Reply to "The morphological response time of nearshore profiles [Plant, Ruessink and Wijnberg, 2001, revisited] by T.J. O'Hare and D.A. Huntley

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O'Hare and Huntley identify two problems in Plant et al. [2001] (hereafter, PRW2001), which ultimately lead them to conclude that sandbars and the "equilibrium" profile (as defined by PRW2001) may interact on the same timescales. We acknowledge the first problem (a mistake in a derivation) and find that the second problem raises an interesting point (how to correctly interpret an ad hoc treatment of Bagnold's efficiency factor). However, we find that their re-analysis does not support their conclusions, and does not significantly change the conclusions presented in PRW2001.

O'Hare and Huntley correctly identified a mistake in equation 13 (an expression for the sediment load supported by an applied bed stress) in PRW2001, where the term written as $\frac{\rho_s - \rho}{\rho}$ should have been $\frac{\rho}{\rho_s - \rho}$. Here, ρ and ρ_s are the density of water and sand, respectively. For water and quartz sand (ρ =1000 kg m^{-3} and ρ_s = 2500 kg m^{-3}), PRW2001 overestimate the sediment load by a factor of 2.25. This error means that the PRW2001 response time estimates were 2.25 times too fast.

The second problem is an objection to an admittedly ad hoc approach to specifying the relevant shear stress that supports the sediment load. In PRW2001, the stress was expressed as

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14. ABSTRACT
O?Hare and Huntley identify two problems in Plant et al. [2001] (hereafter, PRW2001) which ultimately lead them to conclude that sandbars and the ?equilibrium? profile (as defined by PRW2001) may interact on the same timescales. We acknowledge the first problem (a mistake in a derivation) and find that the second problem raises an interesting point (how to correctly interpret an ad hoc treatment of Bagnold?s efficiency factor). However, we find that their re-analysis does not support their conclusions, and does not significantly change the conclusions presented in PRW2001.

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$\tau = C_f^{'} \rho U|U|$, where $\tau = C_f^{'}$ is a modified fluid drag coefficient and U is the free stream velocity. The modified drag coefficient included a so-called efficiency factor that relates the rate of fluid energy dissipation to the work done moving sediment. The objection raised by O'Hare and Huntley is that the use of a modified drag coefficient means that the stress used by PRW2001 does not represent the flux of fluid momentum, through dissipation, at the seafloor. We find merit in this objections, but note that Bagnold's original derivation is itself extremely ad hoc as the efficiency factor makes up for a variety of misrepresentations of the actual sediment transport processes. PRW2001 assign, for convenience, the misrepresentation entirely to the processes that support the weight of sediment that is advected by the near bed fluid velocity. We pointed this out in our original review of O'Hare and Huntley's manuscript, and they responded by assigning the efficiency term entirely to errors in modeling the near bed fluid velocity. Because the time-averaged sediment transport (equation 19 in PRW2001) depends linearly on the efficiency term, assigning to either the stress or the flow velocity, or to their product [e.g., *Plant et al.*, 2004], makes no difference in the computed, time-averaged sediment transport and morphological response times and does not clear up the original ambiguity.

We think that O'Hare and Huntley nicely highlight the ambiguity in the interpretation of the efficiency factor by introducing a fluid velocity correction factor, α_b. However, they do not support their estimates of this new factor with data. In the end, these ad hoc transport formulae can always be calibrated and the resulting coefficients provide an excellent means of characterizing morphologic response times.

Finally, O'Hare and Huntley use the relatively rapid response of nearshore sandbars to justify their modifications of the PRW2001 coefficients. However, the response time analysis presented by PRW2001 (and in O'Hare and Huntley's Table 1) corresponded to the response of the entire width of the surf zone, and does not apply to a range of shorter scale bedforms that are found in this region. That is, the cross-shore scale was on the order of a kilometer and the depth scale was about 10 m. The transport across the offshore boundary was used to scale the response time: $T_m \sim (\Delta h \, \Delta x)/\Delta Q$. Since the cross-shore scale of sandbars may be 10 times shorter than the surfzone and the depth scale is also 10 times smaller, a factor of 100 decrease in estimated response time for sandbars may be achieved without modification of PRW2001 (and this estimate was 2.5 times too fast due to the acknowledged mistake in the sediment load equation). O'Hare and Huntley's estimates may be inaccurate for typical sandy beaches. For instance, the time that a bar takes to traverse the surfzone at the well-studied Duck North Carolina (USA) location is about 10 years [*Lippmann et al.*, 1993; *Plant et al.*, 1999]. The mean wave height at that location is about 1 m, so the original PRW2001 prediction (9 year response time) has the correct order of magnitude here. Thus, the interesting point that O'Hare and Huntley raise about the possibility that short-scale sandbars may interact with the larger-scale "equilibrium" profile is not supported by their reanalysis of PRW2001. This does not mean that they are wrong, but they need to find another means of making this point.

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