Chesapeake Bay Vibrio Seasonal Prediction

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NOAA's Ecological Forecasting Roadmap: Priority Areas and Geographies of Interest

HABS
- Gulf of Maine
- Pacific Northwest
- Lake Erie
- California
- Texas/Florida

Hypoxia
- Gulf of Mexico
- Chesapeake Bay

Pathogens
- Chesapeake Bay
- Delaware Bay
- Pacific Northwest
- Northeast
- Gulf
- Alaska

Habitat
- Chesapeake Bay

Vibrio vulnificus and *parahaemolyticus*

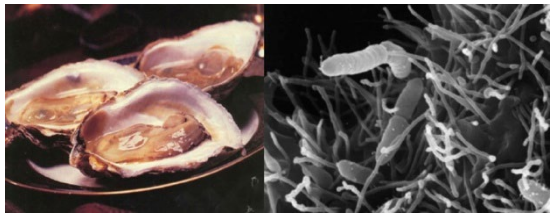
Health & Fitness

Flesh-Eating Bacteria Kills Eastern Shore Man

An Ocean City man died four days after wading into the waters of Assawoman Bay, says his family. Tips to lower risk of deadly infection.

By Deb Belt (Patch Staff) - October 13, 2016 12:22 pm ET

Like 1.9K Share



- Naturally occurring bacteria in coastal waters
- An estimated 80,000 cases (mostly Vp) per year
- *Vv* responsible for 95% of all seafood related mortality
- Over $300 million annually in health care costs alone.
- Unknown losses due to shellfish bed closures and product recall and recreational avoidance

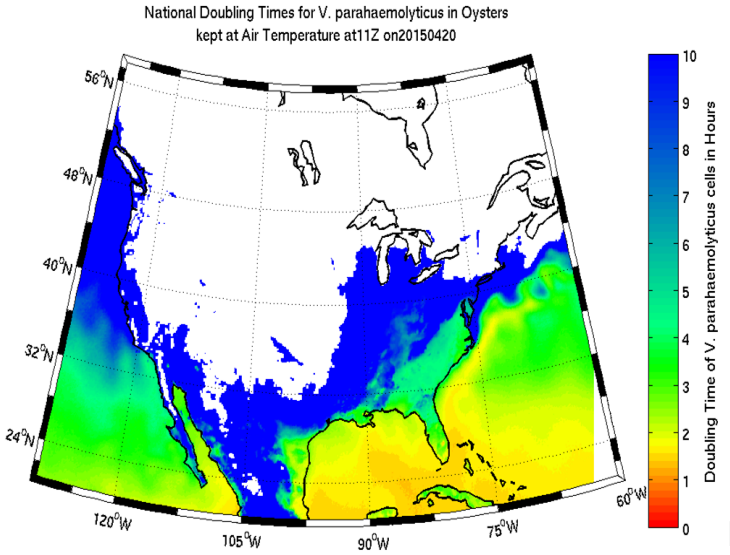
Health Home | Men's Health | Women's Health | Children's Health | Alternative Medicine | Diabetes | Heart Health | Nutrition & Fitness

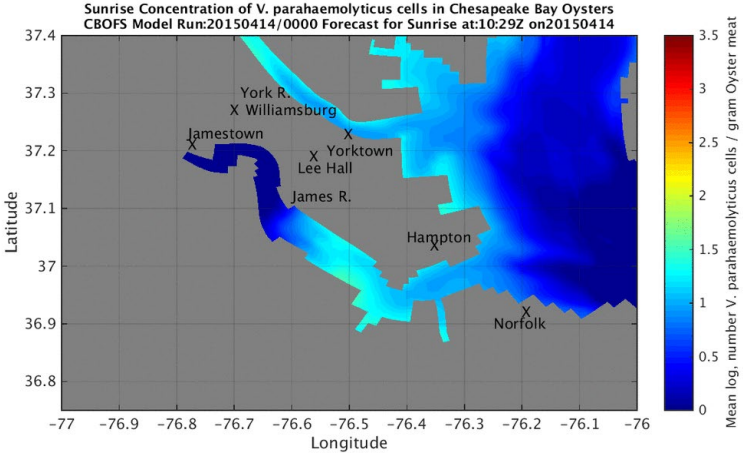
FLESH EATING BACTERIA

Detroit boy loses leg after contracting flesh-eating bacteria

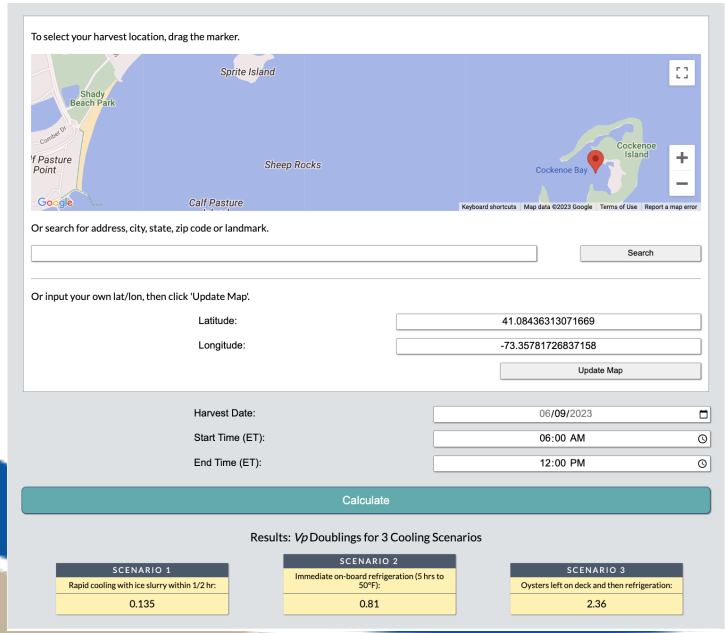
Published August 19, 2016 · FoxNews.com

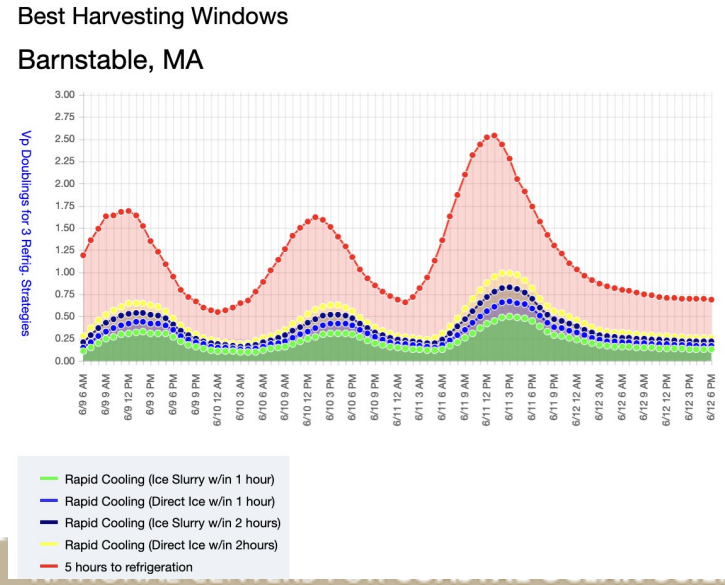
Vibrio Forecasting Tools





https://products.coastalscience.noaa.gov/vibrioforecast/default.aspx



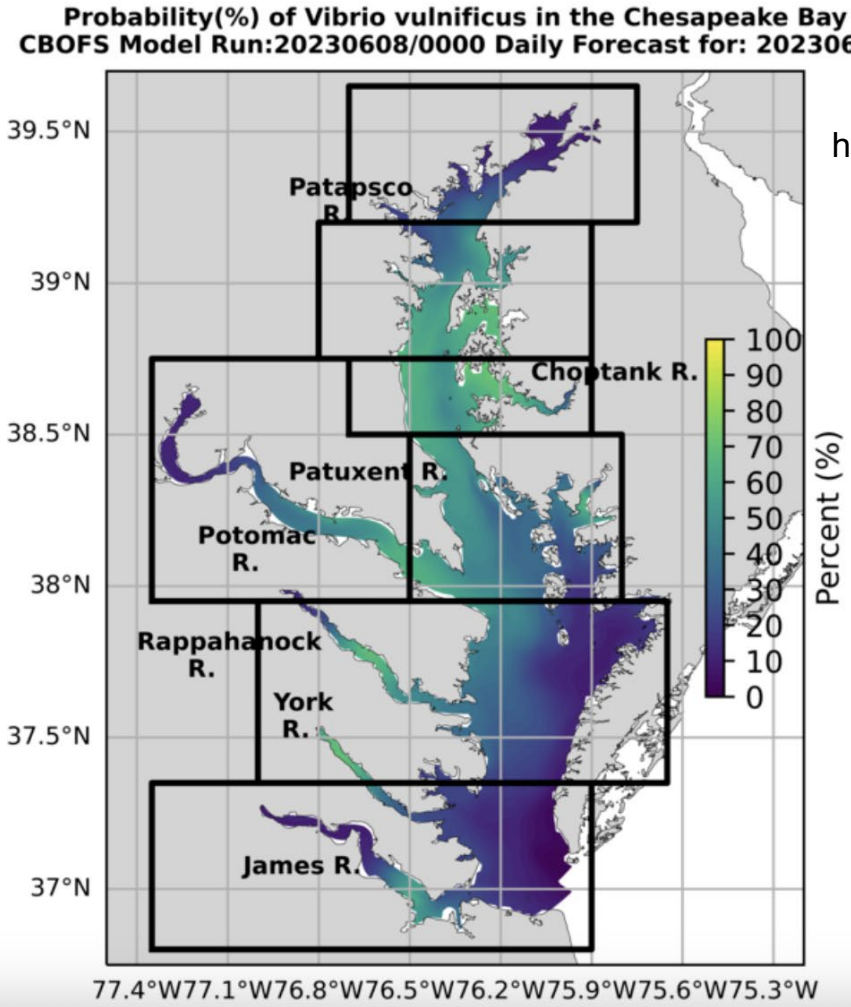


Vibrio vulnificus - Chesapeake Bay

Vv Probability in Chesapeake Bay

Below is the current day's prediction of expected concentrations of *Vv*.

Mouseover and click the desired area, or select full view forecast, to view a running loop of pred
days, current day, and for tomorrow.



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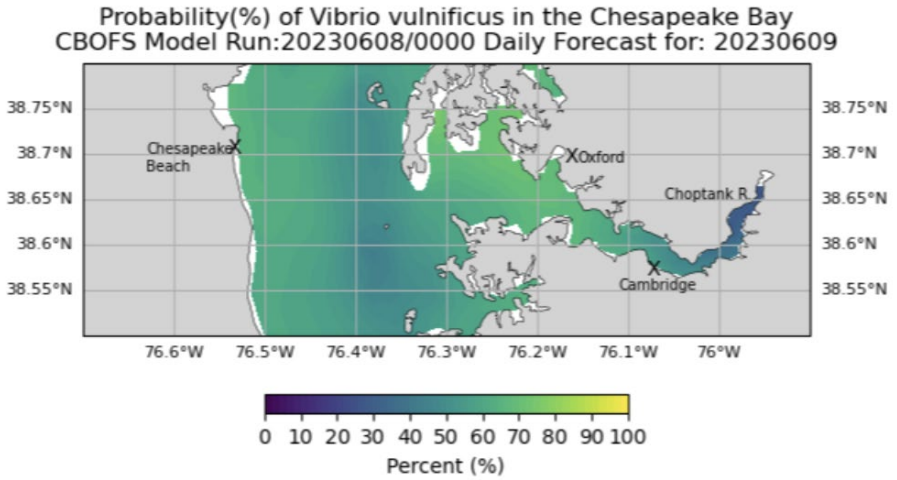
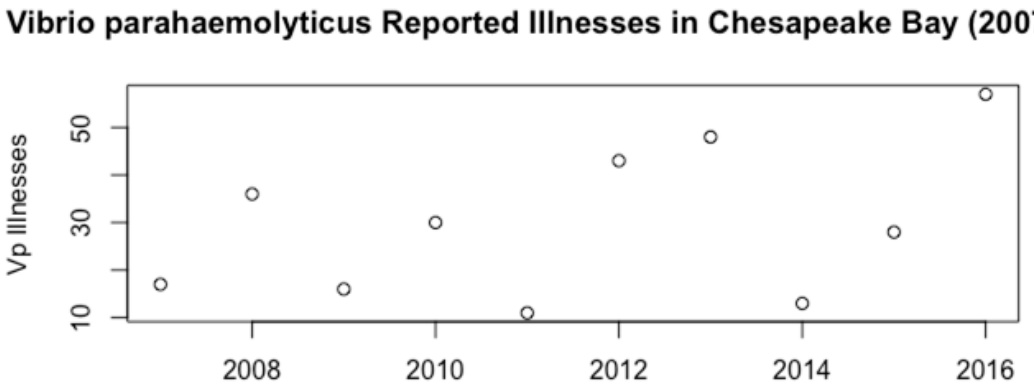
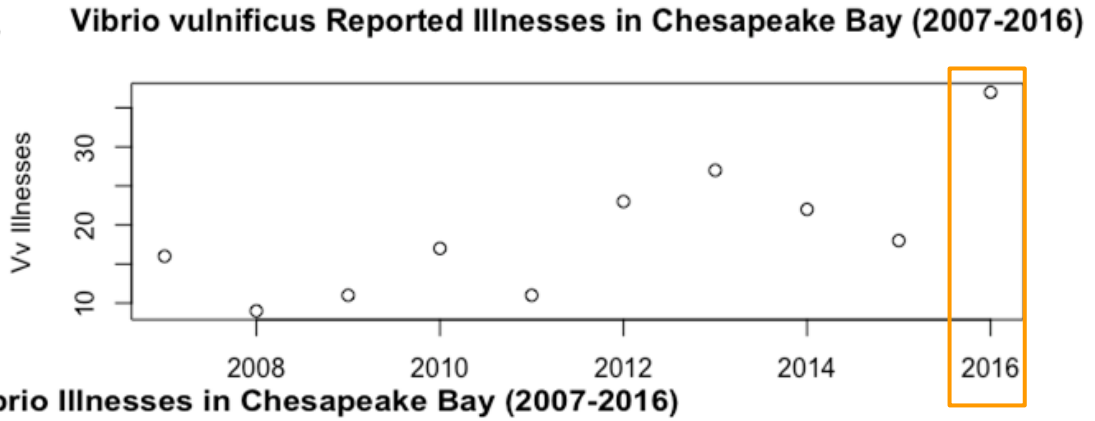
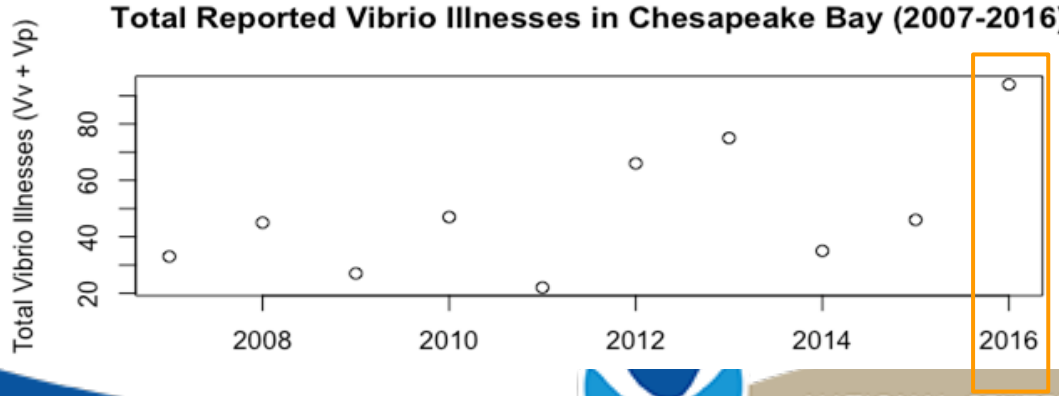


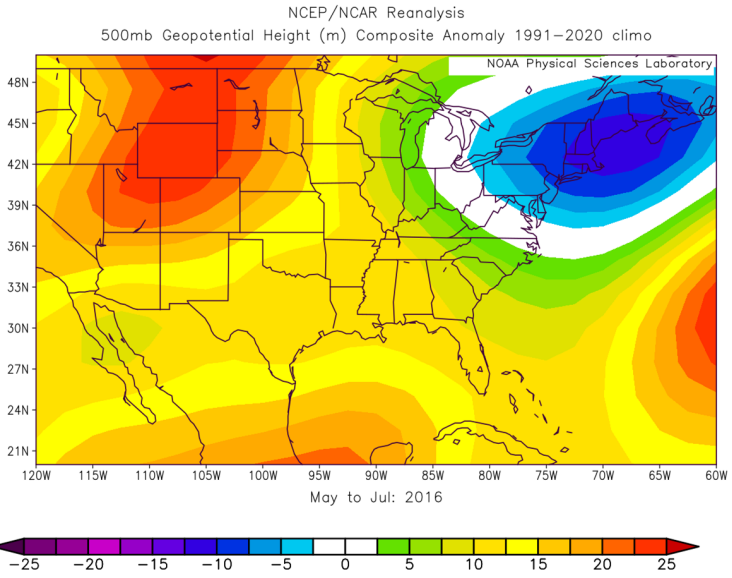
Vibrio illnesses in Chesapeake Bay





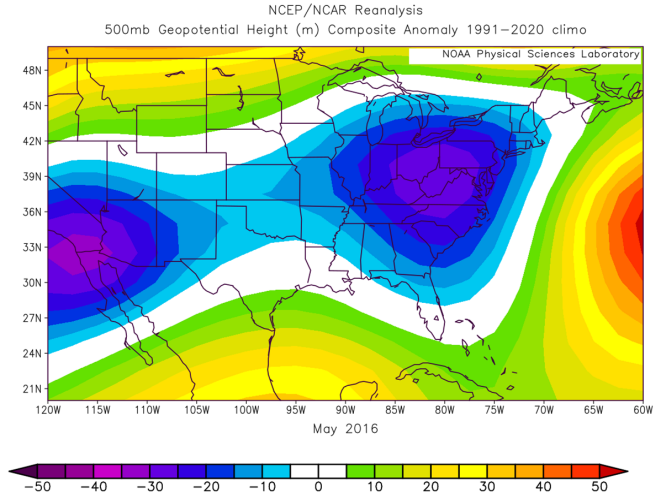


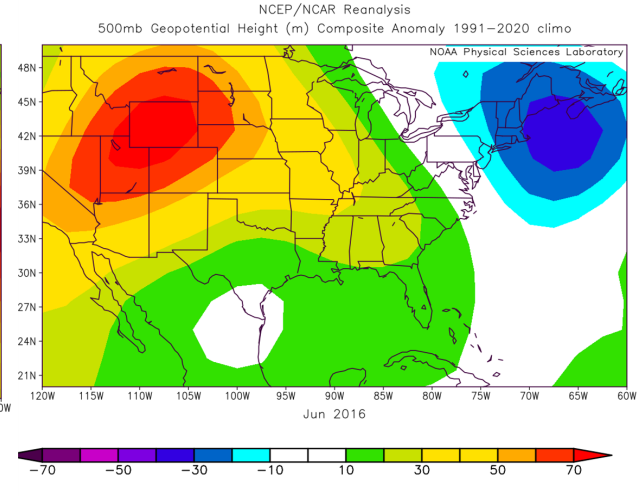
Synoptic Background

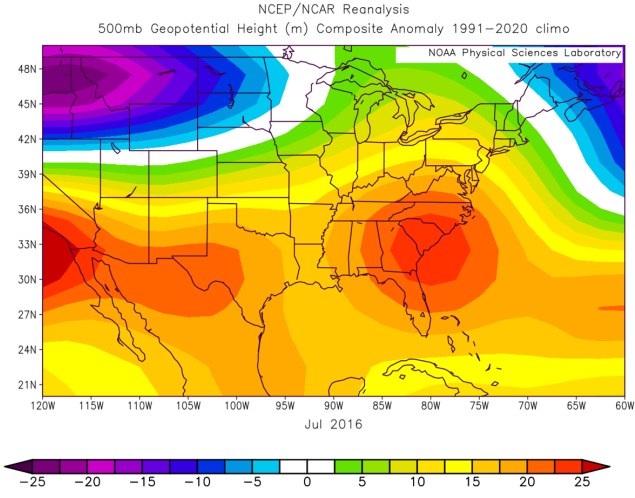


Analysis of 2016 May-Jun-Jul.
April, lead 1 outlook (Mar lead 2)

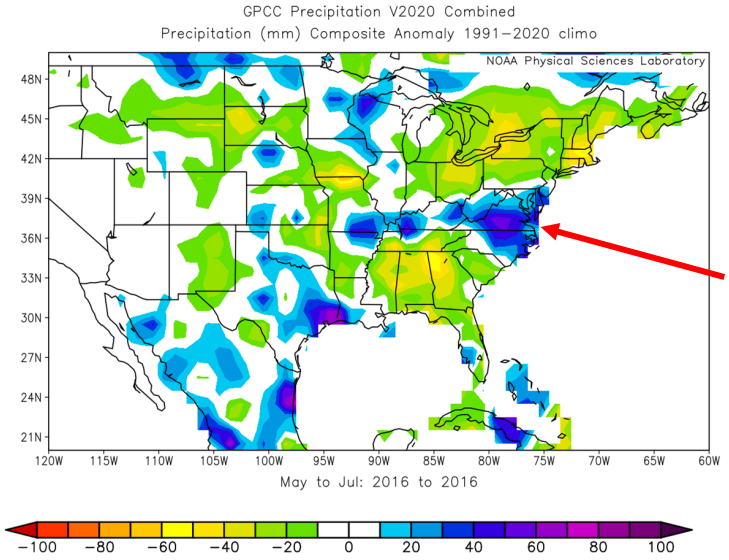
500-mb heights, overall below normal, but a strong increasing trend during the season.





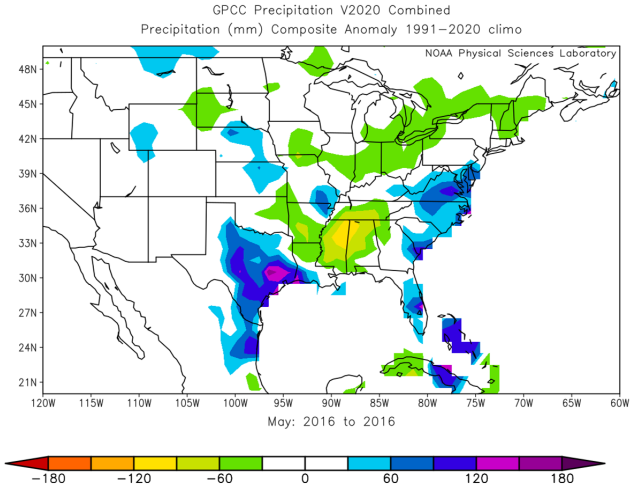


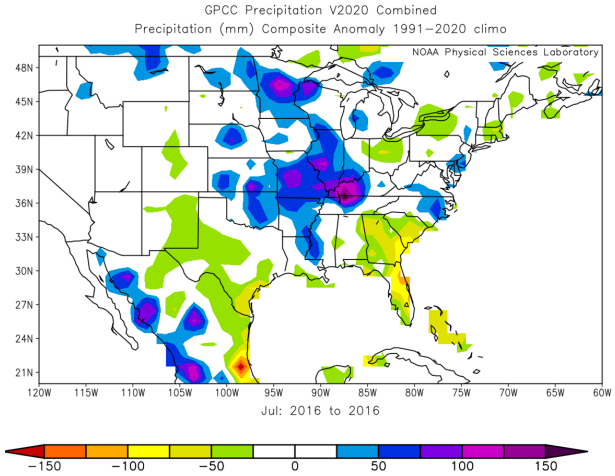
Synoptic Background



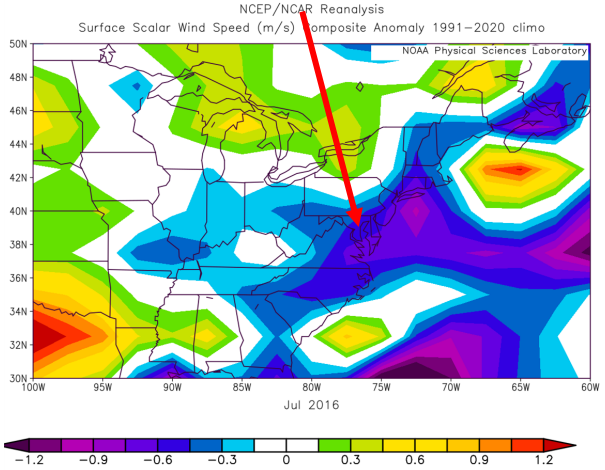
Analysis of 2016 May-Jun-Jul. April, lead 1 Outlook

Precipitation during MJJ was above normal for much of the local region and Chesapeake Bay watershed, parts of PA below normal. Season started wet, but July was closer to normal for much of the Chesapeake Bay watershed.





Surface wind speeds were light MJJ and especially July



Synoptic Background

Large Scale indices - Potential for creating prediction scheme from large scale factors.

ENSO neutral, coming out of strong EN.

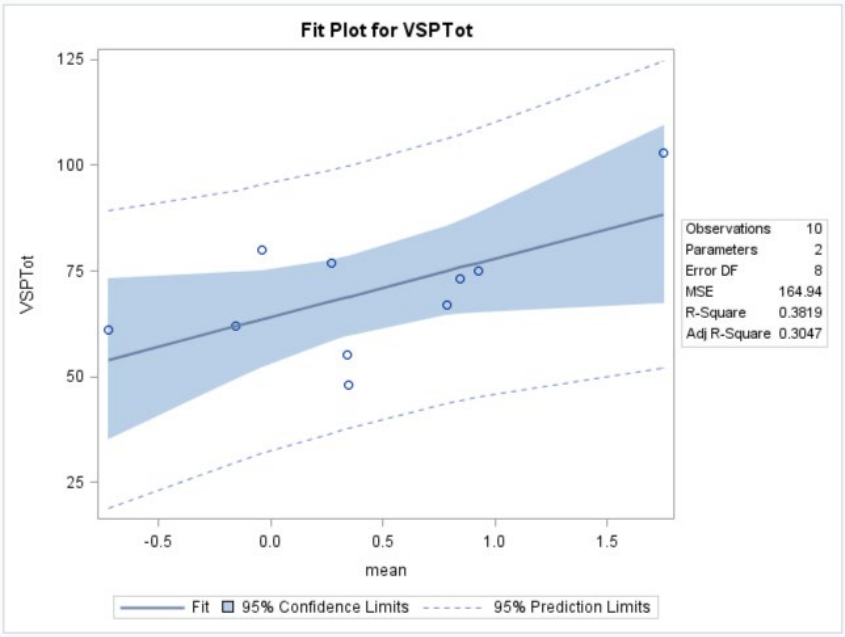
Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA
2016	2.5	2.1	1.6	0.9	0.4	-0.1	-0.4

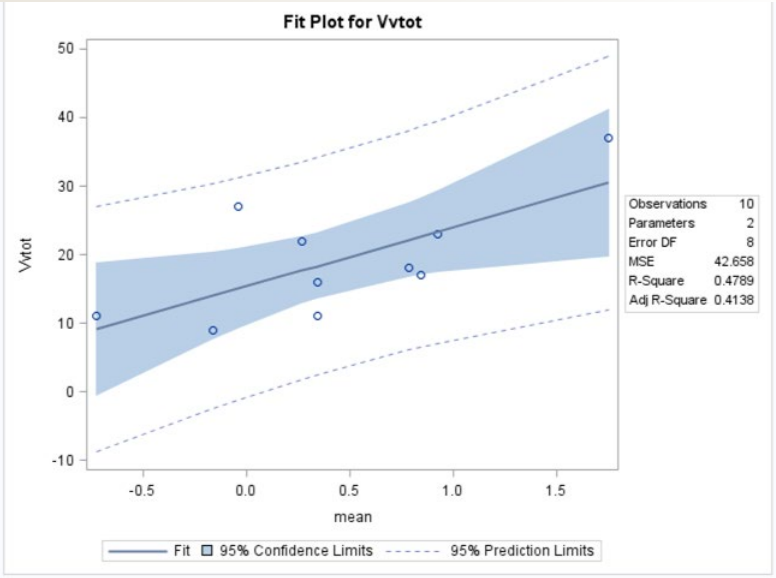
AO transitioning to positive but not overly strong

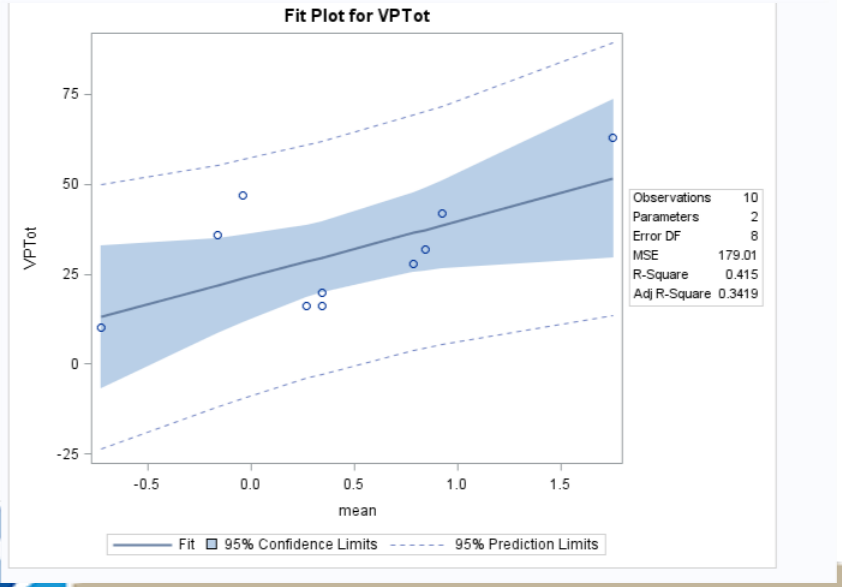
Year	Jan	Feb	Mar	Apr	May	Jun	Jul
2016	-1.449	-0.024	0.280	-1.051	-0.036	0.313	0.085

Needs more investigation and longer data record to properly create prediction scheme beyond model output.

North American Multi-model Ensemble







The initial analysis was using the NMME. Generally low r2's for all but Vv in Virginia. Next tried individual component models of the NMME.

Model Selection/ Dredge Technique

MuMIn: Multi-Model Inference Package for R Studio

Global model call: lm(formula = Vv.Cases ~ CanCM4i + CFSv2 + GEM_NEMO + NASA_GEOS5vs + NCAR_CCSM. + GFDL_Spear., data = data_VibApr1moChes)

Model selection table

	(Int)	CCM	CFS	GEM_NEM	GFD_Spr.	NAS_GEO	NCA_CCS.	df	logLik	AICc	delta	
21	-7.780		-6.96600		10.940			4	-26.146	68.3	0.00	0.492
17	16.010				8.283			3	-30.085	70.2	1.88	0.193
49	15.850				6.715	4.779		4	-27.304	70.6	2.32	0.155
33	17.960					7.371		3	-32.321	74.6	6.35	0.021
9	16.740			6.67300				3	-32.410	74.8	6.53	0.019
51	-8.751		-5.79300		8.352	8.209		5	-25.329	75.7	7.37	0.012
19	23.180		1.69500		7.475			4	-29.908	75.8	7.52	0.011
25	15.870			1.65200	7.101			4	-29.910	75.8	7.53	0.011
1	19.100							2	-35.099	75.9	7.62	0.011
18	9.235	1.153000			7.862			4	-30.058	76.1	7.82	0.010
53	-1.594		-5.13400		9.531	2.159		5	-25.572	76.1	7.85	0.010

Models ranked by AICc(x)

Model Stats

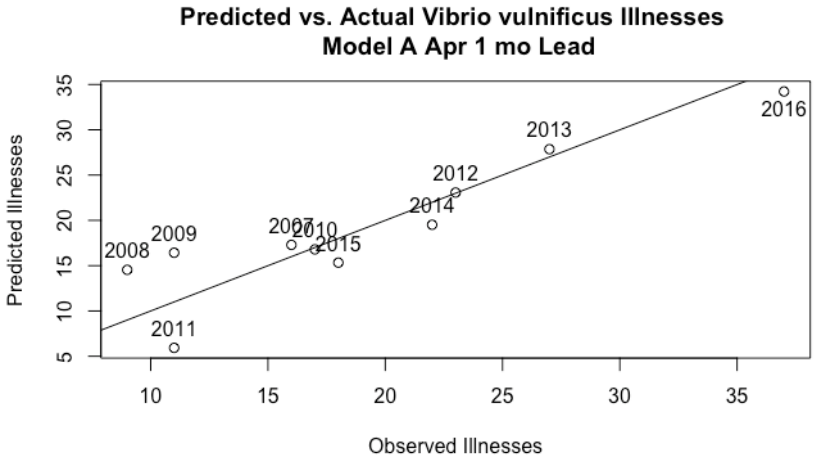
Vpara Best Models	Intercept	CanCM4i	CFSv2	GEM_NEMO	NASA_ GEOS5vs	NCAR_CCSM	GFDL_Spear	Adj R^2	p-value	AICc
April 1 month Lead Model	24.18						16.20	0.67	0.00237	80.4
April 2 month Lead Model	26.47						22.44	0.6854	1.90E-03	79.90
March 1 month Lead Model	28.80						12.93	0.66	0.00266	80.7
March 2 month Lead Model	124.488						19.99	0.61	0.0048	82.1

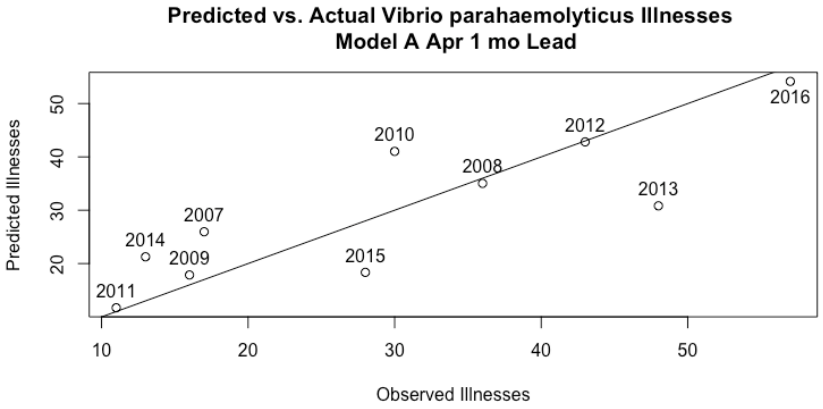
Vvul Best Models	Intercept	CanCM4i	CFSv2	GEM_NEMO	NASA_ GEOS5vs	NCAR_CCSM	GFDL_Spear	Adj R^2	p-value	AICc
April 1 month Lead Model	-7.78			-6.97	10.94			0.79	1.90E-03	68.3
April 2 month Lead Model	26.47						22.44	0.6854	1.90E-03	79.90
March 1 month Lead Model	16.14					8.34		0.60	0.00493	69.7
March 2 month Lead Model	43.62				-5.477		5.597	0.3506	0.09159	62.8

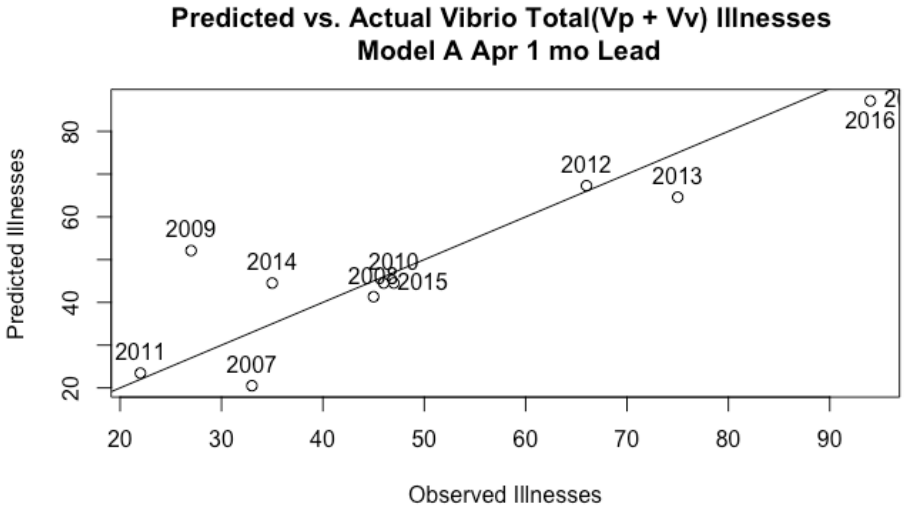
Model Stats

Vtotal Best Models	Intercept	CanCM4i	CFSv2	GEM_NEMO	NASA_ GEOS5vs	NCAR_CCSM	GFDL_Spear	Adj R^2	p-value	AICc
April 1 month Lead Model	39.86				24.50			0.81	4.54E-06	85
April 2 month Lead Model	44.37						30.24	0.5903	5.73E-03	89.80
March 1 month Lead Model	47.50						17.63	0.58	0.00615	89.9
March 2 month Lead Model	141.09					12.84	19.78	0.76	0.0026	88.9

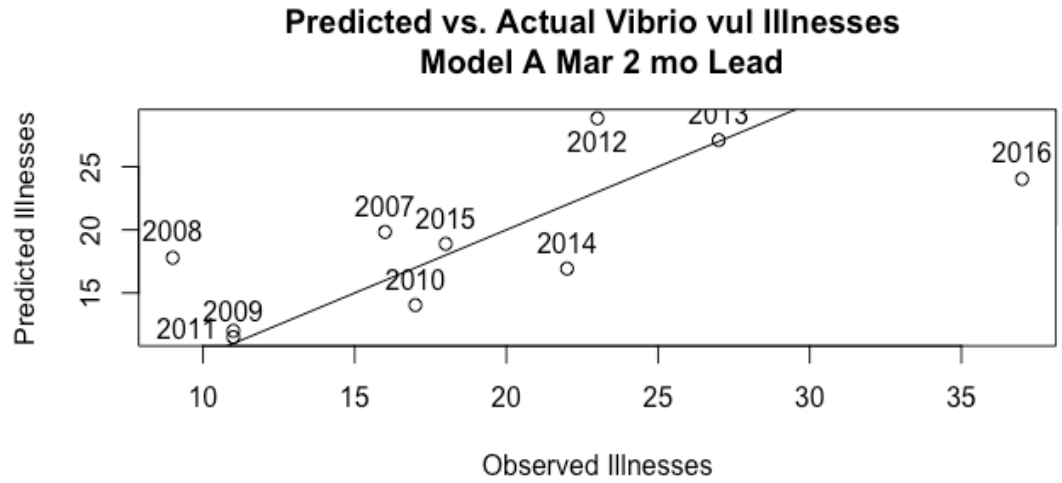
Model Stats

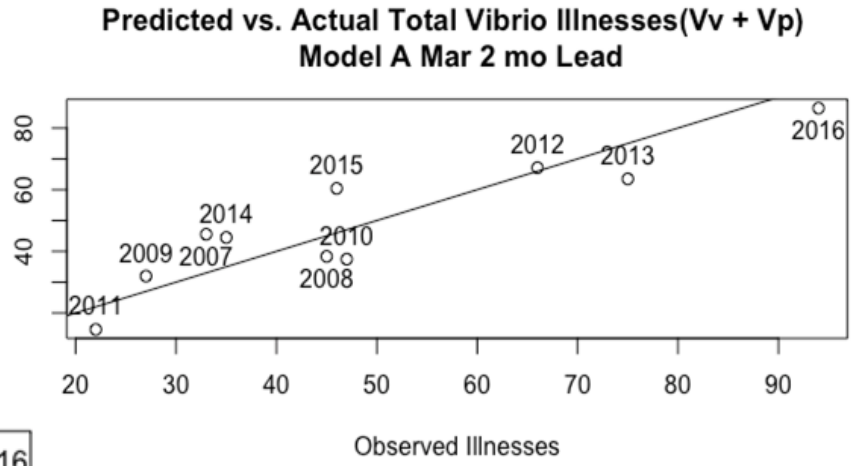

Predicted vs. Actual Vibrio vulnificus Illnesses
Model A Apr 1 mo Lead
Predicted Illnesses
Observed Illnesses
2008
2009
2011
2007
2010
2015
2014
2012
2013
2016

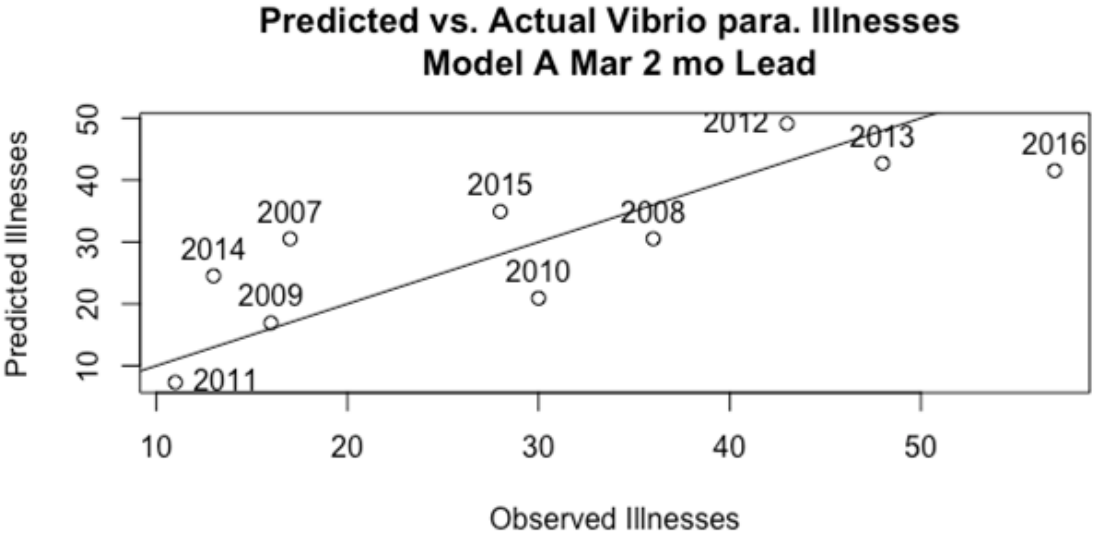

Predicted vs. Actual Vibrio parahaemolyticus Illnesses
Model A Apr 1 mo Lead
Predicted Illnesses
Observed Illnesses
2011
2014
2009
2007
2015
2010
2008
2012
2013
2016


Predicted vs. Actual Vibrio Total(Vp + Vv) Illnesses
Model A Apr 1 mo Lead
Predicted Illnesses
Observed Illnesses
2011
2007
2009
2014
2010
2015
2012
2013
2016

Model Stats


Predicted vs. Actual Vibrio vul Illnesses
Model A Mar 2 mo Lead
Predicted Illnesses
Observed Illnesses
2008
2009
2011
2010
2007
2015
2014
2012
2013
2016
10
15
20
25
30
35


Predicted vs. Actual Total Vibrio Illnesses(Vv + Vp)
Model A Mar 2 mo Lead
Observed Illnesses
2011
2009
2007
2014
2008
2010
2015
2012
2013
2016
20
30
40
50
60
70
80
90


Predicted vs. Actual Vibrio para. Illnesses
Model A Mar 2 mo Lead
Predicted Illnesses
Observed Illnesses
2011
2009
2014
2007
2010
2015
2008
2012
2013
2016
10
20
30
40
50

Conclusions/ Next Steps

- Promising models found for April 1 month lead
- Other models even the March 2 month lead for Vibrio total species (Vv + Vp) were strong
- Component models predicted Vibrio illnesses better than the NMME
- Highest Vibrio illnesses following a strong El Nino in Summer 2016 (N=1 during the 10 year study)

Next Steps

- Publish Results
- Potential Vibrio Seasonal Prediction

Thank you!!

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