



METER

Dual-Input Curated Rainfall Algorithm

The ATMOS 41 produces a single curated rainfall value using two independent measurement methods: drop detection and tipping-spoon events. In practice, the curated value will typically follow whichever method reports more rainfall because the algorithm does not subtract rainfall during normal operation. This is intentional.

During light rainfall, individual drop detection tends to capture more of the true precipitation, while during heavier rainfall the tipping spoon is generally more accurate because water flow through the gauge becomes more continuous. As a result, the curated rainfall estimate naturally shifts toward the more reliable measurement as rainfall intensity changes.

Measurement Inputs

DROP DETECTION

Each detected drop represents 0.017 mm of rain. As drops are counted, rainfall accumulates in small increments.

TIPPING SPOON

Each time the spoon tips represents 0.34 mm of rain, equivalent to 20 drops.

Curated Rainfall Calculation

Two operating conditions are considered:

- Drops occur without tips
- When a tip occurs

Drops occur without tips

In very light rain events, it is common to observe drops without any tipping events. In this case, the rainfall total is simply the drop-based rainfall:

$$R_d = N_d \times 0.017 \quad \text{Equation 1}$$

where R_d is rainfall from drops (mm) and N_d is the number of drops counted.

When a tip occurs

The tipping spoon is calibrated to tip at 0.34 mm of rainfall. Rainfall can be calculated in mm from tips (R_t) as:

$$R_t = N_t \times 0.34 \quad \text{Equation 2}$$

where N_t is the number of tips counted.

When a tip occurs, the firmware ensures the drop-based rainfall is not double-counted. The tip contributes only if the drop-based rainfall accumulated since the previous tip is less than 0.34 mm. If the drop-based rainfall is 0.34 mm or more, the tip contributes nothing additional to the curated total.

This can be expressed as:

$$R_{curated} = R_d + \max(0, R_t - R_d) \quad \text{Equation 3}$$

where R_t is the tip-based rainfall (mm). Under normal conditions, this yields the intuitive behavior that the curated rainfall becomes whichever value is larger: the drop-derived total or the tip-derived total.

EXAMPLE 1

If the instrument records 15 drops (0.255 mm) and 1 tip (0.34 mm), then:

$$\begin{aligned} R_d &= 0.255 \text{ mm} \\ R_t &= 0.34 \text{ mm} \\ R_{curated} &= 0.34 \text{ mm} \end{aligned}$$

In this case, the tipping spoon contributes an additional 0.085 mm beyond the drop total.

NOTE: drops can undercount at high intensities when rainfall becomes too continuous for discrete droplets to form consistently.

EXAMPLE 2

If the instrument records 25 drops (0.425 mm) and 1 tip (0.34 mm), then:

$$\begin{aligned} R_d &= 0.425 \text{ mm} \\ R_t &= 0.34 \text{ mm} \\ R_{curated} &= 0.425 \text{ mm} \end{aligned}$$

In this example the tipping spoon contributes nothing to the curated total because the drops already exceed one tip's measurement of rainfall.

Reporting

At the end of each measurement interval, the ATMOS 41 reports the curated rainfall value along with the number of counted drops and counted tips for that interval. These reported totals reset to zero at the start of the next interval.

Firmware Error Flags

To detect abnormal behavior, the firmware compares drop-based and tip-based rainfall values and sets an error flag if any of the following conditions occur:

Flag 1: $R_t = 0$ and $R_d \geq 0.68$

Flag 2: $(R_t - R_d) \geq 0.68$ and $R_t \geq 1.5 R_d$

Flag 3: $R_t > 0$ and $R_d \geq 2 R_t$

FLAG 1

Checks whether the tipping spoon appears to be functioning correctly.

It is triggered when the drop counter detects at least 0.68 mm of rainfall (two tips worth) while no tips are recorded. This can indicate a problem with the tipping spoon.

FLAG 2

Checks for situations where the drop counter may be undercounting relative to the tipping spoon.

It is triggered when tip-based rainfall exceeds drop-based rainfall by at least 0.68 mm (two tips worth), and the tip-based value is at least 1.5 times the drop-based value. The 0.68 mm threshold helps avoid flagging expected differences during very low-intensity rainfall.

FLAG 3

Checks for cases where the drop counter is greatly overreporting rainfall relative to the tipping spoon while tips are still occurring. This may indicate false drop counts.

When Flag 3 is triggered, the drop-based rainfall is considered unreliable and is not included in the curated rainfall total for that interval.

An error flag is cleared only after a measurement interval contains at least 4 tips (1.36 mm of tip-based rainfall) and none of the flag conditions are detected during that interval. This ensures enough rain has been observed under stable conditions to confirm the error condition has resolved.