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DISCUSSION AND REPLY

Reply to: Houston, *Journal of Coastal Research*, 15(4), Rejoinder to: Pilkey, O.H.; Thieler, E.R.; Young, R.S., and Bush, D.M., 1999. Reply to: Houston, 1999, Rejoinder to: Pilkey, O.H.; Young, R.S.; Thieler, E.R.; Jacobs, B.S.; Katuna, M.P.; Lennon, G., and Moeller, M.E., 1996. Discussion of Young, R.S.; Pilkey, O.H.; Bush, D.M., and Thieler, E.R., 1996.

Orrin H. Pilkey†, E. Robert Thieler‡, Robert S. Young§, and David M. Bush*

†Program for the Study of Developed Shorelines
Division of Earth and Ocean Sciences
Duke University
Durham, NC 27708, USA

‡US Geological Survey
384 Woods Hole Road
Woods Hole, MA 02543, USA

§Department of Geoscience
Western Carolina University
Collowhee, NC 28723, USA

*Department of Geology
State University of West Georgia
Carrolto, GA 30118, USA

We offer the confused reader of this reply a brief summary of events. The original paper (YOUNG *et al.*, 1995), the subject of this series of replies and rejoinders (HOUSTON, 1996, PILKEY *et al.*, 1996, HOUSTON, 1998, PILKEY *et al.*, 1999, HOUSTON, *et al.*, this issue) was a detailed criticism of the mathematical model GENESIS (HANSON and KRAUS, 1989) which is commonly used to predict the behavior of beaches for coastal engineering purposes. In his original discussion of our paper, HOUSTON (1996) chose not to address our detailed criticisms of the GENESIS model, but rather, he chose to criticize our claim that the beach nourishment project at Folly Beach, South Carolina was an example of the failure of GENESIS.

We have responded once to this assertion (PILKEY *et al.*, 1996), and we find continued haggling over the success or failure of the Folly Beach project to be pointless. We have all made our arguments and it is obvious that we disagree. Even if one could argue that the Folly Beach project has performed as designed (and we believe it has not), that still would not prove the veracity of GENESIS. In the original paper (YOUNG *et al.*, 1995) we cite several other examples of the misuse of GENESIS.

We must return the debate to the larger question of the physical accuracy of the GENESIS model. The model's underlying assumptions are not based in physical reality, the model's required input data are almost never available, and most model values are averaged to the point of being meaningless. In our last rejoinder (PILKEY *et al.*, 1999), we posed a series of questions that we believe would be a good starting point for a serious and thoughtful discussion of the GENESIS model. However, our efforts to redirect the debate to the heart of the matter have elicited no response from Houston or the model formulators. We can only assume, then, that our criticisms are valid. The importance of GENESIS far transcends our petty disagreements; our seemingly interminable, did not-did too-did not-did too exchange. GENESIS and models like it may well become mainstays of coastal engineering in the US and as such is worthy of vigorous, open debate. Our criticisms are worthy of response. The following very recent example of GENESIS application clearly demonstrates why a dialogue is sorely needed.

The U. S. Army Corps of Engineers has recently released a General Design Memorandum (USACE, 1999) for a proposal to build jetties at Oregon Inlet, North Carolina. Prediction of the success of jetties and the critical proposed sand bypass system is predicated entirely upon GENESIS output. In applying the model (USACE, 1999), the Wilmington District of the Corps makes all the assumptions and applications that we criticize (YOUNG *et al.*, 1995). Among other GENESIS derived conclusions is the assertion that the wier jetty will pass exactly the amount of sand furnished to the system for the foreseeable future.

The initial cost of the jetty project is around $90 million. It is a major project by any measure. If GENESIS is wrong, either the costs of the project will be much higher or the environmental damage downdrift to the Pea Island National Wildlife Refuge, the Cape Hatteras National Seashore, and four coastal communities will be large. Or both. Our questions that we posed to Houston (PILKEY *et al.*, 1999) are a first step in debating the validity of this hugely important model.

The implications are broader than beach behavior. Called into question here are all deterministic engineering models of earth surface processes that ask the very specific engi-

neering questions, where, when, and how much? This is very different than using an earth surface processes model for an academic purpose asking a why or how type question.

Here is a list of the 8 questions (abbreviated) we asked Houston (PILKEY *et al.,* 1999). We would be pleased to have response from anyone, pro or con.

(1) Assuming good wave data were available, how do you know which average wave characteristics are useful in a GENESIS model run to predict the behavior of a given beach?
(2) What is the field evidence of the existence of a closure depth, as used in GENESIS, as a limit of significant offshore sediment transport?
(3) Because mean and combined flows [on the shoreface] are not considered in GENESIS how do you discount their importance in sediment transport?
(4) How can GENESIS provide useful answers for coastal managers if the error bounds of the model output are unknown?
(5) How can a model such as GENESIS omit a realistic storm climate in predicting beach behavior?
(6) How do you justify the widespread use of average values (e.g., wave characteristics, grain size, nearshore profile shape) in GENESIS?
(7) How do you rationalize the GENESIS assumption of a smooth equilibrium profile without geologic control, offshore bars, or sediment variability?
(8) In view of the great uncertainties concerning all input data and boundary conditions [listed in the GENESIS manual by HANSON and KRAUS, 1989, and discussed in YOUNG *et al.,* 1995] that might affect a GENESIS model run, how can you expect a physically reasonable answer from the model?

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