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DISCUSSION

Discussion of: Young, R.S.; Pilkey, O.H.; Bush, D.M.; and Thieler, E.R. A Discussion of the Generalized Model for Simulating Shoreline Change (GENESIS), *Journal of Coastal Research* 11(3), 875–886.

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ABSTRACT

This paper discusses criticism by YOUNG *et al.*, 1995, of the GENESIS model. YOUNG *et al.*, 1995, provide a single example (beach nourishment at Folly Beach, South Carolina) to support their claim that GENESIS fails in practical-engineering application. This discussion will show they neither provide evidence supporting their contention that the Folly Beach project is performing poorly nor evidence that GENESIS predictions used in project design are incorrect. Extensive monitoring of the Folly Beach project shows the project is performing as expected and that GENESIS predictions for the project were good.

INTRODUCTION

YOUNG *et al.*, 1995, present a lengthy criticism of the GENESIS model (HANSON and KRAUS, 1989), which is a particular example of a class of models known as one-line or shoreline-change numerical-simulation models. They emphasize their criticism is not an academic undertaking, but they are strongly disputing the efficacy of using GENESIS as a predictive tool for practical application. However, they offer only a single example of what they claim is a failure of GENESIS in a practical application (Folly Beach, South Carolina, project) and provide no information demonstrating the model has failed. One-line models such as GENESIS have been used for years worldwide for practical-engineering application. Therefore, if their criticism is valid, YOUNG *et al.*, 1995, ought to be able to cite several specific examples of failure of one-line models in practical-engineering applications. However, they do not do so. Yet without having provided information to support their criticism of GENESIS, they conclude, "Future use of GENESIS for design of coastal engineering projects should not be allowed." I will demonstrate that quantitative monitoring of the Folly Beach project contradicts their assertion that the project is a failure and, moreover, shows GENESIS predictions for this project are quite good. KRAUS and HANSON (to be submitted) discuss applicability of GENESIS from the broader perspective of a number of engineering and scientific uses.

In their paper section entitled "Discussion of GENESIS Case Studies," YOUNG *et al.*, 1995, discuss four projects for which GENESIS was used, but only for the Folly Beach, South Carolina, Shore Protection Project do they indicate the model failed in an engineering application. They note GENESIS predicted that rehabilitation of nine of 43 existing Folly Beach groins would reduce the sediment volume required for initial nourishment from 3.9 to 1.9 million cu m and reduce the cost from $18.9 million to $11.8 million (actual project cost of only $8.9 million was less than estimated). They strongly criticize use of GENESIS to justify reducing the sediment volume, indicating it is just this usage of GENESIS that they wish to evaluate in their paper. However, they present no information showing the GENESIS predictions were incorrect. Further, they say the "Design nourishment interval was 8 years, but qualitative field observations indicate that there will be a need for major renourishment within 1–2 years." They do not provide supporting evidence describing who made the "qualitative field observations," how the observations were performed, what these observations purported to show, nor specifics on what they claim GENESIS failed to predict. Based on the above discussion, it is worthwhile to examine the performance of the 1993 Folly Beach, South Carolina, Shore Protection Project (U.S. ARMY CORPS OF ENGINEERS, 1991).

FOLLY BEACH PROJECT PERFORMANCE

The Folly Beach project was constructed during the winter coastal-storm season from January 1993 through April 1993 so as not to interfere with turtle-nesting season extending from May through October. The project has been monitored extensively since construction. Beach profiles have been surveyed to wading depth using conventional rod surveying with

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the remainder of each profile surveyed to 5.5-m depths using an echosounder. I will summarize results of the first year's monitoring. Ebersole et al., 1995, provide a detailed report of the monitoring.

The design subaerial-beach width for the Folly Beach project is 23 m with approximately 21 m of additional width added as an advanced fill. Before construction the designers predicted that after a year the project would have a 44-m average subaerial-beach width. The measured average subaerial-beach width after a year was 43 m. GENESIS predicted average annual loss of fill material would be 62,000 cubic meters with an annual range of between a 17,000 cubic meter gain to a 151,000 cubic meter loss. The measured loss after one year was 81,000 cubic meters (only about 4 percent of sediment volume placed and 6 percent of the designed renourishment quantity scheduled to be placed every 8 years). The groin-field area that GENESIS predicted would improve project performance by holding sediment has indeed done so with sediment volume after a year being two percent greater than that initially placed and an average beach width of 50 m. The project also performed its primary task of storm-damage reduction with no damage to upland property experienced despite several severe storms including the northeaster widely known along the U.S. east coast as the "Storm of the Century" (the storm has its own Storm-of-the-Century homepage on the Internet World Wide Web at http://www.scri.fsu.edu/cew/sotc/index.html). This March 1993 storm hit the project close to the end of construction with nearly hurricane-force winds.

Only small sections of the Folly Beach project have experienced significant erosion, and GENESIS predicted larger than average erosion in these areas. One section is located in front of a seawall that protects the Holiday Inn property, the only beach-front motel on the project reach. The seawall protrudes considerably seaward of adjacent shorelines. GENESIS predicted a complete loss of subaerial beach would occur in front of this property, and it would not be economically feasible to maintain a beach. Therefore, only a minimal fill was placed there. As GENESIS predicted, this minimal fill largely eroded the first year with the beach only 5-m wide. A second location experiencing notable erosion is a "hot-spot" representing only about seven percent of the fill's 8,600-m length. This area has historically had erosion problems and was protected before fill placement by a stone revetment. GENESIS predicted this area would experience much greater erosion than the remainder of the project (although the hot-spot area location predicted by GENESIS was spatially shifted somewhat from where it actually occurred). Erosion in this area was not of great concern during project design because the existing revetment provided greater storm-damage protection than would the beach fill. This area does not depend on the beach fill for protection.

I am going to show a series of photographs contrasting the condition of Folly Beach in February, 1990, two years before fill construction, with the condition during spring tide in August, 1995, almost 2½ years after fill construction. The photographs clearly show the dramatic beach improvement produced by the fill and the beach's current good condition. Photographs 1–8 are pairs of photographs (odd photograph numbers taken in February 1990 and even numbers in August 1995) with each pair taken at the same location looking northeast. The Holiday Inn is seen in the background (each set of increasing photograph number was taken from a location closer to the Holiday Inn). The 1990 photographs show dunes gone and rubble in front of houses teetering on the brink of destruction, whereas the 1995 photographs show wide beaches with extensive vegetated dunes. Photographs 9 (1990) and 10 (1995) were taken at the same location as Photographs 3 (1990) and 4 (1995), but look southwest. There is no dry beach in Photograph 9, whereas Photograph 10 shows a wide subaerial beach and dunes. Photograph 11 (1990) is a view from the Holiday Inn looking northeast showing storm waves demolishing homes. Photograph 12 (1995) is the same perspective showing extensive vegetated dunes. This view also looks over beach held by the nine rehabilitated groins. Photograph 13 (1990) is a southwest view with the Holiday Inn in the background and ugly rubble and destruction evident. Photograph 14 (1995) is the corresponding view with three rehabilitated groins seen in addition to a wide beach and vegetated dunes. Photographs 15 (1990) and 16 (1995) are northeast views taken in the hot-spot area. The large revetment seen in Photograph 15 was placed prior to 1990 to protect a road in danger of being washed out.

DISCUSSION

Figures 1–16 show the beach fill produced dramatic improvement in subaerial-beach and dune width. In 1990, Folly Beach, severely impacted by Hurricane Hugo in September 1989, was not a pretty sight with almost no beach, ugly piles of rubble, and damaged houses. Although the renourished beach was not designed to be very wide, the photographs show nourishment has greatly improved the esthetics of Folly Beach and protected property from storm damage. The photographs directly contradict the statement by YOUNG *et al.*, 1995, that "qualitative field observations indicate there will be a need for major renourishment within 1–2 years." There has been no change in renourishment plans because the fill is performing about as expected. The hot-spot area does not depend on the fill for protection, and the fill was not expected to remain in front of the Holiday Inn because this property extends far seaward of the adjacent coast. In reference to Folly Beach, Orrin Pilkey, one of the authors of YOUNG *et al.*, 1995, was quoted as saying, "'It's still disappearing,' said Orrin Pilkey, director of Duke University's Program for the Study of Developed Shorelines, 'They're pumping as we speak, and when they're finished, there will be no beach. This is the worst case I've ever seen.'" (CLEELAND, 1993). Dr. Pilkey's quote appeared a month after project completion. Photographs 1–16 provide an apt commentary on Dr. Pilkey's statement and the validity of the "qualitative field observations" cited by YOUNG *et al.*, 1995.

YOUNG *et al.*, 1995, is a curious paper because, although it purports to be an authoritative criticism of GENESIS, it presents little concrete criticism. Much of the paper merely describes GENESIS. The paper devotes considerable space to list what GENESIS developers provide as model limitations, uncertainties, and warnings that should be taken into ac-

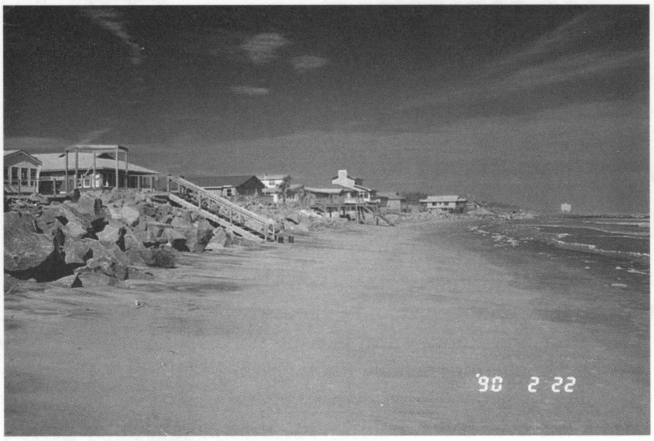

Figure 1. 1990 Folly Beach with rubble revetment and Holiday Inn in right corner.

Figure 2. 1995 Folly Beach fill corresponding to Figure 1. Dunes and wide beach.

Figure 3. 1990 Folly Beach with rubble revetment.

Figure 4. 1995 Folly Beach fill corresponding to Figure 3. Extensive vegetated berm.

Figure 5. 1990 Folly Beach with rubble and erosion up to structures.

Figure 6. 1995 Folly Beach fill corresponding to Figure 5. Extensive vegetated berm and wide beach.

Figure 7. 1990 Folly Beach with remains of pier.

Figure 8. 1995 Folly Beach fill corresponding to Figure 7. Note people on the far right of figure illustrating wide beach.

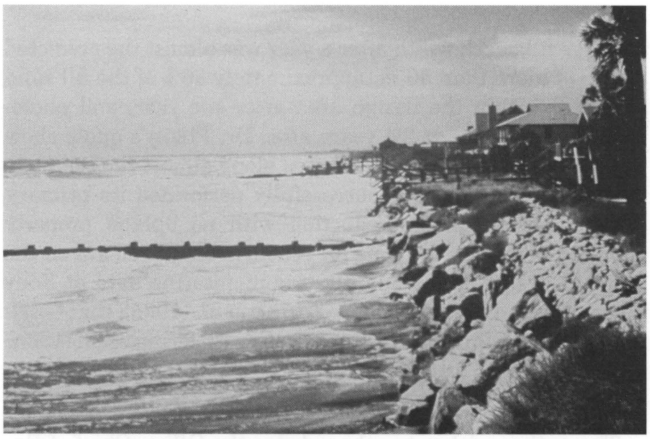

Figure 9. 1990 Folly Beach taken at same location as Figure 3 but looking southwest.

Figure 10. 1995 Folly Beach fill corresponding to Figure 9 and showing wide vegetated berm and beach.

Figure 11. 1990 Folly Beach looking northeast from Holiday Inn.

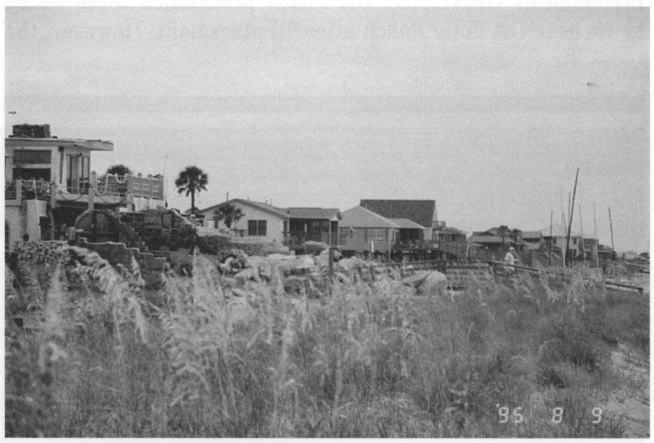

Figure 12. 1995 Folly Beach fill corresponding to Figure 11 and showing vegetated berm.

Figure 13. 1990 Folly Beach looking southwest with Holiday Inn in background and ugly rubble apparent.

Figure 14. 1995 Folly Beach fill corresponding to Figure 13 showing beach too wide for photograph to capture.

count before applying GENESIS. Rather than this section being an effective criticism of GENESIS as apparently YOUNG *et al.*, 1995, believe; the section is illustrative that the developers are well aware of model limitations, desire the model be used properly, and are honest and forthright rather than overstating the capabilities of the model.

CONCLUSIONS

YOUNG *et al.*, (1995), make sweeping statements criticizing the validity of GENESIS, but provide no evidence that GENESIS predictions are incorrect even for the one practical-engineering application they are "particularly interested in evaluating." The groins at Folly Beach are successfully holding the fill as GENESIS predicted with the widest subaerial beach in the rehabilitated groin field. Unusual erosion is occurring along less than 10% of fill length (and at locations predicted by GENESIS). Dr. Pilkey proclaimed there would be no beach at Folly Beach after fill placement. However, the average fill beach width after a year was almost the predicted width of more than 40 m, approximately 96% of the fill sand was still within the design area after one year, and photographs taken almost 2½ years after Dr. Pilkey's quote show wide beaches and extensive dunes along almost the complete fill length. The fill also successfully performed its primary task of storm-damage reduction with no upland property damage experienced. Plans for renourishment remain on the original design cycle. Quantitative monitoring data at Folly Beach contradict the claim by YOUNG *et al.* (1995), that GENESIS was a failure in this practical engineering application.

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Figure 15. 1990 Folly Beach looking northeast and showing large rubble revetment in hot-spot area water line in far right of photograph.

Figure 16. 1995 Folly Beach fill corresponding to Figure 15.

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