Data Quality Control (QC) Basics

Typical QC Structure

QC at stations — QC0

Data retrievals in real-time

Non-real-time data
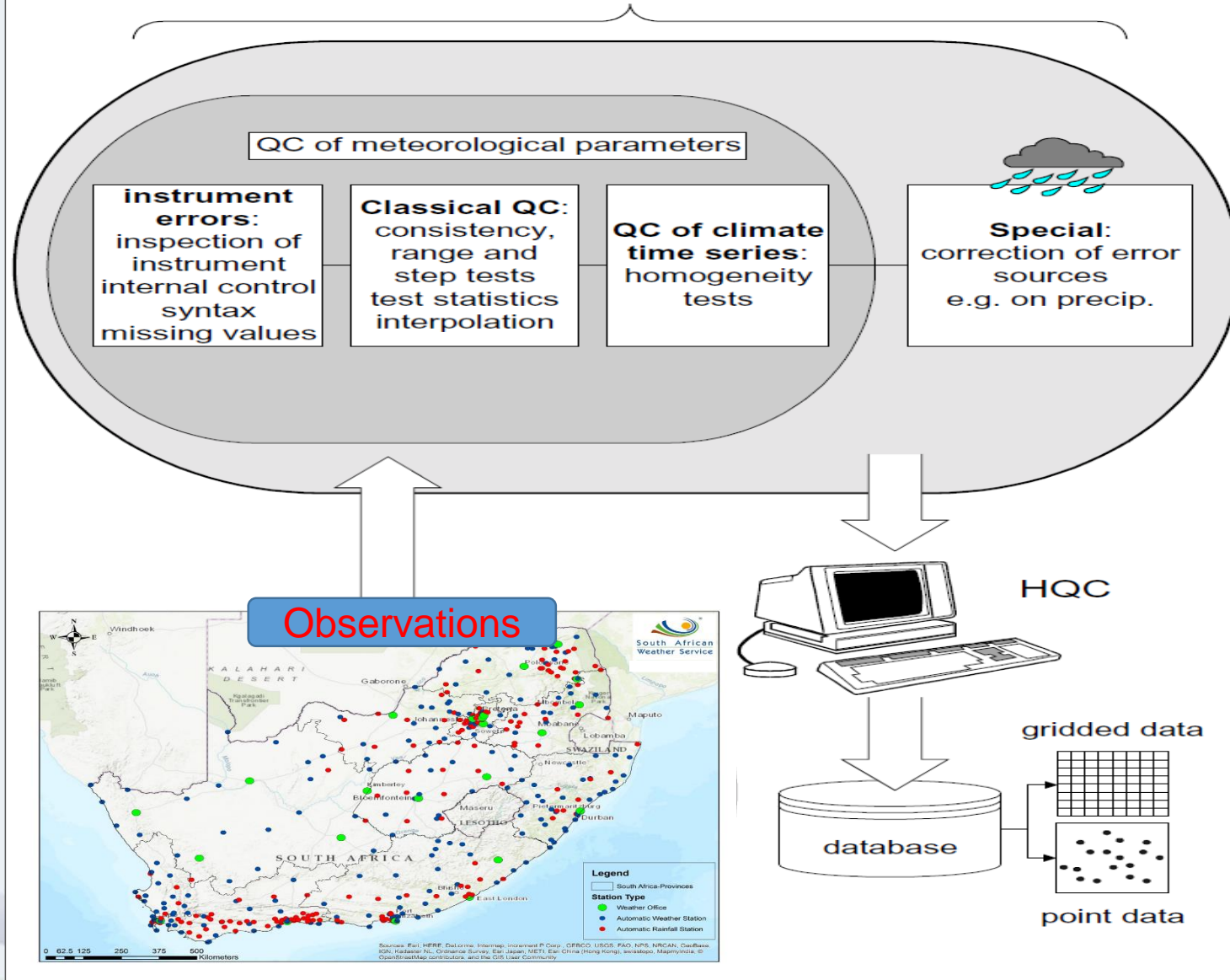
Real-time QC — QC1

Databases (real-time data + non-real-time data)

Non-real-time QC — QC2

Human QC — HQC
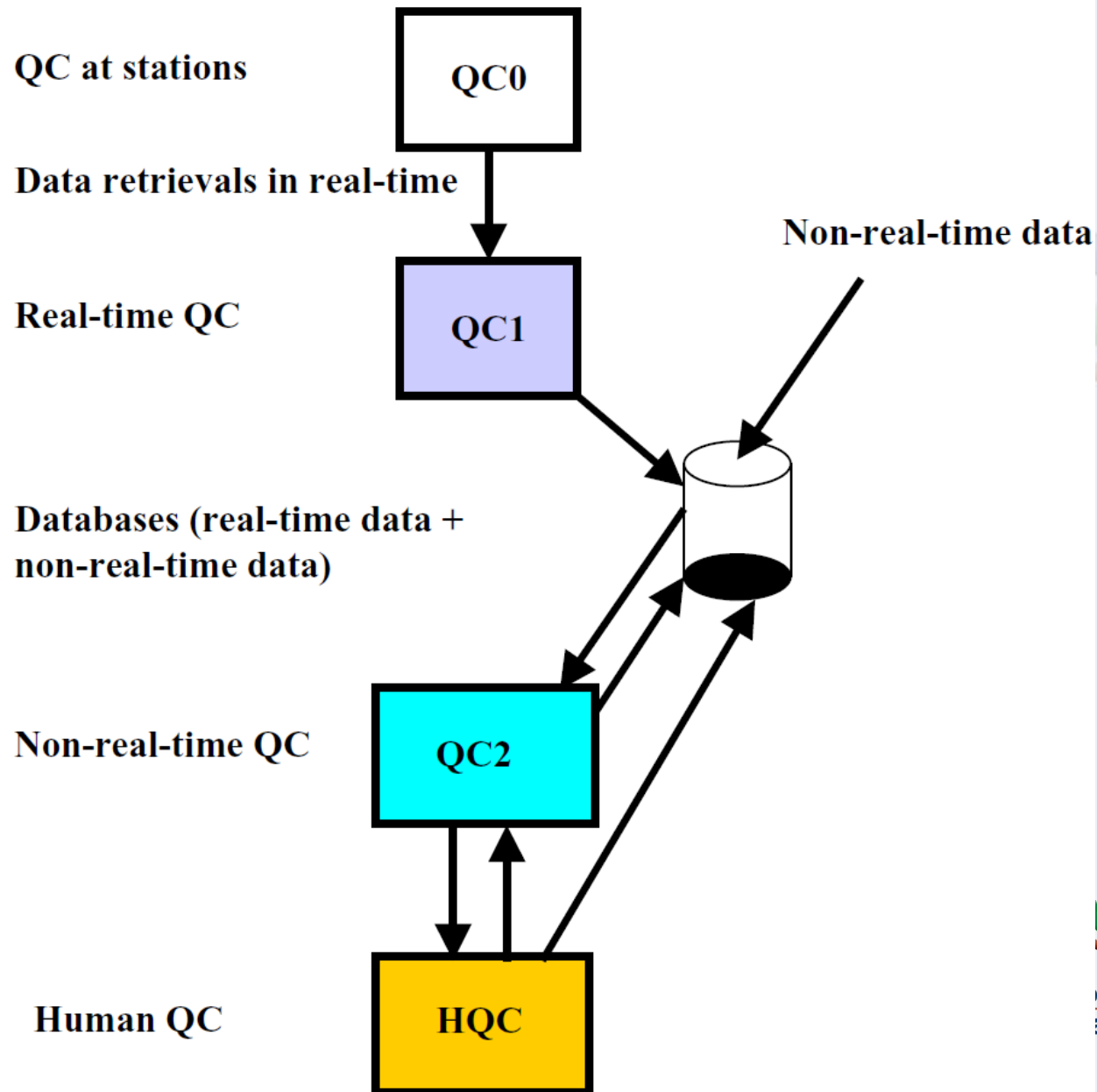
Typical SAWS Data Flow

Basic diagram showing the flow of data from sensor to ClimDB

AWS sends data to regional database and ClimDB

Regional database

Met Tec views and QCs data via Metcap

Met Tec sends data to ClimDB

Blue writing who does what
Green writing refers to QC flags

CLIMDB

QCed data from the regional database has QCflag = 10

Raw data from the logger has QCflag = 0

Climate Data personnel check data and report any problems back to Regional offices for further checking

If Climate Data personnel make changes to or QC data the QC flag = 20

General QC Flow

Observed versus expected value

QC of meteorological parameters

instrument errors: inspection of instrument internal control syntax missing values

Classical QC: consistency, range and step tests test statistics interpolation

QC of climate time series: homogeneity tests

Special: correction of error sources e.g. on precip.

Observations

HQC

gridded data

database

point data

4

Most basic (QC0)data quality checks/assurance

- site evaluation

- installation of instruments

- installation of data collection and transmission systems (hardware and software)

- quality control methods

- instrument service

- personnel training

*** All the above are generally done during the station Inspection because "Data Quality Starts at the Site" ***

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5

Real-time quality control (QC1)

❑ Automatic checking of real-time (SYNOPTIC) data (station-by-station basis).

   ✓   Observations from neighbouring sites not available in real-time (not possible to use interpolation methods)

   ✓ Observations arrive at the Head Office in random order (makes the use of data from neighbouring sites impractical in the real-time window).

❑ Mainly based on the following methods:

   ➢ range and limit checks based on statistical limits

   ➢ step checks for control of parameter value changes

   ➢ internal consistency checking

   ➢ checking missing values

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Non Real-time quality control (QC2)

❑ Automatic data checking after real time

    ✓ observations from neighbouring sites are normally available during quality control.

    ✓ Enables spatial analyses of data through a variety of checking methods, for example interpolation methods.

    ✓ Tests from QC1 can be applied at the QC2 level.

❑ Comprehensive quality data flagging included in this phase as much as possible.

❑ Correction methods could be included in QC2.

    ✓ Missing data will be detected, and it is possible to calculate or interpolate values to compensate for missing data.

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Human Quality Control (HQC)

❑ HQC is the final phase in the quality control procedure

❑ Manual quality control can be done on all levels.

✓ HQ0 is done at station level.

✓ HQ1 includes manual inspection of errors and suspicious values that have been identified at the QC1 level

✓ while HQ2 includes inspection of values found at the QC2 level.

❖ **HQC can include manual inspection at any level.**

After quality control at a certain level, databases may include some unresolved errors in observation data.

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Human Quality Control (HQC) Cont.

❑ The purpose of manual inspection is to examine only erroneous or suspicious values, and a comprehensive flagging will allow the map representation of erroneous, suspicious and modified values.

❑ A manual control system can be used to modify and accept values and these modifications in turn will affect the flagging.

❑ HQC can be done in many different ways;

  ✓ Could be based on various paper formats, error lists and possibly graphical fields

  ✓ Could be based on a GIS system for interpretation of flagging and data values by maps and tables.

  ✓ Visualization of data is very important, e.g. sums, graphical presentations of data, observations of neighbouring stations etc. (Currently, GIS tools are only used)

From the HQC phase it should be possible to return to the previous quality control phase in order to check and trace modifications.
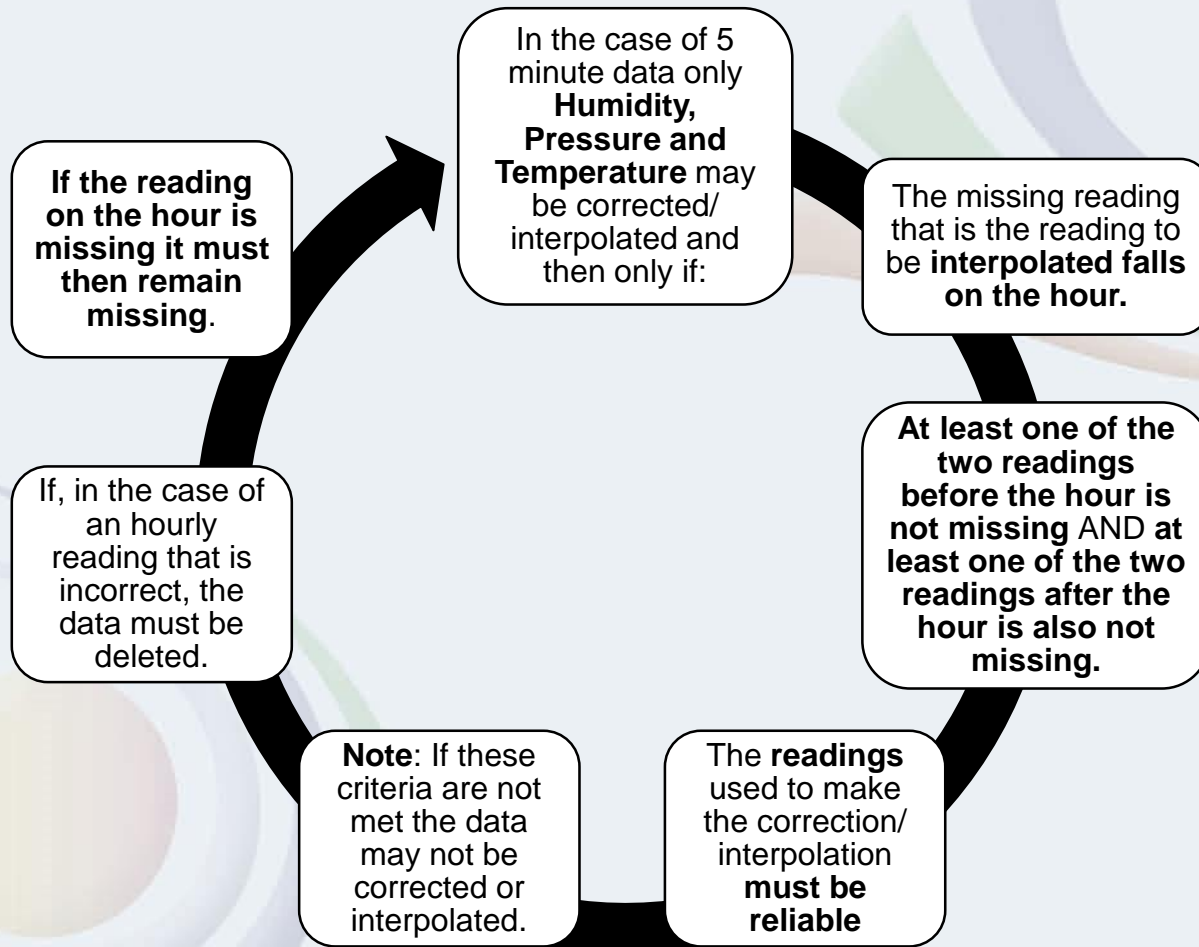
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9

Checks automatically done by MetCap.

➢ Climatological Test

  ✓ An observation is always compared to previously defined limit values.

  ✓ In a step check temporal changes are compared to step limit values.

  ✓ If the check implies control of two or more parameters, it is a consistency check (of time series or instant values).

➢ Limit and range checks can be divided into a check for;

  ✓ physically impossible values (certain errors) and

  ✓ very unusual values (probable errors) that may be wrong, e.g. values with a return period of years

➢ Temporal Test

➢ Inner Consistency Test

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➢ Spatial Test

Temporal Test

❑ Temporal Test (Includes step checks for control of parameter value changes)

- ✓ A step check is a temporal check that in some way can be called a limit check that uses a climatological record of how much various parameters can change within a certain period of time, e.g. limits for temperature changes during 3 hours.

- ✓ For some parameters such as temperature, the limits depend on climate conditions.

- ✓ For other parameters such as changes in pressure, the changes may be less sensitive to local climate.

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Automatic Interpolation

In the case of 5 minute data only **Humidity, Pressure and Temperature** may be corrected/ interpolated and then only if:

The missing reading that is the reading to be **interpolated falls on the hour.**

At least one of the two readings before the hour is not missing AND **at least one of the two readings after the hour is also not missing.**

The **readings** used to make the correction/ interpolation **must be reliable**

Note: If these criteria are not met the data may not be corrected or interpolated.

If, in the case of an hourly reading that is incorrect, the data must be deleted.

If the reading on the hour is missing it must then remain missing.
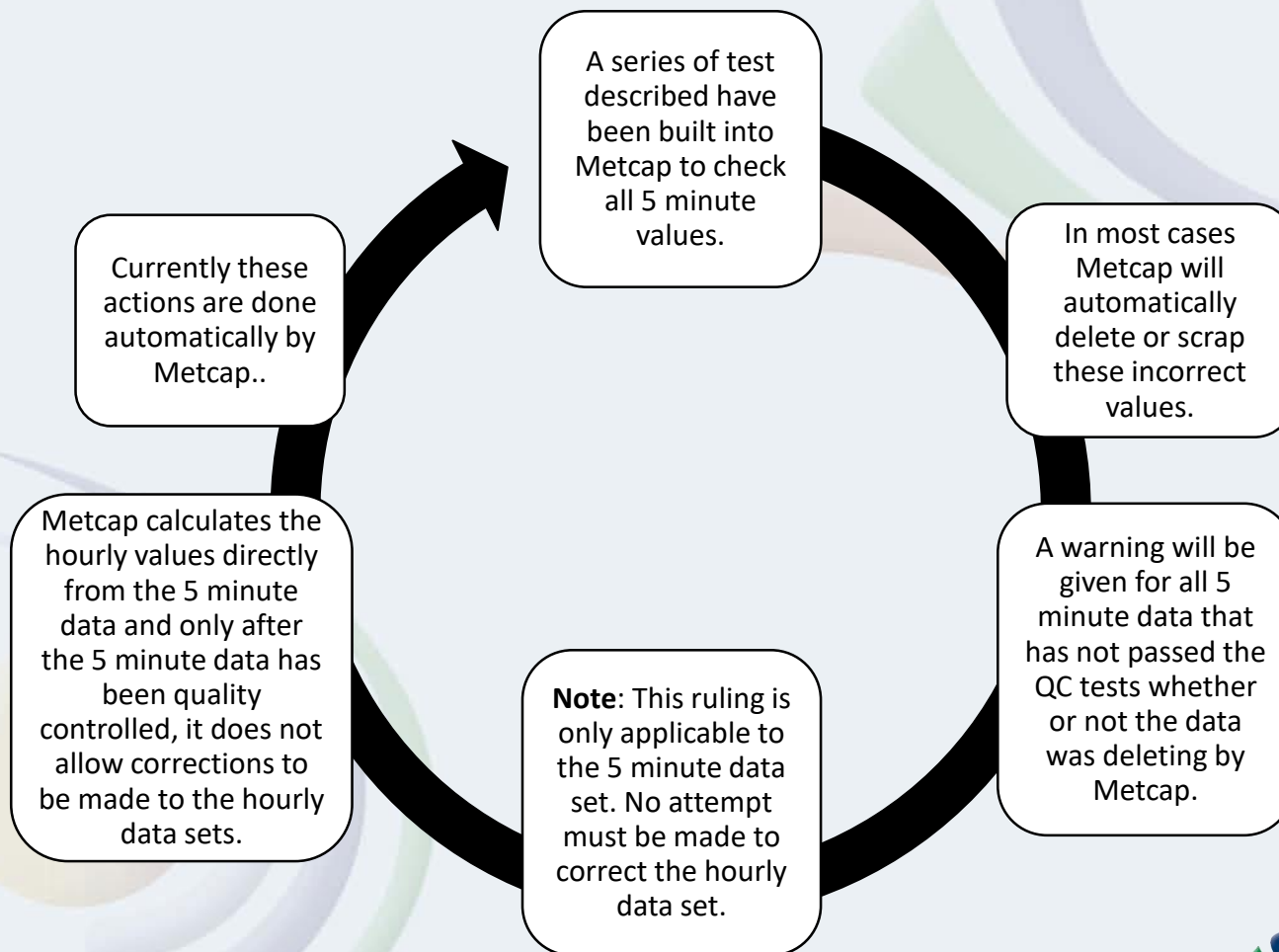
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Internal Consistency Checks [Link to the file]

The basic algorithms used for checking internal consistency of data are based on the relation between two parameters (the following conditions shall be true):

- ✓ dew point temperature ≤ air temperature;
- ✓ wind speed = 00 and wind direction = 00;
- ✓ wind speed ≠ 00 and wind direction ≠ 00;
- ✓ wind gust (speed) ≥ wind speed;
- ✓ both elements are suspect if total cloud cover = 0 and amount of precipitation > 0;
- ✓ both elements are suspect if total cloud cover = 8 and sunshine duration > 0;
- ✓ both elements are suspect if sunshine duration > 0 and solar radiation = 0;
- ✓ both elements are suspect if solar radiation > 500 Wm-2 and sunshine duration = 0;
- ✓ both elements are suspect if amount of precipitation > 0 and precipitation duration = 0;
- ✓ both elements are suspect if precipitation duration > 0 and weather phenomenon is different from precipitation type;
- ✓ All the above (in red) are used only for data from a period not longer than 10 minutes).

If the value fails the time consistency checks it should be flagged as inconsistent.

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Hourly data calculation from 5min data

A series of test described have been built into Metcap to check all 5 minute values.

In most cases Metcap will automatically delete or scrap these incorrect values.

A warning will be given for all 5 minute data that has not passed the QC tests whether or not the data was deleting by Metcap.

Note: This ruling is only applicable to the 5 minute data set. No attempt must be made to correct the hourly data set.

Metcap calculates the hourly values directly from the 5 minute data and only after the 5 minute data has been quality controlled, it does not allow corrections to be made to the hourly data sets.

Currently these actions are done automatically by Metcap..

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The End….

Time for further clarity if needed

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