Abstract. In this paper, we present an innovative methodology, named minimum distance allocation method (MDAM) to help build consistent land use maps, based on the combination of different sources of data. The proposed algorithm is built upon a minimization problem, according to which data from property surveys can be allocated to overlapping or surrounding model geographic units. In the allocation process, we specifically restrictions to avoid assigning crop area to a model geographic unit located completely inside a protected forest, for example. Based on the new methodology, we constructed a new Brazil land use map, to be an input into the GLOBIOM land use model.

Simulation Units. Using the MDAM, we created a new land use map, to be used for simulations performed by GLOBIOM—a global land use model. We produced a harmonized map for Brazil, with information assigned to geographic units, named SIMU’s—simulation units (see Mosnier et al., 2012). There are 11,003 SIMU’s in Brazil.

Input Data. The base year for our GLOBIOM simulations is 2000. We combined land cover information from satellite images (IBGE vegetation map, MODIS and SOS Mata Atlântica) to land use information from rural property surveys. We also used maps for protected areas, indigenous territories, maps for protected areas (IBGE), MODIS and SOS Mata Atlântica) to land use information from rural property surveys. We also used maps for protected areas, indigenous territories, property surveys, and from the IBGE vegetation map outside Legal Amazon. We then added information on forest remnants from SOS Mata Atlântica. After combining all land use satellite data, from different sources, we specified restrictions in the MDAM to obtain the final consistent hybrid land use map.

Building a Consistent Hybrid Map. Figure 2 presents the overall process for creating a new consistent Brazil land use map. Depending on the region in Brazil, we used different sources of information. For example, we used forest information from MODIS inside Legal Amazon, and from the IBGE vegetation map outside Legal Amazon. We then added information on forest remnants from SOS Mata Atlântica. After combining all land use satellite data, from different sources, we specified restrictions in the MDAM to obtain the final consistent hybrid land use map.

Figure 2 - Process for Building a Hybrid Land Use Map

Building a New Land Use Map for Brazil

An Algorithm to Harmonize Different Sources of Land Use Information:

Municipality Data into SIMU’s. Information on crop production and area, number of animals, planted forest etc. are originally obtained at the municipality level. The MDAM automatically allocates municipality variables into overlapping or surrounding SIMU’s. Let m(i) be the crop area for municipality i, for example. The MDAM finds values m(i) corresponding to the crop area in municipality i, allocated into simulation unit j. The MDAM is based on the minimization

\[
\min \sum_{i,j} x(i,j) \times d(i,j)^2,
\]

where d(i,j) is the geographic distance between municipality i and SIMU j. Information on land cover (from MODIS, IBGE vegetation map, and SOS Mata Atlântica), and on protected areas, were used as restrictions on the optimization set up. Therefore, we avoided allocating crops into simulation units covered only by forests, according to MODIS, for example. In fact, let s(j) be the total available area within SIMU j, after excluding forests, protected areas etc. We then specified the restriction

\[
\sum_{i} x(i,j) \leq s(j), j = 1, ... , J
\]

for all J = 11003 simulation units in Brazil. The MDAM also corrects inconsistencies such as sum of crop areas bigger than municipality area.

Figure 1 - Input maps for land use information

Figure 3 presents pasture and forest per simulation unit, in the final land cover map. (a): yellow = Pasture (0 to 100%), (b): green = Forest (0-100%), brown = Forest in protected areas (0-100%), (c): yellow = Pasture (0 to 100%), green = PRODES forest area for comparison (Legal Amazon only), (d): green = Forest (0-100%), yellow = Pasture (0-100%). For more details, access www.redd-pac.org.

Figure 3 - Final Land cover map per SIMU’S

Reference