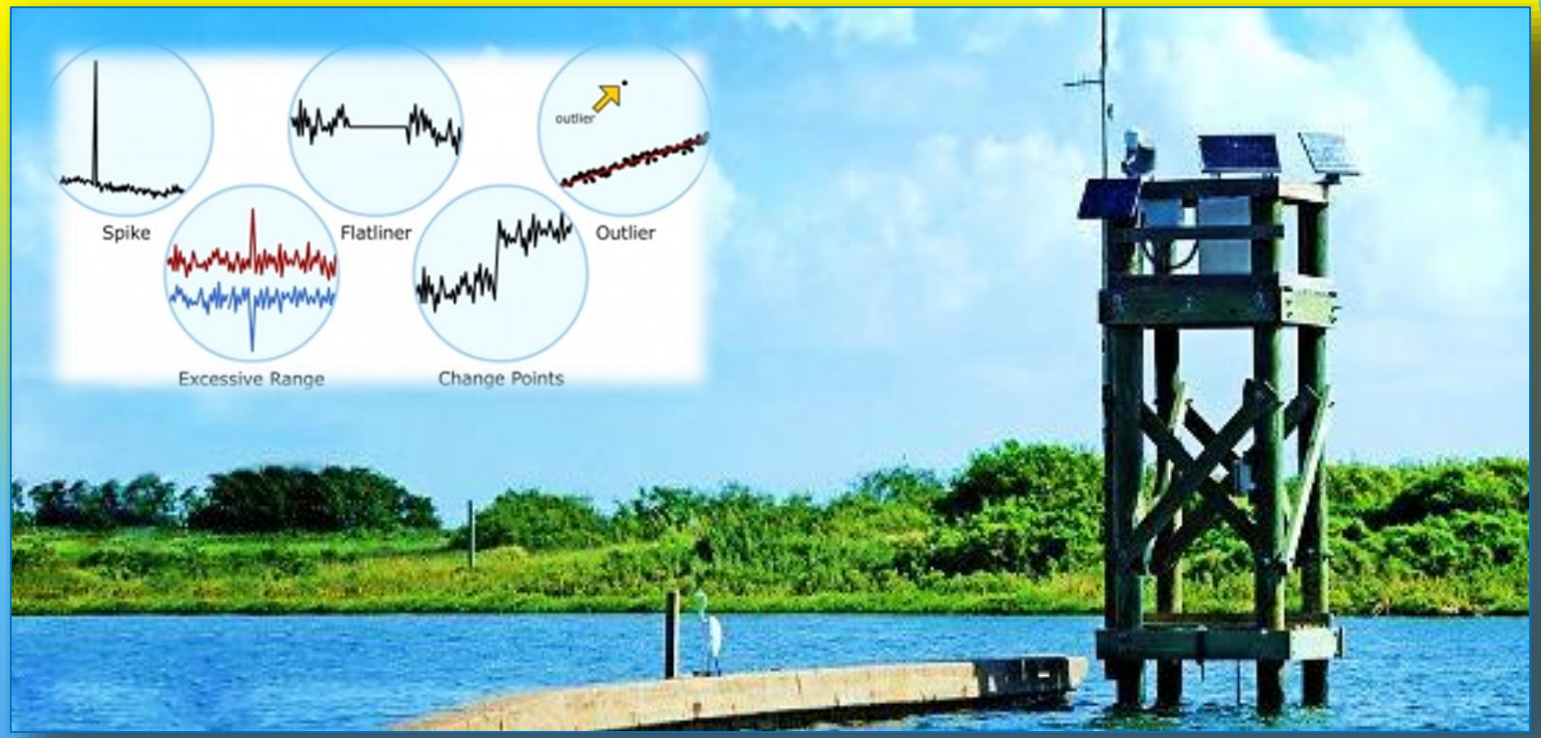
National Ocean Service
NOAA
Center for Operational Oceanographic Products & Services
CO-OPS

CO-OPS' Guide for the Quality Control of Data

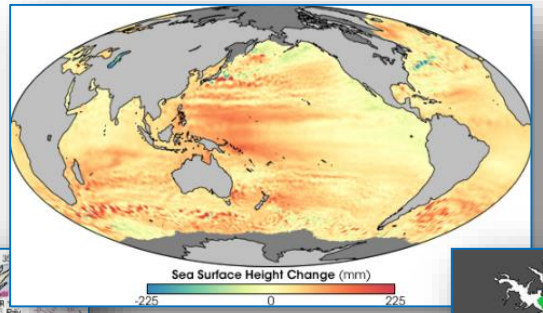


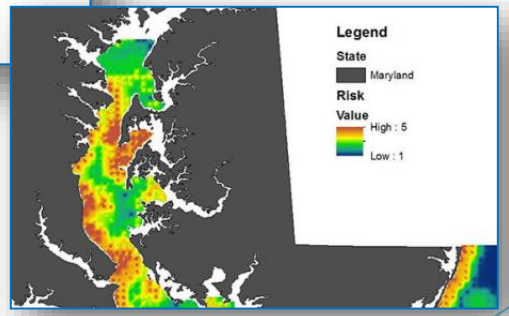
Outline

- CO-OPS & How NWLON Works
- QC Checks
  - CORMS Roles
    - CORMS Methods
      - CORMS Automated Software
        - Sensor QC Checks
          - System QC Checks

Center for Operational-Oceanographic Products & Services (CO-OPS)

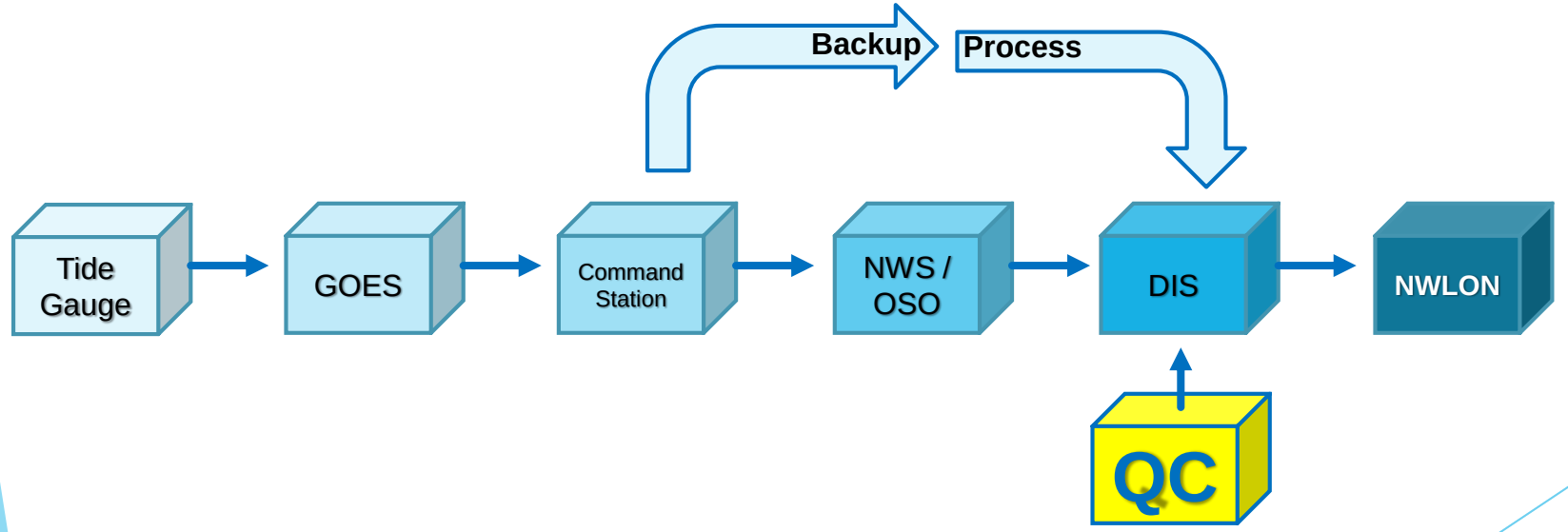
- Manages observing systems (NWLON, PORTS, NCOP, NOCMP)
- Establishes collection/processing standards (water level & currents)
- Designs new observing systems
- Performs QA / QC





Collect, Analyze, Disseminate

- Water level data are collected through our Information Systems Division.
- Data are received via internet & GOES to our command station.
- Data are ingested into our Data Ingestion System.
- Data are copied to temporary tables in our Database Management System.
- Automated software (QC) begins.



Information Files

- Information is collected from the tide gauge on hourly basis.

Station ID	Rainfal min
DCP#	Rainfall max
Platform ID	Wind spd min
Datum offset	Wind spd max
Sensor offset	Conductivity min
Orifice offset	Conductivity max
WL min	Wind gust min
WL max	Wind gust max
Air temp min	Pressure density delta
Air temp max	1° vs 2° tolerance
Dew pt min	height correction tolerance
Dew pt max	Backup gain/offset

- Having the most recent data QC'ed prior to ingestion provides a consistent level of QC for outgoing CO-OPS' products.

Quality Control Checks

Datum offset

Station ID	Rainfal min
DCP#	Rainfall max
Platform ID	Wind spd min
Datum offset	Wind spd max
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Quality Control Checks

Datum offset

Sensor offset

Station ID	Rainfal min
DCP#	Rainfall max
Platform ID	Wind spd min
Datum offset	Wind spd max
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Quality Control Checks

Datum offset

Sensor offset

Water level min/max

Station ID	Rainfal min
DCP#	Rainfall max
Platform ID	Wind spd min
Datum offset	Wind spd max
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Quality Control Checks

Datum offset

Sensor offset

Water level min/max

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Air temp min	Pressure density delta
Air temp max	1° vs 2° tolerance
Dew pt min	height correction tolerance
Dew pt max	Backup gain/offset

Height correction flag

Quality Control Checks

Datum offset

Sensor offset

Station ID	Rainfal min
DCP#	Rainfall max
Platform ID	Wind spd min
Datum offset	Wind spd max
Sensor offset	Conductivity min
Orifice offset	Conductivity max
WL min	Wind gust min
WL max	Wind gust max
Air temp min	Pressure density delta
Air temp max	1° vs 2° tolerance
Dew pt min	height correction tolerance
Dew pt max	Backup gain/offset

Water level min/max

Primary vs backup tolerance

Height correction flag

Primary Quality Control for CO-OPS: CORMS

- Continuous Operational Real-Time Monitoring System (CORMS)
- “Watchstander” for CO-OPS; 24 x 7 continuous QC & QA
- Automated system

Primary Quality Control for CO-OPS: CORMS

- Detects systems & data problems
  - Rectifies situation
  - Forwards to appropriate personnel

- Availability of 500,000+ measurement points/day
  - Originating from ~2,000 sensors in coastal U.S.

CORMS Control Panel

Sensors Stopped On This Watch

8767816: Lake Charles
10/03/16 07:05 Acoustic WL Stopped by [redacted] - Redundant/Backup sensor selected for dissemination (Restarted 10/03/16 11:46)
10/03/16 07:05 Backup WL Stopped by [redacted] - Redundant/Backup sensor selected for dissemination (Restarted 10/03/16 11:46)

9416841: Arena Cove
10/03/16 04:34 Backup WL Stopped by [redacted] - Missing Data - No data received from sensor for 24 hours or more (Restarted)
10/03/16 04:34 Air Temperature Stopped by [redacted] Missing Data - No data received from sensor for 24 hours or more (Restarted)
10/03/16 04:34 Water Temperature Stopped by [redacted] - Missing Data - No data received from sensor for 24 hours or more (Restarted)
10/03/16 04:34 Barometric Pressure Stopped by [redacted] Missing Data - No data received from sensor for 24 hours or more (Restarted)
10/03/16 04:34 Wind Stopped by [redacted] - Missing Data - No data received from sensor for 24 hours or more (Restarted)

Sensors Restarted on this Watch

8767816: Lake Charles
10/03/16 07:05 Acoustic WL Restarted by [redacted] Previously Stopped 09/30/16 08:14)
10/03/16 07:05 Backup WL Restarted by [redacted] Previously Stopped 09/30/16 08:14)

9416841: Arena Cove
10/03/16 04:34 Backup WL Restarted by [redacted] (Previously Stopped 09/27/16 08:02)
10/03/16 04:34 Air Temperature Restarted by [redacted] (Previously Stopped 10/15/15 17:05)
10/03/16 04:34 Water Temperature Restarted by [redacted] (Previously Stopped 10/15/15 17:05)
10/03/16 04:34 Barometric Pressure Restarted by [redacted] (Previously Stopped 10/15/15 17:05)
10/03/16 04:34 Wind Restarted by [redacted] (Previously Stopped 10/15/15 17:05)

Station ID	Station Name	Water Level	Water Temp	Air Temp	Air Pressure	
1100001	Dunbar Inlet GPS Tide Buoy(duplicate)					
1100002	Northern Carroll Inlet GPS (duplicate)					
1611400	Nawiliwili	A1	E1	D1	F1	
1612340	Honolulu	A1	E1	D1	F1	
1612480	Mokuoloe	A1	E1	D1	F1	
1615680	Kahului, Kahului Harbor	A1	E1	D1	F1	
1617433	Kawaihae	A1	E1	D1	F1	
1617760	Hilo, Hilo Bay, Kuhio Bay	A1	E1	D1	F1	
1619910	Sand Island, Midway Islands	A1	E1	D1	F1	
1630000	Apra Harbor, Guam	N1	E1	D1	F1	
1631428	Pago Bay, Guam	N1			F1	
1770000	Pago Pago, American Samoa	N1	E1	D1	F1	
1820000	Kwajalein, Marshall Islands	N1	E1		F1	
1890000	Wake Island, Pacific Ocean	A1	E1	D1	F1	C1
2695535	Bermuda, Ferry Reach Channel	⚠	⚠	D1	F1	
2695540	Bermuda, St. Georges Island	Y1	E1	D1	F1	C1
8311030	Ogdensburg	V1	E1	D1	F1	
8311062	Alexandria Bay	V1	E1		F1	
8410140	Eastport	A1	E1	D1	F1	C1
8411060	Cutler Farris Wharf	A1	E1	D1	F1	C1
8413320	Bar Harbor	A1	E1	D1	F1	C1

Operational Forecast System	Dissemination Status	Water Level	Water Temp	Currents	Wind	Salinity
Chesapeake Bay	✓	✓	✓	✓	✓	✓
Columbia River Estuary	✓	✓	✓	✓	✓	✓
Delaware Bay	✓	✓	✓	✓	✓	✓
Lake Erie	✓	✓	✓	✓	✓	⃠
Lake Huron	✓	✓	✓	✓	✓	⃠
Lake Michigan	✓	✓	✓	✓	✓	⃠
Lake Ontario	✓	✓	✓	✓	✓	⃠
Lake Superior	✓	✓	✓	✓	✓	⃠
Northern Gulf of Mexico	✓	✓	✓	✓	✓	✓
New York/New Jersey	✓	✓	⃠	✓	⃠	⃠
San Francisco	✓	✓	✓	✓	✓	✓
St. John's River	✓	✓	✓	✓	✓	✓
Tampa Bay	✓	✓	✓	✓	✓	✓

Status code for Dissemination Status Column:

✓ : All displays are on

✗ : All displays are off

Ⓦ : Warning Sign - At least one display is off and at least one display is on

⃠ : Not Available

DIS Monitor

CDIS Home | Monitor Home | Help

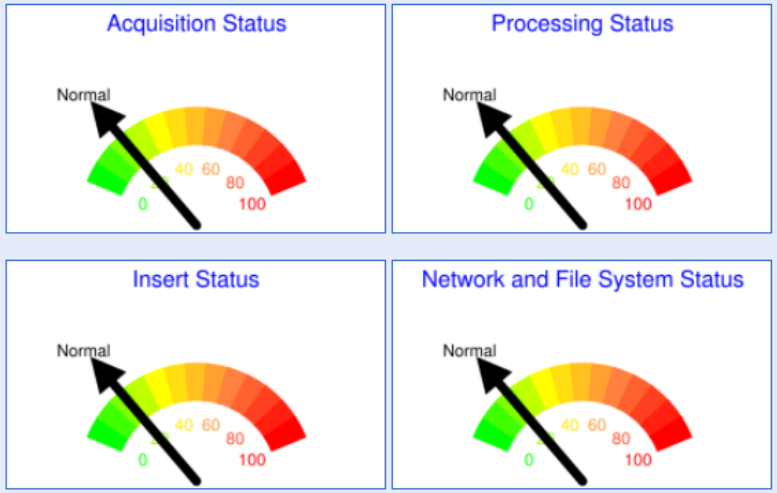
CO-OPS Data Ingestion System (CDIS) Monitor

The CO-OPS Data Ingestion System (CDIS) Monitor gives a snapshot overview of the major components of the system in the form of "temperature" readings. Low temperatures indicate normal operations and high temperatures indicate problems which may require ISD personnel. The information is updated automatically every couple of minutes.

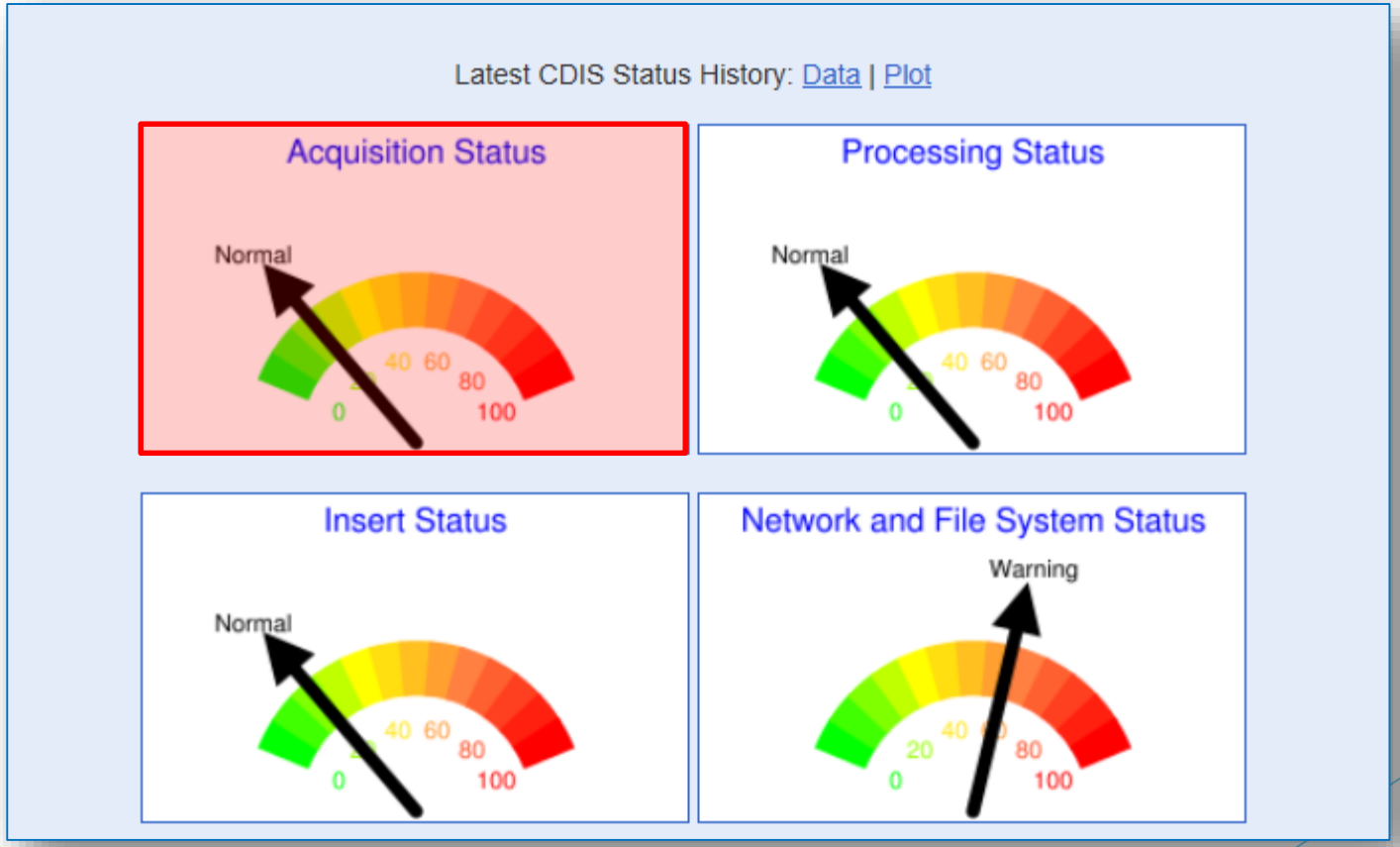
To view detailed status information for a given module, click on the status monitor image. For more information see the Help section.

Last Updated: Mon Oct 3 14:40:08 UTC 2016

Latest CDIS Status History: Data | Plot



DIS Monitor (Acquisition Status)



DIS Monitor (Acquisition Status)

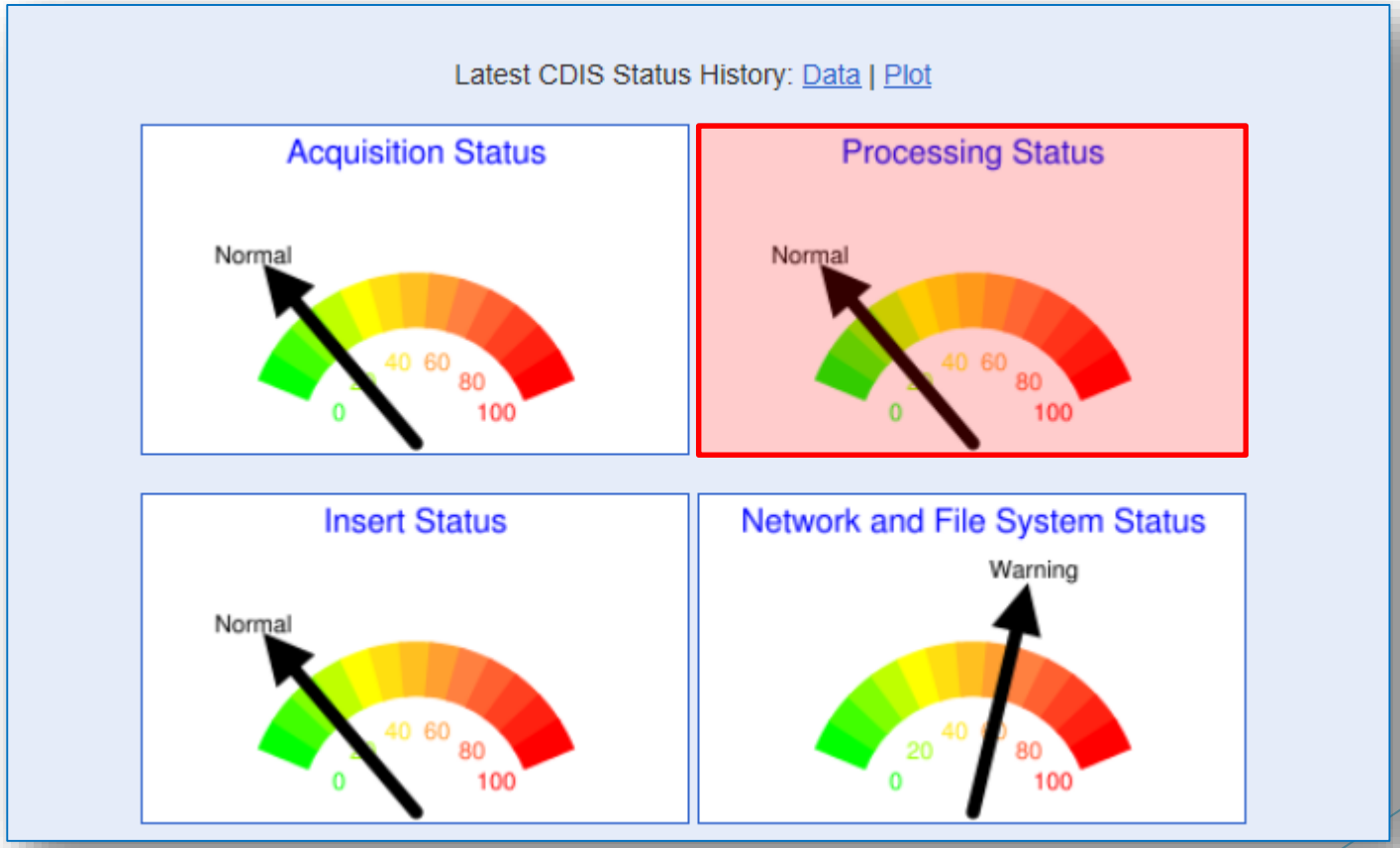
Acquisition Log

```
CDIS Acquisition Status: Mon Oct  3 17:40:02 UTC 2016


Server: oceanus1r

Below is a list by data type (GOES, Iridium, and each of the PORTS)
when data was last retrieved. If the elapsed time for a given data
type is high, a status message is set.

Data Type     Last Retrieved   Elapsed (min)     Status

GOES        Oct  3 17:40 GMT          0
Iridium     Oct  3 17:39 GMT          1

cnports     Oct  3 17:34 GMT          6
cpports     Oct  3 17:35 GMT          5
csports     Oct  3 17:34 GMT          6
dbports     Oct  3 17:34 GMT          6
glports     Oct  3 17:37 GMT          3
gpports     Oct  3 17:38 GMT          2
hbports     Oct  3 17:36 GMT          4
hgports     Oct  3 17:34 GMT          6
jxports     Oct  3 17:39 GMT          1
laports     Oct  3 17:40 GMT          0
lbports     Oct  3 17:37 GMT          3
lcports     Oct  3 17:34 GMT          6
lmports     Oct  3 17:39 GMT          1
mbports     Oct  3 17:35 GMT          5
mcports     Oct  3 17:34 GMT          6
nbports     Oct  3 17:35 GMT          5
nlports     Oct  3 17:39 GMT          1
nyports     Oct  3 17:34 GMT          6
psports     Oct  3 17:35 GMT          5
sfports     Oct  3 17:37 GMT          3
snports     Oct  3 17:35 GMT          5
tbports     Oct  3 17:40 GMT          0


Below are the file sizes of the last 3 available GOES files and their average
size. If the average size is too small, a status message is set.

GOES Filename          Approx. Size (kb)         Status

20161003173601.wal                15.0
20161003173801.wal                14.0
20161003174002.wal                16.0
Average                           15.0


Below is information regarding metadata files used by CDIS. If the elapsed
time for a given file is high, a status message is set.

Metadata File         Last Retrieved   Elapsed (min)  #Lines       Status

PLATFORM_IDS.DAT     Oct  3 17:12 GMT     28            455
STATION.DAT          Oct  3 17:12 GMT     28           2136
VALID_SENSORS.DAT    Oct  3 17:12 GMT     28           4356


Temperature:  20
```

…When data was last received

a) Focusing on elapsed time
b) Size of file

DIS Monitor (Processing Status)



DIS Monitor (Processing Status)

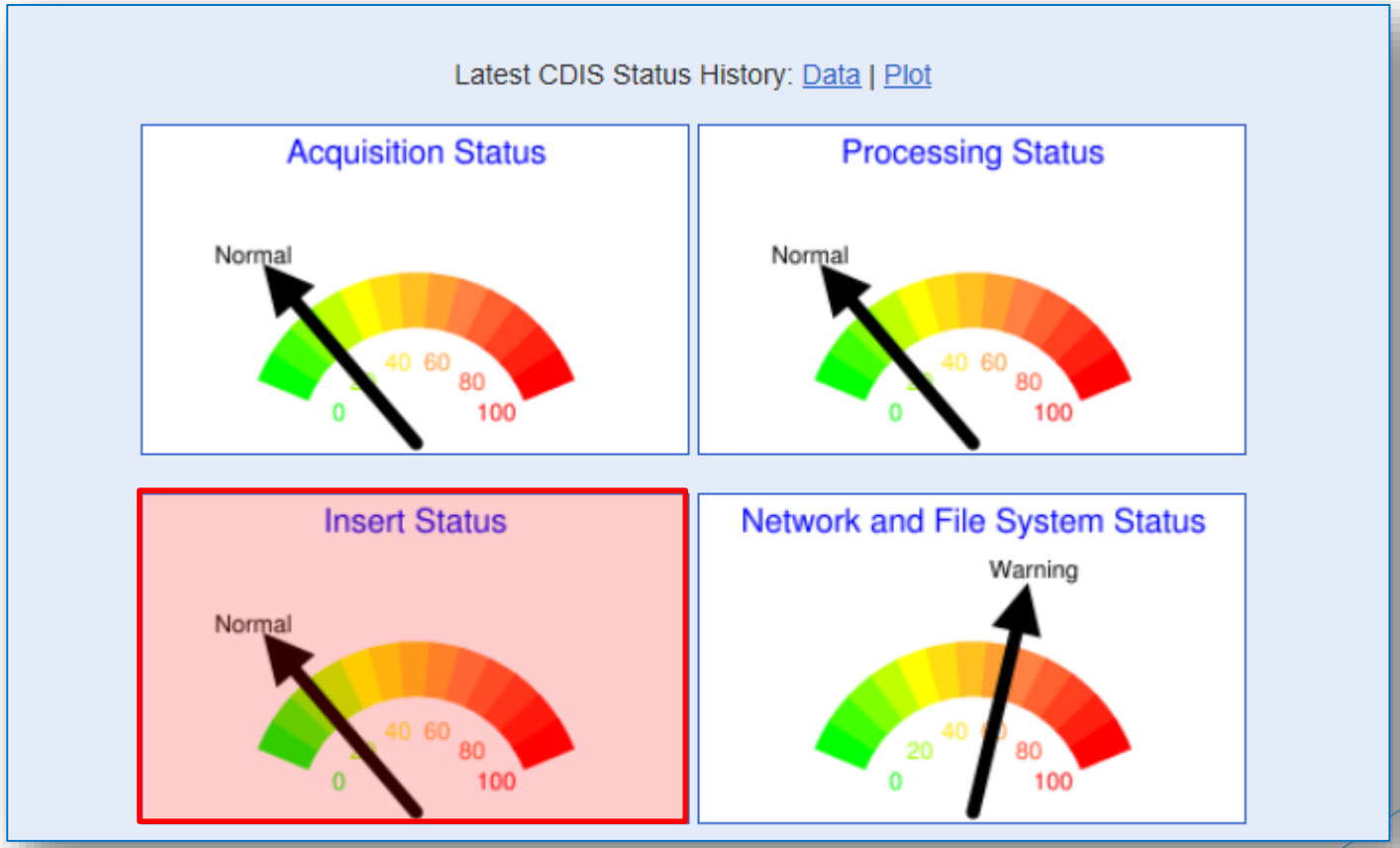
Processing Log

```
CDIS Processing Status: Mon Oct  3 17:45:02 UTC 2016


Server: oceanus1r

Below is a list by data type (GOES, Iridium, and PORTS) showing the
number of data sets waiting to be processed (quality-controlled). If
the number to be processed for a given data type is high, a status message
is set.

Data Type    # to be Processed        Status

GOES                          0
Iridium                       0
PORTS                         0


Temperature:  20
```

…Datasets needing to be processed

a) Focusing on quantity

DIS Monitor (Insert Status)



DIS Monitor (Insert Status)

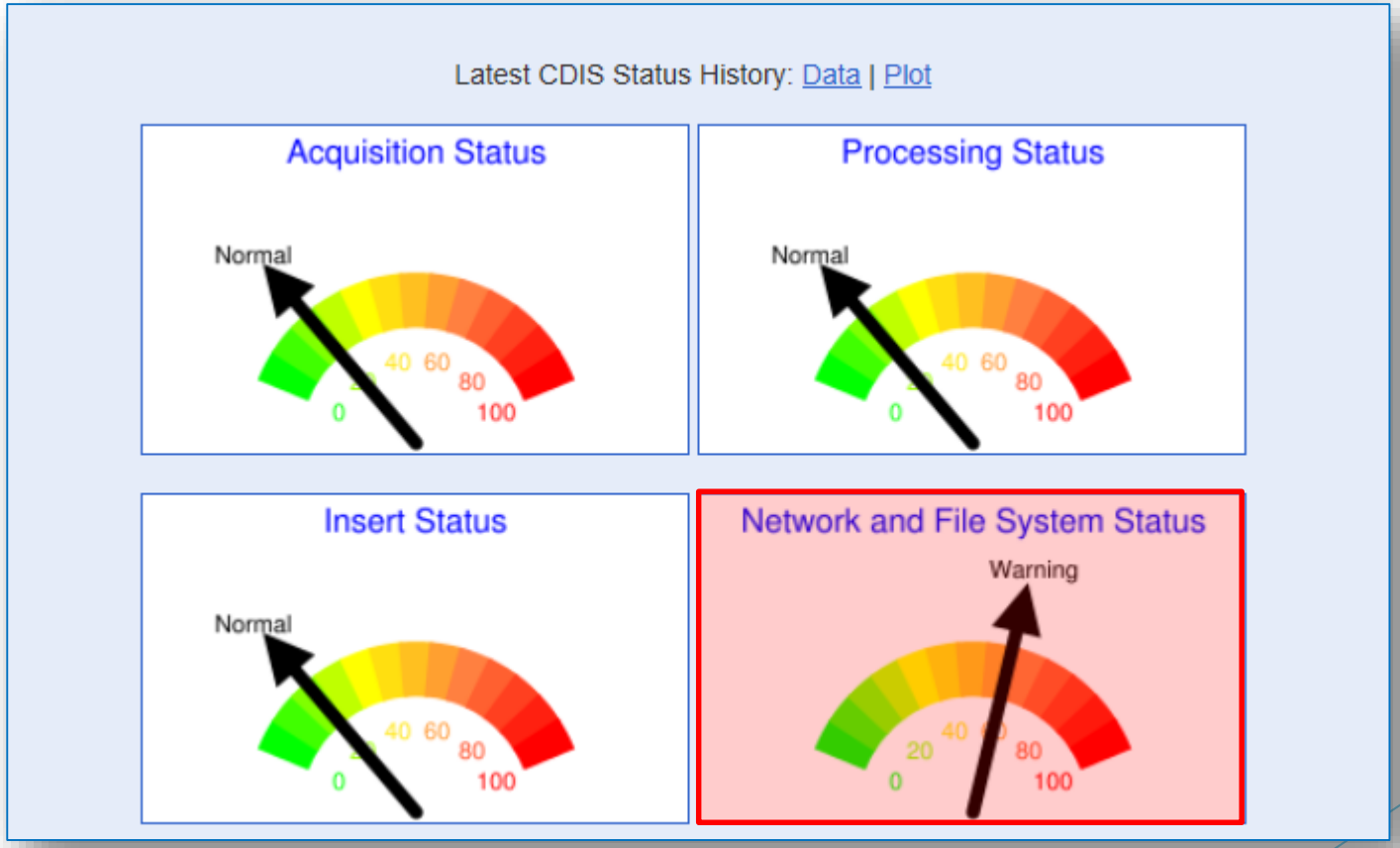
Insert Log

```
CDIS Insert File Status: Mon Oct  3 17:45:02 UTC 2016


Server: oceanus1r

Below is a list by sensor type and acquisition method (GOES or PORTS)
showing the number of data sets waiting to be inserted into the database.
If the total number for a given sensor type is high, a status message
is set.

Sensor  Total   #GOES  #PORTS       Status

 CU         0       -       0

 A1         0       0       0
 B1         0       0       0
 C1         0       0       0
 D1         0       0       0
 E1         0       0       0
 ER         0       0       0
 F1         0       0       0
 G1         0       0       0
 H1         0       0       0
 J1         0       0       0
 L1         0       0       0
 M1         0       0       0
 N1         0       0       0
 Q1         0       0       0
 R1         0       0       0
 TR         0       0       0
 U1         0       0       0
 V1         0       0       0
 Y1         0       0       0


Temperature:  20

------------------------------------------------------------
CDIS Insert Time and Speed Status: Mon Oct  3 17:45:03 UTC 2016


Server: oceanus1r

Below is a list by sensor type showing the last time
data was inserted into the database and insert speed statistics.
If the elapsed time for a given sensor type is high, a status
message is set.
```

…Datasets to be inserted into database

a) Focusing on quantity per sensor
b) elapsed time

DIS Monitor (Network & File System Status)



DIS Monitor (Network & File System Status)

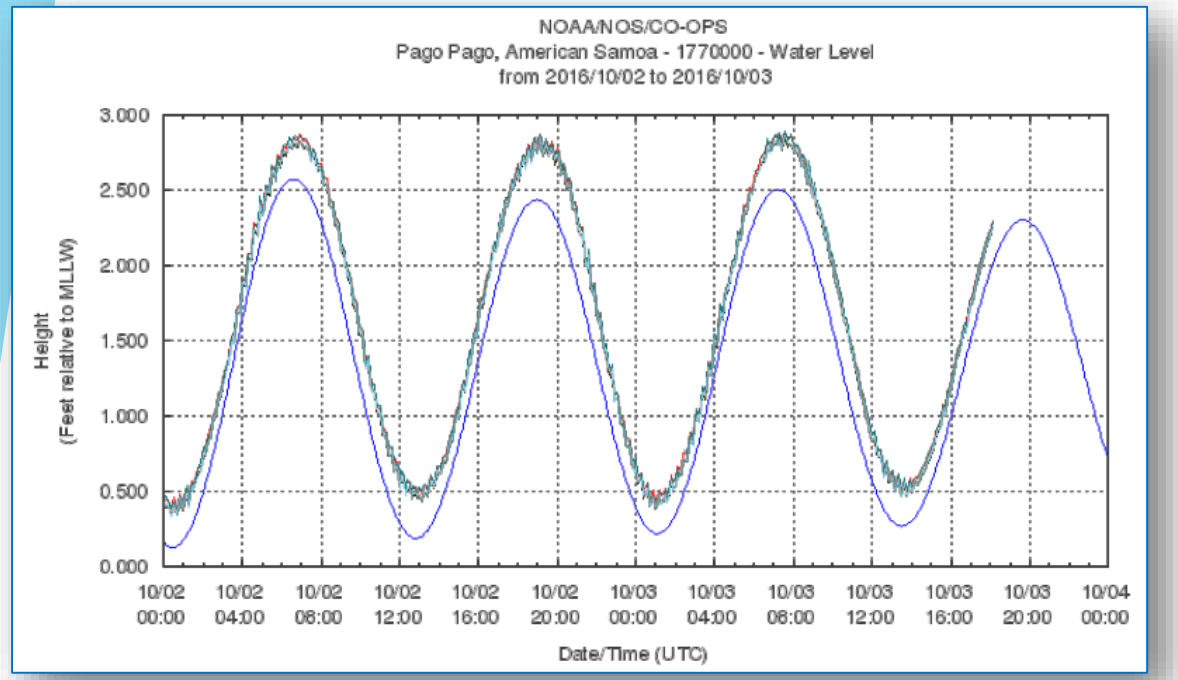
Network and File System Log

```
CDIS Network Status: Mon Oct  3 17:45:04 UTC 2016


Server: oceanus1r

The list below shows connection statuses of our LRGS servers and database.
If the primary or backup DOMSAT is down, we issue a warning status. If the
database or both DOMSATs are down, we issue a critical status. If an
external server cannot be reached we issue a warning status. The
system also checks our primary and backup Data API servers, which
are used by web applications to retrieve time series data. If either
the primary or backup is unreachable, we issue a critical status.

Using configuration file /opt/DIS/dis.cfg

Server Type       Server                                    Connection

Primary LRGS (pw) [redacted]                                OK
Backup LRGS       [redacted]                                OK
Database          riacprod1_svr                             OK
External Server   www.google.com                            OK
Primary Data API  DPS 1                                     OK
Backup Data API   DPS 2                                     OK

Overall Network Status Normal


Temperature:  20

------------------------------------------------------------
CDIS Server File System Status: Mon Oct  3 17:45:05 UTC 2016
```

…Connection statuses to servers & database

a) Connectivity to servers (primary or secondary)
b) Connectivity to database
c) Connectivity to web applications (server)
d) Used disk space

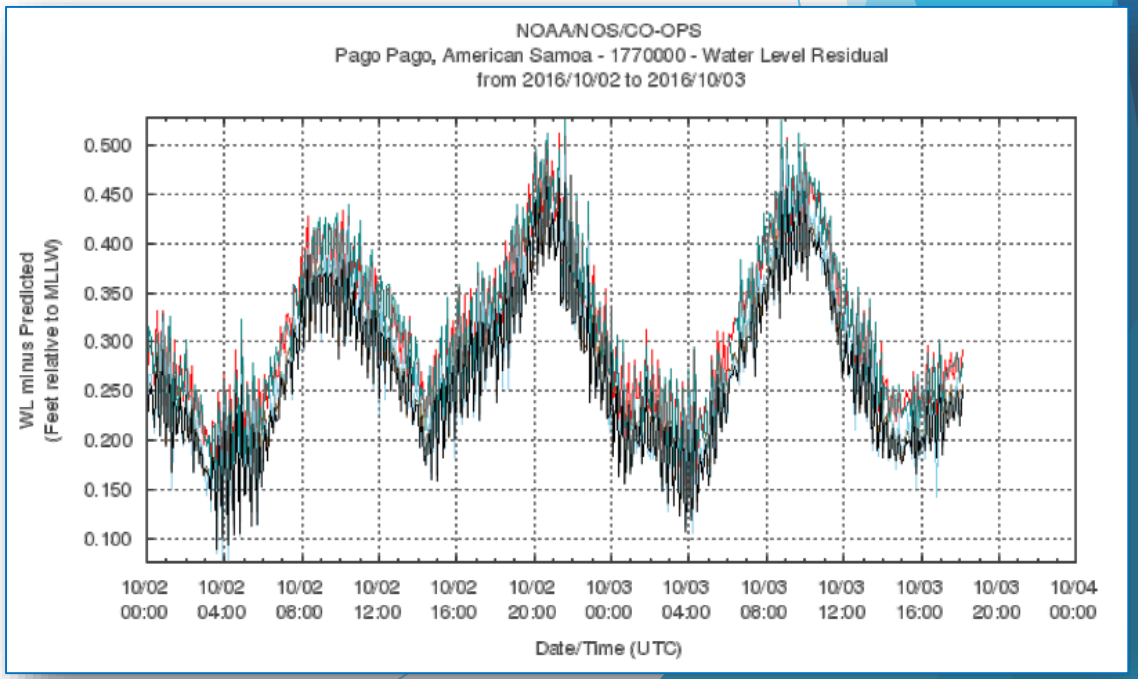
CORMS Methods (DiagTool)



Plot last 24 hrs

a) Verify false data within sensor min/max

b) Compare 1° data with 2° data (and/or neighbor stations)

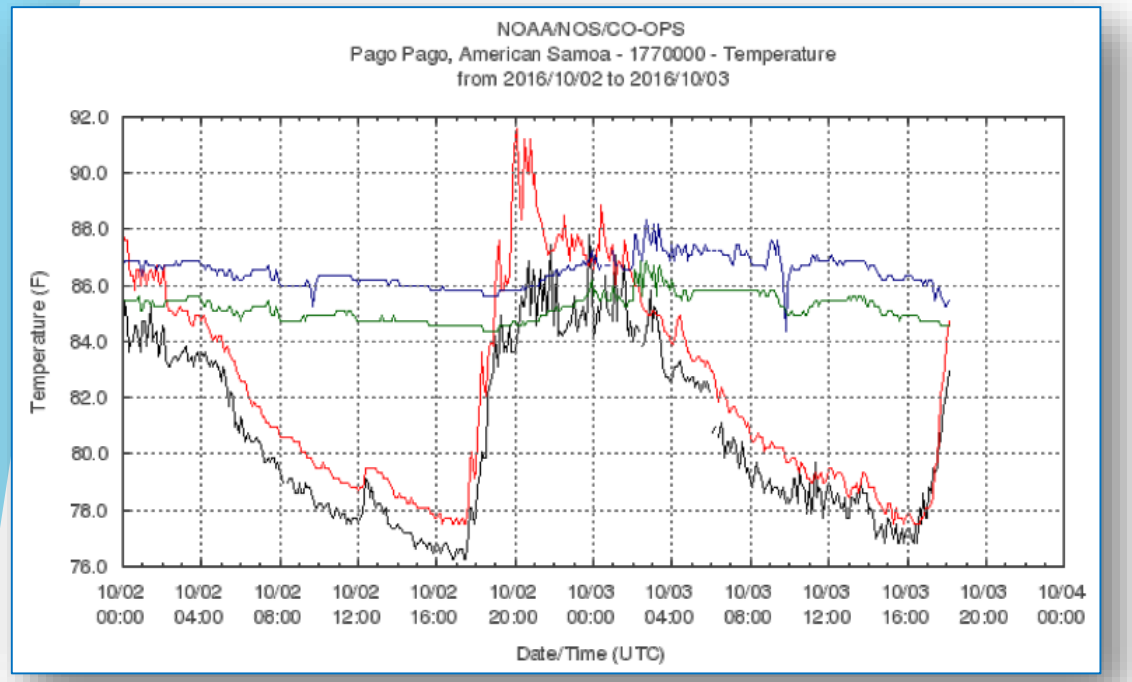


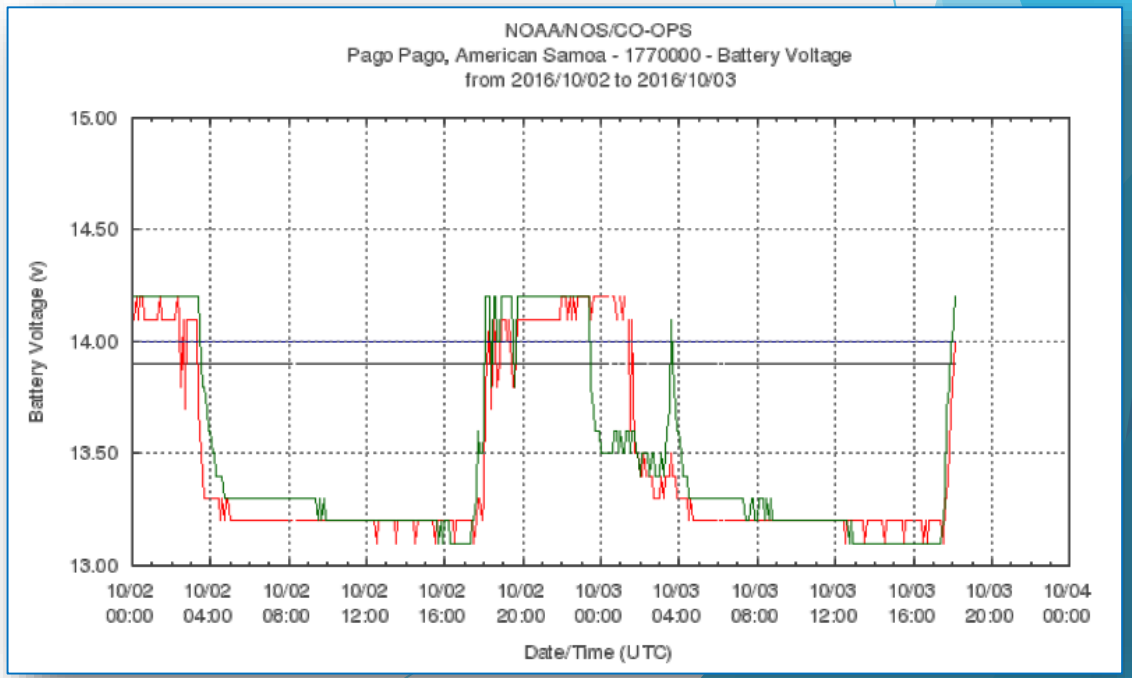
CORMS Methods (DiagTool)

Plot last 24 hrs

c) Consistent Std dev values (0.001m – 0.3m)?

d) Reasonable outliers?





CORMS Methods (Mega Monster Board)

ID	Name	Sensor / DCP	I
1611400	Nawiliwili, HI	[+]	
1612340	Honolulu, HI	[+]	
1612480	Mokuoloe, HI	[+]	
1615680	Kahului, Kahului Harbor, HI	[+]	
1617433	Kawaihae, HI	[+]	
1617760	Hilo, Hilo Bay, Kuhio Bay, HI	[+]	
1619910	Sand Island, Midway Islands,	[+]	
1630000	Apra Harbor, Guam,	[+]	
1631428	Pago Bay, Guam,	[+]	
1770000	Pago Pago, American Samoa,	[+]	
1820000	Kwajalein, Marshall Islands,	[+]	

CORMS Methods (Mega Monster Board)

Station Sensors Configuration

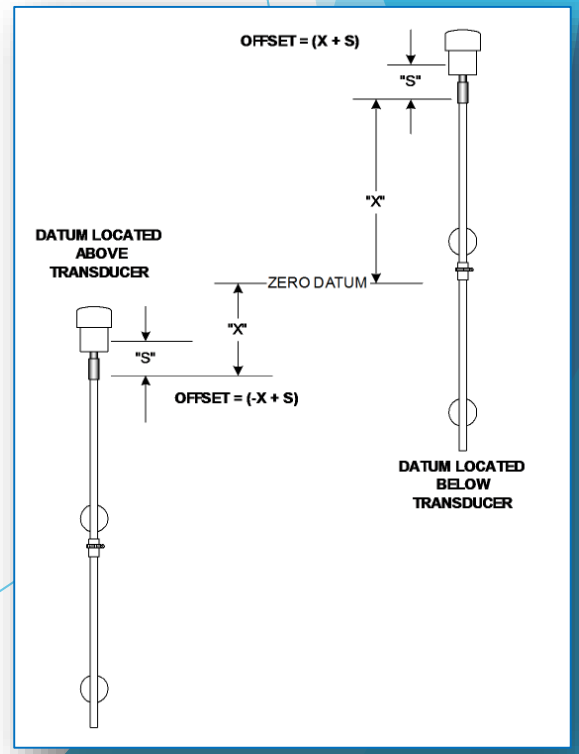
Sensor ID / DCP	Diss. Status	CCP	GOES %	Phone/IP %
B1/4	Fully Operational		100.0	0.0
C1/1	Fully Operational		99.6	0.0
C1/3	Fully Operational		100.0	0.0
D1/1	Fully Operational		99.6	0.0
D1/3	Fully Operational		100.0	0.0
E1/1	Fully Operational		99.6	0.0
E1/3	Fully Operational	Suspect Data - Data failed to meet QC standards - under review	100.0	0.0
F1/1	Fully Operational		99.6	0.0
F1/3	Fully Operational		100.0	0.0
L1/1	Fully Operational			
L1/2	Fully Operational			
L1/3	Fully Operational			
L1/4	Fully Operational			
N1/1	Fully Operational		100.0	0.0
N1/2	Fully Operational		0.0	0.0
N1/3	Fully Operational		100.0	0.0
U1/1	Fully Operational		99.6	0.0
U1/3	Fully Operational		100.0	0.0

System QC Checks

- Monitor weather (CORMS)
  - Coastal flooding & storm surge during major events
  - Effects of smaller storms or severe weather has on water levels & meteorological data
- Tropical weather monitoring (CORMS)
  - Tracking of all tropical systems (June to November)
  - Reports/updates are created, within 72 hrs, if systems are forecasted
  - Reports/updates: intensity, watches, warnings, expected local impacts
  - Develops estimates of storm surge & flooding
- Checks
  - Continuous communication links
  - Sensor & equipment reliability
  - Data accuracy

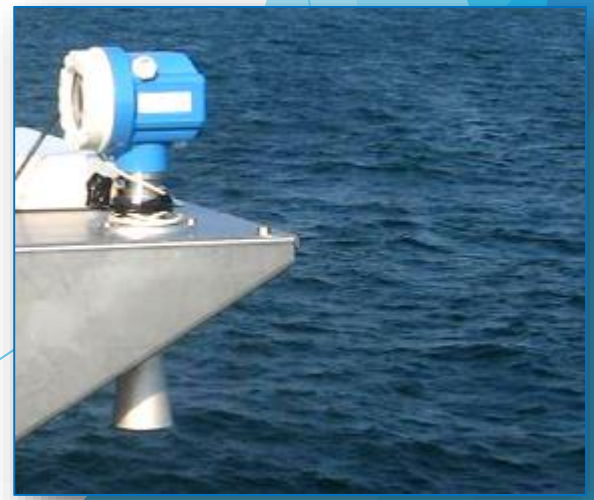
Tide Gauge QC Checks (Acoustic)

- Inspect sounding tube air thermistor values for past 24 hrs
- Values should be within 5° C of each other
- Values should be similar to station air temp
- If not, there may be a problem with air thermistors or sounding tube



Tide Gauge QC Checks (Microwave Radar)

- Determining bad data requires assessment of sensor's raw time series
- Sensor's raw time series is highly dependent on signal technology employed by sensor
- Software: Windows based graphic diagnostic tool (aids in maintenance/setup)



Tide Gauge QC Checks (Pressure)

- Check gain & offset backup analysis (helps correct for sensor drift)
- Dual orifices: compare both orifices for the past 24 hrs (agree within 1 cm)

Meteorological Sensor QC Checks

- Plot last 24 hrs of sensor data (DiagTool)
- Verify data fall within station's min/max range
- Compare with any backup sensors or neighboring stations

CORMS Main Role

- Stop dissemination of data (web/data products)
- Start or restart dissemination of data (web/data products)
- Switch dissemination of sensors
- Add stations to the High Water Advisory List (5 of the last 10 data points > 1.5 ft above tidal predictions)

Summary

- Having the most recent data QC'ed prior to ingestion= consistent level of QC for outgoing data products.
- Important QC checks
  - Datum and sensor offsets
  - Water level min/max
  - 1° vs 2° sensors
  - Height correction
- CORMS provides continuous QA & QC through an automated system
  - Detects problems, rectifies problems, or forwards to personnel that could provide best solution
  - Control Panel
  - Data Ingestion System Monitor
  - Mega Monster Board
  - DiagTool

Summary

- Oceanographic & meteorological sensors
  - Plot last 24 hrs of data
  - Verify if data falls within station's min/max parameters
  - Compare with backup sensors
  - Compare with neighboring stations
- Monitor weather (overall)
  - Evaluate effects of smaller storms or severe weather
  - Estimate storm surge or flooding
  - Report details on tropical systems

National Ocean Service
Center for Operational Oceanographic Products & Services
CO-OPS

Questions?