Tar Print: Novel Convolutional Remote Sensing Techniques To Quantify Urbanization and Study Water Quality

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The use of citizen science has become prominent in studying large-scale environmental issues. Among these issues is urban sprawl, a rapidly growing global trend that is deteriorating drinking water quality and the ecology of water bodies, commonly characterized by the surrounding impervious surface percentage (ISP). Current softwares to analyze ISP are challenging to use and difficult to scale. To fill this need, we developed and published Tar Print, a mobile application to quantify ISP, to the App Store. We enhanced Tar Print's accuracy using novel algorithms and boosted-tree machine learning trained with 2,250 data points, resulting in an 86% validation and 98% testing score. Stream ecology is analyzed through volunteer protocols such as those run by Virginia Save Our Streams (VASOS) which measures nineteen macroinvertebrate (water quality bioindicator) populations at testing locations across Virginia. Using Tar Print, we analyzed the ISP at 143 unique locations and stratified them by ISP into good (0-5%ISP), fair (5-20%ISP), and poor (20%+ISP) categories. We found strong negative correlations as ISP increased (Pearson correlation) and significant differences between ISP stratifications (ANOVA and TukeyHSD). Furthermore, we observed eight taxa increasing along with ISP (Plecoptera most significantly) and five decreasing as ISP increased (Planaridae most significantly). Surprisingly, we noted the generally sensitive taxa Chironomidae, Odonata, and Trichoptera had no significant correlation with ISP. In conclusion, we developed Tar Print, a mobile application that has applicability to monitoring the impact of ISP and urbanization on stream health at both the citizen science and professional level.

Awards Won:
Third Award of $1,000