IC4.3: Microclimates Exercise: The Washington D.C./National Airport Heat Island

M. Sean Ryan, Hydrometeorological Prediction Center (HPC)
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Overview: Washington D.C., between northern Virginia and Maryland, lies at the confluence of the Potomac and Anacostia Rivers, where the Potomac becomes significantly wider and deeper. Reagan National Airport, the ASOS site for Washington, lies on the Virginia side of the Potomac, just south of the confluence with the Anacostia River (Fig. 1). The climate at National Airport, particularly with respect to overnight minimum temperatures differs substantially from the surrounding region. This difference is largely due to the urban heat island affect, but also due to the proximity of the airport and ASOS unit to the Potomac River.

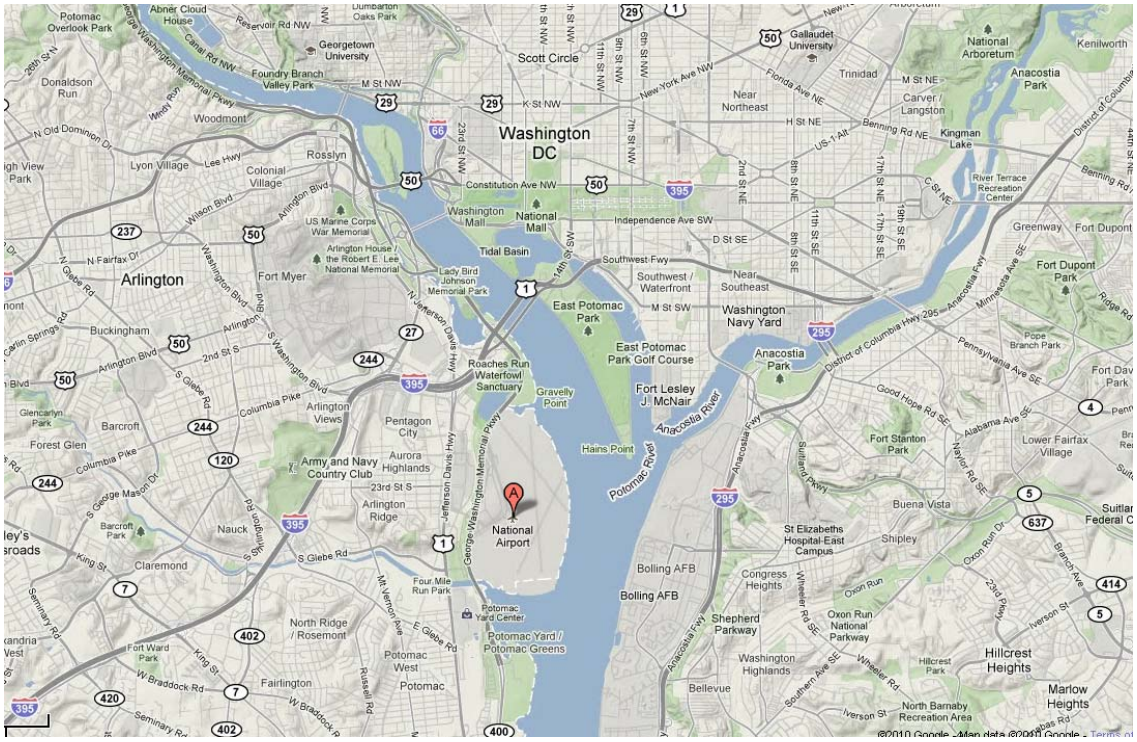

Figure 1: Map (courtesy Google Maps) showing the geography and the terrain surrounding Washington National Airport.

Synoptic Setup: The higher temperatures at DCA are noticed year-round, with the effect highly favored during synoptic environments which support strong radiational cooling, generally with a strong ridge of high pressure at the surface and aloft over the region. On nights with maximized radiational cooling, the difference in temperature between DCA and nearby sites in more rural settings can be as much as 10 or 15 degrees Fahrenheit. In addition to being in an urban environment, the proximity to the Potomac River also likely plays a significant role. During the late summer and fall, the water temperature in the river is still relatively warm. Therefore, cool air flowing across the water would be modified, albeit slightly, to a warmer temperature. This effect would be most likely in a case with south-southeasterly winds, where the air would travel the longest distance

across the warmer river water. These effects may also have some impact on the snowfall measured at DCA, which in many cases measures about 10-20% less snowfall than surrounding sites receive.

Diagnosis/Prognosis: A comparison of the climatological mean temperatures for both National Airport (DCA) and Dulles Airport (IAD) shows the differences in average temperatures between the two sites. The difference in monthly mean temperatures between the two sites is much larger for minimum temperatures than for maximum temperatures. Averaged annually, National Airport is 6 degrees Fahrenheit warmer than Dulles Airport for the minimum temperature, but less than 1 degree warmer for the maximum temperature. Figure 2 shows the monthly mean minimum temperatures for DCA and IAD (left axis) as well as the difference between the two sites (right axis).

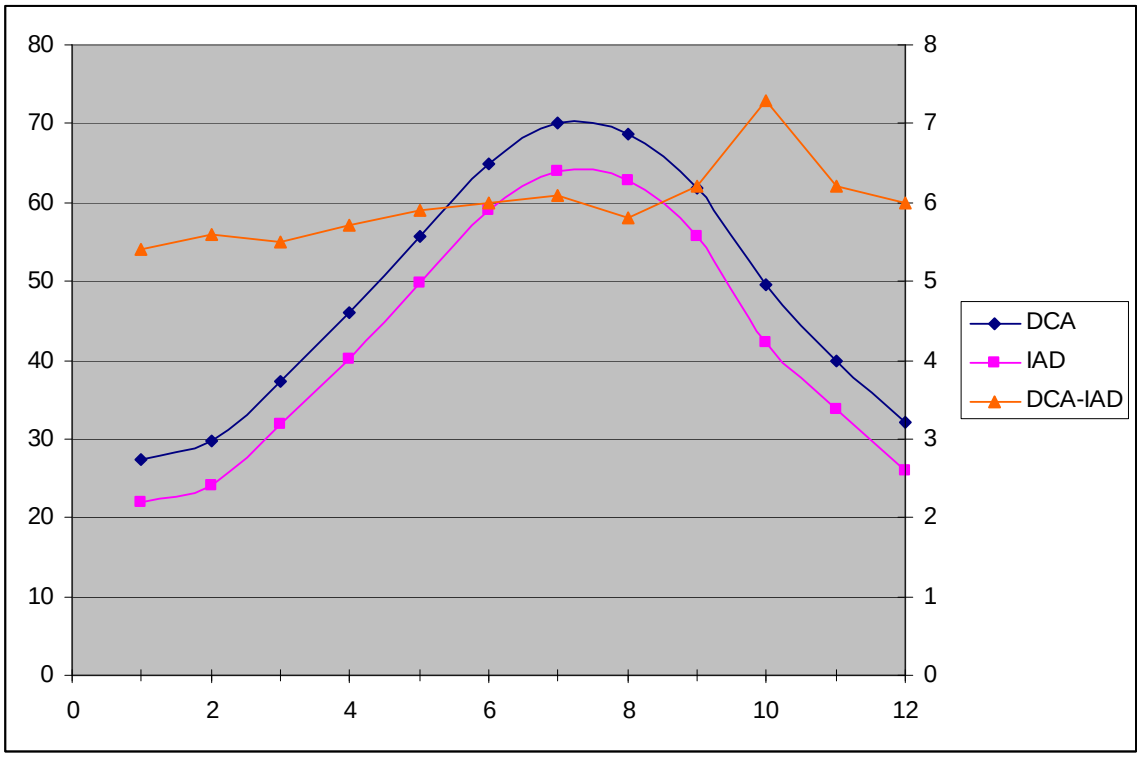

Figure 2: Monthly mean minimum temperatures (F) for Washington National (DCA) and Washington Dulles (IAD) airports (left axis); difference in mean minimum temperature (F) between the two sites (DCA-IAD) on the right axis. Numbers on the X-axis represent the month.

One can see that DCA is warmer than IAD, on average, all months of the year. The difference between the two sites maximizes, however, during the month of October. Fall is a time when the weather is relatively dry with many nights well suited for radiational cooling. The difference between the two sites reaches a minimum in the month of January, when overcast conditions and gusty winds are much more common.

Model output statistics (MOS) generally have a good handle on this common temperature difference, and frequently forecast cooler minimum temperatures at IAD relative to DCA. A good rule-of-thumb when forecasting minimum temperatures at these sites on a night with strong radiational cooling would be to forecast a temperature at IAD at least the

average number of degrees colder relative to DCA for that particular month, keeping in mind that these averages include nights both with and without strong radiational cooling.