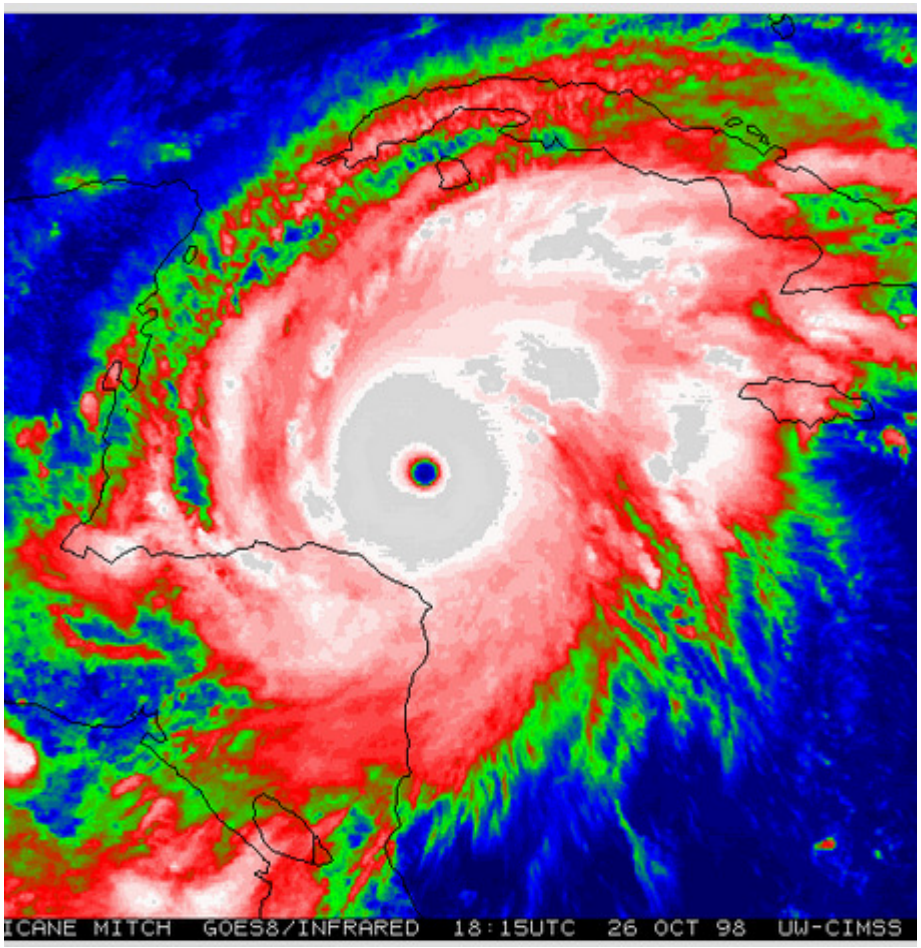
Surviving Big Storms in Port

Presented at the SSCA Melbourne Gam
November 2012

ssca.org

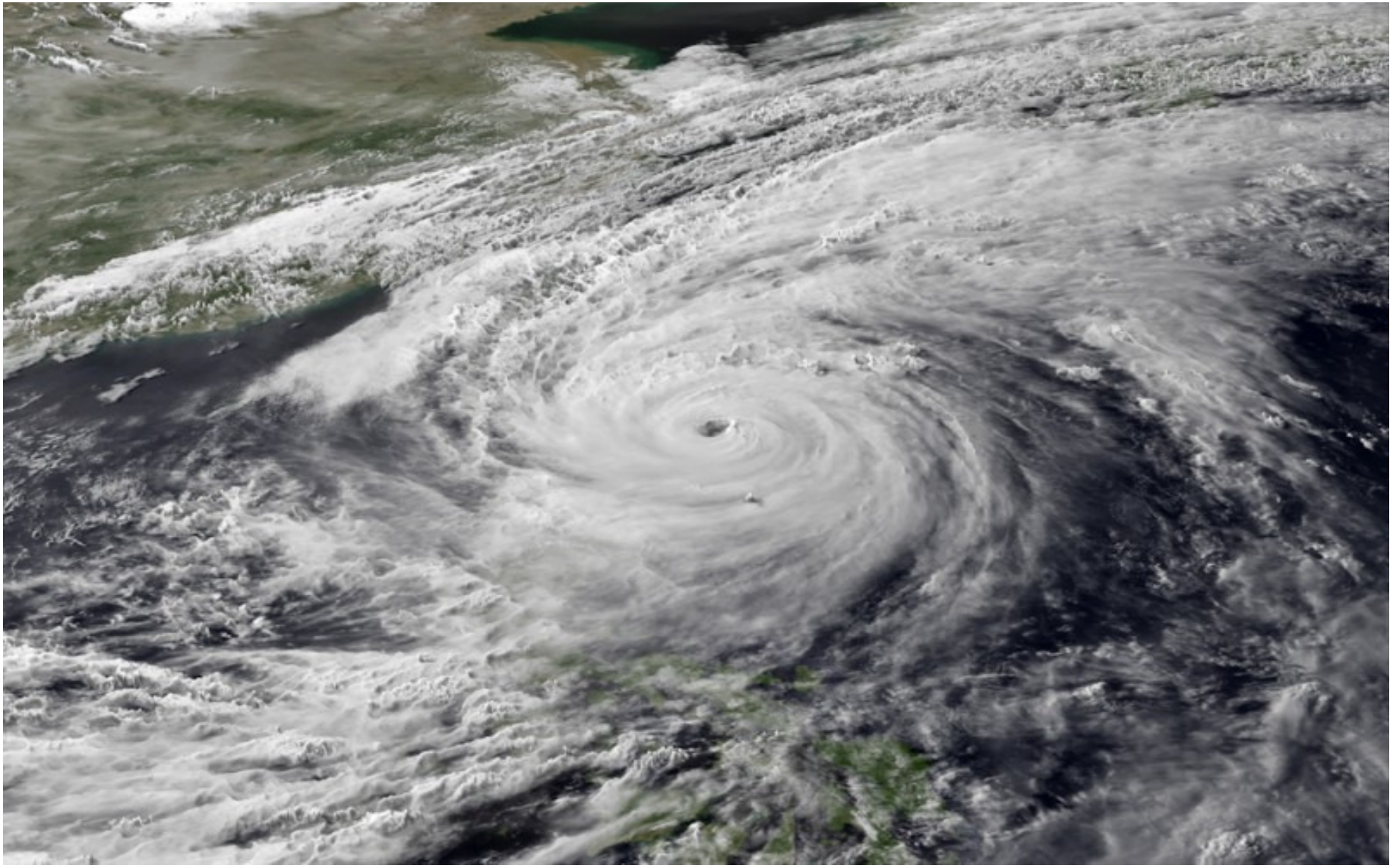
http://svsoggypaws.com

SURVIVING BIG STORMS in PORT



- Dave & Sherry McCampbell
- Storm Experience:
  - 16 years aboard
  - Ten hurricanes & one cyclone
  - Three 60 kt surprise storms at anchor
- This presentation at: SVSoggypaws.com

Typhoon Songda, 2011




Soggy Paws
1981 CSY 44
Soggy Paws

Outline

- Introduction
- Dangerous Storms-Tornados, Cold Fronts, RIM Bombs, Tropical Cyclones
- Finding a Safe Haven
- Preparation & Ground Tackle
- Before, During & After the Storm
- Resources
- Historic Notorious Storms (time permitting)

Storm Survival Issues

- Surviving big storms in port depends on:
  - Adequate preparation
  - Judging storm/wind strength
  - Storm CPA distance/direction
  - Size of storm surge & wave action
  - Avoiding other boats & shore debris
  - Lots of Luck!

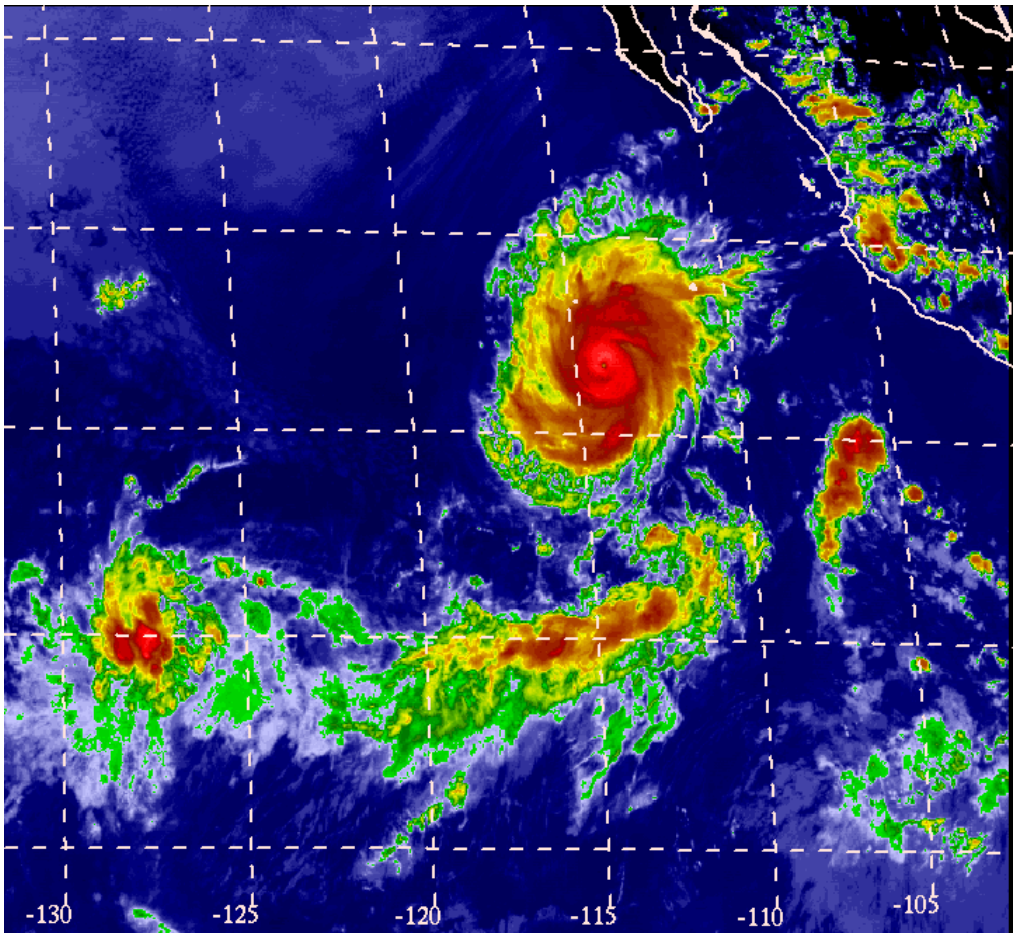
Why Attend this Seminar?

- Survey - who's been in 60 kts?
  - At sea?
  - In port?
- BW cruisers spend 90% time in port
- Weekend cruisers spend 98% time in port
- My 60 knots list
  - At sea - 0
  - In port-15 times!

Soggy Paws Storms

- 1992 Andrew 4 – Homestead AFB/K West, driving
- 1994 Storm Century – Marathon, FL Keys, at home
- 1998 Georges 4 - Shark River FL Eglades, anchor
- 1998 Earl 2 - Marathon, FL Keys, dock
- 2001 Iris 4 - Rio Dulce, Guatemala, river/dock
- 2004 Charley 4 - Shark River, Fl Eglades, anchor
- 2005 Dennis 4 – Marathon, Fl Keys, mooring
- 2005 Katrina 5 - Key West, Fl, in 3D boatyard
- 2005 Rita 5 - Key West, Fl, in 3D boatyard
- 2005 Wilma 5 - L Matecumbe, Fl Keys, anchor
- 2005 Ivan 5 - Shark River, Fl Everglades, anchor
- 2006 Ernesto 1 – L Matecumbe, Fl Keys, anchor
- 2012 Cyril 1 – Vavau, Tonga, mooring, dragged

Dangerous Storms



- Tornados/Water Spouts
- Cold Fronts off a Low
- Rapidly Intensifying "Meteorological Bombs"
- Tropical Cyclones

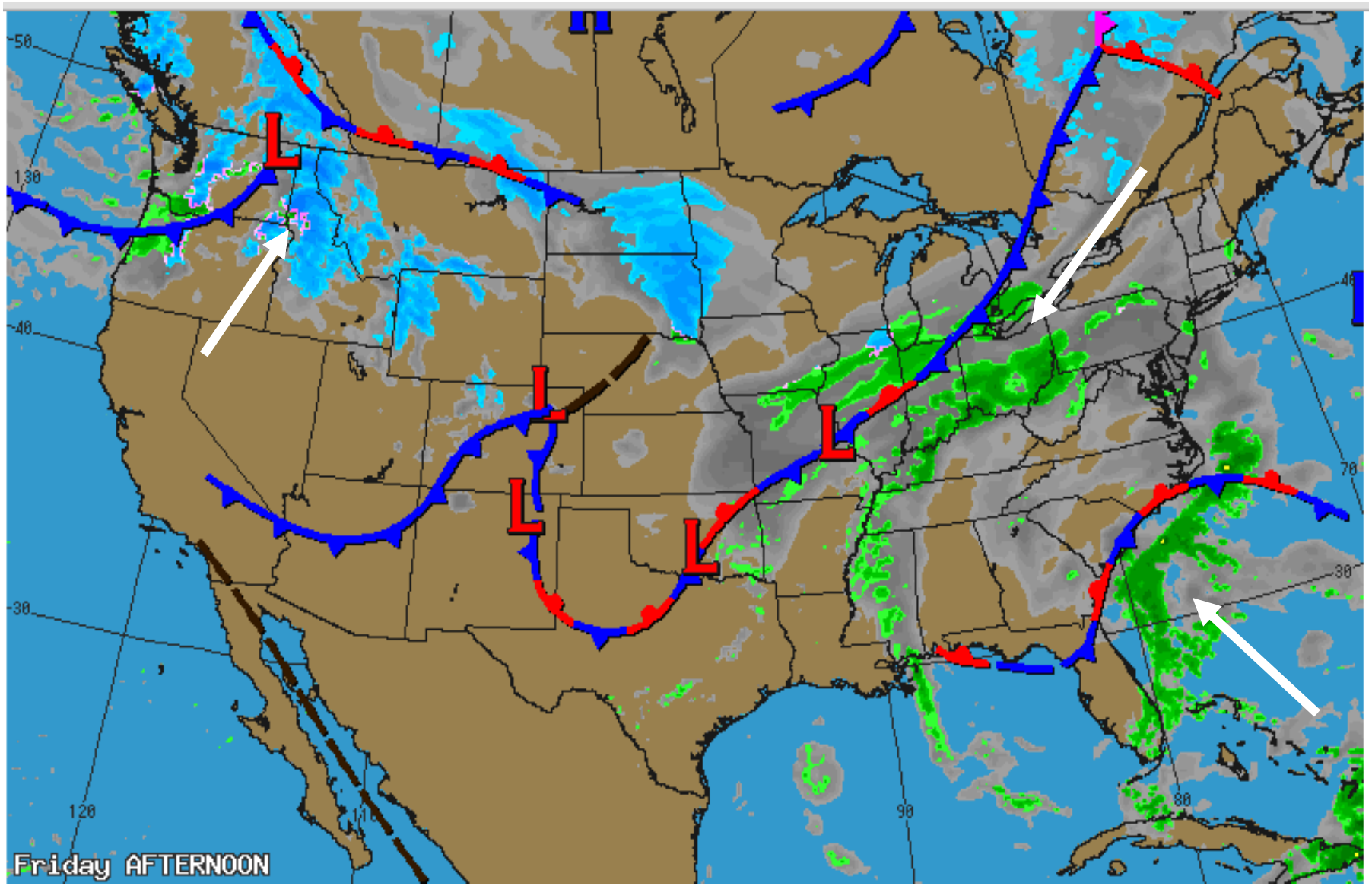
Tornados and Waterspouts

- Tightly wound rotation, small footprint
- Very high winds, 200 kts+
- Fast moving
- Little warning
- Two types waterspouts
  - Summer, under flat based cumulus
  - From tornados ashore
- Move with clouds

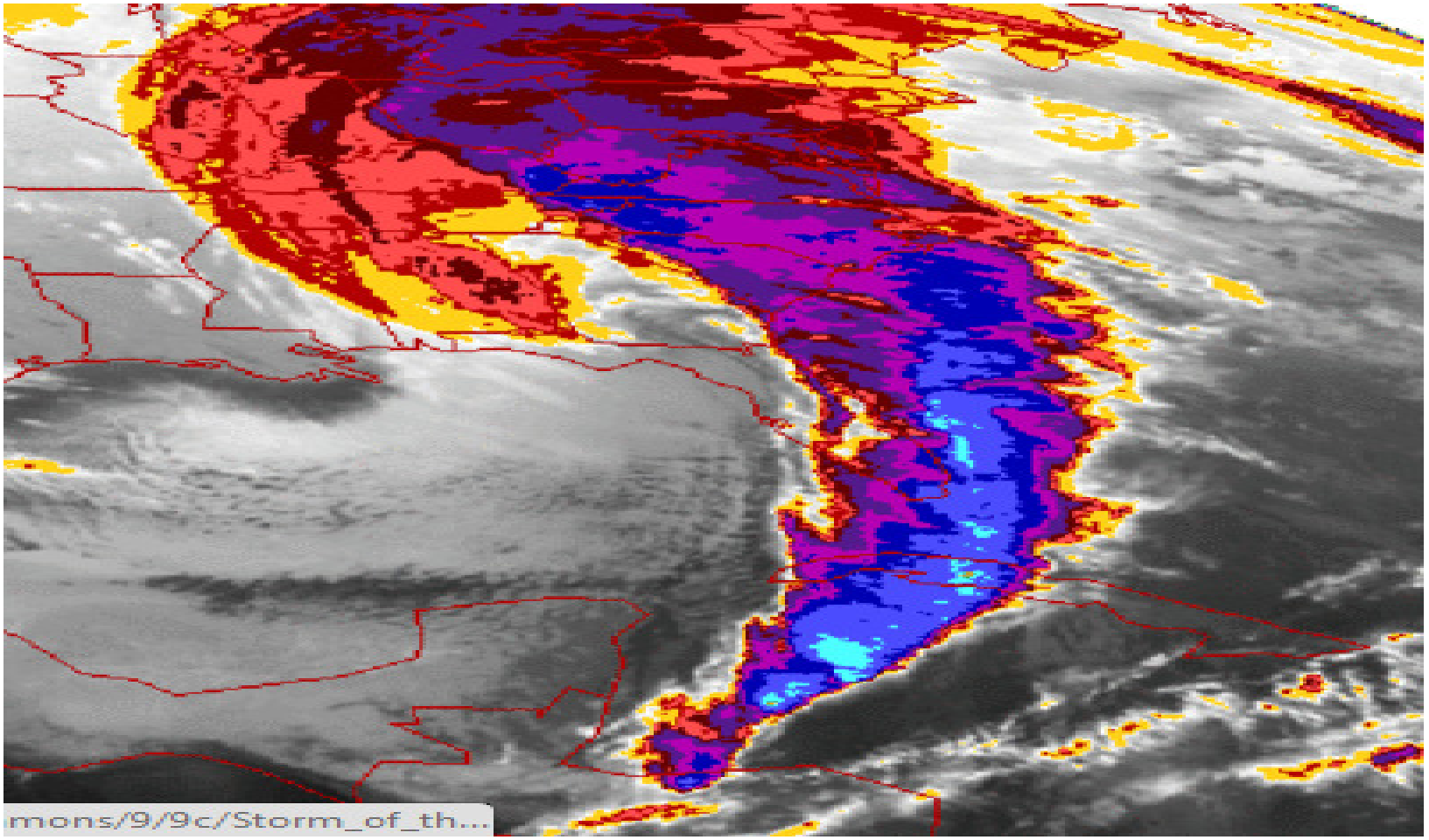
Cold Front from Low

- N Hemi – low to N, front trailing to S, comma shape
- S Hemi - opposite
- Preceded up to 300 nm by violent line squalls
- At front - squally wx, sharp wind shift, rapid drop in temp 10-30°F, up to 60 knots winds
- Wind shift N Hemi – E trades, clocking S, NW-N strong 2-4 days, back to trades
- Front extension – often squally weather
- Example – US March ’93 Storm of the Century with winds to 100 knots

Cold Front



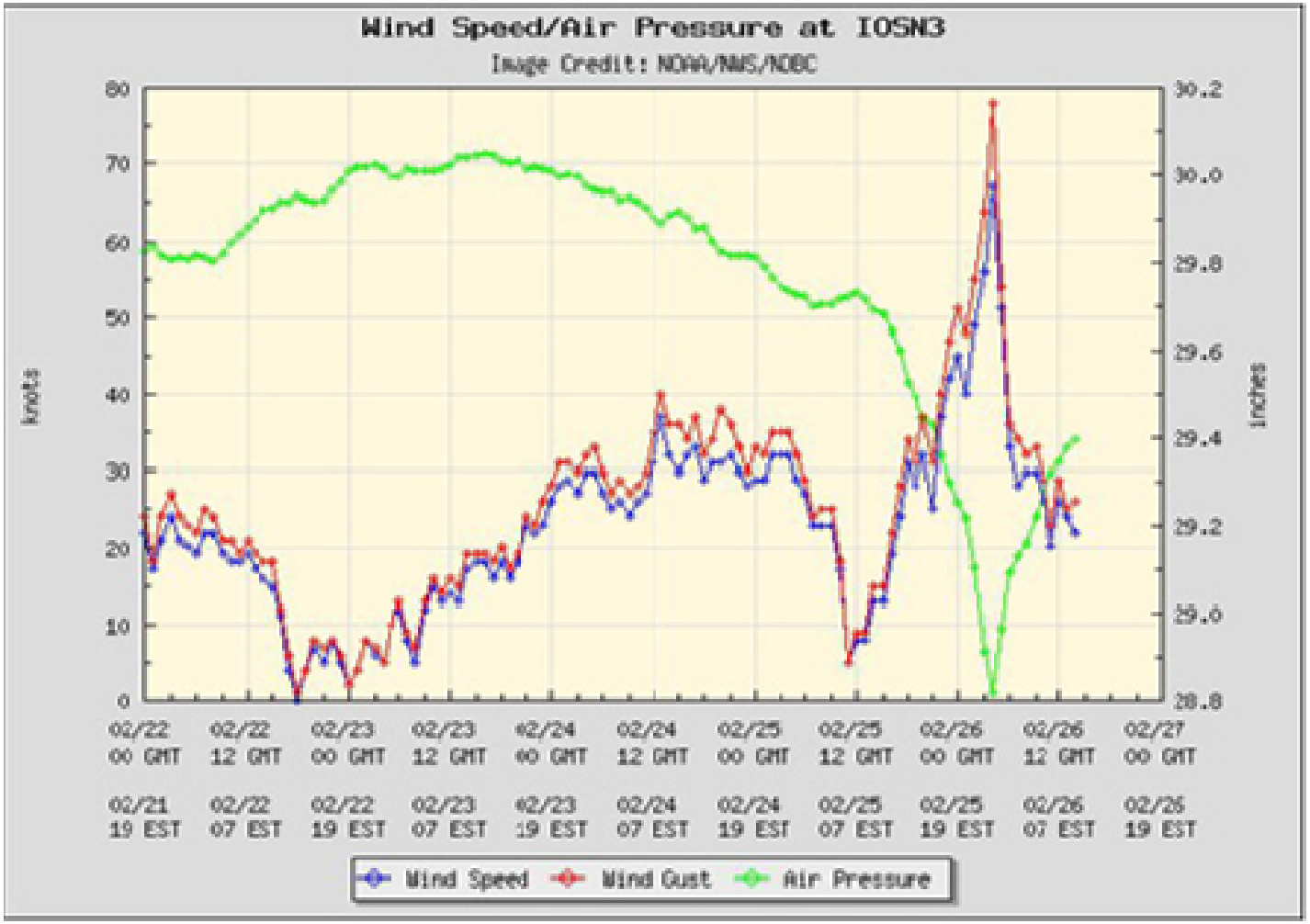
1993 Storm of the Century



Rapidly Intensifying Lows/ "Meteorological Bombs"

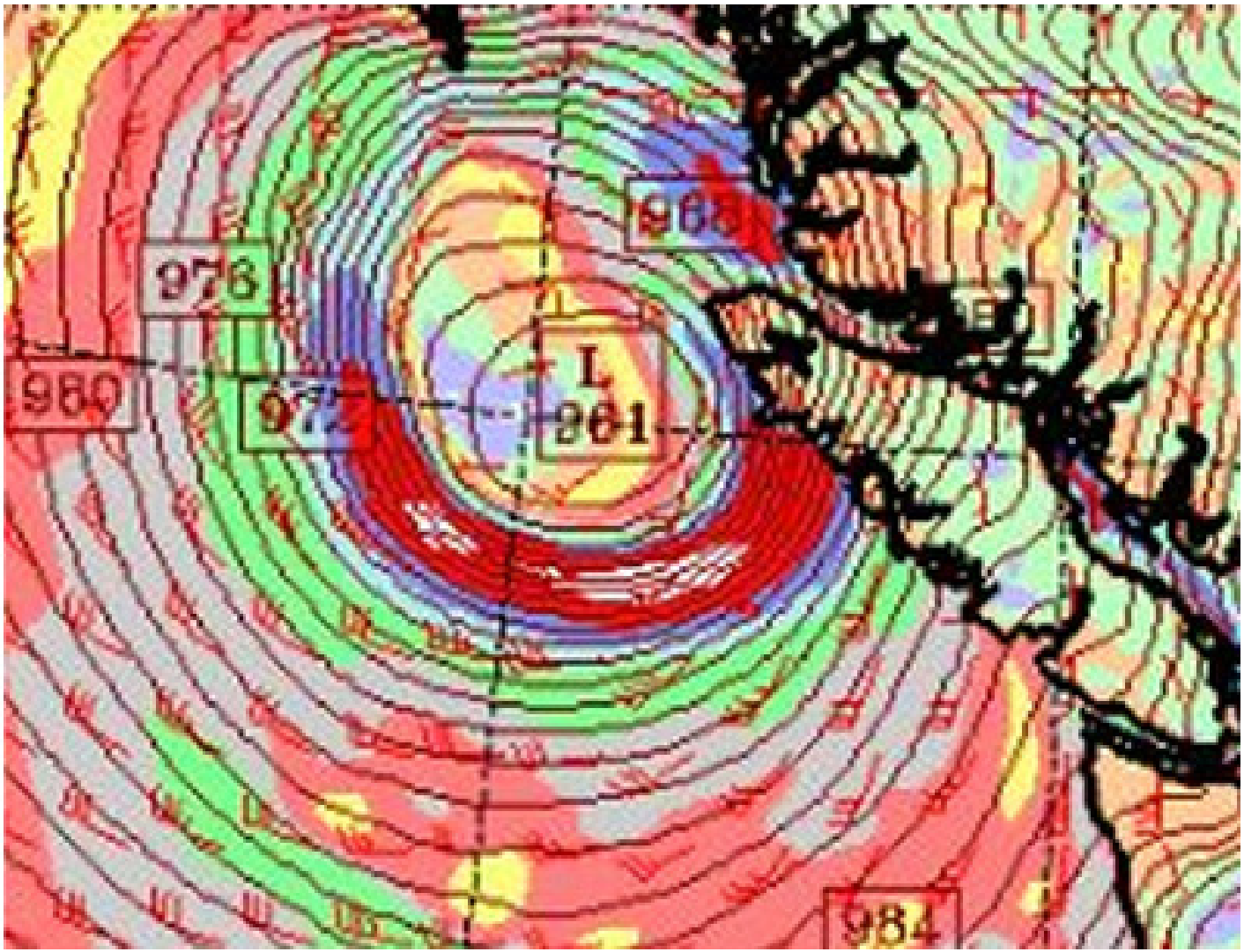
- Strong extratropical low rapidly intensifies
- Powerful as hurricane
- Baro drops >1 mb/hr for more than 6 hours
- Much larger storm center and wider high wind field than TC
- Examples – '79 Fastnet, '94 Queen's Birthday, '98 Sydney Hobart storms

Meteorological Bomb

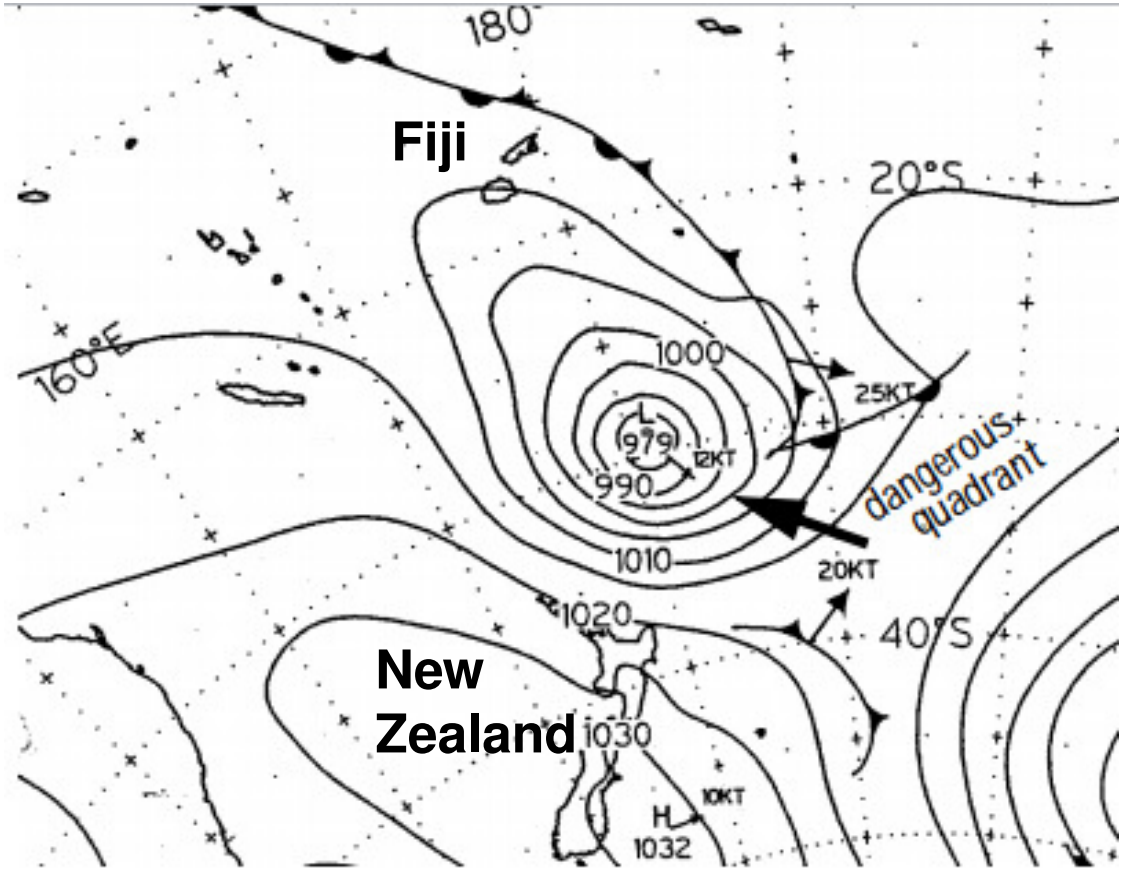


Recording of wind speed, temperature and atmospheric pressure at the Isle of Shoals Lighthouse station near Portsmouth, N.H., Feb. 22-27. The huge spike in winds that coincided with the spectacular plunge in pressure is similar to observations from a landfalling hurricane. Credit: NOAA/NWS/NDBC.

Meteorological Bomb



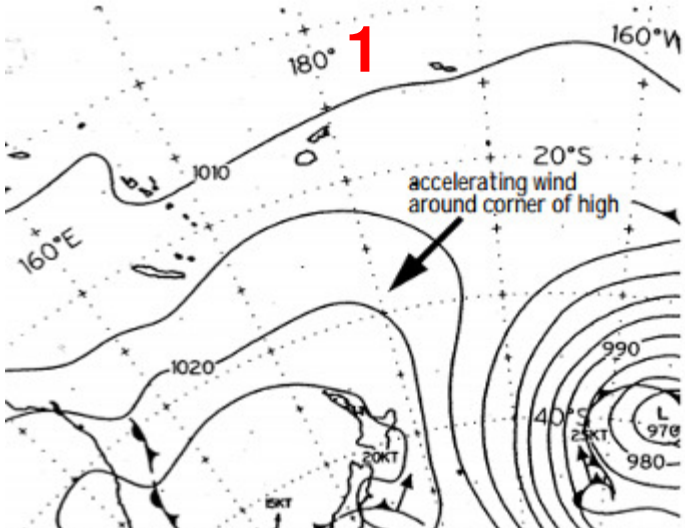
1994 Queen's Birthday Storm

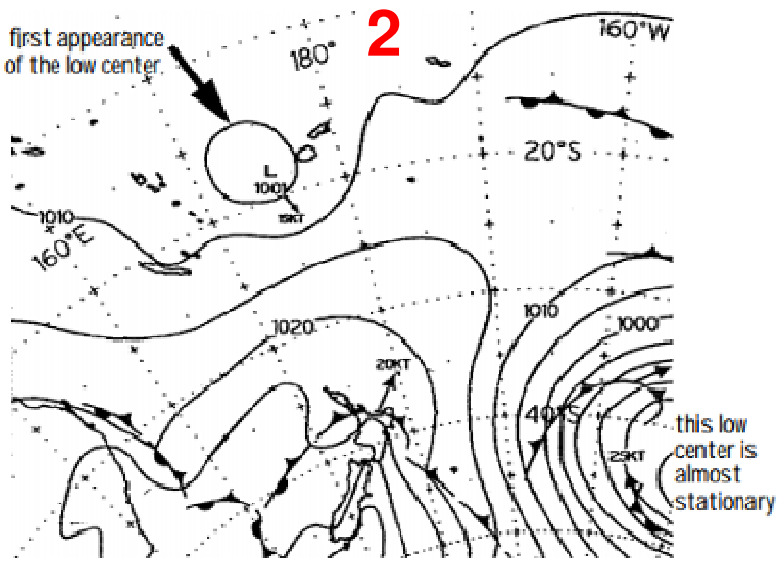


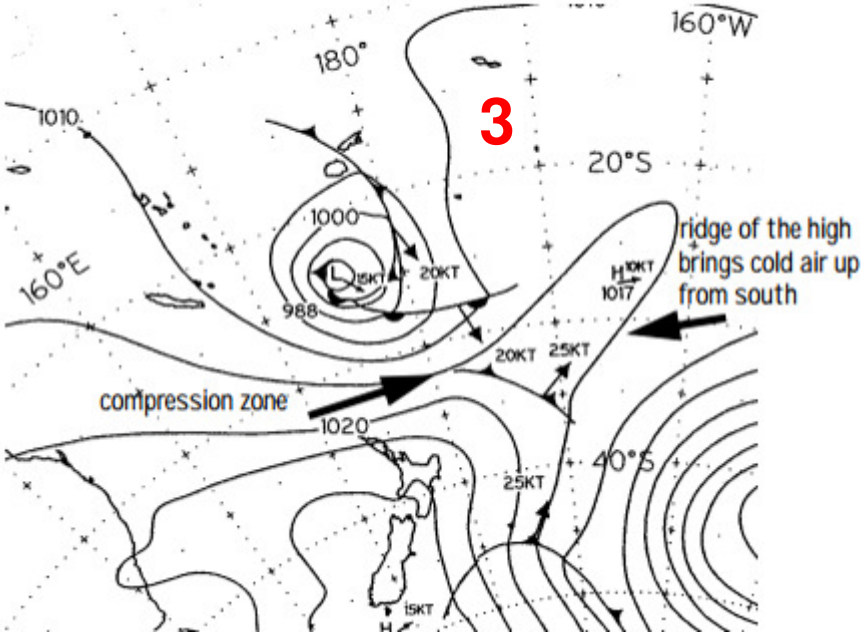
June 5, and the low between New Zealand and the Fiji Islands has deepened to 979mb. It is still squashed against the high to the south, which in turn is still held in place by the stationary depression to the east.

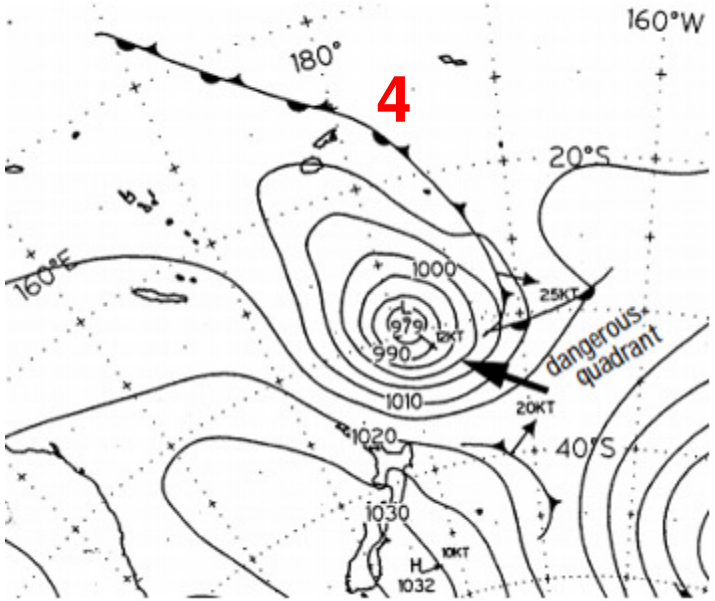
Winds in the dangerous quadrant are estimated at hurricane force. If caught in that part of the storm one should be on port tack, close-hauled. If on the track, or to the west, the wind should be on the port quarter, broad-

1994 Queen's Birthday Storm

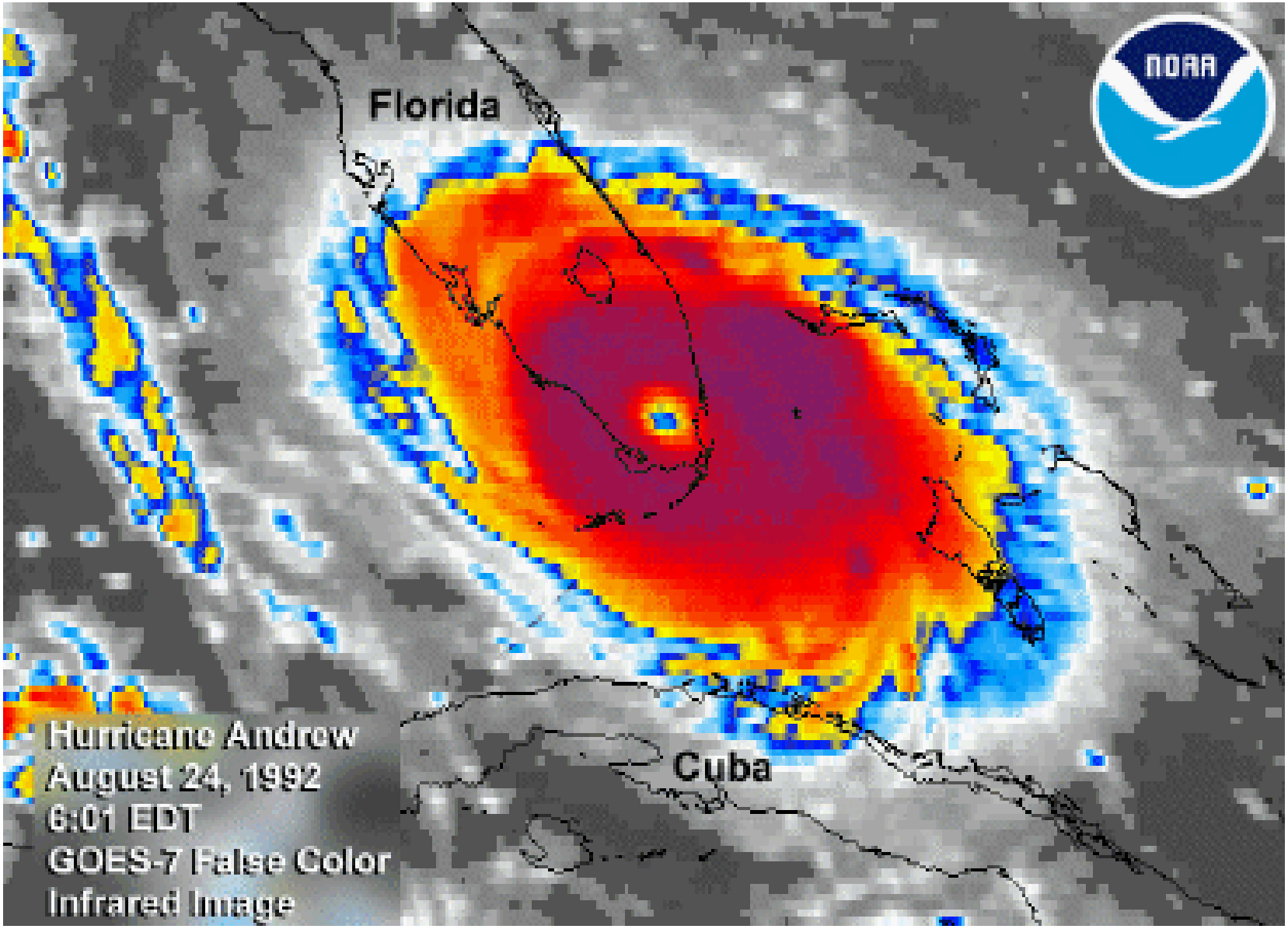








Cyclones, Hurricanes, Typhoons



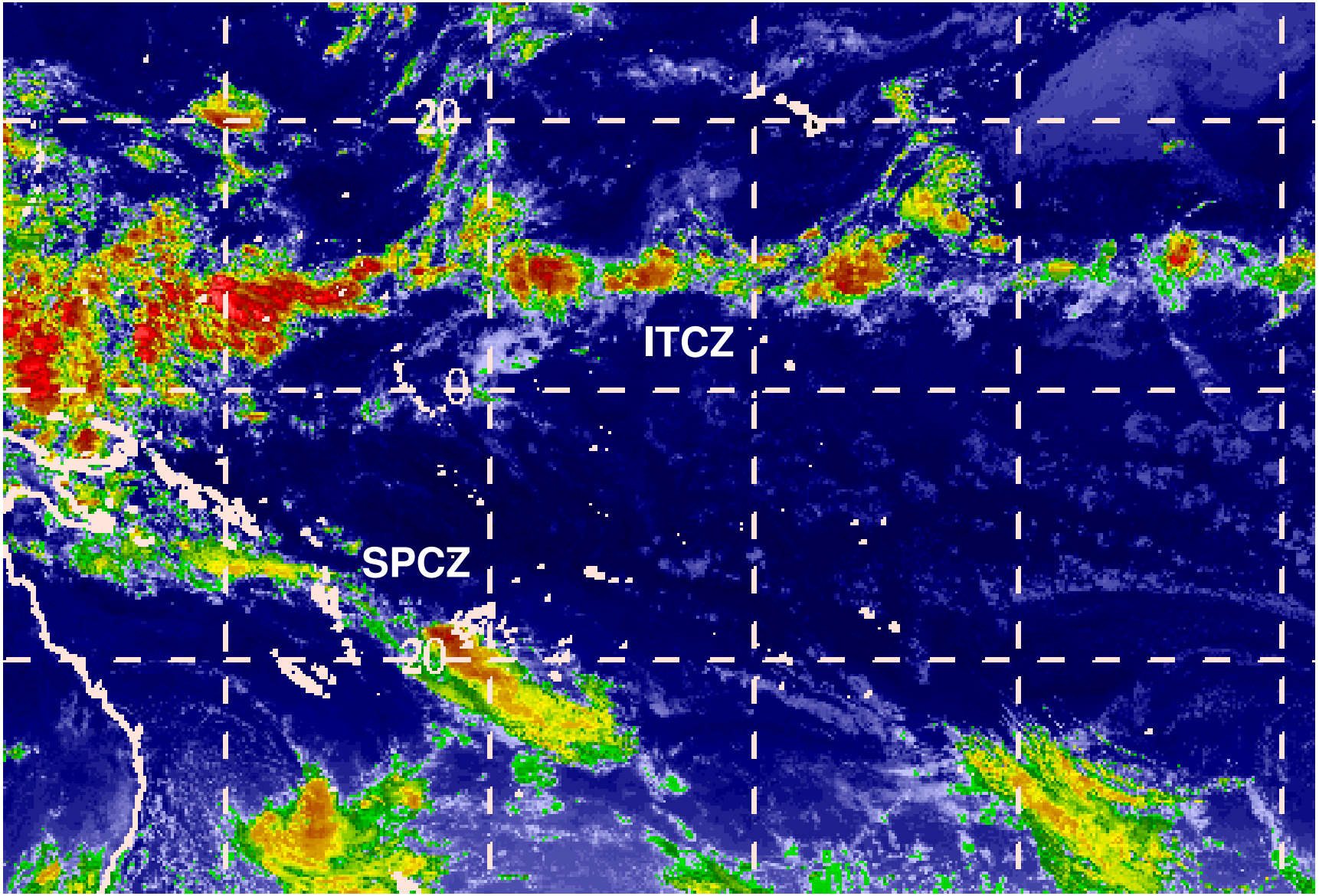
Tropical Cyclone Formation Requirements

- Coreolis Parameter - must be more than about 5° from equator or won't spin
- Ocean Thermal Energy - > 26C/83F to 60 meters depth
- Relative Humidity - > 70% up to 18K feet altitude
- Low Vertical Wind Shear - < 25 kts change between lower and upper atmosphere

TC Formation Enhancers

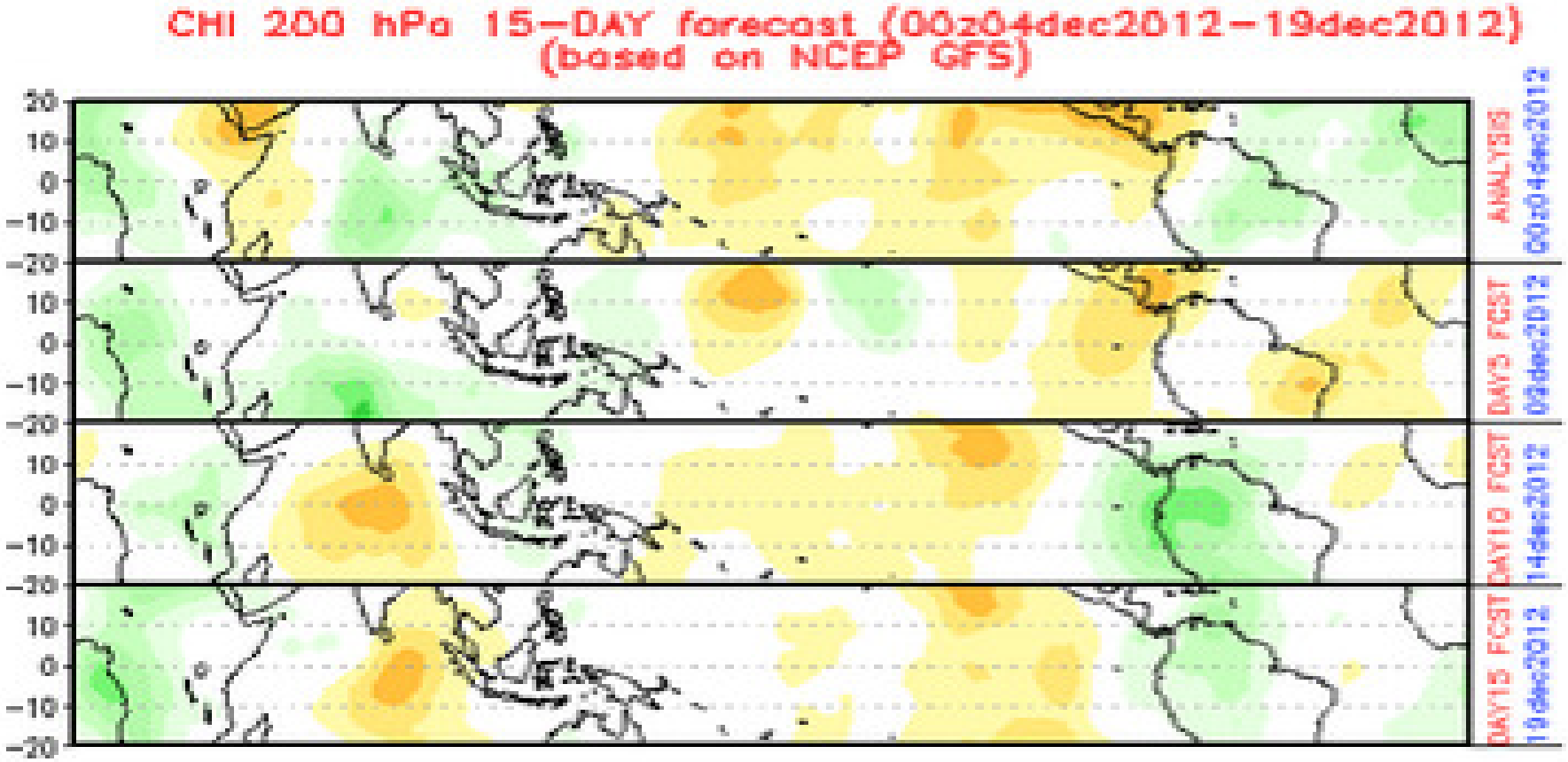
- Inter-Tropical Convergence Zone (ITCZ) on Summer side of equator
- El Nino Southern Oscillation Cycle (ENSO)-
  - In the Pacific where's the warm water?
  - West - La Nina - more storms in W Pacific
  - East - El Nino - more storms in Mid Pacific
- South Pacific Convergence Zone (SPCZ) in area? (Enhanced squally wx)
- Madden-Julian Oscillation Event (MJO) in area? (Enhanced squally wx, 45 day cycle)

ITCZ & SPCZ



Madden Julian Oscillation

(Brown-wet, green-dry. What?)



http://www.esrl.noaa.gov/psd/MJO/Forecasts

Tropical Cyclone Facts 1

- Summer is TC season
- N hemisphere (S hemisphere opposite)
  - if wind and swell veering, you are in dangerous semi-circle
  - backing in navigable semi-circle
  - steady and falling barometer in path of storm
- N hemisphere dangerous semi-circle location
  - To right facing storm direction
  - Highest winds-wind speed plus speed of travel
  - Highest storm surge

Tropical Cyclone Facts 2

- TC forward travel normally 10-20 knots
- First indicator of TC often long period swells
- Forecast warning error up to 100 nm per day, usually much better
- If TC goes extratropical in higher latitudes:
  - storm spreads out w/ high winds to 500 nm out
  - rate of travel speeds to 50 knots (1200 nm/day)!

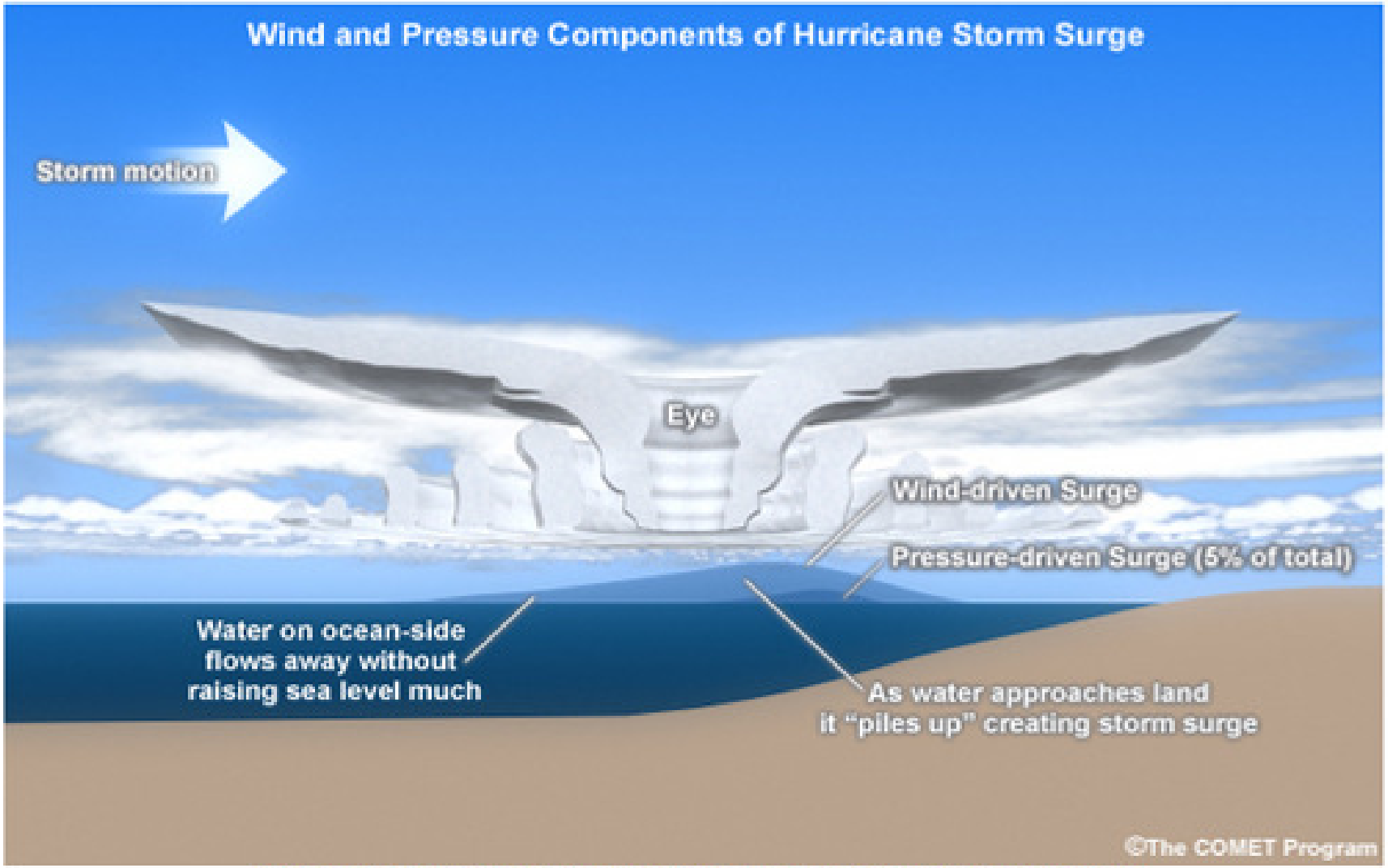
SPaws in TC Cyril, Tonga 2012

Buys Ballot's Law

- **North Hemisphere**
- CCW circulation
- Face the wind, storm center will be 115° to **right**

- **South Hemisphere**
- CW circulation
- Face the wind, storm center will be 115° to **left**

Storm Surge



Wind and Pressure Components of Hurricane Storm Surge

Storm Surge/Tide

- Caused by strong winds pushing water toward shore
- Lower central pressure means tighter pressure gradient causing higher winds
- Shallow bay w/ onshore wind enhances effect of surge
- Storm tide is tidal rise plus storm surge
- Effect is slow rise in water level up to 25'+

Storm Surge Danger

- 2012 Sandy, NY/NJ, Cat 1/2 8-10’
- 2008 Ike, Galveston TX, Cat 3 15-20’
- 2005 Katrina, N Orleans, Cat 4 25-28’
- 1995 Opal, Pensacola FL, Cat 3 24’
- 1989 Hugo, S Carolina, Cat 4 20’
- 1969 Camille, Mississippi, Cat 5 24’

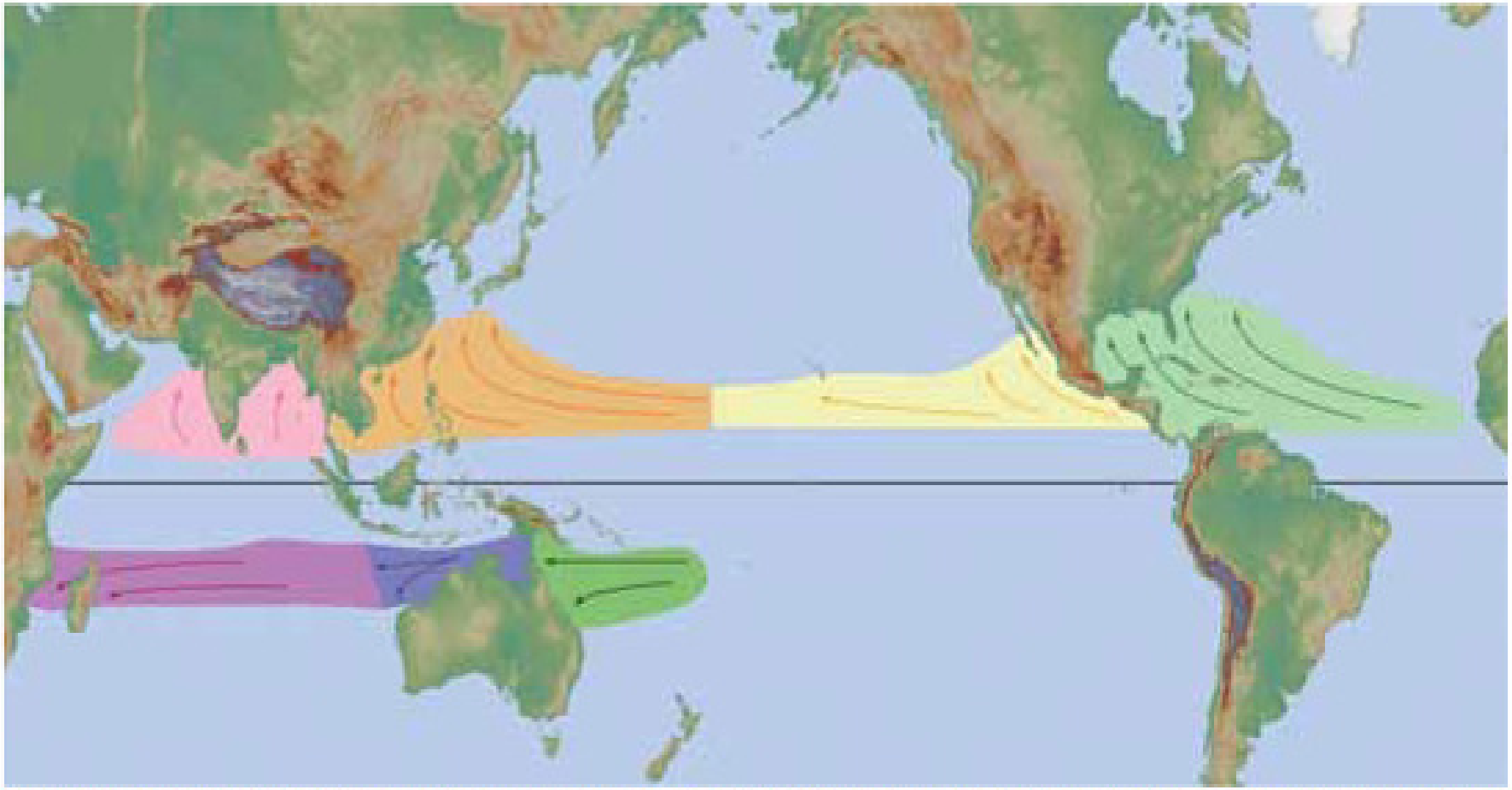
- **Boats tied to docks have no way to deal with large storm surge**

Danger of Staying in a Marina!

Tropical Cyclone Wind Scales

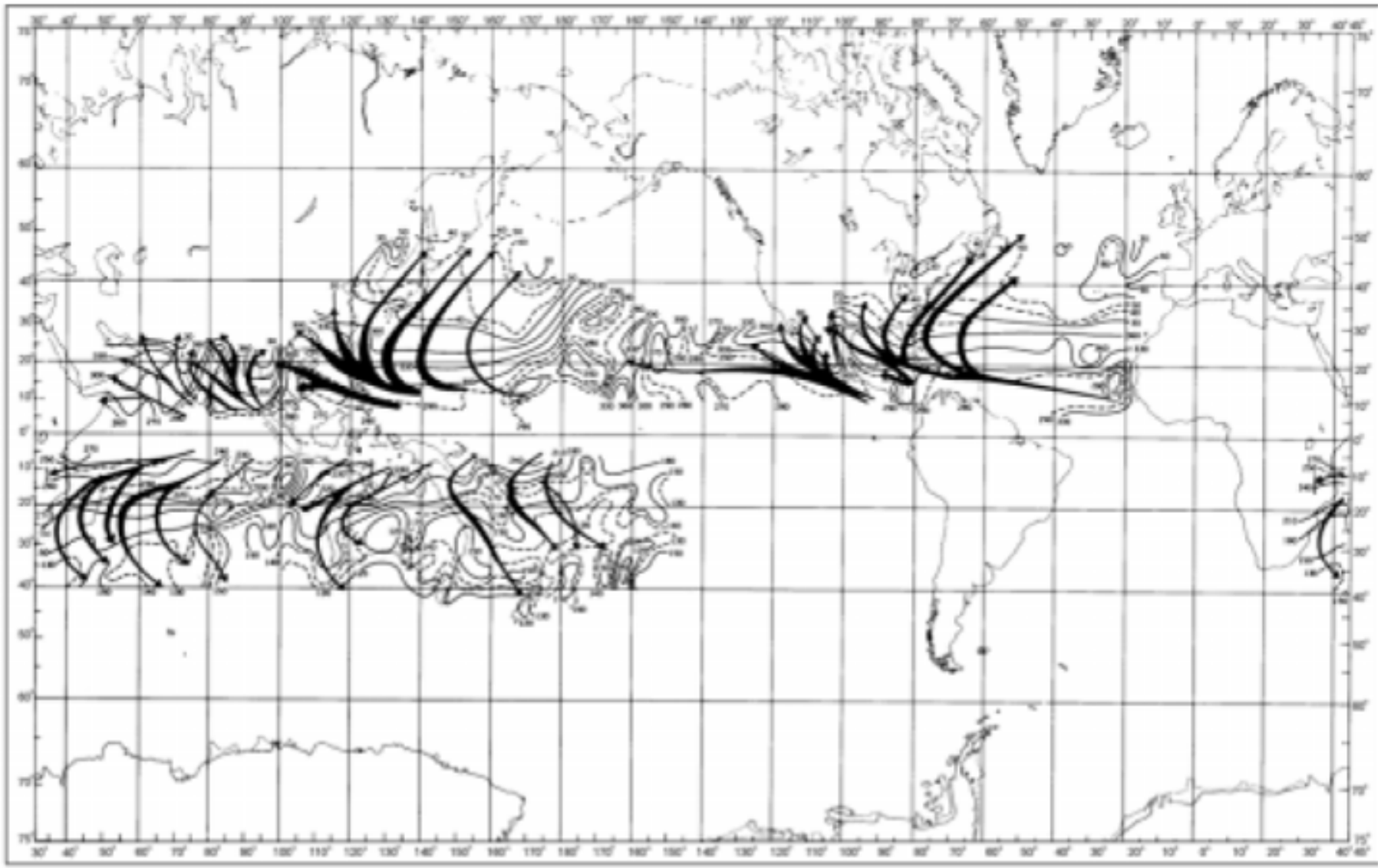
Beaufort Scale	Wind Knots	Hurricanes NE Pac, NW Atl		Typhoons NW Pacific	Cyclones SW Pacific	Storm Surge Feet
8-9	34-47	T Storm		T Storm	Cat 1	0-3
10	48-55	T Storm		T Storm	Cat 2	"
11	56-63	T Storm		T Storm	Cat 2	"
12	64-72	**Cat 1**		Typhoon	**Cat 3**	4-5
13	73-85	Cat 1		Typhoon	Cat 3	"
14	86-89	Cat 2	83	Typhoon	Cat 4	6-8
15	90-99	Cat 2	95	Typhoon	Cat 4	"
16	100-106	Cat 3	96	Typhoon	Cat 4	9-12
17	107-114	**Cat 3**	113	Typhoon	**Cat 5**	"
17	115-119	Cat 4	114	Super Typhoon	Cat 5	13-18
17	120-135	Cat 4		Super Typhoon	Cat 5	"
	>136	Cat 5		Super Typhoon	Cat 5	>18

TC Formation Regions

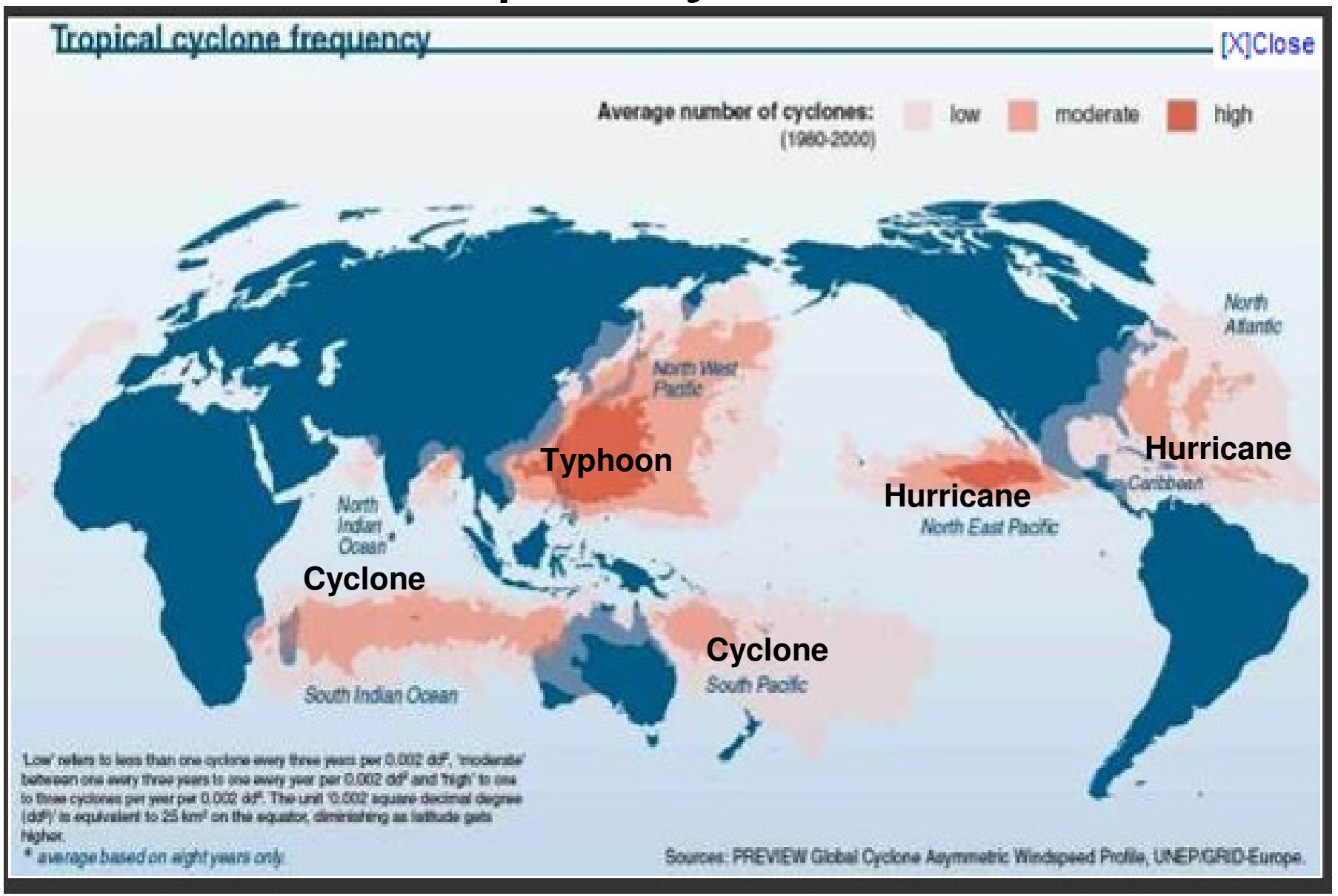


Tropical Cyclone formation regions with mean tracks (courtesy of the NWS JetStream Online School)

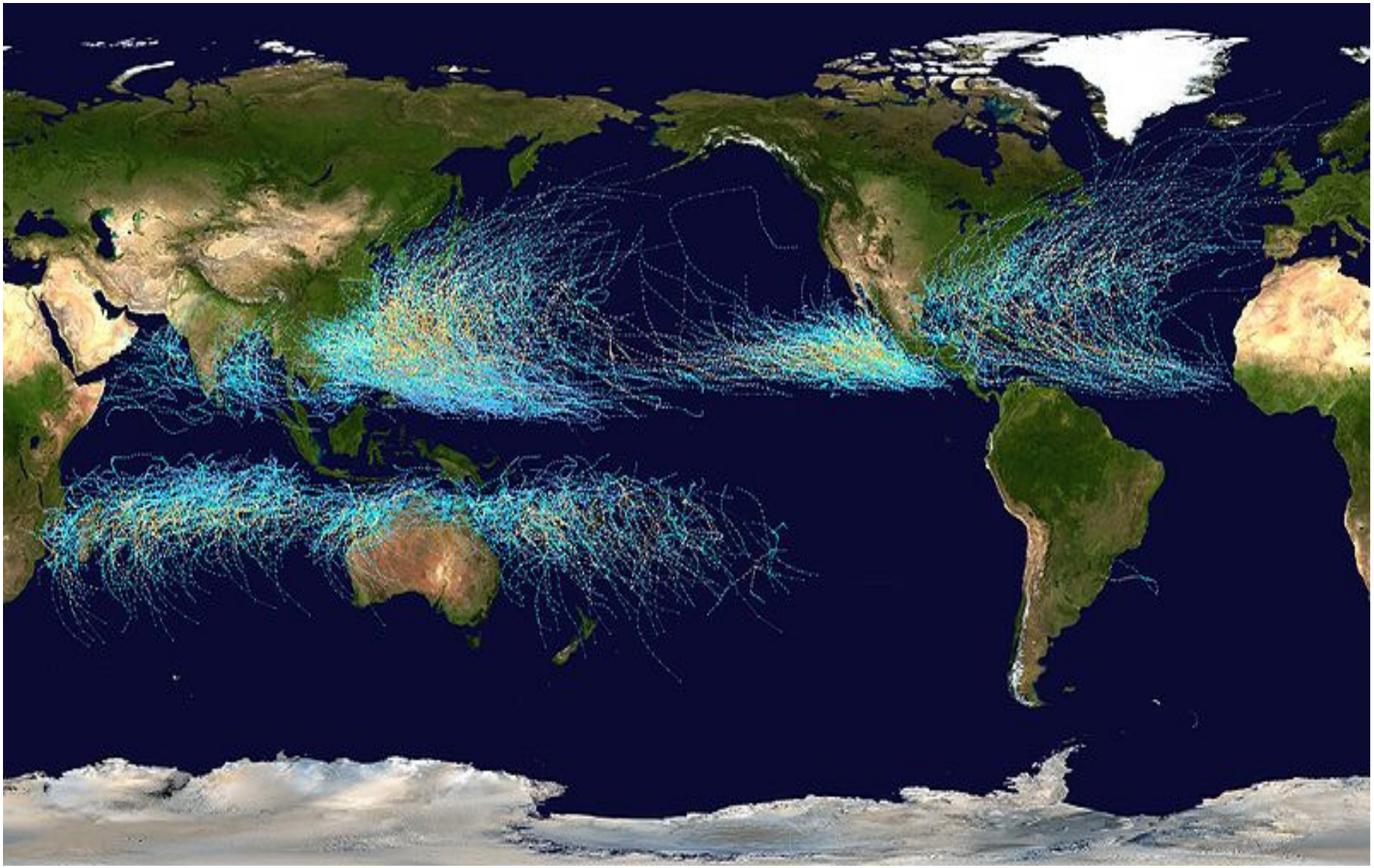
World Tropical Storm Paths



TC Frequency Worldwide

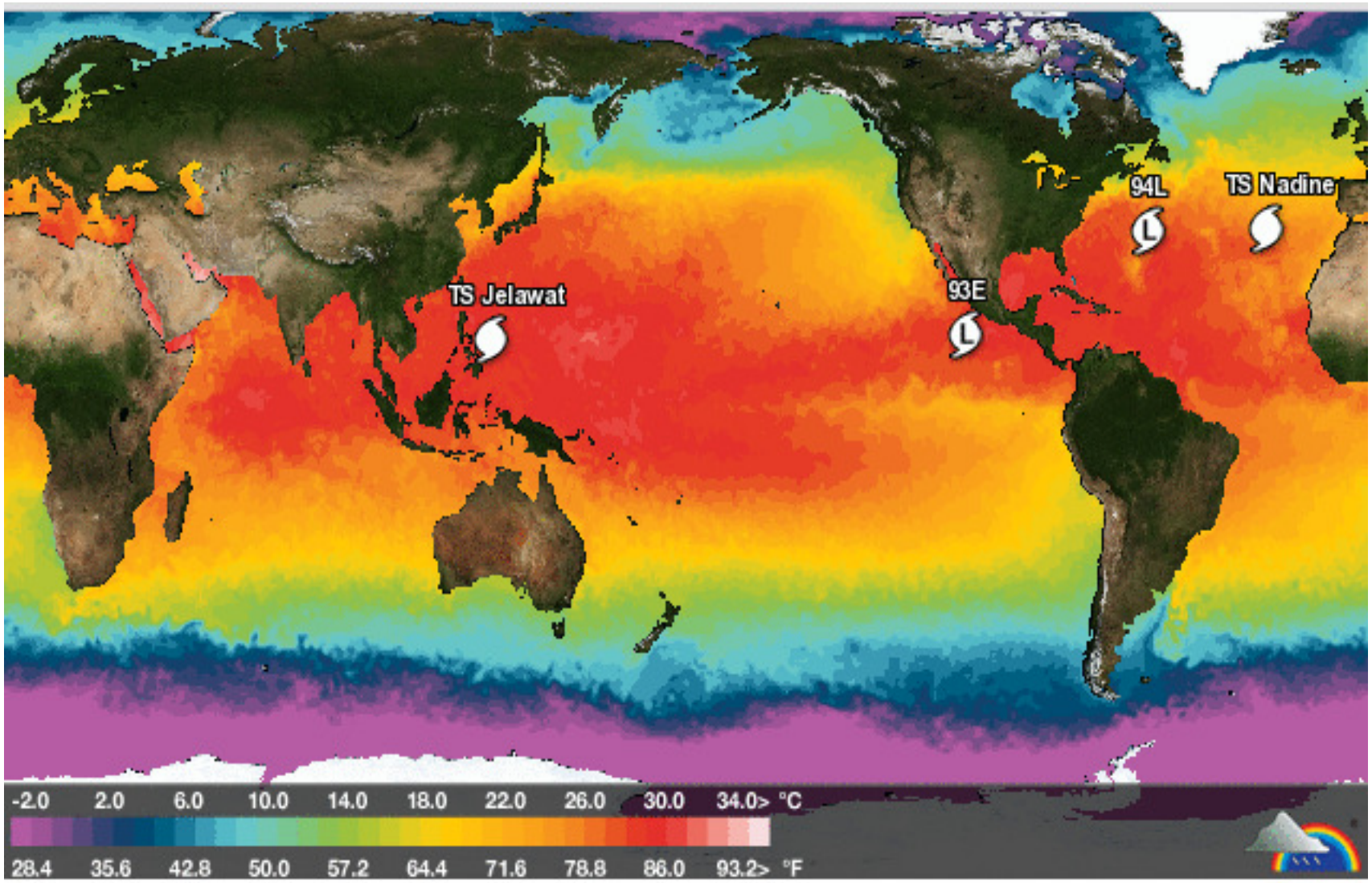


World Tropical Storm Tracks

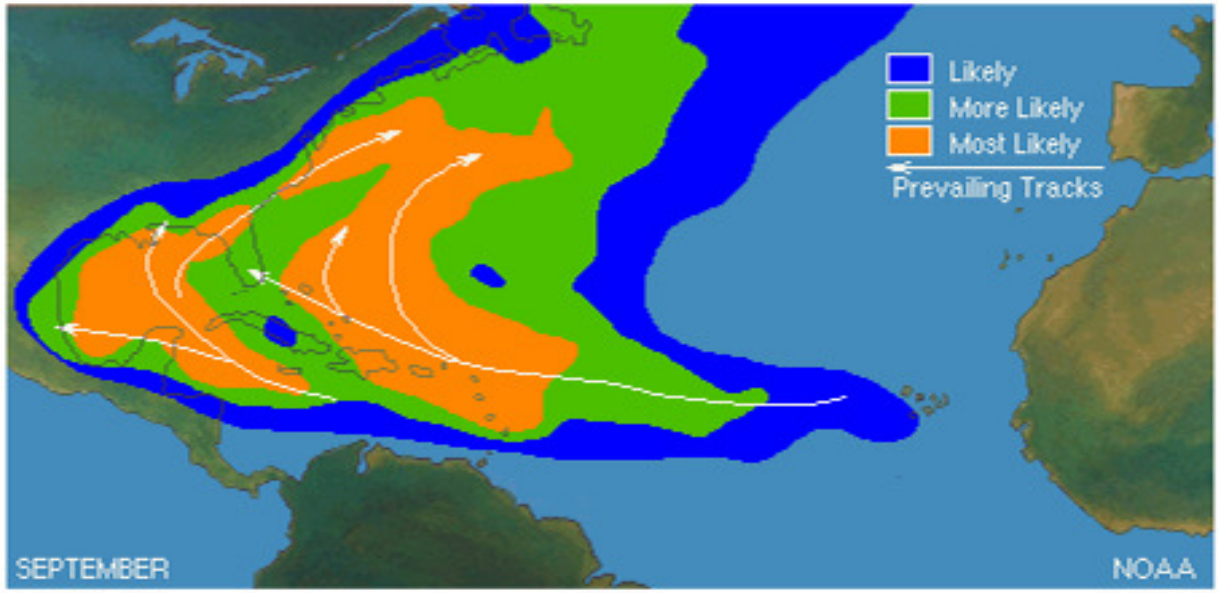


Sea Surface Temperatures

N Hemi TC Season



Atlantic Hurricane Formation

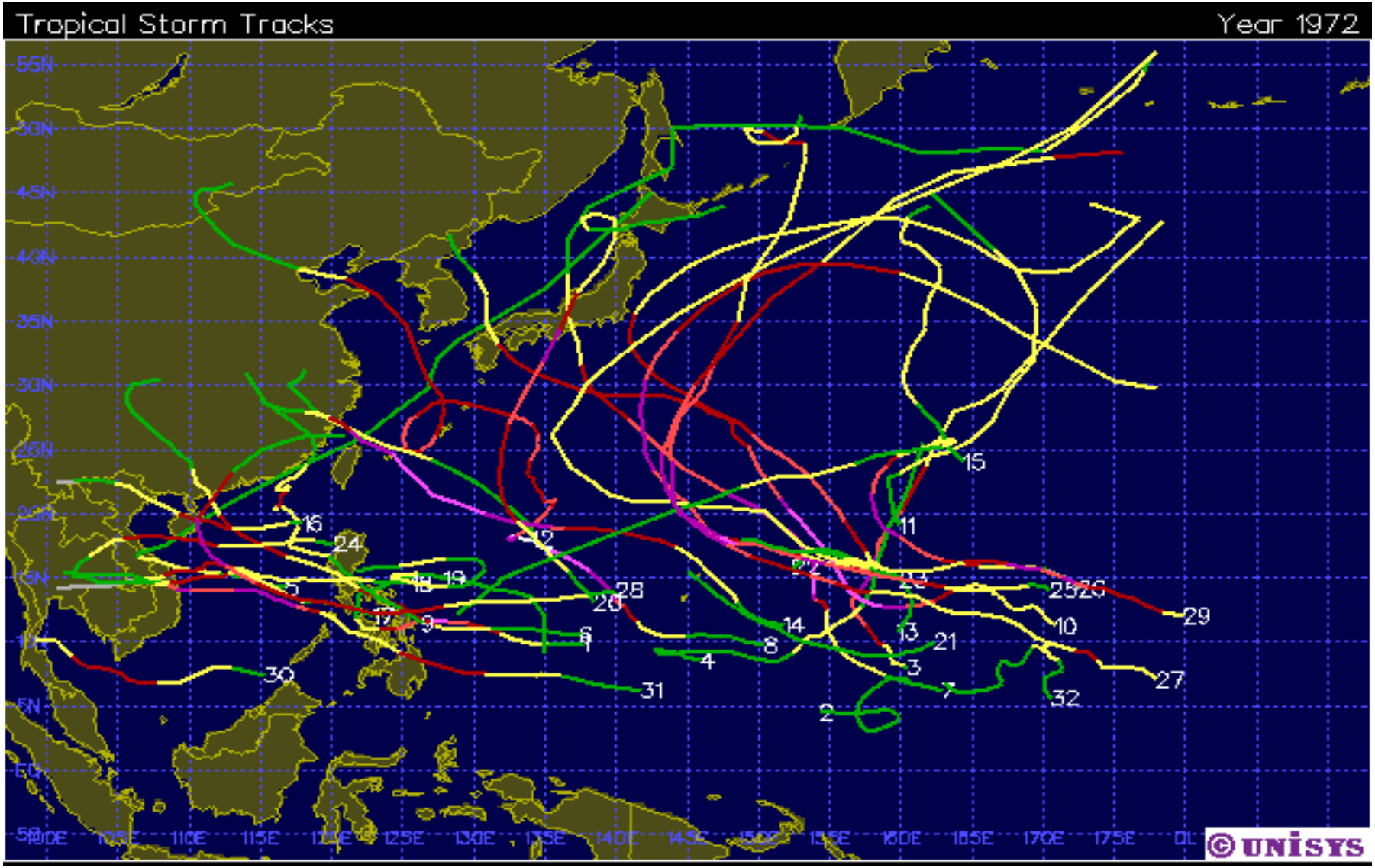


North America Major TCs

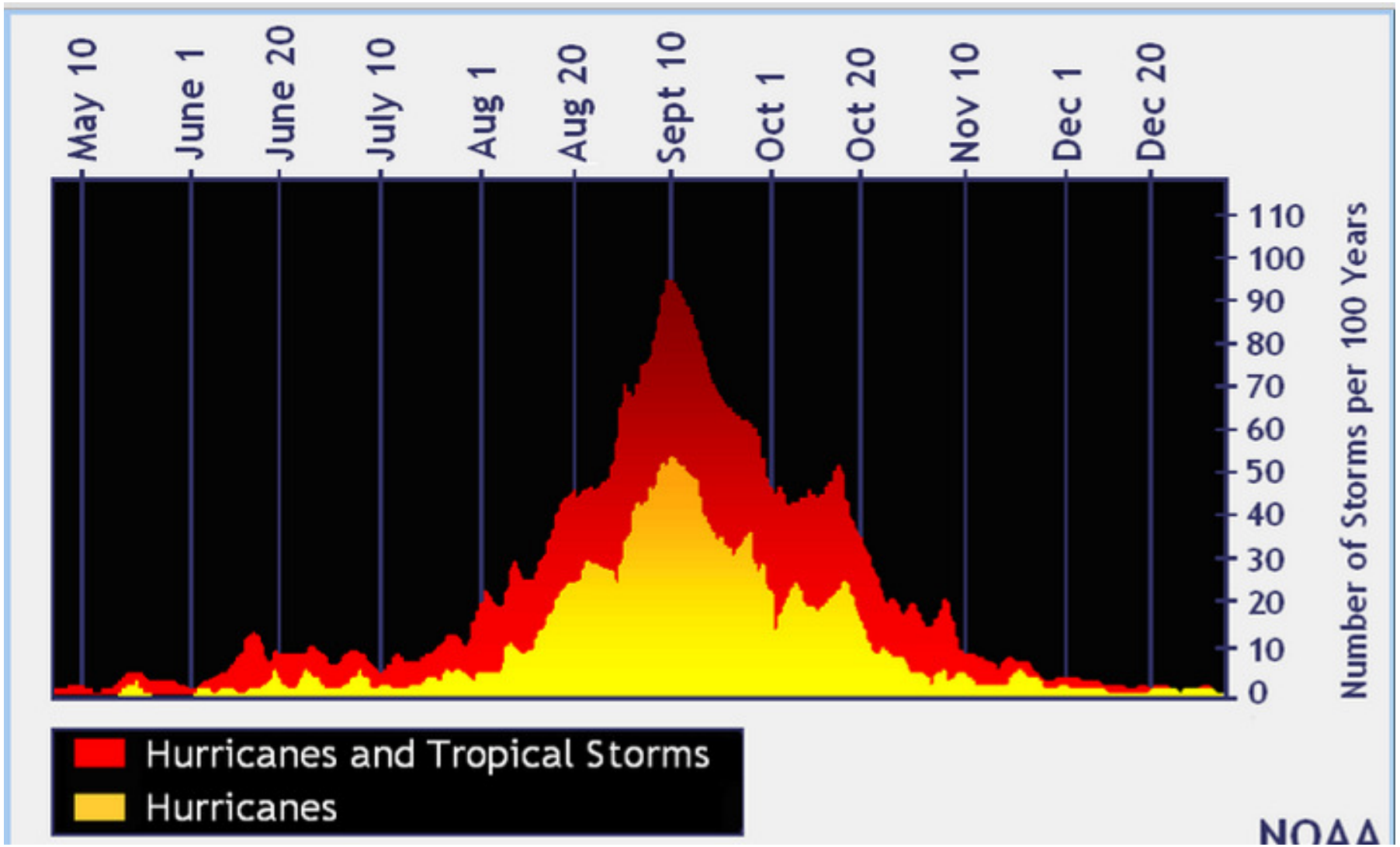
All North Atlantic and Eastern North Pacific major hurricanes
(at least Category 3 on the Saffir-Simpson Hurricane Scale)
Download high resolution jpg (45 MB)

1972 NW Pacific Typhoons

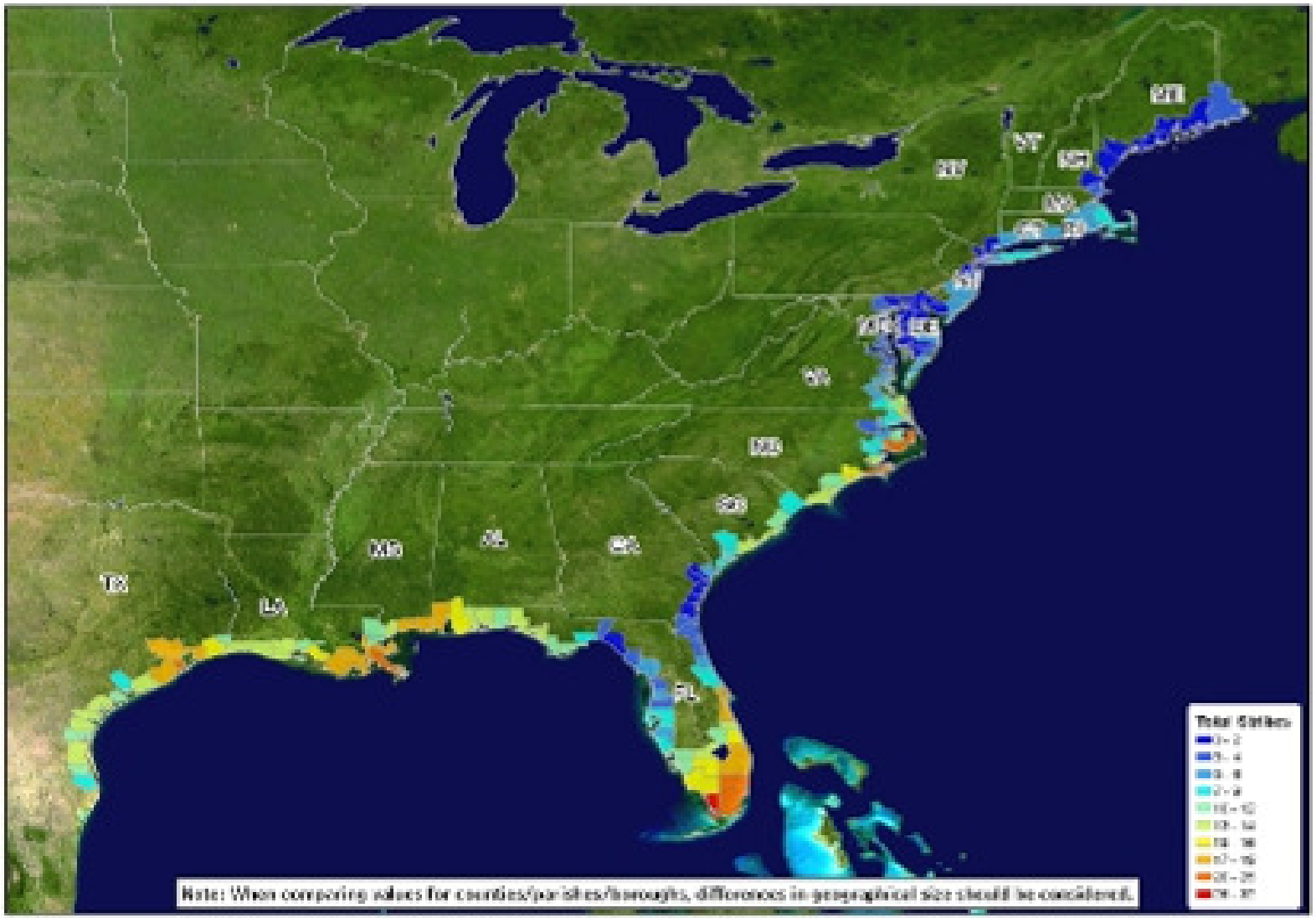
32 Storms



Monthly Atlantic TC Dispersal



US Hurricane Strike Zones



Total number of hurricane strikes by counties/parishes/boroughs, 1900-2010

Worldwide TC Centers

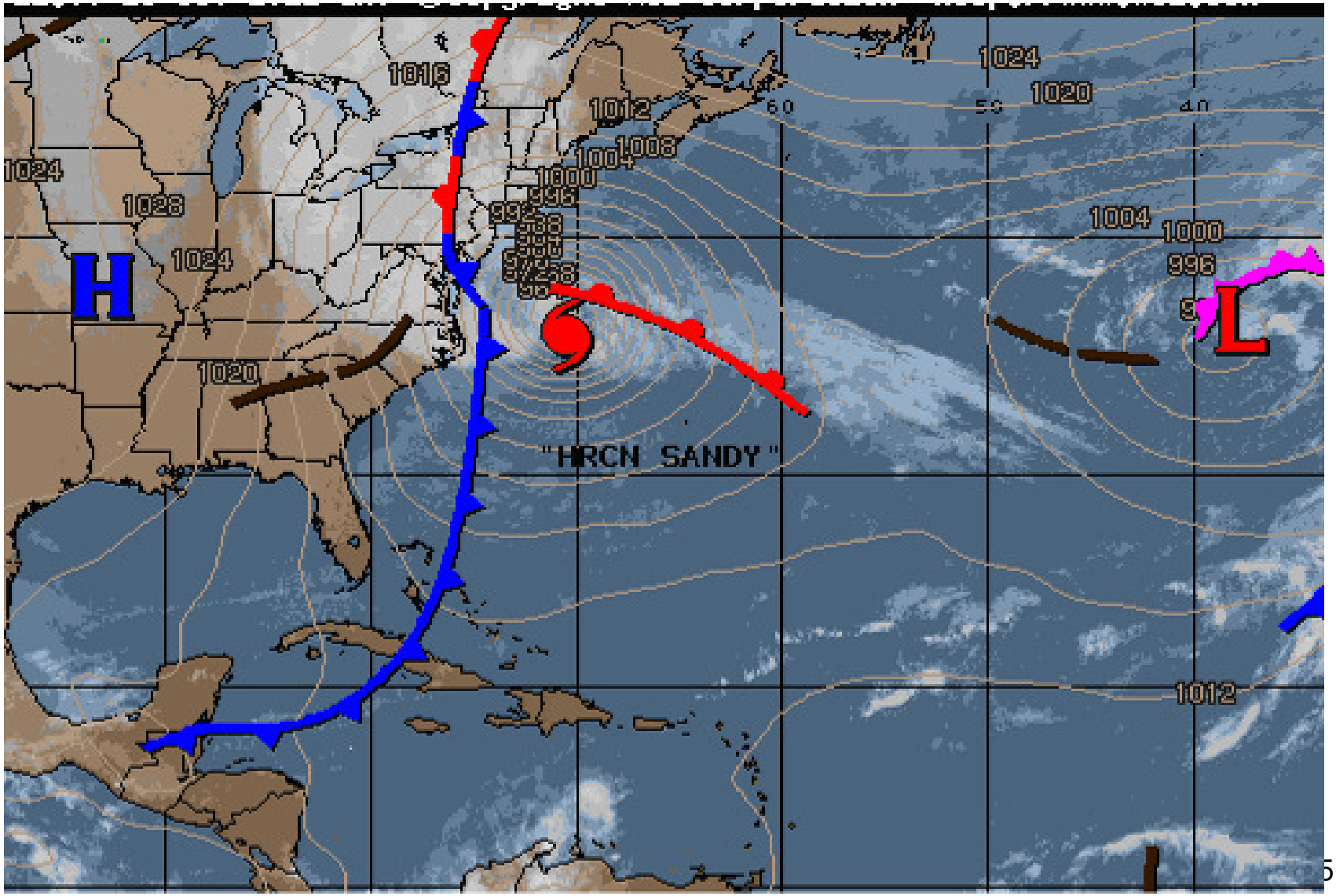
Tropical Cyclones Centers Worldwide

- WMO Severe Weather Info Centre
- RSMC - Miami
- RSMC - Tokyo
- RSMC - Nadi Tropical Cyclone Centre
- TCWC - Wellington
- TCWC - Australia
- RSMC - New Delhi
- RSMC - La Reunion
- Canadian Hurricane Centre

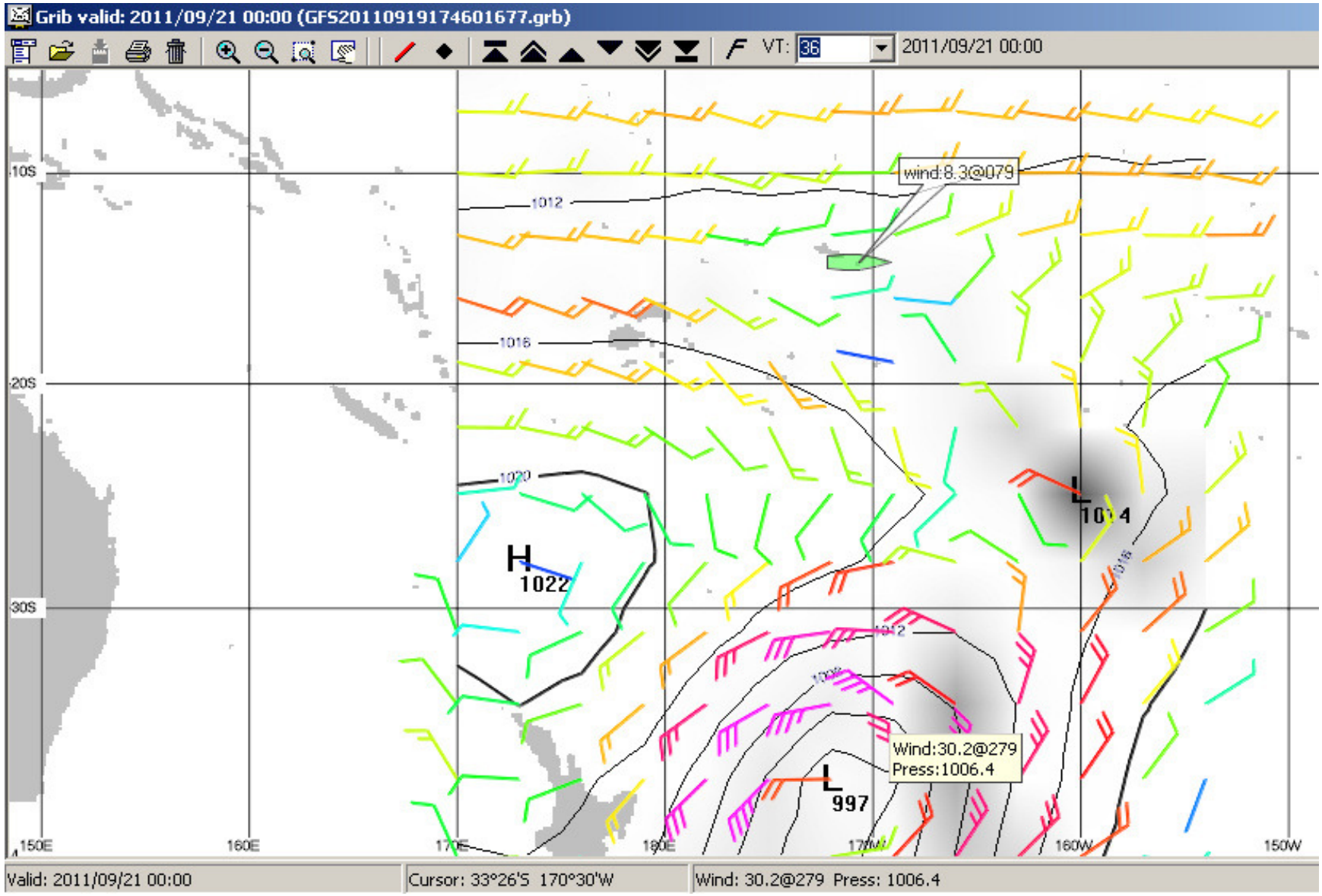
Internet Hurricane Resources

- **National Hurricane Center-best archives, official tracks www.nhc.noaa.gov**
- **USN Joint Typhoon Warning Center- Pacific TC info http://www.usno.navy.mil/JTWC/**
- **Weather Underground - archives, tracks from 1851 www.wunderground.com/hurricane/hurrarchive.asp**
- **Unisys Weather – tracks from 1851, charts, graphics www.Unisys.com**
- **CIMSS Tropical Weather- better storm tracks www.Tropic.ssec.wisc.edu/#SPECIAL**
- **Pics of Strongest Hurricanes Ever http://www.hurricane-facts.com/Hurricane-Pictures.php**

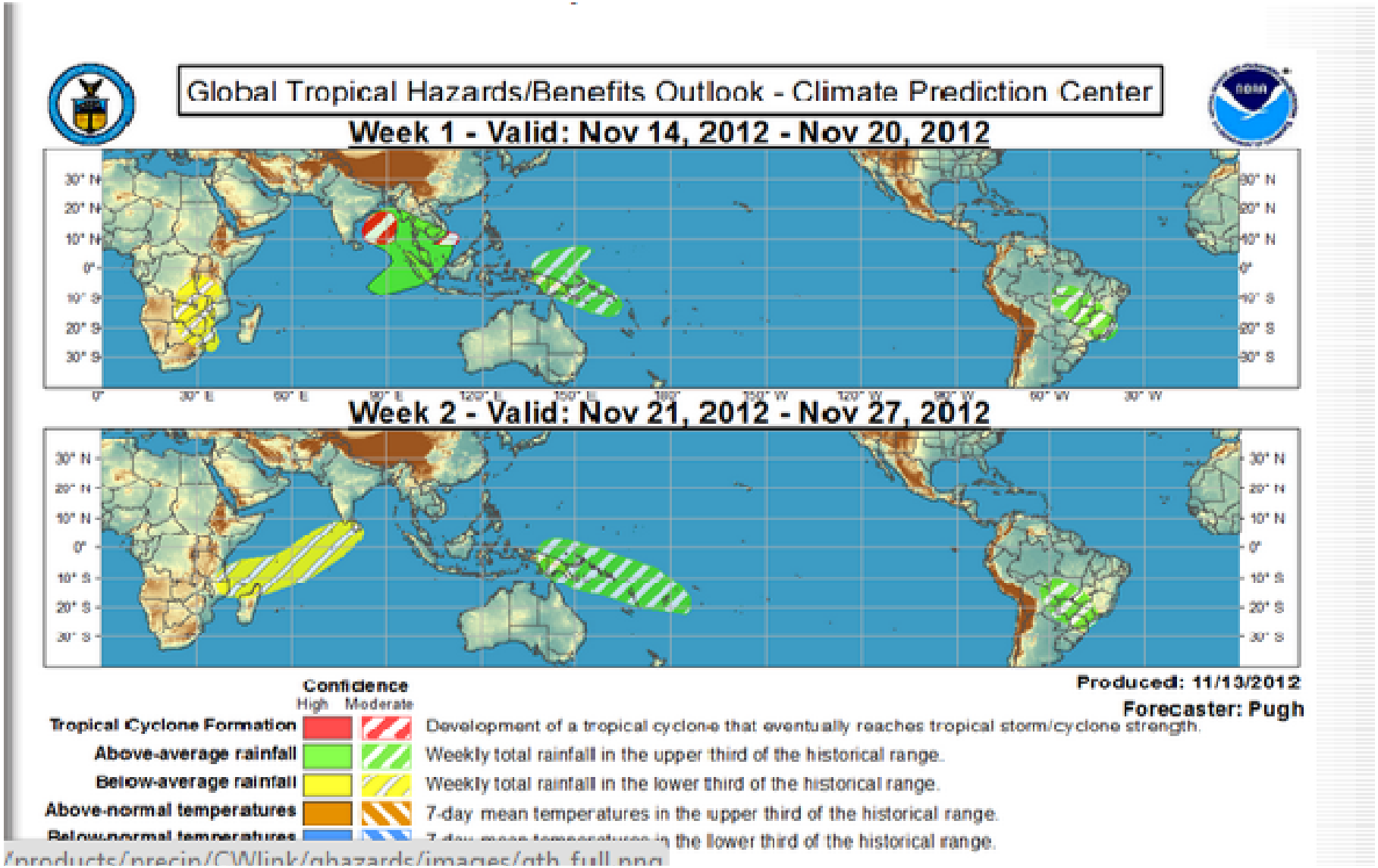
Sample Weather Products



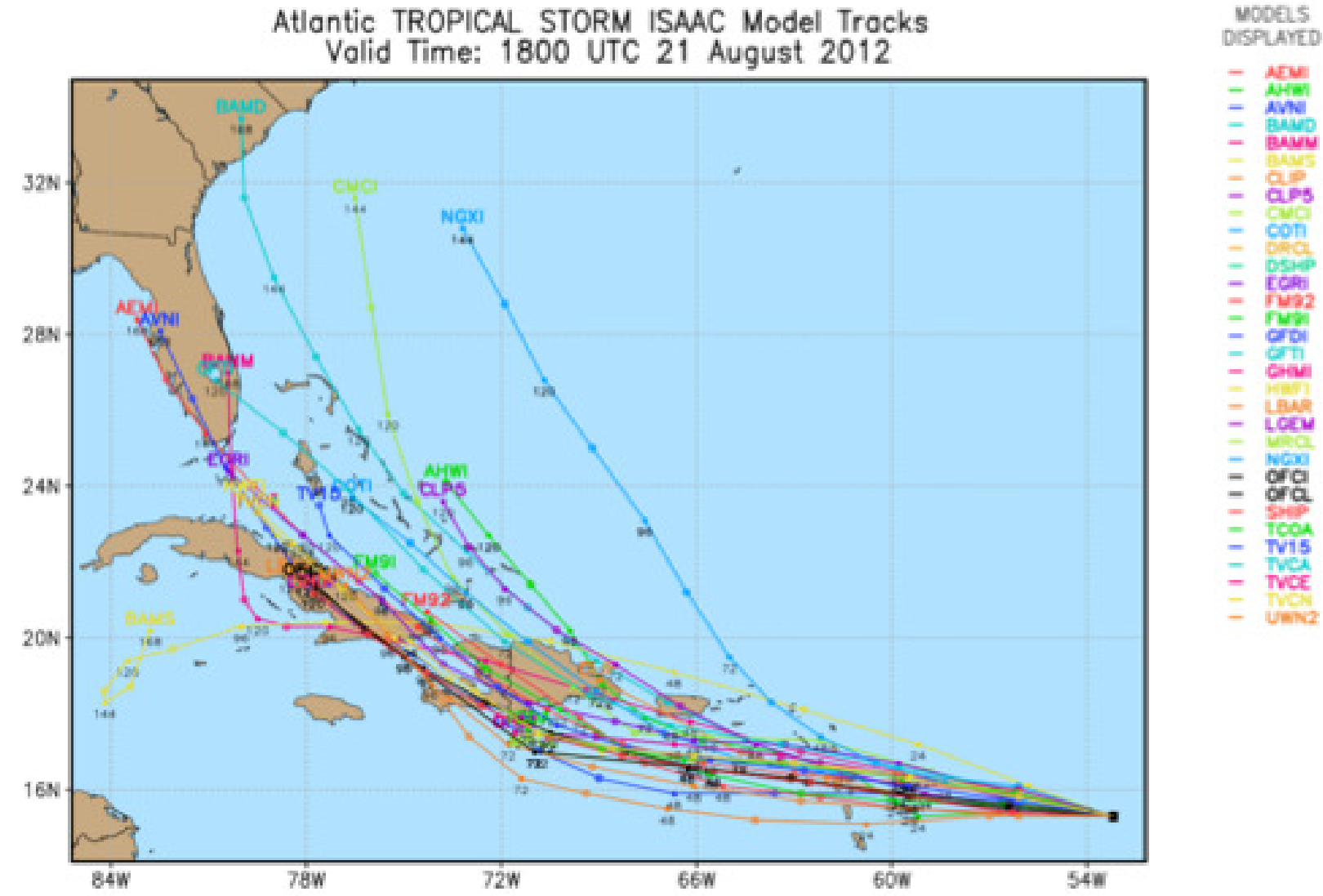
Color Grib


Grib valid: 2011/09/21 00:00 (GFS20110919174601677.grb)
VT: 36
2011/09/21 00:00
wind:8.3@079
1012
1016
1020
H
1022
L
997
Wind:30.2@279
Press:1006.4
10S
20S
30S
150E
160E
160W
150W
Valid: 2011/09/21 00:00
Cursor: 33°26'S 170°30'W
Wind: 30.2@279 Press: 1006.4

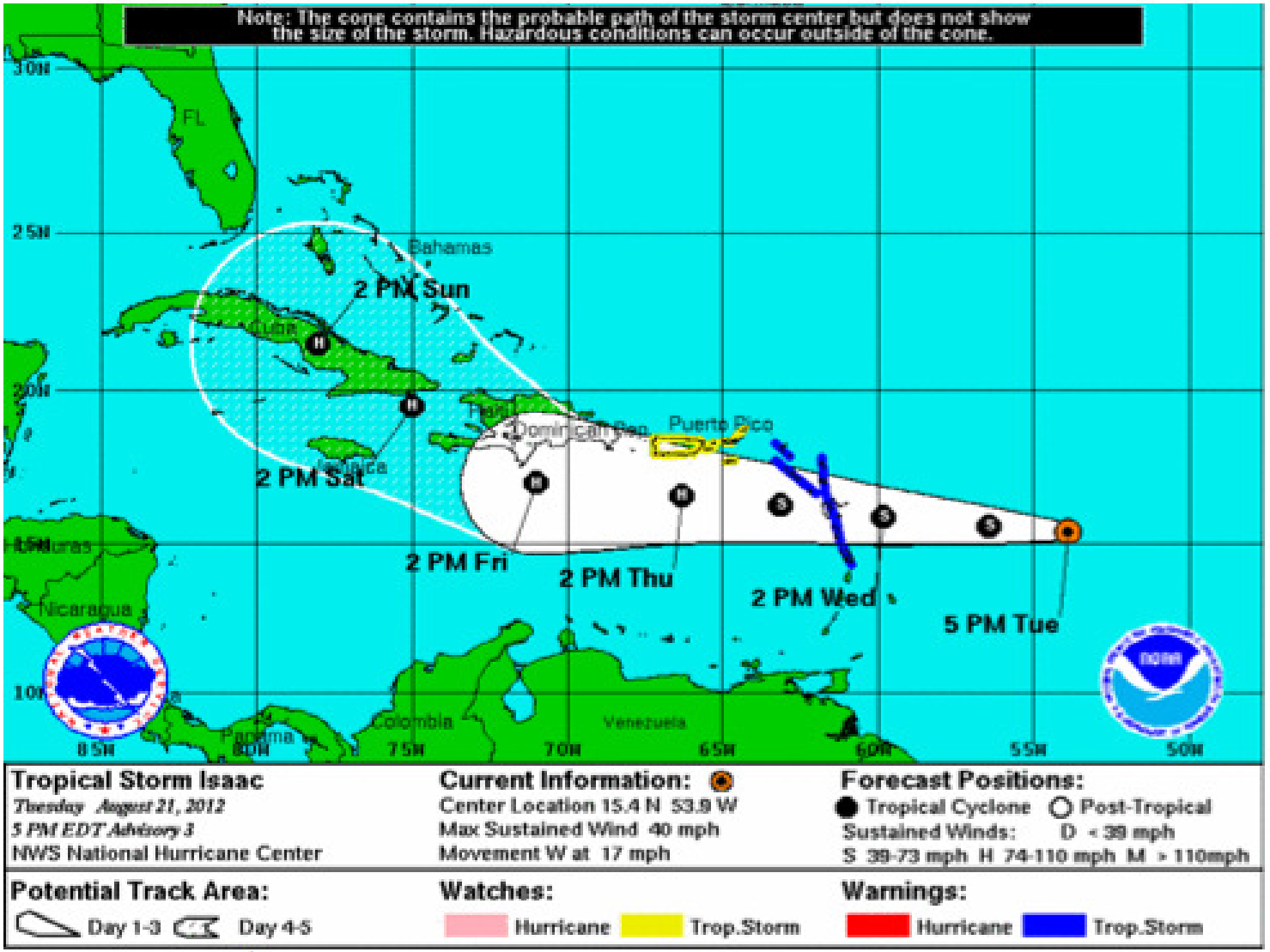
Global Tropical Hazards Outlook



Spaghetti Track Models

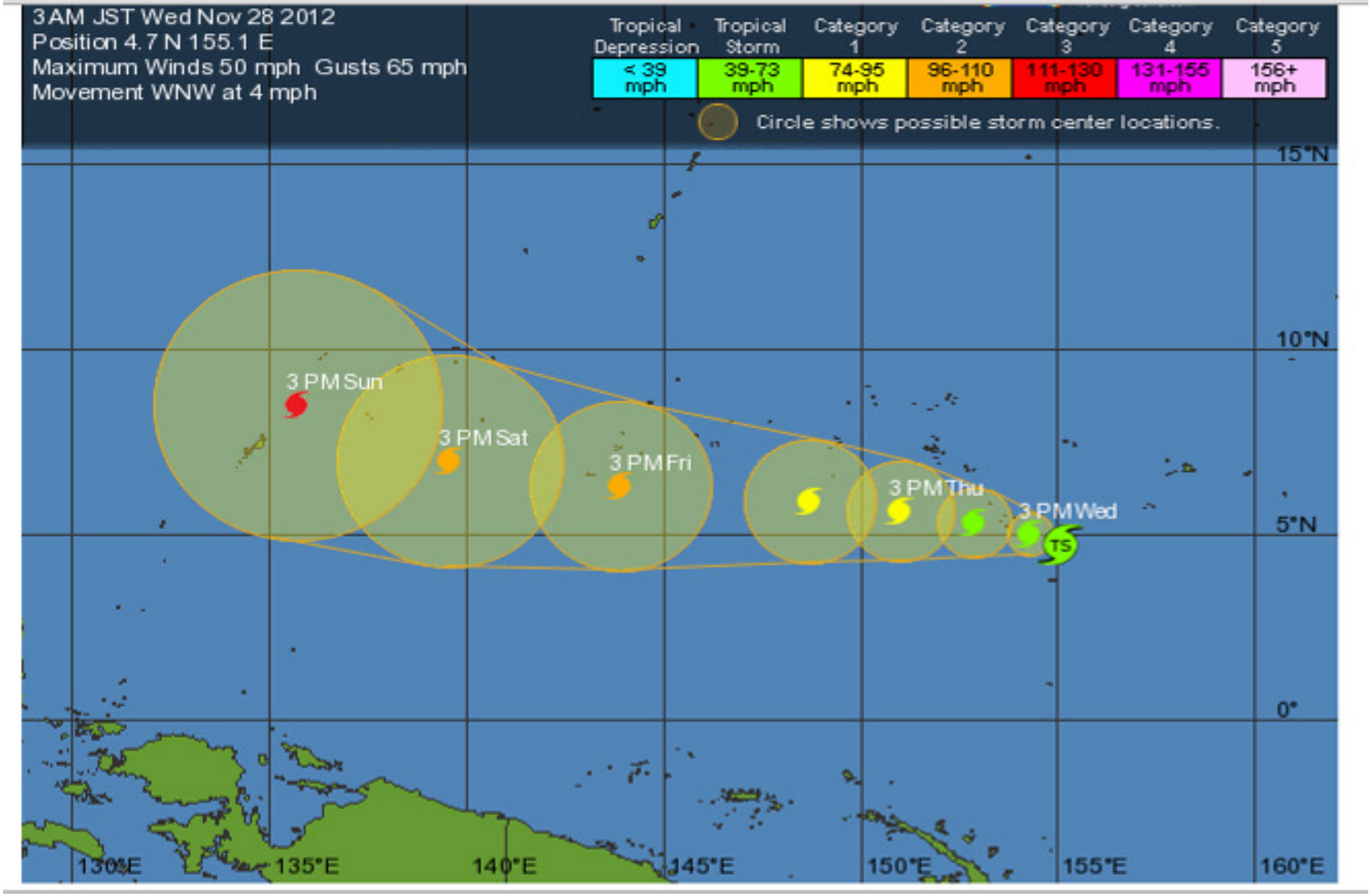


NHC Official Forecast Track

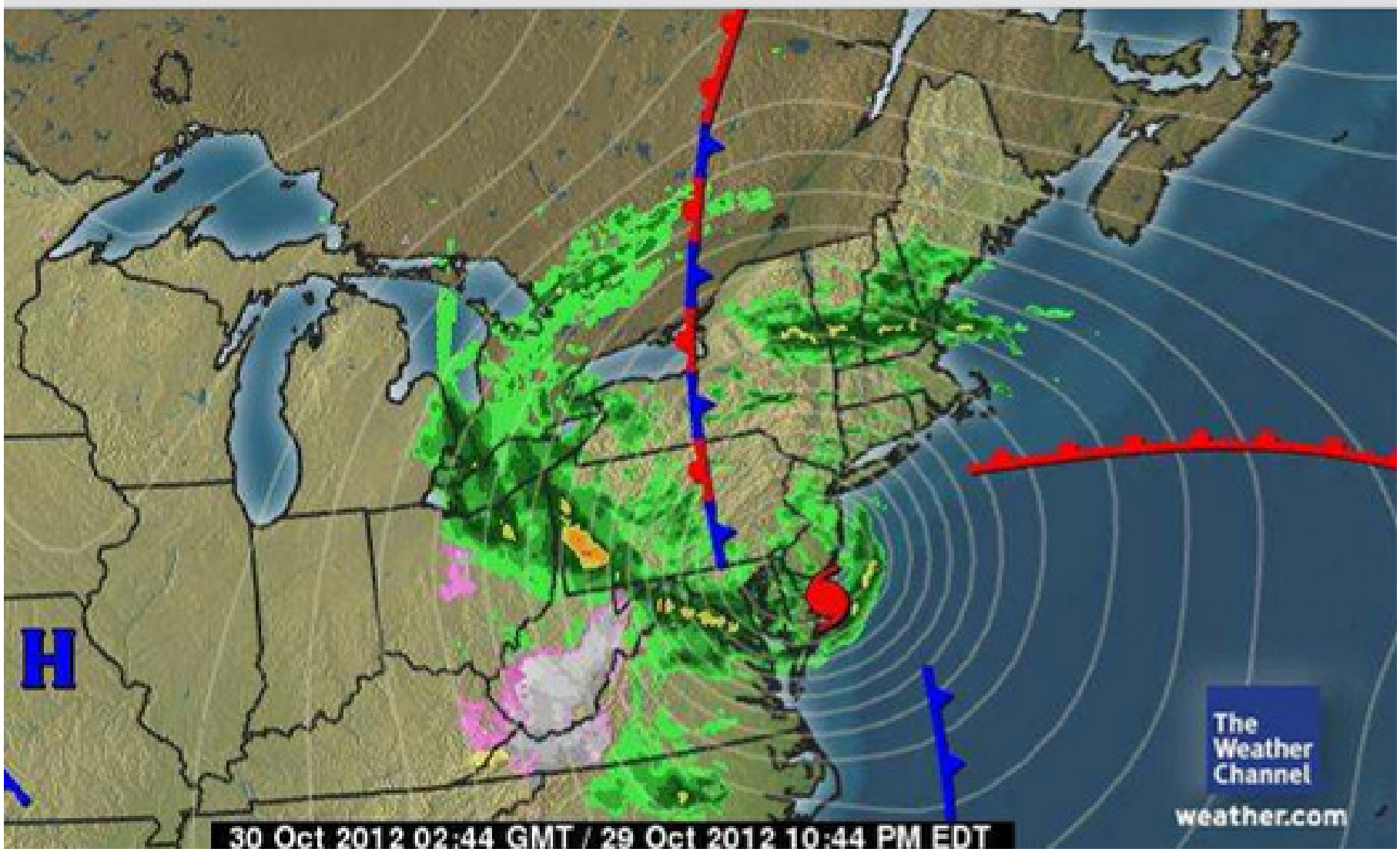


Source: NOAA/NHC

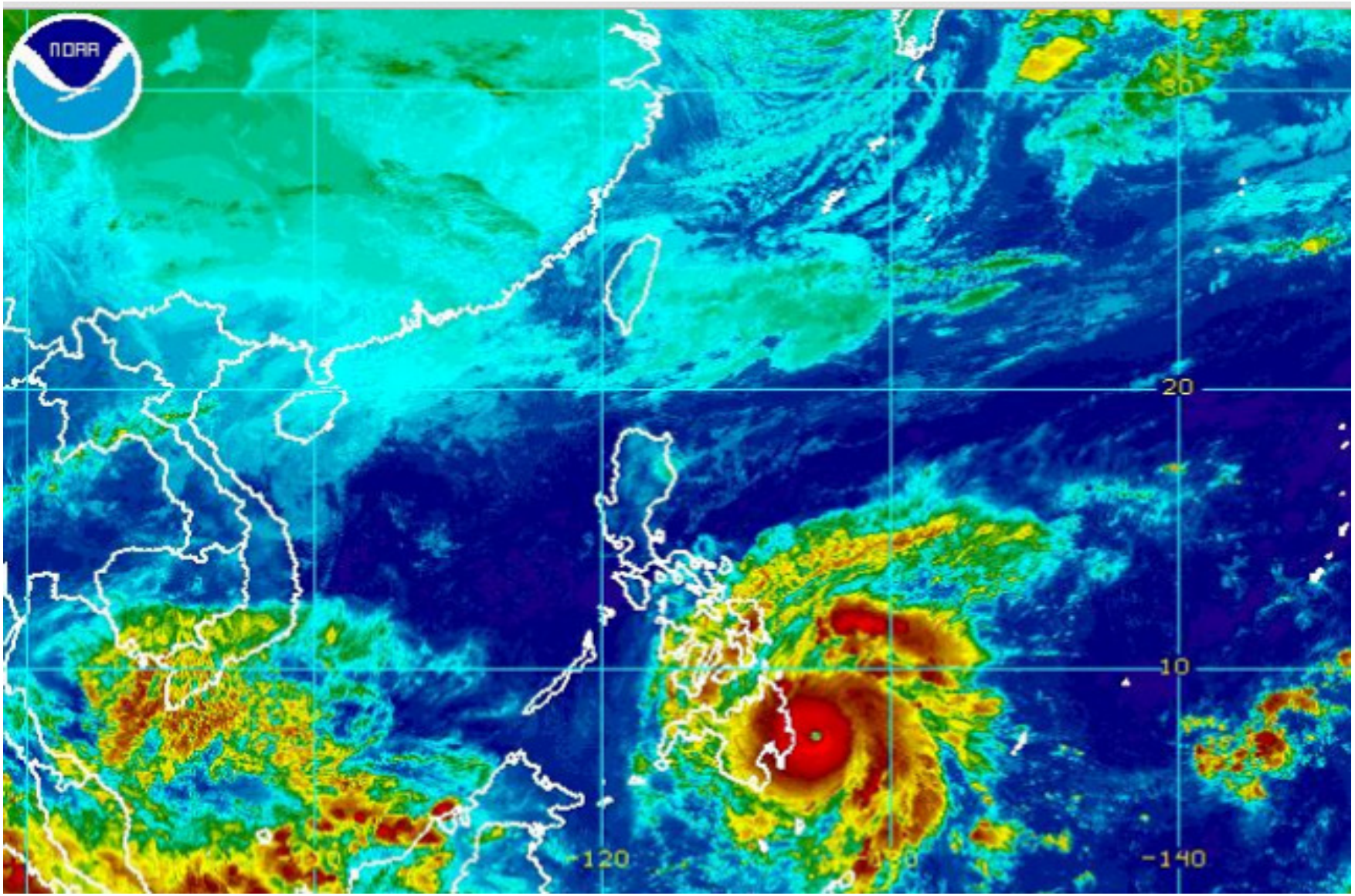
Bopha Forecast Track Error



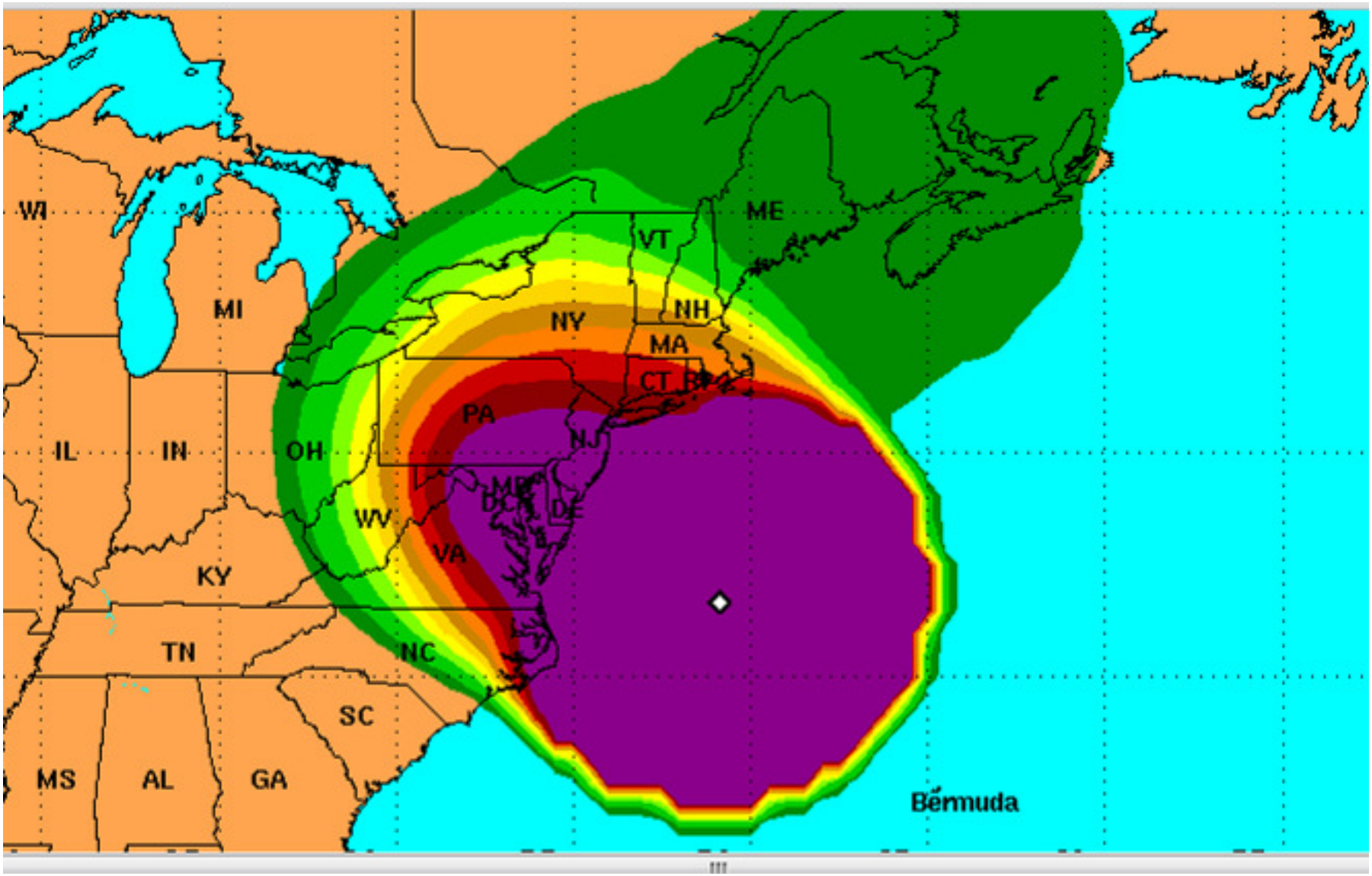
Super Storm Sandy Radar Enhanced Surface Analysis



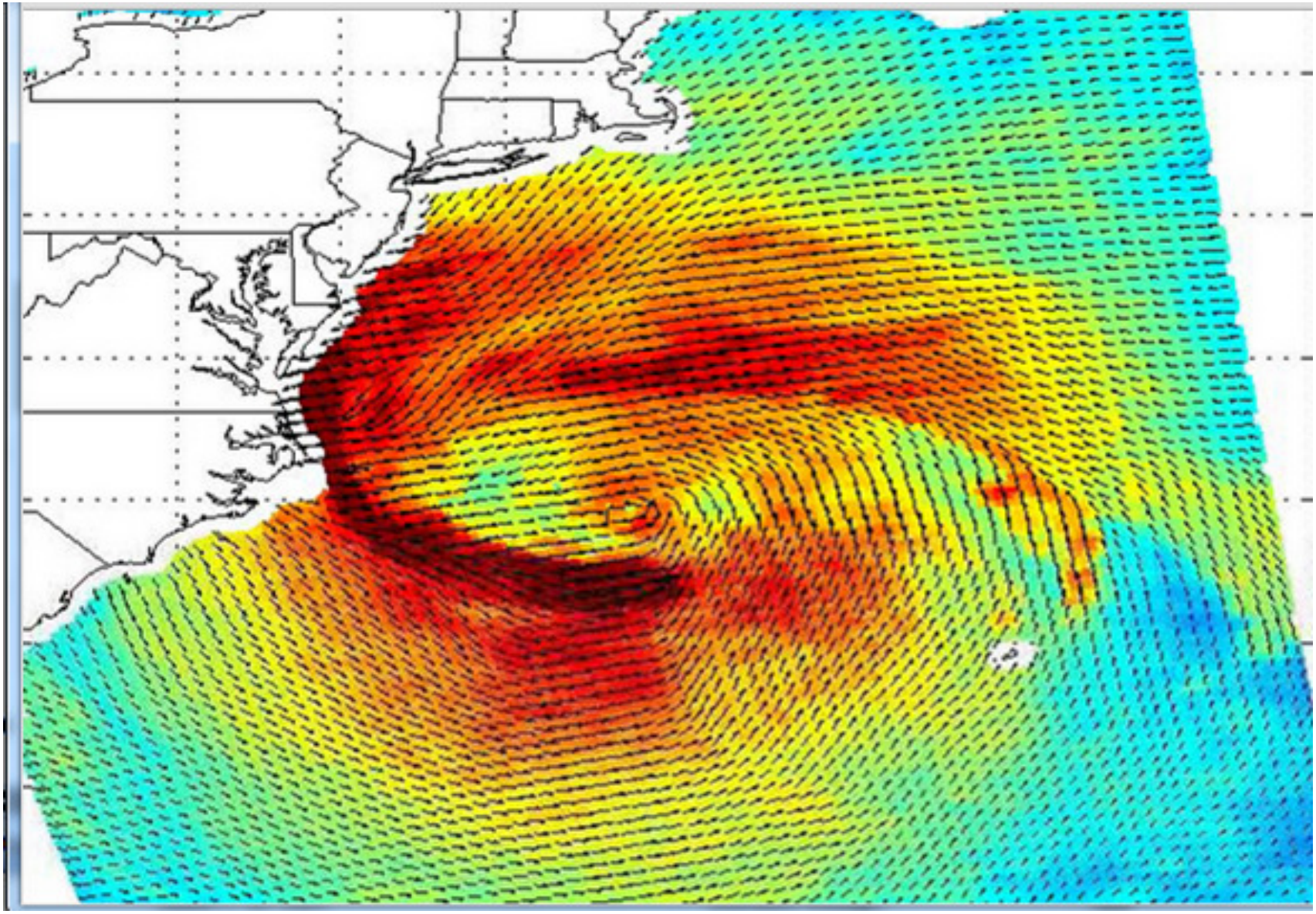
Typhoon Bopha Infrared Satellite



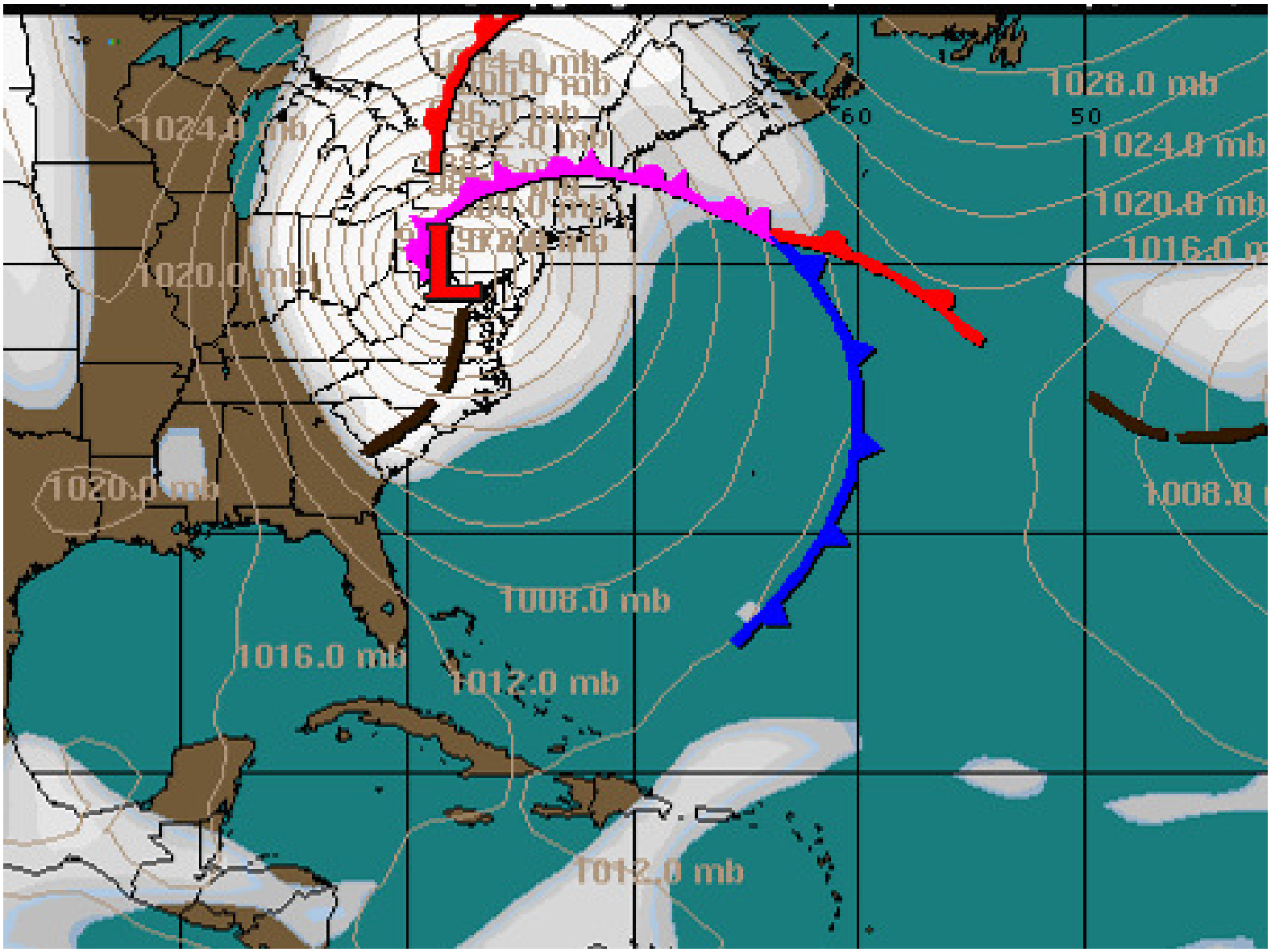
Super Storm Sandy Wind Analysis



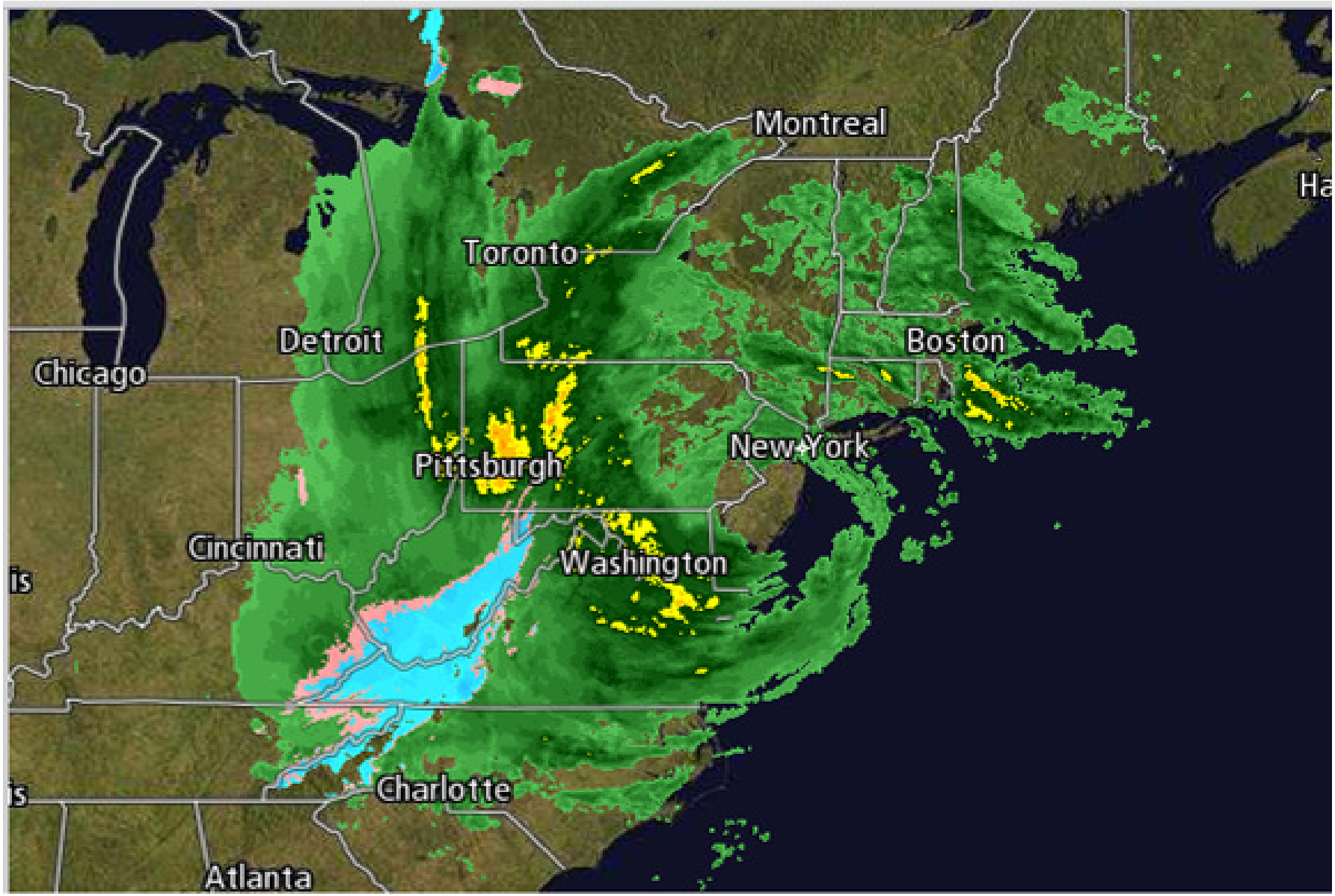
Super Storm Sandy Grib w/ Wind



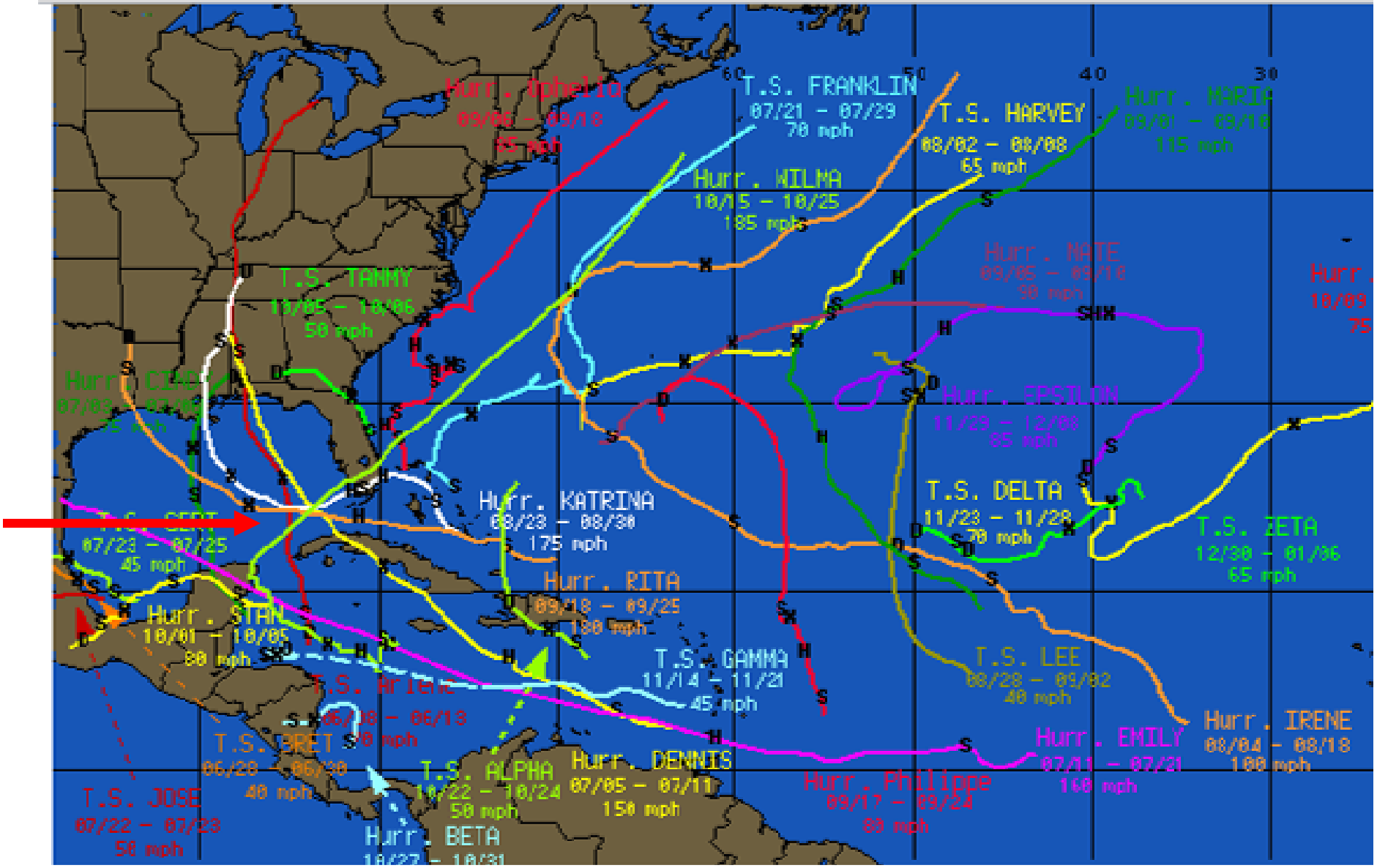
Super Storm Sandy Surface Analysis



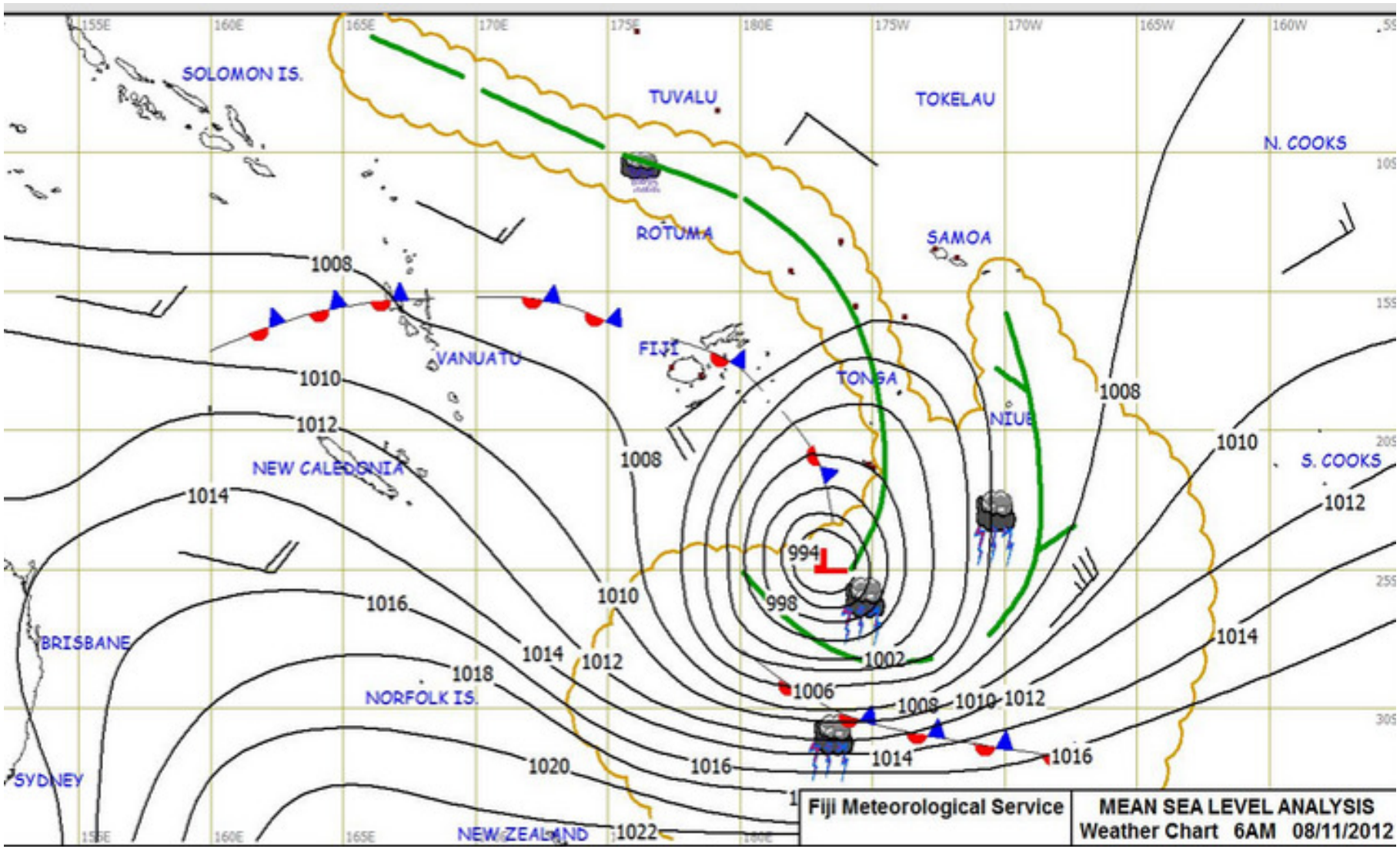
Super Storm Sandy Radar



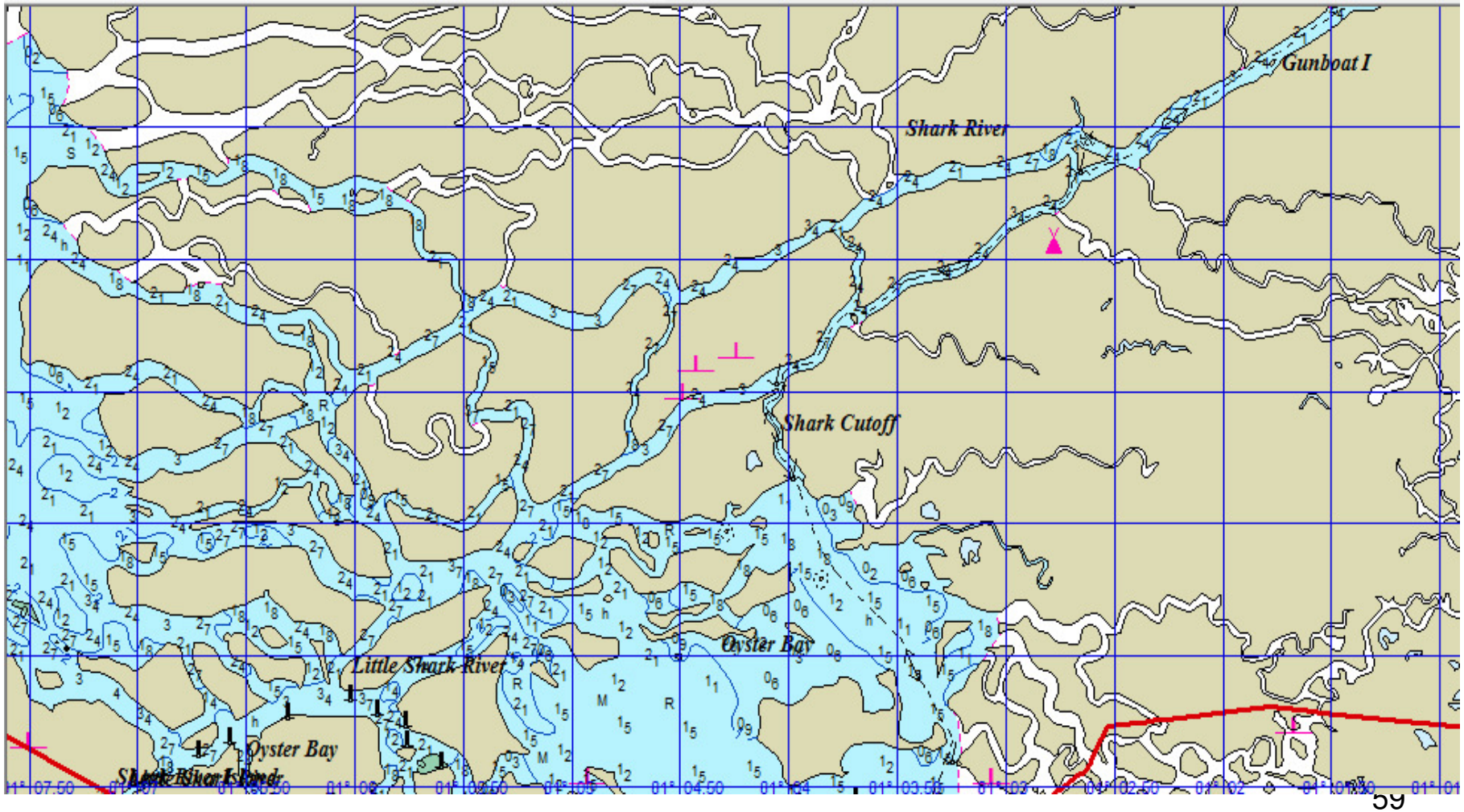
2005 Atlantic TC Tracks



Fiji Pacific Surface Analysis



Finding a Safe Haven



Ideal Safe Havens

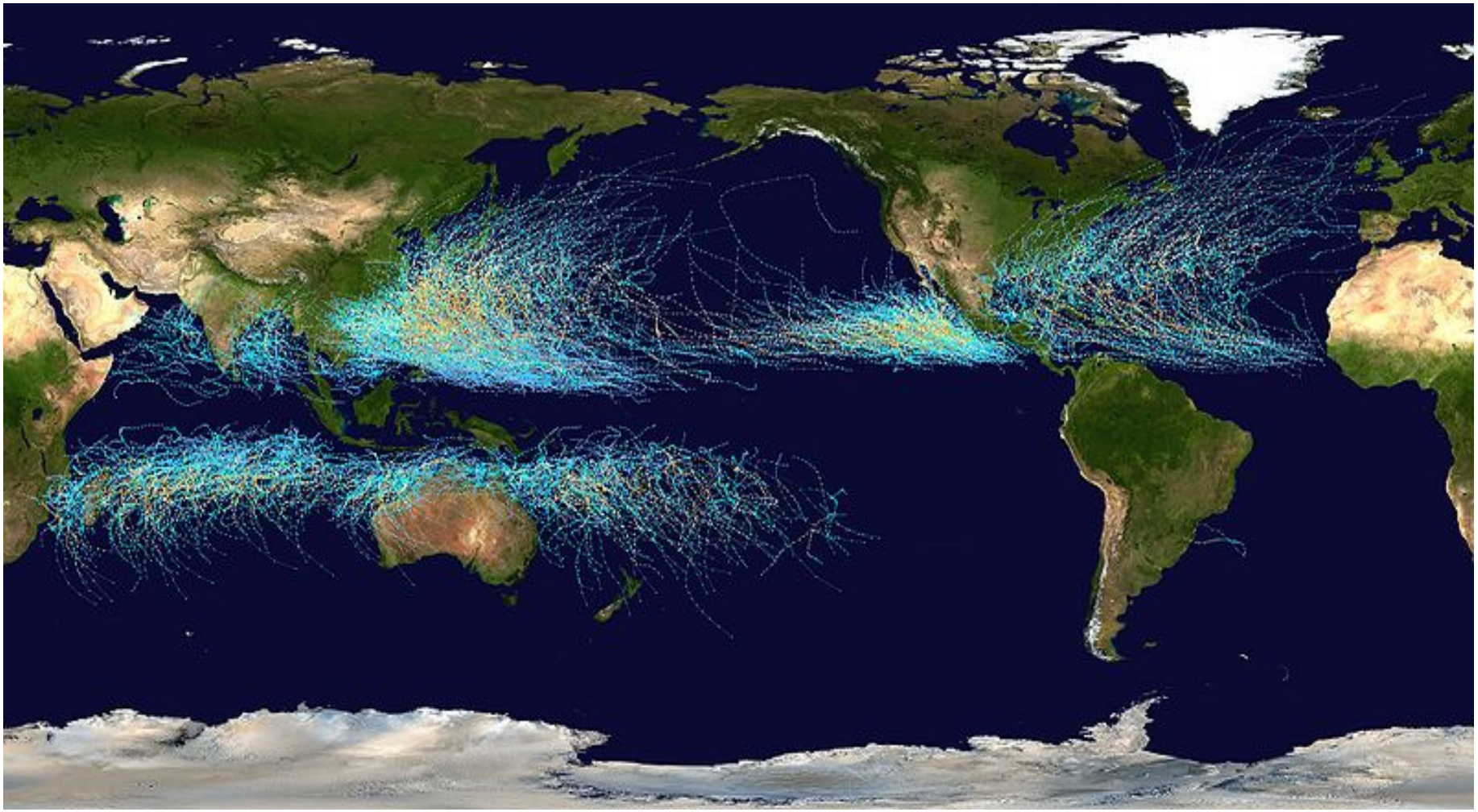
- If must be in hurricane area then look for:
  - All around protection from wind and seas
  - Minimum storm surge issues
  - Strong anchor or mooring possibilities
  - Few other boats/buildings around
  - Wifi or TV and VHF available
  - Secure accommodation options ashore
- Hard to find all above

Safe Haven Options

(in order of preference)

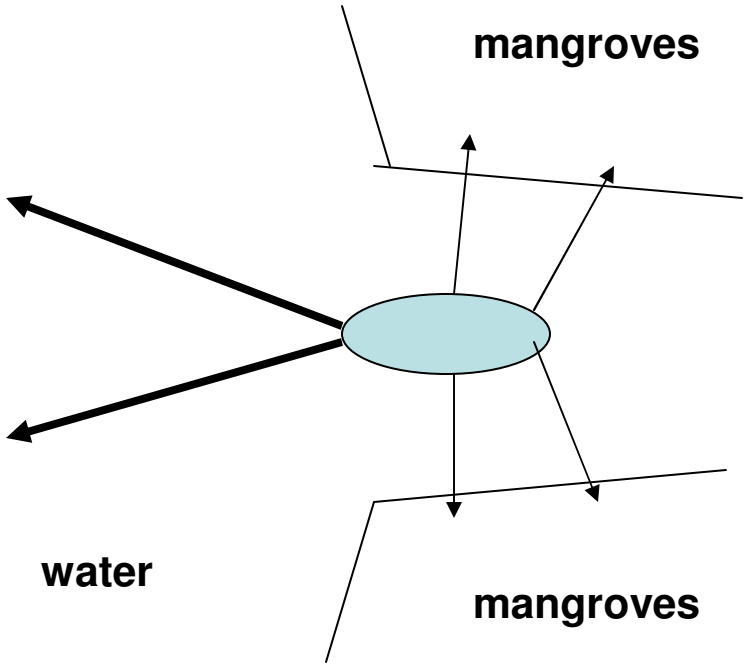
- Out of TC area
- Mangrove creeks
- Enclosed lagoon anchorage
- Strong mooring
- Marginal options:
  - River bank
  - Boat yard
  - Urban canal
  - Marina dock

Out of TC Areas



Mangrove Creeks

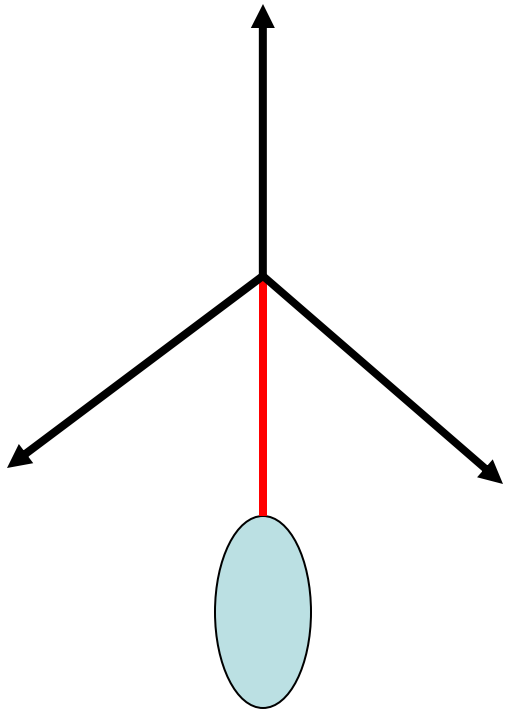
- Great option!
- High mangroves negate windage
- Two anchors off bow
- Tie stern to mature mangroves P&S
- Ensure minimum 10’ depth



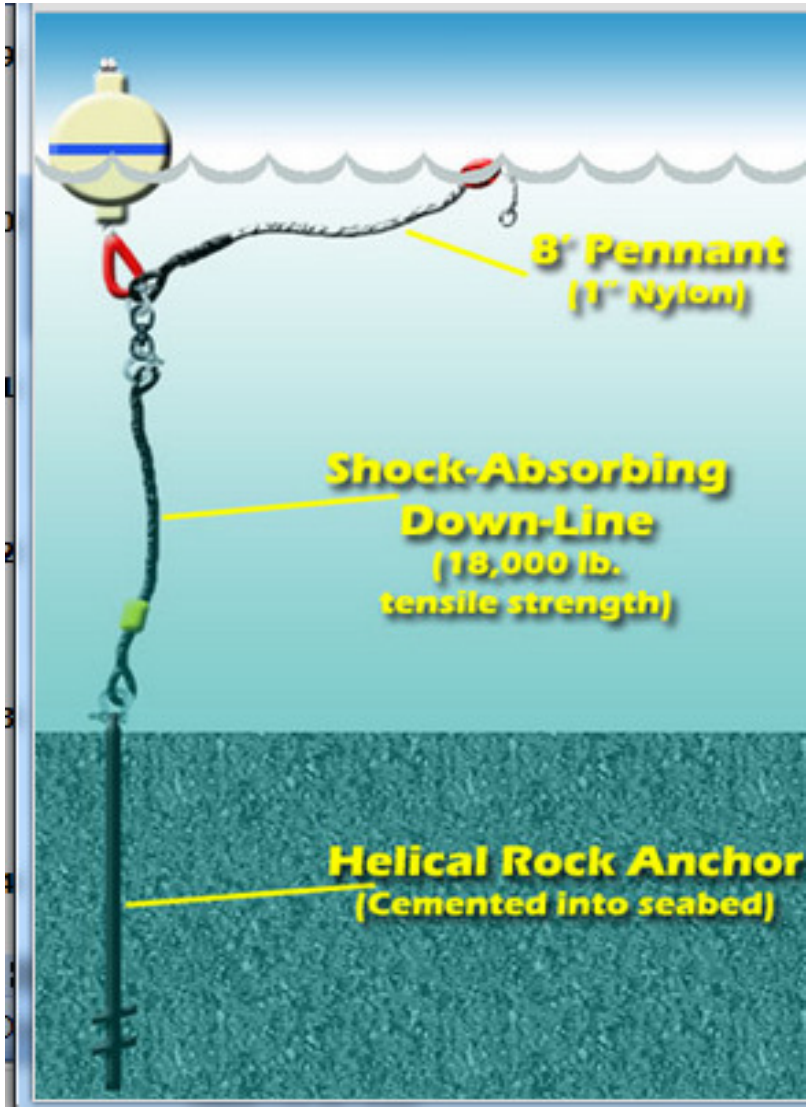
Enclosed Anchorage

- Look for:
  - < .5nm dia,
  - < 25’ depth,
  - sand or firm mud bottom
  - few other boats
  - 360 degree protection
- Lay 3 point mooring w/ strong ground tackle, details later
- Don’t use tandem anchors

- 3 Point Mooring



Strong Mooring



- Look for strong anchor and up lines
- Helix screw anchor best, 20K lbs
- Inspect mooring carefully yourself
- Watch out for other boats breaking loose

Rivers

- Marginal option if no flooding issues
- Major flooding may send trees, houses, cars, etc downstream
- Debris will upset anchors and clog intakes
- Find protected small bay out of current flow
- Side tie to river bank
- Look for good wind protection

Urban Canals

- Risky option due to below problems
- Ensure adequate depth- at least 10’
- Major problems-
  - Storm surge
  - Other boats
  - Flying debris
  - Hard canal sides
  - Finding strong shore ties

Urban Canals – Katrina 2005

Boat Yards

- Really marginal option in big storms due to increased windage
- Windage–hull, sails, canvas, solar panels
- Domino effect - get away from other boats
- Consider storm surge flooding the yard
- Jack stand strength, chain under boat
- Flying debris problem
- Best option - bury keel into ground

Boat Yards - Charlie 2004

Boat Yards - Ivan 2004

Marinas = Major Damage!

- For strong storms worst option due to storm surge potential
- No solution for short dock line stretch/chafe from big storm surge
- Docks
  - Floating vs static docks
  - Dock hardware strength
- Other problems
  - Unsecured sails & canvas
  - Flying debris
  - Other boats breaking loose

Melbourne YC, Francis, 2004

Melbourne YC, Francis, 2004

Marina Hurricane Damage

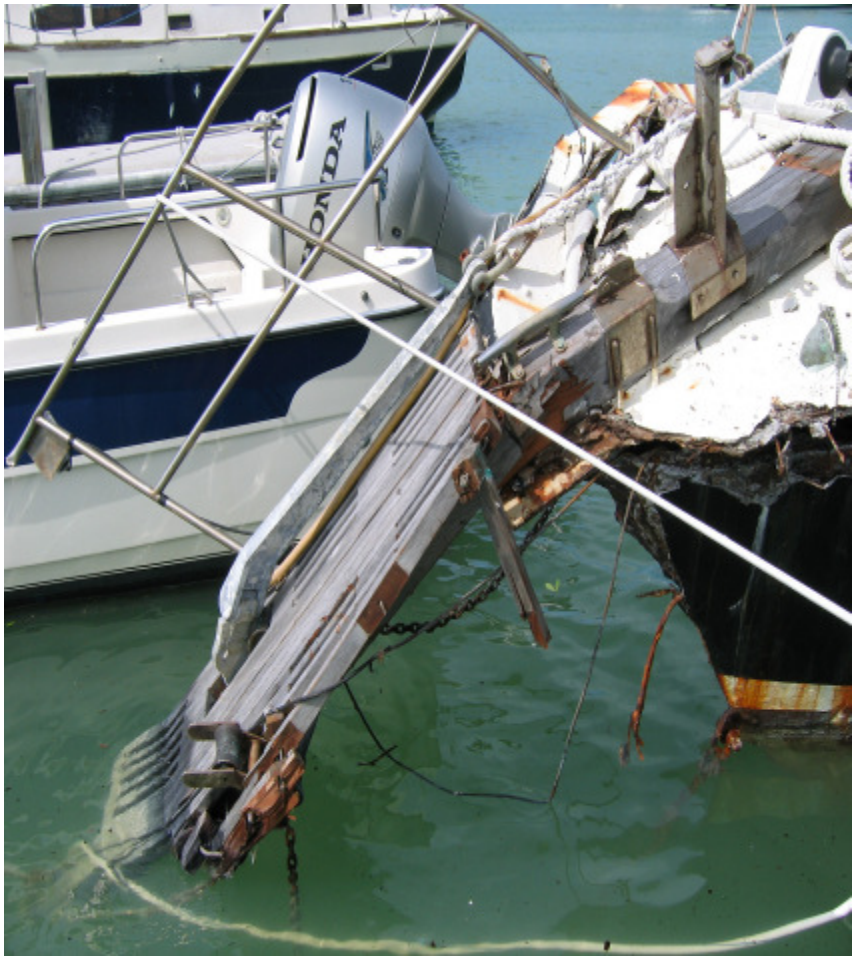
Marinas - Katrina 2005

Marina Damage – Ivan/Hugo

Boca Chica Marina, Wilma 2005

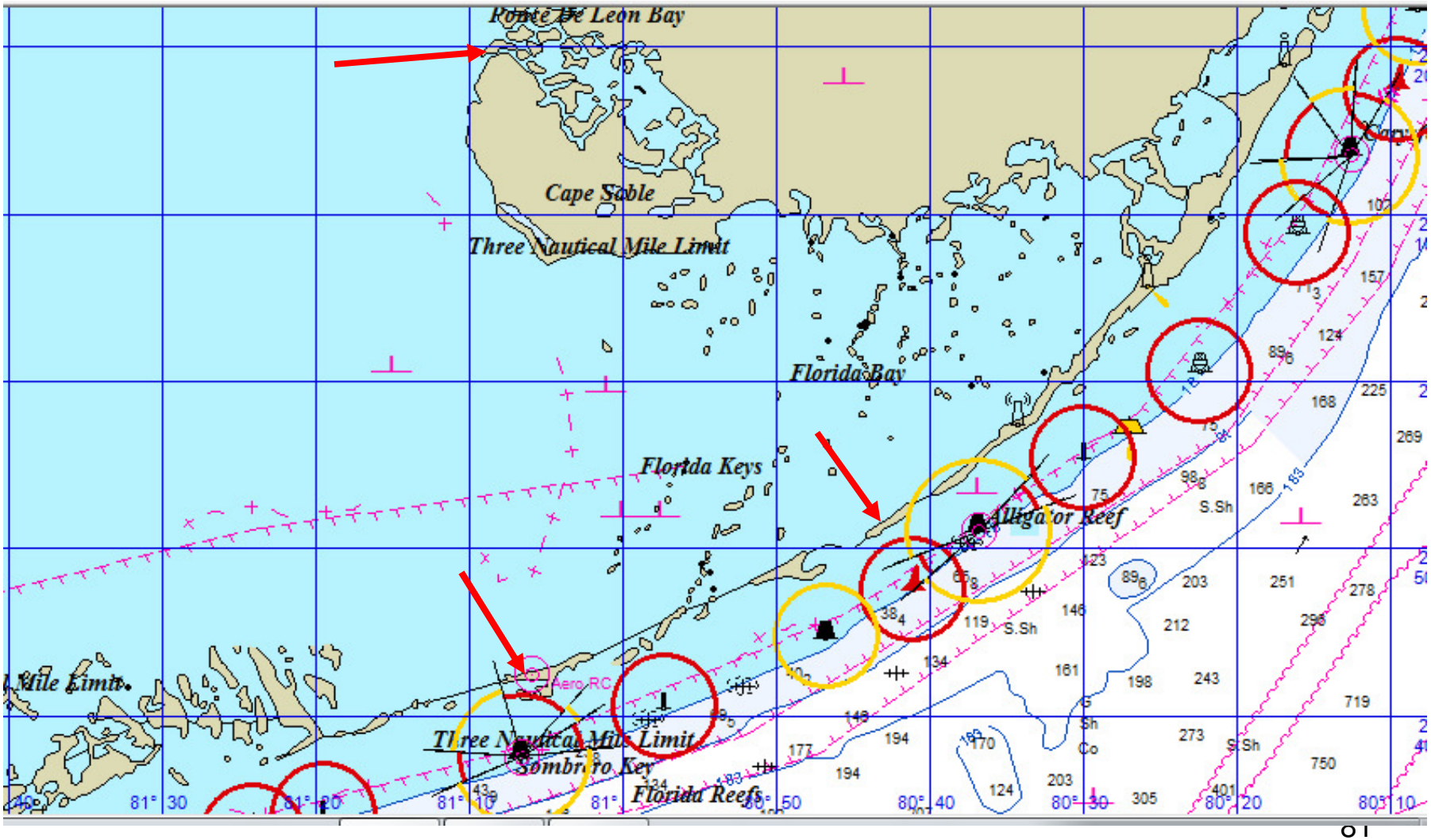
Boca Chica Marina, Wilma 2005

Boca Chica Marina, Wilma 2005

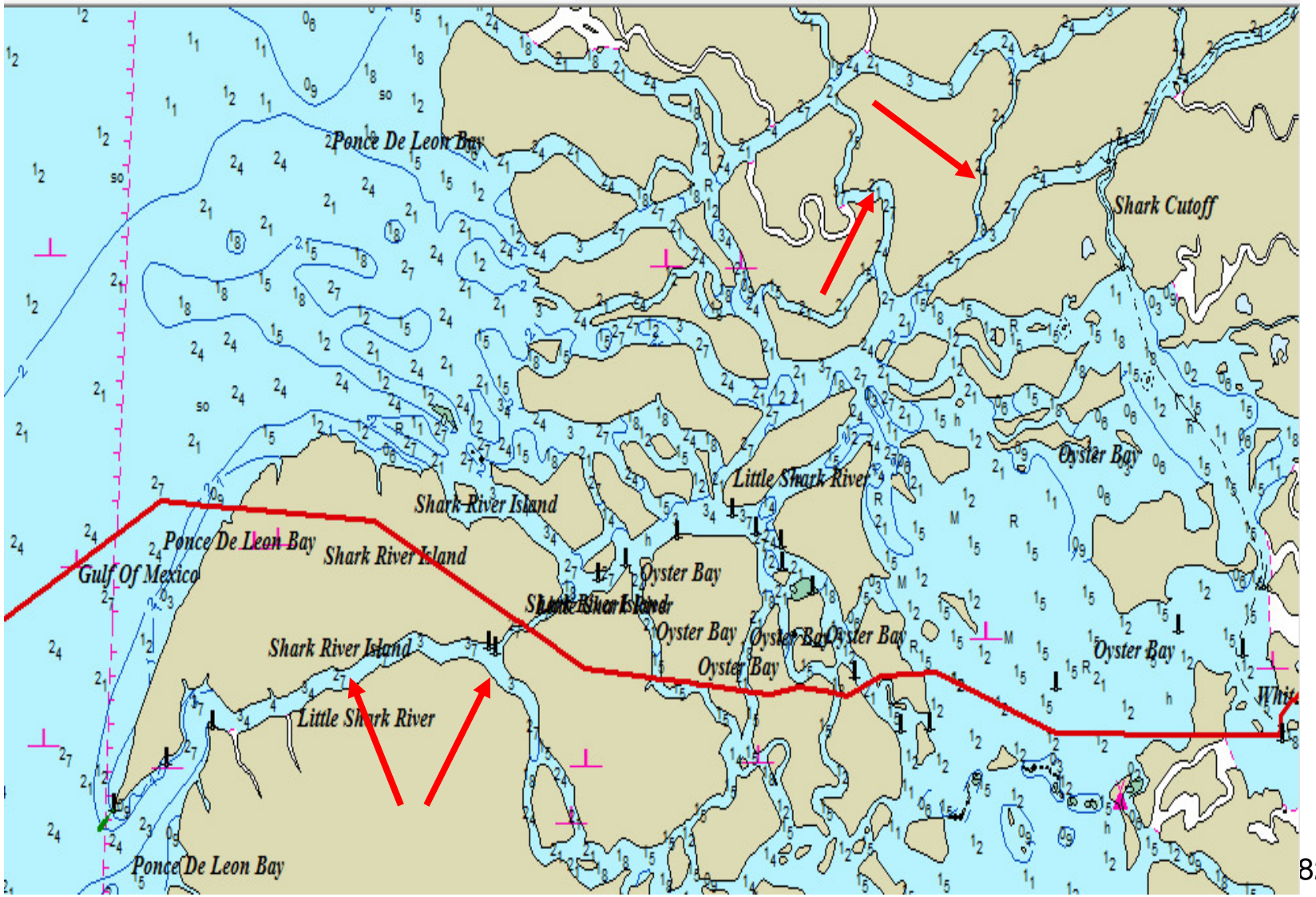


Some Relatively Safe Havens

Fla Keys

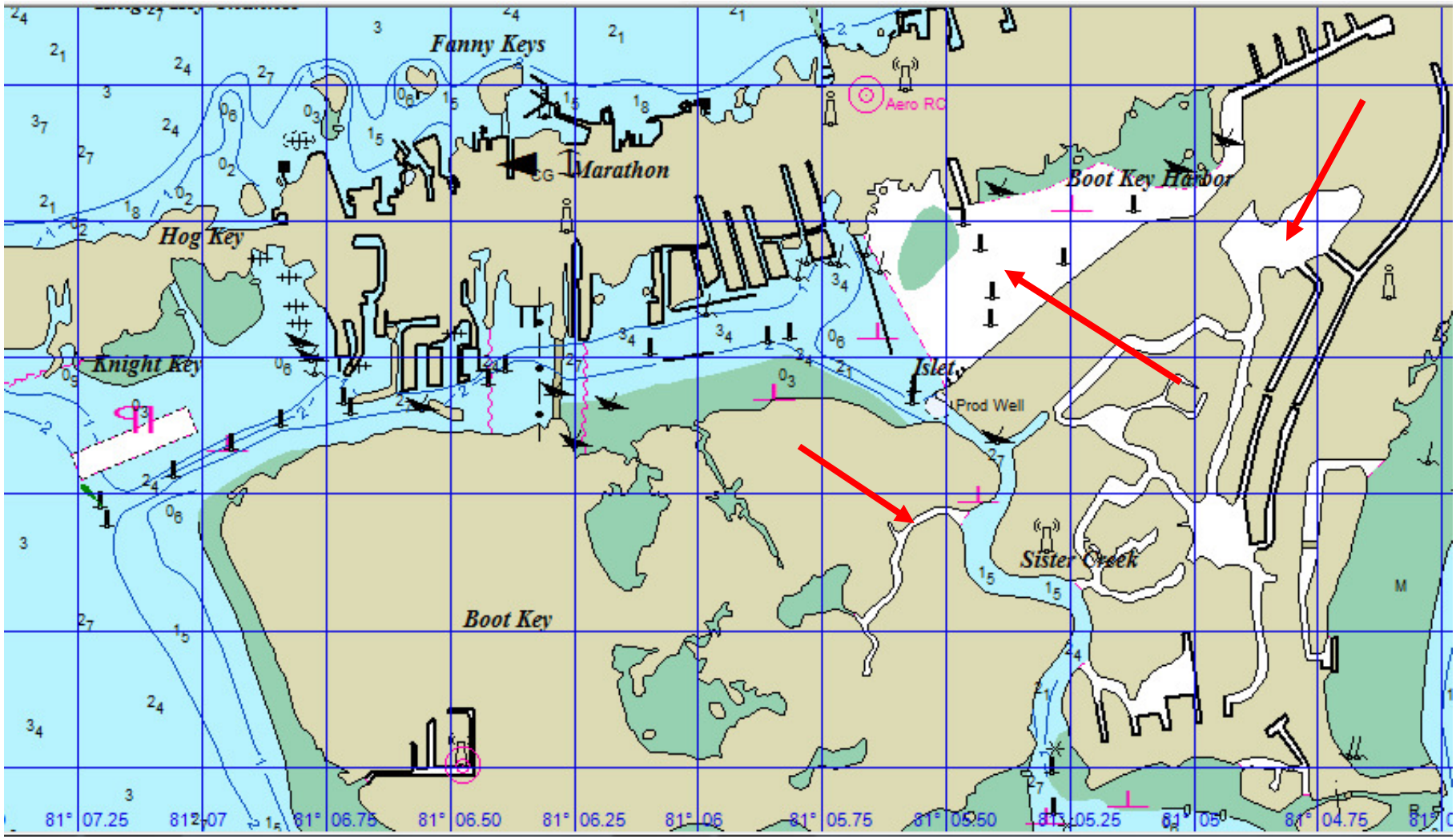


Shark River


Ponce De Leon Bay
Shark Cutoff
Oyster Bay
Little Shark River
Shark River Island
Ponce De Leon Bay
Shark River Island
Gulf Of Mexico
Oyster Bay
Oyster Bay
Oyster Bay
Oyster Bay
Oyster Bay
Shark River Island
Little Shark River
Ponce De Leon Bay

Shark River, Everglades, FL

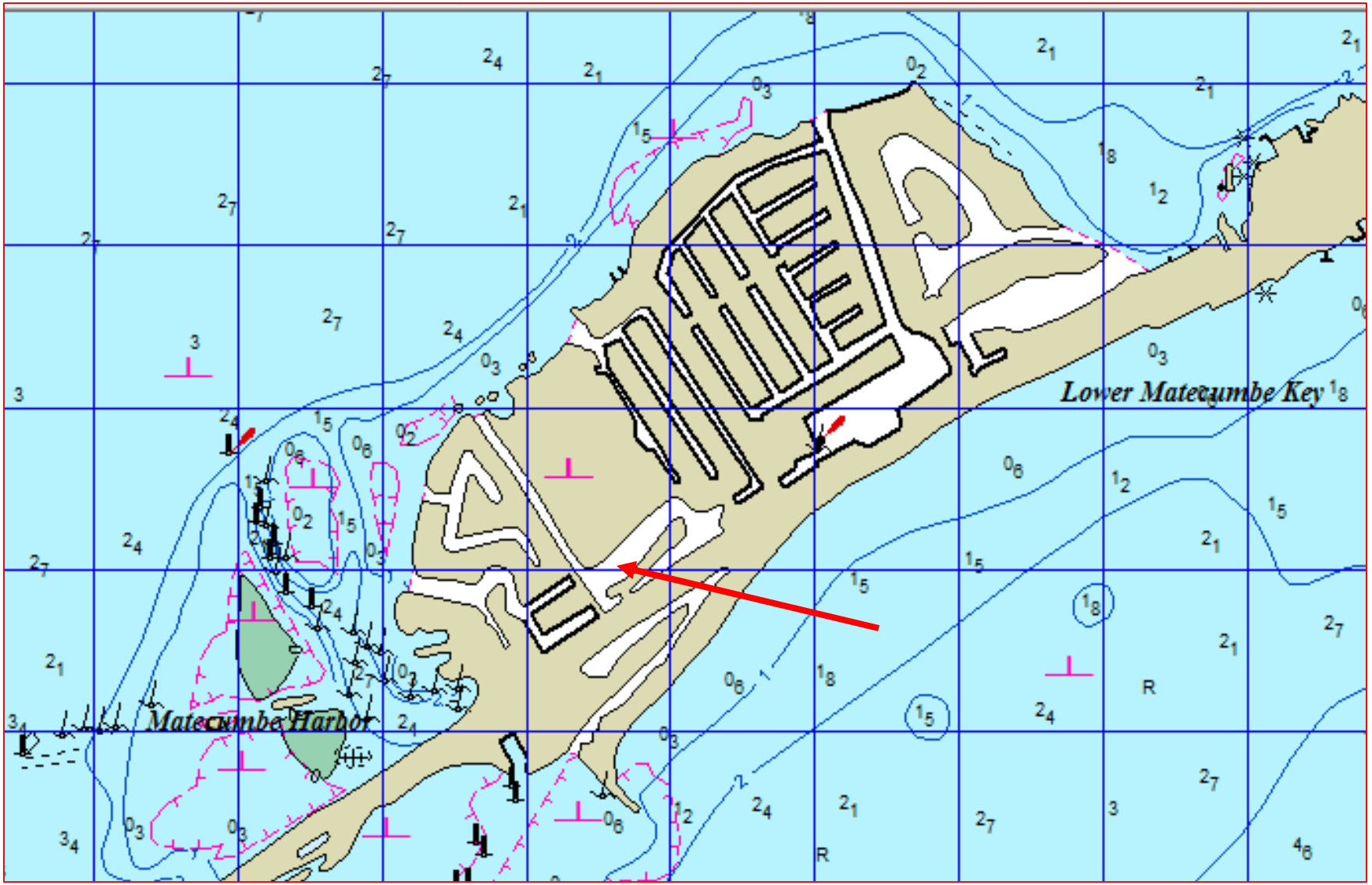
Marathon Harbor, FL Keys



Marathon, FL Keys

Derelict Boat Problem

Lower Matecumbe, FL Keys

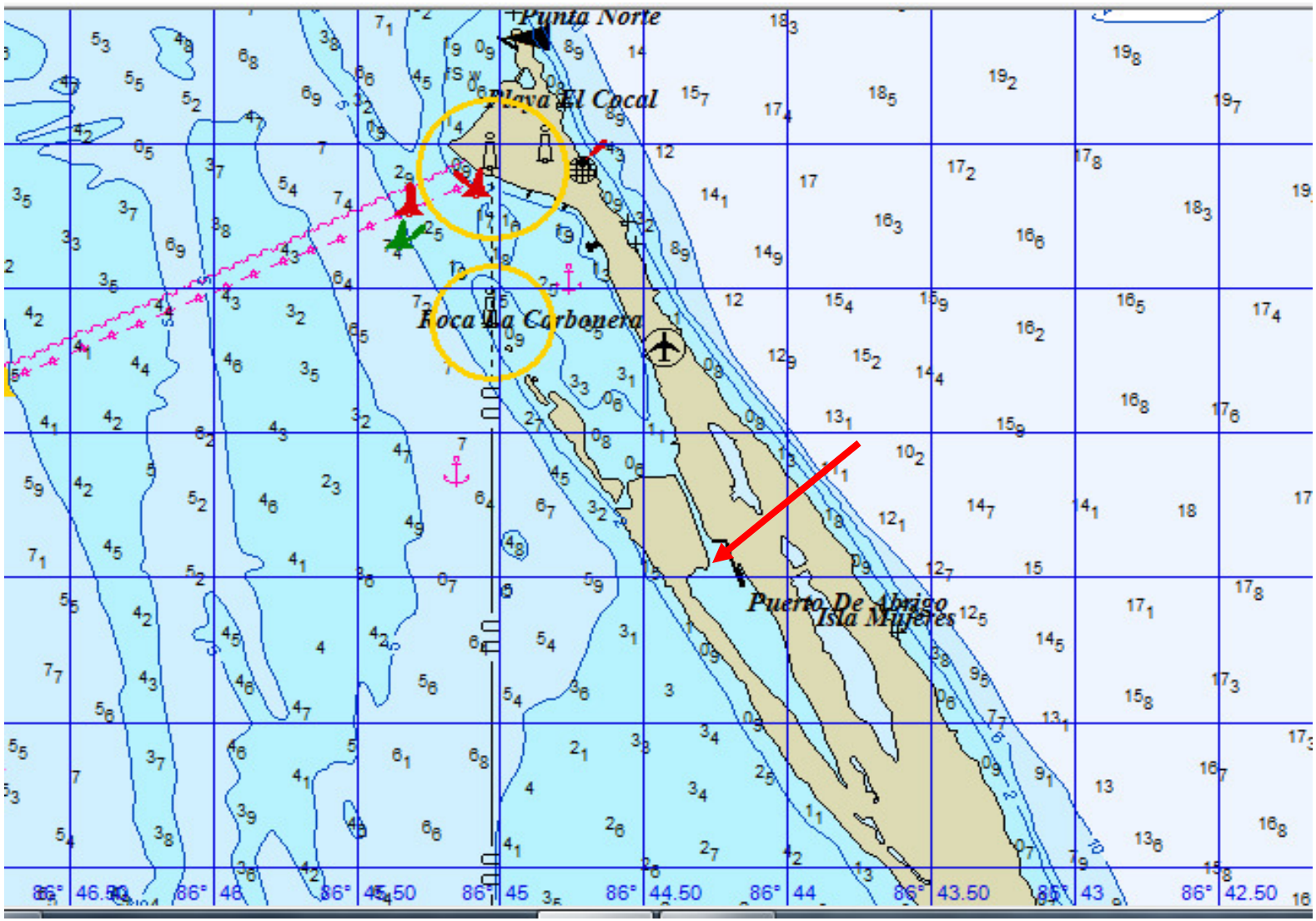


Lower Matecumbe, FL Keys

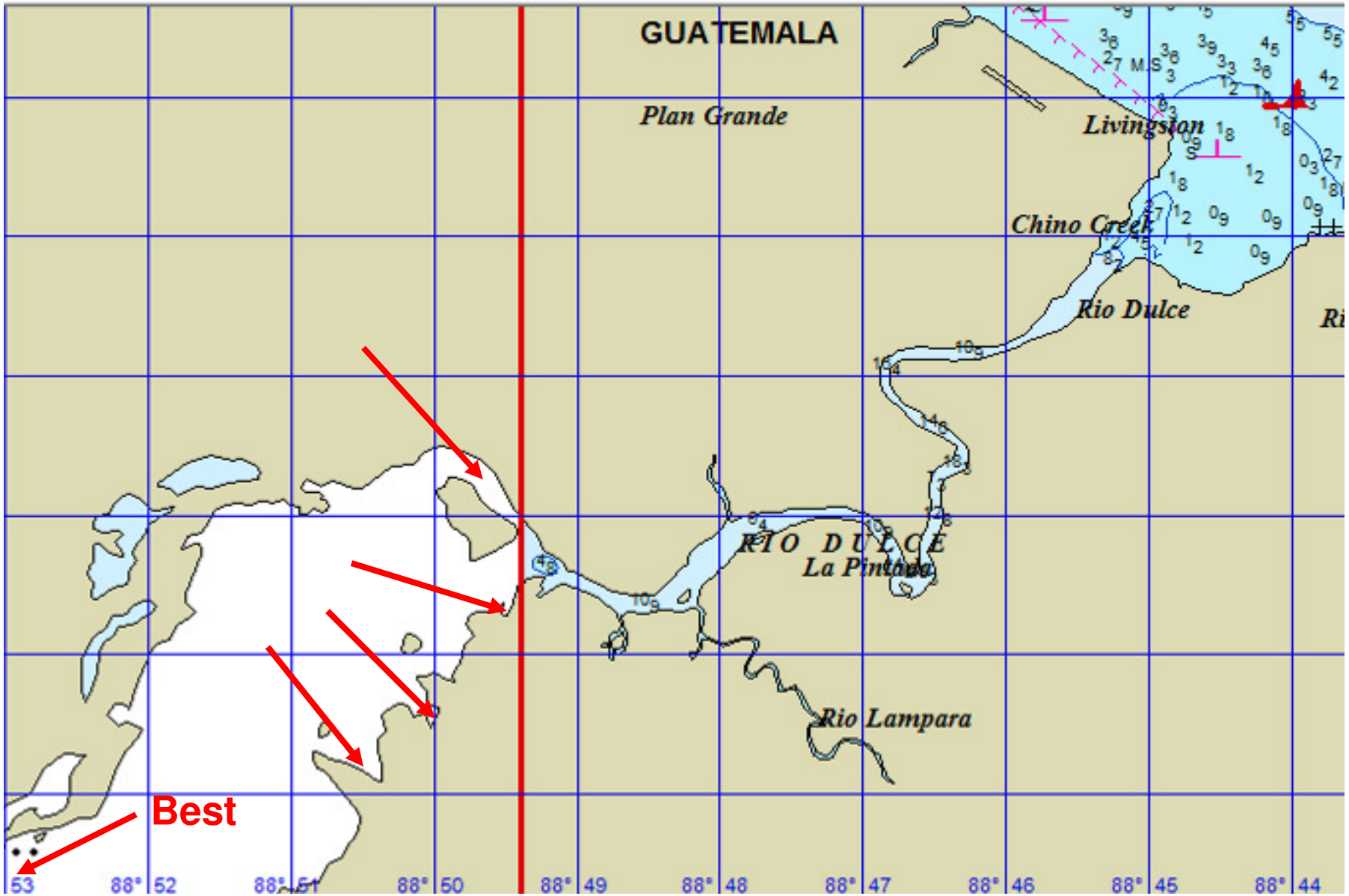
Lower Matecumbe, FL Keys

NW Caribbean

Isla Mujeres, Yucatan, Mexico



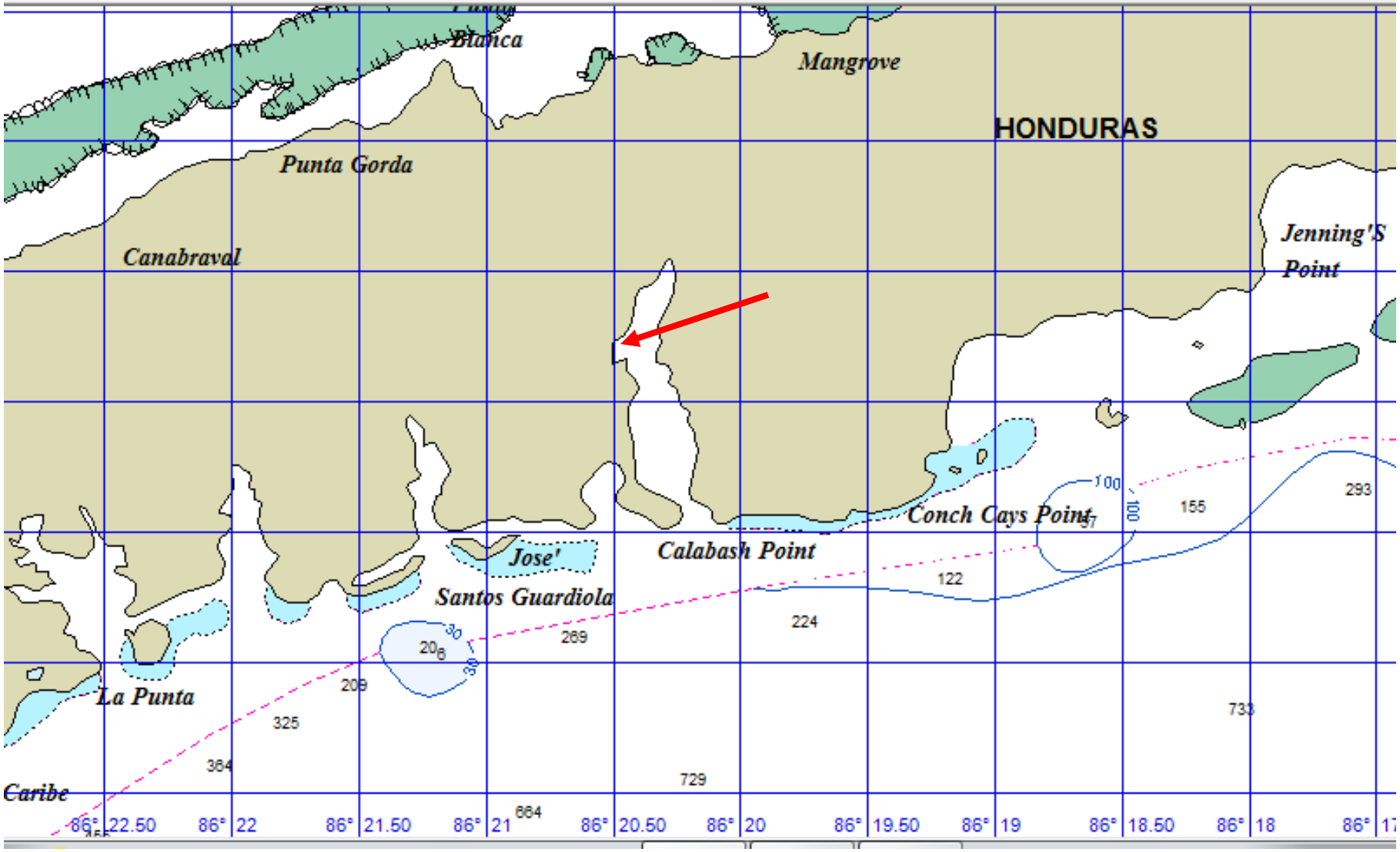
Rio Dulce Entrance, Guatemala



Rio Dulce, Guatemala

Catamaran Marina, Rio Dulce

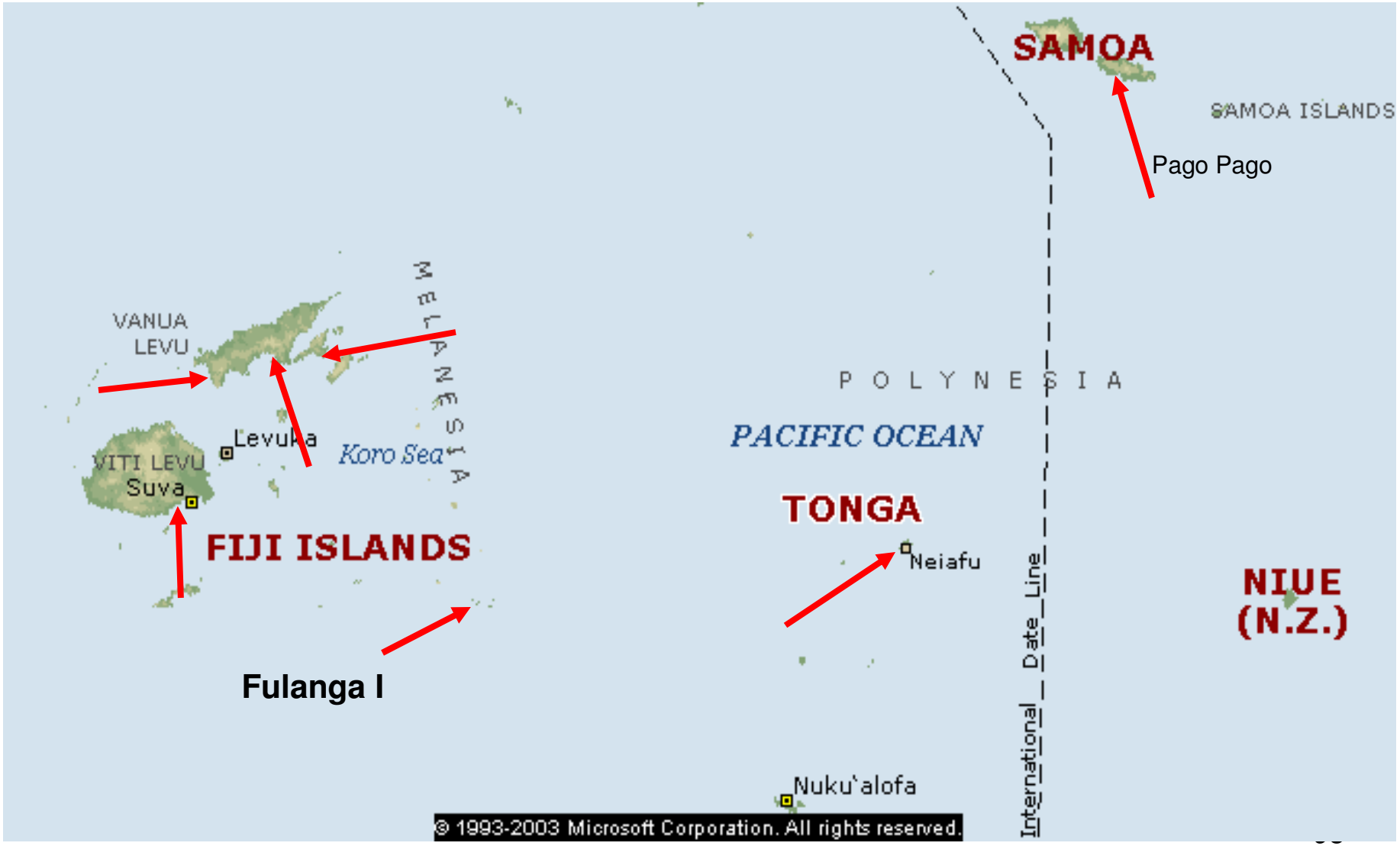
Calabash Bight, Roatan, Honduras



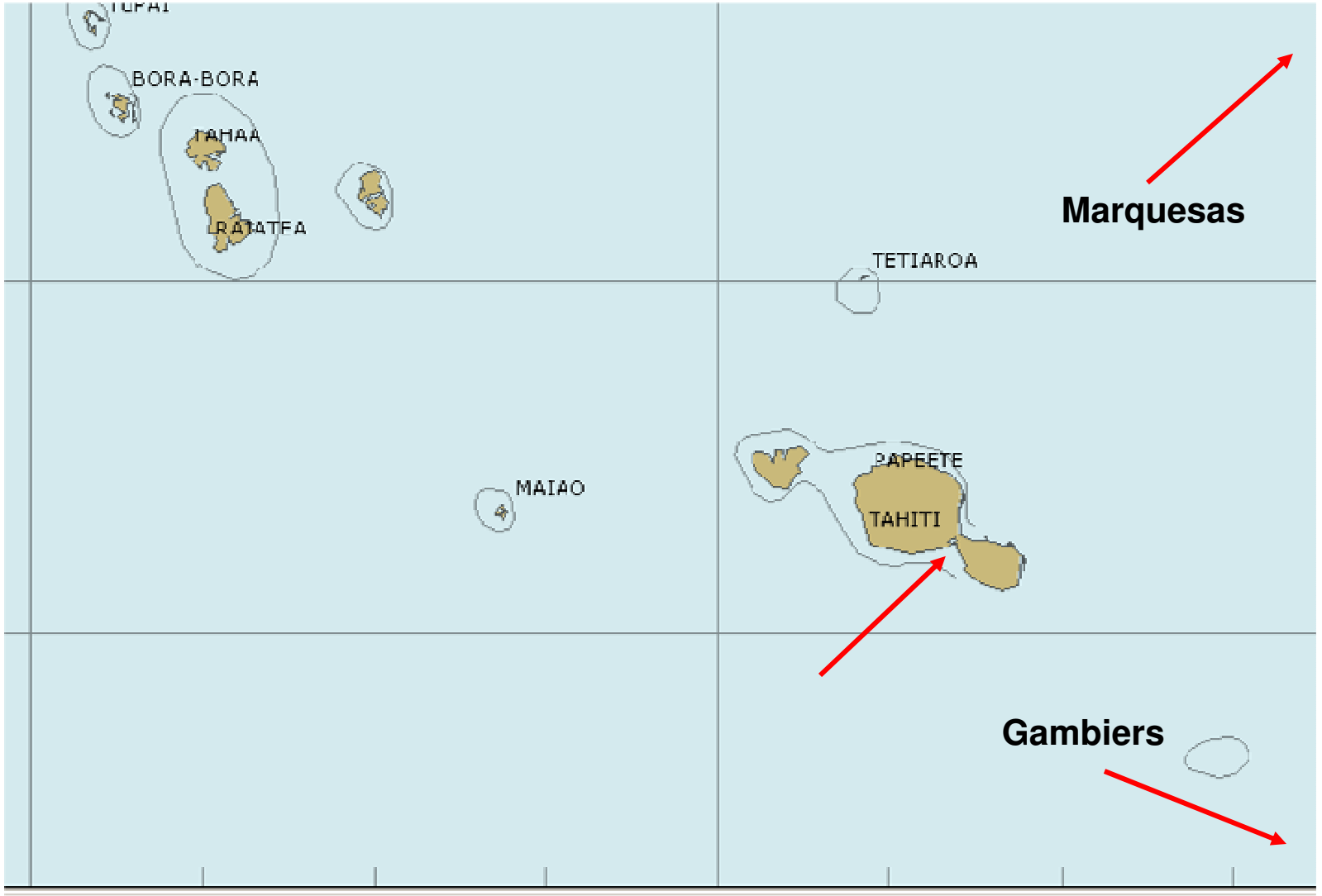
Calabash Bight, Roatan, Honduras

Eastern & Southern Caribbean

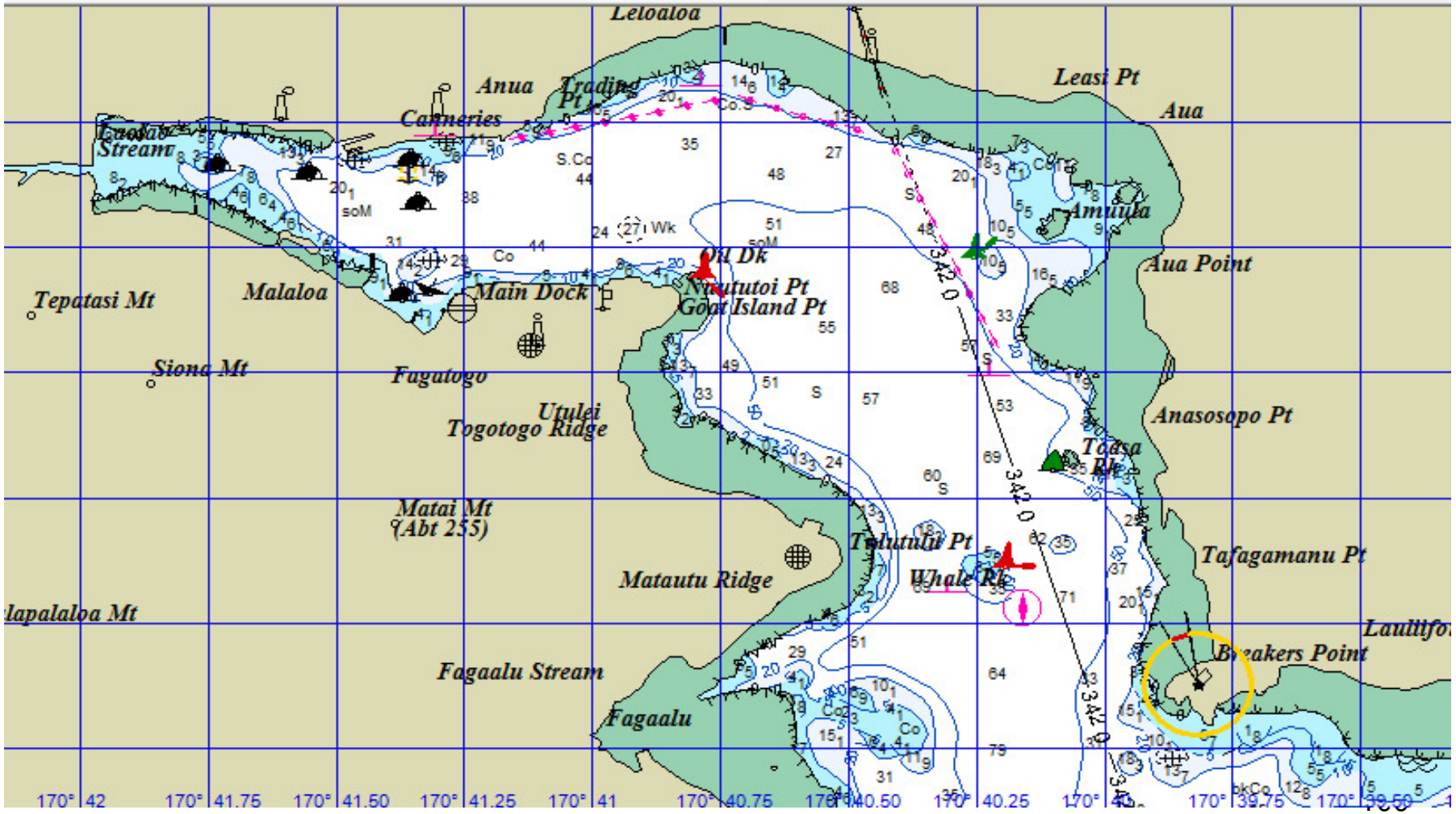
Southwest Pacific



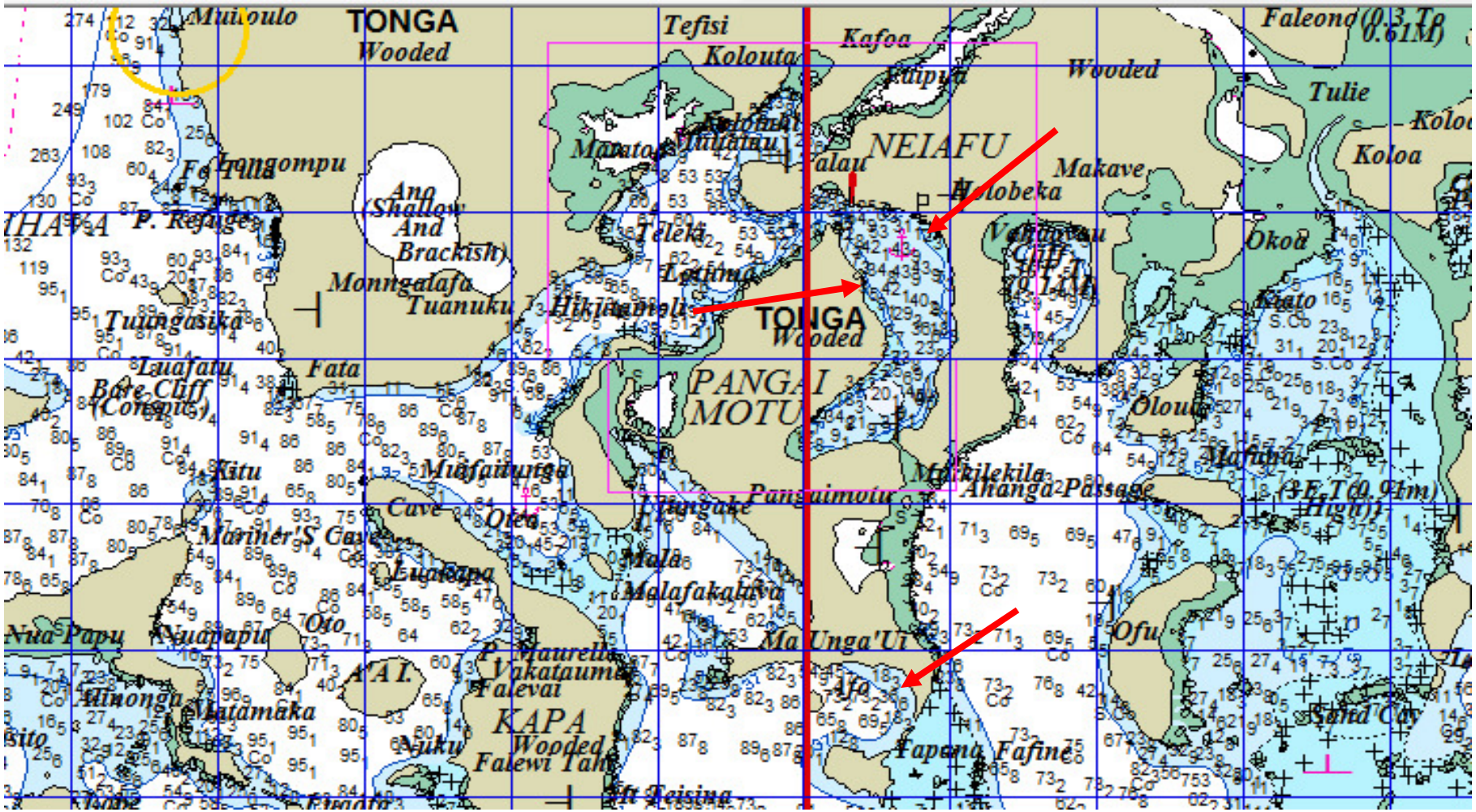
Eastern South Pacific



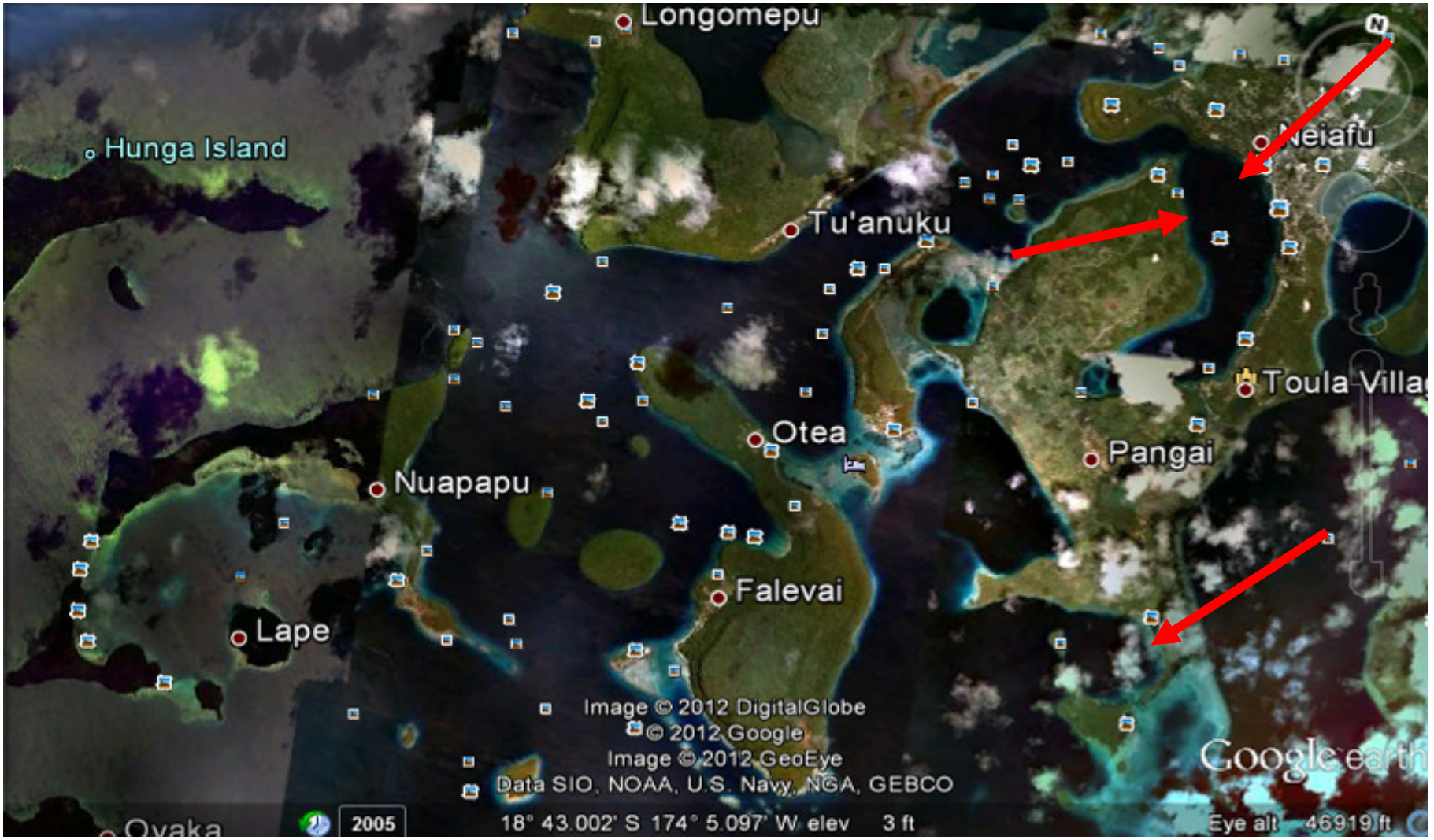
Pago Pago, Am Samoa



Neiafu Harbor, Vavau, Tonga



Vavau, Tonga

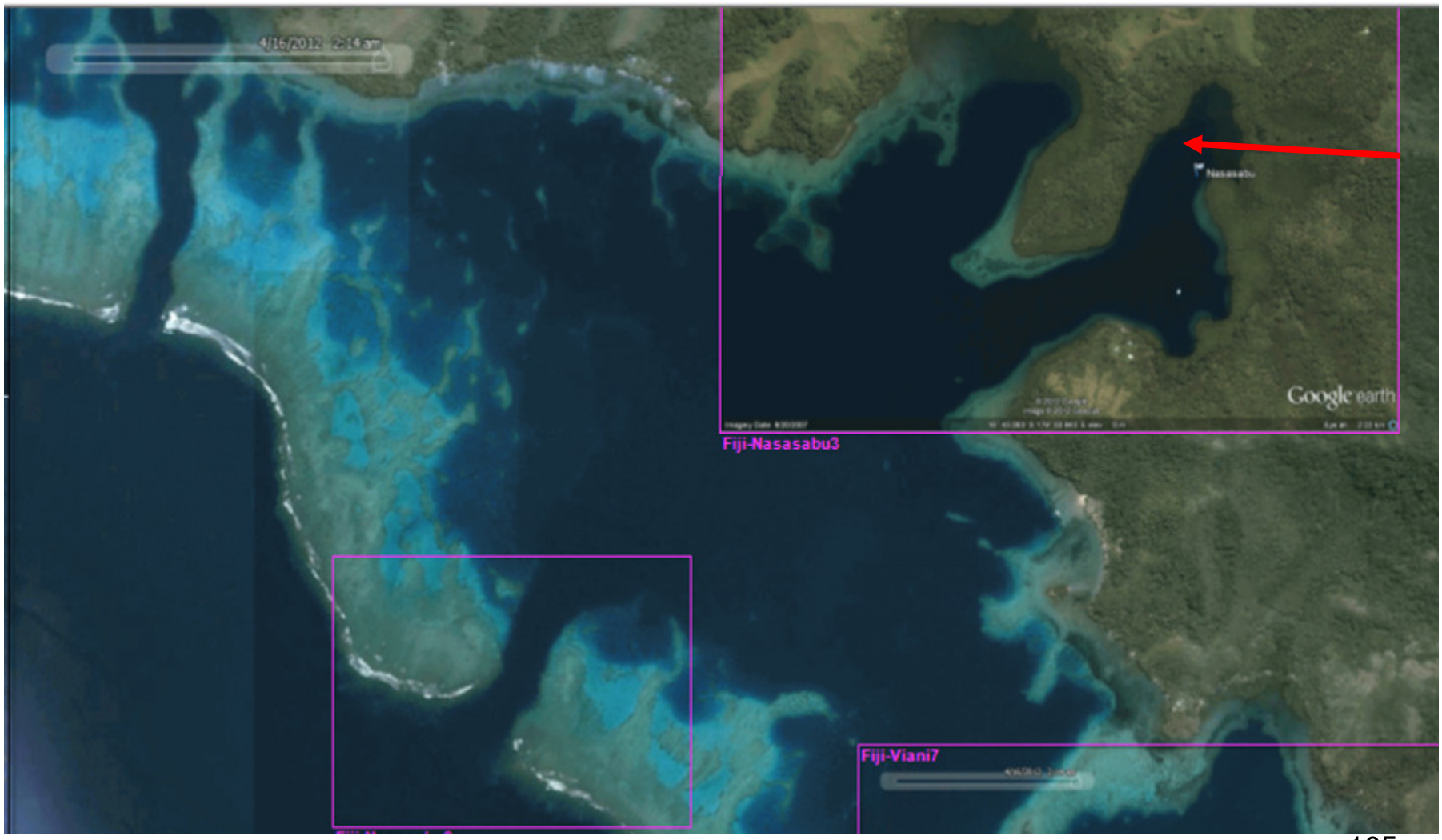

Longomepu
Hunga Island
Neiafu
Tu'anuku
Toula Villa
Otea
Pangai
Nuapapu
Falevai
Lape
Image © 2012 DigitalGlobe
© 2012 Google
Image © 2012 GeoEye
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
2005
18° 43.002' S 174° 5.097' W elev 3 ft
Eye alt 46919 ft
Google earth

Fiji


Lambasa
Vunisea
VANUA LEVU
Savusavu
Nambouwalu
TAVEUNI ISLAND
PACIFIC OCEAN
M E L A N E S I A
KORO ISLAND
Lomaloma
Rakiraki
Lautoka
Levuka
Nadi
FIJI ISLANDS
Momi
VITI LEVU
Nausori
Koro Sea
Singatoka
Suva
LAU GROUP

Savu Savu, Fiji

Dakuniba, Vanua Levu, Fiji

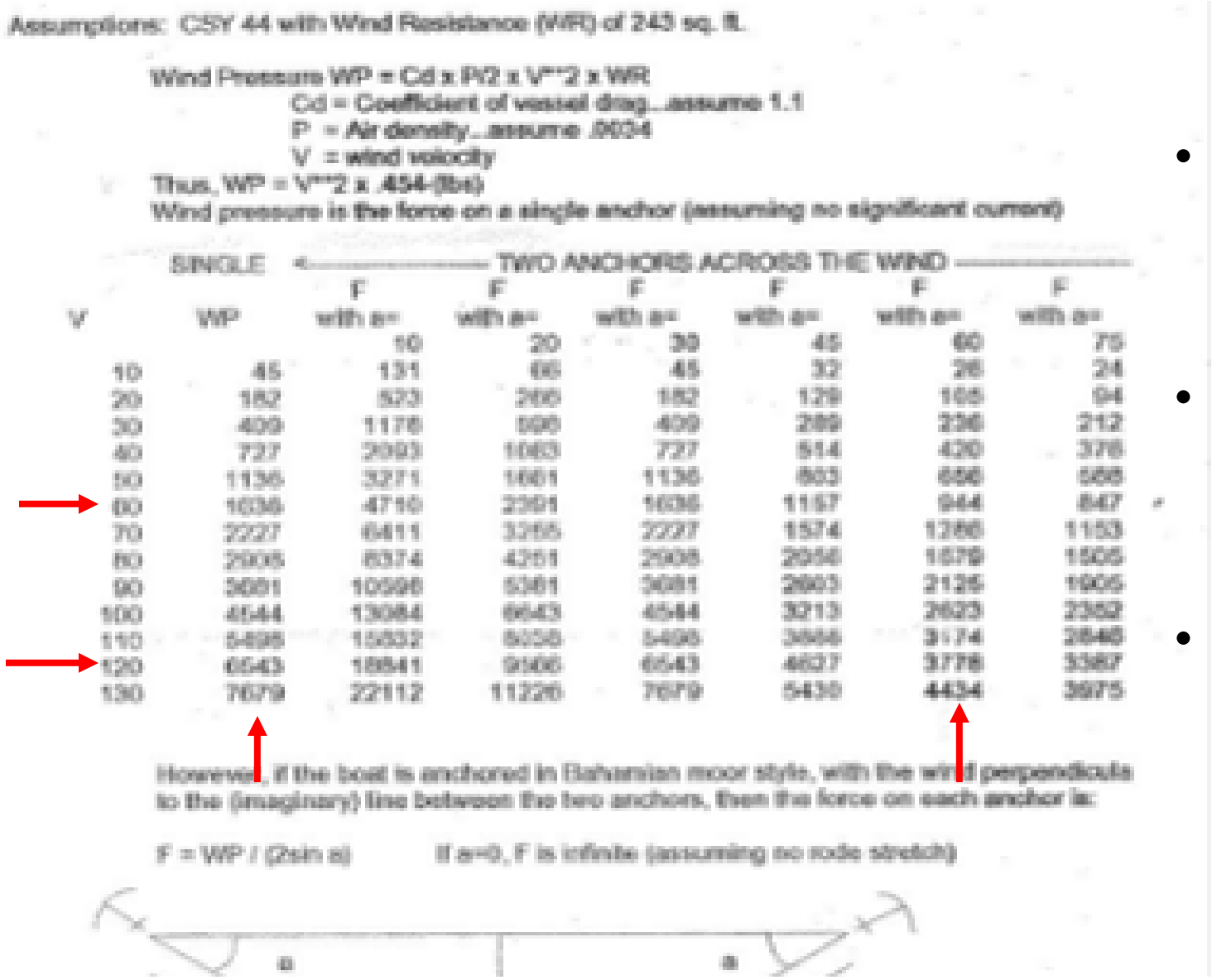


Ground Tackle & Other Preps

Ground Tackle

- Anchors
- Moorings
- Shore attachment
- Spreading loads
- Weak links
- Chafe gear
- Line issues

CSY Wind Load Graph



Assumptions: CSY 44 with Wind Resistance (WR) of 243 sq. ft.

Wind Pressure WP = Cd x P/2 x V**2 x WR
Cd = Coefficient of vessel drag...assume 1.1
P = Air density...assume .0034
V = wind velocity
Thus, WP = V**2 x .454 (lbs)
Wind pressure is the force on a single anchor (assuming no significant current)

	SINGLE	TWO ANCHORS ACROSS THE WIND					
		F	F	F	F	F	F
V	WP	with a=	with a=	with a=	with a=	with a=	with a=
		10	20	30	45	60	75
10	45	131	66	45	32	26	24
20	182	523	266	182	129	105	94
30	409	1176	599	409	289	236	212
40	727	2093	1065	727	514	420	376
50	1136	3271	1661	1136	803	656	588
60	1636	4710	2391	1636	1157	944	847
70	2227	6411	3255	2227	1574	1286	1153
80	2908	8374	4251	2908	2056	1679	1505
90	3681	10598	5381	3681	2603	2126	1905
100	4544	13084	6643	4544	3213	2623	2352
110	5498	15832	8038	5498	3886	3174	2846
120	6543	18841	9566	6543	4627	3778	3387
130	7679	22112	11226	7679	5430	4434	3975

However, if the boat is anchored in Bahamian moor style, with the wind perpendicular to the (imaginary) line between the two anchors, then the force on each anchor is:

F = WP / (2sin a) If a=0, F is infinite (assuming no rode stretch)

- Straight line wind pressure only
- Must add yaw, pitch & shock
- Calder calcs say at least double!

Finding Ground Tackle Weak Links

- Chain 3/8”: SWL
  - – BBB/Proof- $5 2650#
  - - G4- $5 5400#
  - – G7- $!0 6600#
- Shackles:
  - – 3/8” MS/SS 2000#
  - - 7/16” MS/SS 3000#
  - – ½” MS/SS 4000#
  - - 7/16 G4- $12 5300#
  - – 5/8” MS/SS 6500#
- Swivels:
  - – ½” MS- $39 3600#
  - - 5/8” MS- $58 5200#
  - – Kong ½” SS-$240 6600#

Anchoring in 60 Knots

- Good homogenous bottom
- All chain, no weak links
- Strong nylon snubber
- Modern scoop/plow
- Manson/Rocna/Spade/ Ultra/Delta
- Boat length ft + weight in Klbs= anchor weight
- Example CSY 44 - 44’ + 40 Klbs = 84 lbs

Ideal Primary Anchor Characteristics

- High relative holding power – minimum Super High Holding Power rating
- Won't pull out of bottom if drug
- Holds in wide range of sea beds
- High strength design and material
- Always positions itself correctly on bottom for rapid setting
- Superior resetting ability – turns with wind & tide w/o pulling free
- Easy stowage and launching ability

Fisherman/Kedge Anchors-1500s

CQR Anchor - 1933

Danforth Anchor -1939

(High Tensile)

Claw/Bruce Anchor – 1970s

westmarine.com

Fortress Anchor

Fortressanchors.com

Bugel/Wasi Anchor - 1984

First of new generation anchors

Delta Anchor - 1986

Lewmar.com

Last of old generation anchors

Super Max Anchor

Creativemarine.com

Spade Anchor - 1996

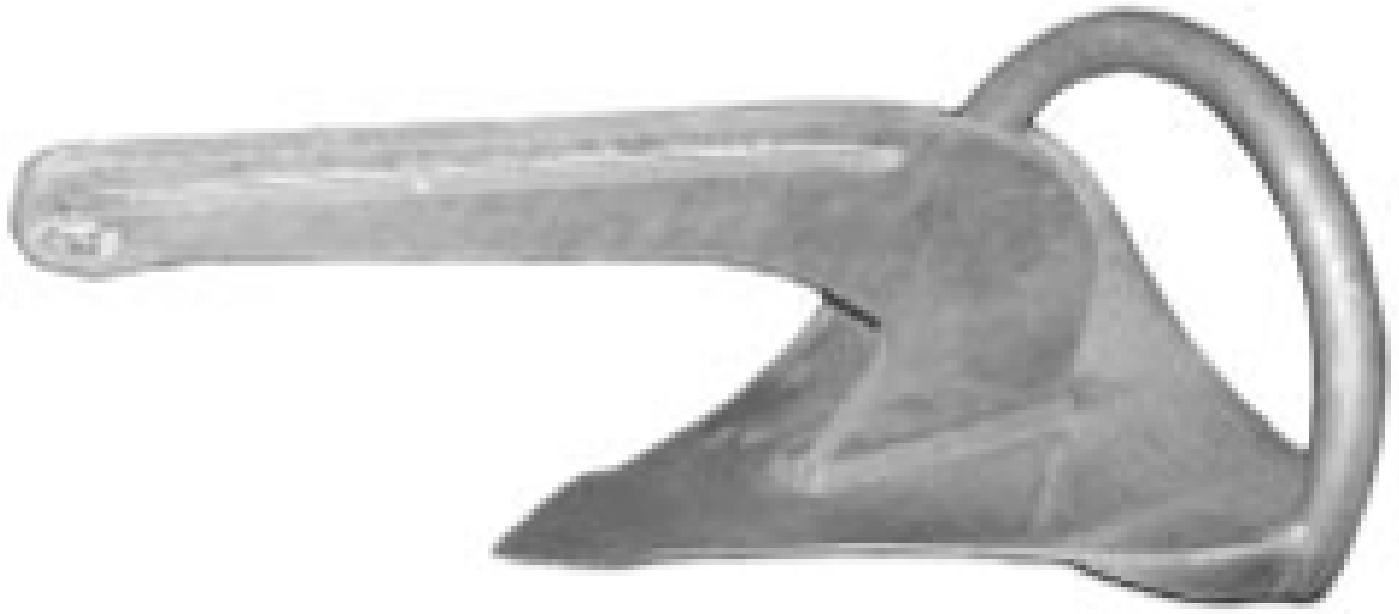
Spadeanchorusa.com

Rocna Anchor - 2004

Rocna.com

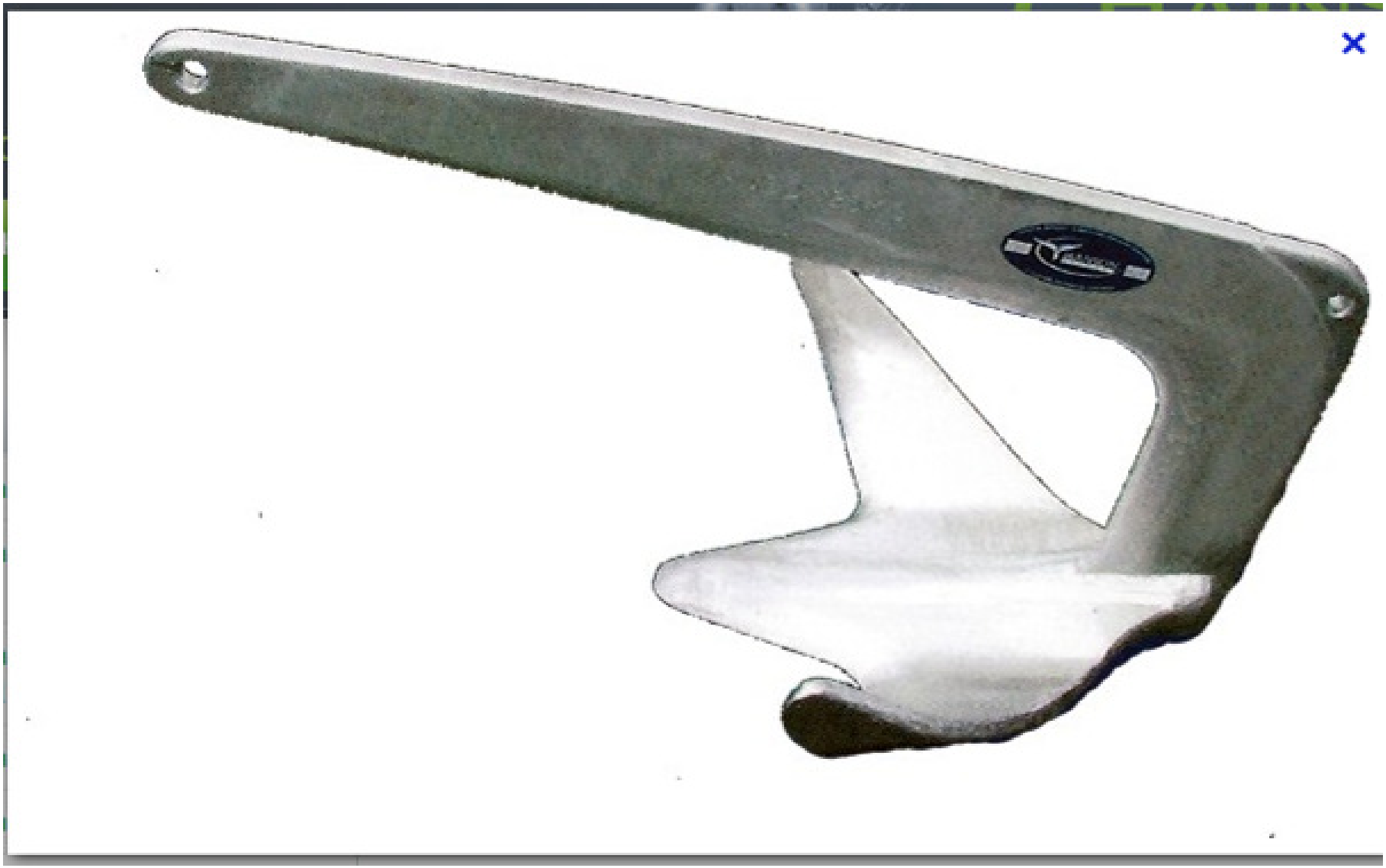
Manson Supreme Anchor – 2006

Manson-marine.co.nz



Manson Supreme

Manson Ray



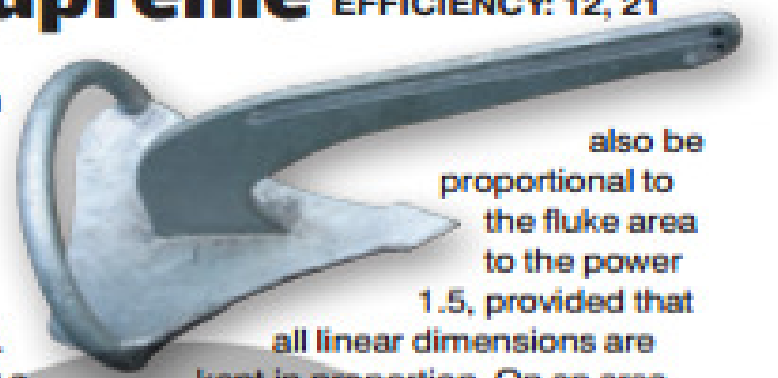
Manson Supreme & Ray

The two Manson Anchors products tested were the roll-bar Manson Supreme (left) and Bruce-style Ray (right).

Anchors Wars!

Manson Supreme

EFFICIENCY: 12, 21



This is a relatively new anchor, again developed in New Zealand. Figure 6 shows the results for the 7.3kg (15lb) model. Over three runs the normalised UHC was 90kgf, giving a normalised efficiency of 12. This is relatively modest for a newer design anchor, and is also be proportional to the fluke area to the power 1.5, provided that all linear dimensions are kept in proportion. On an area basis then, efficiencies should be

Rocna

EFFICIENCY: 21, 30

The Rocna originates from New Zealand and is designed along similar lines to the Manson Supreme, both having rollbars to encourage initial engagement with the seabed. The plots of DHF and SHF against distance ploughed for 4.1kg (nominally 4kg) and 16.2kg (nominally 15kg) Rocna anchors are shown in Figures 5 and 5A. The normalised UHC of the 4.1kg model is 85kgf and the efficiency is 21. The chart for

Ultra Anchor 2006

Quickline.us

Mantus Anchor, 2012

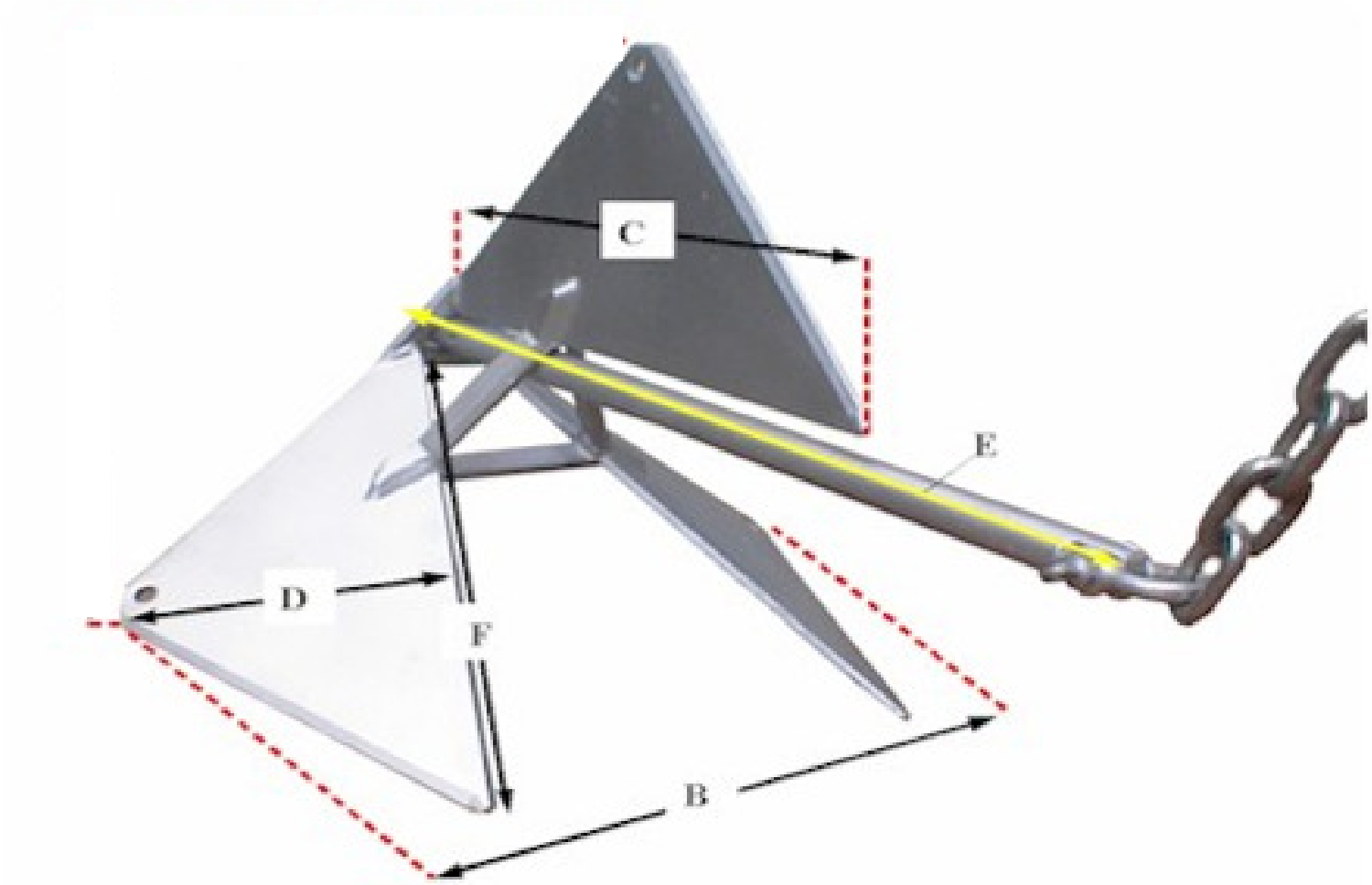
Mantusanchors.com

Hydrobubble Anchor

azuremarine.com, Out of Business

Bulwagga Anchor

(No longer in production)

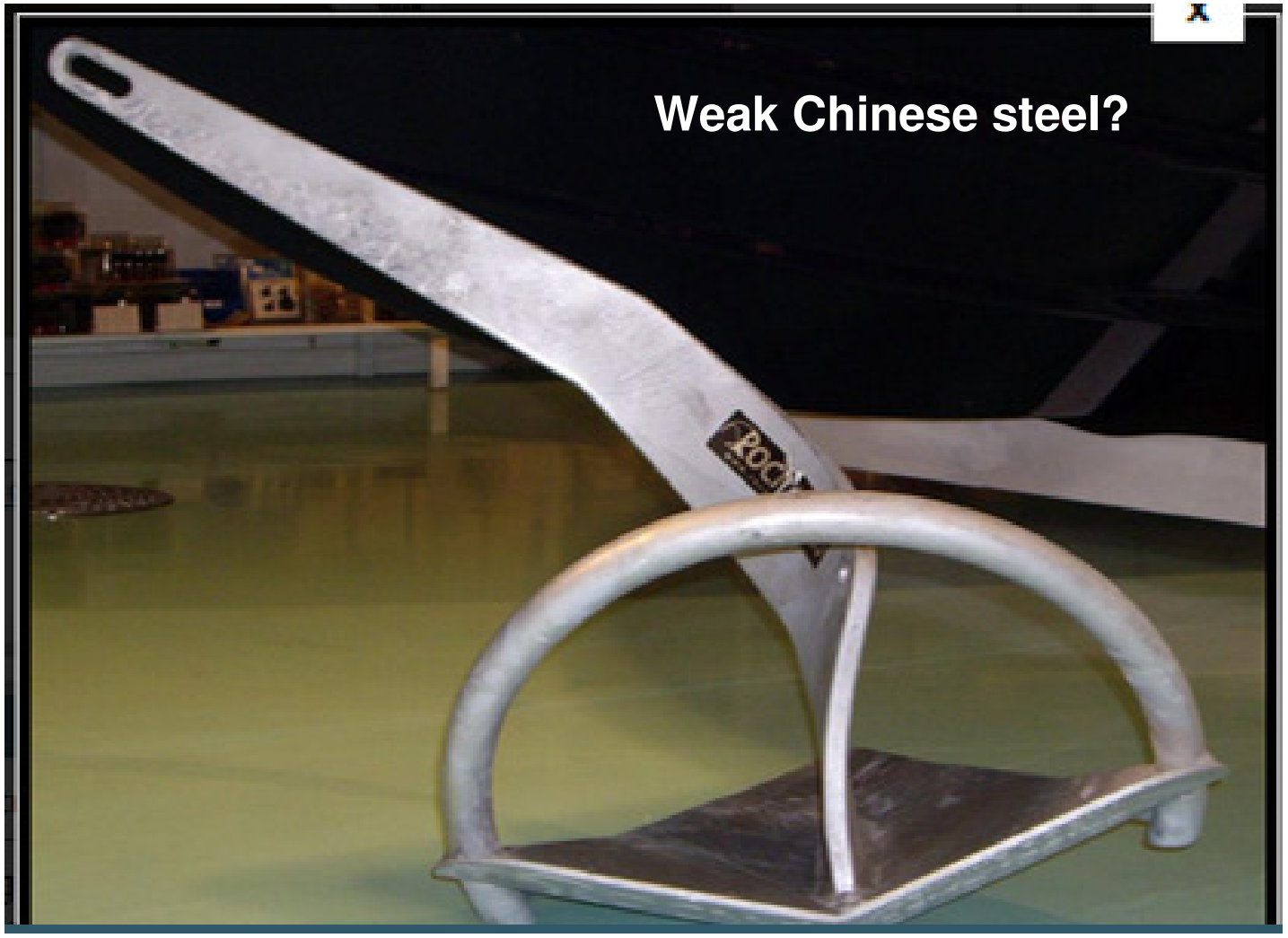


Some Anchor Problems

Broken Stainless CQR Knockoff

Bent Shank on Delta

Bent Shank on Rocna



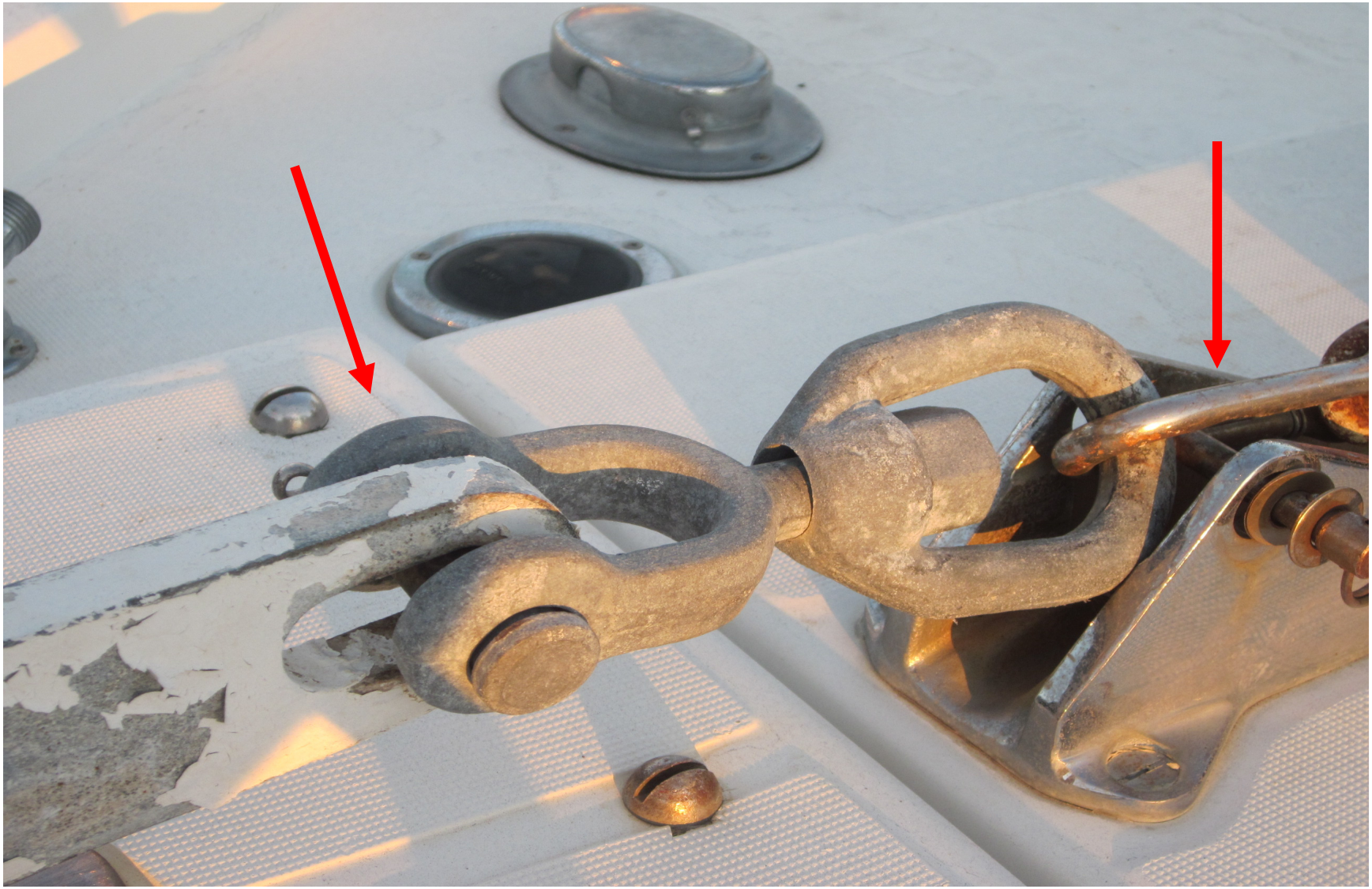
http://www.cruisersforum.com/forums/f118/rocna-recall-china-vs-canada-quality-comparison-67395-5.html

Bent Shank on CQR

Rusted Through CQR

Corroded CQR, Shackles, Chain

Backwards Swivel, Weak Link



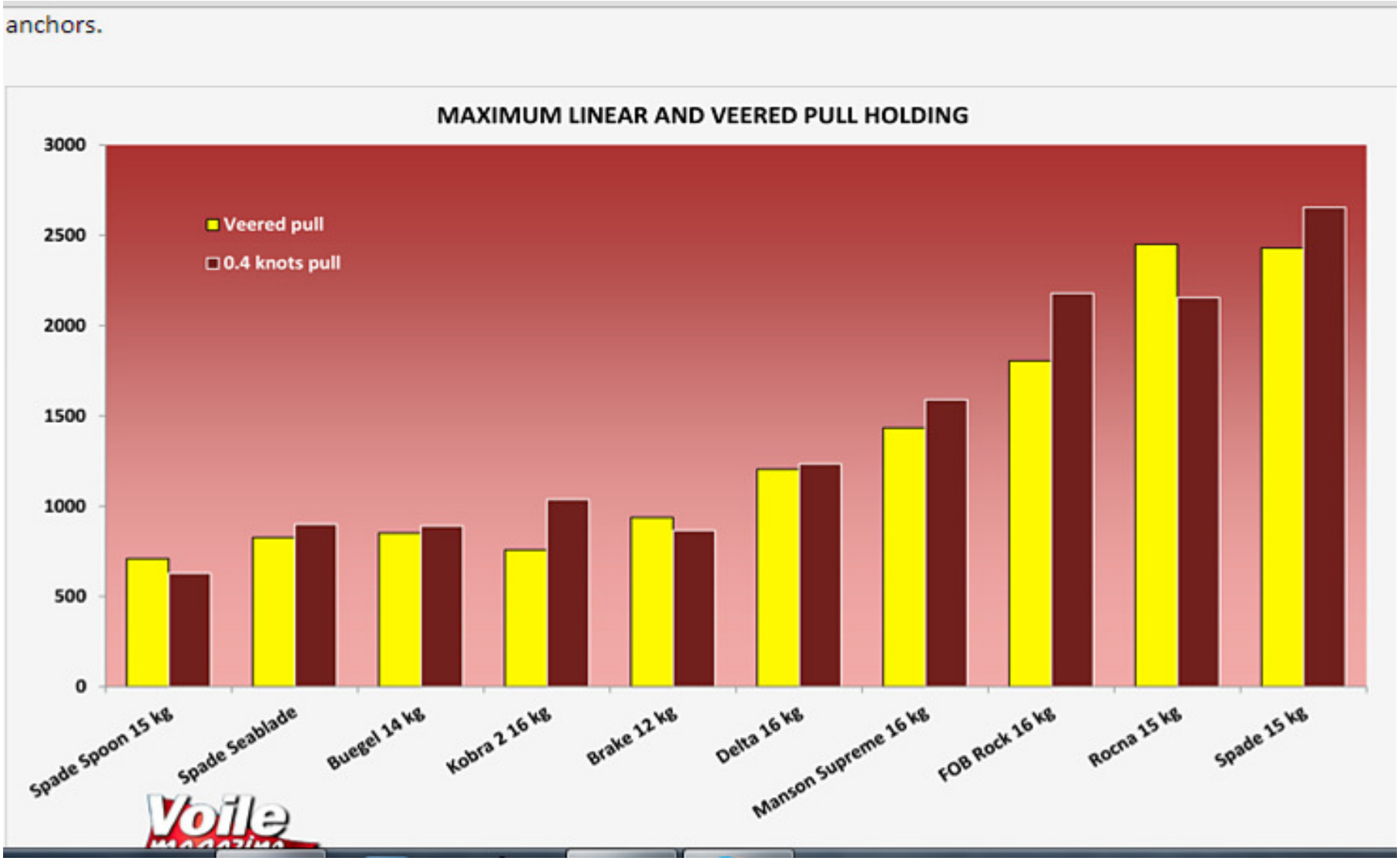
PBO TESTED

Anchors on test

What is the maximum force an anchor will hold without moving in the seabed? Professor John Knox reveals the results of over 20 years' research into the holding capacity of different anchor types

Anchor Testing Results - Voile

anchors.



2006 Anchor Test Results Sail

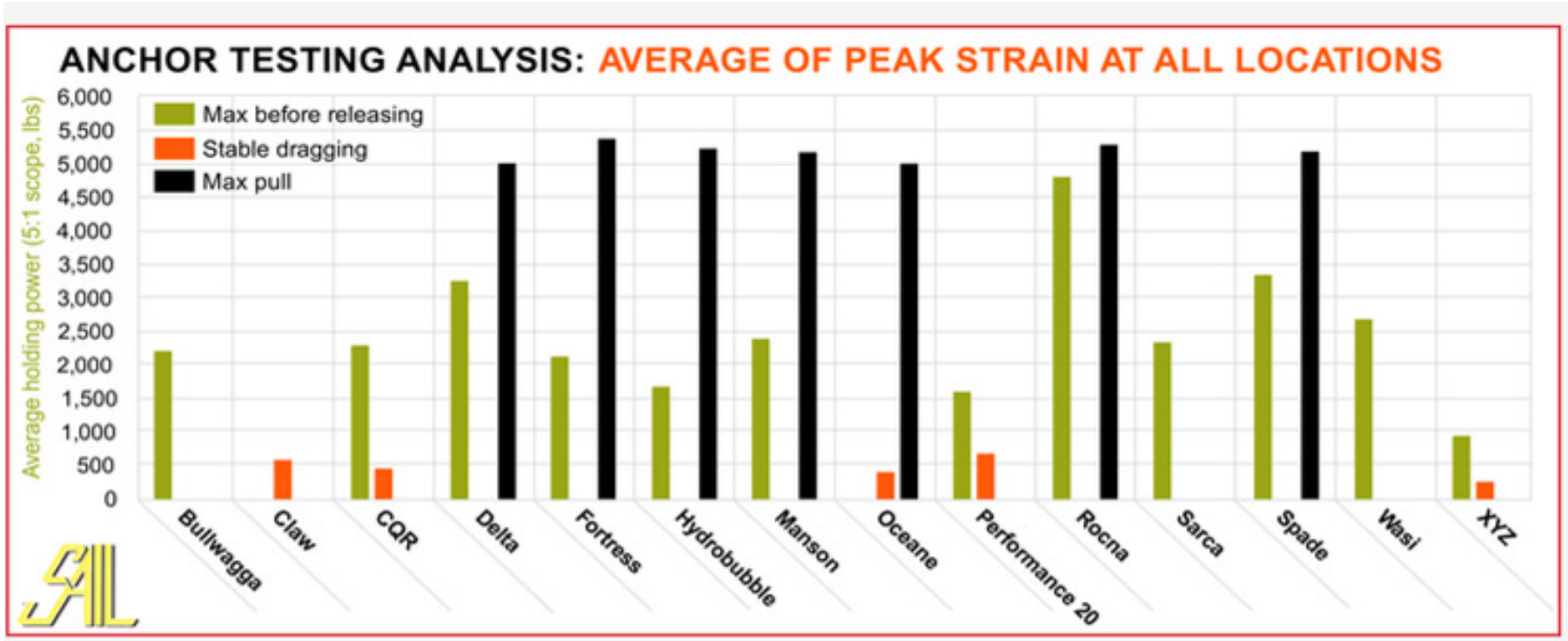
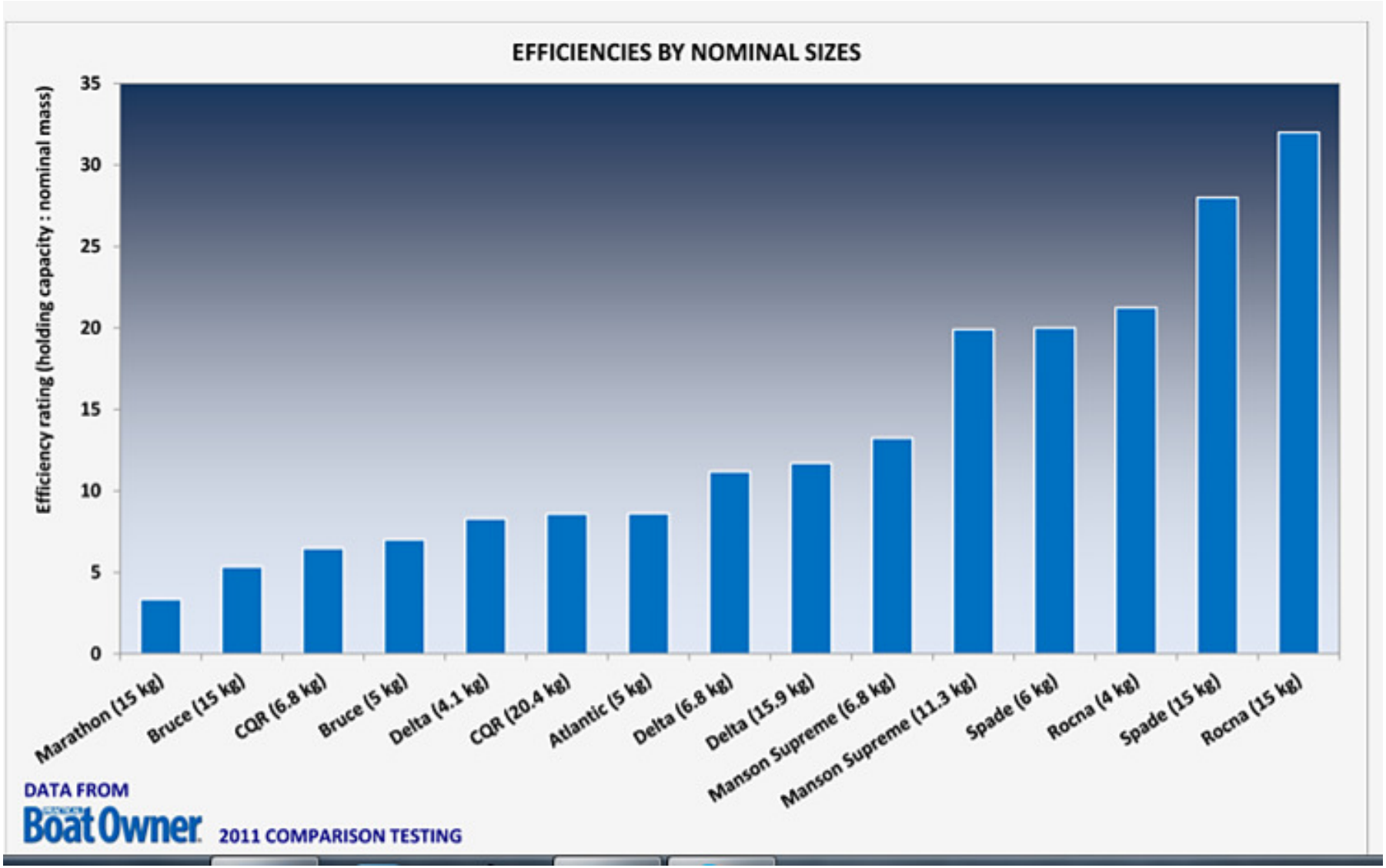
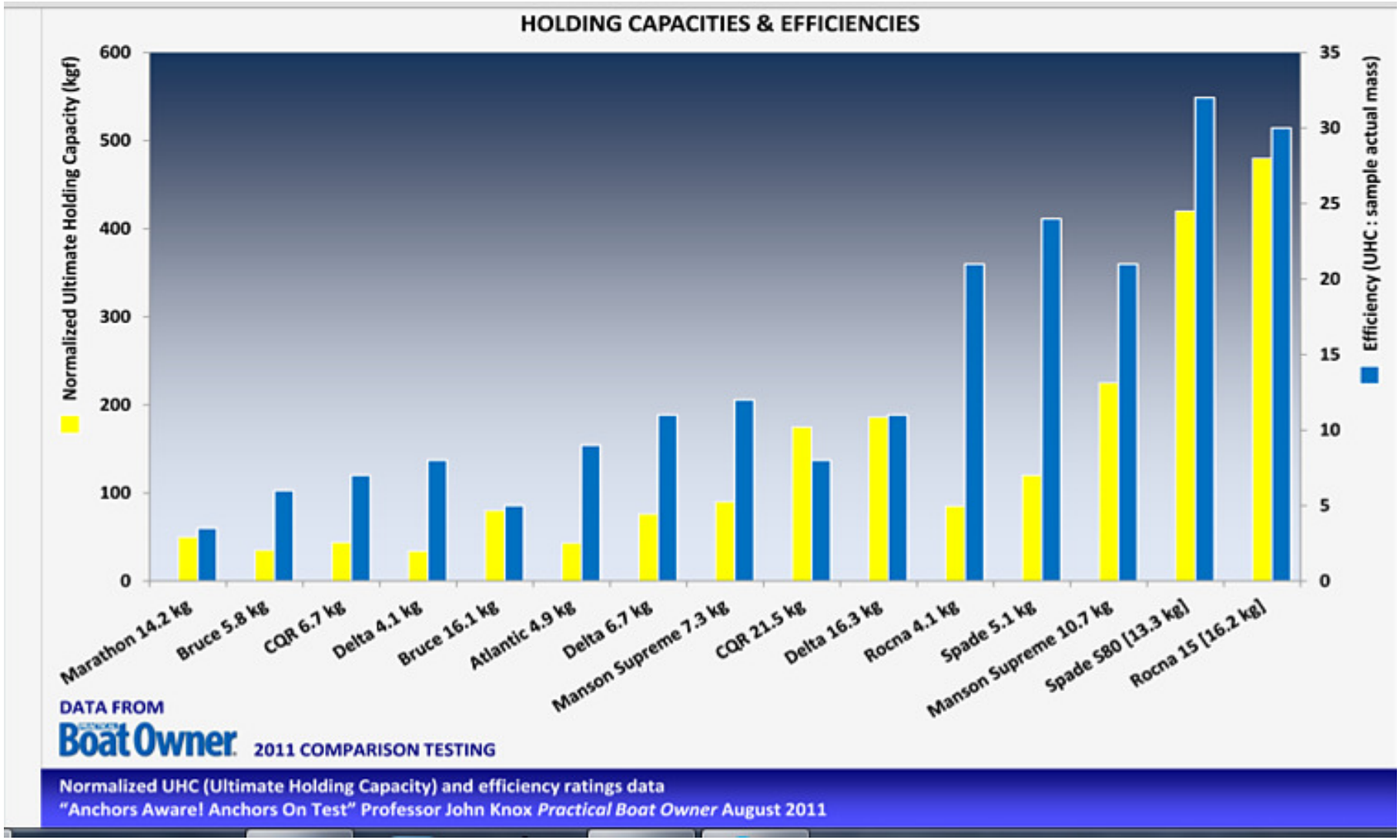


Chart from SAIL October 2006 (page 63). © SAIL 2006

2011 Practical Boat Owner



2011 Practical Boat Owner



Anchor Research Links

- Rocna Website – Great Anchor Information http://www.petersmith.net.nz/boat-anchors/
- Sail-2006 14 Anchor Test, Bill Springer http://www.alberg37.org/Project%20DB/2006AnchorTest/2006%20IndependentAnchorTest.pdf
- Practical Boat Owner-2011 Test, John Knox http://www.roschmarine.nl/images/DownloadStore/prod_20_104.pdf

Anchor Research Links

- West Advisors-Anchor & Mooring Basics 2012 http://www.westmarine.com/webapp/wcs/stores/servlet/WestAdvisorView?langId=-1&storeId=11151&catalogId=10001&page=West-Advisor-Articles#.UK5EL-Thpdk

- Practical Sailor-Rode Loading Analysis 2012 http://www.practical-sailor.com/issues/37_17/features/anchor_testing_rode_loads_10784-1.html

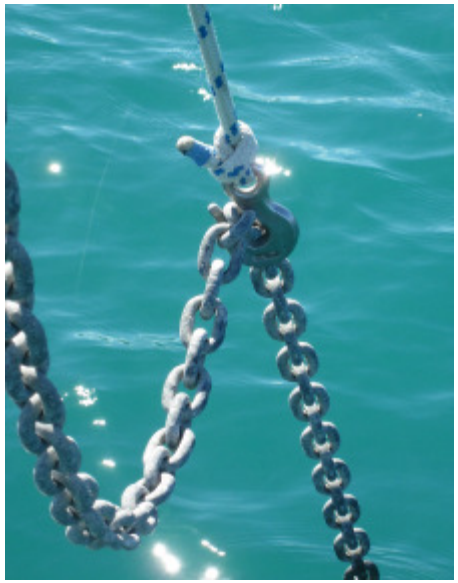
Anchor Research Links

- Practical Sailor-Big Anchors in Bad Bottoms 2008 http://www.practical-sailor.com/issues/34_12/features/Heavyweight-Sailboat-Anchors_5714-1.html
- Bluewater Supplies-Comparisons/Info, 2012 http://www.bluewatersupplies.com/new_gen_anchors.htm

Some Other References

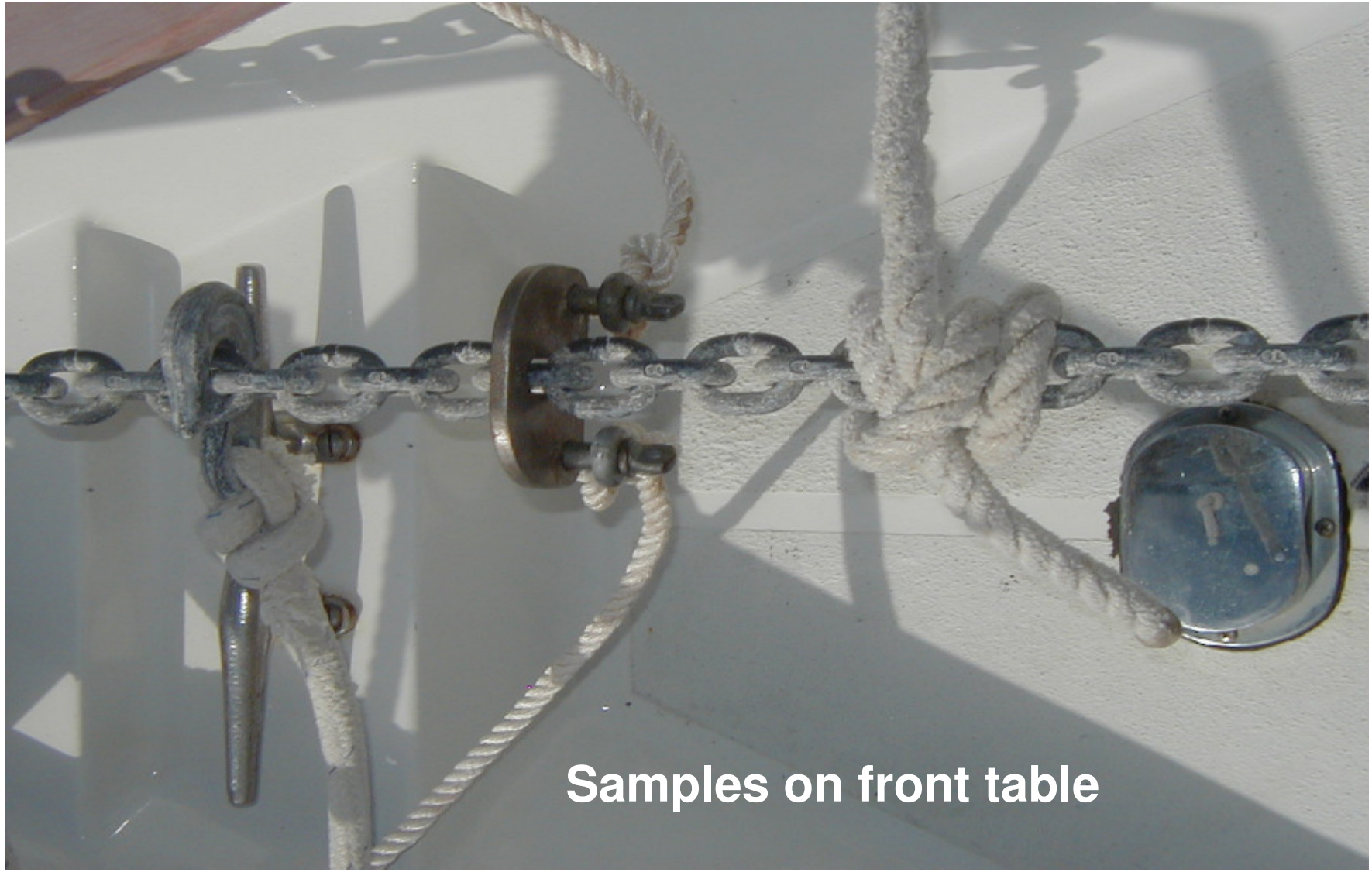
- PS May 12-Anchor Testing and Rode Loads
- PS Nov 11-TStorm Do's & Don'ts
- Bill Springer's Blog Oct 19 11-Which Anchors Hold Best
- CW Jun 2005-Staying Put: Ground Tackle for a Hurricane
- BWS Sep 2005-Hurricane Warning-Riding Out a Big Blow at Anchor

Anchor Snubbers for Chain Rodes

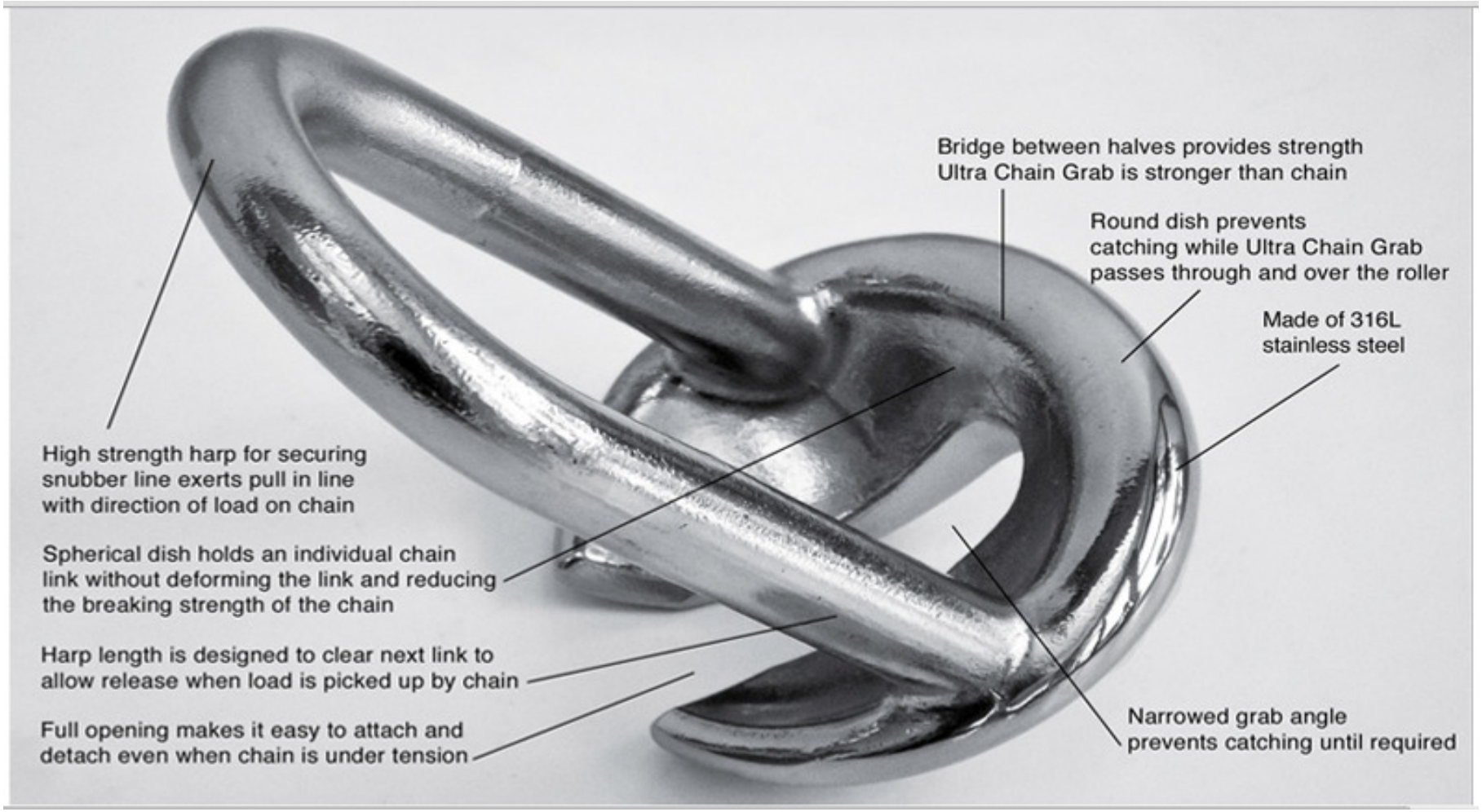


- Materials-
  - Options - nylon, polyester, polypropylene
  - **Nylon** - best strength/stretch combo
- Types-
  - Bridle- chafe at chocks, load aft of stem
  - **Bow stem eye-** chafe at chain loop
  - Through bow chocks - chafe
  - **Over anchor roller-** best option, least chafe
- Connectors-
  - **Chain hook-** drops off, weak, lose 15%
  - Rolling hitch – knot integrity, chafe
  - Shackle –G4 chain, tight fit pin into link
  - **U plate grabber-** v good, strong/secure
  - **Ultra grabber-** SS, great design, expensive

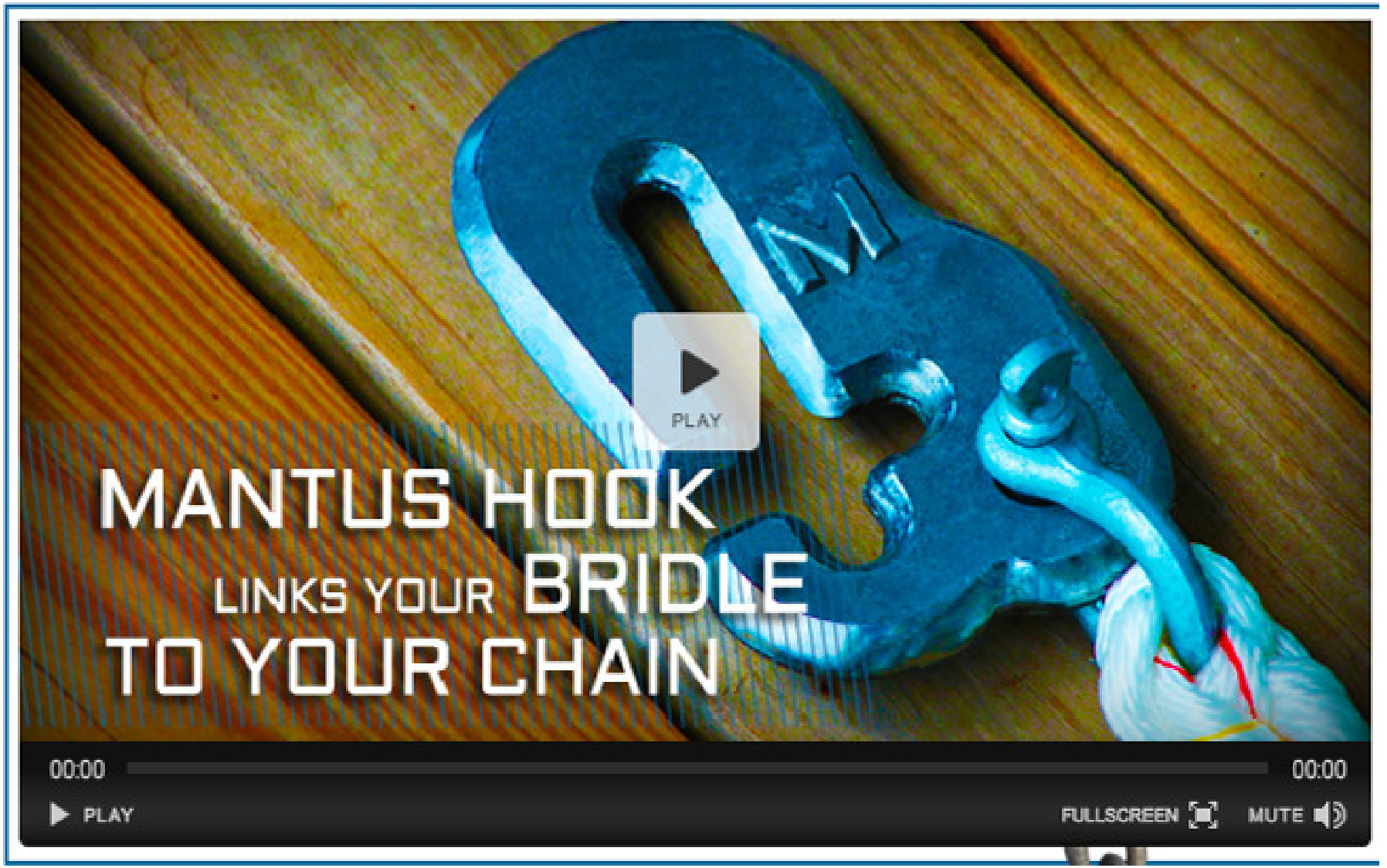
Snubber Chain Attachments



Ultra Chain Grab



Mantus Hook


PLAY
MANTUS HOOK
LINKS YOUR BRIDLE
TO YOUR CHAIN
00:00
00:00
PLAY
FULLSCREEN
MUTE

SPaws Snubbers

- **Light working snubber** - 5/8” polyester w/ SS chain hook
- **Primary** - single heavy ¾” x 35’ nylon line
- Normal attachment to chain just above water
- Easily adjustable to increase length for storm
- Spliced hard eye at chain end
- U Plate full strength SS chain grabber w/ double ½” SS shackles, (future try Ultra Grabber)
- Rigged over bow roller w/ chafe gear
- Strong bollard attachment on deck
- Backup quickly available

U Plate Snubber Connection
(on bridle)

Swivel

- Must have full strength of chain
- Must be attached to anchor with full strength shackle
- With groove in roller keeps chain from twisting
- Allows turning of big anchor before bringing over roller

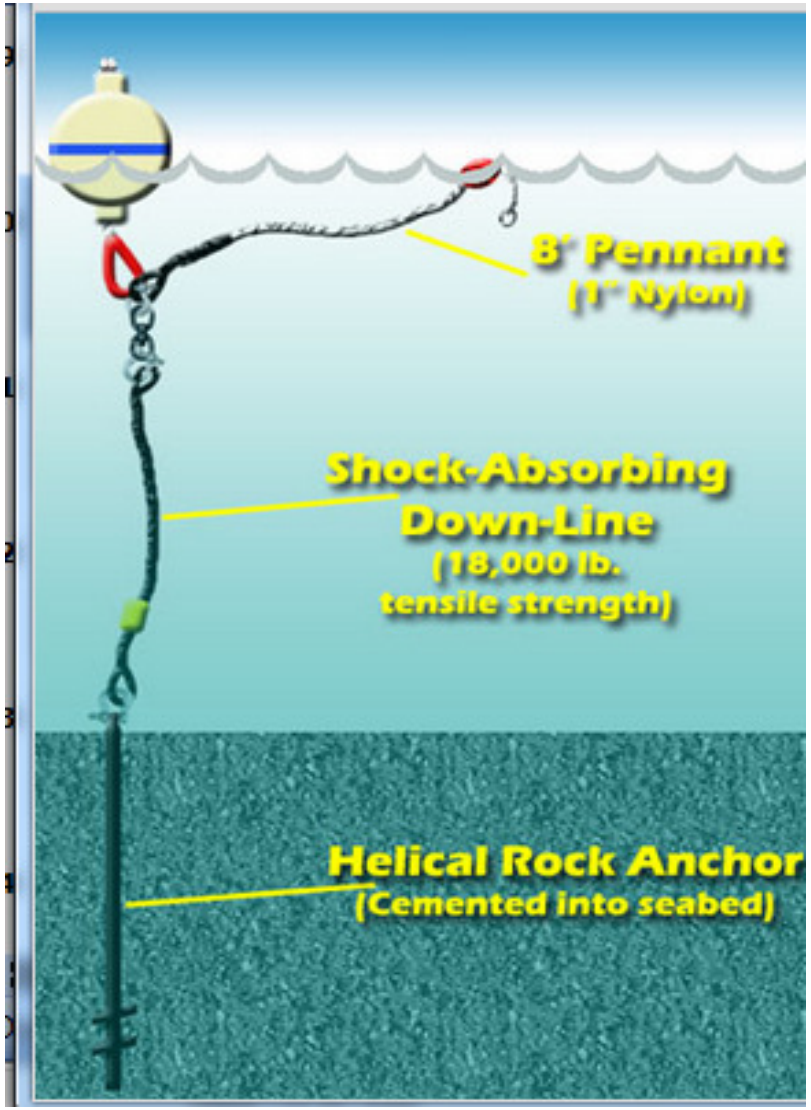
SS Kong Swivel

6600# SWL

MS Swivel Improperly Attached

Moorings

Strong Mooring



- Look for big/strong anchor and up lines
- Helix screw anchor best
- Inspect mooring carefully yourself
- Two up lines for TC use
- Watch out for other boats breaking loose

Mooring Anchor Strengths

Vineyard Haven, Pull Test Results		
Mooring Type	Bottom Condition	Breakout Force
350-lb. Mushroom	5 ft. deep in mud	2,000 lb.
500-lb. Mushroom	in sand bottom	1,700 lb.
3,000-lb. Concrete USCG block	set in mud	2,100 lb.
6,000 lb. cement block	on sand bottom	3,200 lb.
8/10 Helix	soft clay mud	**20,800+ lb.**

Mooring Type	Helix	Dor-Mor anchor 650 lbs	mushroom 500 lbs	single block 2k lbs	double block 8k lbs
Resisting Force (lbs.)	12,000	4,500	1,200	800	4,000
Water Depth	20	18	15	14	35
Scope	4:1	3:1	3.5:1	3:1	3:1

Mooring Attachment Options

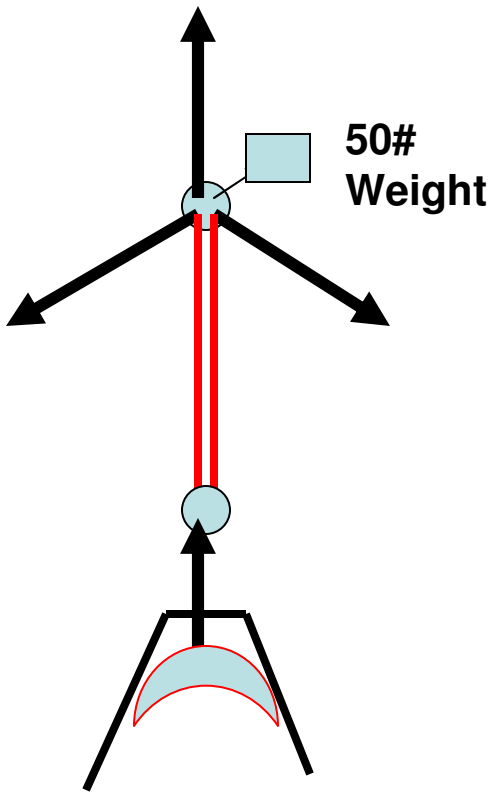
Bridle

- Doubled lines P&S
- Bridle w/ big shackle
- Single line w/ hard eye, shackle
- Multiple lines over bow roller
- Combo-chain, line & shackles
- No-
  - Anchor chain w/ shackle
  - Single line P&S

SPaws Storm Combo Mooring Rig

SPaws Storm Mooring Rig

3 Point Mooring Elements

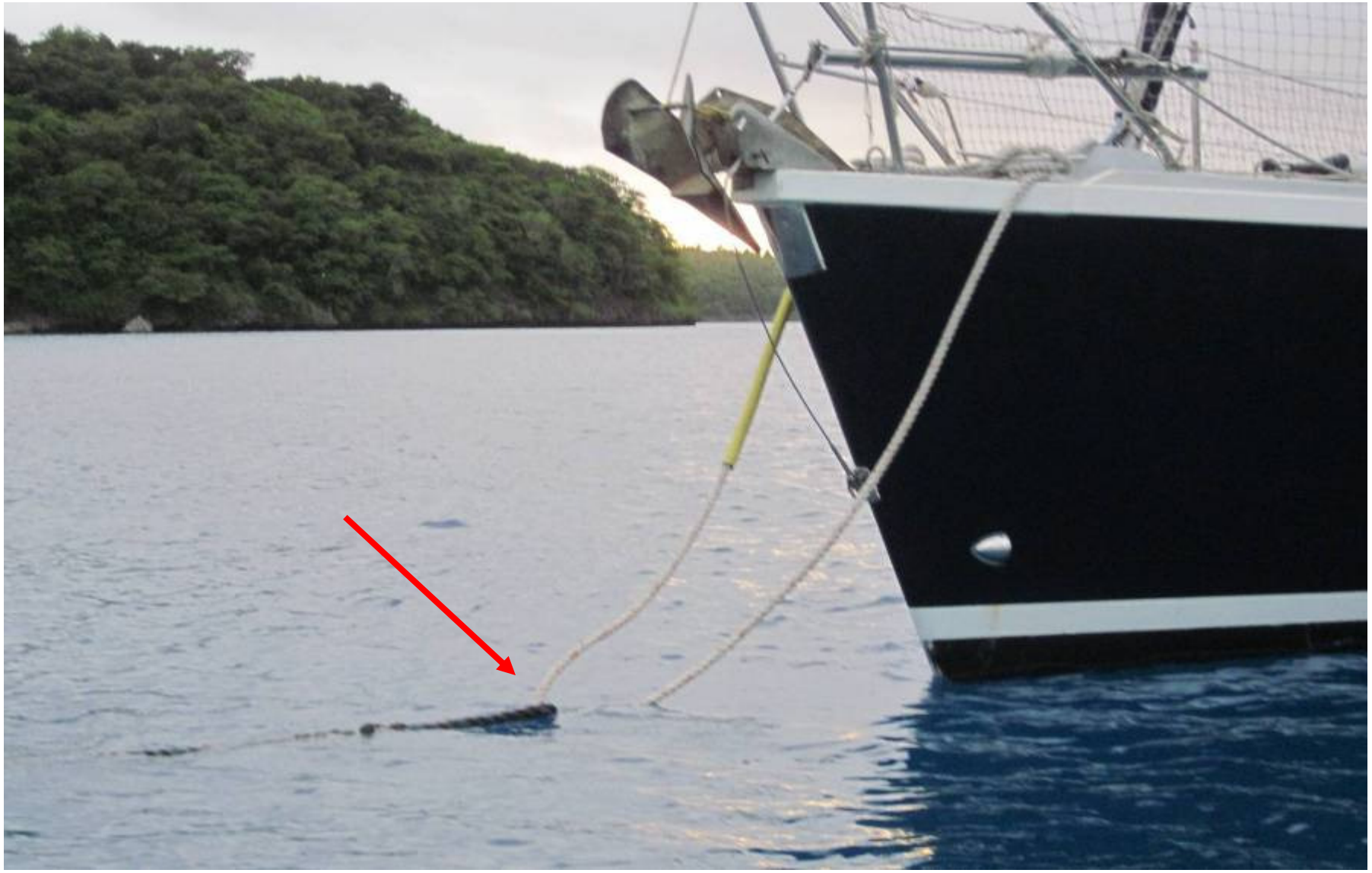


- 3 big strong anchors
- 3 50’ HT chain legs
- Strong center ring with BIG sentinel weight
- 2 up lines to surface
- Maximize scope
- Chain over roller
- Multiple bow cleats
- Full strength shackles
- No weak links!

Doubled Mooring Lines P&S OK

How Not to Tie to a Mooring

How Not to Tie to a Mooring



Line Considerations

- Nylon vs polyester stretch
  - Nylon 20% stretch @ SWL
  - Polyester 2.4% or less
- Abrasion resistance
- Size- bigger better
- Knot strength-
  - Bowline 60%
  - Buntline hitch 85%
  - Splice 90+%
- Thimbles on all eyes

Chafe Gear

- Problem-stretch & movement over chocks, cap rail, etc
- **Heat** big issue
- Must ventilate line
  - Use oversize hose
- 1 Rags/towels/tape/etc
- 2 Commercial polyester, rubber, nylon, leather
- 3 Fire Hose
- 4 Heavy PVC hose
- 5 Dacron minimizes stretch/movement

Sails

- RF Headsails-remove, stow below
- Main/mizzen-stow below or strong wrap/tie
- Halyards-run up w/ strong thin lines

Dinghy Storage

- Options-
  - Davits – no, too much windage
  - Ashore – no, theft and debris problems
  - Sunk – maybe if hard dinghy
  - On deck- yes, deflated and well tied down
- Outboard motor - stowed below, windage and theft issue

Shore Attachment Options

- If using line double wrap to minimize movement
- Use buntline hitch not bowline knot
- Use chafe gear
- Consider using short chain around pilings, trees, etc

Before, During & After the Storm

Before the Storm

- Prepare boat
- Load provisions for min 2 weeks
- Top off fuel and water & cash
- Arrange for someone to monitor internet weather for you
- Consider how to communicate with them
- Consider bailout plan if staying on boat
- Don’t count on your dock space being there after the storm

During the Storm

- **Get off the boat if above Cat 3**, ~100 kts
- Hard to make changes to ground tackle during storm – prepare carefully
- Have goggles and waterproof light ready
- Could us engine to reduce strain on ground tackle or avoid other loose boats
- Leave VHF on Ch 16
- Monitor HF Hurricane Net 14300 USB

After the Storm

- Theft is a big issue – lock everything
- Infrastructure damage ashore
- Lack of provisions/water
- Phone communications a problem
- Sunken debris danger especially in channels
- Transportation difficult
- Plan to be self sufficient for at least 2 weeks

Insurance Issues for Tropical Storms

- May need tropical cyclone zone rider
- Probably no coverage if canvas left up
- No liability coverage if can't prove negligence - "No Fault Law"
- No coverage if improper maintenance
- Marina insurance?

A Few Good Book Resources

- Nigel Calder - Cruising Handbook
- Beth Leonard - The Voyager's Handbook
- Earl Hinz - The Complete Book of Anchoring and Mooring
- Don't believe everything you read especially on the internet!
- Use the eye test to find the truth


The End

HF Hurricane Net

- 14300 USB
- Time

Ultra Chain Grab

Full G4 Strength, Self Release

- May be used to align vessel to waves or weather
- Eliminates noise from anchor chain
- Rubber damper absorbs jerking from anchor chain
- Eliminates strain on windlass and cleats

Books

- Most guides
- World Cruising Routes

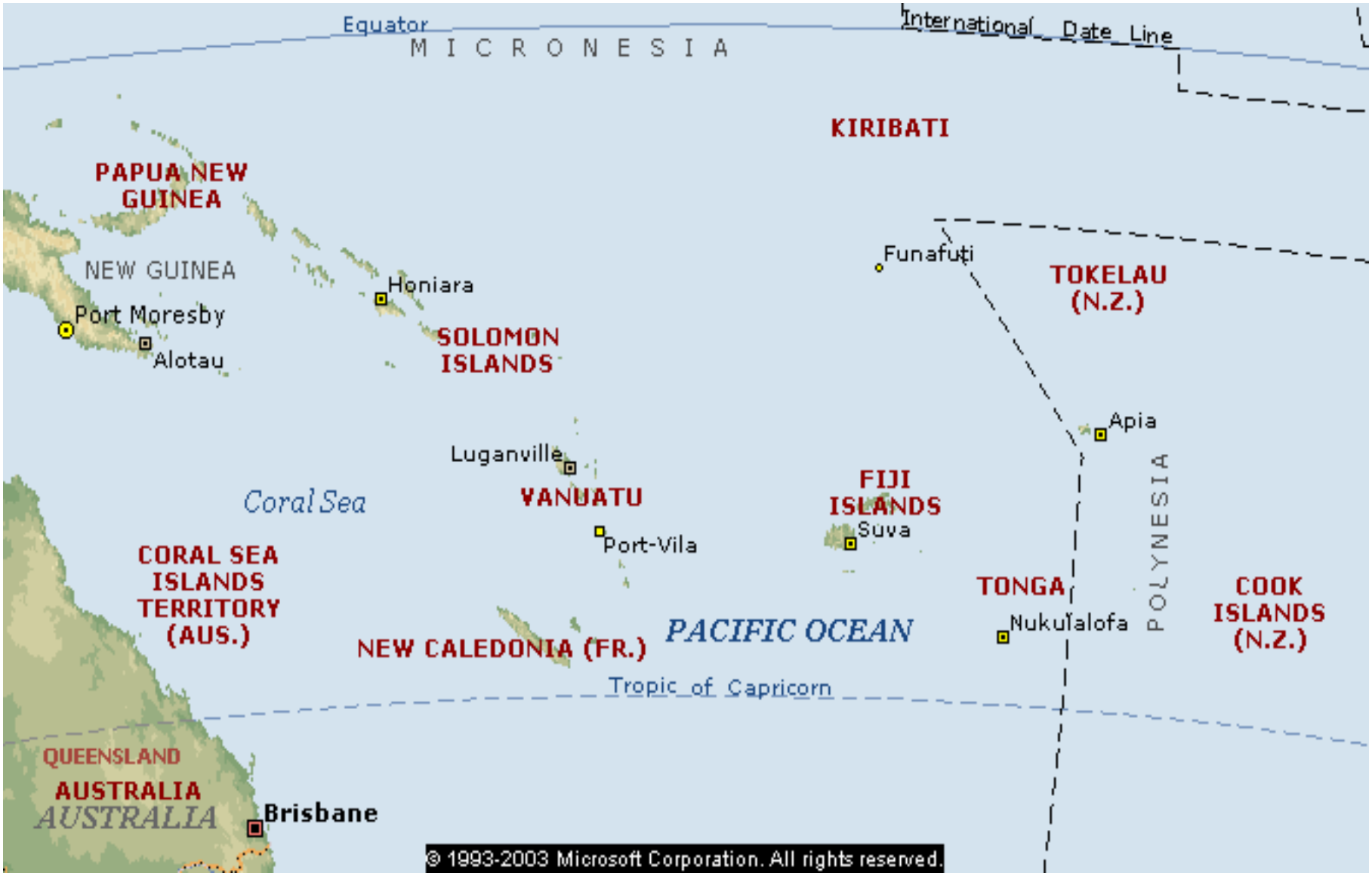
Southeast US Area

- Coasts
- Gulf Mexico
- Florida W
- Florida Keys
- Florida E
- SE US

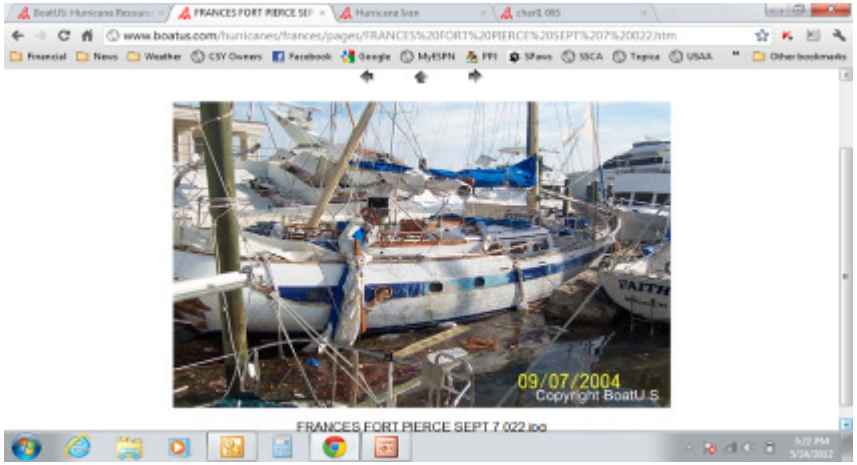
VHF Weather

- From NOAA
- No predictions or track info-why?

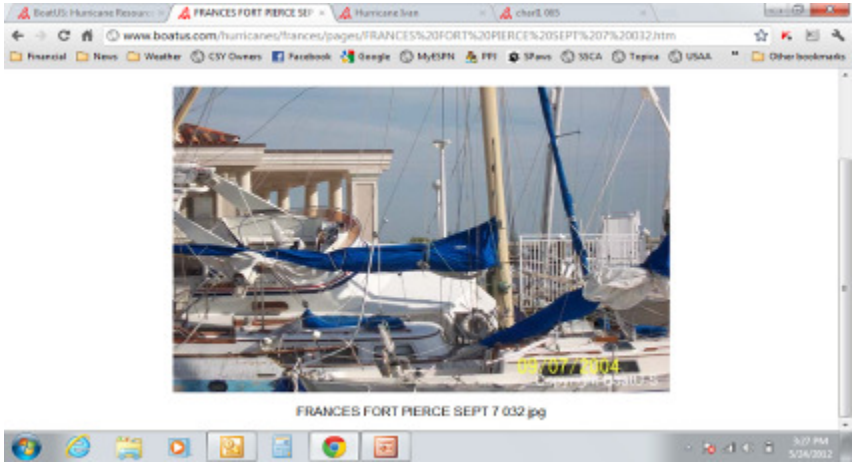
Southwest Pacific Area

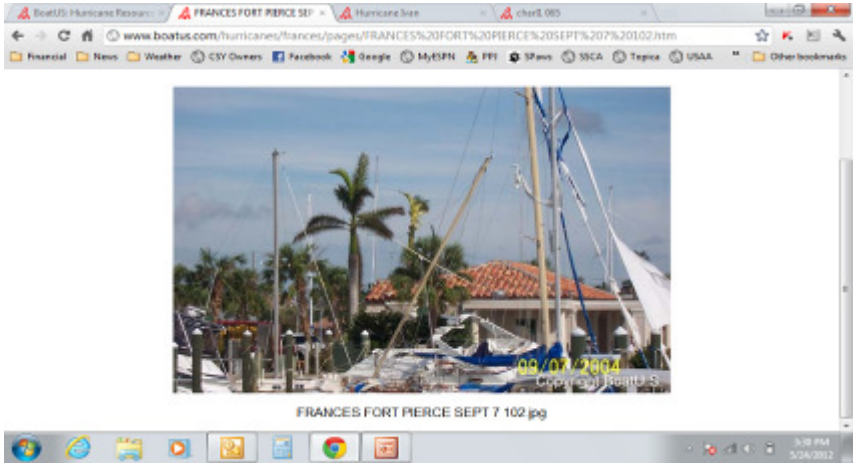


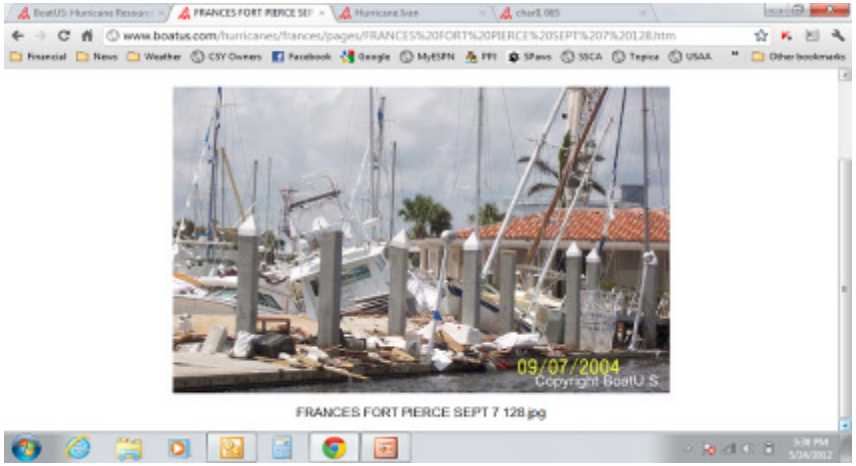
Marinas - Frances 2004



FRANCES FORT PIERCE SEPT 7 022.jpg


FRANCES FORT PIERCE SEPT 7 032.jpg


FRANCES FORT PIERCE SEPT 7 102.jpg



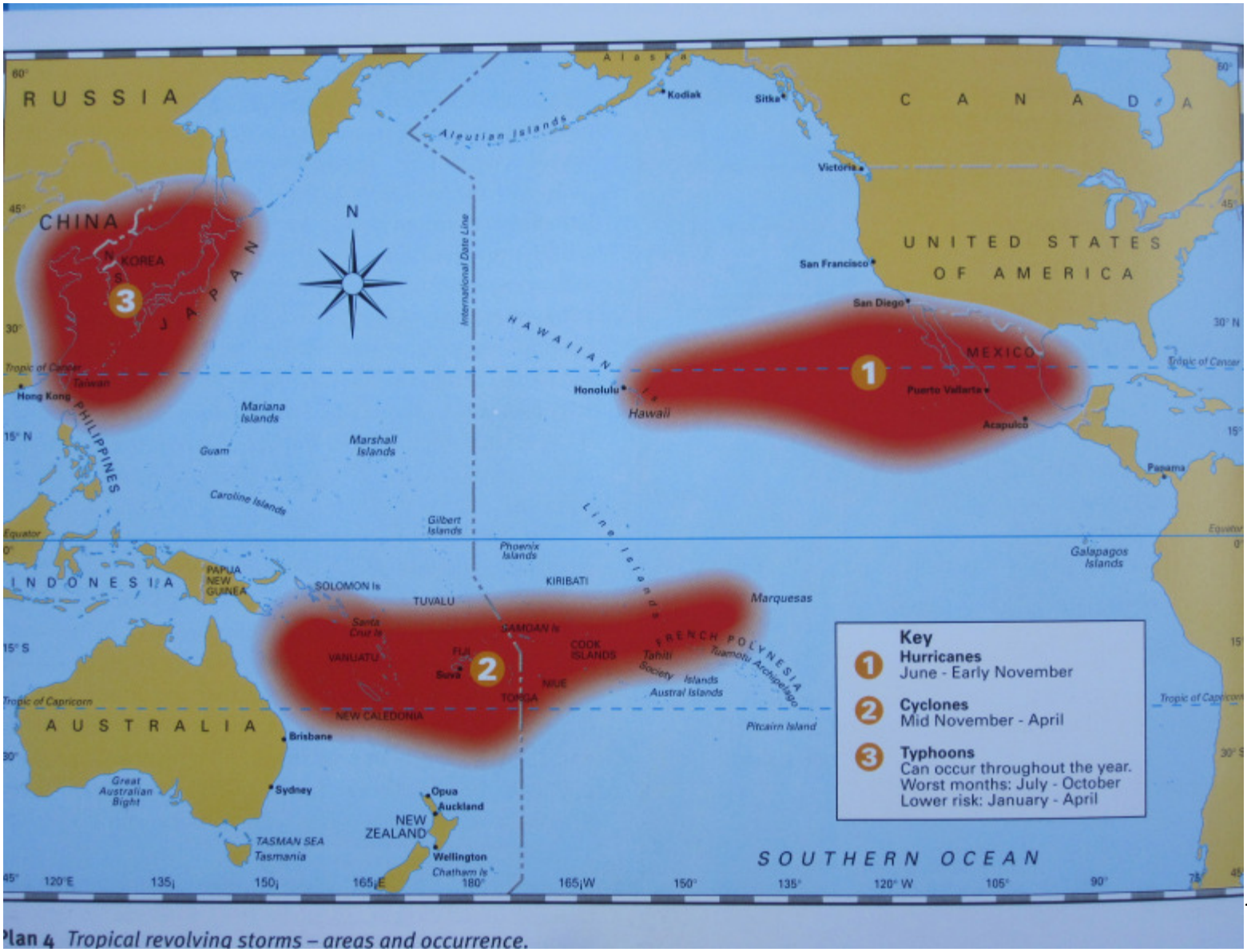
FRANCES FORT PIERCE SEPT 7 128.jpg

Models

- Sphagetti
- GFS
- Others

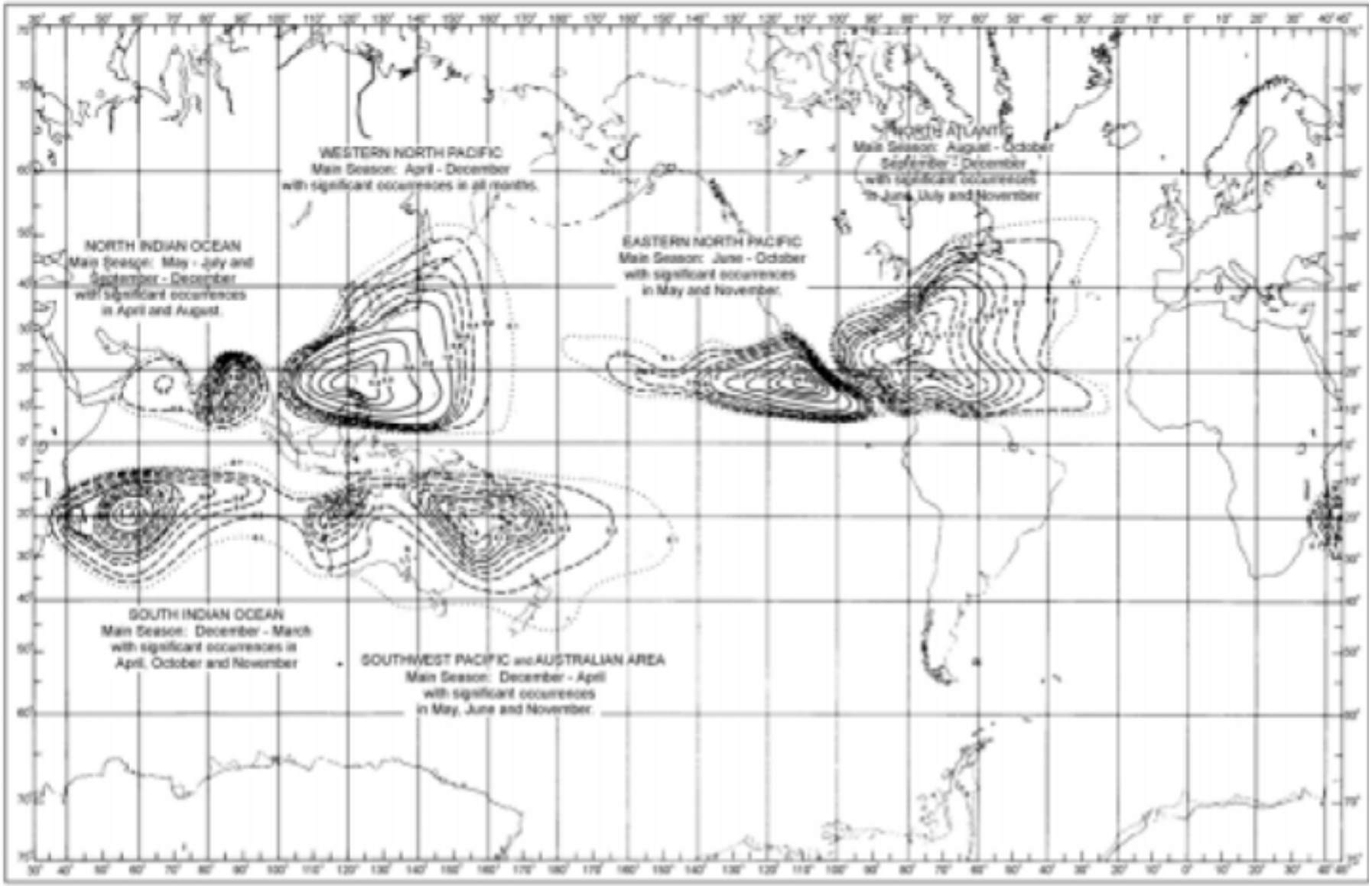
Micro Burst

Pacific Tropical Storm Zones



Plan 4 *Tropical revolving storms – areas and occurrence.*

World Tropical Storm Zones



Popular Anchor Weaknesses

(As a Primary Anchor)

- **Knockoffs** - weaker materials, degraded performance
- **Fisherman** - very small fluke area, difficult stowage
- **Fluke** types -Danforth, weak design, can't point load, reset difficulty
- **Shovel** – Max, penetration difficulties in harder bottoms
- **Plow –** CQR**,** small flukes, wide shank, high knuckle wt
- **Plow** – Delta, stable upside down in soft mud, plow design
- **Claw** – Bruce, basket design, small fluke area, penetration difficulties
- **Modern Scoop** – Spade/Ultra,
- **Modern Scoop w/roll bar** - Manson/Rocna, roll bar can hang up & inhibit deep penetration

SARCA Anchor

Sword/Oceane Anchor

Spadeanchorusa.com

Deck Equipment

- Remove and stow all below:
- Solar Panels
- Wind generators
- Fuel jugs, fenders, BBQs
- Surfboards, etc
- Misc deck eqpt
- Remove and stow all below

Cleats and Chocks

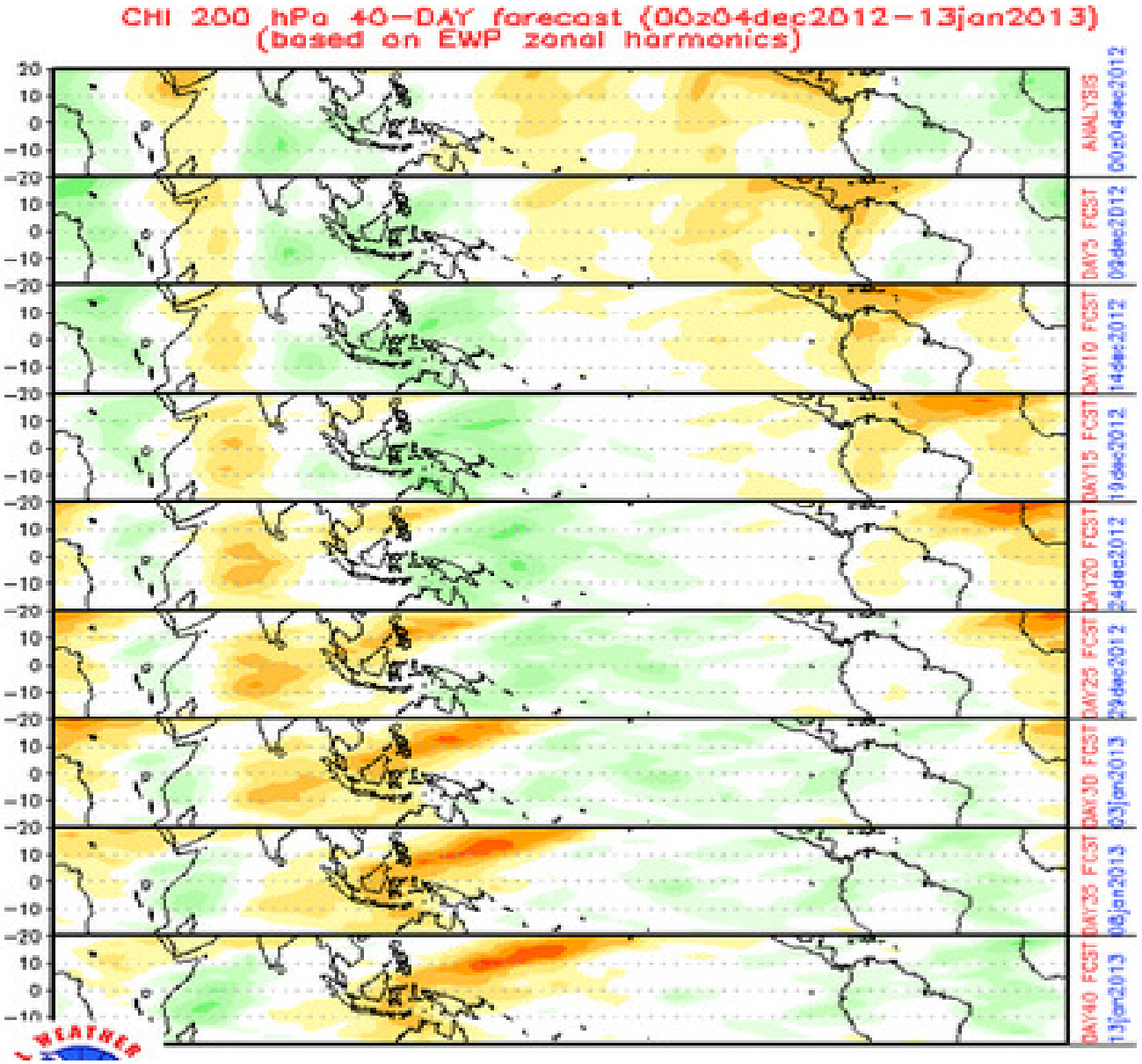
- Show open and closed chocks

- Spread the load
- Minimize angle through chocks
- Parallel cleat load
- Strong backing plates
- Closed chocks only
- Good chafe gear

Fenders

- Two types
- Bigger is better
- During storm?

Madden Julian Oscillation Forecast



Literature Findings

- Newer Scoop anchors have much better setting and holding power than CQR/Bruce
- Fluke styles best suited for soft homogeneous bottoms
- Deep diving modern scoop anchors (Rocna/Manson/Spade/Ultra) must have exceptionally strong shanks
- Windage varies w/ square of surface area
- Force on boat varies w/ square of wind speed
- Max loads on anchor decrease with increased scope
- In 30 kts, shock loads near nil at 10-1 scope

Cockpit Canvas

- Insurance issue for some
- Lightweight bimini & wind screens-remove all and stow below
- Small strong dodger-could leave up if staying onboard and weaker TC

Literature Findings

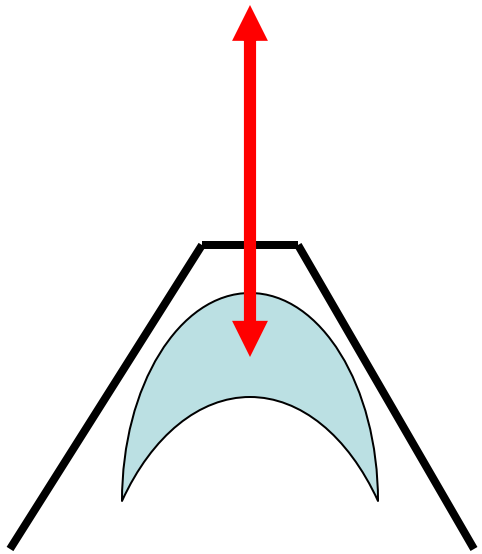
- Yawing develops significant shock loads on ground tackle
- Reduce yawing with kellet, increased scope, second anchor under foot, riding sail
- Minimize shock loads with long snubber, increased scope and kellet

Moorings

- Anchor
  - Helix screw best – up to 20K lbs strength
  - Concrete blocks - lose ~40% weight underwater
  - Engine blocks – need lots of them
  - Weight – depends on expected wind strength
- Up lines
  - Buoyed chain to start off above anchor
  - Minimum – nylon double dock lines
  - Spliced hard eyes

SPaws Storm Mooring Rig

- On deck-multiple bights polyester/Dacron to multiple cleats
- G4 chain over roller
- Full strength shackles to fit at both chain ends



More here…

http://svsoggypaws.com

http://svsoggypaws.blogspot.com

ssca.org