Geophysical Research Abstracts,
Vol. 11, EGU2009-11702, 2009
EGU General Assembly 2009

New generation of airborne lidar for forest canopy sampling

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Biomass in forest cover is an essential actor in climate regulation. It is one of the principal sinks of atmospheric CO2 and a major water cycle regulator. In the coming years, climate change may generate an increase in the frequency of fires in the ecosystems, which are already affected in regions as southern Europe, near the Mediterranean basin. For a better understanding and prevention of the risks created by the propagation and intensity of fires, one requires a detailed characterization of the structural parameters of the forest canopy. Such description is as well essential for a proper management and sustainable use of forest resources and the characterization of the evolution of bio-diversity.

These environmental and socio-economical issues motivate the development of new remote sensing instruments and methodology, particularly active remote sensing by lidar. These tools should be evaluated in order to achieve a global survey of the forest cover by satellite observation. In this framework, a French effort of the Institut Pierre Simon Laplace (LMD, LSCE and LATMOS) and the CEMAGREF has led to the deployment of a new airborne lidar prototype to study the vertical distribution of the forest canopy in the Landes region in France, around the Arcachon basin and Mimizan. The measuring system is the ultra-violet new generation lidar LAUVA (Lidar Aérosol UtraViolet (Aéroporté), Chazette et al., EST 2007), onboard an Ultra-Light Airplane (ULA). This system was developed by the Comissarait pour l'Energie Atomique and the Centre National de Recherches Scientifiques, originally for atmospheric applications, and it was successfully used in West Africa in the framework of the African Monsoon Multidisciplinary Analyses. After a proper adaptation, this compact and polyvalent lidar onboard an ULA is capable of measuring the forest canopy with an unequal malleability, both in terms of adaptability of instrumental parameters (divergence, field of view, sensitivity, pointing angle) and the flight plan (measuring range and field exploration). The use of a ultra-violet wavelength at 355 nm enables eye-safe emission of energetic laser pulses (16 mJ at 20 Hz). Besides the lidar and geo-referencing instruments, the ULA payload has been completed by two cameras operating at three bands (visible, near infrared and ultra-violet) to retrieve the canopy tri-dimensional structure by stereoscopy.

During this experience, the vegetation vertical structure (tree height and crowns, bushes and underbrush) of tree parcels were statistically characterized. A total of three parcels of approximately 500 x 500 m2 composed principally by maritime pines of several ages were sampled following difference experimental configurations. Observations at two flight altitudes at 300 and 500 m were performed, obtaining lidar footprints of 2.4 and 4 m of diameter, respectively. These comparisons will be presented as well as measurements pointing at nadir and 30°.

New experiences are planned for 2009 to sample different types of forest cover (leaf and conifers) and optimize the lidar instrument and the associated methodology, in order to achieve a multifunction tool to measure both the forest canopy and the atmospheric components.