

NOAA Okeanos Ocean Color System Development Update in Support to SNPP-VIIRS Products Processing

Dr. Banghua Yan

NOAA Ocean Color Operational Product Area Lead

NOAA/NESDIS/OSPO/SPSD/Satellite Products Branch

OUTLINE

- Current Okeanos Ocean Color Operational Production System (OPS)
- New Okeanos Ocean Color System Development for VIIRS OC Products
- SNPP-VIIRS MSL12 OC Products Processing Update from New Okeanos

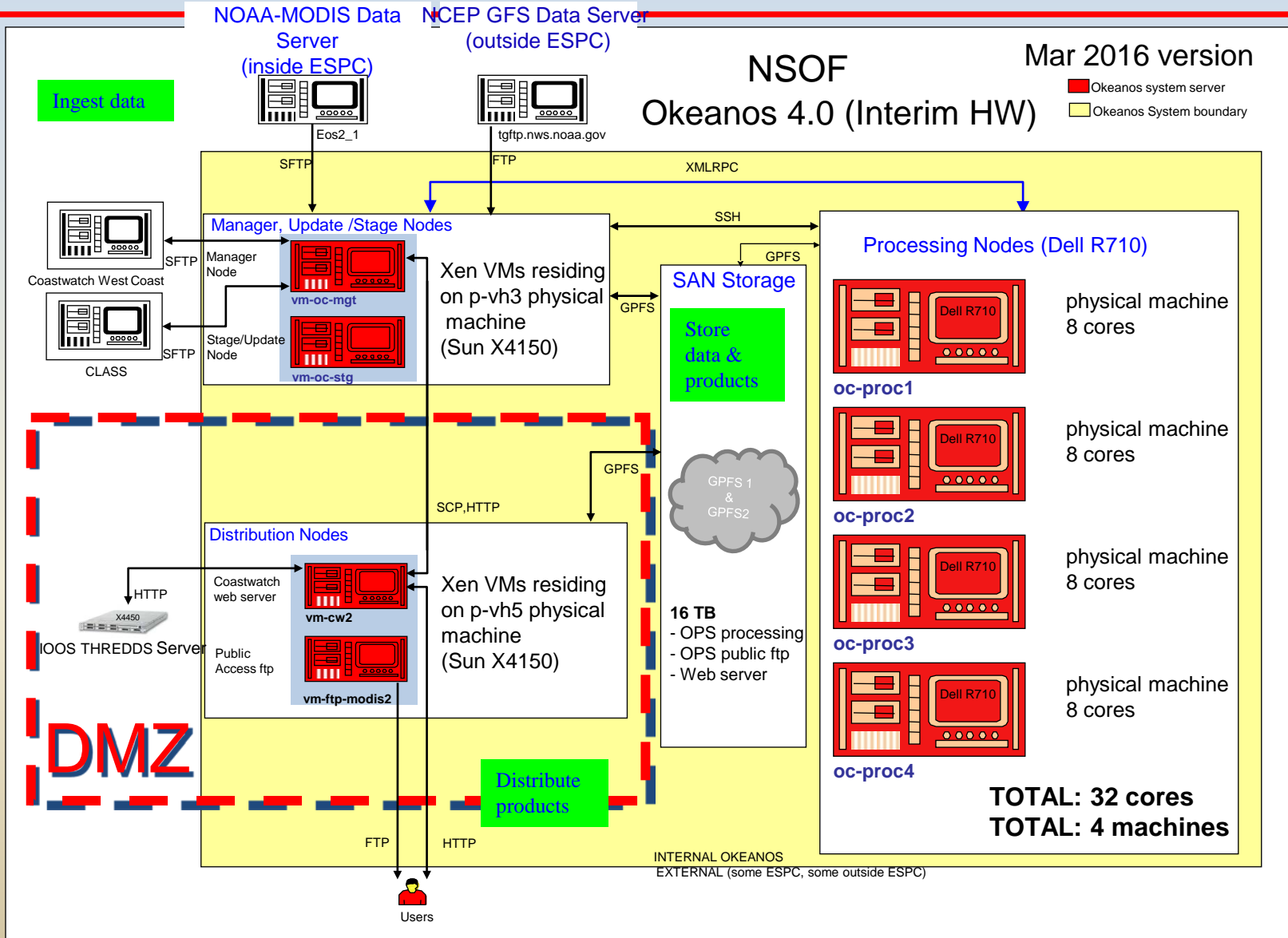
OSPO Ocean Color Products Team

- Lead: Banghua Yan and Antonio Irving
- Members:
 - **Okeanos System Design and Maintenance:** Ian Simpson (primary), Dan Jacob, and Edmond Rodriguez
 - **Okeanos System Building and Configuration:** Okechukwu Nwosu (primary), Ian Simpson, Dewayne Countiss, Michael O Johnson, and Ed Ladd
 - **Okeanos QA Monitoring Tool Development:** Fengying Sun (primary), Dan Jacob, XiaoChuan Huang, and Shen Zhao

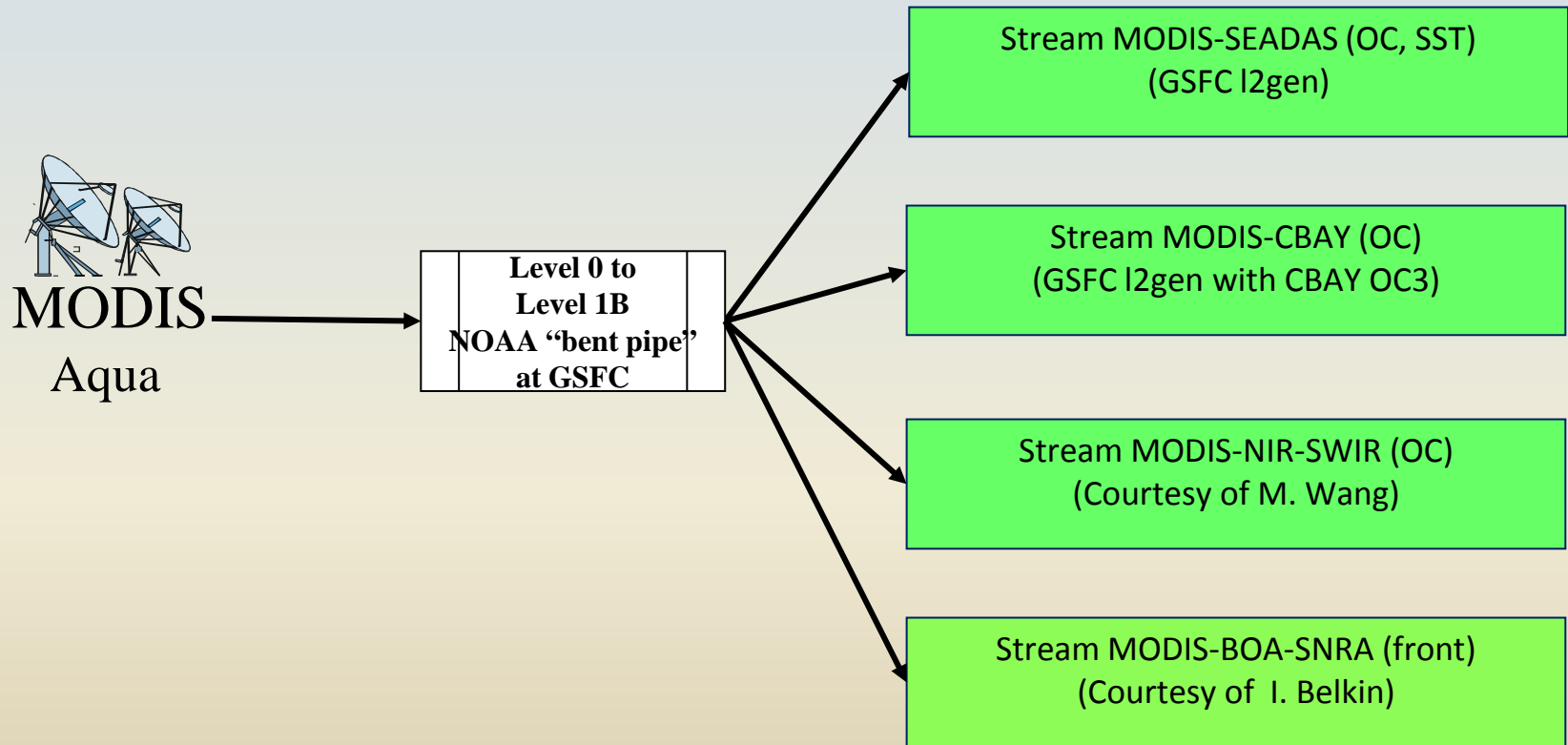
Okeanos Ocean Color System Concept

- The Okeanos system is a flexible, expandable linux-based system capable of processing multiple satellite streams of ocean color products.
- CoastWatch Automatic Processing Software (CWAPS)
(developed by STAR CoastWatch team)
 - File Ingest module
 - CWAPS module
 - Process Manager and Control Module
 - Disk Space Control Module
 - Merge Module
 - Publication Module I (ftp distribution)
 - Publication Module II

Current Okeanos OPS: IT Architecture



MODIS/Aqua Ocean Color Product Processing Streams



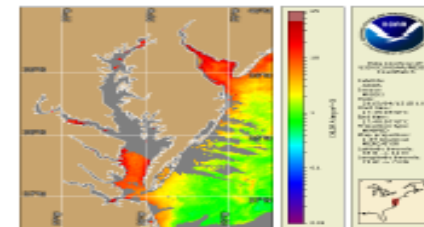
(Courtesy of Phillip Keegstra)

Operational Ocean Color Products from MODIS/Aqua

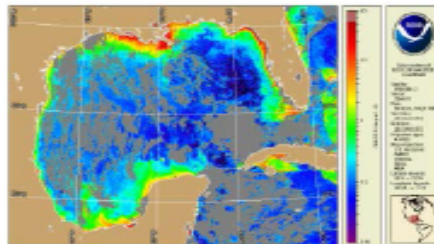
❑ NOAA Okeanos Ocean Color Operational Products

- **Satellites:** Moderate Resolution Imaging Spectroradiometer (MODIS)
- **Instruments:** AQUA (Primary) and TERRA (Backup)
- **Product Specifications**
 - **Products:** daily merged chlorophyll concentration (Chl-a) and remote sensing reflectance (Rrs667); bi-monthly (monthly) mean Chl-a and Rrs667; daily anomaly of Chl-a and Rrs667; daily Chl-a fronts and K_d490
 - **Format:** GeoTiff, PNG, NetCDF4
 - **Coverage:** Northeast (NE), Southeast (SE), Gulf of Mexico (GOM), Caribbean (CB), West Coast (WC), Alaska (AK), East Tropical Pacific (EP), Great Lakes (GL), Hawaii (HI), Equatorial Atlantic (EA), North Atlantic (NA) and Pacific Basin (PB), Chesapeake Bay (CY)
 - **Format:** HDF 4.1, GeoTiff, PNG, netCDF
 - **Horizontal Resolution:** 1 km
 - **Timeliness:** 12 hours
 - **Algorithms:** NASA NIR (SCW), NOAA NIR-SWIR (WCW), and Chlorophyll Frontal Algorithms (BOA)
- **Data Access:** <ftp://cw-okeanos.noaa.gov/pub/modis/>

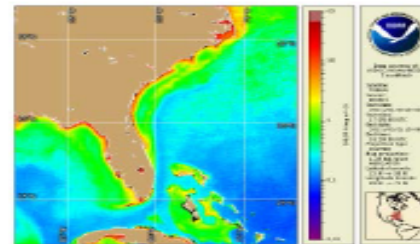
Examples of products are shown in Figures 2(a) - (f).



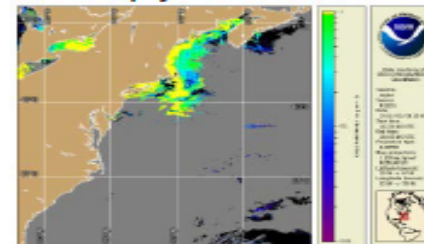
2(c) Chesapeake Bay Daily Chlorophyll Concentration



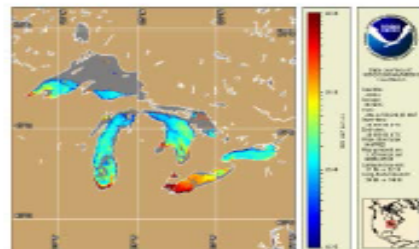
2(a) Daily Chlorophyll Concentration



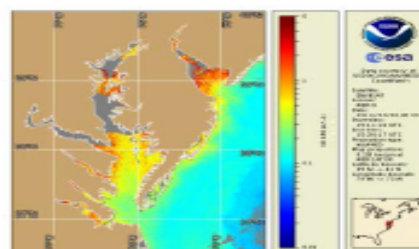
2(b) Bimonthly-mean Chlorophyll Concentration



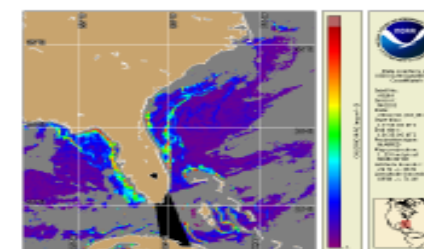
2(d) New algal growth (Positive Chlorophyll Concentration Anomaly)



2(e) Suspended Sediment Proxy (Remote Sensing Reflectance at 667 nm)



2(f) Water Turbidity (Diffuse Attenuation Coefficient at 490 nm)



2(g) Chlorophyll Front (Magnitude)

**Development of New Okeanos Parallel Test
System (PTS) and Operational Production
System (OPS)
in Support to SNPP-VIIRS Ocean Color
Products Processing**

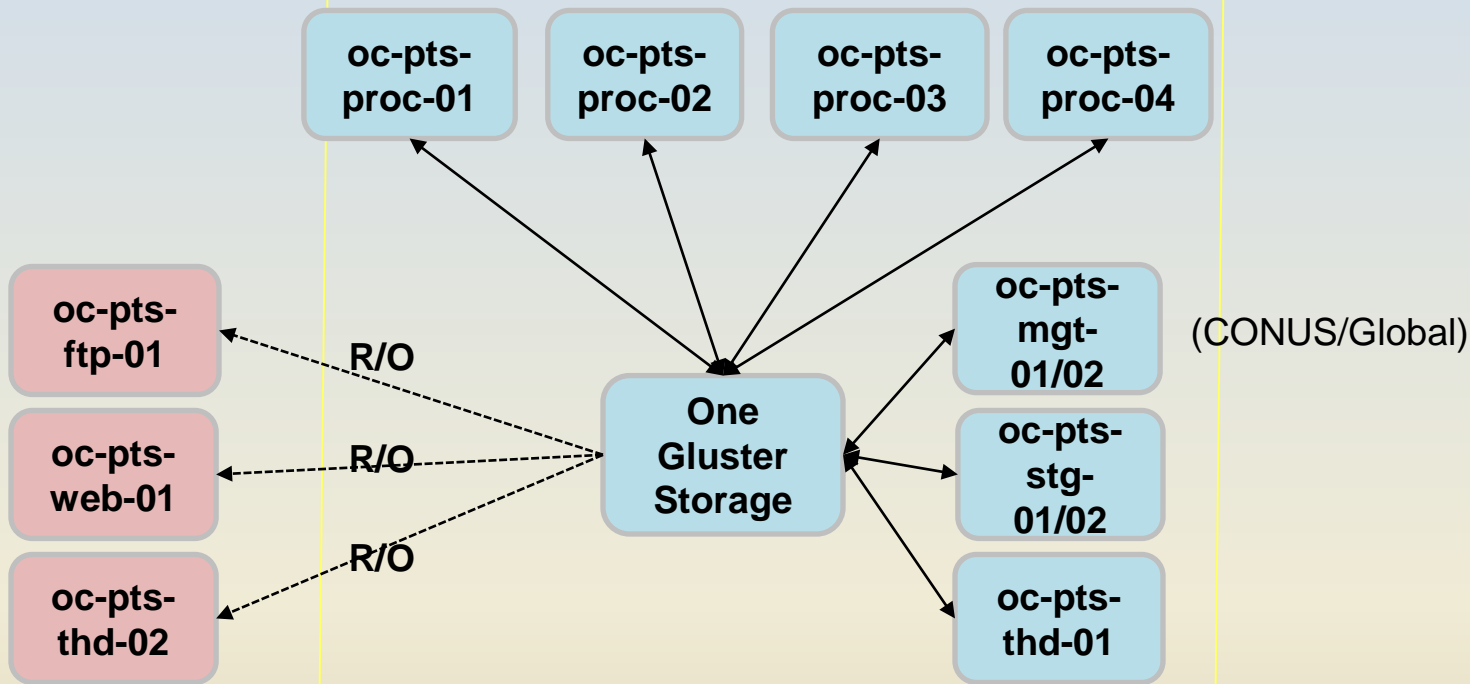
New Okeanos PTS in Support to SNPP-VIIRS OC Products Processing: IT Architecture

DMZ

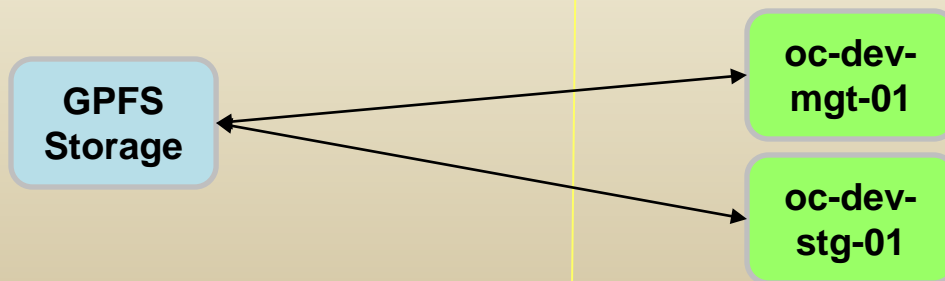
Prod Zone

Dev Zone

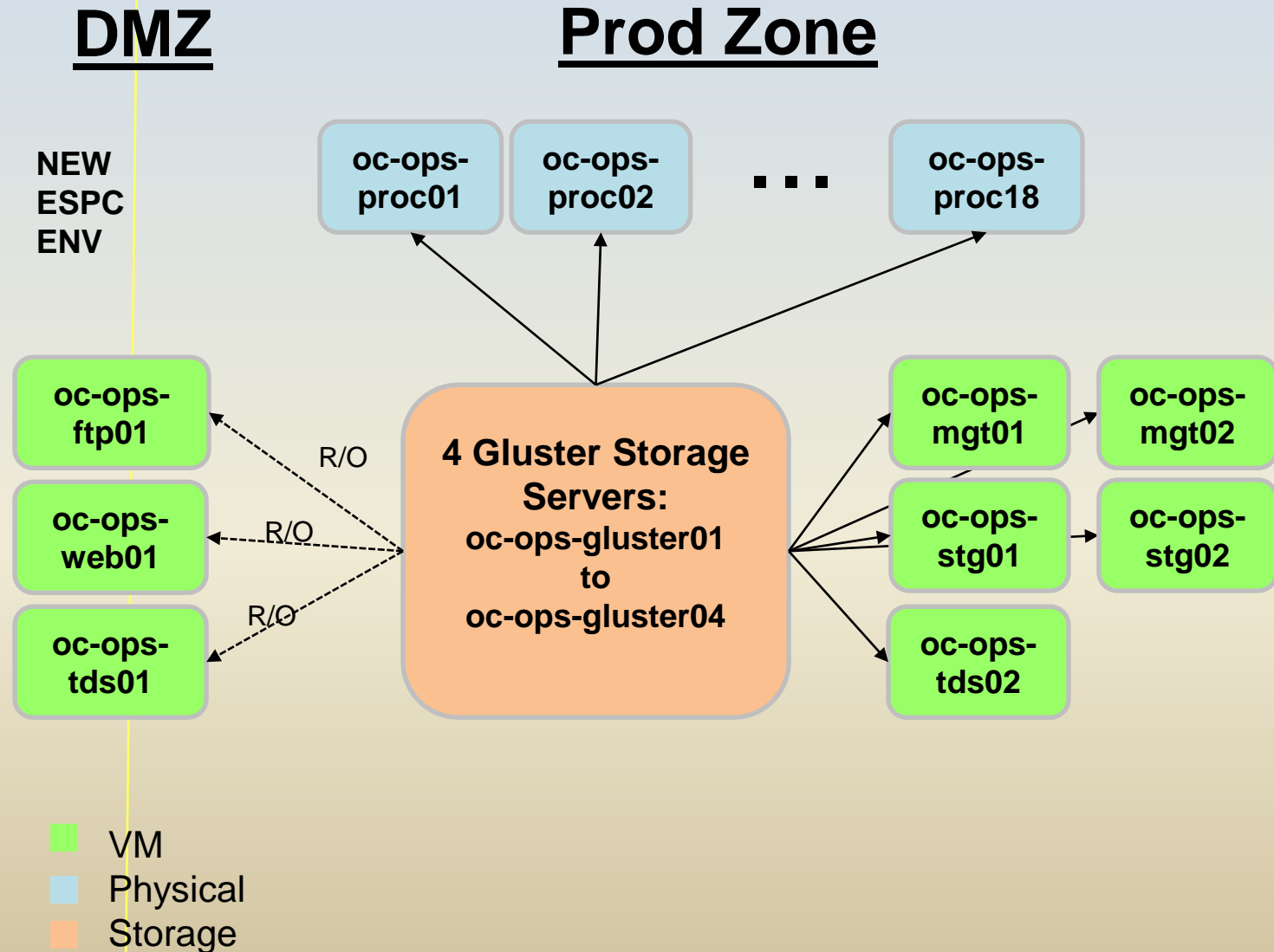
NEW
ESPC
ENV



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New Okeanos OPS in Support to SNPP-VIIRS OC Products Processing: IT Architecture





New OKEANOS Systems Integrated into the ESPC Environment

ESPC Physical Operating Environment

ESPC VMware Operating Environment

10 CHOPS Processing HW Systems

- For distributed batch tasks
- Jobs allocated via Tidal & Condor scheduler

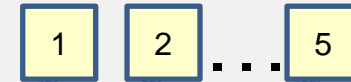
N Okeanos Processor Node HW Systems

- New PTS: N= 4 processors
- New OPS: N= 18 processors



5 VMware HW Systems:

- Non-Okeanos applications
- Okeanos applications: 8 VMs
 - 2 Manager VM
 - 2 Update/Stage VM
 - 1 ftp server VM
 - 1 web server VM
 - 2 Thredds VMs



ESPC Switched Network



4 CHOPS + 4 Okeanos

- NG OPS adds 4 nodes to CHOPS storage pool
- Not separate storage: allocated quota from the pool
- Increases overall CHOPS data storage throughput

Benefits of New Okeanos

- Low Cost : system development, maintenance, integration, due to more than eight years' legacy resources in Okeanos
- Fast integration and migration: early availability of NOAA ocean color NUPS
- Easy adaptation to a different satellite stream (e.g., J1/J2 VIIRS, and Sentinel-3)
- Reliable Product Assurance Monitoring Tool

ESPC Shared Data Storage

SNPP VIIRS Operational Ocean Color Products Category Briefing

- Global
 - Chlorophyll (granule, daily merge per sector, 7-day rolling merge per sector, and global 4km)
 - K_d490 (granule, daily merge per sector, 7-day rolling merge per sector and global 4km)
 - K_d PAR (L2 Granule, daily merge per sector, 7-day rolling merge per sector and global 4km)
 - TOA True Color (L2 granule)
- CONUS (8 CONUS regions, 750 m resolution)
 - Chlorophyll (granule, daily merge per CW region, and bimonthly mean per CW region)
 - Remote Sensing Reflectance (672 nm) (granule and daily merge per CW region)
 - TOA True Color (daily merge per CW region)
 - Chlorophyll anomaly (granule and daily merge per CW region)
 - Chlorophyll frontal products (granule and daily merge per CW region)

Upcoming Operational S-NPP Ocean Color NOAA Unique Products: CONUS Products

					Product Type and Number		
Date	Product Delivery Tracking Name	Environmental Observational Parameters	Satellites	Sensors	N #	T #	Comments
FY16	Ocean Color S-NPP NUPS	True Color	S-NPP	VIIRS	1	31	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas: 8 CW Regions (CONUS) Resolutions: 750 m Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	Chlorophyl-a including Harmful Algal Bloom Products (Daily Merge, Daily Anomaly, 61-Day Merge)	S-NPP	VIIRS	3	93 (3x8x4, excluding New)	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas: 8 CW Regions (CONUS) Resolutions: 750 m Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	Chlorophyll Frontal	S-NPP	VIIRS	1	19	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas: 5 Sectors (covering 9 CW regions) Resolutions: 750 m Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	K490 (7-day Merge)	S-NPP	VIIRS	1	31	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas: 8 CW Regions (CONUS) Resolutions: 750 m Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	Kpar (7-day Merge)	S-NPP	VIIRS	1	31	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas: 8 CW Regions (CONUS) Resolutions: 750 m Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	Rrs672 nm (Daily Merge , Anomaly and 61-Day Merge)	S-NPP	VIIRS	3	93 (3x8x4, excluding New)	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas: 8 CW Regions (CONUS) Resolutions: 750 m Distribution: Okeanos ftp/Thredds/CW Website

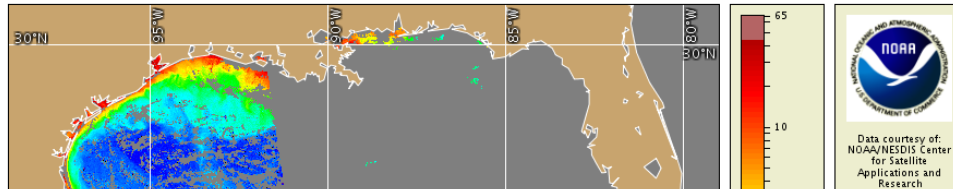
Upcoming Operational S-NPP Ocean Color NOAA Unique Products: Global Products

					Product Type and Number		
Date	Product Delivery Tracking Name	Environmental Observational Parameters	Satellites	Sensors	N #	T #	Comments
FY16	Ocean Color S-NPP NUPS	Chlorophyl-a (7-Day Merge, True Month)	S-NPP	VIIRS	2	198	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas 1 global and 24 sectors Resolutions: 4km (global) and 750 m (sector) Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	K490 (Daily Merge)	S-NPP	VIIRS	1	99	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas 1 global and 24 sectors Resolutions: 4km (global) and 750 m (sector) Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	Kpar (Daily Merge)	S-NPP	VIIRS	1	99	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas 1 global and 24 sectors Resolutions: 4km (global) and 750 m (sector) Distribution: Okeanos ftp/Thredds/CW Website
FY16	Ocean Color S-NPP NUPS	nLwns (412, 445, 488, 555, and 672 nm; 7-day Merge)	S-NPP	VIIRS	5	495 (25x5x4)	Formats: CWHDF, PNG, NetCDF4, GeoTiff Coverage areas 1 global and 24 sectors Resolutions: 4km (global) and 750 m (sector) Distribution: Okeanos ftp/Thredds/CW Website

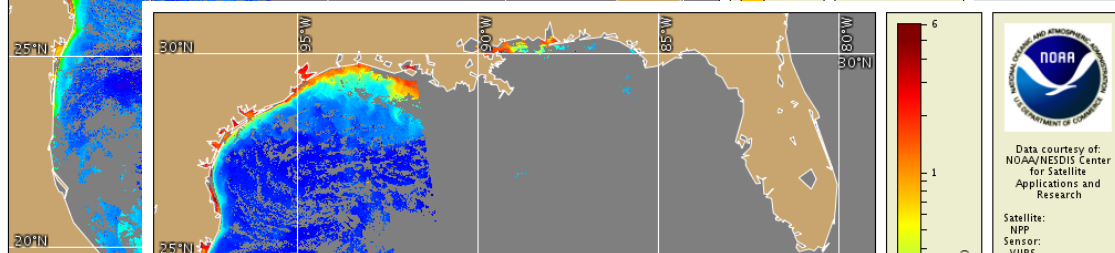
Where Are We Now?

- Completed the installation of the CWAPS-SNPP VIIRS Software Package on the new Okeanos PTS in July 2016
- Pre-operational SNPP-VIIRS OC Products are available in ftp://cw-okeanos.noaa.gov/pub/data1/VIIRS_test/ for users' test and validation
(Products are only saved one week)
- New Okeanos OPS is still in development
 - New Okeanos OPS is expected to be done in early September 2016
 - Pre-operational products from new Okeanos OPS are expected to be available in September
 - ORR of new Okeanos OPS is expected to be done in October 2016

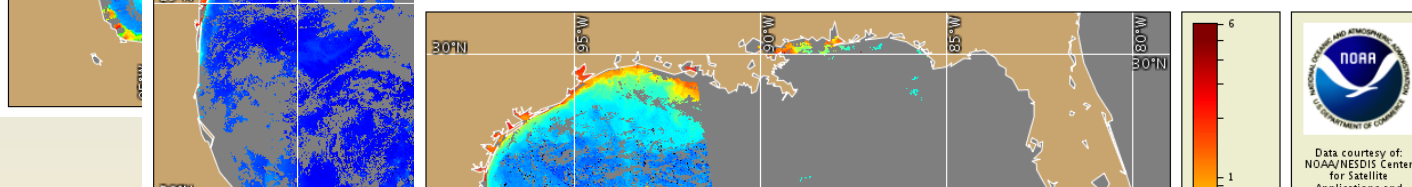
Examples of SNPP VIIRS OC Products Generated in New Okeanos PTS



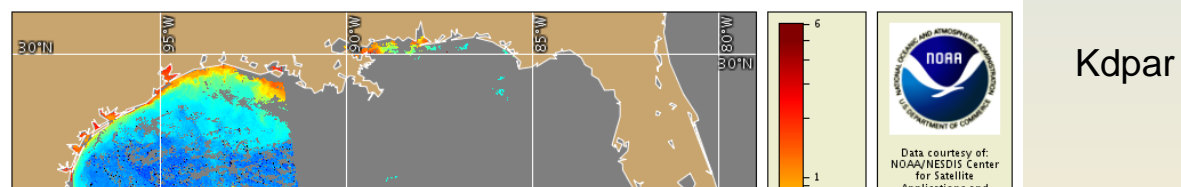
Chl-a



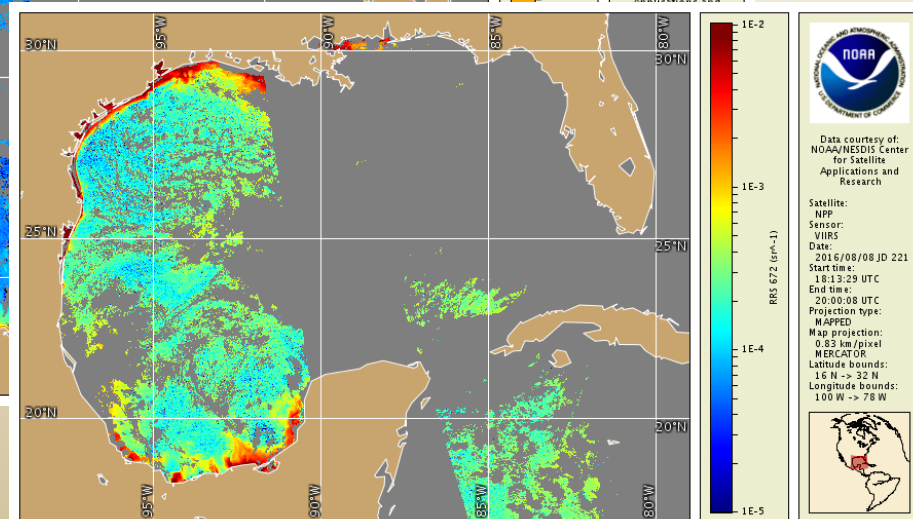
Kd490



Kdpar

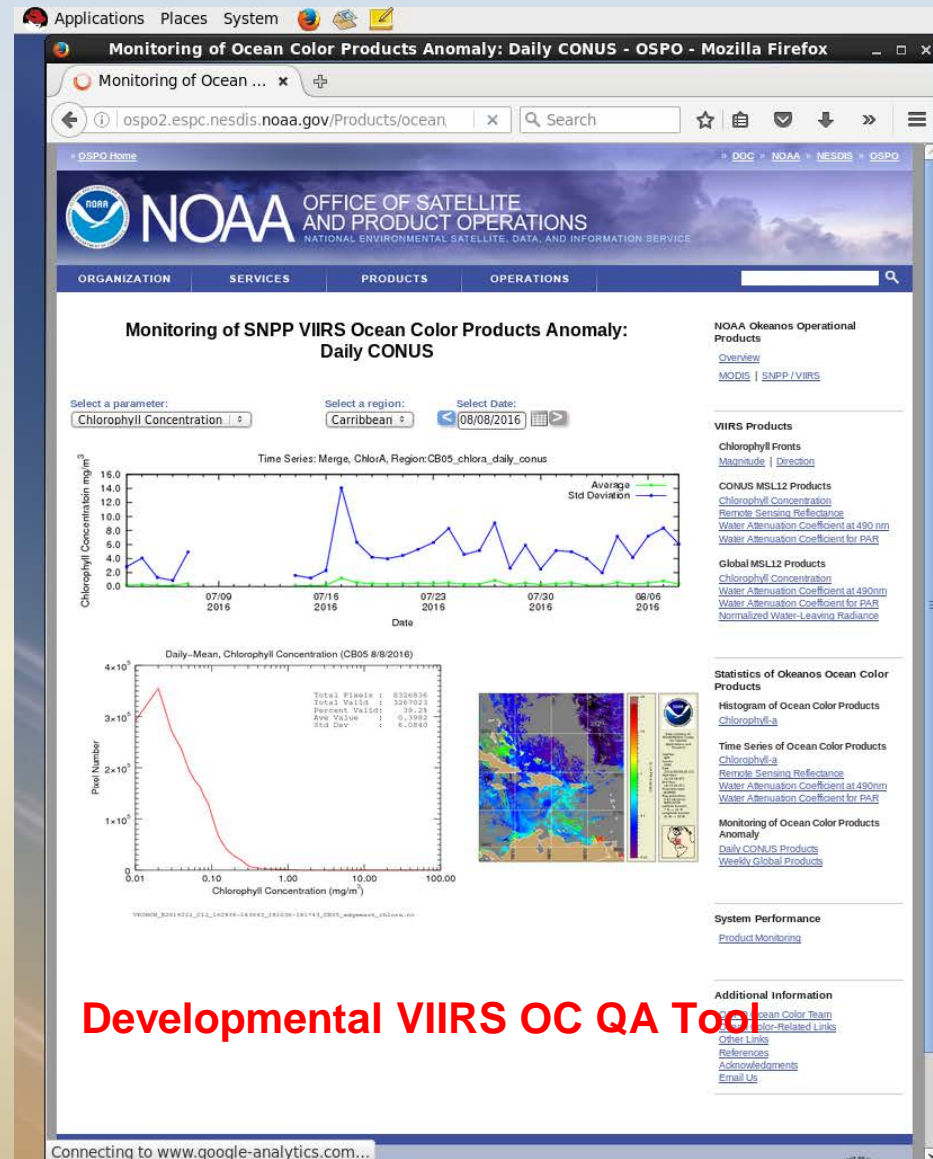


Rrs672

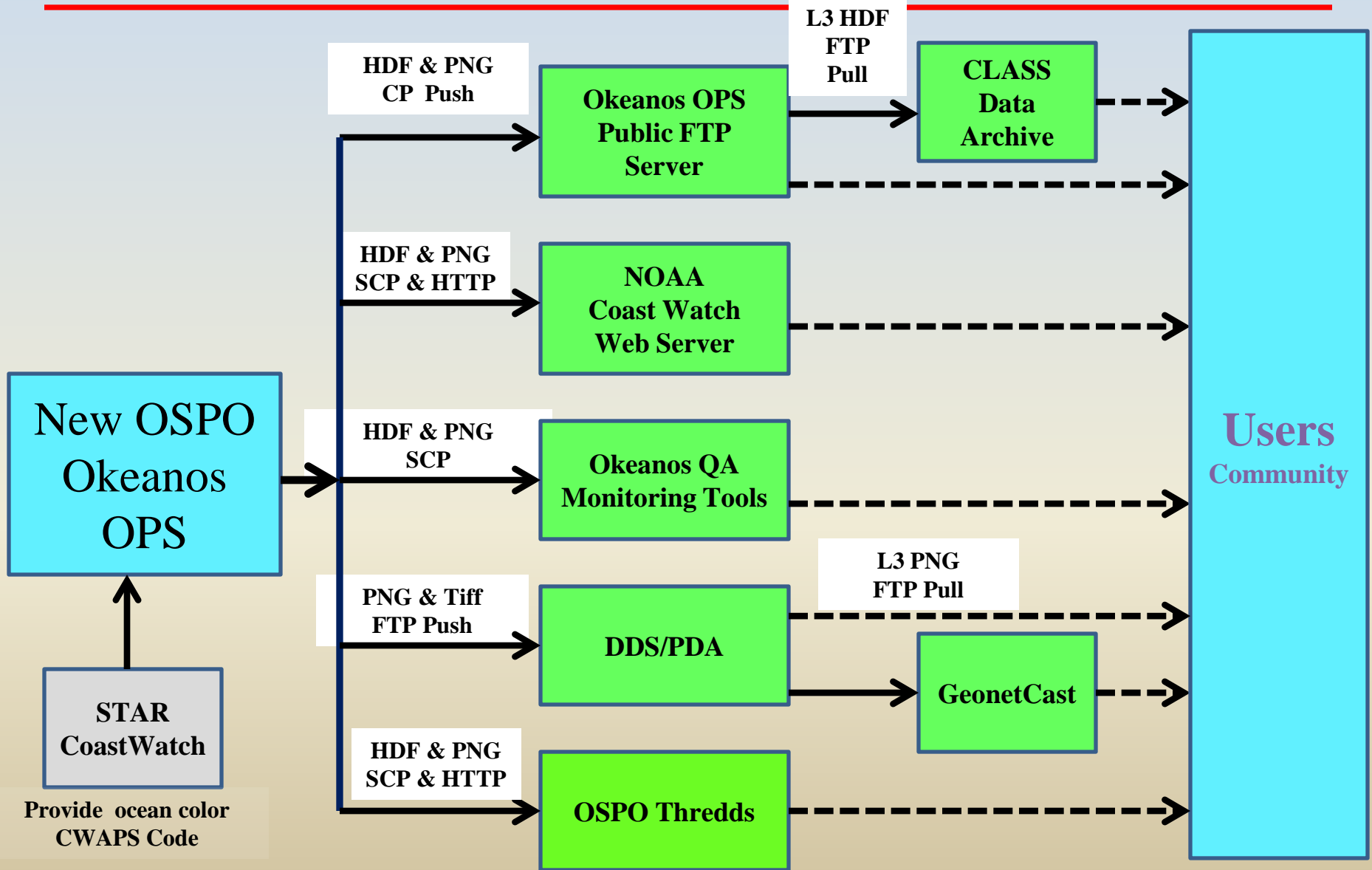


Okeanos Ocean Color Products QA Monitoring Tool Update for VIIRS Products

- Monitor the quality of SNPP VIIRS OC product imagery at L2, L3, and L4
- Monitor the quality of SNPP VIIRS products at L3 and L4 (statistics analysis)
- Identify any suspicious VIIRS OC Products and send alert emails to the system operators and PAL
- Monitor the availability of SNPP VIIRS at L3 with time
- Monitor the stability of new Okeanos OPS with time



SNPP-VIIRS Operational Ocean Color NUPS Data Dissemination Flow Chart



Distribution of NOAA MODIS/Aqua and VIIRS/SNPP Operational Ocean Color Products

- **Products Distributions**

- Okeanos ftp site (<ftp://cw-okeanos.noaa.gov/pub/data1/> subject to change)
- Okeanos Thredds Server (DAR submission is required from users)
- OSPO Ocean Color Product QA Monitoring Web Service
(<http://www.ospo.noaa.gov/Products/ocean/color/index.html>)
- STAR CoastWatch Web Server
- OSPO DDS/PDA (DAR submission is required from users)
- NOAA/CLASS

- **Schedule for VIIRS/SNPP OC Products Distribution**

- July 2016: Pre-operational products
- Oct 2016: operational products