**5 minute QC Program - This program will run [daily]**

\*\* Inline comments are preceded by a "%".

\*\* Questionable functions in *italics.*

**Input: Level\_0**

**Output: Level\_1**

**House Keeping Suggestions:**

\*\* Convert all logger output to consistent units.

\*\* Convert FSDB preferred names during the step between level\_0 and level\_1.

\*\* Clean up the variable output (put air temp and relative in same logger output table at same interval).

**Valid flag labels for operational QC functions:**

'**I**'**:** Invalid value (out of range)

**'Q'**: Flags values used by Fred (q\_lower\_limit and q\_upper\_limit).

'**V**': Flags values n greater than or m less than the mean of the preceding N readings.

'**C**': Flags values greater than or less than N Stdev the mean of the preceding M readings.

**'A':** Flags values with total accumulation over N days greater than some value.

**'S'**: Flags unrealistic sequences of identical or near identical values in time series of non-missing values.

'**T**': For methods or hardware related flags. ie. Broken shield, plugged aspirated fan intake.

'**D'**: Value is outside detection limit.

**'L'**: Low value.

**'H'**: High value.

**'P':** Program ID change.

**Begin Program**

RECORD (number)

x<0='I'; %Flags value is record number is negative

LOGGERID (number)

flag\_notinarray(x,[LOGGERID])='I'; %Flags value if loggerID is incorrect

PROGID (number)

flag\_valuechange(x,0.1,0.1,1)='P'; %Flags value when the program ID changes

Year\_RTM (yyyy)

x<2012='I'; %Flags value if year is outside of the study start range.

Day\_RTM (doy)

x<1='I'; %Flags value if day is less than one

x>366='I'; %Flags value if day is greater than 366

Hour\_Minute\_RTM (hhmm)

x<0='I'; %Flags value if hour is less than zero

x>2400='I'; % Flags value if hour is greater than 2400

SA\_PRECIP (mm)

x<0='I'; %Flags value if precipitation value is less than zero

x>1200='I'; %Flags value if precipitation value is greater than 1200

col\_SA\_TEMP<0='T'; %Flags value if orifice temperature is less than zero

~flag\_valuechange(col\_SA\_TEMP,0.01,0.01,5,2)&~flag\_valuechange(col\_SA\_TEMP,0.1,0.1,15,2)='S'; %Generates 'S' flag for orifice temperature values that don't change by at least +/- 0.01 over a run of 5 readings, and also don't change by +/- 0.1 over a run of 15 preceding readings.

*flag\_valuechange(x,5,10,3)='V'; %Flags value if current value is 5mm above or 10mm below the mean of the preceding 3 values*

*flag\_nsigma(x,5,5,5)='C'; %Flags value if 5 STDEV below or above the mean of the preceding 5 values*

*flag\_total(x,20,12,1) ='A'; %Flags values that make 6-hr running totals >20mm*

SH\_PRECIP (mm)

x<0='I'; %Flags value if precipitation value is less than zero

x>1200='I'; %Flags value if precipitation value is greater than 1200 (Maximum value of water the tank can hold)

col\_SH\_TEMP<0='T'; %Flags value if orifice temperature is less than zero

~flag\_valuechange(col\_SH\_TEMP,0.01,0.01,5,2)&~flag\_valuechange(col\_SH\_TEMP,0.1,0.1,15,2)='S'; %Generates 'S' flag for orifice temperature values that don't change by at least +/- 0.01 over a run of 5 readings, and also don't change by +/- 0.1 over a run of 15 preceding readings.

*flag\_valuechange(x,5,10,3)='V'; %Flags value if current value is 5 above or 10 below the mean of the preceding 3 values*

*flag\_nsigma(x,5,5,5)='C'; %Flags value if 5 STDEV below or above the mean of the preceding 5 values*

*flag\_total(x,20,12,1) ='A'; %Flags values that make 6-hr running totals >20[mm]*

SNOW\_MOIS (mm)

x<0='I'; %Flags values less than zero

x>2500='I'; %Flags values greater than 2500

x>2000='Q'; %Flags values greater than 2000

*flag\_valuechange(x,5,10,3)='V'; % Flags values if current value is 5 above or 10 below the mean of the preceding 3 values*

*%flag\_total(x,250,288,1) ='A'; %Flags values that make the 24-hr running totals greater than 250mm*

*%flag\_nsigma(x,3,3,5)='C'; %Flags value if 3 STDEV below or above the mean of the preceding 5 values (Can you run a conditional stdev along three window moving window)*

TIPPING\_B\_TOT (tips) %This is a snowmelt collected by a lysimeter

x<0='I'; %Flags values less than zero

x>7='I'; %Flags values greater than seven

x>6='Q'; %Flags values greater than six

SNOWDEPTH (m)

x<0='I'; %Flags values less than zero

x>4.5='I'; %Flags values greater than 4.5m

x>4.0='Q'; %Flags values greater than 4.0m

*flag\_valuechange(x,0.05,0.05,3)='V'; %Flags values if the current value is 0.05m above or 0.05m below the mean of the preceding 3 values*

*flag\_total(x,250,12,1) ='A'; %Flags values that make 6-hr running totals >250mm*

*flag\_nsigma(x,5,5,5)='C'; %Flags value if 5 STDEV below or above the mean of the preceding 5 values*

SA\_TEMP (°C)

x<0='T'; %Flags values less than zero

~flag\_valuechange(x,0.01,0.01,5,2)&~flag\_valuechange(x,0.1,0.1,15,2)='S'; %Generates 'S' flag for values that don't change by at least +/- 0.01 over a run of 5 readings, and also don't change by +/- 0.1 over a run of 15 preceding readings.

SH\_TEMP (°C)

x<0='T'; %Flags values less than zero

~flag\_valuechange(x,0.01,0.01,5,2)&~flag\_valuechange(x,0.1,0.1,15,2)='S'; %Generates 'S' flag for values that don't change by at least +/- 0.01 over a run of 5 readings, and also don't change by +/- 0.1 over a run of 15 preceding readings.

BATTERY\_V (v)

x<0='I'; %Flags values less than 0v

x<12='L'; %Flags values less than 12v

x>14='H'; %Flags values greater than 14v

**Function descriptions and examples:**

x<0='I'

-- generates 'I' flags for negative values

flag\_notinarray(x,[0,1,2,3])='I'

-- generates 'Q' flags for any numeric values that are not present in the specified array (or use flag\_inarray to check for values that are in an array, e.g. numeric errors codes)

flag\_nsigma(x,3,3,5)='C'

-- generates 'Q' flags for any values that are more than 3 standard deviations below of above the mean of the preceding 5 values (note: input parameters are 'value','lowlimit','highlimit' and 'framesize', resp.)

flag\_valuechange(x,5,10,3)='V'

-- generates 'Q' flags for any values that are more than 5 below or 10 above the mean of the preceding 3 values, in the native units of measurement for the column (note: input parameters are 'value','lowlimit','highlimit' and 'framesize', resp.)

~flag\_valuechange(x,0.25,0.25,3,2)&~flag\_valuechange(x,0.6,0.6,15,2)='S'

-- generates 'S' flag for values that don't change by at least +/- 0.25 over a run of 3 readings, and also don't change by +/- 0.6 over a run of 15 preceding readings.

flag\_total(x,100,72,1) ='A'

--  flag\_total(vals,highlimit,framesize,iterations),

where: vals = an array of data values; highlimit = flagging threshold in the same units as the data column; framesize = number of preceding records to total; iterations = number of recursive flag check iterations to prevent bad values from affect subsequent ones

**Additional Notes:**

* Large offsets occur in data after tanks are drained \_TODO (can be programmed to adjust if timestamp and offset value is known or could be handled at the data logger level)
* Daily height fluctuation exists as artifact of sampling method \_TODO