Hi Everybody,

This is a summary of what have been done regarding the model:

Per the plan, the following three tasks were targeted:

1. Investigate the application of the change detection
2. Investigate the plugin martingale as an alternative to the power martingale
3. Try any other modification that could be useful.

Also, it was set that the easiest and clearest benchmark that we can apply based on the available data was the Atlantic hurricanes. With quick investigation it was found that two buoys in the Caribbean could be good candidates to build the model upon them, buoy 42059 and 42058 based on the fact that both of them were subjected to only one major event during the 2016 season which is hurricane Matthew and both endured a direct hit (though one was affected more than the other).

Buoy 42059 was used to investigate the different tasks and tune the model and buoy 42058 was seen more suitable for the validation. This is because if we train the model on the strongest evidence we may be underfitting.

<http://komonews.com/weather/scotts-weather-blog/buoy-takes-direct-strike-from-hurricane-matthew-measuring-its-weather-all-the-way>

the results for the three tasks were as follows:

1. Change detection

Two measures were proposed in the literature, the threshold value and the difference. The threshold value requires that the anomaly persists for a considerable amount of time to ensure that the threshold is violated with an acceptable confidence level. Therefore, the difference would be a more practical approach since it does not require this persistence and hence could fit our application. However, one difficulty existed which is the considerable amount of noise in the Martingale difference. For this reason, a smoothing function based on an exponential filter was added to the change detection difference. After this addition, the change detection method became a very convenient method to evaluate the anomaly presence in the data

1. Plugin Martingale

Takes a LOT of processing time and does not give any improvement over the baseline model so it was decided to be disregarded

1. Another approach

Per the literature, it was found that instead of doing a mixture Martingale, the power Martingale could be tuned using the value of Epsilon. In this case the epsilon can be considered among the parameters to be tuned

For the data, when the power martingale was applied to a more longer data set, the values calculated based on the raw signal or the normalized signal were causing an overflowing in the processing and it could not be done. The obvious reason was the memory content in the data. In the meantime, the one step differenced data showed better results when the step size increased from 1 to higher numbers that depends on the autocovariance function of the data. Accordingly, the step size was considered as the second tuning parameter.

After tuning the model on the 42059 data, it was applied to 42058 data and the hurricane signature was very evident.

The score used for the tuning was the outlier measure for the smoothed change detection difference. The aim is to have the hurricane data as the most evident data outlier which corresponds to the maximum detection confidence.

Another buoy was also tested. This one was not exposed to any major event throughout the whole season

The final form of the model can be used for any buoy data. However, one of our suggestions in the Milestone documents was to assign a class to each buoy. I think that this will be somehow difficult because the data is not sequential from all the buoys at the same time. Meaning that you would not expect that at this second you get a data from this buoy and the next from a different one and so forth. Each buoy is self contained and does not communicate with the other. I guess the best approach will be just to concatenate the data for each buoy and apply the model to see if it was capable to detect a climatological anomaly or not

The folder on Github ‘BetaVersion’ includes the data for the three buoy (42058 was also added to the data archive and the 42059 data was extended to include Matthew in the archive) and two notebooks. One called test which includes the model tuning and the second is the production version that can be applied to any buoy data.

During the tuning I was comparing the results with another simulated signal as a benchmark to gauge the performance of the model. This simulated signal was removed from the production version of code.