Gather your data, I've attached in a second sheet some sample data from the DOT-Alaska Highway @ Dot Lake MP 1355.2 site from 6/1/2019 to 6/30/2020. I recommend using air temperature data since the prior June

| A          | В                | С            | D            | E             | F             | G             | н             | 1              | J              | K              | L              | M              | N              | 0            |
|------------|------------------|--------------|--------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|
| 1 Site_Abb | r Obs_Time(AKST) | AirTemp (°F) | PavTemp (ŰF) | Sub0Temp (ŰF) | Sub3Temp (ŰF) | Sub6Temp (ŰF) | Sub9Temp (ŰF) | Sub12Temp (°F) | Sub18Temp (°F) | Sub24Temp (°F) | Sub30Temp (ŰF) | Sub36Temp (ŰF) | Sub42Temp (°F) | Sub48Temp (° |
| 2 DOT      | 6/1/2019 0:00    | 47.48        | 51.26        | 58.82         | 59.72         | 60.08         | 60.26         | 60.08          | 59.72          | 59             | 57.92          | 56.3           | 54.32          | 52.          |
| 3 DOT      | 6/1/2019 1:00    | 46.58        | 51.26        | 58.28         | 59.36         | 59.9          | 60.08         | 60.08          | 59.72          | 58.82          | 57.74          | 56.12          | 54.14          | 52.          |
| 4 DOT      | 6/1/2019 2:00    | 46.22        | 51.08        | 57.74         | 58.82         | 59.72         | 59.9          | 59.9           | 59.54          | 58.82          | 57.74          | 55.94          | 54.14          | 52.          |
| 5 DOT      | 6/1/2019 3:00    | 46.04        | 49.82        | 57.2          | 58.46         | 59.36         | 59.72         | 59.72          | 59.36          | 58.64          | 57.38          | 55.76          | 53.78          | 51.          |
| 6 DOT      | 6/1/2019 4:00    | 45.32        | 49.46        | 56.66         | 58.1          | 59            | 59.36         | 59.54          | 59.18          | 58.46          | 57.2           | 55.4           | 53.6           | 51           |
| 7 DOT      | 6/1/2019 5:00    | 44.96        | 48.56        | 56.12         | 57.74         | 58.64         | 59.18         | 59.36          | 59             | 58.28          | 56.84          | 55.04          | 53.24          | 51.          |
| 8 DOT      | 6/1/20196:00     | 44.96        | 49.1         | 55.76         | 57.2          | 58.46         | 59            | 59.18          | 59             | 58.1           | 56.66          | 54.86          | 53.06          | 51.          |
| 9 DOT      | 6/1/2019 7:00    | 45.86        | 49.64        | 55.4          | 56.84         | 58.1          | 58.64         | 58.82          | 58.82          | 57.92          | 56.48          | 54.68          | 52.88          | 51.          |
| 10 DOT     | 6/1/2019 8:00    | 47.12        | 50.72        | 55.04         | 56.66         | 57.74         | 58.46         | 58.64          | 58.64          | 57.74          | 56.3           | 54.5           | 52.7           | 50           |
| 11 DOT     | 6/1/2019 9:00    | 47.84        | 51.8         | 55.04         | 56.3          | 57.38         | 58.1          | 58.46          | 58.46          | 57.56          | 56.3           | 54.32          | 52.52          | 50           |
| 12 DOT     | 6/1/2019 10:00   | 48.56        | 52.16        | 55.22         | 56.12         | 57.2          | 57.92         | 58.28          | 58.28          | 57.38          | 56.12          | 54.32          | 52.52          | 50.          |
| 13 DOT     | 6/1/2019 11:00   | 49.1         | 53.6         | 55.58         | 56.12         | 57.02         | 57.74         | 58.1           | 58.1           | 57.2           | 55.94          | 54.14          | 52.34          | 50.          |
| 14 DOT     | 6/1/2019 12:00   | 48.74        | 54.32        | 55.94         | 56.3          | 56.84         | 57.38         | 57.92          | 57.92          | 57.2           | 55.94          | 54.14          | 52.34          | 50.          |
| 15 DOT     | 6/1/2019 13:00   | 49.1         | 55.94        | 56.48         | 56.48         | 56.84         | 57.38         | 57.74          | 57.74          | 57.02          | 55.76          | 53.96          | 52.16          | 50.          |
| 16 DOT     | 6/1/2019 14:00   | 49.46        | 56.66        | 57.02         | 56.66         | 56.84         | 57.2          | 57.56          | 57.74          | 57.02          | 55.76          | 53.96          | 52.16          | 50.          |
| 17 DOT     | 6/1/2019 15:00   | 50.72        | 58.46        | 57.74         | 57.02         | 56.84         | 57.2          | 57.38          | 57.38          | 57.02          | 55.76          | 53.96          | 52.16          | 50.          |
| 18 DOT     | 6/1/2019 16:00   | 50.72        | 57.38        | 58.46         | 57.38         | 57.02         | 57.2          | 57.2           | 57.38          | 57.02          | 55.94          | 54.14          | 52.16          | 50.          |
| 19 DOT     | 6/1/2019 17:00   | 50.72        | 57.2         | 59.18         | 57.92         | 57.38         | 57.2          | 57.2           | 57.2           | 56.84          | 55.94          | 54.5           | 52.7           | 50.          |
| 20 DOT     | 6/1/2019 18:00   | 50.36        | 56.48        | 59.36         | 58.46         | 57.74         | 57.2          | 57.2           | 57.2           | 56.84          | 55.94          | 54.32          | 52.7           | 50           |
| 21 DOT     | 6/1/2019 19:00   | 49.82        | 54.86        | 59.54         | 58.64         | 57.92         | 57.38         | 57.2           | 57.02          | 56.66          | 55.76          | 54.32          | 52.7           | 50           |
| 22 DOT     | 6/1/2019 20:00   | 49.1         | 53.6         | 59.36         | 58.82         | 58.1          | 57.74         | 57.2           | 57.02          | 56.48          | 55.76          | 54.32          | 52.7           | 50           |
| 23 DOT     | 6/1/2019 21:00   | 48.2         | 53.24        | 59            | 58.82         | 58.28         | 57.74         | 57.38          | 57.02          | 56.48          | 55.58          | 54.14          | 52.52          | 50           |
| 24 DOT     | 6/1/2019 22:00   | 47.66        | 51.62        | 58.46         | 58.64         | 58.28         | 57.92         | 57.38          | 57.02          | 56.3           | 55.58          | 54.14          | 52.52          | 50           |
| 25 DOT     | 6/1/2019 23:00   | 47.3         | 51.26        | 57.92         | 58.28         | 58.28         | 57.92         | 57.38          | 57.02          | 56.3           | 55.4           | 53.96          | 52.34          | 50.          |
| 26 DOT     | 6/2/2019 0:00    | 46.58        | 49.82        | 57.2          | 57.92         | 58.1          | 57.92         | 57.38          | 57.02          | 56.3           | 55.4           | 53.96          | 52.34          | 50.          |
| 27 DOT     | 6/2/2019 1:00    | 46.04        | 49.64        | 56.48         | 57.38         | 57.92         | 57.74         | 57.38          | 57.02          | 56.3           | 55.22          | 53.78          | 52.16          | 50.          |
|            |                  |              |              |               |               |               |               |                |                |                |                |                |                |              |

## 2. Highlight and copy the time and air temperature at location

| B  | 1         | $\sim$ : $\times \checkmark f_x$ | · V Obs_Time  | e(AKST)       |                |                |                |                |                 |                 |                 |                 |                 |                 |          |
|----|-----------|----------------------------------|---------------|---------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|
|    | А         | В                                | С             | D             | E              | F              | G              | Н              | 1               | J               | К               | L               | М               | N               | 0        |
| 1  | Site_Abbr | Obs_Time(AKST)                   | AirTemp (A°F) | PavTemp (A°F) | Sub0Temp (A°F) | Sub3Temp (A°F) | Sub6Temp (A°F) | Sub9Temp (A°F) | Sub12Temp (A°F) | Sub18Temp (A°F) | Sub24Temp (A°F) | Sub30Temp (A°F) | Sub36Temp (A°F) | Sub42Temp (A°F) | Sub48Ten |
| 2  | DOT       | 6/1/2019 0:00                    | 47.48         | 51.26         | 58.82          | 59.72          | 60.08          | 60.26          | 60.08           | 59.72           | 59              | 57.92           | 56.3            | 54.32           |          |
| 3  | DOT       | 6/1/2019 1:00                    | 46.58         | 51.26         | 58.28          | 59.36          | 59.9           | 60.08          | 60.08           | 59.72           | 58.82           | 57.74           | 56.12           | 54.14           |          |
| 4  | DOT       | 6/1/2019 2:00                    | 46.22         | 51.08         | 57.74          | 58.82          | 59.72          | 59.9           | 59.9            | 59.54           | 58.82           | 57.74           | 55.94           | 54.14           |          |
| 5  | DOT       | 6/1/2019 3:00                    | 46.04         | 49.82         | 57.2           | 58.46          | 59.36          | 59.72          | 59.72           | 59.36           | 58.64           | 57.38           | 55.76           | 53.78           |          |
| 6  | DOT       | 6/1/2019 4:00                    | 45.32         | 49.46         | 56.66          | 58.1           | 59             | 59.36          | 59.54           | 59.18           | 58.46           | 57.2            | 55.4            | 53.6            |          |
| 7  | DOT       | 6/1/2019 5:00                    | 44.96         | 48.56         | 56.12          | 57.74          | 58.64          | 59.18          | 59.36           | 59              | 58.28           | 56.84           | 55.04           | 53.24           |          |
| 8  | DOT       | 6/1/20196:00                     | 44.96         | 49.1          | 55.76          | 57.2           | 58.46          | 59             | 59.18           | 59              | 58.1            | 56.66           | 54.86           | 53.06           |          |
| 9  | DOT       | 6/1/2019 7:00                    | 45.86         | 49.64         | 55.4           | 56.84          | 58.1           | 58.64          | 58.82           | 58.82           | 57.92           | 56.48           | 54.68           | 52.88           |          |
| 10 | DOT       | 6/1/2019 8:00                    | 47.12         | 50.72         | 55.04          | 56.66          | 57.74          | 58.46          | 58.64           | 58.64           | 57.74           | 56.3            | 54.5            | 52.7            |          |
| 11 | DOT       | 6/1/2019 9:00                    | 47.84         | 51.8          | 55.04          | 56.3           | 57.38          | 58.1           | 58.46           | 58.46           | 57.56           | 56.3            | 54.32           | 52.52           |          |
| 12 | DOT       | 6/1/2019 10:00                   | 48.56         | 52.16         | 55.22          | 56.12          | 57.2           | 57.92          | 58.28           | 58.28           | 57.38           | 56.12           | 54.32           | 52.52           |          |
| 13 | DOT       | 6/1/2019 11:00                   | 49.1          | 53.6          | 55.58          | 56.12          | 57.02          | 57.74          | 58.1            | 58.1            | 57.2            | 55.94           | 54.14           | 52.34           |          |
| 14 | DOT       | 6/1/2019 12:00                   | 48.74         | 54.32         | 55.94          | 56.3           | 56.84          | 57.38          | 57.92           | 57.92           | 57.2            | 55.94           | 54.14           | 52.34           |          |
| 15 | DOT       | 6/1/2019 13:00                   | 49.1          | 55.94         | 56.48          | 56.48          | 56.84          | 57.38          | 57.74           | 57.74           | 57.02           | 55.76           | 53.96           | 52.16           |          |
| 16 | DOT       | 6/1/2019 14:00                   | 49.46         | 56.66         | 57.02          | 56.66          | 56.84          | 57.2           | 57.56           | 57.74           | 57.02           | 55.76           | 53.96           | 52.16           |          |
| 17 | DOT       | 6/1/2019 15:00                   | 50.72         | 58.46         | 57.74          | 57.02          | 56.84          | 57.2           | 57.38           | 57.38           | 57.02           | 55.76           | 53.96           | 52.16           |          |
| 18 | DOT       | 6/1/2019 16:00                   | 50.72         | 57.38         | 58.46          | 57.38          | 57.02          | 57.2           | 57.2            | 57.38           | 57.02           | 55.94           | 54.14           | 52.16           |          |
| 19 | DOT       | 6/1/2019 17:00                   | 50.72         | 57.2          | 59.18          | 57.92          | 57.38          | 57.2           | 57.2            | 57.2            | 56.84           | 55.94           | 54.5            | 52.7            |          |
| 20 | DOT       | 6/1/2019 18:00                   | 50.36         | 56.48         | 59.36          | 58.46          | 57.74          | 57.2           | 57.2            | 57.2            | 56.84           | 55.94           | 54.32           | 52.7            |          |
| 21 | DOT       | 6/1/2019 19:00                   | 49.82         | 54.86         | 59.54          | 58.64          | 57.92          | 57.38          | 57.2            | 57.02           | 56.66           | 55.76           | 54.32           | 52.7            |          |
| 22 | DOT       | 6/1/2019 20:00                   | 49.1          | 53.6          | 59.36          | 58.82          | 58.1           | 57.74          | 57.2            | 57.02           | 56.48           | 55.76           | 54.32           | 52.7            |          |
| 23 | DOT       | 6/1/2019 21:00                   | 48.2          | 53.24         | 59             | 58.82          | 58.28          | 57.74          | 57.38           | 57.02           | 56.48           | 55.58           | 54.14           | 52.52           |          |
| 24 | DOT       | 6/1/2019 22:00                   | 47.66         | 51.62         | 58.46          | 58.64          | 58.28          | 57.92          | 57.38           | 57.02           | 56.3            | 55.58           | 54.14           | 52.52           |          |
| 25 | DOT       | 6/1/2019 23:00                   | 47.3          | 51.26         | 57.92          | 58.28          | 58.28          | 57.92          | 57.38           | 57.02           | 56.3            | 55.4            | 53.96           | 52.34           |          |
| 26 | DOT       | 6/2/2019 0:00                    | 46.58         | 49.82         | 57.2           | 57.92          | 58.1           | 57.92          | 57.38           | 57.02           | 56.3            | 55.4            | 53.96           | 52.34           |          |
| 27 | DOT       | 6/2/2019 1:00                    | 46.04         | 49.64         | 56.48          | 57.38          | 57.92          | 57.74          | 57.38           | 57.02           | 56.3            | 55.22           | 53.78           | 52.16           |          |
|    |           |                                  |               | Control 1     |                |                |                |                |                 |                 |                 |                 |                 |                 |          |

3. Paste the data into the sheet with the transpose paste in column 8 and 9, with the date on row 8 and the air temperature on row 9.



## 4. Once it is pasted it will look like this

| rd New<br>ons Script | Auto fill for all  | vert bacк 📘<br>I air temps 📑  | Unhide All Ro   | ows and C     | Freeze S            | election      | P<br>V All<br>Script | Automa<br>s Work | te<br>ates    |               |               |                |                |                |                |                |                |          |
|----------------------|--|---|---|---------------|---------------------|---------------|----------------------|------------------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|
| ~                    | $\sim$ : $\times \checkmark f_{x} \sim$  | Obs_Time(AKS  | ST)   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
| Α                    | B  | С   | D   | E             | F                   | G             | Н                    | 1                | J             | K             | L             | M              | N              | 0              | P              | Q              | R              | S        |
| 1.0                  | (DTIII//he & E))   | 1.5   |   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
| K (1                 | alpha/correction factor  | 0.003159663   | 0.021486193   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
| Ls                   | soil latent heat   | 2161  | 0.021400100   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      |  |   |   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
| las                  | st Column of Air Temp  | MXT   |   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
| S                    | Simulated Data Base  | ed on Air Ten   | nperature   | Aut           | to fill for all air | temps         | Delete               | , and revert bac | k to original |               |               |                |                |                |                |                |                |          |
| Ob                   | bs Time(AKST)  | 6/1/2019 0:00   | 6/1/2019 1:00   | 6/1/2019 2:00 | 6/1/2019 3:00       | 6/1/2019 4:00 | 6/1/2019 5:00        | 6/1/2019 6:00    | 6/1/2019 7:00 | 6/1/2019 8:00 | 6/1/2019 9:00 | 6/1/2019 10:00 | 6/1/2019 11:00 | 6/1/2019 12:00 | 6/1/2019 13:00 | 6/1/2019 14:00 | 6/1/2019 15:00 | 6/1/2019 |
| Air                  | rTemp (ŰF)   | 47.48   | 46.58   | 46.22         | 46.04               | 45.32         | 44.96                | 44.96            | 45.86         | 47.12         | 47.84         | 48.56          | 49.1           | 48.74          | 49.1           | 49.46          | 50.72          |          |
|                      | Depth ft   | T_initial (F)   |   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                | 6        |
|                      | 0.25   | 67.1  | 56.41097223   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                | LUV      |
|                      | 0.5  | 66.2  | 62.29210308   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 0.75   | 64.76   | 63.7760195  |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1  |   |   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      |  | 62.6  | 62.43603316   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5  | 58.64   | 58.70022703   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5  | 58.64<br>55.76  | 58.70022703<br>55.80664897<br>52.00020951   |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5  | 58.64<br>55.76<br>53.96<br>51.8   | 58.70022703<br>55.80664897<br>53.98929851<br>51.83473491  |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5<br>3   | 58.64<br>55.76<br>53.96<br>51.8<br>50.72  | 52.43603318<br>58.70022703<br>55.80664897<br>53.98929851<br>51.83473491<br>50.73768613  |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5<br>3<br>3.5<br>4   | 58.64<br>55.76<br>53.96<br>51.8<br>50.72<br>49.46   | 58.70022703<br>55.80664897<br>53.98929851<br>51.83473491<br>50.73768613<br>49.48027148  |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5<br>3<br>3.5<br>4<br>4.5  | 62:6<br>58:64<br>55:76<br>53:96<br>51:8<br>50:72<br>49:46<br>49:46                          | 58.70022703<br>55.80664897<br>53.98929851<br>51.83473491<br>50.73768613<br>49.48027148<br>48.2203125  |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5<br>3<br>3.5<br>4<br>4,5<br>5   | 62.6<br>58.64<br>55.76<br>53.96<br>51.8<br>50.72<br>49.46<br>48.2<br>47.48                  | 62.43603318<br>58.70022703<br>55.80664897<br>53.98929851<br>51.83473491<br>50.73768613<br>49.48027148<br>48.2203125<br>47.49174563                      |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5<br>3<br>3.5<br>4<br>4.5<br>5<br>5.5                                  | 62.6<br>58.64<br>55.76<br>53.96<br>51.8<br>50.72<br>49.46<br>49.46<br>48.2<br>47.48<br>45.5 | 58.70022703<br>55.80664897<br>53.98929851<br>51.83473491<br>50.73768613<br>49.48027148<br>48.2203125<br>47.49174563<br>45.53160058                      |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5<br>3<br>3.5<br>4<br>4<br>4.5<br>5<br>5<br>5.5                        | 62.6<br>58.64<br>55.76<br>53.96<br>51.8<br>50.72<br>49.46<br>48.2<br>47.48<br>45.5          | 22,4300310<br>58,70022703<br>55,80664897<br>53,98929851<br>51,83473491<br>50,73768613<br>49,48027148<br>48,2203125<br>47,49174563<br>45,53160058        |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | $ \begin{array}{r} 1.5\\ 2\\ .5\\ 3\\ .5\\ 4\\ 4.5\\ 5\\ 5.5\\ \end{array} $         | 62.0<br>58.64<br>55.76<br>53.96<br>51.8<br>50.72<br>49.46<br>48.2<br>47.48<br>45.5          | 22,4380316<br>55,80664897<br>53,98929851<br>51,83473491<br>50,73768613<br>49,48027148<br>48,2203125<br>47,49174563<br>45,53160058                       |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | 1.5<br>2<br>2.5<br>3<br>3.5<br>4<br>4.5<br>5<br>5.5                                  | 62.6<br>58.64<br>55.76<br>53.96<br>51.8<br>50.72<br>49.46<br>48.2<br>47.48<br>45.5          | 22,4380/310<br>58,70022703<br>55,80664897<br>53,98929851<br>51,83473491<br>50,73768613<br>49,48027148<br>48,2203125<br>47,49174563<br>45,53160058<br>32 |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |
|                      | $ \begin{array}{r} 1.5\\ 2\\ 2.5\\ 3\\ 3.5\\ 4\\ 4.5\\ 5\\ 5.5\\ 5.5\\ \end{array} $ | 62.0<br>58.64<br>55.76<br>53.96<br>51.8<br>50.72<br>49.46<br>48.2<br>47.48<br>45.5          | 224380316<br>55.00664897<br>53.98929851<br>51.83473491<br>50.73768613<br>49.48027148<br>48.2203125<br>47.49174563<br>45.53160058                        |               |                     |               |                      |                  |               |               |               |                |                |                |                |                |                |          |

5. Now you are ready to click on the green button labeled "Auto fill for all air temps". Be sure to have some air temperature values so the autofill button works as intended. Once you click it, it may take a few moments depending on the computer speed. This button applies temperature calculations along the whole range of air temperature values by

auto filling the equations all the way to the right. As it starts running, there should be a popup above the cells but bellow the ribbon display that says "The button Auto fill for all air temps is preparing to run", then it will say that it is running, then it will say that the run succeeded

| AutoSa            | 🛐 AutoSave 💽 🗄 🖓 V 🖓 v 🗢 Masters Template to Share Blank With Sample • Saved 🗸 🔎 Search Michael Stoddard 📧 - O X |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               | o ×            |                       |            |
|-------------------|--|--|--------------------|---------------|---------------------------------|-------------------------|--------------------|---------------|---------------|--|----------------------------------|----------------|----------------|---|-------------------------------|----------------|-----------------------|------------|
| File Ho           | ome Insert Page Lay  | out Formula  | as Data            | Review \      | /iew Auto                       | mate Dev                | eloper He          | lp            |               |  |                                  |                |                |   |                               | 모              | Comments              | 년 Share ~  |
| Paste             | B I U V  | 2 11 → A <sup>*</sup><br>3 →   <u>A</u> * → <u>A</u> | A <sup>×</sup> Ξ : | = = *         | ~ १₽ Wr<br>≠Ξ ⊞ Me<br>Alignment | ap Text<br>rge & Center | ↓ Genera<br>↓ \$ ↓ | al<br>% 9 5   |               | nditional Form<br>natting ~ Tal<br>Style | nat as Cell<br>ble ~ Styles<br>s | Insert D       | elete Format   | ∑ × A<br>Z<br>Sort<br>& Filter<br>Editi | 2 O<br>& Find &<br>* Select * | Sensitivity Ac | d-ins Analy<br>dd-ins | /ze<br>a   |
| (I) RUN ST        | TATUS The button Auto fill   | for all air temps                                    | is preparing 1     | o run. Stop   |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       | ×          |
| E4                | $\sim$ : $\times \checkmark f_{X} \checkmark$  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       | ~          |
| A                 | B  | С  | D                  | E             | F                               | G                       | н                  |               | J             | K  | L                                | M              | N              | 0                                       | Р                             | Q              | R                     | S 4        |
| 2                 | k (BTU/(br.ft.E))  | 1.5  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 3                 | a alpha/correction factor  | 0.003159663  | 0.021486193        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 4                 | L soil latent heat   | 2161   |                    |               | 1                               |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 5                 |  | 1017   |                    | _             |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 6                 | Auto fill for all air temps  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 7                 | imulated Data Based on Air Temperature   |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 8                 | Obs_Time(AKST)   | 6/1/2019 0:00  | 6/1/2019 1:00      | 6/1/2019 2:00 | 6/1/2019 3:00                   | 6/1/2019 4:00           | 6/1/2019 5:00      | 6/1/2019 6:00 | 6/1/2019 7:00 | 6/1/2019 8:00                            | 6/1/2019 9:00                    | 6/1/2019 10:00 | 6/1/2019 11:00 | 6/1/2019 12:00                          | 6/1/2019 13:00                | 6/1/2019 14:00 | 6/1/2019 15:00        | 6/1/2019 1 |
| 9                 | AirTemp (A*F)  | 47.48  | 46.58              | 46.22         | 46.04                           | 45.32                   | 44.96              | 44.96         | 45.86         | 47.12                                    | 47.84                            | 48.56          | 49.1           | 48.74                                   | 49.1                          | 49.46          | 50.72                 | . 51       |
| 10                | Depth n  | I_Initial (F)  | 50 41007000        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 12                | 0.23   | 66.2   | 62 29210308        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 13                | 0.75   | 64.76  | 63,7760195         |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 14                | 1  | 62.6   | 62.43603518        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 15                | 1.5  | 58.64  | 58.70022703        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 16                | 2  | 55.76  | 55.80664897        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 17                | 2.5  | 53.96  | 53.98929851        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 18                | 3  | 51.8   | 51.83473491        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 19                | 3.5  | 50.72  | 50.73768613        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 20                | 4  | 49.46  | 49.48027148        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 21                | 4.5  | 48.2   | 48.2203125         |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                | 1                     |            |
| 22                | 55   | 47.40  | 47.49174363        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 24                | 0.0  | 40.0   | 40.00100000        |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
|                   |  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 25                |  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 26                |  |  | 32                 |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 27                |  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 29                |  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 30                |  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 31                |  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| 32                |  |  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       |            |
| $\langle \rangle$ | Temperature Pre  | diction Model  | Sample             | Data          | +                               |                         |                    |               |               |  |                                  |                |                |   |                               |                |                       | •          |
|                   | ePo  |  | Sample             |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               | (m) (m)        |                       |            |
| Keady 🜆           | ોર્≺ Accessibility: Investigate  | 2  |                    |               |                                 |                         |                    |               |               |  |                                  |                |                |   |                               | ▣ 巴 -          |                       |            |

## 6. Now all of the data has been auto filled, it looks like this

| AutoSa                  | we 💽 🖟 🏷 - (   | Qʻ~ ∓ Ma   | asters Templat   | e to Share Bla | ink With Samp                     | ole • Saved                | d 🗸           | ,∕⊃ Search              |                       |                              |                             |                | Michael Stoddard 1 — |                                 |                                 |                            |                |                |
|-------------------------|--|--|------------------|----------------|-----------------------------------|----------------------------|---------------|-------------------------|-----------------------|------------------------------|-----------------------------|----------------|----------------------|---------------------------------|---------------------------------|----------------------------|----------------|----------------|
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| Paste<br>V<br>Clipboard | Aptos Narrow<br>B I U ~ E  | <u>v11</u> v A^<br>⊞ v <u>A</u> v <u>A</u><br>nt | A <sup>×</sup> ≡ | = = *          | ~ פּלי ע<br>ב פּלי ע<br>Alignment | /rap Text<br>lerge & Cente | r ~ \$        | eral<br>~ % 9<br>Number | -00 00<br>-00 →0<br>F | Conditional I<br>ormatting ~ | iormat as C<br>Table ~ Styl | ell insert     | Delete Form<br>Cells | at $\sum_{i=1}^{n} \frac{1}{2}$ | ort & Find &<br>Iter * Select * | Sensitivity<br>Sensitivity | Add-ins A      | nalyze<br>Data |
| RUN S                   | TATUS The button Auto fil  | Il for all air temp                              | s run succeede   | ed. View sci   | ript                              |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                | ×              |
| F2                      | $\checkmark$ : $\times \checkmark f_x \checkmark$  |  |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
| A                       | В  | с  | D                | E              | F                                 | G                          | н             | 1.1                     | J                     | К                            | L                           | м              | N                    | 0                               | P                               | Q                          | R              | S              |
|                         | k (BTU/(hr ft F))<br>a alpha/correction factor<br>L soil latent heat   | 1.5<br>0.003159663<br>2161                       | 0.021486193      |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
|                         | last Column of Air Temp  | MXT  |                  | A              | rto fill for all air t            | temps                      | Delete        | e, and revert bar       | ck to original        |                              |                             |                |                      |                                 |                                 |                            |                |                |
|                         | Simulated Data Based on Air Temperature Regional and a second a second and a second a |  |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
|                         | Obs_Time(AKST)   | 6/1/2019 0:00                                    | 6/1/2019 1:00    | 6/1/2019 2:00  | 6/1/2019 3:00                     | 6/1/2019 4:00              | 6/1/2019 5:00 | 6/1/2019 6:00           | 6/1/2019 7:00         | 6/1/2019 8:00                | 6/1/2019 9:00               | 6/1/2019 10:00 | 6/1/2019 11:00       | 6/1/2019 12:00                  | 6/1/2019 13:00                  | 6/1/2019 14:00             | 6/1/2019 15:00 | 6/1/2019 16:00 |
|                         | Airlemp (A**)  | 47.48  | 46.58            | 46.22          | 46.04                             | 45.32                      | 44.96         | 44.96                   | 45.86                 | 47.12                        | 47.84                       | 48.56          | 49.1                 | 48.74                           | 49.1                            | 49.46                      | 50.72          | 50.72          |
| 1                       | Ueptn ft   | I_initial (F)                                    | 5C 41007002      | 61 10241646    | 40 46526202                       | 46 92601022                | 45.95449651   | 45 20051270             | 45 62411414           | 46 40910265                  | 47 15200010                 | 47 99620506    | 40 51057175          | 40 02201646                     | 49 97670252                     | 40 10054670                | 40.02245002    | 50 20005020    |
| 2                       | 0.25   | 66.2   | 62 20210308      | 59 09087362    | 56 49141038                       | 54 26629722                | 52 4126750    | 50 92825749             | 49.03411414           | 40.40012303                  | 49.05829636                 | 47.00039390    | 40.01007170          | 48.03391343                     | 40.07070232                     | 49.10034072                | 49.30243332    | 49 66038749    |
|                         | 0.5  | 64.76  | 63 7760195       | 62.82581153    | 61 91729057                       | 61.01897317                | 60 14979185   | 59 32765439             | 58 59872649           | 57 97744799                  | 57 42876531                 | 56 94874925    | 56 52394087          | 56 10264021                     | 55 72362693                     | 55 38461226                | 55 1321/32     | 54 89333886    |
|                         | 1  | 62.6   | 62.43603518      | 62.27006394    | 62.10394911                       | 61.93216527                | 61.75845503   | 61.58652272             | 61.42556164           | 61.27914411                  | 61.14159437                 | 61.01282165    | 60.89089384          | 60.76652935                     | 60.64712233                     | 60.53262205                | 60.43218979    | 60.33278545    |
|                         | 1.5  | 58.64  | 58,70022703      | 58,75686525    | 58.80996932                       | 58.85950537                | 58,90549944   | 58,94803595             | 58.98734381           | 59.02370499                  | 59.05730694                 | 59.08833269    | 59.11693172          | 59,14310386                     | 59,16696627                     | 59.18863345                | 59.20836344    | 59.22620326    |
|                         | 2  | 55.76  | 55.80664897      | 55.85345643    | 55.90036379                       | 55.94731286                | 55.99424677   | 56.04111092             | 56.08785518           | 56.1344347                   | 56.18080833                 | 56.22693845    | 56.27279042          | 56.31833016                     | 56.36352597                     | 56.40834849                | 56.45277289    | 56.4967755     |
|                         | 2.5  | 53.96  | 53.98929851      | 54.01887482    | 54.04872609                       | 54.07884864                | 54.10923791   | 54.13988857             | 54.17079456           | 54.20194923                  | 54.23334536                 | 54.26497525    | 54.29683079          | 54.32890344                     | 54.36118429                     | 54.39366414                | 54.42633349    | 54.45918265    |
|                         | 3  | 51.8   | 51.83473491      | 51.86938798    | 51.90396486                       | 51.93847107                | 51.97291196   | 52.00729272             | 52.04161835           | 52.07589367                  | 52.1101233                  | 52.14431169    | 52.17846307          | 52.21258147                     | 52.24667071                     | 52.28073442                | 52.31477601    | 52.34879867    |
|                         | 3.5  | 50.72  | 50.73768613      | 50.75564145    | 50.77386049                       | 50.79233794                | 50.81106866   | 50.83004768             | 50.84927018           | 50.86873151                  | 50.88842715                 | 50.90835273    | 50.92850401          | 50.94887689                     | 50.96946739                     | 50.99027165                | 51.01128594    | 51.03250661    |
|                         | 4  | 49.46  | 49.48027148      | 49.50050621    | 49.52070896                       | 49.54088433                | 49.56103679   | 49.58117062             | 49.60129              | 49.62139894                  | 49.64150132                 | 49.6616009     | 49.68170129          | 49.70180601                     | 49.72191844                     | 49.74204184                | 49.76217938    | 49.7823341     |
|                         | 4.5  | 48.2   | 48.2203125       | 48.24062376    | 48.2609333                        | 48.28124071                | 48.30154566   | 48.3218479              | 48.34214724           | 48.36244355                  | 48.38273679                 | 48.40302696    | 48.42331412          | 48.44359838                     | 48.46387991                     | 48.48415894                | 48.50443572    | 48.52471056    |
|                         | 5  | 47.48  | 47.49174563      | 47.50362716    | 47.51564241                       | 47.52778921                | 47.54006546   | 47.55246904             | 47.56499789           | 47.57764999                  | 47.59042331                 | 47.60331589    | 47.6163258           | 47.62945112                     | 47.64268997                     | 47.65604053                | 47.66950097    | 47.68306954    |
|                         | 5.5  | 45.5   | 45.53160058      | 45.56288831    | 45.59387026                       | 45.62455338                | 45.65494446   | 45.68505015             | 45.71487697           | 45.7444313                   | 45.77371939                 | 45.80274735    | 45.83152118          | 45.86004672                     | 45.88832973                     | 45.91637583                | 45.94419052    | 45.97177917    |
|                         |  |  |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
|                         |  |  |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
|                         |  |  | 32               | 32             | 32                                | 32                         | 32            | 32                      | 32                    | 32                           | 32                          | 32             | 32                   | 32                              | 32                              | 32                         | 32             | 32             |
|                         |  |  |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
|                         |  |  |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
|                         |  |  |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 |                                 |                            |                |                |
| 1                       | Temperature Pre  | ediction Mode                                    | Camel            | - D-t-         | +                                 |                            |               |                         |                       |                              |                             | -              |                      |                                 |                                 |                            |                |                |
| \ /                     | remperature Pre  | curcuon would                                    | Sample           | e Data         | Ŧ                                 |                            |               |                         |                       |                              | 1.4                         | -              |                      |                                 |                                 |                            |                | •              |
| eady 🗔                  | 🛠 Accessibility: Investigat  | te   |                  |                |                                   |                            |               |                         |                       |                              |                             |                |                      |                                 | <b>=</b>                        |                            |                |                |

7. Now the temperature gradient will be shown and it will be color coded to have darker red be the hottest temperature in the gradient, white (no color) to be 32 degrees and darker blue to be the coldest temperature. If you want you can scroll to the point where

the ground temperature starts to thaw. The 1 ft and 5 ft depths are boxed with a border. If you would like a more visual representation, proceed to the next steps

8. The graph, located below the temperature gradient will show all of the relavant data.



9. Look for the point where the temperature lines cross the 32 degree point. And if you hover your mouseover that point it will have a popup with the pertainant details about that point (the date it occurs).



10. To reset back to a state where it is ready for new data, either open a fresh copy of the file or delete the existing values by clicking the "Delete, and revert back to original"

## button which will make it all look like this:

| 8     | 🛿 Autosave 🔐 😨 🖓 - 🖓 - 🕫 Masters Template to Share Blank With Sample • Saved 🗸 🖉 Search Michael Stoddard 😢 - O X |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  | ×  |                            |         |                 |       |
|-------|--|--|------------------|--------------------|--------------|-------------------------------|----------------------------|----------|-----------------|---------------------------|-----------------------------|--------------------------------------|----------------------|-----------------|--|--|----------------------------|---------|-----------------|-------|
| File  | Home   | Insert Page La   | yout Formu       | las Data           | Review       | View Aut                      | omate De                   | eveloper | Help            |                           |                             |                                      |                      |                 |  |  |                            | Commer  | its 🖻 Sh        | are ~ |
| Pas   | tte Car v  | Aptos Narrow<br>B I U ~ E  | - 11 - A^<br>∃ - | A <sup>*</sup> ≡ : | = <u>-</u> » | → độ V<br>→Ξ 🖽 N<br>Alignment | Vrap Text<br>Merge & Cente | er ~ \$  | v % 9<br>Number | v<br>.00. 00<br>.00 ★ 00. | Conditional<br>Formatting ~ | Format as C<br>Table ~ Sty<br>Styles | Cell Inse<br>les * * | ert Delete Form | $ \begin{array}{c} \Sigma \\ \bullet \\ at \end{array} $ | AV<br>Sort & Find &<br>Filter * Select * | Sensitivity<br>Sensitivity | Add-ins | Analyze<br>Data | ~     |
| ()    | RUN STATU  | S The button Delete,   | and revert back  | to original run    | succeeded.   | View script                   |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 | ×     |
| К9    | ~  | $:$ $\times \checkmark f_{x} \checkmark$   |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 | ~     |
|       | A  | В  | с                | D                  | E            | F                             | G                          | н        | 1               | J                         | K                           | L                                    | M                    | N               | 0  | P  | Q                          | R       | S               |       |
| 1     |  |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 2     | k (BT  | U/(hr ft F))   | 1.5              | 0.001405400        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 3     | a aip  | ha/correction factor   | 0.003159063      | 0.021406193        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 5     | 2 301  | tatencheat   | 2101             |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 6     | last (   | Column of Air Temp   | В                |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 7     | Sin  | una rodenin to the temp of a construction of the temps of te |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 9     | Ohe  | Omutated Data Dased on Air Temperature   |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 9     | AirTe  | mp (ŰF)  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 10    |  | Depth ft   | T initial (F)    |                    |              |                               |                            |          |                 |                           |                             | -                                    |                      |                 |  |  |                            |         |                 |       |
| 11    |  | 0.25   | 67.1             | 32.14708756        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 12    |  | 0.5  | 66.2             | 53.01433354        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 13    |  | 0.75   | 64.76            | 61.25490775        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 | _     |
| 14    |  | 1  | 62.6             | 61.95928853        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 | _     |
| 15    |  | 1.5  | 58.64            | 58.69266308        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 10    |  | 2  | 53.76            | 52.00032090        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 18    |  | 2.5  | 51.8             | 51 83473488        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 19    |  | 3.5  | 50.72            | 50,73768613        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 20    |  | 4  | 49.46            | 49.48027148        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 21    |  | 4.5  | 48.2             | 48.2203125         |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 22    |  | 5  | 47.48            | 47.49174563        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 23    |  | 5.5  | 45.5             | 45.53160058        |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 24    |  |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 25    |  |  |                  | 20                 |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 26    |  |  |                  | 32                 |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 28    |  |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 29    |  |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 30    |  |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 31    |  |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 |       |
| 32    |  |  |                  |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  |  |                            |         |                 | -     |
| <     | >  | Temperature Pre  | ediction Mode    | Sample             | Data         | +                             |                            |          |                 |                           |                             |                                      | -                    |                 |  |  |                            |         |                 | •     |
| Ready | 10 k   | Accessibility: Investigat  | te               |                    |              |                               |                            |          |                 |                           |                             |                                      |                      |                 |  | Ħ  |                            |         | ++              | 80%   |