Remote Sensing of *Vibrio spp.* bacteria in the Chesapeake Bay Estuary, MD

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Vibrio in Chesapeake Bay

* V. vulnificus * V. parahaemolyticus



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Percent Satellite Coverage by Month & Station



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z(V.c.) = -1.1939 + (0.1233 * Temp) - (0.1997 * Saln) - (0.0324 * (Temp * Saln))

z(V.v.) = -7.867 + (0.316 * Temp) + (-0.342 * (|Saln - 11.5|))



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Vibrio spp. Modeling in the Chesapeake Bay

- V. vulnificus and V. parahaemolyticus
 - 148 surface samples
 - Mar.-Sept. (2011 & 2012)
- <u>Probability of presence</u> algorithms
 - Generalized Linear Model (GLM)
 - Generalized Additive Model (GAM)
 - Random Forest (RF)
 - Optimal prediction point
- <u>Bacteria abundance</u> algorithms
- <u>HYBRID abundance algorithms</u>
 - GAM/RF



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Vibrio spp. Modeling in the Chesapeake Bay

• **Probability of presence**

		V. vulnificus	V. parahaemolyticus			
Model	GLM	GAM	RF	GLM	GAM	RF
ACC	0.63	0.72	0.68	0.62	0.68	0.67

• <u>Abundance</u>

V. vulnificus						V. parahae	emolyticu	S
Model	GLM	GAM	RF	MEAN	GLM	GAM	RF	MEAN
MAE	4.69	4.79	3.87	4.39	7.43	7.51	5.76	6.34

• HYBRID abundance

	V. vuli	nificus	V. parahaemolyticus		
ABUNDANCE	3.87	4.39	5.76	6.34	
HYBRID/P	2.79	4.30	4.36	5.83	
HYBRID	2.94	3.44	5.26	6.12	

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Summary

- *Vibrio spp*. in the Chesapeake Bay
- Remote sensing and spatial interpolation
- *Vibrio spp*. qualitative and quantitative model development

Next Steps

- Hindcast trend analysis
- Vibrio spp. risk assessment

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Satellite-derived Salinity Algorithms

- MODIS-Aqua Ocean Color Standard Products

- 10 Remote sensing reflectances (visible)
- 2003-2010

- In situ – remote sensed measurement matchups

- 68 CBay Program in situ stations
- Single pass RS ocean color data
- 1km radius RS averaging
- 2003-2010
- Salinity Prediction Models
- GLM
- GAM
- ANN
- MARS

- CART
- BCART
- RF
- BART
- Cross- validation study



Satellite-derived Salinity Algorithms

	GAM	ANN	GLM	CART	BCART	RF	MEAN	BART	MARS
MAE	1.82	1.85	1.93	2.39	2.38	2.06	3.72	2.04	1.98
RMSE	2.38	2.50	2.53	3.03	3.01	2.67	4.69	2.60	2.52

		MAE		
	GLM	GAM	ANN	MEAN
East for West	2.1	1.8	1.7	3.3
West for East	2.6	2.8	4.0	4.1
North for South	3.4	2.1	5.9	5.7
South for North	3.0	6.4	6.1	5.7
High for Low	2.3	2.3	2.6	4.2
Low for High	2.5	2.3	2.8	3.9

- Top performing prediction models: GAM and ANN
- All models outperform MEAN
- GLM and GAM are fairly generalizable in a cross-validation study



Urquhart et al. (2012). RSE