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ON-THE-FLY MASSIVELY MULTITEMPORAL CHANGE DETECTION USING STATISTICAL QUALITY CONTROL CHARTS AND LANDSAT DATA

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ABSTRACT:

One challenge to implementing spectral change detection algorithms using multitemporal Landsat data is that key dates and periods are often missing from the record due to weather disturbances and lapses in continuous coverage. This paper presents a method that utilizes residuals from harmonic regression over years of Landsat data, in conjunction with statistical quality control charts, to signal subtle disturbances in vegetative cover. These charts are able to detect changes from both deforestation and subtler forest degradation and thinning. First, harmonic regression residuals are computed after fitting models to interannual training data. These residual time series are then subjected to Shewhart X-bar control charts and exponentially weighted moving average charts. The Shewhart X-bar charts are also utilized in the algorithm to generate a data-driven cloud filter, effectively removing clouds and cloud shadows on a location-specific basis. Disturbed pixels are indicated when the charts signal a deviation from data-driven control limits. The methods are applied to a collection of loblolly pine (Pinus taeda) stands in Alabama, USA. The results are compared with stands for which known thinning has occurred at known times. The method yielded an overall accuracy of 85%, with the particular result that it provided afforestation/deforestation maps on a per-image basis, producing new maps with each successive incorporated image. These maps matched very well with observed changes in aerial photography over the test period. Accordingly, the method is highly recommended for on-the-fly change detection, for changes in both land use and land management within a given land use.