Data Transmission

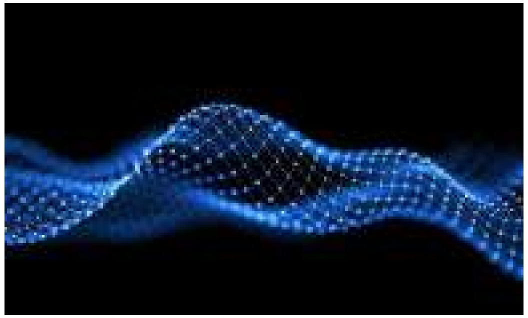
Smart, Reliable and Secure

What does OceanWise do?

What is Data Telemetry?

Data transmission / Data Telemetry

"The mechanism of getting the data from where its collected to where it is needed"



Data Transmission: Uses and Users

- Marine Data has different USES by different USERS
- Data is only ever collected for a purpose
- The point at which the data is collected is rarely the point where the data is assessed / acted upon
  - because of the environment in which the measurements are made (often below the water surface)
  - Because decisions are made using the data at different times and places in the operational process

  i.e. use of tidal information on board a ship as well as ashore
- Typically telemetry uses radio based communication systems allowing communication with different platforms
  - Satellite – Communications Over the Horizon
  - Marine Systems using SOLAS technology
  - Land Based System (Cell Phone Technology)

Data Transmission: Uses and Users

- Operational Monitoring
  - Tide Reading, Wave Height, Wind Speed, Visibility
  - VTS, Pilots, Windfarm Operator etc
  - Only interested on conditions prevailing within the last 5 mins
  - Delivery time is critical

- Long Term Monitoring
  - Sea Level Rise Baseline Studies, Wave and Wind Climatology
  - Multi-parameter Multi-Instrument
  - Every Record is Critical
  - Frequency of data delivery is not so critical (Daily upload)
- Short Term Monitoring
  - Multi-parameter Multi-Instrument
  - Adaptive Sampling /Adaptive Transmission – Sampling might typically be hourly but may increase in frequency during periods of Interest
  - Every Record is still Critical
  - Frequency of data delivery may not be so critical (Daily upload)

- Responsive Monitoring
  - Dredge Monitoring, Tsunami Warning Systems
  - Data collected and automatically assessed against pre-determined threshold to trigger some response or transmit a warning/alarm
  - Trend Analysis - processing onboard the device
    - Only interested in conditions prevailing within the last 5 mins
    - What will happen next is the key objective
    - Delivery time is highly critical

Data Security

- Data is unique and valuable
- Sensors can be replaced but data cannot
- Moving the data from the sensor to a secure site (server) mitigates the risk-> (data management strategy)
- Reliable and complete archives of data allows:
  - prediction of future events
  - assess changes which have occurred over time
- For the records to be meaningful they must be put into a context (metadata describes the context)

Design of the Data Network

Key steps in the design of any monitoring network

Network Design Considerations

- Measurements relative to where the user/s need the information
  - Point to Point
  - One Point to Many Points
  - Many Points to Many Points
- System power budget – servicing requirements, site locations
- Data transmission budget - what will you measure when do you need result and what will this cost
- Data Security (Reliability or Confidentiality)
- Data redundancy/duplication – repeater stations, paired sensors
- Data Latency – Timestamp data as it is measured not when it arrives at the server
- Clock Control – GNSS is typically used to achieve time synchronisation of all data passed across the network. It also can be important for controlling transmission via Satellite (GOES/Meteosat)

Accuracy of Data Required

- Function of sensor/s not network
- Impacts on Network design

- Multiple lower cost sensors gives:
  - redundancy
  - cross checking of data

- Fewer high end sensors gives
  - smaller amounts of data to transmit
  - more reliance on individual sensor
  - less ability to monitor drift/fouling

- Sensor Calibration programme is always key to delivering Accuracy in the data

Transmission Methods

- Serial RS232/422/485/USB
- Ethernet/ Broadband
- Radio Networks UHF/VHF/HF
- GPRS (GSM 2G,3G,4G…..)
- SATELLITE IRIDIUM SBD/RUDICS, INMARSAT, SATELLITE BROADBAND
- GOES/METEOSAT – BROADCASTS
- AIS
- LoRa

Direct Comms

Transmission Protocols

"How you transmit the data depends on what is available (where you are) how much data you need to transmit and how often the transmission should take place"

- SMS
- Email
- FTP
- HTTP
- TCP
- UDP
- MODBUS/SCADA
- AIS

More Data = Larger Costs

More Frequent Transmission = Larger Costs

More Remote Location = Larger Costs

Important to select protocol which matches the complexity and volume of the data as well as the delivery mechanism

Powering the Network

Power is often a controlling factor in Network Design

- Required to run sensors and power the transmission
  - Not a problem on-shore
  - Remote Sites can be an issue
- Energy required vs the amount which can be stored limits:
  - servicing frequency – for battery replenishment
  - size of the scientific payload – batteries are big and heavy
- Stored Power Sources = Batteries
- Replenished Power Sources
  - Solar Panels
  - Wind Generator
  - Wave Energy Converters

- Efficiency of Solar Panels as Power Source is a function of
  - Latitude
  - Season
  - Size of Panels

Powering the Network

0.5m^2 - 50W Panel delivers approx. 100mA of usable power at these latitudes

- Duty Cycle of Acquisition and Transmission is a way of controlling power usage
- How hard the Telemetry has to work (finding GPR Signals for example) to transmit the data is however a big factor in the power demand

The Transmitted Data

- Message should be structured to ensure data is both well described and complete
  - What is being sent
  - Where it is coming from
  - When the data was collected

- Error Checking provides a means of ensuring the data is integral and not duplicated
  - Checksums
  - Structural/Sequential Checks
  - Missing Data (especially timestamps) is difficult to identify if acquisition and transmission are not synchronous
  - Duplicate data – often a problem where relaying of data around the network occurs

Data Delivery Speed

- Real- Time
  - Critical for Operational and Responsive systems
  - Cost impact - the data is mission critical and every record must get through quickly
- Near-Real Time
  - Near Real time delivery is good enough for many applications
  - Cost savings can be made by batching data together for periodic transmission

Servicing of Instrumentation and Network

- Servicing of the system focussed to the sensors not necessarily the telemetry
- If system is efficiently powered (solar panels/low power consumption equipment)- servicing can be planned
- Responsive servicing may still however be required
  - Biofouling - difficult to mitigate against and it's onset is difficult to detect
- Onboard processing allows the sensor performance to be monitored and servicing alerts to be raised
  - Comparison of measurements (same parameter measured independently by 2 sensors)
  - Internal QA/QC of data – identification of spikes, trends etc.

Smart Telemetry

What should we be looking for in any telemetry system

What do we mean by 'Smart' Data Transmission

- **Configurable** - works with any instrument/data type
- **Swift** data delivery with minimum delay
- **Intelligent** – system checks that the message has been delivered correctly (otherwise it will keep transmitting it until the message gets through)
- **Compacts** the data for transmission
- **Flexible -** not restricted to one data delivery mechanism, i.e. can be configured to use a variety of transmission protocols
- **Robust -** copes with the transfer of different data volumes and different data rates
- **Secure -** reliable and confidential

What Do We Mean By 'Smart' Data Telemetry (Cont…)

- **Remotely managed /configured - **facilitates direct comms with the sensor itself
- **Power efficient** (important for buoy mounted systems and "off grid" - solar powered systems)
- **Reformatting** the incoming/outgoing data – legacy/new instruments feeding legacy/new systems
- **Cost efficient –** can multiplex data streams to reduce data transmission / hardware costs / power consumption/provide station metadata

Introduction to the IP/RT Buffer

Working with the manufacturers Scannex Oceanwise have optimised the capabilities of the IP Buffer to full fill most of the functions identified

The IP Buffer has underpinned many of the telemetry applications undertaken for our customers and has proven itself powerful , flexible and reliable

SMART TELEMETRY

Environmental data from anywhere to anyone

KEY BENEFITS

- Smart telemetry with reliability built-in
- Fail-safe and dependable
- Multi-sensor data on any device
- Delivers real-time information

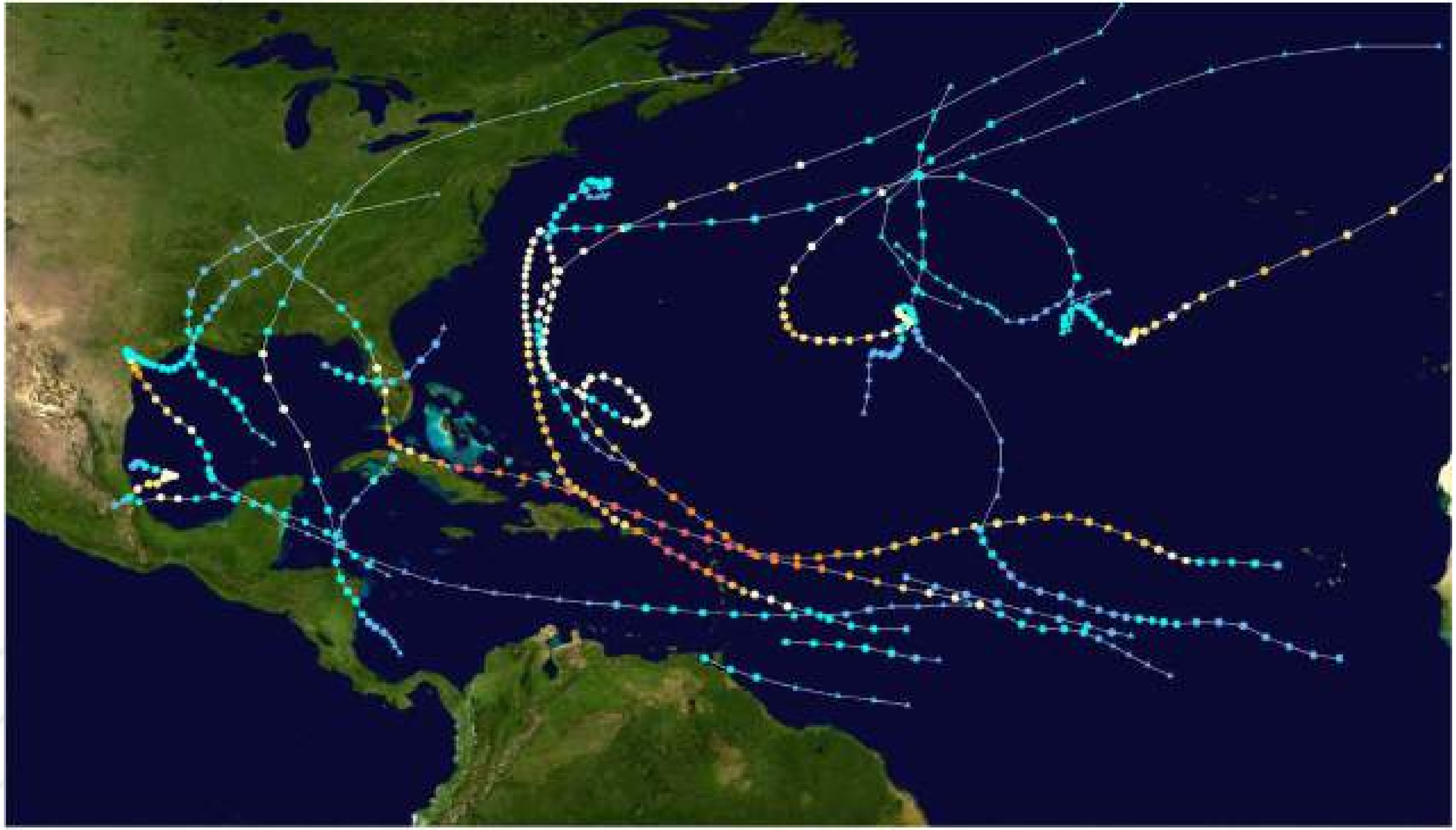
Scannex ip.buffer/rt.buffer

- ✓ Proven reliability
- ✓ Low power consumption
- ✓ Programmable data acquisition
- ✓ Choice of data delivery options
- ✓ Works with a wide range of sensors
- ✓ Bidirectional communication
- ✓ Remote device administration
- ✓ Safe and secure data transmission

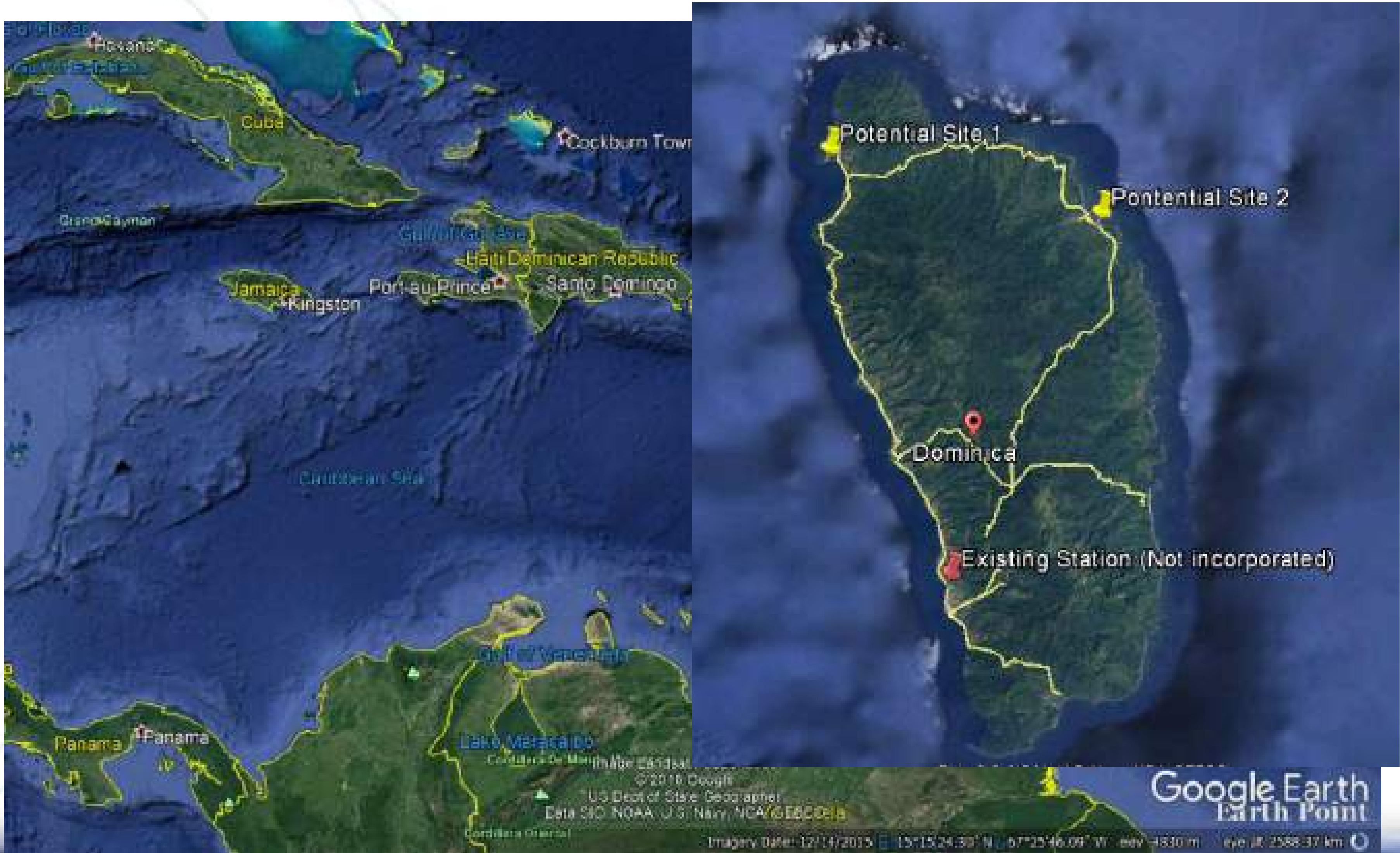
Case Studies

Smart telemetry in action

Case Study 1 – Hurricane Season



Dominica Mean Sea Level



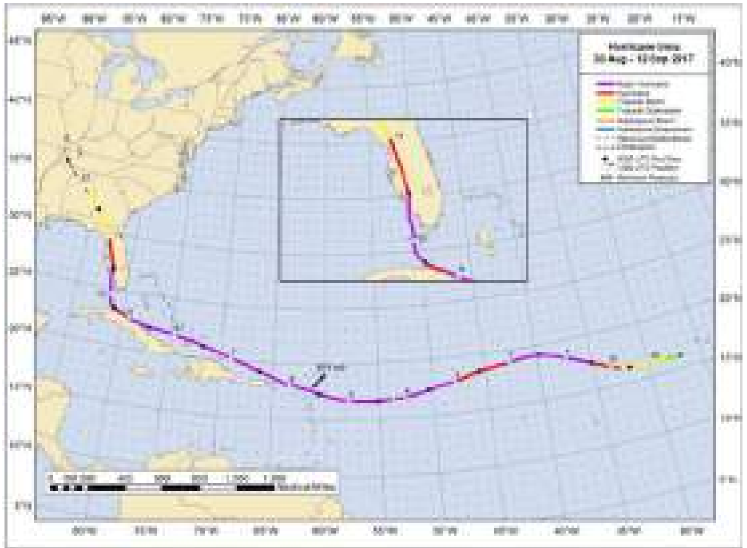
Dominica Mean Sea Level

Two severe ones in quick succession

Hurricane Irma:

30th Aug – 13th Sept 2017

Category 5



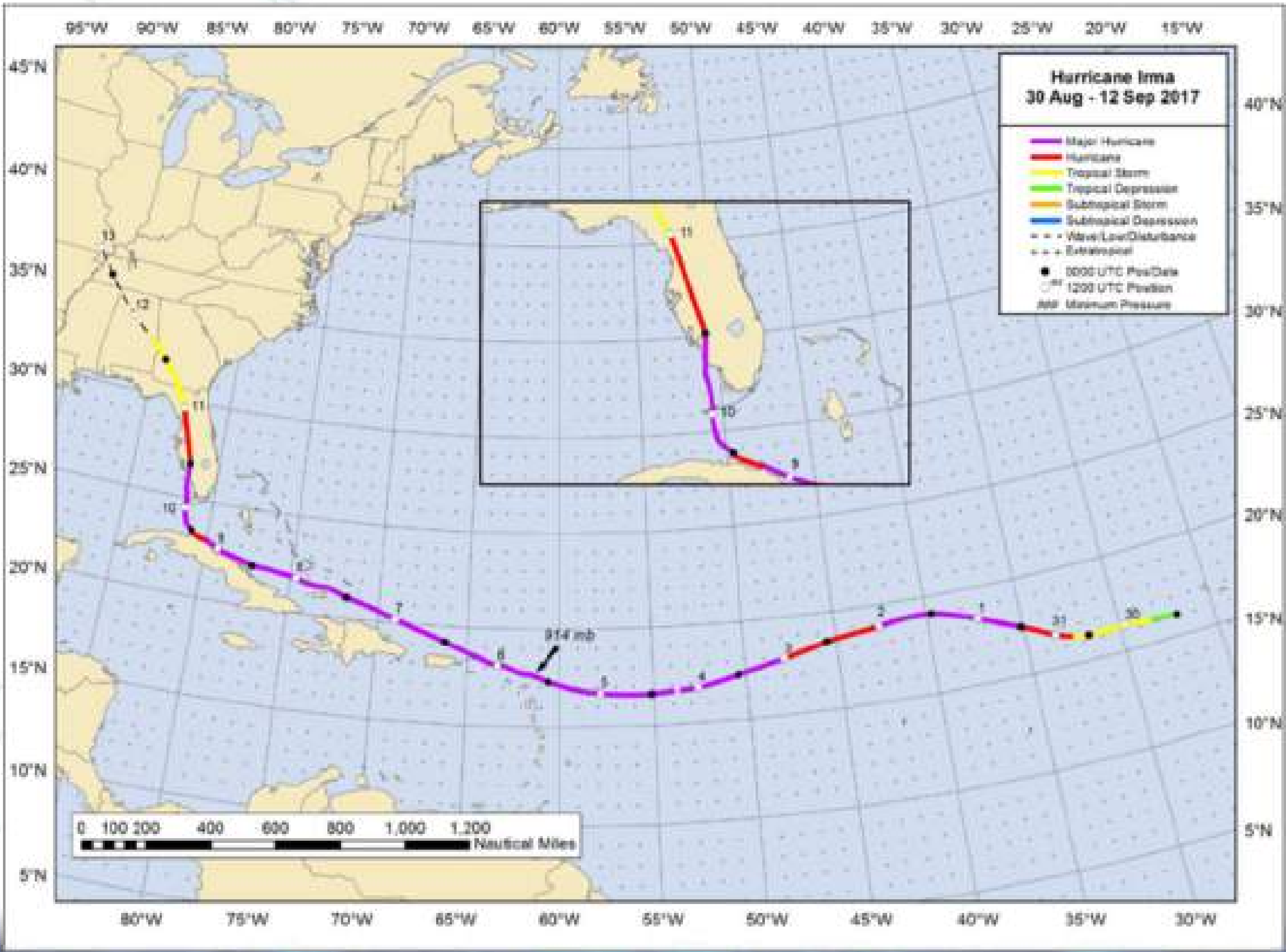
Hurricane Maria:

16th Sep – 30th Sep 2017

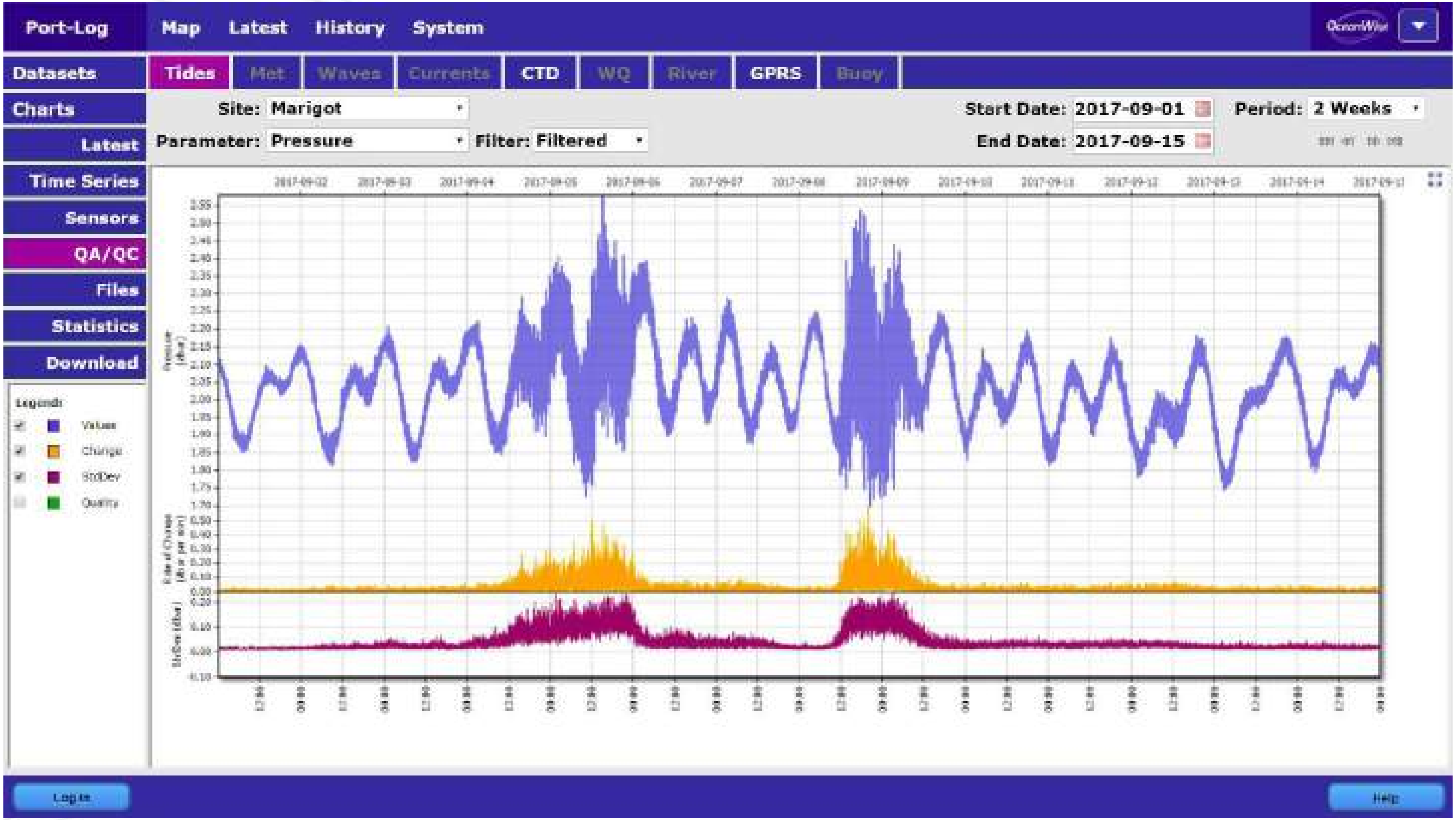
Category 5

the worst natural disaster on record to affect the islands of Dominica, the US Virgin Islands and Puerto Rico

Hurricane Irma



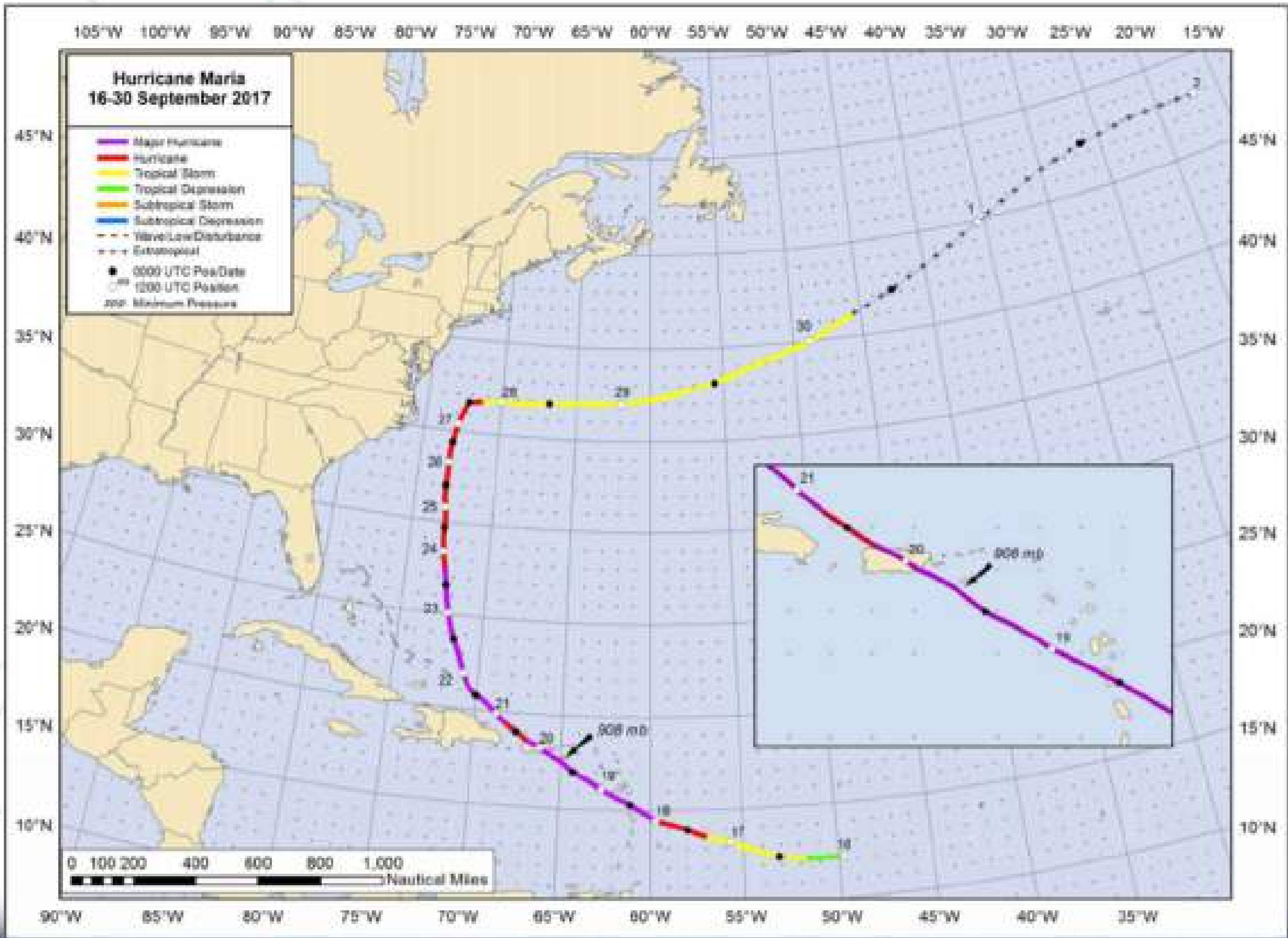
Hurricane Irma



Dominican Republic

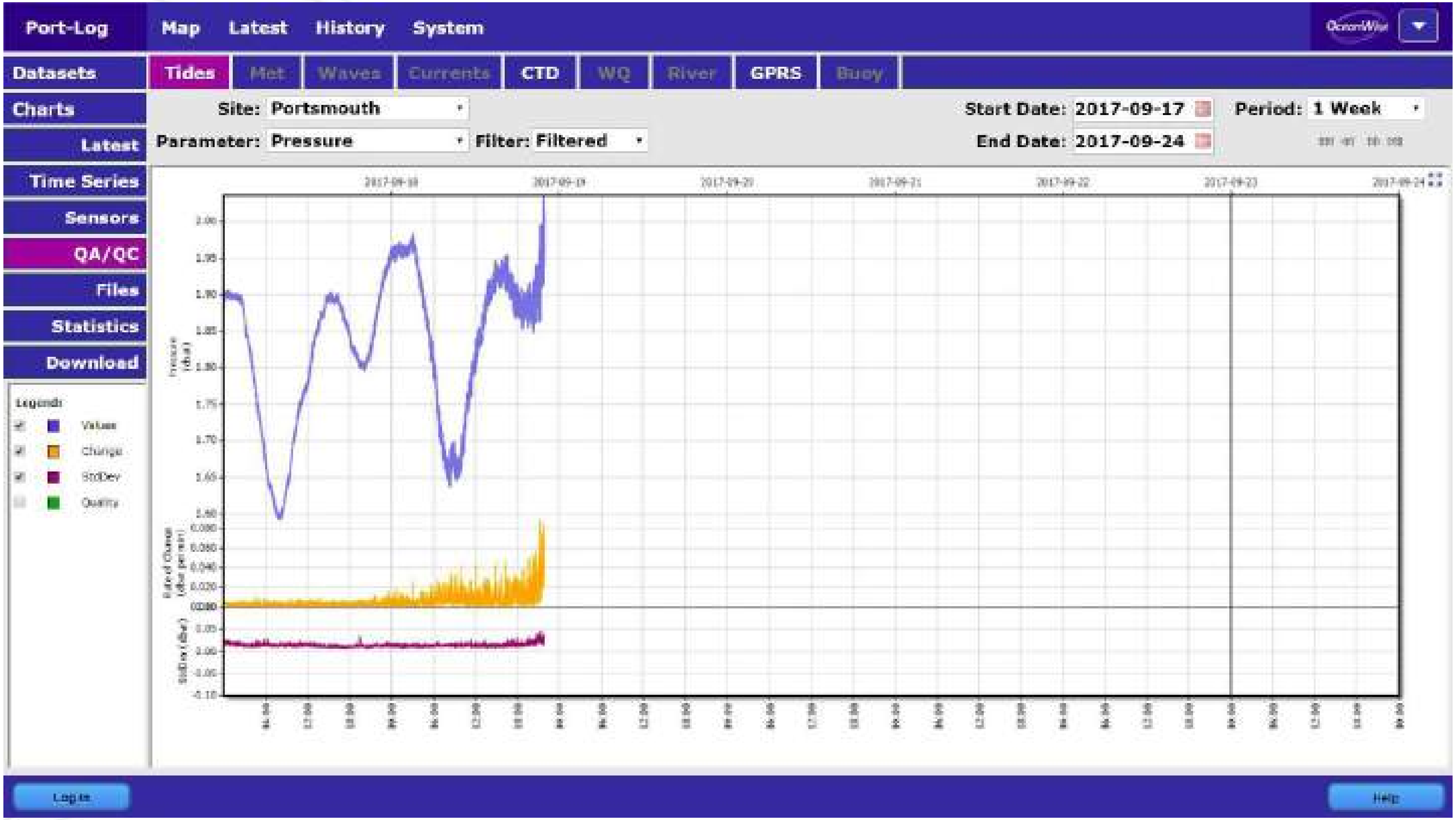
Dominican Republic

Hurricane Maria

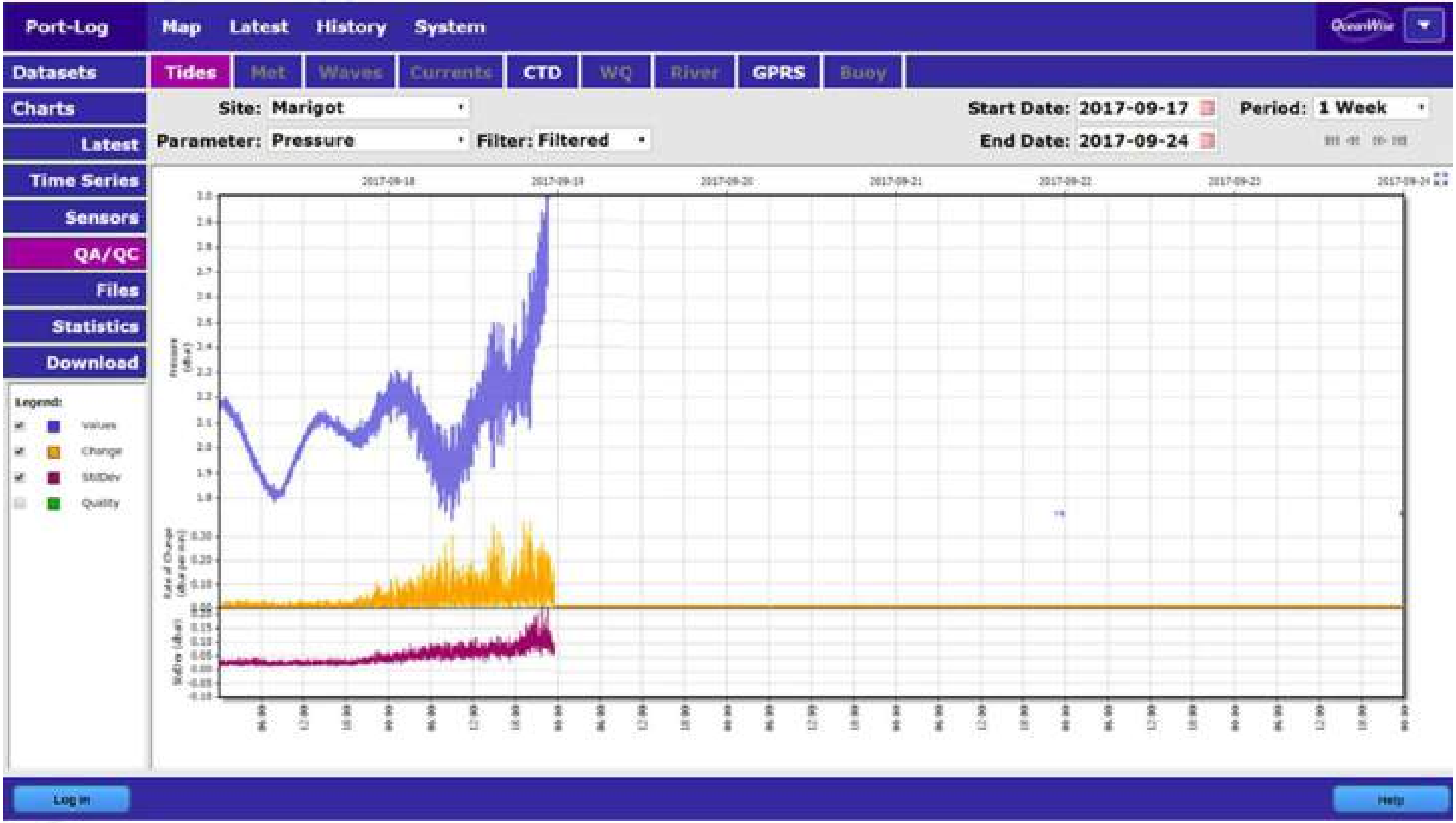


Hurricane Maria

Portsmouth - Maria



Marigot – Maria



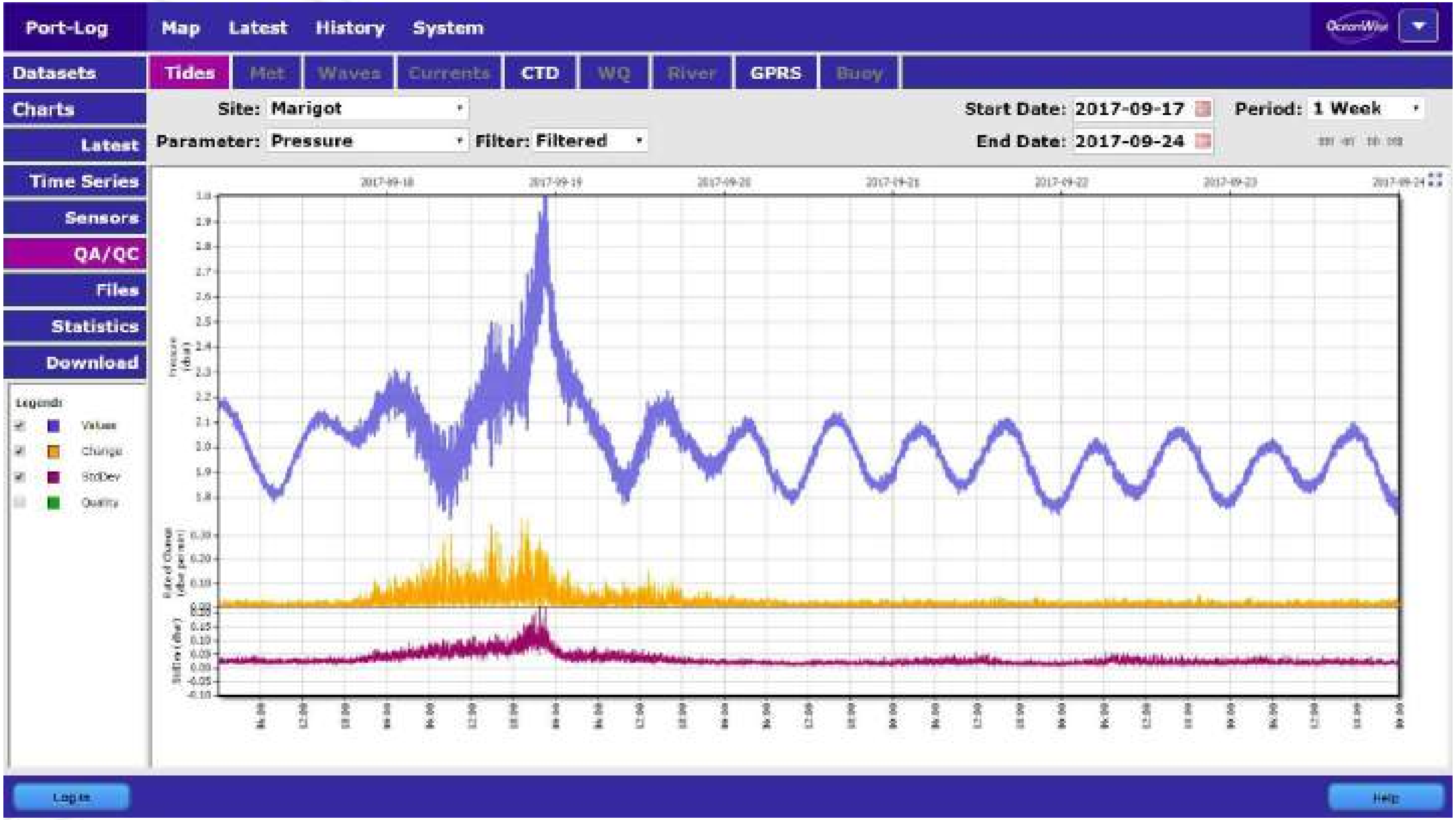
Hurricane Maria

- Communication was lost 2017-09-18 21:49:00 AST (UTC-4)
- All power lines down
- All telecoms down

- Nothing was heard from the island for 4 days.

- GPRS Comms restored about 7 days later …

Marigot – Post Maria



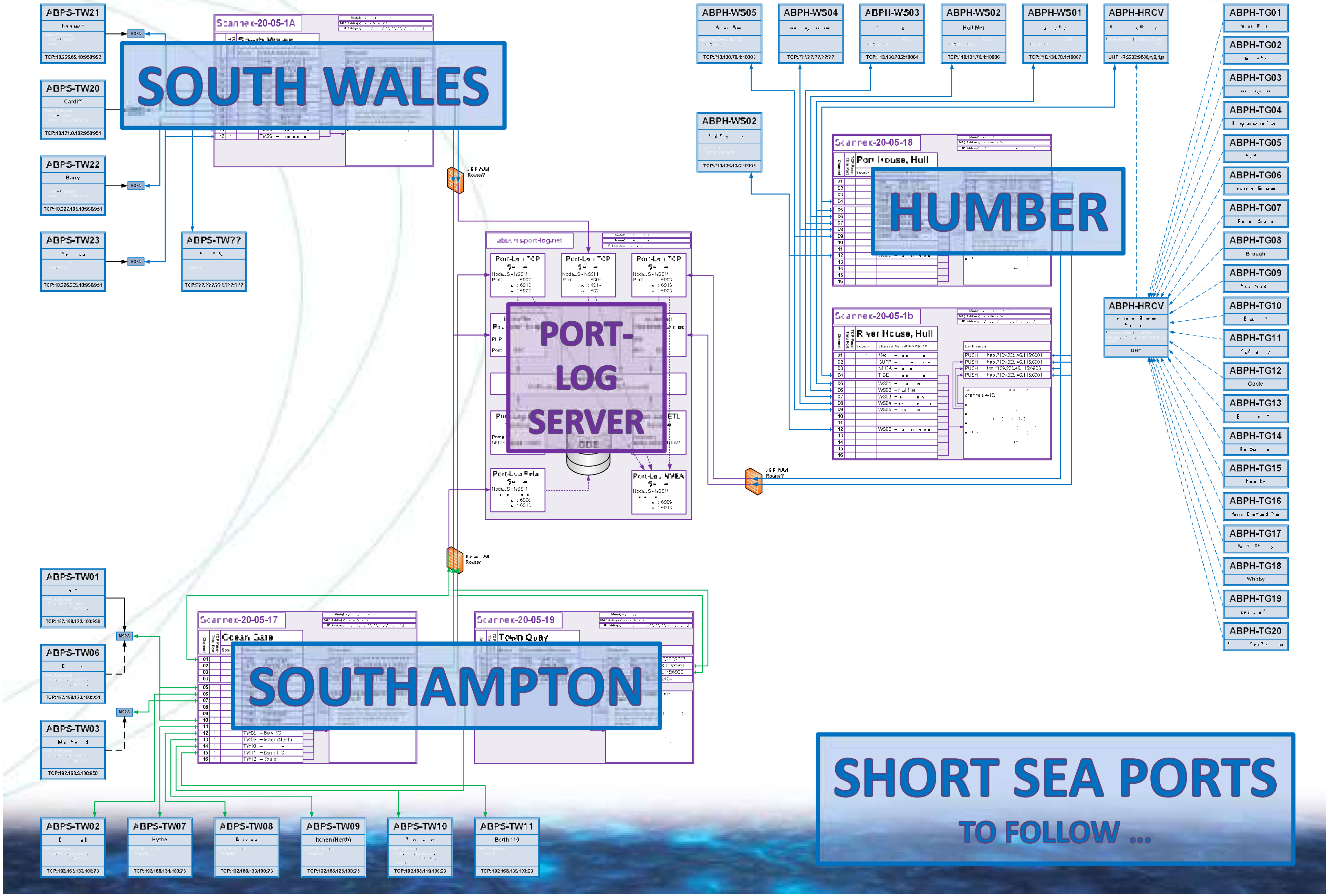
"The ip.buffer was installed for its resilience and ability to store and recover data when communications fail for short periods. However, to capture data throughout the Hurricane and then to recover all this data when communications were restored is unprecedented, we are extremely happy with its performance. We are not aware of any other modem being able to perform to this standard". Dr Mike Osborne, OceanWise

Case Study 2 – ABP Ports Group

Proving that by using the ip/rt.buffer we can deliver real-time environmental data from anywhere to anyone

Smart . Reliable . Secure

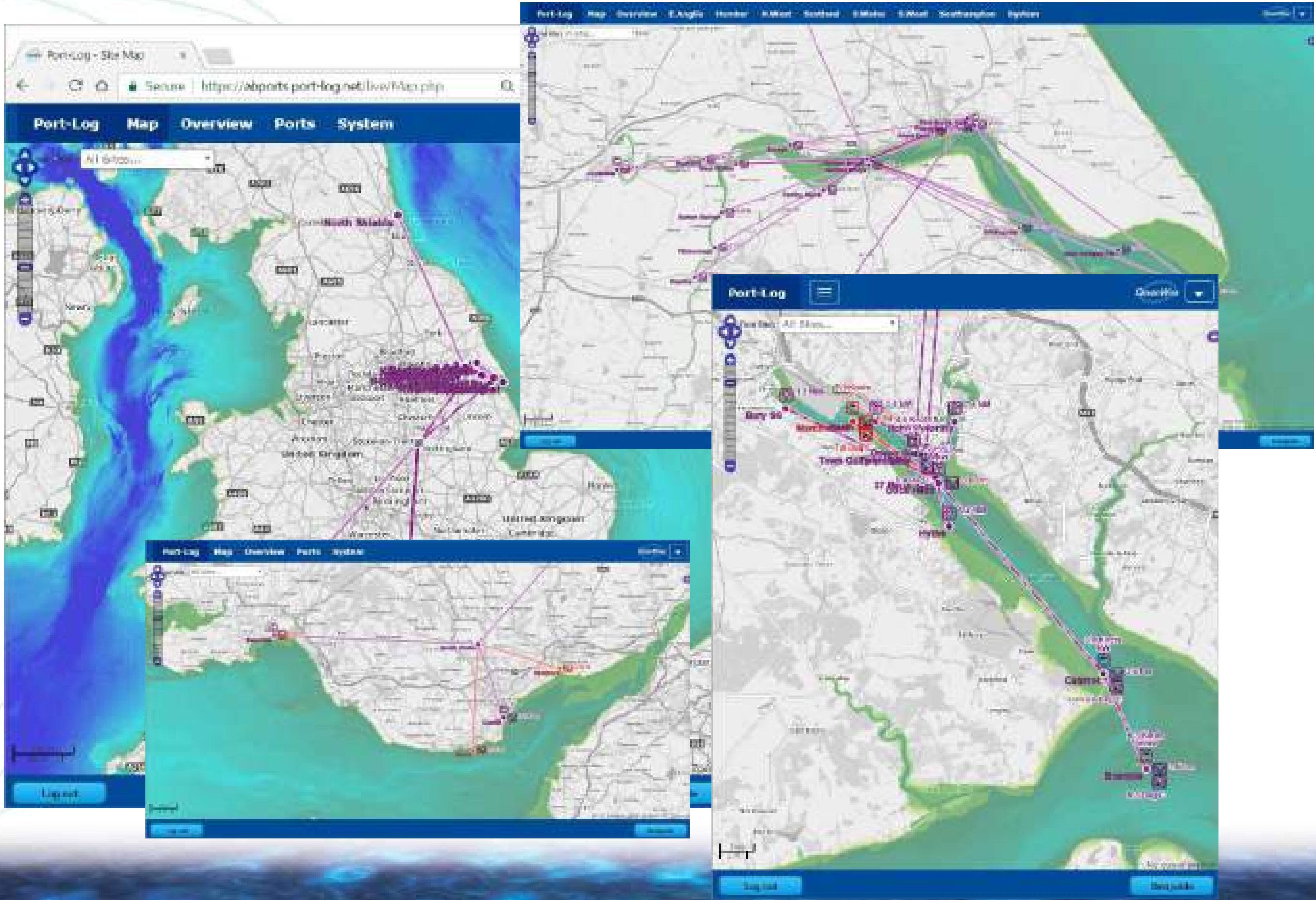
Network Diagram



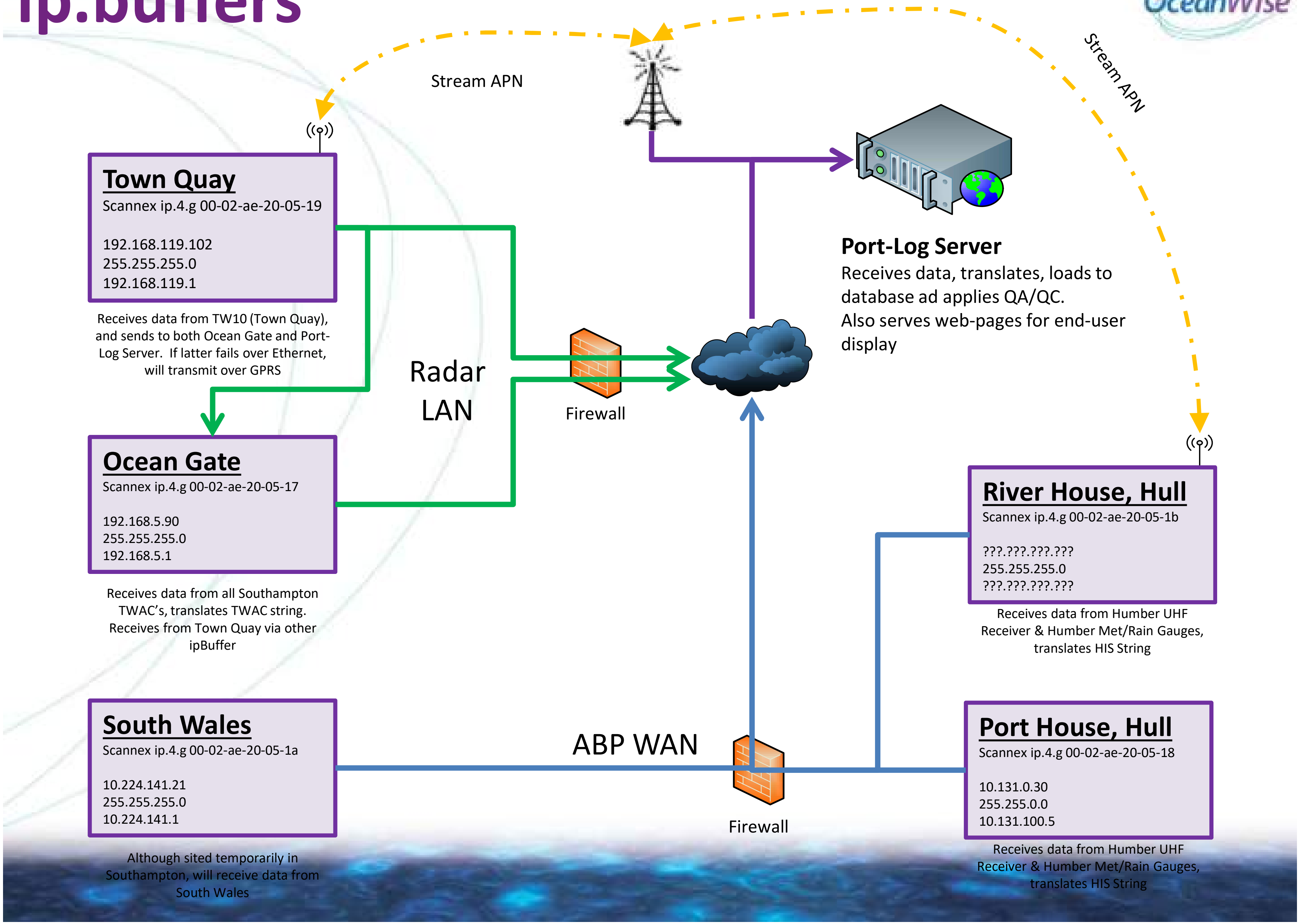
SHORT SEA PORTS

TO FOLLOW …

ABP Port-Log System



ip.buffers



Stream APN
Stream APN
Town Quay
Scannex ip.4.g 00-02-ae-20-05-19
192.168.119.102
255.255.255.0
192.168.119.1
Receives data from TW10 (Town Quay), and sends to both Ocean Gate and Port-Log Server. If latter fails over Ethernet, will transmit over GPRS
Radar LAN
Firewall
Port-Log Server
Receives data, translates, loads to database ad applies QA/QC.
Also serves web-pages for end-user display
Ocean Gate
Scannex ip.4.g 00-02-ae-20-05-17
192.168.5.90
255.255.255.0
192.168.5.1
Receives data from all Southampton TWAC's, translates TWAC string. Receives from Town Quay via other ipBuffer
River House, Hull
Scannex ip.4.g 00-02-ae-20-05-1b
???.???.???.???
255.255.255.0
???.???.???.???
Receives data from Humber UHF Receiver & Humber Met/Rain Gauges, translates HIS String
South Wales
Scannex ip.4.g 00-02-ae-20-05-1a
10.224.141.21
255.255.255.0
10.224.141.1
Although sited temporarily in Southampton, will receive data from South Wales
ABP WAN
Firewall
Port House, Hull
Scannex ip.4.g 00-02-ae-20-05-18
10.131.0.30
255.255.0.0
10.131.100.5
Receives data from Humber UHF Receiver & Humber Met/Rain Gauges, translates HIS String

Colour means everything

☰ Latest

Station	Wind Dir	Wind Sp	Gust Sp	Tide	Vis
Bramble	245° WSW	13.9 ↑	14.2 ↑	2.63 ↓	23.1 ↓
Calshot	242° WSW	10.5 ↑	14.2 ↑	2.64 ↓	27.0 ↓
Hythe					27.0 ↓
Dock Head	263° W	11.2 ↑	14.1 ↑	2.76 ↓	
Town Quay	275° W	10.7 ↑	13.5 ↑	2.99 ↓	32.4 ↓
Berth 105					40.5 ↑
Marchwood	244° WSW	7.4 ↑	7.9 ↑	-.--	
Bury SG					27.0 ↓
Itchen (North)					40.5 ↓

Sat Jan 28 2017 15:11:50 GMT+0000 (GMT Standard Time) Sun Set: 16:50

Updating in 8 seconds

Many Gauges Warning

☰ Latest

Station	Wind Dir		Wind Sp	Gust Sp	Tide	Vis
Bramble	175°	S	5.5 ↓	8.2 ↓	3.72 ↓	5.8 ↓
Calshot	166°	SSE	8.2 ↓	11.2 ↓	3.73 ↓	5.8 ↓
Hythe						5.2 ↓
Dock Head	165°	SSE	20.3 ↓	21.5 ↓	3.78 ↓	
Town Quay	167°	SSE	11.8 ↓	14.5 ↑	3.91 ↓	6.7 ↓
Berth 105						5.8 ↓
Marchwood			-.-	-.-	-.--	
Bury SG						7.3 ↓
Itchen (North)						7.7 ↓

Thu Jan 26 2017 13:05:49 GMT+0000 (GMT Standard Time) Sun Set: 16:47

Updating in 8 seconds

Many Gauges Timeout

☰ Latest

Station	Wind Dir	Wind Sp	Gust Sp	Tide	Vis
Bramble	--- —	-.-	-.-	-.--	-.-
Calshot	--- —	-.-	--.-	-.--	-.-
Hythe					-.-
Dock Head	--- —	--.-	--.-	-.--	
Town Quay	169° S	11.4 ↓	13.8 ↓	3.87 ↓	6.7 ↓
Berth 105					-.-
Marchwood	--- —	-.-	-.-	-.--	
Bury SG					-.-
Itchen (North)					-.-

Thu Jan 26 2017 13:39:56 GMT+0000 (GMT Standard Time) Sun Set: 10:47

Updating in 3 seconds

Parameter TimeOut

☰ Latest

Station	Wind Dir	Wind Sp	Gust Sp	Tide	Vis
Bramble	--- -	--.-	--.-	3.75 ↑	6.0 ↑
Calshot	--- -	--.-	--.-	3.66 ↑	5.3 ↑
Hythe					4.6 ↓
Dock Head	--- -	--.-	--.-	3.66 ↑	
Town Quay		-.-	--.-	3.88 ↑	5.8 ↓
Berth 105					4.8 ↓
Marchwood		-.-	-.-	-.--	
Bury SG					6.0 ↑
Itchen (North)					5.4 ↓

Thu Jan 26 2017 08:39:33 GMT+0000 (GMT Standard Time) Sun Set: 16:47

Updating in 4 seconds

Thank you for listening

Want to know more?

Please come and talk to us on our stand R6

For a copy of the presentation please email
katie.eades@oceanwise.eu


OceanWise
Data
Intelligent Marine and
Coastal Mapping Data
Monitoring
Environmental Data
Sharing and Publishing
Governance
Data Policy, Strategy and
Management Systems
Software
Enterprise GIS and
Productivity Tools
Training
Capacity Building,
Training and Mentoring
where your data matters