Enhanced Detection of Inundation below the Forest Canopy using Multi-Return LiDAR Intensity

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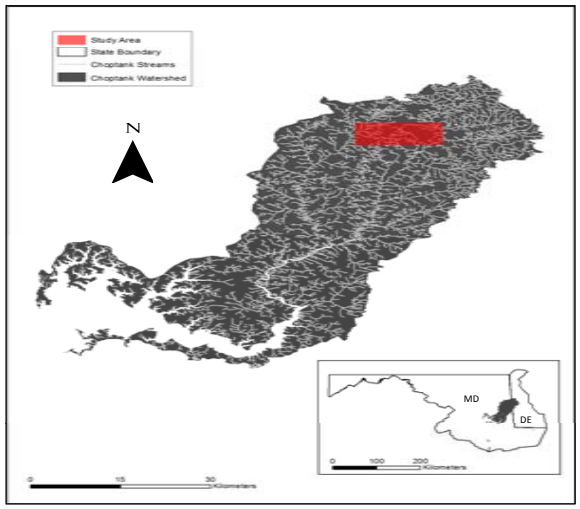
Introduction

Wetland hydrology is an important factor controlling wetland function and extent, and should therefore be a vital part of any wetland mapping program. Broad-scale forested wetland hydrology has been difficult to study with conventional remote sensing methods. Airborne LiDAR data have mainly been used to derive information on elevation. However, the intensity (amplitude) of the signal has the potential to significantly improve the ability to remotely monitor inundation – an important functional driver.

Methods

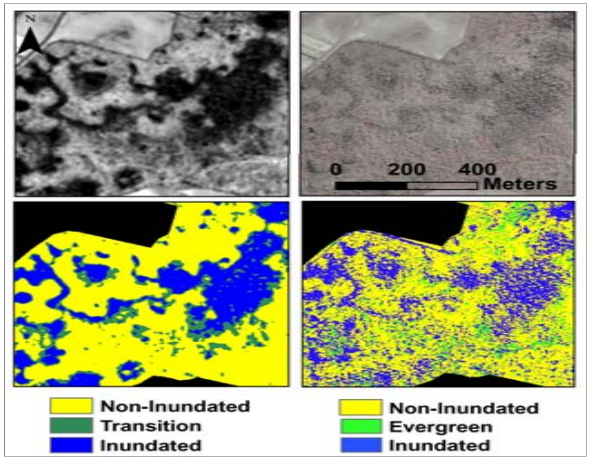
In situ data were used to validate LiDAR intensity based maps of inundation created using a thresholding technique. Evergreen vegetation was found to confound the signal. A transmission model based on multiple-return data was used to correct for evergreen influence. Inundation during drought and average years was compared. The effect of this variability on surface water volume storage was assessed.



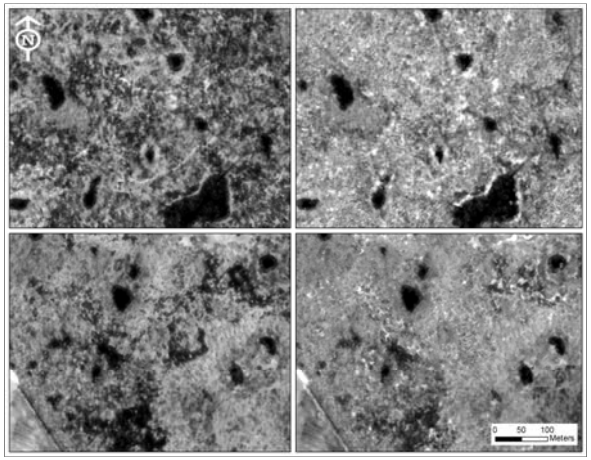
The 33 km^2 study site is located within the headwaters of the Choptank River Watershed, which is situated on the Delmarva Peninsula within the Coastal Plain Physiographic Province.

Results

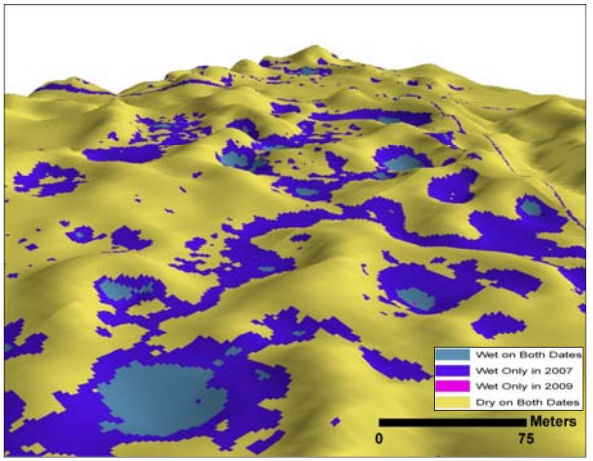
Inundation maps were extremely accurate (~98% both years). During a spring drought, number of inundated areas declined by 72%, area inundated declined by 61%, volume of surface water declined by 66% relative to a year of average precipitation. Surface water connections also declined significantly.



Original datasets (filtered intensity, above left and aerial photography, above right) used to produce forest inundation maps (below).



Ground (left) and evergreen corrected images (right) for two different areas of mixed forest (top and bottom). Inundated areas are dark and easier to distinguish on the corrected images.



Inundation change between an average (2007) and drought (2009) year.

Discussion and Conclusions

Although LiDAR intensity data are not collected regularly, when they are available they represent a highly accurate and under-utilized resource. They are well suited for mapping vernal pools and other relatively small wetlands in forested environments, that have to date been difficult to detect. Intensity-based inundation maps from different years provide important insights into surface water dynamics relative to aquatic connections, surface water storage, carbon sequestration and more, that can be used to better estimate the provision of wetland ecosystem services and guide policy development. These data provide a vital link between field observations and coarser spatial resolution datasets (e.g., Landsat).

Acknowledgments

Support for this project was provided by the Natural Resources Conservation Service and the NASA Land-Cover / Land-Use Change Program.

For more information please contact Megan.Lang@ars.usda.gov or see Lang, M. and McCarty, G. *Improved Detection of Forested Wetland Hydrology with LiDAR Intensity*. (2009) Wetlands. Vol. 29, No. 4:1166-1178.