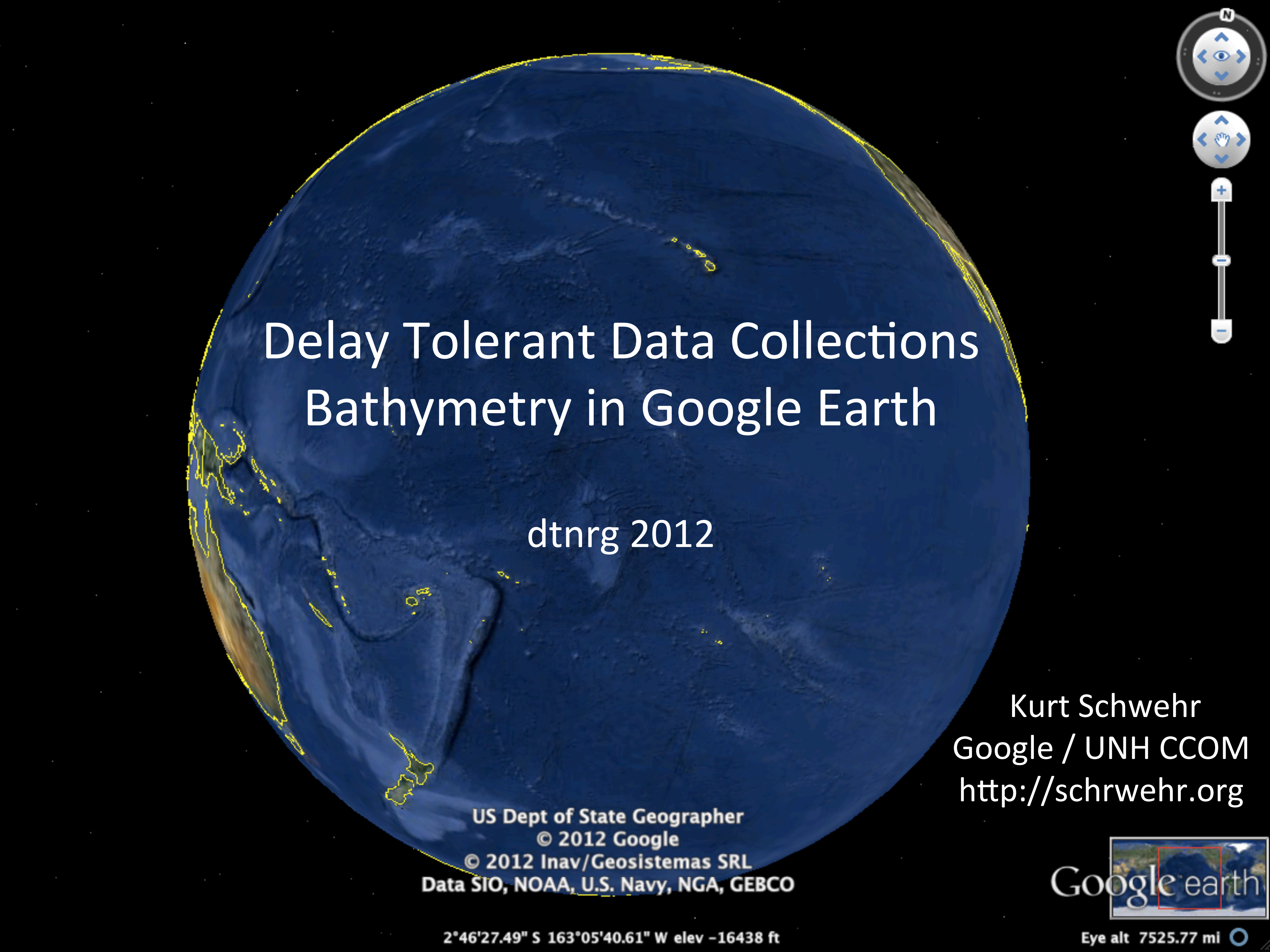
Delay Tolerant Data Collections
Bathymetry in Google Earth

dtnrg 2012

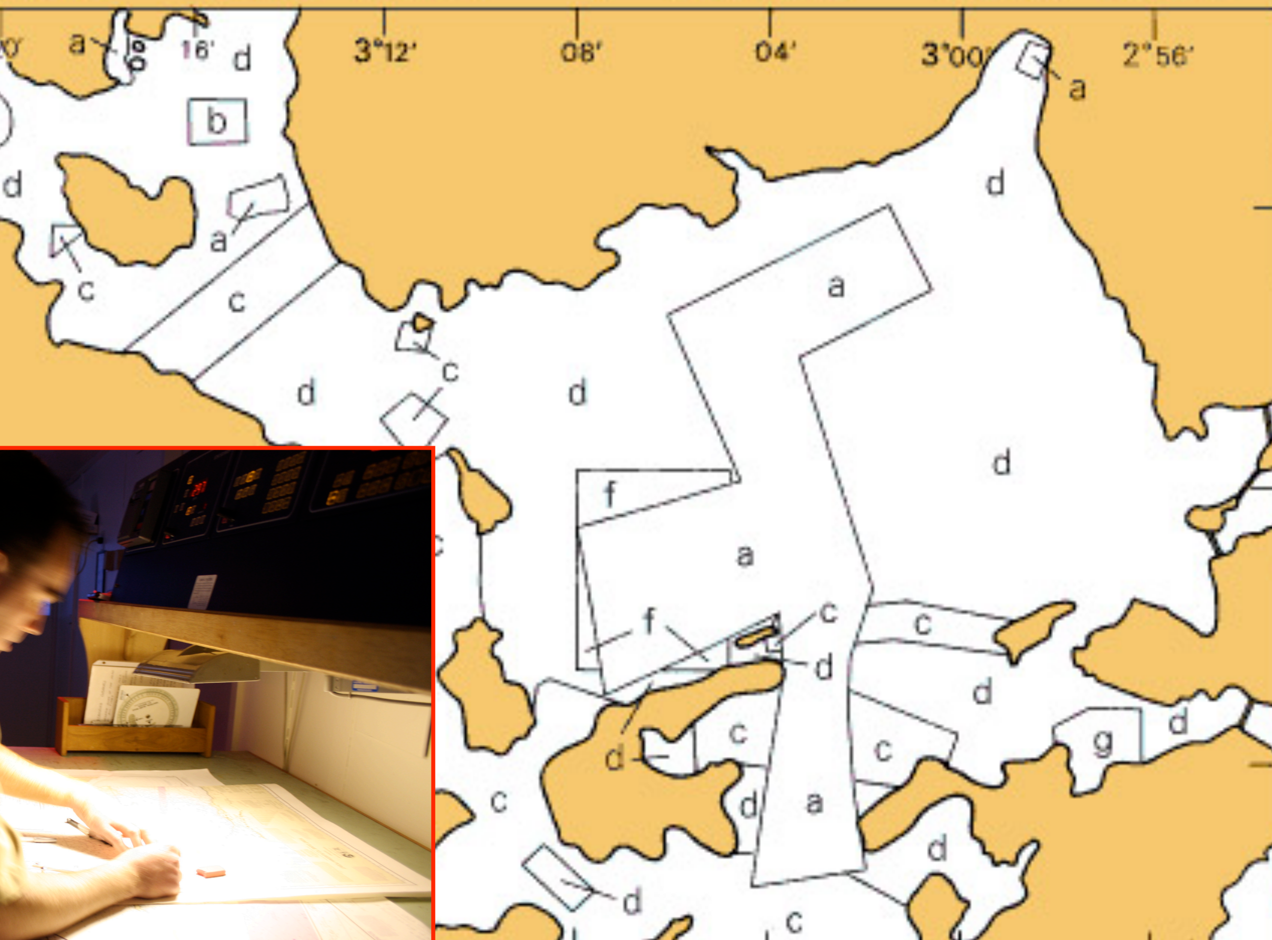
Kurt Schwehr
Google / UNH CCOM
http://schrwehr.org

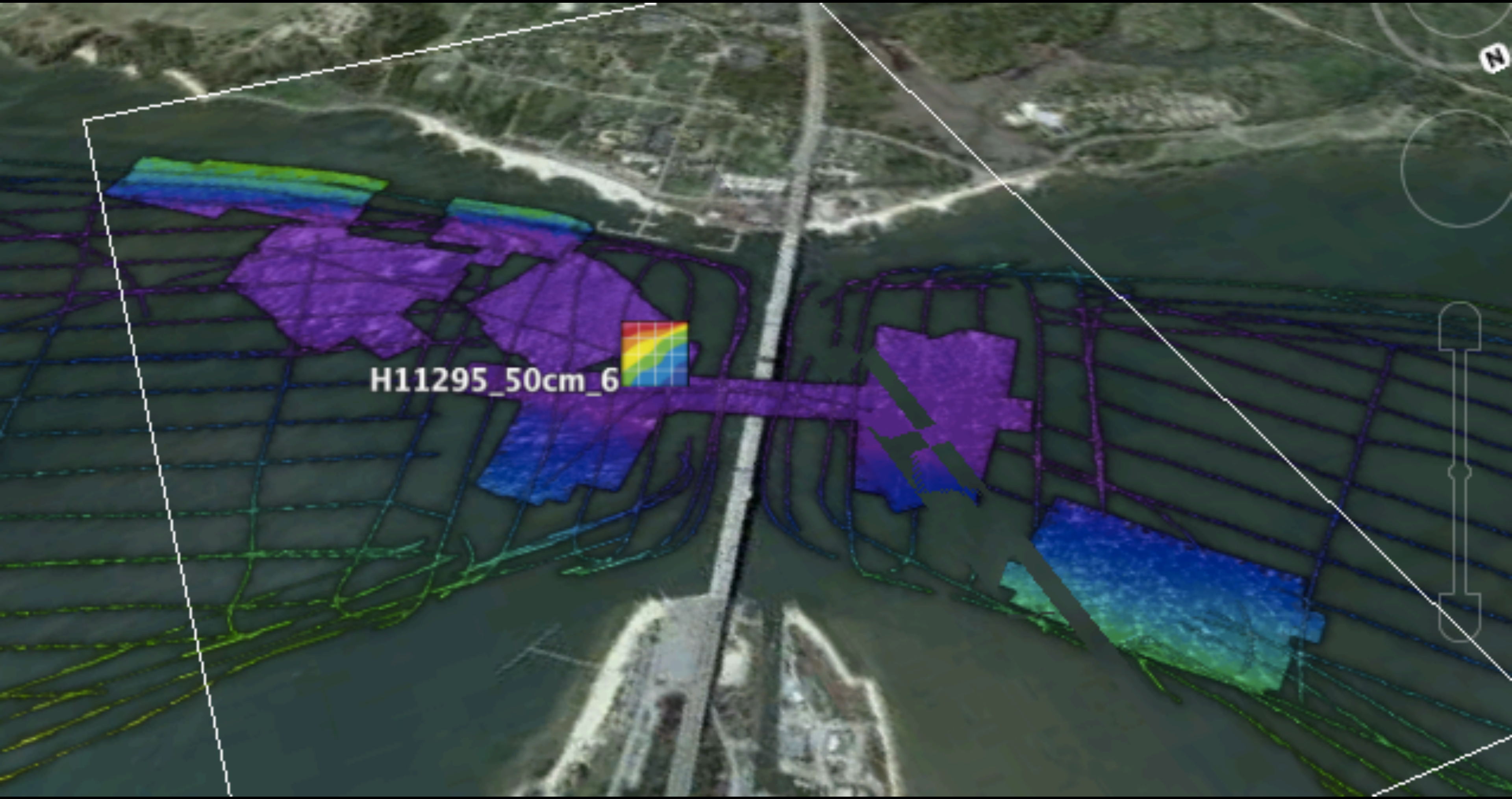


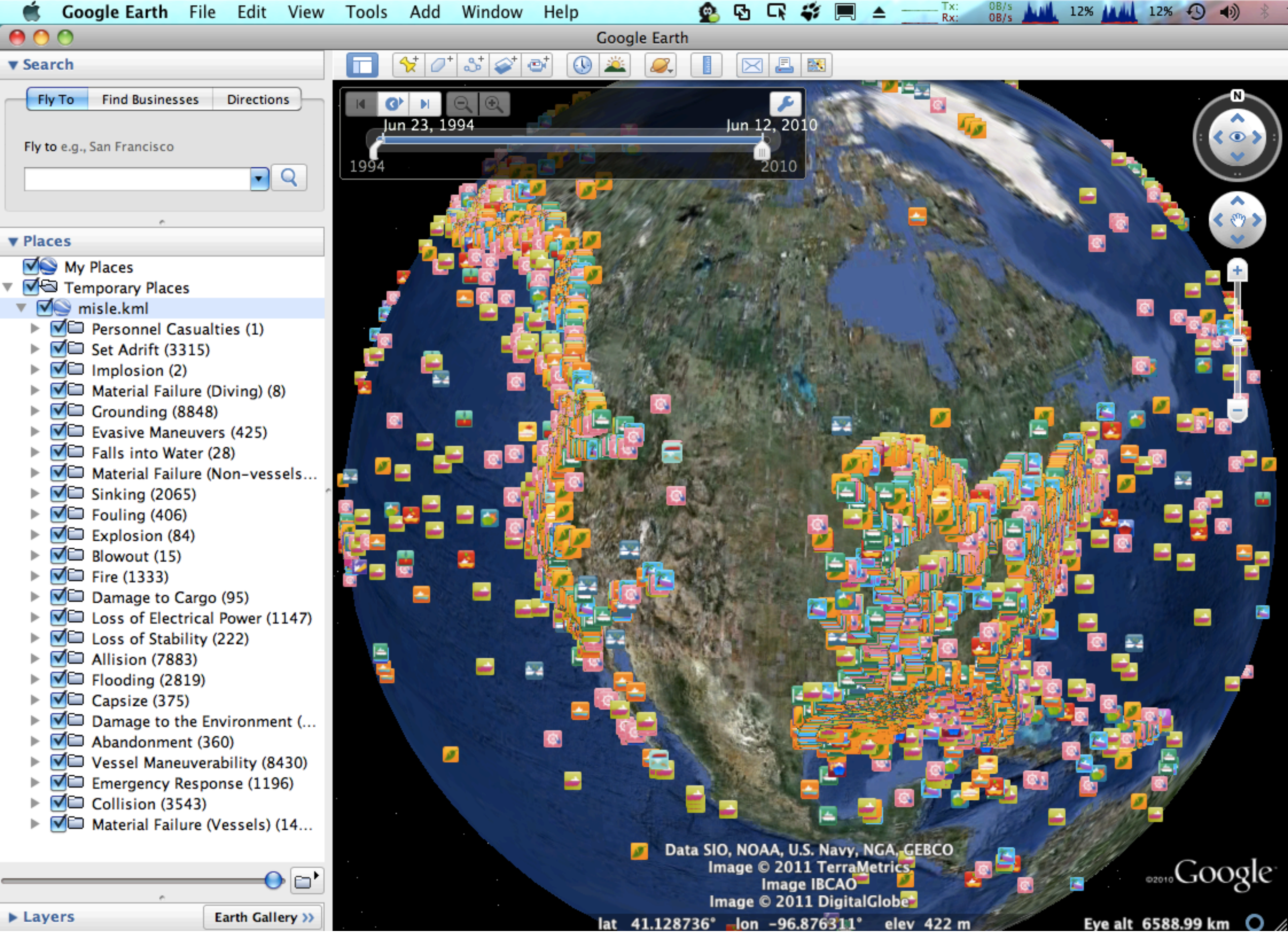
As a community, are we ready for another difficult incident?

SOURCE DATA

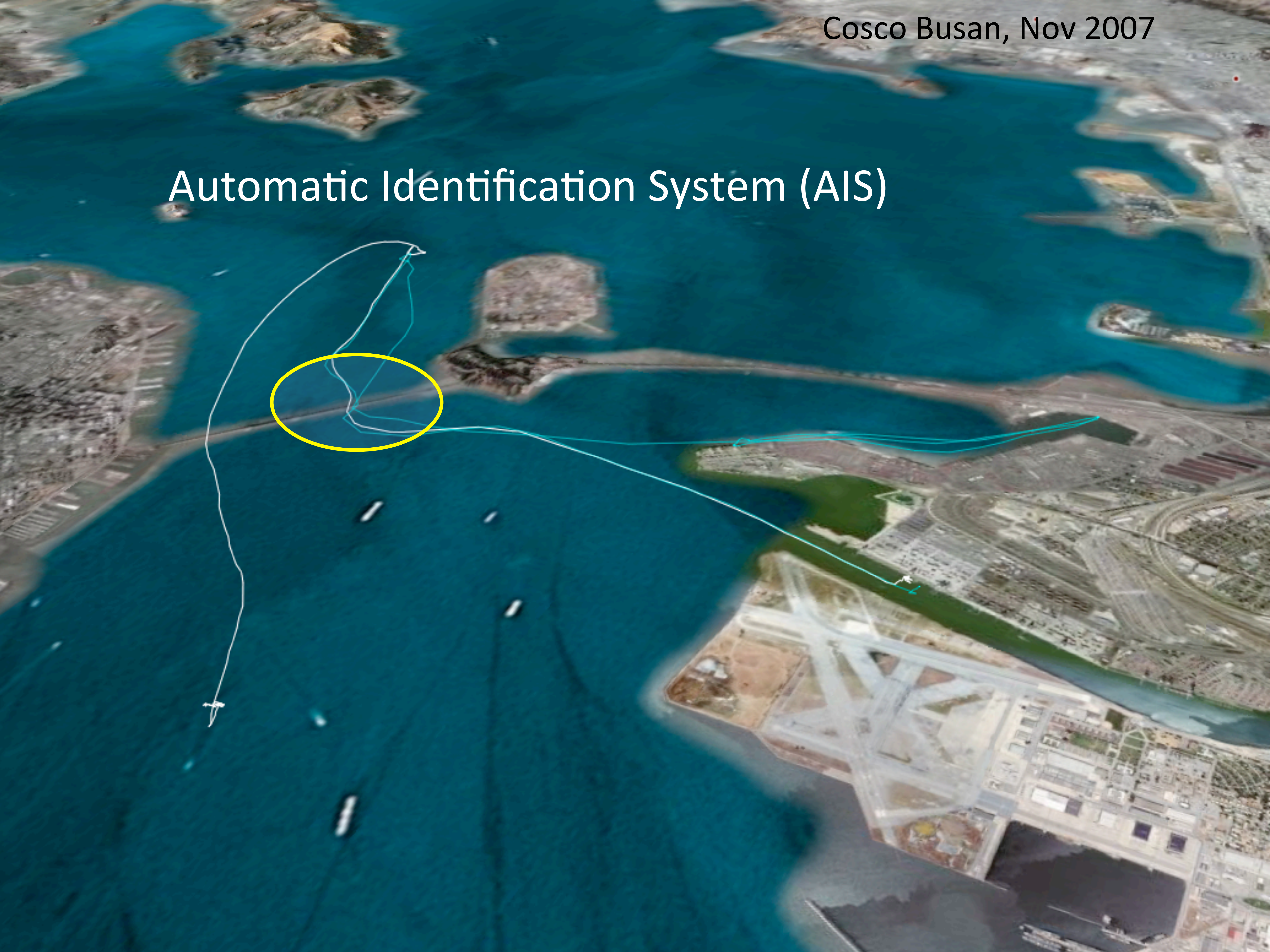
Orkney Islands Council Surveys			**British Government Surveys (leadline)**		
a	2000	Digital	d	1905-1919	1:10 000 - 1:11 083
Highlands & Islands Enterprise Surveys			e	1842	1:25 120
b	2002	1:5000	**Commercial Surveys**		
British Government Surveys			f	1981	1:5000 - 1:10 000
c	1938-1956	1:5000 - 1:13 710	g	1975-1976	1:2000 - 1:5000

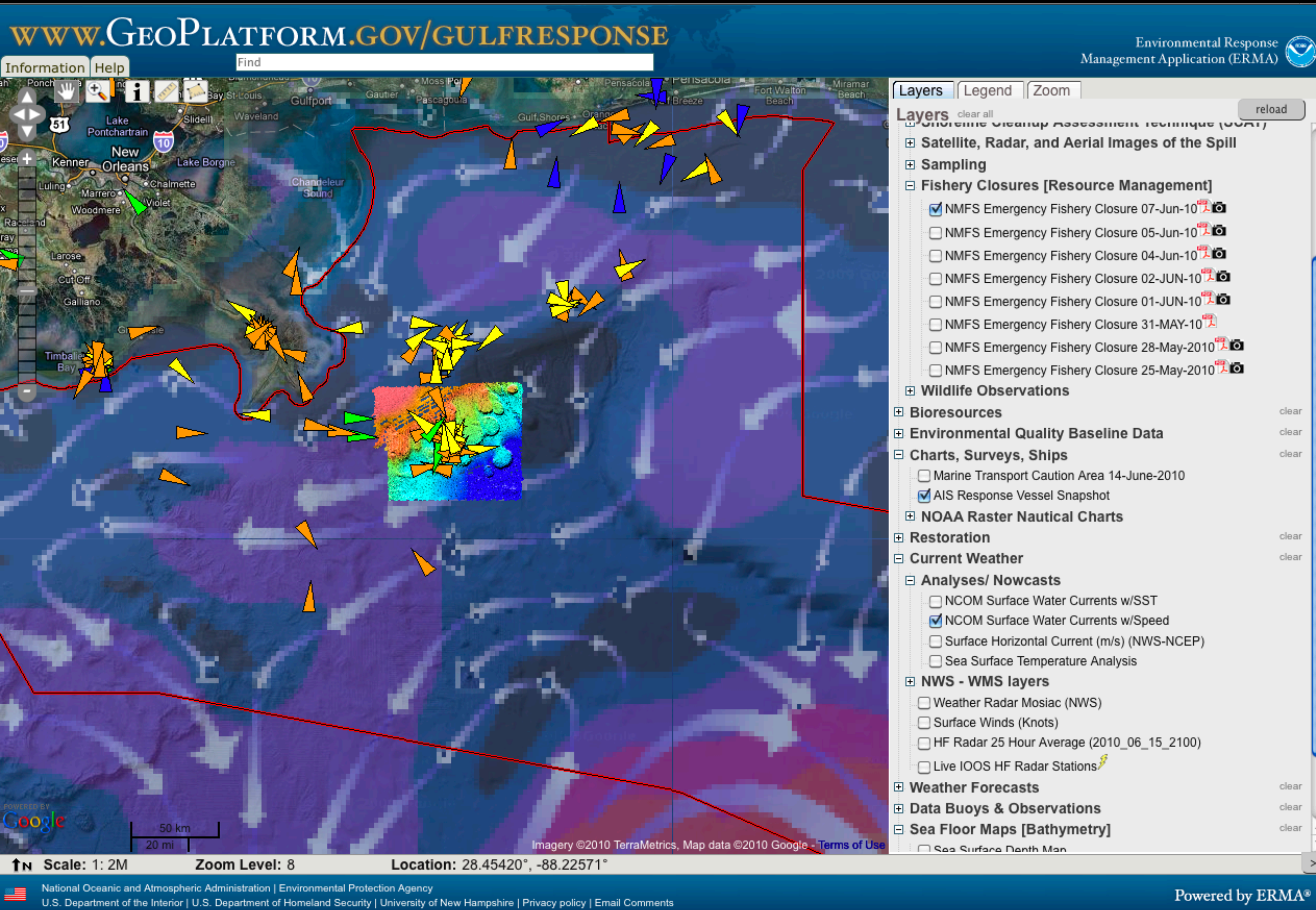



H11295_50cm_6


Google Earth
File
Edit
View
Tools
Add
Window
Help
Google Earth
Search
Fly To
Find Businesses
Directions
Fly to e.g., San Francisco
Places
My Places
Temporary Places
misle.kml
Personnel Casualties (1)
Set Adrift (3315)
Implosion (2)
Material Failure (Diving) (8)
Grounding (8848)
Evasive Maneuvers (425)
Falls into Water (28)
Material Failure (Non-vessels...
Sinking (2065)
Fouling (406)
Explosion (84)
Blowout (15)
Fire (1333)
Damage to Cargo (95)
Loss of Electrical Power (1147)
Loss of Stability (222)
Allision (7883)
Flooding (2819)
Capsize (375)
Damage to the Environment (...
Abandonment (360)
Vessel Maneuverability (8430)
Emergency Response (1196)
Collision (3543)
Material Failure (Vessels) (14...
Layers
Earth Gallery
Jun 23, 1994
Jun 12, 2010
1994
2010
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2011 TerraMetrics
Image IBCAO
Image © 2011 DigitalGlobe
Google
lat 41.128736° lon -96.876311° elev 422 m
Eye alt 6588.99 km


Fly to e.g., 1600 Pennsylvania Ave, 20006
Places
Add Content
3304-636091349
3305-636091349
3306-636091349
3307-636091349
3308-636091349
3309-636091359
3310-636091359
3311-636091371
3312-636091389
3313-636091394
3314-636091394
Layers
Primary Database
Geographic Web
Roads
3D Buildings
Street View
Borders and Labels
Traffic
Transit 3312 : 636091389
MMSI: 636091389
Transit point range: 2715789 to 2717047
Time range: 2008-09-06T04:50:24Z to 2008-09-06T06:09:49Z
Total pos reports: 784
SOG: 13.6 to 14.8
time frame calls: []
time frame names:
all possible names: GREEN POINT
Directions: To here - From here
Transit 3312 : 636091389


Cosco Busan, Nov 2007
Automatic Identification System (AIS)


WWW.GEOPLATFORM.GOV/GULFRESPONSE
Environmental Response
Management Application (ERMA)
Information
Help
Find
Layers
Legend
Zoom
Layers clear all
reload
Satellite, Radar, and Aerial Images of the Spill
Sampling
Fishery Closures [Resource Management]
NMFS Emergency Fishery Closure 07-Jun-10
NMFS Emergency Fishery Closure 05-Jun-10
NMFS Emergency Fishery Closure 04-Jun-10
NMFS Emergency Fishery Closure 02-JUN-10
NMFS Emergency Fishery Closure 01-JUN-10
NMFS Emergency Fishery Closure 31-MAY-10
NMFS Emergency Fishery Closure 28-May-2010
NMFS Emergency Fishery Closure 25-May-2010
Wildlife Observations
Bioresources
Environmental Quality Baseline Data
Charts, Surveys, Ships
Marine Transport Caution Area 14-June-2010
AIS Response Vessel Snapshot
NOAA Raster Nautical Charts
Restoration
Current Weather
Analyses/ Nowcasts
NCOM Surface Water Currents w/SST
NCOM Surface Water Currents w/Speed
Surface Horizontal Current (m/s) (NWS-NCEP)
Sea Surface Temperature Analysis
NWS - WMS layers
Weather Radar Mosiac (NWS)
Surface Winds (Knots)
HF Radar 25 Hour Average (2010_06_15_2100)
Live IOOS HF Radar Stations
Weather Forecasts
Data Buoys & Observations
Sea Floor Maps [Bathymetry]
Lake Pontchartrain
New Orleans
Kenner
Luling
Marrero
Chalmette
Woodmere
Violet
Lake Borgne
Slidell
Gulfport
Waveland
Bay St Louis
Gautier
Pascagoula
Moss Point
Gulf Shores
Pensacola
Fort Walton Beach
Miramar Beach
Chandeleur Sound
Larose
Cut Off
Galliano
Timbalier Bay
Raceland
50 km
20 mi
Imagery ©2010 TerraMetrics, Map data ©2010 Google - Terms of Use
Scale: 1: 2M
Zoom Level: 8
Location: 28.45420°, -88.22571°
National Oceanic and Atmospheric Administration | Environmental Protection Agency
U.S. Department of the Interior | U.S. Department of Homeland Security | University of New Hampshire | Privacy policy | Email Comments
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DTN for Ocean going instruments is not new

Ocean Instrument Internet: Using Disruption Tolerant Networking (DTN) to Join Heterogeneous Oceanographic Instrumentation into a Single Network (OS45D-14)

Andrew Maffei[1], Kevin Fall[2], and Dale Chayes[3], Lee Freitag[1]

[1]Woods Hole Oceanographic Institution, [2]Intel Corporation, and [3]Lamont-Doherty Earth Observatory of Columbia University

Overview

The oceanographic community employs a variety of wireless technologies for communicating with sensors and instrument platforms at sea. High bit-error-rate communications channels, interrupted communications links, electrical power limitations and other challenges can make communications with these devices difficult.

Delay/Disruption Tolerant Networking (DTN) promises a future software framework that will permit researchers to use programs such as *dtnftp*, *dtnping*, and other specialized DTN network applications to communicate with *sometimes-connected* sensors and instruments as though they are reliably connected nodes attached to the Internet (although latencies might be high).

DTN also has the potential to increase the number of hop-by-hop communications paths available for sensor communications, improving reliability. In the following sections we introduce the concept of DTN and how it might be applied in the field of oceanographic research.

Oceanographic Instrumentation Networking Challenges

Lack of Network Infrastructure

- Remote oceanographic sensors may only be intermittently connected to shore-side data analysis and storage systems/data loggers.

Interruption

- Links may be interrupted due to scheduled down time, interference, or environmental hostility
- Due to scarcity of power and/or high $$$, the cost of communications can be high, making efficient utilization of communication opportunities very important.

Heterogeneity

- Instrument networks may require the use of multiple different communications protocols in each individual instrument system

A Sometimes Connected Ocean Observatory

Figure 1: Hypothetical set of ships, AUVs, moorings, aircraft, gliders, and shore stations that make use of a variety of wireless communications devices and protocols. Platforms are grouped into regions based on common data communications needs and device usage.

DTN Architecture: Regions, Gateways, and Convergence Layers

DTN segregates devices with common communications characteristics into groups or **regions**. Regions may be based on the type of wireless devices used by a group of instruments, the special way that a group of instruments optimizes the use of a low bandwidth channel (such as IRIDIUM SMS), by device ownership, or whatever makes most sense.

Once the regions are defined, the network operator configures a set of **gateways** between regions. This allows devices in different regions to communication among themselves or with the Internet, when available.. Gateways know how to talk to more than one region, how to translate protocol operations between regions, and how to store data for later transmission when network links are not immediately available.

Convergence layers are software modules used by gateways that abstract the specifics of a particular communication link so it can be used an interoperable way across regions.

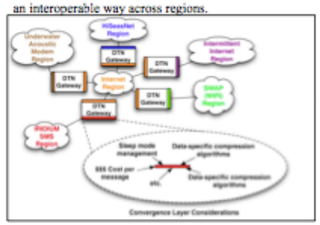


Figure 2: DTN groups devices into regions. In order for regions to inter-operate with one another a gateway is provided to connect the region to the Internet (or some other region). The convergence layer is the common piece of code that all devices in the same region use to deliver DTN messages called "bundles."

DTN Architecture: Bundles and Stacks

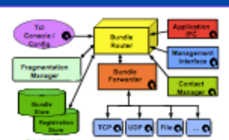
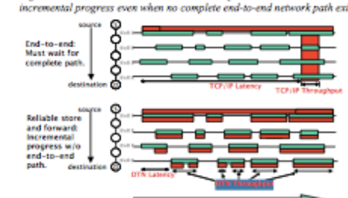
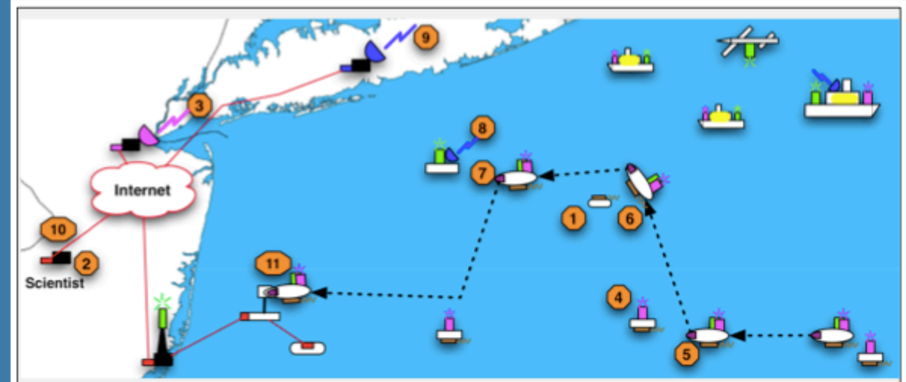


Figure 3: The DTN router module decides where and when to send bundles. The rest of the system handles translation, configuration, storage, and re-sending data if problems occur.

Figure 4: Unlike the common TCP/IP Internet protocols, DTN can make incremental progress even when no complete end-to-end network path exists.



Conceptual use of DTN for Distributed Oceanography



1	Instrument such as video plankton recorder with underwater acoustic modem continually collects data and issues *dtnsend* commands directing bundles to scientist's workstation on shore (even though they often do not arrive until months later). Bundles with plankton counts and summary info tagged as high priority. Video imagery tagged bulk.
2	Scientist on shore discovers Northeaster storm is coming and issues a *dtncp* command to send new sampling configuration file to instrument. File is sent by a bundle being directed to the instrument on the seafloor that is sitting in the AUV acoustics communications region.
3	DTN routing algorithm (unbeknownst to scientist) determines that this bundle (tagged by scientist as high priority) should be forwarded to IRIDIUM region DTN gateway (next-hop) for transmission.
4	Bundle is delivered to a mooring acting as DTN gateway between IRIDIUM region and AUV acoustics communications region knowing visit is scheduled for an AUV assigned to the coastal observatory.
5	DTN gateway code in mooring delivers DTN bundle for the undersea instrument to AUV 2 days later via acoustic modem. Bundle is of high enough priority, and has the appropriate authentication, to influence the AUV schedule to be changed so that it makes an unplanned visit to the observatory instrument for bundle delivery of the high-priority data.
6	AUV changes its schedule and proceeds to instrument. One day later it delivers mission plan (sent via *dtncp* command on shore) to the instrument via acoustic modem. At the same time it picks up the data that has been continually sent via *dtnsend* commands by instrument.
7	DTN routing algorithm indicates a route back to the scientist's workstation (for plankton counts and summary data) is available via a nearby mooring. AUV proceeds to that mooring and delivers high priority bundles via low-bandwidth acoustic modem.
8	Mooring IMMEDIATELY transmits data bundle to the HiSeasNet region gateway that is connected to the Internet.
9	HiSeasNet DTN gateway accepts bundle and delivers it to a data logging process on the scientist's workstation.
10	Data logging process integrates data into model that predicts how storm will affect area that instrument is deployed in.
11	AUV goes back to it's previous schedule and visits next mooring in its route. Afterwards it returns to the AUV dock to recharge its batteries and deliver the remaining bulk (video frames) data via the inductive Ethernet region.

Advantages of DTN for Oceanography

1. Instrument developers can write instrument code that no longer has to directly deal with communications, link management, etc. issues. Code can assume reliable comms and connectivity is handled "elsewhere."
2. Scientists can begin to rely on a more heterogeneous wireless network that is more reliable, better tested and specified, more secure, and that provides a wider geographic scope of availability.
3. Priority-based reliable data transport mechanisms are built into the core network stack, so instrument developers and scientists need not worry about precisely how data is routed but instead can focus on the importance and timeliness requirements for data in the abstract.

Acknowledgements

We thank the National Science Foundation, Intel Corporation, Woods Hole Oceanographic Institution and the Lamont-Doherty Earth Observatory for funding the work presented here.

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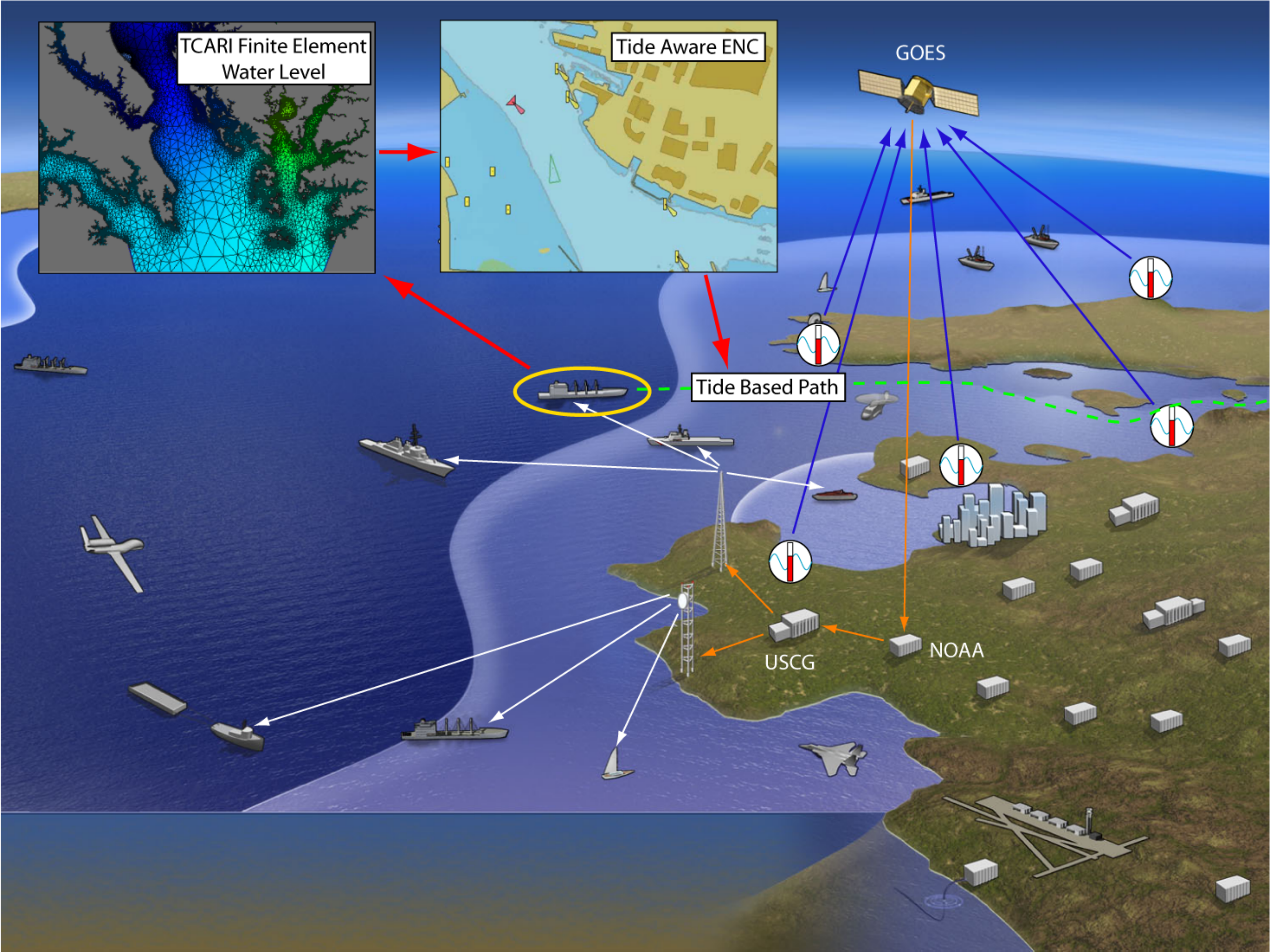
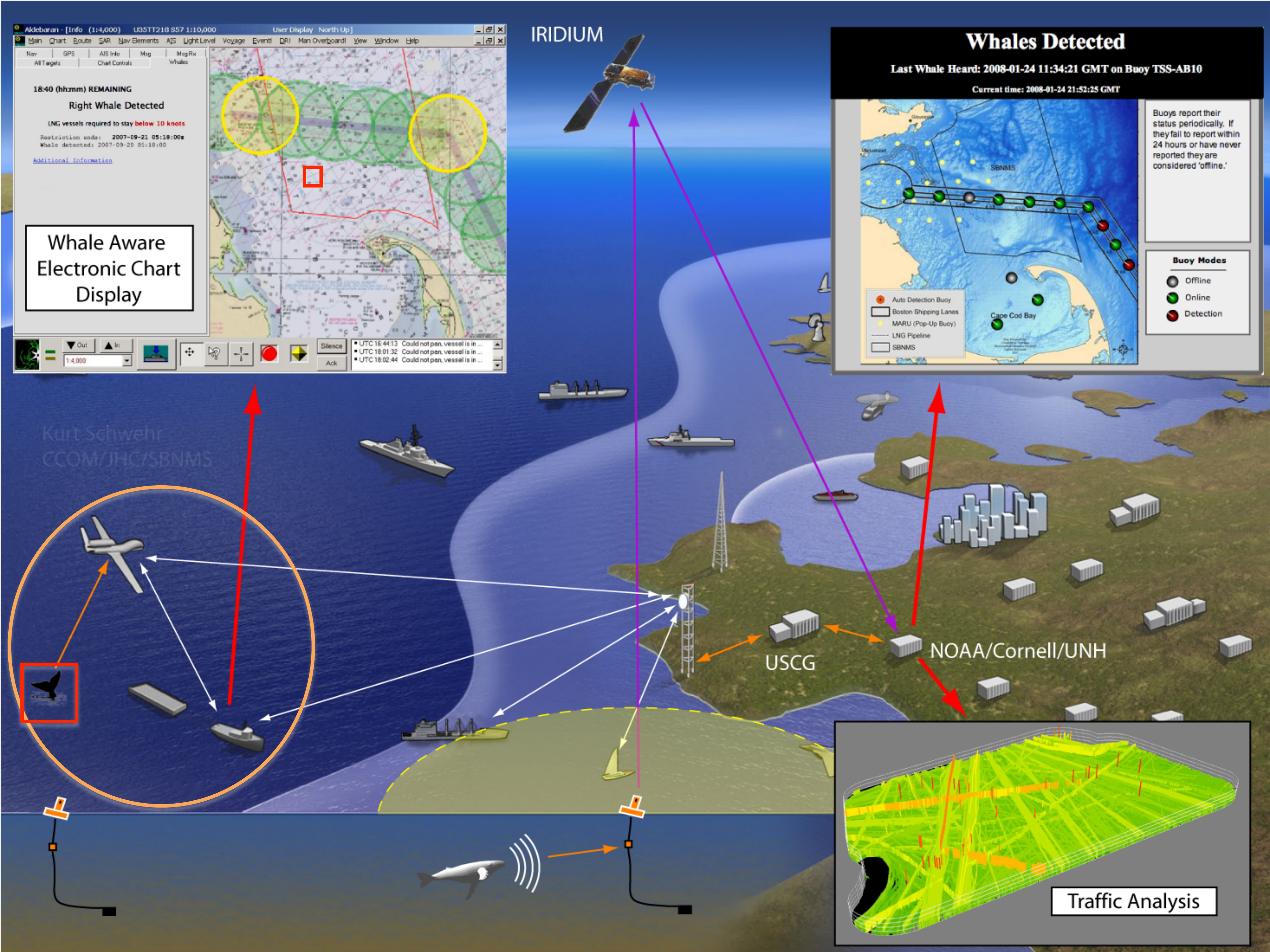

TCARI Finite Element Water Level
Tide Aware ENC
GOES
Tide Based Path
USCG
NOAA



IRIDIUM
Whales Detected
Last Whale Heard: 2008-01-24 11:34:21 GMT on Buoy TSS-AB10
Current time: 2008-01-24 21:52:25 GMT
Buoys report their status periodically. If they fail to report within 24 hours or have never reported they are considered 'offline.'
Buoy Modes
Offline
Online
Detection
Auto Detection Buoy
Boston Shipping Lanes
MARU (Pop-Up Buoy)
LNG Pipeline
SBNMS
Cape Cod Bay
18:40 (hh:mm) REMAINING
Right Whale Detected
LNG vessels required to stay below 10 knots
Restriction ends: 2007-09-21 05:18:00z
Whale detected: 2007-09-20 05:18:00
Additional Information
Whale Aware Electronic Chart Display
Kurt Schwehr
CCOM/JHC/SBNMS
USCG
NOAA/Cornell/UNH
Traffic Analysis

Goals

- Collect great data from sensing platforms
- Get data from platforms to processing teams
- Get raw and processed data to data centers
- End users get data and use it
- Update or create new request for sensing
- Rinse – repeat

Data volumes are growing fast! Currently GB to TB / day for sonars.

- Deep sonar: em302 collects 8GB / day
- Shallow sonar: Reson 7125 collects 2 GB/minute.

Where are we now

- Shipping around USB sticks and hard drives
  - Lots of effort to track physical entities
  - A fraction are lost or destroyed
  - Bizarre consequences of government rules
- Who knows what data has been collected?
- When will data be available?
- How long before an issue gets noticed?
- rsync is the cutting edge of the bathymetry world

Where do we want to be?

- Data sent in priority order (e.g. post huricane survey)
- Anyone can find out what has been collected and see where it is in the scheme
- Be able to push a small subset for validation in a style similar to progressive scan images. Shortest time to problem detection.
- Balance cost and take best advantage of each method of data transfer.
- Factor in backup with platform data capacity and stability. Do we need the “mail buoy”?
- Tools that “just know what to do” but allow the user to know too.

Issues

- Peer-to-Peer bad rap from BitTorrent
- Software technical skill levels generally low
- Need to think about data going both ways
- Community stuck on the file metaphor, but really we have streams of observations that range widely in size from bits to MB per observation. e.g. bool (T/F/Unknown) to seismic shot (thousands of hydrophones on streamers)
- Keeping the channel utilization high
- Ships not designed for data logging

Formats currently in use

- Raw bits/bytes
- ASCII – e.g. MGD77, CSV, old sonars
- ASCII NMEA (proprietary)
- Containers (e.g. netCDF, HDF5, etc)
- Proprietary Binary Packet Systems – e.g. (the not so) Generic Sensor Format (GSF)
- ProtoBuf, ASN.1, JSON/BSON, XML, AIS (w/ English language packet definitions)
- Streaming video / audio
- Email
- etc.

Video

For some applications, you might want realtime HD video if Channel A is available, reduced quality if Channel B, and otherwise 1 frame per X time.

Do we need "mail buoys?"

Thanks for listening!
http://schwehr.org

Want to know more?
http://tinyurl.com/da-paper
QR Code:

QR Code