Micro-Satellite Constellation for Global Surface Water Data
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Abstract
Seasonal inundation of wetlands effects millions of people worldwide as evidenced by the recent flooding in the US and Pakistan. Current methods of tracking surface waters have poor temporal and spatial resolution. We propose a system of micro satellites that take advantage of the properties of sun glint to detect surface waters globally with a 10 meter pixel resolution on a weekly basis. This system will provide enhanced data to resource managers, emergency response teams and climate modelers. Using the ADEOS satellite orbital parameters, a ground track was created to explore the spatial and temporal resolution of off the shelf technology that could be packaged in a micro-satellite constellation of between 4 to 9 satellites.

Coverage by One Satellite
Figures 2 and 3 show the satellite swath along the ground track for a 41 day repeat cycle. Note that there is overlap in both the images, with greater overlap in the Alaskan Study Area due to the proximity to the Earth’s pole. This complete coverage is demonstrated with a 0.7 degree swath width. This swath width was determined as the most likely sun glint enlargement in small protected water bodies.

Advantage of Constellation
This same coverage can be obtained by several satellites increasing the temporal resolution by (41/n) where n is the number of satellites in the constellation. For example if four satellites are deployed the repeat over a given area would be roughly 10 days between flyovers. Thus to achieve a 4 day repeat cycle the constellation would consist of 10 satellites. The use of Off The Shelf (OTS) technology, small size and low weight create a system that would generate near real time data for international, regional and local resource managers, disaster response teams, and climate scientists.

Poster Background
Several factors are visible in the background photo that lead to the original hypothesis: even protected waters reflect the image of the sun from a larger area then would be expected for a completely flat surface. Several ripples, (possibly from insects, detritus or gas vacuoles escaping the surface) that are not due to wind stress, can be seen increasing the image of the sun in the center of the poster, as well as glint from the lensing effect of vegetation protruding the surface. The hydrogen bonds between the water and these surfaces are enough to bend the surface similar to the miniscus seen in graduated cylinders. These effects increase the image size while canopy interference, also visible, ultimately reduces the area that can be reflected.

Figure 1: Specularly reflected light and the reflection of the sky created this striking image of surface waters of the flooded Brazilian rain forest, in this photo taken from the ISS.

Figure 2: Alaska Study Area with a 0.7 degree swath width overlay showing complete coverage by one satellite using the ADEOS planned orbital parameters.

Figure 3: Brazil Study Area with a 0.7 degree swath width overlay showing complete coverage by one satellite using the ADEOS planned orbital parameters.

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