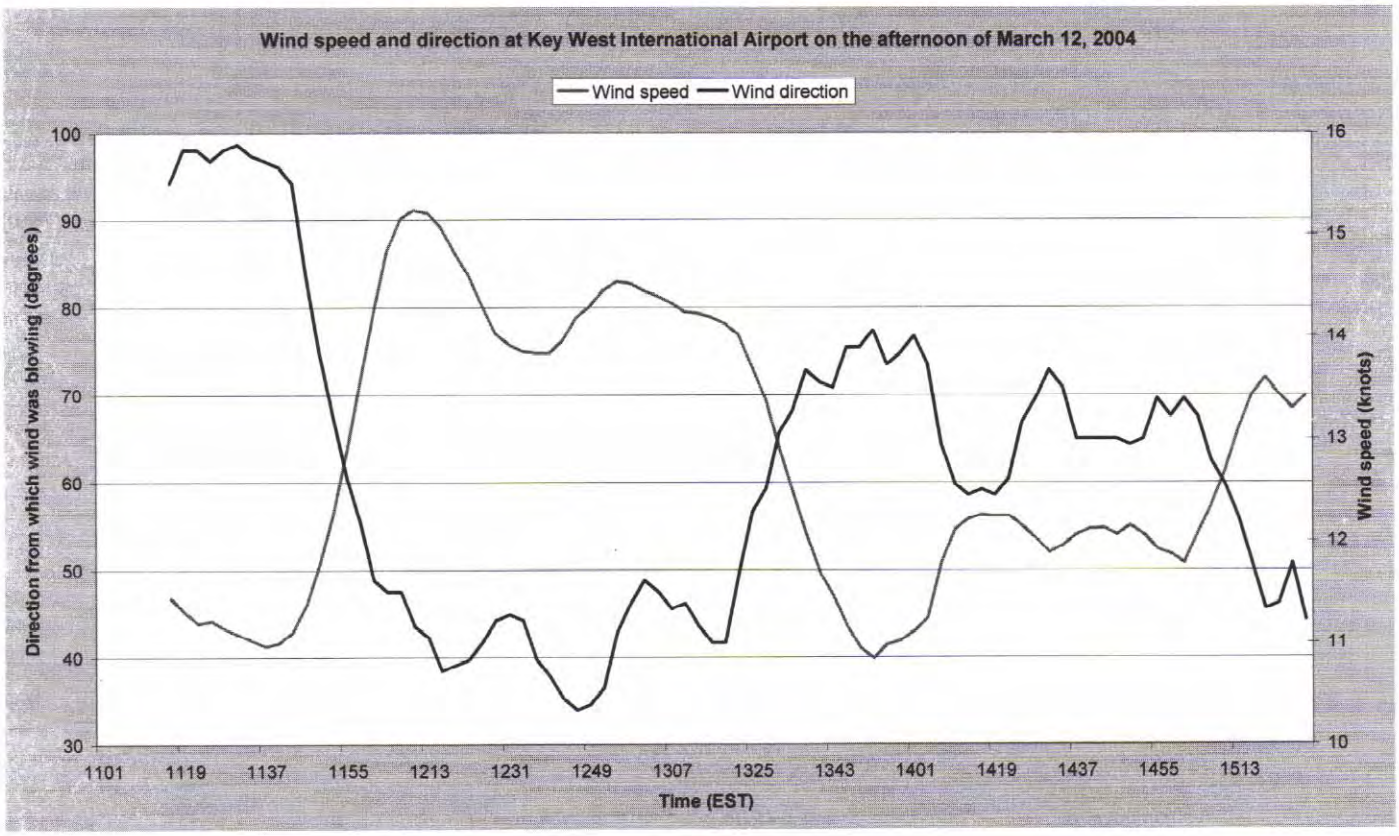
Island Effect Winds

Jim W. Lee, Meteorologist Intern
NWS Key West

The Florida Keys are unique, and can produce unusual weather phenomena. One such phenomenon is the formation of small-scale wind fields created by the interactions between air over the Keys and air over the surrounding waters. This is often referred to as the "island effect" on wind. When the temperature on an island, such as Key West, is significantly warmer than the temperature of the surrounding water, the air over the island will also be warmer than the surrounding air. As a fundamental rule, warm air is less dense than cooler air, so the air over the island will expand and begin to rise. However, the atmosphere always tries to achieve balance, so the rising air must be replaced. As a result, air from over the surrounding waters rushes in from all directions to cover the island. That air then heats over the warm island and rises, and is replaced by more air, and so on. This process maintains a circulation and updraft over the island, which is often responsible for the cloud lines that spawn waterspouts during the summer months.

The primary catalyst for the occurrence of this phenomenon is the temperature of the island, in relation to the temperature of the surrounding water. On March 12, 2004, winds on Key West were northeasterly at around 15 knots during the morning hours, as the island heated under the Sun. The Key West International Airport, where our weather observations are made, is on the eastern side of the island, thus "island effect" winds blow primarily from the east (that is, directly "into" the island). During the midday and early afternoon hours of March 12, the temperature remained nearly constant for several hours, right at the threshold value necessary for this process to take place. As a result, the winds repeatedly shifted between two completely different flows – the prevailing strong, northeasterly flow, and the weaker, easterly "island effect" flow. The graph below illustrates this. You can see that every time the wind reverted to the prevailing northeasterly flow (i.e., the black line which represents direction moved closer to the bottom of the plot), the wind speed increased (i.e., the red line which represents speed moved closer to the top of the plot). Conversely, every time the wind shifted toward the east (i.e., the black line moved closer to the top of the plot) due to the "island effect", the wind speed decreased.



This "back and forth" switching between wind flows is a good illustration of how much of an effect islands in the Florida Keys can have on the local atmosphere. By simply heating these small pockets of land within the larger body of water, small-scale wind fields can be induced, and the changes required to accomplish this are often very small. If the temperature on Key West during the afternoon of March 12 had been just a few degrees lower, the difference between land and water temperatures would not have been large enough to induce an "island effect", and the wind would have remained northeasterly and strong. If the temperature had been just a few degrees higher, the "island effect" would have been stronger, and the winds would have been consistently easterly and weaker.