



The Digital Ocean: Data, Data, Everywhere.

Connecting Sea to Space to Shore:
Satellites in the Digital Ocean.

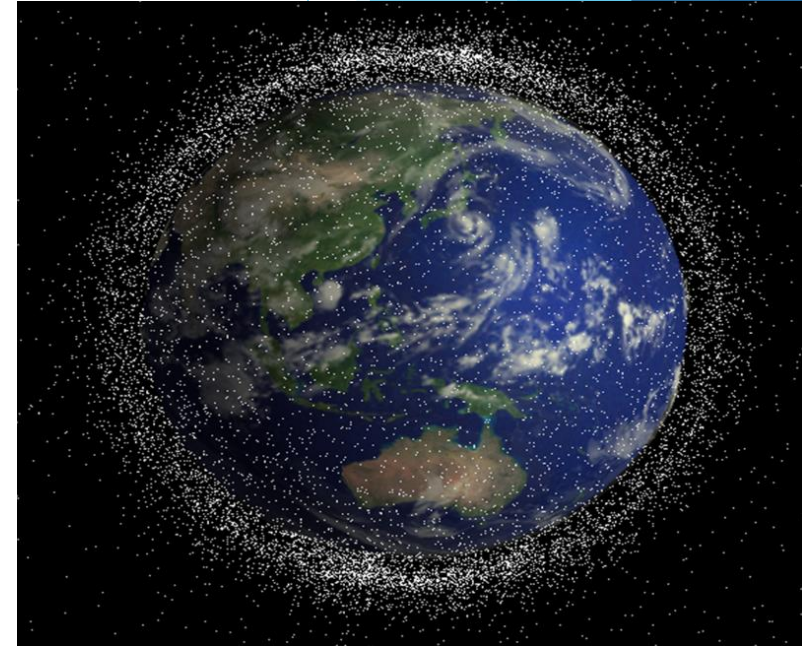
Graham Stickler

World Ocean Council Sustainable Ocean Summit,
Rotterdam, Netherlands, 30 November - 2 December, 2016



Focus

- ▶ Satellites are playing an increasingly important role in the Oceans
 - ▶ Data collection sensors themselves
 - ▶ Sensor communications
 - ▶ Data communications channel
 - ▶ One and two-way
 - ▶ E-Navigation
- ▶ Today, only concentrating on Satellites as Sensor platforms





Imaging from Space

▶ Optical imagery

- ▶ From the early days of Landsat 1 in early 70's the earth has been 'pictured' with increasingly accuracy and regularity
- ▶ DigitalGlobe satellites (WorldView, GeoEye, QuickBird, IKONOS) capture between 50 and 60 terabytes of imagery every day and has a library of more than 80 petabytes.
- ▶ Landsat, Airbus (Pleiades, SPOT,), BlackBridge, RapidEye, Deimos, Urthecast
- ▶ Planet Labs Inc began launching its first 'flock' of nanostaellites into space in 2014. The goal is to capture high-res snapshot of the entire globe every 24 hours.
- ▶ And 70% of the planet (the Ocean) has been largely ignored until now.

▶ Then there's radar!

- ▶ Airbus TerraSAR, RadarSat, Sentinel,



Credit: NASA



Weather and Oceans

- ▶ Weather
 - ▶ TIROS-1 in 1960, Nimbus, ESSA, NOAA, GOES ... GOES-R (Nov 19 2016)
 - ▶ Atmospheric Infrared Sounder, AIRS, NASA
 - ▶ Greenhouse Gases Observing Satellite "IBUKI" (GOSAT), JAXA
 - ▶ Measurement of Pollution in the Troposphere (MOPITT), NASA
 - ▶ Global measurements of atmospheric CO₂, OCO₂, NASA JPL
- ▶ Ocean related
 - ▶ ERS Program, ESA
 - ▶ Wave swell and surface wind, CFOSAT, France/China
 - ▶ MetOp-A, ADEOS-1, QuikSCAT, Jason-1, ERS-1, ENVISAT, TRMM, AQUA




GOES-R
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE R-SERIES

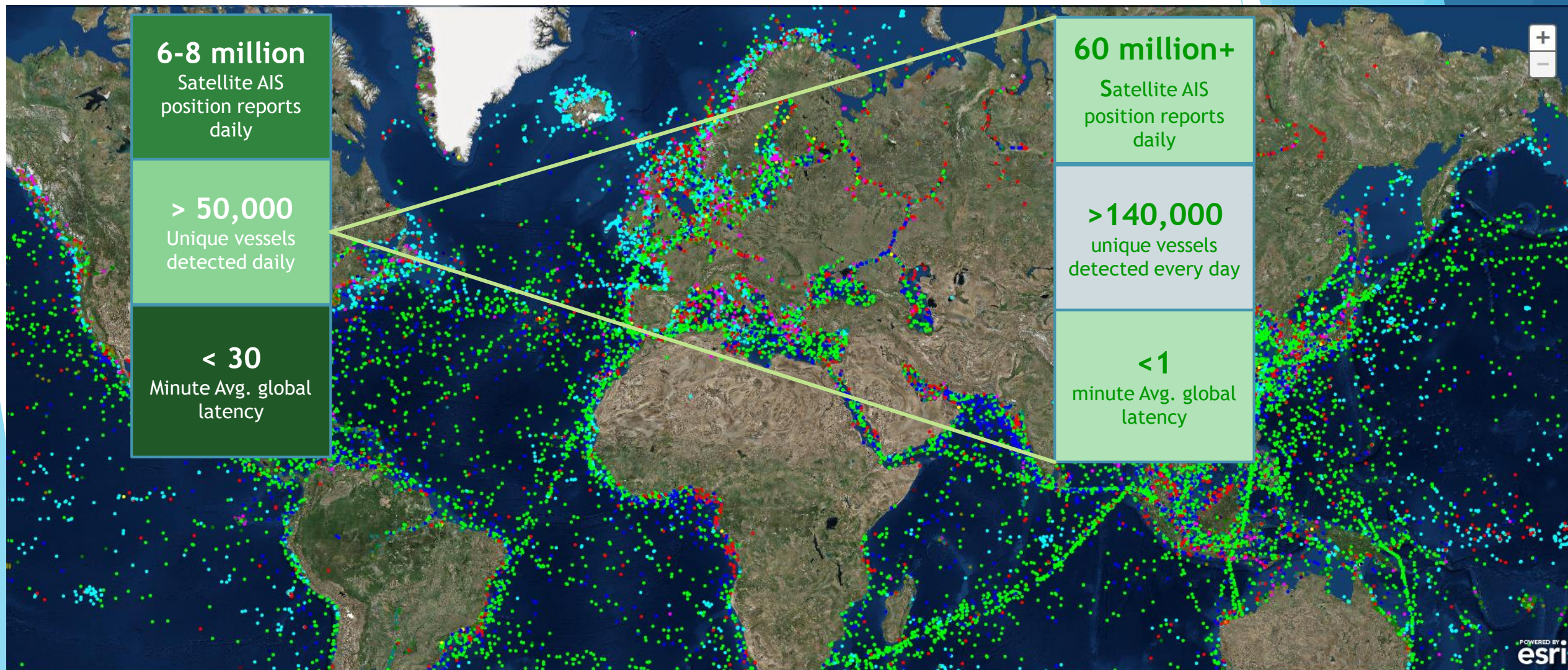
**The next generation
of geostationary
environmental
satellites**

The GOES-R series will provide significant improvements in the detection and observations of meteorological phenomena that directly affect public safety, protection of property and our nation's economic health and prosperity.

 www.noaa.gov  www.nasa.gov



Ship Tracking: Satellite-AIS Growth





Other Sensors

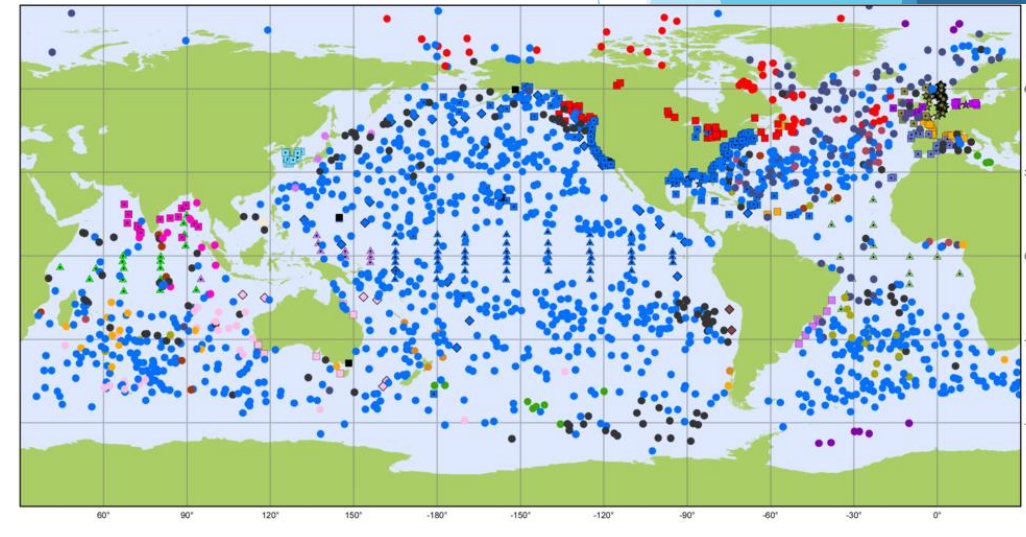
- ▶ Aircraft, Drones, UAVs, Buoys, Ships ('Fleet Sourcing')
- ▶ NOAA GOOS Program
 - ▶ NOAA National Data Buoy Centre
 - ▶ Static plus Global Drifter Array. Satellite-tracked surface drifting buoy observations of currents, sea surface temperature, atmospheric pressure, winds and salinity.
 - ▶ DART (Deep-ocean Assessment and Reporting of Tsunamis)
 - ▶ ARGO - 3739 Buoys reporting 29 Nov 2016
- ▶ Drones, UAVs



Courtesy NOAA



Image courtesy of Liquid Robotics.



Map from the Data Buoy Cooperation Panel (DBCP) website showing deployed Buoys by Platform Type as of September, 2016. 1421 buoys in GDP.



Big data? - Yes, but it's not just the amount of data, its now about volume too - i.e. throughput!



Courtesy of the MITRE Corporate Archive
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The challenge

- ▶ How do we bring all this data together and empower users with information so that they can make decisions?
 - ▶ Without those same users having to invest huge sums in infrastructure and 'technology expertise training'
 - ▶ The remote sensing industry hasn't changed in 30 years - still selling pixels.

- ▶ What is needed?

- ▶ Storage: 'The Cloud'; (the easiest bit) eg Amazon,
 - ▶ Common access points, eg GEOSS, MapMart, CloudEO, DigitalGlobe BGDX
 - ▶ (Big Data) Analytics including AI <coming fast>
 - ▶ <missing layer>: integrate, fuse, access to actionable intelligence
 - ▶ Question for the audience?
 - ▶ Who is defining and delivering your Information and Intelligence requirements?
- ▶ A tidal wave of data is upon us. Yes it could reveal a new whole dimension to our understanding of the Oceans. Do we have the necessary surfboards to ride it or will it just crash all over us?

