Sub-surface temperature variability along the west coast of Canada.

Charles Hannah and Stephen Page
Fisheries and Ocean Canada
Institute of Ocean Sciences
Sidney, BC, Canada
West coast of Canada

Many of the lighthouses have 60 to 90 years of coastal sea surface temperature data.
Can we link the subsurface temperatures that we observe at the moorings with surface temperatures observed from satellites and coastal lighthouses?
Questions

• Can we use SST to map bottom temperature for some months of the year?
• Can we use coastal SST, measured at lighthouses, as proxy for bottom temperature and infer trends?
• Some of the lighthouse records go back 80 – 90 years.
Temperatures between 35 and 100 m from July 2016 to July 2017
Subsurface Temperature

Aug 2015 to July 2016
Scott 2 mooring, 300 m water depth

**Temperature**

**Oxygen**

Dissolved Oxygen (mL/L)

Jul-16  Aug-16  Sep-16  Oct-16  Nov-16  Dec-16  Jan-17  Feb-17  Mar-17  Apr-17  May-17  Jun-17  Jul-17
Mooring locations

Blue : 3 Years  2013-2016
Red : 1 Year 2016-2017
January Mooring Temperature vs Satellite SST

Mooring Temperatures °C

SST Temperatures °C

> 150 m
Relationship between subsurface temperature and satellite SST

\[ y = 1.02x + -0.104 \]
\[ r^2 = 0.927 \]

\[ y = 1.09x + -0.731 \]
\[ r^2 = 0.893 \]
Relationship between subsurface temperature and satellite SST

\[ y = 1.02x - 0.104 \]
\[ r^2 = 0.927 \]

\[ y = 1.09x - 0.731 \]
\[ r^2 = 0.893 \]
West coast of Vancouver Island

Records are about 30+ years long. Test whether previous results were coincidence.
A1, EO1, BP

A1- 100 m

Mooring Temperatures °C

SST Temperatures °C

A1- 100 m
Mooring T vs satellite SST regressions without A1 -100 m

**December**

![Figure for December regression](image)

**Equation:**
\[ y = 0.915x + 0.998 \]
\[ r^2 = 0.776 \]

**January**

![Figure for January regression](image)

**Equation:**
\[ y = 0.849x + 1.79 \]
\[ r^2 = 0.835 \]
Amphitrite Lighthouse

EO1

A1
Satellite SST and lighthouse SST

A1 mooring at shelf edge

EO1 mooring near Vancouver Island

\[ y = 0.94x + 1.28 \]
\[ r^2 = 0.533 \]

\[ y = 0.953x + 0.77 \]
\[ r^2 = 0.57 \]
Conclusion 1

• Can we use satellite sea surface temperature as a proxy for temperature down to 100 or 150 m in January and February?
  • Probably – down to 100 m
    – Errors in the range 0.5 to 1 C
    – Need longer time series for the north coast.
  • Maybe down to 150 m
    – Likely that the mixed layer depth does not reach 150 m every year at every location
• Time series of estimates of winter mixed layer depth would be useful
Satellite SST
Conclusion 2

• Is it feasible to use long records of coastal SST as a proxy for satellite SST and thus bottom temperature in January and February?

• Yes
  – A 3 level classification scheme seems reasonable: low, average, high
January temperature at Amphitrite lighthouse

![Temperature Graph](image)

- **mean +/- 0.5°C**
- **< mean - 0.5°C**
- **> mean + 0.5°C**

Temperature °C

mean = 7.83
HEC1 mooring. 3 years

McInnes Lighthouse. 1955 to present
January Temperature at McInness Lighthouse and HEC1 mooring