



*A QA/QC and Data-Filling
Decision Support System for
Near Real-Time Climate Data*

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Providing computer-assisted quality
assurance, quality control and data
filling

Presentation Overview

- Parameter list
- Quality states
- QAQC checks
- Screen shots
- Conclusions

Parameter List (Hourly)

- Temperature
- Humidity
- Radiation
- Wind Speed
- Wind Direction
- Precipitation (hourly and 6 hourly)
- Soil Moisture
- Soil Temperature

Quality States

- Valid
 - Not needed to be checked by a human
- Suspect
 - Needs to be validated or filled
- Invalid
 - needs to be filled
- Missing
 - needs to be filled

QAQC Checks

- Range
 - within a reasonable range
- Step
 - minimum allowable change
- Persistence
 - maximum allowable change
- Like Sensor
 - similar value to similar sensors
- Spatial
 - similar value to neighboring stations (parameter dependent)

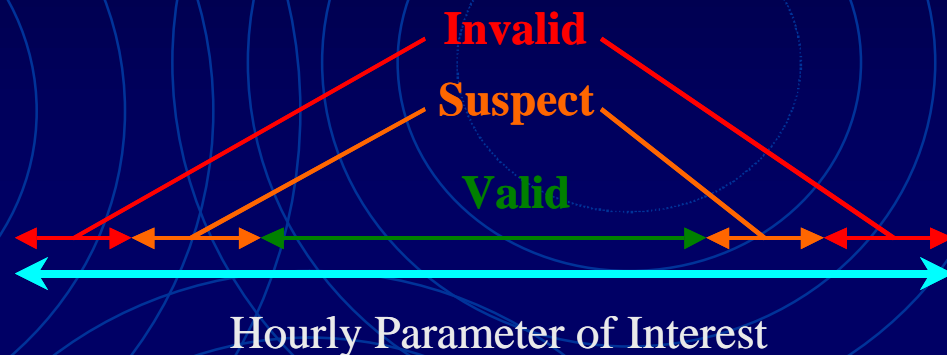
Methodology for Defining QAQC checks

- We used the hourly period of record supplied by Environment Canada that contains >25 million records from 250 stations in and around Alberta
- An adjustable trigger point for the “suspect” occurrences was set at 0.01% (1:10,000) for each test
 - Arbitrary and adjustable
 - For 200 stations examine ? 50 hourly values per day

Range Checks

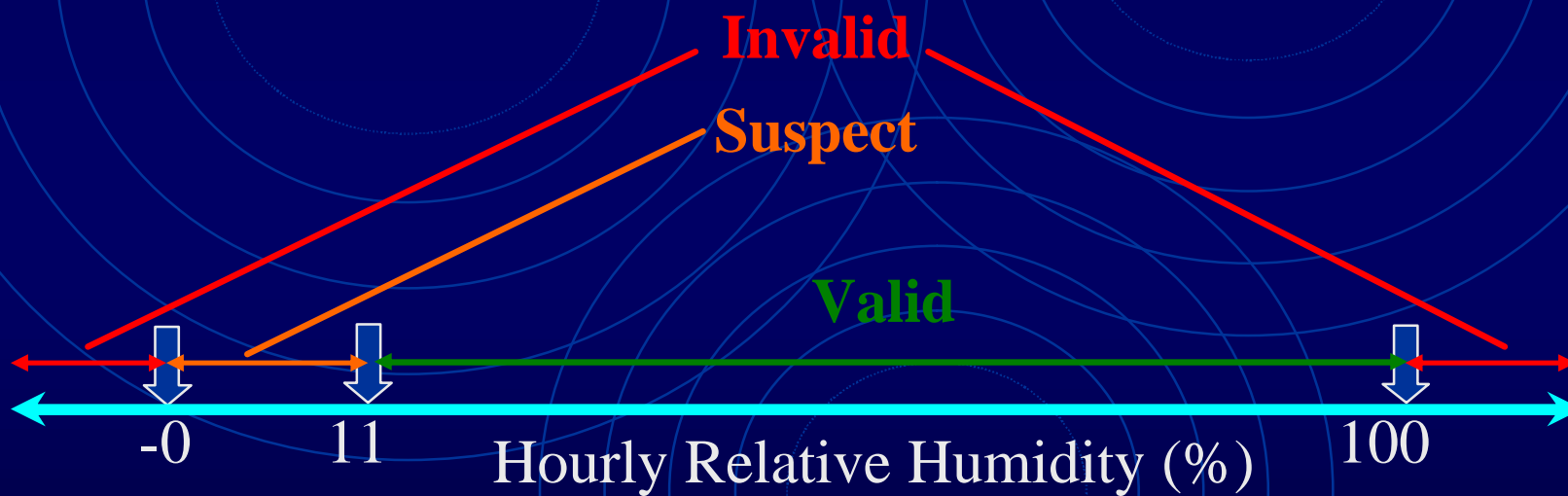
- Three range checks

1. Valid
2. Suspect
3. Invalid

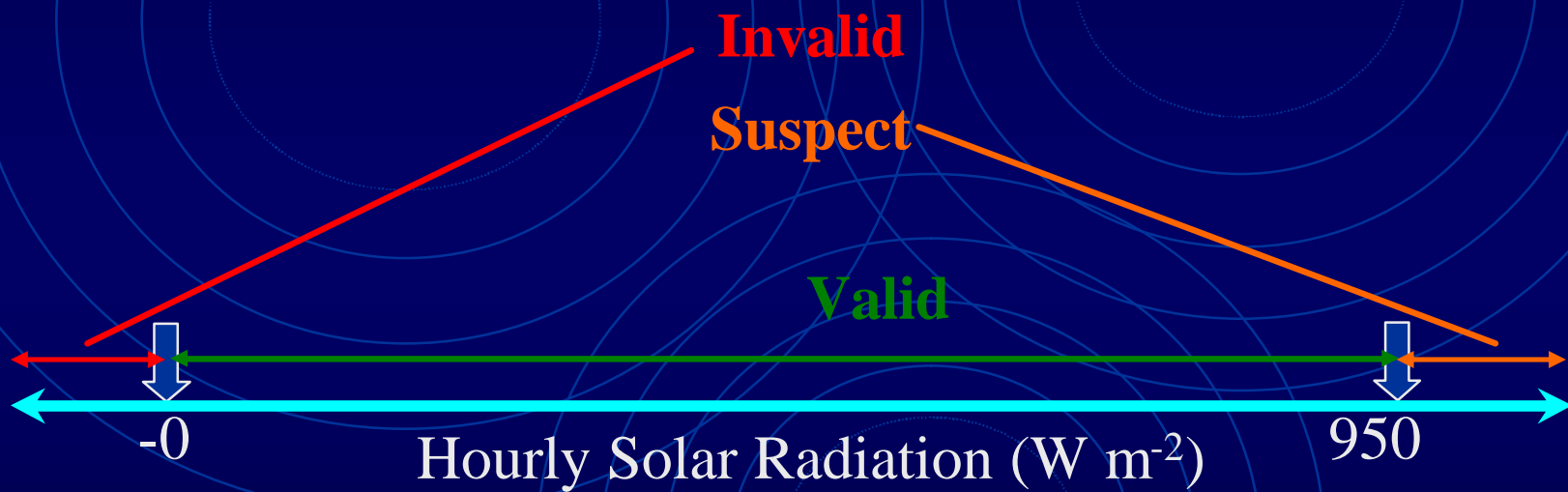


- If data falls outside the outer range it will be marked as **Invalid**
- If it falls in between the outer range and the inner range it will be marked **Suspect**
- If the data is missing it will be marked **Missing**
- If the data falls within the inner range then it will be marked **Valid**

Range Checks: Humidity



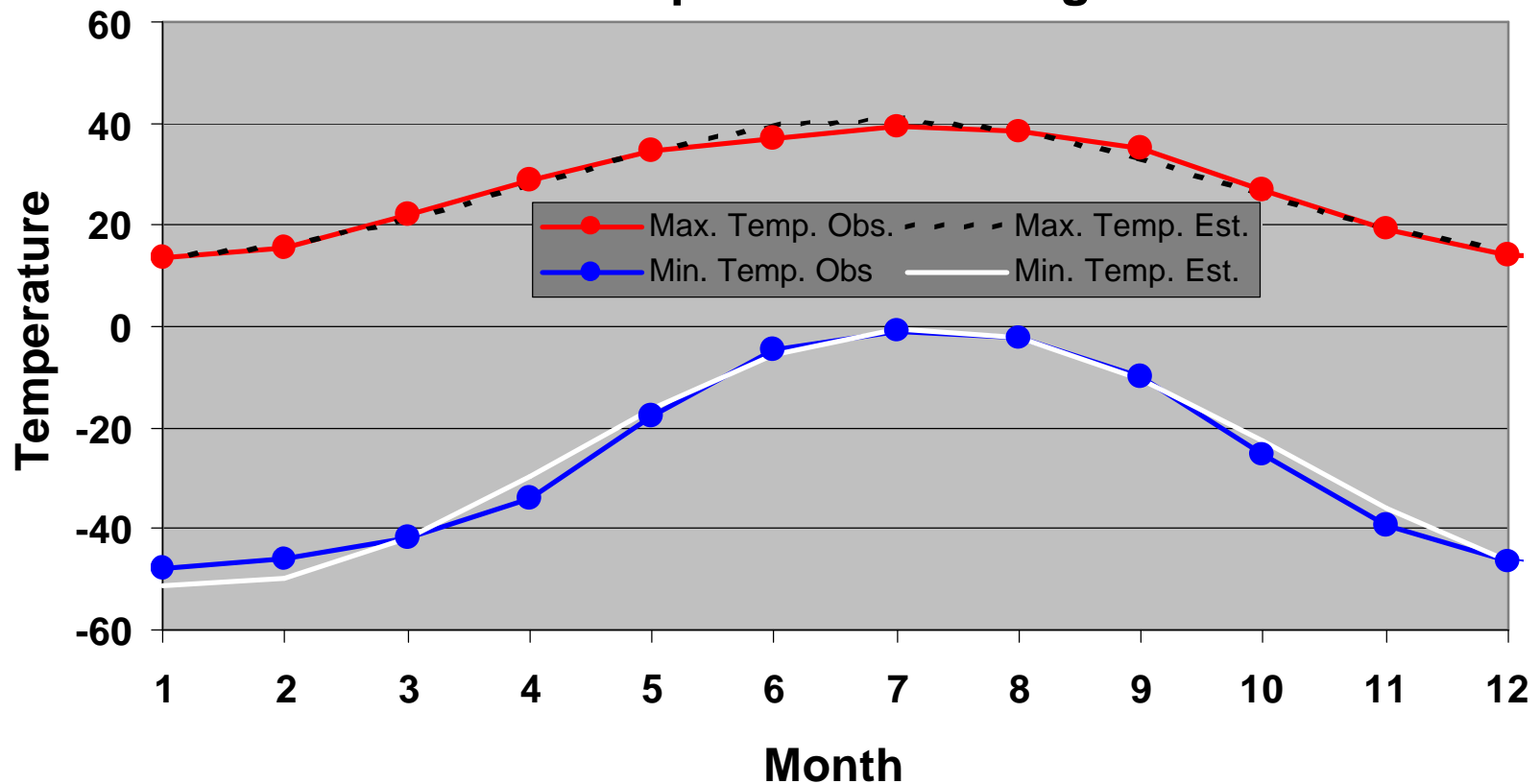
Range Checks: Radiation:



- Use wave function to define when day light occurs:
Daylight = $f(\text{latitude, Julian day})$

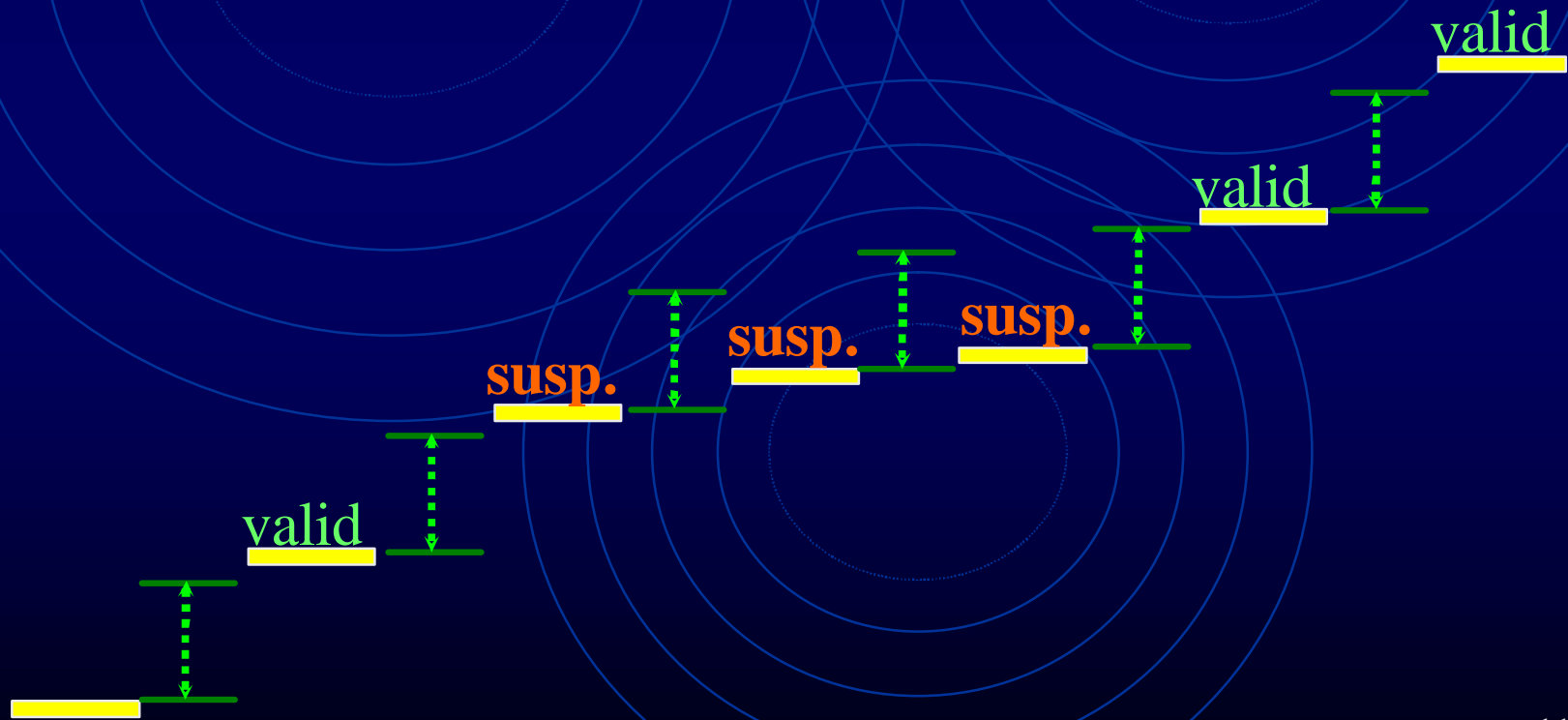
Range Checks: Temperature:

Monthly Max./Min. Extreme (0.01%)
Air Temperature Readings



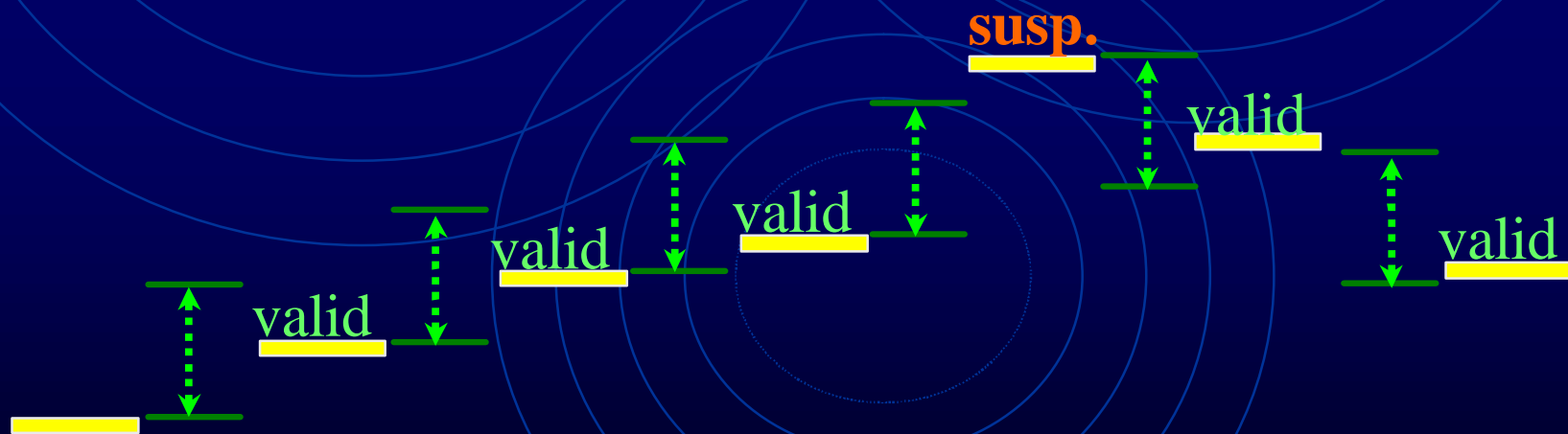
Step Check

Difference of Maximum and Minimum over n steps must be greater than y



Persistence

Difference of maximum and minimum over n steps must be at most y



Other Tests


- Like Sensors
 - Relating wind speed 2M to wind speed 10M
 - Relating occurrence of precipitation to humidity
- Nearest Neighbors:
 - Most appropriate for air temperature, humidity, and radiation
- Data Filling
 - Temporal filling
 - Spatial filling
 - Spatial-Temporal filling
 - Manual filling

Data Filling

- Temporal filling
- Spatial filling
- Spatial-temporal filling
- Manual filling


In every parameter's daily rollup you know how many records were filled so you can judge the validity of the daily value

http://localhost:9080 - QaQc Maintenance - Mozilla Firefox



MINISTRY of AGRICULTURE
INTERNAL COMMUNICATIONS

ACIS QaQc Maintenance



AGRICULTURE, FC
RURAL DEVELOPMENT

ACIS QaQc Maintenance

Confirm **Close**

Station

- Maintenance
- Parameter
- Maintenance Units
- Comparisons
- Validations
- Exceptions**
- Current
- Data
- Management
- QaQc Commands

Server Files

- Add
- Remove

Reports

- Drought Data

Admin

- Users

Logout

Current Exceptions

There are 477 Unconfirmed Records

- Range (4 records)
- Temporal (76 records)
- Icing (0 records)
- Min/Max Consistency (0 records)
- Operating Temperature (0 records)
- Incoming Radiation Invalid Time (7 records)
- Like Sensor (200 records)
- Neighbour (190 records)

Done



ACIS QaQc Maintenance

Save Remove Close

Station

Maintenance

Parameter

Maintenance

Units

Comparisons

Validations

Exceptions

Current

Data

Management

QaQc Commands

Server Files

Add

Remove

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Update Parameter

Interval Length:*	<input type="text" value="3600"/>
Abbreviation:	<input type="text" value="HU"/>
Description:*	<input type="text" value="Humidity"/>
Units:*	<input type="text" value="%"/>
Inner Range Minimum:*	<input type="text" value="11.0"/>
Inner Range Maximum:*	<input type="text" value="100.0"/>
Outer Range Minimum:*	<input type="text" value="0.0"/>
Outer Range Maximum:*	<input type="text" value="100.0"/>
Inner Distance:*	<input type="text" value="70.0"/>
Outer Distance:*	<input type="text" value="100.0"/>
Soil Temperature Threshold:	<input type="text"/>
Icing Temperature Threshold:	<input type="text"/>
Icing Wind Speed Threshold:	<input type="text"/>
Accumulation Restest Threshold:	<input type="text"/>
Max Deviation:*	<input type="text" value="15.0"/>



ACIS QaQc Maintenance

Submit Skip Close

Station

- Maintenance
- Parameter
- Maintenance
- Units
- Comparisons
- Validations
- Exceptions
- Current
- Data
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Logout

Range Exceptions (3 of 4)

Station: Barrhead

Parameter: Humidity

Set all these records: Valid Invalid

Valid	Invalid	Custom	Custom Value	Param Value	End Of Interval	Quality Code
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="text"/>	1.913	2006-01-05 03:00:00.000000	InnerRangeMinimumViolation

[See Station and Neighbouring Station Data for this time period](#)

Number of Neighbours: Number of Intervals before and after interval(s) in question:

End Of Interval	Barrhead		Twin Lakes		Dapp AGDM		Highvale	
	Distance: - km	Elevation: 648m	Distance: 23.0 km	Elevation: 655m	Distance: 40.0 km	Elevation: 616m	Distance: 71.0 km	Elevation: 747m
	Azimuth: 0°		Azimuth: 193.0°		Azimuth: 38.0°		Azimuth: 269.0°	
2006-01-05 00:00:00.000000	93.7	(VALID)	91.0	(VALID)	93.2	(VALID)	43.57	(SUSPECT)
2006-01-05 01:00:00.000000	92.1	(VALID)	92.2	(VALID)	93.3	(VALID)	52.24	(SUSPECT)
2006-01-05 02:00:00.000000	92.2	(SUSPECT)	90.7	(VALID)	91.6	(VALID)	76.3	(VALID)
2006-01-05 03:00:00.000000	1.913	(SUSPECT)	90.4	(VALID)	92.7	(VALID)	82.2	(VALID)
2006-01-05 04:00:00.000000	94.7	(SUSPECT)	92.1	(VALID)	95.0	(VALID)	79.5	(VALID)
2006-01-05 05:00:00.000000	95.4	(VALID)	92.2	(VALID)	96.0	(VALID)	71.7	(VALID)
2006-01-05 06:00:00.000000	95.4	(VALID)	94.0	(VALID)	95.6	(VALID)	69.34	(VALID)

Conclusions

- We have a state of the art process that is both flexible and data driven
- Reduces man power
- Capable of generating error logs for maintenance checks