Buoy Project

Project Presentation

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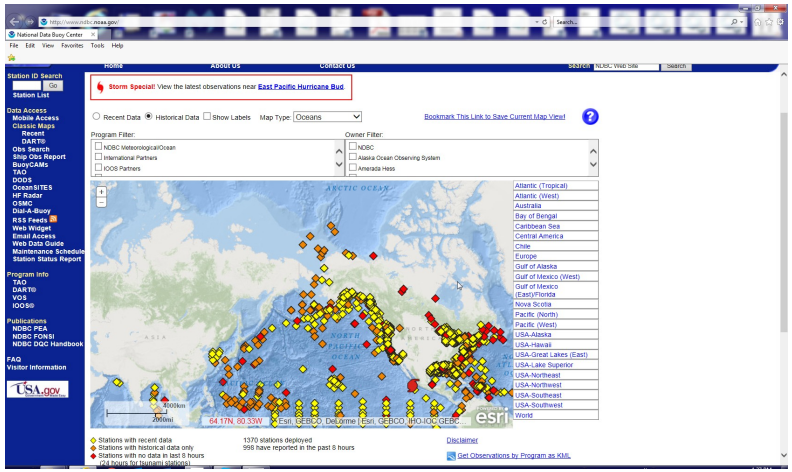
Project Background

- The National Data Buoy Center (NDBC) is a part of the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) of the US government.

- NDBC deploys weather buoys which are instruments which collect weather and ocean data within the world's oceans.

Project Background

- The time-series weather data for each buoy are publicly available from the NDBC website (www.ndbc.noaa.gov).

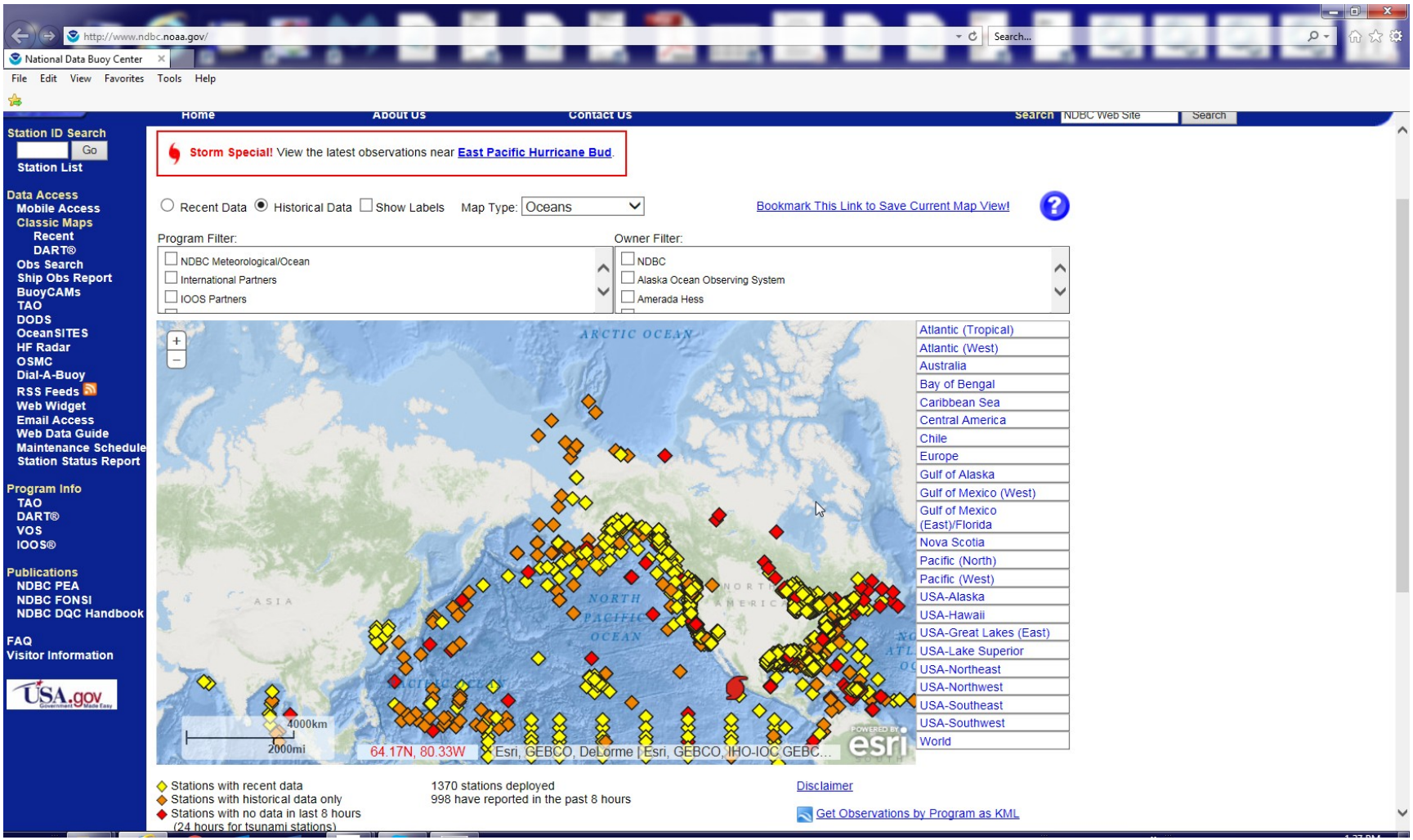


- These data have been used for research (e.g., Chen, Ruf and Cleason, *Journal of Geophysical Research: Oceans*, April 2016) and teaching purposes.

Part (A) - constructing the dataset

- Students are asked to locate the data webpage of the Weather Station buoy 46035 at 57.026 N 177.738 W from NDBC.
- Examine the data format for each yearly data file.
- Write an R program to extract and patch the data into two time-series of daily **Air Temperature** and **Sea Temperature** readings recorded at noon.

Part (A) - constructing the dataset



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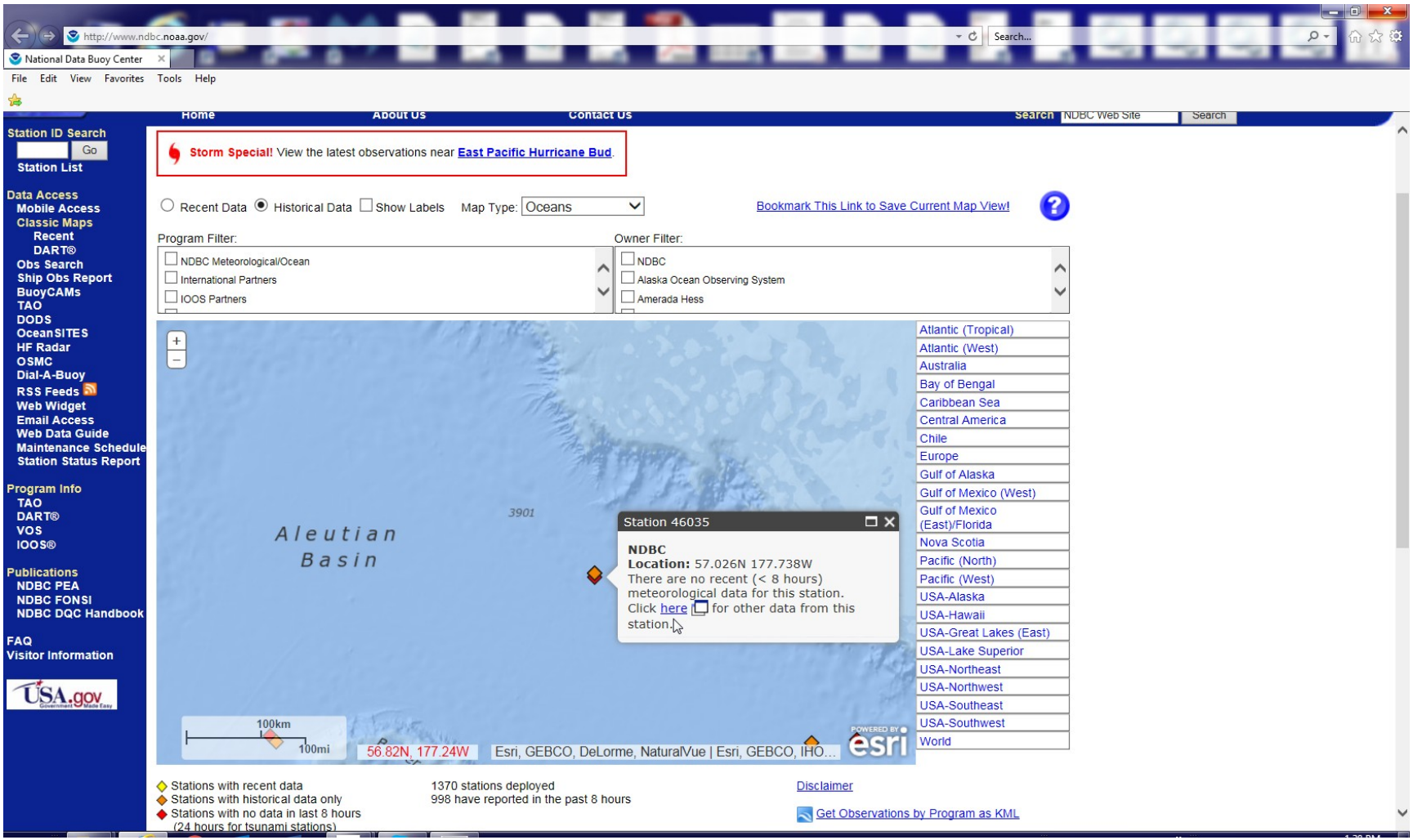

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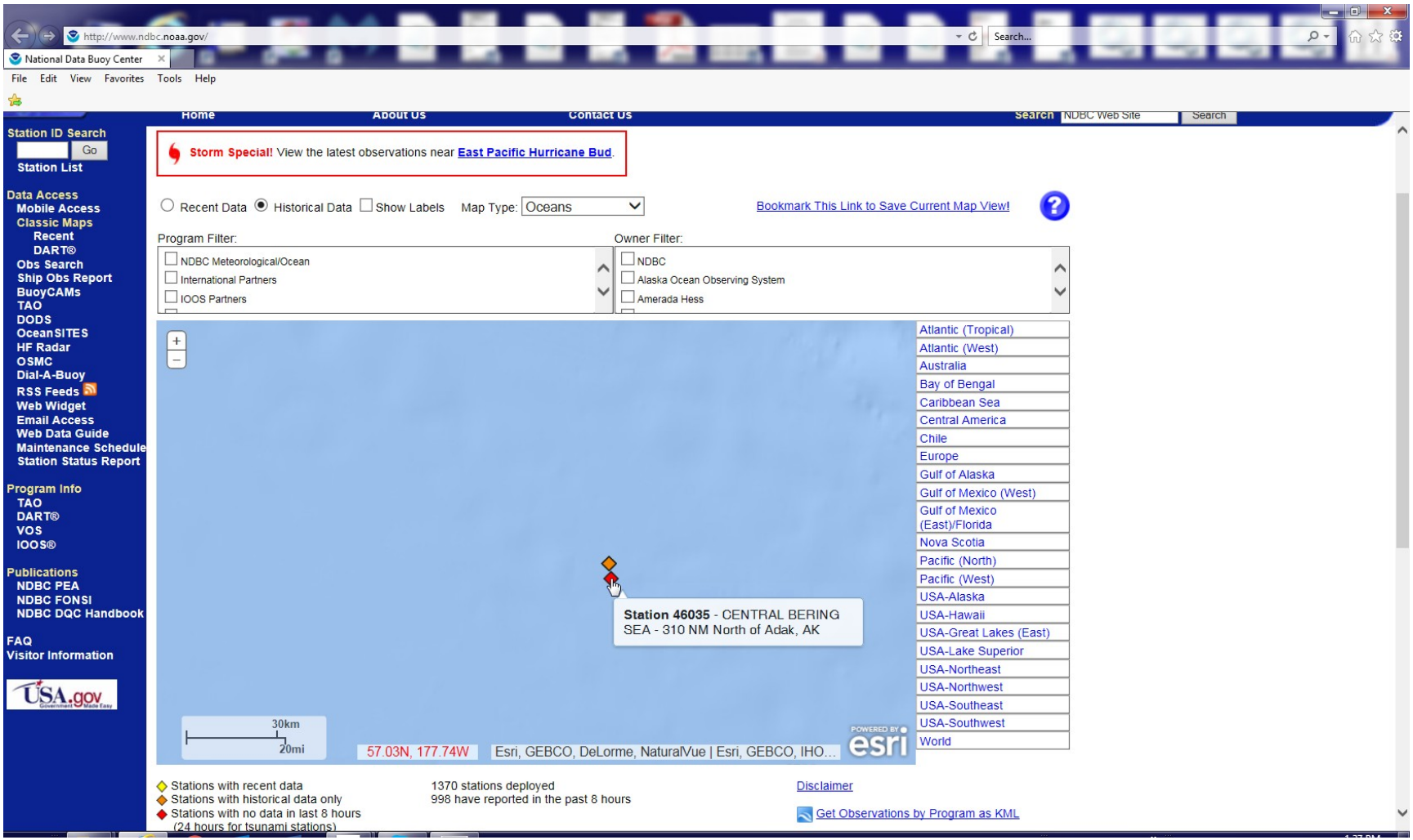

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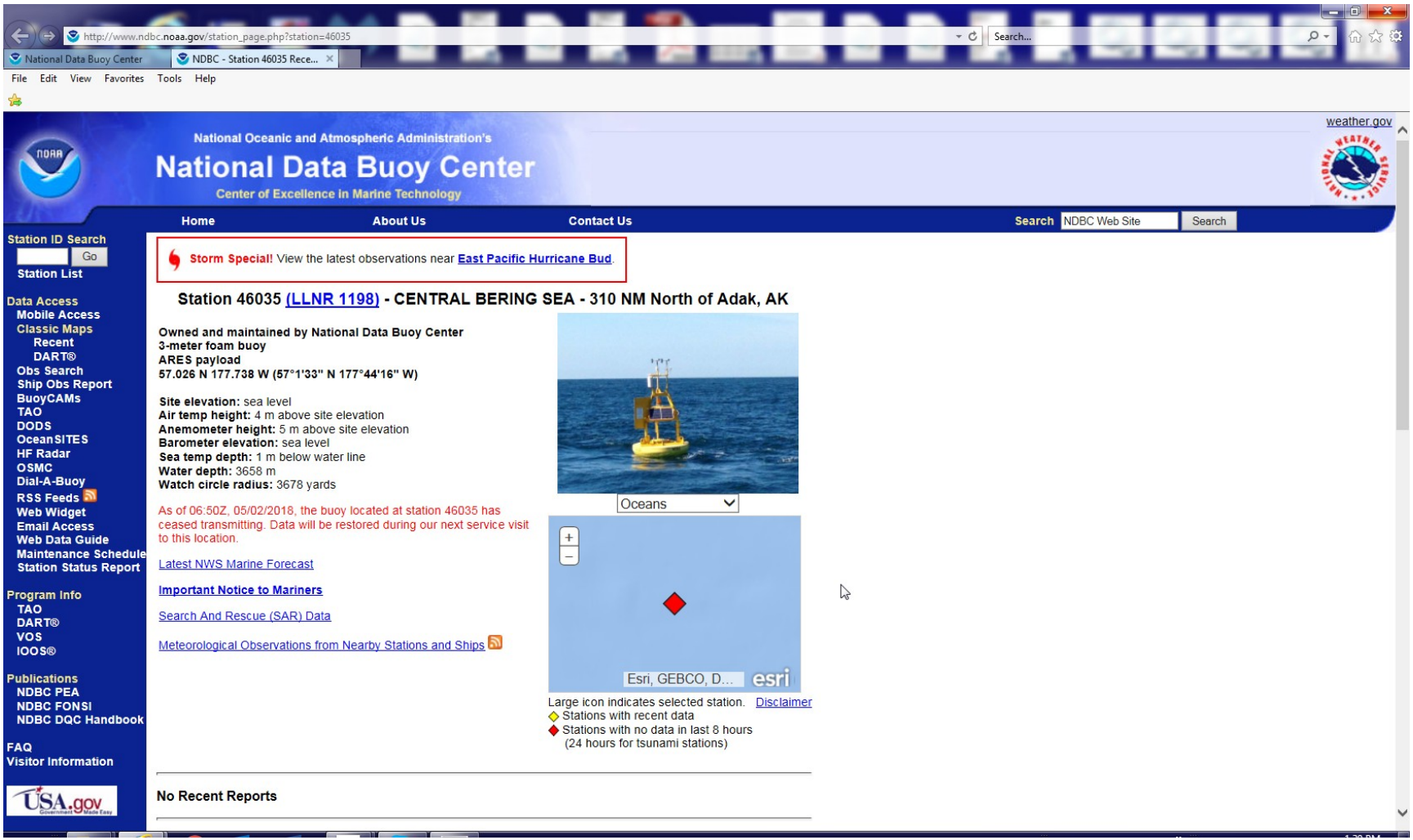

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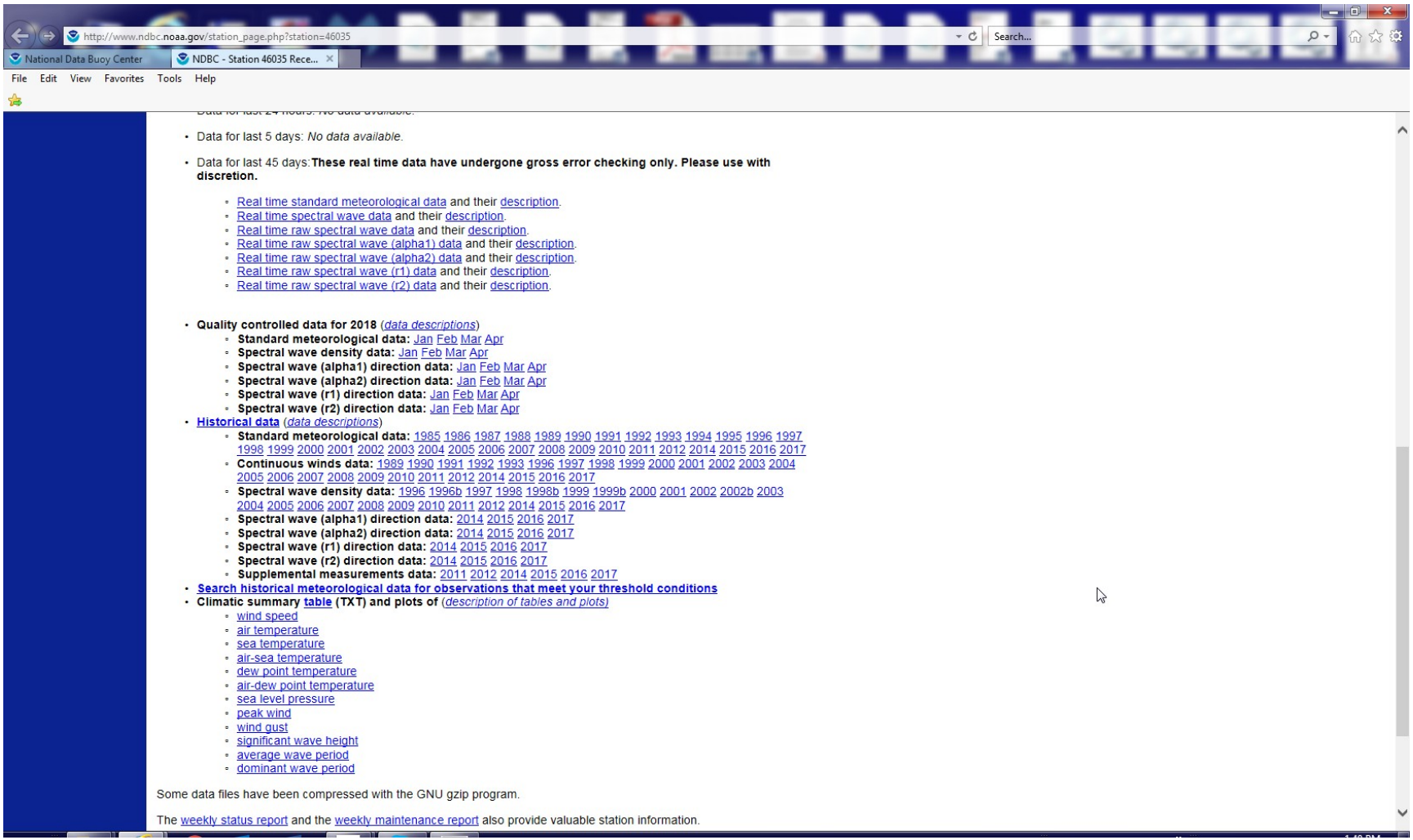
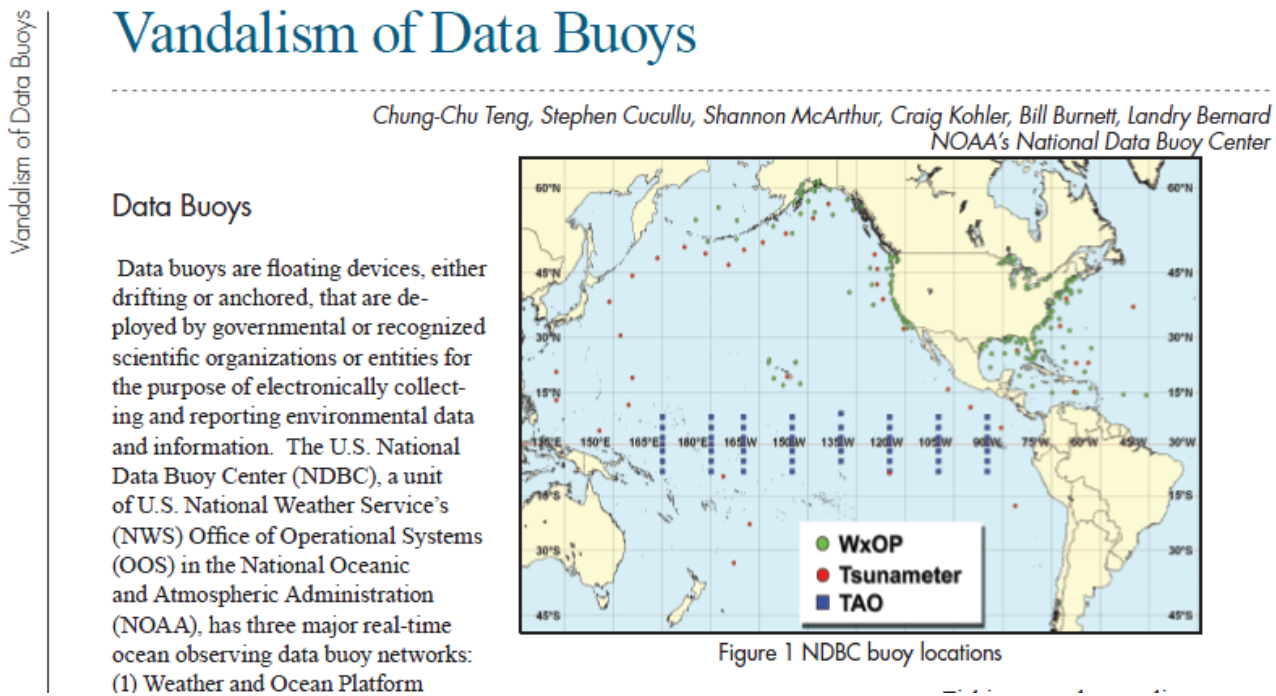


Part (B) - data cleaning

- Students are asked to plot and clean the data.
- Messy data: outliers, missing values, lost of data – due to vandalism/stolen of data buoys



Vandalism of Data Buoys

Vandalism of Data Buoys

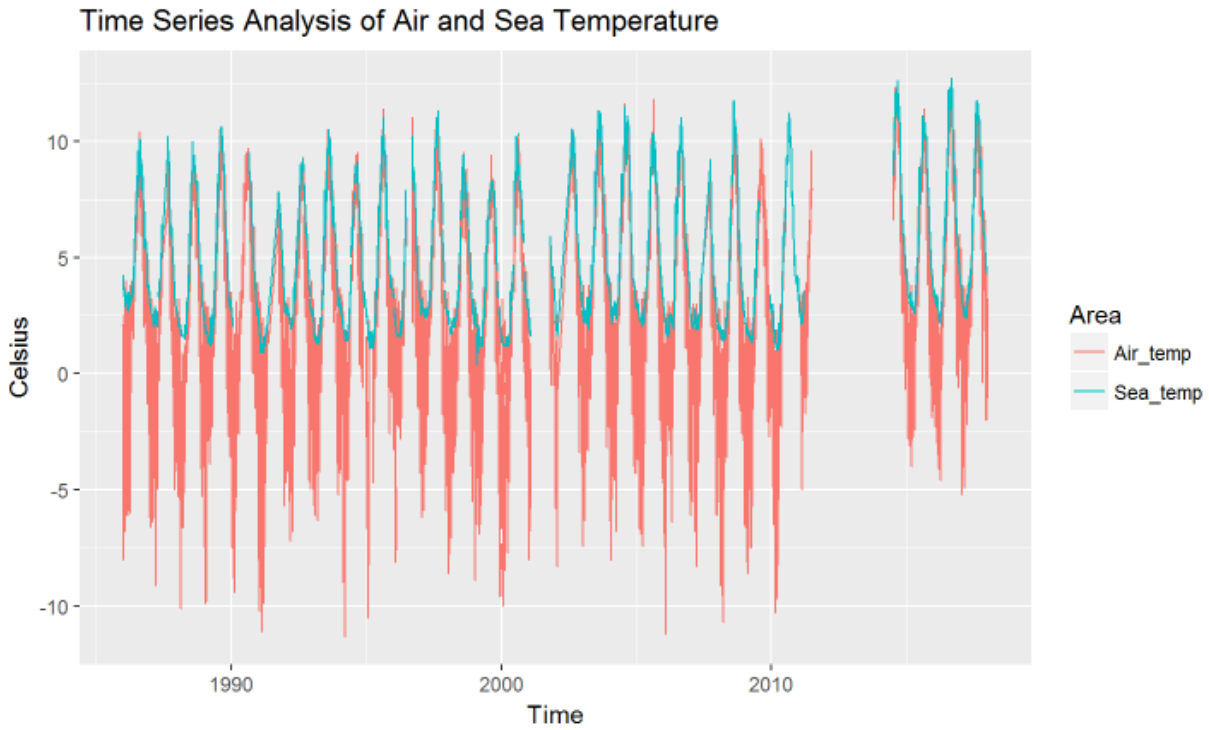
Chung-Chu Teng, Stephen Cucullu, Shannon McArthur, Craig Kohler, Bill Burnett, Landry Bernard
NOAA's National Data Buoy Center

Data Buoys

Data buoys are floating devices, either drifting or anchored, that are deployed by governmental or recognized scientific organizations or entities for the purpose of electronically collecting and reporting environmental data and information. The U.S. National Data Buoy Center (NDBC), a unit of U.S. National Weather Service's (NWS) Office of Operational Systems (OOS) in the National Oceanic and Atmospheric Administration (NOAA), has three major real-time ocean observing data buoy networks: (1) Weather and Ocean Platform

Figure 1 NDBC buoy locations

Part (B) - data cleaning



- Students have to research and decide on how to clean the data.

Part (C) - the research question

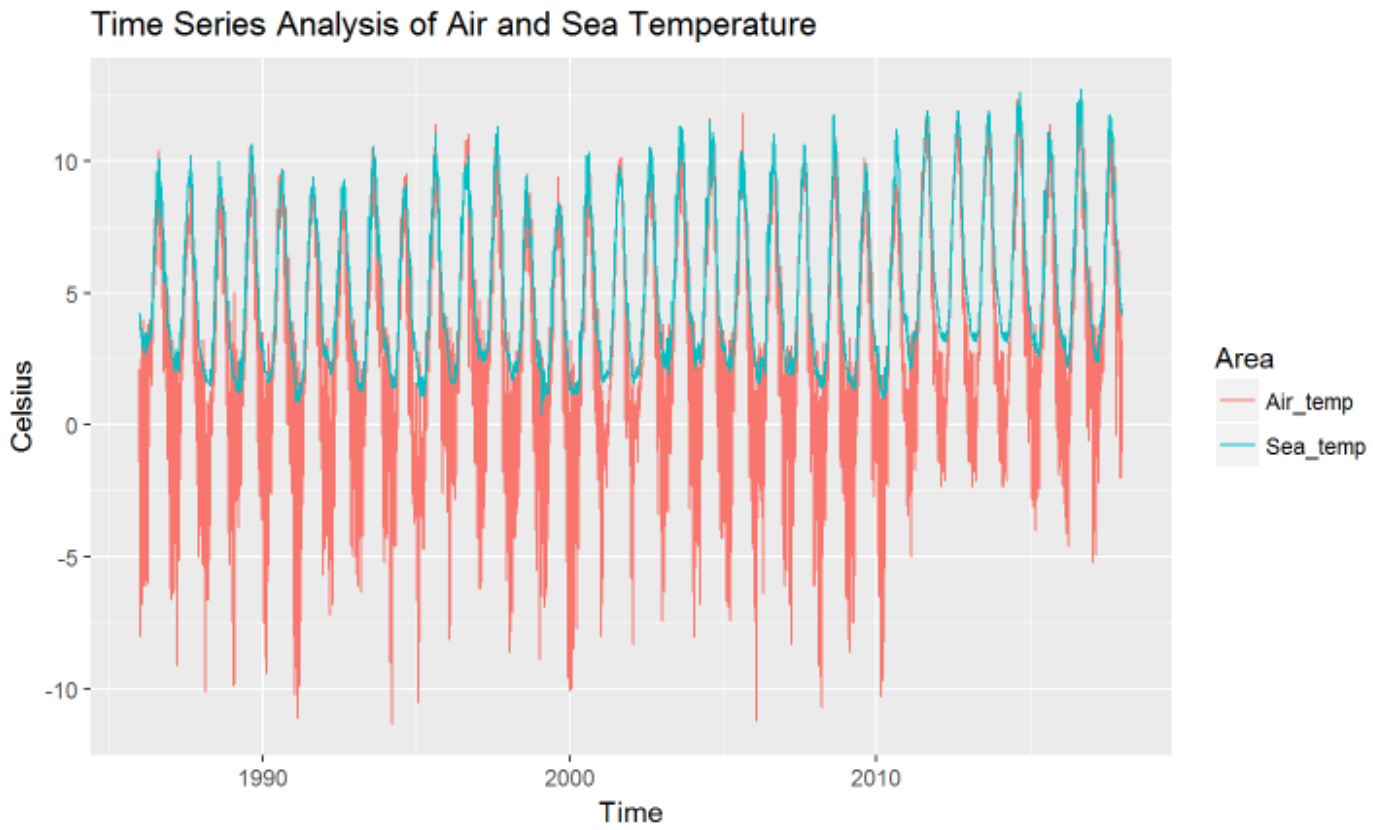
- Students are asked to answer the question: Global warming - have the temperatures (both sea and air) increased over the past 30 years?
- Students can use any statistical methods learned in this course.
- All computations have to be carried out in R.
- Each student has to make a presentation and hand-in a final report (professionally written with proper conclusions and justifications).

My Report - Data Cleaning

- There were approximately 30% of data missing or classified as outliers (“999 degree Celsius”).
- I employed the `imputeTS` package to impute and clean the data time series.
- Three options were available in the package. They are: `na.interpolation` (imputation by different interpolation method), `na.kalman` (imputation by structural model and Kalman Smoothing) and `na.seadec` (imputation by seasonally decomposed missing values).
- It was found that the imputed values from Seadec Function would follow the general trends more “naturally” than those from other methods.

My Report - Data Cleaning

Cleaned Data

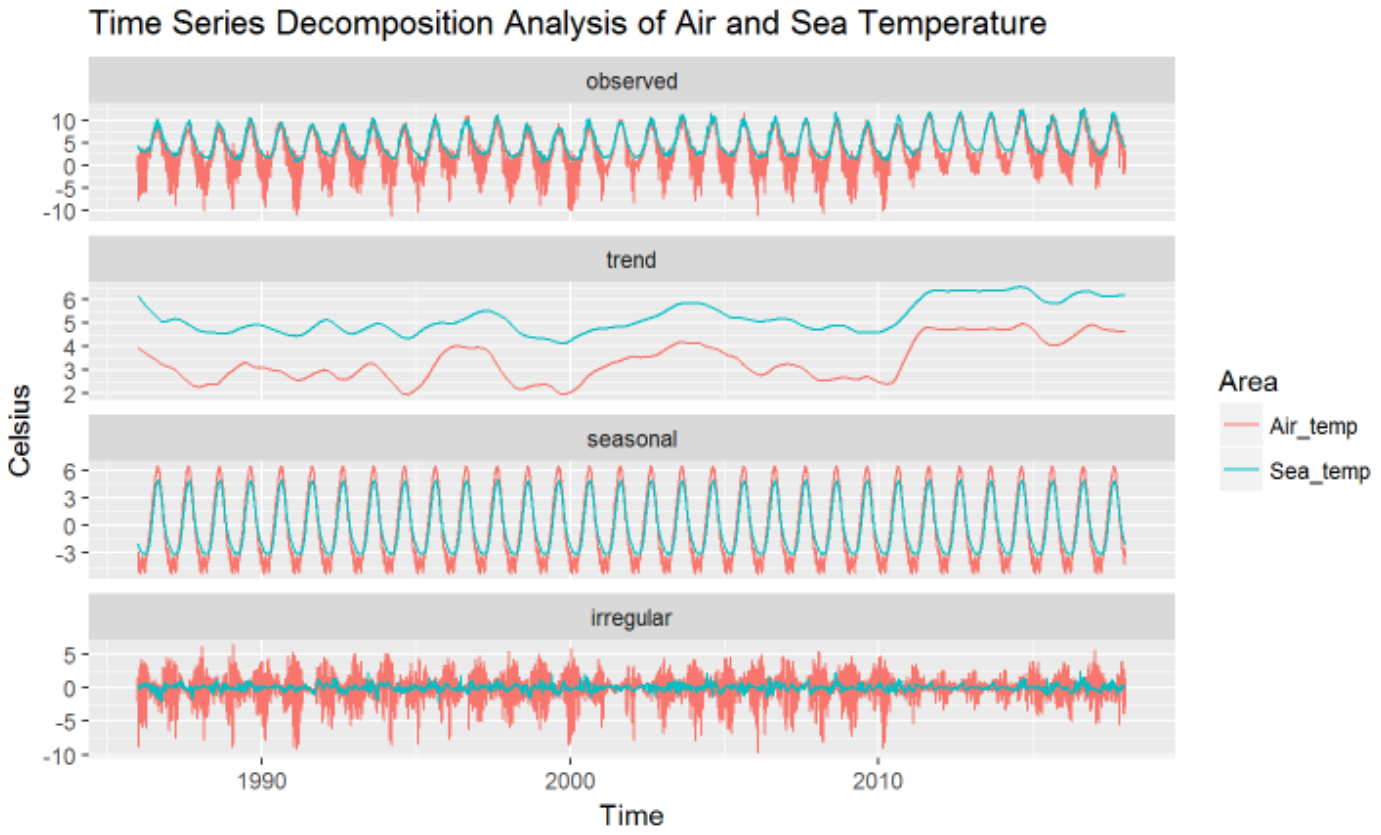


My Report - Seasonal Decomposition

- Since the pattern of seasonality is quite stable as reflected in the time series, an additive model is selected for the decompositions.
- The moving average approach is deployed to decompose the trend, seasonality and noise of the air and sea temperatures.
- The `decompose` function is used.

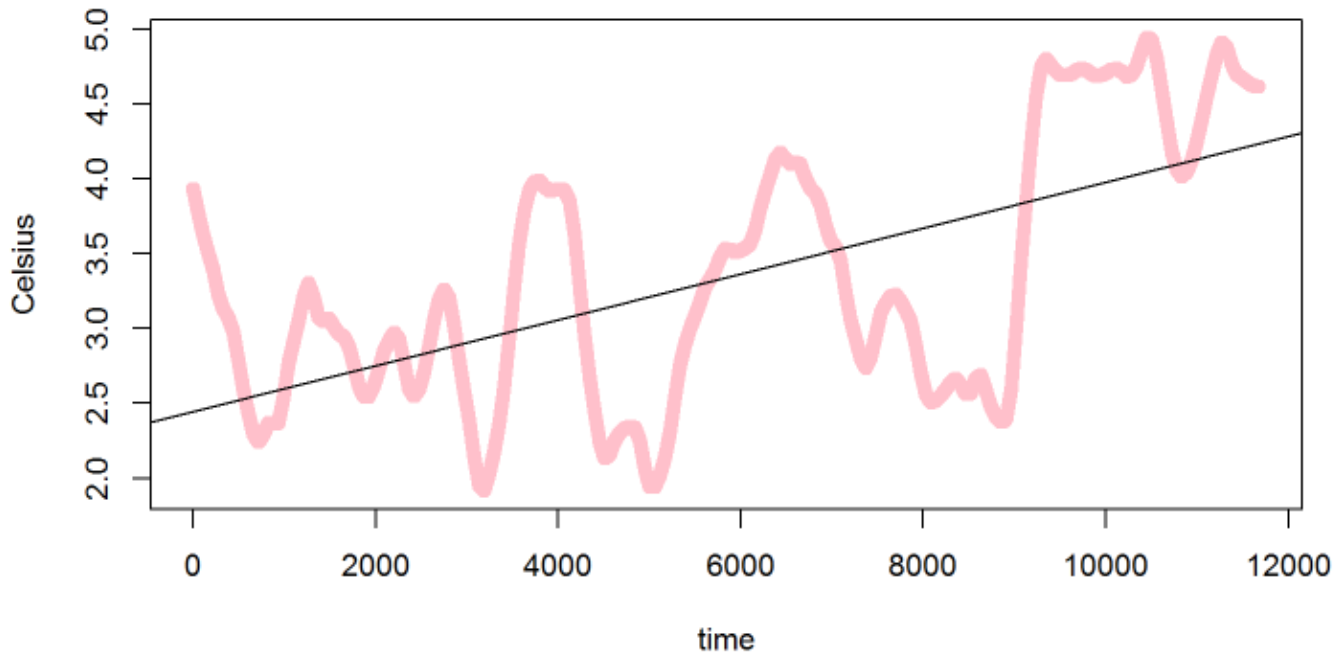
My Report - Seasonal Decomposition

Seasonal Decomposition



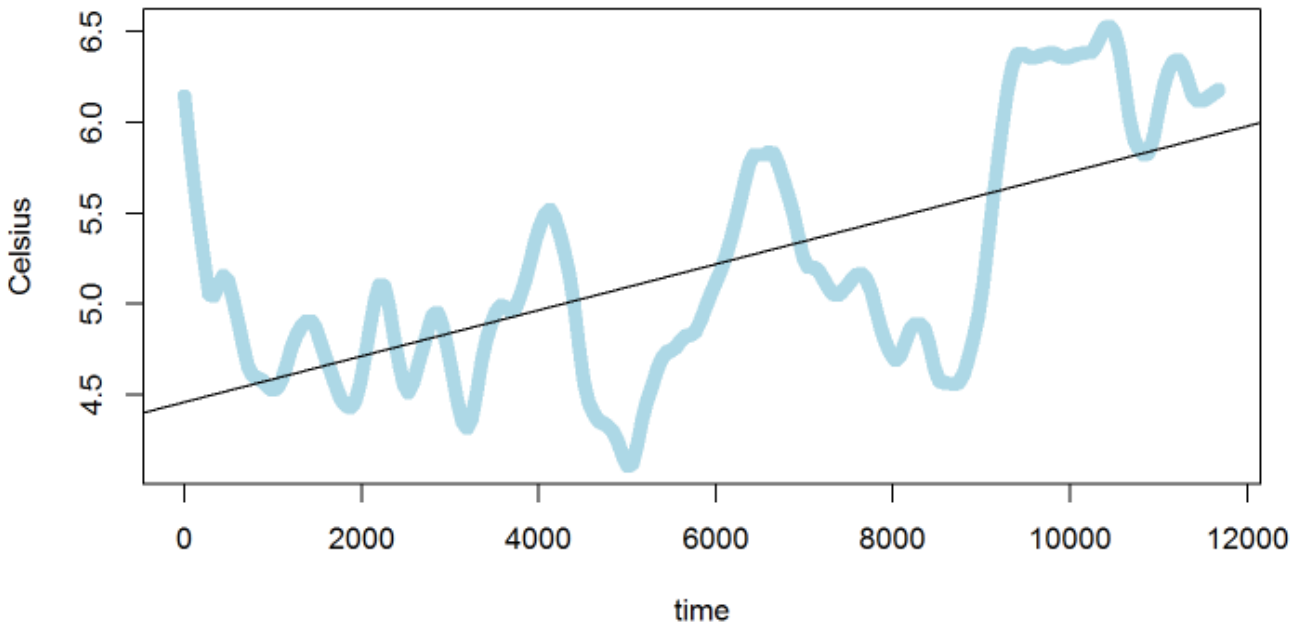
My Report - Linear Trend

Trend: Air temperature



My Report - Linear Trend

Trend: Sea temperature



My Report - Conclusion

- We fitted linear regressions to the trends and find that the slopes are positive and they are statistically significant.
- We conclude that Global warming did exist as the temperatures (both sea and air) increased over the past 30 years.
- The R codes used in the project have been stored and submitted in a separate file.

My Report - Final Remark

Robustness Check

To check whether sampling affected our evaluation of temperature change, lets conduct simple robustness check when temperature = 0:00, 6:00,18:00 and compare with 12:00.

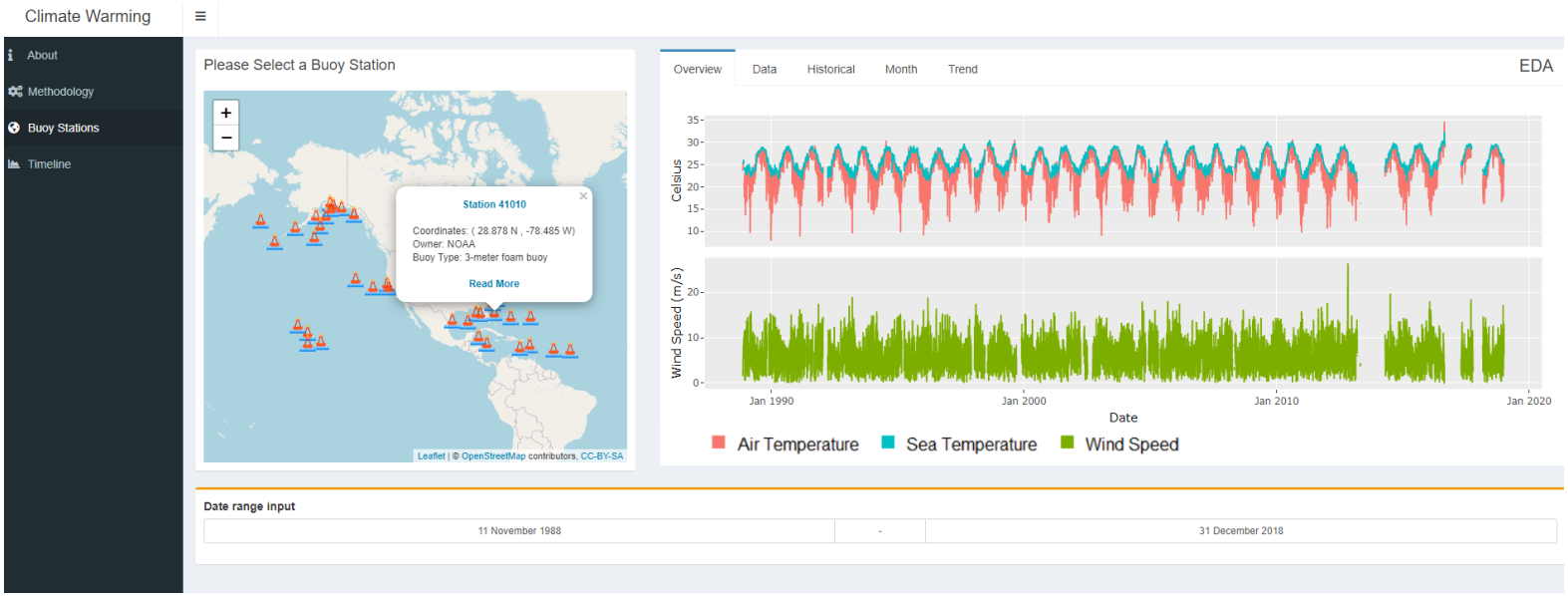
```
##             tau       sl S        D        varS
## Air.Time_0  0.3382657 0  23083382 68240392 177205149696
## Air.Time_6  0.3505084 0  23918828 68240392 177205149696
## Air.Time_12 0.3590287 0  24500260 68240392 177205149696
## Air.Time_18 0.3716339 0  25360442 68240392 177205149696
```

```
##             tau       sl S        D        varS
## Sea.Time_0  0.3823255 0  26090036 68240384 177205149696
## Sea.Time_6  0.3794484 0  25893702 68240384 177205149696
## Sea.Time_12 0.3917121 0  26730586 68240384 177205149696
## Sea.Time_18 0.393612  0  26860232 68240384 177205149696
```

- Similar results and conclusions have been obtained as compared to the noon time data.

My Report - Shiny Dashboard

- Project can be also extended to explore different buoy with shiny dashboard



- kclt.shinyapps.io/climate_warming