5th October 2006

Short comments on the current IC approach and proposal for further refinements derived from the Spanish IC exercise

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Here I analyse some technical problems, and for those I propose further refinements, on the use of an ICMi when regression lines between the EQR of the Member State (EQR_MS) system and EQR_ICMi present a regression intercept on axis Y deviated from the origin (0,0). Both systems (EQR_ICM and EQR_MS) are ratio variables with sets of data for which we know that in the population Y will be zero when X is zero. Our theoretical basis for applying a regression to extrapolate MS boundaries in another ICM system is that our zero in the MS system is 0 when the ICM is zero, so the regression line intercepts in (0,0). This theoretical assumption should result in similar transposition of EQR_MS boundaries into EQR_ICM boundaries, so a G/M boundary of 0.73 has great probabilities of being close to 0.73 transported into the ICM system. Intercepts higher than zero, produced that the EQR_MS G/M boundary from NSpain (0.73) translates into a boundary of 0.82 into the combined types option 4 of the EQR_ICM; value which is used for comparison and harmonisation of boundaries. The opposite occurs with intercepts smaller than zero; the MS boundary value gets reduced. The magnitude of the increase or reduction of the EQR_MS boundary depending on the magnitude of the deviation from the origin.

As a result of this variation, some countries get their same boundaries for an intercalibration comparison, while others get their boundaries significantly changed, and if the deviation is high, some times they have to move their boundaries in the harmonisation band (i.e. Spain).

What causes a regression line deviation from the origin?
An intercept throughout the origin indicates that the dependent variable (EQR_ICMi) can be predicted with a high precision with the independent variable (EQR_MS). If both variables are highly related, the line should cross the origin indicating a high direct relationship between the metrics or indices composing both systems. If a MS classification system has no metric in common with the ICMi, the regression line has higher probability of being non significant showing a bad regression line adjustment, and a diverging interception in axis Y. Also, even if same/similar metrics are provided in both systems, so the r^2 is high, the metrics composition from each system may differ substantially causing the deviation (e.g. proportionally more abundance or hydromorphology related metrics).

This fact highlights the importance of the election of an ICMi for the multiple comparison of many MS systems. ***The ICMi is the key element in the process of the international intercalibration***, and has to be able to provide a significant response to all pressures evaluated, by means of being composed by a numerous array of different balanced metrics able to cover significative equal response to all evaluated IC pressures, and on top of that has to cover all normative definitions of the WFD, for a particular biological element. **Ideally, also the ICM should be able to provide an intercept close to the origin in all MS datasets, to assure that the MS view of their boundaries is not affected by a different performance of the ICMi in their databases.**

ICM sensitivity analysis

The ICM is a scientific valid approach to compare databases on a basis of common metrics, and it has served the purpose of this IC exercise to overcome deficiencies in datasets, establishing a comparable exercise across countries. Meanwhile, time constraints have prevented a more detailed analysis on the ICMi response to pressures in the CB GIG IC river types, which should have resulted in a better selection and improved performance of the metrics composing the ICM. This analysis should have allowed finding alternative solutions to problems like that some countries show a big deviations derived from the regression intercept, which resulted in a considerable change of their boundaries.

Table 2.7 of final report for the GB GIG for macroinvertebrates shows that countries with new WFD compliant systems (i.e. Spain, Austria, Germany) have a significant increase in their boundary values vs a minor change in the boundary from other MS with a low intercept value, in spite of their significant relationship with the ICMi. These countries have included other new specific functionally related metrics (litoral preferences, habitus, species dominance, type reference species) in relation with the new WFD requirements. Their response to pressure is not dominated only by organic/nutrient metrics, a pressure which historically has been mainly evaluated using richness and sensitive/tolerance indices.

EQR_MS_val

MS	slope	intercept	r2	MS HG	MD GM	EQR_MS HG	EQR_MD GM	ICMi HG	ICMi GM	deviation H/G	deviation G/M
band								0.93	0.76		
benchmark								0.95	0.79		
AT	1.04	0.10	0.75	0.80	0.60	0.80	0.60	0.93	0.72	0.13	0.12
BE-W	0.96	0.02	0.96	17.00	13.00	0.97	0.74	0.95	0.73	-0.02	-0.01
DE	0.52	0.47	0.49	0.80	0.60	0.80	0.60	0.88	0.78	0.08	0.18
ES	0.79	0.24	0.82	0.93	0.73	0.93	0.73	0.97	0.82	0.04	0.09
FR	0.86	0.10	0.74	0.92	0.80	0.91	0.80	0.88	0.78	-0.03	-0.02
UK	1.58	-0.61	0.73	0.97	0.86	0.97	0.86	0.92	0.74	-0.05	-0.11
IT	1.00	0.00	1.00	0.96	0.72	0.96	0.72	0.96	0.72	0.00	0.00
LU	0.99	0.00	0.84	14.70	11.00	0.96	0.72	0.94	0.71	-0.01	-0.01
IE	1.10	0.00	0.64	4.50	4.00	0.85	0.75	0.93	0.82	0.08	0.07
LT	0.56	0.40	0.37	9.00	7.00	0.95	0.74	0.93	0.82	-0.02	0.08
NL	0.68	0.31	0.29	0.80	0.60	0.91	0.68	0.93	0.77	0.02	0.09
PL	0.80	0.17	0.68	0.90	0.68	0.89	0.68	0.88	0.71	-0.01	0.04
SE	0.54	0.33	0.46	1.00	0.70	1.00	0.70	0.87	0.70	-0.13	0.00
BE-F	0.96	0.00	0.73	0.80	0.60	0.80	0.60	0.77	0.58	-0.03	-0.02
CZ	0.47	0.50	0.34	0.80	0.60	0.80	0.60	0.88	0.78	0.08	0.18
DK	0.82	0.18	0.74	7.00	5.00	1.00	0.71	1.00	0.76	0.00	0.05
EE	1.37	-0.36	0.75	6.00	5.00	0.92	0.77	0.91	0.70	-0.01	-0.07

Table 2.7 including two new columns showing the MS boundary deviation on its resulting boundary in the ICMi.

A sensitive analysis was performed on the ICMi (CB GIG meeting in Lyon in May 2005; ICM sensitivity analysis: RC-2 and RC-3 pilots. I. Pardo), the analyses indicated that:

- Within the 6 metrics composing the ICM some were highly correlated (>0.8); the richness metrics (number of families and EPT families) and ASPT, arising the issue of redundancy in the information evaluated by the ICMi

- That the different weight provided to the metrics partly contributed to produce and arc effect increasing the tendency for an intercept >0, thus increasing the difference between the MS boundary and the ICM boundary. In comparison, if metrics were combined based on simple average, the arch effect was weaker and consequently the intercept in axis Y (example 1 in the report)

- Moreover, the pressure analyses done in the ICM for the Spanish dataset revealed a weaker performance, type specific, of the two abundance metrics 1-GOLD and SelEPTD (Annex 2.2.5.1. Relationship between pressure data and ICMi in Northern Spain CB GIG Rivers. I. Pardo. 15th September 2006)**.** The 1-GOLD metric was developed to be applied in Southern Portugal and the SelEPTD was developed for Italian rivers.

There is room to consider that the ICMi relationship with all MS classification systems can be improved in different ways in future intercalibration exercises, and that the correspondence of the systems in the regressions can be improved for MS diverging most affected, while not affecting the intercept in other MS datasets (not presented here).

Example showing refinements using the Spanish dataset:

The reference criteria for the North of Spain (from Galicia to the Basque Country) follows the REFCOND guidance. The North of Spain is a relatively well preserved area were it was possible to find a spatial network of sites fulfilling the reference criteria. Reference criteria of the North of Spain also fulfil the reference criteria of the rivers CB GIG.

The Spanish classification system of the ecological status is based presently in type specific multimetrics designed to fulfil the WFD requirement, which have been constructed as indicated elsewhere in the Annex 2.2.5.1. (Relationship between pressure data and ICMi in Northern Spain CB GIG Rivers. I. Pardo. 15th September 2006).

As many other MS we have used the percentile 25 of the reference population to define the H/G boundary for each type in NSpain, theses values ranging from 0.94-0.98. These boundaries were checked against the normative definitions of the types using the boundary setting protocol, and it was found that it was possible to provide a unique boundary candidate for all types (0.93).

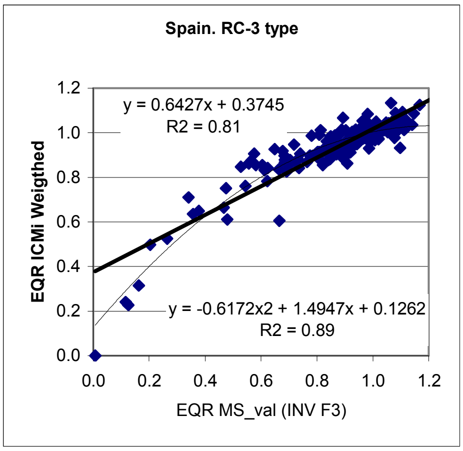
Following also REFCOND guidance, the remaining boundaries per each type were initially derived by dividing the H/G boundary in four, resulting G/M boundaries between 0.74-0.70. Again a check versus normative definitions using the boundary setting protocol indicated a possibility of a unique candidate for the G/M boundary (0.73).

The following examples show:

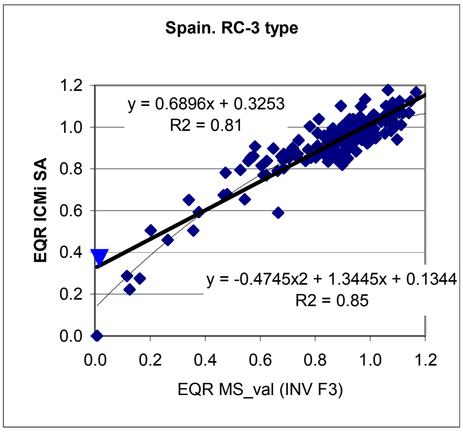
1. Example 1. How the regression can be improved in some Spanish datasets with the simple averaging of the metrics composing the ICM instead of the weighted average of them.

2. Example 2. How the Y intercept of the regression can be improved in some Spanish datasets with the comparison of new ICMi composed by simple average of 4 or 3 metrics, where the 1-GOLD metrics has been replaced by a general abundance metric (the dominance of 5 dominant families, widely used in USA), and the number of families or ASPT are suppressed.

Example 1. ICM sensitivity analysis: RC-3 pilot. The interception term of the regression can be improved in some Spanish datasets with the simple averaging of the metrics composing the ICM instead of the weighted average of them. Resulting in the lowering of the Spanish boundaries when transported into ICMi boundaries.



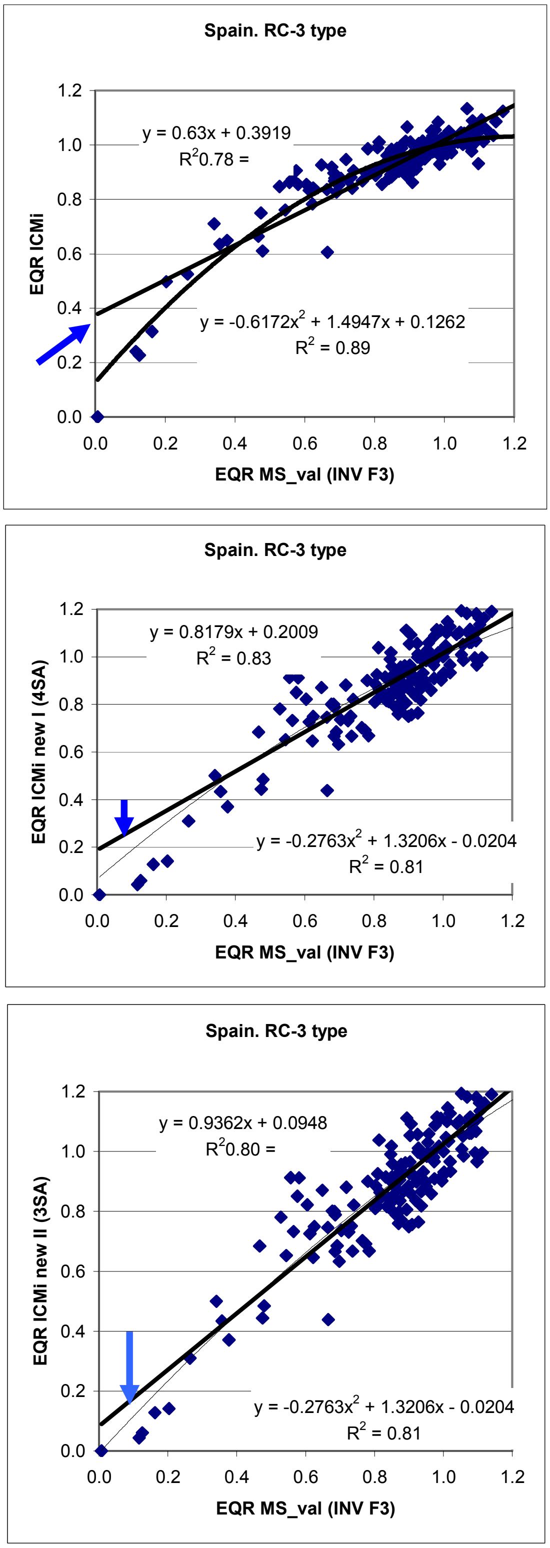
Boundary	EQR MS_val	EQR ICMi weigthed
high-good	0.930	0.972
good-moderate	0.730	0.844
moderate-poor	0.500	0.696
poor-bad	0.250	0.535



Boundary	EQR MS_val	EQR ICMi SA
high-good	0.930	0.967
good-moderate	0.730	0.829
moderate-poor	0.500	0.670
poor-bad	0.250	0.498

Figure 1. Comparison of the ICMi calculated as for the IC exercise (with weight for the different metrics) and with a simple average (SA) of the metrics, for the RC-3 type Spanish dataset.

Example 2. The Y intercept o the regression can be improved in the RC-3 Spanish dataset, **using other ICMi multimetrics for the comparison with the EQR_MS**. New ICM multimetrics composed by simple average of 4 or 3 metrics, where the 1-GOLD metrics has been replaced by a general abundance metric (the dominance of 5 dominant families, widely used in USA), and the number of families or ASPT are suppressed. Resulting in the lowering of the Spanish boundaries when transported into ICMi boundaries.



EQR_ICM with 6 weighted metrics used in IC

Boundary	EQR MS_val	EQR ICMi
high-good	**0.930**	**0.972**
good-moderate	**0.730**	**0.844**
moderate-poor	0.500	0.696
poor-bad	0.250	0.535

present IC boundaries

EQR_ICM new I. ICM composed by simple averaging of 4 metrics (5 Dominant families, ASPT, EPT taxa, selEPTD)

Boundary	EQR MS_val	EQR ICMi
high-good	**0.930**	**0.956**
good-moderate	**0.730**	**0.791**
moderate-poor	0.500	0.601
poor-bad	0.250	0.395

EQR_ICM new II. ICM composed by simple averaging of 3 metrics (5 Dominant families, EPT taxa, selEPTD)

Boundary	EQR MS_val	EQR ICMi
high-good	**0.930**	**0.959**
good-moderate	**0.730**	**0.770**
moderate-poor	0.500	0.553
poor-bad	0.250	0.318

Figure 2 Comparison of different ICMi vs the RC-3 river type Spanish ERQ, and correspondence of boundaries in both systems. **Top**, the ICM calculated as for the IC exercise (with weights for the different 6 metrics); **Middle**, the ICM composed by simple averaging of 4 metrics (5 Dominant families, ASPT, EPT taxa, selEPTD); **Bottom**, ICM composed by simple averaging of 3 metrics (5 Dominant families, EPT taxa, selEPTD)

These two examples show how it is possible to improve MS regressions and the transportation of boundaries, with the change of the ICMi build up and metrics composition, improving that MS have their boundaries, when in comparison, closer to where they original boundaries lie.

The harmonisation procedure of combining types:

The option 4 for MS boundaries harmonisation is combining all MS datasets in a single regression curve. This fact has affected now globally the Spanish boundaries, which used type specific classification systems, but with common boundaries to all types. Combined types with individual regression (option 2) showed that only the G/M boundary for the RC3 type from Spain was higher than the 5% band (Annex 2.2.3.1.). Meanwhile when data from all types are combined in one regression to produce unique boundaries, all 5 Spanish types have as a result a mean higher boundary, so Spain has to move 5 boundaries instead of 1.

The adopted decision of option 4 is very practical, and provides single boundaries, Spain thinks that it should be a possible option for harmonisation, but further IC exercises should analyse and check, before fusing all the types datasets in one single regression per country, that differences between MS boundaries are not due to the different performance of the ICMi in some types (i.e. very different interception). Even if a country has a single boundary for all types, its transformation into ICM changes the boundary values in the types, but ICM is not performing the same in all types as reflected in the Spanish homogeneous dataset comprising 5 types, thus regression of all data in one single regression is averaging ICMi performance in the different types. This issue we think will need further examination and refinement for future exercises on the light of the examples provided from the Spanish dataset.

Boundaries from Spain, are anyhow very close to the benchmark independent dataset, which has been calculated to provide an objective external boundary for the IC comparison results.

Spain has accepted to lower the G/M Spanish boundaries; the continuous classification system involving 3 decimals allows just a slight reclassification of sites in the exercises. The purpose of the present comments are to highlight the need for further refinements of some of the scientific-technical approaches of the actual IC exercise (the ICMi), which has had short time and resources availability, and to indicate future improvements which will need to be taken into account in future IC exercises, when all MS classification systems should be WFD fully compliant, as the Spanish system.