

# ***Comment on “General Orthogonal Regression Relations between Body-Wave and Moment Magnitudes” by Ranjit Das, H. R. Wason, and M. L. Sharma***

**by Paolo Gasperini and Barbara Lolli**

Das *et al.* (2013) describe a modification of the general orthogonal regression (GOR) method (Fuller, 1987) applied to the magnitude conversion problem that the same authors have already published at least twice in other journals (Das *et al.*, 2012; Wason *et al.*, 2012). Unfortunately, as more exhaustively discussed in our comment to Wason *et al.* (2012), published by the *Geophysical Journal International* (Gasperini and Lolli, 2014), some assumptions made by the authors are wrong and therefore their method has to be rejected.

The main mistake made by them consists of assuming as goodness-of-fit statistics the simple standard deviation between observed and computed  $M_w$  estimates, whereas such statistics are only valid if the errors in the independent variable ( $m_b$ ) are negligible.

The correct statistics to evaluate the goodness of fit of regressions between two variables that are both affected by observation errors is the squared statistical distance that, if the uncertainties of the two variables are uncorrelated ( $\sigma_{cu} = 0$ ), is given by

$$\text{Squared statistical distance} = \frac{(Y_{\text{obs}} - \beta_0 - \beta_1 X_{\text{obs}})^2}{\sigma_{ce} + \beta_1^2 \sigma_{uu}}, \quad (1)$$

(see equation 1.3.19 of Fuller, 1987), in which  $\beta_1$  and  $\beta_0$  are the regression coefficient and intercept, respectively.  $Y_{\text{obs}}$ ,  $X_{\text{obs}}$ ,  $\sigma_{ce}$ , and  $\sigma_{uu}$  are the observed values and variances of response and predictor variables, respectively. The squared statistical distance is actually the statistics minimized by the original GOR method.

If the authors had used the squared statistical distance in place of the simple standard deviation to calculate the curves of their figure 2, they would have been able to verify that the

performance of the original GOR method were superior to the modified one they propose. ✉

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