Quality control and management of the long-term time series data holdings at NIOZ Royal Netherlands Institute for Sea Research

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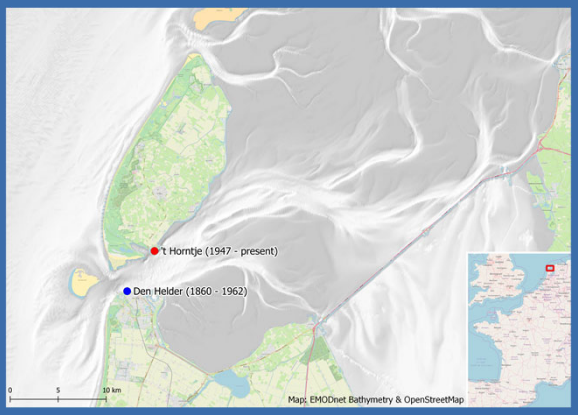
Introduction

Long-term measurements (preferably over many decades) are extremely important and valuable for climate change research and the study of the impact of climate change on ecosystems around the globe.
NIOZ Royal Netherlands Institute for Sea Research and its predecessors have measured temperature and salinity in the Marsdiep tidal inlet on a daily basis, starting in 1860. Since the late 1960s annual macrozoobenthos monitoring was started on the Balgzand tidal flats and since 2008 macrozoobenthos monitoring has been extended to include the entire Dutch Wadden Sea.

Long-term Temperature & Salinity monitoring

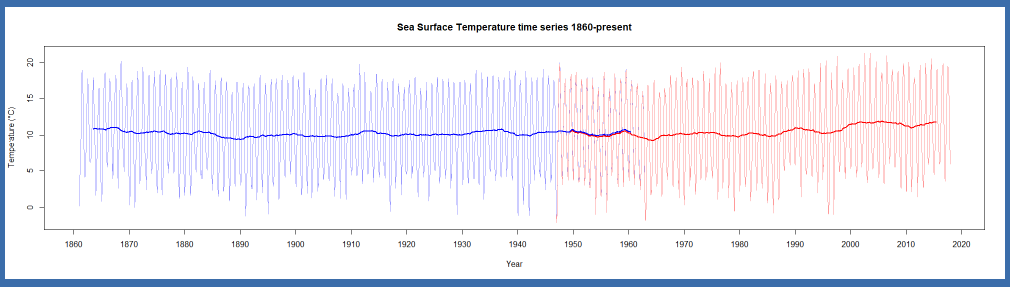
In 1860 the Dutch government started daily monitoring of temperature and salinity at the coast of Den Helder. This series was continued at this location until 1962, so over 100 years. Since 1947 (till present) T&S were also measured daily at the coast of Horntje, on the other side of the Marsdiep tidal inlet.
These two series can be combined into one harmonized time series of almost 160 years. Over this period, several different institutes were involved and different methods (for salinity) were used. The accompanying QC challenges have been addressed by several authors, resulting in a unique dataset.

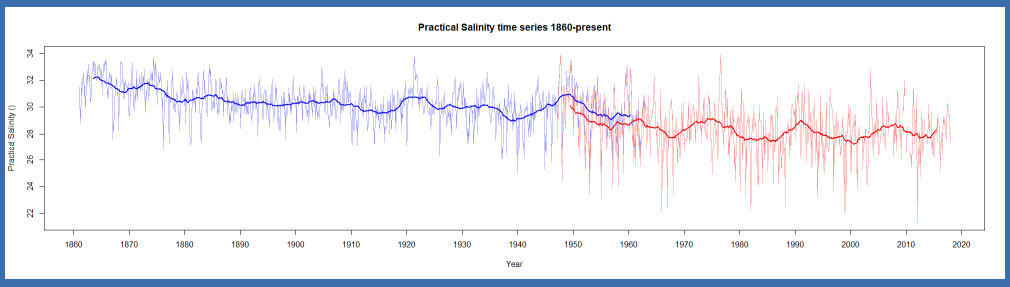


Quality Control of the TS series

Van der Hoeven (1982) processed the period 1860-1981 and made a homogeneous dataset. Van Aken (2008) and Gerkema & Wagemaakers (2017) extended the dataset and applied modern QC methods to the added data. The autocorrelation of 0.95 allows for a reduction from daily to monthly averages. 15 years of overlapping measurements prove that moving the location has not effected the quality of the series. Since 2001 T&S have been measured automatically every minute.

P.C.T. van der Hoeven (1982), Watertemperatuur en Zoutgehalte-waarnemingen van het RIVO: 1860-1981, KNMI W.R. 82-8
H.M. van Aken (2008), Variability of the water temperature in the western Wadden Sea on tidal to centennial scales, JSR 60 227-234
T. Gerkema & E. Wagemaakers (2017), Treatment of salinity and temperature data at NIOZ jetty

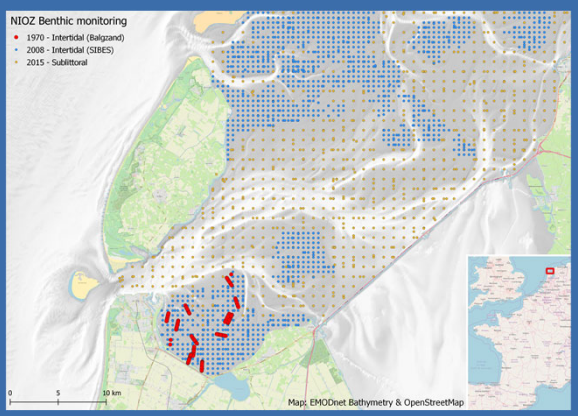




History Balgzand & Wadden Sea monitoring

In 1967 NIOZ started a biannual macrozoobenthos sampling program along 12 transects and at 3 fixed locations on Balgzand tidal flat. Elsewhere in the Wadden Sea, around the island Griend, monitoring of benthos and sediment composition started in 1988. In 2008 the SIBES program expanded this into a 500 meter grid, covering the whole intertidal Dutch Wadden Sea. Today over 4000 samples a year are collected, from which the invertebrates are identified and species, age, length, biomass, sediment size & composition are recorded.

Beukema, J.J., Cadée, G.C., 1997. Local differences in macrozoobenthic response to enhanced food supply caused by mild eutrophication in a Wadden Sea area: Food is only locally a limiting factor. —Limnology and Oceanography 42: 1424-1435.



Quality Control macrozoobenthos monitoring

The Balgzand series has been carried out under supervision of just 2 scientists, one of them an experienced taxonomist. This reduces any QC issues. The SIBES program involves over 20 scientists, who perform both sample analysis as well as data entry. This requires a high level of automation, for the sample analyses (eg. biomass is measured using an in-house developed 'weighing-computer') and for the data entry (automated checks on consistency and errors). This allows for an elaborate data provenance.

Dekker, R., Beukema, J.J., 2007. Long-term and large-scale variability in productivity of the tellinid bivalve Macoma balthica on Wadden Sea tidal flats. —Marine Ecology Progress Series 337: 117-134.

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