Note to users of MODIS Land Cover (MCD12Q1) Products

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This document provides justification for the release of a new Collection 5.1 (C5.1) MODIS Land Cover (MCD12Q1) product based on a critical error identified in the Collection 5 (C5) version of the product. The producers of the map recommend that users download the new C5.1 data for their applications.

The Collection 5 MCD12Q1 product contained a trend of steadily increasing boreal tree cover between 2001 and 2009 that is unrelated to actual forest change. The problem was caused by land cover changes within the training site database used to produce the maps. To resolve this issue, the training site database was filtered for changed and otherwise poor quality sites. The Collection 5.1 MODIS Land Cover product was generated following the algorithm described by Friedl et al. (2010) using the revised training data.

The MCD12Q1 product is generated by applying the same algorithm annually over a ten year period (2001-2010; Friedl et al., 2010). The algorithm takes in monthly and annual metrics of surface reflectance composited from a year of MODIS Normalized BRDF-Adjusted Reflectance (NBAR) data. The supervised classification needs examples for each mapped class and about 2,000 training sites worldwide are used to train the decision tree classifier. The final maps have a high rate of label fluctuation between years that should not be confused with actual land cover changes. Causes of these changes include spectral similarity between classes, land cover seasonality, missing or low quality inputs, errors in the training database, and class definition ambiguities. While the apparent rate of change in the maps exceeds the actual rate of land cover change at the global scale by roughly an order of

magnitude, trends in the distributions of specific classes could be diagnostic of inconsistencies in the training site database.

A trend of increasing boreal forest cover was identified in the C5 MCD12Q1 data (Figure 1). The observed increase in forested area above 50°N between 2001-2009 far exceeds the natural rate of treeline expansion and was largely caused by land cover changes within sites included in the training site database. In particular, forested sites in Northern Eurasia and Canada that had been logged or burned since 2000 have affected classification leading to over-prediction of forest cover at high latitudes. Upon discovery of this trend, the decision was made to reprocess the product and release the new version as Collection 5.1. This decision coincided with an in-depth review of the training site database to prepare for Collection 6.

Since the only difference in processing between the C5.1 and C5 products is the revised training site database, the changes between the two products provide meaningful information about the sensitivity of the algorithm to the quality of the training database. To assess this, we first aggregated the 500-m International Geosphere-Biosphere Programme (IGBP) map labels for each year and product onto a 0.05-degree grid. At each grid cell we retained the proportional cover of each IGBP class. For the purpose of assessing forest cover we have combined the sub-grid proportions of IGBP classes 1 through 5 to include all the forest classes. Here we define the boreal forest zone as all 0.05-degree grid cells above 50°N that have at least 1% forest cover in either 2001 or 2009.

The increase in boreal forest cover between 2001 and 2009 is reduced substantially in the C5.1 maps relative to C5 (Figures 1 and 2). Here we define a significant change in forest cover as a >20% change to the forested proportion of a grid cell between 2001 and 2009. By this criterion, 20% of the cells in the boreal forest zone showed significant increase in forest cover in C5 while in the C5.1 maps only 13% of the cells show such a change (Figure 3). Most of these changes occur in grid cells

where the forested proportion decreased by more than 50% during this period (5% of all forested cells in C5 to 1% in C5.1; Figure 3).

The C5.1 product shows a smaller increase in boreal forest cover relative to the C5 product. The persistence of the trend in the C5.1 maps suggests that forested sites that have changed are still present in the training site database. To address this possibility, one last round of revision will be performed on the database to identify these changes before the generation of the Collection 6 MODIS Land Cover product. In addition to resolving the forest cover issue described above, the C5.1 product addresses a number of other known issues in the C5 maps (described in detail at http://landweb.nascom.nasa.gov/cgi-bin/QA_WWW/displayCase.cgi?esdt=MCD12&caseNum=PM_MCD12_11001&caseLocation=cases_data). Some of these known issues are specific to a single class in a single location while others describe regional biases in land cover characterization.

Citation:

Friedl, M. A., Sulla-Menashe, D., Tan, B., Schneider, A., Ramankutty, N., Sibley, A., & Huang, X. (2010). MODIS Collection 5 global land cover: Algorithm refinements and characterization of new datasets. *Remote Sensing of Environment, 114,* 168-182.

Figure 1. Boreal forest cover changes between 2001-2009 for Collection 5.

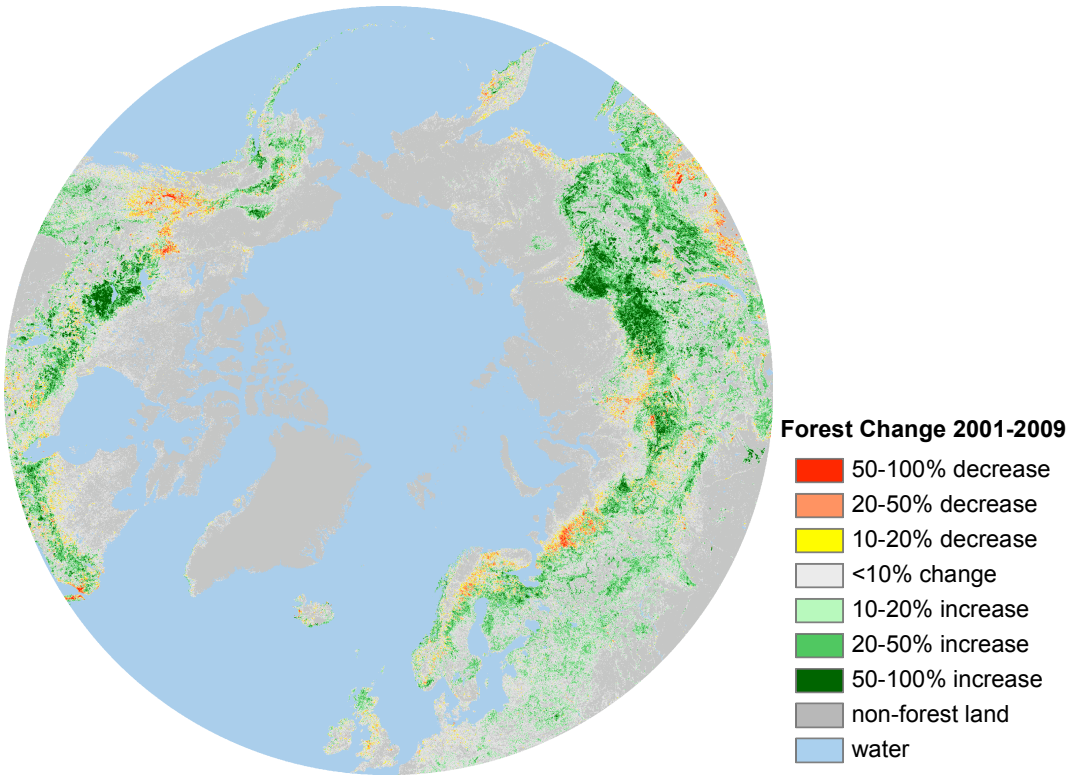

Figure 2. Boreal forest cover changes between 2001-2009 for Collection 5.1.

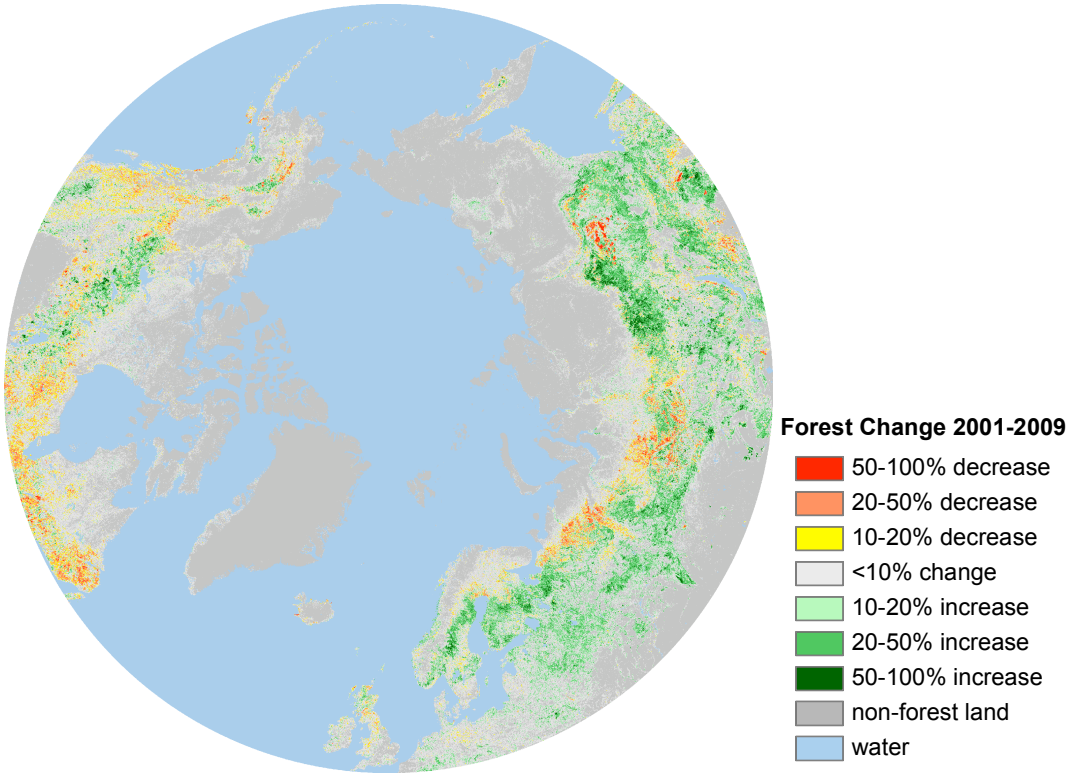

Figure 3. A summary of forest cover changes between 2001-2009 as percentages of the entire boreal forest zone.