

## **DISCUSSION AND SUGGESTIONS FOR USE of AIR TEMPERATURE DATA**

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### **RS01 & RS08 comparisons:**

(RS01 elev = 490m; RS08 elev = )

RS01 and RS08 are two defunct reference stands that were close to one another in what is now watershed 9, just outside the HJ Andrews boundary on the extreme southwest side. Both are on a fairly steep hillside with a southwest exposure.

The only overlap of max and min temps between the two were the years 1970-1972. During this time period a good correlation can be seen between the temp values; however, during 1970 and 1971, RS01's max temp exceeded that of RS08 with a greater amount than it did in 1973. Also, 1970 sees less correlation between the temps than in the other two years. Some RS08 min temps look to be out of calibration (i.e., too low) in the spring of 1970. The dataset for RS01 looks fairly complete until it was dismantled in 1995. During period of data overlap both sensors were at a height of 1m.

### **Recommendations for data use and specific problems**

- RS01: All data appears reasonable for use. Comparison with a benchmark met site? If okay, use in entirety.
- RS08: Data should only be used for the years 1971 and 1972; all temps appear questionable for 1970.

### **RS13, RS13O, & RS14 max/min temp comparisons**

(RS13 elev = 1350m; RS13O elev = 1317m; RS14 elev = 1430m)

Both RS13 and RS14 are located in forests; RS13 is on a WSW-facing slope on the west side of Wildcat Mtn. while RS14 is on a NE-facing slope on the E side of the mountain. Both are at relatively high elevations. RS13 gets considerably more direct sun than RS14. Both have similar tree canopies, with RS13 being a little more dense.

RS13O is the companion station to RS13, located very near it and in a major clearing to the SE of it. There is no tree canopy and the nearest trees are a good 75-100 ft away. Obviously this station receives the most direct solar radiation of the three. RS13 and RS14's data overlap almost perfectly from 1971 to present. RS13O has been operational since 1987.

Min temps for all three stations are similar throughout the year. With respect to RS13 and RS13O, they are geographically so close to one another that differences in nighttime radiation loss between them (one in the forest, the other in the open) appears to not be a factor in their min temps. Min temps for RS14 are almost always lower than the other two stations but only by a degree or less.

Not surprisingly the max temps show a different scenario. During the summer, RS13 max temps exceed those for RS14; to be expected given RS13's WSW-facing slope. However, RS14's max temps are about the same or slightly higher in the fall/winter/spring months than RS13's. This is probably because of the fact the RS14, being on the ENE side of Wildcat Mtn, is a bit more sheltered from the westerly winter storms than RS13. Max temps for RS13O generally exceed those of the other two stations throughout the year which is to be expected.

## **Recommendations for data use and specific problems**

- There is a significant shift between RS13 and RS14 max and min temps starting in the summer of 1983 and continuing through winter 1985. The differences between the stations' temps differ by a larger amount than normal during this period, though the seasonal trends are the same as for other years. RS13O appears out of whack during two episodes in summer and fall 1989
- Entire dataset for all 3 stations appears spotty and questionable for entire year 1990
- RS13 and RS14 both alternate sensor heights between 1m and 3m on an odd, regular schedule from 1973 until 1987 and 1985, respectively.

## **RS12, TSLOOK, UPLMET max/min temp comparisons**

(RS12 elev = 1010m; TSLOOK elev = ; UPLMET elev = 1294m)

Both RS12 and TSLOOK are in the upper Lookout Creek valley (valley runs NW to SE). RS12 is on the NE side of the valley, just up from the stream itself, while TSLOOK is an open thermister directly over the stream. TSLOOK is almost entirely blocked from any direct solar radiation throughout the year due to the bulk of Lookout Mtn to the S and W of it; RS12, though near the bottom of this valley, has a little more exposure to sun than TSLOOK. This portion of the valley is often dark, damp and cool. Tree canopy cover is similar between the sites; both sites are in a fairly dense forest. There is no clearing around the riparian zone of Lookout Creek at this point to speak of; it's really in the forest.

TS35 is upstream and on the E side of the valley; it is located on a W-facing slope. There is no max/min temp data for this site. UPLMET is higher still, on an ENE-facing slope, surrounded to the NW, W, SW, S, and SE by high ridges.

First overlap between station data is between RS12 and TSLOOK starting in 1981. Max temps between the stations show that RS12 exceeds TSLOOK year-round. This is not surprising because in the summer RS12 gets more sunlight, and the fact that TSLOOK lies over a stream channel means that year-round max temps ought to be cooler. Diurnal temp differences are small in the winter and large in the summer.

UPLMET's max temps exceed those of RS12 and TSLOOK consistently in the spring and fall, and to a lesser extent, in the winter. In summers, UPLMET's max temp is equal to RS12 and TSLOOK. Can't really think of a reason for this. Probably not a matter of UPLMET being 'warmer' so much as it is a matter of RS12 and TSLOOK being *very* chilly in spring, fall, and winters. UPLMET's min temps are always lower than the other 2 stations. This is to be expected based on its higher elevation.

## **Recommendations for data use and specific problems**

- Analysis of the RS12/TSLOOK min temps presents a puzzle. In 1981 the RS12 min temps were below TSLOOK's until the fall, when they became essentially the same. This similarity lasted through 1982 and 1983 but in 1984 RS12's min temps dipped below TSLOOK's again. 1985 appears to be another 'transition year' for the min temps, with things out of whack in the winter and spring, then settling down again in the

summer, but the min temps not similar again until 1986. In 1989, RS12 min temps dip below TSLOOK's again, for the entire year; min temps totally out of whack in 1990, calibrate again in 1991. How to deal with this problem?

- UPLMET max temp data spike 11/96, 11/98; maybe sunny days?

### **RS03, RS18, TSMCRA, & CENMET max/min temp comparisons**

(RS03 elev = 945m; RS18 elev = ; TSMCRA elev = ; CENMET elev = 1018m)

RS03 is a defunct RS site on the southern slopes of the upper McRae Creek valley. It was located on a W-facing slope in a heavily forested area with a thick canopy overhead. TSMCRA is an open thermister above the McRae Creek itself, downstream from the RS03 site. The creek channel is quite wide here and thus this sensor receives a fair amount of direct solar radiation. RS18 was located high on the southern side of the ridge separating the McRae Creek drainage from the Lookout Creek drainage. Unfortunately, this site was located in an area with very few stations and we only have data for half of 1972 from it. CENMET is the met station halfway between UPLMET and VANMET on the eastern side of the Andrews. It is located in a clearing on a west facing slope.

The two stations with long-term overlap here are RS03 and TSMCRA. From 1981 through 1987, TSMCRA's max temps generally exceed those for RS03 during the summers but in the autumns and winters, RS03 max temps are higher. Strangely, this trend seems to diminish by the 90s, with RS03 max temps then exceeding those of TSMCRA year-round. Neither site is near a clear cut, and it is not clear what caused this change. TSMCRA is located at the bottom of the McRae stream channel and perhaps only during the summer does it receive enough direct solar radiation to drive its max temps above RS03's. Min temps for TSMCRA are often lower than those for RS03; not surprising considering TSMCRA's position in a valley over a stream channel.

CENMET and TSMCRA overlap during the years 1995 – 1999 and show trends that are to be expected. CENMET's max temps are almost always higher than TSMCRA's; CENMET min temps show more variation than do those for TSMCRA's. CENMET, being an open site, gets much more solar radiation and is more open to greater temperature fluxes than the relatively sheltered TSMCRA.

### **Recommendations for data use and specific problems**

- How to account for the max temp trends from the early 80s to the early 90s? Is this real?
- 1988 is a spotty and questionable year for data. Appears to be a decoupling of temps, especially min temps, between RS03 and TSMCRA during the late summer and early fall.
- Otherwise, data appears okay.

### **RS11, RS26, TS38 & HI15MET max/min temp comparisons**

(RS11 elev = ; RS26 elev = 1040m; TS38 elev = 977m; HI15MET elev = 922m)

All of these sites are on the NNW edge of the Andrews forest near the top of the Blue River Ridge. All are on the S side of the ridge crest (and thus in the forest boundary), on S or SE-facing slopes. Photos of RS11, RS26, and TS38 are lacking. HI15MET is in a clearing at the intersection of two roads. It is fairly open to the south, with a moderately dense forest about 100 ft south of the station. Still, it receives a good amount of direct solar radiation, with no canopy overhead.

RS11 only gives data for a very brief period in the 1970s; otherwise, overlap between the other stations is quite good and complete from 1981 on. TS38 max temps are higher than RS26's year-round; this is likely because of TS38's position in a clearcut area. It's min temps are comparable to RS26's, but a little lower, also attributable to it's more exposed location in a clearcut. HI15MET's max temps generally fall between those for RS26 and TS38, while it's min temps tend to be on the low side of the three sites. During the summers, it is not uncommon for HI15MET's max temps to exceed the other sites.

### **Recommendations for data use and specific problems**

- From 1985-, RS26's min temps are higher than TS38's in the summers. A reversal from previous years. Why? Datasets look good and clean otherwise.

### **GSMACK, TSLOMA & TSMACK max/min temp comparisons**

(GSMACK elev = ; TSLOMA elev = ; TSMACK elev = )

GSMACK and TSMACK are close to each other in the Mack Creek valley to the west of Lookout Mtn. GSMACK's temp sensor is open over the pool just below the gauging station on Mack Creek. TSMACK is upstream a ways (to the south). TSLOMA is at the bottom of the Mack Creek valley, where Mack Creek meets Lookout Creek. It is open to the south (south looks up the Mack Creek valley from its location), N, and W, and is surrounded by a sparse forest. Overhead canopy consists of one decrepit tree, so it is open vertically as well.

Data overlap occurs from 1987-1999. GSMACK's max temp seems to almost always be higher than TSMACK's throughout the year, and it's min temps are almost always lower than TSMACK's. These trends are less distinct in the winters; there are times when TSMACK min temps are higher than GSMACK max temps. Data is available from 1995 on from TSLOMA, generally it's max temps tend to be higher than GSMACK while it's min temps are comparable to GSMACK's. During late spring and early summer, the two sites' max temps are comparable.

### **Recommendations for data use and specific problems**

- 1990 once again proves to be a problem for min temp data; GSMACK min temps are severely out of calibration for the second half of this year (no other min temp data from it for 1990 exists). 1990 min temps appear to commonly be out of calibration in the Andrews climate stations!

### **RS05, RS10 & TSLOMC max/min temp comparisons**

(RS05 elev = 880m; RS10 elev = 610m; TSLOMC elev = )

These sites are located in the middle of the Lookout Creek valley; complete overlap of data here occurs between RS05 and RS10, consistent from 1971 through 1999. RS05 is located on a north-facing slope in a fairly thick forest, with a dense canopy. RS10 is located closer to the valley bottom, on the north side of the valley, on a south-facing slope. TSLOMC is closer yet to the bottom of the valley, at the confluence of Lookout and McRae Creeks.

RS10 max temps exceed RS05 max temps year-round. Not surprising given the aspect of their slopes. Their min temps are more closely aligned with one another. As with other stations, diurnal differences are greater in the summer than they are in the winter. Data for TSLOMC only spans a short period of time (1995-1996); its max temps exceed both RS10 and RS05, and its min temps are lower than both of those other stations. This is the case year-round. Interestingly, it appears common for RS10's min temps to be higher than RS05 max temps during the winter. There is enough of a difference in elevation, aspect, and forest density to account for this.

### **Recommendations for data use and specific problems**

- RS05 and RS10 datasets are remarkably complete and appear to be fairly clean; very few data dropouts. Some questionable data appears throughout 1990 (RS10 min temp out of calibration?) Otherwise, good datasets.

### **RS15, RS16 & GSWS03 max/min temp comparisons**

(RS15 elev = 760m; RS16 elev = 640m; GSWS03 elev = )

These three sites are located to the east of HJA headquarters and all are on the south side of the Lookout Creek valley. They are all located on NW-facing slopes. There is a complete record of overlap between RS15 and RS16 from 1972-1994. GSWS03 provides a miniscule amount of data and probably will not be used in final analysis.

RS16 max temps are higher than RS15's year-round, and the min temps correlate well throughout the year. I don't have any photographs to explain why this is, but these trends are consistent.

### **Recommendations for data use and specific problems**

- RS16's min temp data for 1990 appears out of calibration.. Otherwise, a good dataset.

### **TS74 & TS75 max/min temp comparisons**

(TS74 elev = ; TS75 elev = )

These two thermograph sites are very close to one another just outside the HJA boundary on the extreme west side. Both are on west-facing slopes, with TS74 being slightly higher in elevation than the other.

TS74 consistently shows higher max temps than TS75 throughout the year. Min temps for TS74 generally exceed those for TS75 as well. I don't have photos to comment on specific reasons for this.

### **Recommendations for data use and specific problems**

- TS75's min temp data for 1990 appears out of calibration.. Otherwise, a good dataset.

### **RS02, RS17 & RS20 max/min temp comparisons**

(RS02 elev = 490m; RS17 elev = 490m; RS20 elev = 683m)

All of these sites are located to the NE of the HJA headquarters near the bottom of the Lookout Creek valley. RS02 is in a moderately dense forest with a partial tree canopy above it, located on the south side of Lookout Creek on a NW-facing slope. RS17 is in a thicker forest, with a denser canopy, also on the south side of the creek with a N-facing slope. RS20 is high on the ridge on the north side of the valley, in a moderately thick deciduous/evergreen forest with a thick but low tree canopy above it, on a SE-facing slope.

There is good overlap between the stations from 1981 on. Max temps for all the sites are comparable throughout the year, with RS20 generally being just below the other two. This is probably due to the elevation difference of RS20 from the other two, since the thickness of the surrounding forest and canopies above for all three are comparable. RS20's min temps are also often higher than the other sites. This might be due to cold air drainage at night toward the bottom of the valley; RS20 would not experience this because of its position high on the ridge.

### **Recommendations for data use and specific problems**

- During early 1980s RS20 min temps consistently lower than the others; by mid-80s RS20 min temps exceeding others.
- Jan-Feb 1985 data discrepancy
- 1990 min temps data discrepancy

### **RS86, RS89, TS36 & GSWS10 max/min temp comparisons**

(RS86 elev = 653m; RS89 elev = 470m; TS36 elev = ; GSWS10 elev = )

These sites are located to the NW of HJA headquarters near the top of the ridge which separates Lookout Creek and Blue River. RS86 is at the top of a clearcut area and has a beautiful view and exposure to the south; it is situated on a south-facing slope. RS89 is in a small gully with moderately dense low forest around it and over it. It is on a north-facing slope and the gully is fairly open to the south. GSWS10 is in a small clearing in a creek drainage that is also fairly open to the south, surrounded by a fairly dense forest.

From the early 1980s until 1996 the general trend is for RS89 max temps to actually exceed max temps for RS86 during the summers but dipping below the max temps for RS86 during the winters. This trend abruptly changes in 1997 (RS86 clearcut?) when a trend that is more to be expected based on the current situation prevails (i.e., RS86 being much warmer due to its ample southern exposure). Min temps for the period 1981-1996 are roughly comparable,

with RS86 being a little warmer. GSWS10 provides data only for a limited time during the summer of 1999 but shows a lower max temp than the other two and a comparable min temp.

### **Recommendations for data use and specific problems**

- Data looks okay but how to correct for trend shift in 1997?

### **RS04 & VANMET max/min temp comparisons**

(RS04 elev = 1310m; VANMET elev = 1273m)

RS04 and VANMET are tucked away high in the extreme NE corner of the Andrews, at higher elevations than most of the other sites in the forest. VANMET is in a clearcut area, with a wonderful view to the south and thus high direct solar exposure on a south-facing slope. RS04, on the other hand, is in a fairly dense forest with a high canopy. Thick forest block the southern sky from RS04. Thus it is not surprising to see that VANMET max temps exceed those for RS04 year-round, sometimes by as much as 5 degrees. VANMET's min temps are a little higher than RS04's due to it's more exposed location. Data overlap exists from 1991 on.

### **Recommendations for data use and specific problems**

- No obvious problems with the datasets. Trends appear clear and consistent for the period of record.

### **RS07, PRIMET & CS2MET max/min temp comparisons**

(RS07 elev = 460m; PRIMET elev = 430m; CS2MET elev = 485m)

PRIMET is of course a benchmark climate site in the Andrews, being located just near the forest headquarters. It is in a clearing at the bottom of the Lookout Creek valley in the SW corner of the Andrews. CS2MET is another benchmark station, in a thickly wooded area just to the NE of PRIMET. RS07 is between them, also in a thickly wooded area with a thick canopy. RS07 and CS2MET are both on gentle NW-facing slopes. There is decent overlap between all three stations for a good period of record.

As expected, CSMET has higher max temps than the shady forested RS07, especially in the summer; their min temps are comparable. PRIMET's max temps often exceed both of the others, as it is in a clearing, while it's min temps are also comparable to the other two. However, compared to CS2MET, PRIMET's min temps fall consistently lower.

### **Recommendations for data use and specific problems**

- There are no obvious problems with these datasets.

### **RS24 & TSQRTZ max/min temp comparisons**

(RS24 elev = 651m; TSQRTZ elev = )

Both of these sites are well out of the boundaries of the HJ Andrews. RS24 is down the McKenzie valley NE of Nimrod, on the north side of Mt. Hagan, in an area with northern

exposure. TSQRTZ is in the Quartz Creek valley, a N-S running creek that feeds into Blue River Lake. No photos of these sites are available so I don't know much about their characteristics.

Trends appear to be inconsistent between these two sites. During certain years the max temps for RS24 uniformly exceed those for TSQRTZ, while in other years the reverse is true. It is unclear what might account for these differences. Min temps are consistently comparable, however.

### **Recommendations for data use and specific problems**

- See above; TSQRTZ temps severely out of calibration Oct 1988, Jan-Feb 1990.

### **GSWS06, GSWS07 & GSWS08 max/min temp comparisons**

(GSWS06 elev = ; GSWS07 elev = ; GSWS08 elev = )

All three of these gauging stations are up in the vicinity of TS38, RS11, RS26, and HI15MET on the south side of Blue River Ridge. They all are located on slopes with southern exposures, in stream channels. GSWS06 is in a thick, low forest, with a low but consistent canopy above it; GSWS07 is in a taller forest but not as thick, with a moderate canopy above; and GSWS08 is in a similar location. Data only exists for the station during 1998 and 1999.

Max temps for the stations are comparable throughout the year, with perhaps GSWS06 being the coolest of the three; GSWS07's min temps appear to be the lowest of the three, with GSWS08 having the warmest min temps.

### **Recommendations for data use and specific problems**

- Data, though brief appears good.

### **GSWS01, GSWS02 & GSLOOK max/min temp comparisons**

(GSWS01 elev = ; GSWS02 elev = ; GSLOOK elev = )

These gauging stations are all down in the vicinity of forest headquarters in the SW corner of the Andrews. GSWS01 is at the bottom of WS01, near the bottom of Lookout Valley but up a ways from Lookout Creek itself; slope is NW-facing, forest is dense surrounding it. GSWS02 is up in the forest above CS2MET, also on a NW-facing slope, relatively open towards the NW but thickly forested to the S; and GSLOOK is just below PRIMET at the bottom of the Lookout Valley over Lookout Creek; It is in a grove of deciduous trees but otherwise open to the E, S, and W.

GSLOOK's max temps are consistently higher during the year than GSWS02's; not surprising due to its relative openness. Min temps between then two stations are comparable. GSWS01's max temps fall right between the other two, with its min temps also comparable.

### **Recommendations for data use and specific problems**

- No apparent problems with this brief dataset.