

**Data Analysis: Identifying a Sea Breeze Front**

- A. Complete this portion on the provided Figures 1-4.  
Based on the information in the introduction, students should complete the line graphs to the  
If used as an Invitation/Engagement activity with little or no introductory material, answers will  
vary based on prior content knowledge.
- B. Using Figures 5 and 6:
1. What differences do you notice between the two profiles?  
Observations include, but are not limited to:
    - Drop in air temp at DBBB at 10:00AM
    - Higher maximum temperature at DLAU
    - During initial observations, DBBB has higher air temp than inland station
    - ~8°F increase at DBBB at 8:00AM
    - ~10°F increase at DLAU at 8:00AM
  2. When did the sea breeze front begin? 9:30AM
  3. How long did the front have an effect? ~4 hours
  4. How much did air temperature change during this time?
    - a. At DBBB: Dropped 7°F; then increased 4°F
    - b. At DLAU: Increased 5°F; then dropped 5°F
  5. How much did the relative humidity change?
    - a. At DBBB: Increased 15%; then dropped 10%
    - b. At DLAU: Dropped 15%
- C. Using Figures 7 and 8:
6.
    - i. By approximately how much did the wind speed increase at DBBB? ~12mph
    - ii. From what direction did the wind shift? South-Southwest (SSW)
    - iii. To what direction did the wind shift? South-Southeast (SSE)
    - iv. How long did the increased wind speed and direction shift last? ~5 hours
  7. Were there any other drastic shifts in wind direction during the 24 hour period?  
At DLAU station, shift of ~90° after 6:00PM.
  8. Based on the data from Figures 1-4, did the DLAU station experience the sea breeze?  
Provide evidence for your answer.  
Direction changed slightly from 195-235°; Wind speed increased ~4 mph on average
- D. Using the radar loop:
9. Does the front cross the entire state of Delaware? No
  10. Using the time stamps in the upper right corner, determine how long it takes for the front to  
move from the coast to the furthest point inland. ~9 hours
- E. Using real-time data from DEOS ([www.deos.udel.edu](http://www.deos.udel.edu)):
11. The date and time of the current observations: Real time data. Answer will vary.
  12. Current air temperature: Real time data. Answer will vary.

13. Current relative humidity: **Real time data. Answer will vary.**
14. Current wind speed: **Real time data. Answer will vary.**
15. Current wind direction: **Real time data. Answer will vary.**
  
16. By looking at the plots of air temperature and relative humidity, is there evidence of a sea breeze front taking place in the last 24 hours?  
**Real time data. Answer will vary.**
  
17. Is there evidence of a sea breeze front in other areas? Describe the evidence for or against the presence of a sea breeze front.  
**Real time data. Answer will vary.**

### Discussion Questions

Answers may include the following; however, they are not limited to what is listed here.

1. How might the following affect the formation and characteristics of a sea breeze front?
  - a. A cloudy day  
Clouds can prevent air temperatures at surface from excessive summertime heating. If air temperature over land is not drastically different from air temperature over water, the movement of air onshore (sea breeze) will not be as strong.
  
  - b. A brief, but strong thunderstorm moving west to east over the area  
Thunderstorms may cool air temperatures over land and dissipate a strong sea breeze. Winds associated with thunderstorm will displace sea breeze.
  
  - c. A northeaster  
Northeasters typically form in the cooler months when sea breezes are least likely. If a northeaster did occur during warmer months, the land will not heat excessively due to cloud cover. Northeasterly winds associated with the storm would dominate.
  
  - d. An intense heat wave, with temperatures exceeding 100°F, for a week straight  
Air over land would heat excessively while the air over water would heat slower. Sea breeze would be stronger and longer in duration at the beginning of the heat wave than at the end.
  
  - e. Increased development of the coastal area, including wider road, more impervious surface, and large skyscraper hotels.  
Increased heat island effect and surface roughness (from new construction) would cause sea breezes to form earlier in the day, and last longer, and potentially form stronger sea breeze fronts. However, the heat island effect and surface roughness would also act to hold the sea breeze in place in the developed area.

2. The radar loop definitively shows the movement of the sea breeze front. If you were a meteorologist on the news, what would be the advantages and disadvantages of showing a modeled or predicted loop as opposed to an actual radar loop?  
**Advantages: Helpful for planning purposes**  
**Disadvantages: Like forecast models, radar models can be incorrect, reducing the weather-person's credibility.**
  
3. In the radar loop, we can see what appears to be a slow moving sea breeze moving northeast from Delaware Bay into New Jersey. Why do you think there is not a sea breeze front moving west to east from Chesapeake Bay onto Maryland's Eastern Shore?  
**Chesapeake Bay is shallower and typically has less turnover/flushing than Delaware Bay and the Atlantic Ocean, therefore the water temperature is much warmer. Because the temperature gradient between the air over Chesapeake Bay and the air over the adjacent land is not that great, no sea [bay] breeze forms.**
  - a. If there was a Chesapeake Bay sea breeze front, what would be the result of the two fronts converging?  
**Similar to what we observe in Florida during summer afternoons, the two converging fronts would be produce brief, but strong thunderstorms.**
  
4. Discuss the advantages and disadvantages of environmental observing system data.  
**Advantages: Makes continuous data available for many different uses (vs. scientists physically collecting discrete data a little at a time—may miss anomalous data, e.g. a storm event).**  
**Disadvantages: Systems can be unreliable if not well maintained and calibrated.**
  
5. If you were city manager, and were presented with the data and models found in this activity, how would you guide future development in your city?  
**Provide more green space and pervious surface in development.**  
**Use sustainable development best practices.**  
**Increase local albedo (the fraction of solar energy reflected from the Earth's surface back into space) by creating more reflective surfaces**  
**Increase vegetation cover**  
**Increase width of roads that run perpendicular to the coast, thereby creating wind channels**  
**Use irregular building positioning and varying building height to encourage air flow**
  
6. Describe other methods of determining the impact of urbanization on sea breeze fronts.  
**Varied student responses.**