

Stepping Stones in the Evolution of a National Hurricane Policy

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ABSTRACT

Like most government policies directly affecting the welfare of the nation, the evolution of a coherent national policy on hurricane warnings, public preparedness, and subsequent disaster relief has been event motivated—a product of crisis management. This process began near the turn of this century, first with the Spanish–American War, which placed an urgent requirement for warnings to protect naval vessels from hurricanes, and second following the hurricane disaster at Galveston in 1900, reaching maturity after the Camille disaster in 1969. The latter, for the first time, resulted in a spontaneous effort by both federal and state governments and the university community, particularly by the social scientists, which led to the present hurricane policies.

The result of successive crisis management actions by the government and, after Camille, the broadly based response and analyses by the scientific and engineering communities, led to the evolution of a national policy on hurricanes that identifies and assigns responsibilities and actions required for each phase of a threatening event, from anticipation and preparedness, to relief and recovery from a hurricane disaster.

The plan that evolved is a remarkable example of cooperation between federal, state, and local organizations devoted to the protection of life and property, and recovery from disaster. And it is a tribute to the altruism with which both government and private organizations have collaborated to protect and promote public welfare. Nevertheless, the mechanics of relocating coastal residents from harm's way in the face of a hurricane emergency remain complex and in some areas uncertain, considering the ever-increasing time required for systematic evacuation.

1. Introduction

It has been my observation and experience that policies with regard to public services by government agencies are often generated more by default than by design. Sometimes they evolve from the perceptive leadership and urgings of field officials who provide these services. Other times they are the response of policy level officials to an incident in which earlier policies either failed or were nonexistent. Or they may stem from politically motivated actions of Congress. Most often they are the product of crisis management involving hasty responses to a combination of all three with varying degrees of cost effectiveness.

Until the late 1960s, national policies on public protection and recovery from hurricanes were almost entirely the outcome of various crisis management efforts. The overall outcome was a progressive upsurge in attention to scientific and technological aspects of the warning problem with less than adequate attention to the societal problems of preparedness and response to warnings. The process became notably apparent after

the greatest single weather catastrophe in the United States—the Galveston hurricane of 1900 in which more than 8000 lives were lost (Hebert et al. 1997; Rappaport and Fernandez-Partegás 1995).

2. The early years

The earliest systematic effort to detect, track, predict, and warn of hurricanes came from Cuba, based upon research at Belém College by the scholarly Jesuit Benito Viñes. He issued public forecasts and warnings of hurricanes as early as 1873 based upon his analyses of movements of upper and lower clouds observed at a number of observing stations (Calvert 1935). Not until 1898, when the crisis introduced by the Spanish–American War required more detailed hurricane warnings to protect the U.S. fleet in Caribbean waters, did the United States hastily establish a hurricane warning office, located initially in Kingston, Jamaica. However, before the first hurricane warning was issued, the war was over and the office was relocated to Havana in collaboration with the Cuban weather service, which had a head start of two decades' experience using Father Viñes methodologies (Calvert 1935). The focus, however, remained on marine interests and island areas rather than the coastal areas of the United States, which continued to depend upon advices based upon hurricane tracking by the Washington forecast office, a collateral function of

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general forecasts issued for the United States at large (Dunn 1971).

Weather forecasts and warnings for the United States, initially a responsibility of the U.S. Army Signal Corps beginning in 1870, then transferred in 1891 to the newly established U.S. Weather Bureau (Whitnah 1966), were handicapped by the wide spacing of observing stations and the lethargy of communications. This was especially true of marine storm systems since there were no means of transmitting observations from ships at sea, since wireless telegraphy did not become available until the first decade of the twentieth century.

The Weather Bureau, nevertheless, had the most comprehensive access to such communications as were available. So nearly all public services relating to the hurricane event fell by default to that agency. From 1891 the collection of weather reports, their analysis, and tracking of storm systems was done centrally in Washington. Warnings for coastal areas were issued to field offices where the official in charge was expected to rally the resources of the community to prepare for the impending threat and to deal with the consequences if a disaster did occur. The scope of potential disaster in the absence of a dedicated hurricane warning system was dramatized at Galveston on 8 September 1900, a tragic saga grippingly recounted by Isaac Cline. An erudite, dedicated Weather Bureau official-in-charge at Galveston, Cline himself was swept away together with his wife, two children, and a brother, clinging to the wreckage of his residence, which collapsed in the extraordinary storm surge, and floated first into Galveston Bay, then, with shifting winds, back onto the island, a treacherous journey in which amazingly only Isaac's wife failed to survive (Garriott 1900).

After moving northward from the Caribbean to the west coast of Florida, the hurricane raced westward across the Gulf of Mexico to Galveston in little more than 48 hours. Remarkably, warnings for this hurricane were credited by news accounts all over the United States as being excellent and timely (Garriott 1900), but went largely unheeded by a public that could not perceive the threat posed by the devastating storm surge that inundated the entire city. Its height, from various reports ranged from 12 to 20 feet (Rappaport and Fernandez-Partegás 1995). Clearly the failure at Galveston, which cost more than 8000 lives, was more one of communicating risks than of deciding what the risks were.

The response to this disaster was a policy decision to extend the forecast responsibilities in Washington to include specific responsibilities for coastal warnings of hurricanes. New Orleans was assigned responsibility for coordination and timely dissemination of hurricane warnings in the Gulf of Mexico (G. Norton 1944, personal communication). Isaac Cline was named head of the New Orleans center where his leadership played a key role in generating public awareness of the hurricane hazard. He also published many scientific papers and an authoritative textbook *Tropical Cyclones* on hurri-

cane structure and hazards. For more than three decades, hurricane tracking, prediction, and warnings continued to be done solely in Washington, while the responsibility for coordinating preparedness and recovery actions remained with, and depended upon, the initiatives and leadership of local Weather Bureau officials, many of whom, while dedicated, were ill prepared, technically, for this task.

The first changes in this policy occurred in 1935, when the last of a series of notable hurricanes raked the U.S. coastlines, four of which had very significant political impacts. The first was the great hurricane of 1919, which virtually destroyed Key West then continued across the Gulf of Mexico to bring a major storm surge at Corpus Christi with large losses of life at both places. The second was the Miami hurricane of 1926, which devastated that rapidly developing city. Hard on its heels was the Lake Okeechobee hurricane of 1928 with a loss of more than 1800 lives, as waters from the lake surged over the levees inundating vast areas to the south (Tannehill 1943). Finally the Florida Keys storm of 1935, the most intense of record in the Atlantic basin, destroyed road and rail access between the keys, with major loss of life (Dunn and Miller 1960). In none of these were warnings sufficiently timely, or public awareness—much less preparedness actions—worthy of mention. Each uniquely demonstrated that the policy of generating hurricane predictions and warnings from a central (and usually remote) location simply had not worked: first, because of the limitations of communication; second, because it was impossible for meteorologists at the single source to respond sensitively to the varying character of risks from one community to another in preparing and disseminating warnings.

3. Decentralization of forecasts and warnings

The Weather Bureau's response to increasing public and congressional dissatisfaction was to establish in the early 1930s regional hurricane prediction and warning offices at New Orleans, Louisiana, Jacksonville, Florida, Washington, D.C., Boston, Massachusetts, and San Juan, Puerto Rico.¹ Each provided complete hurricane services for their respective regions of responsibility (Calvert 1935). However, again by default, the development and coordination of preparedness and recovery planning remained tacitly a responsibility of these offices.

With the exception of the transfer of the hurricane forecast office at Jacksonville to Miami in 1943, there were few additional changes in the policies for administering hurricane warning services for the U.S. Atlantic

¹ San Juan earlier had been given limited authority for hurricane warnings for the vicinity of Puerto Rico when the Kingston office was transferred to Havana at the turn of the century.

and gulf coasts until the mid-1960s.² During the postwar years, however, the navy and air force established separate centers for military warning services. This required careful coordination before warnings were issued by any of the three agencies. This post-world war era saw incredible advances in science and technology, particularly in hurricane detection and prediction, and in communications. Along with it came the growth of middle-class affluence, the migration of population to the southern seashores, and into harm's way from hurricanes. While the application of better science and technology was clearly responsible for more timely and informed predictions and warnings, the programs for hurricane preparedness, public awareness, and evacuation became ponderous and ever more complicated—too much so to remain effective as an adjunctive responsibility of the forecast and warning service.

Little by little, coastal state governments began establishing programs for public preparedness and evacuation, partly in response to encouragement from hurricane forecast offices, and partly as crisis management measures following hurricane disasters. At the same time the rapid rise in property losses with each successive hurricane disaster was too much for the states to cope with. This resulted in the creation in the mid-1960s of a national Office of Emergency Preparedness (OEP), which, from the first, appeared to be more aggressive in disaster relief than with preparedness and evacuation.

The abundance of hurricanes, albeit few of great severity, that occurred in the decade from the mid-1940s to mid-1950s, culminated with Carol, Edna, and Hazel in 1954. This upswing in hurricane landfalls convinced Congress that drastic action was needed to improve the Weather Bureau's ability to deal with this growing threat. The customary crisis management procedures resulted in a massive infusion of funds for research and the application of new technologies. The National Hurricane Research Project (NHRP) was established at West Palm Beach, and a 12-station network of upper air sounding stations was created in the Caribbean and adjacent areas (Simpson et al. 1956). These funds, together with concomitant support for numerical weather prediction, and the first installations in a national radar network, increased the annual budget of the Weather Bureau from approximately \$27.5 million to more than \$58 million in a five-year period during the 1950s. This infusion of funds for research succeeded not only in the systematic collection of vast amounts of data on hurricane structure and energy processes but also attracted the interests and research efforts of university scientists in a wide range of problems in tropical meteorology of global concern.

The NHRP at Palm Beach became a permanent re-

search laboratory in 1960 and was transferred to Miami in collocation with the Hurricane Forecast Office. Shortly afterward the responsibilities of the Miami forecast office were broadened to recognize the tacit role of its director in promoting hurricane risk awareness, for encouraging and supporting the development of state programs for hurricane preparedness and evacuation, and for coordinating the responses to warnings and special advices by local preparedness officials

4. The National Hurricane Center

In 1965 the Miami hurricane office was designated The National Hurricane Center (Sheets 1990). This center, under its first director, Gordon Dunn, became responsible for overseeing and coordinating hurricane predictions and warnings from all hurricane offices, for the proper flow of information to local and state preparedness officials, and for all concerned governments in the Caribbean, Bahamas, and Bermuda. It was also responsible for special advices to the U.S. military, and disaster relief organizations such as the Red Cross, Salvation Army, and OEP, which were concerned primarily with the probable location of hurricane landfall, and the damage potential as this pertained to the amount of supplies required to deal with the impending disaster.

This was indeed a daunting responsibility involving decision making that begged for expertise in engineering, societal, and logistical disciplines, all too little of which was directly available to the director of the Hurricane Center. Nevertheless, the collaboration of all concerned political entities with the Hurricane Center worked well *up to a point*. That point was reached with occurrence of Hurricane Camille in 1969, the first category 5 hurricane to reach a densely populated coastal area of the United States since the small but intense 1935 hurricane passed over the Florida Keys (Simpson and Sugg 1970).

Camille became an icon in the annals of national disaster policies. The application of scientific knowledge and modern technology produced much more timely and accurate predictions and warnings, and the actions of preparedness officials at the state and local level were commendable. However, the concern of Congress and the public was aroused in the face of unprecedented amounts of damage (\$1.4 billion) and the loss of 256 lives (Simpson and Sugg 1970). Questions about the response of coastal residents to warnings, and of public awareness, were the focus of attention for spontaneous initiatives by universities, and some private institutions, especially by social scientists, and the engineering community. These efforts first highlighted the need for a more effective manner of communicating the character and scope of a hurricane threat to life and property, and the impending crisis in planning and conducting the relocation of exposed residents. Much attention was given to the need for devising optimal hurricane resistant, cost-effective building standards and codes, as well as

² San Francisco and Honolulu were designated hurricane forecast offices for the eastern Pacific in the late 1950s.

the need for federal flood insurance to supplement what was available for wind damage through commercial institutions.

Perhaps the most significant leadership in revisiting the problems posed by Camille came from Gilbert and Ann White at the University of Colorado. Their Natural Hazards Research Center sponsored conferences annually to review, evaluate, and coordinate researches across the nation on the problems highlighted by the Camille experience (White and Haas 1975).

From this massive spontaneous effort, national policies and procedures have been reshaped, and responsibilities residing at the state, national, and local levels were clarified. The communication of warnings, both electronic and in textual structure, have evolved into a far more effective and efficient system.

5. Conclusions

The evolution of the present cooperative plan, from its initial stepping stones molded from crisis management decisions, to the present mature policy framework embracing multidisciplinary expertise from many sources, has led to a sound and effective integrated system, within limitations of science and technology, for the protection of life and property from natural hazards. It is a tribute to the altruism and initiatives with which local, state, and federal governments, and university and private organizations have collaborated in the betterment of public welfare.

It must be conceded, nevertheless, that despite the effectiveness of the cooperative programs described here, much work remains to be done before the potential for disaster from hurricanes can be reduced to an acceptable level. The difficult challenge is the complexity of relocating an ever-increasing number of coastal residents from harm's way within the amount of time that present prediction skills can provide. Unless some viable means can be devised for sheltering a significant portion of the coastal residents at risk without trans-

porting them significant distances inland, the only alternative is to develop means of extending the number of hours of warning. In this author's opinion, new technologies offer little promise in this regard. It would appear, therefore, that any extension of hours of warning must await a better understanding of the complex circulation properties that determine the point of hurricane landfall and arrival time.

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