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Supplement of

The tidal measurements of James Cook during the voyage of the *Endeavour*

Philip L. Woodworth and Glen H. Rowe

Correspondence to: Philip L. Woodworth (plw@noc.ac.uk) and Glen H. Rowe (growe@linz.govt.nz)

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Cook's Depth Soundings

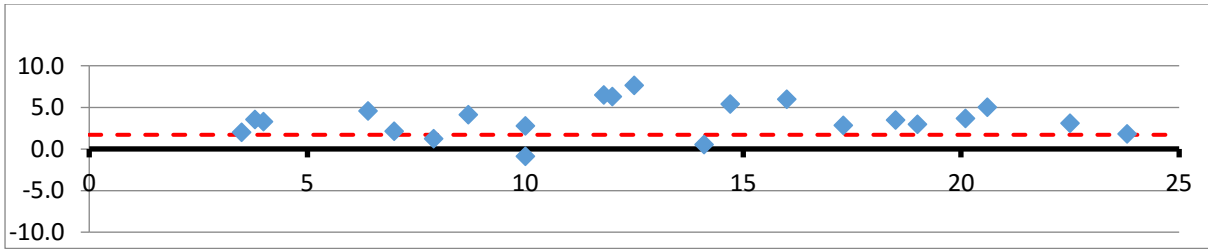
In addition to charting New Zealand's coastline, Cook undertook detailed surveys of the locations at which we have reviewed his tidal observations. The charts produced from these surveys depict the coastline, islands, rocks (above and under the water) and water depth (soundings) in fathoms. We have compared Cook's depths to those shown on the sounding sheets of the latest hydrographic surveys of Tolaga Bay, Mercury Bay, River Thames, Bay of Islands and Queen Charlotte's Sound. These sounding sheets have been produced by hydrographic surveyors and are archived at Land Information New Zealand (LINZ). They provide a far greater density of sounding values than the relatively few shown on published nautical charts, and so were preferred for the comparisons described below.

Images of Cook's charts were subjected to distortion (stretching) in two directions in order to georeference them to current nautical charts. This was done by matching identifiable features on both sets of charts. This enabled each of Cook's soundings to be matched with modern depths provided by the sounding sheets. Graphs of the differences in metres between Cook's depths and the modern values plotted against the true (modern) depths in metres are shown below. Positive values indicate that Cook's depths were greater than those shown on the sounding sheet.

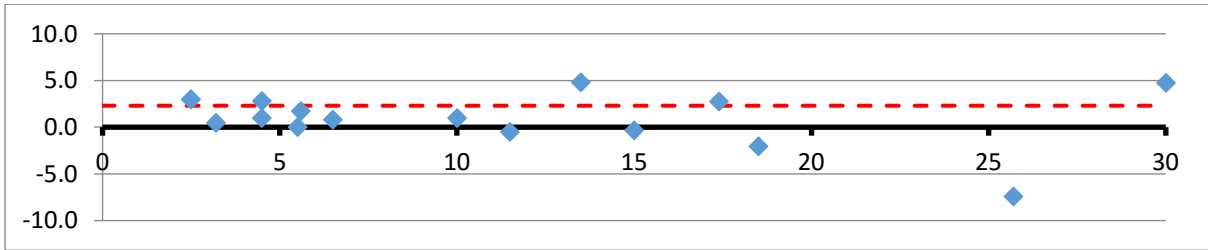
Cook's depth measurements include the height of the tide at the time whereas the depths on the sounding sheets are referenced to sounding datum which corresponds to within a few cm to Lowest Astronomical Tide (i.e. the tide has been removed from the modern soundings). The maximum height of the tide above sounding datum during the period that Cook spent at each location is indicated by the red dashed line in the plots. If Cook's charts were georeferenced perfectly, and if there had been no changes in depth between Cook's time and the present, then the differences in the soundings would fall between zero and the red dashed line.

Whilst we know that Cook was a skilled hydrographer, and that in principle the 'massaging' of his charts in the georeferencing process will have aligned them with modern charts reasonably well, there will inevitably be some uncertainty in the positions of his depth measurements. Position uncertainty has little impact where the seabed is flat, but is more significant where the seabed topography is varying rapidly.

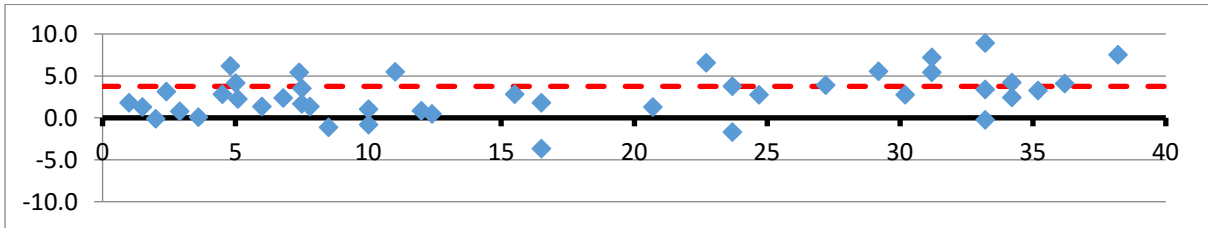
Out of all the locations investigated, the seabed at River Thames slopes gently and Cook's chart of this area required least distortion. As a result, the River Thames analysis offers the most reliable insight into Cook's ability to make soundings. Many of the depth differences fall within the tidal range, which is between zero and the red dashed line. Cook's charts at the other locations needed more distortion to improve their alignment; this spatial uncertainty combined with more variable seabed topography means that the depth comparisons are not a valid reflection of the accuracy of Cook's sounding observations alone.



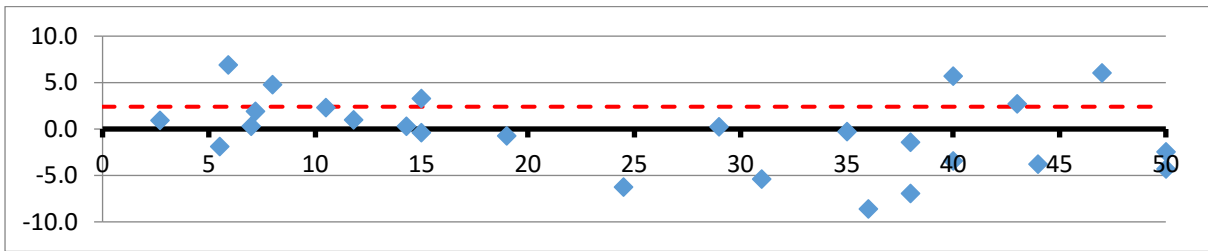
Tolaga Bay



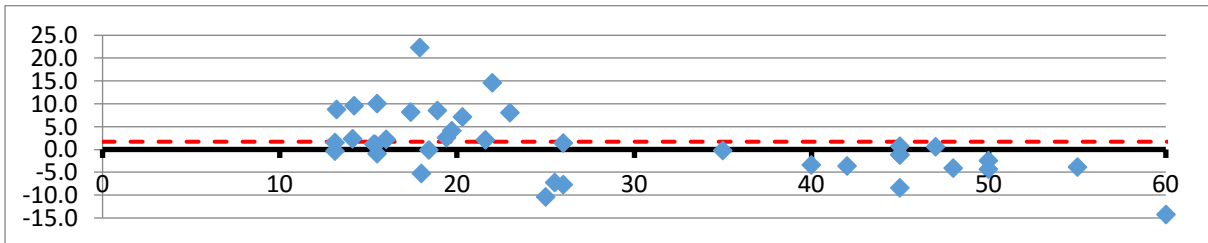
Mercury Bay



River Thames



Bay of Islands



Queen Charlotte's Sound

Sources of Cook's charts:

Images from the David Rumsey Map Collection, <https://www.davidrumsey.com> :

River Thames and Mercury Bay in New Zealand. (with) Bay of Islands in New Zealand. (with) Tolaga Bay in New Zealand. (London: printed for W. Strahan and T. Cadell in the Strand, MDCCLXXIII).

Chart of Cook's Strait in New Zealand. John Ryland scupl. (London: printed for W. Strahan and T. Cadell in the Strand, MDCCLXXIII).

Sources of modern data:

Location	Nautical Charts	Sounding Sheets
Tolaga Bay	NZ 5551 Plans on the East Coast, Hydrographic Office RNZN, April 1997	Waipiro Bay to Gable End Foreland, RNZN, February – April 1996, sheet 55/45
Mercury Bay	NZ 534 Mercury Bay to Katikati Entrance, Land Information New Zealand, February 2017 NZ 5318 Great Mercury Island (Ahuahu) to Otara Bay, Land Information New Zealand, December 2016	Mercury Bay, RNZN, October – December 1979, sheets 5318/17 - 21
River Thames	NZ 533 Firth of Thames, Land Information New Zealand, July 2017	Colville to Te Mata, RNZN, December 1975 – May 1976, sheets 532/70-74 Firth of Thames, RNZN, May, September - December 1978, sheets 533/10-16
Bay of Islands	NZ 5125 Bay of Islands, Land Information New Zealand, November 2015	Bay of Islands, RNZN, April 1990 – November 1992, sheets 5124/8, 9, 13 – 16, 19 – 21, 24 – 26
Queen Charlotte's Sound	NZ 615 Marlborough Sounds, Land Information New Zealand, March 2011	Queen Charlotte Sound / Tōtaranui and Tory Channnel / Te Kura Au, LINZ, October 2016 – June 2017, Standard Sheets 2, 3, 4 and 6