The Coastline
its Physical and Legal Definition

I. Aurrocoechea
Faculty of Law, University of Hull, UK
J.S. Pethick
Department of Geography, University of Hull, UK

Introduction

The position of the coastal baseline of a maritime country is fundamental to its maritime law. The boundaries between its internal waters, territorial seas and the high seas have, of course, always been of importance, but perhaps never more so than today when a country's economic future may depend upon the precise location of one of these boundaries. All such boundaries are defined with reference to the coastal baseline, and yet, although the coast itself is tangible in its gross form, a low-water mark is, as we show in this paper, a theoretical and vacillating concept when any attempt is made to define it in detail. The increasing economic importance of the seas does, however, necessitate a precise definition of the baseline. In this paper we examine the problem from two viewpoints; the existing legal provisions which cover the definition of the coast are reviewed and the physical factors which govern the boundary between land and sea are summarized. Our objective is to attempt to synthesize these two approaches and to make recommendations for a more unambiguous and internationally acceptable definition.

The coast as linear boundary

The use of the coastal baseline as a reference line for international boundary definition is almost axiomatic. Yet the coast is not a line but a zone, and herein lie all the difficulties which are explored in this paper. The exact position in space of the meeting between sea and land varies over time. There are numerous reasons for such variation, some of these are amenable to precise prediction, some are random events whose occurrence may only be predicted in a statistical sense. Most of these variations in position are due to movements of the sea surface; these are produced by such factors as tidal forces, meteorological conditions such as winds or pressure differences and oceanographical conditions such as water temperature or current
velocities. A small but extremely significant long-term change in sea level is caused by the melting of glaciers thus increasing the total volume of water held in the world ocean. Some changes in the position of the coast, however, are due to movements of the land surface. These may include small-scale deposition or erosion, or large-scale movements of the land due to tectonic activity or the so-called rebound after glaciation which is still affecting many areas of the world. Occasionally, extreme land movements, such as earthquakes or volcanic eruptions may themselves give rise to movements of the sea surface — giant waves known as tsunami.

The scale of these relative movements is of great importance to the problem of the definition of the position of the coastal baseline. The vertical movement of the sea surface, and therefore of the coastline, due to tidal forces may vary from a few centimetres to over 10m (12m in the Bay of Fundy) and represents the most important of all the movements of the sea surface. Meteorological conditions may produce waves in the open sea of 25m high or more but at the shore few waves exceed 5m in height. Short-term changes in sea level due to pressure differences are known as storm surges and may result in vertical movements of 3m while variations in temperature density or current velocity rarely produce variation of more than 1m. All of these variations in sea level are short term, lasting from between a few seconds for a wave to a few weeks for temperature induced movements. As a result, it is relatively easy to distinguish the causes of such variations in sea level. In contrast, the small-scale, long-term movements of the coastline produced either by the increase in the volume of water in the oceans or by the gradual uplift of the land after glaciation, cannot be so distinguished. Such vertical movements are consequently described as "relative changes" in sea level. Although the changes in sea level due to increased water volume are worldwide and are therefore known as eustatic changes, the movements of the land surface due to uplift after glaciation or tectonic activity varies from place to place (and are known as isostatic movements). The combined effect of these two processes varies from -13mm per year in Alaska, where land is rising faster than the sea due to recent deglaciation, to +9.1mm per year in Louisiana. Most coastlines of the world, however, are at present experiencing a sea level rise of between 1mm and 2mm per year.

The horizontal position of the coastal baseline depends, of course, upon these vertical changes in sea level. However, it is clearly impossible to generalize here since the effect of any vertical change in the baseline on its horizontal position will depend on the slope of the shore at each point along the coast. An example of a particular shore may, however, give some idea as to the importance to any nation state of a precise definition of its coast. Survey work by one of the authors on the coastline of Essex, England, immediately to the north of the mouth of the Thames showed that the gradient (i.e. tangent of slope angle) of the mudflat shore here is 0.00124. The tidal range is approximately 4.5m which means that the horizontal position of the "coastline" if defined merely as the meeting of land and sea, may vary over 3.6km. This is clearly a significant variation, but even the small-scale rise in sea level due to eustatic and isostatic processes is of more than academic interest in this context. A sea level rise of 2mm per year on such a shore means a horizontal change in the