CLIMATOLOGY OF SEA SURFACE TEMPERATURE AROUND TASMANIA

1. Aim

Calculate representative climatologies of sea surface temperature (SST) around Tasmania for the Tasmanian Salmon aquaculture industry.

2. Background:

The Tasmanian Salmon aquaculture industry rely on knowledge of sea surface temperature for their marine operations. Interest lies in determining a representative climatology of sea surface temperatures every month around Tasmania.

3. Findings:

(1) The data must be classified based on the El Niño-Southern Oscillation (ENSO) if the monthly climatologies are to be representative.
(2) If the ENSO is in El Niño phase climatological SST around Tasmania is warmer than usual.
(3) If the ENSO is in La Niña phase climatological SST around Tasmania is cooler than usual.
(4) NetCDF files are provided as raw data for further use. They can be found here: https://github.com/RobTheOceanographer/tassie_sst_climatology - users accept the Bureau of Metrology disclaimer: http://www.bom.gov.au/other/disclaimer.shtml. These data will be available for download until November 2016.
(5) A temporary web based mapping service is available here: http://115.146.84.241:3838/sample-apps/sst_clim/ - users accept the Bureau of Metrology disclaimer: http://www.bom.gov.au/other/disclaimer.shtml.
(6) Keep in mind that measurements in regions of very shallow water and/or in regions nearly surrounded by land can be less accurate than those in more open water.

4. Appendix

4.1. **SST Data.** I used the Integrated Marine Observing System L3S Nighttime gridded multiple-sensor multiple-swath Australian region High Resolution Picture Transmission (HRPT) AVHRR skin SST data retrieved from the Australian Ocean Data Network thredds data server at this url in June 2016:

http://thredds.aodn.org.au/thredds/catalog/IMOS/SRS/SST/ghrsst/L3S-1d/ngt/catalog.html.

This data are skin SST retrievals produced by stitching together HRPT direct broadcast data from NOAA polar-orbiting satellites received at Australian receiving stations. SSTs are on a 2km grid. SSTs were calibrated to drifting buoy depths (20-30cm) followed by a cool skin correction of -0.17K to convert to a skin (10 micron) SST. SSTs are a weighted average of the SSTs of contributing pixels. Calibration info can be found here: http://imos.org.au/sstdata_validation.html

Any use of these data requires the following acknowledgment as per the metadata within the files: "HRPT AVHRR SSTskin retrievals were produced by the Australian Bureau of Meteorology as a contribution to the Integrated Marine Observing System - an initiative of the Australian Government being conducted as part of the National Collaborative Research Infrastructure Strategy and the Super Science Initiative. The imagery data were acquired from NOAA spacecraft by the Bureau, Australian Institute of Marine Science, Australian Commonwealth Scientific and Industrial Research Organization, Geoscience Australia, and Western Australian Satellite Technology and Applications Consortium."

I de-biased the data and converted the Skin SST to Bulk SST, which is representative of approximately 10m depth, by following the GHRSST/IMOS instructions as per: www.imos.org.au/reading-data.html. In summary this entailed:

(1) Convert SST from integer to floating point (Kelvin)
(2) Convert bias and standard deviation from signed byte to floating point (Kelvin)
(3) Correct for biases in the SST measurements
(4) Convert from skin to buoy depth temperatures
(5) Select only the highest quality level data.

I cropped each datafile using netCDF Operators (NCO) netCDF Kitchen Sink (ncks) tool to the following boundaries:
Southern-most latitude: -45.0
Northern-most latitude: -39.0
Eastern-most longitude: 143.0
Western-most longitude: 151.0

4.2. **ENSO.** It was noted that the SST in the region around Tasmania is influenced by the El Niño-Southern Oscillation (ENSO) and that in order to make the climatologies representative this would need to be accounted for. The SST data were divided up

and climatologies created based on the Southern Oscillation Index phases: neutral, El Niño, and La Niña. The Southern Oscillation Index (SOI) is an indication of the development and intensity of El Niño or La Niña phases of the ENSO in the Pacific Ocean. It is calculated using the atmospheric pressure differences between Tahiti and Darwin. Sustained positive values indicate La Niña conditions and sustained negative values indicate El Niño conditions. More info can be found here: http://www.bom.gov.au/climate/glossary/soi.shtml

For this analysis $SOI < -7$ indicates the El Niño (warm) phase, $SOI > 7$ indicates La Niña (cool) phase, and between the two indicates Neutral phase (http://www.bom.gov.au/climate/enso/#tabs=SOI).

The SOI data I used came from the BOM climate division: http://www.bom.gov.au/climate/current/soihtm1.shtml

4.3. **Climatology Calculations.** I calculated three different climatologies for each month of the year from '1993-01-01' to '2015-12-31' :

- The average climatology over ENSO Neutral months.
- The average climatology over ENSO El Niño months.
- The average climatology over ENSO La Niña months.

I grouped the daily SST files into directories based on the SOI value for the corresponding month and year. I then used the netCDF Operators (NCO) netCDF Ensemble Average (ncea) tool to create the average of each group of netCDF files and rename the resulting file according to it's ENSO classification and month.

4.4. **Plotting.** There is a netcdf file for each month × three ENSO phases, totalling 36 files, making it cumbersome to present these data as static plots in a static document. Therefore I have put a prototype web based viewer together and the data can be viewed using a web browser. This is temporary service and will be discontinued by November 2016. The viewer is available here: http://115.146.84.241:3838/sample-apps/sst_clim/

4.5. **Climatology Download.** The data are available for download at the following site: https://github.com/RobTheOceanographer/tassie_sst_climatology