Maximum Daily Tidal Range for Summer, 2010

The figure shows the maximum daily tidal range for Boothbay Harbor, Maine for June, July and August of 2010, based on NOAA-predicted tides for Portland, corrected for Boothbay. The maximum range is the difference between the highest and lowest stands of water level for each 24 hour day starting at midnight. The maximum range on a given day is not necessarily the same as the difference between successive highs and lows listed in tide tables; e.g. the maximum range may result from an early morning high and a late evening low. The arrows and letters (A, N, P, F) at the top of the figure refer to events in the lunar cycle (apogee, new, perigee, full). The moon in its elliptical orbit is closest to the earth at perigee and most distant at apogee.

The largest ranges are associated with near-coincidences of perigee with the new moon. The confluence produces ‘proxigean’ tides, or spring tides with larger than usual ranges, and the closer the coincidence the larger the range. The figure shows the increasing range each month as the perigee converges with the new moon.

They converge because the time between successive lunar perigees is about 27.5 days on average, which is a bit shorter than the mean synodic month of about 29.5 days between new or full moons. Thus the perigees drift in and out of step with the new or full moon, with near coincidence occurring about every seven months. For example, backing up about seven months from August, the extremely large tidal range (13.2 ft) that occurred in Boothbay Harbor on January 31, 2010 resulted from a close coincidence between perigee and the full moon, with only about 2 hours separation (see figure below). For comparison, the August perigee follows the new moon by about 14 hours, and the maximum range is about 12.6 ft on both the 10th and the 11th. The January event was further amplified because the earth is near its closest approach to the sun (perihelion) in late January.

The graphs show that the tide at Boothbay Harbor (and throughout the Gulf of Maine) responds more strongly to the perigee-apogee cycle, i.e. the earth-moon distance, than it does to the new moon-full moon cycle, i.e. the relative positions of the moon and sun with respect to the earth. This is unusual because in most places the influence is reversed. The tides in the Gulf of Maine are ‘anomalous’ in this regard because of the particular shape of the basin and the shallow offshore banks, which also leads to the unusually large ranges in the Bay of Fundy.