

# HABscope

A Portable Red Tide Detection/Counting System For Under \$500



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## HABSCOPE TEAM



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Co-PI/GCOOS Executive Director



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Senior Data Engineer/Product  
Developer



DR. WAYNE LITAKER  
NOAA



RANCE HARDISON  
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CHRIS HOLLAND  
NOAA



DR. JOHN PAUL



DR. TRACY FANARA

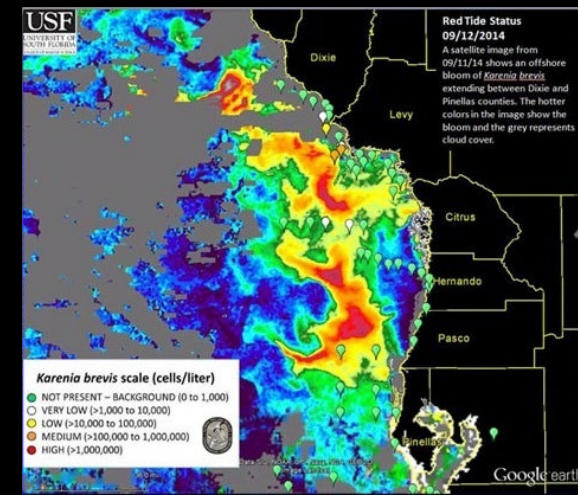


DEVIN BURRIS

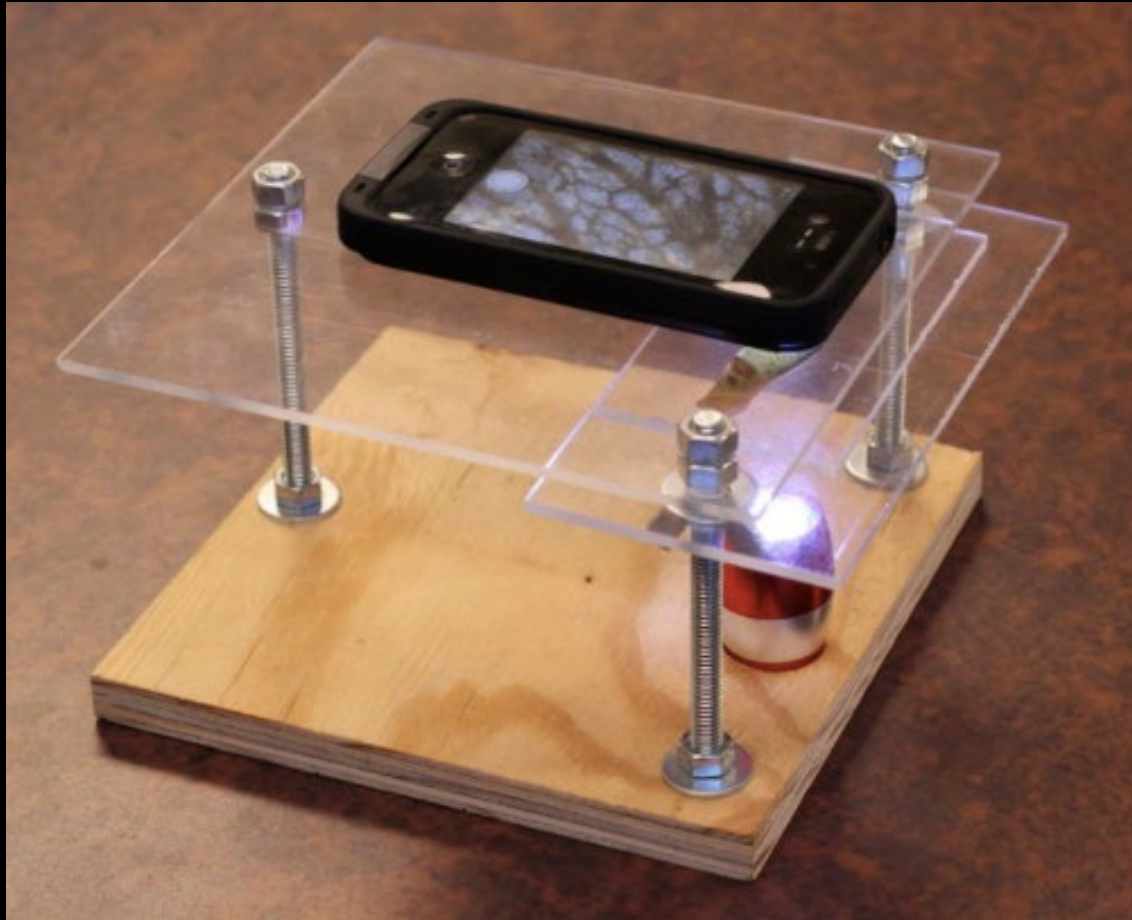


## GENESIS

- HAB forecasts are low resolution – per county or a subset of beaches
- Long lead time for results – up to a week
- Limited staff for sampling
- Original concept: volunteers with smart phones
- Low-cost “Instructables” microscope w/laser pointer lens
- Videos uploaded to GCOOS for hosting
- Videos reviewed by HAB analyst
- Provide localized data for NOAA forecasting models



## INITIAL CONCEPT

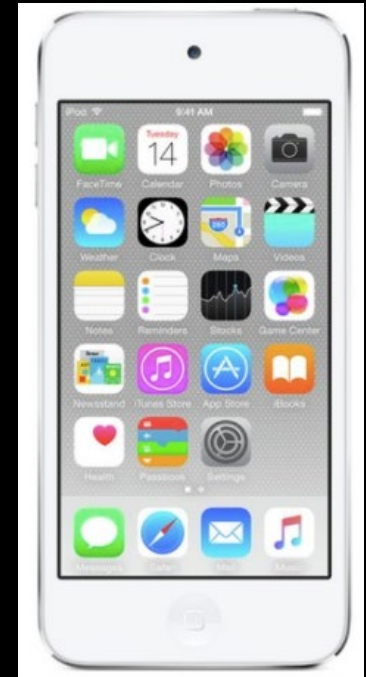


## PROBLEMS WITH INITIAL CONCEPT

- Extremely hard to align camera with lens hole
- Low quality laser pointer lens
- Magnification too high
- Very limited field of view
- No protection from environmental conditions
- Vibration/bumping a problem

## NEW PLAN

- Off-the-shelf microscope
- Apple iPod Touch
- 3D printed adapter by GJK
- Straight Talk hot spot
- Total Cost: \$500



## HABSCOPE IN ACTION



## 3D Printer





**VOLUNTEERS COLLECT WATER SAMPLES**  
*The Right Way*





# **VOLUNTEERS COLLECT WATER SAMPLES**

*The Wrong Way*



## Processing on-site



## AUTHENTICATION AND UPLOAD

### Login

dan.demo@gcoos.org

password

Submit

-82.55738

28.89645

Capture Video

Upload Video

Log out



## HABSCOPE WEB SITE

<https://habscope.gcoos.org>

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



About ▼

robertdcurrier@gmail.com ▼

# HABscope

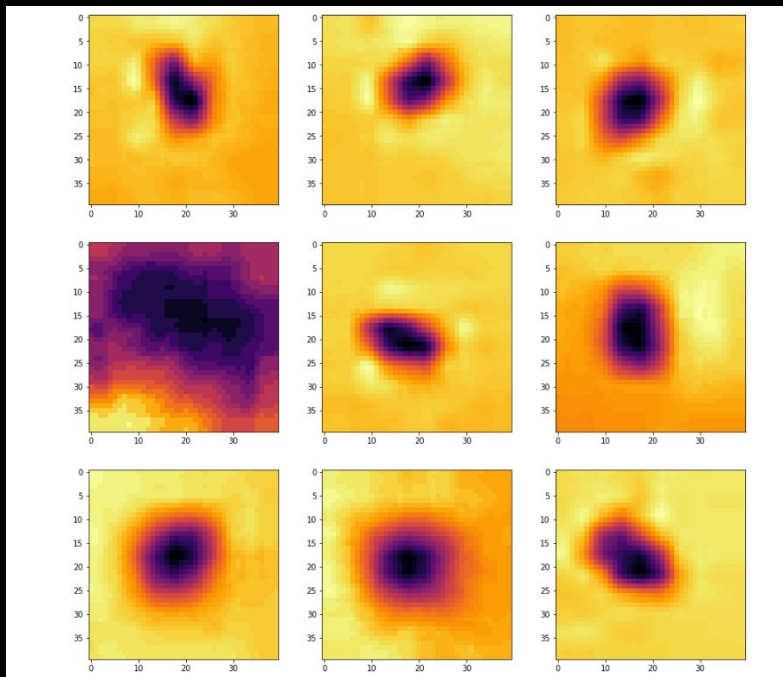
An aerial photograph of a coastal region. In the foreground, a wide, white sandy beach curves along the left side, meeting a shallow, greenish-yellow body of water. The beach is bordered by a dense line of green trees and vegetation. Behind the trees, several small, white-roofed buildings are visible. The water extends into the background, where more land and structures can be seen under a blue sky with scattered white clouds.

# HABSCOPE VIDEO TABLE

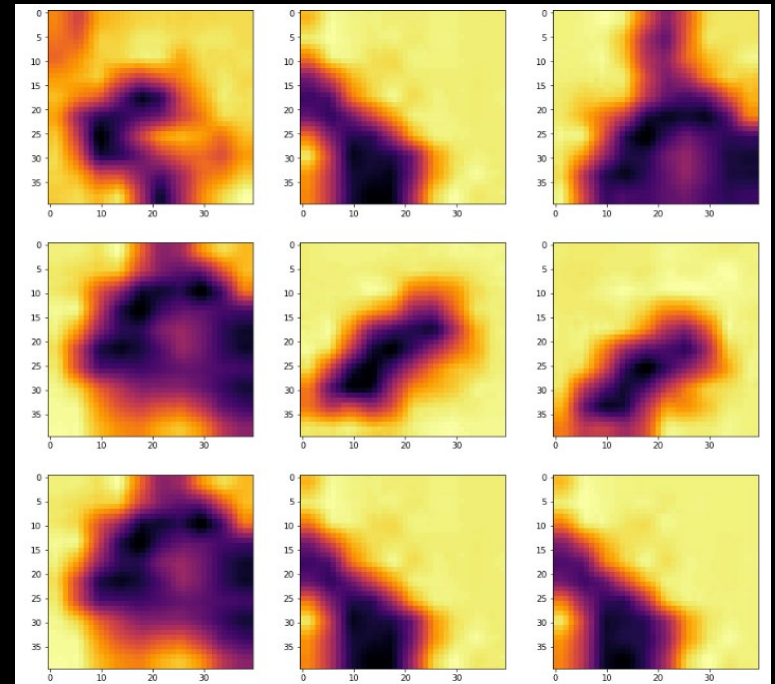
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Filter	Type here...									
Timestamp (UTC)	Sentinel	Organization	Site	GPS	Video	Status	Analyst	HABscope c/L	Manual c/L	Admin
2018-12-04 18:22:46	Patrick Grandelli	Mote	Nokomis Beach	-82.4707 27.1251		Approved	Chris Holland	50000	0	 
2018-12-04 17:56:26	Caryl Mason	Mote	Coquina Beach	-82.6362 27.0000		Approved	Rance Hardison	50000	50000	 
2018-12-04 17:54:48	Caryl Mason	Mote	Coquina Beach	-82.6362 27.0000		Approved	Rance Hardison	120000	50000	 
2018-12-04 17:52:47	Caryl Mason	Mote	Coquina Beach	-82.6362 27.0000		Approved	Rance Hardison	50000	50000	 
2018-12-04 17:51:11	Caryl Mason	Mote	Coquina Beach	-82.6362 27.0000		Approved	Rance Hardison	50000	0	 
2018-12-04 13:42:37	Rhonda Watkins	Collier County	Naples	-81.1596 26.0083		Approved	Chris Holland	50000	120000	 
2018-12-04 13:32:30	P&J Wolf	Mote	Siesta Key Village	-82.5694 27.2786		Approved	Chris Holland	0	0	 
2018-12-04 13:28:24	P&J Wolf	Mote	Siesta Key Village	-82.5694 27.2786		Approved	Chris Holland	50000	50000	 
2018-12-04 13:23:21	Rhonda Watkins	Collier County	Naples	-81.1596 26.0083		Approved	Chris Holland	50000	0	 
2018-12-04 13:18:32	Rhonda Watkins	Collier County	Naples	-81.1596 26.0083		Approved	Chris Holland	50000	50000	 
2018-12-04 13:14:43	Rhonda Watkins	Collier County	Naples	-81.1596 26.0083		Approved	Chris Holland	50000	50000	 
2018-12-04 13:11:27	Rhonda Watkins	Collier County	Naples	-81.1596 26.0083		Approved	Chris Holland	120000	50000	 
2018-12-04 12:56:18	Caryl Mason	Mote	Coquina Beach	-82.6362 27.0000		Approved	Rance Hardison	0	0	 
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2018-12-04 12:39:34	Lindsey Flynn	CMA	CMA	-82.8194 27.9774		Approved	Chris Holland	0	0	 
2018-12-04 12:34:33	Lindsey Flynn	CMA	CMA	-82.8194 27.9774		Approved	Chris Holland	0	0	 
2018-12-03 23:29:04	Alicia Hoeglund	FWRI	Varied	-82.8237 27.9598		Approved	Chris Holland	120000	50000	 
2018-12-03 23:26:34	Alicia Hoeglund	FWRI	Varied	-82.7391 27.6133		Approved	Chris Holland	50000	50000	 
2018-12-03 23:19:57	Alicia Hoeglund	FWRI	Varied	-82.6522 27.4959		Approved	Chris Holland	642000	590000	 
2018-12-03 23:18:37	Alicia Hoeglund	FWRI	Varied	-82.6522 27.4959		Approved	Chris Holland	120000	120000	 



## TRAINING IMAGES



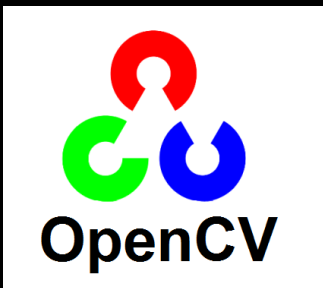
Brevis



Not Brevis

## Deep Learning

- Written in Python
- Uses OpenCV for image processing
- Uses Keras for Deep Learning framework
- Uses Google TensorFlow for neural networks
- 20,000+ *K. brevis* images for training
- 1,500 'non-*brevis*' images for training
- 50 epochs (iterations) to train model
- Trained on GPU-enabled custom built Deep Learning box

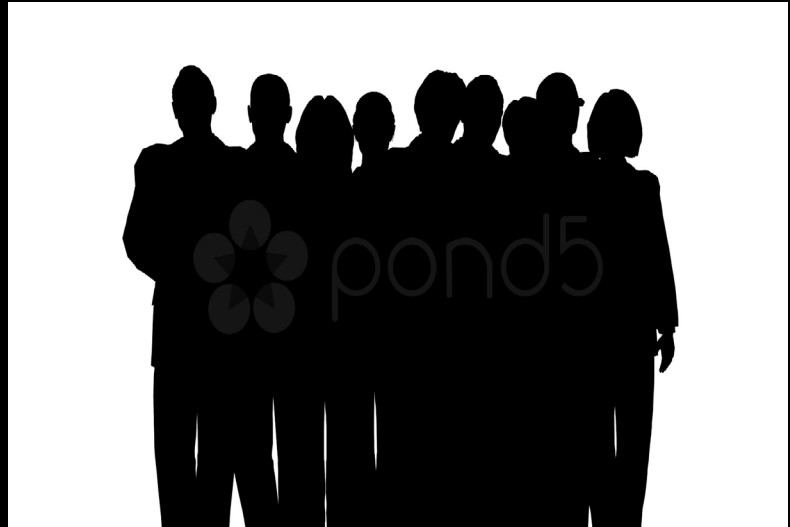




## Reality Is Not CSI



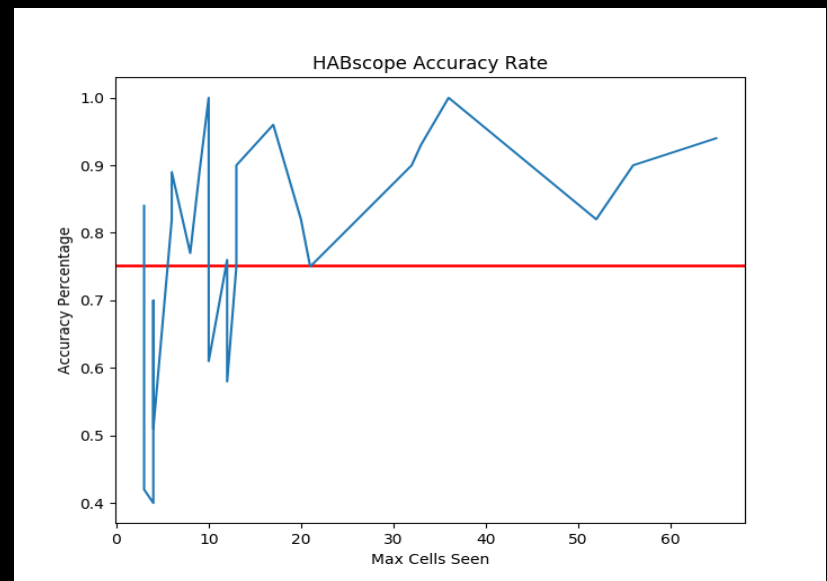
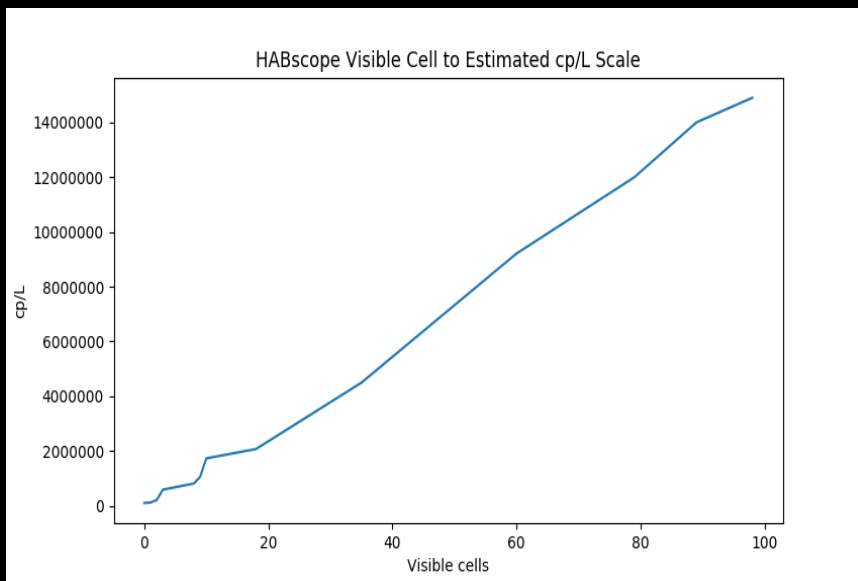
CSI



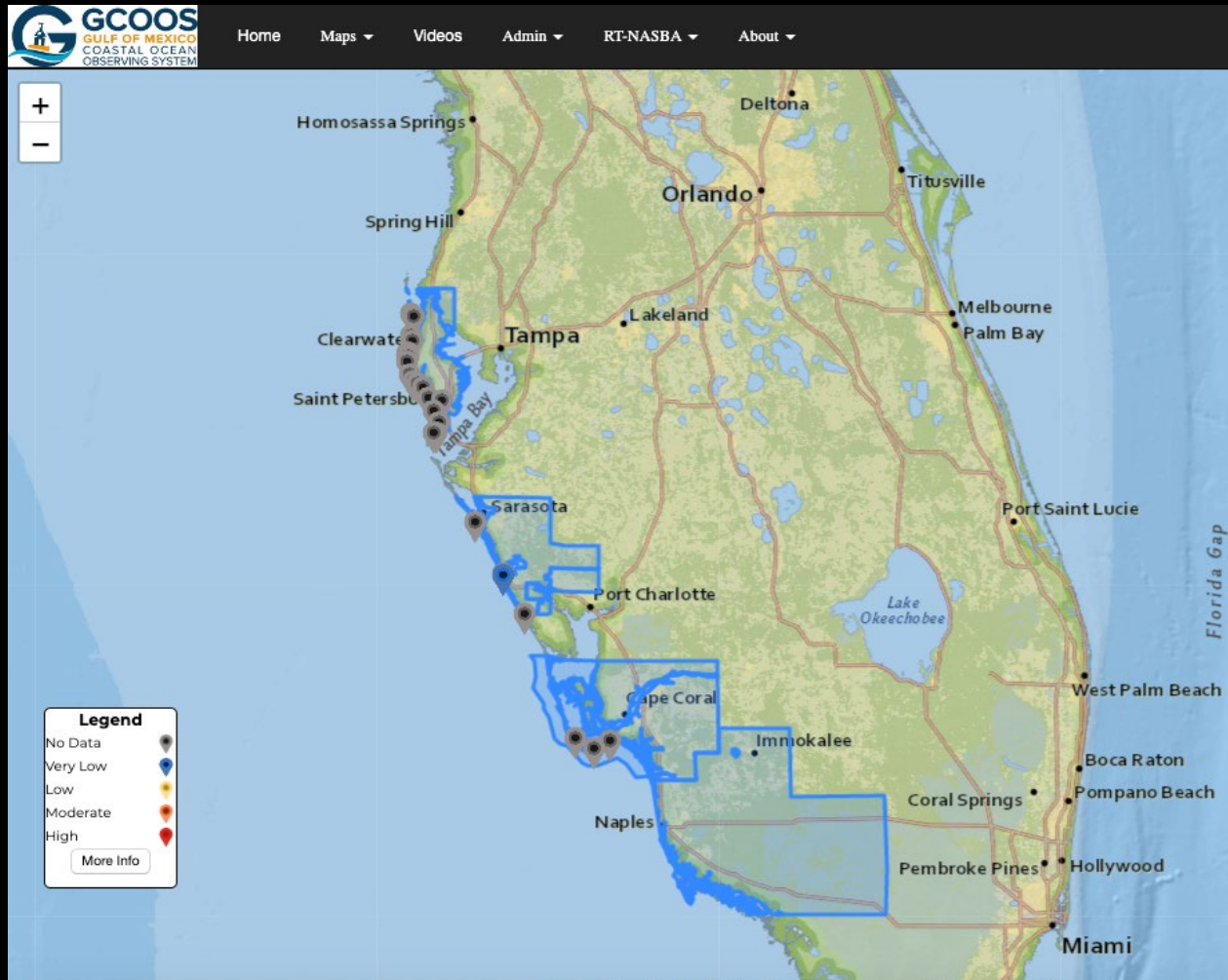
Reality

## RESULTS

- Cell counts accurate to within  $\pm 10\%$  of manual count
- The lower the cell count the wider the margin of error
- We are counting LIVE cells in motion w/only 30% FOV
- Some problems w/objects of similar size, shape and movement
- Some problems w/camera noise on edge of image



# Respiratory Forecasts



# RESPIRATORY FORECASTS

<https://habscope.gcoos.org/forecasts>

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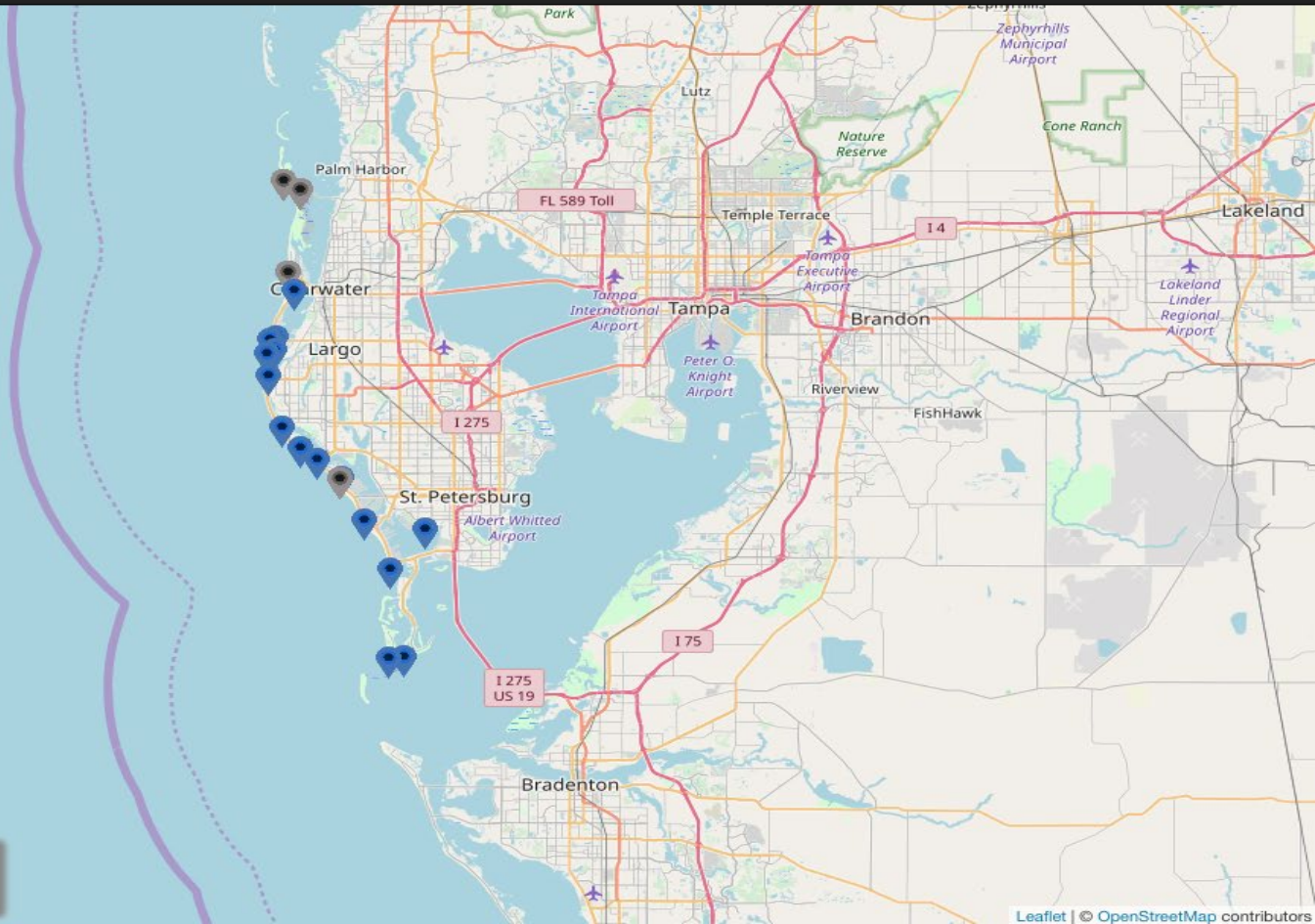
robertdcurrier@gmail.com ▾



**Legend**

- No Data
- Very Low
- Low
- Moderate
- High

[More Info](#)





# December 2018

<https://habscope.gcoos.org/forecasts>

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## Madeira Beach

Sample Taken: 2018/11/30 10:05 AM EST  
Model Run: 2018/12/03 14:12 PM EST

Forecast			
Time	Risk	Wind Speed	Wind Dir
2018/12/03 07:00 PM EST	None	9.0 knots	SSW
2018/12/03 10:00 PM EST	None	7.0 knots	SSW
2018/12/04 04:00 AM EST	None	6.0 knots	W
2018/12/04 07:00 AM EST	None	7.0 knots	NNW
2018/12/04 10:00 AM EST	None	9.0 knots	N
2018/12/04 01:00 PM EST	None	9.0 knots	N
2018/12/04 04:00 PM EST	None	10.0 knots	N
2018/12/04 07:00 PM EST	None	11.0 knots	N
2018/12/05 01:00 PM EST	None	15.0 knots	N

### Legend

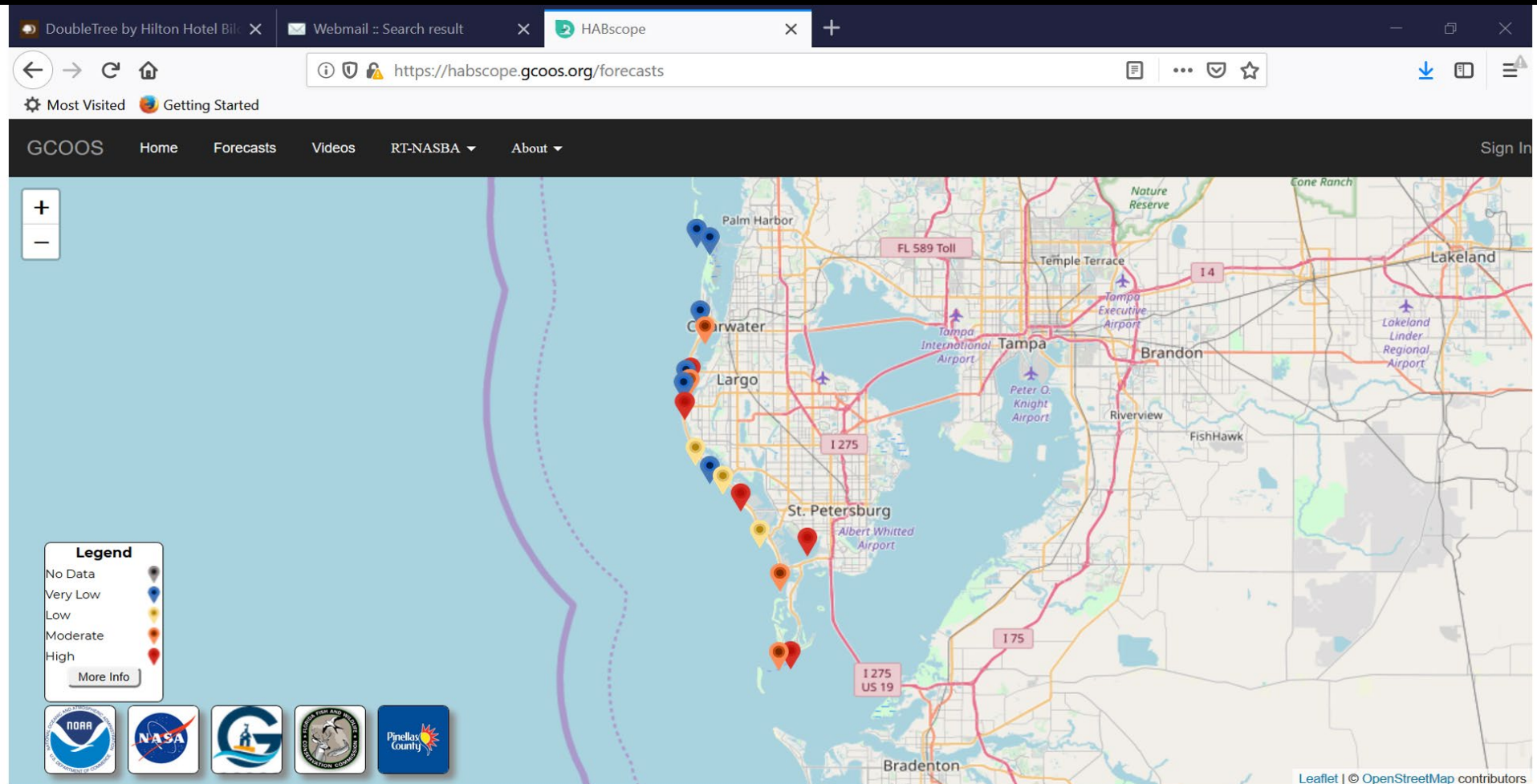
No Data  
Very Low  
Low  
Moderate  
High

More Info



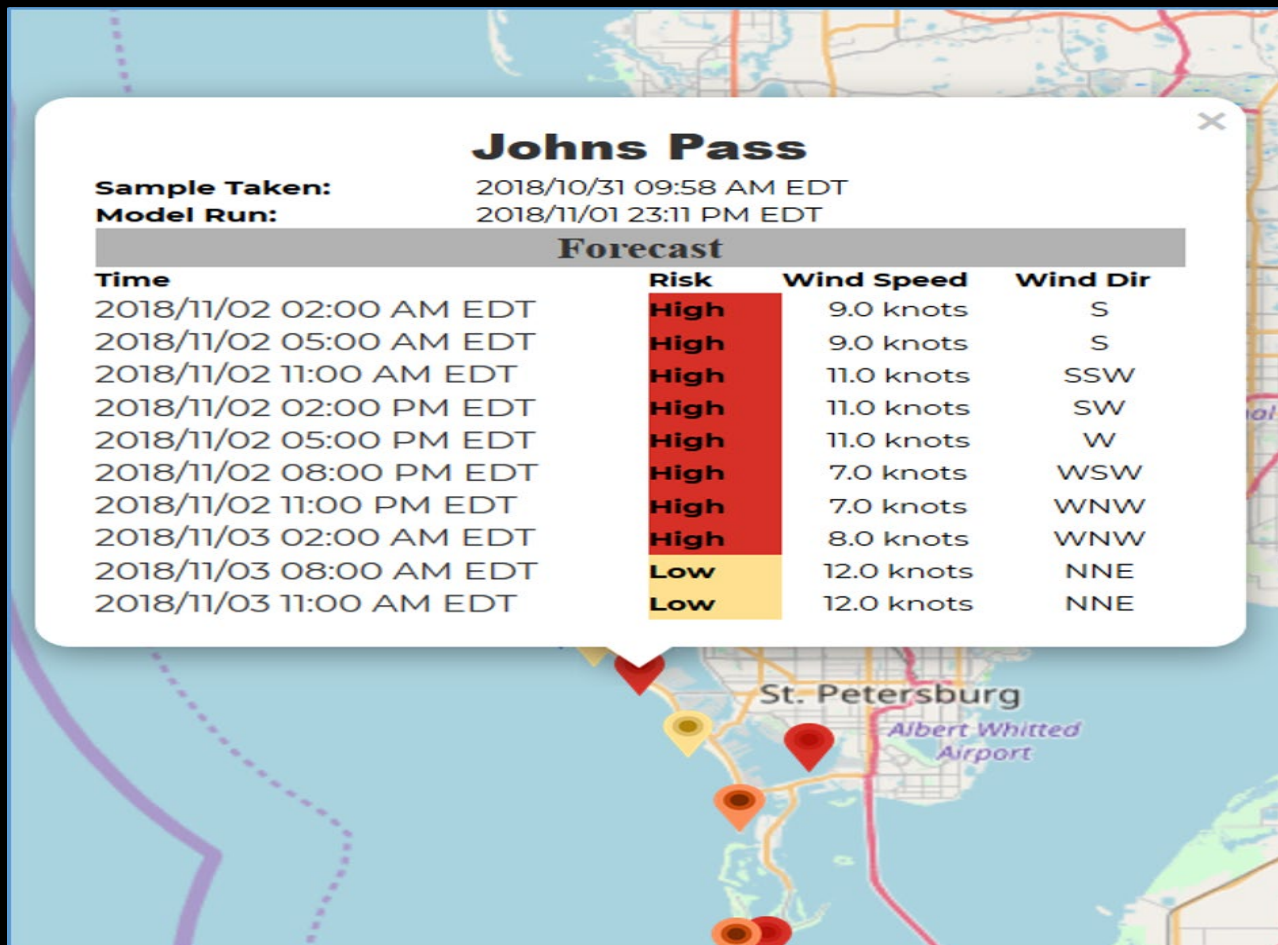
November 2018

<https://habscope.gcoos.org/forecasts>



## November 2018 on a bad day

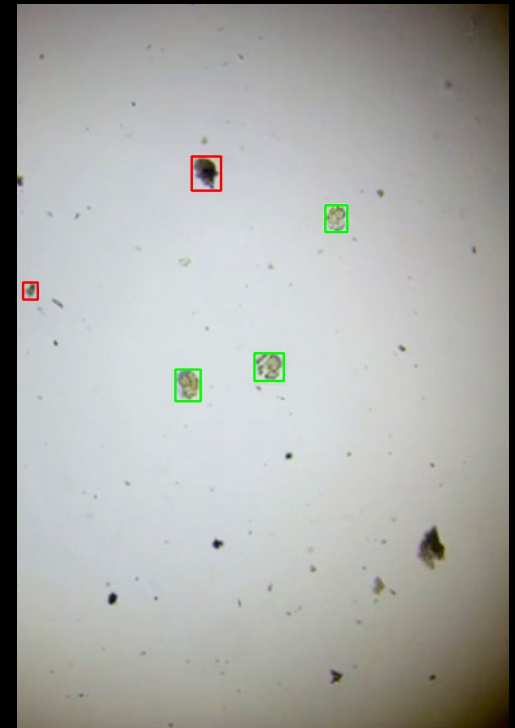
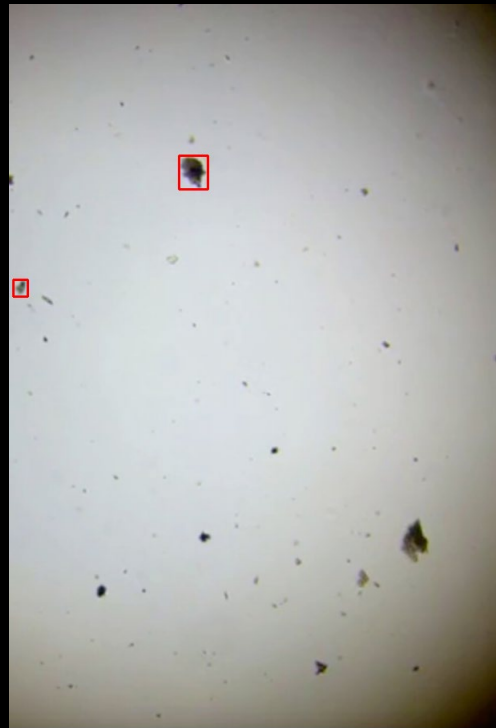
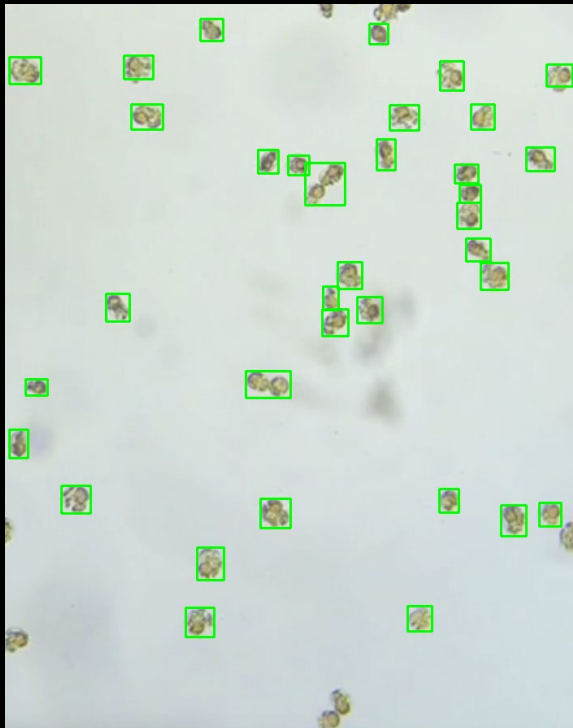
<https://habscope.gcoos.org/forecasts>





## MOVING FORWARD

- Adding multiple species to HABscope model list
- Operationalizing Every Beach Every Day forecasting tool
- Version 2 likely will use Lugol's fixed cells at 100x for better resolution



## ACKNOWLEDGEMENTS

- NASA for the Research Opportunities in Space and Earth Sciences grant
- NOAA scientists and technicians
- Florida Fish and Wildlife Conservation Commission
- Pinellas County staff
- All of our wonderful HABscope volunteers

# THANK YOU

