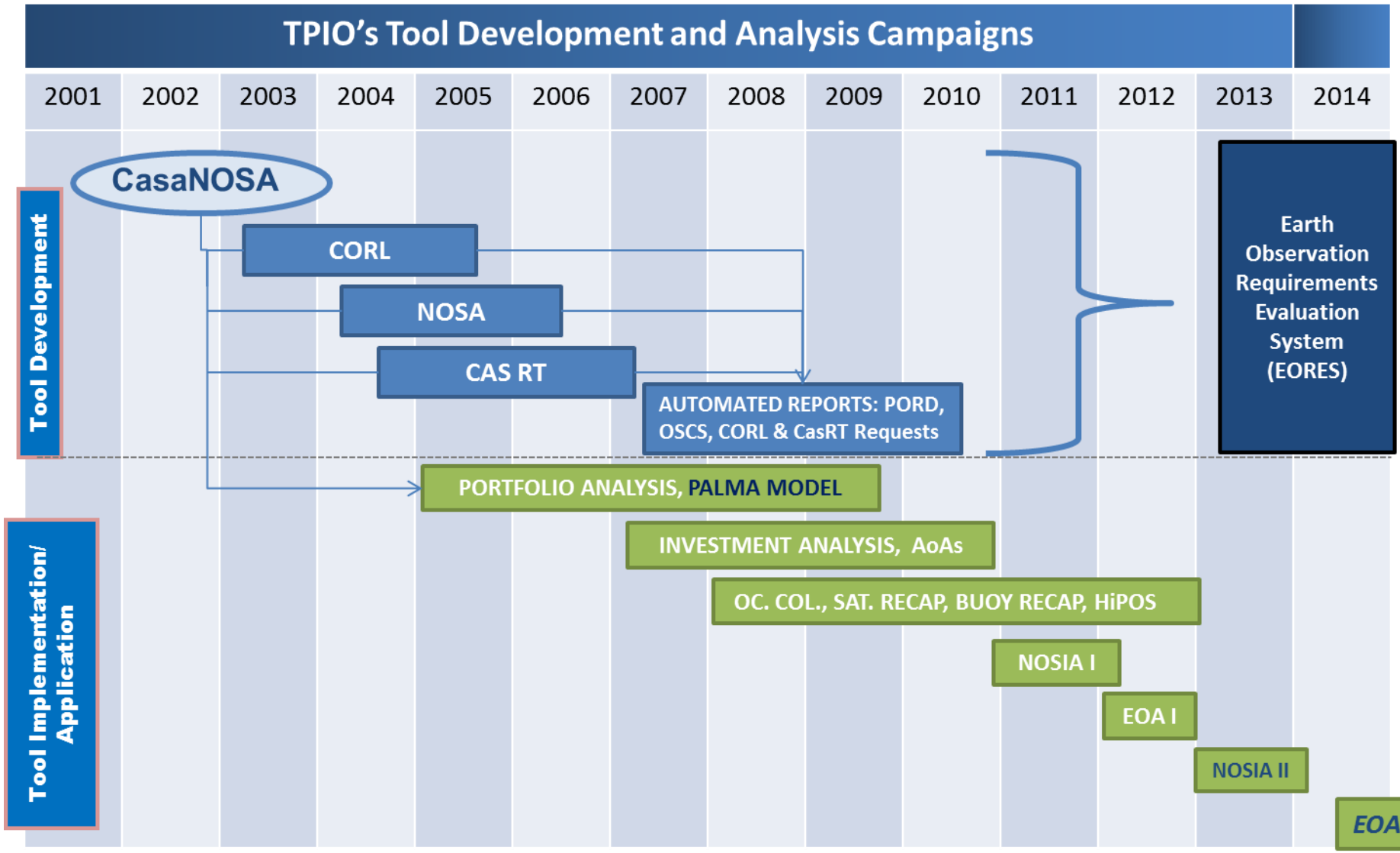
March 2012: NOAA & OSTP Direction

- *NOAA Leadership directs TPIO to complete NOSIA across NOAA*
- *OSTP directs use of NOSIA process for first federal Earth Observation Assessment (EOA-I)*

Mar-Sep 2012: NOSC/TPIO conducts OSTP EOA-I across 14 Federal Agencies

Mar-Dec 2013: OSC/TPIO conducts NOSIA II across 4 NOAA Goals & Research

Assessment Capability Evolution

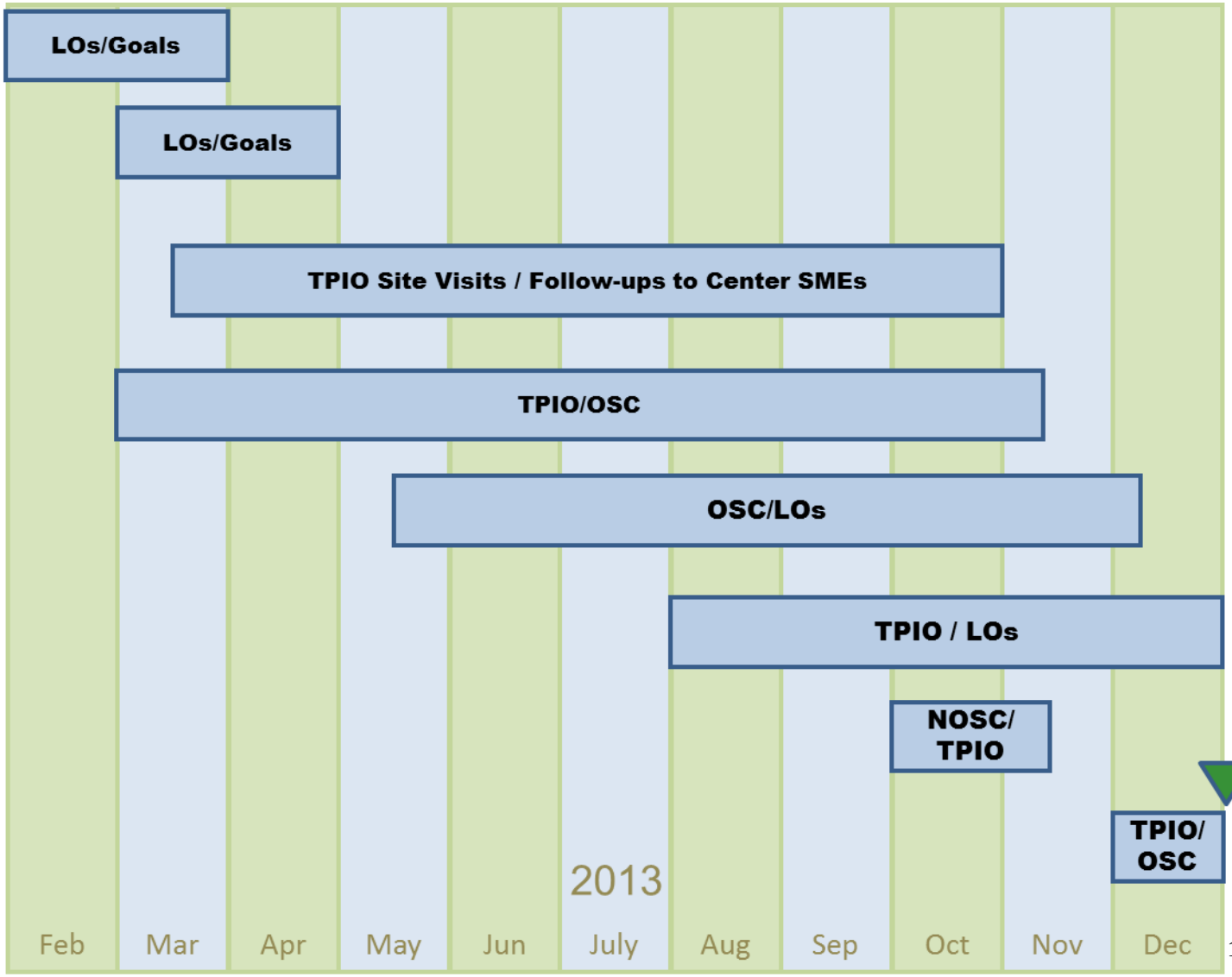


NOSIA II - Objectives

- ✓ Complete observing system impact assessment (NOSIA) for Weather-Ready Nation and Climate Adaptation and Mitigation Goals
- ✓ Extend NOSIA to Resilient Coastal Communities and Economies and Healthy Oceans Goals
- ✓ Determine if we need to collect information separately for Science and Technology – A holistic understanding of the Earth system through research
- ✓ Build upon NOSIA I and Earth Observation Assessment I (EOA I)
- ✓ *Support continuing current mission, product and observing system impacts and future architecture assessments*
- ✓ Support FY15 pass-back using model results
- ✓ *Support continuing FY15 scenarios/impacts*

NOSIA II - Timeline

1. Ratify MSAs
2. Identify Key Products and Services
3. Assess Obs System Impact
4. Populate Model
5. Update Obs System Costs
6. Review Model Output
7. Support FY15 Passback
8. Deliver Results

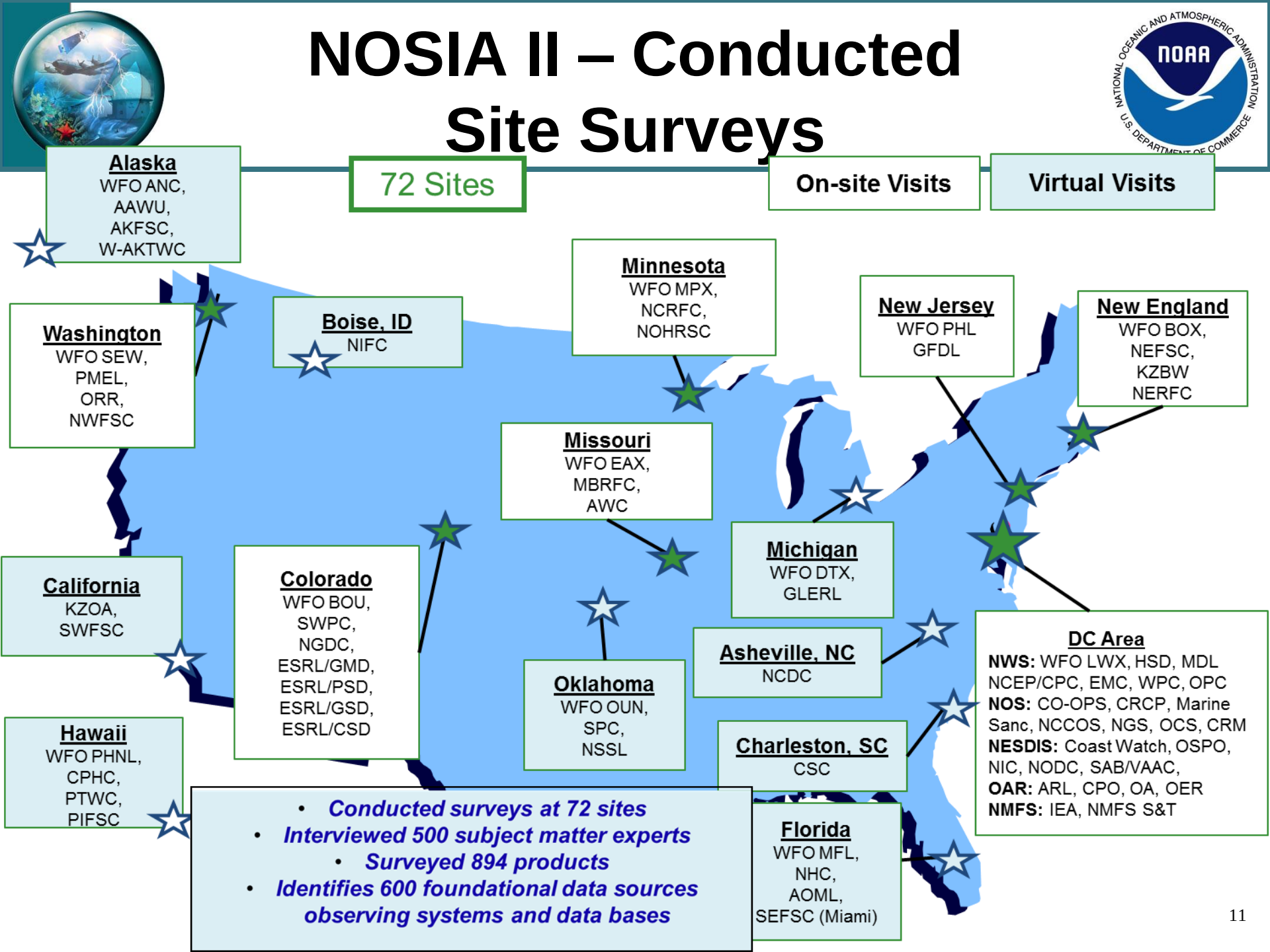


NOSIA II – Conducted Site Surveys

72 Sites

On-site Visits

Virtual Visits



- *Conducted surveys at 72 sites*
- *Interviewed 500 subject matter experts*
- *Surveyed 894 products*
- *Identifies 600 foundational data sources observing systems and data bases*

NOSIA II - Overview of Scope

NOSIA II Scope vs NOSIA I and EOA I

	NOSIA-I	EOA-I	NOSIA-II
Sites	14	26	**72**
SMEs [1]	95	~300	**500**
Goals	< 2	Na	**4**
MSAs/SBAs	14	13	**25**
Surveyed Products	122	177	**894**
Data Sources [2]	(70)	(356) 525	**(288) 600**
Model Connections	1,419	4173	**15,000+**

[1] Line Offices identified Subject Matter Experts (SME)

–SMEs represent thousands of years' experience

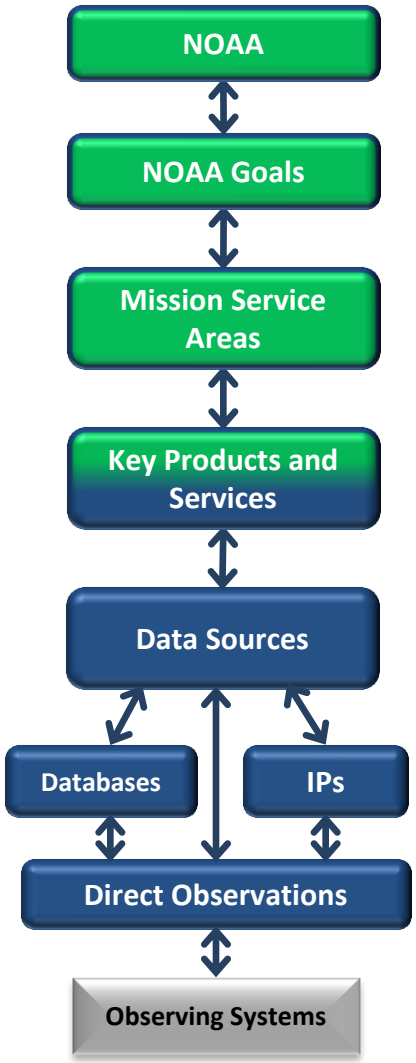
[2] (Observing Systems) All Data Sources

NOSIA-II

APPROACH / PROCESS

NOSIA Approach

Value Chain



- The **value chain** is a linked collection of activities that begins with an Earth observation, adds value to it to ultimately achieve a key objective or deliver a product or service, which in turn contributes to a mission service area (MSA) and a **NOAA Goal**
- **Mission Service Areas (MSA)** provide a natural breakdown of the Goals into topical/application areas that encompass the major functions
- **Key Products and Services (KPS)** represent the most important things to be accomplished within the MSA, includes Key Science Objectives
- **Data Sources** are those direct observations, databases and intermediate products (IP) required to produce Key Products and Services

****Goal is to make the connection between observations/data and the value they provide to the product and/or service delivered**

e.g. The National Weather Service is not funded to "Measure precipitation and wind speed", the National Weather Service is funded to "Provide advance warning of severe weather to save lives"

Translating Performance into Numerical Values

Performance Evaluation

- Performance scored using the scale at right
  - KPS Status Quo Performance
  - Data Source Impact Swing Score
  - Data Source Satisfaction

Swing Weighting Ground Rules

- Score removal of one Data Source at a time
  - All other Data Sources remain unchanged & available
- Score your direct use of Data Source only
  - Assume everyone else has the data
- Score normal / operational impacts
- Integrate impact over a yearly/climatic cycle
- Initialization & verification can impact a KPS, estimate societal impact of uncertainty

Performance (Satisfaction) Scale		
100	**Ideal**	Meets all requirements and exceeds some
90	**Fully Satisfied**	Meets all requirements
80	**Good**	Meets all major requirements, with minor limitations
60	**Fair**	Meets most major requirements, with significant limitations
40	**Poor**	Fails to meet many major requirements, but provides some value
20	**Very Poor**	Fails to meet most major requirements, but provides minor value
1	**No Capability**	Provides no value

NOSIA-II

INITIAL CAPABILITIES

NOSIA II – Baseline Assumptions

Treated as Fact in the NOSIA-II Model but Can Be Changed

- As a starting point: NOAA Goals, MSAs and KPs addressed in the study are of equal importance – can be changed and rerun easily
- SME inputs effectively incorporate the many dimensions of impacts on product quality
  - Study team depended on SMEs to consider OSSE, OSE, and other study results in their assessments
- Same products surveyed at multiple sites were averaged (WRN)
- Observing system costs provided by system program managers, NOSA, or latest reference documents
- Processing costs for Non-NOAA systems are generally $1M / year for satellites and $10-500K / year for non-satellite sources – more definitive data can be substituted easily

NOSIA II - “Firsts”

- ✓ First identification of 25 NOAA MSAs mapped to NGSP objectives
- ✓ First NOAA-wide comprehensive identification and listing of NOAA Key Products and Services, including Research Objectives
- ✓ First Assessment of Performance levels of each KPS
- ✓ First Full listing of Data Sources (Observing Systems, Databases and Models) for each KPS
- ✓ First Impact Scores of each Data Source to each KPS
- ✓ First Level of satisfaction of each Data Source

NOSIA II – Capabilities

All of the above allowed for:

- ✓ Overall performance at MSA level
- ✓ Overall performance at Goal level
- ✓ Overall performance at NOAA level
- ✓ Full listing of data sources used across NOAA (600)
- ✓ Individual system listings for missions & KPS they support with specific impacts & satisfaction values
- ✓ Impact scores for each data source at the KPS, MSA, Goal and NOAA levels
- ✓ Single Period Observing System Portfolio analysis of performance and cost

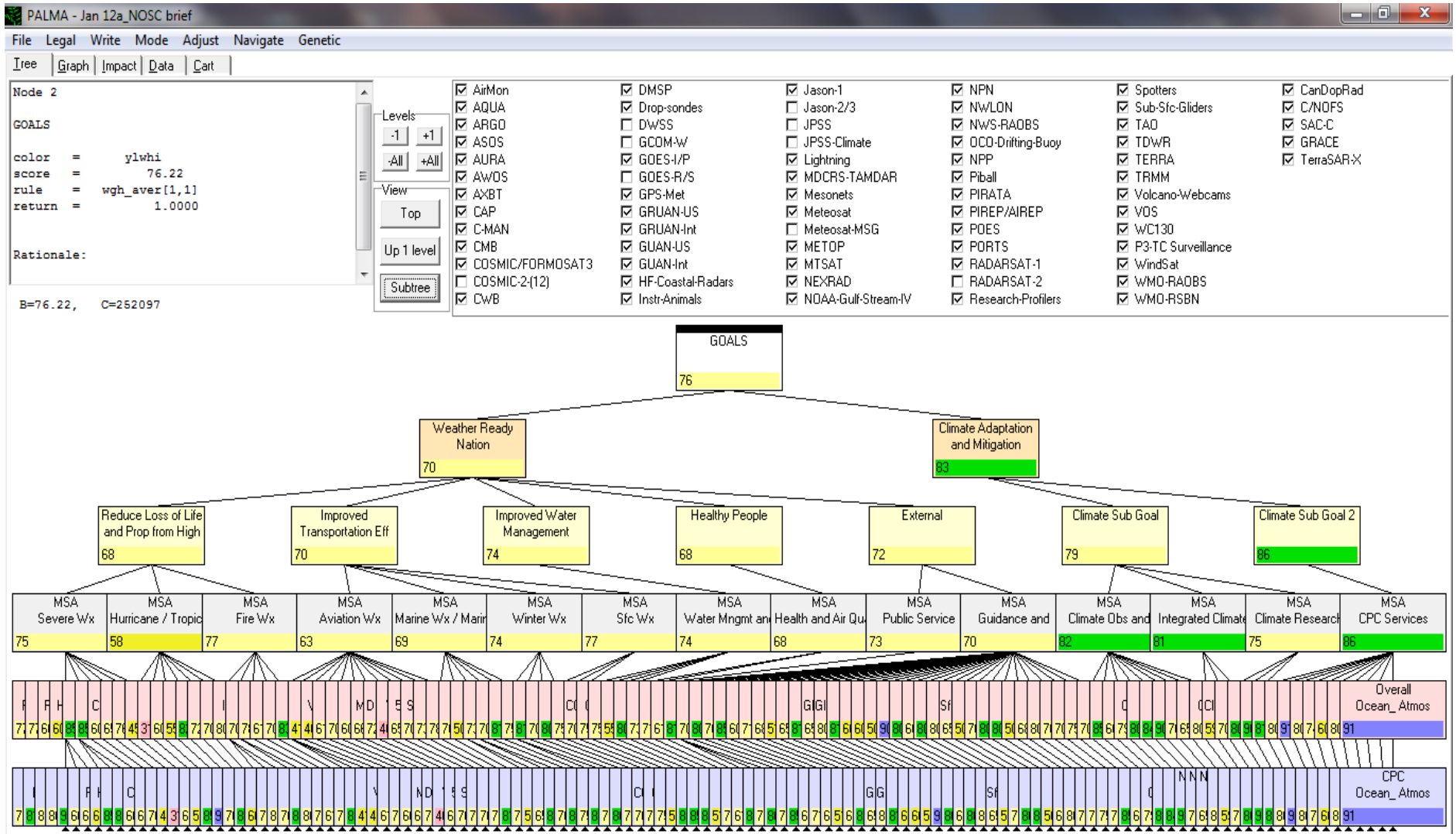
NOSIA II - Performance: Number of Goal MSAs & Products

GOAL	MSA	MSA Acronym	Surveyed Products
CLIMATE (5)	Assessments of Climate Changes and its impacts	CLI_ACC	83
	Climate Mitigation and Adaptation strategies	CLI_CMA	3
	Climate Prediction and Projections	CLI_CPP	22
	Climate Education and Outreach	CLI_EDU	2
	Climate Science and Improved Understanding	CLI_SIU	46
HEALTHY OCEANS (5)	Ecosystem monitoring, assessment and forecast	HO_ECO	33
	Fisheries Monitoring, Assessment and Forecast	HO_FMA	49
	Habitat Monitoring and Assessment	HO_HAB	34
	Protected Species Monitoring	HO_PSM	76
	Science, Services, and Stewardship	HO_SSS	19
RESILIENT COASTS (5)	Coastal Water Quality	RC_CWQ	25
	Marine Transportation	RC_MTS	20
	Planning And Management	RC_PAM	32
	Resilience to Coastal hazards and Climate change	RC_RCC	12
	Science, Services, and Stewardship	RC_SSS	3
WEATHER READY NATION (10)	Aviation Weather and Volcanic Ash	WRN_AWX	57
	Fire Weather	WRN_FWX	20
	Hydrology and Water Resources	WRN_IWF	66
	Marine Weather and Coastal Events	WRN_MWX	104
	Hurricane/Tropical Storms	WRN_NHC	20
	Routine Weather	WRN_RWX	28
	Severe Weather	WRN_SEV	61
	Space Weather	WRN_SWX	31
	Tsunami	WRN_TSU	22
	Science, Services, and Stewardship	WRN_SSS	26
4	TOTALS	25	894

NOSIA II – Performance: Values, Goal, MSA and KPS

- Demo of Palma
  - Overview of Palma Structure / Model Basics
  - Performance Values at NOAA, Goal, MSA & KPS levels

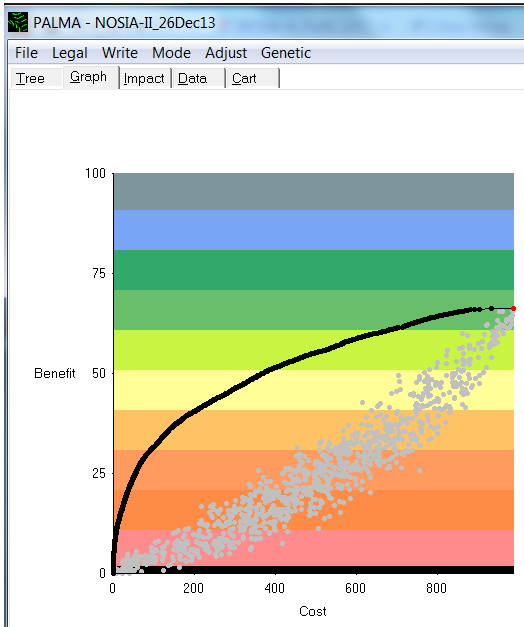
NOSIA II - NOAA “Value Tree”



NOSIA II
Initial Efficient Frontier

- Demo of Efficient Frontier

NOSIA II - Initial Efficient Frontier



PALMA - NOSIA-II_26Dec13

File Legal Write Mode Adjust Genetic

Tree Graph Impact Data Cart

B=66.30, C=989

Show opt frontier

250 generations of evolution
648 points on frontier

Search

Academic_Magnetometers	Chartered_Vessels_Habitat_Surveys	GLERL(AUVs)
ACE(EPAM)	Chartered_Vessels_Protected_Resources	GLERL(Divers)
ACE(MAG)	Chartered_Vessels_Protected_Species_Surveys	GLERL(Gliders)
ACE(SIS)	Chartered_Vessels_Research(Atmos_Ocn_Chem_Bio)	GLERL(Moored_Thermistors)
ACE(SWEPAM)	CHUAS	GLERL(ROVs)
Acoustic_Moorings	CLIVAR	GLERL(Ship)
AERONET	CloudSat	GLERL(Small_Boats)
Airborne_AirQuality_Field_Campaigns	C-MAN	GLERL(Towed_Sensors)
Airborne_Chartered_LiDAR_Hydrography	CoCoRaHS	GLERL(Wave_Sensor)
Airborne_HiRes_Imagery	Colorado_LMA	GLOSS
Airborne_LiDAR(aerosols)	Comm_HiRes_RTK_Data	GMD_Obs_Capab(trace gas)
Airborne_Obs(Snow)	Comm_HiRes_Sat_Imagery	GOCE
Airborne_Obs_USCG	Commercial_Catch_Monitoring	GOES-NOP(EPEAD)
Airborne_SAR/IfSAR	Commercial_Catch_Monitoring(Bio_Smpl_Shrsd)	GOES-NOP(EUVS)
Aircraft_Charter_Fish_Surveys	Commercial_Catch_Monitoring(DealerRcds_Permits)	GOES-NOP(HEPAD)
Aircraft_Charter_Habitat_Surveys	Commercial_Catch_Monitoring(Fish_Tagging)	GOES-NOP(Imager)
Aircraft_Charter_High_Res_Imagery	Commercial_Catch_Monitoring(Log_Books)	GOES-NOP(MAG)
Aircraft_Charter_Protected_Species_Surveys	Commercial_Catch_Monitoring(State_Tickets)	GOES-NOP(MAGP/ED)
Aircraft_NOAA_Fish_Surveys	CoOp_Agncy_Prof	GOES-NOP(Sounder)
Aircraft_NOAA_Habitat_Surveys	COSMIC(GPSRO)	GOES-NOP(SXI)
Aircraft_NOAA_Ice_Obs	COSMO-SkyMed(SAR)	GOES-NOP(XRS)
Aircraft_NOAA_XBT	CREIOS/NCRMP	GOM_Oil_Platforms
AIREP	CREIOS/NCRMP(ARMS)	GONG
AIRNoW	CREIOS/NCRMP(Divers)	GOOS_Carbon_Network
AMDAR	CREIOS/NCRMP(Partner_Small_Boats)	GOOS_ORS
AMNet	CREIOS/NCRMP(Small_Boats)	GO-SHIP
AMoN	Crowdsource_Media	GOS-Sfc
Animal_Borne_Sensors	CRYOSAT	GOS-UA
ANSS	CSD_Obs_Capab	GPMN
Antarctic_UV_Network	CTD	GPS
AON	CTOS	GPS_Met
AQS	CWB	GRACE
AQUA(AIRS)	CWOP	GRACE(GNSSRO)
AQUA(AMSR)	DART	G-Rad
AQUA(AMSU)	DCA_LMA	G-RAD (STAR)
AQUA(CERES)	DMSP(OLS)	GravD(Airborne)
AQUA(MODIS)	DMSP(SSIES)	GravD(Marine)
AQUARIUS	DMSP(SSJ)	GravD(Terrestrial)
ARGO	DMSP(SSM)	Ground_Based_LiDAR
ARL_Obs_Capab	DMSP(SSMIS)	GRUAN-Int
ARL_Obs_Capab(DCnet-Meso)	DODGrav(Marine)	GSN
ARL_Obs_Capab(Deploy_Sys)	DOE_ARM	Habitat-Data_Surveys
ARL_Obs_Capab(NNTS-Meso)	Drifting_Buoy_Network	Habitat-Data_Surveys(Divers)
ASOS	Earthscope	Habitat-Data_Surveys(Small_
AURA	EcoFOCI	HabitatEquivalencyAnalysis
AURA(OMI)	EcoPAS	HADS
AUV(Acoustic)	Ecosystem Surveys	HATS
AWOS	EM_Dispatch_911	HCT-HMT
Bio_Chem_Buoys	ENTLN	HF_Coastal_Radars
BLM_Fire_Fuel_Reporting	EO-1	Human_Reports(Fire, Volcanc
BLM_Lightning_Data	EPA_Water_Qual_Samples	HYDRO
C/NOFS(GPSRO)	EPA-LIDARS	HYDRO(Small_Boats)
CALIPSO(CALIOP)	ESP NCCOS	IAGOS
Can_Doppler_Rad	f10.7_Solar_Flux	IGRA
Can_Sfc_WX_Ntwk	FACE	IMPROVE
Can_Wx_Buoy_Ntwk	FDSN	INDOEX
Canada_Stream_Gage_Network	Fisheries_Observers_Commercial_Vessels	INL Mesonet
CASA	FlowCytobot NCCOS	INSAT(VHRR)
CASTNET	FLUXNET	In-situ AERO
CBIBS	Gamma Snow Surveys	INTERMAGNET
Charter_Vessel_Coral_Field_Surveys	GAW_Aerosol_LiDAR(GALION)	International_Magnetometers
Chartered_Vessels_Ecosystems_Surveys	GCOM-W(AMSR2)	Intnl_Doppler_Rad
Chartered_Vessels_Fish_Surveys	GEWEX	Intnl_Reg_Vessels_Prot_Res(

NOSIA-II

NEXT STEPS

NOSIA II - Way Ahead

- By May 1st incorporating/completing:
  1. Grouping and tiering
  2. Model and Data Integrity
  3. Cost Validation
  4. Multi Year resulting in IOC Summer 2014

NOSIA-II

BACK-UP SLIDES

NOSIA II - Key Products

Key Products (KP) identification was an iterative process

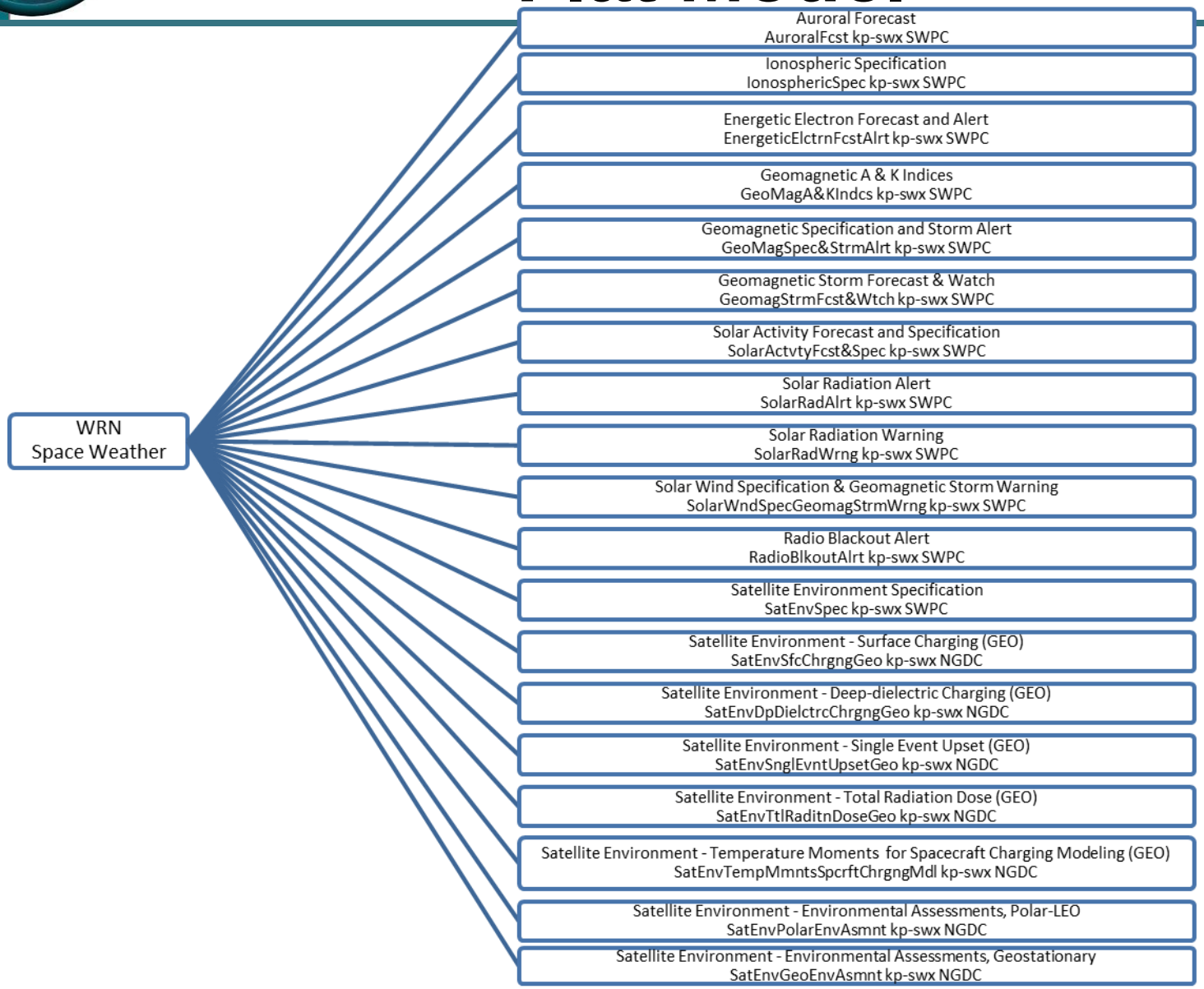
- Line Offices proposed initial Key Products (KP) List
  - From LO HQ or via direct lab/program submissions
- Line Offices provided KP assignment to primary MSA
  - In general, OAR non-Climate KPs assigned to new dedicated Science, Service & Stewardship (SSS) MSA within each Goal
- Line Offices provided Sites/SMEs per KP to survey
- Sites/SMEs proposed changes/additions to initial KP list during survey discussions
  - Substantial changes to Climate and Healthy Oceans MSA's initial KP list
- TPIO proposed primary MSA assignments to additional surveyed products
- Line Offices and/or Goal Leads reviewed and concurred with inclusion of surveyed products and assignments to MSAs
  - In-Review: Mapping of OAR non-climate KPs to MSAs other than SSS MSA
  - In-Review: Mapping of KPs to multiple MSAs
  - In-Review: Groupings of the 894 surveyed products to final KP listings

NOSIA II – Data Sources: Types

- NOSIA II Data Sources - Types

Observing Systems			
NOAA SoR Observing Systems	110		
NOAA SoR - Subsystems		191	
NOAA non-SoR Observing Systems	55		
non-NOAA Observing Systems	123		
non-NOAA - Subsystems		5	
Sub-Total	**288**	**196**	**484**
Databases			
NOAA Databases	34		
non-NOAA Databases	82		
Sub-Total	**116**		**116**
Total Data Sources			**600**

Example: WRN Space Wx. MSA Flat Model



Example: WRN Space Wx. MSA Groups and Tiers