Primary author: **Eglitis, Paul** (Met.no - Norwegian Meteorological Institute), paul.eglitis@met.no

Abstract ID: 5O2

Status and Performance of automated non-real time quality control methods (Qc2) within KVOSS

The KValobs Open Source Software (KVOSS) project is carried out with collaboration between met.no and SMHI where the real-time quality control software (Qc1), initially developed by met.no, was released as an open source distribution. Additionally a non-real time suite of applications, kvalobs Qc2 (kvQc2), is under development to provide statistical analysis and quality control of ensembles of synoptic meteorological measurements to further validate the Qc1 controlled observations and deliver functions to provide improved estimates of missing or highly suspicious data. The Qc2 methods rely on both spatial and temporal interpolation methods and other geo-statistical algorithms. Special attention is made to the selection of data to process and the search for ancillary information to minimize the uncertainty in the Qc2 estimates and quality controls. The development of each Qc2 method relies on gaining experience from human quality control specialists and groups of experts, e.g. NORDKLIM co-operation, in order to establish the best practices for quality control and the most effective techniques to apply. The status of the Qc2 software is presented as well as the analysis of the performance of the applied algorithms and the first steps to put Qc2 into full and automatic operations.

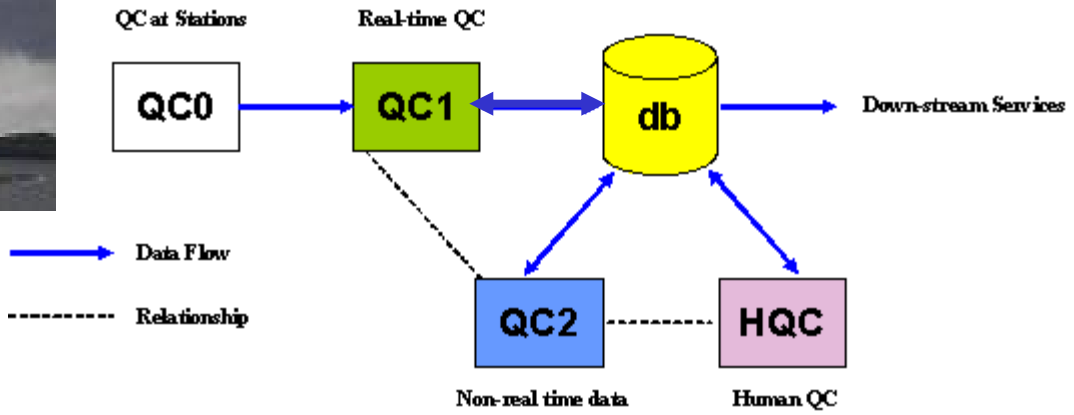
Norwegian Meteorological Institute
met.no

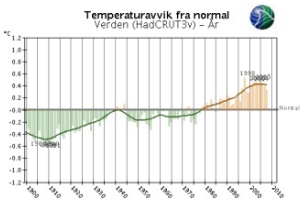
Status and performance of automated non-real time quality control methods (Qc2) within KVOSS

7th ECSN Data management workshop, DMI, Copenhagen

paul.eglitis@met.no

Status and Performance of automated non-real time quality control methods (Qc2) within KVOSS



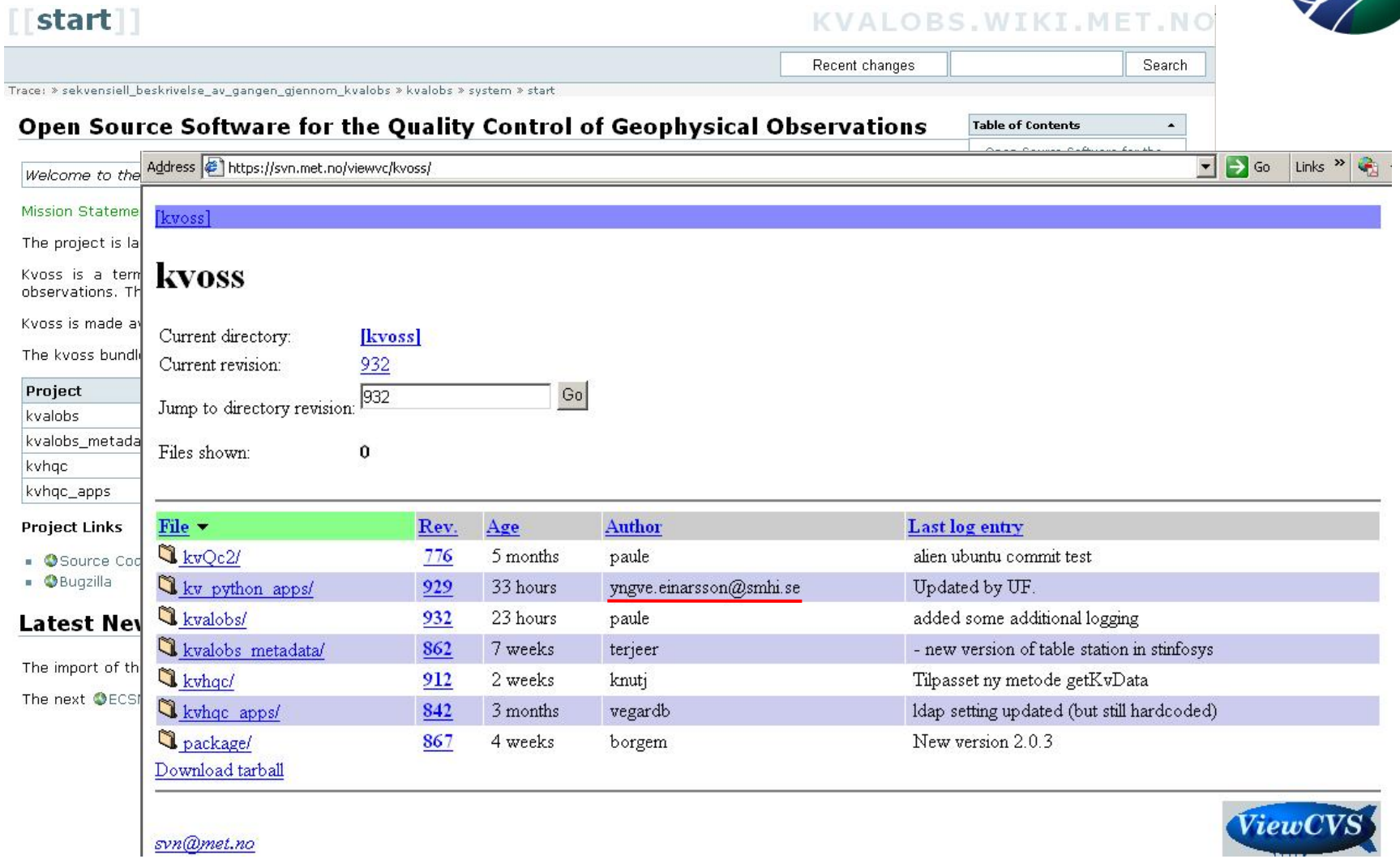


Definitions [http://www.smhi.se/hfa_coord/nordklim/task1/quality_control.pdf]

QC0	Quality Control at the Station Site
QC1	real-time on-line Quality Control
QC2	non-real-time Quality Control
HQC	Human Quality Control
kvalobs†	Quality assurance system at met.no
KVOSS	KValobs Open Source Software

† ***kval****itetssikring av* ***obs****ervasjoner*

KVOSS overview



Kvalobs Qc1 Overview

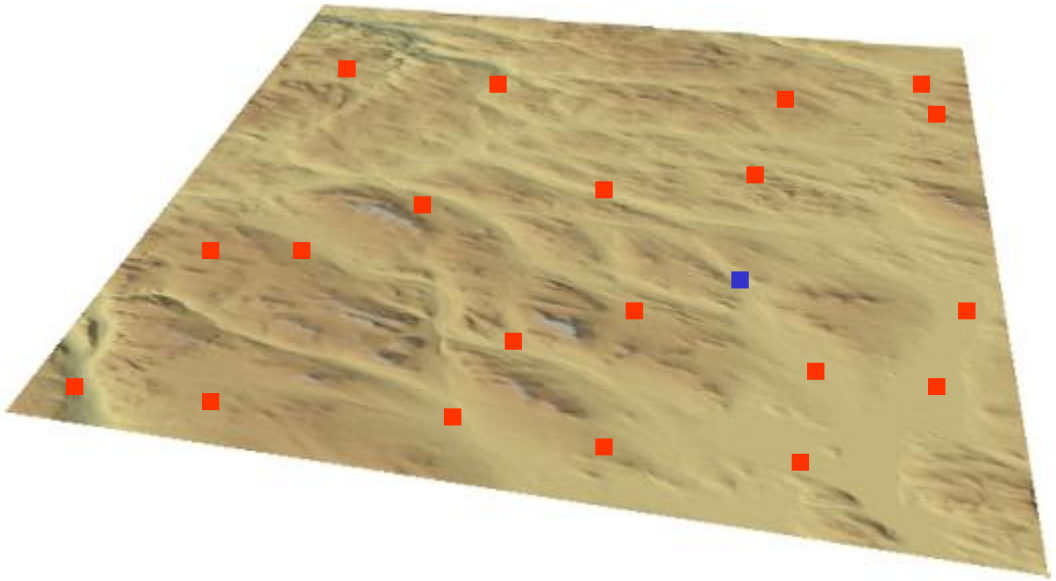
- Fully automatic system
- C++ engine interfacing a postgresql database
- Quality controls implemented as interpreted scripts.

QC1-0 Prequalification controls (application of a priori knowledge about the observation)
QC1-1 Threshold control s(value within possible or expected physical range)
QC1-2 Formal consistency controls (consistency checks between different parameters, e.g. minimum temperature is not greater than the maximum temperature for a given period)
QC1-3 Time development controls (step, freeze, dip/extreme …)
QC1-4 Prognostic space control (check based on comparisons with numerical model values)
QC1-5 Message control (specific checks for moving stations)
QC1-6 Climatological consistency (consistency checks based on probable climatological relationships between parameters)
QC1-7 Detection of aggregate value

++ Generic algorithms not necessarily specific to one control type.

Qc1 tests are all single station oriented and can be performed immediately when the measurement in acquired. Qc2 requires other measurements: time-series, nearest neighbours, other simultaneous fields or combinations…

Non real-time Quality Control Qc2



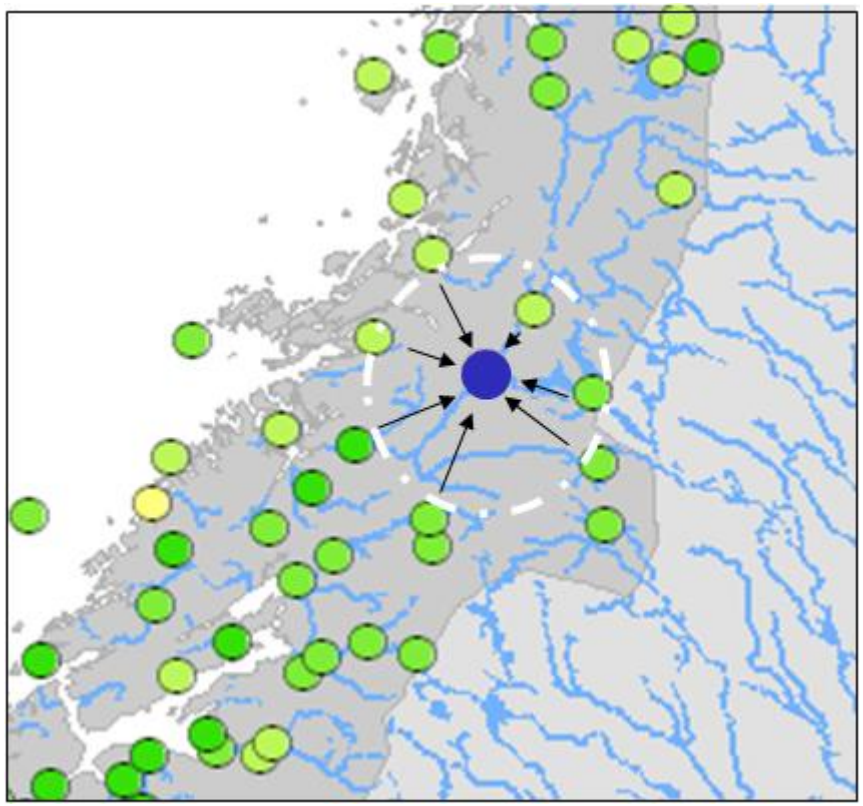
• Reliant on the availability of other observations,
• For all observations at (λ,φ,z,t) calculate a model value where:

model(λ,φ,z,t) = f(neighbour observations)

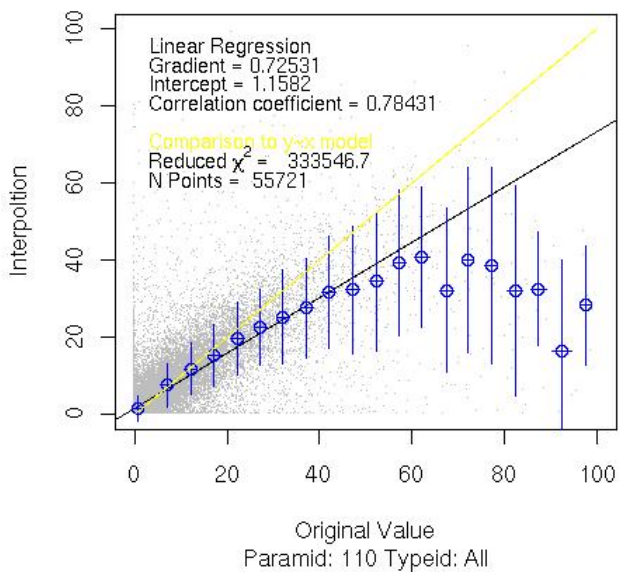
• Neighbours to be considered can be in space, time or both,

• Comparison of observation and model/neighbours => affirm Qc1 results, new control flags and, where appropriate, a correction.

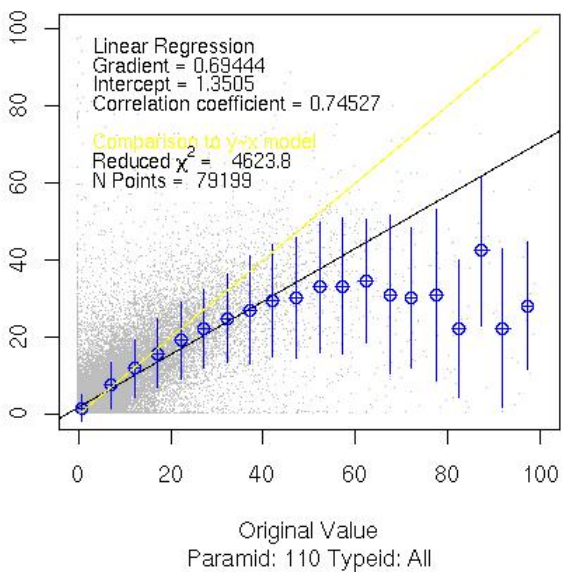
• Choice of method, neighbours etc. determined by characteristics of the algorithm, Qc1 controls, Qc2 controls, and other information, e.g. radar, satellite, NWP fields



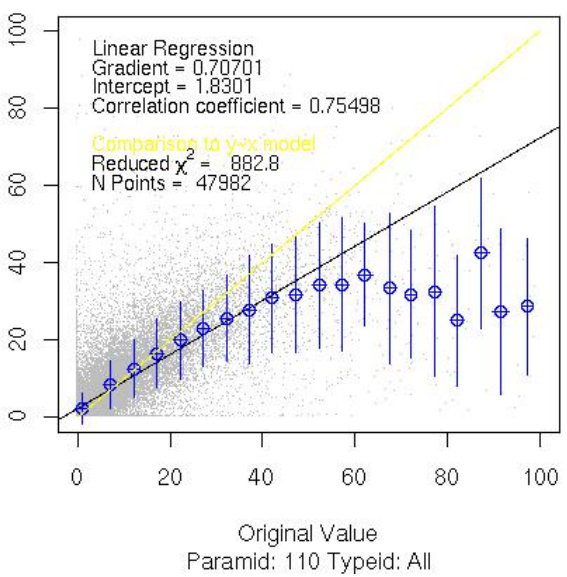
Linear Interpolation of Triangulated Neighbours



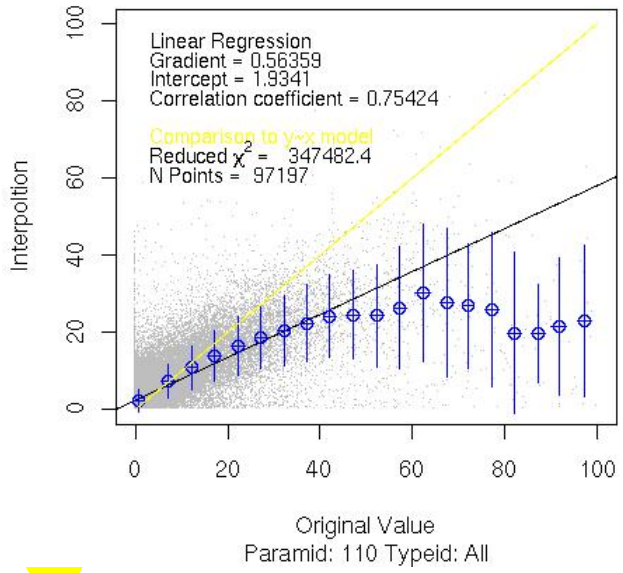
Inverse Distance Square <= 50 km



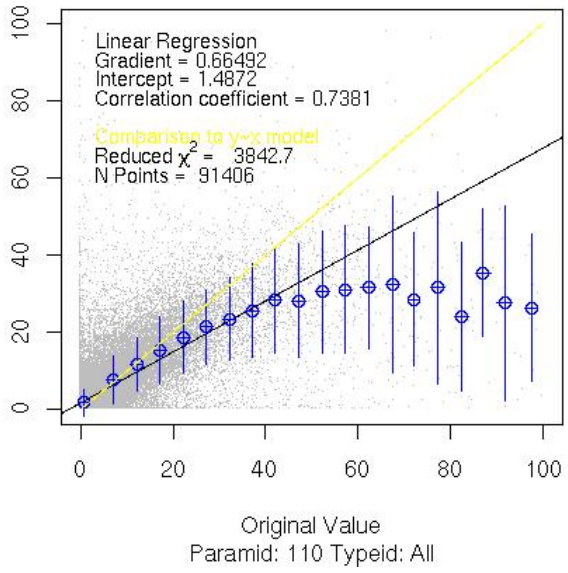
IDS <= 50km Wet/Dry Separation



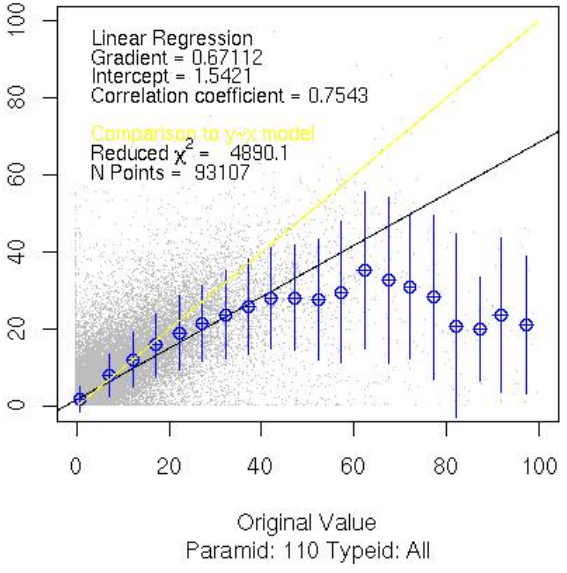
Inverse Distance Square



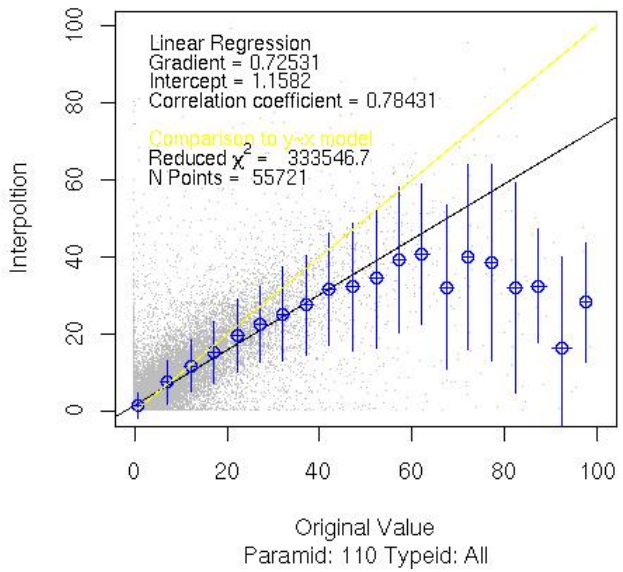
Inverse Distance Square <= 100 km



IDS <= 50 km & Height Correction



Linear Interpolation of Triangulated Neighbours



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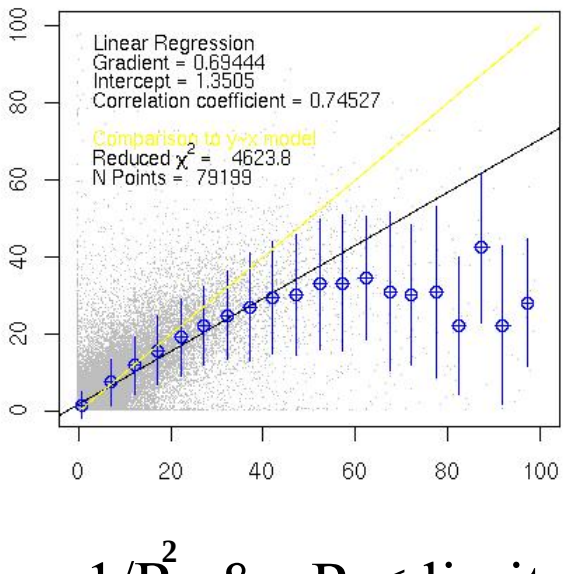

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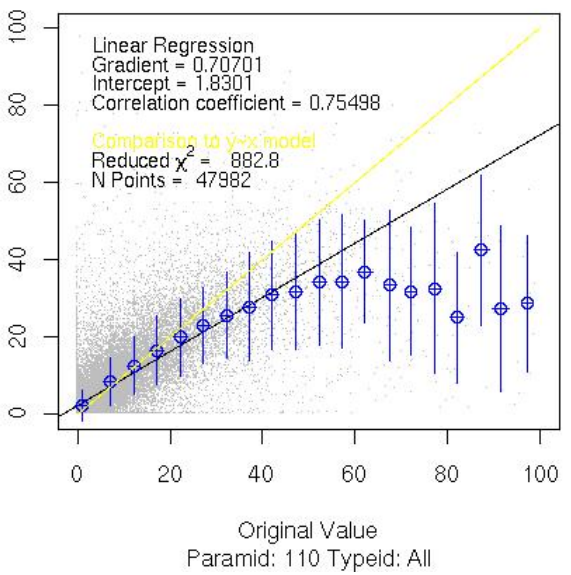
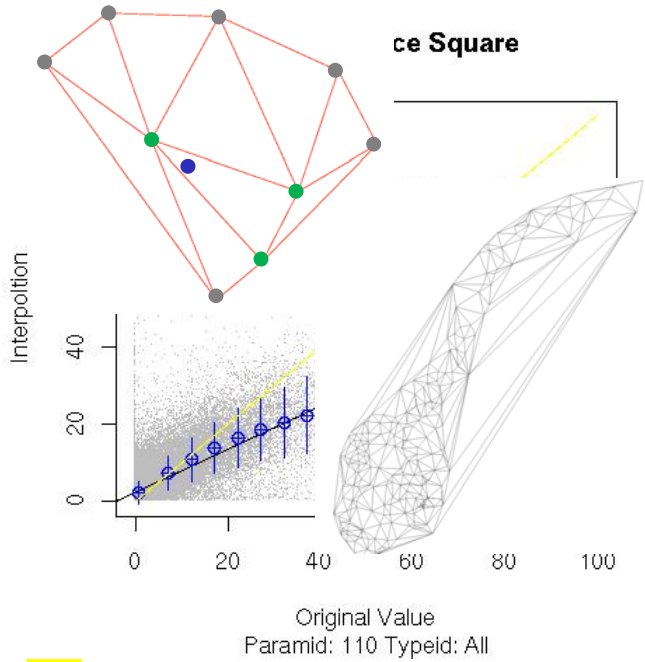
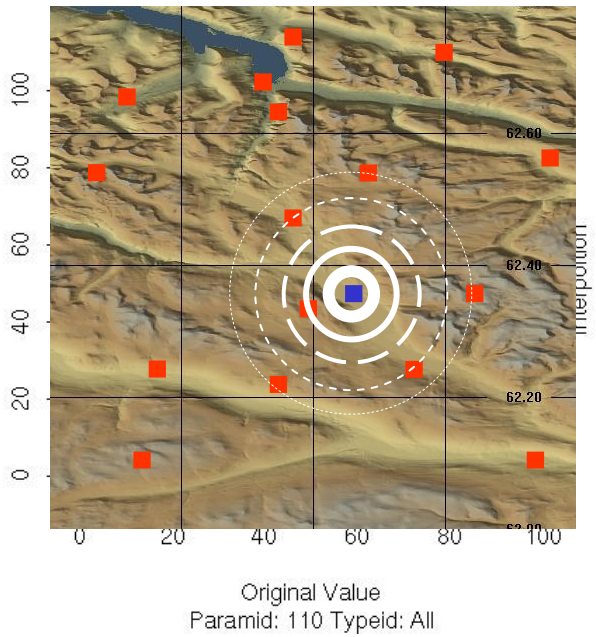
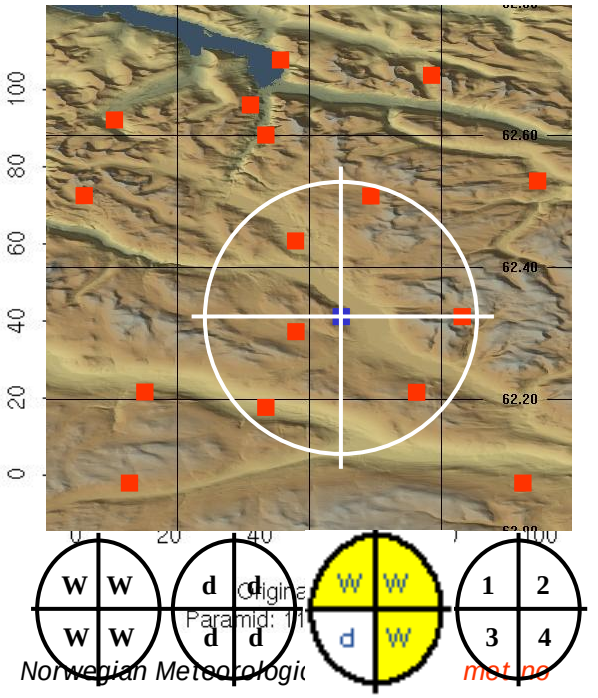


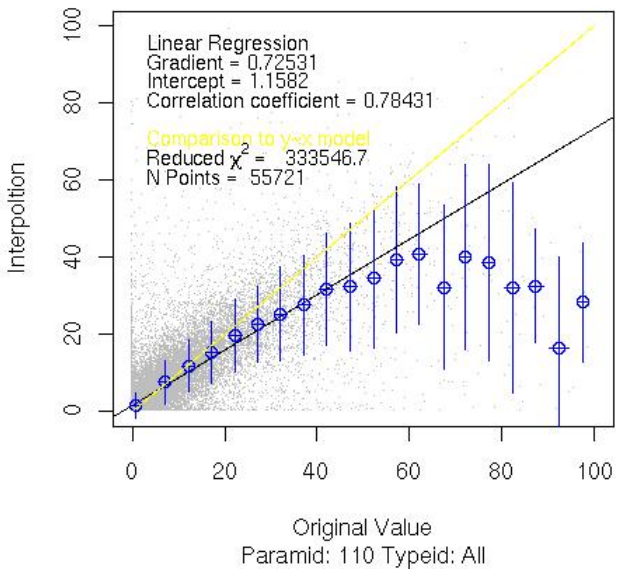


$1/R^2$ & R < limit

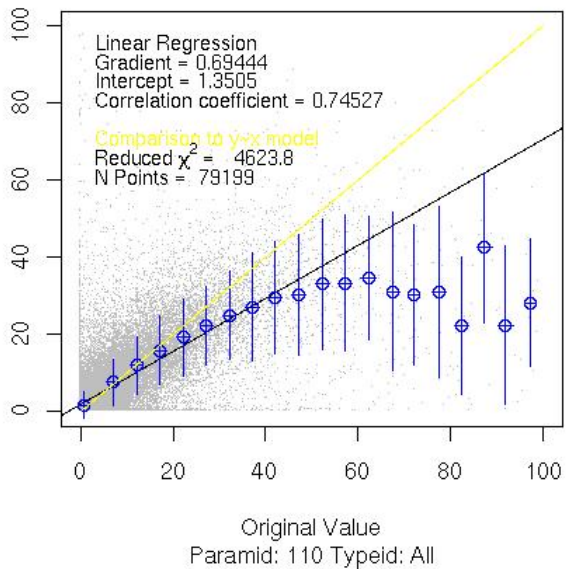




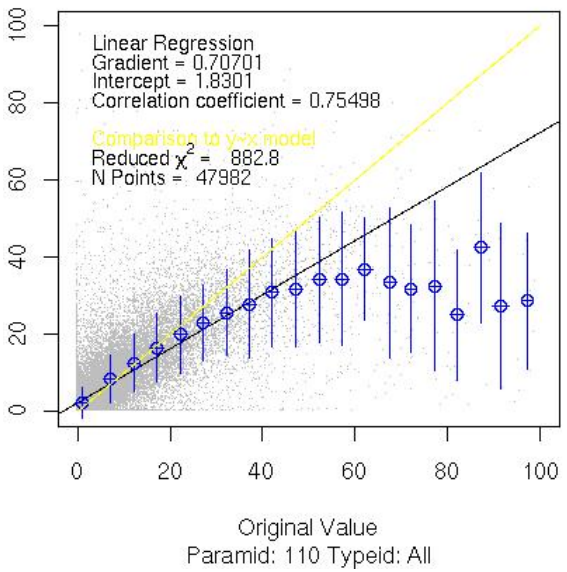
Linear Interpolation of Triangulated Neighbours



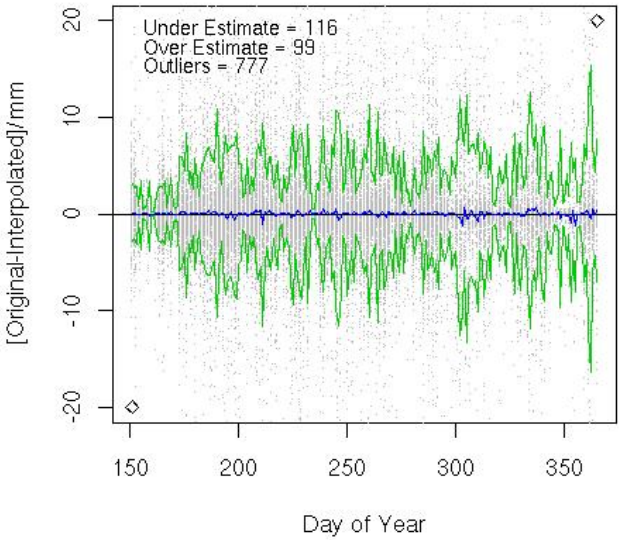
Inverse Distance Square <= 50 km



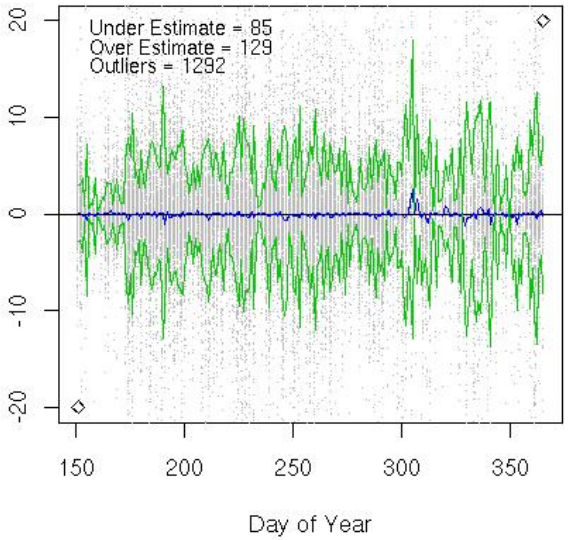
IDS <= 50km Wet/Dry Separation



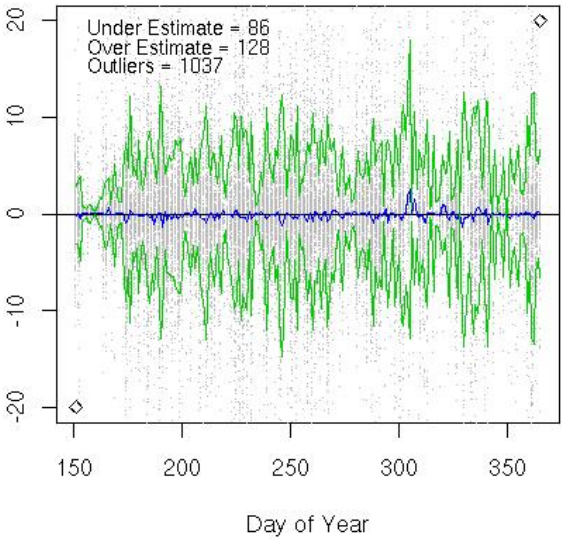
Delaunay-Linear.nc



L50-IDS.nc



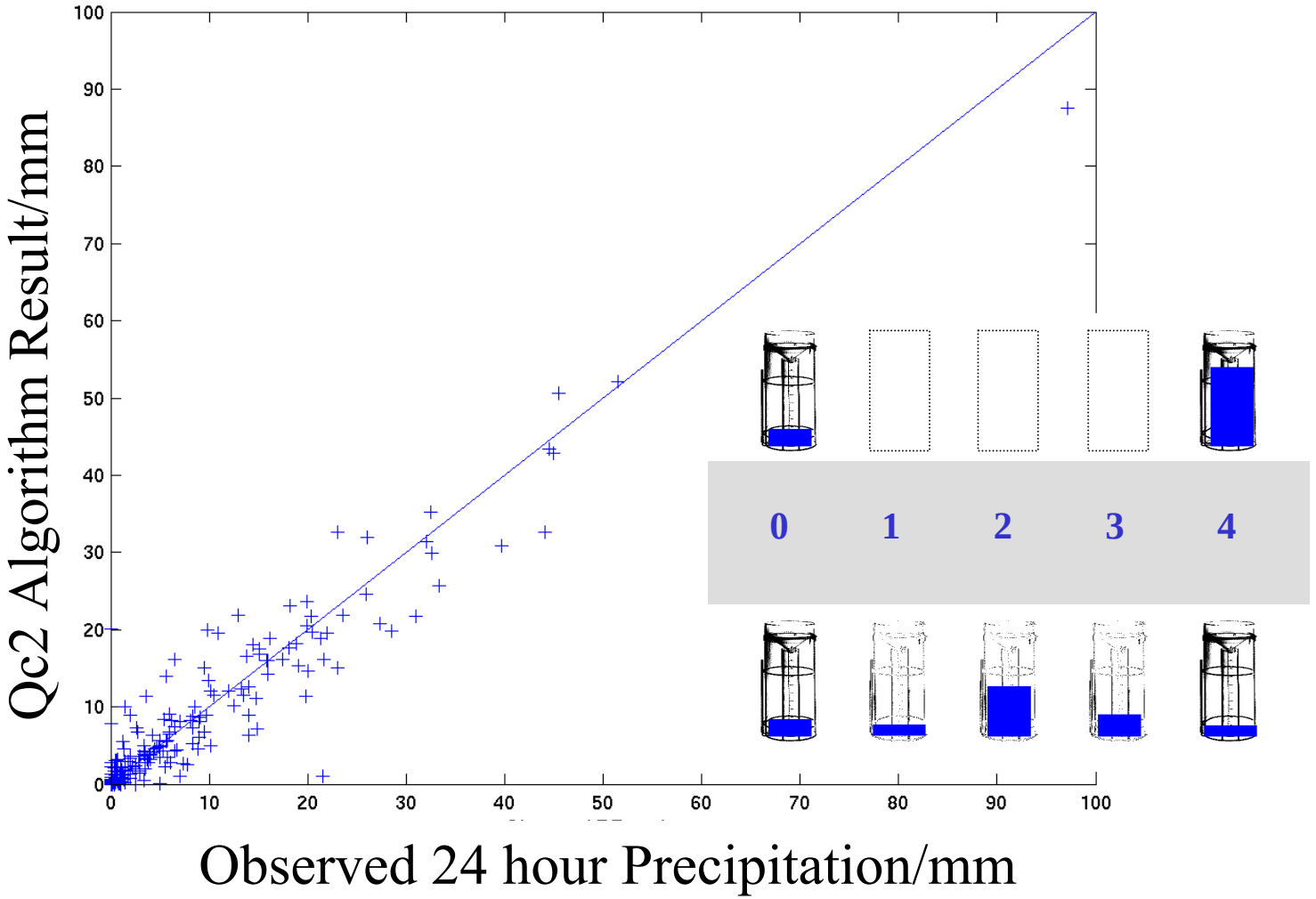
WetDry50-IDS.nc



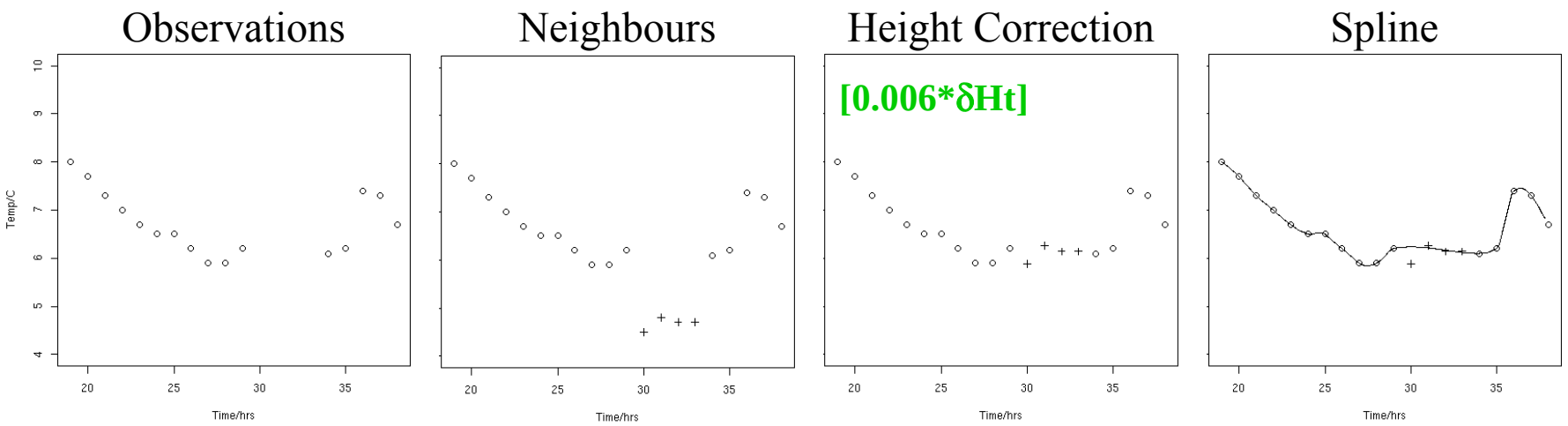
Challenges

- **Avoid introducing additional uncertainty.**
- **Many methods to choose from.**
- **Choice of method dependent on conditions.**
- **Build an expert system.**
- **Exploit cases where additional information is available.**

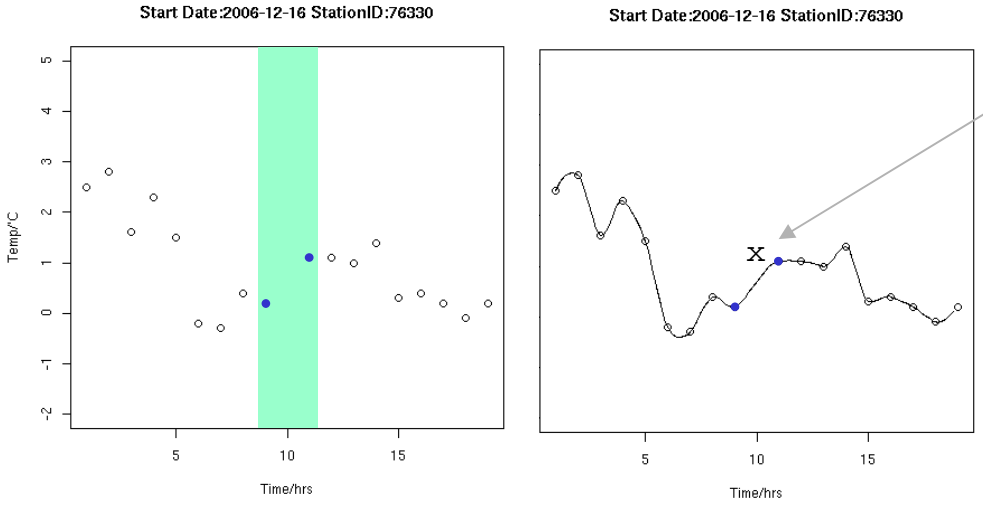
Redistribution of accumulated precipitation



Time Interpolations: splines & neighbours



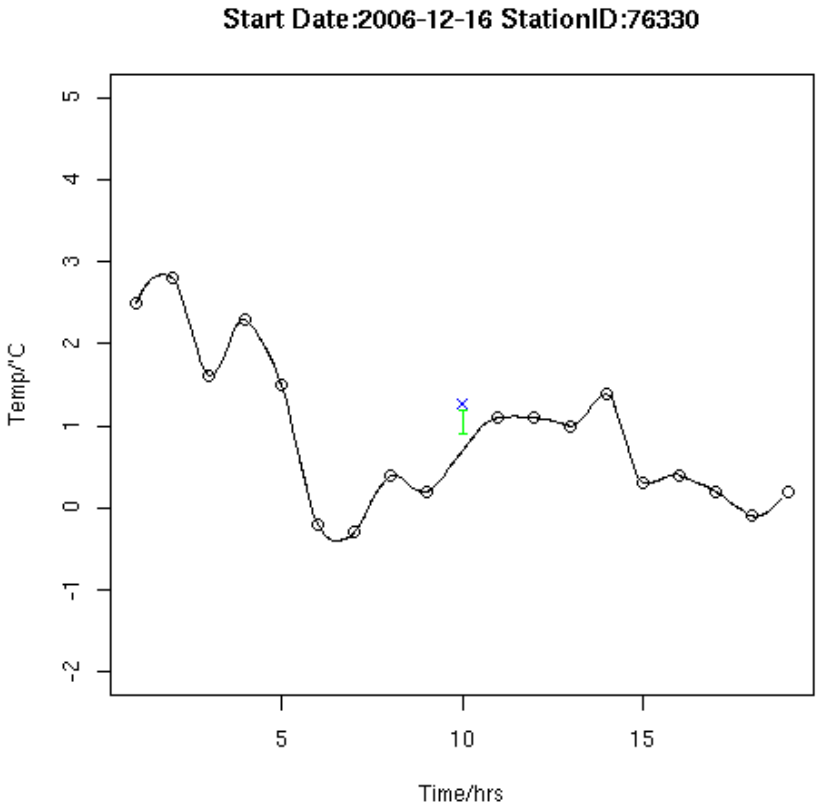
Time Interpolations: single points

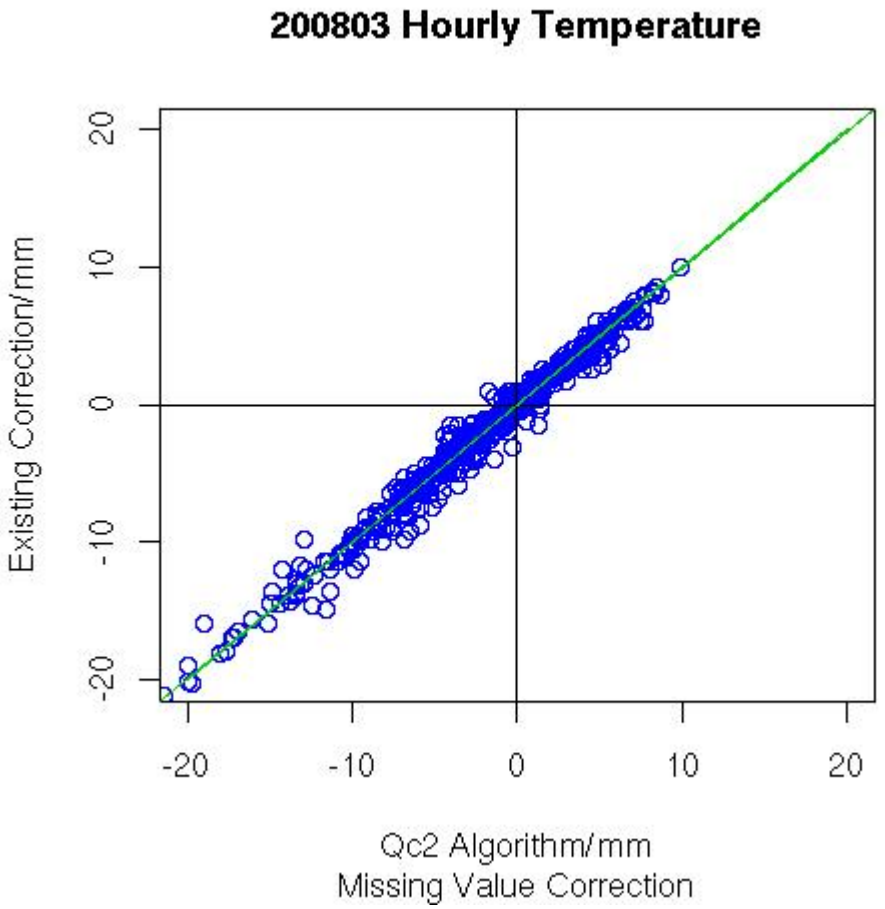


Height corrected nearest neighbour

hour	TA	TAN	TAX
09	0.2	0.2	0.5
10	-32767	-32767	-32767
11	1.1	1.1	0.9

hour	TA	TAN	TAX
09	0.2	0.2	0.5
10	-32767	-32767	-32767
11	1.1	1.1	0.9





Good estimate for single missing temperature = 0.5*(TAN + TAX)

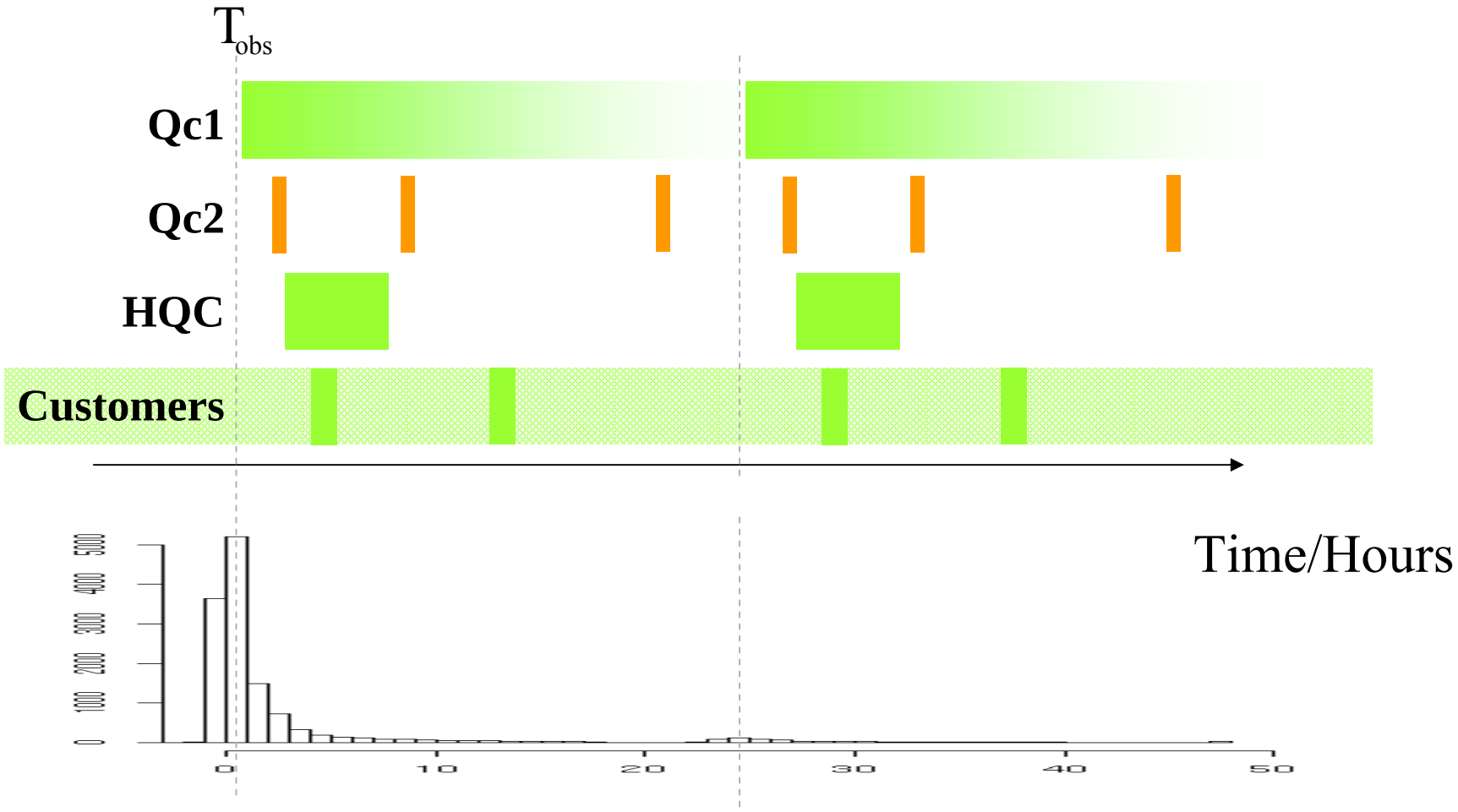
Lessons learned in building a Qc2 System

- **Expert system required exploiting supporting information. All conquering algorithms are not enough … build in decision making.**
- **Learn from HQC**
- **Scheduling**
- **Agreement on additional metadata**
- **Testing**

Qc2 Schedule based on:

bulk data availability

maintaining Qc1-Qc2-HQC-Customer workflow



Before Qc2 Control		After Qc2 Control		
Controlinfo	Useinfo	Controlinfo	Useinfo	#
[1100000000002000]	[7300000000000000]	[1100000003008000]	[5906000000000001]	38
[1110000000002000]	[7300000000000000]	[1110000003008000]	[5906000000000001]	93
[1110000000002000]	[73000000000000B0]	[1110000003008000]	[59060000000000B1]	1
[1110000000002000]	[73000000000000D0]	[1110000003008000]	[59060000000000D1]	1
[1040000000002000]	[7320400000000001]	[1040000003008000]	[5926800000000002]	2
[1140000000002000]	[7320400000000001]	[1140000003008000]	[5926800000000002]	85
[1040000000002000]	[7320400000000021]	[1040000003008000]	[5926800000000022]	2
[1040000000002000]	[7320400000000041]	[1040000003008000]	[5926800000000042]	1
[1100000000002000]	[7330900000000000]	[1100000003008000]	[5906000000000001]	36
[1110000000002000]	[7330900000000000]	[1110000003008000]	[5906000000000001]	71
[1140000000002000]	[7330900000000001]	[1140000003008000]	[5926800000000002]	115
[1110000000002000]	[73309000000000D0]	[1110000003008000]	[59060000000000D1]	3
[1140000000002000]	[73309000000000D1]	[1140000003008000]	[59268000000000D2]	6
[1110000000002000]	[73309000000000E0]	[1110000003008000]	[59060000000000E1]	2
[1140000000002000]	[73309000000000E1]	[1140000003008000]	[59268000000000E2]	1
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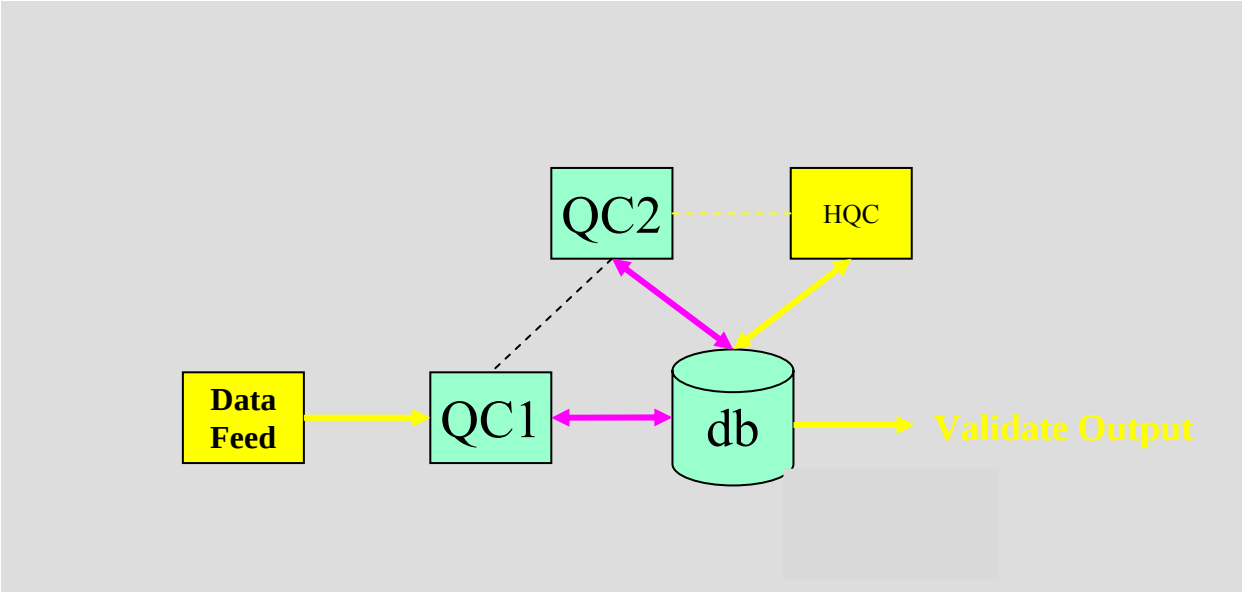
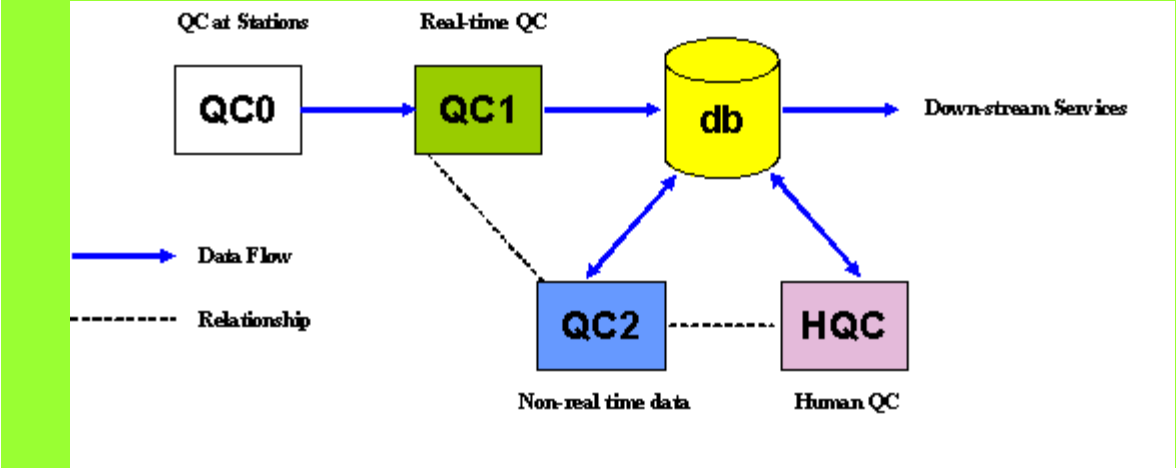
Flags for redistribution algorithm.

Test environment

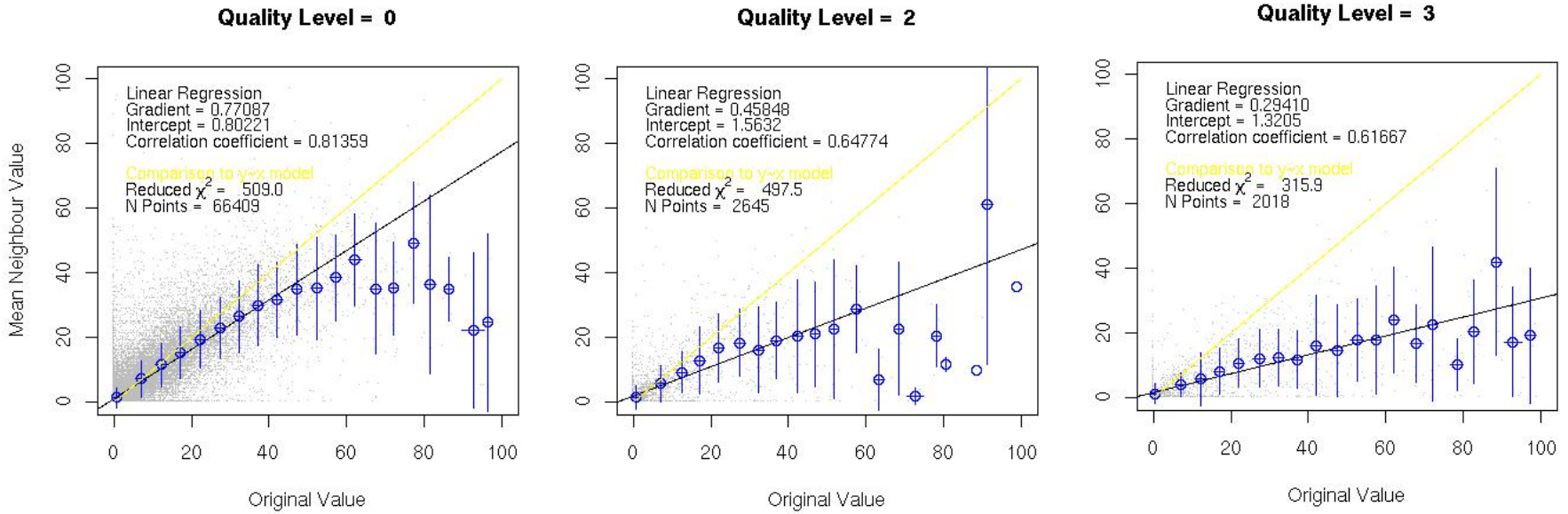


Operations



Conclusion

- **Favourable results with careful selection of algorithm and use of constraining information.**
- **System under rigorous testing prior to operational release.**
- **Use Qc2 results to affirm Qc1**



Thank you!