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Sea-Level Data from the Australian Coastal Experiment; a Data Report

A. Forbes

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G.P.O. BOX 1538, HOBART, TAS. 7001, AUSTRALIA

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SEA-LEVEL DATA FROM THE AUSTRALIAN COASTAL EXPERIMENT; A DATA REPORT

A. FORBES

Division of Oceanography
CSIRO Marine Laboratories
GPO Box 1538, Hobart, Tasmania, 7001
Australia

CSIRO Marine Laboratories Report No. 171

Abstract

This report presents sea-level data acquired by the CSIRO and the Institute of Ocean Sciences (Canada) during the Australian Coastal Experiment as well as data recorded during the same period by the Hobart Marine Board (Tasmania), the NSW Public Works Department, the Maritime Services Board (NSW) and the Division of National Mapping (Canberra). Data are presented as time-series plots of sea level and, where available, sea temperature.

Introduction

During 1983/84, sea-level data were gathered from seven coastal and three offshore stations as part of the Australian Coastal Experiment (ACE), which was designed to study the dynamics of coastal trapped waves (CTW). Two characteristic signals of CTWs are large-scale rotational currents and long-period oscillations of sea level. The current meter data are presented in a separate Data Report No. 169 (Freeland *et al.*, 1985).

A number of tide gauges are operated by public authorities on a long-term basis at various points along the ACE region of the NSW coast. Records were made available to CSIRO from seven of these, covering the 6-month period of ACE, from September 1983 through March 1984. The sea-surface expression of a CTW should be largest at the coast and decrease across the continental shelf, so seven bottom-mounted pressure gauges were deployed to study this structure. Four were on the Cape Howe line of current meters, one on the Stanwell Park line and two on the Newcastle line. Atmospheric pressure data (required to adjust the sea-level data) were obtained from a network of coastal stations maintained by the Australian Bureau of Meteorology. Figure 1 shows the locations of all 13 sea-level stations and 16 Bureau of Meteorology stations.

Instrument Deployment

The seven coastal tide gauges are part of a network of recorders that monitor sea level around Australia. No single authority maintains these gauges. The CSIRO obtained copies of chart records from four different sources (listed in Table 1) and digitised them hourly.

The bottom-mounted pressure gauges were deployed from the R.V. 'Sprightly' in September 1983, using two different mooring techniques. The five CSIRO gauges were mounted independent of the current meter moorings in specially cast concrete blocks, each with an acoustically operated release and subsurface buoyancy for recovery. They were all model TG12A, manufactured by Applied Microsystems Ltd, and recorded pressure and temperature every half hour. Table 1 lists the depth at which each CSIRO gauge was moored. The fifth CSIRO gauge was originally also intended for the Cape Howe line at 200 m, but bad weather prevented its deployment, so it was placed on the middle line of current meters at Stanwell Park, in 200 m of water.

Two pressure gauges (also Applied Microsystems) were deployed by IOS on the Newcastle line but not on separate moorings. They were included in the current meter moorings, placed immediately above the acoustic releases, which meant that they were susceptible to vertical excursions induced by mooring motion.

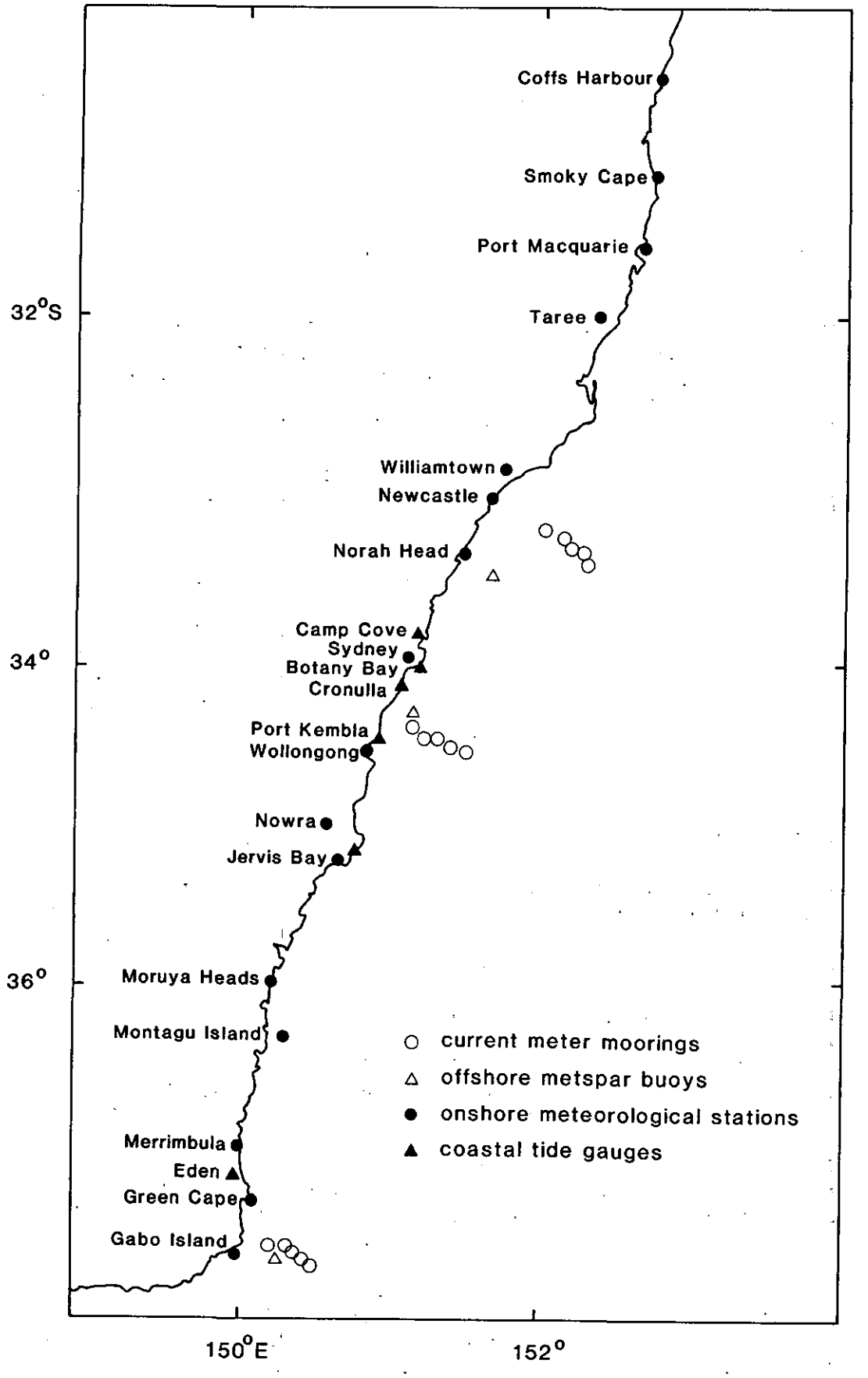

Figure 1 Locations of 'ACE' recording sites, including current meters, tide gauges, meteorological buoys and coastal meteorological stations.

Table 1 Sea-level data acquisition

Station	*Type	Latitude	Longitude	Depth (m)	Period of Record		Source
					Start	Finish	
Triabunna	C	42° 32.0'S	147° 55.0'E		13.4.83	28.3.84	Hobart Marine Bd
Cape Howe No.1	O	37° 32.4'S	150° 11.0'E	151	10.9.83	22.3.84	CSIRO
Cape Howe No.3	O	37° 33.3'S	150° 17.7'E	537	11.9.83	22.3.84	CSIRO
Cape Howe No.4	O	37° 33.0'S	150° 21.6'E	1360	11.9.83	22.3.84	CSIRO
Cape Howe No.5	O	37° 35.1'S	150° 24.9'E	2300	18.10.83	22.3.84	CSIRO
Eden	C	37° 04.5'S	149° 54.0'E		1.9.83	4.5.84	Public Wks Dept (NSW)
Jervis Bay	C	35° 07.5'S	150° 42.5'E		1.9.83	18.4.84	Div. Nat. Mapping
Port Kembla	C	34° 28.5'S	150° 54.5'E		29.11.83	31.3.84	Maritime Serv. Bd (NSW)
Stanwell Park No.2	O	34° 21.0'S	151° 18.7'E	190	No data		CSIRO
Port Hacking	C	34° 04.8'S	151° 08.9'E		15.9.83	11.1.85	Public Wks Dept (NSW)
Camp Cove	C	33° 50.8'S	151° 17.0'E		1.9.83	2.4.84	Maritime Serv.Bd (NSW)
Newcastle No.2	O	33° 11.1'S	152° 17.9'E	210	14.9.83	17.3.84	Inst. Ocean Sciences
Port Stephens	C	32° 42.5'S	152° 09.0'E		1.9.83	28.4.84	Public Wks Dept (NSW)

* C - Coastal
O - Offshore

Data Recovery

Table 1, under the heading 'period of record' shows the quantity of sea-level data acquired . One coastal station, Port Kembla, is short by three months at the start (there was no gauge until 29 November 1983), and the Jervis Bay record has a gap from 1 October to 1 December 1983. The other four are complete. The Port Hacking record has many gaps and is only 60% complete.

The four bottom-mounted pressure gauges on the Cape Howe line provided complete records from mid-September 1983 to mid-March 1984, but the two deep gauges at 1360 and 2300 m suffered from two problems: an error in operational setup that reduced the resolution to 15 cm; and an ambiguity of ± 1 day in the time base. Processing of these two records has not, therefore, proceeded past the raw (unfiltered) stage.

At Stanwell Park, the recording tape became fouled upon deployment, so there is no offshore sea-level data for this line.

At the Newcastle line, the two IOS pressure gauges yielded complete records, but as they were mounted in current meter moorings, several metres off the sea bed, they suffered from contamination by mooring motion. Strong currents of 2-3 knots associated with the East Australian Current resulted in larger than expected mooring motion, and the pressure records were seriously affected. An attempt was made to decontaminate the records by applying a variable pressure correction based on the depth excursions calculated from the recorded currents, but this procedure was not sufficiently accurate. The data from these two gauges are available, but are not plotted here.

Data Handling and Presentation

The raw data from the coastal stations were derived by hourly digitising of chart records. A 'check tide' program was then used to flag obvious errors in digitisation, gaps in the record, and datum changes. After correcting these errors, the data were low-pass filtered, using a 120-element Lanczos-Cosine Filter, Lancz6 (Thompson, 1983), which effectively discriminates against tidal and other high frequencies in the 0-3 day band. These filtered files were then subsampled at half-daily intervals and stored in a format compatible with the current meter data (Freeland *et al.*, 1985) and the meteorological data (Forbes, 1985).

The half-hourly raw data from the offshore pressure gauges were first plotted and checked visually for 'spikes', which were manually edited, rather than using 'checktide'. There were two abrupt datum changes of 2-3 metres, which could be attributed to moorings being accidentally shifted by a trawler. One of these occurred near the end of the Cape Howe No. 1 record, and one in the middle of the Cape Howe No. 4 record. More gradual datum changes occurred in the other two Cape Howe gauges: near the beginning of the No.3 record, and near the end of the No. 5 record. The abrupt datum change in Cape Howe No. 1 was corrected by fitting (in the least squares sense) a sine curve to 24 hours of data on each side of the disparity to calculate the displacement. A trial plot of the filtered data was then used to make a final, small, arbitrary correction within the error limits of the curve-fitting procedure. The more gradual changes were not easily justified, so the records were truncated to exclude the doubtful data.

The edited half-hourly values were then decimated to hourly values, using a simple gaussian filter, and low-pass filtered using the same Lancz6 filter as for the coastal station data. The filtered files were subsampled at half-daily intervals for archiving and plotting. Time series plots of mean sea level were then constructed to also show 'adjusted' sea level. That is, the sea level has been corrected for the effect of atmospheric pressure, in which the sea level rises approximately 1 cm for each 1 millibar decrease in atmospheric pressure. In the plots of coastal data, the bottom trace (mean sea level) is the total water level signal plotted about the long-term mean and the second trace (adjusted msl) has the atmospheric pressure effect removed. In the plots of offshore (pressure gauge) data the top trace, labelled 'adjusted', is the net pressure signal, which is the sum of the atmospheric and hydrostatic pressures. In this case, it was necessary to correct or readjust the net signal to yield total mean sea level, the bottom trace. The vertical scale is constant for all plots at ± 20 cm. The oustanding feature is that the variations of adjusted sea level are consistently smaller by 5-10 cm than the variations of raw mean sea level. The atmospheric pressure correction only explains about half of the observed variation, and the remainder ('adjusted') decreases offshore (see Cape Howe No. 3), as predicted by CTW theory.

Temperature at the instrument depth (see Table 1) is plotted (also filtered) for the offshore gauges.

References

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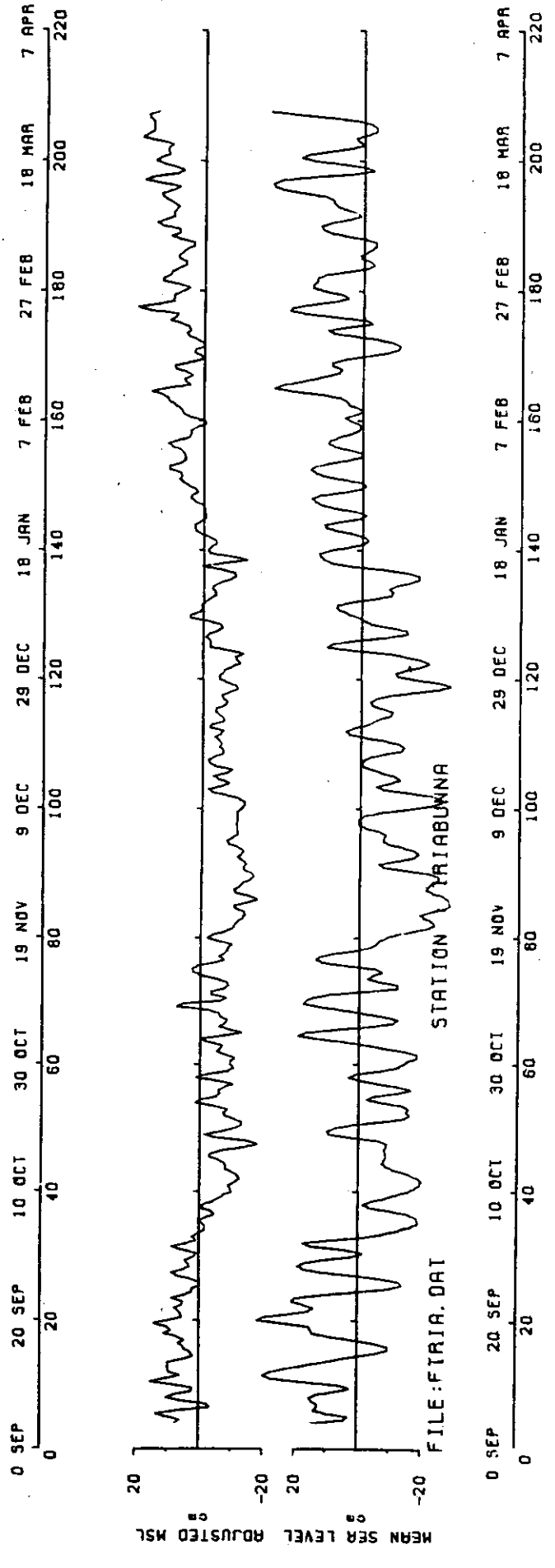

Figure 2a Sea-level data from Triabunna station

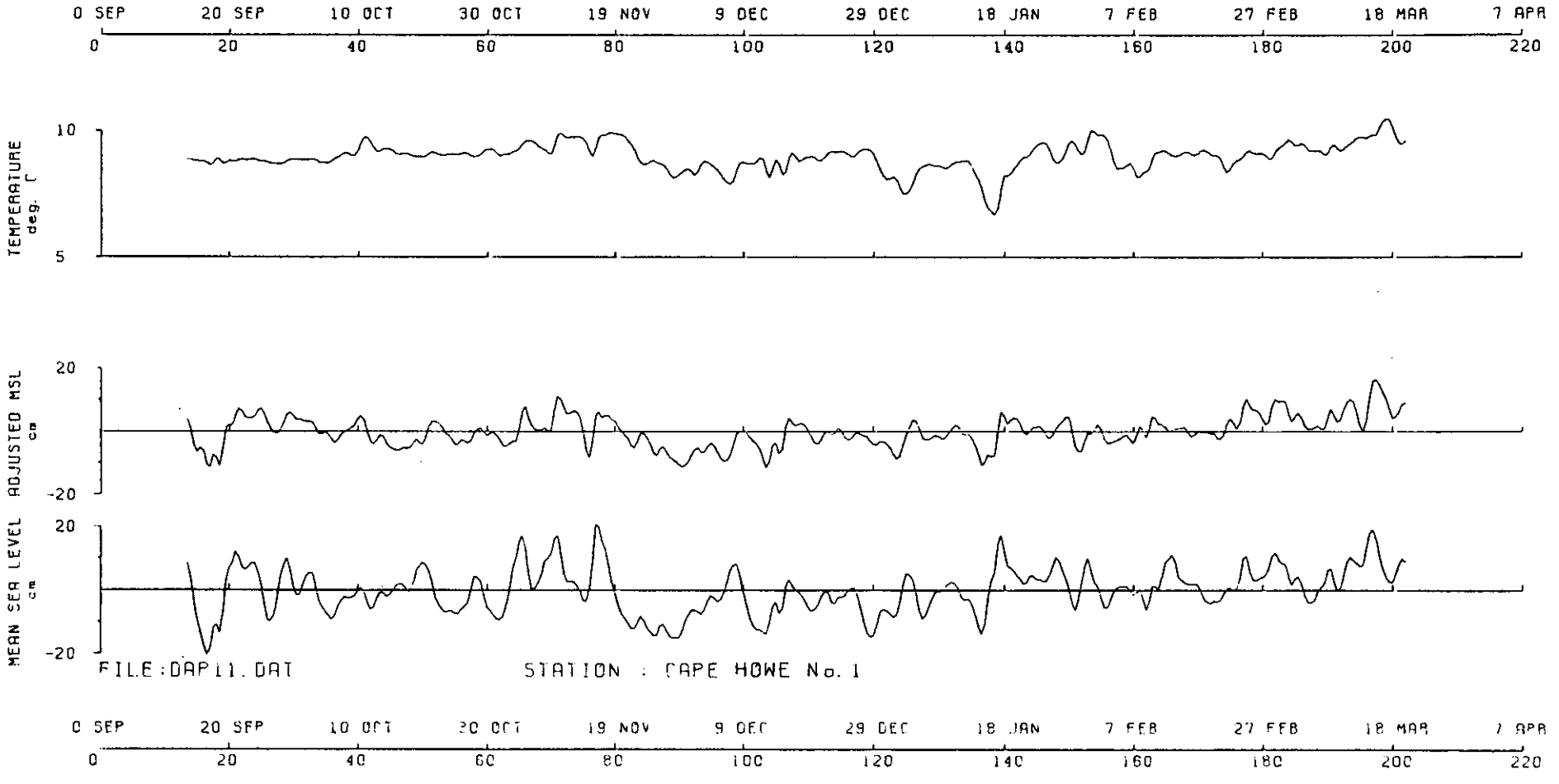

Figure 2b Sea-level data from Cape Howe No. 1 station

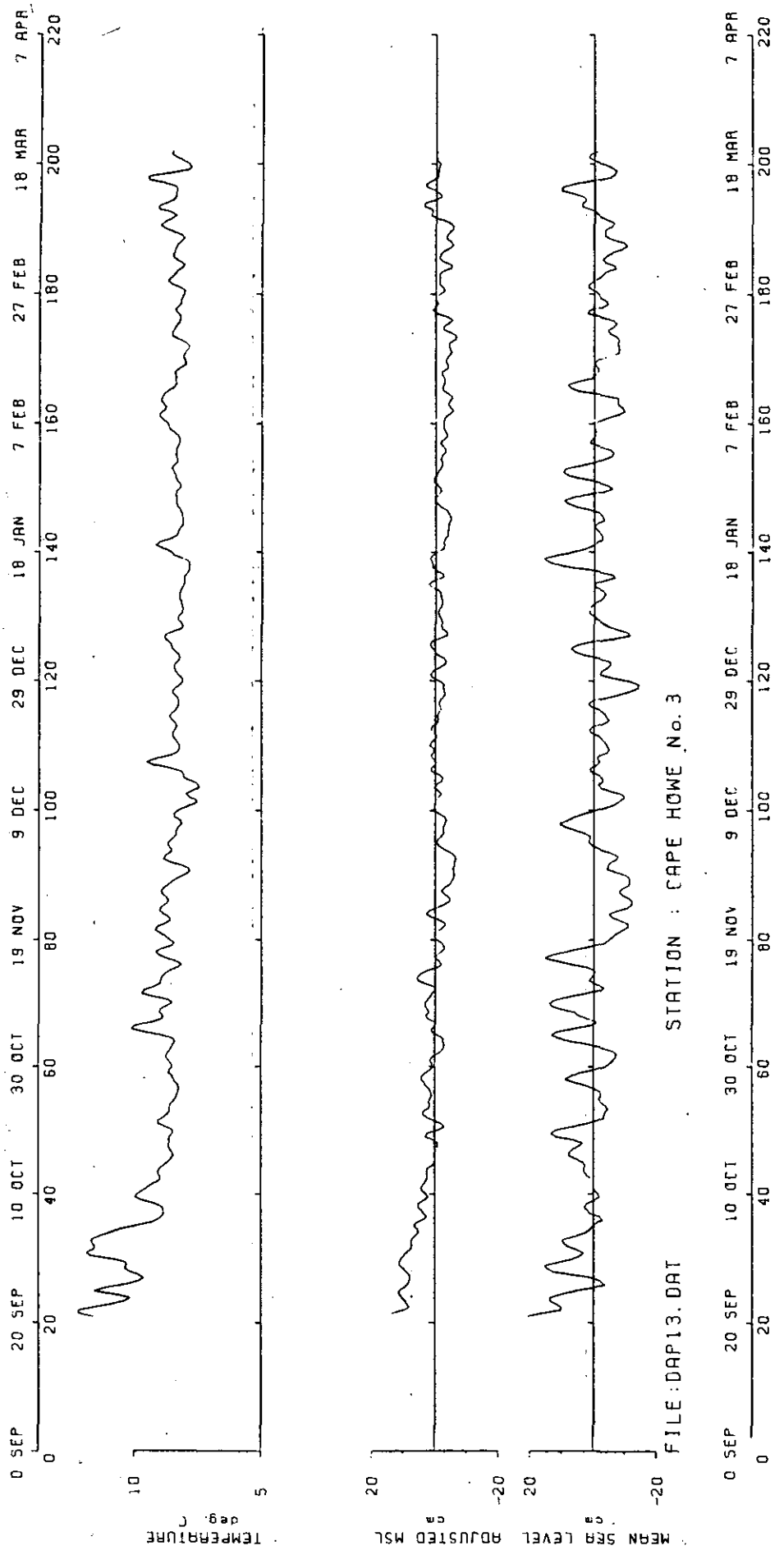

Figure 2c Sea-level data from Cape Howe No. 3 station

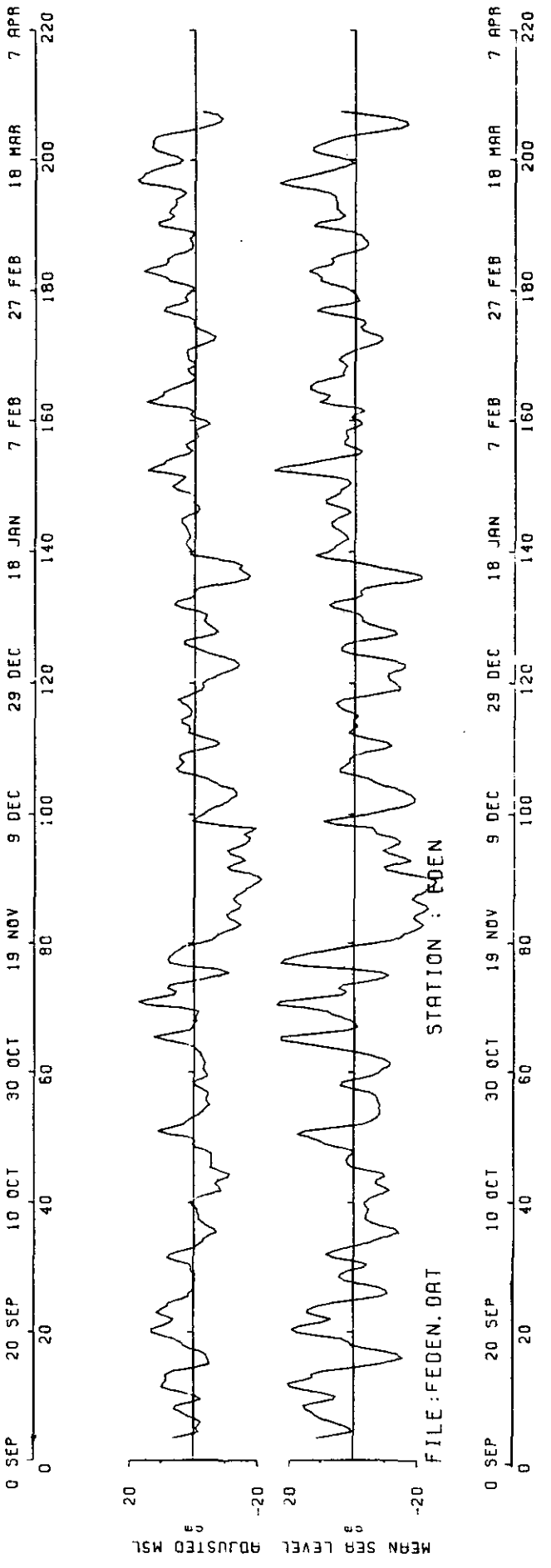

Figure 2d Sea-level data from Eden station

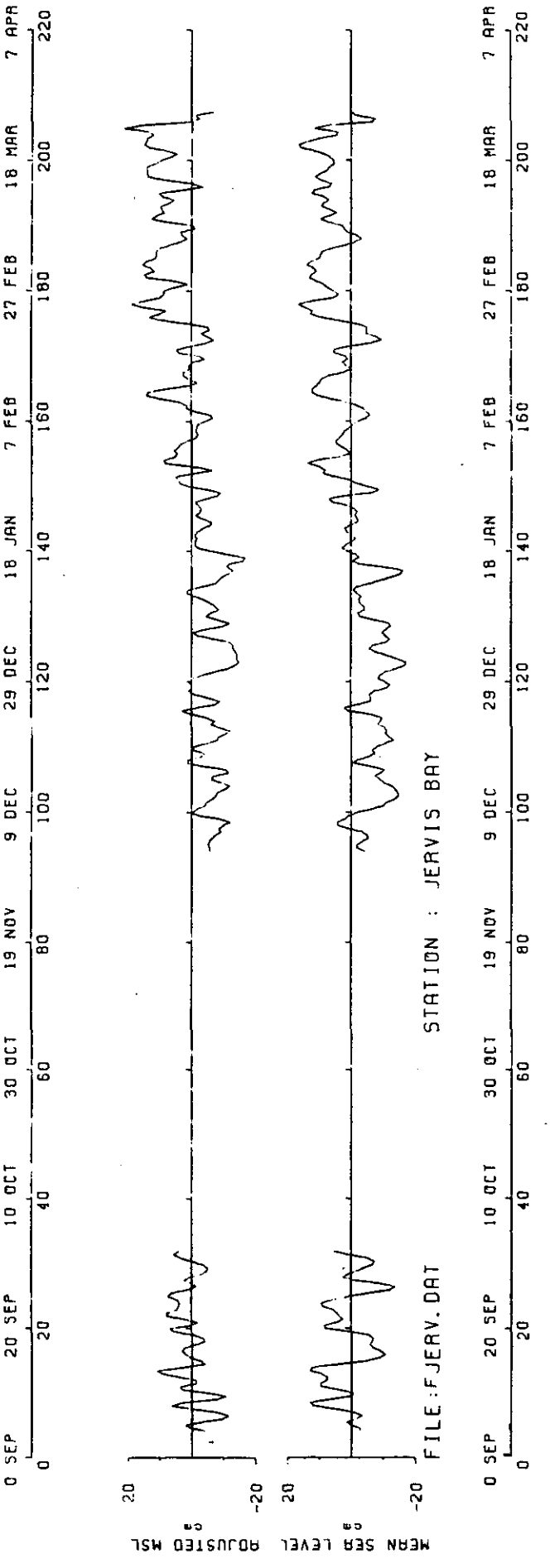

Figure 2e Sea-level data from Jervis Bay station

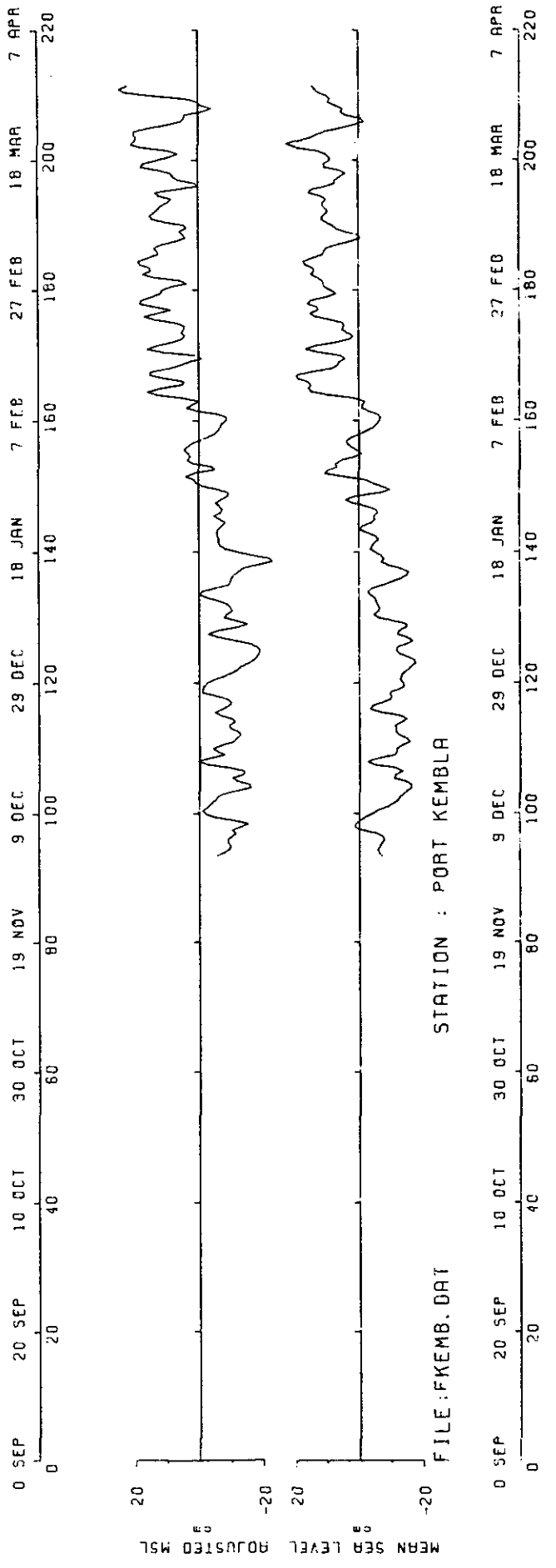

Figure 2f Sea-level data from Port Kembla station

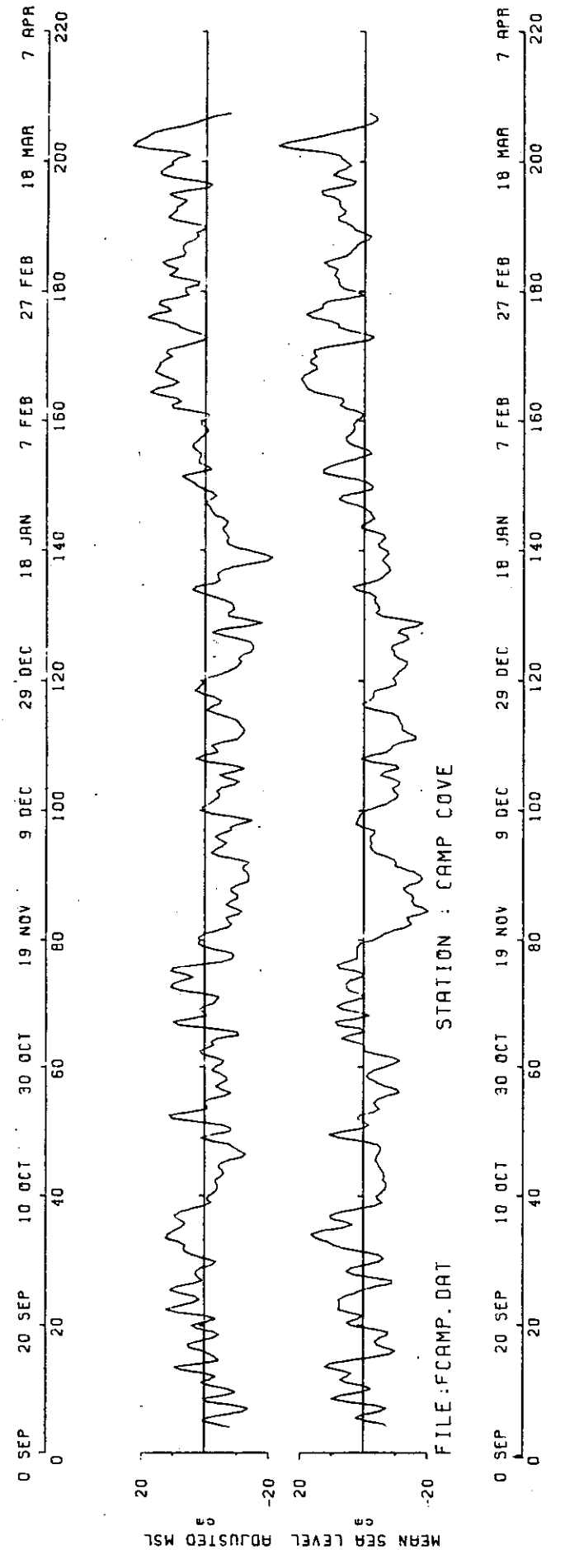

Figure 2g Sea-level data from Camp Cove station

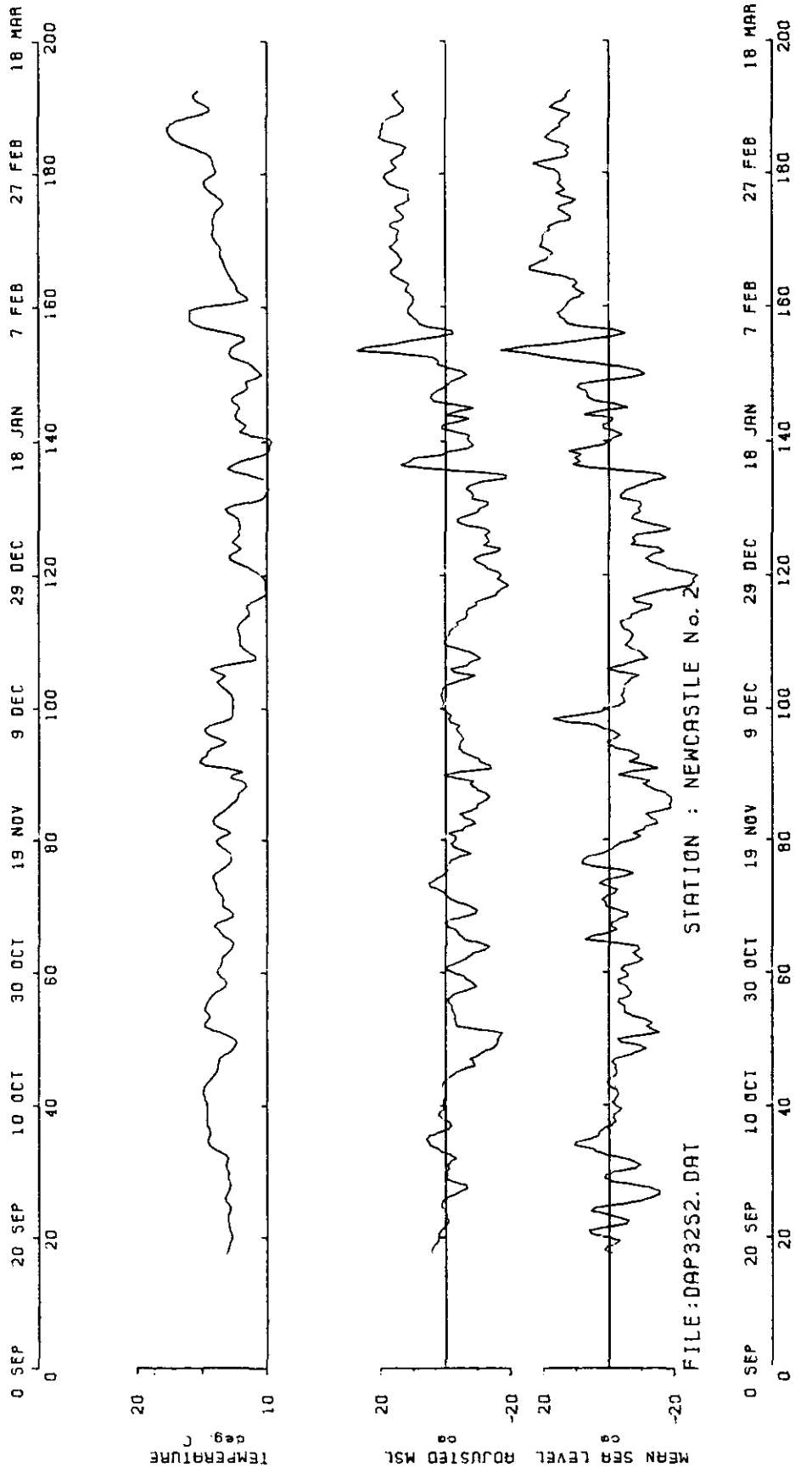

Figure 2h Sea-level data from Newcastle No. 2 station

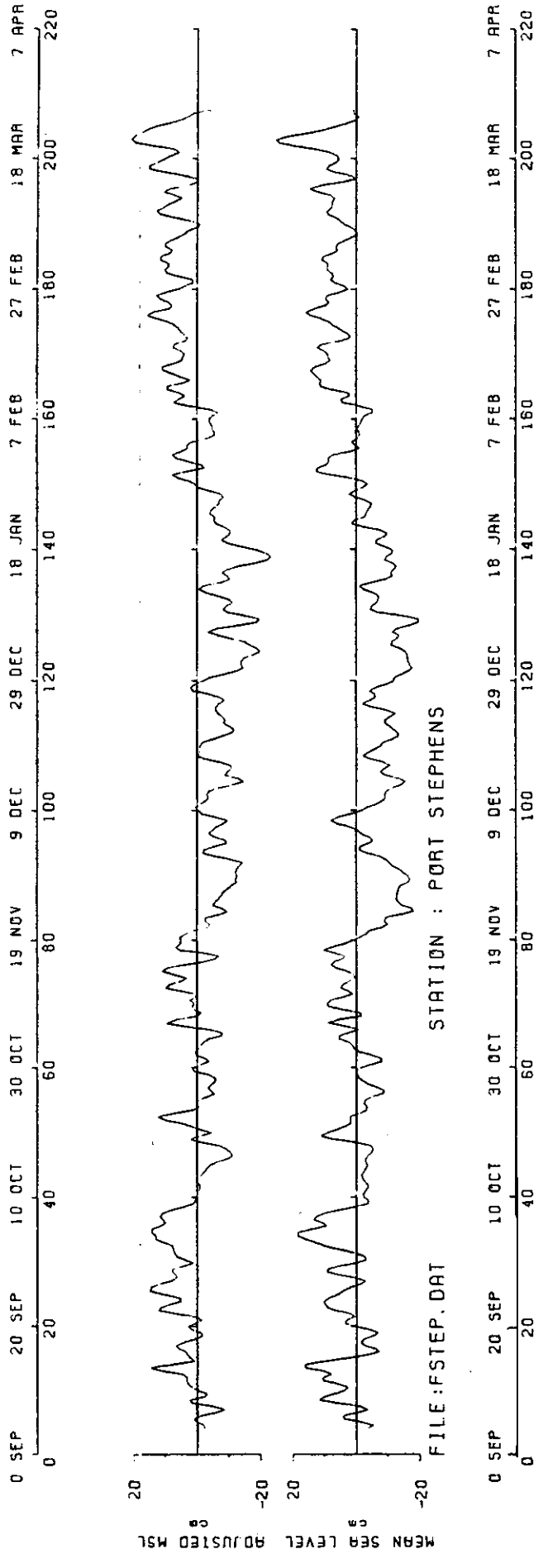

Figure 2i Sea-level data from Port Stephens station

CSIRO

Marine Laboratories

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Division of Fisheries Research
Division of Oceanography
Central Services Group

TASMANIAN LABORATORY
Castray Esplanade, Hobart, Tas
G.P.O. Box 1538, Hobart, Tas 7001

QUEENSLAND LABORATORY
233 Middle Street, Cleveland, Qld
P.O. Box 120, Cleveland, Qld 4163

WESTERN AUSTRALIAN LABORATORY
Leach Street, Marmion, WA
P.O. Box 20, North Beach, WA 6020

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