Modeling the Influence of Environmental Factors on Human Respiratory Irritation from Natural Exposures to *Karenia brevis* Aerosols

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Background

- *Karenia brevis,* toxic dinoflagellate
- Produces brevetoxins
- Annual blooms off the west coast of Florida
- Causes neurotoxic shellfish poisoning (NSP)
- Wind and wave action cause toxins to become part of the marine aerosol
- Woodcock (1948) first identified the association of respiratory irritation with Florida red tide

Human respiratory impacts from toxic aerosols

- Asthmatics: changes in pulmonary function and symptoms after 1-hour beach exposure during red tide
- Remain symptomatic with decreased respiratory function 5 days after exposure
- Amount of toxin in the air highly variable from day to day, from beach to beach, and from morning to afternoon

What factors might contribute to variability in public health impacts?

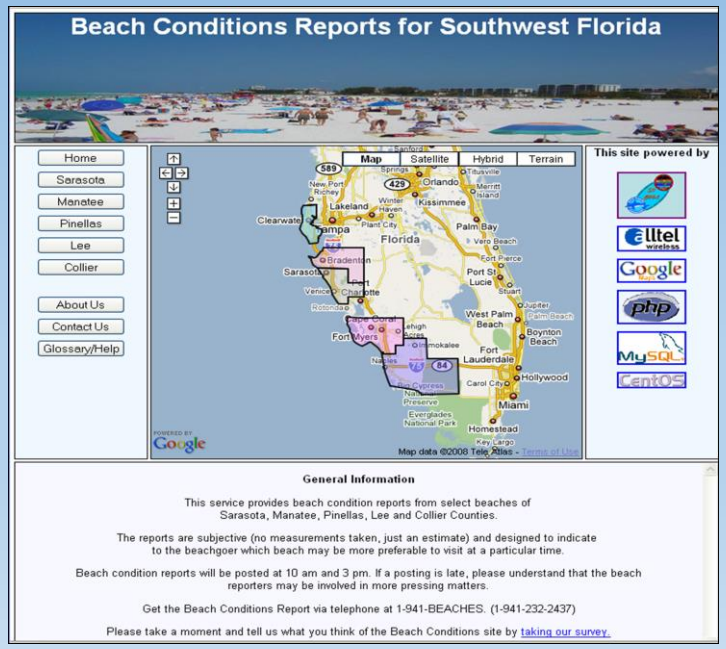
- We analyze data on:
  - Lifeguard reports of beach conditions
  - Bloom occurrences (cell counts)
  - Environmental conditions (meteorological and oceanographic measures)

Data:

1. Beach Conditions Reporting System

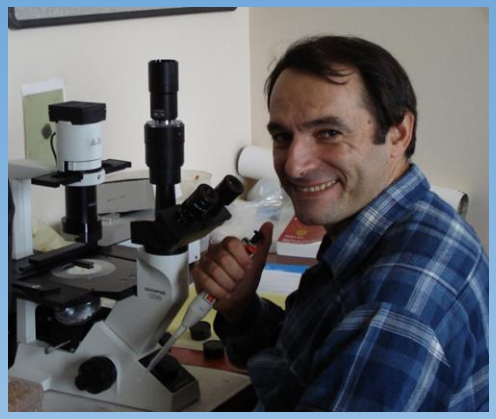
Respiratory Irritation:

None, Slight, Moderate, High



Data:

2. Bloom Conditions



- *K. brevis* abundance
  - Mote Marine Lab
  - FWC/Florida Wildlife Research Institute
  - FL ECOHAB project
- Used to identify periods of blooms
- For potential beach/respiratory impacts, we used cell counts 5 km from shore and >1,000 cells/L

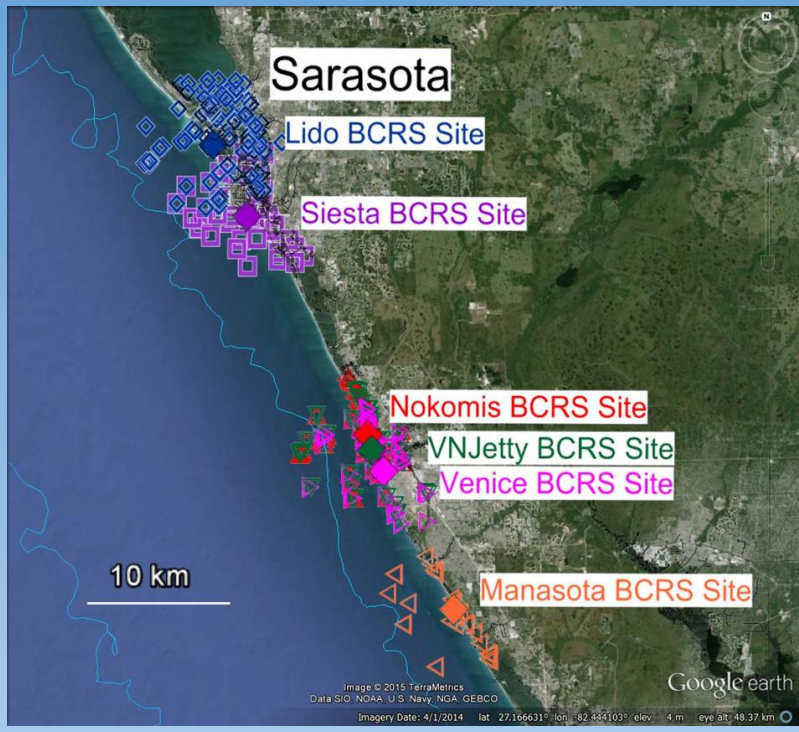
Data:

3. Meteorology/Oceanography

- NWS station at Venice, FL
- Mote Marine Lab weather station at Sarasota, FL
- Water temperature
- Dew point
- Relative humidity
- Barometric pressure
- Wind direction relative to beach
- Wind speed

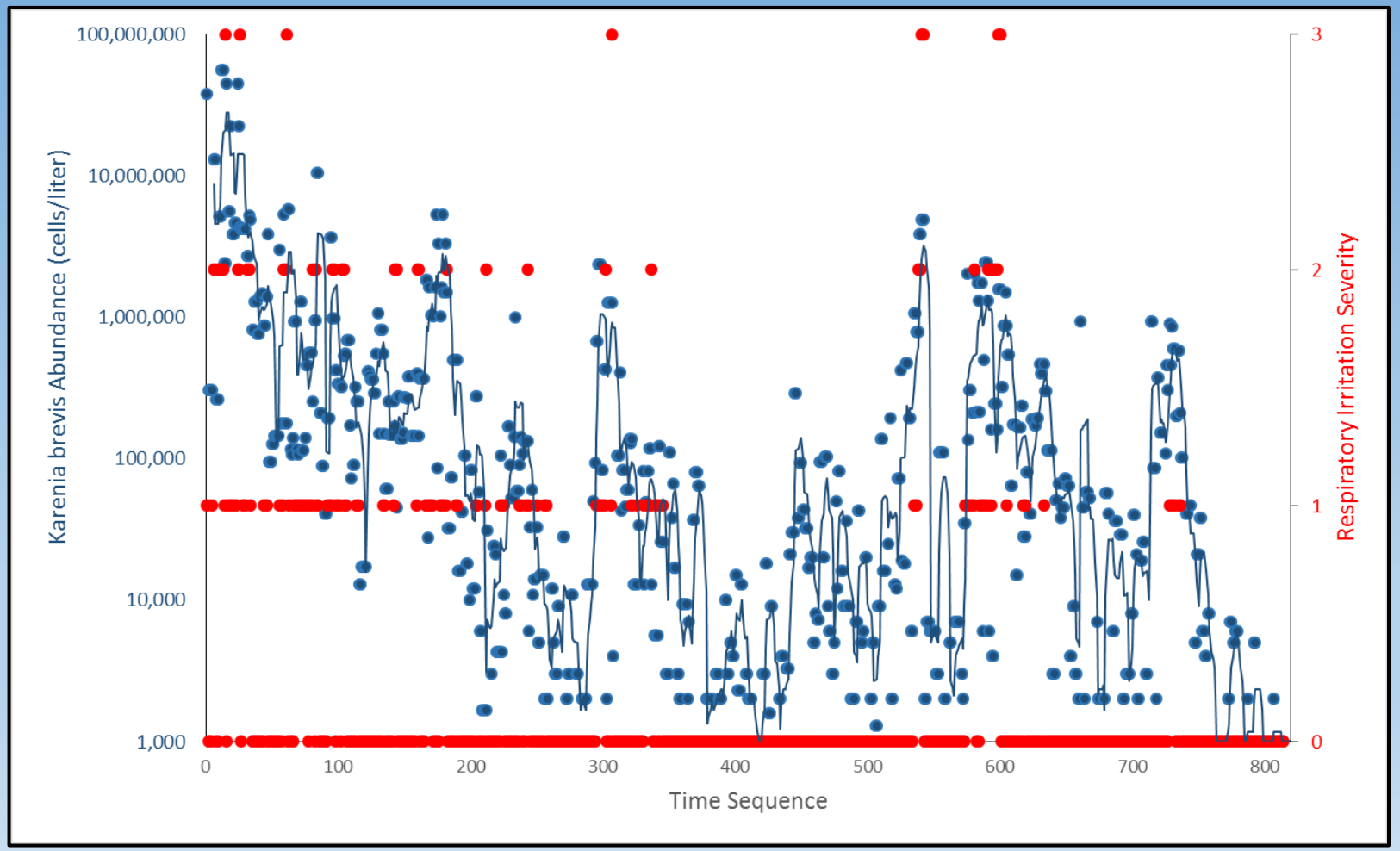
Analysis:

- Data was analyzed using PRIMER-E
- Two analyses were conducted to evaluate each factor and its contribution to observed respiratory irritation data from 6 BCRS sites in Sarasota County
  - Analysis of Similarity (ANOSIM)
  - Similarity Percentages (SIMPER)



Results:

Respiratory irritation highly correlated with *K. brevis* abundance. No surprise there!



Differences* in Public Health Impacts due to Environmental Factors

From No Impact to:	Water Temperature (+)	Barometric Pressure (-)	Wind Direction (Normal)	Relative Humidity (+)	Others	p-value
Slight	1	2	3	--	--	< 0.002
Moderate	1	2	3	--	--	< 0.006
High	2	--	3	1	--	< 0.007

*Estimated using PRIMER-E multivariate, nonparametric analysis

Summary:

- *Karenia brevis* abundance was the strongest controlling factor for severity of respiratory irritation.
- Environmental factors had **much** less influence (low ‘R’ values) on respiratory severity than did *K. brevis* abundance.
- The contributions of environmental factors were highly significant to the differences between the respiratory irritation level of ‘None’ and all three others (‘Slight’, ‘Moderate’ and ‘Severe’).
  - Environmental factors that contributed the most to dissimilarities between samples from groups ‘None’ and ‘Slight’, and ‘None’ and ‘Moderate’ were **water temperature** and **barometric pressure**.
  - Dissimilarities between samples in groups ‘None’ and ‘Severe’ were largely based on **relative humidity** and **water temperature**.

Conclusions:

- ***Scientific hypotheses***:
  - Brevetoxin aerosolization is due to air-sea interactions, partially related to diffusion and evaporation rates between the water and the surrounding atmosphere
- ***Policy relevance***:
  - Projections of human public health impacts from *K. brevis* blooms may be improved through incorporation of relevant environmental parameters

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