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User document : CRDS short term working standard

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Diffusion :

- Project CarboCount City
- Picarro processing chain users
- Losgatos processing chain users

Validation :

Date	Version	Name	Signature

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1. Introduction

1. Purpose of the document

This document presents the modifications and specific features done on the [processing chain](#) of the CRDS instruments in order to handle the data from the CarboCounty City (CCC) project.

2. Object of the evolution

The evolution of the processing chain has been made in order to handle the calibration procedure defined in the frame of the CarboCount City project. This does not impact the ICOS default behavior.

The CCC sites perform calibration less often than the ICOS stations and to compensate, a new type of gas, the [Short Term Working Standard \(STWS\)](#) gas, is used to correct the short term drift of the instrument. The STWS gas is measured about once a day.

The STWS data are used to correct continuous air, target and test gases.

2. Reference correction

A new correction method has been developed, it uses the variation of the STWS gas to correct continuous air, target and test gases. The STWS data used for this correction is calibrated using calibration data.

This additional correction implies a new sequence of processing.

1. Process calibration data

- 1.1. Calibration data are corrected to consider the influence of **water** (steam).
- 1.2. Calibration **coefficients are computed**.
- 1.3. Calibration data and coefficients are **saved in database**.

2. Process STWS data

- 2.1. STWS data are corrected to consider the influence of **water** (steam).
- 2.2. STWS data are **calibrated**.
- 2.3. STWS data are **saved in database**.

3. Process continuous air (and target)

- 3.1. Air data are corrected to consider the influence of **water** (steam).
- 3.2. Air data are **calibrated**.
- 3.3. Air data are **corrected with the STWS**.
- 3.4. Air data are **saved in database**.

1. Automatic control on STWS

The STWS is used to correct automatically air and target data, so an automatic control is done on STWS data to avoid bad correction on air and target.

1. Standard deviation

A filter on standard deviation on every level of aggregation can be configured : minute and injection. If the standard deviation is above the threshold the data is marked with the [corresponding flag](#) and invalidate.

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2. Outlier

The filter outlier is used to invalidate STWS injection data with a too different concentration value than the previous valid STWS injections.

First the median value of N previous valid STWS injections is computed. If the absolute value of difference between the STWS injection data and the previous STWS median value is above the threshold the data is invalidate.

There is three parameters for the filter method :

- N : The number of previous valid STWS injection to use to compute median. If less than N value are found no outlier filter will be performed.
- A temporal limit in number of day. Before this temporal limit the STWS injection won't be used for the median computation.
- A threshold, the unit is species dependent.

If the N valid previous injection cannot be found no flag is added and the data is considered correct. If no valid calibration can be found before the STWS injection to filter, no flag is added and the data is considered as correct.

2. Correction computation

Every data in a given gas [injection](#) (air or target) have the same reference correction. The reference correction is an offset based on the local variation of the measured STWS.

Two averages of STWS injection are computed :

- Long term : the first valid STWS injection after the previous valid calibration is used as the long term average. (The word average is used despite the use of only one STWS because the correction computation is updated, the previous version used several injection data). Calibration interpolation breakpoint are not used.
- Short term : the average of the surrounding valid STWS injections.

The research of the STWS injections to use is based on the start date of the current gas injection to correct.

The calculated offset for the reference correction is the difference of the short term average minus the long term average. The offset is subtracted from each data to correct. The data marked as non-valid with automatic flag (stabilization, instrument problem, ...) are not corrected.

3. New flags

This evolution has introduce a set of new [flags](#) listed below.

1. On air, target and test data

- 'No period reference' : This flag indicates that the long term average cannot be calculated because no STWS injections where found between the considered calibrations. There are two main reasons for this : no valid calibration before the in-situ data or there is no valid reference

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injection since the valid calibration. **The in-situ data is still valid but not corrected by the reference.**

- ‘No reference’ : This flag indicates that the short term average cannot be calculated because no near valid STWS injections were found. The main reason is that the two nearest STWS injections before and after the considered in-situ data are outside the defined time range. **The in-situ data is still valid but not corrected by the reference.**
- ‘One reference’ : This flag indicates that only one near STWS injection was found for this injection. The main reason is that the data are transmitted day by day. If the last STWS injection is in the middle of the day, no reference injection can be found for the in-situ data of the second part of the day. See [Frequently asked questions](#) for details. Most of these flags will disappear after a reprocess (quality control or new calibration). **The in-situ data is corrected and valid.**

Only one of those flags can be associated to a raw data.

2. On reference data

- ‘Minute standard deviation’ : This flag indicates that the minute aggregated data have a standard deviation above the defined threshold. **The data is invalid.**
- ‘Injection standard deviation’ : This flag indicates that the injection aggregated data have a standard deviation above the defined threshold. **The data is invalid.**
- ‘Outlier’ : This flag indicates that the injection data is above the defined threshold defined for the filter outlier. See [Outlier](#) for more information. **The data is invalid.**

3. Data processing

1. New features

1. Reference correction

The new correction method takes two parameters defining the temporal limits for the search of the near STWS injections. These parameters are specified in hours. If there are no valid STWS injections in the specified time frame a flag ‘No reference’ will be added to the in-situ data.

2. Additional correction

For all CRDS instruments (Picarro and LosGatos) a new information is now available for raw data : the concentration after each correction.

For continuous air, target and test two values : calibrated correction and reference corrected mole fraction (available in the new output format 5 for raw data file).

For STWS : only the calibrated concentration is available, as the STWS gas data are not corrected with the new reference correction.

For calibration air : no additional information, as the calibration gas data are not corrected by calibration and by reference neither.

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3. Quality control

The quality control is available for STWS gas as for any other type of gas.

Whenever manual quality control is done on STWS data, the updated STWS data are used in turn to update in-situ and target data as the correction offset may have changed.

After a quality control on STWS the data marked are reprocessed right after the quality control session. But the air, target and test data that can be modified by this quality control are reprocess only at the end of the day.

A new calibration episode or manual quality control on calibration data also lead to a reprocess of the reference, in-situ and target data.

2. Data reprocessing

The new type of correction uses many data for the correction of air and target.

The data, continuous air and STWS, are processed day by day. So every day some new STWS injections are processed, and these STWS injections are used to correct the continuous air. The continuous air data must be reprocessed with the new STWS injections.

This represents a very heavy task for the server, so the continuous air and target are not reprocessed each time a new STWS injection is processed.

A new calibration or a quality control on continuous air or target will performs a reprocessing. If needed a manual reprocess can be ask at : atc-help@lsce.ipsl.fr

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4. Frequently asked questions

Why the air/target data have a flag 'One reference' but two valid STWS injections are stored in the database ?

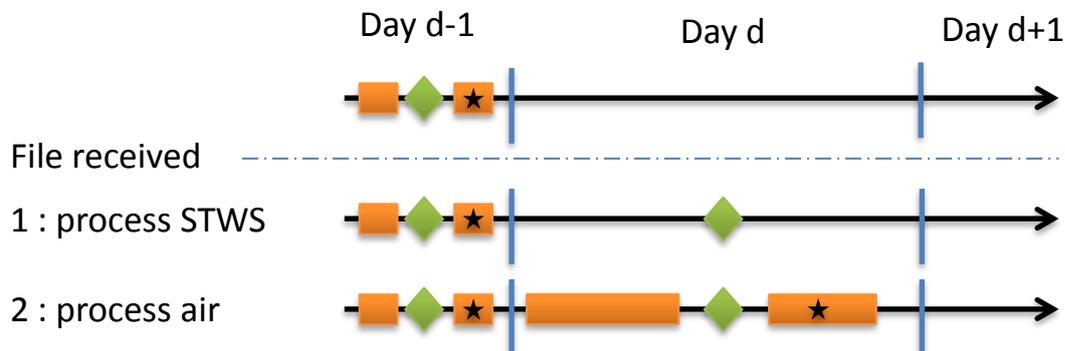
Data are received day by day, most of the time in the data file of the day there are :

Air or target in the beginning of the day, a STWS injection in the middle of the day and air or target again at the end of the day.



-  : Air or target
-  : STWS injection
-  : Flag 'One reference'

In this configuration the last part of the day doesn't have any STWS injection after (data of the next day are not received). So the flag 'One reference' is added on the data, see [New flags](#) for details.



After a reprocessing the flag will be reset, see [Data processing](#) for more details.



I added a calibration interpolation breakpoint, how does the STWS correction use it ?

The calibration interpolation breakpoint is not used by STWS correction.

It affects the STWS value with the calibration correction but the calibration interpolation breakpoint is not used as 'STWS correction breakpoint'.

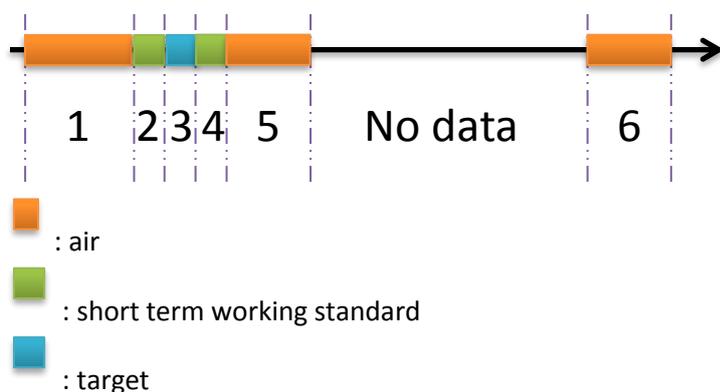
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5. Glossary

Processing chain : The processing chain is the program that process the data. The main functions of the processing chain are :

- Receive and parse data file
- Correct data with the defined sequence
- Aggregate data in minute, hour or sequence average
- Store data in the database
- Retrieve data from the database

Injection : In this document an injection is a continuous input of gas. Example :



In this schema each dotted line represent the begin and/or the end of an injection. There are 6 injections in this example.

Flag : The flag is an indicator of an error or a warning during the process of the data. For example a flag 'Filter' is a warning meaning the data has been invalidate because the concentration is out of the defined range.

Short term working standard (STWS) : The short term working standard is a tank with a height measure frequency (about 1 or 2 measure per day).