Based on time serial images to detect abnormity

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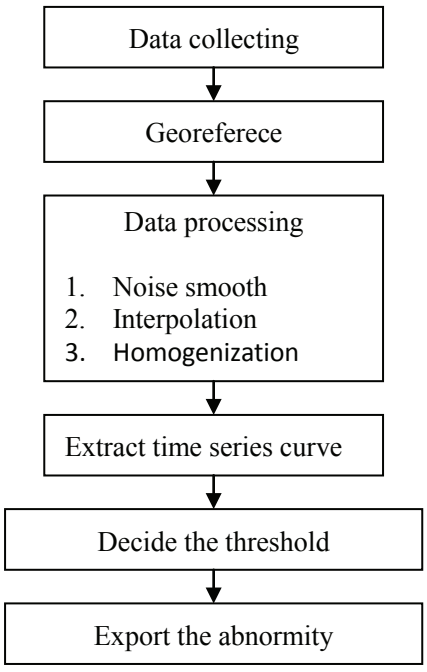
Introduction

Traditionally, people use the information difference in one image to distinguish the different area or to extract the object from the background, for example, the classification uses the difference of reflection or texture of different area or classes [1, 2, 3]. And in the field of red tide or oil spill abnormal detection, people usually use the experienced value, such as the reflection, SST or Chly-a, as the threshold combined with multi-band ration [4]. That means the traditional methods used the information of spatial difference to process or analyses the image [5] . Today, people can get a mass of images from satellites and these data is so huge that people can not deal with it by the traditional methods. Here we use a new detecting method which is based on the time serial images to detect the abnormal date and the abnormal spatial pattern in the image of this date.

Research Method

The time serial images can be looked as a sequence of data points, measured typically at successive times spaced at uniform time intervals. According to the trend of change from the time series curve, we can tell where is the abnormal part distinguished from the normal parts, which is exactly what we demand. For example: When the oil spill event



Flowchart of dectaction

happens, the area covered by the spilled oil will show abnormally on the satellite image. It might show either darker or brighter than the adjacent area which is not covered by the oil, both of which we call it anomaly. We can generate a time series of the reflectance change along the quantitative time period pixel by pixel from the MODIS 1B reflectance data source, then analysis the change of those times series by Probability and statistics algorithm to extract the abnormal pattern. These kind of abnormal parts are exactly what we want to distinguish from the normal background. What we obtained from the mathematic analysis or computer program processing is just the part where show abnormally, but as a matter of fact, in the real-world circumstances that anomaly might be noise which is not the oil spill event we want to detect but affects our results, hence, in the end, we should distinguish our target anomaly from those meaningless noise ones by our experience background.

Experiment

1. Data collecting and preprocessing

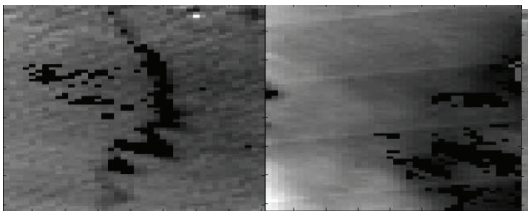
The MODIS 1B images dated from 2009.10.3 to 2009.11.22 was collected as the time series.After noise smooth, interpolation and homogenization, we got the image time series with the same pixel number as 40*71. And we got the 2840 time series curves.

Because of the reflectance of the sea surface are different day to day, homogenization is indispensable to make all these datas comparable, and meanwhile eliminate the negative effect caused by the accidently issues. After homogenization we could see all the images are at the same gray-scales(0—255), which would make it easier to detect the anomalies accurately.

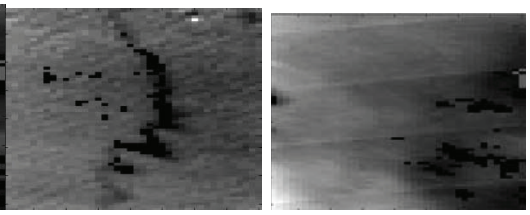
2. Decide the threshold and export the abnormity

Each time series has a mean, variance as well. According to probability and statistics we could use the variance to depict the fluctuation of the array and use the odds to detect the anomaly. When we use the threshold of μ-1.6σ, μ-1.7σ or μ-1.8σ, we got two images dated Nov.3rd and Oct.21st as the anomaly. And the result shows following.

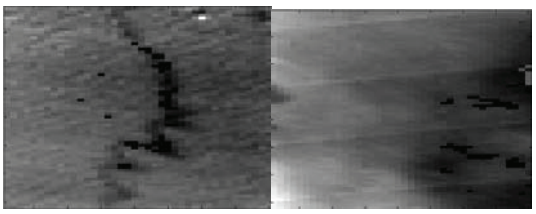
μ-1.6σ



μ-1.7σ



μ-1.8σ



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