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NOAA / Office of Ocean & Coastal Resource Mgmt

NOAA Coastal Hazards
Assessment Final
Report

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF OCEAN AND COASTAL RESOURCE MANAGEMENT
Washington, D.C. 20535

V. Allin's Copy
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N/ORM4:VA

February 23, 1984

TO: Distribution
FROM: N/ORM4 - Vickie A. Allin
SUBJECT: NOAA Coastal Hazards Assessment Final Report

Attached is the final report of the NOAA Coastal Hazards Assessment. The report incorporates the comments I received on the previous draft. In addition, I have reorganized it to delete two sections dealing with changes in Federal coastal hazards policy and emerging coastal hazards issues and have fit these points into the general issue discussion. Hopefully, this will help those who were confused by the previous format about how these points fit into the analysis and recommendations. There was general agreement with the recommendations and they remain unchanged.

In accordance with Kelly Taggart's memorandum of November 29, 1983, OCRM is implementing the recommendations. First, we have established the structure within OCRM for carrying out our coastal hazards responsibilities. The co-chairs of OCRM's Coastal Hazards Task Force, Marcella Jansen in the Policy Coordination Division and Dennis Carroll's replacement in the Coastal Programs Division, will have overall responsibility for the program, with the advice and assistance of the Task Force members. Second, we have established the NOAA Coastal Hazards Coordinating Committee. The Committee has held two meetings and has basically agreed on a statement of purpose, operation and objectives. Third, we have worked with FEMA to revise and consolidate annexes D, E and F of the NOAA/FEMA MOU. Our proposed revisions are presently in clearance within NOAA and FEMA. We will contact you, through the Committee or individually, as we implement the remaining recommendations.

I want to thank all of you for your time and thoughtful attention to the report and ask for your continued cooperation in its implementation.

Attachment

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ABSTRACT

NOAA COASTAL HAZARDS ASSESSMENT

A. Introduction/Purpose:

Natural hazards pose a large and growing threat to lives and property along much of the Nation's shoreline. Inadequate land use controls and intense development pressure have resulted in rapid population growth and accelerated economic development within the floodplain, in low-lying areas and on barrier islands that are particularly vulnerable to coastal hazards such as hurricanes, flooding, erosion, tsunamis and land subsidence. In recent years, policy-makers have recognized that Federal programs have also facilitated development and population growth in hazardous coastal areas. The growing awareness of our vulnerability to natural hazards has led to heightened interest in natural hazard management to minimize loss of life and property.

This paper examines the future direction of NOAA's coastal hazards policy coordination efforts and the NOAA Coastal Hazards Program (NCHP). These two issues are intertwined because the NCHP was intended to establish a new direction in NOAA coastal hazards policy--by integrating NOAA's products and services to facilitate comprehensive regional coastal hazard planning. The intent was not implemented fully because funds were not available. The responsibility for NOAA-wide policy coordination on coastal hazards and the NCHP became part of the Office of Ocean and Coastal Resource Management (OCRM) in the November, 1982 NOAA reorganization. The reorganization provided a new opportunity to reconsider NOAA coastal hazards policy objectives and explore new ways to work with states, other parts of NOAA and other Federal agencies to improve coastal hazards planning and mitigation.

B. Background

For several reasons, the efforts of all levels of government to deal with natural hazards have not been effective in curbing the trend towards mounting property losses and increasing vulnerability to catastrophic loss of life. At the state and local level, the obstacles include:

1. Inadequate standards for properly locating and constructing new development.
2. Lack of pre-disaster planning to guide reconstruction following a disaster.
3. Legal challenges to state and local programs designed to avert or mitigate hazard damage. (Claims of liability against local governments for failing to protect their citizens from hazard losses are beginning to counteract this obstacle.)

At the Federal level, the biggest problem is the lack of a consistent and coordinated policy to minimize development in hazardous areas. Most Federal infrastructure investment programs have the effect of subsidizing

development in hazardous areas because they do not discriminate between development in these areas and development in less hazardous locations. In addition, the National Flood Insurance Program provides flood insurance for existing construction and even some new construction in floodprone areas at subsidized rates. Furthermore, although not designed to protect against all magnitudes of a hazard, structural solutions like flood and erosion control projects may encourage development in hazardous areas by giving people a false sense of security. Increases in population and development in some of these "protected" areas have created the potential for truly staggering losses if storms exceed the design capacity of a protective structure. In addition to increasing the risks to people, these programs have the effect of committing the Federal government to large, continuing expenditures to rebuild communities devastated by natural hazards.

On the other hand, several Federal efforts have been directed to reducing the risks (and future Federal costs) of hazard losses. These include coastal zone management planning, the Floodplains and Wetlands Executive Orders (which direct Federal agencies to avoid development in hazardous areas), the Interagency Agreement on Flood Hazard Mitigation (which directs Federal disaster relief and recovery programs to cooperate on plans to reduce future flood losses), and the recently enacted Coastal Barrier Resources Act (which restricts Federal expenditures, financial assistance and flood insurance on undeveloped coastal barriers.)

The Federal Emergency Management Agency (FEMA) was created to coordinate and direct federal policy in dealing with emergency situations, including natural disasters. The agency's efforts to carry out this mandate have been impeded by a lack of authority over other federal agency hazards programs. Since 1980, however, general trends in Administration policy have resulted in major changes in the incentive structure for hazards management and more consistency in Federal policy to avoid supporting unwise development and encourage measures to reduce hazard risks and, thus, future Federal costs.

The "New Federalism" is placing greater programmatic and financial responsibility on the states for the management of coastal resources. Natural hazards management is part of this trend. At the same time, the states and localities are being asked to provide 25 percent cost sharing with the Federal Government for disaster relief. This new cost sharing policy will encourage more cost effective disaster response efforts and it will provide an important incentive for state/local emphasis on hazard mitigation and preparedness to reduce future hazards losses and associated disaster relief costs.

C. Summary Analysis of NOAA's Role in Coastal Hazards and Future Directions:

As one of three Federal agencies with major coastal hazards programs (the others are FEMA and the U.S. Army Corps of Engineers), NOAA has an important interest in improving its coastal hazards policy coordination efforts and the direction of its resources to deal with coastal hazards problems. The NOAA Coastal Hazards Program (NCHP) was a step in this direction. However, it emphasized NOAA's traditional technical services for emergency preparedness rather than the planning elements that are essential

for hazard mitigation. It also did not establish a process for effectively involving state and local units of government, which have the major implementation authority for most actions to reduce hazard losses.

In addition, the NCHP's role as the coordinating point for NOAA Coastal Hazards programs did not develop as intended. While institutional arrangements exist to coordinate with other Federal coastal hazards agencies--the NOAA/FEMA MOU, the Hurricane Committee and the Interagency Agreement on Hazard Mitigation--there is no regular mechanism at present for coordinating the coastal hazards programs within NOAA. Such coordination is needed, not only to take advantage of OCRM's links with the states to "market" existing products and services, but to coordinate evacuation planning with development and mitigation planning and to take advantage of dual use opportunities for NOAA's products and services.

The key coastal hazards issue of the next decade will be to correct existing problems of hazardous development. The focus of the 1970's was on new development--avoiding new development in hazardous areas or making it more resistant to damage. However, such a focus provides only a marginal opportunity to lower mounting hazards losses. The need in the 1980's is to find incentives to motivate individual property owners and state and local officials to take site-specific, and statewide and community actions to reduce the vulnerability of existing development to hazards losses.

In a way, the NOAA Coastal Hazards Program was intended to help in this effort. However, the Program evolved in a different direction and clearly needs reorganization and refocusing to be an effective addition to NOAA's coastal hazards role. The NOAA reorganization has created an opportunity to balance NOAA's ongoing expertise in warning and evacuation with a new pre-disaster planning capability. This will address the needs for:

- o better coordination of NOAA coastal hazards programs, particularly its evacuation planning and mitigation efforts,
- o better coordination both within NOAA and with other Federal agencies to adjust to budget changes and make maximum use of limited resources, and
- o better NOAA services on an agency-wide basis.

D. Summary Recommendations:

1. Redirect the NCHP to encourage comprehensive coastal hazards planning and mitigation by states and communities. The new FEMA policy of requiring 25 percent state/local cost sharing in disaster relief creates a strong incentive for states and communities to undertake hazard planning and mitigation efforts. The structure of state planning and management programs established under the CZMA is equipped to translate the high priority states and communities may place on comprehensive hazard planning and mitigation into concrete plans and actions to reduce future hazards losses, and thus, state and community costs of disaster relief and rehabilitation. NOAA should balance its ongoing operational expertise in issuing warnings and assisting in evacuations with a new pre-disaster planning capability to encourage and facilitate state and local hazard mitigation efforts and improve NOAA's overall hazards program.

2. Restructure the NCHP by incorporating it into OCRM's overall technical assistance program.

Coastal hazards has already been identified as a high priority issue for the OCRM technical assistance program. Incorporating the NCHP into this program will allow us to bring substantial resources to bear immediately. Also, OCRM's existing links with states should improve the effectiveness with which we target and deliver technical assistance and handle liaison between the states and the other Federal coastal hazards agencies.

3. Establish a regular mechanism for coordinating NOAA's coastal hazards programs.

Marshalling technical assistance from all of the NOAA elements involved in coastal hazards and maximizing our limited coastal hazards resources requires coordination. To put in place a regular mechanism for NOAA-wide coordination, OCRM should establish a NOAA coastal hazards coordination group, including representation from the other NOAA line offices with coastal hazards programs.

4. Improve NOAA products and services to address this issue by charging the OCRM Coastal Hazards technical assistance task force and the NOAA coastal hazards coordination group with:

- improving packaging and marketing of coastal hazard related products and services to increase their use by our constituents,
- considering new or modified products and services that reflect an increased emphasis on pre-disaster planning, and
- increasing our efforts to exchange information with constituents on effective techniques for reducing hazard losses and to provide feedback from them to improve NOAA's mix of products and services.

The new External Affairs Offices, and the new Ocean Service Centers provide opportunities to address these needs.

5. Improve interagency and intergovernmental coordination on coastal hazards by charging the OCRM Coastal Hazards technical assistance task force with:

- compiling and exchanging information on innovative and cost effective state techniques for dealing with coastal hazards,
- working with other NOAA offices, the Federal Emergency Management Agency and the U.S. Army Corps of Engineers to share inter-agency hazards information more effectively with the states, and
- exploring with the Federal Emergency Management Agency ways to reorganize and develop implementation plans for portions of the NOAA/FEMA Memorandum of Understanding dealing with coastal zone management, risk and damage assessment, and mitigation.

NOAA COASTAL HAZARDS ASSESSMENT

Natural hazards pose a large and growing threat to lives and property along much of the Nation's shoreline. Inadequate land use controls and intense development pressure have resulted in rapid population growth and accelerated economic development within the floodplain, in low-lying areas and on barrier islands that are particularly vulnerable to coastal hazards such as hurricanes, flooding, erosion, tsunamis and land subsidence. In recent years, policy-makers have recognized that Federal programs have also facilitated development and population growth in hazardous coastal areas, and have supported a construction-destruction-reconstruction cycle, largely at the taxpayer's expense. The growing awareness of our vulnerability to natural hazards has lead to heightened interest in natural hazard management to minimize loss of life and property.

A. Background

Several factors contribute to the Nation's vulnerability to catastrophic coastal hazards losses:

1. Population

According to the 1980 Census, about 40% of the Nation's population lives along its coasts.^{1/} Current population data show the nationwide migration of people to the coasts that took place in the 1960s and 1970s is continuing in the South Atlantic (coastal population up 31% from 1970), Gulf (up 25%),

^{1/} Author's Note: The commonly used figure of 53% comes from a 1970 Census Bureau calculation that included the population of all counties any portion of which was within 50 miles of the coast or the Great Lakes. This more conservative figure represents the population of coastal counties as identified by the Office of Ocean and Coastal Resource Management for the 30 coastal states (not including territories).

and West coast states (up 17%), while coastal population in the New England states increased by only 4% and coastal population in the Mid-Atlantic and Great Lakes states declined (by 2% and 3%, respectively). The largest growth in coastal population is now concentrated in Florida, Texas, Alaska and California. For example, Florida's coastal counties grew by 57.4% from 1970 to 1980, Alaska's grew by 37.8%, Texas' grew by 33.2%, and California's grew by 27.9%.^{2/} Much of the continued growth in coastal population is taking place in some of the areas most vulnerable to natural hazards.

2. Lack of Awareness

Many new coastal residents have not experienced the hazards associated with their locations. In the last two decades, there has been an unusual lull in major Atlantic/Gulf hurricane strikes. Thus, many people have no direct appreciation of the destructive power of these storms.

3. Inadequate Evacuation Infrastructure

Meteorologists say that in spite of improvements in severe storm forecasting, the potential for catastrophic loss of life in a major disaster is greater now than at any time in the past. The rapid growth of many population centers has exceeded their ability for timely evacuations. Bridges, ferries, and exposed coastal highways that allow adequate transportation in normal times can become clogged during an attempted emergency evacuation. Rising tides and rainfall can disrupt transportation routes many hours before a storm strikes, trapping people to become potential victims of high winds and storm surge. For example, Dr. Neil Frank of the National Hurricane Center has suggested that only one-half of the 60,000 residents of the Florida

^{2/}

1980 Control List, by County -- Number 30, Robert W. Marx, U.S. Bureau of the Census, June 6, 1983.

Keys could be evacuated before a major storm, given the limitations of current weather prediction methodologies and the evacuation routes available.

The major authority and responsibility for dealing with natural hazards rests with state and local governments. The Federal government assists states and communities primarily by providing forecast, warning and disaster preparedness services, by providing flood insurance, by constructing flood and erosion control projects and by providing funds for disaster relief and infrastructure replacement and repair.

For several reasons, the efforts of all levels of government to deal with natural hazards have not been effective in curbing the trend towards mounting property losses and increasing vulnerability to catastrophic loss of life. At the state and local level, the obstacles include:

1. Inadequate standards for properly locating and constructing new development.

In part, the policies for proper location and construction of development are guided by community participation in the National Flood Insurance Program (NFIP), which requires that communities adopt floodplain management standards in order to qualify for federal flood insurance. However, many communities are still in the emergency phase of the program, where the requirements are minimal. When communities enter the regular phase of the program (which begins when the Flood Insurance Administration has completed the detailed hydrological and topographic studies necessary to determine the base flood elevation for the 100 year flood), the floodplain management requirements are more stringent. However, even here the required standards and rates are artificially low because they are based on calculations of storm surge/wave heights which do not account for shoreline erosion and there is only one

locational requirement: structures must be located landward of mean high tide. While there is nothing to prevent states and communities from establishing stricter standards, few have done so. A notable exception is the State of North Carolina, which has established an oceanfront setback and permitting system to protect structures from coastal storms and at least 30 years of erosion.

2. Lack of pre-disaster planning to guide reconstruction following a disaster.

The post-disaster period is a critical time for hazard mitigation. It is a time when fundamental decisions are made that will determine the pattern of development for years to come--or at least until the next disaster. Sound decisions at this time can substantially reduce federal costs for flood insurance, disaster relief, erosion control structures and infrastructure investment, as well as future exposure of lives and private property to hazard losses. Unfortunately, such planning is usually neglected until a disaster strikes. At that point, quick action is required and short-term recovery is emphasized over long-term hazard mitigation.

There is tremendous pressure following a disaster to restore the affected area to its original state. To withstand this pressure, reconstruction policies need to be in place to take advantage of mitigation opportunities (be they relocation of infrastructure and residences, reconstruction of facilities to safer standards, acquisition of high hazard areas for public open space, etc.) that occur following a disaster. Unless prudent reconstruction policies are implemented more widely, hazard losses will be repeated again and again.

3. Legal Challenges---

During the 1970's many state and local programs were designed to avert or mitigate hazard damage. These programs employed regulation, tax incentives and/or compensation, depending on the character of the land and its existing use.^{3/} Two types of challenges to regulatory programs arose:

- "Taking." Regulations that help the public by lessening hazard losses also tend to decrease the value of regulated land because this value to some extent reflects the discounted value of its prospective development. If that prospect is limited by regulations, the landowner may challenge the regulations, alleging that his property has been "taken" in the sense that the restrictions deprive him of a substantial portion of the property's value. Many court decisions on this issue hold that regulation enacted for a valid public purpose will be upheld unless the landowner is denied all reasonable beneficial use of the land.^{4/}

- Equal Protection. This requirement means that laws must not be discriminatory. In the context of hazard mitigation regulations, it means that similarly situated property must be treated similarly. Legal challenges on this basis have arisen usually in regard to the establishment of hazard area boundaries, specifically the inclusion or exclusion of particular properties. The technical sufficiency of FEMA's floodplain studies and resulting Rate Maps is a case-by-case decision because the studies are done by different contractors throughout the country. This entire issue is under study by FEMA, with the assistance of the National Academy of Sciences/^{5/} National Research Council.

^{3/}

A Report on Flood Hazard Mitigation, National Science Foundation (NSF), September, 1980, p. 73

^{4/}NSF, p. 76

^{5/}NSF, p. 76

While these legal challenges can constrain state and local initiative to undertake hazard mitigation programs, another development may encourage such programs. This is the potential liability of local governments for failing to protect their citizens from natural hazards.

Courts are changing their attitude toward legal defenses on "Acts of God" arguments. No longer are all damages resulting from natural disasters viewed as unavoidable and, hence, liability free. Technological advances provide important guidelines on how to build, where to build, and how to forecast disaster events. Those who ignore such technologies, or fail to implement them in a reasonable manner, may be held negligent under some circumstances.^{6/} Suits against local governments have been successful in redressing flood-related losses in inland settings, particularly in California. It is likely that actions of coastal jurisdictions regarding hazard management may be subjected to judicial scrutiny in the near future.^{7/}

At the Federal level, the biggest problem is the lack of a consistent and coordinated policy to minimize development in hazardous areas. Most Federal infrastructure investment programs have the effect of subsidizing development in hazardous areas because they do not discriminate between development in these areas and development in less hazardous locations. In addition, the National Flood Insurance Program provides flood insurance for existing construction and even some new construction in floodprone areas at subsidized rates. Furthermore, although not designed to protect

^{6/} NSF, p. 126

^{7/} Association of State Floodplain Managers, Proceedings of a National Symposium on Preventing Coastal Flood Disasters (Ocean City, Md., 1983), p. 308.

against all magnitudes of a hazard, structural solutions like flood and erosion control projects may encourage development in hazardous areas by giving people a false sense of security. Increases in population and development in some of these "protected" areas have created the potential for truly staggering losses if storms exceed the design capacity of a protective structure. In addition to increasing the risks to people, these programs have the effect of committing the Federal government to large, continuing expenditures to rebuild communities devastated by natural hazards.

On the other hand, several Federal efforts have been directed to reducing the risks (and future Federal costs) of hazard losses. These include coastal zone management planning, the Floodplains and Wetlands Executive Orders (which direct Federal agencies to avoid development in hazardous areas), the Interagency Agreement on Flood Hazard Mitigation (which directs Federal disaster relief and recovery programs to cooperate on plans to reduce future flood losses), and the recently enacted Coastal Barrier Resources Act (which restricts Federal expenditures, financial assistance and flood insurance on undeveloped coastal barriers.)

The Federal Emergency Management Agency (FEMA) was created to coordinate and direct federal policy in dealing with emergency situations, including natural disasters. The agency's efforts to carry out this mandate have been impeded by a lack of authority over other federal agency hazards programs. Since 1980, however, general trends in Administration policy have resulted in major changes in the incentive structure for hazards management and more consistency in Federal policy to avoid supporting unwise development and encourage measures to reduce hazard risks and, thus, future Federal costs.

The "New Federalism" is placing greater programmatic and financial responsibility on the states for the management of coastal resources. Natural hazards management is part of this trend. At the same time, the states and localities are being asked to provide 25 percent cost sharing with the Federal Government for disaster relief. This new cost sharing policy will encourage more cost effective disaster response efforts and it will provide an important incentive for state/local emphasis on hazard mitigation and preparedness to reduce future hazards losses and associated disaster relief costs.

B. NOAA's Role in Coastal Hazards

NOAA, the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers (the Corps) all have major coastal hazards programs. NOAA's coastal hazards programs address two basic missions: 1) protection of people, property and natural resources, and 2) providing financial and technical assistance under the Coastal Zone Management Act (CZMA) to help states to provide balanced management of their coastal zones. Most components of NOAA have programs to deal with coastal hazards. These programs, and associated products and services, are summarized in Appendix A.

1. Institutional arrangements for Coordinating NOAA Coastal Hazards Programs.

NOAA's institutional arrangements for coordinating its coastal hazards programs with those of other Federal agencies are primarily through the NOAA/FEMA MOU, the interagency Hurricane Committee and the Interagency Agreement on Flood Hazard Mitigation.

In 1980, NOAA and FEMA entered into a Memorandum of Understanding (MOU) to coordinate their respective emergency-related responsibilities. A series of nine annexes (later reduced to seven through the combination of annexes A and B and F and G) to the MOU were developed to provide specific guidance in

several program areas. Three of the annexes are now the responsibility of NOS: Annex D on Coastal Zone Management, Annex E on Risk and Damage Assessment, and Annex F on Mitigation and Research. Implementation plans have not been completed for these Annexes.

The NOAA/FEMA MOU established a NOAA/FEMA Review Board, which meets annually to review the coordination between the two agencies and consider other issues as appropriate. NOAA is represented on the Review Board by Richard E. Hallgren, Acting Assistant Administrator for the National Weather Service, and FEMA is represented by Hugh Richardson, Director of the Office of Emergency Response. NOAA's representation by Dr. Hallgren of NWS is appropriate because the MOU covers all emergency-related responsibilities, not just those relating to coastal hazards. Although other NOAA Line Offices, including NOS, have major emergency responsibilities, none in NOAA covers as wide an array of emergency programs as NWS.

In addition to the Review Board, each of the seven annexes to the NOAA/FEMA MOU calls for a Joint Working Group. These generally consist of one or two members from each agency, who meet infrequently. Present members are:

Annex A (combined with Annex B) - Planning and Preparedness and

Warning and Communications Systems

Ric Coleman, NWS
Dick Wood, NWS

Ross McKay, FEMA

Annex C - Technical Assistance

Ric Coleman, NWS

Ross McKay, FEMA

Annex D - Coastal Zone Management

Vickie Allin, NOS

Mike Robinson, FEMA

Annex E - Risk and Damage Assessment

NOS

Joe Bishop, FEMA

Annex F - (combined with Annex G) - Mitigation and Research

NOS

Art Zeizel, FEMA

Annex H - Public Information

Stan Eames, NOAA/PA

Sandy Farrell, FEMA/PA

Annex I - Training and Education

Dick Wood, NWS

Gary Sepulvado, FEMA

Since the Annexes were developed, both NOAA and FEMA have reorganized and readjusted resources among their program areas. As a result, in some cases the Annexes do not reflect present organizations, resources and responsibilities. NOAA and FEMA need to explore ways to reorganize and combine Annexes further to match existing programs and available resources.

The Hurricane Committee is an informal group of representatives from NOAA, FEMA and the Corps that was formed about two years ago. There were two or three initial meetings and then the Committee was dormant until December, 1982. Since then, the Committee has met monthly to exchange plans and discuss SLOSH, vertical evacuation and other topics. Richard Sanderson, Director of FEMA's Natural Hazards Division, is chairing the Committee, with Ross McKay of his staff as an active member. The Corps is represented by Bill Donovan, Chief of the Division of Floodplain Management and Coastal Resources, and Jerry Petersen. NOAA is represented by Ric Coleman of NWS and Bill Millhouser and Marcella Jansen of NOS (OCRM). Many others have attended from time to time. The Committee expects to continue meeting at approximately monthly intervals. Through this Committee, NOAA, FEMA and the Corps coordinated their financial and technical assistance to the State of Florida for regional evacuation planning.

Through the Department of Commerce, NOAA also participates in the Interagency Agreement on Hazard Mitigation. The Agreement was developed in 1981 in response to an Office of Management and Budget directive to develop and implement a common policy for flood disaster planning and postflood recovery to ensure that Federal financial assistance minimizes future flood losses. FEMA was designated the lead agency. Other participants are the Departments of Agriculture, Army, Commerce, Housing and Urban Development and Interior, the Environmental Protection Agency and the Small Business Administration. Under the Agreement, Hazard Mitigation Teams are mobilized when major disasters are declared. They recommend actions by Federal agencies and state and local governments to reduce future hazard losses. Federal agencies have agreed to comply with the recommendations of the Team reports to the maximum extent practicable. Under Section 406, state and local governments can be required to comply with the recommendations as a prerequisite for obtaining Federal disaster assistance.

While these mechanisms provide opportunities to coordinate with other Federal coastal hazards agencies, there is no regular mechanism at present for coordinating the coastal hazards programs within NOAA. The NOAA Coastal Hazards Program was to serve as the coordinating point, but because the program did not develop as intended, the coordination did not develop as intended either. Ad hoc coordination is taking place--for example, the NWS has met with OCRM and other NOAA units several times to gain our assistance in implementing the SLOSH model more widely and effectively for state/local evacuation planning. SLOSH was developed as a forecasting tool. Its use for evacuation planning, not envisioned initially, makes possible a major advance in the accuracy and reliability of area evacuation plans because it

estimates not only the maximum height and areal extent of the surge, but also time-histories of both surge and winds over the forecast area. This information could also be used in mitigation planning by improving the vulnerability assessment of particular areas and, hence, providing a guide to the proper location and construction of new development. This effort has shown the need for more regular coordination, not only to take advantage of OCRM's links with the states to "market" existing products and services, but to coordinate evacuation planning with development and mitigation planning and to take advantage of dual use opportunities for NOAA's products and services.

2. Special NOAA Initiative in Coastal Hazards--The NOAA Coastal Hazards Program

In 1980, NOAA initiated the NOAA Coastal Hazards Program (NCHP) and prepared a Program Development Plan (PDP) outlining a program to be of major assistance in minimizing loss of life and property from coastal hazards. A NCHP Office was established in the National Ocean Survey (NOS) to coordinate the program. The intention was to bring to bear all relevant NOAA program efforts in the development of 39 regional comprehensive hazards assessments, encompassing storm surge modelling, climate data packages, storm evacuation mapping, "land use controls," hazard warnings, evacuation planning, and public education. The PDP was based on a budget initiative of approximately \$2 million per year for the period FY 1983-1986. The budget initiative did not receive a high enough priority to be funded in the NOAA budget. As a result, the NCHP Office became a small technical services group, concentrating on developing and disseminating a limited range of mapping and charting products and services. Its current functions consist of a cooperative storm evacuation mapping program with states and a joint NOS/Corps shoreline

movement study of segments of the Mid-Atlantic coast. It also has provided modest funding, jointly with the former Office of Coastal Zone Management, FEMA, and the Corps, of regional evacuation studies in Texas and Florida, and has supported a Coastal Hazards conference in Charleston, South Carolina, that was very successful in generating a number of hazard mitigation and preparedness activities in that state.

Although the NCHP was an important step toward assisting states in comprehensive planning for coastal hazards, it emphasized NOAA's traditional technical services for emergency preparedness rather than the planning elements that are essential for hazard mitigation. It also did not establish a process for effectively involving state and local units of government, which have the major implementation authority for most actions to reduce hazard losses. The NCHP Office was merged into NOS's Office of Ocean and Coastal Resource Management (OCRM) in the November 1982 reorganization of NOAA and its future direction is a major issue addressed in this paper.

C. Future Directions for NOAA's Role in Coastal Hazards

The key coastal hazards issue of the next decade will be to correct existing problems of hazardous development. The focus of the 1970's was on new development--avoiding new development in hazardous areas or making it more resistant to damage. However, such a focus provides only a marginal opportunity to lower mounting hazards losses. The need in the 1980's is to find incentives to motivate individual property owners and state and local officials to take site-specific, and statewide and community actions to reduce the vulnerability of existing development to hazards losses.

In a way, the NOAA Coastal Hazards Program was intended to help in this effort. However, the Program evolved in a different direction and clearly needs reorganization and refocusing to be an effective addition to NOAA's

coastal hazards role. The NOAA reorganization has created an opportunity to take action to improve NOAA coastal hazards policy coordination efforts and the direction of NOAA resources to assist states and communities to deal with coastal hazards problems. These actions should address the needs for:

- o better coordination of NOAA coastal hazards programs, particularly its evacuation planning and mitigation efforts,

- o better coordination both within NOAA and with other Federal agencies to adjust to budget changes and make maximum use of limited resources, and

- o better NOAA services on an agency-wide basis.

1. NOAA's Objectives in Coastal Hazards

NOAA has data and expertise in coastal hazards. It has a well-established program of technical services to provide forecasts and warnings of approaching storms and to assist states and localities in designing and implementing appropriate responses to those warnings. It provides statistical probabilities of hazards to guide design, planning and zoning decisions. It's Federal CZM Program can also influence state and local actions to reduce the vulnerability of people and development to coastal hazards. State and local governments have the authority and responsibility for most risk reduction (i.e., mitigation) and evacuation actions. Through state CZM programs, they are already addressing the difficult question of how best to use the coast without unacceptable risks of loss of life and property. These programs are ideal vehicles for incorporating the difficult social and economic judgments involved in promoting prudent coastal development and planning future uses of coastal areas so that fewer people and less development will be affected by a natural disaster. Such planning is the key to reducing hazards losses.

For these reasons, NOAA's coastal hazard objectives should be to continue its programs of research and technical services for early and accurate storm warning and effective evacuation, and to:

a. serve as a catalyst for hazard mitigation (i.e., loss reduction) planning at the state and local level,

b. coordinate NOAA programs to provide technical assistance to states and localities in their planning efforts, and

c. work with other Federal agencies to promote information exchange between the Federal Government and the states and localities and to gain Federal support for state/local hazard mitigation planning and actions.

2. NOAA's Coastal Hazards Constituents

Although NOAA does provide products and services to other Federal agencies, its main hazards constituents are state agencies charged with emergency preparedness and CZM responsibilities, local governments and private individuals and businesses. This is because states, localities and private citizens have the primary authority to undertake those aspects of hazard planning and mitigation to which most of NOAA's programs apply--particularly evacuation planning and community and individual actions to reduce hazard losses.

3. Strategy for Achieving NOAA's Coastal Hazards Mitigation Objectives

a. Hazard Mitigation Planning - NOAA's main incentive for encouraging hazard mitigation planning by states has been financial assistance under the CZMA--particularly under the Significant Improvement provisions of the 1980 amendments. However, the new FEMA policy of requiring 25 percent state/local cost sharing in disaster relief adds another, and potentially stronger incentive. Many states and communities have expressed concern that this requirement could bankrupt them if a major disaster were to strike.

The structure of state planning and management programs established under the CZMA is equipped to translate the high priority states and communities may place on comprehensive hazard planning and mitigation into concrete plans and actions to reduce future hazards losses, and thus, state and community costs of disaster relief and rehabilitation. NOAA should balance its ongoing operational expertise in issuing warnings and assisting in evacuations with a new pre-disaster planning capability to encourage and facilitate state and local hazard mitigation efforts and improve NOAA's overall hazards program.

b. Better Services - NOAA's current hazards products and services are heavily concentrated in the area of evacuation and warning systems, based on the historic development of NOAA's weather, charting and geodetic survey programs. Supporting data collection and research has also been concentrated in these areas. NOAA's planning assistance program under the CZMA is a relative latecomer. Despite several new products and technological advances, the needs of this program for products and services that are better tailored to pre-disaster hazard mitigation planning require more attention. Areas where improvement is needed include:

- improved packaging and marketing of related products and services to increase their use by our constituents,
- consideration of new or modified products and services that reflect emerging trends and issues in reducing hazards losses, and
- increased effort to exchange information with constituents on effective techniques for reducing hazard losses and to provide feedback from them to improve NOAA's mix of products and services.

OCRM's technical assistance program, the new External Affairs Offices, and the new Ocean Service Centers provide opportunities to address these problems.

c. Improved Interagency and Intergovernmental Coordination -

The NWS has excellent ties with state and local civil defense offices and with FEMA, just as OCRM has excellent ties with state CZM programs. NOAA should use these ties to encourage coordinated coastal hazards planning and mitigation at the state and local level and persuade other Federal agencies to use acceptable state/local hazard mitigation plans to guide their own disaster relief and rehabilitation activities.

The 1980 amendments to the CZMA and the NOAA/FEMA MOU provide a statutory and policy basis for improving interagency and intergovernmental coordination. Through them, NOAA can build a more effective coordination mechanism with states and other Federal agencies to achieve the overriding objective of reducing coastal hazards losses. Opportunities for improvement include:

- exchanging information between states and Federal agencies on innovative and cost effective techniques for coastal hazard management, and

- developing remaining implementation plans for key annexes to the NOAA/FEMA MOU dealing with coastal zone management, risk and damage assessment, and mitigation, including considering ways to reorganize and combine the annexes to match existing programs and available resources.

D. Options for Reorganizing the NCHP

1. Reinstitute the NCHP initiative as originally proposed.

This is not feasible because of fiscal constraints and the increasing reliance on state/local versus Federal initiative in coastal hazards. Rather, our aim should be to improve the direction of existing programs to meet current needs.

2. Obtain renewed NOAA management commitment to a redirected NCHP, but incorporate it into the overall OCRM technical assistance program.

The redirection would involve dropping the 39 regional comprehensive hazards assessments as the focus of the program and, instead, concentrating on encouraging state/local hazard mitigation planning and on improving our products and services to help states do this. This redirection is fully consistent with the Administration's philosophy that states and communities should assume more of the responsibility for managing coastal resources. It will also promote state and community measures to reduce future hazard losses, and thus, future Federal costs of flood insurance, public works, infrastructure repair and disaster relief.

The program would be carried out initially with existing staff and resources. Organizationally, the NCHP fits in well with OCRM's expanded technical assistance program. Coastal hazards has already been identified as a high priority issue for the OCRM technical assistance program. Also, OCRM's existing links with states should improve the effectiveness with which we target and deliver technical assistance and handle liaison between the states and the other Federal coastal hazards agencies. The technical assistance program will be carried out by task forces, made up of existing OCRM staff serving on a part-time basis, in each of the high priority issue areas. This structure will allow substantial resources and expertise to be devoted to coastal hazards immediately. The disadvantages of merging the NCHP into the OCRM technical assistance program are: (a) the NCHP may lose visibility by being subsumed within a broader program, and (b) a high level of coastal hazards activity may strain the informal task force structure. However, the overriding need to get the program underway indicates that we try this approach.

Coordination among NOAA MLC's with coastal hazards programs (NOS, NWS, RD and NESDES) would be needed to build up our hazard mitigation capability and assist states and communities in using our coastal hazards products and services more effectively in their planning efforts. This need for continued NOAA-wide coordination on coastal hazards is the reason we still need a NOAA Coastal Hazards Program. Achieving coordination in coastal hazards requires active NOAA management commitment to the program.

3. Drop the idea of a NCHP and concentrate on NOS/OCRM coastal hazards issues and technical assistance.

As mentioned above, OCRM has already made coastal hazards a high priority of its technical assistance program and can bring to bear the products and services of the many units with coastal hazards functions that have been co-located in the new NOS. If active NOAA management priority for coastal hazards is not forthcoming, it makes no sense to keep the notion of a NOAA CHP alive because it cannot be effective. Therefore, this alternative would allow us to proceed to address current needs in this area without commitments beyond NOS.

E. Recommendations

1. Implement Option 2 and seek NOAA management's commitment to a restructured and redirected NCHP to achieve the objectives discussed above.

2. Organizationally, incorporate the NCHP into OCRM's technical assistance program for the present. If the future level of activity becomes too great for this informal structure, organizational alternatives such as re-establishing a NCHP Office or establishing a branch of PCD to deal exclusively with hazards policy coordination issues could be considered.

3. Put in place a regular mechanism for NOAA-wide coordination on coastal hazards. The Assistant Administrator for Ocean Services and Coastal

Zone Management should send a memorandum to the other NOAA Line Offices with coastal hazards programs asking them to designate representatives to a joint coastal hazards coordination group. (Done 11/29/83; two meetings have been held).

4. If sufficient priority from top NOAA management cannot be obtained within a reasonable time, implement Option 3 as the fallback position.

5. Independent of a decision regarding Option 2 or Option 3, charge the Coastal Hazards Task Force of OCRM's technical assistance program (Task Force), working with other NOAA representatives to the joint coastal hazards coordination group, with the following actions to improve NOAA's coastal hazards products and services:

a. establishing priorities and making recommendations to NOAA management for new or modified products and services to reflect increased emphasis ^{on} ~~in~~ pre-disaster planning. In establishing these priorities and recommendations, the group should survey state and local constituents and should coordinate with other Federal agencies to avoid duplication. The group should evaluate the following topics, among others: legal issues, the relative costs and benefits of structural and non-structural measures for flood and erosion loss reduction, sea level rise, and issues identified in the 1981 OCZM Hazards Policy Paper.

b. exploring the new Ocean Service Centers as vehicles to improve the distribution of NOAA's coastal hazards related products and services and the integration of related products and services so that they are more meaningful and easier to use. It is particularly important to integrate new maps, data, etc., with interpretive services to help constituents determine their policy implications and how they can be incorporated into existing planning efforts. The new regional Ocean Service Centers appear to be ideal vehicles

for accomplishing this integration. One of the concepts around which they were organized was to integrate NOAA's oceanographic and marine information. Since they are on-line, 24 hour facilities, they can interface constantly with Civil Defense offices during disasters, providing them the most current information and analyses.

c. consulting with the relevant NOAA External Affairs Offices to obtain advice on improving information exchange with and feedback on products and services from constituents.

6. To improve interagency and intergovernmental coordination on coastal hazards, charge the Task Force with:

a. compiling information on the status of state hazard planning under the CZMA and innovative techniques developed by the states, such as the non-regulatory approaches embodied in Massachusetts Executive Order on Barrier Islands and in North Carolina's, South Carolina's and Florida's hazard mitigation policies that predate the Federal Coastal Barrier Resources Act. The CZM Management Information System (CMIST) should be very useful in this effort when it is operational.

b. working with other NOAA coastal hazards programs, FEMA, and the Corps to share interagency coastal hazards information more effectively with the states.

c. exploring with FEMA ways to reorganize, combine and develop implementation plans for Annexes D, E and F in order to give effect to the cooperative hazard mitigation policies contained in Annex D and to improve our liaison with FEMA for the benefit of the states. (Proposal submitted to NOAA and FEMA; presently in clearance.)

Appendix A

NOAA Coastal Hazard Related Programs, Products and Services

National Weather Service (NWS) - The NWS has four programs that provide warnings of hazards and related services for all coastal areas. The National Hurricane Center (NHC), the Eastern Pacific Hurricane Center, and the Central Pacific Hurricane Center track and monitor tropical storms, issue hurricane watches and warnings, conduct meteorological research aimed at increasing warning time and decreasing the area of hurricane watch and warning, and provide public information presentations. The Severe Weather Branch performs and coordinates studies of weather and flood hazards, develops guidelines for the protection of life and property, and prepares and disseminates informational materials designed to help educate the public and public officials regarding hazards and the means of protection. Weather Service Forecast Offices in coastal states issue warnings and forecasts for coastal storms, and Warnings and Preparedness Meteorologists provide technical assistance to communities in weather hazard preparedness planning. The Coastal Flood Warning Program provides a forecast of the degree of coastal erosion and unusually high water due to storm surge or storm tides and waves associated with tropical and extratropical storms. The Tsunami Warning System monitors seismic activity and provides watches and warnings of tsunamis for U.S. states and territories bordering the Pacific Ocean.

National Earth Satellite, Data and Information Service (NESDIS) - NESDIS supports NWS warning programs with satellite data and analysis. It also acquires, archives and disseminates environmental (atmospheric, marine, geophysical) data and information; prepares summarized and descriptive information packages tailored to specific regions based on long-term

historical records; prepares information on hurricanes and other geophysical phenomena along with the impact on people and property; and determines statistical probabilities of occurrences of these phenomena.

Office of Oceanic and Atmospheric Research (OAR) - OAR conducts weather research including research on the modification of hurricanes and studies to improve forecast accuracy. Its Office of Sea Grant (SG) sponsors hazard-related research at various Sea Grant universities, particularly in the area of evacuation. The Sea Grant Marine Advisory Service conducts workshops, seminars and public meetings, and otherwise disseminates information to educate local officials and the public about coastal hazards and appropriate mitigation efforts.

National Ocean Service (NOS) - NOS is responsible for NOAA's ocean and coastal zone services program which includes analyses, statistics, forecasts and warnings of weather and oceanographic phenomena off the U.S. shores. NOS is responsible for the NOAA Coastal Waves Program which is in a prototype operational mode. Since 1971, NOS's Office of Charting and Geodetic Services has been producing Storm Evacuation Maps, which show evacuation routes, elevation data, and topographic features of various coastal areas. Only about 10 of the 190 base maps required for the Atlantic and Gulf of Mexico coasts remain incomplete. The program is now being conducted on a cooperative basis with states to accelerate production and tailor the base maps to meet specific local requirements. NOS is also involved in a cooperative pilot program with states and the Corps of Engineers to produce shoreline migration maps and related documents, which will show the movement of the shoreline over the past 150 years for certain areas of the Atlantic coast.

NOS provides aerial photographic services to record hurricane damage and provides storm surge data through the National Tide Observation Network. The Coastal Zone Management Program, now part of NOS, provides states and territories with financial and technical assistance to develop planning and management processes to mitigate the effects of coastal hazards.

National Marine Fisheries Service (NMFS) -

Under subsection 4(b) of P.L. 88-309, the Commercial Fisheries Research and Development Act, NMFS provides disaster assistance to states to restore commercial fisheries harmed by natural disasters. States can apply for funds when there is a Presidentially declared disaster or the NMFS Regional Director determines that a restorable commercial fishery resource has been damaged. Most funds have gone for replanting oyster seeds. Funds for this subsection are not routinely appropriated. Instead, NMFS usually requests a supplemental appropriation from the Congress when it receives an eligible state application.

The products and services generated by these programs are listed on the following pages according to four categories:

- I. Routine Products
- II. Financial and Technical Assistance
- III. Special Purpose Studies/Surveys
- IV. Other

I ROUTINE PRODUCTS

Geodetic Data - NOS(C&GS)

The National Geodetic Survey (NGS) develops and maintains the National Horizontal and Vertical Networks of Geodetic Control which consist of about 1 million precisely determined control points. These points provide the common base of reference to correlate longitude, latitude, elevation, scale, and orientation throughout the Nation for communication, transportation, boundary surveys, land records, public utilities, mapping, charting and a variety of other activities. These data are available from the National Geodetic Information Center of NGS.

Hydrographic Surveys - NOS(C&GS)

The results of hydrographic surveys called smooth sheets are detailed survey studies of water areas and provide the least depths of shoals; the controlling depths in natural waterways; and the positions of islands, rocks, reefs and obstructions. Additional depths in these survey areas are available in either digital or graphic form. In offshore areas where sufficient data is not available in bathymetric maps, these original surveys are necessary to determine the effects of storm waves on coastal areas.

Bathymetric Maps - NOS(C&GS)

Bathymetric Maps are topographic maps of the sea floor and portray the size, shape, and distribution of underwater features through the use of depth contours and point depths. These maps are used to determine the effects of storm waves on coastal areas.

Bathymetric/Topographic Maps - NOS(C&GS)

These maps are produced by NOS in conjunction with USGS and show a graphic presentation of the sea floor and adjacent-land areas through the use of land and water contours and multiple tints. They are useful in determining the effects of storm waves on coastal areas.

Nautical Charts - NOS(C&GS)

These charts are printed reproductions of some portion of the navigational part of the Earth's surface and show the nature and shape of the coast, depths of water, configuration of the sea floor, prominent landmarks, etc. They are used in coastal hazard planning.

Marine Weather Service Charts - NOS(C&GS)/NWS

This series of 15 charts, list the NOAA Weather Radio stations, and the commercial and U.S. Coast Guard marine radio stations that broadcast marine weather forecasts and warnings and their frequencies and schedule of weather reports, the location of visual storm warning display sites, and an explanation of marine warnings and other information. These charts cover the coastal waters of the United States and Puerto Rico.

Storm Evacuation Maps - NOS

This series of 160 maps covers most of the Atlantic and Gulf coast of the U.S. These maps show the main evacuation and feeder routes and critical elevations along these routes. They also include the shoreline, and elevation zones along the coast in multiple tints.

Coastal Mapping Handbook - NOS(C&GS)

This handbook is designed to help planners and managers of coastal programs in determining their mapping requirements, selecting the best maps and charts for their needs, and communicating effectively with those who gather data and prepare maps.

Tide Data - NOS(OMS)

Actual measurements and predicted tidal heights are available in many forms for the entire U.S. coast and many other parts of the world. The height of storm waves is somewhat dependent on the tide at a specific location and knowledge of tidal variation is important in planning for several coastal hazards.

Hurricane and Severe Storm Forecast and Warnings - NWS

The Hurricane and Severe Local Storm forecast and warning service supplements the Public Weather Service by providing watch and warnings information on hurricanes, tropical storms, tornadoes, severe thunderstorms, winter storms and flash floods. NWS offices issue advisories, warnings and statements about these phenomena. The National Hurricane Center issues watches and warnings for hurricanes, while local offices issue statements.

Coastal Flood Warning Program - NWS

Weather Service Forecast Offices with marine responsibility issue coastal flood watches and warnings to the public and marine interests during coastal storms events. During tropical cyclone (hurricane) events, forecasts of storm tide and flood threat are scheduled in advisories issued by the Hurricane Centers. Local statements are then issued by Weather Service Forecast Offices and Weather Service Offices to amplify tropical cyclone advisories.

Marine Weather Program - NWS/NOS

Weather Service Forecast Offices issue warnings, advisories, and forecasts for winds, waves, weather, visibility, and ice conditions essential to conducting safe and efficient marine operations. The principal products include coastal, offshore, high seas and Great Lakes forecasts, small craft advisories, and gale, storm, high surf, and coastal flood warnings.

Tsunami Warning System - NWS

Tsunamis or seismic sea waves are usually caused by earthquakes under the seas. Seismograph stations which participate in this system detect earthquakes and report to the Pacific Tsunami Warning Center (PTWC) and the Alaska Tsunami Warning Center (ATWC), where the earthquake location and magnitude are determined. The PTWC and ATWC issue watches and warnings of tsunamis which are disseminated by the Weather Services Forecast Offices responsible for U.S. states and territories bordering the Pacific Ocean.

II FINANCIAL AND TECHNICAL ASSISTANCES

Geodetic Advisory Service - NOS(C&GS)

This service assists State and local governments in performing supplemental geodetic surveys and mapping and provides planning assistances. This is a co-operative service which varies from occasional technical assistance in an area to the assignment of a permanent full-time NOS employee to a State government.

Disaster Preparedness Program - NWS

Disaster Preparedness Meteorologists (DPMs) provide assistance in developing disaster preparedness plans in various communities. They also work with local officials to test these plans, to ensure rapid dissemination of warnings, encourage proper response to warnings, and to enlist the aid of news media to increase public awareness of the threat of natural disaster. NWS DPMs are instrumental in developing storm spotter networks which provide critical feedback to NWS during severe storm events.

Coastal Zone Management/Coastal Energy Impact Program Grant and Loans - NOS(OCRM)

These grants and loans to coastal states are to help states to implement management programs dealing with the competing demands on the lands and waters surrounding the Nation's coast and to mitigate adverse effects of coastal energy development. The Coastal Zone Management Act, as amended, identifies improved management of coastal areas to minimize the impacts of coastal hazards as one of nine national coastal management objectives. Federal funding for both CZM and CEIP is scheduled to be phased out.

Marine Advisory Service - OAR(SG)

Sea Grant agents and specialists provides a link between the people who live and work in coastal areas and researchers in the universities. These advisors identify problems confronting coastal communities and aid is their solution by their own expertise or through the Sea Grant University Network. They also sponsor workshops, conferences and seminars on marine and coastal issues.

III SPECIAL PURPOSE STUDIES/SURVEYS

Crustal Movement - NOS(C&GS)

The National Geodetic Survey conducts high precision geodetic surveys to determine horizontal movement of the earth's crust in earthquake prone areas and vertical crustal movement in areas where subsidence (sinking) is suspected.

Aerial Photography - NOS(C&GS)

The NOS Photogrammetry Division operates a fleet of aircraft routinely used for chart update pictures. These aircraft are sometimes used for past disaster surveys.

Shoreline Movement Mapping - NOS(C&GS)

NOS, in cooperation with the Corps of Engineers, is producing coastal maps showing the changing position of the U.S shoreline along portions of the East and West coast over the past 150 years. These maps are produced by digitizing shorelines from historic NOS maps and portraying them along with the present shoreline position obtained from aerial photography. Since NOS possesses the only long-term history of shoreline movement along the U.S. coast, these maps serve as the basis for erosion studies and any attempt to predict future shoreline movement.

Coastal Wave Program - NOS(OMS)

This program provides ocean wave field data and statistics from stations in the U.S. coastal waters of the mid-Atlantic region. As this new program matures and is extended regionally, data for all coastal waters will be available.

Circulatory Surveys - NOS(OMS)/ESDIS(NODC)

Recent measurement of water currents, temperatures and salinity structures and associated data for selected areas are available from OMS. Older data of this type, and that collected by other agencies, is available from NODC. These data are necessary when hazardous substances enter the water.

Diving Program - NOS(OMO)

The NOAA Diving Program provides basic and specialized diver training to NOAA, state, and other Federal personnel and conducts underwater research.

Storm Surge Models - NWS

The National Weather Service is adapting the generalized SLOSH model to predict storm surge along the Atlantic and Gulf coast for particular bays and estuaries. Model output is also used for evacuation planning conducted by State and local agencies. Model outputs have been provided to planners in Galveston, Texas and Tampa and Ft. Meyers, Florida and used in development of evacuation plans. These models will be developed for at least 22 coastal regions along the Atlantic and Gulf Coast.

IV. OTHER

Research

Research on Climate, Severe Weather, Geophysics, and the behavior of individuals in a disaster is conducted and/or supported by NWS and OAR. Much of this research is related to hazards.

Data and Analysis

NESDIS archives and analyzes marine, atmospheric and geophysical data which is necessary in hazards research, planning and mitigation efforts.

