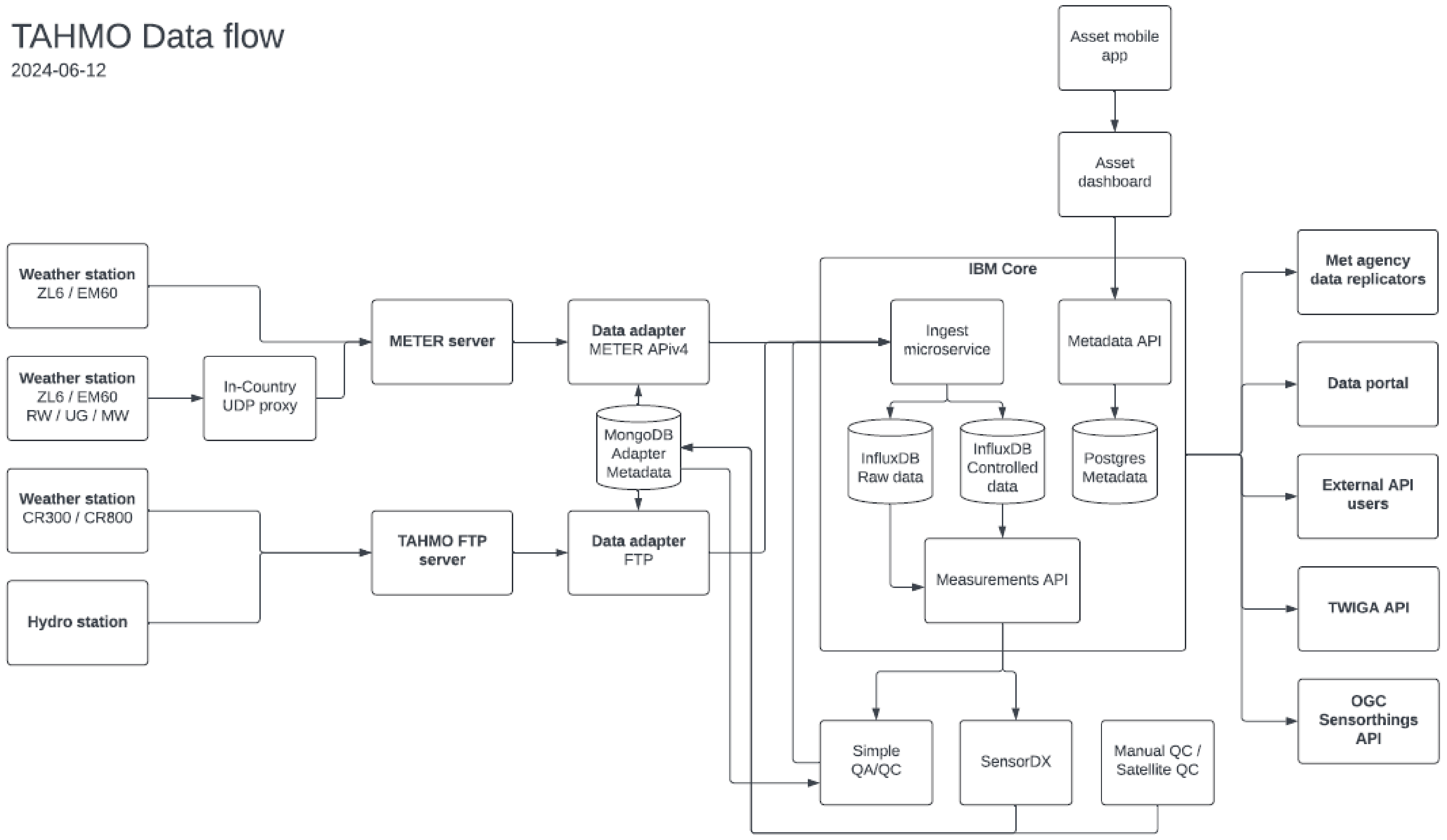
Understanding TAHMO Data Flow for QC

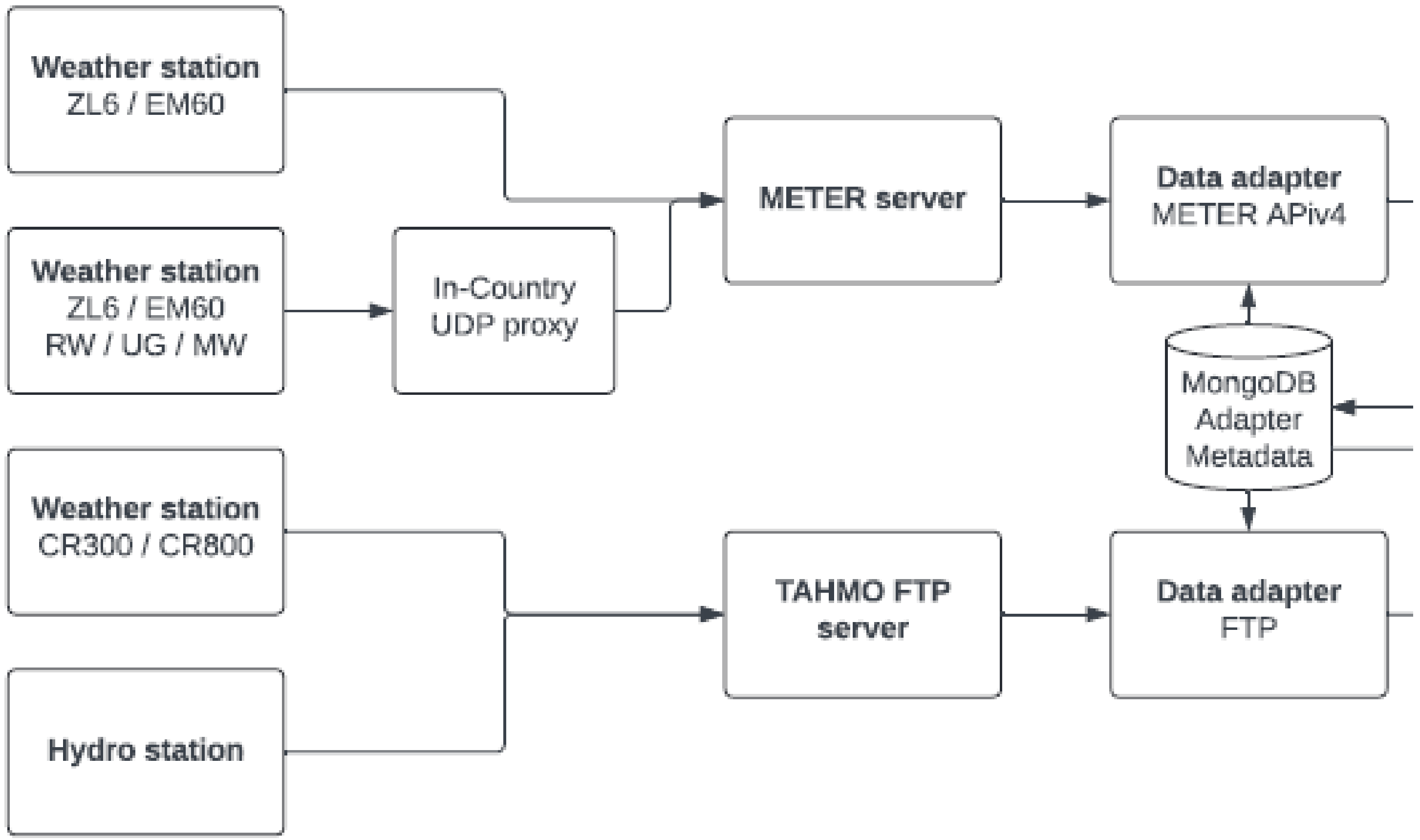
Tom Dietterich

Goal: Understand where QC happens



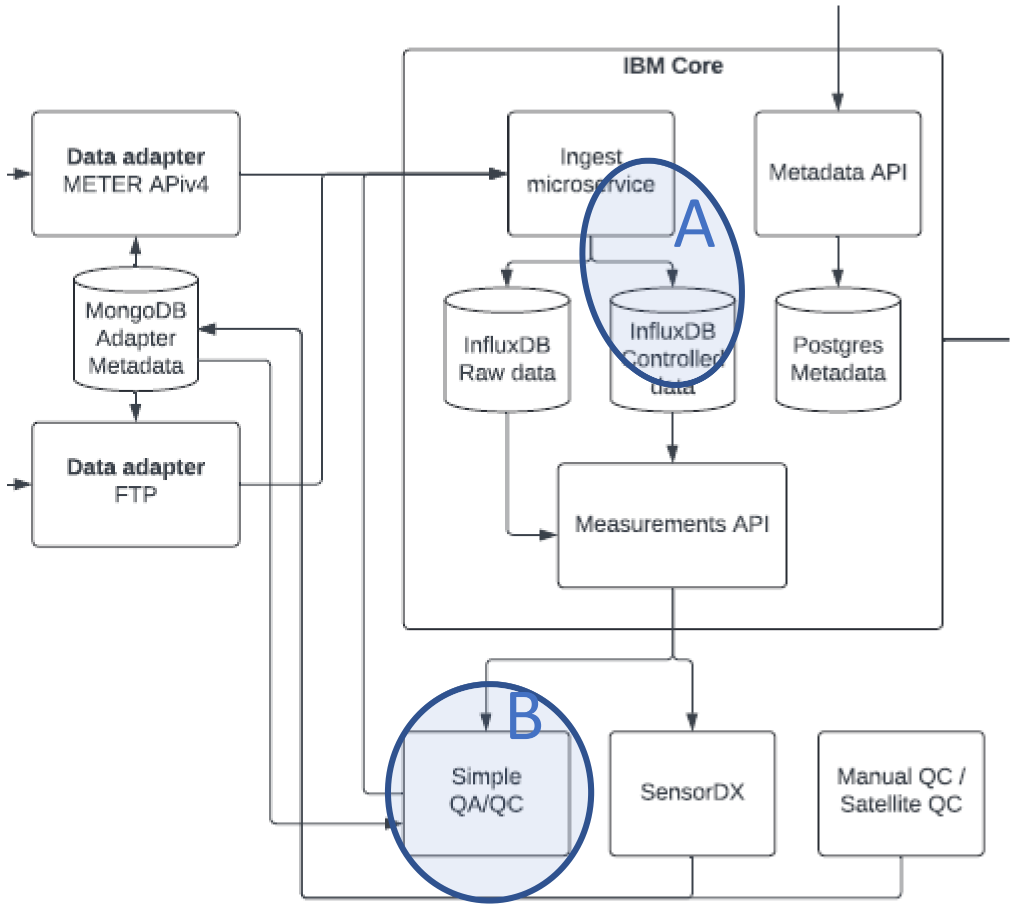
Data Acquisition

- Questions for Rick:
  - What are these different weather station types?
  - What is in the MongoDB?
- Note:
  - Output from the two Data adapters goes to the Ingest Microservice



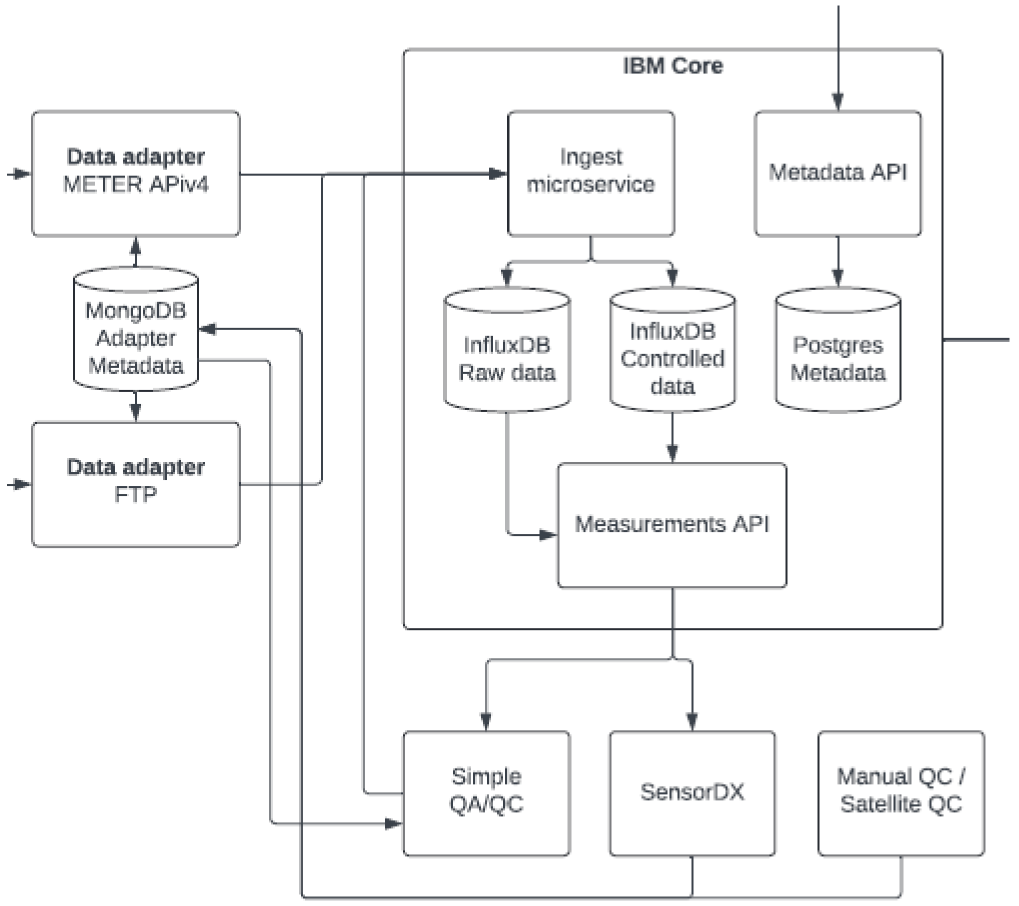
Limit Checks and Related Rules

- Where: A vs B?
- Range checks
  - Temperature
  - Relative Humidity
  - Atmospheric Pressure
  - Precipitation
  - Solar Radiation (?)
- Other rules?
  - Minimum variance (to catch stuck sensors)?



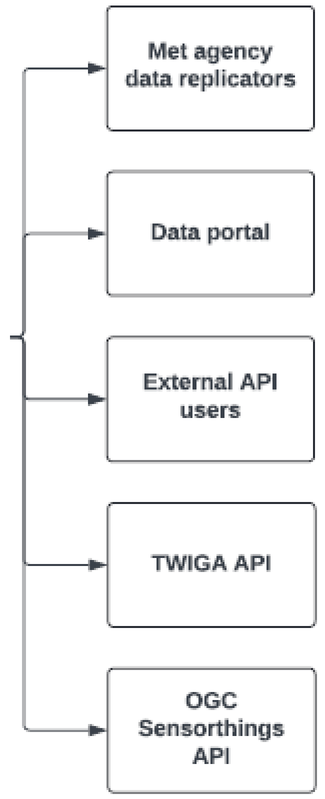
Order of Processing: Is this correct?

- Raw data →Ingest → InfluxDB Raw data
- Simple QA/QC requests raw data, applies range checks and other rules → Ingest → InfluxDB Controlled data
- SensorDX requests Controlled data and applies neighbor regression → writes output to MongoDB?
- Manual/Satellite. Rick prepares spreadsheet, Gilbert & Victor manually compare and create QC Objects in MongoDB



Customer Data Access

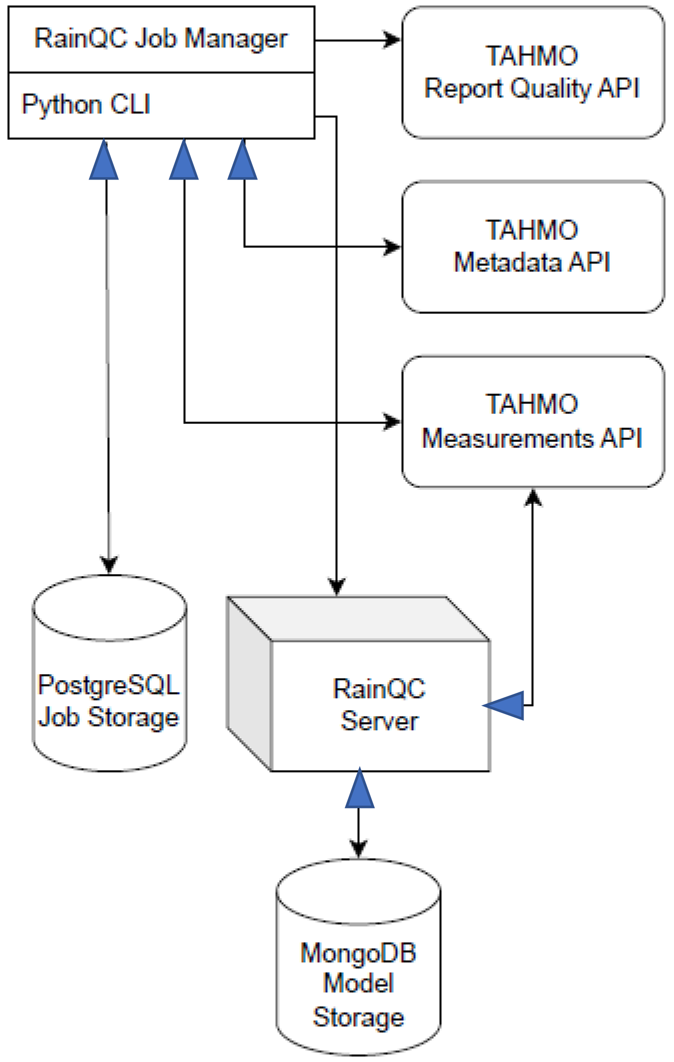
- How do the QC flags in the MongoDB become visible to the customers?
- What API do they access?



SensorDX Quality Control

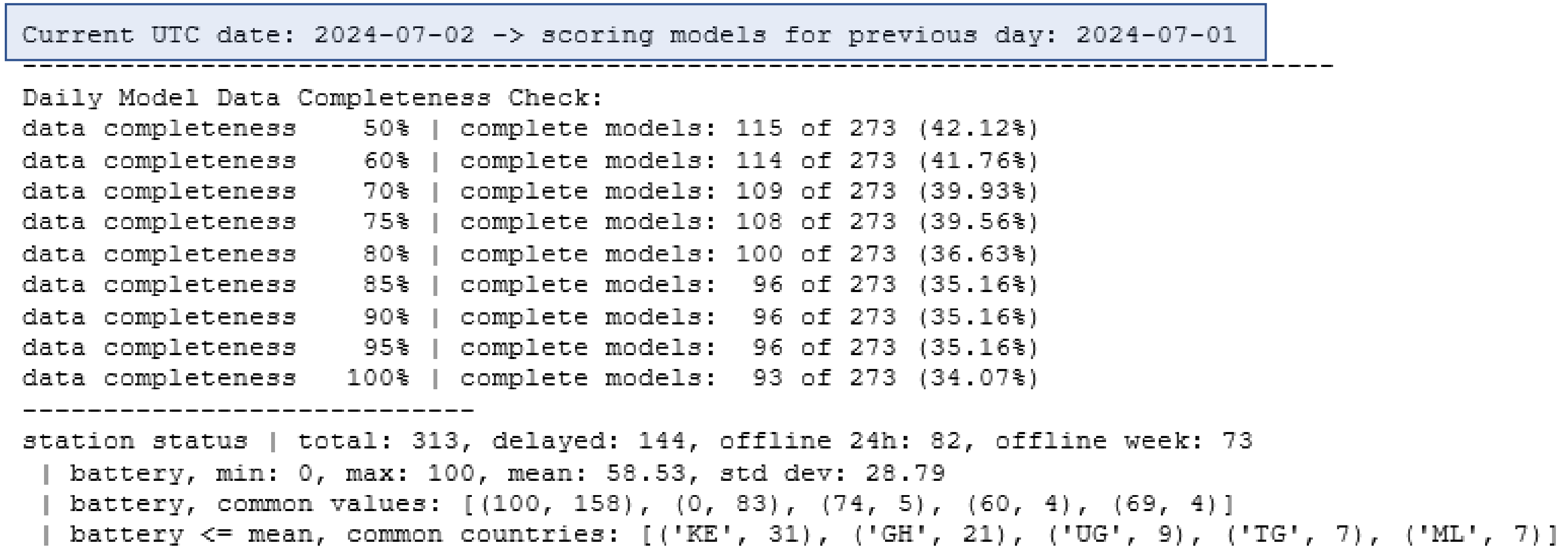
[Not to be confused with the ticketing system]

- JobManager queries ?? to find the list of stations having models ("target stations")
- JobManager creates a new job for each target station for the current day
- JobManager queries PostgreSQL to find list of incomplete jobs from previous run and merge them into the list of jobs
- JobManager queries Measurements API to determine which jobs are "data complete" and can be run
    - Target station and its neighbors must all have sufficient data for the specified date
- JobManager invokes RainQC server on all runnable jobs
- RainQC server retrieves data for the target station and its neighbors from the Measurements API
- RainQC server computes the data quality score (1 or 2) and writes it to the Measurements API ?? [missing on Rick's diagram]
- RainQC server returns a result code to the Job Manager
- JobManager updates the PostgreSQL Job table to indicate which jobs succeeded and which failed. The failed jobs will be re-tried the next day



Explanation of the Daily JobManager report

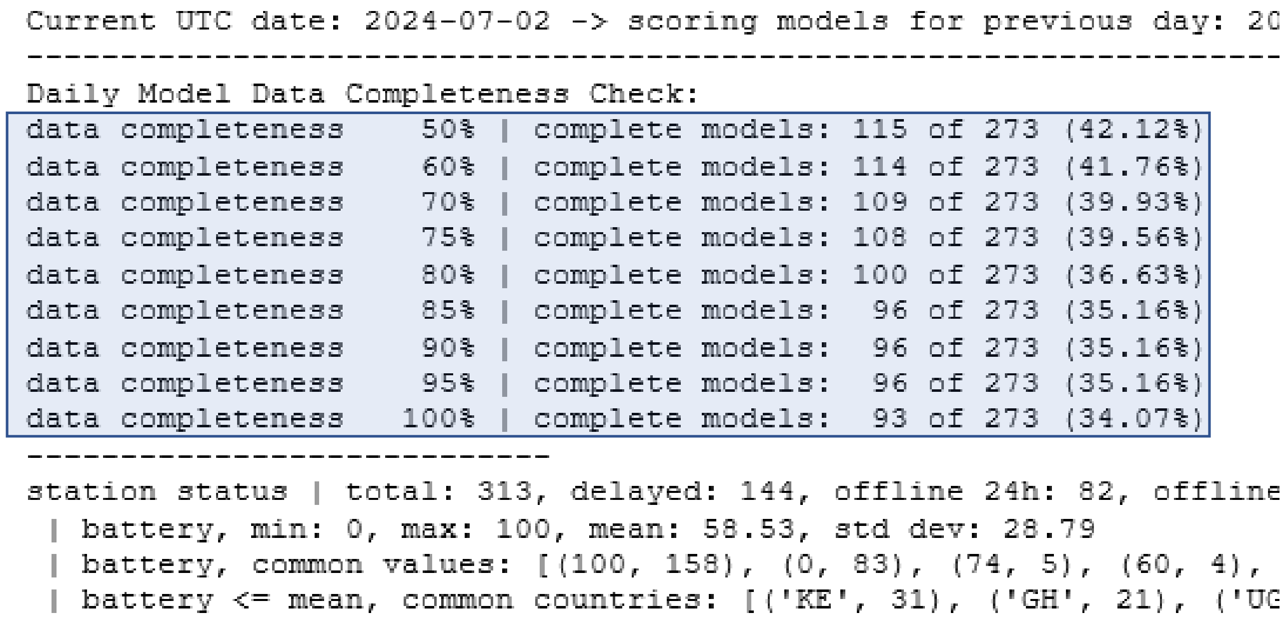
- Indicates which date is being scored
- Note: the Job Manager is stateful, rerunning it will create new jobs. There is a command line flag to prevent this



```
Current UTC date: 2024-07-02 -> scoring models for previous day: 2024-07-01
--------------------------------------------------------------------------------
Daily Model Data Completeness Check:
data completeness    50% | complete models: 115 of 273 (42.12%)
data completeness    60% | complete models: 114 of 273 (41.76%)
data completeness    70% | complete models: 109 of 273 (39.93%)
data completeness    75% | complete models: 108 of 273 (39.56%)
data completeness    80% | complete models: 100 of 273 (36.63%)
data completeness    85% | complete models:  96 of 273 (35.16%)
data completeness    90% | complete models:  96 of 273 (35.16%)
data completeness    95% | complete models:  96 of 273 (35.16%)
data completeness   100% | complete models:  93 of 273 (34.07%)
----------------------------
station status | total: 313, delayed: 144, offline 24h: 82, offline week: 73
 | battery, min: 0, max: 100, mean: 58.53, std dev: 28.79
 | battery, common values: [(100, 158), (0, 83), (74, 5), (60, 4), (69, 4)]
 | battery <= mean, common countries: [('KE', 31), ('GH', 21), ('UG', 9), ('TG', 7), ('ML', 7)]
```

Explanation of the Daily JobManager report

- What fraction of models (target stations) are data complete?
- I watch the 100% completeness number as an overall indication of network health
- Question: What is the definition of data completeness?



```
Current UTC date: 2024-07-02 -> scoring models for previous day: 20
-------------------------------------------------------------------
Daily Model Data Completeness Check:
data completeness    50% | complete models: 115 of 273 (42.12%)
data completeness    60% | complete models: 114 of 273 (41.76%)
data completeness    70% | complete models: 109 of 273 (39.93%)
data completeness    75% | complete models: 108 of 273 (39.56%)
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data completeness    95% | complete models:  96 of 273 (35.16%)
data completeness   100% | complete models:  93 of 273 (34.07%)
----------------------------
station status | total: 313, delayed: 144, offline 24h: 82, offline
 | battery, min: 0, max: 100, mean: 58.53, std dev: 28.79
 | battery, common values: [(100, 158), (0, 83), (74, 5), (60, 4),
 | battery <= mean, common countries: [('KE', 31), ('GH', 21), ('UG
```
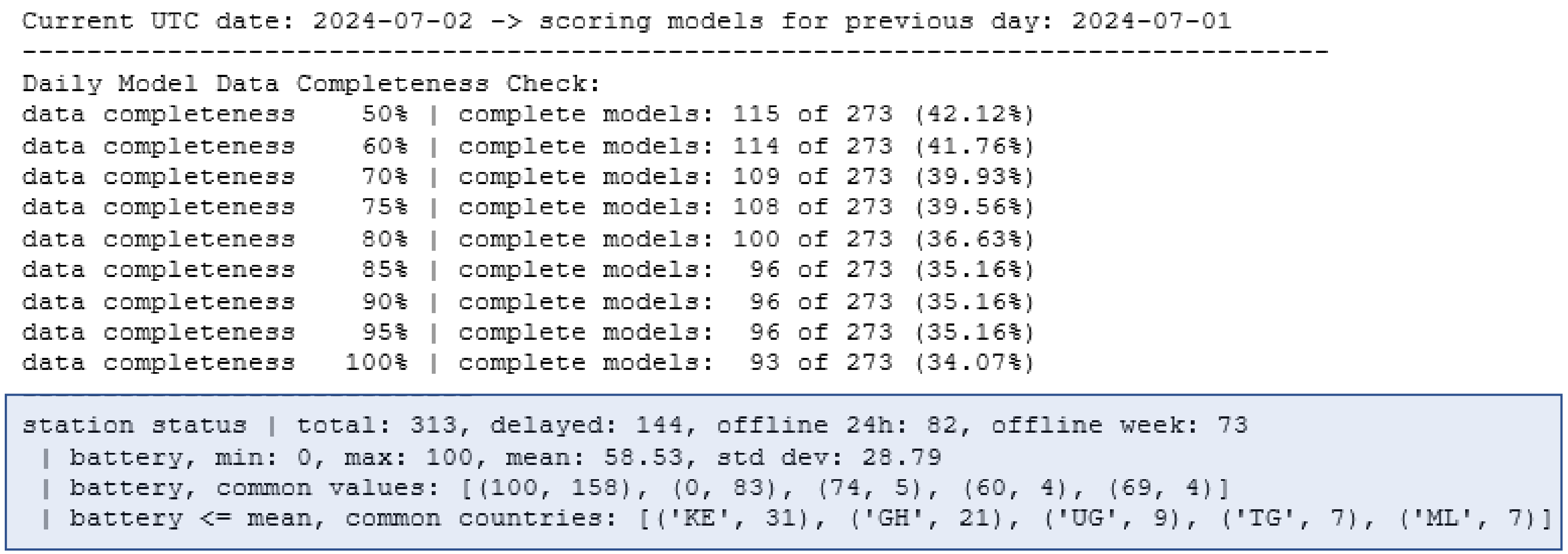

Explanation of the Daily JobManager report

- General status information (not required by JobManager, but it was easy to show)
- Question: What is “total”? Are these all of the target stations and neighbors that we use?



```
Current UTC date: 2024-07-02 -> scoring models for previous day: 2024-07-01
-------------------------------------------------------------------------------
Daily Model Data Completeness Check:
data completeness    50% | complete models: 115 of 273 (42.12%)
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data completeness    95% | complete models:  96 of 273 (35.16%)
data completeness   100% | complete models:  93 of 273 (34.07%)
station status | total: 313, delayed: 144, offline 24h: 82, offline week: 73
 | battery, min: 0, max: 100, mean: 58.53, std dev: 28.79
 | battery, common values: [(100, 158), (0, 83), (74, 5), (60, 4), (69, 4)]
 | battery <= mean, common countries: [('KE', 31), ('GH', 21), ('UG', 9), ('TG', 7), ('ML', 7)]
```
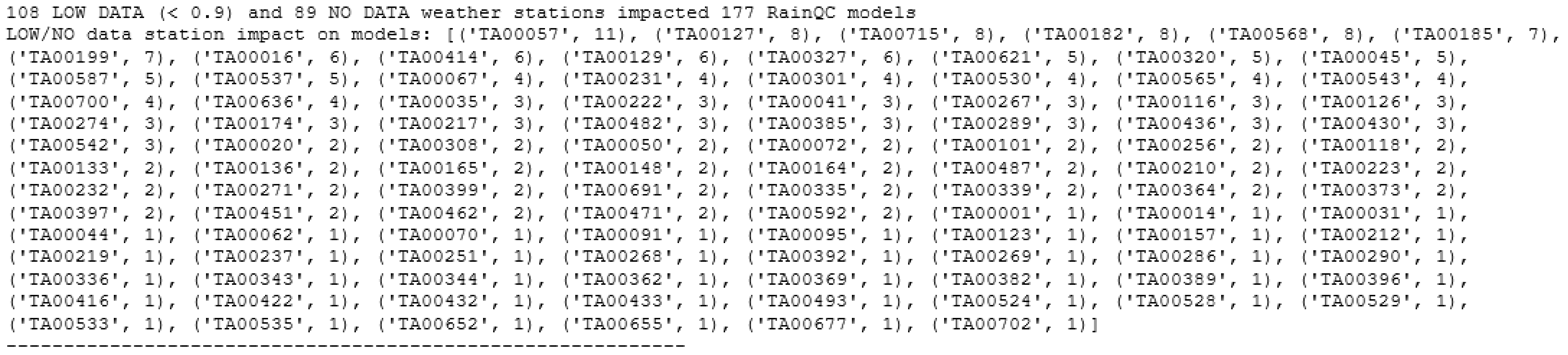

Number of targets affected by low-data stations

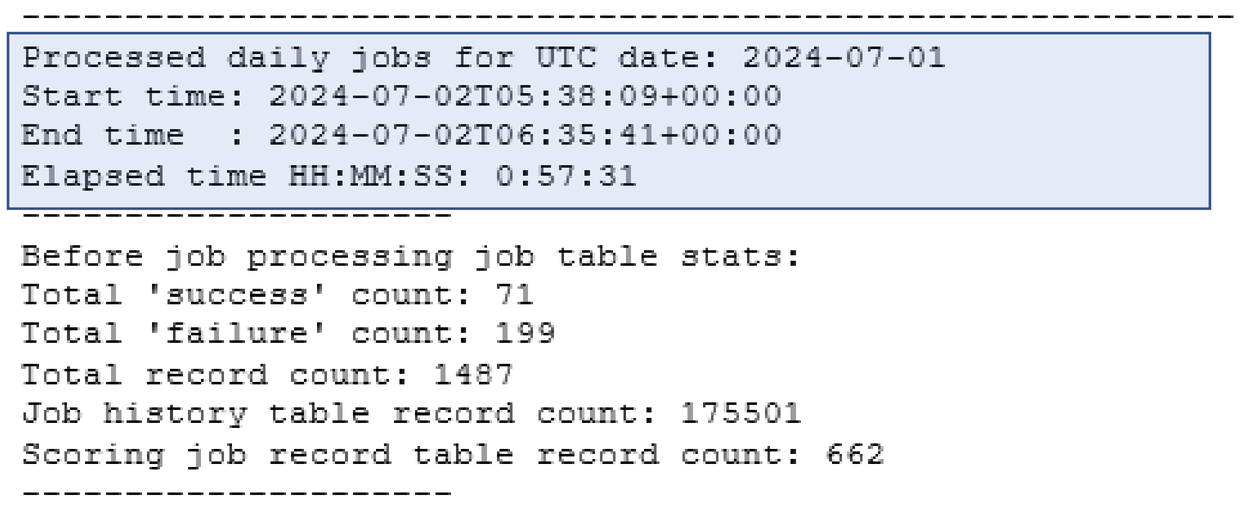


```
108 LOW DATA (< 0.9) and 89 NO DATA weather stations impacted 177 RainQC models
LOW/NO data station impact on models: [('TA00057', 11), ('TA00127', 8), ('TA00715', 8), ('TA00182', 8), ('TA00568', 8), ('TA00185', 7),
('TA00199', 7), ('TA00016', 6), ('TA00414', 6), ('TA00129', 6), ('TA00327', 6), ('TA00621', 5), ('TA00320', 5), ('TA00045', 5),
('TA00587', 5), ('TA00537', 5), ('TA00067', 4), ('TA00231', 4), ('TA00301', 4), ('TA00530', 4), ('TA00565', 4), ('TA00543', 4),
('TA00700', 4), ('TA00636', 4), ('TA00035', 3), ('TA00222', 3), ('TA00041', 3), ('TA00267', 3), ('TA00116', 3), ('TA00126', 3),
('TA00274', 3), ('TA00174', 3), ('TA00217', 3), ('TA00482', 3), ('TA00385', 3), ('TA00289', 3), ('TA00436', 3), ('TA00430', 3),
('TA00542', 3), ('TA00020', 2), ('TA00308', 2), ('TA00050', 2), ('TA00072', 2), ('TA00101', 2), ('TA00256', 2), ('TA00118', 2),
('TA00133', 2), ('TA00136', 2), ('TA00165', 2), ('TA00148', 2), ('TA00164', 2), ('TA00487', 2), ('TA00210', 2), ('TA00223', 2),
('TA00232', 2), ('TA00271', 2), ('TA00399', 2), ('TA00691', 2), ('TA00335', 2), ('TA00339', 2), ('TA00364', 2), ('TA00373', 2),
('TA00397', 2), ('TA00451', 2), ('TA00462', 2), ('TA00471', 2), ('TA00592', 2), ('TA00001', 1), ('TA00014', 1), ('TA00031', 1),
('TA00044', 1), ('TA00062', 1), ('TA00070', 1), ('TA00091', 1), ('TA00095', 1), ('TA00123', 1), ('TA00157', 1), ('TA00212', 1),
('TA00219', 1), ('TA00237', 1), ('TA00251', 1), ('TA00268', 1), ('TA00392', 1), ('TA00269', 1), ('TA00286', 1), ('TA00290', 1),
('TA00336', 1), ('TA00343', 1), ('TA00344', 1), ('TA00362', 1), ('TA00369', 1), ('TA00382', 1), ('TA00389', 1), ('TA00396', 1),
('TA00416', 1), ('TA00422', 1), ('TA00432', 1), ('TA00433', 1), ('TA00493', 1), ('TA00524', 1), ('TA00528', 1), ('TA00529', 1),
('TA00533', 1), ('TA00535', 1), ('TA00652', 1), ('TA00655', 1), ('TA00677', 1), ('TA00702', 1)]
------------------------------------------------------------
```

- Example: TA00199 is used as a neighbor or target for 7 models, so it prevented 7 target stations from being scored
- This is for general information only, but it suggests that TA00199 should be a high priority to fix, if possible

Session Summary

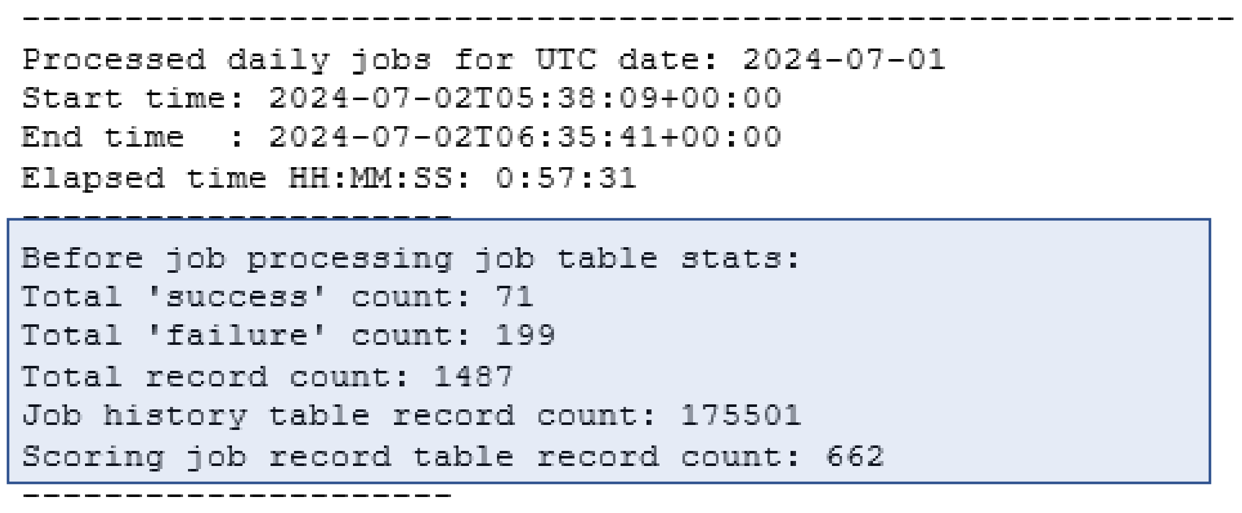
- Total time: 57 minutes + 31 seconds



```
------------------------------------------------------------
Processed daily jobs for UTC date: 2024-07-01
Start time: 2024-07-02T05:38:09+00:00
End time  : 2024-07-02T06:35:41+00:00
Elapsed time HH:MM:SS: 0:57:31
---------------------
Before job processing job table stats:
Total 'success' count: 71
Total 'failure' count: 199
Total record count: 1487
Job history table record count: 175501
Scoring job record table record count: 662
---------------------
```

Session Summary

- I don’t remember what the success and failure counts mean “Before” job processing
  - Michael??
- Job history table record count is the total number of jobs that have been created since the database was initialized. This will just keep growing



```
-----------------------------------------------------------
Processed daily jobs for UTC date: 2024-07-01
Start time: 2024-07-02T05:38:09+00:00
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Elapsed time HH:MM:SS: 0:57:31
---------------------
Before job processing job table stats:
Total 'success' count: 71
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---------------------
```
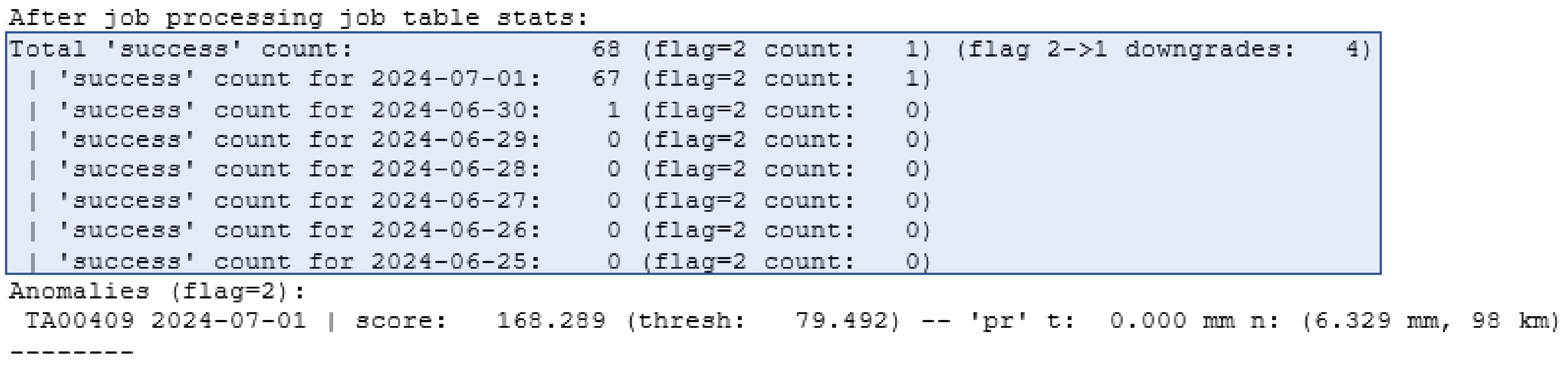
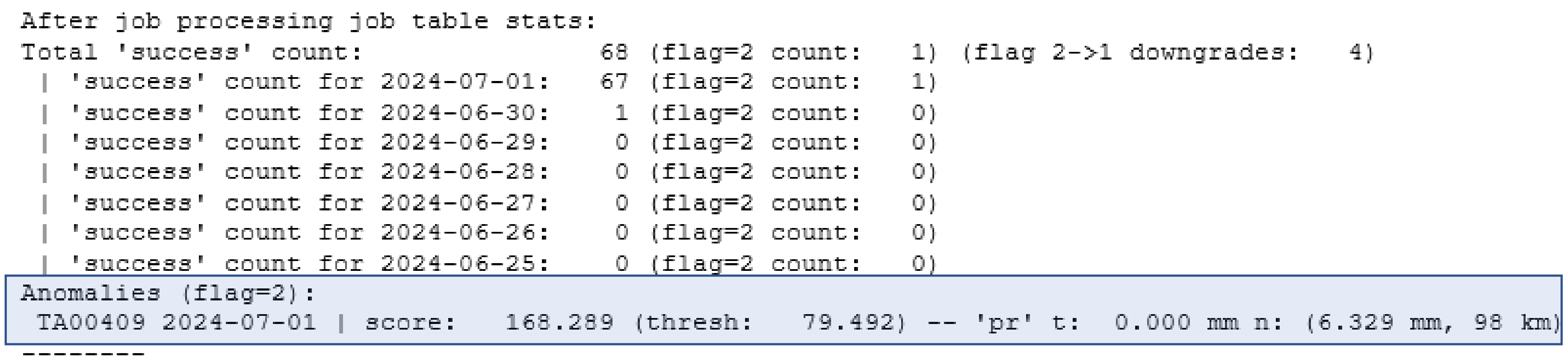

Job Results Table



```
After job processing job table stats:
Total 'success' count:              68 (flag=2 count:   1) (flag 2->1 downgrades:   4)
 | 'success' count for 2024-07-01:   67 (flag=2 count:   1)
 | 'success' count for 2024-06-30:    1 (flag=2 count:   0)
 | 'success' count for 2024-06-29:    0 (flag=2 count:   0)
 | 'success' count for 2024-06-28:    0 (flag=2 count:   0)
 | 'success' count for 2024-06-27:    0 (flag=2 count:   0)
 | 'success' count for 2024-06-26:    0 (flag=2 count:   0)
 | 'success' count for 2024-06-25:    0 (flag=2 count:   0)
Anomalies (flag=2):
 TA00409 2024-07-01 | score:   168.289 (thresh:   79.492) -- 'pr' t:  0.000 mm n: (6.329 mm, 98 km)
--------
```

- 68 jobs were successfully run
  - 67 for today
  - 1 left over from yesterday
- Two flag = 2 (“inconsistent”) QC flags were reported
- Four stations scored as “anomalous” (flag 2) by the neighbor regression model were “downgraded” (flag 1) by a special rule that detects and removes false alarms involving low, but non-zero, precipitation values
  - Anyone remember the exact details?

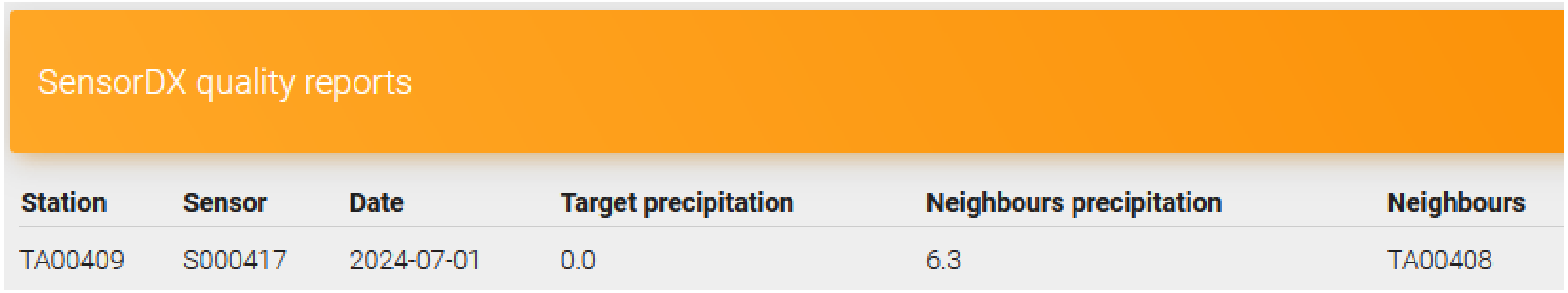
Most important result: List of flagged stations



```
After job processing job table stats:
Total 'success' count:                68 (flag=2 count:    1) (flag 2->1 downgrades:    4)
  | 'success' count for 2024-07-01:   67 (flag=2 count:    1)
  | 'success' count for 2024-06-30:    1 (flag=2 count:    0)
  | 'success' count for 2024-06-29:    0 (flag=2 count:    0)
  | 'success' count for 2024-06-28:    0 (flag=2 count:    0)
  | 'success' count for 2024-06-27:    0 (flag=2 count:    0)
  | 'success' count for 2024-06-26:    0 (flag=2 count:    0)
  | 'success' count for 2024-06-25:    0 (flag=2 count:    0)
Anomalies (flag=2):
 TA00409 2024-07-01 | score:   168.289 (thresh:   79.492) -- 'pr' t:  0.000 mm n: (6.329 mm, 98 km)
--------
```

- TA00409 was flagged as 2.
  - Score: 168.289 is an anomaly score assigned by the model
  - Thresh: is the anomaly threshold (also computed by the model)
  - Because 168.289 > 79.492, this is flagged as 2
  - Measured precipitation (‘pr’) was 0.000 mm
  - There is one neighboring station 98km away, and it reported 6.329mm

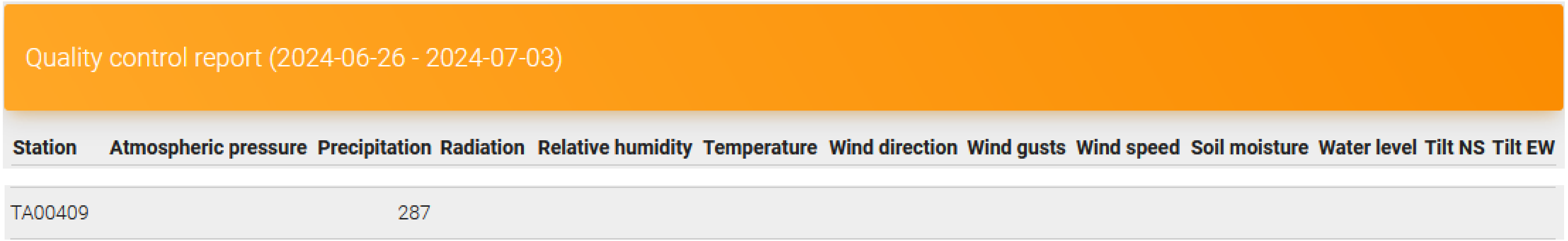
Asset Dashboard / Sensordx


SensorDX quality reports

Station	Sensor	Date	Target precipitation	Neighbours precipitation	Neighbours
TA00409	S000417	2024-07-01	0.0	6.3	TA00408

- The results also appear here
- However, here the station ids are listed, but not the distances
- In the jobmanager report, the distances are listed, but not the station ideas

Total flags are also summarized in assetdashboard/qc



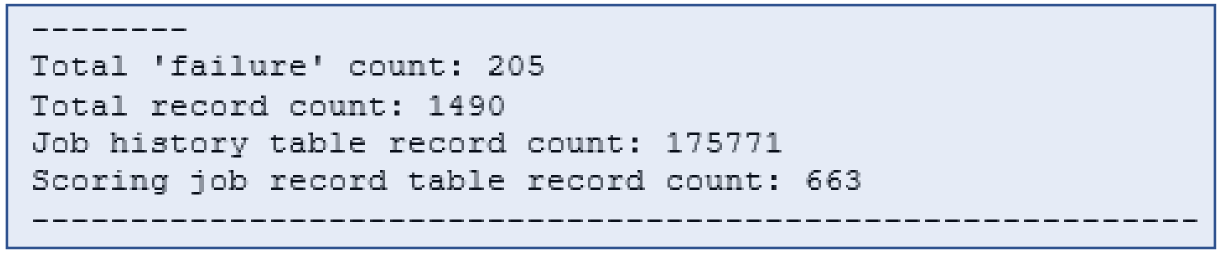
Quality control report (2024-06-26 - 2024-07-03)

Station	Atmospheric pressure	Precipitation	Radiation	Relative humidity	Temperature	Wind direction	Wind gusts	Wind speed	Soil moisture	Water level	Tilt NS	Tilt EW
TA00409		287										

- I don’t see how TA00409 could have been flagged 287 times in just one week. Rick?
- Neither dashboard is sortable or searchable
- No linkage to a time series of the ‘pr’ readings plotted along with the neighbors (e.g., as a double mass plot or parallel time series plot)

Job table statistics after scoring

- Michael, can you explain this?
- Which of these numbers is the count of jobs that still need to be run?
- How many jobs "timed out" after waiting a week?



```
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Total 'failure' count: 205
Total record count: 1490
Job history table record count: 175771
Scoring job record table record count: 663
------------------------------------------------------------
```
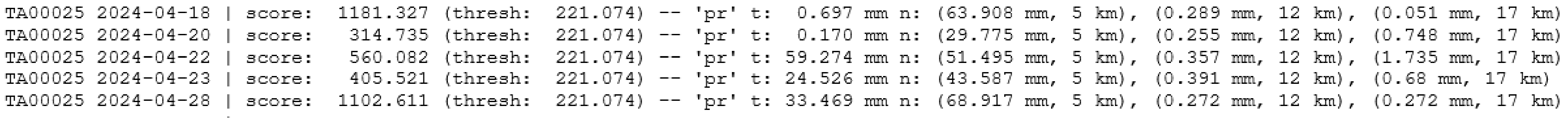

Monthly Summary



```
TA00025 2024-04-18 | score:  1181.327 (thresh:  221.074) -- 'pr' t:  0.697 mm n: (63.908 mm, 5 km), (0.289 mm, 12 km), (0.051 mm, 17 km)
TA00025 2024-04-20 | score:   314.735 (thresh:  221.074) -- 'pr' t:  0.170 mm n: (29.775 mm, 5 km), (0.255 mm, 12 km), (0.748 mm, 17 km)
TA00025 2024-04-22 | score:   560.082 (thresh:  221.074) -- 'pr' t: 59.274 mm n: (51.495 mm, 5 km), (0.357 mm, 12 km), (1.735 mm, 17 km)
TA00025 2024-04-23 | score:   405.521 (thresh:  221.074) -- 'pr' t: 24.526 mm n: (43.587 mm, 5 km), (0.391 mm, 12 km), (0.68 mm, 17 km)
TA00025 2024-04-28 | score:  1102.611 (thresh:  221.074) -- 'pr' t: 33.469 mm n: (68.917 mm, 5 km), (0.272 mm, 12 km), (0.272 mm, 17 km)
```

- Michael produces a monthly summary report. I assume this is a separate script?
- For each station, it prints one row for each day that station was flagged
- In this example, TA00025 was flagged 5 times in April
    - The first two times, TA00025 reported low precipitation when one of its neighbors was reporting high values
    - The final three times, TA00025 reported large values when two of its neighbors were reporting small values
        - These look like false alarms to me