Impact of irrigated agriculture on near surface humidity.

Rick Allen, Univ. Idaho, Dec. 13, 2004.

The following sets of figures show the influence of irrigation (and evapotranspiration) of the local environment on measured vapor pressure in an arid climate.

Figure 7 from a memo from Paul Brown, Univ. Arizona to the ASCE-EWRI ET Task Committee (personal communication, 2001) shows impact on vapor pressure measured at an "AZMET" automated weather station located in a fallowed field in western Arizona vs. vapor pressure measured at a similar type of weather station, but located within a nearby, irrigated alfalfa field. The impact on vapor pressure measurement was about 17%.

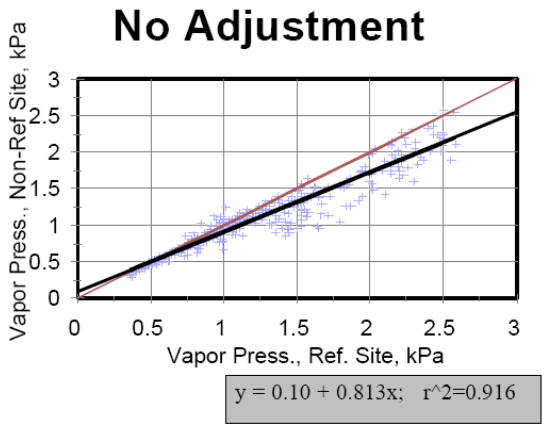
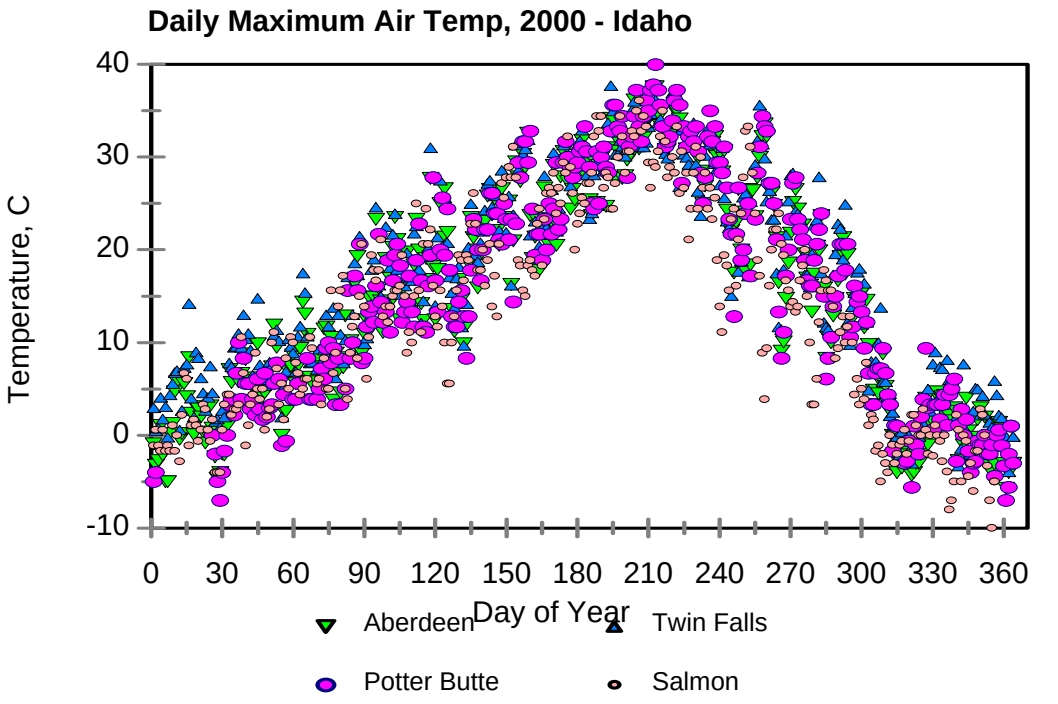


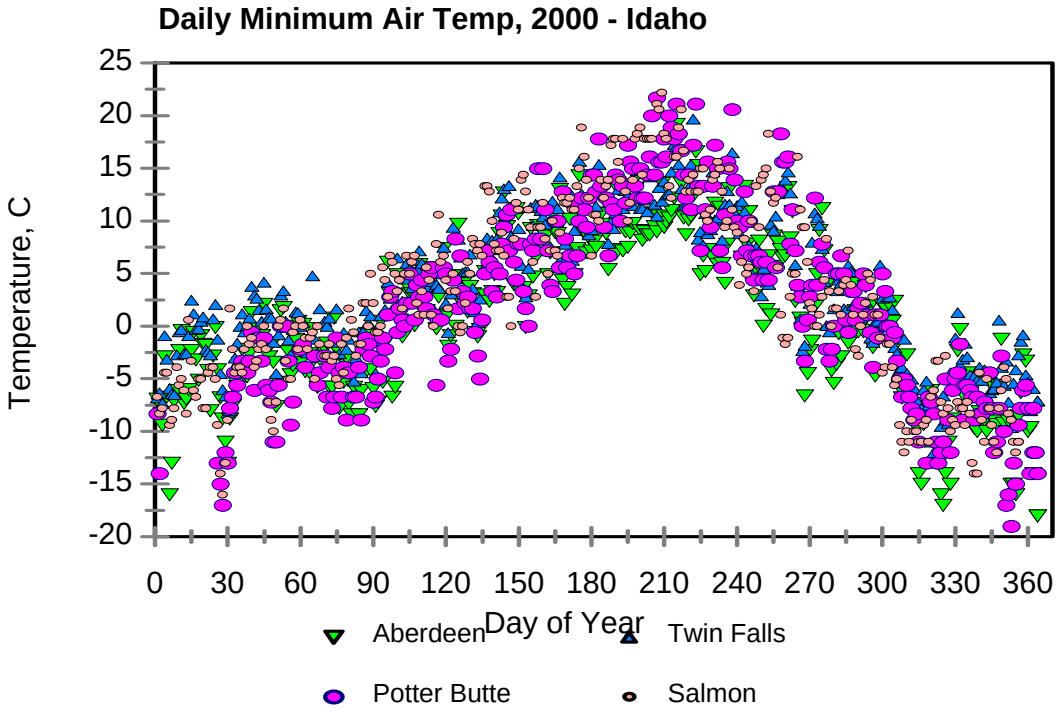
Figure 7. Vapor pressure measured at the AZMET station vs. vapor pressure measured at the reference site. No adjustments made made to non-reference (AZMET) data.

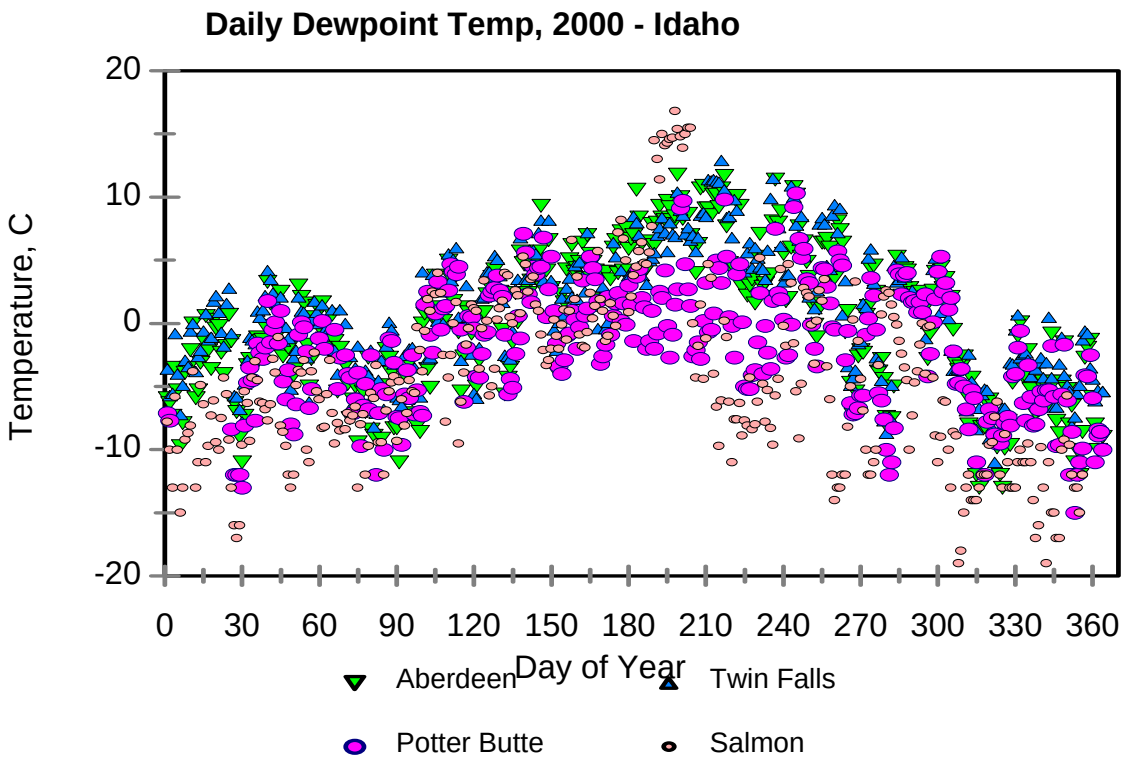
The next sequence of four figures show daily maximum air temperature, daily minimum air temperature, daily average dewpoint temperature, and daily average vapor pressure for four weather station in southern Idaho for all of year 2000. Two stations (Aberdeen and Twin Falls) are in irrigated agricultural settings. One station (Potter Butte) is in sagebrush desert near Craters of the Moon national monument (where all Apollo space missions were flown), with no agriculture within 50 km. The Salmon station is an automated station in rangeland in a medium sized mountain valley near Salmon, Idaho, and within a few km of the Salmon River and riparian vegetation.

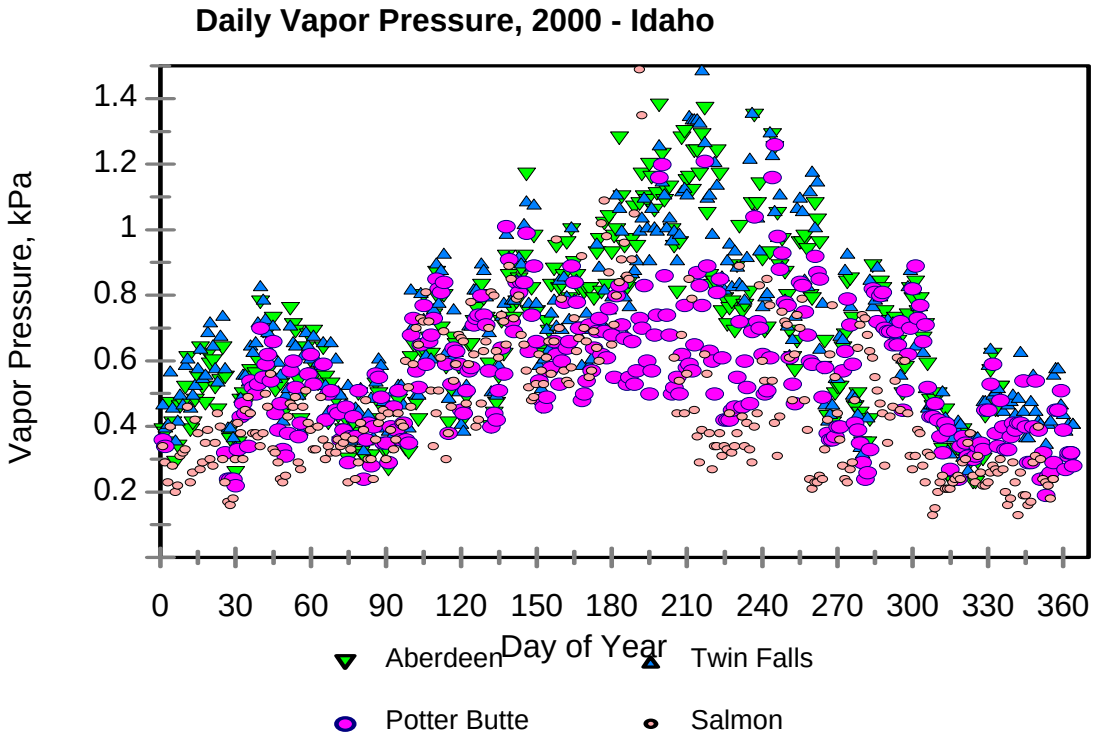
The daily maximum air temperatures are similar among the four stations, whereas the daily minimum air temperatures at the two rangeland stations are elevated over the irrigated stations by about 5º C during midsummer, as one would expect.

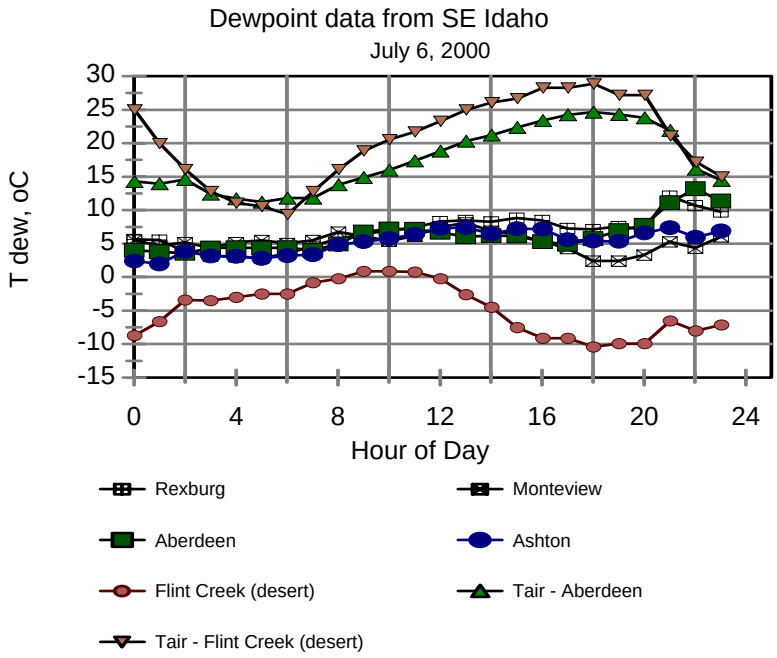
The largest differences are seen in dewpoint temperature and vapor pressure (these parameters are both derived from reported RH and air temperature data). Vapor pressure at Potter Butte (desert site) is similar to the irrigated stations during fall, winter and spring, when the is some moisture available, but becomes as low as one-half that for the irrigated stations in summer. The Salmon rangeland site is similar in behavior.


Daily Maximum Air Temp, 2000 - Idaho
Temperature, C
40
30
20
10
0
-10
0 30 60 90 120 150 180 210 240 270 300 330 360
Day of Year
Aberdeen
Twin Falls
Potter Butte
Salmon

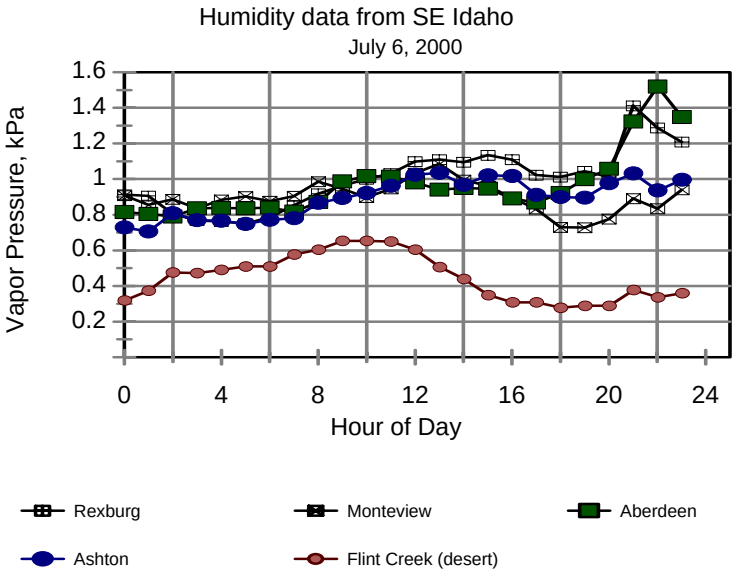

Daily Minimum Air Temp, 2000 - Idaho
Temperature, C
25
20
15
10
5
0
-5
-10
-15
-20
0 30 60 90 120 150 180 210 240 270 300 330 360
Day of Year
Aberdeen
Twin Falls
Potter Butte
Salmon


Daily Dewpoint Temp, 2000 - Idaho
Temperature, C
20
10
0
-10
-20
0
30
60
90
120
150
180
210
240
270
300
330
360
Day of Year
Aberdeen
Twin Falls
Potter Butte
Salmon


Daily Vapor Pressure, 2000 - Idaho
Vapor Pressure, kPa
1.4
1.2
1
0.8
0.6
0.4
0.2
0
30
60
90
120
150
180
210
240
270
300
330
360
Day of Year
Aberdeen
Twin Falls
Potter Butte
Salmon



The upper graph on this page shows an hourly sequence of dewpoint temperature measurements from four irrigated stations in SE Idaho (first four listed) and from a station in a desert location (Flint Creek) for one day. The figure is from Appendix D (Fig. D-10, page D-28) of the ASCE-EWRI (2002) report on standardization of Reference ET calculation (http://www.kimberly.uidaho.edu/water/asceewri/appendix.pdf). The two top lines are air temperature at an irrigated station (Aberdeen) and at the desert location, for reference. Dewpoint measured at the extreme desert station averaged about 10º C below that of the irrigated stations during daytime. The figure below shows the equivalent for vapor pressure, where the vapor pressure measured at the extreme desert station averaged one-half that for the irrigated stations during the 24 hour period. These figures represent the extreme conditions expected between complete desert and a large irrigated environment in the same region.



Conclusions that can be drawn are that an irrigated environment in an arid climate does significantly impact the humidity level at the near surface (lower 10 m or so) during parts of the year when the local climate is arid and soil moisture of native vegetation is depleted. The hourly Idaho case shows an extreme condition for one day only, when conditions are the worst.

One hopes that the weather data sets in the FAO ClimWat and IWMI World Climate Atlas data base represent agricultural settings. To the degree that they do not, constitutes an opportunity for understatement of relative humidity (see Droogers and Allen, 2002, for example (Droogers, P. and R.G. Allen. 2002. Estimating reference evapotranspiration under inaccurate data conditions. *Irrigation and Drainage Systems* (16):33-45).

The extremely dry Flint Creek environment would probably never be reached even at "airport" or "city" weather stations in the FAO and IWMI climate bases, as the airport and city environments generally contain some anthropogenic features that add some humidity to the airstream.