

# “Half Seas Over”: The Impact of Sea Level Rise on International Law and Policy

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“Some were quite Drunk, and some were Sober, And some were also half Seas over.”<sup>1</sup>

## I. INTRODUCTION

“Half seas over,” a term traditionally reserved for the semi-drunk sailor, appears to be particularly appropriate for the uncontrolled rise in sea level predicted by many proponents of the global warming theory. The term not only reflects the distortions which would occur in international law and policy “under the influence” of such a projected rise, but also, quite literally, calls to mind a picture of

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1. J. BALTHARPE, STRAIGHTS VOYAGE 38 (Bromley ed.)(1671), quoted in THE OXFORD DICTIONARY OF ENGLISH PROVERBS 344 (F. Wilson 3d ed. 1970). The term “half-seas over” refers to a half-drunk condition, *see id.*; 1 J. FARMER & W. HENLEY, A DICTIONARY OF SLANG AND COLLOQUIAL ENGLISH 210 (abr. ed. 1905) (“Loosely applied to various degrees of inebriety: Formerly, halfway on one’s course, or towards attainment.”); E. Partridge, A DICTIONARY OF SLANG AND UNCONVENTIONAL ENGLISH 368 (5th ed. 1982) (“Half or almost drunk: late C. 17-20: nautical > gen.; in C. 19-20, coll. . . . Either *half sea’s over* or a corruption as Gifford maintained, of *op-zee zober*, ‘over-sea beer’, a heady drink imported from Holland; but, in C. 16, the phrase = halfway across the sea, which rather rebuts Gifford.”). According to *id.*, “half sea” referred to “mid-[English] Channel.”

the problems which would face many of the world's coastal areas were such an event to occur.

This study opens with a short introduction to sea level rise. This is followed by a historical discussion presenting the problem in its current social context. A "case study" of the effect of sea level rise on ocean boundary issues is given, as well as a summation of other potential problem areas in international law and policy. Finally, the conclusion offers some suggestions for an integrated law-policy approach to the problem of sea level rise.

## II.

### "AND THE WATERS PREVAILED"<sup>2</sup>: A BACKGROUND TO THE PROBLEM OF SEA LEVEL RISE

Stories of the biblical Flood have a worldwide currency.<sup>3</sup> Long before Noah's ark was launched,<sup>4</sup> the Sumerian Epic of Gilgamesh reported its own deluge, when:

With the first light of dawn a black cloud came from the horizon; . . . .  
Then the gods of the abyss rose up; Nergal pulled out the dams of the nether waters, Ninurta the warlord threw down the dykes . . . . A stupor of despair went up to heaven when the god of the storm turned daylight to darkness, when he smashed the land like a cup.<sup>5</sup>

Other tales speak of sunken cities (with muffled bells!) and of fields

2. See *Genesis* 7:11-12, 17-24 (King James) for this famous passage concerning the drastic effects of sea level rise:

In the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the same day were all the fountains of the great deep broken up, and the windows of heaven were opened.

And the rain was upon the earth forty days and forty nights.

. . . .

And the flood was forty days upon the earth; and the waters increased, and bare up the ark, and it was lift up above the earth.

And the waters prevailed, and were increased greatly upon the earth; and the ark went upon the face of the waters.

And the waters prevailed exceedingly upon the earth; and all the high hills, that were under the whole heavens, were covered.

. . . .

And all flesh died that moved upon the earth, both of fowl, and of cattle, and of beast, and of every creeping thing that creepeth upon the earth, and every man:

All in whose nostrils was the breath of life, of all that was in the dry land, died.

And every living substance was destroyed which was upon the face of the ground, both man, and cattle, and the creeping things, and the fowl of the heaven; and they were destroyed from the earth: and Noah only remained alive, and they that were with him in the ark.

And the waters prevailed upon the earth an hundred and fifty days.

3. See J. FRAZER, *ANCIENT STORIES OF A GREAT FLOOD* (1916).

4. See *Genesis*, *supra* note 2, chs. 6-8.

5. THE EPIC OF GILGAMESH 110 (N. Sanders intro. 1960).

beneath the sea, immersed because of the wickedness of the citizenry, the drunkenness of some dyke keeper, the "sins of the fathers" visited upon descendants, or other reasons of public morality.<sup>6</sup> Occasionally, traditions are more than old wives' tales. Strabo, the Greek geographer, discussed the evidence for sea level rise at a number of sites,<sup>7</sup> while Giraldus Cambrensis noted that in 1171-72:

The wind blew with such unprecedented violence that the shores of South Wales were completely denuded of sand. . . . Tree-trunks became visible, standing in the sea, with their tops lopped off, and with the cuts made by the axes as clear as if they had been felled only yesterday. . . . By this strange convulsion of nature, the element through which ships were wont to move so freely became impassable to them, and the sea-shore took on the appearance of a forest grove, cut down at the time of the Flood, or perhaps a little later, but certainly very long ago, and then by slow degrees engulfed and swallowed up by the waves, which encroach relentlessly upon the land and never cease to wash it away.<sup>8</sup>

Dr. Nicholas Flemming, a geologist and marine archaeologist, surmises that traditions of inundation may be distorted memories of sea level rise due to the melting of ice at the end of the Ice Age. The melting "produced a rising sea level from about 18,000 B.C. to 3,000 B.C., and the rate of rise was often three to six feet per century, which would provide noticeable changes in a man's lifetime."<sup>9</sup> There have been continuing fluctuations in sea level over time which some experts argue are responsible for the rises registered today.<sup>10</sup>

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6. See Basset, *Les Villes Engloutis*, 6 REVUES DES TRADITIONS POPULAIRES (1892); F. J. NORTH, *SUNKEN CITIES: SOME LEGENDS OF THE COAST AND LAKES OF WALES* (1957); N. FLEMMING, *CITIES IN THE SEA* 19-26 (1971); J. RHYS, *CELTIC FOLKLORE, WELSH AND MANX* 408-10, 413-15 (1901); Doan, *The Legend of the Sunken City in Welsh and Breton Tradition*, 92 FOLKLORE 77 (1981).

7. STRABO, *GEOGRAPHY*; see also N. FLEMMING, *supra* note 6, at 18 (characterizing it as an "extremely rational discussion").

8. GERALD OF WALES, *THE DESCRIPTION OF WALES* 157 (Penguin ed. 1978) (c.1191). Nicholas Flemming adds: "George Owen saw the same forest in the first decade of the sixteenth century, and the 1623 manuscript on Llys Helig describes a submerged forest on the Levan sands. People concluded that the relative sea level had changed, and of course they were right . . ." N. FLEMMING, *supra* note 6, at 23. See also F. NORTH, *supra* note 6, at 11-98, 181-83.

9. N. FLEMMING, *supra* note 6, at 23, noting: "while the sea was rising it would often build shingle and sand ridges, and the rivers would raise natural levees, which would prevent flooding . . . Now and then the banks would break, and there would be a large and permanent flood." *Id.* See also F. NORTH, *supra* note 6, at 181-212.

10. See J. BARDACH, *COASTAL ZONE ACTIVITIES AND SEA LEVEL RISE 1* (Environment and Policy Institute, East-West Center, Working Paper No. 11, Aug. 1988):

Other experts, however, view sea level rise as a projected and serious offshoot of global warming, also known as the greenhouse effect.<sup>11</sup> In the worst case scenario, the increasing presence of CO<sub>2</sub> in the atmosphere could result in major changes to the world's oceans.

Many scientists expect the sea level to rise 2 to 6 feet in the next century as CO<sub>2</sub> and other gases blanket the atmosphere, warming oceans and melting polar ice. Netherlanders, after fighting the sea for seven centuries to reclaim two fifths of their land, now must live with predictions that rising waters could flood half of their nation. A 3-foot rise in the sea level would drown 10 percent of Bangladesh and one fifth of Egypt's arable land. Under the worst-case scenario, many small island nations would cease to exist. The United Nations Environmental Program [UNEP] warns that 1 billion people, nearly a fifth of the world's population, could become greenhouse refugees in the 21st century.<sup>12</sup>

Estimates vary as to the extent of the projected rise. Bird and Prescott suggest an increase in the oceans "of one meter within the next 50-100 years. Of the various scenarios of future sea level rise so far proposed, the most likely is a rise of 12-18 centimeters by the year 2030, and 1 meter by the year 2090 . . . ."<sup>13</sup> A longer term and

The level of the sea has, in the past, stood both higher and lower than it stands today. Changes in the height of the water were caused by fluctuations in climate with a warmer atmosphere leading to a larger ocean volume both by natural expansion and by the melting of glaciers, while a cooling of it would cause withdrawal of water into ice and a density dependent shrinking in the volume of the sea . . . .

11. For articles on this general topic, see Moomaw, *Assessing the Greenhouse Challenge*, 14 S. ILL. U. L.J. 169 (1990); Miller, *Policy Responses to Global Warming*, 14 S. ILL. U. L.J. 187 (1990); Fitzgerald, *The Intergovernmental Panel on Climate Change: Taking the First Steps Towards a Global Response*, 14 S. ILL. U. L.J. 231 (1990); Usher, *Climate Change and the Developing World*, 14 S. ILL. U. L.J. 257 (1990); Nanda, *Global Warming and International Environmental Law—A Preliminary Inquiry*, 30 HARV. INT'L L.J. 375 (1989); Yates, *Global Warming: A New Priority*, 123 PUB. UTIL. FORT. 39 (Feb. 2, 1989); Studness, *The Greenhouse Effect and Electric Utilities*, 122 PUB. UTIL. FORT. 37 (Dec. 22, 1988); Radford, *Are We Planning for the Greenhouse Effect*, 121 PUB. UTIL. FORT. 4 (Apr. 14, 1988); Yates, *Global Warming: The Making of Public Policy*, 122 PUB. UTIL. FORT. 29 (Aug. 18, 1988); Einhorn & Charo, *Carbon Dioxide and the Greenhouse Effect: Possibilities for Legislative Action*, 11 COLUM. J. ENV'T'L. L. 495 (1986); Frye, *Climatic Change and Fisheries Management*, 23 NAT. RESOURCES J. 77 (1983); Hoffman, *Contingency Planning for a Better Earth: Will Rising CO<sub>2</sub> Levels Bring Economic Catastrophe or Simply Create New Investment Opportunities?*, 7 DIRECT. & BOARDS 34 (Fall, 1982); Weiss, *A Resource Management Approach to Carbon Dioxide During the Century of Transition*, 10 DEN. J. INT'L L. & POL'Y. 487 (1981).

12. 107 U.S. NEWS & WORLD REPORT 12 (Nov. 20, 1989).

13. Bird & Prescott, *Rising Global Sea Levels and National Maritime Claims*, 1 MAR. POL'Y. REP. 177 (1989). An editors' note to Titus & Barth, *An Overview of the Causes and Effects of Sea Level Rise*, in M. BARTH & J. TITUS, GREENHOUSE EFFECT AND SEA LEVEL RISE: A CHALLENGE FOR THIS GENERATION 1, at 2 (1984), notes that

more cataclysmic rise is projected by Titus and Barth. They state that “[g]laciologists have suggested that the sea could rise five to seven meters (approximately twenty feet) over the next several centuries from the resulting disintegration of the West Antarctic ice sheet.”<sup>14</sup> Using “conservative” and “high” models, Hoffman projects a rise between 56.2 cm. (22 inches) and 345 cm. (11.5 feet) by the year 2100, a fluid fluctuation indeed!<sup>15</sup>

These different figures reflect the difficulty of accurately predicting the effect of climatic change. Hoffman notes:

Future global sea level will depend primarily on three factors: the total quantity of water filling the oceans’ basins; the temperature of the oceans’ layers, which determines the density and volume of their waters; and the bathymetry (shape) of the ocean floor, which determines the water-holding capacity of the basins. A rise in global temperature can, by a variety of physical mechanisms, transfer snow and ice from land to the sea, increasing the quantity of water in the ocean basins, and can raise the oceans’ temperatures, causing the thermal expansion of their volumes. Changes in the bathymetry of the oceans’ floors occur independently of climate change. Because geological changes in the ocean floor could not raise or lower global sea level by more than a centimeter or two by 2100 . . . this factor was not considered in constructing the global scenarios. An evaluation of the impacts of sea level rise at specific coastal sites, however, will require consideration of local uplift or subsidence, which by 2100 could cause changes in land elevation that are large enough to be of significance to local planning . . . .

Projecting sea level rise requires the means to estimate future changes in atmospheric composition, to relate these changes to global warming, and then to determine how the warming can cause land-based snow and ice to enter the sea and the oceans to expand thermally.<sup>16</sup>

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“the NAS released a projection that sea level could rise seventy centimeters by 2080, not including the impact of Antarctica . . . .”

14. M. Barth & J. Titus, *supra* note 13, at 1-2.

15. Hoffman, *Estimates of Future Sea Level Rise*, in M. BARTH & J. TITUS, *supra* note 13, at 79. See also J. BARDACH, *supra* note 10, at 3 (“a range of several putative sea level rises from a moderate 44 to an extreme 258 cm. by 2075 . . .”).

16. Hoffman, *supra* note 15, at 80. Pages 82-100 discuss the relationships set forth by Hoffman and the “alternative assumptions and models used to represent them” in his scenarios.

In order to improve substantially the estimates of future sea level rise and to narrow the range of scenarios, more time and more scientific research will be needed. Merely waiting for observations will, however, be the slowest way to learn more about sea level’s future rise. To maximize the value of future observations, the theoretical base and models used to interpret the relevant data must be improved. Rapid progress can

In considering these phenomena, one should note that there is a lag between an increase in temperature and a rise in ocean level, such that any diminution or reversal of the greenhouse effect will not prevent a certain amount of sea level rise.<sup>17</sup> Similarly, the exact effect of global warming on the ice caps and any melting's consequent influence on sea levels is open to debate.<sup>18</sup> What is *not* open to question is that rises in sea level have already occurred; in the United States over the past one hundred years, "the relative sea level has increased by a foot on average along the Atlantic coast, six inches along the Gulf of Mexico and four inches along the Pacific coast . . . ."<sup>19</sup>

The results of sea level rise would be global, far-reaching, and generally negative; as one report states, "it is difficult to see how there could be any winners at the national level."<sup>20</sup> One summation

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be made by accelerating the research aimed at improving our basic understanding of the processes that underlie climatic change and sea level rise.

Unfortunately, a serious acceleration of research will require additional resources. The present shortage of federal funds has already reduced research in many of the areas of greatest concern. Therefore, three demonstrations need to be made to justify changing this situation and accelerating research.

First, a demonstration of the value to society of speeding the development of better information must be made. . . . Second, the possibility of speeding research to narrow the range of sea level rise and the probable progress under different funding levels must be demonstrated. Finally, it must be demonstrated that the appropriate organizational and management processes can be used to ensure that research is effective and accomplishes what is theoretically possible.

*Id.* at 96, 98. For a specific discussion of research needed, see M. BARTH & J. TITUS, *supra* note 13, at 18-19.

17. J. BARDACH, *supra* note 10, at 3; J. TITUS & M. BARTH, *supra* note 13, at 2 ("Although action may be taken to limit the eventual global warming from rising atmospheric CO<sub>2</sub>, the warming expected in the next sixty years and the resulting rise in sea level are not likely to be prevented.")

18. See Hoffman, *supra* note 15, at 93-96.

19. See *Coastal Communities Must Face Sea Level Rise*, United Press International, Sept. 23, 1987 (NEXIS) (hereinafter *Coastal Communities*). But see Hoffman, *supra* note 15, at 93-96. ("An exception is Alaska and other northern areas where the sea level has been falling because the land is rising as glacial weight is reduced by melting.")

20. COASTAL ZONE MANAGEMENT SUBGROUP, ADAPTIVE OPTIONS AND POLICY IMPLICATIONS OF SEA LEVEL RISE AND OTHER COASTAL IMPACTS OF GLOBAL CLIMATE CHANGE 3 (Nov. 27 - Dec. 1, 1989) (Workshop Report). More specifically, the report notes:

Nature requires coastal wetlands and the dry land found in coral atolls, barrier islands, and river deltas to be just above sea level. If sea level rises slowly . . . these systems can keep pace. . . . If sea level rise accelerates, however, at least some of these environments will be lost. Riverside lands tens of kilometers inland could be as vulnerable as land along the open coast. The loss of productive wetlands, which act as protective buffers from the sea and provide crucial habitats for many animal species important to human society, could be particularly important.

A one-meter rise in sea level could inundate a major part of Bangladesh, for exam-

notes that a rise would:

(1) inundate wetlands and lowlands; (2) erode shorelines; (3) exacerbate coastal flooding; (4) increase the salinity of estuaries and aquifers and otherwise impair water quality; (5) alter tidal ranges in rivers and bays; (6) change the locations where rivers deposit sediment; and (7) change the heights, frequencies, and other characteristics of waves; and (8) decrease the amount of light reaching the sea floor. Local subsidence can exacerbate all of these effects.

These physical changes could pose a threat to ecological balances and to the coastal infrastructure, including roads, ports, industrial facilities, and residential and commercial structures. Populations and land-based activities could be forced to abandon the inundated areas. The productivity of agricultural lands adjacent to the coast could be threatened, and the economic and social culture of small communities dependent upon fishing and related activities could be severely damaged. As the resources and uses of the coastal area are affected, secondary social and economic impacts may be felt both locally and nationally. Delicate ecosystem balances could be upset, threatening fisheries, wildlife, and other resources important to mankind.<sup>21</sup>

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ple; a two-meter rise could inundate Dhaka, its capital, and over one-half of the populated islands of several atoll nations, including the Maldives, Kiribas, and the Marshal Islands. Shanghai and Lagos—the largest cities of China and Nigeria—are less than two meters above sea level, as is 20 percent of the population and farmland of Egypt. In many cases the total shoreline retreat from a one-meter rise would be much greater than suggested by the amount of land below the one-meter contour on a map, because shorelines would also erode.

Sea level rise would also increase the risk of flooding. The higher base for storm surges would be particularly important in areas where hurricanes and typhoons are frequent, such as islands in the Caribbean Sea, the Southeastern United States, and the Indian subcontinent. Had flood defenses not already been erected, London and The Netherlands would also be at risk due to winter storms.

Rising sea level could also degrade water quality. Saltwater would advance inland in both aquifers and estuaries; and wetlands could become saltier even if the salinity of adjunct bays does not increase. Moreover, by deepening shallow bodies of water, sea level rise could cause them to stagnate. Fish ponds . . . would require more flushing to avoid stagnation.

In atolls, coral reefs supply the sand necessary to keep the islands from being eroded and inundated. In the long run, any limitation of coral productivity could increase the risk that these islands will suffer from erosion or inundation.

In addition to sea level rise, global warming could alter the frequency and severity of storms; change ocean currents and the resulting local climates; change the amount of rainfall and hence, the flow of freshwater in rivers; and alter the wave climatology along shores . . . .

*Id.*, at 2-3.

21. *Id.* at 2-3. In addition, an expert conducting a study for the United Nations on the effects of sea level rise states: "South-East Asia, and its large cities like Calcutta, Shanghai, Bangkok, Jakarta, Tokyo and Osaka, is probably the most endangered part of the world. Elsewhere in the world, London, New York, New Orleans, Venice and Rotterdam will also experience the devastating effects of a higher sea." Michelson, *Rising*

While the Coastal Zone Management Subgroup's report alone is enough to set off alarms in the world's capitals, other consequences not yet envisaged may also result from this process. Having sketched the causes and effects of sea level rise, this article now addresses how the problem has been treated to date in public forums.

### III.

#### "TIME AND TIDE"<sup>22</sup>: A HISTORICAL DISCUSSION OF THE PROBLEM OF SEA LEVEL RISE

##### A. 1981

The earliest works on sea level rise do not appear to have had a major impact outside the scientific community.<sup>23</sup> In August, 1981, however, *Science* published an article by seven scientists from the U.S. National Aeronautics and Space Administration's Goddard Space Flight Center.<sup>24</sup> The article was based on computer-generated models of the greenhouse effect and incorporated temperature readings from as far back as 1880. This work, which received wide publicity, noted that "global warming projected for the next century

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*Sea Threatens Major Cities Around the World*, Reuter Ltd, Dec. 7, 1987 (NEXIS, Reuter file). For intensive study of two potentially-affected areas, see Milliman, Broadus, and Gable, *Environmental and Economic Implications of Rising Sea Level and Subsiding Deltas: The Nile and Bengal Examples*, 18 *AMBIO* 340 (1989). Useful economic studies of the problem include J.M. Broadus, *Economizing Human Responses to Subsidence and Rising Relative Sea Level* (unpublished manuscript) (paper presented to Scope Working Group on Rising Sea Level and Subsiding Coastal Areas, Nov. 1988, Bangkok, Thailand); Broadus, *Impacts of Future Sea Level Rise*, in R. DEFRIES & T. MALONE, *GLOBAL CHANGE AND OUR COMMON FUTURE: PAPERS FROM A FORUM* 125 (1989).

22. F. WILSON, *supra* note 1, at 822 ("Time and tide wait for no man").

23. See Bentley, *Response of the West Antarctic Ice Sheet to CO<sub>2</sub> Induced Climatic Warming*, in 2 DEPT. OF ENERGY, ENVIRONMENTAL AND SOCIAL CONSEQUENCES OF A POSSIBLE CO<sub>2</sub>-INDUCED CLIMATE CHANGE 1 (1982); Dubois, *Hypothetical Shore Profiles in Response to Rising Water Level*, in M. SCHWARTZ & J. FISHER EDS., PROCEEDINGS OF THE PER BRUUN SYMPOSIUM 13 (1979) (IGU Commission on the Coastal Environment); Flohn, *Climate Change and an Ice-Free Arctic Ocean*, in W. CLARK ED., *CARBON DIOXIDE REVIEW*: 145 (1982); HUGHES, FASTOOK & DENTON, *Climatic Warming and the Collapse of the West Antarctic Ice Sheet in 1 WORKSHOP ON ENVIRONMENTAL AND SOCIETAL CONSEQUENCES OF A POSSIBLE CO<sub>2</sub>-INDUCED CLIMATE CHANGE 1* (1980); Kopec, *Global Climate Change and the Impact of a Maximum Sea Level on Coastal Settlement*, 70 *J. OF GEOGRAPHY* 541 (1971); Kukla & Gavin, *Summer Ice and Carbon Dioxide*, 214 *SCIENCE* 497 (1981); Mercer, *West Antarctic Ice Sheet and CO<sub>2</sub> Greenhouse Effect: A Threat of Disaster*, 271 *NATURE* 321 (1978); Thomas, Sanderson, & Rose, *Effect of Climatic Warming on the West Antarctic Ice Sheet*, 277 *NATURE* 355 (1979).

24. Hansen, Johnson, Lacis, Lebedeff, Lee, Rind & Russel, 213 *SCIENCE* 957 (1981).

is of almost unprecedented magnitude,"<sup>25</sup> and that the melting of the West Antarctic ice sheet could cause a major increase in the size of the oceans. "A sea level rise of five meters would flood 25 percent of Louisiana and Florida, 10 percent of New Jersey and many other lowlands throughout the world."<sup>26</sup>

#### B. 1982-1983

A January 1982 piece in *Science* by Robert Etkins and Edward Epstein, two National Oceanic and Atmospheric Administration (NOAA) scientists, claimed that the melting of the West Antarctic ice sheet had already begun and could account for the fact that "global sea levels have risen more than one-tenth of an inch on the average each year since 1940—triple the rate measured during the preceding 50 years."<sup>27</sup> Furthermore, in the spring of 1982 the United States Environmental Protection Agency (EPA) "organized a project aimed at developing methods to study the effects of sea level rise and estimate the value of policies that prepare for this rise."<sup>28</sup> This resulted in the completion of an interdisciplinary study in April, 1983,<sup>29</sup> and its subsequent publication in 1984 as *Greenhouse Effect and Sea Level Rise: A Challenge for This Genera-*

25. United Press International, Aug. 22, 1981, AM cycle (Washington News; keyword: warm) (Nexis).

26. *Id.* See also Reuters Ltd., Aug. 22, 1981, (NEXIS, Reuter file).

Potential effects on climate in the 21st century include the creation of drought-prone regions in North America and Central Asia as part of a shifting of climatic zones, erosion of the west Antarctic ice sheet with a consequent worldwide rise in sea level and opening of the fabled Northwest Passage . . . .

Sullivan, *Study Finds Warming Trend That Could Raise Sea Levels*, N.Y. Times, Aug. 22, 1981, at II-1, cols. 1-2; *id.*, Aug. 28, 1981, at I-22, col. 1; Hansen, Johnson, Lacis, Lebedeff, Rind, & Russell, *Climate Impact of Increasing Atmospheric Carbon Dioxide*, 213 SCIENCE 957 (Aug. 28, 1981); Bagley *et al.*, *Is Antarctica Shrinking*, 98 NEWSWEEK 72 (Oct. 5, 1981).

27. Etkins & Epstein, *The Rise of Global Mean Sea Level as an Indication of Climate Change*, 215 SCIENCE 287-89 (1982); See also Rossiter, *Antarctic Ice May Be Melting*, United Press International, Jan. 8, 1982, (NEXIS, wire file); see also Sullivan, *Some Polar Ice Melting Linked to Global Heating*, N. Y. Times, Jan. 8, 1982, at B-5, col. 5 (noting the existence of no direct evidence of a substantial recent decrease in polar ice); Etkins & E. Epstein, *The Rise of Global Mean Sea Level as an Indication of Climate Change*, 215 SCIENCE 287 (Jan. 15, 1982).

28. M. BARTH J. TITUS, *supra* note 13, at 3.

29. According to Titus and Barth, "[t]he project proceeded in the following steps":

Available scientific research we used to project conservative, low, medium, and high scenarios of global sea level rise through 2100.

The scenarios were adjusted for local trends in subsidence to yield local sea level

tion.<sup>30</sup> One major point of the study was supposedly "to get the engineers and planners to take into account an unstable sea level from now on."<sup>31</sup>

In October 1983, another major report was released with sea level rise implications; the EPA's "Can We Delay a Greenhouse Warming?" This report noted that a rise in ocean levels "could flood or cause storm damage to many of the major ports of the world, disrupt transportation networks, alter aquatic ecosystems and cause major shifts in land development patterns."<sup>32</sup> The report strongly recommended that planning begin now to cope with projected global warming developments.<sup>33</sup> Closely following the release of this EPA study, the National Research Council of the National Academy of Sciences distributed another report, "Changing Climate." The National Research Council agreed with some of the EPA's conclusions, including a projected increase in sea levels, and warned that ramifications of the greenhouse effect could prove divisive in world affairs.<sup>34</sup> According to an October 31 news bulletin The Department of Energy responded to these alarming reports:

[t]he Environmental Protection Agency last week published a second

rise scenarios through 2075 for two case study sites—Galveston, Texas, and Charleston, South Carolina.

Economic and environmental scenarios were developed for the two case study sites, assuming no rise in sea level.

The physical effects of sea level rise for the case study areas were estimated.

The economic effects of sea level rise if it were not anticipated were estimated.

Options for preventing, mitigating, and responding to the effects of sea level rise were developed.

The economic effects of sea level rise if it were anticipated were estimated.

The value of anticipating actions and better projection of sea level rise were assessed.

M. BARTH & J. TITUS, *supra* note 13, at 3; *see also* United Press International, Apr. 30, 1983, (noting that "the EPA's Sea Level Rise Project was 'definitely not a doomsday scenario. The underlying assumptions are so conservative they're hardly arguable.'").

30. *See* M. BARTH & J. TITUS, *supra* note 13.

31. United Press International, April 30, 1983, *supra* note 29.

32. S. SEIDEL & D. KEYES, CAN WE DELAY A GREENHOUSE WARMING? (sept. 1983) 1-7 through 1-8; *see also* Sangeorge, *Next Century's Forecast: Wet*, United Press International, Oct. 18, 1983 (NEXIS, Upstat file); *see also* Houck, *Rising Water: The National Flood Insurance Program and Louisiana*, 60 TUL. L. REV. 61, 126 n. 380 (1985); *U.S. Report Predicts that Earth Will Warm Up Second*, Reuters Ltd., Oct. 21, 1983 (NEXIS, Reuter file) (stating the report predicts the effect "could ultimately turn northern areas such as New York City into a semi-tropical area," but tactfully avoiding the word "jungle.").

33. SEIDEL & KEYES, *supra* note 32, at 1-9 through 1-14.

34. Reuters, Ltd., Oct. 20, 1983, (NEXIS, Reuter file); *see also* N.Y. Times, Oct. 21, 1983, at B-5, col. 1 (noting the likely unequal distribution of benefits and damages resulting from climate change).

report on the "greenhouse effect"—this one focusing on projected sea-level rise—while DOE [Department of Energy] was preparing to issue its own paper on the subject [of the greenhouse effect] as an indirect response to the EPA greenhouse report released earlier this month. Disturbed by what they saw as an unnecessarily alarming tone and some questionable content in EPA's first report ("Can We Delay a Greenhouse Warming?"), DOE experts have been mulling what to put out to counterbalance the EPA document without seeming to undercut a sister agency.

. . . .

. . . An observer outside the department characterized the DOE fretting over EPA's paper as evidence of a "turf battle." But DOE officials, while expressing some mystification that EPA is releasing its reports independently of the interagency policy board coordinating federal greenhouse-research efforts, have emphasized that a battle is just what they seek to avoid.<sup>35</sup>

Others also disagreed with the more extreme predictions of the reports. Mark F. Meier of the U.S. Geological Survey, for example, took issue with the prediction of ocean rises of ten to twenty feet over a century, arguing that "the process would take at least 500 to 1,000 years and this would give people and governments ample time to adjust."<sup>36</sup>

Apart from scientific research on sea level rise, little seems to have been done in a public policy context in 1984. In 1985, the problem of rising ocean levels was raised internationally by Dr. Irving Mintzer, a representative of the World Resources Institute at the third meeting of the World Commission on Environment and Development in Oslo.<sup>37</sup> In June of the same year at the Skidaway Institute of Oceanography in Savannah, Ga., coastal geologists prepared a position paper for a new national strategy for beach preservation calling for a strategic retreat from the coastline.<sup>38</sup> In May, 1986 the United States EPA issued another report on the problem: "Greenhouse Effect, Sea level Rise and Salinity in the Delaware Estuary."<sup>39</sup> The Senate Subcommittee on Environmental Pollution

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35. Manning, *DOE Ponders, Polishes Its "Greenhouse" Paper as EPA Issues a Second One*, INSIDE ENERGY WITH FEDERAL LANDS, Oct. 31, 1983, 1-3 (NEXIS, Inergy file).

36. United Press International, Dec. 27, 1983 (NEXIS, UPI file).

37. *Acid Rain, Greenhouse Effects Discussed at Meeting of World Commission on Environment and Development*, Xinhua General Overseas News Service, June 25, 1985 (NEXIS, Xinhua file).

38. Sargent, *A Sea of Troubles*, Christian Science Monitor, Feb. 20, 1987, at 23, Col. 1.

39. Raeburn, *Rising Worldwide Sea Levels Ravaging Coastlines*, Associated Press, May 27, 1986 (NEXIS, Wires file); see also *Salt to Head Up Delaware. Threaten Water*

heard testimony on the matter<sup>40</sup> and its chairman, Senator Chafee, proposed a six point plan

that included both studies and an immediate international effort involving the United Nations, the Soviet Union, and the People's Republic of China.

First . . . the Environmental Protection Agency should begin immediately to identify policy options to stabilize levels of atmospheric gases, and the National Academy of Sciences should review gaps in existing knowledge and recommend efforts to close those gaps. Meanwhile, the Department of State should try to bring these issues to the attention of other nations, particularly the Soviet Union and China

. . . .

The United Nations Environment Program and the World Meteorological Organization should expand their efforts to assess global climate change, while EPA conducts its own studies on these effects. . . . Finally . . . the President's Council on Environmental Quality . . . [would] direct all federal agencies to recognize ozone depletion and the greenhouse effect and account for those problems when making environmental policy decisions.<sup>41</sup>

Other than this "roadmap" and a report on sea level rise by the Atmospheric Resources Division of the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Melbourne,<sup>42</sup> no further major policy actions were undertaken during 1986.<sup>43</sup>

#### D. 1987

In 1987, U.S. congressional committee testimony on sea level rise and the greenhouse effect continued<sup>44</sup> and more organizations ad-

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*Supplies*, United Press International, June 16, 1986 (NEXIS, Upstat file). At roughly the same time, another EPA study, "Potential Impacts of Sea Level Rise on Wetlands Around Charleston, S.C." appeared. See *Policy Shifts Urged to Avert Problems from Ozone Depletion, Carbon Dioxide Emissions*, Bureau of National Affairs, Inc., June 12, 1986 (NEXIS, Drexec file) (hereinafter *Policy Shifts Urged*); see also *Study Says Sea Rise Could Inundate Coastal Marshes*, United Press International, June 15, 1986 (NEXIS, Upstat file).

40. See Goeller, *Congress Told to Go Slow on Air Pollution Fight*, Associated Press, June 11, 1986 (NEXIS, Wires file).

41. *Policy Shifts Urged*, *supra* note 39.

42. *Australian Climatologists Predict Rise of World Temperature*, Xinhua General Overseas News Service, June 30, 1986 (NEXIS, Xinhua file).

43. Ironically, the lack of concerted activity on sea level rise during the mid-1980s may have been due in part to concentration on the climatic problem of ozone depletion. See Kindt & Menefee, *The Vexing Problem of Ozone Depletion in International Environmental Law and Policy*, 24 TEX INT'L L. J. 261, 275-83 (1989).

44. Lammi, *Scientists Call for More Atmospheric Research*, United Press International, Jan. 29, 1987 (NEXIS, Wires file); see also *Scientists Warn World Temperatures to Rise*, Reuters, Nov. 9, 1987 (NEXIS, Reuter file).

ded their voices to the chorus of concern over the problem. The Worldwatch Institute's "State of the World 1987" report contained references to potential melting of icecaps and coastal flooding.<sup>45</sup> The World Resources Institute also released a report calling for strong government actions to prevent negative consequences of the greenhouse effect such as a rise in sea level and intrusion of salt water into drinking supplies.<sup>46</sup> CSIRO again warned of the possibility of a rise in ocean levels.<sup>47</sup> A committee of the U.S. National Research Council issued a report, "Responding to Changes in Sea Level: Engineering Implications," considering three possible sea level rise scenarios.<sup>48</sup>

The report said as the seas move inland, coastal communities will have to decide whether to protect the shoreline with levees and sea-walls, to build it up with sand or to let nature take its course.

Community managers and engineers should consider sea level trends in planning for future development, particularly for facilities expected to last 50 years or longer . . . .

"The effects of sea level rise can be accommodated during maintenance periods or upon redesign and replacement of most existing structures and facilities . . . ." (quoting the report)<sup>49</sup>

Tom McMillan, the Canadian Environment Minister conceded the possibility of sea level rise and massive flooding due to increased carbon dioxide levels.<sup>50</sup> Perhaps most encouraging, however, was action by the United Nations to obtain information on the effects of sea level rise as a prelude to "a world charter on climate to prevent further rises of temperature and sea levels."<sup>51</sup> The deputy director

45. *Earth's Future Habitability Threatened, Says Worldwatch*, Xinhua General Overseas News Service, Feb. 14, 1987 (NEXIS, Xinhua file).

46. Hooper, *Report: Earth Is Heating Up*, United Press International, Apr. 11, 1987 (NEXIS, Wires file); see also Darst, *Fuel Conservation Can Slow Greenhouse Effect, Group Says*, Associated Press, Apr. 11, 1987 (NEXIS, Wires file); L.A. Times, Apr. 12, 1987, at I-4, col. 3; Aepfel, *Greenhouse Effect: Group Uses Computer Models to Forecast Global Climate*, Christian Science Monitor, Apr. 13, 1987, at 5, Col. 1; *Fuel Conservation Can Slow Greenhouse Effect, Group Says*, Associated Press, April 13, 1987 (NEXIS, Wires file).

47. *Australian Scientists Warn Against Greenhouse Effect*, Xinhua General Overseas News Service, Sept. 22, 1987 (NEXIS, Xinhua file); see also *supra* note 42.

48. *U.S. National Research Council Indicated Danger of Rising Seas*, Xinhua General Overseas News Service, Sept. 22, 1987 (NEXIS, Int'l file) (giving the scenarios as a rise of 20 inches, a rise of 40 inches, or a rise of almost five feet, "with the increases starting slowly and increasing more rapidly in later decades"); *Coastal Communities*, *supra* note 19; Morrissey, *States News Service*, Sept. 25, 1987 (NEXIS, Wires file).

49. *Coastal Communities*, *supra* note 19.

50. *Carbon Dioxide Affects Canada*, Xinhua General Overseas News Service, Oct. 7, 1987 (NEXIS, Int'l file).

51. Michelson, *supra* note 21.

of the Delft Hydraulics Laboratory, commissioned by the United Nations to prepare a study on sea level rise, noted:

"These changes take place gradually and I fear governments will act to prevent catastrophes only after the first disasters have taken place" . . . .

. . . .

In many countries, the responsibilities for coastal protection are dispersed among a patchwork of local authorities and it is doubtful they could come up with a feasible overall solution . . . .

"I'm glad the United Nations has started the studies and discussions because only a supra-national organisation like the U.N. can fully cope with the world-wide scope of this problem."<sup>52</sup>

#### E. 1988

In 1988, the United Nations took further action on sea level rise. The United Nations Environmental Program (UNEP) cooperated in a study by the Delft Hydraulics Laboratory and Thai public works engineers to discover the effects of rising sea level and "help [T]hailand control floods and consequent subsidence in [B]angkok."<sup>53</sup> In June, UNEP and The World Meteorological Association issued a joint report entitled, "Developing Policies for Responding to Climatic Change." The report summarized "the discussions and recommendations of a two-stage workshop in Villach, Austria, and in Bellagio, Italy, [that took place] in late 1987."<sup>54</sup> Gordon Goodman, one of the report's co-authors noted that,

"[e]ven with moderate sea level rises, storms and tidal waves could have devastating effects," . . . adding that 50 million people in Bangladesh and 10 million in the Nile delta were at immediate risk.

. . . .

"Half the world's population lives by the coast. It would mean investments of billions of dollars in coastal defenses and enormous changes in lifestyle," . . . .

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52. Michelson, *supra* note 21 (quoting and paraphrasing Pier Vellinga, the Deputy Director of the Delft Hydraulics Laboratory).

53. *Netherlands to Help Solve Flood Problem in Thai Capital*, Xinhua General Overseas News Service, May 19, 1988 (NEXIS, Xinhua file).

54. See Foyen, *Greenhouse Effect Poses Major Global Threat, U.N. Report Says*, Reuters, June 6, 1988 (NEXIS, Reuter file); *Environment, Higher Temperatures, Rising Seas Seen Unless Greenhouse Gas Emissions Lowered*, 19 ENV'T REP. 206 (B.N.A.), June 10, 1988 [hereinafter *Higher Temperatures*] (The workshop was co-sponsored by the Beijer Institute in Stockholm, the Environmental Defense Fund in New York, and the Woods Hole Research Center in Massachusetts).

He noted that the Maldivé Islands in the Indian Ocean, which had no area higher than eight feet (2.5 meters) above sea level, had voiced its concern at the United Nations.<sup>55</sup>

The report stated that long-term action would be required to identify areas that sea level rise might affect, and to plan "for installations near the sea to allow for the risks of sea-level rise."<sup>56</sup> The most important of the priorities enunciated in the report should be:

Examination by organizations, including the intergovernmental mechanism to be constituted by the World Meteorological Organization and United Nations Environmental Program in 1988, of the need for an agreement on a law of the atmosphere as a global commons or the need to move towards a convention along the lines of that developed for protection of the ozone layer.<sup>57</sup>

This call for an international convention on atmospheric protection was taken up by the prime ministers of Norway and Canada at the World Conference on the Changing Atmosphere, in Toronto in late June of 1988.<sup>58</sup> Scientists at the fortieth annual meeting of the Brazilian Society for the Progress of Science, noted that rising sea levels could seriously threaten coastal cities such as Rio de Janeiro and San Francisco,<sup>59</sup> and a new EPA report predicted that the United States could lose thirty to eighty percent of its wetlands to sea level rise.<sup>60</sup> A paper presented at the twenty-sixth Congress of the International Geographic Union in Sydney claimed that

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55. Foyen, *supra* note 54.

56. *Higher Temperatures*, *supra* note 54.

57. *Id.*

58. Bradley, *Norwegian Leader Proposes Plan of Action on Climate*, Associated Press, June 27, 1988 (NEXIS, Wires file); *Canada, Norway Call for International Agreement to Protect Atmosphere from Pollution*, Xinhua General Overseas News Service, June 28, 1988 (NEXIS, Xinhua file); Shabecoff, *Norway and Canada Call for Pact to Protect Atmosphere*, N. Y. Times, June 28, 1988, at C-4, col. 2; *Greenhouse Effect, Turning the Heat Off*, Christian Science Monitor, June 30, 1988, at 1. *But see* the comment of one U.S. scientist, who "said it was premature to start work on such an international covenant, since researchers have much more to learn." J. Bradley, *supra*.

59. Serrano, *Environment: Coastal Cities Threatened by Rising Sea Levels*, Inter Press Service, July 15, 1988 (NEXIS, Wires file).

60. United Press International, Aug. 16, 1988 (NEXIS, News file) (discussing the report, released in August, 1988 entitled "Greenhouse Effect, Sea Level Rise and Coastal Wetlands"); *see also U.S. Wetland Threatened by Water-level Increase*, Xinhua General Overseas News Service, Aug. 17, 1988 (NEXIS, Int'l file); *The Nation*, L. A. Times, Aug. 17, 1988, S1, at 2, col. 3; D. Goeller, *Agency Says Gas Emissions Threaten Coastal Wetlands*, Associated Press, Aug. 17, 1988 (NEXIS, Wires file); *Rise in Sea Level from Greenhouse Effect May Mean Major Wetland Losses. EPA Says*, 19 ENV'T REP. 692 (BNA), Aug. 19, 1988 (LEXIS, B.N.A. library, Envrep file) [hereinafter *Rise in Sea Level*]. The report made the point that

[a]lthough new wetlands could form where areas are flooded, this cannot happen where the land adjacent to today's wetlands is developed and protected from the rising

“[r]ising sea levels caused by the world’s warming will have ‘catastrophic’ effects on many small Pacific islands and some may vanish underwater . . . .”<sup>61</sup> The Japanese National Institute for Environmental Studies announced that it would study the greenhouse effect, in part because of the potential problem of sea level rise.<sup>62</sup> In October 1988, the new Global Change Programme (IGBP), under the auspices of the International Council of Scientific Unions (ICSU) held a meeting. Professor Thomas Rosswall, director of the IGBP stated the purpose of the meeting was to allow “scientists around the world and United Nations agencies . . . [to] contribute with scientific data from satellites, observatories, laboratories, and field studies” in a global research effort on climate change and, among other problems, on sea level rise.<sup>63</sup>

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sea . . . . [T]oday’s coastal development could limit the ability of coastal wetlands to survive sea level rise in the next century, . . .

[The report said the] wetlands of Louisiana appear to be the most vulnerable to a rise in sea level. . . .

The coastal wetlands of the Mississippi River delta are already converting to open water at a rate of 50 square miles per year because of . . . human activities, such as construction of levees and navigation channels, and current relative sea level trends caused by land subsidence.

*See also* Lobsenz, *Report: South Faces Biggest Threat from Global Warming*, United Press International, Oct. 20, 1988, (NEXIS, News file) (noting that a later EPA report the same year, “The Potential Effects of Global Climate Change in the United States,” predicted a necessary expenditure of \$73-111 billion for dykes and other structures to protect coastal areas, and said that even so some 7000 square miles of land—an area approximately the size of Massachusetts—would be lost to the sea.)

61. *Rising Seas Threaten Pacific Islands*, Associated Press, Aug. 22, 1988 (NEXIS, AP file). This notes that sea level rise of about a meter within the century may swamp many low-lying coral atolls such as Kiribati—formally the Gilbert Islands—and Tuvalu. The two nations have a combined population of about 68,000.

Also at risk are the Maldives in the Indian Ocean as well as the Marshall Islands and Tokelau in the Pacific . . . .

. . . .  
Not only would there be very little higher ground for the population to retreat to but fresh water on these islands was likely to dry up, destroying the ecology . . . .

The scientists suggested immediate attention be given to engineering work to keep the sea at bay.

“Increased migration, to high islands and overseas, is the single most probable outcome of rising sea levels,” the congress was told. “Some of the most recently populated islands are likely to be depopulated, and even abandoned, as a new class of ‘environmental refugee’ is superimposed on that of ‘economic refugee.’”

*Id.* (quoting Brian Walker, Chief Ecologist of the Australian Government’s Commonwealth Science and Industrial Research Organization); *see also* L. A. Times, Aug. 23, 1988, at I-6, col. 6.

62. *Environment Institute to Initiate Study of Greenhouse Effect*, Kyodo News Service, Sept. 5, 1988 (NEXIS, Wires file).

63. *International Research Project on World Climate Unveiled*, Reuters, Oct. 24, 1988 (NEXIS, Reuter file).

On October 24, 1988, in a speech reminiscent of Pardoe's claim that the resources of the deep seabed were the "common heritage of mankind," Vincent Tabone, Malta's Foreign Minister, introduced a new U.N. General Assembly agenda item: "Conservation of Climate as Part of the Common Heritage of Mankind," proposing a panel to study social and economic results of global warming.<sup>64</sup>

The new body, which could be called "the Inter-Governmental Panel on Climate Change," would review the state of the science of climate and recommend corrective appropriate action . . . .

. . . .

The statements made today as well as at other international forums recently indicate that there is universal recognition that there must be a global strategy to conserve climate and to reverse the warming trend.

However, it was not immediately clear whether Malta's proposal would be accepted.

There was some concern, for instance, about the cost of creating yet another U.N. agency.

Some governments believe that coordination can be achieved through existing agencies like the U.N. Environmental Program (UNEP) and the World Meteorological Organization (WMO) once the General Assembly gives a clear political directive.

. . . .

Some governments had alternative suggestions for dealing with the problem, although they were not presented as formal proposals as Malta's [sic].

Norway suggested an international convention, and Bangladesh—the scene of recent flood disasters—suggested an international summit.<sup>65</sup>

The Maltese proposal resulted in the establishment of the Intergovernmental Panel on Climate Change (IPCC), under the sponsorship of UNEP and WMO. The IPCC's goal was to develop "an internationally-accepted strategy for addressing climate change."<sup>66</sup> Its first session, attended by over 100 experts from more than thirty-five countries, occurred in Geneva in November 1988.<sup>67</sup>

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64. *U.N. Urged to Create New Body on Climatic Change*, Inter Press Service, Oct. 24, 1988 (NEXIS, Wires file) [hereinafter *U.N. Urged*].

65. *Id.* This also notes that "the concept of climate as the 'common heritage of mankind' may find disfavor with countries like the United States, which objected to a similar definition of the mineral wealth on the ocean floor." *Id.*

66. COASTAL ZONE MANAGEMENT SUBGROUP, *supra* note 20, at B-1 (Appendix B: Background Information: Intergovernmental Panel on Climate Change).

67. *Experts Will Study How to Cope With a Warmer World*, Reuters, Nov. 11, 1988 (NEXIS, Wires file) [hereinafter *Experts Will Study*].

[T]he Panel agreed that the focus of its efforts should be to (I) assess the available scientific and technical information on climate change; (II) assess the resulting socio-economic and environmental impacts; and (III) formulate realistic response strategies. To carry out these tasks, three working groups were established on science, impacts, and response strategies, chaired respectively by the United Kingdom, Soviet Union and United States.<sup>68</sup>

The three IPCC working groups worked separately in the following years. For example, in January 1989, the Response Strategies Working Group (RSWG or Working Group III) met in Washington, D.C., where it established a steering committee and four subgroups (including energy and industry, coastal zone management, and resource use management). The Coastal Zone Management Subgroup (CZMS), closely concerned with the problem of sea level rise, organized workshops in Miami in November 1989 (dealing with the Americas, Europe, the Mediterranean, and Western Africa) and in Perth in February 1990 (dealing with the rest of the world).<sup>69</sup> The goal of the CZMS is

to provide information and recommendations to national and international policy centers, enabling decision-making on (1) coastal zone management strategies for the next 10-20 years; and (2) long-term policies dealing with adaptation to the impacts of global climate change, including sea level rise.<sup>70</sup>

#### F. 1989 - 1990

Other international responses to the problem continued during 1989. In inaugurating a conference on the greenhouse effect, H. M. Ershad, the President of Bangladesh, noted that his country "may be the worst victim of the greenhouse effect by way of increased flooding as well as sea-level rise."<sup>71</sup> A report by Britain's National

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68. *Coastal Zone Management Subgroup*, *supra* note 20, at B-1. "The groups set up by the Geneva meeting . . . begin work in January . . . Their members range from 11 to 17 countries, drawn from all continents, and include the United States and the Soviet Union . . . [F]irst reports were expected in spring." *Experts Will Study*, *supra* note 67. See also remarks of William Reilly, Administrator, Environmental Protection Agency, Hearing on Ozone Depletion and Global Warming before the Environmental Protection Subcommittee of the Senate Environment and Public Works Committee, Federal Information Systems Corporation, Mar. 17, 1989 (NEXIS, Currnt file) ("Let me point out that the United States is chairing a working group on response strategies under the IPCC, and I believe that this is a good forum for moving forward internationally on this issue.").

69. See *Coastal Zone Management Subgroup*, *supra* note 20, at B-1, 1.

70. *Id.*, at B-1.

71. *International Seminar on Greenhouse Effect Begins in Dhaka, Bangladesh*, Xinhua General Overseas News Service, Mar. 5, 1989 (NEXIS, Wires file).

Environment Research Council stated that "London and areas of eastern and southern England are particularly vulnerable to sea level rises resulting from global warming."<sup>72</sup> In April 1989, the Indian Environment and Forest Ministry "initiated a national coordinated research project to study the possible effects of the sea rise . . . on India's coastline . . ."<sup>73</sup> In addition, the (appropriately-named) Ark Report claimed that "London and other British cities could disappear beneath the sea within 50 years unless action is taken to combat global warming."<sup>74</sup> In May, the United States government signaled its approval for developing "full international consensus on necessary steps to prepare for a formal treaty-negotiating process [on global warming]."<sup>75</sup>

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72. *Use of Coal May Have to Be Cut*, The Daily Telegraph, Mar. 7, 1989, at 11. For a 1988 report, "The Heat Trap — Threats Posed by Rising Levels of Greenhouse Gases," commissioned by Friends of the Earth, which deals with other ramifications of sea level rise for the UK, see Clover, *Scientists Seek Big Cuts in Use of Energy*, The Daily Telegraph, Dec. 6, 1988, at 9.

73. *Project of Studying Sea Rise Effects Initiated in India*, Xinhua General Overseas News Service, Apr. 3, 1989 (NEXIS, Xinhua file).

74. M. Rees, *London Could Be Swamped, Report Warns*, United Press International, Apr. 11, 1989 (NEXIS, UPI file); see also Elgood, *World Faces Catastrophe from Rising Seas, Group Claims*, Reuters, Apr. 11, 1989 (NEXIS, Reuter file) (After referring to a map produced by Ark the report stated, "Cambridge would become a seaside town as vast tracts of eastern England slipped beneath the waves."); Berry, *Parliament "At Risk from Flood in 2050,"* The Daily Telegraph, Apr. 12, 1989, at 7 ("Parliament may have to move to Birmingham because vast areas of Central London will have disappeared beneath the water . . ."). Another, however, argued that this breakaway group from Greenpeace failed to take necessary data into account. See *id.*

75. *U.S. Now Favors Talks on Global Warming*, Chi. Tribune, May 12, 1989, at 5; Hunt, *White House Changes Course, Supports Efforts on Global Warming Treaty*, Associated Press, May 12, 1989 (NEXIS, Wires file).

"To further this process, please make every effort to obtain agreement on a global warming workshop this fall, hosted by the United States," [White House chief of staff] Sununu said.

. . . [S]uch a meeting "should be designed to identify the scientific, legal, technical and economic issues critical to further progress on beginning negotiations on an international convention on global climate change."

While seeking consensus on steps for a treaty negotiating process, Sununu cautioned that "because the size of the problem is so large, improper or ill-advised actions could have enormous unintended environmental, economic and social consequences."

Moreover, he said the interests of developing nations must be taken into account.

. . . [T]he proposed workshop "should be structured to help identify the elements that should be included in a framework convention on global climate, as well as identifying key domestic and economic policies of all countries that must be included in any comprehensive process."

*Id.* According to Begley & Hager, *Feeling the Heat on the Greenhouse*, NEWSWEEK, May 22, 1989, at 79, Sununu's statement, "came on the heels of British Prime Minister Margaret Thatcher's call for such a convention. The Geneva participants agreed to the workshop immediately."

Although there was occasional dissent,<sup>76</sup> meetings and reports continued to express concern regarding the costs of sea level rise. A seminar entitled "Global Warming: Global Warning" which convened in Sri Lanka "held that the entire southwest coastal belt of the island may be engulfed by the sea, and a vast number of people in densely populated coastal towns may have to abandon their homes and be relocated inland."<sup>77</sup> In a preliminary report, Japan's Environment Agency predicted that rising seas could permanently flood one third of metropolitan Tokyo as well as other coastal cities.<sup>78</sup> At an environmental conference in Nairobi in June, UNEP's Executive Director, Mostafa Tolba, pointed out the danger of rising sea levels to the Nile Delta: one fifth of Egypt's arable land could be inundated and millions of refugees created. Tolba also predicted, however, that an international treaty on global warming could be concluded within three years.<sup>79</sup> In July, a meeting of the South Pacific Forum endorsed an Australian greenhouse initiative to establish a "[P]acific-wide network of climate monitoring stations set up to measure the sea level rises."<sup>80</sup> At a meeting sponsored by UNEP, the South Pacific Commission, and the Association of South Pacific Environmental Institutes, the President of the Marshall Islands, Amata Kabua, warned that his country could disappear due to sea level rise.<sup>81</sup> Meanwhile, the British Minister of Agriculture, Fisheries, and Food told a conference on the greenhouse effect that "the safety margin of coastal flood defenses is

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76. See Stanley, *States News Service*, June 1989 (NEXIS, Wires file) citing a report of the George C. Marshall Institute that government action anticipating a global warming "may be unnecessary or even harmful."

77. *Rising Sea Levels May Engulf Sri Lankan Coasts*, Xinhua General Overseas News Service, June 8, 1989 (NEXIS, Xinhua file) This seminar was organized by the Central Environmental Authority, the National Academy of Sciences, and the Sri Lanka Association for the Advancement of Sciences. *Id.*

78. *Global Warming Could Parch, Flood Asia*, Kyodo News Service, June 26, 1989 (NEXIS, Wires file).

79. *U.N. Sees Treaty on Global Warming by 1992*, Reuters, June 28, 1989 (NEXIS, Reuter file).

80. *South Pacific Forum Signs Declaration to Halt Driftnetting*, Xinhua General Overseas News Service, July 11, 1989 (NEXIS, Xinhua file). See also, *South Pacific Forum Discusses Massive Resettlement*, Xinhua General Overseas News Service, July 11, 1989 (NEXIS, Xinhua file) (dealing with the question of refugees caused by sea level rise).

81. See *Pacific Nation Fears Ocean Will Turn Against It*, Reuters, July 18, 1989 (NEXIS, Reuter file) (Kabua further stated, "It is truly frightening to think that our ocean will turn against us. . . . We hope that we don't have to say goodbye just yet."); Johnson, *Pacific Islands Fear They Could Be Submerged by Rising Tides*, Reuters, June 27, 1989 (NEXIS, Reuter file); see also Dumanoski, *UN Group to Weigh Effect of Warming on Islands*, Boston Globe, July 22, 1989, at 3.

likely to be exceeded in the next decades as sea levels rise, putting agricultural land as well as lives and property at risk."<sup>82</sup> The Japanese Transport Ministry predicted that 3.8 trillion yen would be needed to protect Japan's harbors from ocean increases.<sup>83</sup> In September 1989, Japan sponsored an environmental conference that covered some of the problems of sea level rise.<sup>84</sup> The World Wide Fund for Nature reported from Britain that many coastal plants and birds would be deprived of their habitats by a rise in sea levels, because most of the Sites of Special Scientific Interest where they are found are not amenable to relocation.<sup>85</sup> The "Commonwealth Summit" was held in Malaysia in October 1989 where a report "on the interconnected issues of climate change and global warming, sea-level rise and flooding" was discussed.<sup>86</sup>

One of the most serious initiatives of late 1989 was a November conference at Noordwijk, co-hosted by the Dutch and the United Nations, that resulted in a compromise agreement that CO<sub>2</sub> emissions should be frozen at current levels after the year 2000.<sup>87</sup> The conference and its compromise agreement was:

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82. *Rising Seas Threaten British Flood Defenses*, Xinhua General Overseas News Service, July 15, 1989 (NEXIS, Xinhua file); see also Connor, *Global Warming Flood Will Swamp Coastal Defenses*, Daily Telegraph, July 15, 1989, at 2.

83. *Nine Million Japanese to Be Affected by Global Warming*, Kyodo News Service, Aug. 28, 1989 (NEXIS, Wires file).

84. Thurber, *Experts Say Global Warming Could Devastate Low-Lying Countries*, Associated Press, Sept. 12, 1989 (NEXIS, Wires file) ("Thousands of Pacific islands could disappear as a result of melting polar icecaps . . ."; "The houses and lives of millions of people living in the deltas of the Ganges, the Nile, the Mekong, the Yangtze and the Mississippi could be at risk . . .").

85. See Clover, *Greenhouse Effect "Threat to Wildlife on Coasts"*, Daily Telegraph, Sept. 13, 1989, at 7 ("Without humans, sea level rise would present no problems for wild fauna and flora. People have fossilised [sic] the coastline so that it can no longer respond to the changes in sea level . . ."); Brown, Press Association Ltd., Sept. 13, 1989 (NEXIS, AP file); see also Unwin, *Greenhouse Threat to Wildlife*, The Press Association Ltd., Dec. 27, 1989 (NEXIS, Wires file).

86. See Gregson, *Global Temperature and Sea Level to Rise Sharply, Report Says*, Reuters, Sept. 29, 1989 (NEXIS, Reuter file) (quoting the report as saying "Sea level rise could have far reaching social and economic effects on low-lying coastal areas as in Guyana, Bangladesh, the Maldives, Kiribati, Tuvalu and other Commonwealth countries . . ."); *Environment May Get Priority at Commonwealth Summit*, Xinhua General Overseas News Service, Oct. 6, 1989 (NEXIS, Xinhua file); Plummer, *Sanctions Cloud Over Summit*, Sunday Telegraph, Oct. 15, 1989, at 15 (noting that the report "Climate Change, Sea-level Rise and Flooding," was drawn up at the request of the President of the Maldives and the President of Bangladesh, both potentially-affected nations).

87. Raun, *States to Back Global Warming Convention*, Financial Times, Nov. 7, 1989, § I at 2. But see de Ligny, *Developing Nations Struggling to Cope with Global Warming*, Associated Press, Nov. 10, 1989 (NEXIS, Wires file) (noting that the resolution called for stabilization of CO<sub>2</sub> emission "as soon as possible," but that the United States and Japan refused to commit to 2000 as a date); *Is It Time to Build Another Ark?*,

seen as an important step in preparing for a worldwide convention on climate control [as early as 1992]. At the conference, some objections by participating nations were played down.

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The convention process should take place within the framework of the Intergovernmental Panel on Climate Change (IPCC), a group established by UN members last year for that purpose, according to Britain and the U.S.<sup>88</sup>

Pressure continued to build for an international solution. Later in November 1989, a three day ministerial conference on sea level rise was held in the Maldives, "attended by delegates from over 25 low-lying states and observers from a number of industrialized nations."<sup>89</sup> At the conference, there were calls for the stabilization and subsequent reduction of CO<sub>2</sub> emissions as well as an international convention to control the problem. Maldorian President Maumoon Abdul Gayoom stated, "[N]either the [M]aldives nor any small island nation wants to drown. . . . [A]ll we ask for is that the more affluent nations, and the international community in general, help us in this fight."<sup>90</sup>

Near the end of 1989, scientific research produced new and surprising results. An article published in *Nature* stated that, based on a new computer simulation, Antarctica's ice sheets would probably not melt, and thus would not add their waters to a rising sea level.<sup>91</sup> Other studies similarly concluded that sea level rise would occur, but not necessarily to the catastrophic extent of previous predictions.<sup>92</sup>

Despite this scientific development, the end of 1989 and beginning of 1990 showed new signs of international cooperation over the

107 U.S. NEWS & WORLD REPORT, at 12 (Nov. 20, 1989) (suggesting that the USSR also opposed a timetable).

88. Raun, *supra* note 87.

89. *International Conference on Sea Level Rise Held in Maldives*, Xinhua General Overseas News Service, Nov. 18, 1989 (NEXIS, Xinhua file).

90. *Id.*

91. See Booth, *Computer Predictions of Greenhouse Effect Have a Northern Accent*, Wash. Post, Dec. 7, 1989, § A at 13; Highfield, *Greenhouse Danger to Ice Is Remote*, Daily Telegraph, Dec. 7, 1989, at 5.

92. See Siegel, *Ocean Rise Will Be Less Severe Than Thought*, Associated Press, Dec. 7, 1989 (NEXIS, Wires file); Dye & Dolan, "Greenhouse" Threat to Sea Level Scaled Back, L.A. Times, Dec. 8, 1989, § A at 3, col. 5; Siegel, *Don't Pack Up Your Beach Chairs Yet - Sea Level Rise Will Be Modest*, Associated Press, Dec. 8, 1989 (NEXIS, Wires file); Booth, *Sea Level Due to Warming Was Exaggerated, Scientists Say*, United Press International, Dec. 22, 1989 (NEXIS, UPI file); *Scientists Attending 59th Anzeas Congress on Sea Levels*, Xinhua General Overseas News Service, Feb. 14, 1990 (NEXIS, Xinhua file).

question of sea level rise. In addition to the CZMS meetings of November 1989, and February 1990, mentioned above,<sup>93</sup> there was a December 1989, assemblage in Venice under United Nations auspices of some thirty "cities on water" to discuss sea level problems.<sup>94</sup> In support of the November Maldives meeting of small nations threatened by rising waters, an "action group" was formed in January to draw global attention to sea level problems.<sup>95</sup> The group included representatives from Mauritius, the Maldives, Malta, and Trinidad.

The IPCC held a third plenary meeting in Washington, D.C. to assess the progress of its Working Groups.<sup>96</sup> There were "[s]harp differences," however, between the United States and U.S.S.R. on one side, and Sweden, West Germany, and Austria on the other, "who pressurised [sic] the world's largest polluters to agree [to] immediate reductions in greenhouse gases."<sup>97</sup> The final CZMS report was to be submitted to the Response Strategies Working Group in May<sup>98</sup> and a June meeting of the Energy and Industrial Group was scheduled for London.<sup>99</sup> The science group of the IPCC "reached a consensus that confirms the threat of global warming but sa[id] sea level rises may not be as high as originally feared."<sup>100</sup>

The IPCC is scheduled to complete a report, incorporating the work of all three working groups, by September 1990, prior to the November 1990 45th United Nations General Assembly and the Second World Climate conference. Formal negotiations on a climate change framework convention will be based on the IPCC report, and thus will be strongly influenced by the CZMS component.<sup>101</sup>

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93. See *supra* note 69 and accompanying text.

94. *Italian Minister Slams Delay Over Venice Rescue Plan*, Reuters, Dec. 11, 1989 (NEXIS, Reuter file). "Countries at the conference include the Netherlands, Japan, Egypt and Bangladesh, all of which have large urban areas vulnerable to flooding." *Id.*

95. Neale, *Paradise Islands Face Prospect of Hell from Greenhouse Effect*, Sunday Telegraph, Jan. 21, 1990, at 16.

96. See Lobsenz, *Bush to Hold Global Warming Conference This April*, United Press International, Feb. 3, 1990 (NEXIS, UPI file).

97. Clover, *Rise in Sea Level "Will Flood Essex Marsh Forever"*, Daily Telegraph, Feb. 10, 1990, at 2.

98. COASTAL ZONE MANAGEMENT SUBGROUP, *supra* note 20, at B-2.

99. See *id.*; Hunt, *London Will Host Meeting to Study Global Warming*, Financial Times, Feb. 10, 1990, § I at 4.

100. Hunt, *supra* note 99.

101. COASTAL ZONE MANAGEMENT SUBGROUP, *supra* note 20, at B-2. Clover adds that after the November meeting of the Second World Climate Conference in Geneva, "the US has agreed to host a meeting of diplomats early next year [1991] to decide what action could be taken on a global convention." Clover, *supra* note 97.

Currently, the question of international policy and sea level rise has been left "at sea."

Having reviewed the question in its social context, this article discusses problems of sea level rise in international law and policy. One problem which has been clearly identified and which has benefitted from the work of academicians, is that of ocean boundary issues. This will form the basis for an illustrative case study.

#### IV.

#### WRIT ON WATER?: A CASE STUDY OF OCEAN BOUNDARIES AND SEA LEVEL RISE

As noted, the ocean boundary issue provides a useful case study for our discussion of sea level rise as it has already received a fair amount of attention.<sup>102</sup> Bird and Prescott have subdivided the boundary question into four subgroupings: (i) "normal baselines," (ii) closing lines across river mouths and bays, (iii) "straight baselines" drawn along coasts which are indented or fringed with islands, and (iv) "straight archipelagic baselines."<sup>103</sup> Bird and Prescott further note that in considering boundaries it is rising low tide levels rather than high tide levels that matter,<sup>104</sup> and that "[s]ince national maritime claims are measured from the most seaward fragments of territory, whether they are headlands, islands, rocks, or low tide elevations, chief interest must center on such fragments."<sup>105</sup>

##### A. Normal Baselines

"Normal baselines" are defined by Article 5 of the Convention on

102. Bird & Prescott, *supra* note 13; Prescott & Bird, *The Influence of Rising Sea Levels on Baselines from Which National Maritime Claims Are Measured and an Assessment of the Possibility of Applying Article 7(2) of the 1982 Convention on the Law of the Sea to Offset Any Retreat of the Baseline* (unpublished paper presented at the Conference on International Boundaries and Boundary Conflict Resolution, University of Durham, Sept. 14-17, 1982) (Professor Prescott reports that this will appear in a JOURNAL OF INTERNATIONAL BOUNDARIES to be published by Durham, letter of Prof. V. Prescott, n.d. [1990].) (Additionally, Professor Prescott reports that another article of his on Article 7(2) of the 1982 Convention on the Law of the Sea will appear in E.M. BORGESSE, GINSBERG, *et al.*, OCEANS YEARBOOK Vol. 8 [See S. McDonald and V. Prescott, *Baselines Along Unstable Coasts: An Interpretation of Article 7(2)*, in E.M. BORGESSE, N. GINSBERG, & J. MORGAN, 8 OCEAN Y.B. 70 (1990 [c. 1989]).]

103. See Bird & Prescott, *supra* note 13, at 185; see also Prescott & Bird, *supra* note 102, at 15.

104. V. Prescott & Bird, *supra* note 102, at 1-2.

105. Bird & Prescott, *supra* note 13, at 185. See also Prescott & Bird, *supra* note 102, at 16.

the Law of the Sea,<sup>106</sup> which, although not in force, has been accepted by many as representing customary international law<sup>107</sup> in its non-Part XI aspects.<sup>108</sup> According to Article 5, “[e]xcept where otherwise provided in this Convention, the normal baseline for measuring the breadth of the territorial sea is the low-water line along the coast as marked on large-scale charts officially recognized by the coastal State.”<sup>109</sup> Any rise in sea level should theoretically result in a new series of benchmarks for a state’s territorial sea. Prescott and Bird note that “normal baselines can be pushed landwards along any part of their length . . . .”<sup>110</sup> Practically, however, the problem may not be settled so easily. First, the definition of normal baselines is qualified by “as marked on large-scale charts officially recognized by the coastal State.”<sup>111</sup> This wording is used elsewhere in the Convention,<sup>112</sup> but it is not specifically defined. The treaty comes closest to defining this phrase in Article 16 (charts and lists of geographical coordinates) which speaks of “charts of a scale or scales adequate for ascertaining their [straight baselines’] position”<sup>113</sup> and notes that, “[t]he coastal State shall give due publicity to such charts . . . and shall deposit a copy of each such chart . . . with the Secretary-General of the United Nations.”<sup>114</sup> The argument could therefore be made that an “officially recognized chart” is one that has been deposited with the Secretary General of the United Nations, and that any chart meeting this test would qualify under Article 5. In other words, a state could deposit a set of 1990 charts (showing a *lower* low-water line) with the Secretary-General, while its naval and maritime interests utilized a current chart (showing the *higher* low-water mark) and still be in compliance with the letter, if not the spirit, of the Convention.<sup>115</sup> Even if it

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106. United Nations Convention on the Law of the Sea, Dec. 10, 1982, art. 5, Montego Bay, Jamaica, (not in force) [hereinafter Convention on the Law of the Sea], reprinted in 21 I.L.M. 1261 (1982). For further reference see 1 UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA 1982: A COMMENTARY (M. Nordquist, ed. 1985)

107. See Menefee, *The New “Jamaica Discipline”: Problems with Piracy, Maritime Terrorism and the 1982 Convention on the Law of the Sea*, 6 CONN. J. INT’L L. 127 (1990). While similar arguments might be made using relevant parts of the 1958 Geneva Convention, the 1982 Convention on the Law of the Sea and its provisions have been used throughout this section to provide continuity with other commentaries.

108. Part XI deals with “The Area” and seabed mining.

109. Convention on the Law of the Sea, *supra* note 106, art. 5.

110. Prescott & Bird, *supra* note 102, at 15.

111. Convention on the Law of the Sea, *supra* note 106, art. 5 (emphasis added).

112. *See id.*, art. 6.

113. *Id.*, art. 16 (1) (i.e., “large-scale charts”).

114. *Id.*, art. 16 (2).

115. *See id.*, art. 3 (“Every State has the right to establish the breadth of its territorial

were judged that the current official charts of each state must be utilized, some states have the technical and financial capacity to update charts more frequently than others, and would therefore be disproportionately penalized by a rise in sea level, other factors being equal.<sup>116</sup>

Another problem caused by sea level rise and the use of normal baselines is the question of islands, rocks<sup>117</sup> and "low-tide elevations."<sup>118</sup> Each of these groupings generates a different set of maritime claims, and an increase in the height of the oceans could move marginal cases from one group to another.<sup>119</sup> While such diminution is only significant if rocks and islands lie outside the territorial sea, in such cases conversion to a low-tide elevation would mean that they could normally not be considered as points in the state's baseline. The rocks on *Parece Vela* (known as *Okinotorishnima*) are one example, lying only two feet out of the water at high tide.

Japanese authorities are reportedly spending millions of dollars to ensure that these rocks do not disappear under the assault of massive waves so that they can be used for claims to an extended fishing zone. There seems to be a *prima facie* case that the rocks do not satisfy the requirements of Article 121 [to sustain human habitation or an economic life of their own]. There is a real chance that some time in the

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sea up to a limit not exceeding 12 nautical miles, measured from baselines determined in accordance with this Convention.")

116. That this problem is of more than theoretical interest is suggested by the fact that Konvitz reports that no fewer than eighty of the 1500 new admiralty charts produced by Sir Francis Beaufort and the (British) Hydrographic Service between 1829-55 are still in use, although they have been partially corrected by new data. Konvitz, *Changing Concepts of the Sea*, 11 *TERRAE INCOGNITAE* 1, at 8 (1979). See also S.P. MENEFFEE, *Pre-UNCLOS Marine Scientific Research: An Introductory Survey of Law and Policy*,—SEA CHANGES—(forthcoming).

117. See Convention on the Law of the Sea, *supra* note 106, art. 121, which states:

1. An island is a naturally formed area of land, surrounded by water, which is above water at high tide.
2. Except as provided for in paragraph 3, the territorial sea, the contiguous zone, the exclusive economic zone and the continental shelf of an island are determined in accordance with the provisions of this convention applicable to other land territory.
3. Rocks which cannot sustain human habitation or economic life of their own shall have no exclusive economic zone or continental shelf.

118. See *id.*, art. 13:

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.

119. See Bird & Prescott, *supra* note 13, at 186.

next century they will be reduced to low tide elevations and would certainly not qualify as a basis for extended maritime claims.<sup>120</sup>

Although Bird and Prescott speculate that "[t]he loss of low-tide elevations submerged by higher sea levels will not usually influence the maritime claims of countries very significantly,"<sup>121</sup> they note that "[t]he most serious import will be on claims to territorial waters in narrow seas, such as the Baltic and Aegean seas, and in narrow straits such as the Strait of Singapore and Bab el Mandeb."<sup>122</sup>

Some Arctic coasts are composed of "soft glacial drift and potentially melting permafrost and coastlines that could retreat rapidly."<sup>123</sup> Commentators speculate that, because both Canada and the U.S.S.R. use straight baselines and the United States does not, "the major initial effects on maritime claims are likely to be along the Arctic coast of the United States."<sup>124</sup> Could the United States, under the terms of the 1982 Convention, change its delineation system? Article 14 suggests a manner in which this might be justified: "The coastal State may determine baselines in turn by any of the methods provided for in the foregoing articles to suit different conditions."<sup>125</sup> While one interpretation of this is that states may use different methods at a single point in time to determine their baselines, an equally plausible rendering is that states may replace prior choices with baselines determined by a different method "to suit different conditions." Thus, the United States could switch to straight baselines along the Alaskan coast to compensate for projected sea level rise.

### B. *Closing Lines Across River Mouths and Bays*

Articles 9 and 10 of the Convention on the Law of the Sea address closing lines across the mouths of rivers and bays.<sup>126</sup> Bird and

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120. *Id.* at 186-87.

121. *Id.* at 186.

122. *Id.*

123. *Id.* at 188.

124. *Id.*

125. Convention on the Law of the Sea, *supra* note 106, art. 14.

126. These read as follows:

#### Article 9

##### *Mouths of Rivers*

If a river flows directly into the sea, the baseline shall be a straight line across the mouth of the river between points on the low-water line of its banks.

#### Article 10

##### *Bays*

1. This article relates only to bays the coasts of which belong to a single State.

Prescott appear to see little effect on the river mouths due to sea level rise:

Most river mouths enter the sea where the coast is low and in the form of a level or undulating plain. Such low areas obviously have some risk of inundation but the actual changes in the configuration and location of the mouths of rivers will depend on a number of factors, such as the sediment load carried by the river, the movement of marine sediment along the shore toward and away from the river's mouth, and the extent to which the volume of water in the water-course varies seasonally.

In view of the precedents that exist for closing the mouths of very large rivers under the terms of this article, it does not appear that rising sea levels could ever produce a situation where the mouth of the river could not be closed by a straight line.<sup>127</sup>

While this latter point is strictly true, Bird and Prescott ignore the possibility that sea level rise could turn areas around certain low lying river mouths into bays. In such cases, the question arises as to what a state's responsibilities would be if this affected the construction of baselines delimiting the territorial sea.<sup>128</sup> Another possibility is that sea level rise might result in changes sufficient to remove a river mouth from the controlling ambit of Article 9, but *not* sufficient to create a bay under the terms of Article 10. In their discussion of Article 9, Bird and Prescott note that "[t]he French version . . . refers to river [sic] that flow into the sea without forming an

2. For the purposes of this Convention, a bay is a well-marked indentation whose penetration is in such proportion to the width of its mouth as to contain land-locked waters and constitute more than a mere curvature of the coast. An indentation shall not, however, be regarded as a bay unless its area is as large as, or larger than, that of the semi-circle whose diameter is a line drawn across the mouth of that indentation.

3. For the purpose of measurement, the area of an indentation is that lying between the low-water mark of its natural entrance points. Where, because of the presence of islands, an indentation has more than one mouth, the semi-circle shall be drawn on a line as long as the sum total of the lengths of the lines across the different mouths. Islands within an indentation shall be included as if they were part of the water area of the indentation.

4. If the distance between the low-water mark of the natural entrance points of a bay does not exceed 24 nautical miles, a closing line may be drawn between these low-water marks, and the waters enclosed thereby shall be considered as internal waters.

5. Where the distance between the low-water marks of the natural entrance points of a bay exceeds 24 nautical miles, a straight baseline of 24 nautical miles shall be drawn within the bay in such a manner as to enclose the maximum area of water that is possible with a line of that length.

6. The foregoing provisions do not apply to so-called "historic" bays, or in any case where the system of straight baselines provided for in article 7 is applied.

Convention on the Law of the Sea, *supra* note 106, arts. 9, 10.

127. Bird & Prescott, *supra* note 13, at 188.

128. See *supra* notes 110-16 and accompanying text.

estuary. Presumably the implication is that if the river forms an estuary it is dealt with by the rules for a bay."<sup>129</sup> According to Article 10(2), however, "[a]n indentation shall not . . . be regarded as a bay unless its area is as large as, or larger than, that of the semicircle whose diameter is a line drawn across the mouth of that indentation."<sup>130</sup> Furthermore, the Convention clearly states that Article 10 applies only to bays that are within a single state.<sup>131</sup> Because Article 9 applies to any river flowing directly into the sea, some border rivers might not qualify as bays under Article 10 if sea level rise takes place.

In considering bays, Bird and Prescott note that

[r]ising sea levels could affect the use of bay closing lines in three contradictory ways. First, . . . rising sea levels will increase tidal ventilation of bays and will augment the water area of the bay. Such a development will increase the likelihood of a well-marked indentation and of the bay satisfying the semicircle test. Second, coastal erosion on either side of the bay's mouth might result in enough deposition in the mouth to cause narrowing of not more than 24 nautical miles [thus removing it from art. 10(5) and bringing it under 10(4)]. Third, in the case of bays formed in coasts fashioned from deltas or glacial drift, the erosion of comparatively soft natural entrance points might widen the mouth so that the bay can no longer satisfy the maximum permissible width of 24 nautical miles [moving it from the ambit of art. 10(4) to that of article 10(5)].<sup>132</sup>

According to these authors, "[i]t is not usual for countries having declared closing lines across legal bays to monitor any changes in the width of the mouth and remove the closing line if the mouth exceeds 24 nautical miles."<sup>133</sup> The question remains, however, what would be the responsibility of a state to recognize the existence of a qualifying bay under Article 10 if it gained territorial sea by changing baselines. Could a state do so without readjusting other baselines to reflect losses due to sea level rise elsewhere on its

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129. Bird & Prescott, *supra* note 13, at 188. A problem might arise with this interpretation as regards the area of the estuary to be considered for computation as a bay under the terms of article 10(2) and (3). See Convention on the Law of the Sea, *supra* note 106, art. 10(2)-(3).

130. See Convention on the Law of the Sea, *supra* note 106, art. 10(2).

131. See Convention on the Law of the Sea, *supra* note 106, art. 10(1).

132. Bird & Prescott, *supra* note 13, at 188.

133. *Id.*, at 188-89. *But see id.*, at 189 ("[I]t is reported that some consideration is being given by the United States' authorities to abandon the closing line across Kotzebue Sound because of the erosion of glacial tidal flats off the Baldwin Peninsula. Kotzebue Sound is situated about 67 degrees north on the west coast of Alaska and the closing line was drawn in September 1970.").

coast?<sup>134</sup> And what if sea level rise produced a bay "shared" by two nations which would not come under the terms of the Convention?<sup>135</sup>

A final potential problem concerning bays and sea level rise relates to the "historic bays" mentioned in Article 10(6). "Historic bays" are a complex concept<sup>136</sup> and are not defined in the Convention on the Law of the Sea. Sea level rise adds to this uncertainty by introducing the problem of whether a bay can be "historic" when new waters add to what was formerly dry land. One argument is that bays normally viewed as historic are those with mouths wider than 24 nautical miles. The problem would only arise if sea level rise moved a bay with an aperture under this width into the affected category. Even if a bay *was* so shifted, the waters beyond the three mile territorial limit would be subject to scrutiny to determine the bay's status. Thus, sea level rise would have to make deep inroads before this theoretical problem would result.

### C. *Straight Baselines*

The problem of sea level rise and "straight baselines," which has been discussed at some length,<sup>137</sup> derives from Article 7 of the 1982 Convention.<sup>138</sup>

According to Bird and Prescott, Article 7(2) "appears to deal

134. See *supra* notes 110-16, 128 and accompanying text.

135. See *supra* text accompanying at note 131.

136. See G. WESTERMAN, *THE JURIDICAL BAY* (1987); 1 D.P. O'CONNELL, *THE INTERNATIONAL LAW OF THE SEA* 419-20 (1982); "Historic Bays," Doc. A/conf. 13/1, in 1 UNITED NATIONS CONFERENCES ON THE LAW OF THE SEA: OFFICIAL RECORDS 1-38 (1980) [reprint].

137. See Bird & Prescott, *supra* note 13, at 189-92. See also Prescott & Bird, *supra* note 102, at 16-30.

138. Article 7 of the 1982 Convention states:

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.

2. *Where because of the presence of a delta and other natural conditions the coastline is highly unstable, the appropriate points may be selected along the furthest seaward extent of the low-water line and, notwithstanding subsequent regression of the low-water line, the straight baselines shall remain effective until changed by the coastal State in accordance with this Convention.*

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 régime of internal waters.

4. Straight baselines shall not be drawn to and from low-tide elevations, unless lighthouses or similar installations which are permanently above sea level have been

with precisely the problem . . . [of sea level rise]."<sup>139</sup> Elsewhere, however, they argue that, "[o]nly in the case of straight baselines along deeply indented coasts or coasts fringed with islands is there special provision for particular action if the coast retreats."<sup>140</sup>

[T]here is disagreement about whether the rule applies to any highly unstable delta or only to highly unstable deltas that are either deeply indented or fringed with islands. Second, there is disagreement about whether a delta must be present or whether other highly unstable coasts can be treated by this procedure. The English version and every other official translation except Russian insists on the presence of a delta. The Russian version, like the original draft in the Informal Single Negotiating Text, refers to "deltas or other natural conditions."<sup>141</sup>

In addition to uncertainty about the types of geographical configurations covered by the section, "[t]here could be debate about the precise meanings of 'other natural conditions', 'highly unstable', and 'until changed', . . . ."<sup>142</sup> In mentioning these terms, Bird and Prescott have touched on a number of potentially serious ramifications of sea level rise. "Highly unstable", for example, is undefined in the Convention.<sup>143</sup> In their scheme of action under this article section, Prescott and Bird note:

The first question to be decided is whether the coast is highly unstable . . . . In one sense this is a very difficult question to answer, in another sense it is very easy. It would be a daunting task for a doctoral student to produce a definitive definition . . . which could univer-

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built on them or except in instances where the drawing of baselines to and from such elevations has received general international recognition.

5. Where the method of straight baselines is applicable under paragraph 1, account must be taken, in determining particular baselines, of economic interests peculiar to the region concerned, the reality and the importance of which are clearly evidenced by long usage.

6. The system of straight baselines may not be applied by a State in such a manner as to cut off the territorial sea of another State from the high seas or an exclusive economic zone.

Convention on the Law of the Sea, *supra* note 106, art. 7 (emphasis added).

139. Bird & Prescott, *supra* note 13, at 191. Prescott & Bird, *supra* note 102, at 17-21, gives a very useful discussion concerning the origin of this article.

140. Prescott & Bird, *supra* note 102, at 16.

141. Bird & Prescott, *supra* note 13, at 191-92. *See also* Prescott & Bird, *supra* note 102, at 24-27.

142. Bird & Prescott, *supra* note 13, at 191. *See also* Prescott & Bird, *supra* note 102, at 21-22, 24.

143. Prescott & Bird, *supra* note 102, at 21 ("[t]he interpretive document issued by the United Nations (1989) is of no help in defining the term 'highly unstable' . . . .") (citing UNITED NATIONS OFFICE FOR OCEAN AFFAIRS AND LAW OF THE SEA, BASELINES: AN EXAMINATION OF THE RELEVANT PROVISIONS OF THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA (1989)).

sally be applied with confidence and which would receive wide acceptance. Presumably it would involve measuring rates of instability around the world's coasts and deciding what values fall within a normal range and which might be considered unusually high. Perhaps it would be necessary to produce these values for different levels of coasts.

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In the absence of agreed threshold values to objectively define highly unstable coasts it is easy . . . to claim that . . . [a] particular section of coast can be considered highly unstable. After all there is no indication of the rate or amount of retreat of the coast in Article 7(2). . . . In short it appears that the phrase "highly unstable" is so imprecise it will not be a major impediment to countries claiming that their coasts possess this characteristic.<sup>144</sup>

One important point that the authors do not make is that if their emphasis on the unusualness of the instability is to be followed, then to the extent that sea level rise equally affects the landward extension of coastlines, Article 7(2) does not come into play. Similarly, although any country can claim that its coastline was "highly unstable" and comes under the terms of this section, it does not follow that every other country will passively accept such reasoning. To judge by other boundary questions,<sup>145</sup> it seems likely that, at the least, the Convention's dispute mechanism might be called into play.<sup>146</sup> As in other baseline discussions, there is also the question of when straight baselines drawn in accordance with Article 7(2) are to be changed.<sup>147</sup>

In discussing the rest of Article 7, attention should be given to those areas most likely to be affected.

Unlike normal baselines, where the rising sea levels can influence any part of the baseline, straight baselines are only vulnerable to change at the points that anchor the straight baselines to the land. Even if there is some advance of the low-water line landward at some of these points, there is no limit on the length of lines that can be drawn in straight baseline systems. Thus, the existing line could simply be extended to reach the new low-water line.

It will be generally true that those straight baselines drawn between points established on rocks on coasts will not be significantly affected by rising sea levels. The straight baselines anchored on coasts that are

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144. *Id.* at 23-24.

145. See J. PRESCOTT, *POLITICAL MARITIME BOUNDARIES OF THE WORLD* (1985).

146. See Convention on the Law of the Sea, *supra* note 106, Part XV (Settlement of Disputes), arts. 279-99.

147. See *supra* text at notes 109-16, 128, and 134 and accompanying text.

composed of soft sediments might have to be reconstructed because of significant landward advances of the low-water line in the vicinity of the turning points. On the basis of these estimates, the baselines of Canada, Chile, and Norway along fjord coasts do not seem to face any real risk of disruption. Probably the most vulnerable straight baselines are those of the Soviet Union and Canada along their mainland Arctic coasts, where rising sea levels could have a major impact on the erosion of soft tundra coasts.<sup>148</sup>

While straight baselines are more resistant to sea level changes than are normal baselines, one problem associated with sea level rise could be the disappearance of island fringes bringing states under the purview of Article 7(1)—and straight baselines—in the first place. Would this perforce cause the removal of the straight baselines already constructed? Not necessarily. According to Article 7(4), baselines may be drawn to and from low-tide elevations if they have works which remain permanently above sea level or in instances where such baselines have “received general international recognition.”<sup>149</sup> Thus, in cases where former islands were still visible at low tide, and the State’s prior system of straight baselines had achieved international recognition,<sup>150</sup> nothing would change. Additionally, for cases in which some fringing islands disappeared, but others remained, Article 7(5)’s statement that “account may be taken, in determining particular baselines, of economic interests peculiar to the region concerned, the reality and the importance of which are clearly evidenced by long usage,”<sup>151</sup> arguably provides for retention of baselines connecting certain points overtaken by sea level rise. Significant rise, however, could deprive a state from the right of using straight baselines, and force them back to the normal baselines of Article 5.

#### D. *Straight Archipelagic Baselines*

The fourth subgrouping, “straight archipelagic baselines,” are defined in Article 47 of the 1982 Convention.<sup>152</sup> Bird and Prescott minimize the impact of this article by stating that at least in the case

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148. Bird & Prescott, *supra* note 13, at 190.

149. Convention on the Law of the Sea, *supra* note 106, art. 7(4).

150. This would not necessarily always be the case. For State breaches in the construction of straight baselines, see Bird & Prescott, *supra* note 13, at 190-191.

151. Convention on the Law of the Sea, *supra* note 106, art. 7(5).

152. Article 47 of the 1982 Convention states:

1. An archipelagic State may draw straight archipelagic baselines joining the outermost points of the outermost islands and drying reefs of the archipelago provided that within such baselines are included the main islands and an area in which the ratio

of coral atolls, "rising sea levels will not cause any problems for baseline construction providing the coral grows at the rate the sea level rises and providing debris from the reef's edge maintain cays and other deposits and islands on the reef."<sup>153</sup> There are, however, some theoretical problems. The first involves the "outermost points" of Article 47(1). A rapid rise in sea level could erase some of these, necessitating a revision of the archipelagic baselines. Another relates to the allowable length of the baselines under 47(2). As Bird and Prescott point out, "[t]he 3 percent rule can be easily overcome by creating many short, unnecessary segments so attention must focus on the absolute limit of 125 nautical miles."<sup>154</sup> If any islets within an archipelago are submerged, creating boundary lines longer than the upper limit, this would force a restructuring of

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of the area of the water to the area of the land, including atolls, is between 1 to 1 and 9 to 1.

2. The length of such baselines shall not exceed 100 nautical miles, except that up to 3 per cent of the total number of baselines enclosing any archipelago may exceed that length, up to a maximum length of 125 nautical miles.

3. The drawing of such baselines shall not depart to any appreciable extent from the general configuration of the archipelago.

4. Such baselines shall not be drawn to and from low-tide elevations, unless light-houses or similar installations which are permanently above sea level have been built on them or where a low-tide elevation is situated wholly or in part at a distance not exceeding the breadth of the territorial sea from the nearest island.

5. The system of such baselines shall not be applied by an archipelagic State in such a manner as to cut off from the high seas or the exclusive economic zone the territorial sea of another State.

6. If a part of the archipelagic waters of an archipelagic State lies between two parts of an immediately adjunct neighbouring State, existing rights and all other legitimate interests which the latter State has traditionally exercised in such waters and all rights stipulated by agreement between those States shall continue and be respected.

7. For the purpose of computing the ratio of water to land under paragraph 1, land areas may include waters lying within the fringing reefs of islands and atolls, including that part of a steep-sided oceanic plateau which is enclosed or nearly enclosed by a chain of limestone islands and drying reefs lying on the perimeter of the plateau.

8. The baselines drawn in accordance with this article shall be shown on charts of a scale or scales adequate for ascertaining their position. Alternatively, lists of geographical co-ordinates of points, specifying the geodetic datum, may be substituted.

9. The archipelagic State shall give due publicity to such charts or lists of geographical co-ordinates and shall deposit a copy of each such chart or list with the Secretary-General of the United Nations.

Convention on the Law of the Sea, *supra* note 106, art. 47.

153. Bird & Prescott, *supra* note 13, at 192 (who go on to note, however, that "[i]slands lacking any coral base will be vulnerable to erosion if they are formed from soft sediments or if they are very low").

154. *Id.*

the baseline claims.<sup>155</sup> (A similar result would occur if the sea level rise resulted in too many lines which were over the 100 mile limit.) The restrictions on the use of low-tide elevations, which differ from those imposed for straight baselines,<sup>156</sup> mean that an increase in the level of the oceans could negate the benchmarks used in the construction of several archipelagic baselines. Finally, there is a problem with the requirements of water to land ratio necessary for an archipelagic State to be able to take advantage of the 1982 Convention's archipelagic baseline rules.<sup>157</sup> Bird and Prescott note:

For countries that have difficulty in keeping below a ratio of 9:1, it is permissible to count as land those waters enclosed within fringing reefs. If coral reefs fail to grow upward at the same rate as sea level rises, some fringing reefs could be submerged and this loophole would be lost. This would be a matter for concern on the part of some archipelagoes with very small land areas.<sup>158</sup>

Indeed, in cases of extreme sea level rise, entire island nations (and, presumably, their archipelagic baselines) might possibly be extinguished!<sup>159</sup>

#### E. *Other Problems: Ports and Submerged Land Boundaries*

Having Bird and Prescott's four subdivisions of the problem, *other* potential problems in the determination of boundaries are discussed: (v) ports; and (vi) the impact of submerged land boundaries.

Regarding ports and the limits of the territorial sea, Article 11 of the Convention on the Law of the Sea states:

For the purpose of delimiting the territorial sea, the outermost permanent harbour works which form an integral part of the harbour system are regarded as forming part of the coast. Off-shore installations and artificial islands shall not be considered as permanent harbour works.<sup>160</sup>

A rise in sea level could cause problems because many ports are built in coastal areas, and increase in water level could convert some ports into "off-shore installations" if remedial construction is not undertaken.<sup>161</sup> Such action, however, might change ports into "artificial islands" under the terms of the Convention. This term is not

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155. This would presumably result in a diminution of archipelagic waters as it is probable that an archipelago would put its "best claim forward" to begin with.

156. See Convention on the Law of the Sea, *supra* note 106, art. 7(4).

157. See Convention on the Law of the Sea, *supra* note 106, art. 47(1).

158. Bird & Prescott, *supra* note 13, at 192.

159. See notes 55, 61, 81, 90, and accompanying text and notes 84 and 86.

160. Convention on the Law of the Sea, *supra* note 106, art. 11.

161. While the term "offshore installation" is *not* defined in the 1982 Convention,

defined in the treaty, although in Article 60 "artificial islands" are differentiated from "islands" on the one hand, and from "installations and structures" on the other.<sup>162</sup>

Another sea level rise problem relates to *land* boundaries between two states which become flooded by rising sea levels. Do these remain the same, although submerged, or would the onslaught of the oceans trigger the necessity for a new boundary agreement? According to Article 15 of the 1982 Convention:

Where the coasts of two states are opposite or adjacent to each other, neither of the two States is entitled, failing agreement between them to the contrary, to extend its territorial sea beyond the median line every point of which is equidistant from the nearest points on the baselines from which the breadth of the territorial seas of each of the two States is measured. The above provision does not apply, however, where it is necessary by reason of historic title or other special circumstances to delimit the territorial seas of the two States in a way which is at variance therewith.<sup>163</sup>

The initial wording suggests problems in retaining an old land boundary if the states involved are not equally affected by the rise in sea level. At the same time, one could expect an argument based on "historical title or other special circumstances" by any state gaining advantage by retaining the old land boundaries. A similar argument is that the doctrine of changed circumstances is not usually held to apply in boundary matters<sup>164</sup> and the former (dry land) territorial agreement would therefore apply, constituting an "agreement between them to the contrary."<sup>165</sup>

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Article 60(3), in speaking of artificial islands, installations and structures in the exclusive economic zone, notes:

Due notice must be given of the construction of such artificial islands, installations, or structures, and permanent means for giving warning of their presence must be maintained. Any installations or structures which are abandoned or disused shall be removed . . . . Appropriate publicity shall be given to the depth, position and dimensions of any installations or structures not entirely removed.

Convention on the Law of the Sea, *supra* note 106, art. 60(3). Article 60(8) adds that, "[t]hey have no territorial sea of their own, and their presence does not affect the delimitation of the territorial sea, the exclusive economic zone or the continental shelf." *Id.*

162. *See supra* note 161. According to Article 60(8), "artificial islands, installations and structures do not possess the status of islands." Convention on the Law of the Sea, *supra* note 106.

163. Convention on the Law of the Sea, *supra* note 106, art. 15.

164. Convention on the Law of the Treaties, Vienna, May 23, 1969, 1155 UNTS. 331; UN Doc. A/Conf. 39/27; 63 A.J.I.L. 875 (1969), reprinted in 8 I.L.M. 679 (1969).

165. *See* Convention on the Law of the Sea, *supra* note 106, art. 15; *see also supra* text accompanying note 163.

## F. *Boundary Policies*

Bird and Prescott appear generally correct in their assumption that sea level rise will affect some countries' shorelines—and therefore their boundaries—more than others and that such changes “will probably have the greatest impact on the outer edge of the territorial sea and only a negligible influence on the outer edge of the exclusive economic zone.”<sup>166</sup> They posit six policies<sup>167</sup> that affected governments can follow to maintain existing ocean boundaries in the face of rising sea levels:

- (1) defense against coastal erosion by the construction/ enlargement of sea walls;<sup>168</sup>
- (2) defining outer limits of maritime zones and maintaining these limits even though the baselines on which they depend have changed;<sup>169</sup>

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166. See Bird & Prescott, *supra* note 13, at 193; see also Prescott & Bird, *supra* note 102, at 16. If one accepts that the further from the coast a zone lies, the less it would be affected, this would indicate that internal waters would tend to be more affected by a rise than would territorial seas.

167. See Bird & Prescott, *supra* note 13, at 193-94; see also Prescott & Bird, *supra* note 102, at 30-32 (listing five policies “unrelated to article 7(2) which might be used to maintain existing maritime claims”; the omitted policy (5), see *infra* text at note 172, being of course a policy related to article 7(2)).

168. See Bird & Prescott, *supra* note 13, at 193; Prescott & Bird, *supra* note 102, at 30-31. The former notes:

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. . . . [E]lsewhere the costs of these structures will be prohibitive and coastal lowlands will be lost as sea level rises. When seawalls are built on coasts . . . they often produce a scouring of nearshore sediments by reflected waves. This erosion means that the high-water mark is stabilized but the low-water line will move landward, perhaps to the foot of the wall.

. . . [V]arious devices for resisting erosion . . . [include] artificial islands, precast concrete structures, armor stone, concrete mats, and sandbags.

Bird & Prescott, *supra*, at 193 (citing Japan and the Netherlands as countries that have utilized this policy, and Thailand and Indonesia as countries that might consider it).

169. See Bird & Prescott, *supra* note 13, at 193; Prescott & Bird, *supra* note 102, at 31.

[C]ountries could follow the lead of Haiti, Malaysia and North Korea by defining the outer limits of maritime zones without disclosing the baselines from which they were measured. Without resorting to phantom straight baselines, countries could define the outer limits of maritime zones from proper baselines and maintain these outer limits even though the coastline retreats. Article 16 provides that countries should define either the straight baselines and closing lines or the limits of the territorial sea derived from those baselines. The definition can be by charts or lists of the coordinates of points. The outer limit of the exclusive economic zone should be shown in one of the same ways according to Article 75. According to Article 47(8) archipelagic states do not have the option of sharing their archipelagic baselines or the limits of territorial seas derived from them. They shall show the baseline either on charts or by lists of the coordinates of points.

- (3) using straight baselines (from points unlikely to suffer erosion) along those sections of coast liable to erosion;<sup>170</sup>
- (4) (in enclosed or semi-enclosed seas) agreeing on maritime boundaries with opposite/adjacent neighbors, which would not be affected by subsequent baseline movement;<sup>171</sup>
- (5) (for countries possessing deltas [or *possibly*, unstable coasts]) drawing straight baselines around the area once erosion becomes apparent;<sup>172</sup>
- (6) "masterly inactivity" - *not* resurveying or revising charts so that ocean boundaries are not altered despite sea level rise.<sup>173</sup>

For the purposes of this case study, it may prove useful to revise and reformulate these boundary policies within a broader scheme that might apply to other sea level rise issues. Of great use in this restructuring has been the November, 1989 Workshop Report of the CZMS, *Adaptive Options and Policy Implications of Sea Level Rise and Other Coastal Impacts of Global Climate Change*.<sup>174</sup>

## I. EVALUATIVE POLICIES<sup>175</sup>

### (a) Studies to determine the *cause* of sea level rise

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*Id.*

170. See Bird & Prescott, *supra* note 13, at 193; Prescott & Bird, *supra* note 102, at 31-32.

In view of the baselines that have already been drawn by some countries such as Vietnam, Burma, Ecuador, Iceland, and Albania, it would be easy to justify straight baselines on the basis of precedents apparently accepted by most of the international community. The advantage of straight baselines drawn between prominent rocky points is that they are unlikely to be affected by a 1-meter rise of sea level, whatever happens to the coasts behind the straight lines.

Bird & Prescott, *supra*, note 13 at 193.

171. See Prescott & Bird, *supra* note 102, at 32.

172. See Bird & Prescott, *supra* note 13, at 194-95. As noted in note 167, *supra*, this would be done under the auspices of Article 7(2) of the Convention on the Law of the Sea.

173. See Bird & Prescott, *supra* note 13, at 194 ("Of course the baseline will move, and that fact could be presented in a court if a dispute arose about whether a defendant was within or beyond the territorial sea."); Prescott & Bird, *supra* note 102, at 32.

174. See COASTAL ZONE MANAGEMENT SUBGROUP, *supra* note 20.

175. This section is foreshadowed by Bird and Prescott's following statement:

The first task for governments concerned with these issues is to arrange for a careful assessment of the effects of rising sea levels on their coasts by people who understand coastal processes and can apply that knowledge in detailed field work. If that assessment indicates that there are major areas in which a significant retreat of the shoreline is likely and the government decides that it wants to avoid the effects of that retreat flowing through to its existing maritime limits, it can consider some of the following policies.

Bird & Prescott, *supra* note 13, at 193. See also Prescott & Bird, *supra* note 102, at 30. Policies can, of course, be generated on a non-governmental, local, state, municipal, or international level.

- (b) Studies to determine the *effect* of sea level rise
  - (i) Determination of *timing* of rise
  - (ii) Determination of *magnitude* of rise
- (c) Studies to determine the *impact* of sea level rise
  - (i) Determination of *environmental impact* of rise
  - (ii) Determination of *socio-economic impact* of rise
  - (iii) Determination of *legal impact* of rise
- (d) Studies to determine the *impact* of *responsive strategies*
  - (i) Determination of *environmental impact* of responses
  - (ii) Determination of *socio-economic impact* of responses
  - (iii) Determination of *legal impact* of responses

## II. REACTIVE POLICIES

- (a) Inaction as a response to the *causes* of sea level rise
- (b) Efforts to slow or reverse the *causes* of sea level rise
- (c) Inaction as a response to the *effects* of sea level rise
- (d) Efforts to slow or reverse the *effects* of sea level rise
- (e) Inaction as a response to the *impact* of sea level rise<sup>176</sup>
- (f) Efforts to mitigate the *impact* of sea level rise
- (g) Inaction after initiation of preliminary *responsive strategies*
- (h) Efforts to fine tune or change *responsive strategies*

The Bird-Prescott responses would arguably come under II(f)(iii) of the scenario: Reactive efforts to mitigate the *legal impact* of sea level rise. Revised and reformulated, they might appear as follows:

## II. REACTIVE POLICIES

- (f) Efforts to mitigate the *impact* of sea level rise
  - (iii) Efforts to mitigate the *legal impact* of rise
    - (A) General defense to protect *all* boundaries against erosion<sup>177</sup>
    - (B) Defense against coastal erosion to protect boundaries *at specific points*<sup>178</sup>
    - (C) Implementation of *existing agreements in ways mitigating* the effect of the rise

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176. This and subsequent sections could, of course, be divided into environmental, socio-economic, and legal subdivisions.

177. This would come under the rubric of Bird-Prescott policy No. 1. See *supra* text accompanying note 168.

178. See *supra* note 177.

- (1) "Masterly inactivity"<sup>179</sup>
- (2) Use of straight baselines where possible<sup>180</sup>
- (3) Recognition of claims by others<sup>181</sup>
- (4) Construction of structures at key points<sup>182</sup>
- (D) Drafting/enactment of *new agreements on ways to mitigate* the effect of the rise
  - (1) Boundary agreements<sup>183</sup>
  - (2) Agreements concerning affected areas<sup>184</sup>
  - (3) Amendment of the 1982 Convention<sup>185</sup>
- (4) Drafting of a *new agreement* dealing with the problem<sup>186</sup>

179. This would be the equivalent of Bird-Prescott policy No. 6. *See supra* text accompanying note 173. This inactivity is not the same as that contemplated under II(c), as it is purposeful rather than purposeless.

180. This would include Bird-Prescott policies Nos. 3 and 5. *See supra* text accompanying notes 170, 172.

181. Arguably this is equivalent to Bird-Prescott policy No. 2. *See supra* text at note 169. Any reason for recognition of existing claims that did not require a subsequent revision for loss of coastline, however, would suffice.

182. This new policy addition is based on the fact that because of the wording of articles 7(4) and 47(4) of the 1982 Convention on the Law of the Sea, low-tide elevations with "lighthouses or similar installations which are permanently above sea level" can continue to serve as endpoints for archipelagic or straight baselines while otherwise they might not.

183. This would include Bird-Prescott policy No. 4. *See supra* text accompanying note 171.

184. *See* Convention on the Law of the Sea, *supra* note 106, art. 311(3):

Two or more States Parties may conclude agreements modifying or suspending the operation of provisions of this Convention, applicable solely to the relations between them, provided that such agreements do not relate to a provision derogation from which is incompatible with the effective execution of the object and purpose of this Convention, and provided further that such agreements shall not affect the application of the basic principles embodied herein, and that the provisions of such agreement do not affect the enjoyment by other States Parties of their rights or the performance of their obligations under this Convention.

This suggests a way in which particularly onerous boundary results due to sea level rise might be varied, though it might prove difficult in application.

185. *See id.*, art. 312 (noting that a conference to consider amendments may be convened 10 years after the date of entry into force of the Convention); *id.*, art. 313 (providing for amendment of the Convention by a simplified procedure).

186. This could either be part of an umbrella CO<sub>2</sub> emission convention, a global atmospheric convention like that resulting from UNCLOS III (although this appears unlikely), or an agreement relating specifically to sea level rise. According to Article 311 (2) of the Convention on the Law of the Sea, *supra* note 106: "This Convention shall not alter the rights and obligations of States Parties which arise from other

In a similar manner, other responses and problems can be fit into the general schema, which is, of course, subject to revision as necessary.

The foregoing illustrative case study shows sea level rise in the context of ocean boundary issues. The next section outlines several other problems in international law and policy.

## V.

### KING CANUTE AND THE TIDE<sup>187</sup>: OTHER POTENTIAL PROBLEM AREAS OF SEA LEVEL RISE IN INTERNATIONAL LAW AND POLICY

There are several other areas of international concern which could be affected by a rise in sea levels. Each of these is worthy of individual study. The following is an inclusive but not necessarily exhaustive list of concerns:

#### (a) *disappearance of entire countries*

As has been noted,<sup>188</sup> an extreme rise in sea level could cause the disappearance of several island nations, including Kiribati, Tuvalu and the Maldivian Islands. Such results would not only be a tremendous national tragedy for the countries concerned, but would reveal unanswered questions of international law. Could the countries be held to survive "in exile" if no physical territory remained? If they

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agreements compatible with this convention and which do not affect the enjoyment by other States Parties of their rights or the performance of their obligations under this Convention." Whether another convention could successfully "thread the needle" is not clear.

187. According to John Selden,

. . . King *Canutus* (or *Cnute*) hath left testimonie also whereby he most expressly asserts the Sea to bee a part of his Dominion . . . . Hee placing himself on a seat by the Sea side as it flowed upon *Southampton* Shore, having a minde to demonstrate to his flatterers, that Kings themselvs are but men, is reported to have made trial of the obedience of the Sea (it being flood) after this manner, Thou, O Sea, art under my Dominion, as the Land also upon which I sit is mine. And There never was any that disobeied my Command without punishment. Therefore I command thee not to ascend upon my Land, nor do thou presume to wet the feet or garments of thy Sovereign[.] *But the tide* (saith *Huntington*, and *Florilegus* who relate this storie) *swelling as at other times, did very unmannerly wet not onely the feet, but legs of his Majestie*. Whereupon the King leaping up proclaimed with his own mouth none to bee worthy the name of King, but him alone who command's both the Sea and land, and they obey.

2 J. SELDEN, OF THE DOMINION, OR, OWNERSHIP OF THE SEA 279-80 (1972) (M. Nedham trans. 1652) (as text appears in original).

188. See *supra* note 159 and references therein.

purchased or were given other territory subject to their exclusive sovereignty, would they retain their statehood? Would they be new countries required to reapply to the United Nations and other international bodies? Would they retain the right to assets abroad and be responsible for their previous debts—or would the latter be “washed away”? What would be the status of international agreements which they had signed, but which had not come into force? These are just a few of the questions that would arise.

(b) *refugee issues*

Closely related to the former issues, but deserving of its own treatment, is the question of refugee issues brought about by sea level rises. Horrendous figures have been quoted and projections made of the dislocations which sea level rise might cause,<sup>189</sup> even when parts of countries survive the onslaught of the oceans. Would “ecological refugees” gain the same status as political refugees? What international provisions could be made for the massive resettlements required? Would famines and international disorders result? Could provision be made for group resettlements, or would the individuals involved be forced to relinquish their social identity, perhaps even their nationality? What new strains might be placed on or opportunities made available to the international order?

(c) *the effect on Antarctica*

While the effect of sea level rise on this continent has recently been downplayed,<sup>190</sup> melting of even part of the ice cap could pose new problems. What effect would this have on national claims? On the Antarctic Treaty? Obviously a change in the Antarctic environment would have ecological repercussions which could in turn affect the continent’s marine living resources. What result would the thinning ice cover have on the extraction of mineral resources? Would melting cause increased utilization along with pollution problems, clashes, perhaps someday even the question of self-determination?

(d) *navigational issues*

In addition to peripheral changes due to a flux in ocean boundaries,<sup>191</sup> major sea level rise could create new straits subject to navi-

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189. See *supra* notes 55, 77, and 79 and accompanying text, and notes 60, 80, and 84.

190. See *supra* note 91 and accompanying text.

191. See *supra* notes 102-65 and accompanying text.

gation. In particular, it could open up the Northwest Passage to commerce<sup>192</sup> with the pollution and strategic ramifications such a development would entail. Sea lanes and traffic separation schemes might need revision as new navigational hazards were created, and old ones submerged.

(e) *fishery and marine mammal problems*

Major rises in sea level could potentially disrupt ocean life and coastal breeding grounds.<sup>193</sup> Disruptions might range from changes in species' feeding grounds to extinction of entire species. Control over fishery stocks might shift. On both an ecological and a pragmatic food level, the repercussions could be enormous, requiring the renegotiation of treaties, inclusion of new States Parties, even entire new agreements.

(f) *ocean disputes*

Obviously, all of the issues raised above would put new strains on bilateral and multilateral relationships, on "customary practice" and treaties, indeed, on the entire international system. While one may agree that there are no winners in sea level rise, some parties stand to lose far more than others. In the absence of a unanimous global approach, attempts to alleviate the situation by one country might worsen the situation for another country. Sea level rise will undoubtedly negatively affect international relations—from court cases to the possibility of localized conflicts.

(g) *other developments*

It is impossible to touch on all areas of international law and policy that might be significantly affected by sea level rise. At first glance they might appear remote or unrelated. Economic agreements, equilateral policy, or security alliances, for example, could all be imperiled by the "rip-tide" of a rising sea. This is particularly true regarding the contents of the 1982 Convention on the Law of the Sea. Massive sea level rises could trigger calls for a new Convention just as the prospect of sea bed mining and the "common heritage of mankind" led to the present agreement. It seems safe to predict that many of the most important law and policy ramifications of this threat remain obscure at the present time.

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192. See *supra* note 26.

193. See *supra* note 85 and accompanying text.

VI  
CONCLUSION

In reviewing sea level rise, this article discusses the cause and some of the potential effects of this global problem. A historical survey has shown the growth of concern, from scientific reports and national studies to international meetings, and ultimately to the continuing evaluations of the Intergovernmental Panel on Climate Change (IPCC), in particular, of the Coastal Zone Management Subgroup. Hopefully, worldwide concern will result in a global agreement that will deal specifically with the question of sea level rise, i.e., an agreement curbing CO<sub>2</sub> emissions.

Such an agreement is only one of numerous possible approaches. The scheme of evaluative and reactive policies offered above<sup>194</sup> and its particular application to the question of ocean boundaries in the sample case study<sup>195</sup> suggests a methodology that can be revised and expanded to fit other ramifications of sea level rise. As the overview of potential problems should make clear, if these tides continue to rise significantly, all law and policy "boats" will be floated. By anticipating these problems with an integrated law/policy approach, by evaluating, and by reacting in a considered manner, the world will hopefully not find itself "half seas over".

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194. See *supra* text accompanying notes 175-76.

195. See *supra* text accompanying notes 177-86.