

Marine Extension Bulletin

From the Woods Hole Oceanographic Institution Sea Grant Program

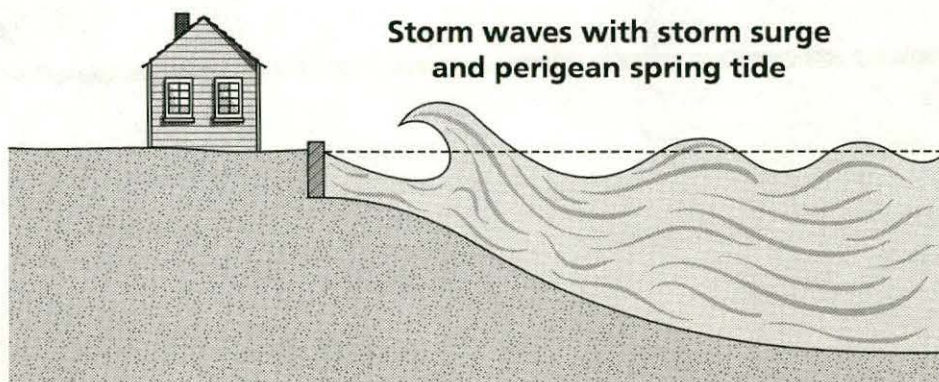
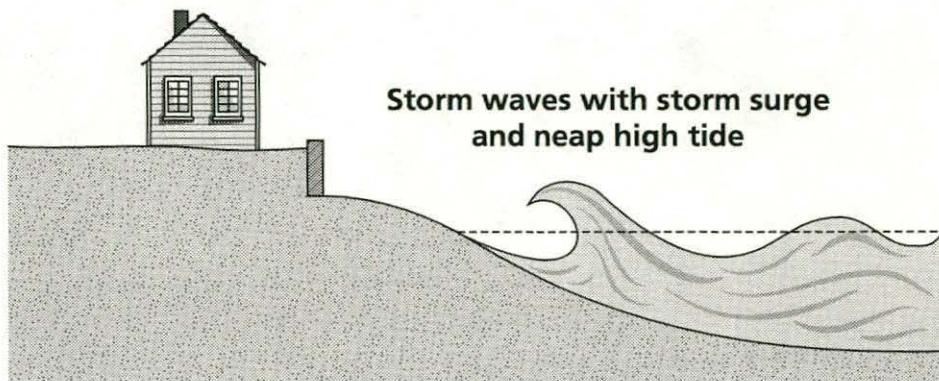
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Perigean Spring Tides

**Predicting Potential Disasters:
How Tidal Information May Save
You From a Coastal Crisis**

The memorable blizzard of February, 1978, caused coastal flooding and \$500 million in damages to Massachusetts alone, much of the loss to coastal properties. The storm began a few hours after the moon was in perigee (closest to the earth) on February 6, and the day before a new moon. The property damage resulted not only from the severity of the storm and its accompanying storm surge, but also from the extreme high water caused by the nearly coincident new moon tide, or "spring tide," and a perigean tide.

Though meteorological conditions, such as those that produced the Blizzard of '78, are predictable only days or hours in advance, astronomical high tides are predictable centuries in advance. If you are a coastal property owner in Massachusetts, or a boat owner, you may want to note dates on your calendar when a perigean high tide is predicted, as it could combine with a storm to produce coastal flooding and property damage. You can find the dates for perigean tides—and information about tides and tidal ranges in general—in several reference materials that are listed in this bulletin.



Perigean Spring Tides

The term "spring tide" does not refer to the season, but rather to the higher high tides and lower low tides which occur at new and full moons. At new and full moons, the sun, earth and moon are aligned such that the pull of the sun on the oceans adds to the pull of the moon on the oceans. Spring tides alternate at one week intervals with "neap tides." Neap tides occur during the first or third quarter moons when the sun and moon are aligned at right angles with respect to earth, and the sun tides subtract from the moon tides.

A perigean tide refers to a tide that

occurs when the moon is closest to the earth. The moon's orbit around the earth is elliptical rather than circular, which means that the distance between earth and moon is always changing. Perigee refers to the time when the moon and the earth are closest to one another. At perigee, the moon is about 30,000 miles closer to earth than at apogee, when the moon is farthest from earth. Perigee is reached about once a month, roughly the time it takes for the moon to revolve around the earth. When the moon is closest to earth, its effect on tides is greatest.

The largest astronomical tides, peri-

gean spring tides, occur when spring tides and perigean tides coincide. Perigean spring tides occur at intervals that are slightly more than six months long, so each year they are later in the season than the preceding year. For this reason, we must refer to tables of predicted tides to know exactly when to expect these unusually high tides.

The term "storm surge" denotes the high sea levels—those not related to astronomical tides—that often accompany severe storms. There are two major causes of storm surges: strong onshore winds and the low atmospheric pressure accompanying such storms.

As in the Blizzard of '78, major coastal flooding and storm damage is likely to occur when perigean spring tides coincide with a major storm and storm surge. The direction of the wind (onshore) and low atmospheric pressure (which effectively contributes to a higher sea level) will add to the severity of storm damage. Because Massachusetts has coastline facing the ocean at virtually every point of the compass rose, coastal flooding during storms is likely to occur somewhere regardless of the direction of the wind. The role of tides in increasing storm damage is more significant in areas having larger tidal ranges (i.e., the North and South Shores, Boston, Cape Cod Bay and the open ocean side of outer Cape Cod) than in areas with smaller tidal ranges (i.e., the south shore of Cape Cod, Buzzards Bay, Nantucket, Martha's Vineyard, Fairhaven, and New Bedford).

While damaging storms can occur under other sea and tidal conditions, high astronomical tides caused by the near coincidence of a spring tide and perigee can be especially dangerous. By becoming more informed of the timing of these predictable events, you will also be preparing yourself for the unpredictable events of nature.

Knowledge of tidal cycles and tidal currents is critical for planning trips and for operating vessels safely.

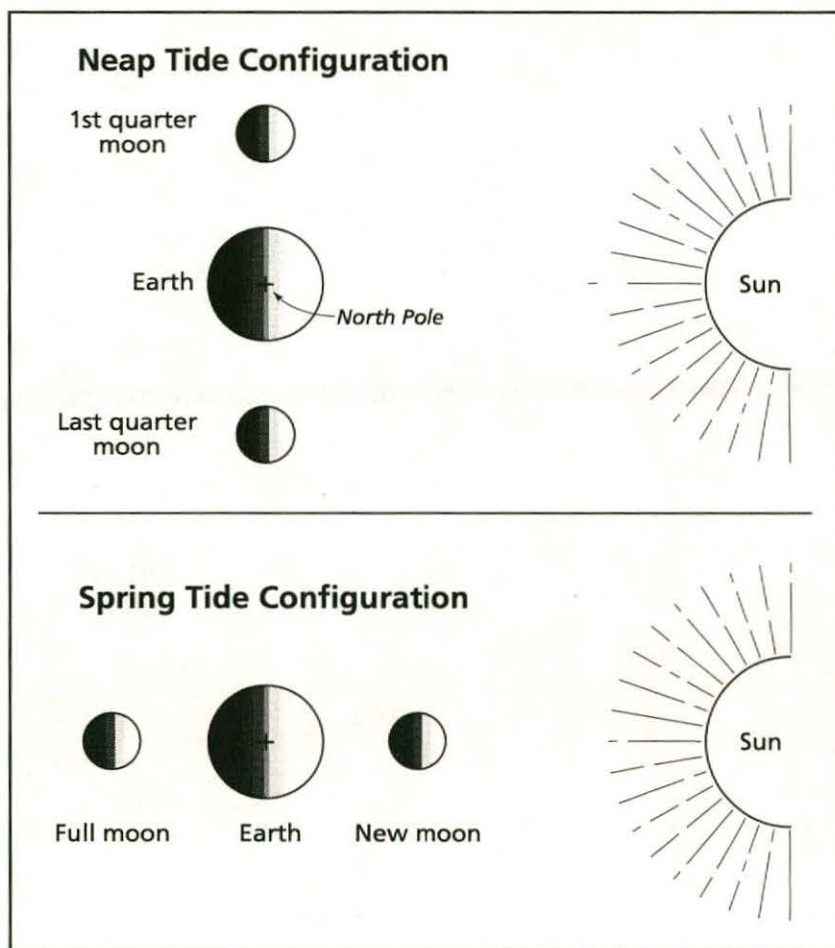
In 1890, the federal government began to publish both high and low water data annually. In 1995, the National Ocean Service (NOS) redefined its role to be maintaining and updating the tidal predictions database and published its last hard copy volumes of *Tide Tables* and *Tidal Currents*.

Currently, tidal data are available on-line through the National Oceanic and Atmospheric Administration (NOAA) website, <http://www.noaa.gov> and from several private publishers who utilize NOS databases. The website lists tidal forecasts for the next four days. For long-term tide predictions, you can call the NOS office at (301) 713-2815 between 7 a.m. and 3 p.m. EST. You may also request long term tide predictions by e-mailing: ipss@ceob.nos.noaa.gov. If you submit your request by e-mail, include: your full name, your postal mailing address, your phone number including area code, the location(s) for which

you want predictions, the format and options you desire (see NOAA website for available formats and options)

The fee for these services is \$31 per year for predictions at one location; add \$10 for a year of predictions at each additional location.

NOTE: For readers who do not have on-line capabilities, many of the public libraries on Cape Cod now offer free on-line services and assistance.



Sources of Tidal Data for Mariners and Coastal Residents

Massachusetts coastal residents, fishers, shellfishers, aquaculturists, and mariners need to know the times and heights of high and low tides. Some harbors, for example Wellfleet and Barnstable, do not have enough water to allow passage of vessels at low tide. In other places, rocks are a hazard to boats during some parts of the tidal cycle.

Although NOS ceased publishing tide and tidal currents volumes with the 1995 editions, NOS makes its data available to commercial publishers who continue the tradition of hard copy volumes of tides and tidal currents for coastal waters. The three publishers that NOAA recognizes as publishing complete tidal references using NOAA data are:

ProStar Publications

East Coast: 3 Church Circle, Suite 109,
Annapolis, MD 21401 (800) 481-6277
West Coast: 13486 Beach Avenue, Marina
Del Rey, CA 90292 800-481-6277

Reed's Nautical Almanacs

Thomas Reed Publications, Inc., 13A
Lewis Street, Boston, MA 02113 (800)
995-4995

International Marine, P.O. Box
182607, Columbus, OH 43218-2607
(800) 262-4729

NOTE: These volumes are available from their publishers as well as marine suppliers. The list price of Reed's Nautical Almanacs, which include both tide and current tables, is \$29.95. Reed's also includes the Coast Pilot and Light List and a complete nautical ephemeris. Both ProStar Publications and International Marine, a division of McGraw-Hill, publish separate volumes for tides and currents by region. Each volume costs \$13.95.

In addition to the official NOS data, many navigators in the northeast use the *Eldridge Tide and Pilot Book* which was first published in 1854 as *Eldridge's Pilot for Vineyard Sound and Monomoy Shoals*; the *Tide and Pilot Book* followed in 1875. The 1998 *Eldridge Tide and Pilot Book* costs \$9.95.

Many coastal residents, boaters, and beachgoers use weekly tide tables from local newspapers or yearly tide tables provided by local fishing supply and hardware stores. Many fishers and boaters use NOAA's National Weather Service radio broadcasts which give tidal information as well as wind and sea conditions. An inexpensive dedicated receiver may be purchased at home electronics stores or marine suppliers. Many VHF marine radios receive the weather channel.

More about Tides

In addition to tidal and current predictions, readers who want more information on how tides work can find a clearly presented summary of tidal theory at the NOAA website: <http://www.noaa.gov> or consult the sources below.

Sources

- Willard Bascom. 1980. *Waves and Beaches*, pp. 92-104.
- Edward P. Clancy. 1968. *The Tides: Pulse of the Earth*.
- *Eldridge Tide and Pilot Book*, 1998.
- William T. Fox. 1983. *At the Sea's Edge: An Introduction to Coastal Oceanography for the Amateur Naturalist*, pp. 94-106.
- NOAA, National Ocean Service, Office of Coast Survey. "Our Restless Tides: A Brief Explanation of the Basic Astronomical Factors which Produce Tides and Tidal Currents," <http://www.opsd.nos.noaa.gov/prettide.html>
- 1998 *NOAA Tide and Tidal Current Tables*, International Marine.
- *Reed's Nautical Almanac: North American East Coast*, 1998

For more information about the research or outreach projects profiled in the *Marine Extension Bulletin*, contact WHOI Sea Grant at the address listed above.