

## **Cellular-based sea level gauge**

R.G. PRABHUDESAI & ANTONY JOSEPH

**The National Institute of Oceanography has developed a coastal sea-level monitoring system that can be accessed on the Internet.**

THE National Institute of Oceanography (NIO) in Goa has developed a real-time reporting and Internet-accessible coastal sea-level monitoring system and it has been operational at Verem jetty in the Mandovi estuary in Goa since September 24, 2005. The gauge uses a cellular modem to put on the Internet real-time sea-level data, which can be accessed by authorised personnel. By using a cellular phone network, coastal sea-level changes are continuously updated on to a web-server. The sea-level gauge web site can be made available to television channels to broadcast real-time visualisation of the coastal sea level, particularly during oceanogenic hazards such as storm surges or a tsunami. A network of such gauges along the coast and the islands that lie on either side of the mainland would provide data to disaster management agencies to disseminate warnings to coastal communities and beach tourism centres (Joseph and Prabhudesai, 2005).

The gauge incorporates a bottom pressure transducer as the sensing element. The sea unit of the gauge, which houses the pressure transducer, is mounted within a cylindrical protective housing, which in turn is rigidly held within a mechanical structure. This structure is secured to a jetty. The gauge is powered by a battery, which is charged by solar panels. Battery, electronics, solar panels, and cellular modem are mounted on the top portion of this structure. The pressure sensor and the logger are continuously powered on, and their electrical current consumption is 30 and 15 mA respectively. The cellular modem consumes 15 mA and 250 mA during standby and data transmission modes, respectively.

The pressure sensor located below the low-tide level measures the hydrostatic pressure of the overlying water layer. An indigenously designed and developed

microprocessor-based data logger interrogates.

the pressure transducer and acquires the pressure data at the rate of two samples a second. The acquired pressure data is averaged over an interval of five minutes to remove high-frequency wind-waves that are superimposed on the lower frequency tidal cycle. The averaged data is recorded in a multimedia card.

The measured water pressure is converted to water level using seawater density and acceleration owing to the earth's gravity. The water level so estimated is then referenced to chart datum (CD), which is the internationally accepted reference level below which the sea level will not fall.

The data received at the Internet server is presented in graphical format together with the predicted sea level and the residual. The residual sea level (that is, the measured minus the predicted sea level) provides a clear indication of sea-level oscillation and a quantitative estimate of the anomalous behaviour, the driving force for which could be atmospheric forcing (storm) or geophysical (tsunami). A network of sea-level gauges along the Indian coastline and islands would also provide useful information to mariners for safe navigation in shallow coastal waters and contribute to various engineering projects associated with coastal zone management, besides dredging operations, port operations and management of inland water resources (reservoirs, dams). The system can also be used effectively for sharing of water resources between States and neighbouring countries, and for monitoring and implementation of river water treaties with greater transparency. Among the various communication technologies used for real-time transmission of sea-level data are the wired telephone connection, VHF/UHF transceivers, satellite transmit terminals and cellular connectivity. Wired telephone connections are severely susceptible to loss of connectivity during natural disasters such as storm surges, primarily because of telephone line breakage. Communication via VHF/UHF transceivers is limited by line-of-sight distance between transceivers and normally offer only point-to-point data transfer. Satellite communication via platform transmit terminals (PTTs) has wide coverage and, therefore, allows data reception from offshore platforms. However, data transfer speeds are limited. Further, many

satellites (for example, GOES, INSAT) permit data transfer only at predefined time-slots, thereby inhibiting continuous data access. Technologies of data reporting via satellites have undergone a sea change recently in terms of frequency of reportage, data size, recurring costs and so forth. Broadband technology has been identified as one that can be used optimally for real-time reporting of data because of its inherent advantages such as a continuous two-way connection that allows high-speed data transfer and near real-time data reporting.

While satellite communication is expensive, wireless communication infrastructure and the ubiquity of cellular phones have made cellular communication affordable. Low initial and recurring costs are an important advantage of cellular communication. A simple and cost-effective methodology for real-time reporting of data is the cellular-based GPRS technology, which has been recently implemented at the

NIO for real-time reporting of coastal sea level data (Prabhudesai et al., 2005; Joseph and Prabhudesai, 2005).

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*R.G. Prabhudesai and Antony Joseph are senior scientists at the National Institute of Oceanography, Dona Paula, Goa.*