Project 2 - World Wide Ocean/Air Temperature

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1. Description

We used the data from the Voluntary Observing Ship Climate Fleet (VOSCLIM) from https://www1.ncdc.noaa.gov/pub/data/vosclim/ to look at the sea surface temperature and air temperature readings of ships in Southeast Asia from 2001 to 2016. This data includes readings from ships at various longitudes and latitudes around the world. We broke up the data from years 2001-2016 into four groups of years, so that we could each read and bind four years. We used readLines for the links of VOSCLIM data, so that it could be reproducible for analysis and downloading all of the data files for each month would not be necessary. We read the data for all of the months of each year and then rbinded the months to create a dataframe for the whole year. Finally, we binded all of the sixteen years.

Next, we determined a rectangle of coordinates for our region of Southeast Asia using Google Earth. We drew a rectangle around Southeast Asia and obtained the coordinates. We then used the coordinates to subset the data into readings that were only within our region of Southeast Asia. But before we could do that, we had to convert LON (longitude) to numeric since it was of type character and not numeric, which made subsetting longitudes by a range of numbers unsuccessful. We then had to decide to remove all of the data from years 2005 and 2012 because they would not bind after using the given code from Blackboard, possibly because there were not the same number of columns for each month. We also converted the longitudes, latitudes, and the temperatures to the correctly represented decimals by dividing by 100 for latitude and dividing by 10 for temperatures. Then, we formatted the date using lubridate to create a column containing year, month, day, and time of the temperature reading.

To clean the set the data containing readings within Southeast Asia, we looked at the data to observe where there were NAs and removed these data points, while keeping the useful data. To do that, we decided to remove the rows in which the air temperature and sea temperatures both had NA since there was no valuable data for us in those rows. Unfortunately, once narrowing down our data into our coordinate region and omitting our designated NAs, there are much fewer sea surface temperature readings than air temperature readings, which is just something to note. Another tidbit of information to note is that our data is of relatively low density because there are only 3,408 rows of readings.

Since the ships are always moving all over the region, a map of data collection location points is not very valuable to analysis and would be spread out all over Southeast Asia. For graphs, we decided on analyzing four months (January, April, July, October) because they are each in a different season, are the extreme months of those

seasons, and are evenly spread out across the year. We are looking at how temperature has changed over time during different times of years in Southeast Asia to get a more comprehensive understanding of the temperature changes in the region from 2001-2016.

2. Analysis

Based on the data we organized, we plotted four graphs to see the trend and variation of air temperature and sea surface temperature in the four seasons from 2001 to 2016. Since we had chosen the data with the smallest time difference from noon, we then picked the first row of the data in each four months for each year to stand for each corresponding season and we therefore obtained values of air temperature and sea surface temperature for each season. Next, we used ggplot2 to plot four point plots and add the smooth curve to see the trend, range, and variation of air and sea surface temperature.

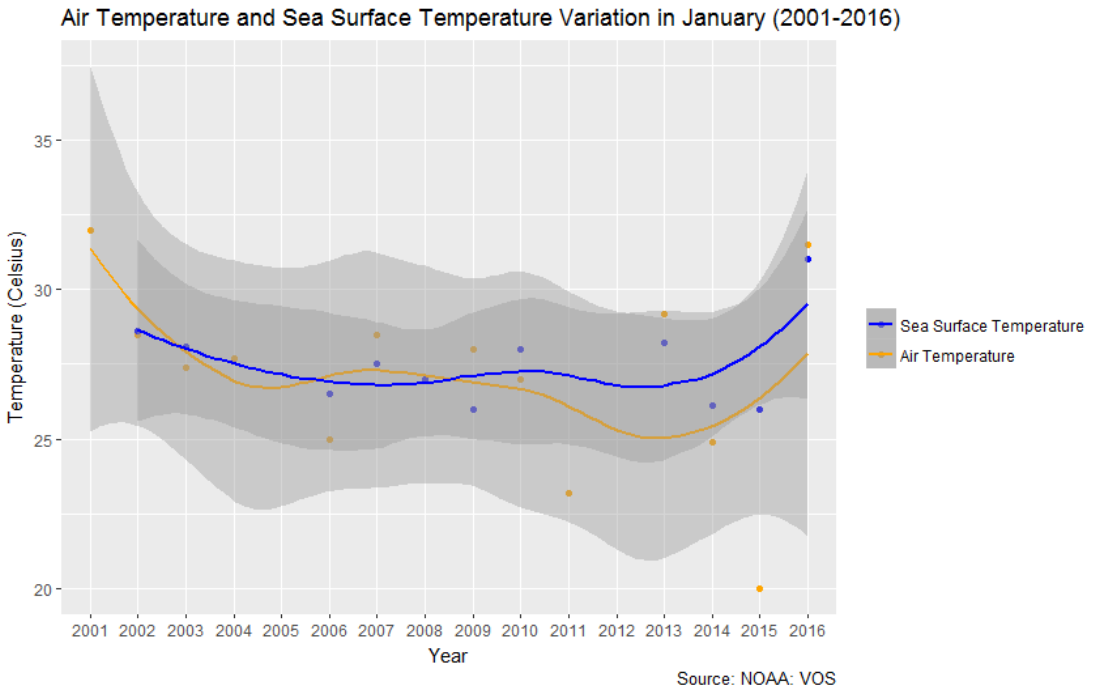

Figure2.1 Air Temperature and Sea Surface Temperature Variation in January (2001-2016)

In figure2.1, for air and sea surface temperature in January, we can see that the two lines have similar trends, they both go down after 2001 and then rise up. The range of each temperature shows that the air temperature has a higher range than ocean temperature which means that from 2001 to 2016, air temperature of Southeast Asia has a larger variation in January.

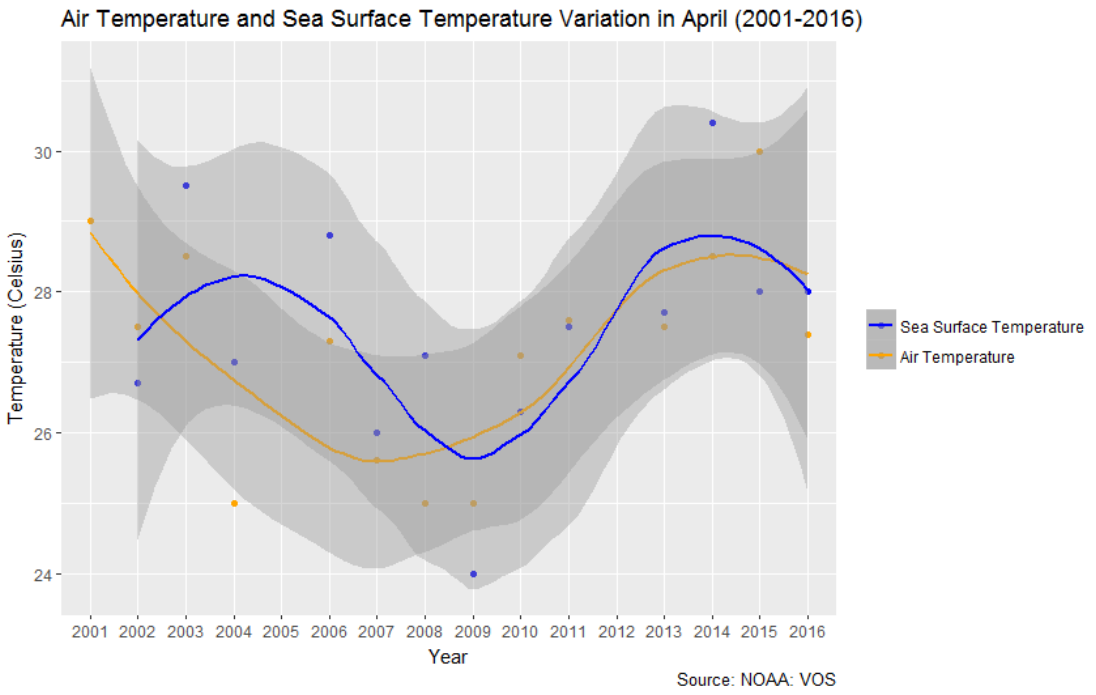

Figure2.2 Air Temperature and Sea Surface Temperature Variation in April (2001-2016)

In figure2.2, for air and ocean temperature in April, the two temperature trends seem to have some differences. The air temperature goes down, up and down while the sea surface temperature follows two cycle of going up and down. Both of them decrease at 2016 while the sea surface temperature experiences more change over time. The range of each temperature shows that the sea surface temperature has a greater range than air temperature which shows that from 2001 to 2016, ocean temperature of Southeast Asia has a larger variation in April.

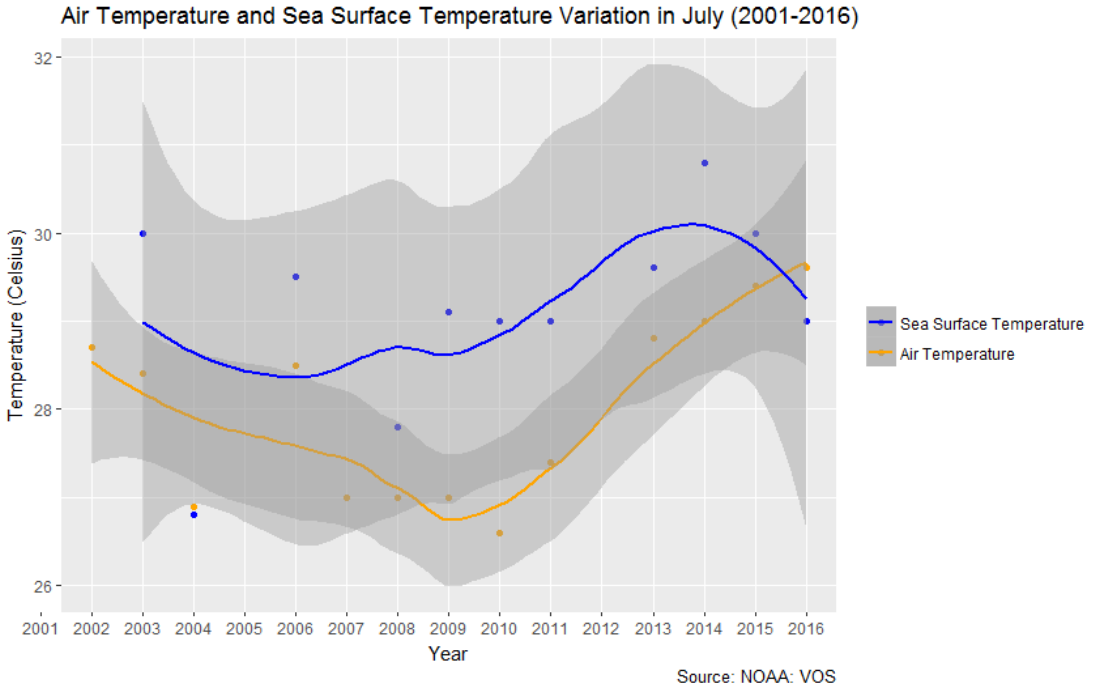

Figure2.3 Air Temperature and Sea Surface Temperature Variation in July (2001-2016)

In July from 2001-2016, the ocean temperature is higher than air temperature throughout 2001 to 2015. Looking at the trend, air temperature first goes down and then rises up after achieving its valley value in 2010. Ocean temperature goes down, up and down and is for the first time lower than air temperature in 16 years in 2016. The range of each temperature shows that the sea surface temperature has a higher range than air temperature, showing that from 2001 to 2016, ocean temperature of Southeast Asia has a larger variation in July.

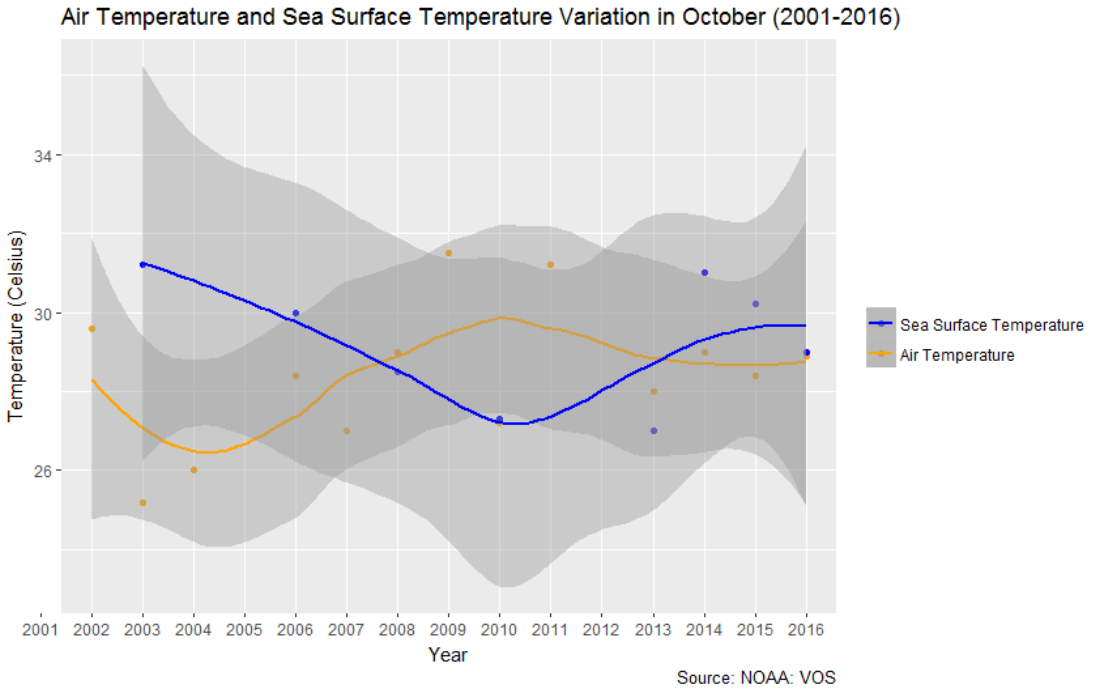

Figure2.4 Air Temperature and Sea Surface Temperature Variation in October (2001-2016)

In October from 2001-2016, we can see two opposite trends between two temperatures. The air temperature goes up and achieves the peak value in 2009 then goes down while the ocean temperature decreases and meets the valley value then increases. The range of each temperature shows that the sea surface temperature has a larger range than air temperature which means that from 2001 to 2016, sea surface temperature of Southeast Asia has a larger variation in October.

Comparing our four graphs together, ocean temperature seems to get its valley between 2007 and 2010, so maybe there are some ocean current movements or climate changes in those years. But for air temperature we have not found any summarizing features. Generally, none of these two temperatures have monotonically increasing trends which is contradictory to our guess based on the theory of global warming. I think further analysis should focus on the longer trend and especially analyze the pattern of temperature changing with climatic phenomenon behind them.