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Evaluation of Beach Morphological Changes Using the Emery Profiling Method

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Beaches are dynamic landforms shaped by waves, tides, currents, sediment supply and human activity. Repeated beach-profile measurements help distinguish short-term fluctuations from longer-term erosion or accretion. The Emery profiling method is a low-cost field technique that uses two graduated poles and a tape to record relative elevation and distance along a cross-shore transect. This article outlines its principles, procedure, interpretation, benefits and limitations.

Introduction

A beach is never completely static. Storms can remove sediment from the upper shore, while calmer conditions may return it. Seasonal waves, sea-level changes, coastal structures, sand extraction and changes in river sediment supply can all affect beach shape. A profile represents the cross-sectional form of a beach at a particular time. Comparing profiles from repeat surveys provides evidence of where the surface has lowered or risen.

Method and field procedure

Choose a transect roughly perpendicular to the shoreline and establish a stable landward reference point. Record date, time, tide, weather, recent wave conditions and sediment type. Two surveyors hold graduated poles vertically at successive points; a tape provides horizontal distance, while pole readings are used to estimate the change in elevation. Measurements should be taken at slope breaks and features such as the backshore, berm crest, beach face and accessible lower beach. Reuse the same transect and benchmark for later surveys.

Data interpretation

Calculate cumulative horizontal distance and relative elevation, then plot elevation against distance. Overlaying profiles from different dates reveals changes in beach shape. Lowering can indicate erosion and rising can indicate deposition, but tide stage and seasonal variability must be considered. One profile cannot represent an entire beach, and one survey cannot establish a long-term trend. Where elevation data are reliable, the area between profiles can be estimated as an indicator of cross-sectional change.

Strengths, limitations and applications

The method is inexpensive, portable and easy to teach, making it suitable for student projects and preliminary monitoring. Error may arise from tilted poles, inconsistent readings, soft surfaces and changing water levels. It is less precise than total stations, RTK-GNSS or laser scanning, and a single transect misses alongshore differences. Good practice includes duplicate measurements, fixed transect locations, photographs, clear field notes and explicit uncertainty. For engineering decisions, combine profiles with shoreline mapping, sediment sampling, tide and wave information.

Why repeated measurements matter

A beach profile is a snapshot, and coastal environments can change quickly. A profile measured after a storm may look very different from one measured during a calm period, even if the longer-term sediment balance has not changed substantially. Repeated surveys at comparable tidal stages help researchers separate event-driven change from seasonal patterns. Where possible, surveys should be scheduled at consistent intervals and additional measurements should follow major storms. The observer should also record unusual conditions, such as recent nourishment, construction, vehicle traffic or the presence of temporary sand bars, because these can affect interpretation.

Sources of uncertainty

The largest sources of uncertainty are often procedural rather than mathematical. A pole that is not vertical changes the apparent reading; a tape that sags or is not aligned consistently changes horizontal distance; and an observer may choose different points on an irregular surface. Water movement can make measurements near the swash zone difficult. To reduce these problems, teams should agree on a standard reading convention, use a consistent point interval, repeat selected readings and check calculations in the field. A simple uncertainty statement makes the final report more credible than presenting measurements as exact.

Reporting results clearly

A useful report should include a location map, a photograph of the transect, the survey date and tidal context, a table of field readings, and a profile graph with clearly labelled axes and units. Different survey dates should use the same scale so that visual comparison is meaningful. Explain whether elevation is relative to a benchmark or tied to a recognised vertical datum. If the benchmark itself may have moved, the apparent profile change could be misleading. The discussion should distinguish measured observations from interpretations and should avoid claiming that a single transect represents the whole coastal system.

Management relevance

Profile monitoring can inform decisions about beach access, dune restoration, nourishment projects and the placement of infrastructure. A record of erosion near a seawall, for example, can prompt further investigation of wave reflection and sediment movement. A profile may also show that a beach naturally changes seasonally, which can prevent an unnecessary response to temporary narrowing. Nevertheless, management decisions should not rely on the Emery method alone where people, buildings or critical infrastructure are at risk. More precise surveys and specialist coastal assessments may be required.

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Conclusion

The Emery method remains useful because it offers a repeatable, transparent way to document beach morphology without costly equipment. Its value is greatest when surveys are carefully controlled, repeated over time and interpreted alongside environmental conditions. It is best treated as a practical monitoring method rather than a complete sediment-budget assessment.