Development of NODC Satellite Data Quality Monitoring System (DQMS)

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1. Introduction: Background and Objective
2. Implementation of Satellite Data Quality monitoring at NODC
3. Future Perspective
In 2008, NODC launched this work in order to provide capabilities to monitor quality of Jason-2 products based on the concept of Rich Inventory (RI), which is originally developed in NGDC for supporting data management in CLASS/NOAA.

The RI principle concept is to extract existing metadata from granule headers and calculate descriptive statistics for the parameters in the files, load the data to store them in a database, and make it available as part of a data discovery system. Data anomalies are also monitored and reported to interested parties (data archivist, producers and users).
1. To build a software system that will enable NODC data archive managers to view the live satellite data ingest in near real-time, and to see if the descriptive data quality statistics in the selected parameters fall out of acceptable ranges.

   QA statistics: observation number, minimum, maximum, mean, media, and standard deviation .... after applying the quality and mask flags in the calculation.

1. To develop friendly interfaces for public users to access the data quality information (NetCDF-formatted data or images of time series) in near real time through OpeNDAP, THREDDS and Live Access Server (LAS), or a direct access to pre-generated images.

2. To build a notification system for data archivist, producer and users and provide them alert information when a bad file is identified according to the defined thresholds.
Why do we need a DQMS?

Mean statistics of radiometer water vapor in each pass (ascending or descending orbit) from Jason-1 satellite-observed Interim Geophysical Data Records (IGDRs).
Why Do we need a DQM?

Monitored change of data values with the change of product versions.

Statistics of sea surface height in each pass (an ascending or descending obit) from Jason-2 satellite-observed IGDR data.
Implementation of Satellite Data Quality monitoring at NODC
NODC Data Quality Monitoring Flow Chart

Extract granule metadata data and quality/mask flags, calculate QA statistics in selected parameters in each data file, and create binned data.

Packaging relevant granule metadata with the statistics time series data and merge them into NetCDF file.

Access the data through OPeNDAP, TDS, http and ftp.

Visualize the data on Live Access Server

Visualize QA statistics time series and binned data (GrADS, IDL, MATLAB), and save to PNG/GIF images

Generate quality monitoring dashboard, and check whether the QA statistics fall outside of an acceptable range.

Send notification to archivist, producer and user if a bad granule is identified

Satellite products from ESPC, NOAA and PO.DAAC, JPL
Implementation of Satellite Data Quality monitoring at NODC:

- Jason-2/3 level-2 altimetry (X-GDRs), NOAA
- Pathfinder V5.2 SST, NODC/NOAA
- Aquarius level-2 sea surface salinity (SSS), NASA
- Soil Moisture and Ocean Salinity (SMOS) mission level-2 SSS, ESA
- Sentinel-1 SAR wind products, NOAA
- Satellite-derived ocean heat content, NOAA
- Pathfinder V5.3 & V6.0 SST, NODC/NOAA
- Ocean Color Reprocess products, NOAA
- Group for High Resolution SST (GHRSSST)
NODC Jason-2 GDR Rich Inventory published on NGDC RI Database

Jason-2 GDR rich inventory webpage

Plotting and downloading
NODC Jason-2 Geophysical Data Record (GDR) and Interim GDR Data Quality Monitoring Homepage

You are here: NODC Home > Satellite Oceanography Team > NODC Jason-2 Archive > GDR/IGDR Data Quality Monitoring

Jason-2 Geophysical Data Record (GDR) and Interim GDR Data Quality Monitoring

The data quality monitoring (DQM) system developed by the satellite oceanography team at NODC is based on the concept of a Rich Inventory developed by the Enterprise Data Systems Group at the National Geophysical Data Center (NGDC). The principle concept of a Rich Inventory is to calculate statistics for selected parameters as files are received and ingested into the archive, store them in a database, and make them available to users and managers of the archive. A "granule" is the smallest data unit over which statistics are calculated - in this case, one pass (half-orbit) of the Jason-2 satellite. Thus, the DQM produces 284 statistical estimates per cycle, one for each pass.

Below are some representative statistics calculated from the selected parameters in a granule as it is ingested into NODC's archive. Parameters we monitor include sea surface height anomaly, Ku-band significant wave height, altimeter wind speed, the difference between altimeter and radiometer wind speeds, the radiometer water vapor content, and the difference between the the radiometer and model wet tropospheric corrections.

- [Click me to the Data Quality Monitoring Interface]

GDR Granule Statistics

IGDR Granule Statistics

Observations gridded to 3.0x1.0 longitude/latitude:
- Sea surface height anomaly: GDR; IGDR
- Significant wave height (Ku Band): GDR; IGDR
- Altimeter wind speed: GDR; IGDR
- Difference between radiometer wet tropospheric and model correction: GDR; IGDR
- Difference between altimeter and radiometer wind speeds: GDR; IGDR
- Radiometer water vapor content: GDR; IGDR

Quality Monitoring News

- 2012-Sep-13: The Jason-2 satellite is fully operational

http://www.nodc.noaa.gov/SatelliteData/jason/qa.html
NODC Jason-2 GDR/IGDR Data Quality Statistics published on LAS and OPeNDAP Servers

http://data.nodc.noaa.gov/las/getUI.do

http://data.nodc.noaa.gov/opendap/jason2/QA_assurance/GDRs/contents.html
NODC-binned Sea Surface Salinity from SMOS and Aquarius satellites provided by LAS

SMOS 3-day mean

Aquarius 7-day mean
Quality Monitoring on Aquarius Sea Surface Salinity level-2 products

QA Statistics for SSS (psu) in each Aquarius level-2 granule. Red line represents the results from original data while black line denotes the results after contaminated records are filtered by applying radiometer and scatterometer quality flags.

Histogram of monthly level-3 sea surface salinity difference between SMOS and Aquarius satellites, April 2012
Quality Monitoring on Pathfinder V5.2 SST

Monitored anomalous increase of hot spot events in 2011-2012 years

QA statistics in each granule of Pathfinder V5.2 daily SST for ascending orbit during 1981-2012, in unit of degree.
## Jason-2 OGDR Data Quality Monitoring

(SWH: Ku Band significant waveheight; WSPD: Altimeter wind speed; DRWTMC: Difference between radiometer wet tropospheric and model correction; DWSPD: Difference between altimeter and radiometer wind speed; RVAP: Radiometer water vapor content; SSHA: Sea surface height anomaly.)

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Future Perspective

Data quality monitoring system should:

- Provide capabilities of automatic monitoring data quality during the archive ingest process at near real time and sending out notification for the anomalies.
- Be designed and built as a common tool (from calculator, database to web-based monitoring interface).
- Provide capabilities of web-based interface search tools for the QA statistical time series. The user can specify their needs and search with criteria.
- Provide different levels of services from pure data QA monitoring to scientific evaluation and validation of satellite products with the conventional observations (for example, satellite sea surface salinity via NODC Word Ocean Database in situ data).

More work need to do:

- Development of data quality monitoring methods and tools.
- Improve user’s service and trace user’s needs.