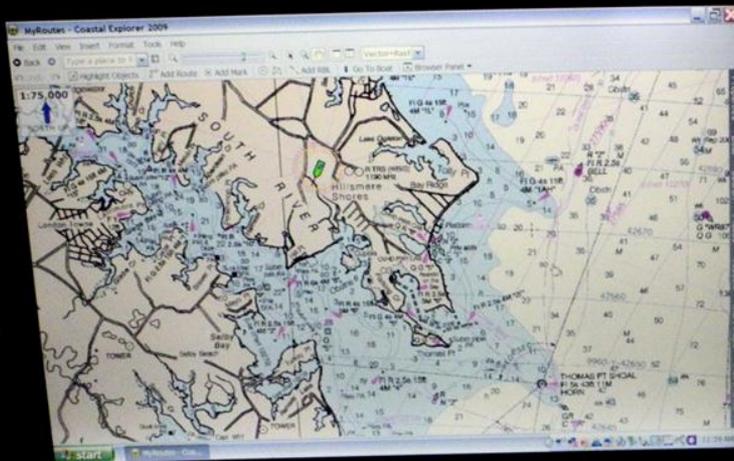




# *The Navigator's Art* *electronic navigation*

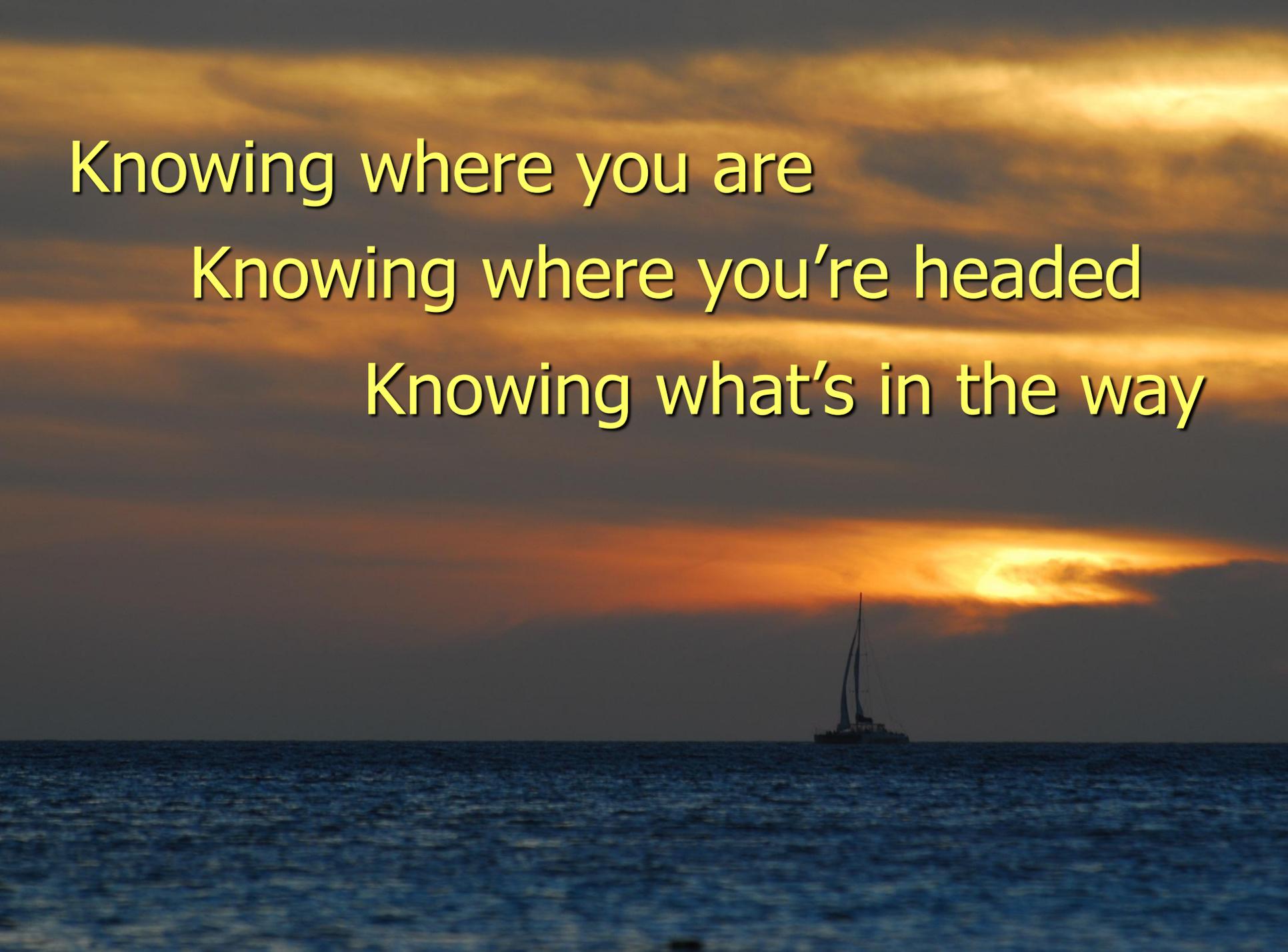
*Presented by- Ralph Naranjo*



Knowing where you are

Knowing where you're headed

Knowing what's in the way



# A new solution to an old puzzle



# Measuring certainty

▶ Visual fix



▶ Electronic fix



▶ Estimated position



▶ Dead Reckoning (DR)



# NMEA Conference



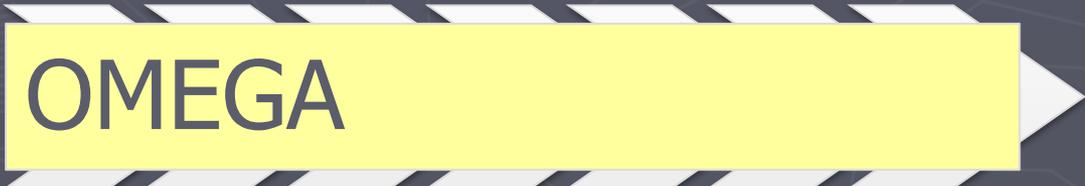
# Electronic Navigation



LORAN

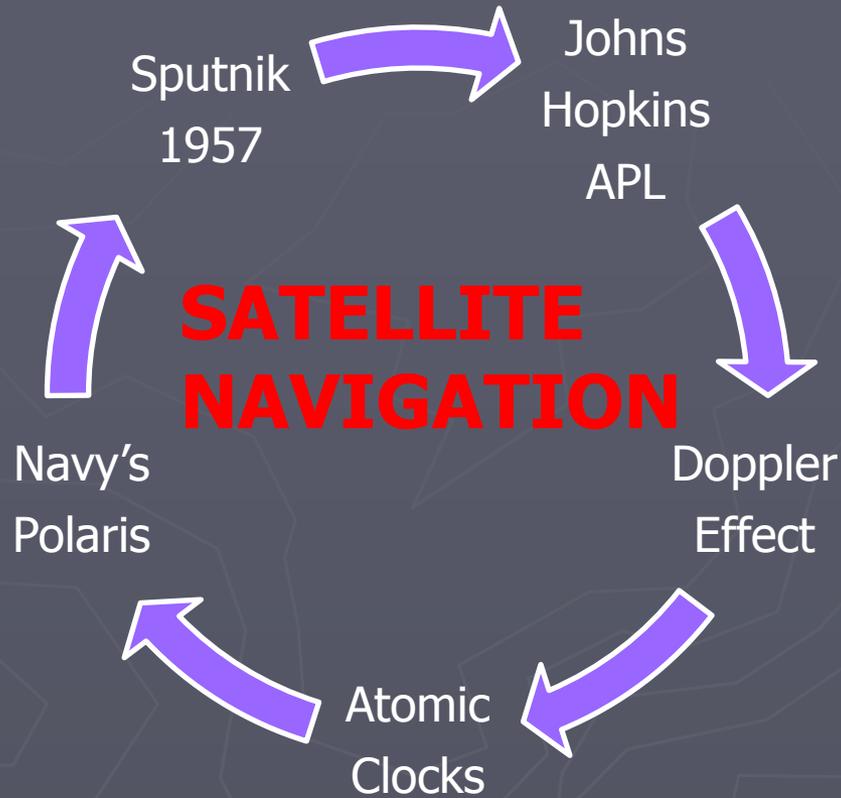


DECCA



OMEGA

# General Relativity



1973

Sat Nav

1984

GPS

2000

GPS (SA)

2012

Remove SA

GPS (Gen III) WASS



GLONASS

GALILEO

CHINA/INDIA



# Pseudorange



# Time counts

Sundial

Hour glass

Harrison's clock

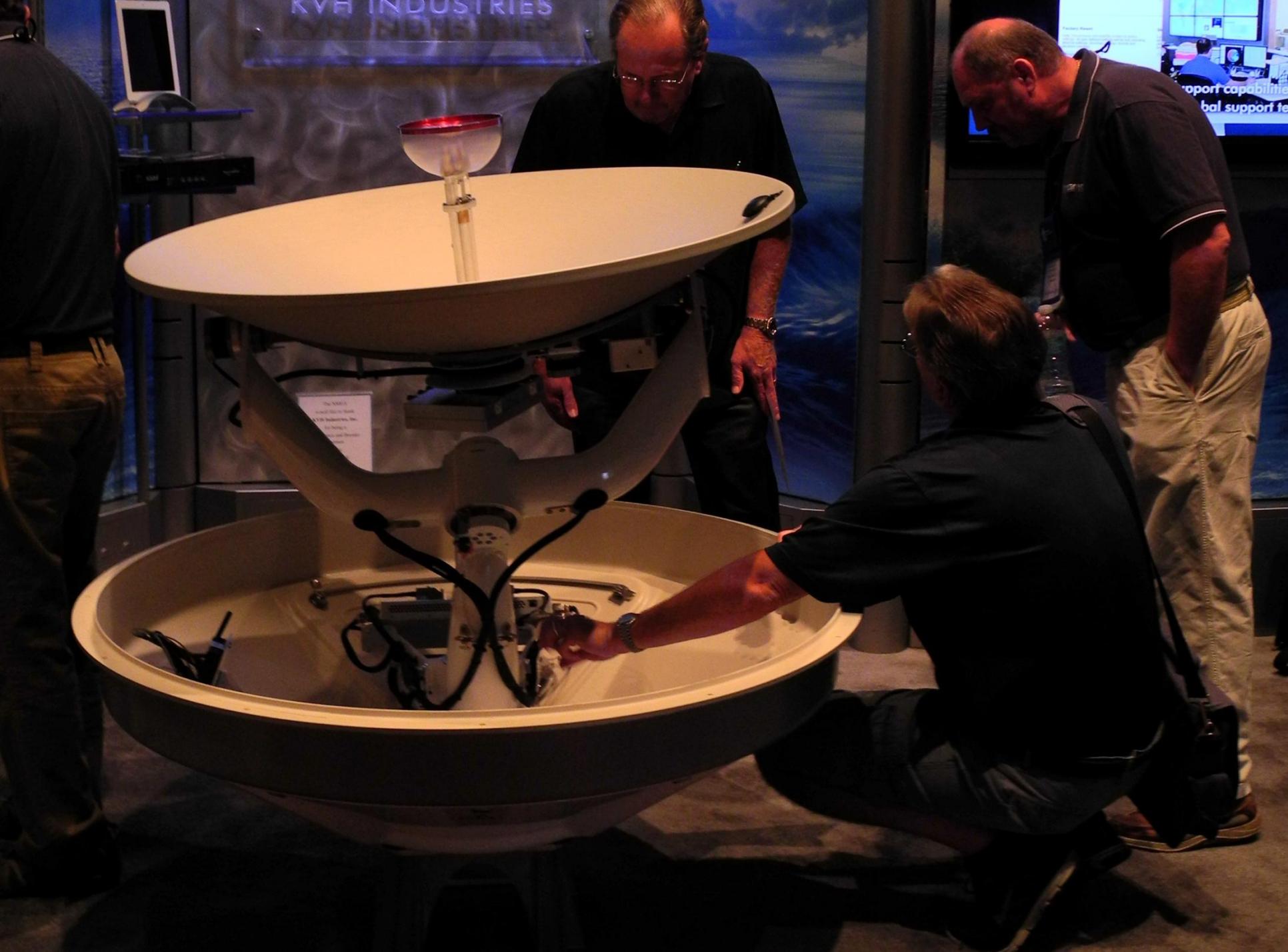
Quartz watch

Atomic clock

Quantum logic clock



KVA INDUSTRIES



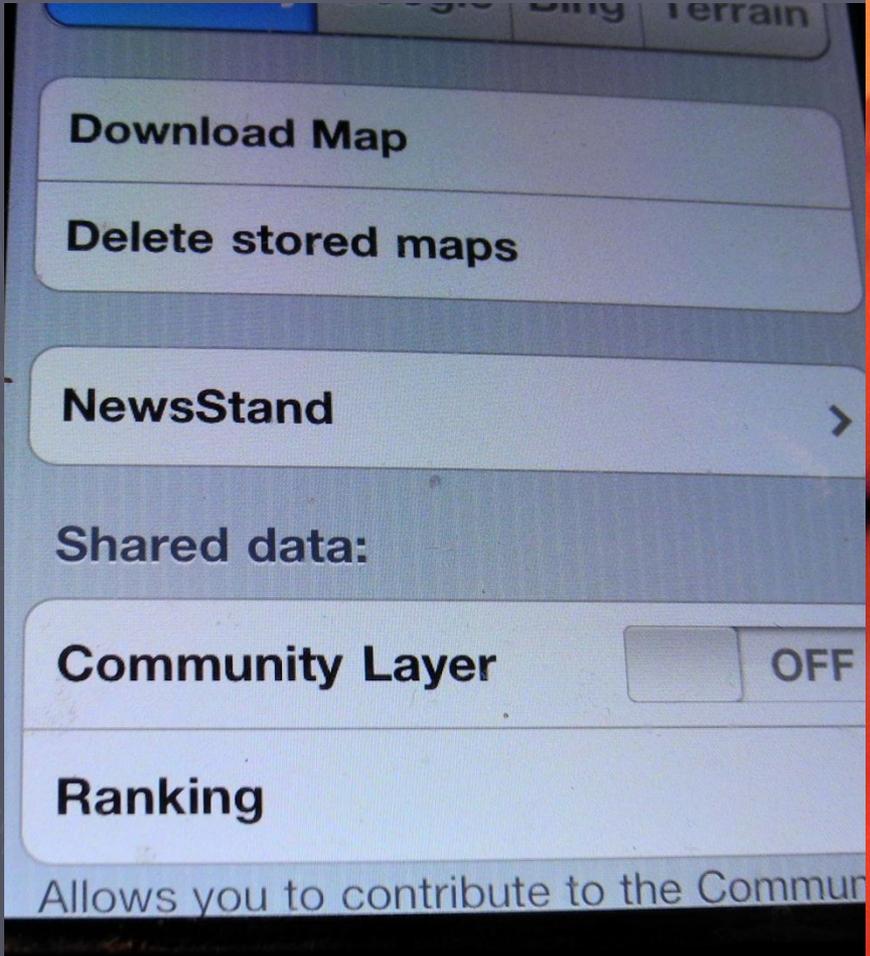
The KVA-100  
is a high performance  
satellite antenna, the  
KVA-100 is a  
high performance  
satellite antenna.

Support capabilities  
Global support te

© 2008 KVA Industries, Inc. All rights reserved.

# Smart phone interface





FURUNO

MAXSEA

emo:NN50\_North Bay (with radar).nnd

Navigation Planning Radar Dual Nav Nav & Radar Update Polar



41° 38'

ZONE  
Z)

North Bay

St Marys

Shem  
Port

289.0 COG

4.9 SOG  
kn

16.1 ft DPT

CTS

TTG

Little Island

Cable  
Area

1:0 300

1.355 NM

start

MaxSea TimeZero

5:54 PM

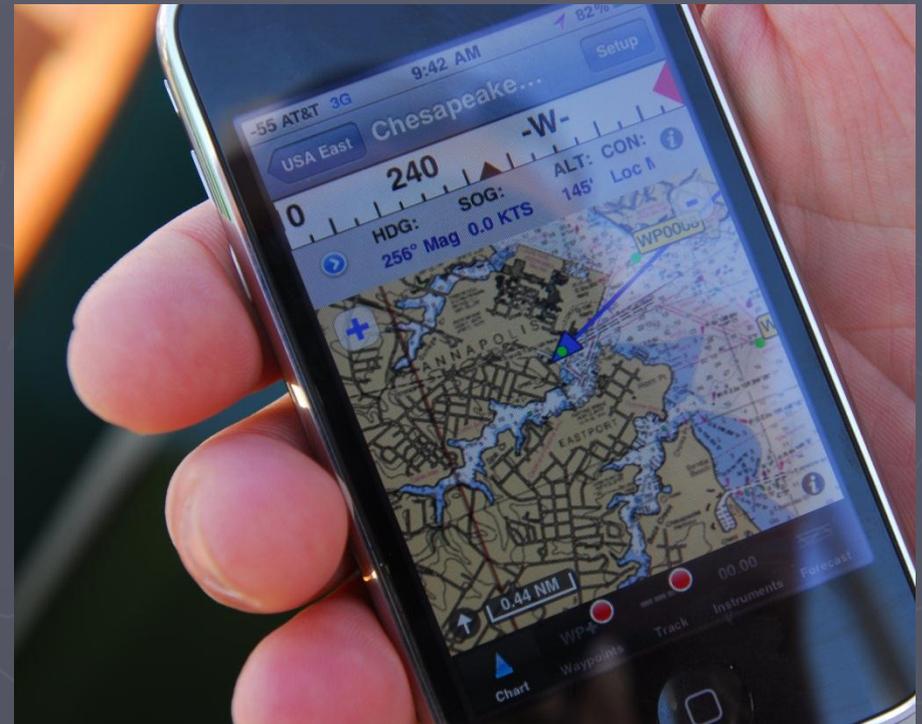
# Furuno NavNet EZTouch



# Tradition



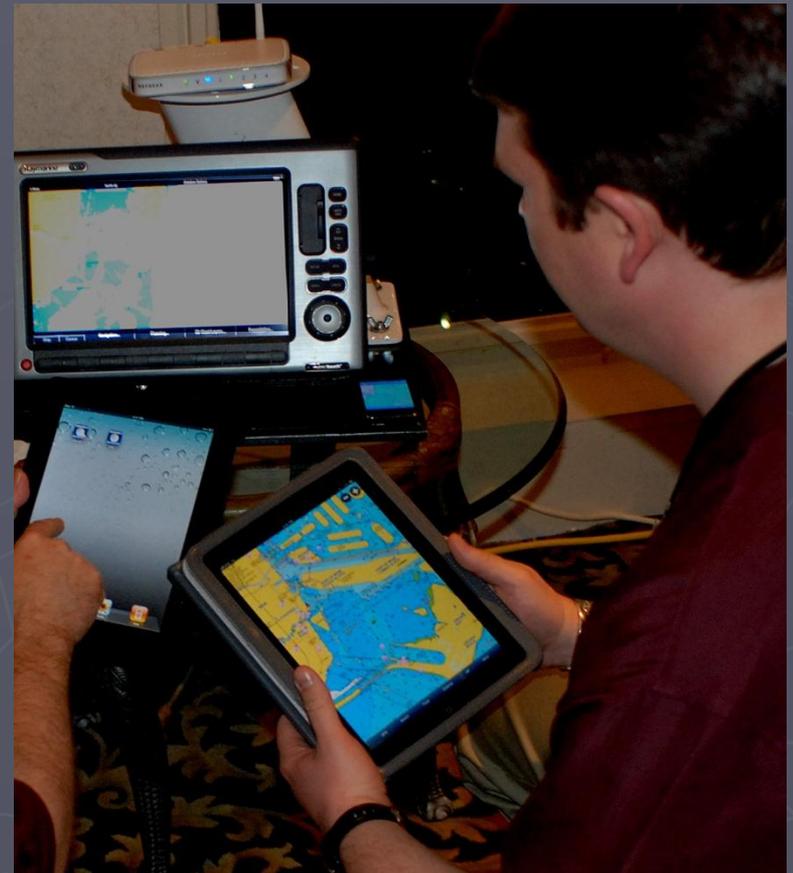
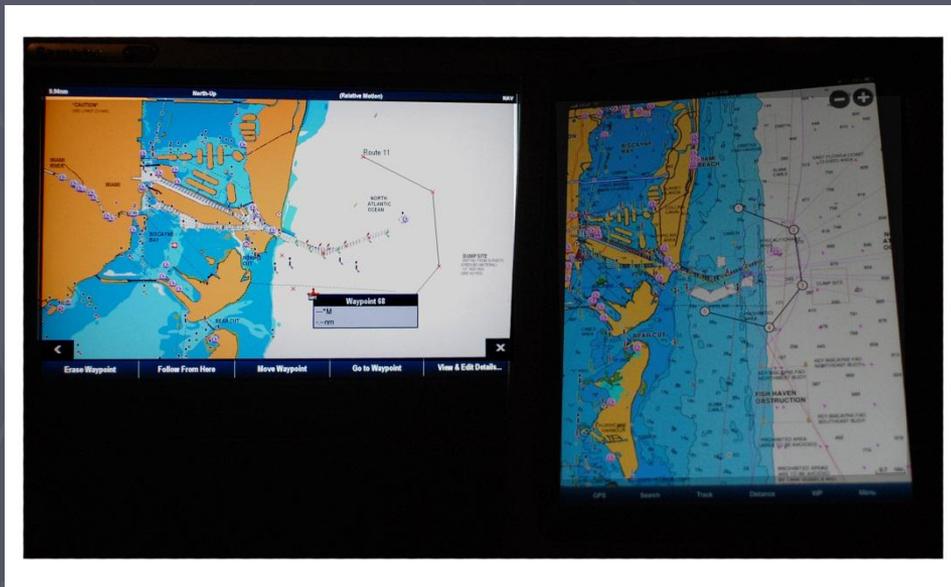
# A well connected crew



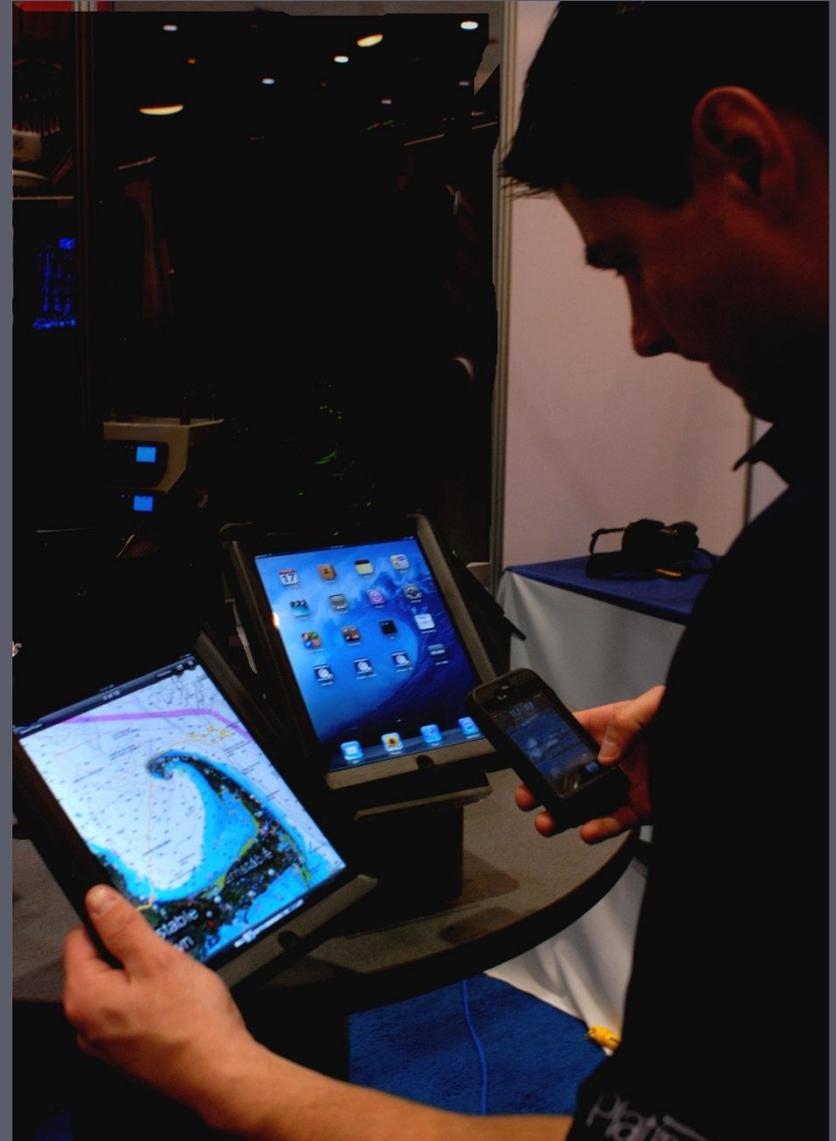
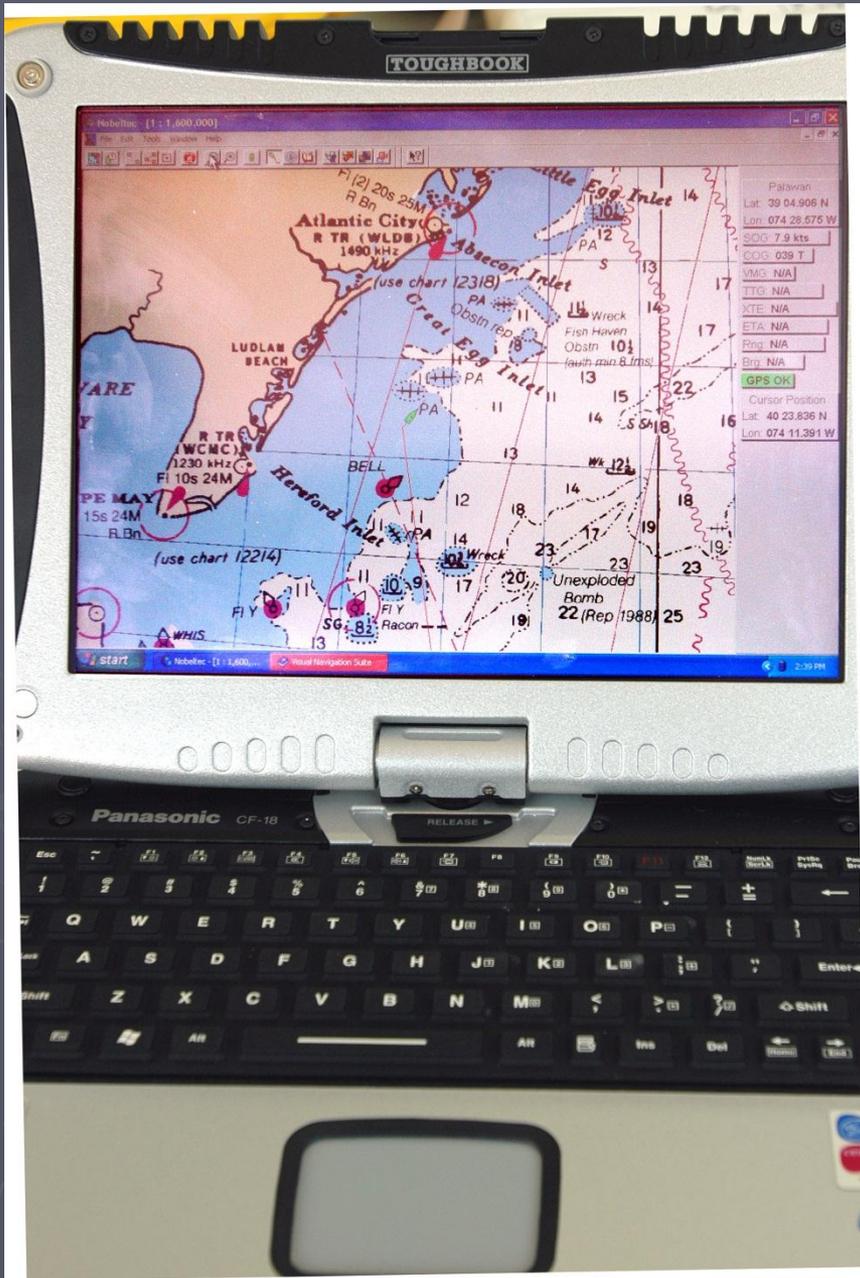
# Smartphone seaworthiness



- ▶ Wifi sync to a Network
- ▶ Added portability
- ▶ Remote data access



# Portable platforms



# The navigator's amalgam

- ▶ Intuition
- ▶ Sense of direction
- ▶ Vector awareness
- ▶ Relative motion



# The Goal

- ▶ Knowing where you are
- ▶ Defining where you want to go
- ▶ Monitoring progress



# Human interface



- ▶ Doubt
- ▶ Double check
- ▶ Deliberate
- ▶ Decide

# Virtual grounding



# Flinders Islet Incident



CYC Photo



← Flinders

## Outcome...

- ▶ Grounding
- ▶ Vessel a total loss
- ▶ Two crew members dead

# FLINDERS ISLET YACHT RACE

## INQUIRY

*Cruising Yacht Club of Australia Internal Inquiry*

The contributory factors identified are:

a. General navigation

i. Lookout and sea room

ii. Reliance on chart plotter and GPS

iii. GPS inaccuracies

b. Organization of the boat

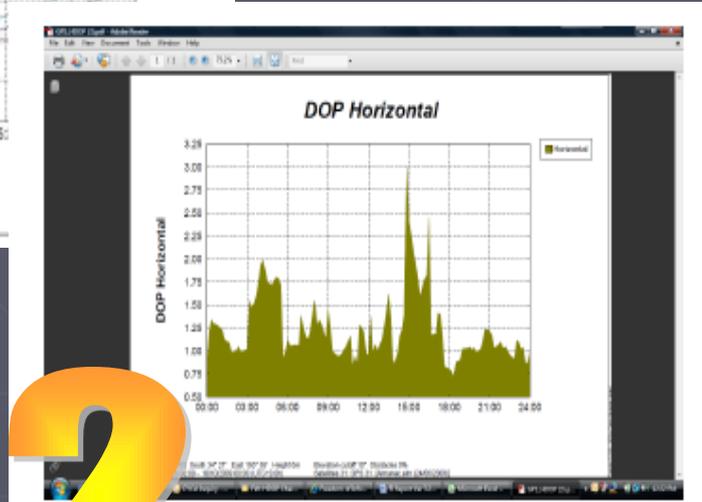
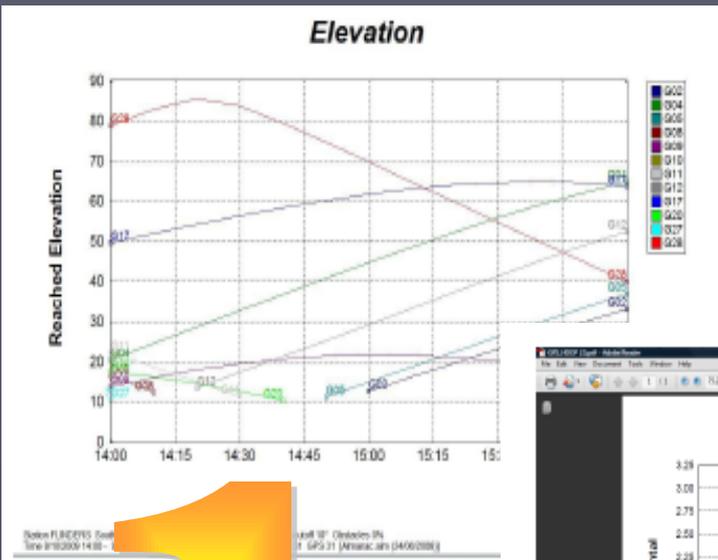
c. Fatigue and overload.



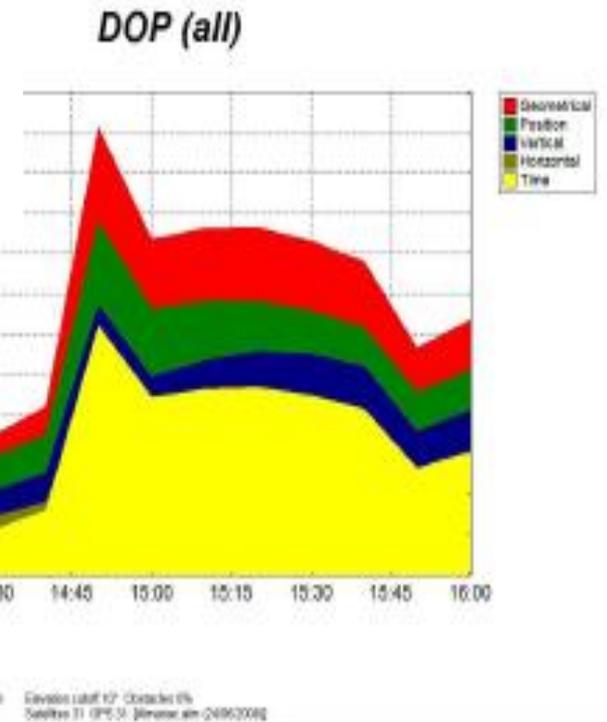
# Networked Digital Charting System



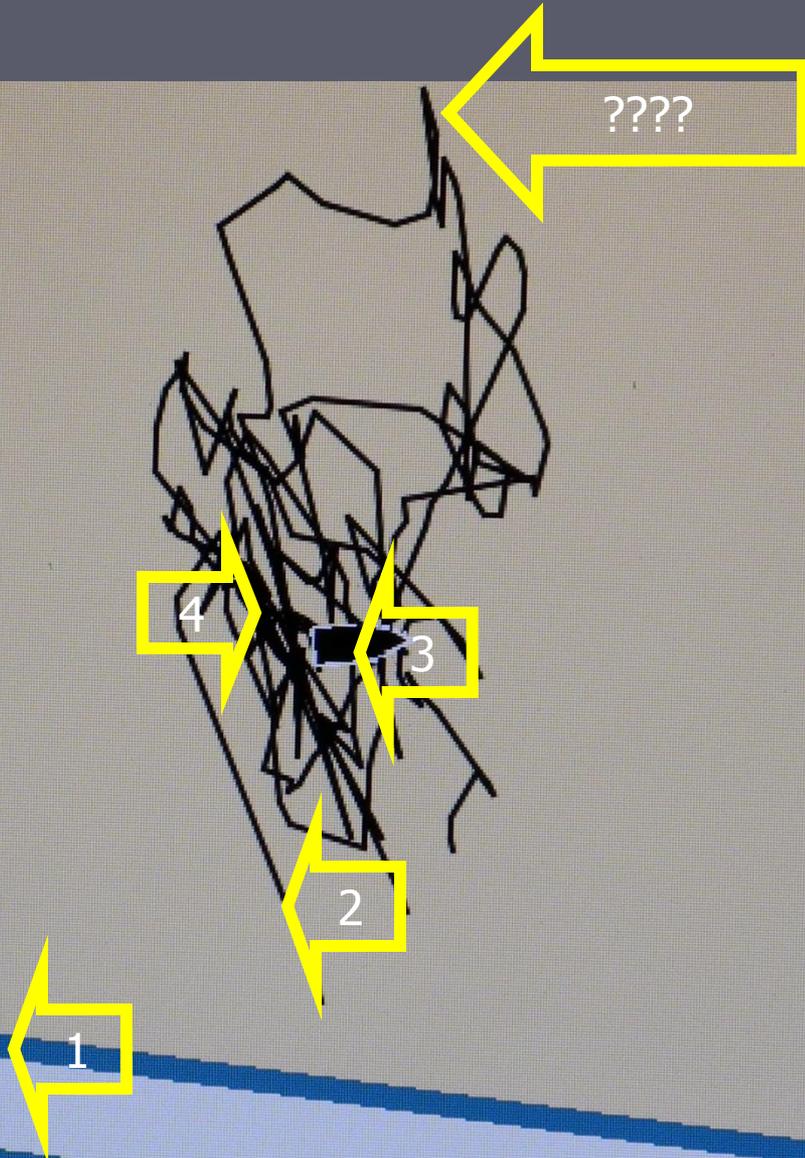
# Dilution of Precision



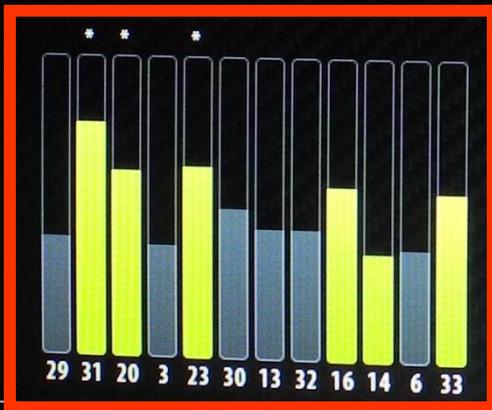
3



# The navigator's Rorschach Test



# Satellites



## Status

**Fix:** 3D, WAAS  
**EPE:** 6.6 m  
**HDOP:** 1.0  
**SNR best 4:** 32.8  
**SNR avg all:** 25.4

## Position

**N 38°56.623'**  
**W 76°29.413'**

## Time

**11:06:34 am**  
**07/29/2011**

## GPS Source

ZG50 [000DDF#]

Change

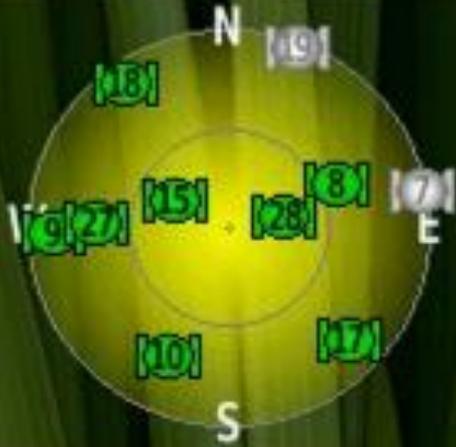
Configure

Location

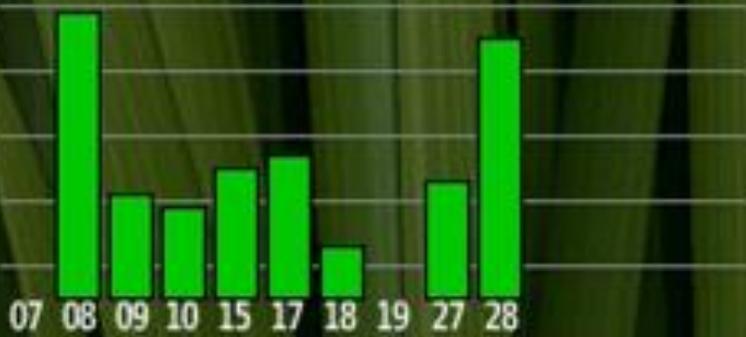
N 48°11.917'  
E 016°20.037'

GPS Accuracy

21 m



229 m



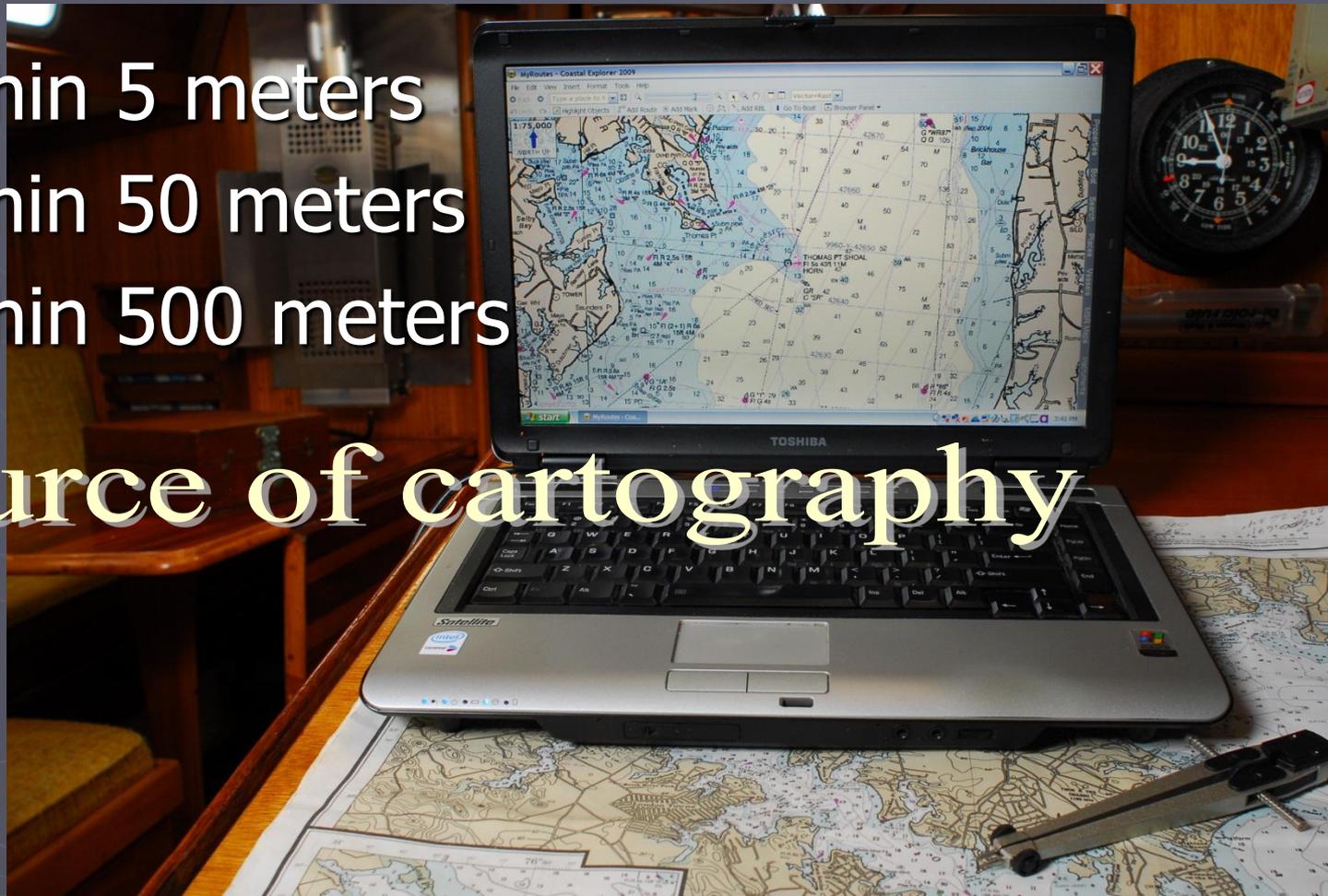
# Zone of Confidence



# Implications of ZOC

- ▶ A= within 5 meters
- ▶ B= within 50 meters
- ▶ C= within 500 meters

source of cartography



# I agree button

- ▶ “electronic charts are inadequate as a primary means of navigation”



Nobeltec software

# Your slant on sailing

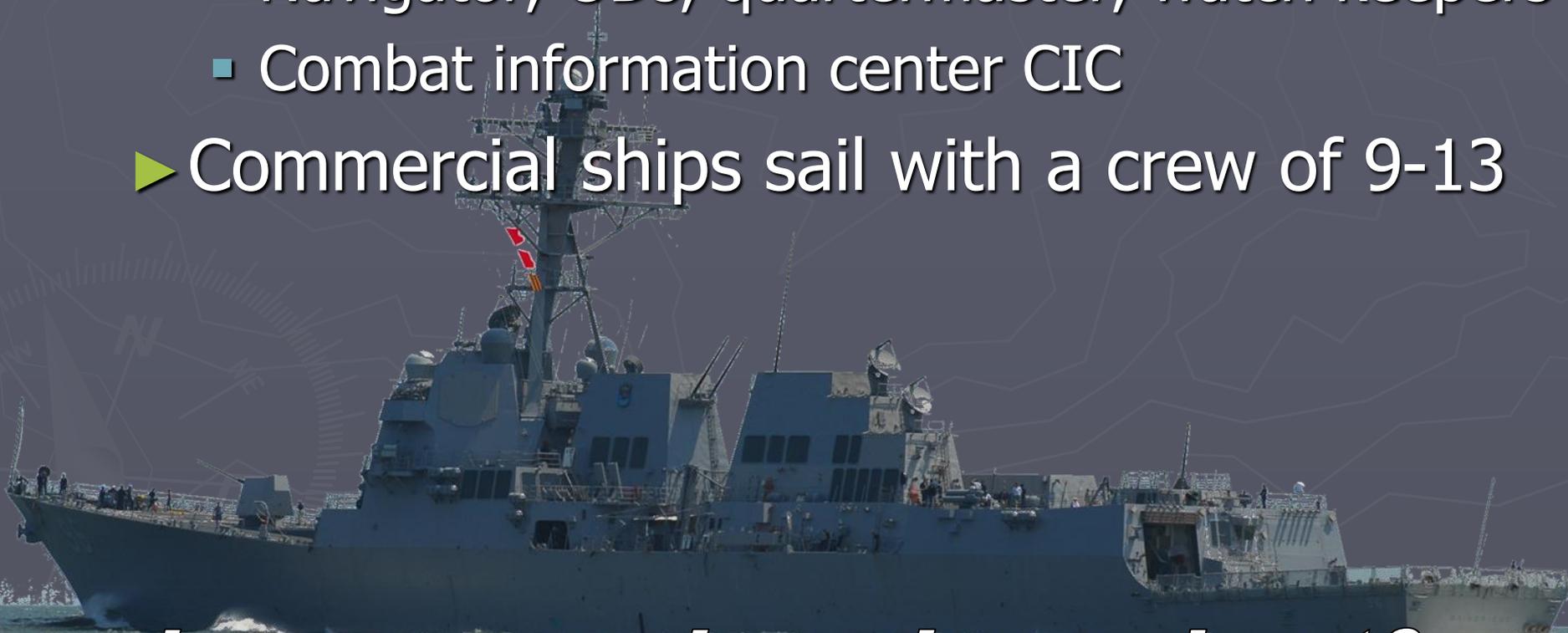
- ▶ Day sail local waters
- ▶ Club racing
- ▶ Coastal/Offshore racing
- ▶ Coastal cruising
- ▶ Ocean passage making



# The Navy way

- ▶ Full bridge compliment
  - Navigator, ODs, quartermaster, watch keepers
  - Combat information center CIC
- ▶ Commercial ships sail with a crew of 9-13

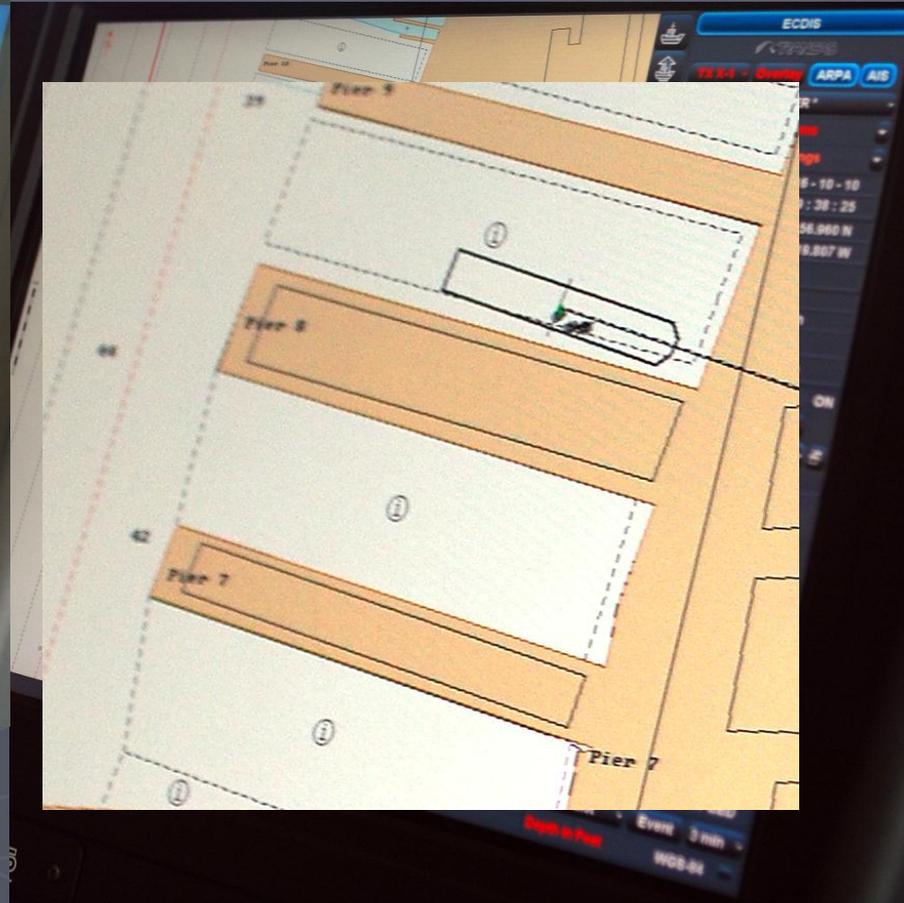
*how many aboard your boat?*





# ECDIS

ELECTRONIC CHARTING AND DIGITAL INFORMATION SYSTEM





# The shorthanded mandate



- ▶ Streamline navigation process
- ▶ Add accuracy to position fixing
- ▶ Concerned about shortcuts



# Data input

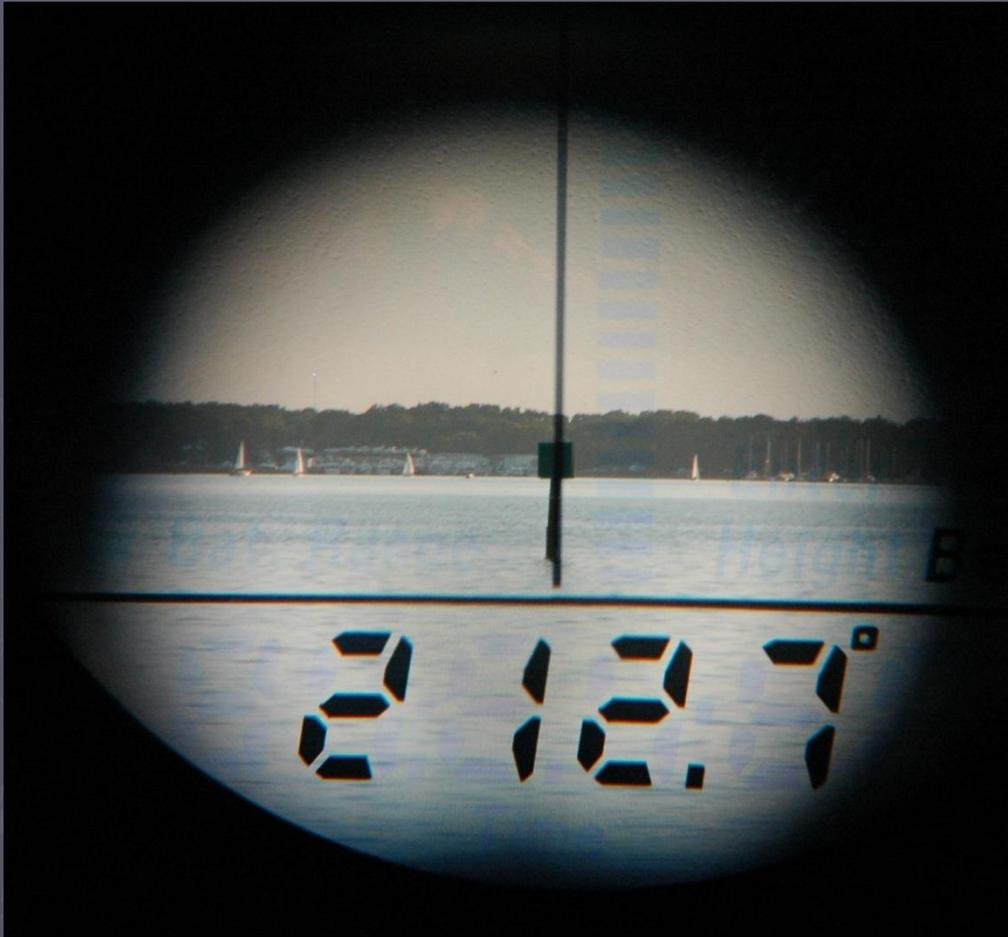
- ▶ Compass
- ▶ Knot meter/log
- ▶ Fathometer
- ▶ Radar
- ▶ GPS
- ▶ AIS
- ▶ FLIR



Plotting becomes a reflex

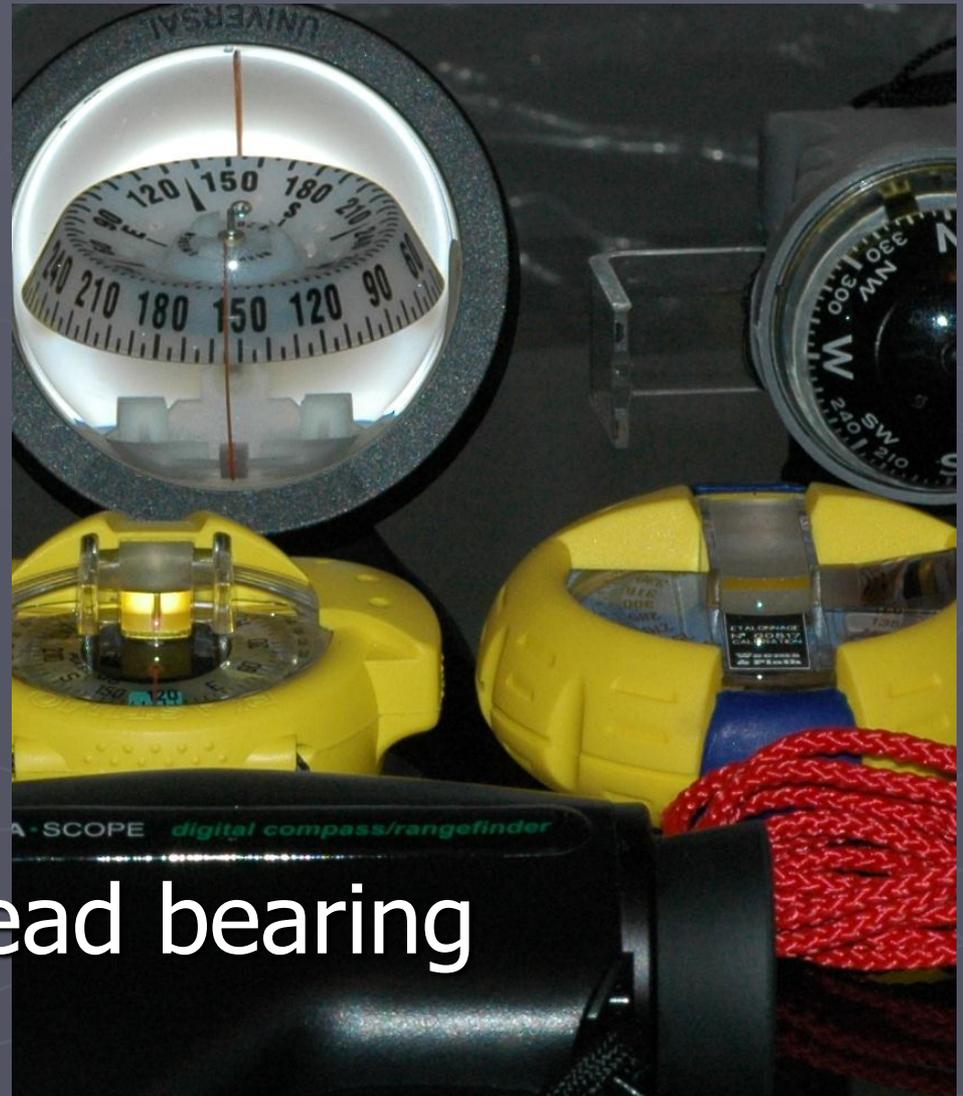


# Taking bearings



# Using a hand bearing compass

- ▶ Identify object
- ▶ Engage in sight
- ▶ Simultaneously read bearing



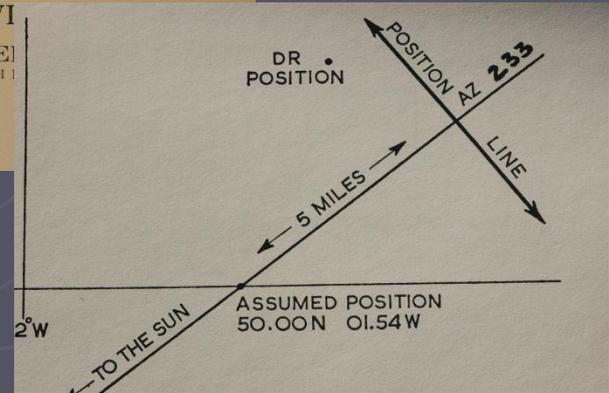
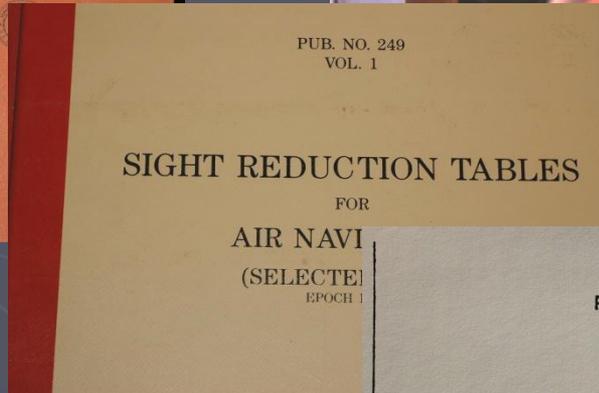
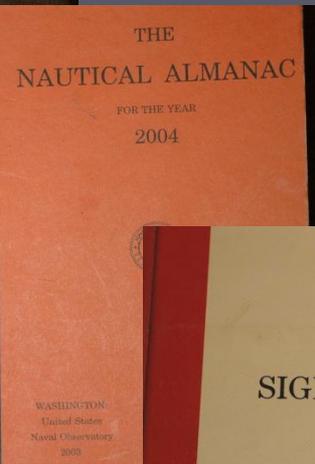
# Checking a range



- ▶ Align two fixed objects show on a chart
- ▶ Measure the bearing with a HB compass
- ▶ Plot bearing line on chart
- ▶ Compare ranges (measured and observed)







# Celestial Navigation

# The navigator's routine



# DR and Piloting





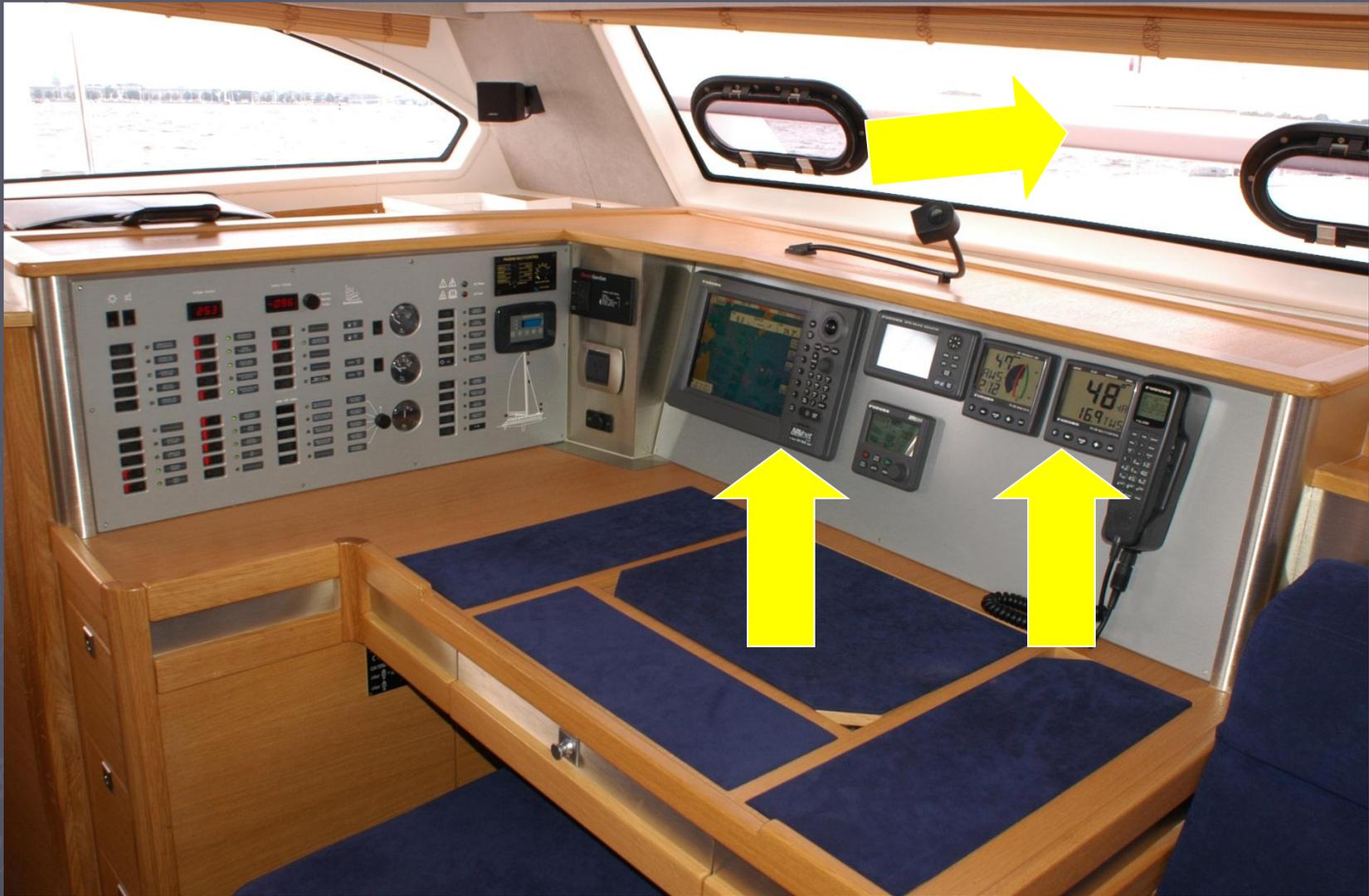
**Compare visual bearing with cursor bearing line to same object**



# More data

- ▶ Set and drift
- ▶ Leeway
- ▶ Steering proficiency

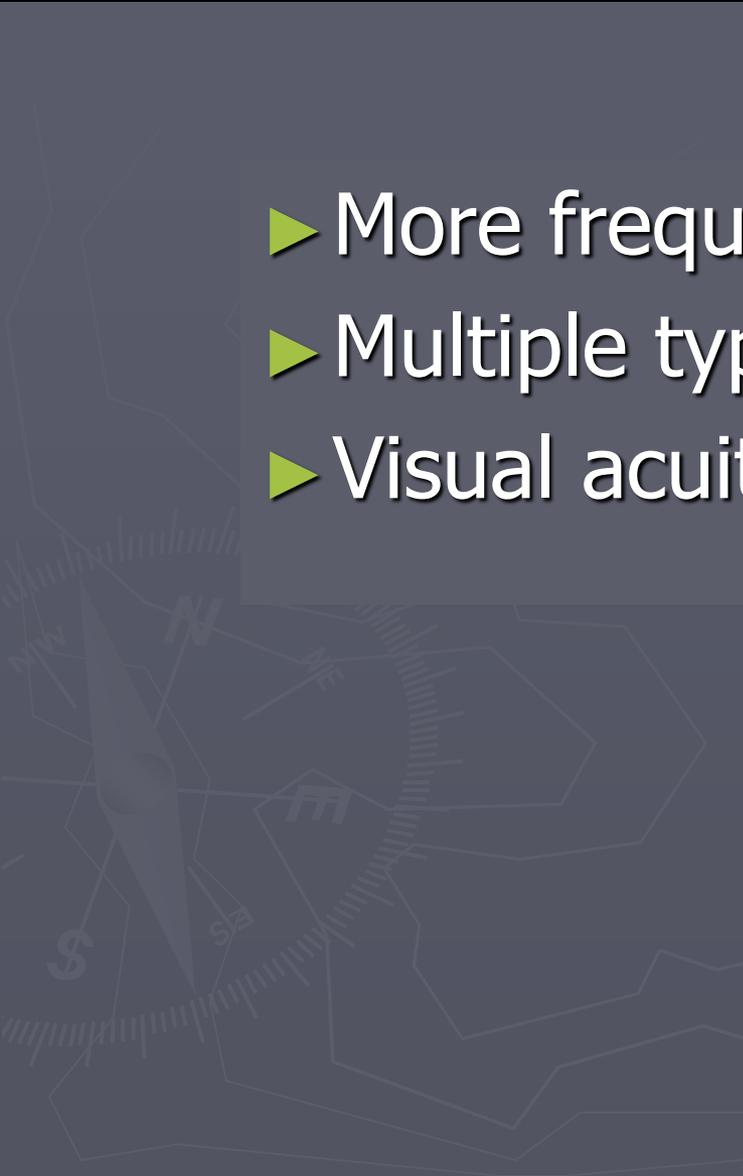






# The nighttime routine

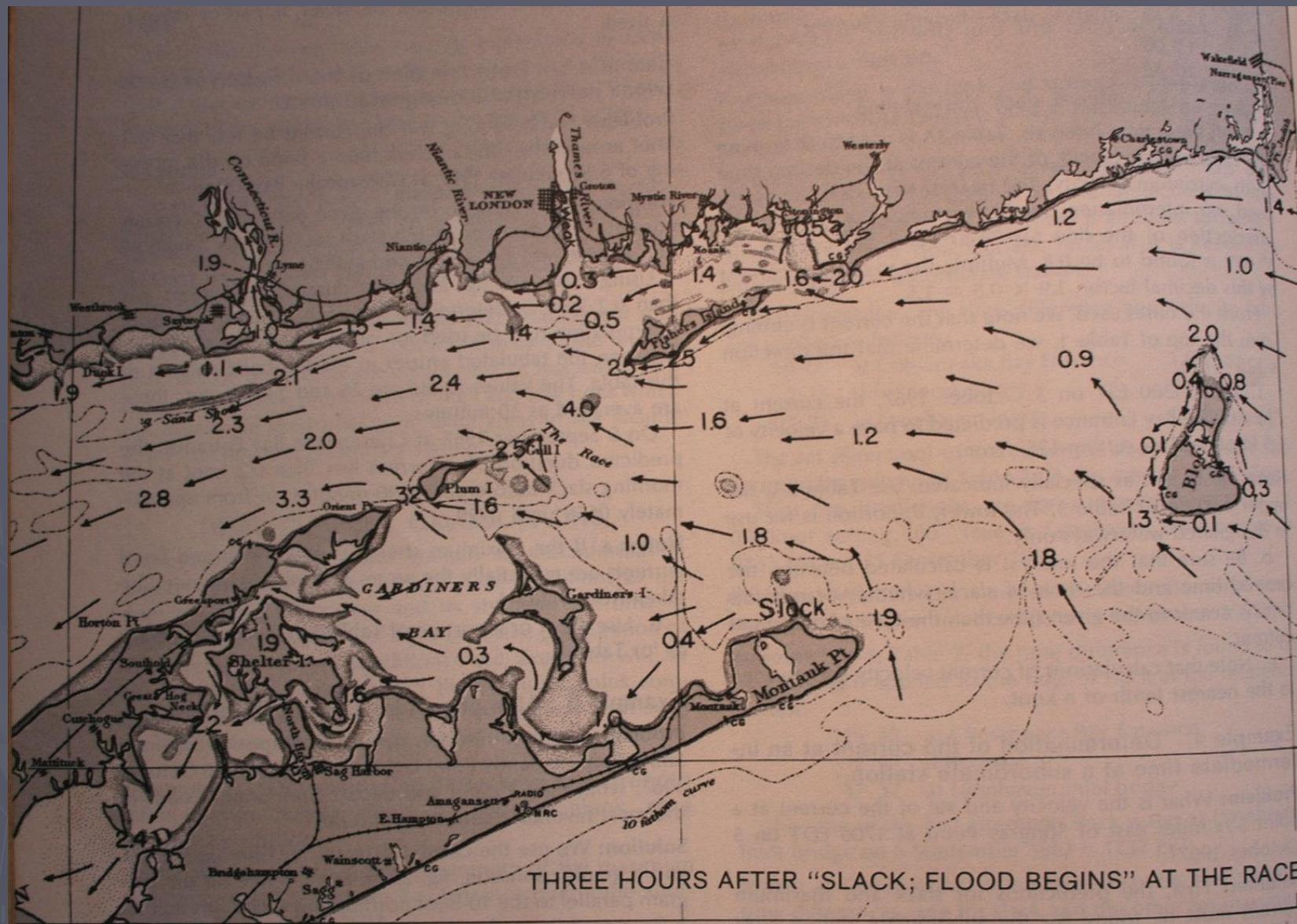
- ▶ More frequent plots
- ▶ Multiple types of fixes
- ▶ Visual acuity enhancers



# Light levels





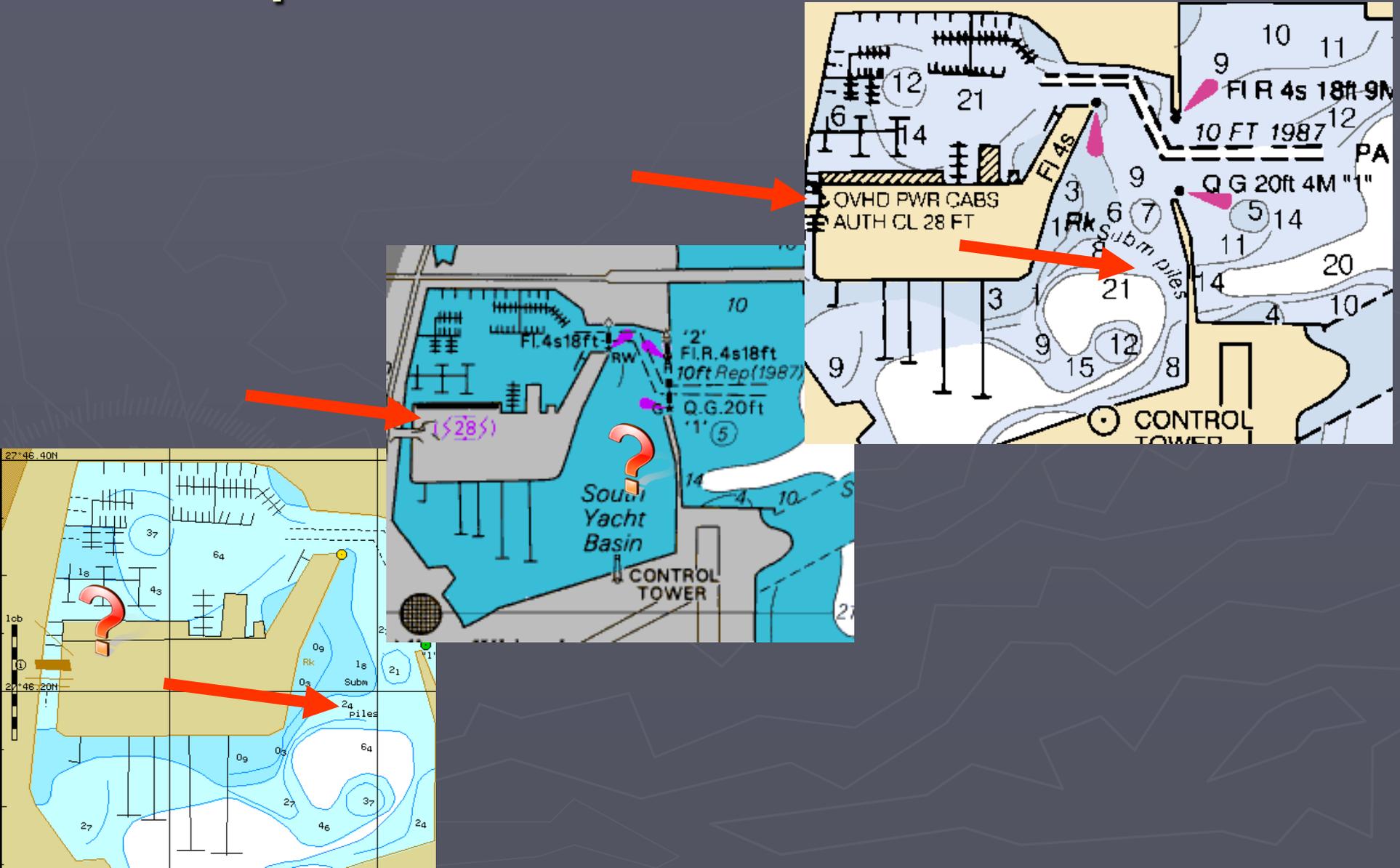


DOUBTFUL DATA: Reported but unconfirmed depths or dangers are indicated by an encircling dotted line.

NOTE  
The representation of international boundaries is not necessarily authoritative.



# Graphics and detail





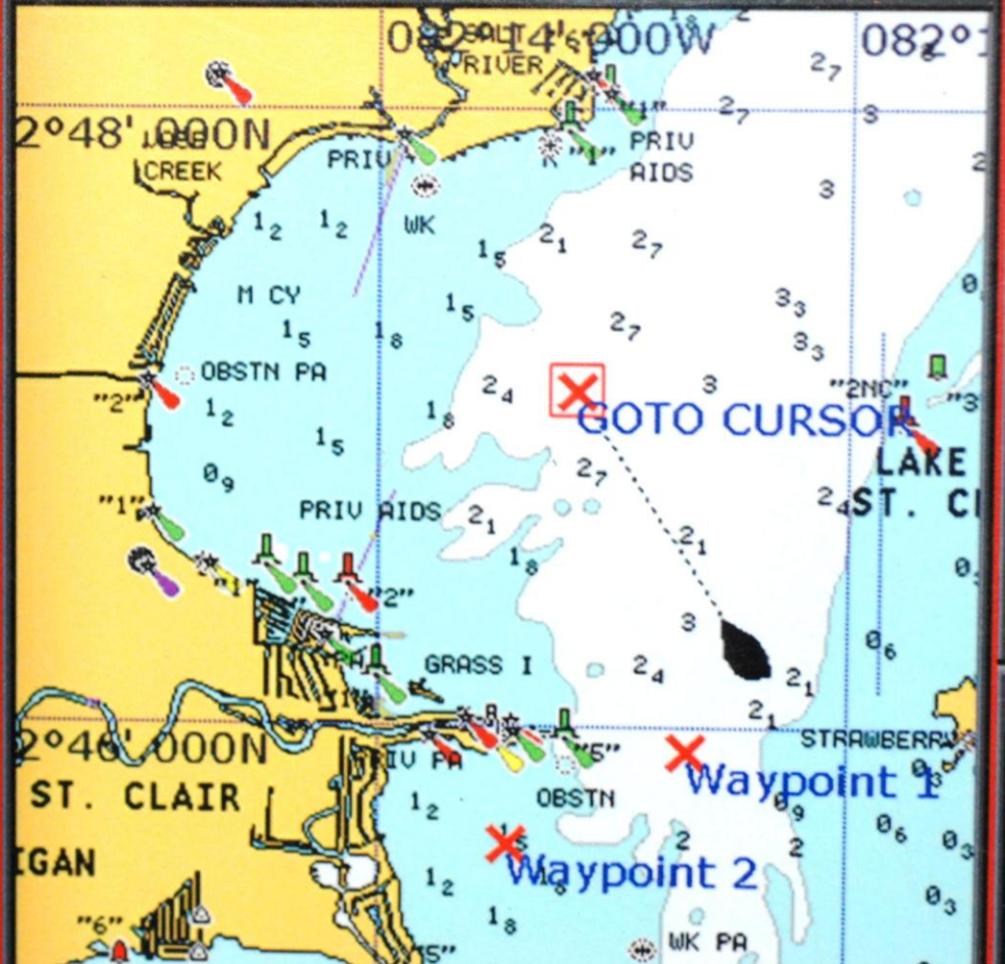
Raymarine

C80

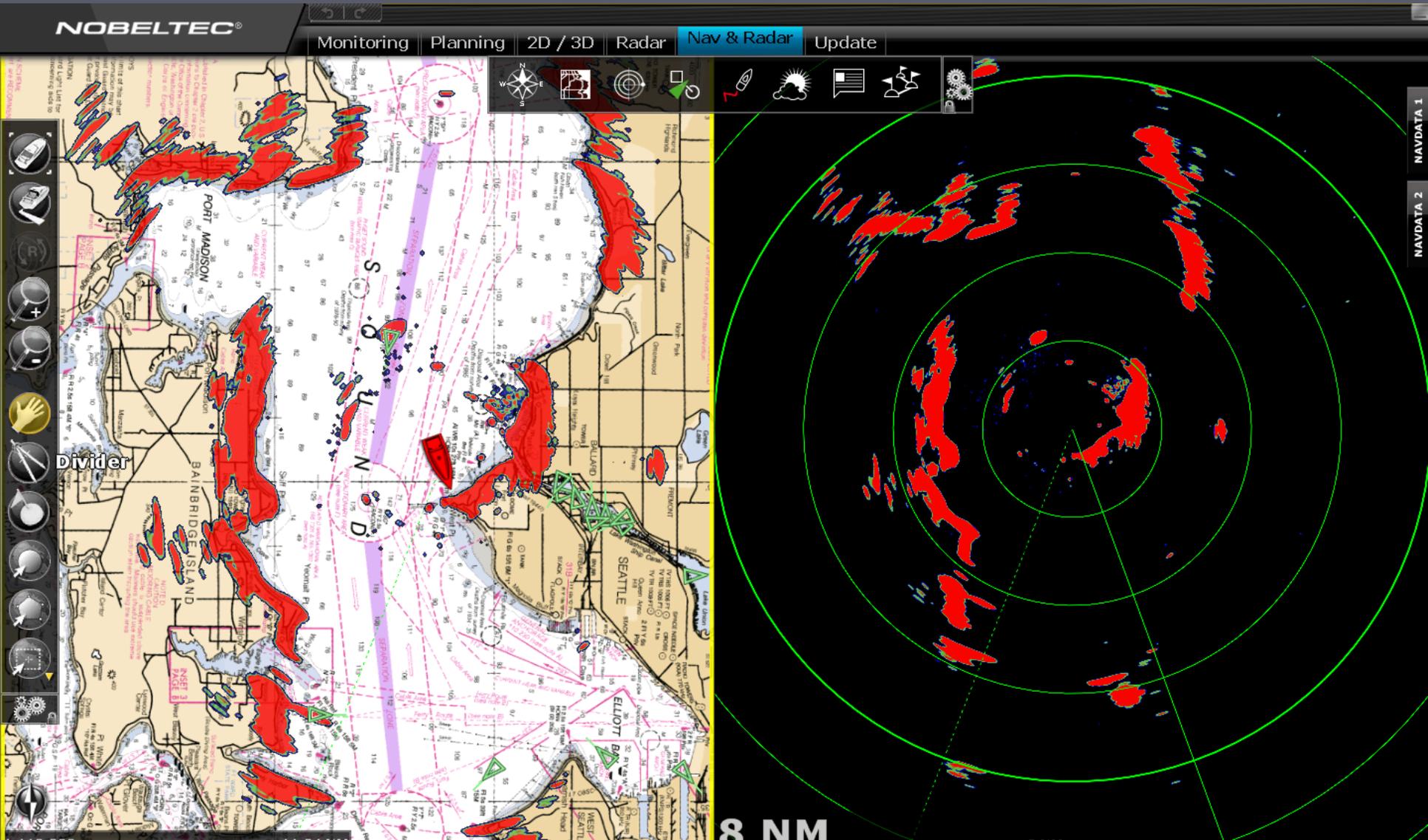
16nm

N-UP (RM)

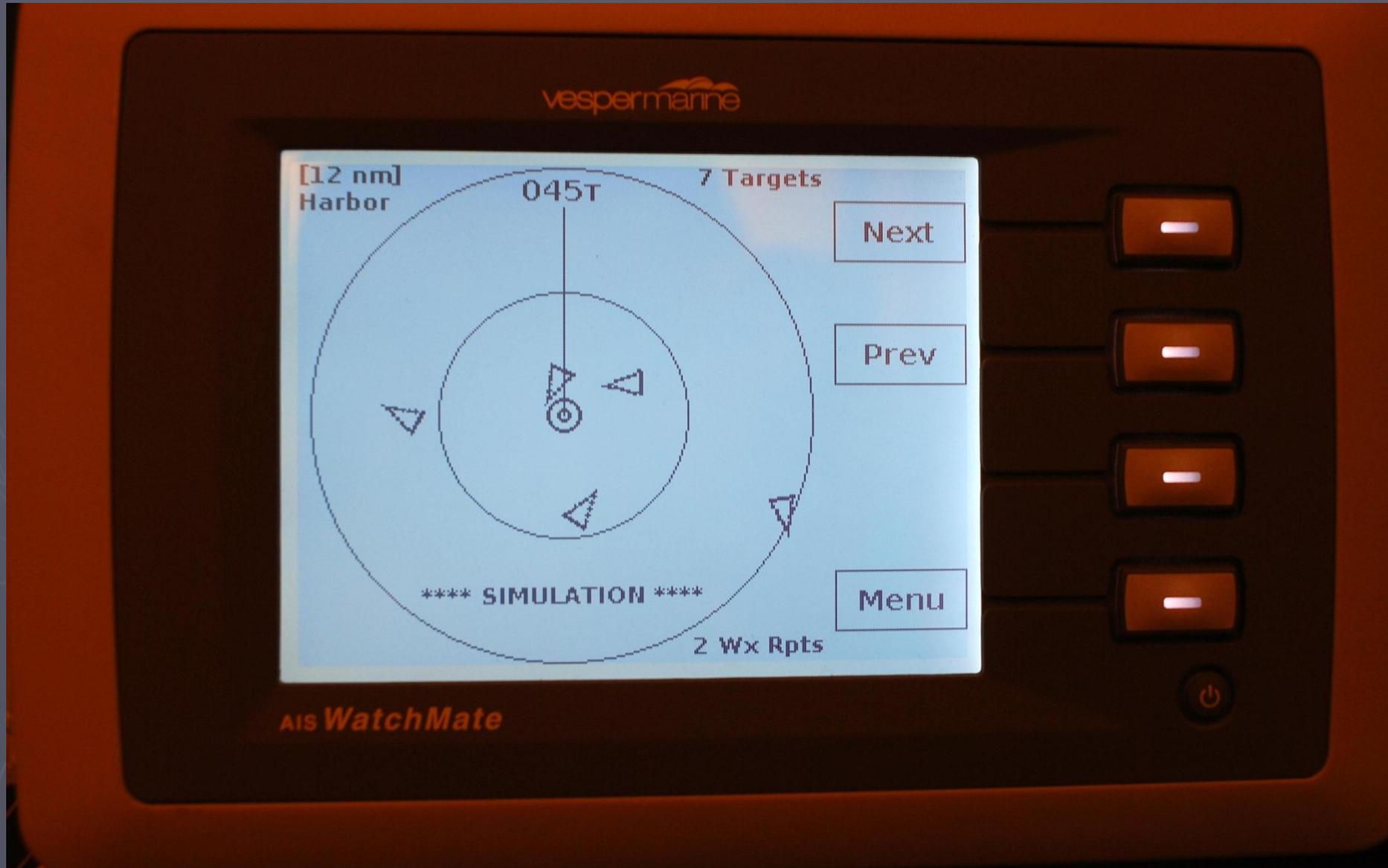
Local



# Overlay capability



# AIS standalone



Vesper Marine



Vesper Marine  
 12VDC 1A max, 3W nom  
 safe distance: 0.6m (2ft)  
 162/4321414/10  
 ID: YJDVESPWMX900  
 model: **WNC200**  
 USCG: 165.156/1210  
 IC: 9118A-WMX900 B  
 S/N: **KZ74126**  
**CE 0168** **FC** **Z1039**

For customers in the US:  
 This device must be programmed with data corresponding to the vessel on which it will be installed. Programming must be carried out by a Vesper Marine dealer. The included instructions contain information on how to verify the correct programming.  
**WARNING:** It is a violation of the rules of the Federal Communications Commission to input an MMSI that has not been properly assigned to the end user, or to otherwise input any inaccurate data in this device.

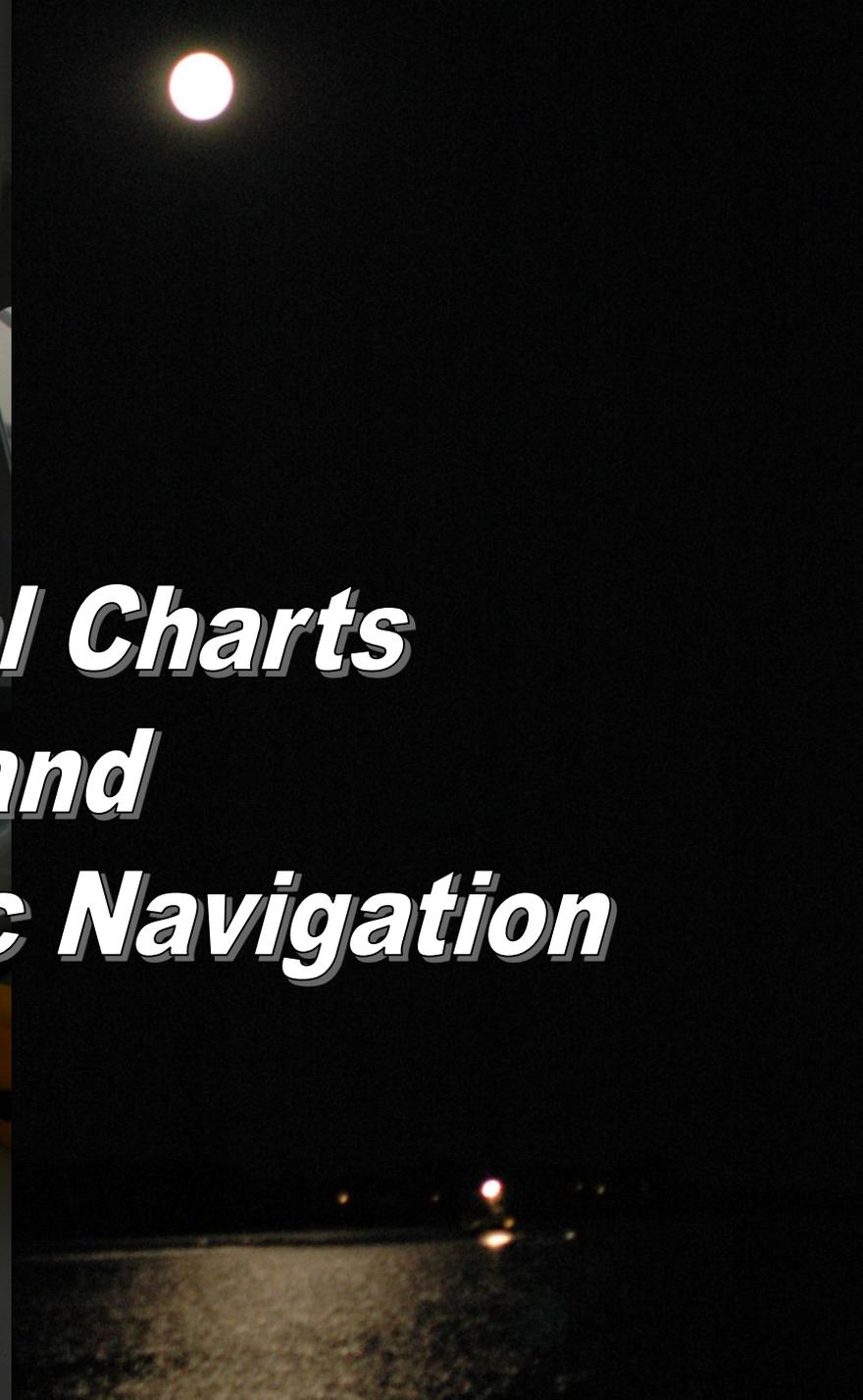
Vesper Marine

# AIS networked





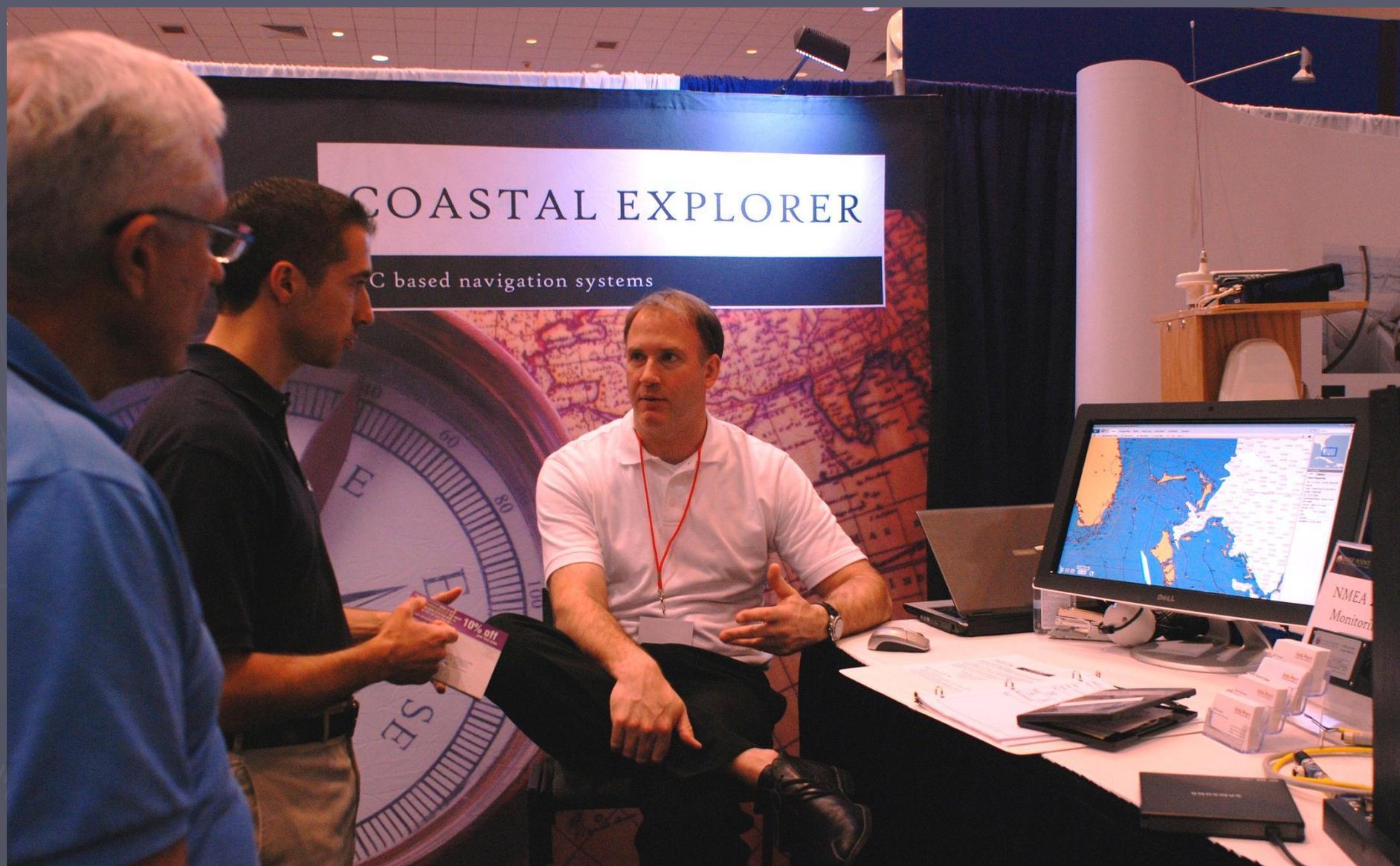
***Digital Charts  
and  
Electronic Navigation***



# Cartography 2011



# Boat show opportunities



SOC

COG

M POS

DEPTH

m TIME

Settings

System

Chart

Echo

Radar

Navigation

Fuel

Tracks

Alarms

Units

Network

Vessels

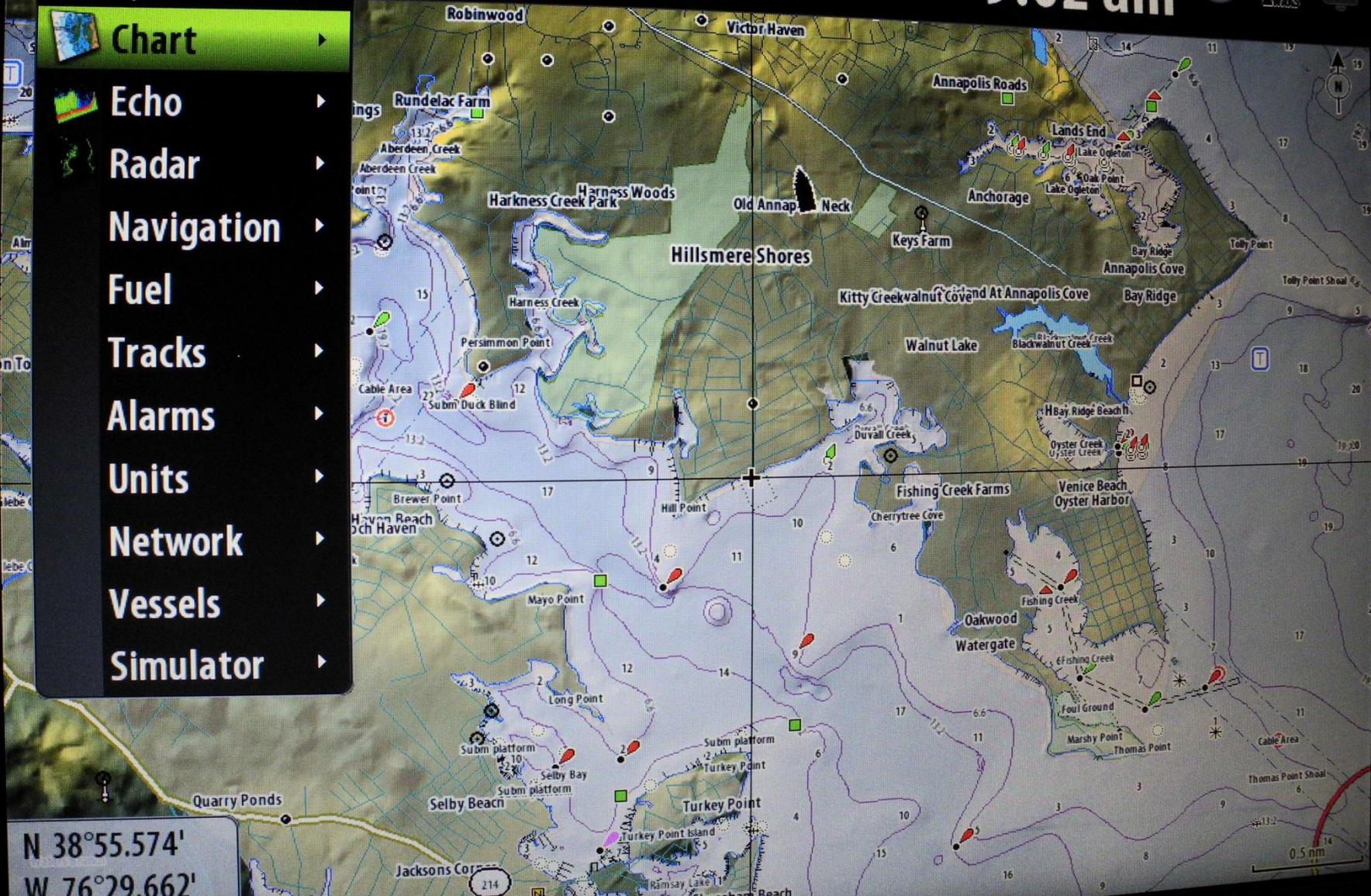
Simulator

001

N 38°56.624'  
W 76°29.416'

---

9:02 am



N 38°55.574'  
W 76°29.662'

0.5 nm

**GARMIN**  
GMS 10

LNK    DUP  
ACT    COL    100

POWER







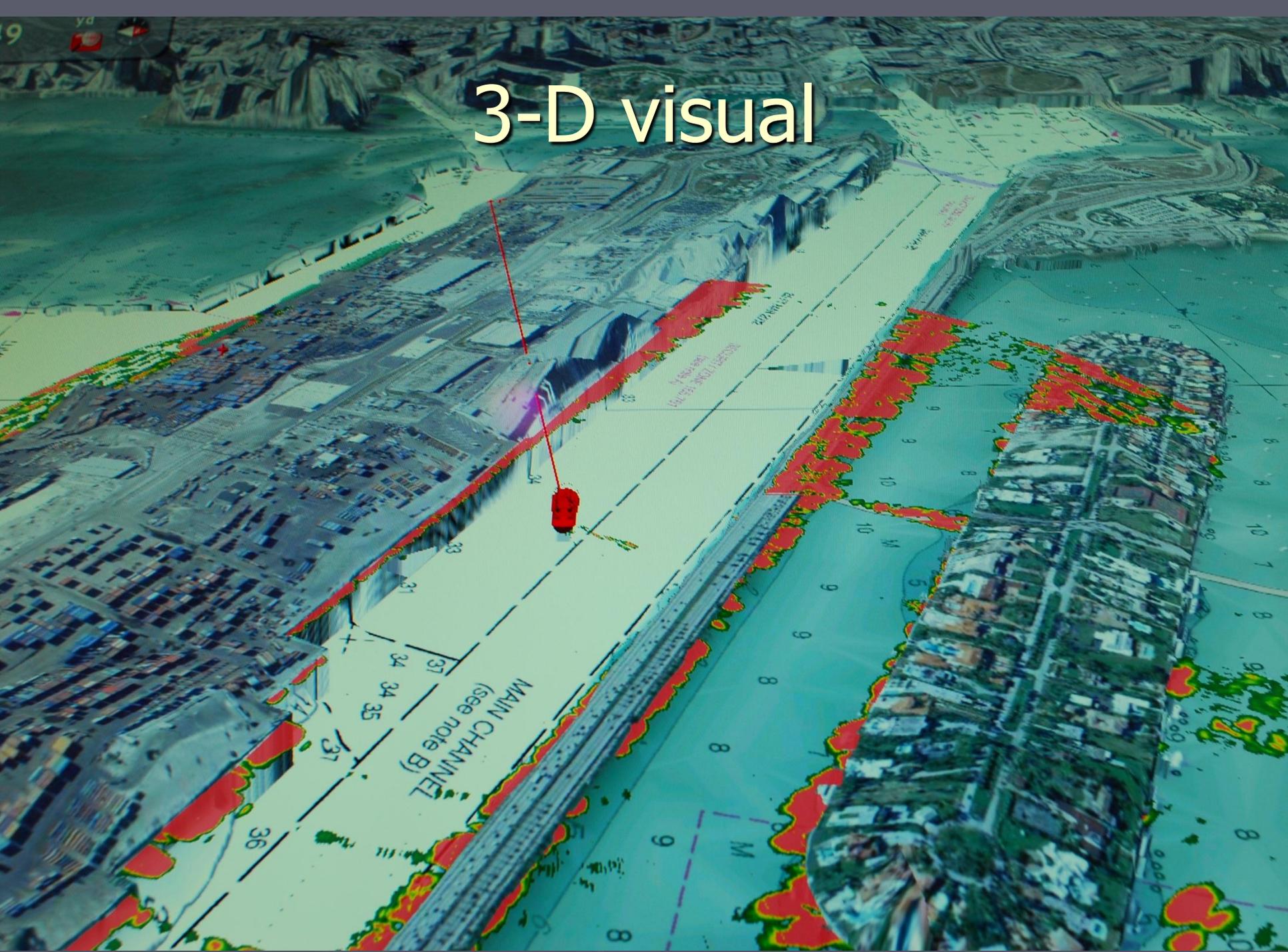
Raymarine



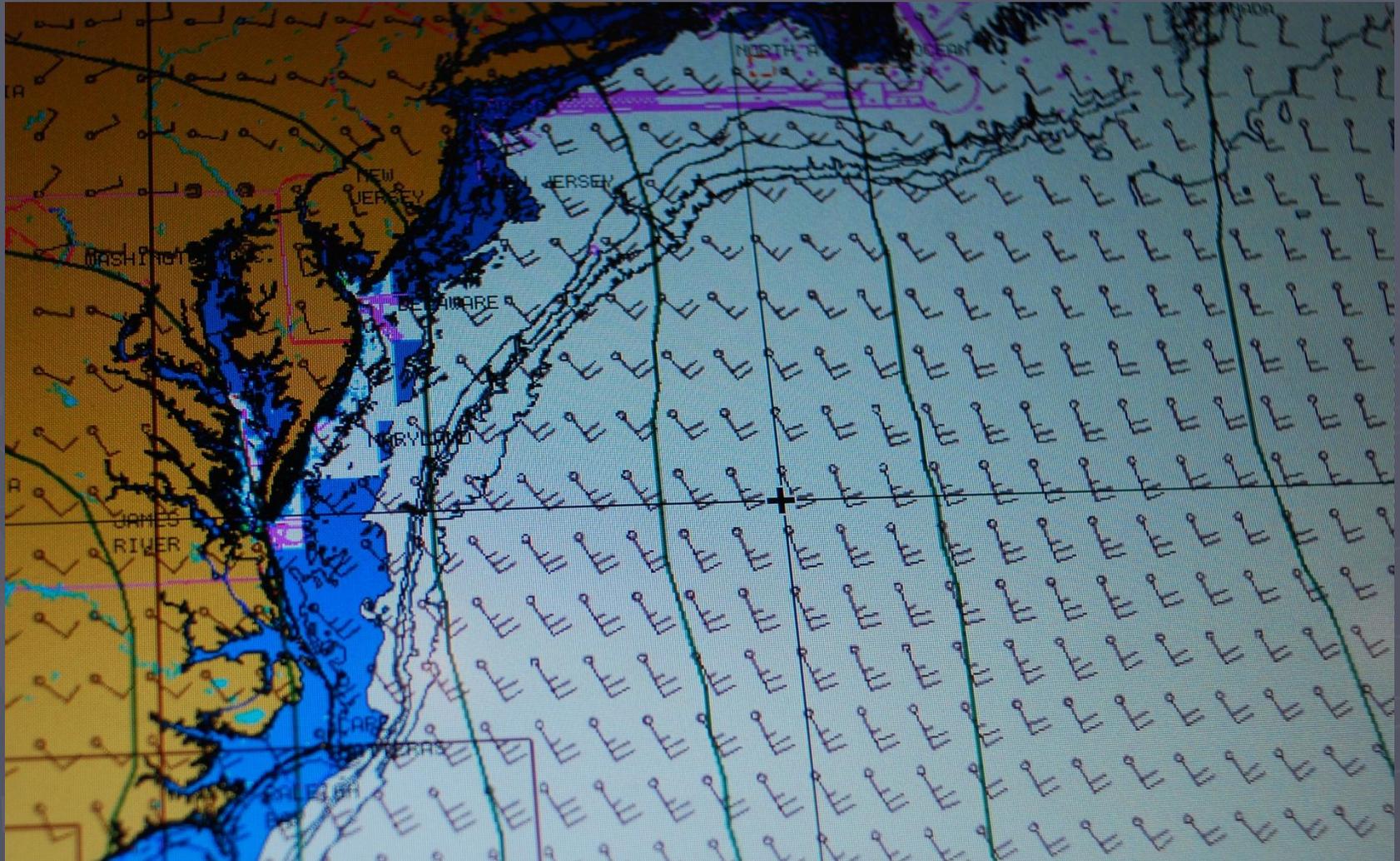
Raytheon



# 3-D visual



# GRIB Files



# Infrared imaging





***What suits your needs***

# Faced the same challenges

- ▶ Where you are
- ▶ Location of the destination
- ▶ Tracking progress

