

Karumba Tides

When you travel around the coastline of Northern Australia, you soon notice something odd about the tides. Over on the West coast of Western Australia near Derby, you get your standard two high tides and two low tides a day (and the difference between high and low tide can be up to 12 metres). But travel East across



to Karumba (down in the bottom right hand corner of the Gulf of Carpentaria, or the bottom left-hand corner of Cape York), and the tides are very different. Even though Karumba is roughly as far from the equator as Derby, you'll find that the tide in Karumba is back to the average height of a few metres or so, but that there is only one high tide and one low tide each day. What's going on?

While I was up in the Gulf, I asked everybody why Karumba had just one tide each day. Everybody had answers that were very convincing, and very different.

But eventually I got the right answer (I think it's the right answer) from Bill Mitchell, a research associate at the National Tides Facility at Flinders University. In fact, he'd written a scientific paper on the tides in the Gulf. His answer reads "A Kelvin wave with a clockwise rotating amphidrome just west of the centre of the Gulf is the dominant feature of the diurnal components of the tide. The semidiurnal components exhibit a line of minimum amplitude with associated amphidromes located centrally in the Gulf. This feature prevents a large amount of the potential energy at the latter periods penetrating the southern half of the region." So here's my attempt to explain Bill's answer in words, not equations.

It turns out that the tides involve more than just the Earth, Sun and Moon. Once you add in complicating factors (like the ocean has different depths at different places, and the continents have odd shapes, and the Earth is actually tilted some 23° off the vertical, and the Earth spins, and half a dozen other factors) and then you do the complicated equations, you'll find that there are about 120 different possible tides. So there are possible tides that happen once a day, twice a day, three times a day, four times a day, and so on.



World-wide, there's a certain amount of energy available for the tides, but as we can see at the beach, most of the energy appears in the tide that happens twice a



day. Most of the remaining tidal energy appears in the once-a-day tide, and the small amount of energy left over is shared between the other 118 possible tides.

Now most of the tidal energy in the Gulf, and in fact most of the water in the Gulf, comes from the Indian Ocean. Hardly any gets through that little 200 km gap between the tip of Cape York and New Guinea. So the Gulf of Carpentaria is virtually a closed body of water, almost like a bath tub with the plug in.

If you fill your bathtub with water, and gently pat a bread board onto the water at one end, you'll see that the wave takes 2 seconds to get to the other end of the bathtub, and another 2 seconds to get back - a total of 4 seconds. So, if you pat the water with the bread board every 4 seconds, you'll soon get a big wave of water sloshing over the end of your bathtub. The timing is critical, like the pushing of a swing.



Now this is the hard bit, so you might have to concentrate. It takes 2 seconds for a wave to slosh along your average bathtub, but the mouth of the Gulf of Carpentaria is much bigger, and it takes 12 hours for a wave to slosh across from east to west (and vice versa). By an enormous coincidence, this 12-hour-period is the same as the time between two high tides (or two low tides).

As the twice-a-day tide comes across the top of Australia from the Indian Ocean into the Gulf of Carpentaria, it has to pass through the mouth of the Gulf. The twice-a-day tide heading into the Gulf gets trapped by this potential 12-hour-wave that exists across the mouth of the Gulf. Very little twice-a-day energy is left over to go into the Gulf. Now the next most energetic tide is the once-a-day tide. This tide gets through because its timing is different. And that's why you have only one tide a day at Karumba. (The other tides get through as well, but you don't notice them because they are so small.)



Now this special one-tide-a-day thing happens in other places, for exactly the same reason - places like the Gulf of Thailand, the Persian Gulf, the South China Sea and even the Gulf of Mexico. It just so happens that all these places are some of the very best places on Earth for



catching fish. I wonder if the once-a-day tides makes the fish all confused, and easier to catch?

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