Marine Resource Bulletin

Vol. 19, No. 1

Spring 1987

Virginia Sea Grant College Program-Virginia Instuitute of Marine Science-College of William and Mary

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The Marine Resource Bulletin is a quarterly publication of Marine Advisory Services of the Virginia Sea Grant College Program which is administered by the Virginia Graduate Marine Science Consortium with members at **The College of William and Mary, Old Dominion University, University of Virginia and Virginia Polytechnic Institute and State University.** Subscriptions are available without charge upon written request.

Sea Grant is a partnership of university, government and industry focusing on marine research, education and advisory service. Nationally, Sea Grant began in 1966 with passage of the Sea Grant Program and College Act.

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Cover: Satellite photo courtesy of National Hurricane Center/NOAA. See top of page 3 for caption.

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Marine notes

Wallop-Breaux funds awarded recreational fishing studies

Two grants totalling $56,000 have been awarded Jon A. Lucy, Sea Grant Marine Recreational Specialist in the Department of Marine Advisory Services at the Virginia Institute of Marine Science by the U.S. Fish and Wildlife Service, funded under the Sport Fish Restoration Act, which is also known as the Wallop-Breaux Act.

Grant money in the amount of $32,000 was funded to continue studies on catch trends and fish utilization in Virginia's offshore recreational fishery for marlin and tuna. In addition to providing catch trend data on white and blue marlin, bluefin and yellow tuna, dolphin and wahoo, the study will also document catch handling practices.

The second grant, $24,000, was funded to determine fishing catch trends on Virginia's artificial reefs. This project involves systematically tabulating and analyzing fish catch data from fishermen utilizing fishing reefs established by the Virginia Marine Resources Commission. Fishing success rates will be determined for reef sites off the Virginia coast as well as inside Chesapeake Bay.

Intoxicated rivers and sleepless nights

Lee Lawrence, Sea Grant Education Specialist at VIMS, receives over 500 written requests for information each year from students and teachers in Virginia, and nearly as many phone calls. "We are studying toxic waste in rivers," wrote one student, "please send the name of the nearest intoxicated river for me to study."

The favorite request the Sea Grant Marine Advisory staff receives is: Please send me everything you have about marine science (or the Chesapeake Bay). "There's a tremendous desire on particularly busy days to deliver a giant tractor-trailer load of material to someone's house," says Lawrence. But the Sea Grant Advisory staff take these requests very seriously, "Everyone we reach is one more person who can help us protect Virginia's marine resources."

Many of the students are interested in careers in marine science, "Marine Biology is the dream of my life," wrote another student. "I have spent many sleepless nights thinking of the day when I become a Marine Biologist." Sea Grant provides materials on careers in marine science as well as printed advice for science projects, all of which are sent out at the rate of 7,500 publications a year, not counting the 44,000 quarterly newsletters, from the Sea Grant Advisory Office.

Barbara Kriete, Department Publications Secretary, has a full-time job just keeping up with the mailings, reordering of publications, and requests for specific materials that don't require additional information from the Education staff.

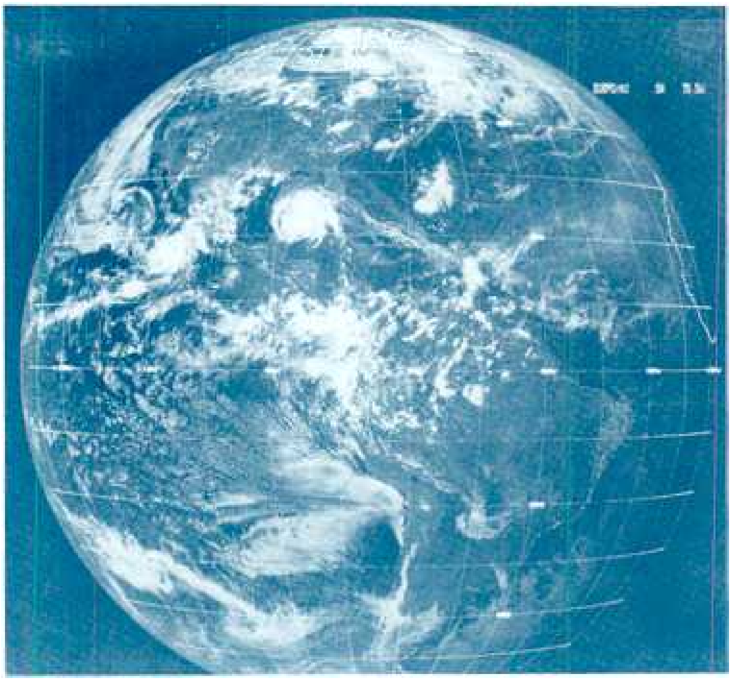
To receive a list of publications available from the Sea Grant Program, write Publications Request, Marine Advisory Services, Virginia Institute of Marine Science, Gloucester Point, VA, 23062.

Marine science "on-the-air"

Sue Gammisch, Sea Grant Marine Advisory Specialist at VIMS, coordinates marine science radio and television appearances for scientists at the Institute. In addition to frequent appearances describing her own work to educate the public about the preparation and benefits of seafood, Gammisch helps local television and radio stations select scientists and marine science topics for general audiences.

Two spots per month appear on WAVY-TV 10, "Tidewater Today," hosted by Mac McManus. Shows are also scheduled for WTKR-TV 3 "News at Noon" and WVEC-TV 13 "Good Morning Hampton Roads." According to Gammisch, "The programs keep the public informed about research at VIMS, local Sea Grant projects, and help to educate the public about the importance of Virginia's marine resources."

(continued page 24)



Cover photo

This visible, full-disk image from the East Coast GOES (Geostationary Operational Environmental Satellite) operated by the National Oceanic and Atmospheric Administration (NOAA) shows two hurricanes bearing down on the North American continent. On the day (August 7, 1980), Hurricane Allen is entering the Gulf of Mexico on a straight line to the Texas coast, while Hurricane Howard is in the Pacific Ocean south of Baha California, Mexico. Each of two NOAA operational GOES spacecraft--GOES East and GOES West–provides imagery routinely every 30 minutes, day and night, using visible and infrared channels. At altitudes of about 22,300 miles, the satellites' orbits keep them always above the same points on the Equator. In addition to full disk images, a variety of images of sections of the full disk also are available to weathercasters every half hour. (Official NOAA Satellite Image)

A LITTLE WEATHER

The prevailing weather in coastal Virginia is determined partly by latitude, oceanic conditions such as the position of the Gulf Stream, and also by confrontations between atmospheric conditions sweeping across the Piedmont meeting atmospheric conditions over the ocean. Weather events which impact the coast include northeasters, hurricanes, storm surge and thunderstorms.

The livelihood of many coastal residents is closely tied to the weather. Fishing, tourism, recreational boating, many military activities and to a certain extent, development, are affected by the prevailing weather patterns and by weather events.

In this issue biologists, oceanographers, meteorologists and a commercial fisherman describe some of the ways weather conditions and living things interact. Scientific research of atmospheric conditions has developed most rapidly since the placement of orbiting weather satellites. Much of this high-tech research has been used to directly benefit mankind by improving weather forecasts, analyzing oceanic fishing conditions and helping to identify long-term events which may affect the entire planet.

Special thanks to the National Hurricane Center and the National Weather Service for their assistance. Sea Grant and the Weather Service are administered by the National Oceanic and Atmospheric Administration (NOAA).

RESEARCH LINKS WIND AND FISH POPULATIONS

In 1981, the MRB reported the initial results of research by Brenda Norcross, then a Ph.D. candidate at VIMS. Today Dr. Norcross continues and expands on that original work.

In 1979, Brenda Norcross hoped to develop a computer model which would help predict the number of young croaker which would eventually be available for commercial and recreational fishing in Virginia. That model was developed, in part with Sea Grant research funding, and other similar models are being developed for other finfish. Equally important, however, is what has been learned about the relationship between local wind regimes and the fish from Norcross' work.

The Atlantic croaker *(Micropogonias undulatus)* are found from Massachusetts to Brazil, but its range along the U.S. east coast is often limited to Delaware through Florida. The fish spawn on the shelf in the Mid-Atlantic Bight (an area between Long Island, New York and Cape Hatteras, North Carolina), in the fall when the bottom water is warmest. The eggs hatch as tiny, floating larvae moved by wind and water until they begin to change into the post-larval or juvenile stage of development. The juveniles move into estuaries where they will remain through their first winter.

Dr. Norcross' original question was: what caused the sometimes extreme fluctuations in the numbers of juvenile fish such as croaker from year to year. As a result of answering the original question, she has become an authority on the environmental events which are the primary cause of these fluctuations.

Recruitment (number of juvenile fish in each year class) can be directly related to the direction, strength, duration and time of seasonal change of the meridonal (north-south) wind in the Chesapeake Bay. In late summer, prevailing winds switch from the south to the north, spreading the masses of warmer bottom water offshore from the nearshore beach area. The result is that the bottom waters of the Mid-Atlantic Bight are warmer than any other time of the year. Depending on when the fish spawn, the change in wind direction and the duration of the wind and its effect on water temperature can cause a number of environmental effects which will alter recruitment success. If the bottom water temperature change does not come before spawning, the croaker will swim south and spawn off the coast of North Carolina. Then when the winds blow the eggs or larvae into the estuaries where the juveniles spend their first winter, it will be North Carolina estuaries which receive the largest number of young fish. If the wind has switched prior to croaker spawning, bottom water temperatures are warm, croaker spawn near the Virginia coast, and juvenile croaker come into Virginia's estuaries.

Norcross' original research was greatly aided by Sea Grant studies carried out by ODU researchers in the late 70s and VIMS trawl samplings which had been on-going since the 50s. Today the results of her work are shared by other researchers and resource managers.

With Sea Grant funding, Dr. Norcross has expanded her research to include a species of flounder, *(Paralichthys dentatus)* also called fluke, the most valuable finfish harvested in Virginia. From October 20 to November 7 of 1986, she organized plankton and groundfish surveys aboard the NOAA Ship Ferrel in order to develop base data which would relate flounder movements to wind regimes. Her belief at this point is that summer flounder begin spawning in the north in September and spawn progressively later and to the south. If, after analyzing samples from the cruise and consecutive cruises throughout the coming years, she is able to relate spawning of flounder with wind regimes, then a model similar to the croaker predictive model can be developed.

How important are these predictions to Virginia fishermen? Shown below are the values of croaker and summer flounder along with landings for selected years.

Virginia Marine Resources Commission
Commercial Fisheries Statistics

Pounds/Values

Croaker		
1985	2,168,762 lbs.	$552,844
1981	429,682 lbs.	$124,924
Fluke		
1985	5,036,803 lbs.	$4,384,235
1981	3,665,033 lbs.	$1,985,432

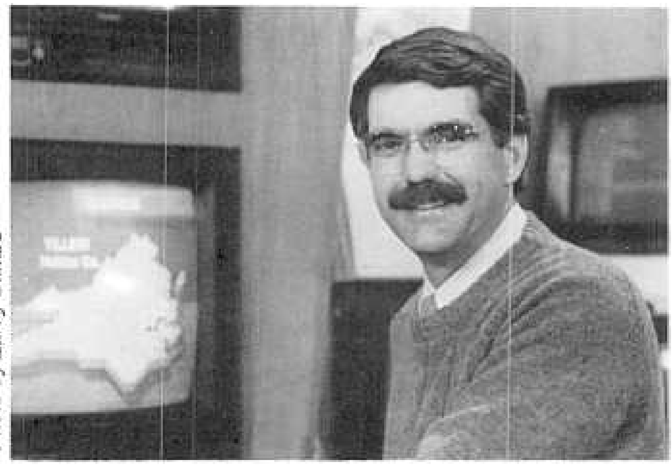
One of the major problems for researchers such as Norcross is access to vessel time for adequate sampling. "At sea" research, even in the Bay, is expensive and all cruises are designed to maximize both the ship and crew time. Generally, several scientists and their experiments are onboard for any cruise. If weather or other conditions prevent a scheduled departure or force an early return, projects must be rescheduled. Federal, state and private research vessels also try to cooperate on similar projects in order to save costs. Norcross feels fortunate that, through Sea Grant, ship time aboard the Ferrell has been made available specifically for her research.

Sampling must be carried out in the same location over different seasons and for several years in order for the samples to be compared to each other so that normal versus abnormal conditions can be identified. In some cases, as in Dr. Norcross' early work, new methods for sample taking need to be developed when older methods prove ineffective or inappropriate for the scientist's research needs. Early in her work, Norcross discovered that the original theories of croaker larvae transport up the estuaries made assumptions based on the types of sampling. As a result of changes and adjustments she made to the method and location of sampling, a better idea of how croaker are moved into the estuaries has been established. Understanding the importance of estuaries in the life-cycle of the many species of fish that use them helps resource managers make decisions about the estuaries which can affect the numbers of fish which survive each year.

It is often difficult to understand and appreciate that many scientists spend a lifetime studying one aspect or even one species in our complex world. Dr. Norcross' years of studying the relationship between climatic conditions and finfish recruitment have far-reaching importance both in understanding the individual species and in managing the fisheries. In addition to the work's importance to fishery biologists and managers, the relationship between all life forms on earth and weather is an area of growing research importance.

We tend to think of weather events in terms of hurricanes, northeasters and other dramatic events, forgetting that prevailing weather conditions have far greater effects on the plants, animals and physical features of the land. Understanding the effect of the seasonal wind change on one or two species of finfish has and will open windows to the understanding of how atmospheric forces shape our physical world and affect our economy.

SCIENTIST ...
TEACHER ...
WEATHERMAN



Dr. Duane Harding
Meteorologist
WVEC-TV

Photo by Larry Cumbo

In 1978, Dr. Duane Harding was walking around the rim of the volcano, Kiliuea, in Hawaii taking samples for acid rain research. Today he is the popular Channel 13 weatherman. The transition, which Harding says is not as great as it seems, came about through his efforts to be an innovative college professor.

As with many scientists, a teacher kindled his interest in meteorology. Beginning with that original impetus in seventh grade, through his research on cloud physics for his Ph.D. from the University of Michigan, Harding's enthusiasm never wavered. After a year with the National Oceanic and Atmospheric Administration (NOAA) in Hawaii, Harding moved to Eastern Kentucky University to teach.

"I loved it. We had an inter-disciplinary department designed to interest science and non-science majors in a variety of subjects. I had to become creative in teaching natural science," Harding says.

"One of the things I was curious about myself, that I thought my students would also be interested in, was how television weather shows are put together. So I visited one of the local programs." Eventually, Dr. Harding was asked to take over the station's weekend weather program.

"The first attempts were a fiasco," he says. "I kept hopping all over the set and bringing in glasses of water and other props to help people understand the atmospheric forces. I wanted to teach a sixty-minute class in three-and-a-half minutes."

Today Dr. Harding has found a way to combine all of his skills as a scientist and teacher in presenting the daily forecasts. "Actually I'm an interpreter. The information comes to the station from a number of sources; my job is to interpret what those forecasts actually mean for an area from Northern North Carolina up through the Northern Neck of Virginia. I also design the graphics that will help to explain what is going to happen, and why."

Accurately predicting local weather for any coastal area is no mean feat, but particularly difficult off the Virginia/North Carolina coast. "I remember in school reading about the 'Hatteras Storms,'" Harding says. "It's an area that is a notorious birthplace of coastal storms; now I'm watching them form."

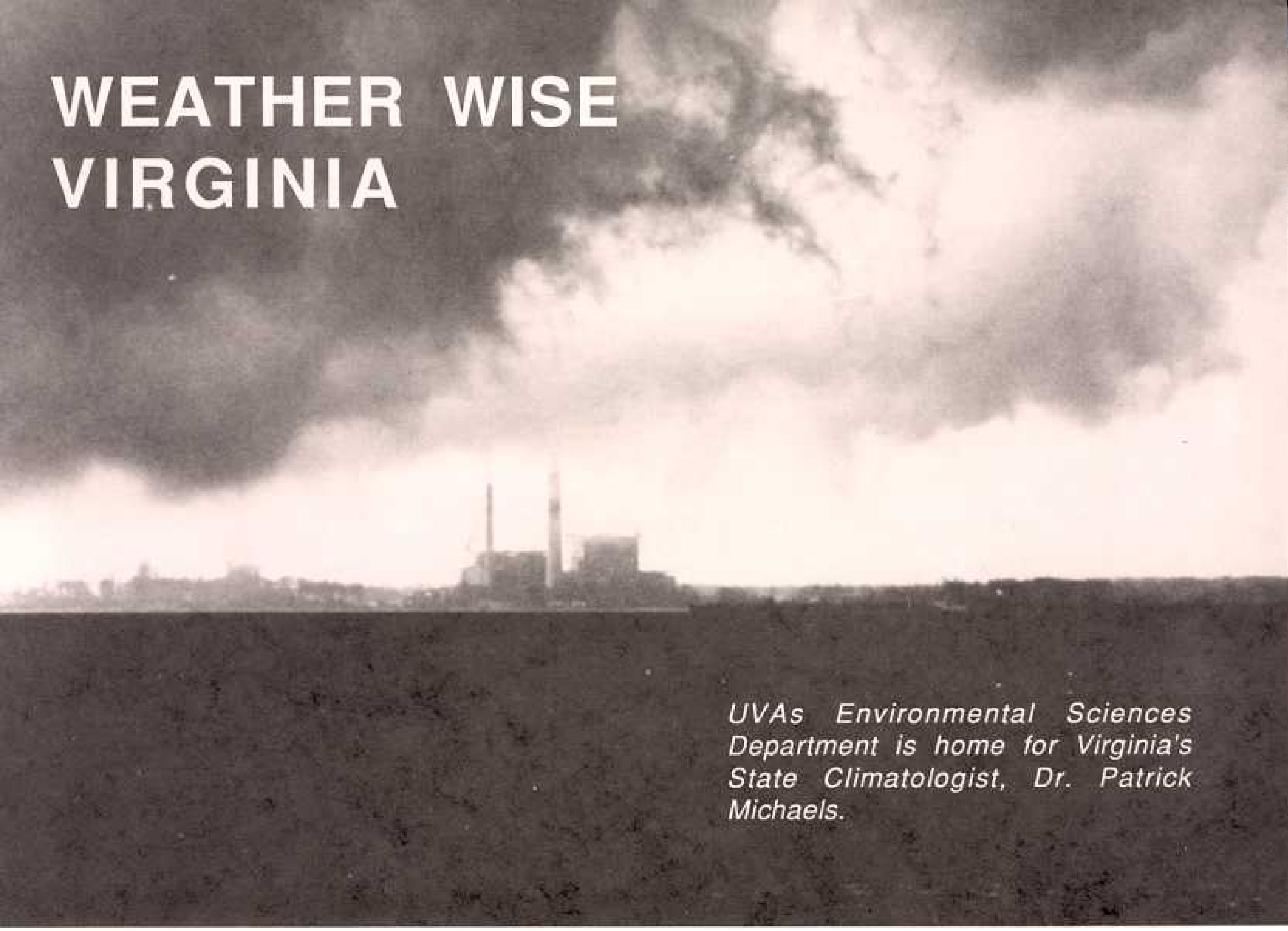
When the big ones brew up, the meteorologist can expect long hours at the station in Norfolk. During one major northeaster this past winter, he arrived at 8 a.m. and didn't leave until after midnight.

Are weather forecasts more accurate today? "For years," Harding says, "television weather forecasting was a joke. That's why so many stations literally used clowns. As more stations hire professionals, forecasts appear more accurate. Actually, it's more that the presentations ARE forecasts rather than just chronicles or lists of temperatures and conditions."

"But the real secret to good local forecasts is callers; people who call in to say that it's hailing at the Beach, or that the flurries you expected in Mathews County are piling up into inches. They tell me what is actually going on in a localized sense, and that added to the satellite, radar and other reports gives a balanced picture for the region."

Duane Harding's seventh grade ambition has been accomplished; he's a scientist and a teacher with a very large audience. But stay tuned; Dr. Harding has plans for some science shows.

WEATHER WISE VIRGINIA



UVAs Environmental Sciences Department is home for Virginia's State Climatologist, Dr. Patrick Michaels.

Photo by G. L. Anderson

The Office of the State Climatologist is located at the University of Virginia within the Department of Environmental Sciences. The Department was developed in 1970 as an interdisciplinary teaching and research unit which emphasizes communication among research specialists. Interdisciplinary units such as UVA's are particularly geared toward solving problems, as well as performing classical research.

The services provided by the State Climatologist's Office, which is directed by Dr. Patrick Michaels, are excellent examples of how applied and pure research benefit the State. One nearly completed study has had major impacts on local Virginia weather forecasting, and much of their research extends to the national and even global scale.

An early research project undertaken by the State Climatologist's Office was a Sea Grant funded study of thunderstorm systems in Virginia. These fast-occurring, thunderstorm systems can cause flash floods in low-lying coastal areas and be devastating for boaters caught on the open waters of the Bay or offshore. This summer Dr. Michaels hopes to complete the final analysis of the data which resulted from the Sea Grant study.

Virginia's topography partially dictates the state's overall climate, and particularly the small thunderstorm systems which occur predominantly in the summer. According to Michaels, "The change in elevation between the Blue Ridge and the Piedmont is one of the most climatically significant in the United States. Forecasting severe weather in eastern Virginia, particularly near the Chesapeake Bay, has always been a problem because of the interplay between the mountains to the west, the rolling Piedmont and the water."

The need for accurate, fine-tuned forecasts has increased tremendously with the numbers of commercial and recreational users on Virginia's waterways. Dr. Michaels' work takes on added significance in view of plans to increase coaling and port facilities. "This research has been in response to a real problem," says Dr. Michaels, "It is an excellent example of applied research."

Weather forecasts are largely made using a system of mathematical calculations and models. The problem with forecasting small, sudden thunderstorm systems is that they often "fall between the cracks" of any forecasting system. Meteorologists call these storms "mesoscale phenomena" -- those with an area under 1,000 square miles.

The National Weather Service recognized this shortcoming several years ago and increased the number of zones in Virginia from ten to sixteen. Dr. Michaels' work may provide additional input into NWS forecast models.

The most interesting outcome of this research is a better understanding of preferential thunderstorm patterns. "Certain large scale upper-air patterns are related to certain local thunderstorm patterns," Michaels says. "It is the isolation of these patterns that is at the core of this research."

As part of the Environmental Sciences interdisciplinary program, Roger Pielke of UVA studied Virginia's unique topographical features. His work also examined local features that can affect the formation and intensify conditions which give rise to thunderstorms. Simultaneously, the State Climatologist's office initiated studies to relate upper air patterns to local thunderstorm distributions.

A massive data collection involving over 275 individual stations examined some 50,000 thunderstorm observations. Data was mathematically sorted by computer and a series of maps resulted which illustrate both the average or mean thunderstorm pattern for the state as well as the most likely deviation from that mean.

During any given summer the most likely deviation from the mean is either above or below normal thunderstorm activity. Some areas may increase more than others. For example, in a year when there are more storms than usual, the area of higher increase is likely to be the northwestern corner of the Bay.

Accurate local forecasts have a strong effect on commercial fishing and shipping, recreational activities and tourism in particular. It is economically important not to "over-warn" an area while at the same time it is vital for the protection of lives and property that adequate warnings be issued for every area that might fall within a storm's path.

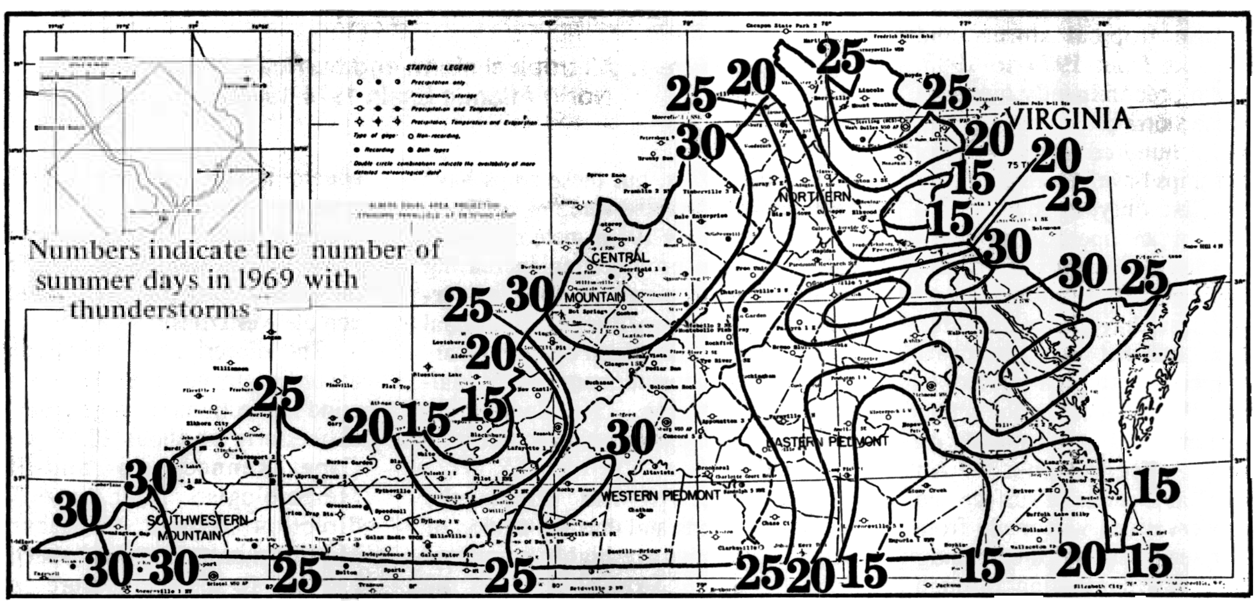
Significant applied research such as the localized thunderstorm prediction studies are just a small part of the services performed by the State Climatologist's Office for Virginians. The VIRGINIA CLIMATE ADVISORY, issued quarterly, is available to the public free of charge. This advisory discusses major climatological events regionally and globally, explaining what they mean in practical terms. In addition, the State Climatologist examines both existing and long-range forecast issues for Virginia, such as last year's extended drought. It is the largest circulating local climate publication in the U.S.

Dr. Michaels' straightforward style and response to some of the media's "alarmist" articles about climatic catastrophes make for entertaining as well as informative reading. To receive the Virginia Climate Advisory, write: State Climatologist, Department of Environmental Sciences, Clark Hall, University of Virginia, Charlottesville, VA, 22903.

Dr. Patrick Michaels,
Virginia State Climatologist.

Portions of this article researched and written by Deborah M. Dowd.

Seasonal thunderstorm patterns show considerable diversity across the state. Such patterns, shown here for 1969, result from concentrations of storms over particular regions.



WILL THE HURRICANE HIT VIRGINIA?

In Coral Gables, Florida, research meteorologists with NOAA's National Hurricane Center are trying to improve forecasters' ability to predict the paths and intensity of tropical storms.

(Excerpted, in part, from work published in the American Statistician *by Charles J. Neumann and Arthur C. Pike, Meteorologists.)*

Very few of the storms brewing in the Atlantic each year during "hurricane season" are threats to Virginia. Worldwide, an average of 83 major tropical storms (those with winds over 64 knots) are generated over various ocean areas. These regions are called tropical cyclone basins. Each year on the average, only ten potentially dangerous storms are born in the North Atlantic basin -- birth site for U.S. East and Gulf Coast hurricanes.

Since tropical storms develop and intensify over oceanic areas, often 600 or more miles from the nearest inhabited land, collecting and analyzing data from the immediate storm area and its surrounding environment have always been a problem. Figure 1 shows all North Atlantic tropical storms and hurricane tracks from 1974 to 1983, illustrating the predominantly maritime nature of these storms.

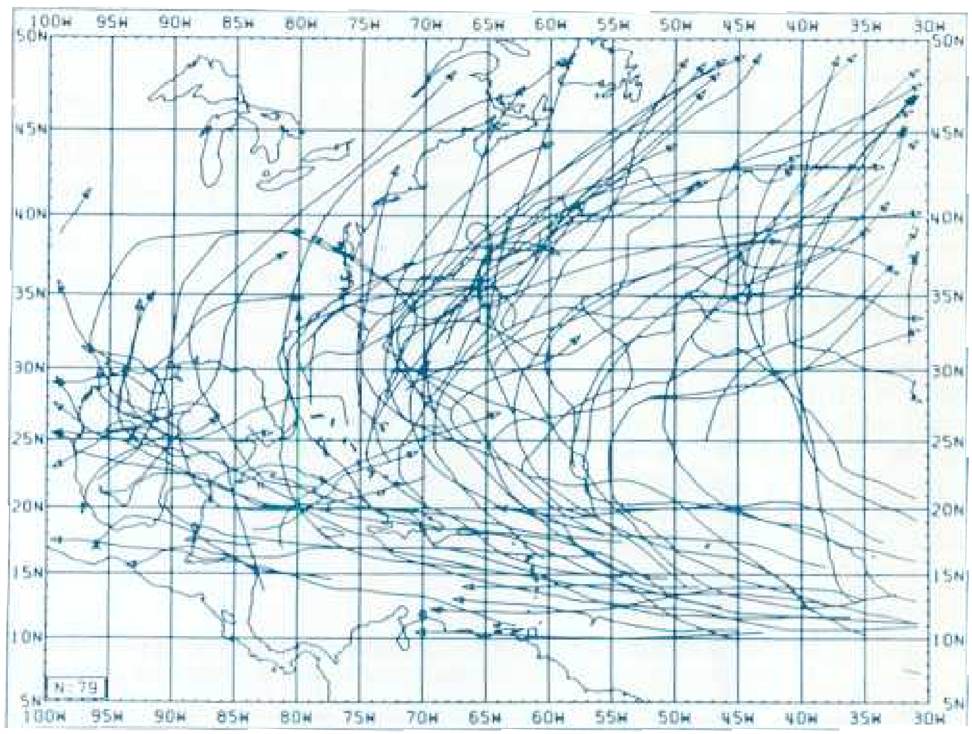


Figure 1. All tropical storm and hurricane tracks over the North Atlantic Basin 1974-1983.

For several hundred years, weather reports from ships have been useful data sources, at first only in a historical context, but in an operational sense since the development of radio. However, ship reports from the centers of tropical storms have been irregular. Until the advent of aircraft reconnaissance of tropical cyclones during World War II, locating the center of these systems was based mainly on fragmentary observations. An extremely valuable series of surface and upper-air observations was made from midocean air-sea rescue ships beginning in the 1940s and continuing through part of the 1970s, but these ships have been removed from service.

Since the early 1960s meteorological satellites have provided an increasing number of tropical cyclone observations. Daily satellite observational coverage is global, based on both polar-orbiting and geostationary (equatorial-orbiting) vehicles. No developing tropical cyclone now escapes detection by satellite.

Over the Atlantic Basin, the prevailing winds and thus the motion of tropical cyclones are highly correlated with latitude. Storms close to the equator typically move toward the west, whereas those in the more poleward latitudes tend to move eastward. The large-scale broad bands of winds that move the storms are called the easterlies and the westerlies.

The direction of storm movement according to latitude changes with the wind's directional change from easterly to westerly at about 28.5° N (around Cape Kennedy in mid-Florida). Meteorologists refer to this storm direction change as recurvature. Minimum storm forward speeds occur just before the recurvature zone and

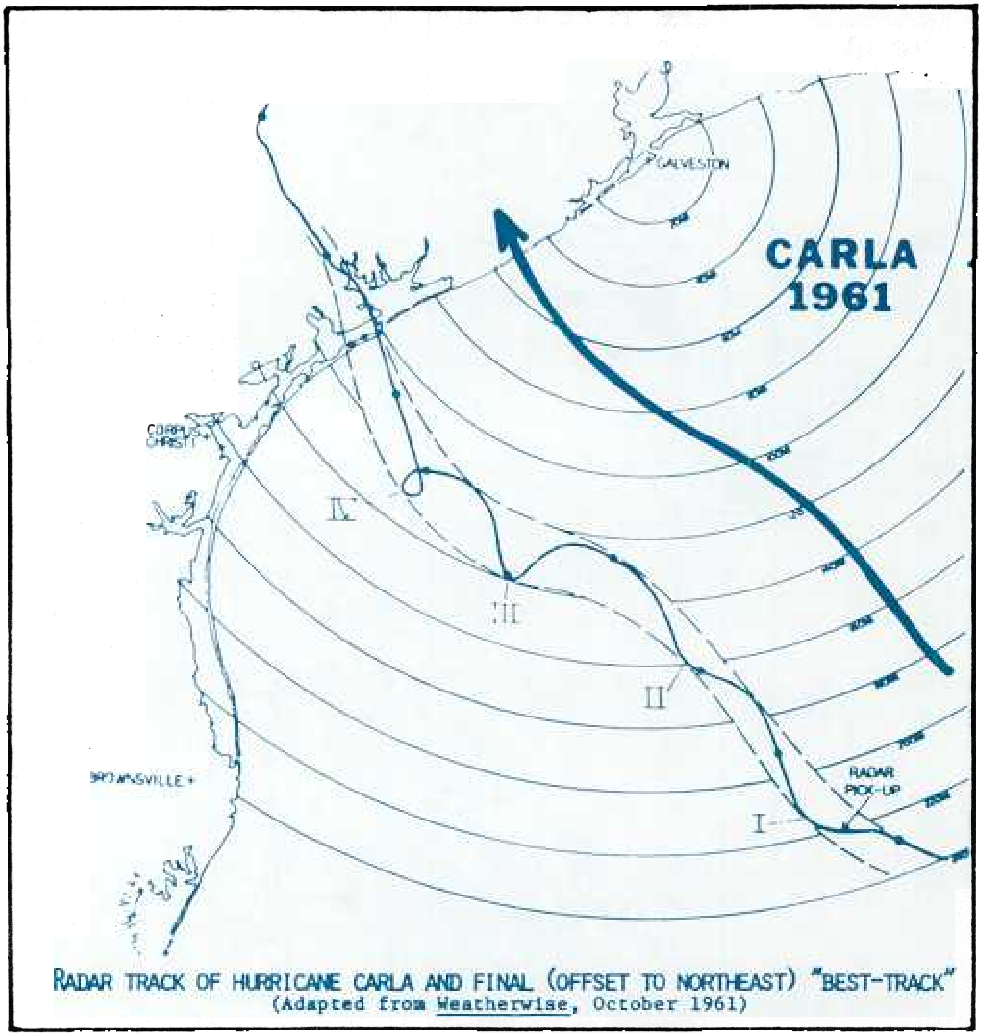


Figure 2. Short-term fluctuations in the path of Hurricane Carla. September 9-12, 1961.

maximum forward speeds occur near 50° N (northern Newfoundland).

The scientists at the National Hurricane Center (NHC) use a number of methods to help predict the track and intensity of tropical storms. Because the storms are moved by the atmospheric conditions surrounding them, meteorologists must have a great deal of information about the surrounding conditions as well as from within the storm. These raw data include wind directions and speeds, barometric pressures, temperatures, moisture content, storm height and other information.

Since Atlantic storms have been tracked at least since 1886, part of a prediction can be based statistically on historical patterns of behavior.

Both statistical and dynamical computer models are used for predicting a storm's future track. The programs for these models use estimates of the storm's initial position and motion. Temporary fluctuations in a storm center's path often make it difficult to sort-out the short-term changes from the actual path the storm will follow.

One of the main problems facing the operational forecasters is the evaluation of the forecasts from different models. At the NHC, the forecaster routinely receives guidance from seven predictive models. Even though in many instances the models are in agreement, there are other instances when they disagree completely.

From the viewpoint of track predictions, the most important level to be described is near the 4 miles height above the earth's surface, where the pressure is about half that found at the surface. Environmental winds and pressure gradients at this middle level show a strong relationship to storm motion.

However, middle-level data are often sparse in the vicinity of storms. Part of the scarcity can be traced to the change from propeller- driven aircraft to jet aircraft, which cross the oceans at higher altitudes.

Meteorologists are seeking improvements in satellite technology and aircraft reconnaissance to make up the difference in information gathered. Advanced satellite methods such as microwave soundings of the surface-wind field, should improve initial positioning and intensity estimates. Satellites and aircraft reconnaissance can increase their knowledge of environmental wind and pressure conditions.

By integrating information from a variety of sources, and continued development of new computer models, researchers expect to increase their forecast accuracy for both the track of a storm and its intensity.

Accuracy is particularly important to

the NHC because it is also responsible for finding ways to improve the public's response to warnings. Unfortunately, if people have responded in the past to a warning and the storm either missed their area or was a very weak storm by the time it hit land, the public is less inclined to respond the next time a warning is issued. In the absence of perfect accuracy, however, overwarning must be used in order to avoid a storm striking a completely unwarned area.

Virginia has been very fortunate for a number of years. Several storms have recurved, brushing the coast, but not directly coming inland. Until the NHC has a method for perfect forecasting, its warnings should be taken seriously even though the warned area may often escape unharmed.

The illustrations below show the 244 Atlantic tropical storms in June and August from 1886 to 1983. The coastline is nearly obliterated by the tracks of these storms, reminding residents that what has happened before will happen again.

The National Hurricane Center provides tropical and subtropical meteorological and oceanographic information to governmental, private and international users. The information is of two types: 1) meteorological and oceanographic analyses, and 2) tropical storm forecasts and warnings issued on a case by case basis.

The forecasts and warnings issued by the NHC are made with the knowledge that thousands of lives and billions of dollars in property depend upon their accuracy.

The functions of NHC are grouped into three categories.

1) collection, assimilation, analysis and interpretation of incoming information to the center;

2) forecasts and warnings; and

3) developing improved forecast techniques and information, including improving public and governmental response to warnings.

The responsibility for developing objective forecast methods falls to a group of scientists in the Techniques Development Applications Unit. One of the unit's chief concerns is improved prediction of the actual path a potentially dangerous storm will follow.

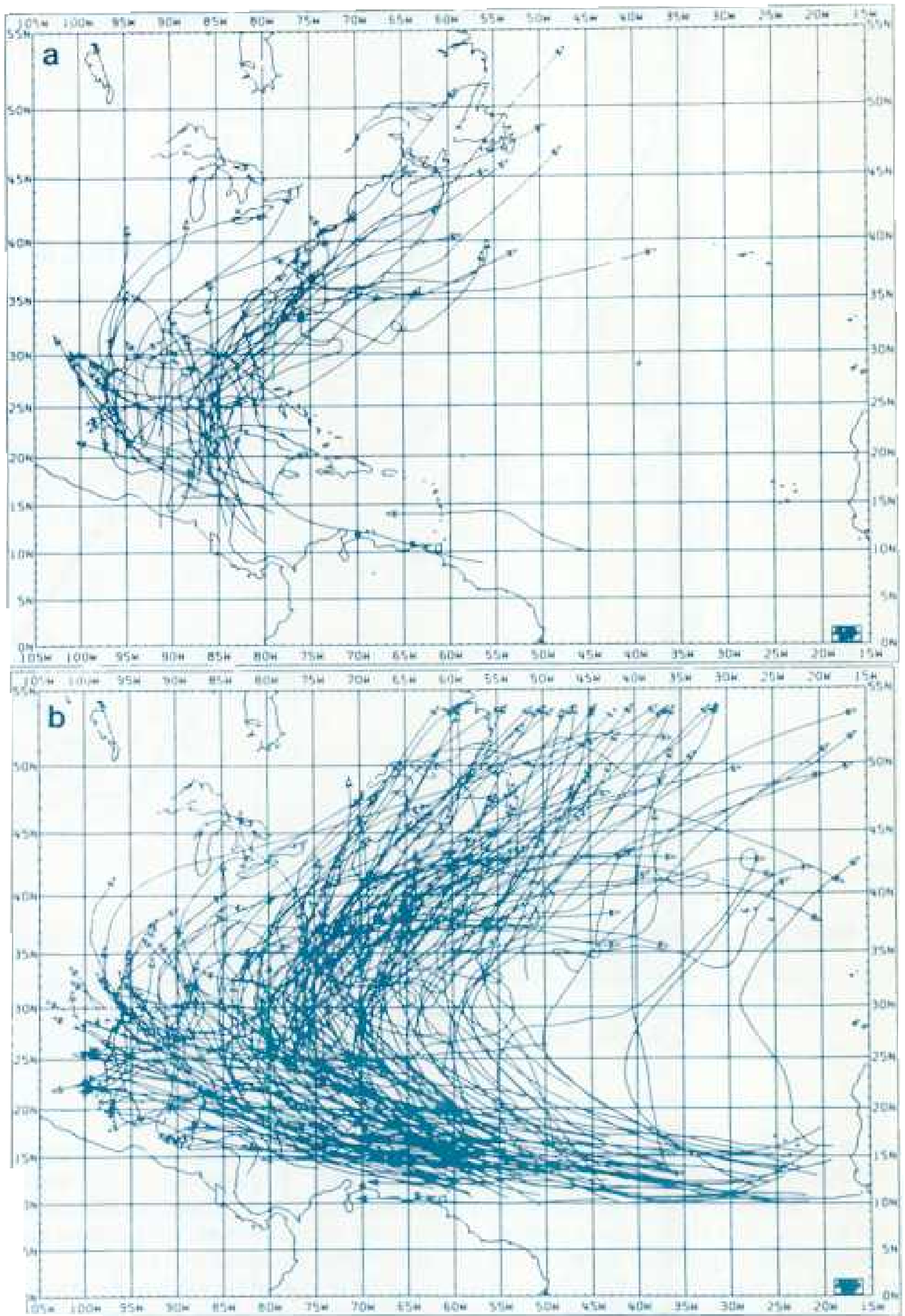
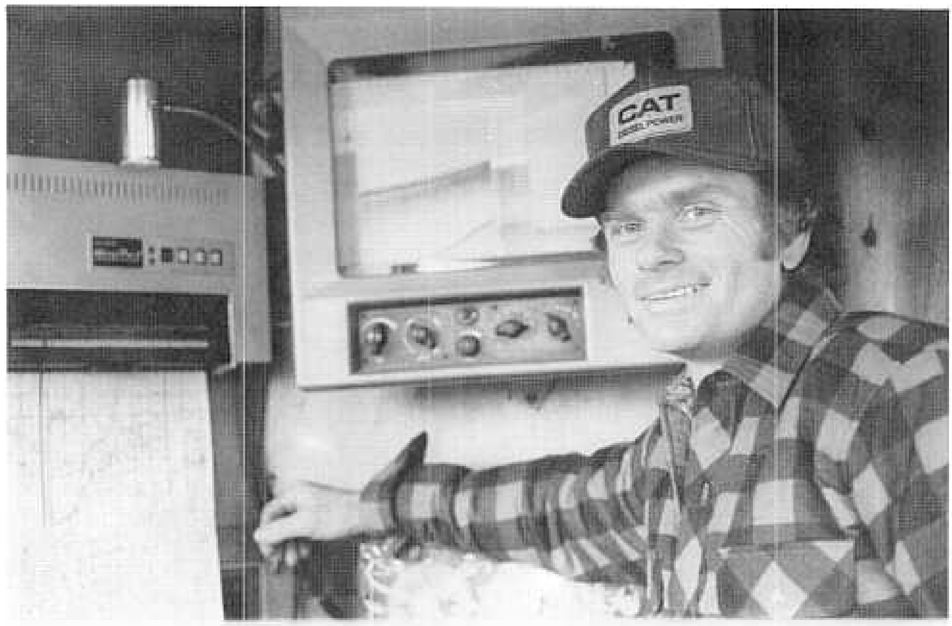


Figure 3 a & b. (a) North Atlantic tropical cyclone tracks beginning in June 1886-1963 (53 storms). (b) North Atlantic tropical cyclone tracks beginning in August 1886-1983 (191 storms).

Nil Sig Wx

by Wanda Cohen



Captain Jimmy Ruhle onboard the Daranna R out of Hampton.

photo by Nan Brown

Standing in the wheel house of the *F/V Daranna R* equipped with VHF radios, radar, barometers, and electronic receivers that print weather and sea condition charts, Captain Jimmy Ruhle says, "Those old sea captains, now they had the weather thing down to a science. I still don't understand it." Ruhle, who started fishing with his father 22 years ago, describes commercial fishing as "playing the game," with weather controlling "where you fish, what you fish for and how long you fish."

On board, he has access to information from the National Weather Service in Boston, the Norfolk Weather Service and the Coast Guard providing local, Atlantic, and global weather charts that include twelve, twenty-four and forth-eight hour weather prognosis and sea surface analysis. Using this information plus instinct and experience, he decides how long to remain in one area and where to move in relation to the approaching weather.

The west side of a weather system, especially a storm, is weaker and a storm will veer more quickly to the east; therefore, staying west in relation to weather can mean another two days of fishing as opposed to coming in without a full catch. "You don't want to get into heavy weather in the first place, but you can run around or ride out just about any storm if you just watch it," says Ruhle. "If you want to go NW but the winds are 60-70 knots, then you turn SE and 'run off before' the weather."

In this boat he has fished up and down the East Coast and into the mid-Atlantic as far as Ireland encountering 120 mile winds and 40 foot seas. "In weather you don't try to drive a boat too hard, the gears have to be handled gently--by hand. All you have to do is pay attention and hope everything works." Twelve to fifteen foot seas and winds from 30-40 knots will strain most fishing boats.

Ruhle describes fog as "just a pain because you can't see." Radar on board allows him to visualize land contours and detect buoys and small boats as blips on the screen. Ice, however, is another story. When air temperature drops below about 27°F, spray quickly freezes on decks and railings causing the boat to list, creating a potentially tense situation especially if the boat is carrying a sizable catch.

"When several thousand pounds of fish begin to shift, you start rearranging things real fast." Often the only solution is to go out with a hammer and break up the ice. Icing is most likely to occur within 150-200 nautical miles from shore because the air has had less time to be warmed by the sea. Wind, however, is the fisherman's greatest adversary.

High and low systems that cause little difficulty on land meet on open waters producing both clockwise and counter-clockwise winds. If the winds in each system are 20 miles an hour, the boat gets 40 mile winds; if each system has winds of 40 miles an hour, sea winds can reach 80 miles an hour. A following sea can "broach-around" pushing a boat like a surf board. In a situation with two- or three-way seas, "... you just have to drift and roll with it. It isn't fun and you'll be getting plenty wet" says Ruhle, "but you know you will be able to stand it. Mainly you have to be real careful about how your catch is loaded."

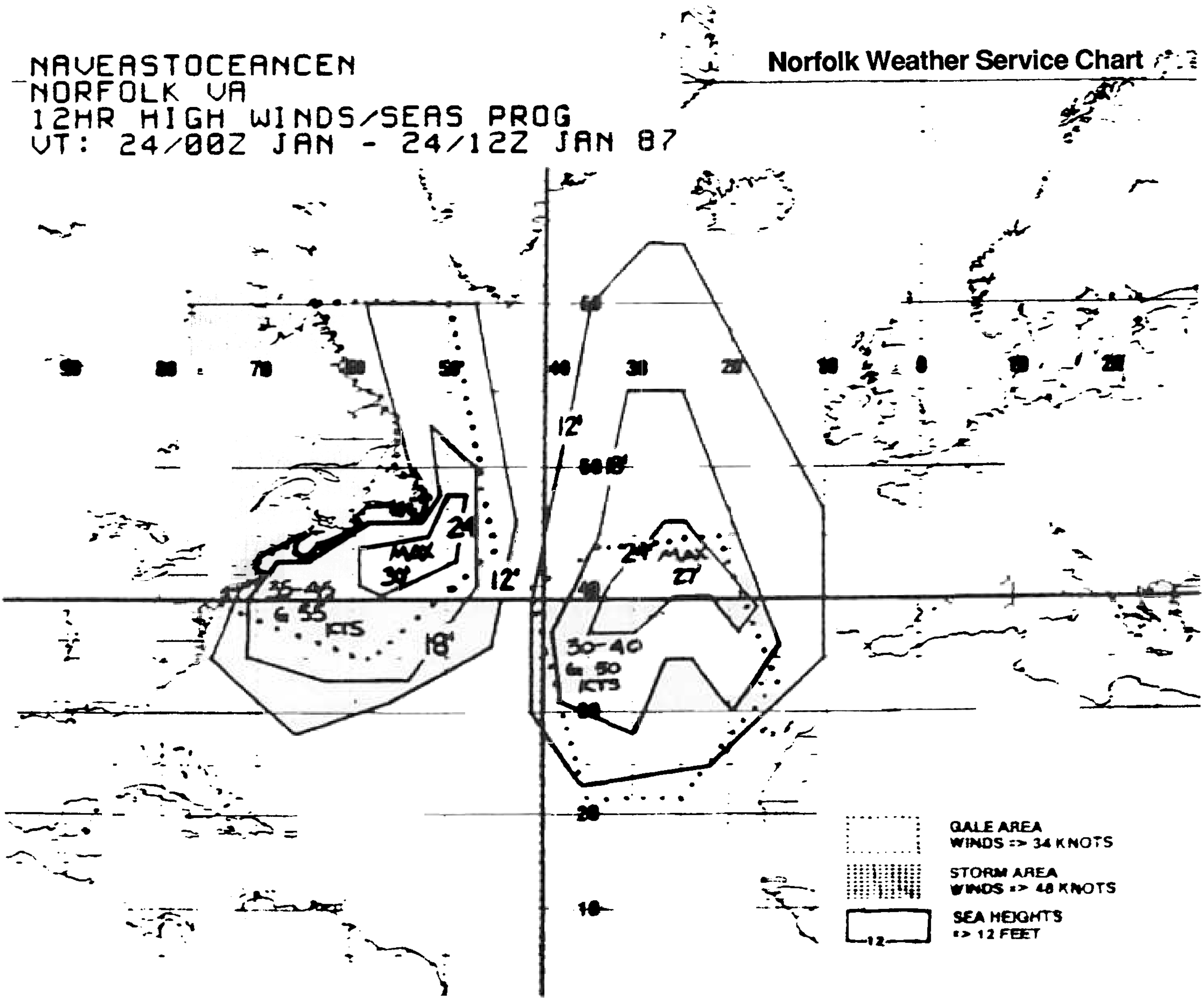
The faster the wind, the higher the waves become in a shorter period of time. On the open ocean, waves will continue to develop until they reach the maximum height for existing conditions. Cold air blowing over warmer water will create higher and steeper waves than a warm wind having the same speed blowing over colder water. In tropical waters, torrential downpours can almost quench the waves. High winds in either warm or cold weather means wet, rough working conditions.

Although westerly winds are generally more predictable than easterly winds, most fishermen take heed of age-old warnings and are wary of "backing" or "wrong" winds. This occurs when the winds blow from the West back to South West, which may even die out for a time, then come back around from the West and quickly shift to North West and blow twice as hard. Another situation to watch carefully is a falling barometer on a west wind. This can indicate that your position is on the back side of a low front with a second front behind it and you are in danger of being caught in the effects of both systems.

Ruhle recently experienced a situation like this with winds whipping from 15-50 knots between the two fronts. Cold fronts and rain are more likely to be associated with N-NW winds while warm fronts and sunny weather come with S-SW winds.

The National Weather Service and the Coast Guard began broadcasting actual weather maps to mariners in the early 1970's (see Fishing From Satellites, page 14). About eight years ago Ruhle installed equipment to receive the maps. Data collected from satellites, weather buoys, ships at sea and land stations is received on board by the radiofacsimile or "Weather Fax" which prints the charts. Printouts which are updated every six hours (Greenwich mean time), show weather system development and movement, wind speeds, sea heights and sea water temperatures. He is one of only two fishermen in the area with this equipment.

While the equipment is used to track weather, it is especially helpful in finding pockets of water the best temperature for a particular kind of fish. Tuna and swordfish like warm temperatures for feeding and are likely to be found in the warm water pockets that travel down the Atlantic. Porgies favor cooler temperatures found at the edge of the Gulf Stream. Mackerel and fluke prefer cooler waters. Summer squid (Illex) run about 100 miles offshore



Norfolk Weather Service Chart

from May to August and Loligo or winter squid move into the same waters from late fall until January when water temperature is cooler.

Occasionally, forecasters miss, and having this equipment on board means the difference between riding out a storm in relative calm or being caught in the middle of it. Ruhle recalls watching a system carrying extremely heavy winds move toward the area he was fishing. He knew there were some small boats out that would have difficulty in the high seas and needed time to get in. When he felt the system was less than thirty hours away and VHF broadcasts (twenty-four hour radio weather service) still weren't mentioning the potential danger he "issued the warning" on the channel that he saw "bad weather" coming. "They listened because they trust me, and they know I've got the equipment. Besides, you don't do that sort of thing unless it's really something to worry about or you can lose friends real quick."

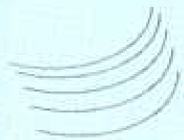
Technology, however, does not replace experience, and Ruhle, like most fishermen, listens to his intuition as attentively as he listens to his VHF radio. "You just can't describe some things; you just feel changes coming, you see signs." Color speaks clearly to the experienced eye; for instance, a lot of red around a sunrise brings good weather while streaky-looking, cloudy sunsets usually signal bad weather coming. "Sun-dogs," circles on one or both sides of the sun with light or color showing through are traditionally a sign of heavy wind and rain in one to two days. Often before a bad "easterly storm" a "Luming" is observed; this is described as being able to see light under objects on the horizon. "When you look at things on the horizon, it looks like you can see under them, like they are just off the water." Marine animals also sense approaching bad weather. Before a heavy storm, sea gulls will fly in circles higher and higher until they are barely visible specs in the sky. The further inland gulls and other marine birds go, the more severe the weather on open waters. As storms approach, porpoises will jump entirely out of the water and completely flip. Generations of mariners have noted that before a "really bad blow" cod fish will eat tiny rocks or debris.

"Sometimes you will get caught, but most of the time you can avoid it; you just have to know how to read what you're looking at." Putting it all together is part of the job says Ruhle. Perhaps it has also been part of the lure and challenge to generations of mariners. As Ben Franklin said, "Some men are weather wise, but most are otherwise."

Marine Weather Symbols

Nil Sig Wx: No significant weather.

Zulu: Time reference for weather charts. Greenwich (Prime Meridian--0°) Mean Time.



Isobars: Lines showing weather pressure system pattern. The closer the lines the stronger the system and the winds in it. Wind strength is directly related to the difference in barometric pressure between two points.

Wind speed of thirty-five knots.

Wind speed of fifty knots.

Wind speed of seventy knots.

Trough: Area where weather fronts form and move away from low pressure centers. Often areas of cloudy, inclement weather.

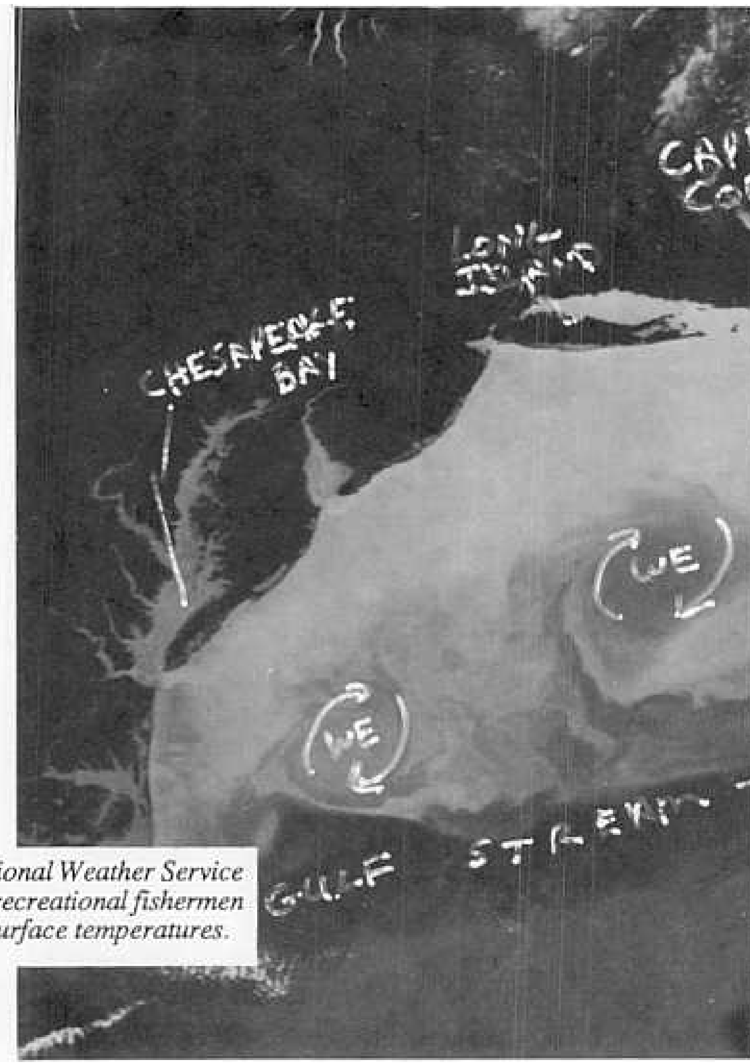
Ridge: Often (not always) area of fair weather. Moving farther west or east of the ridge axis brings you closer to adjacent troughs and more adverse weather. Troughs and ridges may be oriented in any direction.
Gale force winds: 34 to 47 knots
Storm force winds: 48 knots and up

Wind Fetch: Distance, in nautical miles, over which the wind blows. Wave heights are directly related to fetch.

Wind Duration (hrs)	Wind Speed (Knots)	Fetch (NM)	Wave Height (Ft)
2	20	50	1.5
2	40	50	11
3	30	100	7
3	40	100	15
1	60	20	16

FISHING FROM SATELLITES

Jenifer Clark, Oceanographer
National Weather Service, NOAA



Oceanographers with our National Weather Service are able to help commercial and recreational fishermen locate fish by "mapping" ocean surface temperatures.

The National Oceanic and Atmospheric Administration (NOAA) satellites have high resolution infrared sensors that detect ocean surface temperature differences where warm water meets cooler water. These temperature fronts (thermal boundaries) are rich in forage (small plants and animals). Small fish feed on this plankton and larger fish feed on the smaller fish. Fishermen can be guided to these areas of high fish concentration by oceanographic analyses charts made from these satellite infrared images. The reduction of time spent searching for fish results in a savings of both fuel and money.

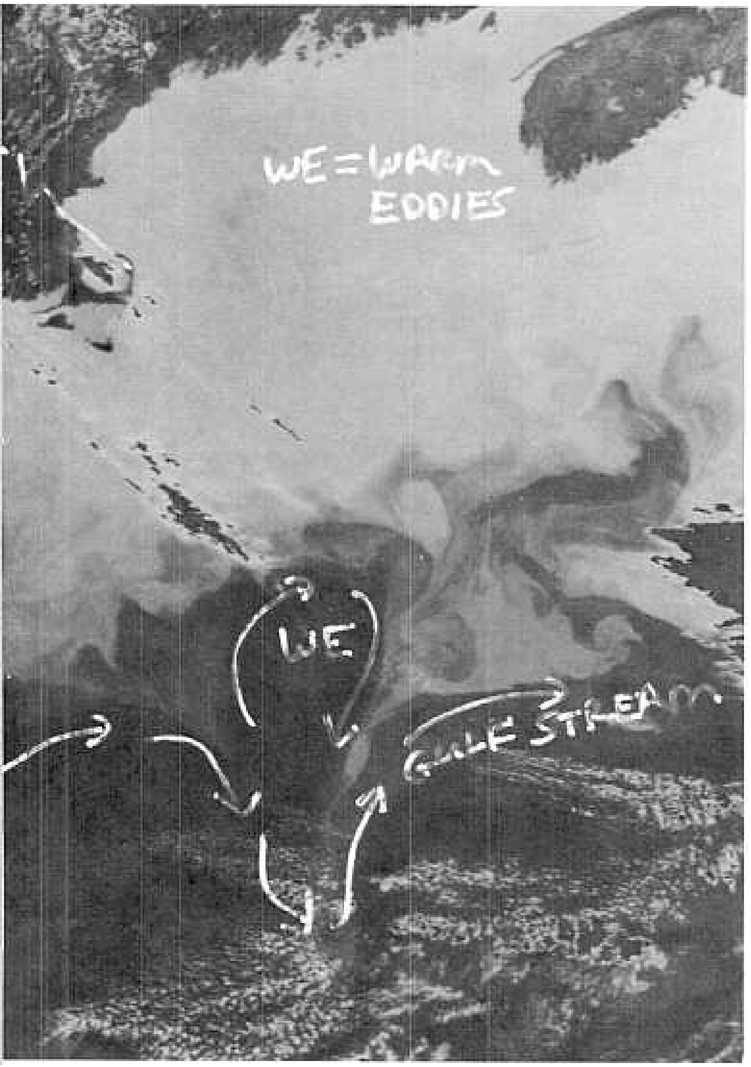
NOAA's polar orbiting satellite infrared imagery is the primary data source for generating the Oceanographic Analysis and the Sea Surface Thermal Analysis. The satellite orbits the earth as the earth spins on its axis inside of the satellite's orbit. Each geographic area of the earth is viewed twice daily.

Geostationary Operational Environmental Satellites (GOES) infrared imagery is the secondary data source for generating the Oceanographic Analysis. This satellite orbits the earth at the same speed that the earth spins on its axis. Therefore, the GOES satellite appears fixed over the same point at all times over the equator. The advantage of GOES data is that the frequency of coverage is every 30 minutes whereas the NOAA-polar orbiting frequency of coverage is about every 12 hours. However, the resolution is higher for the polar orbiting data (1/2 mile) than for the GOES data (4 miles).

Infrared satellite images are analyzed by oceanographers from the National Weather Service (NWS) of NOAA. An example of this imagery shows high temperatures in dark gray shades, while low temperatures are assigned light gray shades. The warm gulf stream appears as a dark band east of Cape Hatteras. Warm water eddies (dark circles) circulate clockwise and appear north of the Gulf Stream.

A solid line indicates a front observed 0-3 days ago. A dashed line indicates a front observed 4-7 days ago. A dash dot line indicates a front observed more than 7 days ago. A submarine canyon is a narrow, deep, steeply sloping depression in the ocean bottom. The submarine canyon legend indicates locations of canyons useful to fishermen, because large pelagic fish (such as tuna) prefer the temperatures of these canyons and feed on other fish (such as bluefish) which congregate in the deeper, cooler waters.

In addition to the Oceanographic Analysis, a more detailed chart is available, the Sea Surface Thermal Analysis of the East Coast. These charts are produced twice weekly from digital data obtained from the Advanced Very High Resolution Radiometer (AVHRR) onboard the NOAA polar orbiting satellites. The measurements



are digitized onboard the satellite and transmitted to the Command and Data Acquisition Stations at Wallops Island, Virginia and Gilmore Creek, Alaska. Then they are relayed to the data processing facility at Suitland, Maryland. The primary users of the Sea Surface Thermal Analysis include sportsfishermen and recreational boaters who venture only a few miles offshore. (In several coastal states, Sea Grant programs provide a link between the federally produced analyses and the fisherman or boater. ed)

The Oceanographic Analysis provides a good "snap-shot" of the interfacing of the water masses in the ocean. These interfacings are areas of temperature breaks, or areas where water temperatures vary significantly over a short distance. Some of these are the shelf water/slope water interface, along eddies, and along warm water filaments attached to the Gulf Stream. Fishermen, who learn how to interpret the charts, are able to detect temperature features which have proven to be productive fishing areas.

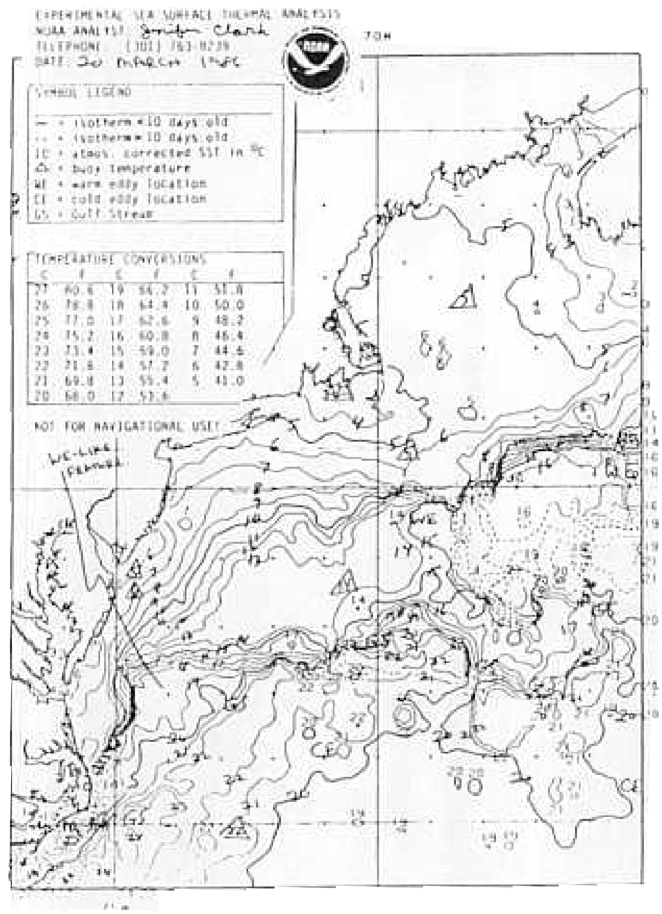
Certain parts of warm water eddies have been found more productive than others. Warm eddies spin on a vertical axis. This tends to accumulate nutrients such as plankton on the outer edges. Therefore, eddy circulation may form the basis for a food chain. Also the warm eddies move from east to west; this movement tends to congregate predators and prey in the northeast inshore portion of the eddy. As the eddy migrates west, the fish fall out of its warmth into the cooler surrounding shelf water. They then keep playing "catch-up" to stay within the comfort and feeding area of the eddy.

Fishermen, especially sport fishermen who are limited by vessel size, should study the analyses carefully to anticipate when eddies are going to be located near the continental slope. When this situation occurs, weather permitting, they should try to fish the eddy edges.

The charts, however, only show the temperature at the surface with no real penetration into deeper layers. The subsurface temperatures may vary from the surface temperature, changing the location of the fish.

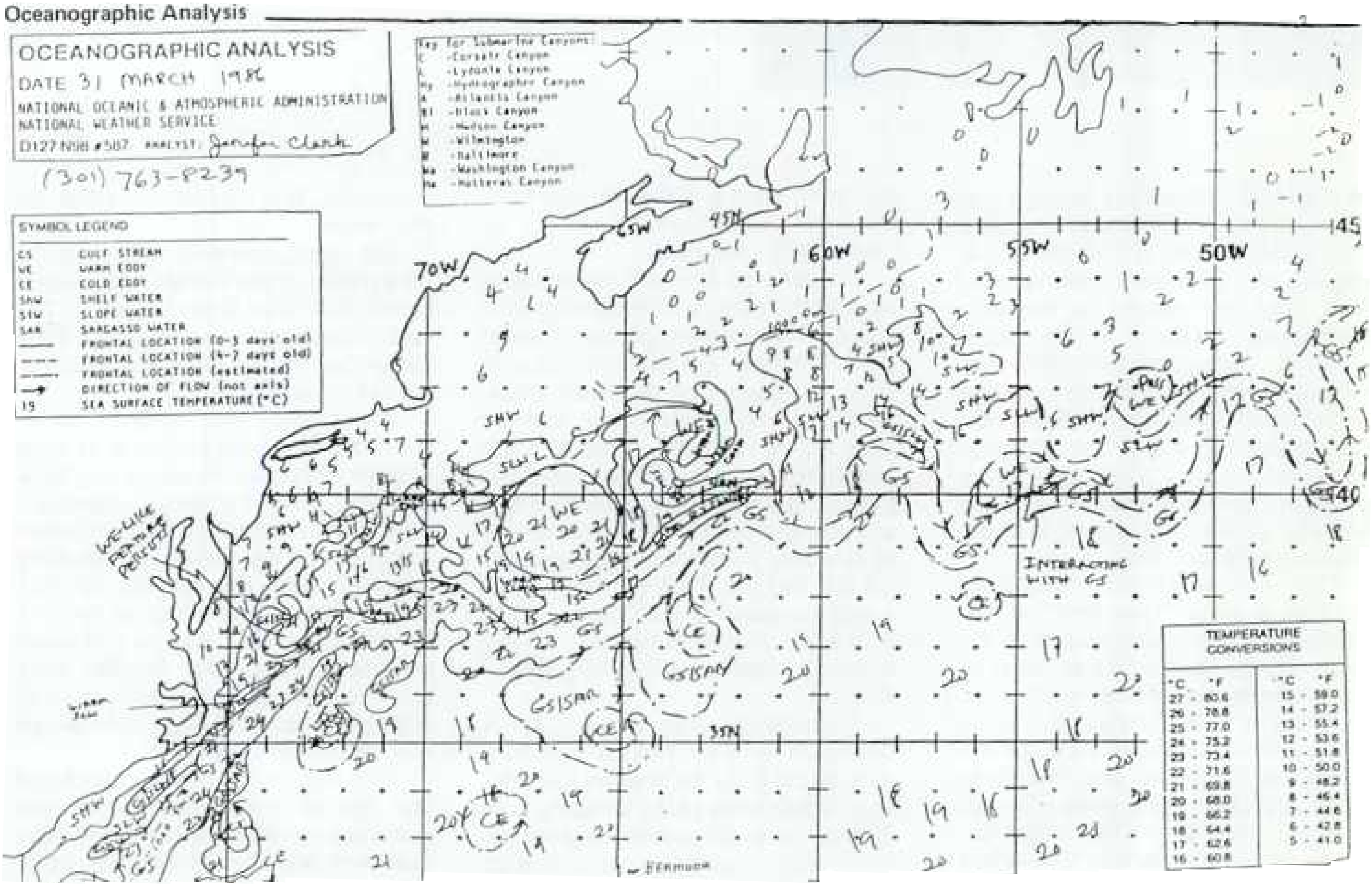
Until recently, only large species fin fishermen have been addressed as users of these charts, but the charts may have relevance in other sectors. Lobstermen who set far offshore on the continental slope should be aware of the eddy positions since the velocity of their movement can either submerge buoys or move lobster gear. Also as mid-water trawling in deeper water becomes more prevalent, harvesters will want to avoid dragging against an eddy current and go with the current to save fuel.

As a final point, it should be noted that use of these charts does not guarantee a good catch of fish. But the charts will help identify areas where fish are highly likely to be found. For more information, contact Jenifer Clark at (301) 763-8030 or Dorothy Kropp at (301) 763-8239 or Address: NOAA/NWS, World Weather Building, Room 206, Washington, D.C. 20233.



Experimental Sea Surface Thermal Analysis

Oceanographic Analysis



THE WINTER'S TALE......
Northeasters and high tides

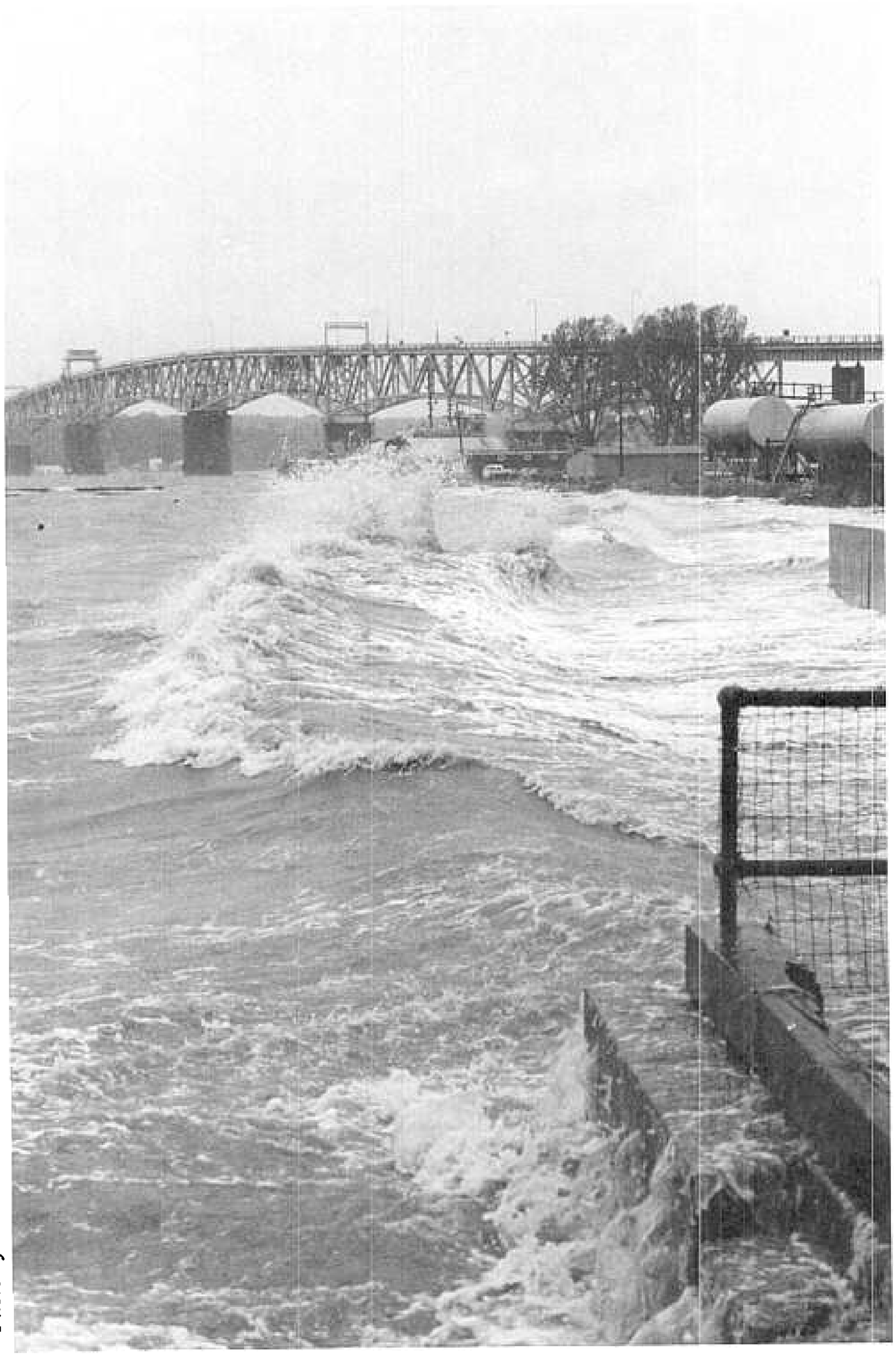


Photo by Dick Cook

Dr. Boon's complete guide to tides in the mid-Atlantic will be available soon as a Sea Grant Report. Excerpted here are some simplified explanations and helpful advice from: THE TIDES: A GUIDE TO MID-ATLANTIC TIDAL EVENTS.

by Dr. John Boon
Senior Marine Scientist
Virginia Institute of Marine Science

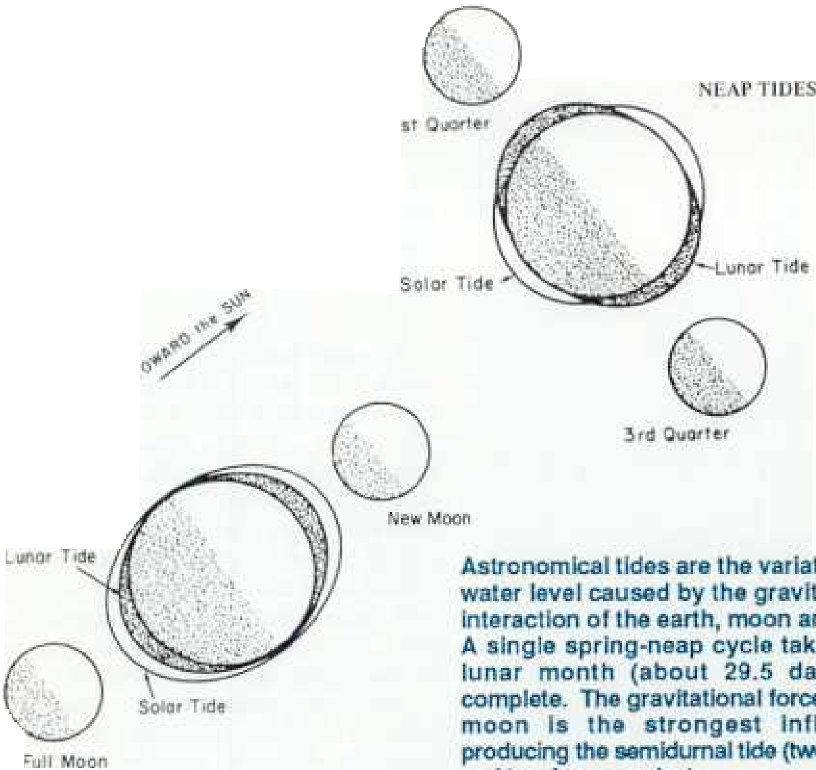
A winter storm means action for the beaches and shores of Virginia. This is a time when the forces of nature sharpen their edge. Steep, plunging waves brought on by storm winds cut away the shorelines behind them. Like a Shakespearean classic, this drama is played before a captive audience (wary coastal residents) again and again, but with more memorable performances in some years than in others. A look at the characters can help tell us why.

Although storms are the dominant factor in the creation of high waves that erode the shoreline, damage piers and undermine dwellings built too near the shoreline, there is the added factor of higher-than-usual water levels to be considered. High water levels not only cause coastal flooding, they also increase the destructive power of waves by allowing them to reach higher ground and attack ordinarily untouched areas.

Water level changes in two ways: 1) the daily rise and fall due to the astronomical tide and 2) the temporary rise in water level caused by the storm itself, called the STORM SURGE. Sometimes these two natural phenomena interact to produce a damaging coastal storm in Tidewater.

Winter extratropical storms of the Atlantic coast (northeasters) are moving low pressure systems with winds spiraling around the central low in an anticlockwise (cyclonic) direction. Unlike tropical storms and hurricanes which confine their central low and highest winds within a relatively small area (typically inside a 30 nautical mile radius), the northeaster is a sprawling storm system that may stretch over several hundred miles.

As the storm center reaches our coast, it is common to find the winds veering in direction, first from the south, then east and finally north or northeast with high wind speeds existing for a day or more (several days in the case of the Ash Wednesday storm of March 1962, the most damaging winter storm on record in our area).



The moon's slightly elliptical orbit around the earth causes stronger tidal forces as the moon reaches its closest approach to earth (lunar perigee) with lesser force as it passes its most distant point (lunar apogee).

Astronomical tides are the variations in water level caused by the gravitational interaction of the earth, moon and sun. A single spring-neap cycle takes one lunar month (about 29.5 days) to complete. The gravitational force of the moon is the strongest influence producing the semidurnal tide (two highs and two lows per day).

SPRING TIDES

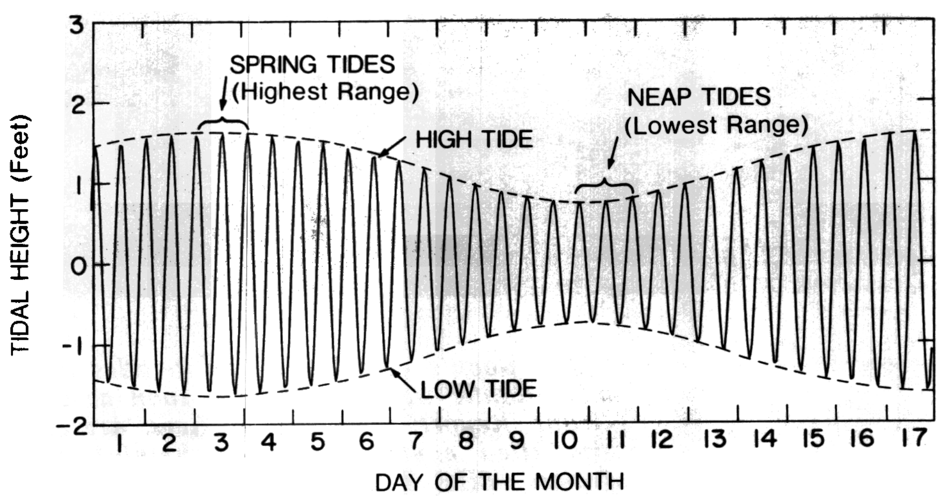
Wind stress acting on the surface of the water sets it in motion, causing water to pile up in shallow areas or against a shoreline, thereby producing a setup that may last from minutes to hours until the storm passes. The maximum height of the setup at any location depends on several things including the local water depths, shoreline configuration and exposure, the duration of the strongest winds and the distance over which they blow uninterrupted.

Other forces are also at work at the same time, including a pressure setup or rise in water level due to lower than usual atmospheric pressure near the center of the storm. AS A RULE OF THUMB, A PRESSURE DROP OF ONE INCH OF MERCURY AS MEASURED ON A BAROMETER WILL CORRESPOND TO A WATER LEVEL RISE IN THE SEA OF ONE FOOT. All of the forces affecting water level as a direct result of the storm produce what is collectively called the storm surge.

The maximum water level that results during a winter storm consists of two components ádded together, the storm surge and the astronomical tide. The way they are added together, specifically the timing of the arrival of the peak heights for both components, is very crucial.

If a three foot storm surge reaches its peak just as an astronomical high tide of two feet above mean sea level (msl) reaches its peak, then the maximum water level will be five feet above mean sea level. On the other hand, if the three foot surge coincides with a low tide of two feet below mean sea level, the result could be a maximum water level of one foot above mean sea level. Virtually any maximum water level between these two extremes is possible,

The tide cycle can be represented by a sinusoidal curve which illustrates the high spring tides and low neap tides.



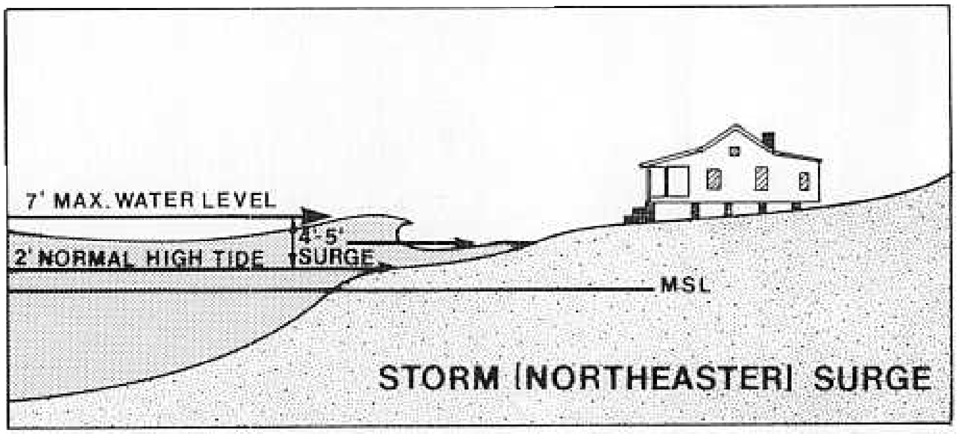
however, and is as likely as any other due to the fact that the arrival and form of the surge is entirely a matter of chance.

In preparing for an approaching winter storm, a property owner can judge the approximate maximum height the water may reach. The high water extremes matter most during storms, so property owners should note and be able to recall the location approximating average high water. Although tidal predictions are given in feet above mean low water, it is easy to convert to a height above mean high water in two steps: 1) find the mean range of tide stated in feet for the location nearest you on the tide tables (produced quarterly by the Marine Advisory Service at the Virginia Institute of Marine Science, based on data from the National Ocean Service/NOAA); and 2) subtract the mean range from each high water height obtained from the tables. You then have the predicted high water height in feet above mean high water for your location. Like predicted low water heights, the numbers may turn out to be slightly negative at times.

You will often hear television or radio warnings just before or during a major storm that include a statement that tides will be running so many feet (let us say three) above normal. This statement simply means the actual tides that occur are expected to be three feet higher than predicted in this example. Adding three feet to the predicted high water height above mean high water gives the maximum water level to be expected relative to the mean high water mark you have found on your property. The media may give you the calculated height of the storm surge, but it is up to you to add the other very important item in the maximum water level formula, the predicted astronomical tide from the tide graphs for the time at which the surge is forecast to occur.

There are wide variations in tidal range at Hampton Roads (and other nearby stations as well) throughout the year. Several cycles affecting range, and not just the spring-neap cycle, are all working at the same time. We can certainly say that some tidal ranges are "spring-ier" than others from one month to the next. New Year's Day of 1987 produced the highest tidal range of the century, a fact widely mentioned in the news media at the time. On this day as if given a cue, a large winter storm appeared along the east coast causing

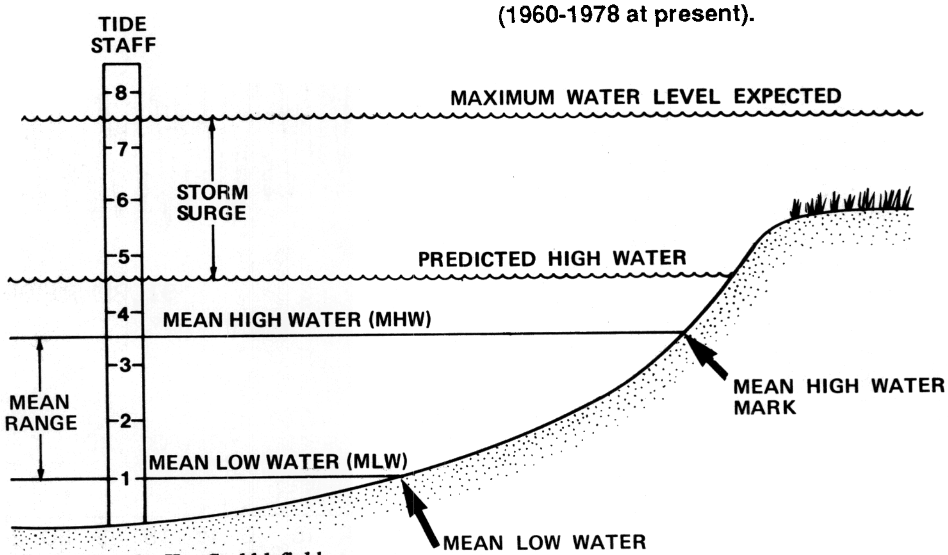
(continued page 21)



adapted from NOAA

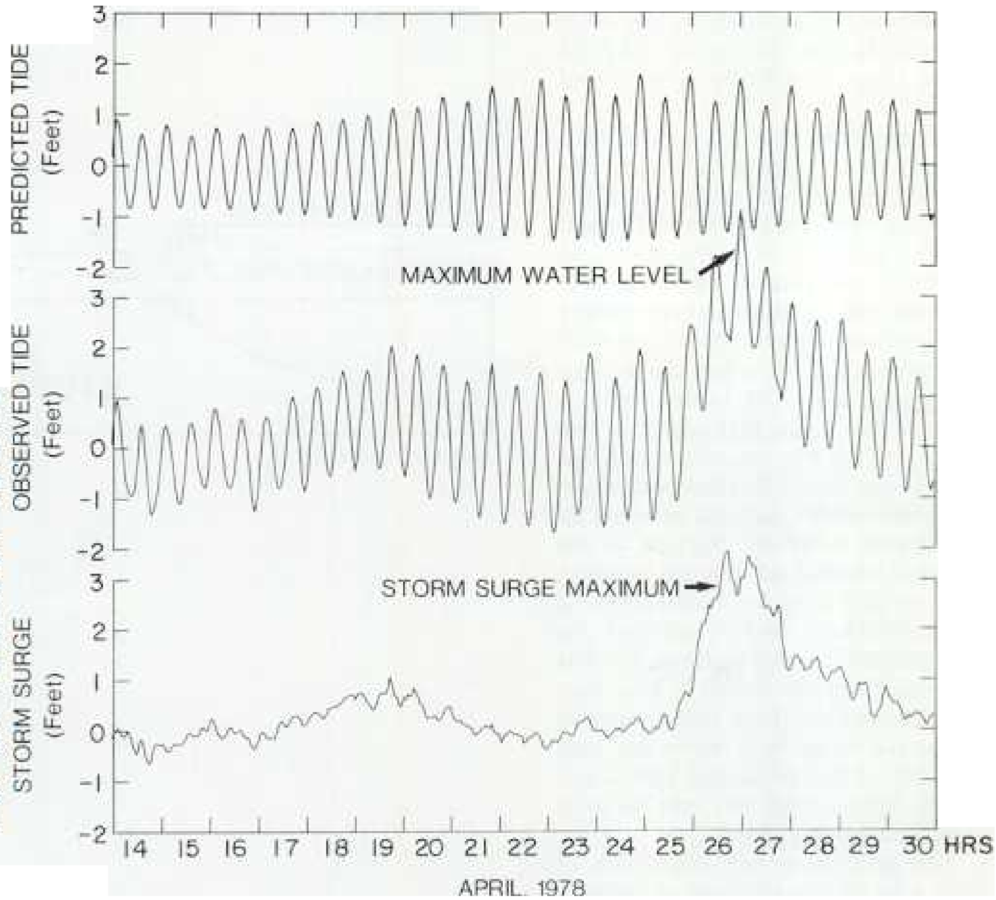
This diagram illustrates tidal datums, storm surge and maximum water level. If this predicted high water is 1.0 feet above mean high water and the storm surge is 3.0 feet, the maximum water level expected is 4.0 feet above MHW as shown. The property owner must find the approximate mean high water mark to estimate areas likely to be flooded by the maximum water level.

Tide range is measured along the coast with tide gauges, devices that continuously record water level relative to land. In order to compare tidal height, a standard elevational level called the tidal datum is legally established by the National Ocean Service and defined as the arithmetic mean of low water heights measured over a specific 19-year period called the National Tidal Datum Epoch (1960-1978 at present).

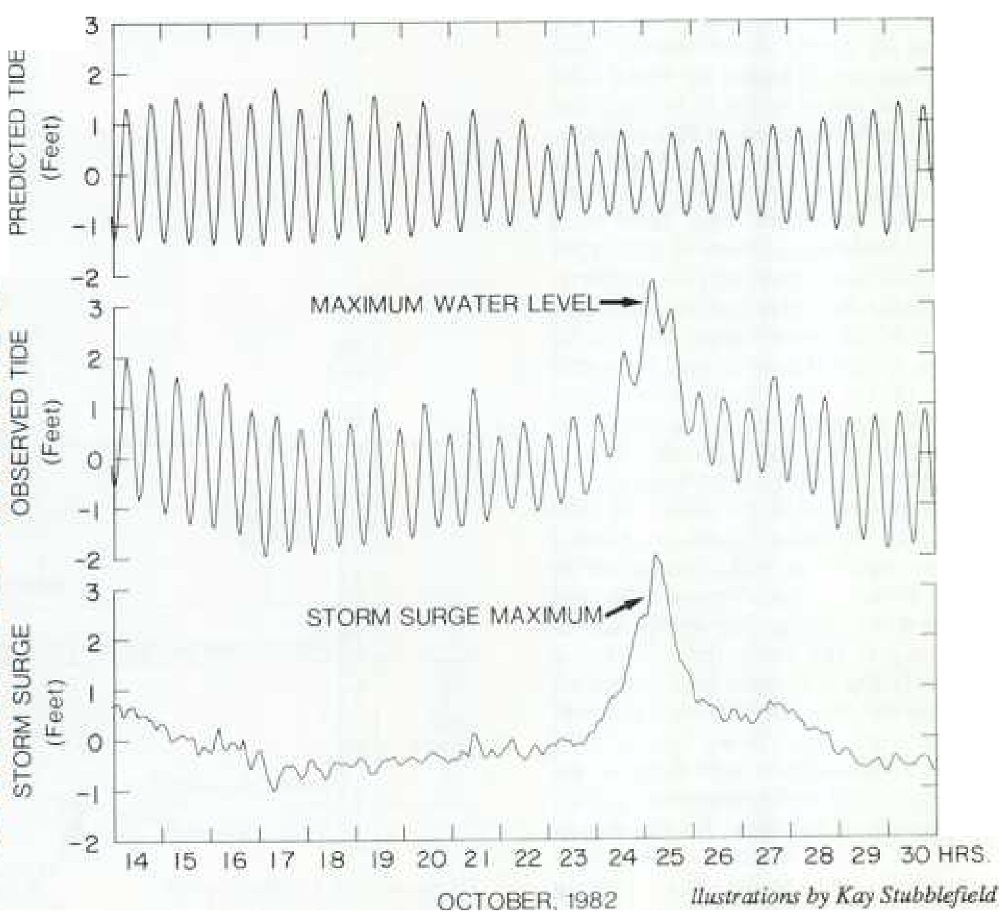


Illustrations by Kay Stubblefield

A hydrograph for Gloucester Point, VA during a major winter storm on April 26-27, 1978. This northeaster produced one of the highest maximum water levels ever recorded for a winter storm at Gloucester Point (4.8 feet above 1960-78 mean sea level). The storm surge varied between 3.0 and 3.5 feet at the height of the storm. The astronomical tide was near its maximum range within the spring-neap cycle and very near maximum range for the apogean-perigean cycle as well, producing an extreme tidal range of 3.3 feet. The storm surge was unevenly distributed. Instead of a single sharp peak at its center, it contained two lesser peaks to either side of the astronomical high.



On October 25, 1982, another major storm occurred which produced an exceptionally large storm surge with a maximum height of 3.6 feet at Gloucester Point. This occurred within a single peak at the center of a more narrowly distributed surge hydrograph. The maximum water level during this storm reached 4.1 feet above 1960-78 mean sea level, less than the April 1978 maximum. The tidal range was again a crucial factor, this time reaching only 1.3 feet, a value near the absolute minimum range for this station. Helping to minimize the resulting water level extreme was the fact that the storm surge peak did not coincide with astronomical high tide, falling instead near the half-tide level midway between high and low. However, even if the high had occurred coincident with the storm surge peak, there would have been only 0.6 feet of additional rise.



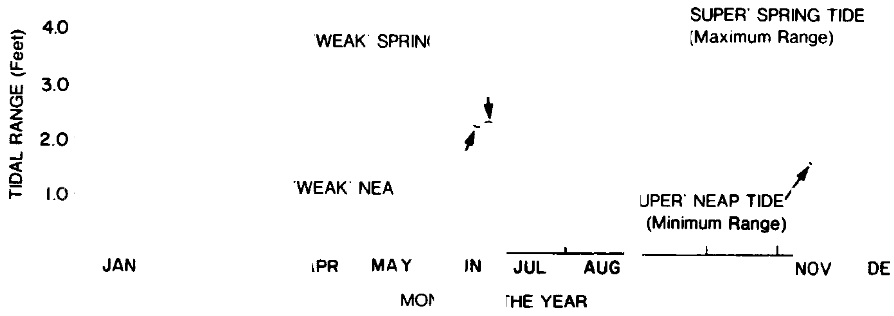
Illustrations by Kay Stubblefield

(continued from page 19)

considerable damage from New Jersey to Massachusetts.

Five additional extreme range peaks of nearly the same magnitude are predicted for 1987 as you can see in the illustration. In fact, about six of these super-range events occur every year (on different days each year) and those falling due in the winter season should get our attention and be well marked on our storm watch calendar.

Any tidal or storm event which may cause higher than normal water levels should be watched by coastal residents. While most such events are no cause for panic, a bit of precaution can prevent even minor property loss.



Weather-related publications to order

Sea Grant

The Chesapeake: A Boating Guide to Weather. Jon Lucy, Terry Ritter and Jerry La Rue. Educational Series No. 25. 22 pages. $1.00.

Shoreline Erosion in Virginia. S. Hardaway and G. Anderson. Educational Series No. 31. 25 pages. $1.00.

Tide Graphs for Hampton Roads, Virginia and Tide Graphs for Wachapreague, Virginia. Published quarterly. Free subscription by written request.

Publications request
Marine Advisory Services
Va. Institute of Marine Science
Gloucester Point, VA 23062

State

The Virginia Climate Advisory. Publlished quarterly. Free subscription by written request.

State Climatologist
Dept. of Environmental Sciences
Clark Hall, UVA
Charlottesville, VA 22903.

Federal

Public's Guide to General Weather Information. Public safety, education, travel, forecasts, a general guide to National Weather Service activities.

Thunderstorms and Ligntning. Description, statistics and safety information.

Storm Surge and Hurricane Safety with North Atlantic Tracking Chart. General hurricane information and explanation of storm surge.

NOAA. A pamphlet which describes the agencies administered by NOAA.

NOAA Public Affairs
8060 13th Street, Room 618
Silver Spring, MD 20910

Donna Soul
Extension Specialist
Seafood Utilization

CRABMEAT IN A CAN

Pasteurization is the best thing to happen to the blue crab since seafood seasoning. The taste and overall quality of pasteurized crabmeat is generally indistinguishable from that of the fresh meat.

There are many advantages to purchasing pasteurized crabmeat, especially in the winter. During the colder months, crabs dig into the sandy bottom and they have to be harvested by dredging; therefore, much of the fresh crabmeat available may be gritty. Most pasteurized crabmeat available at this time, however, was packed in the warmer months when a surplus of crabs were being caught in crab pots. The dredging season in Virginia begins on December 1 and ends March 31.

In addition to its uniform quality, pasteurized crabmeat has a much longer shelf-life than fresh packed crabmeat. The shelf-life for fresh crabmeat is about 2-4 days with a maximum of 10 days if the meat is purchased the day it is packed. The expected shelf-life for pasteurized crabmeat is 6-9 months, when it is held under commercial conditions. Consumers can expect quality crabmeat for 2-3 months in a home refrigerator after purchase. As with other pasteurized products, such as milk or canned ham, this type of crabmeat must be stored well chilled, 34°F is recommended.

Once a can of pasteurized crabmeat is opened it should be handled as if it were fresh, that is, it should be used within 2 to 3 days. Occasionally, some of the meat may take on a blue-gray color. This color variation is due to a processing temperature that was too high, but the meat is not harmful.

Pasteurized crabmeat can be thought of as a convenience food after purchase because of its extended shelf-life. It's in the refrigerator and ready when you are! If unexpected guests pop in they will be surprised to see a delicious crab dish on such short notice.

Nutritionally, pasteurized crabmeat is also comparable to fresh crabmeat. They both provide about 18 percent protein and only 2.5 percent fat. A 3 1/2 ounce serving of crabmeat is only 78 calories and contains about 80 mg cholesterol.

The market forms available are the same as for fresh meat; backfin/lump, special/flake, claw and cocktail claw. Get out your seafood seasoning and try one of these tempting recipes!

CRAB DIP

1/2 c plain, lowfat yogurt
6 oz cream cheese
2 T low calorie mayonnaise
1 T lemon juice
1 t Worchestershire sauce
1/2 t celery powder
1/2 t dry mustard
1 t chives
2 T milk
1/4 c cheddar cheese, grated
1/4 c green onion, minced
1/4 c green pepper, chopped
1/2 lb crabmeat (pasteurized or fresh)

In a double boiler or an electric fondue pot, combine all ingredients except the crabmeat. Stir over medium-low heat until the cheeses melt. Gently fold in crabmeat and heat thoroughly. Sprinkle with paprika. Serve hot with raw vegetables, crackers or party bread.

Makes 2 1/2 cups of dip.

HOT AND CHEESY CRAB DIP

12-16 oz crabmeat (pasteurized or fresh)
16 oz processed cheese spread
1/2 c skim milk
1/2 c dry white wine
2 T each finely chopped onion and green pepper
1 t Worchestershire sauce
1 t parsley
1/2 t cayenne pepper
1/4 t ground celery seed

Cut cheese in small pieces; combine with milk in saucepan or fondue pot. Stir over low heat until cheese melts. Stir in remaining ingredients; heat crabmeat and vegetables thoroughly.

Serve in fondue pot or chafing dish with crackers or bread sticks.

Makes about 3 cups.

BAKED CRAB PUFFS

1 T margarine, melted
1/2 c each chopped green onions, green peppers and mushrooms
1 lb fresh packed or pasteurized crabmeat, cartilage removed
6 oz Swiss cheese, grated
3/4 c mayonnaise
1/4 c pimento, chopped
2 T chopped parsley
4 t prepared mustard
2 t seafood seasoning
2 t lemon juice
4 cans (8 rolls each) crescent rolls

Preheat oven to 375.

Saute onions, green peppers and mushrooms in margarine until tender. Combine sauteed mixture with remaining ingredients (except rolls) and mix thoroughly. Separate crescent rolls and lie them out flat. Cut each triangle in half crosswise to form two triangles. Place each piece of dough over a small muffin cup. Spoon about 2 teaspoons of the crab mixture into each and fold corners of dough over filling. Bake at 375°F for 10-12 minutes until golden brown. Makes about 64 puffs.

Reader Survey/Renewal

Dear Bulletin Reader:

In the past few years, the Marine Resource Bulletin readership has more than doubled in size. The Bulletin has become an important source for information about the marine environment in Virginia for educators, managers, legislators and citizens. We hope that the Bulletin also serves as an impetus for public discussion of the many marine-related issues that are facing all of us.

To improve the distribution of the Bulletin, we are reviewing our mailing list. If you wish to continue to receive the Bulletin and other notices from Advisory Services, please re-affirm your interest by returning this portion of the Bulletin with your name and address which is on the back. Please make any corrections to the mailing label.

In addition, we would appreciate your filling in the short readership survey to help us serve you better. Please return your response by July 30, 1987. If we do not receive your request by then, we will assume you no longer wish to receive the Bulletin.

Thank you for your continued interest in the Bulletin and in Virginia's magnificent marine resources.

QUESTIONNAIRE

1. Rank your response to individual articles in this issue:

	Very Interesting	Interesting	Not Interesting
People on the Water	_____	_____	
Fish House Kitchen		_____	_____
Northeasters and high tides	_____	_____	
Marine notes (general information)	_____	_____	
Scientist, teacher, weatherman			
Fishing from satellites			
Research links winds and fish populations			
Will the hurricane hit Virginia?			
Weather Wise Virginia			

2. The articles are: too simple about right _____ too technical _____

3. My contacts with the marine environment are: (check as many as apply)

Resident
Research
Recreation
Government
Education
Media

Private Business:
Commercial fishing
Marine trades and industries
Recreational fishing
Coastal development

4. Topics you would like covered in future issues:

____

____

5. Would you be willing to pay for this publication? (check maximum)

$4/yr. _____ $8/yr. _____ $12/yr. _____

Return to: Marine Advisory Services
Virginia Institute of Marine Science
Gloucester Point, VA 23062

Hatchery Outreach in second year at VIMS

The Virginia Institute of Marine Science developed a pilot-scale hatchery for the production of "eyed" larvae during 1986. An existing building was converted to an oyster conditioning and larval culture facility, and additional improvements are underway for the 1987 season.

Two mobile remote setting tanks were constructed early in 1986 and were taken to sites around the state to demonstrate the setting procedures for eyed larvae and to examine potential areas for commercial remote setting facilities. In addition, concurrent research activities include examinations of differing setting, nursery, and larval culture methods, disease-resistant stocks, alternative oyster setting materials, and hatchery economics studies.

For 1987, plans are to continue expansion of current research projects. For more information, contact Marine Advisory Services, Virginia Institute of Marine Science, Gloucester Point, VA, 23062.

Walton League honors Bay Team teachers

The Izaak Walton League of America recently published articles in their magazine "Outdoor America," highlighting the efforts of "Local Heroes" in the Chesapeake Bay clean-up efforts.

"In a classroom located in the Blue Ridge Mountains of western Virginia, children who have never seen the Chesapeake Bay laugh with delight as they pass around a bucket that contains a live blue crab, jars of preserved fish specimen, some oyster shells, a clam rake and a fisherman's net. This is not an ordinary school lesson -- the students are learning about the Chesapeake Bay through an innovative program called The Bay Team, run by the Virginia Institute of Marine Science. Funded by the Virginia Council on the Environment, the program has been a statewide hit since its inception in 1985.

"The Bay Team is made up of a small group of marine scientists, marine educators and full-time instructors who devise project activities designed to help Virginia students understand their connection with and the importance of the Chesapeake Bay. At present there are two instructors, Barbara Guthrie and Robert Steele, who visit schools across the state presenting the education programs."

According to Lee Lawrence, Sea Grant Education Coordinator at VIMS, the purpose of the program is also to interest teachers in presenting information about the Bay in their regular teaching programs. "During the 1985-86 school year, the Bay Team taught lessons in 38 Virginia school systems, travelled more than 15,000 miles and reached over 16,000 students. They expect to reach an impressive 25,000 students by this school year's end."

Sea Grant Communications
Virginia Institute of Marine Science
Gloucester Point, Virginia

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