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| **Improved area estimation technique based on the stratification of forest and forest change area using a continuous probability layer.** |
| **Introduction/Aim:**  Precise estimates of forest area and change help nations meet their reporting obligations under various international agreements and are a requirement to receive payments for verified reductions in carbon emissions under carbon accounting standards. During the last decade many countries used sample-based methods to report unbiased area estimates of deforestation to the United Nations Framework Convention on Climate Change (UNFCCC). Change is rare relative to large, stable land cover classes and estimates are challenging to obtain with sufficient precision to judge progress towards the desired goal of reducing deforestation over time. Failure to produce precise estimates can prohibit countries from taking advantage of funding and impact efforts to mitigate or adapt to climate change.  The statistics for sample-based area estimation are well established. Large-scale, operational application of the statistics to meet rigorous climate finance criteria, however, is novel and challenging. Stratified area estimation, in which a categorical map of stable forest and non-forest, plus additional change classes, are used to design and distribute a sample for reference data collection is often employed to reduce uncertainties around area estimates as much as practicable. However, the stratification layer is prone to error, which in turn leads to omission of changes in the stable strata being included in the reference data. Under optimal sample allocation, those reference samples typically have a huge weight in the estimation process and inflate the uncertainty beyond acceptable levels. The introduction of a spatial buffer stratum that accompanies most of those omissions has been useful, but not always successful.  **Method & Results:**  To practically improve precision of area estimates, we propose a general framework based on a continuous layer of forest change probability, accommodating all possible change categories. The forest change probability proxy variable is calculated using well-known remote sensing techniques such as dense time-series analysis and other approaches of characterizing land cover change. Strata boundaries and subsequent sample unit allocation follows, specifically designed to address, and alleviate the issue of omission of change in the stratification. Essentially, the procedure establishes a statistical buffer stratum based on the change probability layer. Additional statistical estimators to improve precision are also introduced. The theoretical concept is accompanied by results from simulations and real-world examples in the context of international carbon finance. |