**Hydrology and
Earth System
Sciences
Discussions**

Interactive comment on "A dynamic rating curve approach to indirect discharge measurement" *by* F. Dottori et al.

R.nbsp;T. Clarke (Referee)

clarke@iph.ufrgs.br

General comment.

Good estimates of flow in river channels are fundamental for the management of surface water resources, flood control and reservoir management. However where records of river flow are used in hydrological analysis, the recorded discharge sequences are all too often accepted as given, without questioning either the validity of the rating curves used to estimate them, or the range of water levels for which the rating curves were calculated. The paper by Dottori et al. is a timely and important contribution to the methodology of river flow estimation, and the authors are to be congratulated not only on their very comprehensive summary of the literature, but also for their DyRaC (Dynamic Rating Curve) formula, and for a careful comparison of its

performance by means of numerical simulation with other formulae found in the literature. The DyRaC formula uses water-levels recorded at two adjacent cross-sections in a river reach, and assumes (i) that no significant discharge enters or leaves the reach between the two cross-sections, and (ii) that the two cross-sections are sufficiently close for the derivative of discharge with respect to longitudinal distance $\partial Q/\partial x \approx 0$. The distance between the sections must be sufficiently small for the assumption of constant flow rate to be valid, but sufficiently large for the difference between water-levels to be greater than the sensitivity limit of the instrument used to measure it, and greater than the error resulting from short-term fluctuations in water-level. The advantages claimed for the DyRaC formula are not only that it takes account of hysteretic loops generated by unsteady flow conditions, but also that the only calibration required is of the roughness coefficient, thereby eliminating errors of extrapolation encountered where traditional rating curves are used (the geometries of the two cross-sections are also required, and are presumably taken to be time-invariant). The authors propose a methodology by which simultaneous water-levels could be calculated by an instrument at the two cross-sections, allowing for short-term fluctuations in level caused by rippling and other factors. The conclusion to the paper says that an instrument is being built for this purpose, and that it will be tested on several rivers with different hydrological characteristics and conditions. A full evaluation of the DyRaC formula must await the results of such field trials, but the numerical simulations show that the formula has much promise.

The field trials will reveal whether there are problems of instrument maintenance in remote sites, and of instrument security in populated areas. Clearly, DyRaC shows the way to better estimation of discharge under benign conditions, on rivers that are comparatively well-behaved in terms of channel stability and ease of access. But in much of the world, such benign conditions are rare: the rivers in central Amazonia wend their meandering, varicosed courses through remote forest where even conventional rating curves are enormously difficult to obtain, whilst at the other extreme, the River Bermejo, a tributary of the Paraná-Paraguay system, transports and deposits enormous volumes

of Andean sediment, giving an intensely-braided, constantly changing channel. It will be some time before even the most unsophisticated flow estimation procedures can be consistently used in such rivers.

This, however, must not detract from the authors' achievement. What is encouraging is the growth of interest in research to improve methods of flow estimation, to which the authors' paper is an important contribution. Furthermore, research is developing along several lines; see, for example, papers by A Petersen-Øverleir and T Reitan on Bayesian methods applied to rating-curve definition in the journal Stochastic Environmental Research and Risk Assessment and J. Hydrology.

Specific comment.

To write any scientific paper in a language other than one's mother tongue is a very significant achievement, and even the written texts of native English speakers can be extremely poor. Whilst the message of the authors' paper is very clear, their text has a number of minor errors in English spelling and grammar which should be corrected before the definitive version appears.

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