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When Law Makes Climate Change Worse: Rethinking the Law of Baselines in Light of a Rising Sea Level

David D. Caron*

INTRODUCTION

Edward Teller reportedly once proposed that nuclear detonations be used to close the Strait of Gibraltar. His idea was that as the Mediterranean rose and became fresher, the water could be used to bring the Sahara to life. He acknowledged, of course, that the cost of such progress would be the loss of Venice and other Mediterranean sea-level cities.1 Ironically, we find today that, rather than Tellerite fantasies, the more banal and prosaic day-to-day activities of a growing world population threaten to change the climate of the world and flood coastal cities, not only in the Mediterranean but around the globe.

The Intergovernmental Panel on Climate Change has concluded that overall global temperatures will rise in the next century and that this global warming will have tremendous effects on the environment.2 This

is not to say, however, that uncertainties do not remain. Climatologists readily admit that they cannot predict with any certainty what the meteorological effects of climate change will be for a particular area.\(^3\) Kansas may be drier; it may be wetter. Scientists likewise admit their uncertainty regarding "feedback mechanisms."\(^4\) Will global warming, for example, cause increased cloud formation which will in turn block some solar radiation from reaching the Earth?\(^5\) Or will the increase in average temperature release methane trapped in Arctic tundra thereby accentuating the greenhouse effect?\(^6\) Amidst such uncertainties, however, scientists agree that one widespread consequence of any warming will be a rise in sea level: "[S]ea-level rise seems the most probable and perhaps the most globally uniform consequence of warming projected into the next century."\(^7\) The consequences of this rise, depending upon its extent, are potentially disastrous.

The response of the international community, individually and collectively, to the possibility of global climate change has been both to seek to prevent such change and, additionally, to prepare to adapt to the changes that are likely to occur despite such prevention efforts. The scholarly agenda regarding both prevention and adaptation strategies to climate change is growing\(^8\) but is not yet clearly articulated for many disciplines, including law. This Article deals with an aspect of adaptation to climate change: the effect of a rising sea level on the law of baselines.

Part I considers the prospects for, and consequences of, a rising sea level. Part II discusses the evolution of the law of baselines and notes how this aspect of the law of the sea rests upon the assumption that there will not be a significant rise in sea level. In particular, the international legal order provides that the outer boundary of maritime zones, such as

4. A feedback mechanism is a cyclic process in which phenomenon B caused by phenomenon A subsequently affects, either positively or negatively, phenomenon A, thereby either accentuating or moderating phenomenon A.
6. See, e.g., Pearce, Methane: The Hidden Greenhouse Gas, New Scientist, May 6, 1989, at 37, 41 (northern bogs and tundra in northern latitudes likely to warm 6-8 degrees Celsius in the next 50 years, thereby releasing methane); Pearce, Methane Locked in Permafrost May Hold Key to Global Warming, New Scientist, Mar. 4, 1989, at 28 (frozen tundra of Canada and Siberia will warm more than other parts of the world in the near future, potentially releasing "huge amounts of methane"). As to another possible positive feedback, see Gribbin, Warmer Seas Increase Greenhouse Effect, New Scientist, Jan. 6, 1990, at 31 (water vapor from warming oceans traps more solar radiation thereby intensifying the greenhouse effect).
7. S. Schneider, supra note 5, at 163.
the 12-mile territorial sea or the 200-mile exclusive economic zone, is measured from a baseline, normally the low water mark. Moreover, these boundaries are to advance or recede in step with the baselines from which they are drawn. Those involved with the development of this arrangement scarcely could have imagined that significant problems could result from shifting baselines because it was assumed that the sea level and the low water mark were relatively constant features. But the possibility of global climate change forces us to rethink many of our fundamental assumptions about the world.

Part III examines how the law of baselines will not only hamper adaptation to a rising sea level, but indeed may aggravate the consequences of climate change. In this section I argue that the rule that maritime boundaries should move with baselines that recede as a result of a rising sea level will lead states confronted with such possible recession to respond in inefficient ways, thereby wasting resources during a time when they will be in increased demand because of climate change. Moreover, the same rule will lead to uncertainty in the position of maritime boundaries and, hence, increase the likelihood of interstate and private transnational conflict.

More generally, I argue in part III that the rule that boundaries are contingent upon their baselines is a legal rather than a natural feedback mechanism. Legal feedbacks will not alter the amount of climate change, but will aggravate the suffering that will accompany such change. The greater the change, the greater the aggravation. In this sense, legal feedbacks should be important elements of the scholarly agenda regarding adaptation to climate change.

Part IV considers possible alternatives to the present law of baselines. In this section, I propose that that aspect of the law of baselines which provides for the adjustment of boundaries to match shifts in baselines should be replaced by a system in which the boundaries of all maritime zones, in particular the exclusive economic zone, are fixed on the basis of presently accepted baselines.

Although to the uninitiated this proposal might seem reasonable, questions of boundaries involve many disciplines, touch upon the sensitivities of many interests, and consequently can be quite controversial. This is the case where, as here, a rather fundamental assumption concerning boundary delimitation is questioned. It is particularly so where, as here, the allocation of areas of great value are at stake. Nevertheless, as discussed below, the costs of not adapting our legal structures, both in terms of waste and conflict, are also potentially very great.
THE PROSPECTS FOR, AND CONSEQUENCES OF, A RISING SEA LEVEL

Although one may debate the extent of climate change that will occur over the coming century, it is widely accepted that a rise in sea level will accompany even conservatively projected levels of global warming.\(^9\) The prospect of a rising sea level in one sense is daunting because the global average level of the oceans has risen only slightly over the last several centuries.\(^10\)

Changes in sea level are not unknown, however. First, some states have had limited experience with effective changes in sea level which have resulted from changes in the height of the land relative to the sea. These changes can involve a complex mix of forces, some of which are natural: uplift of the land due to tectonic action or uplift due to glacial rebound.\(^11\) Other changes in the height of land relative to the sea are caused by human activity: unintentional subsidence of the land due to pumping out of water or oil or the intentional reclamation of submerged lands. These relative changes in sea level preceded predictions of a general rise in the sea level and will continue. Thus, an area such as Alaska may experience an effective drop in sea level despite a true rise in sea level because the land’s rebound from the last ice age may continue at a rate faster than the sea will rise.

Second, if we focus on the global (eustatic) level of the sea, it is clear that sea levels have fluctuated dramatically over the course of the Earth’s climatic cycles.\(^12\) When the last glacial period ended approximately

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9. See infra notes 19-23 and accompanying text.
10. Over the past century, scientists believe that the average global level of the oceans has risen 4-6 inches (10-15 centimeters). See Barnett, Global Sea Level: Estimating and Explaining Apparent Changes, in COASTAL ZONE ’83 2777, 2780 (O. Magoon ed. 1983); Gornitz, Lebedeff & Hansen, Global Sea Level Trends in the Past, 215 SCIENCE 1611 (1982); see also Wells & Edwards, Gone with the Waves, NEW SCIENTIST, Nov. 11, 1989, at 47 (“The sea has been rising for the past 18,000 years, since the last ice age ended, sometimes by as much as 10 to 20 millimetres a year. For the past century the water has risen about 1.2 millimetres a year.”). Most recently, Professors Peltier and Tushingham of the University of Toronto have estimated that the sea is rising at about 2.4 millimeters per year. Sea Rise Tied to Possible Warming, N.Y. Times, May 20, 1989, at A9, col. 4; Scientists Report Sea Rising Faster Than They Thought, San Francisco Chron., Apr. 20, 1989, at A4, col. 1 (“New measurements reveal that the oceans are warming and rising about twice as rapidly as scientists had thought, strongly suggesting that greenhouse warming caused by the burning of fossil fuels has already begun.”)).
11. Glacial rebound is also often termed “isostatic rebound.” See Guttenberg, Changes in Sea Level, Postglacial Uplift, and Mobility of the Earth’s Interior, 52 BULL. GEOLOGICAL SOC’Y AM. 721 (1941).
12. Ice ages of approximately 100,000 years in duration have occurred quite regularly for the last million years, and were only slightly different during the two million preceding years. These ice ages are separated by interglacial periods of approximately 10,000 to 20,000 years in length. It is believed that these ice ages are related to the orientation of the Earth as it orbits the Sun (in particular, precession and tilt of the Earth’s axis and tilt of the Earth’s orbit) and are accompanied by, if not caused by, an increased concentration of carbon dioxide in the...
12,000 to 16,000 years ago, the sea was about 100 meters lower than it is today because the oceans were colder and great amounts of water were stored in enormous ice sheets covering much of North America and Europe. At the peak of the last interglacial period some 120,000 years ago, the oceans were approximately six meters higher than today's level. The height the oceans attained 120,000 years ago, however, neither necessarily indicates that current global warming will result in that much of a rise over the next century nor ensures that six meters is the most that the sea eventually could rise.

Estimates of how much the sea level will rise over the next century vary considerably. The variation results from different assumptions concerning the likely extent of global warming and, to a lesser degree, some uncertainties as to the scientific relationship between sea level atmosphere. See Gribbin, The End of the Ice Ages?, NEW SCIENTIST, June 17, 1989, at 48; Stevens, In the Ebb and Flow of Ancient Glaciers, Researchers Seek Clues to the Next Ice Age, N.Y. Times, Jan. 16, 1990, at B5, col. 6.

13. Titus & Barth, An Overview of the Causes and Effects of Sea Level Rise, in GREENHOUSE EFFECT AND SEA LEVEL RISE 1, 7 (M. Barth & J. Titus eds. 1984) [hereinafter GREENHOUSE EFFECT]. Scientists believe that the sea level was even lower during earlier ice ages. See, e.g., Donn, Farrand & Ewing, Pleistocene Ice Volumes and Sea-Level Lowering, 70 J. GEOLOGY 206 (1962).

14. Marshall & Tom, The Sea Level in the Last Interglacial, 263 NATURE 120 (1976) (estimating the level to have been two to five meters above present sea level).

15. Scientists debate whether the six-meter differential at the end of the last interglacial period should be attributed to the melting of the West Antarctic ice shelf or the ice pack over Greenland. It is estimated that the melting of both would have yielded a differential of approximately 12 meters. See West Antarctic Ice Won't Melt Quickly, NEW SCIENTIST, June 17, 1989, at 41 (summarizing research of Roy M. Koerner, Geological Survey of Canada, supporting the view that the ice over Greenland had melted).

16. A variety of estimates have been advanced for the projected rise in sea level. For an excellent summary of the scientific issues, the uncertainties, and the range of estimates as of 1983, see Hoffman, Estimates of Future Sea Level Rise, in GREENHOUSE EFFECT, supra note 13, at 79, 96 ("the moderate scenario produces a rise of 144.4 cm (4.8 ft) by 2100"). For an update of this survey, see NATIONAL RESEARCH COUNCIL, RESPONDING TO CHANGES IN SEA LEVEL: ENGINEERING IMPLICATIONS 24-30 (1987); see also S. SCHNEIDER, supra note 5, at 159-65.

In 1983, the National Research Council estimated that factors such as thermal expansion of the oceans and continued melting of glaciers will result in a rise in sea level of 70 centimeters by the year 2075. Monastersky, Rising Sea Levels: Predictions and Plans, 132 SCI. NEWS, Nov. 21, 1987, at 326 (referring also to a University of East Anglia study predicting a rise of 4-8 centimeters over the next 40 years). The Villach Conference of 1985 concluded that global warming of 1.5-4.5 degrees Celsius would result in a sea level rise in the next century of 0.2-1.4 meters. Wind, Preface, in IMPACT OF SEA LEVEL RISE ON SOCIETY xv (H. Wind ed. 1987) (citing to UNITED NATIONS ENVIRONMENT PROGRAMME, INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS & WORLD METEOROLOGICAL ORGANIZATION, PROCEEDINGS OF INTERNATIONAL CONFERENCE ON THE ASSESSMENT OF THE ROLE OF CARBON DIOXIDE AND OF OTHER GREENHOUSE GASES IN CLIMATE VARIATIONS AND ASSOCIATED IMPACTS (1985) (held in Villach, Austria) ("The waters in the Mediterranean are expected to rise by between 13 and 55 centimeters before the year 2025 and by up to 2 meters within a century."); Jäger, Anticipating Climate Change, ENVIRONMENT, Sept. 1988, at 12, 14 (30-150 centimeters by the year 2050); Nierenberg, Atmospheric CO2: Causes, Effects, and Options, 18 THE BRIDGE 4, 9 (1988) (60 centimeters by the year 2075).
change and temperature variations. The predictions concerning the rise in sea level over the next century consider two mechanisms: thermal expansion of surface waters (the "steric effect") and the continued melting of glaciers. Estimates for at least the next century assume that there will not be a sufficient rise in temperature to require consideration of a third source of sea water, significant melting of Antarctic ice.

Until late 1989, a conservative and widely accepted estimate advanced in, among other places, a 1987 National Research Council study was that a doubling in the amount of carbon dioxide present in the atmosphere in 1950 (estimated to occur between 2010 and 2050), would cause the sea to rise 1 meter, or 3.3 feet. In 1989, an emerging view held that this estimate was too high. Mark Meier, Director of the Institute of Arctic and Alpine Research at the University of Colorado estimated a one-third-meter rise in sea level, but added that the margin of error was "horrendous." The most recent and important estimate, however, is that contained in the draft report on global climate change released in May 1990 by a working group of the Intergovernmental Panel on Climate Change. The working group estimated that by the year 2100 the sea level would rise two-thirds of a meter, or 2.15 feet. Many of the projected effects of a rising sea level cited to in the following discussion were formulated by scientists with reference to the earlier projected one-meter rise. Given the range of error in the two-thirds-meter estimate, however, these projected effects remain valuable touchstones.

17. See generally supra note 16.
22. Id.
23. Moreover, for the purposes of the legal feedback to be discussed in part III of this study, the waste aspect of the feedback originates from the perception states have of the danger they face, rather than the certainty of how high the sea might rise. As to the general importance of perception as a key force, see, for example, O'Neill, Cities Against the Seas, NEW SCIENTIST, Feb. 3, 1990, at 46 ("While the scientific community ponders and re-evaluates the evidence for global warming, Warringah Shire [a local authority in Australia] has adopted planning regulations that require entrepreneurs to consider the consequences of the greenhouse effect on proposed developments along the foreshore.").

It also should be noted that the estimates of possible sea level rise assume that there are no human efforts to reduce that rise. For a discussion of lowering the sea through increased continental storage, see Newman & Fairbridge, The Management of Sea-level Rise, 320 NATURE 319 (1986).
The effect of what might seem to be a modest rise will in many cases be quite dramatic.\textsuperscript{24} In general, it is believed that a rising sea level will result in (1) the inundation of some coastal areas, particularly since scientists think that global warming also will result in fiercer weather and consequently greater coastal erosion;\textsuperscript{25} (2) loss of wetlands;\textsuperscript{26} (3) interference with deltaic formation;\textsuperscript{27} and (4) increased salinity in estuaries, aquifers, and freshwater reservoirs located on islands.\textsuperscript{28} Moreover, many of the above consequences obviously will destroy habitats and endanger species, as well as threaten coastal investments such as cities and harbors.\textsuperscript{29} A rise in sea level also poses less obvious dangers such as increasing the likelihood of flooding hazardous waste disposal sites.\textsuperscript{30}

The significance of these impacts is more apparent when viewed in terms of specific geographic areas. If the sea level rises as projected, for example, hundreds of thousands of acres of Louisiana lowland would be inundated and the Port of New Orleans might have to be relocated.\textsuperscript{31} Bangladesh and Guyana, countries with huge low-lying river deltas, already are subject to flooding. A one-meter rise in sea level would submerge approximately fifteen percent of Bangladesh.\textsuperscript{32} The coastal plain of Guyana, in most places already below high tide level, houses 90\% of the 750,000 citizens of Guyana and produces more than 70\% of the country’s gross national product.\textsuperscript{33} A rise in sea level of half a meter

\begin{enumerate}
\item See \textit{NATIONAL RESEARCH COUNCIL, supra} note 16, at 64-71. See generally \textit{ENVIRONMENTAL PROTECTION AGENCY, GREENHOUSE EFFECT, SEA LEVEL RISE, AND COASTAL WETLANDS} (1988).
\item See, e.g., S. SCHNEIDER, \textit{supra} note 5, at 147-48; Rodgers-Miller & Bardach, \textit{In Face of a Rising Sea}, 7 OCEAN Y.B. 177, 182-87 (1988).
\item See generally \textit{NATIONAL RESEARCH COUNCIL, supra} note 16. As to the possible relation between changes in sea level and prehistoric waves of extinctions, see Bowler, \textit{Three Steps on the Road to Extinction}, \textit{NEW SCIENTIST}, Sept. 8, 1990, at 37.
\item Flynn, Walesh, Titus & Barth, \textit{Implications of Sea Level Rise for Hazardous Waste Sites in Coastal Floodplains}, in \textit{GREENHOUSE EFFECT, supra} note 13, at 271.
\item Dickson, \textit{Poor Countries Need Help to Adapt to Rising Sea Level}, \textit{NEW SCIENTIST}, Oct. 7, 1989, at 22.
\end{enumerate}
reportedly would inundate the Canton area of China.\textsuperscript{34} It is estimated that the total land area at risk throughout the world is on the order of five million square kilometers, roughly three percent of the total land surface of the globe.\textsuperscript{35} This three percent carries a disproportionately high number of people and cities, and constitutes significantly more than three percent of the world's arable land. The Chairman of the Coastal Impacts Working Group of the Intergovernmental Panel on Climate Change estimates that a one-meter rise would directly affect up to 300 million people.\textsuperscript{36}

A rising sea level potentially could submerge certain groups of islands, thus creating nations of refugees.\textsuperscript{37} The Maldives in the Indian Ocean is a double chain of 26 atolls comprised of some 1,300 tiny islands with 200,000 people inhabiting over 200 of the islands. The average height of these islands is between 1 and 1.5 meters above sea level; the highest point in the Maldives is 3.5 meters.\textsuperscript{38} Kiribati and Tuvalu in the western equatorial Pacific Ocean are similarly vulnerable to sea level rise.\textsuperscript{39} All told, a recent Worldwatch Institute study estimates that the flooding of islands and coastal areas caused by a one-meter rise in sea level will create approximately fifty million refugees.\textsuperscript{40}

Protecting only the developed portions of these threatened areas would be extremely expensive.\textsuperscript{41} In a report to Congress on climatic change, the Environmental Protection Agency estimated that the United States could spend as much as $111 billion before the year 2100 to protect beaches and developed portions of coasts and still lose 4,000 to 9,000

\textsuperscript{34} Sinclair, Rising Sea Levels Could Affect 300 Million, NEW SCIENTIST, Jan. 20, 1990, at 27 (citing Mukan Han, University of Beijing).

\textsuperscript{35} See, e.g., Vreugdenhil & Wind, supra note 18, at 1, 3-4.


\textsuperscript{37} Revkin, Endless Summer: Living with the Greenhouse Effect, DISCOVER, Oct. 1988, at 50, 57 (generally discussing implications of warming in coastal areas); Titus, How It Might Be: Sea Levels, 15 EPA J., Jan.-Feb. 1989, at 14 (cursory overview of global warming and sea level rise); Johnson, Pacific Islands Seek Western Help Against Greenhouse Effect (Reuters, July 21, 1989) (available on NEXIS) ("Now everyone will have to consider relocation as an option."). Many of the world's populated islands are coral atolls. Natural coral growth may not keep pace with a rising sea level, necessitating artificial measures to protect islanders from a drowning disaster. Vreugdenhil & Wind, supra note 18, at 15-17; see Pain, Coral Reefs Will Thrive in the Greenhouse, NEW SCIENTIST, Mar. 3, 1990, at 30 (although warming may stimulate coral growth, effect will be insufficient to compensate for water level rise).

\textsuperscript{38} Wells & Edwards, supra note 10, at 48; see Crossette, 1190 Islands in Danger: Sea Could Drown Them, N.Y. Times, Nov. 26, 1990, at A4, col. 3.

\textsuperscript{39} Id.

\textsuperscript{40} See Wildlife Digest, INT'L WILDLIFE, Mar.-Apr. 1989, at 29 (citing a report of the Worldwatch Institute).

\textsuperscript{41} See Sinclair, supra note 34, at 27 ("the global cost . . . is likely to reach £13.3 billion per year").
square miles of land area, an area potentially the size of Massachusetts. In the developing world, it is highly questionable whether financial resources will be available to protect even the developed areas along the coast. In addition to the highly populated areas of Bangladesh and China already mentioned, Alexandria, Egypt, with its population of 3.5 million, for example, is barely above the present sea level. For all of these reasons, the potential effects of the anticipated rise in sea level and the limited resources available to protect even developed portions of the world's coasts present a major challenge to us and to future generations.

II

MARITIME BOUNDARIES AND THE BASELINES FROM WHICH THEY ARE MEASURED

Many people assume that the notion of the territorial sea and the baseline from which it is measured is an ancient tradition among nations which originated centuries ago and gradually ripened into a rule of international law. However, this notion of the territorial sea, not to mention notions about its width, became firm only in the 19th century. It likewise can be surprising that the law of baselines followed rather than preceded this coalescence of doctrine because baselines in many ways were a consequence of the theoretical effort to clarify this maritime zone. Indeed, much of the law of baselines emerged only toward the end of the 19th century. In this sense, we should not invest the law of baselines too greatly with the wisdom implied by tradition. It is a relatively recent set of rules that deserves rethinking in light of a rising sea level.

42. ENVIRONMENTAL PROTECTION AGENCY, THE POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE ON THE UNITED STATES - REPORT TO CONGRESS (1989); see Joyce, America Counts the Cost of Global Warming. NEW SCIENTIST, Oct. 29, 1988, at 26 (even expenditure of $111 billion could not prevent loss of 18,000 square kilometers); Titus, supra note 37 (partial summary of draft report); Shabecoff, Draft Report on Global Warming Foresees Environmental Havoc in U.S., N.Y. Times, Oct. 20, 1988, at A14, col. 1.

43. Adaptation strategies for developing countries confronted with a rising sea level have been the subject of recent study within the British Commonwealth. See Dickson, supra note 32, at 22 (referring to a study prepared by a group of scientists chaired by Martin Holdgate, director of the International Union for Conservation of Nature and Natural Resources). Island states, some of which lack financial resources to adapt, are particularly frustrated because they are not a significant source of greenhouse gases. See, e.g., Threatened Islands Demand Urgent Action on Global Warming, NEW SCIENTIST, Dec. 2, 1989, at 30 (stressing that developing nations will need assistance from developed nations to cope with the consequences of rising sea levels). But see Land, Building the Great Sea Wall, INTERDEPENDENT, Nov. 3, 1990, at 4 (publication of the United Nations Association of the United States) (reporting that an international conference of donors has approved a plan for Bangladesh that includes provision for the building of a sea wall approximately 2,500 miles in length at a cost of at least $20 billion).

The evolution of the territorial sea and much of the law of baselines has been explored extensively by others. It is not the purpose of this study to reexamine a field so ably covered. Rather, this section draws upon this earlier scholarship to briefly place in perspective the evolution of the law of baselines.

Although the origins of the practice of delimitation from a baseline are unclear and generally not addressed in the literature, they likely have much to do with the practicalities, and hence difficulties, of position-fixing at sea in past centuries. Indeed, all of the original theories concerning sovereignty over the waters adjacent to the coast were influenced by the impossibility of demarcating a boundary upon the sea. Grotius, in arguing that the ocean generally was not subject to appropriation, noted that the “nature of the sea . . . differs from that of the shore, because the sea, except for a very restricted space, can neither easily be built upon, nor inclosed. . . .” Theorists, including Grotius, did recognize, however, that the coastal state might be said to sufficiently dominate some marginal zone of water so as to support a claim of jurisdiction or even sovereignty.

These theories were often coupled with systems whereby a boundary might be identified while at sea. These systems turned upon reference to the land and yielded zones whose widths were debatable. The “line of sight” approach set the outer boundary at the point at which the shore became visible above the curvature of the Earth. This approach led to an uncertain width because that distance to shore varied with the observer’s distance above the water. (It also was not particularly practical if the weather was not clear.) The “cannon shot” approach set the outer boundary at the range of a cannon’s shot from shore. Obviously, the


46. For example, although there is an extensive body of literature addressing the width of the territorial seas or the rights of a coastal state over the living resources of its exclusive economic zone, this literature simply states that the low water marks provide the baseline for the generation of maritime zones. There is also an extensive body of literature dealing with the resolution of maritime boundaries claims, and this literature also accepts as given the present system of baselines.

47. H. Grotius, Mare Liberum 31 (R. Van Deman Magoffin trans. 1916).

48. As to early views, see C. Colombos, The International Law of the Sea 68-70 (3d rev. ed. 1954). As to the debate in the 19th century, see 1 D. O’Connell, supra note 45, at 60-71 (valuable discussion of the theoretical bases of control and possible jurisdiction).


50. This approach was advocated in, among other works, C. van Bynkershoek, De
width of this zone depended upon the state of the development of this technology.

The transition to claiming a zone of fixed width is often ascribed to a letter in 1793 by then Secretary of State Thomas Jefferson to the foreign ministers of France and Britain. In this letter, the United States, in order to ensure its neutrality in a conflict between France and Britain, provisionally adopted a marginal sea of conservative width: "the utmost range of a cannon ball, usually stated at one sea league" (i.e., three nautical miles). In other words, the United States adopted a conservative fixed width view of the "cannon shot" approach.

As the practice of claiming such fixed-width marginal seas became more widespread during the 1800's, the question of the points from which these widths should be measured grew in importance. The line from which the outer edge of the zone was to be measured, and from which it remains measured, was called the "baseline." Some people who based the entitlement of the coastal state to a marginal sea on domination in the sense of the range of a cannon thought that the width should be measured from the first point firm enough to support an emplacement. By the year 1900, however, the adoption of the low water mark as the primary baseline was quite widespread.

Baselines have taken on much greater significance during this century as new and progressively greater maritime zones have been asserted and recognized because these new zones also are measured from "the baseline from which the territorial sea is measured." The four major maritime zones present today arguably are set forth most authoritatively in the not-yet-in-force 1982 Law of the Sea Convention (UNCLOS III or 1982 Convention). All of these zones are to be measured from the

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51. See, e.g., P. Jessup, supra note 45, at 6; 1 J. Moore, A Digest of International Law 702 (1906) (explaining U.S. position); 1 F. Wharton, A Digest of the International Law of the United States 100 (1886) (detailed discussion of U.S. approach). The fixed cannon-shot approach had been suggested earlier by Italian jurist Galiani. P. Jessup, supra note 45, at 6.

52. 1 D. O'Connell, supra note 45, at 172.

53. As a technical matter, it should be noted that what is taken to be the low water mark can vary considerably from state to state. As to the 19th century debate concerning which coastal waterline (i.e., high water or low water) should be used, a survey can be found in id., ch. 5. See D. Kapoor & A. Kerr, A Guide to Maritime Boundary Delimitation 16-18 (1986).

baseline from which the territorial sea is measured. In order of increasing width, these zones are:

1. **The territorial sea.** The sovereignty of a coastal state extends to an adjacent belt of sea called the territorial sea. The territorial sea may not exceed twelve nautical miles in breadth, "measured from baselines determined in accordance with this Convention." 55

2. **The contiguous zone.** In a belt of sea contiguous to the territorial sea, the coastal state may exercise the control necessary to prevent or punish infringement of customs, fiscal, immigration, and sanitary laws in its territory or territorial sea. This contiguous zone may not exceed twenty-four nautical miles in breadth "from the baselines from which the breadth of the territorial sea is measured." 56

3. **The exclusive economic zone.** The exclusive economic zone is an area beyond and adjacent to the territorial sea in which the coastal state possesses certain rights and jurisdiction and all other states possess certain rights and freedoms. As a general matter, the coastal state possesses sovereign rights over the natural resources, whether living or nonliving, of the waters and seabed in the zone, while all other states possess the freedoms of navigation and overflight. The breadth of the exclusive economic zone shall not exceed 200 nautical miles "from the baselines from which the breadth of the territorial sea is measured." 57

4. **The continental shelf.** The coastal state possesses sovereign rights over the continental shelf adjacent to it beyond those rights already recognized in the exclusive economic zone to the degree the shelf extends beyond the outer limit of that exclusive economic zone. The outer edge of the continental shelf is determined under a complex physical definition, but "shall not exceed 350 nautical miles from the baselines from which the breadth of the territorial sea is measured." 58

The law of baselines in its particulars is quite complicated. The most extensive articulation of these rules is set forth in articles five through fourteen of UNCLOS III, which generally continue, but nonetheless expand somewhat upon the rules set forth in the 1958 Convention on the Territorial Sea and Contiguous Zone. 59 Generally, if no special

55. *Id.* art. 2.
56. *Id.* art. 3.
57. *Id.* art. 33(1).
58. *Id.* art. 33(2).
59. *Id.* art. 55.
60. *Id.* art. 56(1)(a).
61. *Id.* art. 58(1).
62. *Id.* art. 57.
63. *Id.* art. 77.
64. *Id.* art. 76(6).
features, such as a roadstead or an offshore rock which is dry at low tide, are present, the "normal" baseline is the low water mark along the coast. To make this baseline continuous, "closing lines" may be used across the mouths of rivers or the entrances to bays if the distance between the low water marks of the natural entrance points to the bay does not exceed twenty-four nautical miles. Although the low water mark is the "normal" baseline, it often may not be the baseline normally encountered because of the just-mentioned special features or because of some other exception. The major exception to the combination of the low water mark and closing lines is the use of straight baselines following the general direction of a deeply indented coast or joining the outermost points of an archipelagic state.

It is important to recognize that these baselines not only provide the point of reference for maritime zones extending outward, but also delimit and thus in a sense define the juridical character of the waters landward

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66. Special coastal features addressed in the 1982 Convention include reefs (article 6), ports (article 11), roadsteads (article 12), and low tide elevations (article 13). UNCLOS III, supra note 54. A roadstead is an offshore area, outside of what would otherwise be the territorial sea, designated for the loading and offloading of ships. See 1 D. O'Connell, supra note 45, at 219.

67. Article 5 of the 1982 Convention states that the normal baseline "is the low-water line along the coast as marked on large-scale charts officially recognized by the coastal State." UNCLOS III, supra note 54, art. 5.

68. Id. art. 9.

69. Id. art. 10(4).


71. The most relevant paragraphs of article 7 of the 1982 Convention provide:

1. In localities where the coastline is deeply indented and cut into, or if there is a fringe of islands along the coast in its immediate vicinity, the method of straight baselines joining appropriate points may be employed in drawing the baseline from which the breadth of the territorial sea is measured.

3. The drawing of straight baselines must not depart to any appreciable extent from the general direction of the coast, and the sea areas lying within the lines must be sufficiently closely linked to the land domain to be subject to the regime of internal waters.

UNCLOS III, supra note 54, art. 7. Although the notion of straight baselines along deeply indented coasts was discussed at the 1930 Hague Codification Conference, the turning point in international acceptance of the practice of straight baselines came about in the Fisheries Case (U.K. v. Nor.), 1951 I.C.J. 114 (Judgment of Dec. 18). Seven years later, the Court's acceptance of the straight baseline practice of Norway was codified in the Territorial Sea Convention, supra note 65, art. 4. For a discussion of both the Fisheries Case and the 1958 Convention, see Gihl, The Baseline of the Territorial Sea, 11 Scandinavian Stud. L. 119 (1967).

72. UNCLOS III, supra note 54, arts. 46-47. See generally B. Dubner, The Law of Territorial Waters of Mid-Ocean Archipelagos and Archipelagic States (1976). "There is a fundamental distinction between closing lines on the one hand and straight and archipelagic baselines on the other. Closing lines deal with single features and they are generally short." Prescott, Straight and Archipelagic Baselines, in Maritime Boundaries and Ocean Resources 38, 39 (G. Blake ed. 1987).
of the baselines. The waters inside the "normal" system of the low water mark and closing lines are called "internal waters." These waters are different from the waters of the territorial sea in that foreign vessels possess a right of innocent passage in the latter but not the former. In the cases of straight baselines and straight archipelagic baselines which enclose greater areas of ocean, certain rights of passage are preserved within such baselines.

Most importantly for the purposes of this Article, maritime boundaries under the 1982 Convention generally are contingent upon the continued existence of the baseline. If the baseline moves, the boundary moves. If a baseline point such as an exposed rock disappears, the boundary generated by that point also disappears. Although this is obviously an important principle, it often goes unstated. UNCLOS III does not expressly provide that boundaries shall move with the baselines. It does do so, however, by negative implication. In particular, the 1982 Convention has a special rule for deltas which provides that when straight baselines are used in an area "[w]here because of the presence of a delta and other natural conditions the coastline is highly unstable... notwithstanding subsequent regression of the low water line, the straight baselines shall remain effective." The 1982 Convention arguably also permanently

73. UNCLOS III, supra note 54, art. 8.
74. Compare id. art. 8 with id. art. 17.
75. Compare id. arts. 8(2), 50 with id. arts. 52-53. Note that the waters enclosed by straight archipelagic baselines are not termed "internal waters." Id. art. 8(1).
76. The possibility of such boundary changes is noted occasionally in the literature, however. See, e.g., Alexander, Baseline Delimitations and Maritime Boundaries. 23 VA. J. INT'L L. 503, 535 (1983) ("Normal baselines may change over time as the low-water line changes because of erosion. . . .")

It should also be noted that, as a practical matter, "once the normal baseline has been established and cartographically depicted on large scale charts, it remains in place until such time as it is redrafted, irrespective of whether or not the actual low-water line has physically moved." D. KAPOOR & A. KERR, supra note 53, at 31. This circumstance, however, does not alter the legal question.
77. UNCLOS III, supra note 54, art. 7(2). The delta provision was put forward originally by Bangladesh at the 1974 Caracas session of UNCLOS III in a form substantially different from that quoted above. Provision 9 of the Second Committee's Main Trends Report provided:

In localities where no stable low-water line exists along the coast due to continual process of alluvion and sedimentation and where the seas adjacent to the coast are so shallow as to be non-navigable by other than small boats and pertain to the character of inland waters, baselines shall be drawn linking appropriate points on the sea adjacent to the coast not exceeding [the] 10 fathom line.


A different provision appeared, however, in the 1975 Informal Single Negotiating Text (ISNT). This different text follows almost exactly the wording ultimately adopted in 1982. There was only one textual difference of substance. Article 6, section 2 of the 1975 ISNT text provided: "Where because of the presence of a delta or other natural conditions the coastline
fixes the outer boundary of the continental shelf. The 1982 Convention provides that the "coastal State shall deposit with the Secretary-General of the United Nations charts and relevant information, including geodetic data, permanently describing the outer limits of its continental shelf." Professor Bernard H. Oxman states that, given the fixed nature of investment in the continental shelf, the inclusion of the word "permanent" was intentional. In his view, the inclusion of the word "permanent," at least as far as the United States is concerned, likely also reflects earlier recommendations such as that made in an influential 1968 U.S. study which proposed that the outer limit of the continental shelf "should . . . not be subject to change because of subsequent alterations in the coastline or revelations of more detailed surveys."79

No such provisions, however, apply to regression of baselines other than article 7(2) deltaic baselines, nor do provisions operate to freeze maritime boundaries other than possibly those of the outer continental shelf. Rather, the 1982 Convention appears to provide that, in other than article 7(2) situations, the outer boundary of the exclusive economic zone, the contiguous zone, and the territorial sea are ambulatory in that they will move with the baselines from which they are measured. Appar-

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78. UNCLOS III, supra note 54, art. 76(9) (emphasis added).
ently, the conference of experts who met throughout the decade of the 1970’s did not anticipate that there could be a significant global regression of coastlines. Nonetheless, it is noteworthy that in the two cases where they were presented with concern over such a possibility — deltas and arguably the outer edge of the continental shelf — the negotiating states apparently were willing to permanently fix such boundaries.

III

WHEN BASELINES RECEDE: THE RISKS OF WASTE AND CONFLICT

A rising sea level in theory could result in quite dramatic shifts in baselines and the maritime boundaries which are dependent upon those lines. Given the theoretical possibility of such shifts, two questions deserve consideration. First, will there in fact be significant shifts in baselines in the next century? Second, what are the risks which result from our present system of requiring that the boundaries move with these receding baselines?

Significant shifts in baselines are inevitable. Part I identified certain areas of the world threatened with extensive flooding by rising sea levels. Compiling a more complete list of the particular locations where a one-meter rise in sea level over the next century will result in substantial shifts in baselines is beyond the scope of this Article. More importantly, such a list is not necessary for the purposes of this study because although some coastlines may not be affected significantly by a rising sea level, the nature of the nation-state system virtually ensures that some significant problems will arise. In particular, states, in developing the law regarding maritime boundaries, sought to maximize these claims over the ocean by supporting a liberal set of baseline rules that allowed territorial seas of fixed width to, in effect, extend further to sea. The baseline rules do this by recognizing less than substantial points of land as valid baseline points.

It is precisely these less than substantial points that are most threatened by a rising sea level. These points of land fall into three main


81. There is reason to believe that for many coastline configurations the effect will not be significant. See, e.g., Bird & Prescott, supra note 80, at 179-85.

groups. First are low tide elevations, sometimes called drying rocks. A low tide elevation can serve as a baseline point if it is located within what otherwise would be the territorial sea. Assuming a drying rock was located just short of twelve miles from shore, permanent submergence of this rock by a rising sea level would mean a loss in width of all maritime zones. Fringing reefs comprise the second category. Such reefs can serve as a baseline point regardless of whether they are within what otherwise would be the territorial sea of the island they fringe.

It is the third category, islands, however, that will potentially result in the most significant shifts. Islands, as opposed to uninhabitable rocks, are entitled to a 200-mile wide exclusive economic zone. An island could be an offshore barrier island which in a practical sense only extends the maritime zones of a coastal state somewhat in the same sense as a drying rock. The offshore island could also be an anchor point of a straight baseline. Most significantly, a small island could be an island

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83. UNCLOS III, supra note 54, art. 13. Article 13 of the 1982 Convention, repeating the text of article 11 of the 1958 Convention, provides:

1. A low-tide elevation is a naturally formed area of land which is surrounded by and above water at low tide but submerged at high tide. Where a low-tide elevation is situated wholly or partly at a distance not exceeding the breadth of the territorial sea from the mainland or an island, the low-water line on that elevation may be used as the baseline for measuring the breadth of the territorial sea.

2. Where a low-tide elevation is wholly situated at a distance exceeding the breadth of the territorial sea from the mainland or an island, it has no territorial sea of its own.

84. See Bird & Prescott, supra note 80, at 185-86 ("[A] retreat of 2 nautical miles will have a significant impact on the location of the 12 nautical-mile outer limit of territorial seas, a proportionately smaller impact on the outer edge of the contiguous zone, which is 24 nautical miles distant, and a negligible effect on the outer boundary of an exclusive economic zone 200 nautical miles wide.").

85. UNCLOS III, supra note 54, art. 6.

86. As to the distinction between an island and a uninhabitable rock in article 121(3) of the 1982 Convention, see C. Symmons, The Maritime Zones of Islands in International Law (1979); Discussions and Questions, The UN Convention on the Law of the Sea: Impact and Implementation 355-59 (E. Brown & R. Churchill eds. 1987) (although difficult to categorize definitively, uninhabitable rocks are thought to be entitled to only a 12-mile territorial sea); Van Dyke, Morgan & Gurish, The Exclusive Economic Zone of the Northwestern Hawaiian Islands: When Do Uninhabited Islands Generate An EEZ?, 25 SAN DIEGO L. REV. 425 (1988) (detailed chronology of the evolution of the present UNCLOS III norm); see also Fusillo, The Legal Regime of Uninhabited "Rocks" Lacking an Economic Life of Their Own, 4 ITALIAN Y.B. INT’L 47 (1978-79) (describing evolution of legal distinctions between uninhabitable rocks and islands).

"At present, many states seem to have taken inconsistent positions with regard to their various island possessions." Van Dyke, Morgan & Gurish, supra, at 464. In particular, several states, such as France, claim exclusive economic zones around what in the ordinary sense would be regarded as uninhabitable rocks. Id.

As to islands, see generally D. Bowett, The Legal Regime of Islands in International Law (1979); H. Jayewardene, The Regime of Islands in International Law (1990); C. Symmons, supra.

87. For a case study of such an offshore barrier island, see Titus, Greenhouse Effect, Sea Level Rise, and Barrier Islands: Case Study of Long Beach Island, New Jersey, 18 COASTAL MGMT. 65 (1990).
state or, more likely, one of a group of islands that form a state. This is significant because such island states do not merely extend the zones of an adjacent coastal state but potentially each generates an exclusive economic zone of its own enclosing at least some 125,664 square nautical miles of ocean. Numerous island states exist. A rising sea level could taint the freshwater reservoir of an island potentially rendering it uninhabitable, submerge enough of it to leave only an uninhabitable rock, or submerge it entirely. In any of these circumstances, the island state potentially would lose the right to use that part of its island group to extend its exclusive economic zone. Consequently, for the island state there is little doubt that the combination of a rise in sea level and the contingent nature of boundaries is or will be of grave concern.

My emphasis on these less than substantial baseline points should not be taken to imply that there also may not be significant alterations in the normal combination of the low water mark and closing lines. For example, the United States Department of the Interior currently argues in opposition to the State of Alaska that a closing line may no longer be drawn across a certain point of Kotzebue Sound because erosion of a shoal on one side of the sound has increased the closing line past the maximum allowable length of twenty-four miles, from 23.9 miles to 25.8 miles in length. Consequently, the U.S. argues that the closing line must fall back approximately thirty miles into the Sound until the maximum allowed width of twenty-four miles is reached again.

In order to understand how coastal and island states may respond to circumstances such as these, it must be recalled that states have fought for control of marine resources. The possibility of such conflict results from the richness of the resources located in the exclusive economic zones. It is estimated, for example, that 75-80% of present commercial fisheries fall within these 200-mile zones. Moreover, it is likely that the

88. If the island is taken to be a point, then 125,664 square miles represents the area of a circle with a 200-mile radius around that point. If the island is regarded as having area, the area of the surrounding exclusive economic zone could only be greater than 125,664 square miles.
89. As to the general concern of island states over the threat of a rising sea level, see Threatened Islands Demand Urgent Action on Global Warming, NEW SCIENTIST, Dec. 2, 1989, at 30.
90. Telephone interview with John Briscoe, Washburn, Briscoe & McCarthy, San Francisco (Sept. 19, 1990). The proposed change would result in the loss of "nearly one million acres" of internal waters which to this point have been enclosed as part of the Sound. The change would also create a narrow corridor of international waters penetrating nearly 30 miles into a bay which to date has been considered internal waters. Id.; see Memorandum of the State of Alaska to the United States Baseline Committee Regarding the Closing Line of Kotzebue Sound (July 10, 1990).
value of such resources will be much greater by the year 2100, particularly if global climate change causes great dislocations and alters food production in a more populated world.

Consequently, one plausible scenario is that a state threatened with loss of maritime areas will commit great amounts of resources to protect baselines threatened by a rising sea level. It will do so not because it cares about the baselines themselves, but rather because it values the maritime zones which the baselines generate. In other words, one behavioral risk is that countries will act to maintain the assumption of constancy underlying the law of baselines.

The hypothesis underlying this assertion is that an aspect of a legal order which continuously reincorporates the assumption of a constant climate will lead parties faced with a changing climate to react inefficiently. For example, assume that a portion of a legal order grants certain rights and entitlements and then ties them to a physical aspect of the world, such as sea level, presuming that the physical aspect is relatively constant. If the presumption of constancy is incorrect, then the rights and entitlements potentially are threatened. The holders of the entitlements may seek to preserve their rights and entitlements by committing resources to stabilize that aspect of the physical world which is threatened by climatic change. This is inefficient to the extent that resources are committed to preserve a physical aspect of the world, not because that aspect itself is valuable, but rather because the entitlements are valuable and those entitlements — for purely conventional reasons — require the preservation of the physical aspect.

An economics perspective on the law has demonstrated the inefficiency of somewhat analogous legal structures. In particular, rules of first possession, such as ownership of oil and gas based on its extraction or land ownership depending on its being fenced, encourage speculative over-investment.92 “The transfer-effect under the rule of first possession thus causes over-investment in the activities that the law defines as neces-


92. R. COOTER & T. ULEN, LAW AND ECONOMICS 130 (1988). Another more recent example is that of homesteading laws in Brazil which until recently required evidence of occupation and thus encouraged the burning of rainforest since such burning was considered use and improvement under Brazilian law. See Simons, Amazon Settlers Turn Forests To Ash in Name of Progress, N.Y. Times, Oct. 11, 1988, at A1, col. 1.
sary to obtain legal possession.”93 The baseline situation is different since what is at stake is not the acquisition of rights but rather the retention of rights. The law of baselines encourages overinvestment in activities that the law defines as necessary to retain legal possession. This cost is socially inefficient because it relates neither to the production of wealth nor to its distribution.

A recent example of the waste which could flow from the combination of a rising sea level and the present law of baselines is Japan’s commitment in 1988 of $240 million over three years to save Okinotorishima, two rocks 1400 yards apart that extend no more than two feet out of the water at high tide.94 Japan seeks to preserve these rocks, not from a rising sea level but from erosion by wave action, by constructing circular blocks of steel and concrete to save their deteriorating support.95 Such expenditures will be absurd, if not irresponsible, amidst the full impact of global climate change in the next century. Far more important will be the need to relocate habitats and species, feed peoples, and protect coastal investments. Yet, the present assumptions of our law of maritime zones encourage nations to expend funds to preserve baselines. While a state may justifiably attempt to protect a headland against a rising sea level because the nation values something as intangible as the headland’s beauty, a state should not be encouraged to preserve a headland solely because a dependent maritime zone is threatened.

A graver risk than waste of resources is that shifting baselines will lead to uncertainty as to the boundaries of some maritime zones during a time when the value of the resources of those zones will be increasing. Uncertainty regarding ownership of a valuable resource is a fertile ground for conflict between states or citizens — such as fishermen — of

93. R. Cooter & T. Ulen, supra note 92, at 130.
94. See Haberman, Japanese Fight Invading Sea for Priceless Speck of Land, N.Y. Times, Jan. 4, 1988, at A1, col. 2; Van Dyke, Speck in the Ocean Meets Law of the Sea, N.Y. Times, Jan. 21, 1988, at A22, col. 1 (letter to the editor). Professor Van Dyke points out that a rock such as Okinotorishima, so far from the mainland, most likely cannot serve as a baseline point for the generation of a 200-mile exclusive economic zone but rather only the more modest twelve-mile territorial sea. Id. I agree with Professor Van Dyke. This circumstance, however, only makes the proposition in the text stronger. Specifically, Japan values the resources surrounding these rocks so much that they are willing to spend $240 million on the remote chance that they are preserving a claim to those resources.

Bird and Prescott, in a recent study discussing policies unrelated to article 7(2) which might be used to maintain existing maritime claims, wrote:

The first policy involves defending the coast against erosion by constructing and enlarging sea walls. Such works are expensive and would only be built to avoid the submergence of coastal lowlands that are highly productive, densely settled, and intensively developed. . . . [In most places] the costs of these structures will be prohibitive and coastal lowlands will be lost as sea level rises.

Bird & Prescott, supra note 80, at 193 (citations omitted). The Okinotorishima example tells us the present law of baselines also encourages states to construct defenses if the offshore area is sufficiently valuable.

95. Haberman, supra note 94, at A1, col. 2.
these states. Indeed, one governmental advisor expressed concern to the author that during the possibly great strains accompanying climate change, states might question the fairness of past delimitation agreements with neighboring states. Even though states generally have a great interest in upholding the sanctity of such agreements, it is entirely plausible that a state might argue that circumstances had changed in that the parties had not foreseen such a rise in sea level.96

Thus, the risks of waste and conflict are part and parcel of the rule that maritime boundaries should recede in step with the baselines from which they are measured. The simple possibility of losing part of one's fishing ground will encourage states to allocate resources to preserve the baseline defining that zone. The uncertainty as to whether a fishing ground is still within one state's exclusive economic control will tempt others to make use of the resource and create a situation ripe for conflict.

IV
MOVING BASELINES VERSUS FIXED BOUNDARIES

The risks of waste and conflict described in the previous sections exist because states must each respond individually against the backdrop of a collective rule which is difficult for any one of them to authoritatively alter. One way to lessen the risks of waste and conflict is for the community as a whole to alter the rule. In particular, the international community could retain the current system of using ambulatory baselines to determine the boundaries of maritime zones or it could freeze the boundaries of some or all of the maritime zones on the basis of presently accepted baselines. Implementation of such a freeze could be accomplished in at least three ways: the assertion of a new rule; the liberal interpretation of existing rules such as the allowance for the freeze of baselines off of deltas as provided in article 7(2) of the 1982 Convention; or the assertion of historic rights over waters that would otherwise be lost.

In this section, I evaluate the two alternative boundary systems (ambulatory baselines vs. frozen boundaries) and the means by which a freeze could be partially or completely implemented. In doing so, I consider a number of factors. These include the soundness of each approach as a boundary system in terms of the ascertainability and certainty of the resultant boundaries;97 the technical feasibility and costs of each ap-

96. The reality of shifting baselines may be less significant in lateral delimitations because less substantial baseline points such as drying rocks or even islands may already have been discounted somewhat in the agreement. See, e.g., M. EVANS, RELEVANT CIRCUMSTANCES AND MARITIME DELIMITATION 156-59 (1989).

97. For theoretical works regarding boundaries generally, see S. BOGGS, INTERNATIONAL BOUNDARIES: A STUDY OF BOUNDARY FUNCTIONS AND PROBLEMS (1940); Kristof, The Nature of Frontiers and Boundaries, 49 ANNALS A. AM. GEOGRAPHERS 269 (1959);
proach; the fairness of each approach given the present international allocation of authority over ocean space; and the value of each approach as part of an adaptation strategy to climate change.

As these factors suggest, any evaluation of whether it is in the best interests of the international community to change the present regime of maritime boundary delimitation must be multidisciplinary. The analysis should consider economic, legal, scientific, and political impacts, as well as assess historical rights and technical feasibility. In this sense, this study should be viewed as an initial assessment of issues deserving further study by scholars in appropriate disciplines.

Recalling that UNCLOS III may already provide for a fixed continental shelf boundary, the maritime boundaries of particular importance to the following analysis are those of the exclusive economic zone and the territorial sea. Following the general analysis sketched above, the final section considers whether the differences between the exclusive economic zone and the territorial sea affect the analysis and whether they should lead to zone specific conclusions.

A. Soundness as a Boundary System

1. The Value of Ascertainability in Boundaries

A primary value in boundary making is that there be a clear division of authority over territory. A clear division presupposes that the boundary may be readily identified. Consequently, it could be argued that the continued tie of maritime boundaries to existing physical features is desirable because persons at sea may more easily ascertain boundaries if they need only look to the shoreline which generates the boundary. Conversely, it could be argued that if the community froze maritime boundaries on the basis of presently accepted baselines, then as the shoreline altered over time the boundary would no longer have a close relation to the shore. This latter argument is flawed because it assumes that maritime boundaries at present have a close relation to the shoreline.

A concern for the ascertainability of boundaries by those at sea heavily influenced the position of the United States delegation to the 1930 Hague Codification Conference. S. Whittemore Boggs, then Geographer of the U.S. Department of State, wrote:

Since the legal rights of the coastal state and of foreign states within the territorial sea differ greatly from the rights of all states on the high sea, it should be made possible for a navigator, or a fisherman, or the
coastal state, to determine with certainty whether or not a vessel is in territorial waters or on the high sea.

The difficulties hitherto encountered in delimiting portions of the territorial sea have arisen, however, largely from the fact that the problem has generally been considered from the viewpoint of a man on the land rather than the viewpoint of the navigator. 99

Although concern for how the mariner and fisherman were to locate a boundary upon the sea was occasionally present, it generally was overwhelmed by economic or security concerns. 100

Consequently, under the present regime of maritime boundaries, ascertainment by a navigator of a boundary by simple reference to the shoreline is not always possible and hence not reliable. First, the international acceptance of drying rocks as valid baseline points makes reference to the shoreline as the "normal" baseline unreliable. 101 Second, the adoption of a closing line of 24 miles for bays means that "the relevance of [vision-based] navigational considerations [relating to bays has] been virtually eliminated." 102 Third, the significantly increased use of straight baselines by states after the Second World War makes reference to charts necessary in the waters of much of the world. 103 Fourth and more fundamentally, the entire objective of ascertainability of boundaries by reference to existing physical features is perhaps misplaced because of the increased zone widths now recognized. Today, the mariner and fisherman can be out of radar, not to mention visual, range of the coastline and still be within a state's coastal waters.

Finally, a concern for a boundary identification by those at sea through reference to physical features generally may be misplaced since satellite navigation systems likely will allow an increasingly wide cross section of ocean users to fix not only their position, but also their position relative to stored information regarding boundaries. The historical evolution of the current regime of maritime boundaries has been influenced by the development of various technologies, from cannons to radar, that were referenced on geophysical formations. Today's satellite technology, however, may serve to free parties, from individual fishermen to national coast guards, from having to locate physical reference points in order to determine maritime boundaries. 104

99. Id. at 541, 543.
101. As to the subordination of the previous customary practice that rocks be permanently dry, see 1 D. O'Connell, supra note 45, at 185.
102. 2 id. at 648.
103. See 1 id. at 211. For a survey of the practice of some of these states, see J. Prescott, The Maritime Political Boundaries of the World 66 (1985).
104. See generally D. Johnston, supra note 70, at 71-73; 2 D. O'Connell, supra note 45,
One group that could benefit from the ability to ascertain maritime boundaries by simple reference to the shoreline is aircraft. Until a few years ago, satellite navigational assistance was unavailable for aircraft because of the great speed at which such craft travel. Furthermore, a practical navigational practice at present for aircraft is merely to stand outside a certain number of miles from the radar image of a coast. This practice may not ensure a safe distance, however, if maritime boundaries are frozen sometime in the past on the basis of baselines that no longer exist. On the other hand, the practice does not ensure a safe distance under the present regime either for all the reasons outlined above.

Thus, in terms of boundary ascertainability, for both those at sea and those in the air, retaining the current regime of tying boundaries to existing physical features offers no apparent advantage over the freezing of such boundaries on the basis of presently accepted baselines.

2. The Value of Stability in Boundaries

Another primary value underlying theoretical constructs regarding boundaries is that they be certain and undisputed thereby allowing stability of expectations on both sides of the border. Thus, for example, in 1793 the United States sought to preserve its neutrality not only by adopting a conservative width for its territorial sea, but also a zone of a fixed width and, consequently, greater certainty. The stability afforded by zones of a fixed width, however, rests upon the assumption that the coastal or island formations from which the width is measured will remain relatively unchanged. A rising sea level calls this assumption into doubt. Retaining the current system of referencing baselines on existing geographical features thus may not bring certainty, for some of these features may recede or vanish altogether because of a rising sea. Therefore, the present regime may lead to increased uncertainty in maritime boundaries. Furthermore, this uncertainty will arise at a time when the global system will be strained by the same climate change that caused...
the rise in sea level. The two tensions thus will grow together. The greater the strain imposed on all states by climate change, the larger the shifts in baselines and the greater the uncertainty in maritime boundaries. Since uncertainty in boundaries is a prime ingredient in many recipes for interstate and private transnational conflict, maintaining the current system of moving baselines invites such conflict. The fixing of boundaries would create more certainty.

B. Technical Feasibility and Costs

1. Technical Feasibility

There is no apparent technical impediment to the fixing of maritime boundaries on the basis of presently accepted baselines. Many nations already indicate their maritime boundaries upon charts, or publish data or coordinates which yield such lines. However, the technical question remains whether at present there is sufficient information regarding the configuration of coastlines so as to allow for resolution of boundary disputes in the future with reference to the baselines as they allegedly exist today. In contrast, although charts at present are not always revised to reflect the most recent coastal configuration, the present regime of adjusting baselines to changing configurations does not present the same evidentiary problems for a dispute resolution process because the parties need only examine existing coastal features.

The potential difficulty, therefore, with the fixing of maritime boundaries is that there may not be sufficient hydrographic and coastal survey information for many parts of the world. Under the 1982 Convention on the Law of the Sea, states are required to give due publicity to their baselines by showing such lines on charts of a scale adequate for ascertaining their position or alternatively through a list of geographical co-ordinates of points, specifying the geodetic datum. In fact, however, hydrographic survey information for offshore waters often is limited or dated, particularly in many developing countries. Moreover, this information is likely depicted on charts produced by the industrialized countries. Although the 1982 Convention allows countries to officially recognize charts produced by other states, countries may be reluctant to do so, particularly if the country producing the chart is the former colonial power for that area of the world.

This practical problem for the resolution of disputes which arise later can be avoided, however, if the community conditions the right to

108. See UNCLOS III, supra note 54, arts. 16 (baseline and outer boundary of territorial sea), 75 (outer boundary of exclusive economic zone), 84 (outer boundary of continental shelf).


110. See, e.g., UNCLOS III, supra note 54, art. 5 ("[T]he normal baseline... is the low-water line... as marked on large-scale charts officially recognized by the coastal state.").
freeze boundaries on the contemporaneous publication of the baseline which is claimed to be presently accepted by the international community. Moreover, by providing the clear opportunity for objections by third states to the assertion of a permanent boundary, the process would aid further in the resolution of any later boundary dispute. Such a process approach perhaps might also discourage the occasional practice by a few countries of declaring maritime boundaries without reference to baselines. Thus, although a lack of hydrographic information presents some technical difficulties for dispute resolution if boundaries were frozen on the basis of presently accepted baselines, requiring the potential parties to establish their claims or objections will serve to focus the parties on the particular hydrographic information at issue and minimize the problem.

2. Costs

Retaining the current system of ambulatory baselines has several types of costs. First, the system carries with it the risk of waste by individual countries which may expend resources to protect particular geophysical baselines through, for example, erection of barriers against an encroaching sea. Second, if baselines are allowed to move, there are costs associated simply with adjustment of the boundary.

The potential costs of adjustment are dramatically shown by the United States' experience with its Submerged Lands Act of 1953. The Submerged Lands Act addressed the question of federal versus states' rights in the offshore seabed through a quitclaim by the United States to the several states of the lands underlying the waters within three miles of the coastline. The coastline was defined as "the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters." In 1965 in United States v. California, the U. S. Supreme Court held that the line delimiting inland waters was to be determined in accordance with the 1958 Convention on the Territorial Sea and the Contiguous Zone. By doing so, the Court rendered ambulatory the baseline described in the Submerged Lands Act. Given that title to valuable offshore oil reserves would move with this ambulatory baseline, litigation was inevitable —

111. For discussion of this practice, see Prescott, supra note 72, at 45-46.
112. See, e.g., supra notes 94-95 and accompanying text.
particularly in the case of Louisiana where the shoreline of the soft silt-like delta of the Mississippi River constantly shifts. In 1969 in *United States v. Louisiana*, the Court stated that, because in its view the Submerged Lands Act refers the Court to the 1958 Convention, the Court could not accept Louisiana's argument that the Court should adopt a fixed rather than ambulatory line.\(^{117}\) Justice Black wrote in dissent that:

> [T]he doctrine is tending to bring about interminable litigation. . . . Shorelines are constantly changing, and thus under the Court's formula even this painstaking work cannot provide a means of marking the boundary for all time.

\(^{117}\) To avoid such "interminable litigation," the federal government and Louisiana in effect froze the boundary by entering into a special boundary agreement — although even with the agreement, a final decree was not entered until 1981.\(^{119}\) As a general solution to the possibility of such interminable litigation with other states, legislation has been proposed in both the House and the Senate authorizing the federal government to enter into seabed boundary agreements with the several states and setting forth a process whereby such boundaries may become immovable.\(^{120}\)

In this sense, a permanent fixing of maritime boundaries would avoid the cost of adjustment. In addition, since the majority of states already indicate their maritime boundaries upon charts, there would be no added cartographic costs resulting from the fixing of such maritime boundaries. Nonetheless, there may be transactional costs associated with reaching international agreement as to the precise location of such fixed boundaries.

Finally, if the outer boundary of the maritime zones was fixed on the basis of a baseline accepted at a certain point in time, then there would be no conventional reason compelling the physical preservation of baselines. Decisions as to whether a shoreline should be allowed to recede or an island be allowed to submerge would instead be based on an analysis of the direct value of the shore or island, for example, to tourism or recreation.

\(^{118}\) *Id.* at 85, 88 (Black, J., dissenting).
\(^{120}\) *See, e.g.*, S. 1878, 98th Cong., 1st Sess. (1983); S. 2068, 99th Cong., 2d Sess. (1986). Both bills provided that the agreement on such a boundary would be without prejudice to the international claims of the United States.
The present complex set of maritime zones resulted from an exhaustive balancing during UNCLOS III of the ocean-related interests of coastal states, maritime states, and the international community. These interests included fishing and fishery conservation, navigation, military uses, environmental and marine mammal protection, and marine law enforcement.

Although the rules governing allocation would remain the same if maritime boundaries were to move with receding baselines, the allocation of authority in fact would change. For example, as baselines and dependent boundaries recede, the extent of the high seas would increase. Similarly — remembering that in the past military planners were concerned that the increase of territorial seas from three to twelve miles in width might close off a strait used for international navigation\textsuperscript{121} — receding baselines could free such a strait from overlapping territorial seas. But why should the fortuity of a coastal state having a low-lying coastal plain lead to the loss of maritime areas over which it at least formally has exercised jurisdiction? Is it not a windfall to some other state or the international community that others should gain the right to use that area of the ocean?

The fixing of maritime boundaries, on the other hand, does not affect the allocation agreed to at UNCLOS III because it merely freezes the present division of authority over the oceans. If maritime boundaries are frozen and baselines recede, states do not gain any additional portion of the surface of the Earth.\textsuperscript{122} Rather, the mix of their jurisdiction over land and ocean portions of the surface changes. The fixing of maritime boundaries potentially means that some international strait may not become freed from overlapping territorial seas. But then again, the covering of that strait was apparently part of the balance struck at UNCLOS III and was a fact with which military planners felt they could live given the Convention's provision for straits passage.\textsuperscript{123}

Indeed, the fixing of maritime boundaries might help to preserve the present balance. During this century, before the present balancing of in-


\textsuperscript{122} This proposal need not, and is not intended to, foreclose the possibility that a state might gain, rather than lose, territory through, for example, accretion and in this sense be entitled to extend its maritime boundaries out to a new fixed position. Accretion and other natural processes, however, must be distinguished from artificial extensions of territory. See, \textit{e.g.}, N. Papadakis, \textit{The International Legal Regime of Artificial Islands} (1977). Papadakis addresses issues involving the artificial island, or "non-naturally formed structure." \textit{Id.} at 6.

\textsuperscript{123} See Wainwright, \textit{supra} note 121, at 370-73.
terests was reached, there was a progression of increasingly greater coastal state claims over the ocean, a phenomenon labelled "creeping jurisdiction." The practice of measuring zones from a baseline perhaps contributed to the psychology of this creeping jurisdiction. It seems easier somehow for a state to proclaim that the width of its territorial sea will be extended from three miles to six miles and then later to twelve miles, than it would be to move fixed outer boundaries. A discussion about the width of a zone is one step removed from the reality of moving a boundary on the surface of the Earth. Indeed, the fixing of boundaries on the basis of presently accepted baselines might serve to counter the newer psychology of "creeping uniqueness," that is, the tendency to claim that one's coastline is unique and deserving of a special and extensive straight baseline system. 124

In essence, if one regards the allocation of authority arrived at by UNCLOS III to be appropriate, then the fixing of maritime boundaries will, more than the present regime of ambulatory baselines, preserve this allocation. Simultaneously we must bear in mind that it is entirely possible that global climate change may eventually mean that the present allocation of authority over the oceans is not the most desirable or equitable. For example, it is unclear whether changes in surface ocean temperatures will lead fisheries to move. It is at least equally unclear how the present system for fisheries management could adapt to such shifts. Such possibilities, however, do not alter the conclusion that fixed boundaries best preserve the division of authority over the world's oceans that resulted from UNCLOS III.

D. Value as an Adaptation Strategy to Global Climate Change

At first blush, allowing baselines to move appears highly flexible and adaptive. It almost appears environmentally sensitive in that it is responsive to nature's changes. However, maintaining the current system of ambulatory baselines and boundaries carries with it the inherent risks of waste and conflict described above in part III. Moreover, it is anything but environmentally sensitive since the regime only encourages states to attempt to counter such responsiveness and to deny the changes in baselines that a rising ocean seeks.

The fixing of maritime boundaries, on the other hand, will aid adaptation to climate change in at least three ways. First, as mentioned previously, the fixing of maritime boundaries will free states from the need to preserve baselines so as simply to preserve their maritime zones. The resources not devoted to preserving a baseline for this conventional rea-

son thus will be available for more substantive adaptation needs, such as the protection of harbors or the relocation of species.

Second, adaptation may suggest that low-lying coastal areas in some cases be allowed to be inundated so that, for example, new wetlands can be formed to replace those lost between a rising sea and developed areas that clearly require protection.

Third, and in particular for islands, the fixing of maritime boundaries will preserve what may be the prime asset of the peoples of those islands. Many of the refugee groups who may result from a rising sea level reside in states composed entirely of islands. If maritime zones recede with baselines, these people will witness the diminishment of their maritime zones and may ultimately be forced to abandon uninhabitable rocks which under the 1982 Convention are entitled only to a territorial sea and not the more extensive and valuable exclusive economic zone. On the other hand, if the maritime zones remain intact despite the recession or eventual submergence of baseline points, then a nation of potential refugees would continue to possess something of value. In essence, the existence of the zone would depend upon the continued existence of the state and not upon a particular part of the territory of that state. Of course, a sufficient rise in sea level might call into question even the existence of that state. Nonetheless, preservation of the integrity of its maritime zones still could afford some protection to this nation of potential refugees in that the zones could form the basis for some form of federation between the island state and a state less threatened by the rising sea level. In this sense, the maritime zones of an island state would continue in the same way that a coastal state would retain an exclusive economic zone it validly claims around an oceanic island that is part of its territory.

E. The Means of Implementation: The Assertion of a New Rule of Custom

The above analysis indicates that a freezing of maritime boundaries is desirable. It does not, however, indicate how best to achieve such a freeze. In particular, the international community through its members could assert, either through custom or treaty, a new rule: members could seek to achieve a freeze in their maritime boundaries through liberal interpretations of the present rules concerning straight baselines or the specific rule for deltaic formations in article 7(2) of the 1982 Convention; or members could seek to achieve a freeze despite the retreat of baselines through the assertion of historic rights. The key value used in weighing these different means of implementation is the resulting certainty of the boundary. To the degree that the boundary is not certain, conflict is more likely.

For example, the notion of historic rights generally is appealing quite simply because it seems fair that a coastal state retain the present
extent of its use of the oceans. Yet, although the assertion of historic rights might provide a result similar to that provided by fixing the boundary on the basis of presently accepted baselines, the assertion of such rights must be proved. The assertion is more easily contested than the location of a baseline, and hence carries with it its own uncertainties. If states ultimately intend to assert historic rights, it is better for them to fold that rationale into the justification of fixing such maritime boundaries generally. The uncertainties and possibility of argument likewise would accompany liberal interpretations of the present rules concerning straight baselines. Certainty is gained through the clear assertion of a new rule of international law.

Given the fact that the 1982 Convention is not yet in force and may not come into force for some time, it appears that the assertion of a new rule could most quickly occur through customary law. In the sense that it is the maritime zones of islands that are most threatened, one can envisage support for a new customary rule coming from island states such as the Maldives, the Philippines, and Japan, and coastal states with oceanic islands such as France and the United States. It would be best if such assertion occurred before specific disputes emerged, potentially confusing the issue.

F. Conclusions: The Desirability and Scope of a Freeze

The preceding analysis indicates that a freeze of maritime boundaries on the basis of presently accepted baselines would be wise in that it promotes stability in boundaries, be fair in that it preserves the present allocation of authority over the oceans, and be efficient in that it avoids the costs of adjustment while facilitating adaptation to climate change.

It should be asked, however, whether all, or only some, of the various types of maritime boundaries need be frozen. Since it is the economic value of offshore living and nonliving resources that will spur states confronted with global climate change and a rising sea level towards waste and conflict, these risks perhaps can be avoided merely through a freeze of the boundaries of the exclusive economic zone and the continental shelf. In other words, perhaps the territorial sea need not

125. See supra notes 31-44, 90 & 103 and accompanying text for discussion of the challenges facing various countries. In particular, see Wells & Edwards, supra note 10, at 47-51 (Maldives); J. Prescott, supra note 80, at 157, 182, 188-89 (France), 230-31 (Phillipines), 241-48 (Japan); Van Dyke, Morgan & Gurish, supra note 86, at 429-33 (United States), 449-51 (Japan).

126. Although the conclusion calls for a freeze of maritime boundaries, ambulatory baselines may continue to be of value for other purposes. In particular, baselines at present also serve to separate the territorial sea from internal waters, the latter being waters where no right of innocent passage is held by the international community. To the degree that internal waters are to remain limited to waters within the land mass of the state, then the international community may still desire that states indicate closing lines for rivers and bays.
be a part of the freeze. Yet, for some parts of the world it will be the territorial sea that needs to be frozen because in enclosed or semienclosed areas, it very well may be the territorial sea, rather than the exclusive economic zone or continental shelf, that is at issue. Outside of such particular areas, however, it is debatable whether an ambulatory or frozen territorial sea is preferable. Although it may be particularly desirable to be able to ascertain whether one is within the territorial sea, and thus the full civil and criminal jurisdiction of a state, we should recall the earlier observation that the present baseline regime does not in any event yield a zone easily ascertainable by those upon the sea.\footnote{If the baseline rules were a simple combination of the low water mark and closing lines, then the value of ascertainability would suggest, putting aside other considerations, that the boundary of the territorial sea remain ambulatory. Yet, although talks on the revision of the baseline regime are reportedly contemplated, Letter from Cdr. J. Waldron, U.S.C.G., to the author (March 15, 1990), such a fundamental simplification of the baseline rules coordinated with a freeze of boundaries on the basis of the more complex present system of baselines must be regarded as highly unlikely.}

Moreover, although some maritime states may welcome the reversion over time of some present territorial waters to areas in which free navigation might be exercised, coastal states may feel the need to continue to exercise their full sovereignty over areas recently submerged.

In conclusion, the risks of waste and conflict which may accompany a rising sea level can be best avoided by the assertion of a new rule of international law which freezes maritime boundaries on the basis of presently accepted baselines. In some parts of the world it will be particularly important that the boundaries of the exclusive economic zone and continental shelf are frozen. In other, more enclosed areas, it may be the boundary of the territorial sea that is at issue. As a practical matter, the risks, as noted above, are greatest in terms of the exclusive economic zone generated by insular formations, and it is thus the boundary of the exclusive economic zone that in particular needs to be frozen.

CONCLUSION

This Article offers not only a hypothesis, but also an avenue for legal research relating to global climate change. As far as the agenda for legal research, this Article asserts that there may not only be natural feedback mechanisms to climate change, but also legal ones. These legal feedbacks do not alter the amount of climate change, but instead aggravate the suffering that will accompany such change. It is a task of legal scholarship to aid societal adaptation to global climate change by identifying and addressing these legal feedbacks.

The example of such a legal feedback mechanism discussed in this study is the present law of baselines. In particular, it is argued that the rule that maritime boundaries should be tied to ambulatory baselines...
will, as the result of a rising sea level, encourage wasteful spending by states and lead to uncertainty in boundaries. The Article asserts that the remedy to these risks, which flow from decentralized decisionmaking based on the existing rule, is collective alteration of the rule. It is recommended that maritime boundaries, most importantly the boundary of the exclusive economic zone, should be frozen on the basis of presently accepted baselines. The proposal is particularly significant for island states and the peoples of those islands.

The contingency of maritime boundaries upon the continued existence of baselines is a vestigial remnant of the naturalist's position that the existence of the land is the source of authority over the ocean. That it has persisted through more positivist times reflects the fact that until recently it was assumed that baselines were relatively constant. But, as we have come to realize that our assumption regarding the constancy of nature was simplistic, and inasmuch as nature declines to negotiate, it is we and our laws which must adapt.