georeferenced to the same coordinate system using a topographical map of the study area. Bands 2, 4, and 5 suitable for vegetation studies were used. Idrisi32 and ArcGIS were used for the analyses and map production, respectively, while Markov chain was used for future land-cover projection. A supervised classification scheme of natural forest (NF), plantation, and farmland was adopted after reconnaissance survey and field work in the study area. NF occupied 55.7% of the area in 1984, but declined to 3.9% in 2006. Plantation covered 13.7% in 1984 and increased to 59.8% in 2006, while farmland, which occupied 30.6% in 1984, increased to 36.3% in 2006. NF, plantation, and farmland will likely cover 12.7, 38.6, and 48.7%, respectively, by 2016. The implications of the declining NF and other land classification schemes for sustainability of the study area are discussed.

Slash-and-burn agriculture, fragmentation, and landscape dynamics in the lowland rainforest of Madagascar: the case of Manompana, northeast of Madagascar. Rabenilalana, F., Rakoto Ratsimba, H. (*University of Antananarivo, Madagascar; rmihajamanana@yahoo.fr; rrharifidy@moov.mg*), Bogaert, J. (*University of Liège, Belgium; j.bogaert@ulg.ac.be*), Sorg, J. (*Federal Institute of Technology Zurich, Switzerland; jean.pierre.sorg@env.eth.ch*).

Shifting cultivation, or tavy, is a traditional subsistence farming practice, predominant in the Betsimisaraka population in the eastern part of Madagascar. It consists of clearing and burning an area of forest for cultivation. The fire control when burning is precarious; the extent of the tavy generally exceeds the expected area, leading to a progressive loss of forest. This activity shapes the landscape with many significant openings leading to a very heterogeneous structure. This study analyzed the spatial dynamics of tavy, particularly in the toposequence. Based on spatial analysis using two series of SPOT 5 multispectral images and field data, the study showed that the choice of land for shifting cultivation was particularly driven by the slope. Indeed, it was observed that the hillsides having a slope between 25 and 50% are most favorable for this kind of practice because soil erosion risk is still low. These results allow a better understanding of the dynamics of the observed crop rotation and fragmentation processes.

National integration of in-place and remotely sensed forest and landscape pattern inventories to evaluate changes in forest health. Riitters, K. (*U.S. Forest Service, USA; kriitters@fs.fed.us*).

In-place forest inventory measurements are ideal for tracking changes in forest characteristics over time, while remotely sensed information is more suitable for tracking changes in landscapes which contain forestland. As a result, it is necessary to integrate in-place and remotely sensed information in order to analyze how landscape-level land use patterns may be managed to reduce risks of forest health impacts from changing climate. Such integration at national scale has only recently become practical in the United States. To illustrate current practices, this presentation highlights national analyses prepared for the 2015 Update of the U.S. Forest Service, Resource Planning Act (RPA) Assessment. Changes in forest land-cover fragmentation between 2001 and 2006 were evaluated using national land-cover maps. Spatial integration with approximately 150 000 field plot measurements permitted the interpretation of fragmentation in relation to about 125 different forest types, local versus public forest owners, and other plot-based observations.

Morphological analysis of state and trends of landscape pattern. Vogt, P. (*European Commission Joint Research Centre, Italy; peter.vogt@jrc.ec.europa.eu*).

Pattern, connectivity, and fragmentation can be considered as key elements for a comprehensive quantitative analysis of digital landscape images. Morphological spatial pattern analysis (MSPA) provides an intuitive, repeatable, and scale independent description of image pattern structures, i.e., forest patches. Dedicated additional routines describe and quantify the connectivity network and the spatial fragmentation of the forest landscape. A morphology-based change analysis aims to reliably detect coherent forest change areas by excluding uncertainties due to differences in image quality, ortho-correction, and classification accuracy of the input images. These tools and more are available in the free software GuidosToolbox (http://forest.jrc.ec.europa.eu/download/software/guidos). The principal processing steps are explained and illustrated on synthetic and sample data sets. The reliable assessment of forest pattern and its change over time is a prerequisite for a meaningful understanding and interpretation of forest landscape dynamics. As an additional benefit, it permits measuring progress in biodiversity and landscape planning projects. The provision of tools for monitoring and especially quantifying the impact of human activities on forest landscapes should facilitate the design of efficient and assessable forest resource policies.

G-17 Changes in distributional ranges in a changing world

Organizers: Patrick Tobin (U.S. Forest Service) & Christelle Robinet (National Institute for Environmental and Agricultural Science and Research-URZF, France)

Climate-associated range shifts of mountain pine beetle in western Canada. Aukema, B. (*University of Minnesota, USA; bhaukema@umn.edu*), Sambaraju, K. (*Canadian Forest Service, Canada; kishan.sambaraju@nrcan.gc.ca*), Carroll, A. (*University of British Columbia, Canada; allan.carroll@ubc.ca*).

The ongoing epidemic of mountain pine beetle in western Canada covers approximately 18 million ha of mature pine forest. Improved climatic suitability in recent decades has been invoked as a key reason for the insect's recent range expansion over the historical geoclimatic barrier of the Rocky Mountains into jack pine forests of northern Alberta. Continued range expansion through jack pine to the east threatens to encompass pine species native to eastern North America. Here, we utilize spatiotemporal regression approaches to examine range expansion of this insect north and east, as well as to higher elevations, at different population stages. Temperature affects population growth at endemic and epidemic levels, and subtle warming at the landscape level has helped set the stage for rapid range expansion in the past decade. Shifts of increasing mean annual temperatures of only 2 °C created highly suitable habitat directly west of the invasion zone into northwestern Alberta. Similar temperature changes have had disparate effects on elevational boundaries, however. If new host associations, in concert with warming temperatures, allow the expanding populations to exist at epidemic levels, rapid expansion in a short time frame can be expected.