National Report of New Zealand

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1. Introduction

New Zealand does not have a formal, nationally administered, network of sea-level gauges. Instead, sea-level gauges are mostly operated independently by various agencies, with some national coordination of daily downloads of data, post processing and archiving undertaken through voluntary partnerships with either Land Information NZ (LINZ) or National Institute of Water and Atmospheric Research Ltd (NIWA). NIWA has been funded in the past by the NZ Foundation for Research Science and Technology to support and coordinate an informal open-coast network. However, large funding cuts in 2004 have curtailed more extensive contributions of quality-assured datasets to New Zealand and international science and geodetic communities. This continues to be an issue but quality-assurance of past records up to 2006 was undertaken with a one-off funding from NIWA.

The following brief report outlines activities in New Zealand associated with sea-level gauges and availability of data. The main development since the last report has been the work currently underway to establish a network of tsunami monitoring sites.

2. Sea Level Stations

A large number of organisations own and operate sea level stations in New Zealand. These stations can be grouped into four categories; sites at major ports operated by the local port company or regional council, an open coast network managed by NIWA, a tsunami monitoring network being established by LINZ in partnership with the Crown-owned research organisation GNS Science (GNS), and other sites.

2.1 Stations at Major Ports

Table 1: Sea level stations whose data is used to produce daily tide predictions.

Station	Latitude	Longitude
Marsden Point	35° 50’ S	174° 30' E
Auckland	36° 51’ S	174° 46' E
Onehunga	36° 56’ S	174° 47' E

Tauranga	37° 39’ S	176° 11' E
Gisborne	38° 40’ S	178° 02' E
Port Taranaki	39° 03’ S	174° 02' E
Napier	39° 29’ S	176° 55' E
Nelson	41° 16’ S	173° 16' E
Wellington	41° 17’ S	174° 47' E
Picton	41° 17’ S	174° 00' E
Westport	41° 45’ S	171° 36' E
Lyttelton	43° 36’ S	172° 43' E
Timaru	44° 23’ S	171° 15' E
Port Chalmers	45° 49’ S	170° 39' E
Dunedin	45° 53’ S	170° 30' E
Bluff	46° 36’ S	168° 21' E

2.2 Open Coast Network

NIWA coordinates a loose nation-wide network of open-coast sea-level gauges in partnership with some port companies (counted above), regional and local councils and for one installation each, the National Tidal Centre, Bureau of Meteorology (Australia) and Antarctica New Zealand. There are currently 18 gauges that are coordinated and/or archived by NIWA, (excluding those stations counted above in Section 2.1), 10 of which are operated by NIWA itself. These stations complement the gauges operated by individual ports (section 2.1) and other local/regional councils (section 2.4). Details on sites and the characteristics of the 18 stations in the open-coast network are listed in Table 2.

Table 2: Sea level gauges in an open-coast network (excluding Standard Port Stations). Gauge type abbreviations are: B = gas bubbler with ParoScientific PS2 pressure sensor; SW = still-well float/counter weight + digital logger; US = ultrasonic in air; SEAFR = SEAFRAME acoustic gauge; R = radar.

Station	Latitude	Longitude	Start date of NIWA archive	Recording interval (min)	Gauge Type
Moturiki Is.	37° 38’ S	176° 12’ E	27-May-1971	1, 5	B+SW
Tararu	37° 08’ S	175° 31’ E	1-Nov-1992	5	US
Sumner Head	43° 34’ S	172° 46’ E	6-Jun-1994	1	B
Kaikoura	42° 25’ S	173° 42’ E	10-Aug-1994	1	B
Jackson Bay	43° 57’ S	168° 37’ E	13-Dec-1996	1, 6	SEAFR
Dog Island	46° 39’ S	168° 25’ E	5-Apr-1997	1	B
Kapiti Island	40° 51’ S	174° 56’ E	24-Jul-1997	1	B
Charleston	41° 54’ S	171° 26’ E	25-Apr-1998	1	B
Anawhata	36° 55’ S	174° 28’ E	19-Nov-1998	1	B
Whitianga	36° 50’ S	175° 43’ E	13-Jul-1999	5	R
Little Kaiteriteri	41° 03’ S	173° 02’ E	17-Jun-2000	1	B
Tarakohe	40° 49’ S	172° 54’ E	28-Jan-2005	1	B
Kaingaroa (Chatham Island)	43° 44’ S	176° 16’ W	24-Sep-2000	1, 5	B

Scott Base (Antarctica)	77° 51' S	166° 46' E	15-Jan-2001	5	B
Poutu Point	36° 22' S	174° 11' E	21-Apr-2002	5	B
Green Island	45° 57' S	170° 23' E	6-Dec-2002	1	B
Raglan Harbour	37° 48' S	174° 53' E	15-Jul-2008	1	B
Kawhia Harbour	38° 04' S	174° 49' E	29-Aug-2008	1	B

2.3 Tsunami Monitoring Network

LINZ is working in partnership with GNS to improve the system of sea level recorders around New Zealand and its off-shore islands to allow better detection and confirmation of tsunamis.

A network of 18 sea level recorder stations is proposed - the first of these became operational during 2007 and the network is scheduled for completion by mid-2010.

The data from these sites will be transmitted to GNS which is responsible for monitoring New Zealand's geophysical hazards (earthquakes, volcanoes, landslides and tsunamis). Real time data from this network is available via the Global Telecommunications System (GTS). Data is also archived and made freely available from LINZ's web-site.

The Pacific Tsunami Warning Center (PTWC) has two tsunami monitoring stations on Chatham Island; at Waitangi and Owenga. PTWC is about to decommission their site at Owenga, leaving LINZ/GNS to maintain their installation at this location.

Table 3: Operational sea level stations in the tsunami monitoring network. Dates indicate when the LINZ/GNS sites commenced operation.

Station	Latitude	Longitude	Start date
Wellington	41° 17' S	174° 47' E	23-Mar-2007
Napier	39° 29' S	176° 55' E	20-Sept-2007
Owenga (Chatham Island)	44° 02' S	176° 22' W	7-Dec-2007
Gisborne	38° 40' S	178° 02' E	11-Mar-2008
Tauranga	37° 39' S	176° 11' E	6-Jul-2008
Lottin Point	37° 33' S	178° 10' E	10-Oct-2008
North Cape	34° 25' S	173° 03' E	24-Dec-2008
Devonport	36° 50' S	174° 47' E	26-Mar-2009
Waitangi (Chatham Island)	43° 57' S	166° 33' W	

2.4 Other Sea-level Gauge Sites

In addition to the sites described above, continuous sea level measurements are also taken at sites at minor ports, supplementary gauges at major ports and several estuaries. Most of these stations are owned and operated by either local/regional councils or port companies.

LINZ operates a sea level station in Antarctica at Cape Roberts.

Table 4: Other sea-level gauge sites.

Station	Latitude	Longitude
Opua (Bay of Islands)	35° 19’ S	174° 07' E
Rangaunu Harbour (Awanui)	35° 00’ S	173° 15' E
Frenchman Island (Marsden Point)	35° 52’ S	174° 32' E
Dargaville	35° 56’ S	173° 52' E
Tauranga Harbour (Kotuku Reserve)	37° 40’ S	176° 03' E
Tauranga Harbour (Sulphur Point)	37° 41’ S	176° 10' E
Tauranga Harbour (Oruamatua)	37° 42’ S	176° 13' E
Tauranga Harbour (Hairini Bridge)	37° 43’ S	176° 10' E
Whakatane Town Wharf	37° 57’ S	177° 00' E
Ohiwa Harbour (Port Ohope Wharf)	37° 59’ S	177° 06' E
Opotiki	38° 02’ S	177° 14' E
Milford Sound	44° 40’ S	167° 56' E
Spit Wharf (Otago Harbour)	45° 47’ S	170° 43' E
Avon/Heathcote (Ferrymead Bridge)	43° 33’ S	172° 43' E
Cape Roberts (Antarctica)	77° 02’ S	163° 12' E

2.5 GLOSS Stations

Five stations in the GLOSS Core Network are located within New Zealand.

GLOSS stations 101, 127 and 129 appear in Table 1, station 128 is included in Table 3 and station 134 is part of Table 2.

Table 5: New Zealand’s GLOSS Core Network stations.

GLOSS ID	Station
101	Wellington
127	Auckland
128	Waitangi (Chatham Island)
129	Bluff
134	Scott Base (Antarctica)

3. Sea Level Technologies

3.1 Stations at Major Ports

Sea level data at all major ports (Table 1) is recorded digitally.

A variety of sea level measurement technologies are used, including sub-surface pressure transducers, float and stilling well, downward-looking radar and ultrasonic systems.

Data is recorded once every minute at half of the sites with the balance producing data at intervals of either 5 or 10 minutes.

3.2 Open Coast Network

As listed in Table 2, most of the sites operated by NIWA use a bubbler gauge technology with PS2 ParoScientific pressure sensors, while other installations use either radar, acoustic, ultrasonic or float/counter weight systems (see Table 2).

All sites record data in digital form, mostly at 1 minute recording intervals, with the remaining gauges recording at either 5 or 6 minute intervals.

3.3 Tsunami Monitoring Network

Each of the LINZ/GNS tsunami monitoring sites listed in Table 3 incorporates a pair of Druck PTX 1830 pressure sensors. The vented sensors have a range of 0 – 20 metres and output a 4-20mA signal. Sea level is measured at a rate of 10Hz and a record is output at 1 minute intervals.

3.4 Other Sea-level Gauge Sites

Details of equipment used at these sites has not been collated, however pressure sensors, ultrasonic, bubbler and float/counter weight technologies would be most likely.

4. Continuous GPS (CGPS)

CGPS observations have been made at three of the major ports (Wellington, Lyttelton and Dunedin) since late 1999. These stations are operated by GNS.

5. Data Availability

5.1 Hourly Data for GLOSS stations

a) Wellington (101) and Bluff (129):
Fast delivery of data for these GLOSS stations commenced May 2007 and is forwarded to UHSLC each month.

b) Auckland (127):
Efforts are being made to obtain permission from the port company to make this data available to the international community.

c) Chatham Island (128):
Near real-time data is provided through PTWC.

d) Scott Base (134): The entire dataset up to the start of 2007 has been quality-assured by PSMSL after receipt of data from NIWA and also submitted to UHSLC. In future, data will be made available by NIWA at annual update intervals to UHSLC and PSMSL.

5.2 Monthly and Annual Means (PSMSL)

Data held by PSMSL for other New Zealand stations is neither comprehensive nor complete. Permission has been obtained to make this data available and this will be carried out as time and funding permits for undertaking quality-assurance on the datasets. Some progress has been made in this regard since the GE X meeting in 2007; recent data supplies to PSMSL are summarised in the following table.

Table 6: Stations for which monthly and annual mean sea level data has been submitted to PSMSL since the GE X meeting in 2007.

Station	Data submitted to PSMSL	
	Start date	End date
Whangarei	January 1987	December 2007
Marsden Point	January 1975	December 2007
Tauranga	August 1984	December 2008
Port Taranaki	January 1984	December 2007
Nelson	June 1984	December 2007
Lyttelton	January 1995	December 2007
Timaru	January 1987	December 2007
Dunedin	January 1996	December 2007

5.3 Open Coast Network

The open-coast network data (Table 2) is processed nightly and uploaded to the internet in the form of plots from tide, storm surge and long-wave/tsunami analyses. The web site is:
http://www.niwa.co.nz/services/sealevels/

Processed and quality-assured datasets for the NIWA-operated gauges (9 sites) up to the start of 2007 are available by registering with the following web site: http://edenz.niwa.co.nz/

5.4 Tsunami Monitoring Network

Data recorded by the tsunami monitoring sites is available for free download in the form of daily files. Metadata about the sites and the data can be accessed at the following web site: http://www.linz.govt.nz/hydro/tidal-info/gauges/sea-level-data-downloads/index.aspx

5.5 Other requests

Metadata for Antarctica gauges at Scott Base and Cape Roberts are listed at: http://gcmd.nasa.gov/KeywordSearch/Home.do?Portal=amd_nz&MetadataType=0 under the Oceans and Tide Gauges sub-sections.

Requests for information or data not covered above can be made to the authors of this report – contact details shown on the first page.

SEA LEVEL SITES IN NEW ZEALAND

Major port sites (Table 1) are shown in **red**
Open coast sites (Table 2) are shown in **green**
Tsunami monitoring sites (Table 3) are shown in **purple**
Other sites (Table 4, except the Tauranga Harbour sites) are shown in **blue**

Names of GLOSS stations are appended with their GLOSS ID number