The Chesapeake Bay Interpretive Buoy System and the Winter of 2015: *Problems and Solutions*

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Chesapeake Bay Interpretive Buoy System

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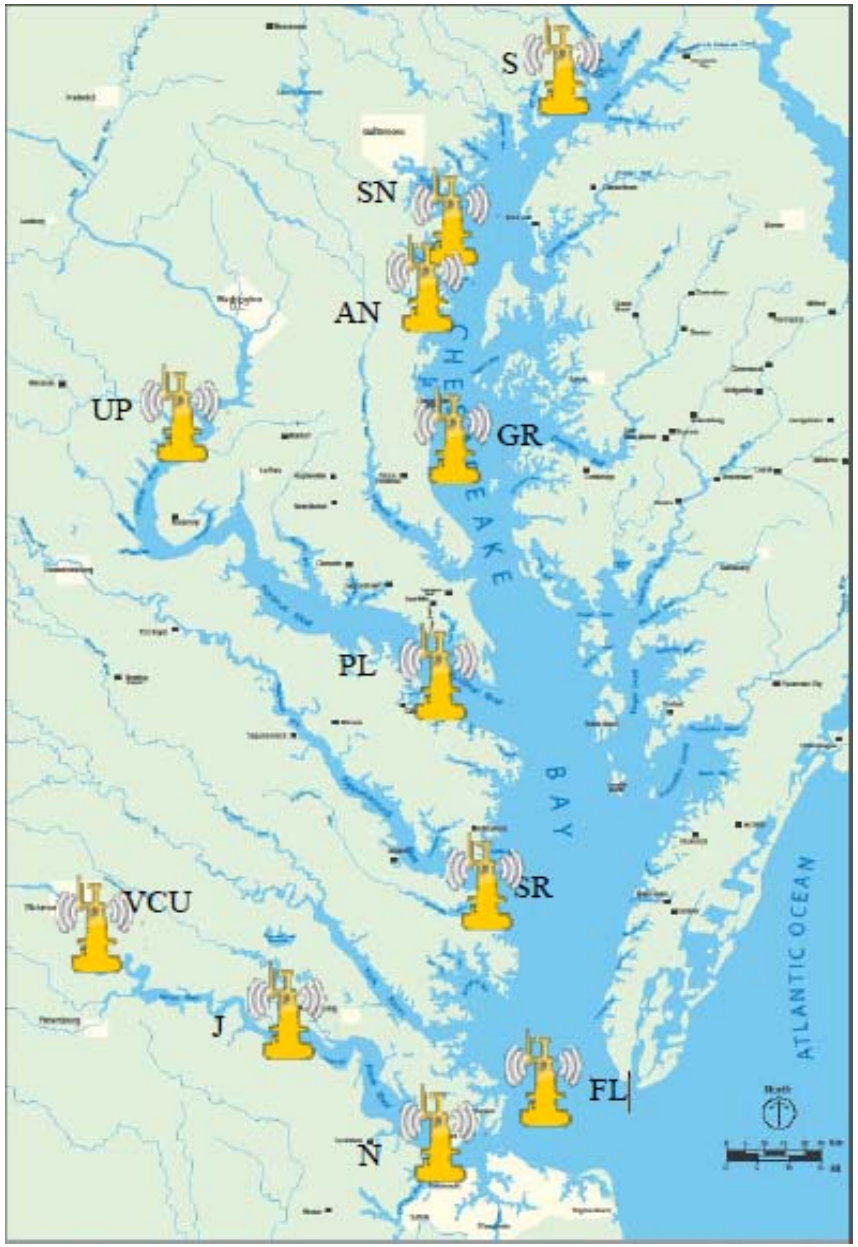
CBIBS

Jamestown

CBIBS Locations

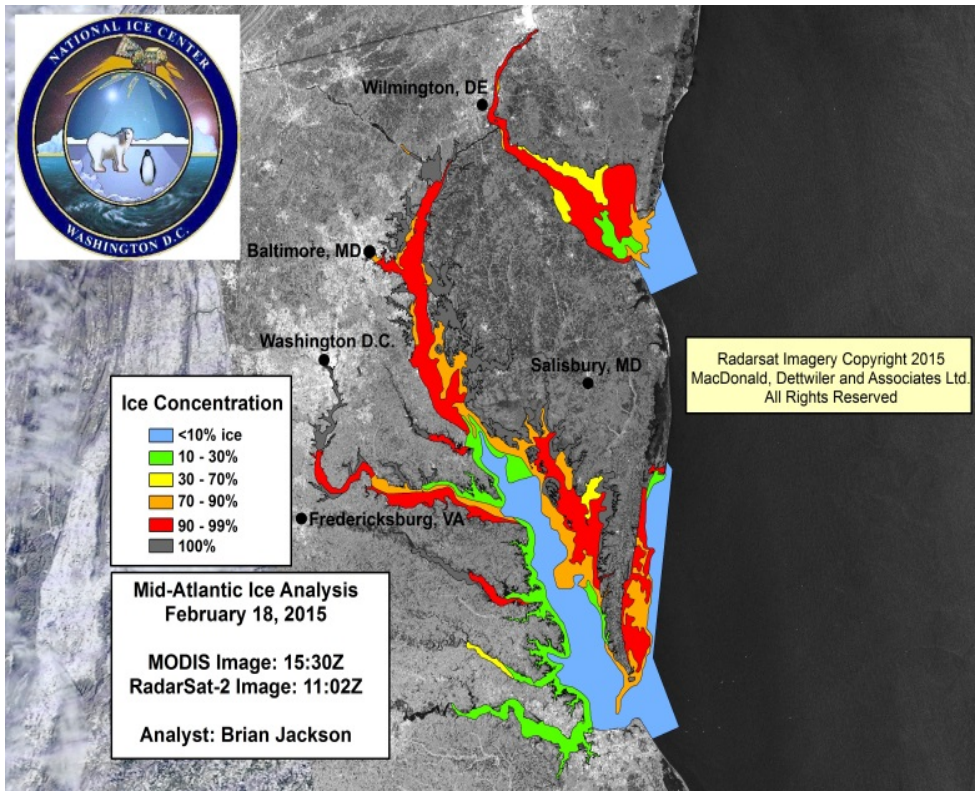


S	Susquehanna	44057
SN	Patapsco / Six Ft. Knoll	44053
AN	Annapolis	44063
GR	Gooses Reef	44062
UP	Upper Potomac	44061
PL	Point Lookout / Potomac	44042
SR	Stingray Point	44058
J	Jamestown	44041
N	Norfolk	44059
FL	First Landing	44064
VCU	VCU Rice Center, James R	

February 14 – 17, 2015

As of Feb. 18th, 2015, 90% of the northern Bay was covered in ice with significant coverage in mid-Bay and hugging the Eastern Shore.

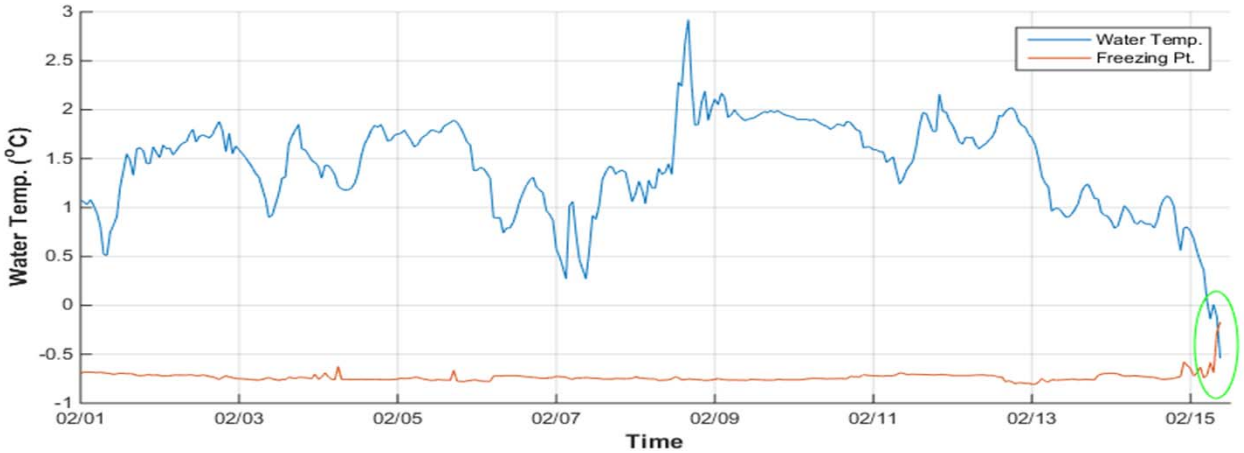
Majority of ice was thin (<10.2cm), but several areas reported ice exceeding 0.3 m thick.

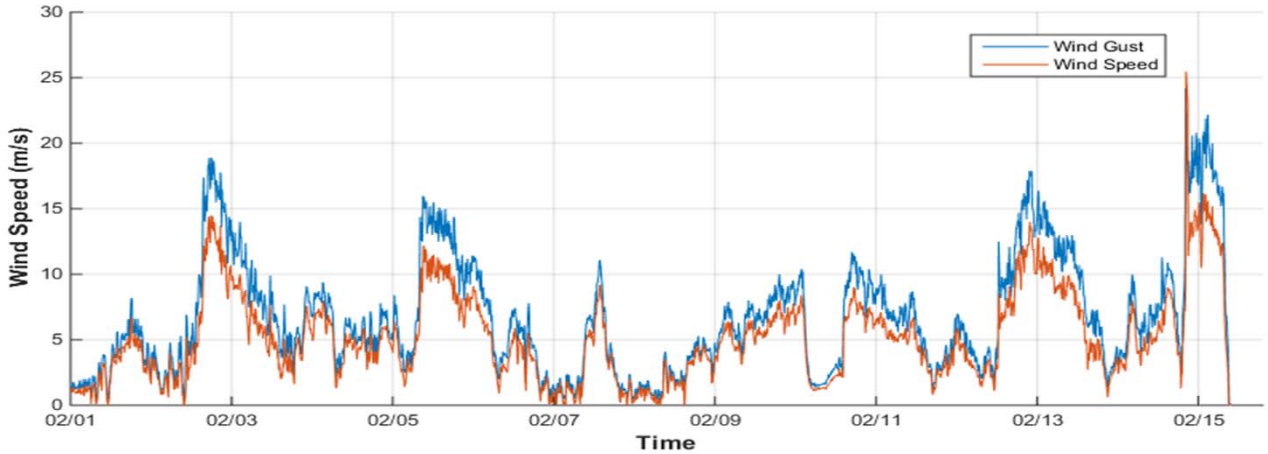


The National Ice Center—operated by the U.S. Navy, U.S. Coast Guard, and NOAA, produced this map above of ice coverage on the Bay on February 18.

Jackson, Brian. (2/23/2015). "Weekly Ice Forecast for the Chesapeake and Delaware Bays." National Ice Center.

Annapolis Buoy Feb. 2015 Observations





February 2015 Annapolis buoy seawater temperature & freezing point (°C, top) and wind speed & gust (m/s, bottom) observations. The green circle indicates where the water temperature dips below freezing point.

Wind vs. Wave Icing

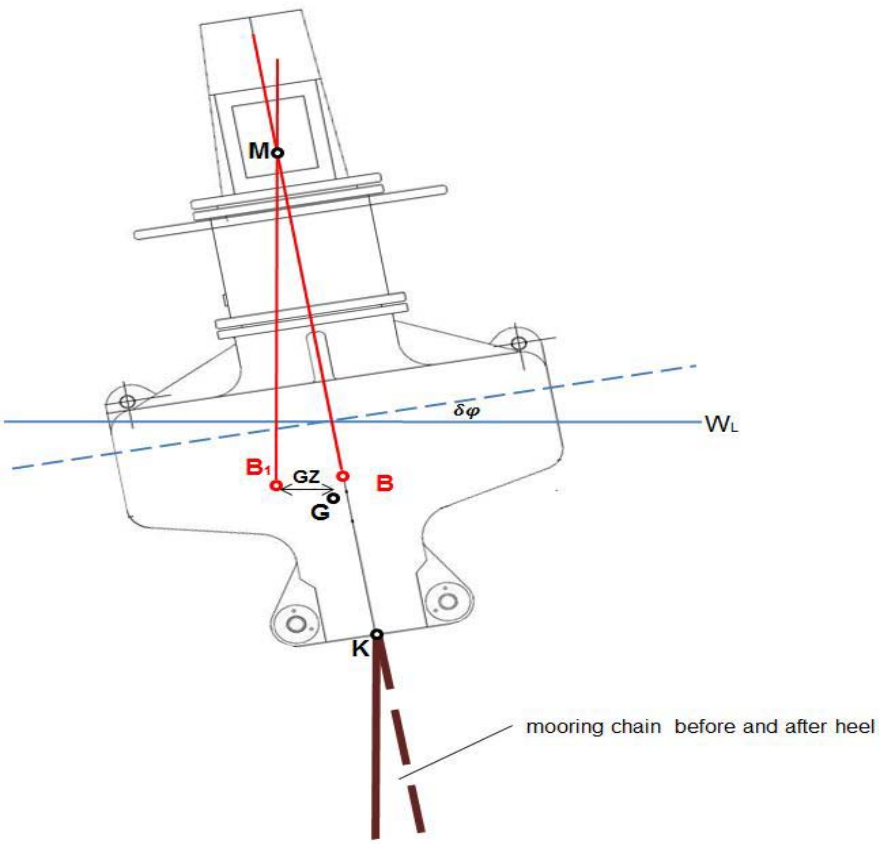
The wave run-up and splash height was calculated using the following:

$$R = n_{max} + m\frac{u^2}{2g}$$ *(Jones & Claffey, 2015).*

The mean run up and splash height for Feb. at Annapolis was 0.238 and 0.539 m, respectively, and the buoy sits about 3.048 m above the waterline. Thus, the icing seen on the top of the anemometer, was most likely not due to wave action and instead can be attributed to the sustained wind gusts at approx. 20 m/s.

Buoy Hydrodynamic Stability Analysis

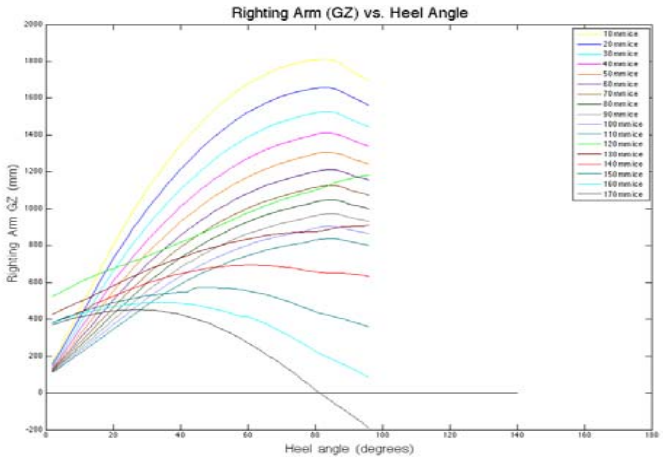
- Modeled as a function of ice thickness and heel angle.



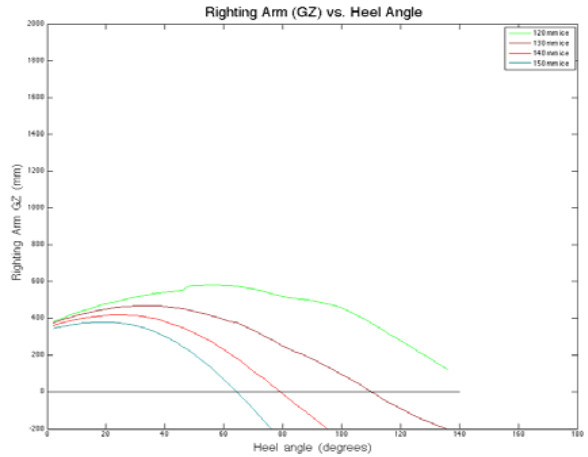
- Assumed ice thickness to vary between 10 and 170 mm and the buoy heeling angle to range between 0 and ~140°

- The added mass of ice is a function of ice thickness and was calculated by multiplying the surface area with the thickness and the density of ice

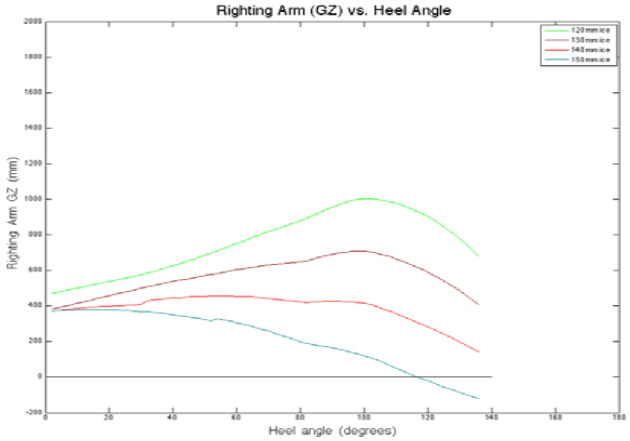
Model Results



The magnitude of the righting arm (mm) as a function of heel angle (°) for ice thicknesses ranging from 10 to 170 mm added to all surfaces onto which ice was assumed to accumulate.



The magnitude of the righting arm (mm) as a function of heel angle (°) for ice thicknesses ranging from 120 to 150 mm with the skirt (above) and without (below).

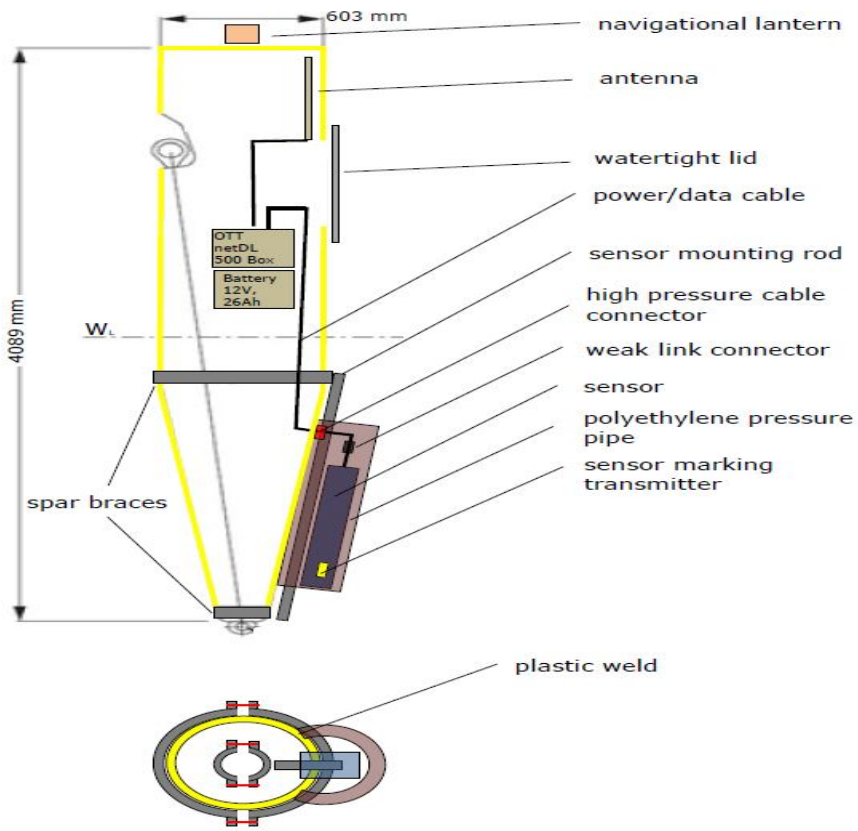


Discussion & Design Improvements

- Monitoring the waterline would be a valuable indicator of stability. (Pressure sensor)
- There is a large increase in stability by just removing the buoy skirt (max heel angle increases by 52° for 150 mm ice thickness)
- Buoy is splash-proof, not submergible
  - Meet International Protection Rating code?
- Heated Gill vs. RM Young
- Lower patch antenna

Alternative to Watchkeeper Buoy over Winter

- Modify Tideland Signal SB-60 spar buoy
  - Sea Bird Coastal HydroCAT vs WQM



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