NESDIS Update to the Committee on Earth Science and Applications from Space

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NOAA

Satellite and Information Service

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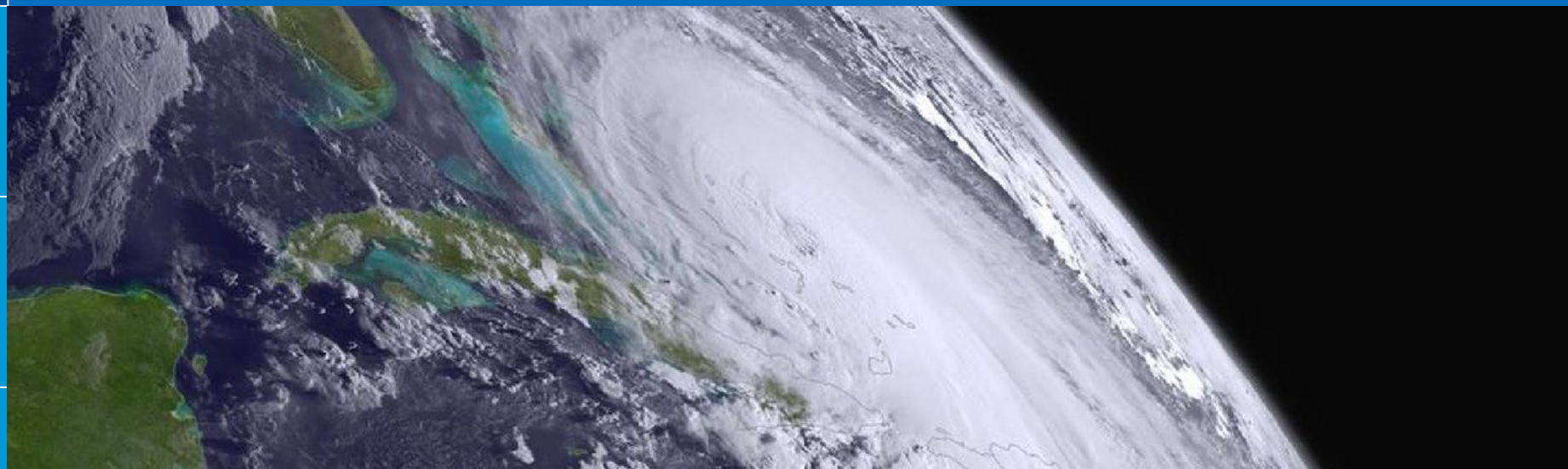


Outline

- Updates since December (FY21 PB)
- NESDIS System Objectives
  - Next Generation Observations
  - New ground systems activities
- Overall challenges/hot topics

NESDIS Program of Record

Major Program Commitments

Presented at Dec 2019 CESAS Briefing

Development:

JPSS – Joint Polar Satellite System

- JPSS through 2038: FY19 $878M, LCC ~$19B (PFO baseline update expected this winter)

GOES-R – Geostationary Operational Environmental Satellites

- GOES-R through 2036: $408M, LCC ~$11B (LCC update expected in coming months)

SWFO – Space Weather Follow On

- SWFO through 2029: FY19 $27M, LCC ~$700M

Operations, Science, and Data Archives

- Annual operations funding FY19 $243M, adjusted (with difficulty) as systems evolve for support and execution

NOAA is committed to long term planning, with the necessary supporting investments to do it.

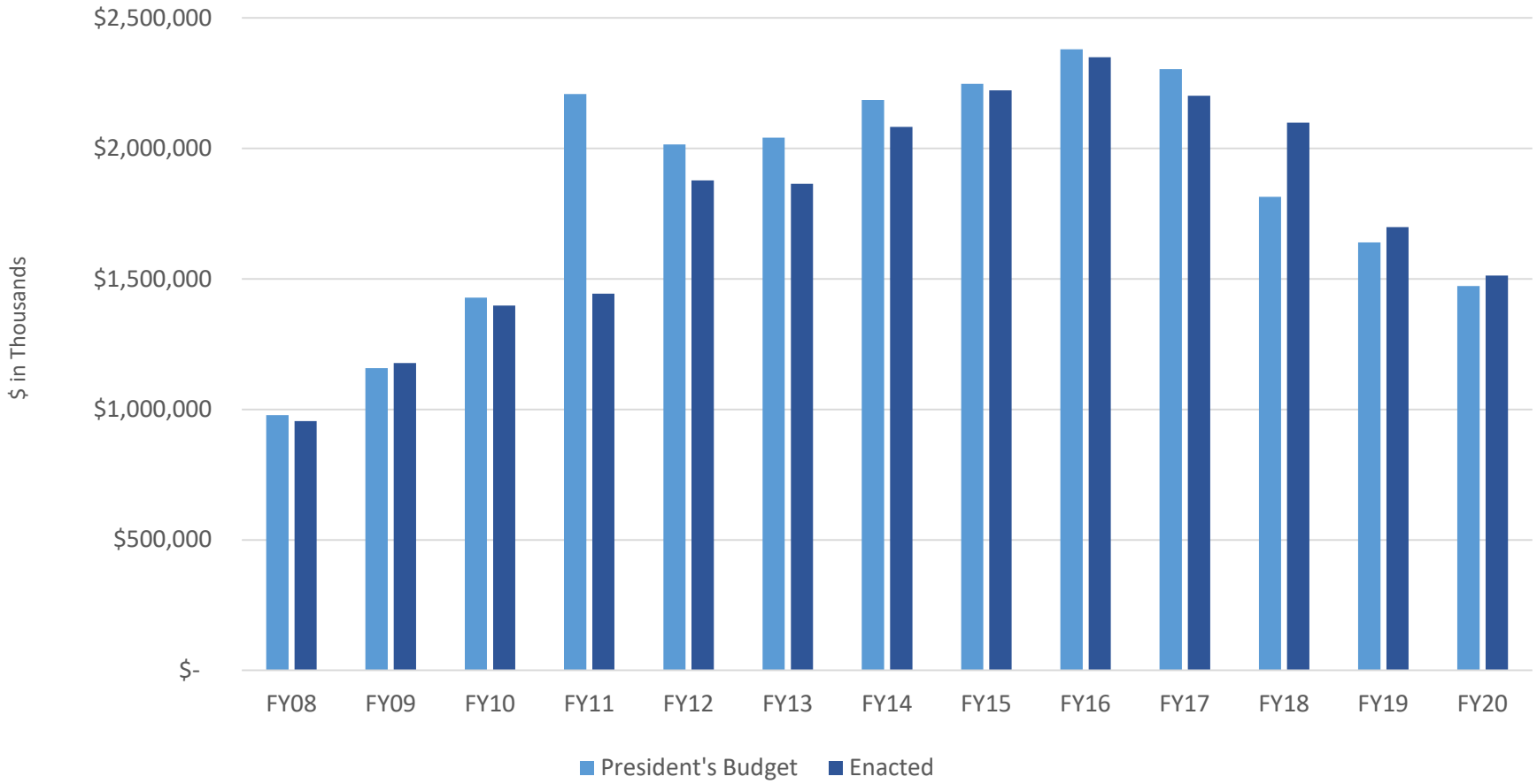
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
($ in Thousands)

FY 2021 PROPOSED OPERATING PLAN	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2022	FY 2023	FY 2024	FY 2025
Geostationary Systems - R	**408,380**	**304,056**	**334,500**	292,500	250,000	250,000	86,027
Polar Weather Satellites	**0**	**745,000**	**657,835**	665,020	574,521	608,130	462,399
- Joint Polar Satelite System (JPSS)	**548,035**	[425,082]	[371,538]	[253,020]	[139,521]	[135,576]	[132,443]
- Polar Follow On	**329,956**	[319,918]	[286,297]	[412,000]	[435,000]	[472,554]	[329,956]
Cooperative Data and Rescue Services (CDARS)	**26,539**	**11,350**	**14,400**	1,300	1,300	1,300	1,300
Operation of MEOLUT in NM			*[(450)]*	*0*	*0*	*0*	*0*
Space Weather Follow On	**27,000**	**64,000**	**108,115**	146,900	136,200	97,200	41,200
COSMIC 2/GNSS RO	**5,892**	**5,892**	**5,892**	8,100	8,100	8,100	8,100
Satellite Ground Services	**58,000**	**55,707**	**39,287**	39,287	39,287	39,287	39,287
Maintenance of legacy ground systems			*[(17,198)]*	*0*	*0*	*0*	*0*
DACS			[5,015]	TBD	TBD	TBD	TBD
System Architecture and Advanced Planning	**4,929**	**0**	**0**	0	0	0	0
Projects, Planning and Analysis	**40,000**	**31,000**	**15,941**	15,941	15,941	15,941	15,941
Commercial Weather Data Pilot	**6,000**	**0**	**0**	0	0	0	0
Geostationary Earth Orbit (GEO)		**0**	**10,000**	TBD	TBD	TBD	TBD
GEO-XO			*[10,000]*	TBD	TBD	TBD	TBD
Systems/Services Architecture & Engineering (SAE)		**33,990**	**49,322**	61,322	71,322	81,322	91,322
- Architecture, Requirements, and Planning		[13,722]	[21,322]	[21,322]	[21,322]	[21,322]	[21,322]
Tech Maturation and Sys. Eng. Support			*[7,600]*	*[7,600]*	*[7,600]*	*[7,600]*	*[7,600]*
- Commercial Data Program		[8,000]	[23,000]	[35,000]	[45,000]	[55,000]	[65,000]
-Commerical Data Purchase		[5,000]	[15,000]	[25,000]	[30,000]	[35,000]	[40,000]
-Commerical Weather Data Pilot		[3,000]	[8,000]	[10,000]	[15,000]	[20,000]	[25,000]
- Joint Venture		[2,268]	[5,000]	[5,000]	[5,000]	[5,000]	[5,000]
Joint Venture base			*[2,732]*	*[2,732]*	*[2,732]*	*[2,732]*	*[2,732]*
- GEO-XO		[10,000]	**0**	[0]	[0]	[0]	[0]
GEO-XO base			*[(10,000)]*	*0*	*0*	*0*	*0*
Subtotal, NESDIS Systems Acquisition	**1,454,731**	**1,250,995**	**1,235,292**	**1,230,370**	**1,096,671**	**1,101,280**	**745,576**
Transfer to OIG	**(1,302)**	**(1,302)**	**(1,302)**	(1,301)	(1,301)	(1,301)	(1,301)
Total, NESDIS - PAC	**$1,455,879**	**1,252,143**	**1,233,990**	**1,229,069**	**1,095,370**	**1,099,979**	**744,275**
GRAND TOTAL NESDIS	**1,698,545**	**1,512,882**	**1,503,982**	**1,499,061**	**1,365,362**	**1,369,971**	**1,014,267**

Trends

NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE ($ in Thousands)							
FY 2021 PROPOSED OPERATING PLAN	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**
Environmental Satellite Observing Systems							
Satellite and Product Operations	146,924	166,063	189,099	189,099	189,099	189,099	189,099
Product Development, Readiness & Application	31,000	28,434	27,886	27,886	27,886	27,886	27,886
Commercial Remote Sensing Regulatory Affairs	1,800	1,800	0	0	0	0	0
Office of Space Commerce	1,800	2,300	0	0	0	0	0
U.S. Group on Earth Observations (USGEO)	500	500	500	500	500	500	500
National Center for Environmental Information (NCEI)	60,642	61,642	52,507	52,507	52,507	52,507	52,507
Total, NESDIS - ORF	242,666	260,739	269,992	269,992	269,992	269,992	269,992

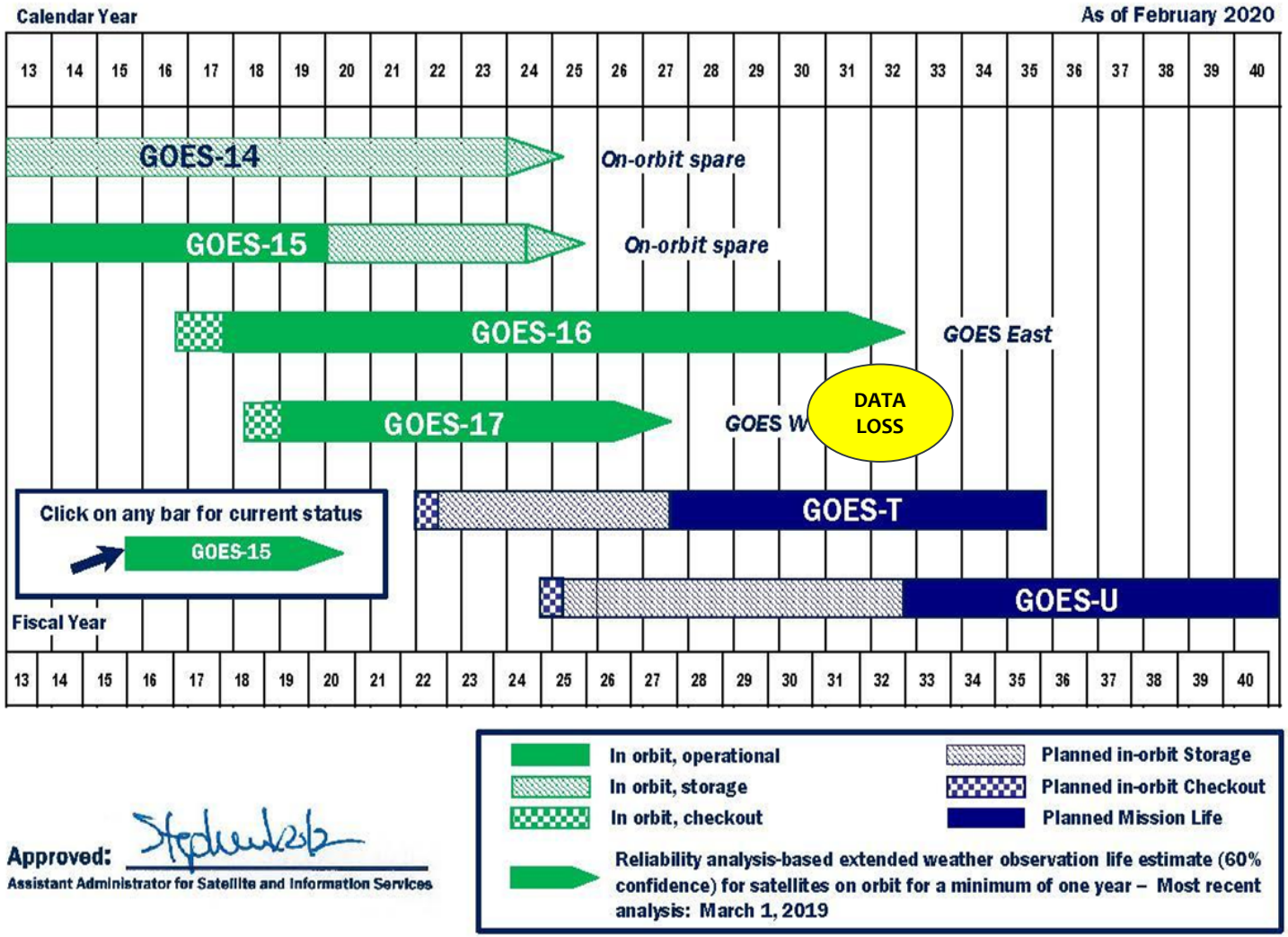
NESDIS Budget Trends



Today's Space Architecture is Highly Capable, But Not Adaptable

Planned Architecture 2025

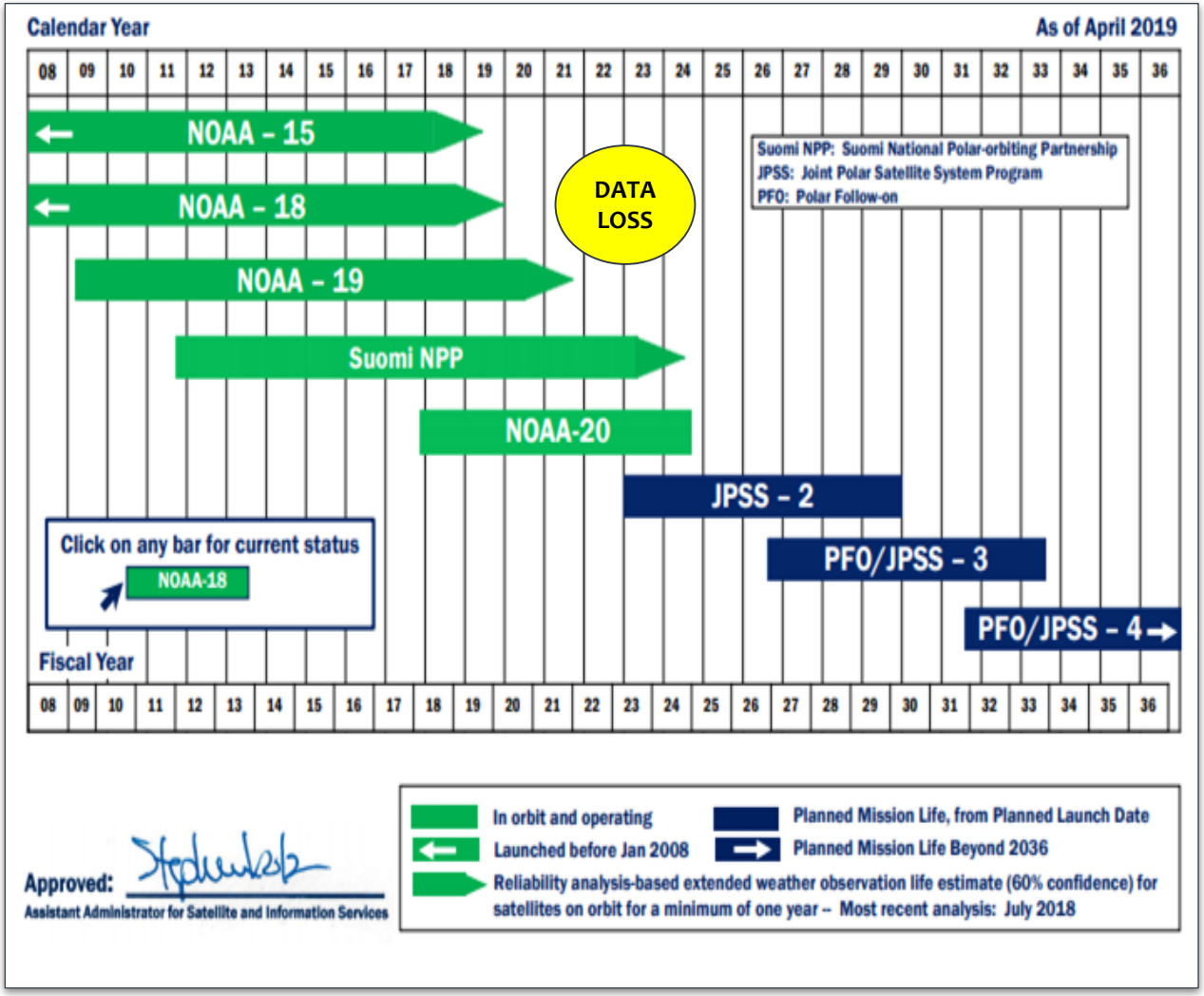
Need for Continuity in GEO Observations



The GOES-R series will lose on-orbit backup capacity by ~2030.

Replacement observations are needed by that time to maintain system performance and continuity.

Need for Continuity in LEO Observations



Legacy POES (NOAA-15, -18, -19) are not baseline requirements for NOAA, but continue to provide useful observations for NWP.

DMSP is a baseline national asset, but DOD does not plan to replace all observations with their new programs.

NOAA will lose all these observations by the mid-2020s.

Critical replacement sounding data is needed at that time to maintain performance and more to improve NWP forecasts

Our aspiration

Provide a truly integrated digital understanding of our earth environment that can evolve quickly to meet changing user expectations by leveraging our own capabilities and partnerships

NESDIS Reimagined

Pillars of NESDIS Observing System Implementation

Integrated, Adaptable and Affordable: Orbits, Instruments & Systems

GEO

Continuous real-time observations supporting warnings and watches of severe weather and hour-by-hour changes. High-inclination orbits to observe northern latitude & polar regions.

LEO

Miniaturized instruments on small, affordable and proliferated satellites and partner data improving forecasts through better and additional data. Better precipitation forecasts, wave height predictions, ocean currents, and more.

Space Weather

Reliably monitoring Coronal Mass Ejections from L1, GEO and LEO can protect the nation's valuable, vulnerable infrastructure. New capabilities at L5 and HEO can provide additional insight and improve forecasts.

Common Ground Services

Secure ingest of data in different formats from different partners requires a flexible, scalable platform. Common Services approach integrates Cloud, AI and machine-learning capabilities to verify, calibrate and fuse data into new and better products and services.

We will set out a path for NESDIS to use the opportunities provided in this changing landscape and continue to lead the field of environmental observation. This will be done by prioritizing five strategic objectives

NESDIS Reimagined

GEO & Space Weather

1

Advance observational leadership in geostationary and extended orbits

LEO

2

Evolve LEO architecture to enterprise system of systems that exploits and deploys new observational capabilities

Common Ground Services

3

Develop agile, scalable ground capability to improve efficiency of service deliverables and ingest of data from all sources

4 

Provide consistent ongoing enterprise-wide user engagement to ensure timely response to user needs

5 

Deliver integrated program development to provide a suite of products and services

Presented at Dec 2019 CESAS Briefing

Future GEO-XO Builds on NSOSA Findings

GEO-XO will provide:

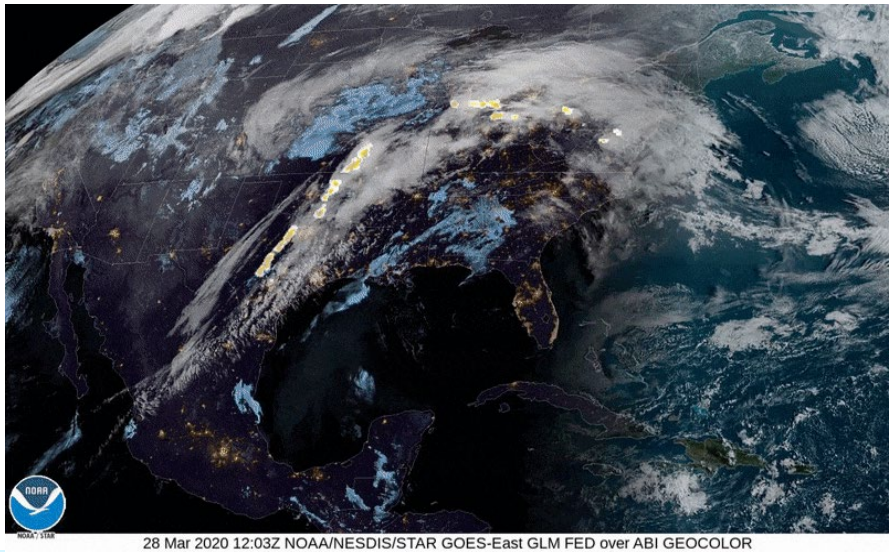
- Continued critical real-time imagery of extreme weather
- Currently unmeasured Arctic data, supporting emerging economic activity
- New data to revolutionize weather forecast models
- Accurate, timely and high-reliability warning of geomagnetic storm events

Analyzing concepts recommended by NSOSA:

- Spacecraft in either GEO or Tundra (over the Arctic) based on need
- Space weather satellites rideshare to GEO or L1
- Hosting instruments on commercial satellites, partner instruments on NOAA satellites

Budget Activities:

- FY20 budget funds GEO-XO concept analyses within SAE Subactivity
- FY21 requests funds to initiate GEO-XO Phase A within new GEO Subactivity



28 Mar 2020 12:03Z NOAA/NESDIS/STAR GOES-East GLM FED over ABI GEOCOLOR

GEO-XO Industry Concept Analyses

From the BAA, FY20 funds are being used to partner with industry for options to **replenish GOES-R data by 2030:**

Instruments

- Regional, real-time weather imagery
- Space weather data
- High latitude observations – highly elliptical orbits (Tundra) for Arctic observations
- Lightning mapping; hyperspectral sounding to support

Implementation solutions

- Standard satellite bus, including GEO/Tundra shared
- Hosting services, for NOAA instruments on others' platforms and for partners to fly on NOAA satellites
- Small satellites for space weather instruments
- Commercial data and services

2020: Complete pre-Phase A studies, ready for detailed trades
2021: Phase A start, focused industry design trades

Future LEO Builds on NSOSA Findings

Future LEO constellation to provide:

- Replenish critical sounding data to prevent gap in capability from loss of DMSP and POES
- Never-before-measured wind data with highest potential for improving weather forecasts
- Continuity of other measurements made today by JPSS and NASA satellites

Analyzing concepts recommended by NSOSA:

- 3-5 small satellites in 2-3 orbits to provide sounding data, launched every 3 years
- Purchasing commercial radio occultation data to augment RO data from NOAA satellites
- Additional small to medium satellites needed by early 2030s to observe 3D winds, ocean surface vector winds, precipitation data, and low-light imagery

Budget activities:

- FY20 budget provides $2.3M for Joint Venture within the SAE Subactivity
  - Applying those Joint Venture funds to Small Sounder Satellite design trades
- FY21 request continues Joint Venture funding to assess design options for data types beyond soundings

SounderSat Industry Concept Analyses

Commercial sector advances are most promising in LEO: affordable, high-value sounding instruments, rapidly-developed small spacecraft and frequent launch opportunities.

Sounding data is critical to Numerical Weather Prediction models. NOAA will lose sounding data from DoD's DMSP and older NOAA POES satellites beginning in the early 2020s.

From the BAA, NESDIS is pursuing industry contracts for best design options to begin demonstration flights to **augment JPSS by mid-2020s**:

- Sounding Instruments (microwave, infrared, radio occultation)
- New acquisition and observing system concepts
  - Commercial services
  - Multi-orbit coverage
  - Common satellite bus for flexibility in instruments flown
  - Rapid launch cadence
  - Demonstration missions
  - Risk tolerance and observing system risk management

2020: Initial pre-Phase A studies

2021: Complete pre-Phase A begin focused industry designs and collaborations

Commercial Partnerships

NESDIS has released a number of Requests for Information (RFI) and Requests for Proposals (RFP), and regular engagements.

Broad Agency Announcements (BAA): In October 2019, NESDIS released of a pair of Broad Agency Announcements (BAA) to engage the community in producing new concepts for instruments, spacecraft, business models, and mission elements in geostationary and extended orbits, and LEO small sounder satellites.

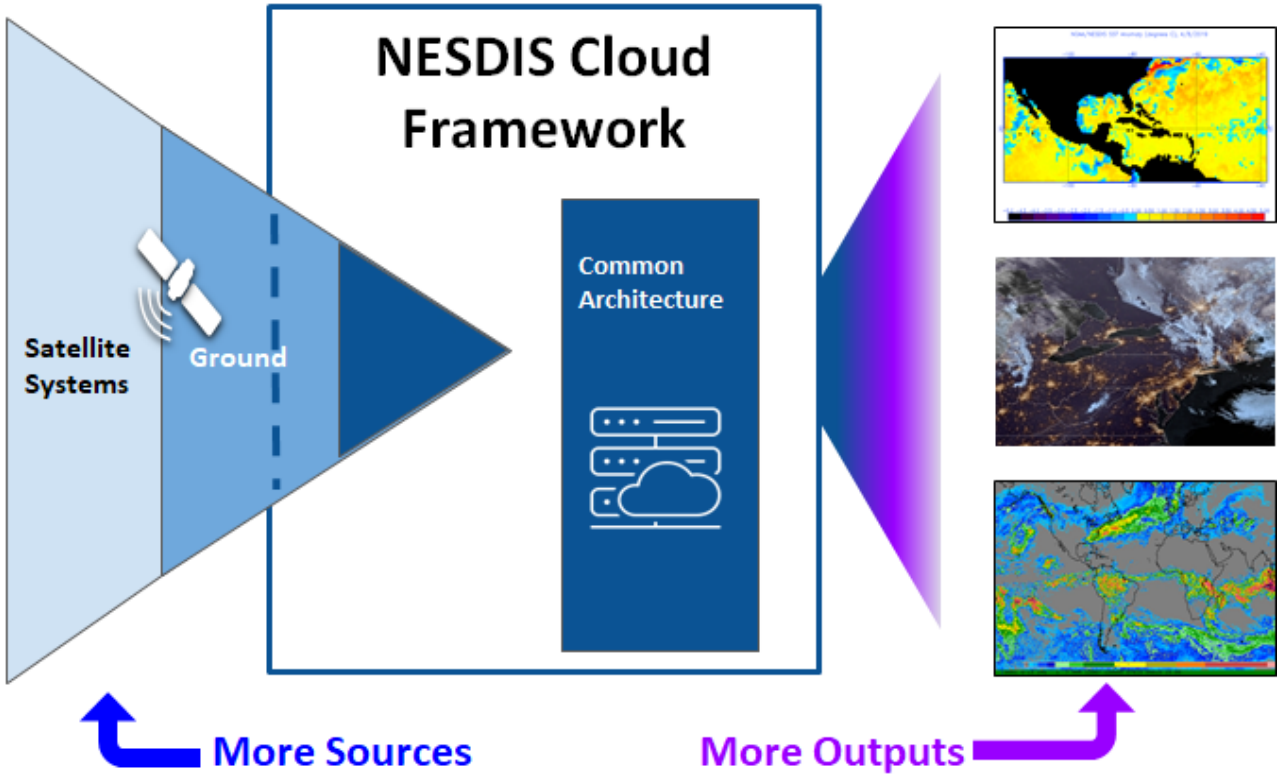
Commercial Weather Data Pilot (CWDP): In Fall 2019, CWDP Round 2 data delivery period was completed. Data evaluation is ongoing and to be completed by Q2 FY 2020.

Commercial Weather Data: In 2020, NESDIS will pursue the first operational commercial Radio Occultation (RO) data purchase.

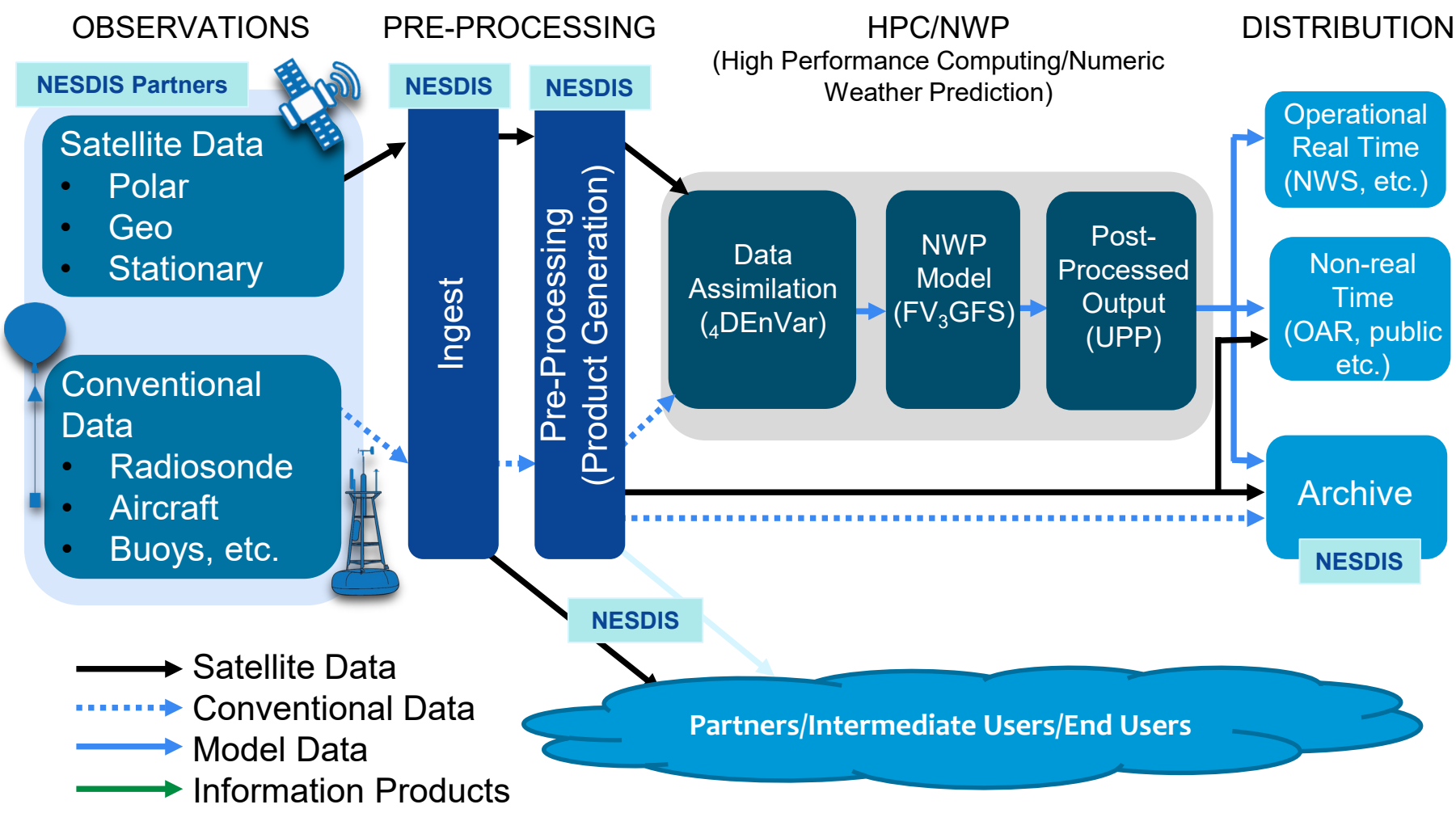
Commercial Partnerships

Actual BAA contracts placeholder

Looking Toward NOAA's Data and Information Services in the Cloud



End-to-End Product and Data Management – Synergies Across NOAA



Benefits of the NESDIS Cloud Framework Architecture

- **Secure** – FISMA compliant FedRAMP Moderate cloud services
- **Fault-Tolerant** – redundant and highly available services lead to robust, fault- tolerant applications
- **Scalable** – capacity to accommodate all current and future workloads
- **Data Agnostic** – enable any data type and workflow within the framework
- **Decoupled** – services are independent of each other and are interchangeable
- **Cloud Agnostic** – workloads and services run in **any cloud service provider**
- **Resources On-Demand** – rapid provisioning of cloud framework services based on business needs
- **Agile** – support agile processes with DevOps

All these apply to our operations within the Big Data Project as well

IT and Cloud Computing Service Transitions

Feasibility Areas	Description	Status
Security in the Commercial Cloud	Develop the NESDIS methodology and processes for how to securely operate in a commercial cloud computing environment	Start: Q2 FY 19 **Status: Complete**
Data Ingest, Catalog, and Storage	Demonstrate that common data ingest, cataloging, and storage capabilities are feasible in the commercial cloud for current NESDIS business functions	Start: Q2 FY 19 Status: On Schedule
Product Generation and Science Development	Demonstrate an optimized methodology for product generation and algorithm development in the commercial cloud while meeting the JPSS and GOES performance requirements	Start: Q2 FY 19 Status: On Schedule
Data Dissemination and Access	Demonstrate common data distribution approaches and data visualization tools to enhance collaboration via a commercial cloud environment	Start: Q2 FY 19 Status: On Schedule

Recent Accomplishments

- *Demonstrate near-time processing of Himawari-8 (H-8) data Product Generation (Dec 2020)*
- *Transitioned to operations Secure Ingest of data into the cloud (OSIS) (March 2020)*

Upcoming Major Milestones

- *Test near-real time dissemination of H-8 data to the operational distribution system (Q2 FY 2020)*
- *Distribution of NESDIS and NOAA data sets through 10 year contract with Big Data Project (w/AWS, Azure, Google)*

NOAA Big Data Project

- In late 2019 NOAA signed a contract with AWS, Google Cloud, and Microsoft to host NOAA data and provide access to the public at no cost. 2 year IDIQ Contract, + (4) - 2 year option periods
- Open data/no charge for egress/charge for services and products built on data. Partners store data and provide access for free.
- NOAA Allocation (data determined by NOAA) of NLT 5 PB of storage per contract
- The partnership helps NOAA meet its commitments to share its wealth of environmental data with the public.
- The partnership opens up the potential for new applications, and new areas of research by allowing easy access of the data to the academic community, federal partners, and the commercial sector.
- NOAA is working with the cloud providers to maximize the amount of data that it can make available to the public.

FY21 Initiative: Data-source Agnostic Common Services

- Allows NOAA to utilize data and observations from an increasingly capable and diverse array of partner and commercial systems in an efficient manner
- Uses a public cloud architecture to increase end-to-end efficiencies through a more flexible and scalable infrastructure; enables advanced processing capabilities such as AI
- Provides for the following common services:
  - Secure ingest of partner/commercial data
  - Data and information product generation
  - Initial dissemination to select user communities
  - Permanent archive and stewardship of NOAA's mission data
- While DACS focuses on non-NOAA data; it must be managed together with transition of legacy product processing and other new initiatives

FY 2021

- Develop cloud enabled products for new data sources (e.g., Himawari 8, ScatSAT, Sentinel 1, Jason CS)
- Expand the Operational Secure Ingest (in the cloud) for the above sources
- Architect a cloud framework for full end-to-end data management and production functions
- Continue enterprise product transition from existing (legacy) sources to the common cloud framework

Opportunities with a Global Integrated Observing System: Now and Future

	Today	2025	2030
Observations	GOES-16, -17 GOES-NOP PWS POES DMSP COSMIC-2 Metop-A/B/C Meteosat-10 Himawari-8 Acoustic ECS Jason-3 DSCOVR ACE SOHO Sentinel-1/3	GOES-17, -18 PWS COSMIC-2 Metop-SG MTG-I, -S GOES-IO SWFO Sounder µsats Commercial RO Himawari-9 GOCI Acoustic ECS Sentinel-1/3/6 PACE NISAR SWOT TEMPO USV, UAS	GOES-18, -19 PWS COSMIC-3 Metop-SG MTG-I, -S GOES-IO SpWx-new SpWx-L5 Sounder µsats Commercial RO Geo Hyper Himawari-10 GOCI Acoustic ECS Sentinel-1/3/6/x ACCD 3D Winds Tundra Citizen Science USV, UAS
Ground Systems	Harris Raytheon Legacy OSPO CLASS Cloud Pilots	**Integrated OSPO +** Cloud dissemination Cloud processing CLASS 2.0	**Integrated OSPO/Cloud +** Sat-Sat communication 3rd party Command & Control
Products & Services	Weather, Climate, Severe Events (W/C/SE)	**W/C/SE +** Water quality Ocean HAB Genomics Coastal zone	**All Previous +** CO2/CH4 Monitoring Air Quality Ecosystem Forecasting

Hot Issues for NESDIS

- Funding the next generation satellite observing and ground systems with investments that will deliver space assets 2030 to 2050

- Maintaining and growing commercial and international partnerships to deliver a resilient and high-performing observing system

- Refreshing our Information Technology to exploit existing and emerging technology trends

NOAA

Satellite and Information Service

Thank you.