Climate Change: Pelorus Sound waters have warmed

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Introduction

There is universal consensus within the scientific community that our earth's climate is changing and that human activities have been the dominant driver of change in the past century (and will continue to be the dominant driver in coming decades/centuries). Despite seasonal-scale and inter-annual fluctuations, temperatures are trending upwards – albeit that the magnitudes of the trends vary across the planet. Here, we present evidence that water-temperatures in Pelorus Sound have risen by approximately 0.5˚C since the 1980s.

Chemical and biochemical reactions are temperature dependent. The majority of marine organisms are cold-blooded. Their behaviour and physiology is strongly influenced by ambient water-temperatures.

Methods

There have been several field campaigns dedicated to studying the water quality of Pelorus Sound over the past 35 years. Most of these have measured water-temperature as a part of the sampling regime. At Schnapper Point and two locations in Beatrix Bay (West Beatrix and Laverique Bay) and in outer Pelorus, it is possible to concatenate two or more data-sets to yield longer, composite time-series. We sought to determine whether there is any evidence for long-term trend in the temperature data by:

- Calculating the so-called Sen slope for each time-series.
- Testing two different null hypotheses about the Sen-slope:
    a) The slope is not significantly greater than zero.
    b) The slope is not significantly less than zero.

In the event that neither hypothesis is rejected, we conclude that the trend direction cannot be reliably determined (i.e., the nature of any trend cannot be determined). If one or other hypothesis is rejected, we conclude that the direction of the trend can be determined with high (95%) confidence.

For the purposes of this analysis, we have calculated the average water-temperature in the upper 15 m of the water-column from raw data measured at a finer vertical resolution.

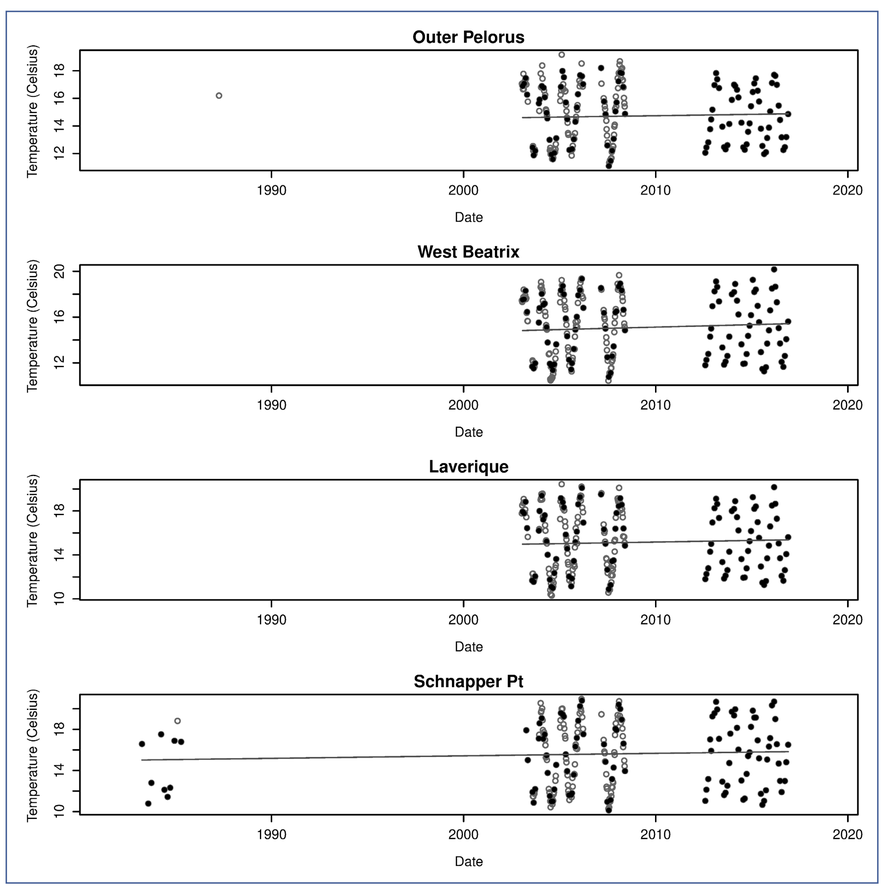
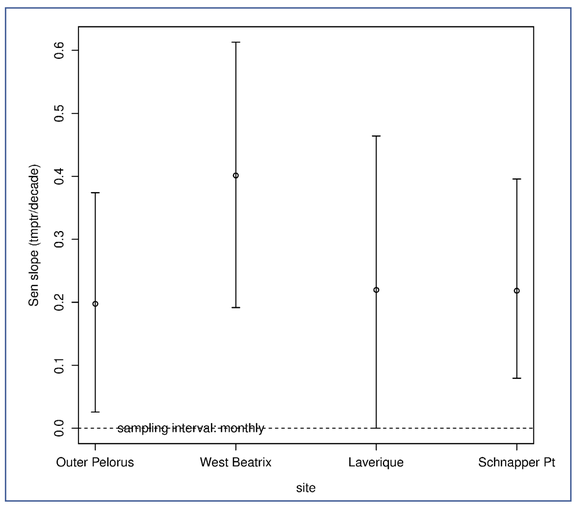


Figure 1: *Time-series of water-temperature records measured at outer Pelorus, West Beatrix, Laverique and Schnapper Point. Sampling was weekly during the 2000–2010 period but approximately monthly at other times. To avoid bias arising from over-representation of the central period, those data have been sub-sampled onto a monthly frequency. Thus, only the filled points were used in the analyses.*



Results

Our analysis enables us to conclude that, with high confidence, water temperatures in the upper 15 m of Pelorus Sound have trended upwards. At three sites (Outer Pelorus, West Beatrix and Laverique), the trends have been calculated over approximately the past 15 years. At a fourth site (Schnapper Point), there are sufficient data to calculate the trend over almost 40 years. Waters have warmed by around 0.2–0.4 degrees per decade.

Conclusions

The rate of warming that we have calculated for Pelorus Sound is similar to the rates which have recently been calculated for offshore waters around New Zealand (Sutton and Bowen, 2019). Recent coupled ocean-atmosphere models suggest that offshore warming will continue (Law, Rickard et al. 2018). Thus, we anticipate that inshore warming will also continue. If the warming continues, average water temperatures in Pelorus Sound may further increase by approximately one degree by the middle of this century and by up to about two degrees by the end of the century. The consequences of this are unclear – though it seems probable that the warming will inhibit species that favour cold/cool waters and promote species that favour warm waters. Surface warming may also lead to stronger thermal stratification within the water-column (though this may be countered by increased storm-driven mixing). Strong stratification tends to favour very small phytoplankton species and motile species such as dinoflagellates whilst well-mixed and weakly stratified waters favour diatoms. Thus, it is possible that the composition and productivity of the phytoplankton community will change over the coming decades. It is not clear whether this will induce consequent changes amongst higher trophic levels.

Bibliography

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