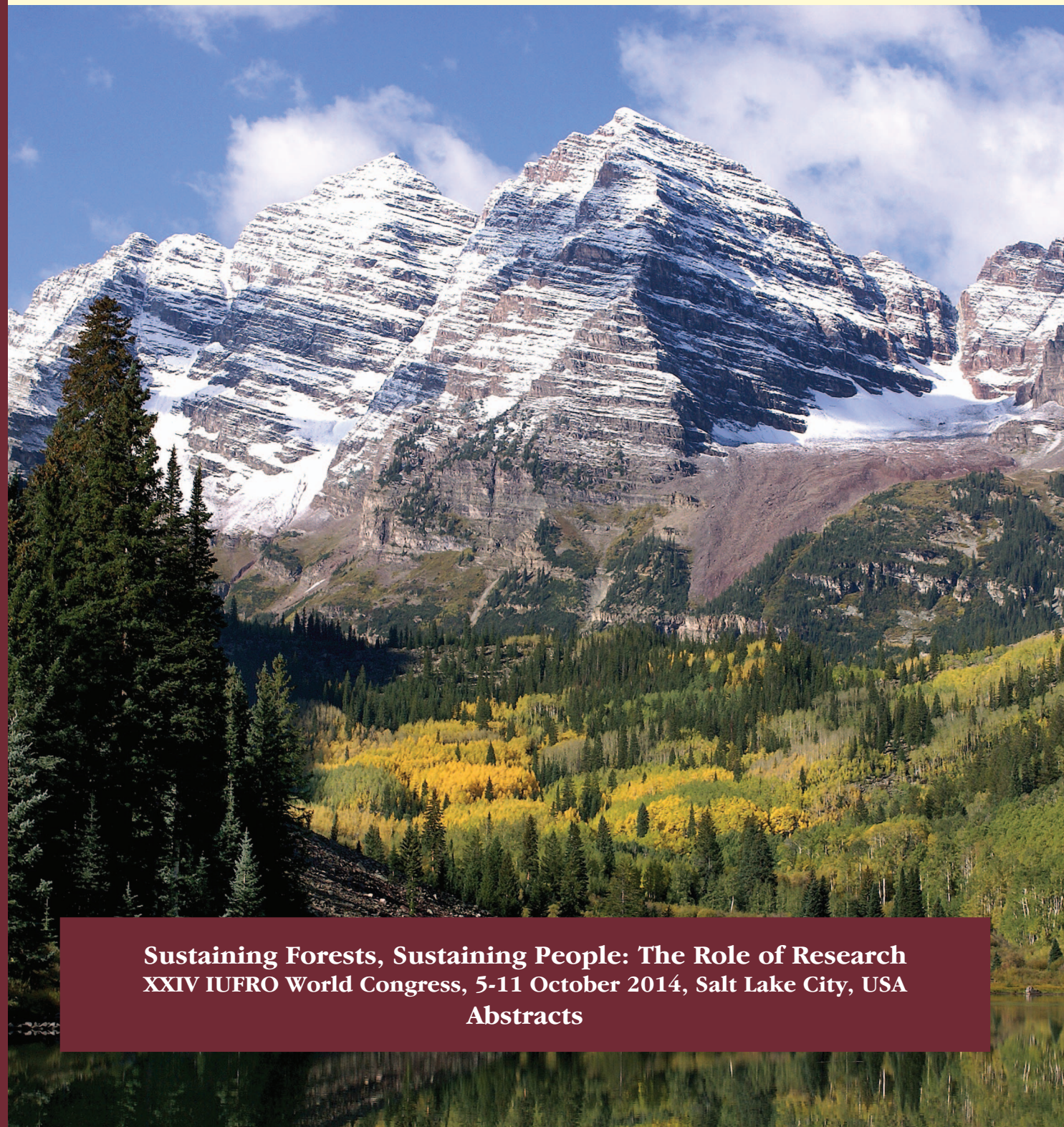


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# The International Forestry Review



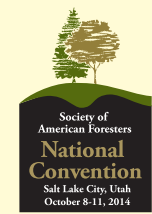
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**Sustaining Forests, Sustaining People: The Role of Research**  
XXIV IUFRO World Congress, 5-11 October 2014, Salt Lake City, USA  
Abstracts

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stocking, TS = species composition, D = average diameter, H = average height, N = number of trees, and H100 = expected height at 100 yr. BEF are defined for seven LB components: stems, branches, foliage, coarse roots, fine roots, understory+undergrowth, and green forest floor based on measurements at approximately 8 000 sample plots. At a country level, the system has been applied for forests of Russia and Ukraine. Results were presented in a spatially explicit form. "Within method" uncertainties depend on quality of inventory data and regional accuracy of BEF and are estimated at 5–7% (CI 0.9). The modeling system can be used in integrated observation systems, e.g., for apportioning remotely sensed forest biomass.

**Assessing the climate change mitigation potential of residue-based bioenergy in Canada's forest sector.** Smyth, C., Rampley, G., Lemprière, T., Kurz, W., Schwab, O. (*Natural Resources Canada, Canada*; *carolyn.smyth@nrcc.gc.ca*; *greg.rampley@nrcc.gc.ca*; *tony.lempriere@nrcc.gc.ca*, *wkurz@nrcc.gc.ca*; *olaf.schwab@nrcc.gc.ca*).

The potential of the forest sector to mitigate greenhouse gas (GHG) emissions is widely recognized, but challenging to quantify at the national scale. This study determined the mitigation potential of harvest residue-based bioenergy derived from the 230 million ha of Canada's managed forest using a dynamic systems approach. The authors took into account forest carbon stocks, C stored in harvested wood products including landfills, expected bioenergy use and facility types, and the likely alternative energy system displaced by the bioenergy to calculate how net GHG emissions vary over time and across the country. Two indicators of mitigation potential are presented: break-even points, the time required for bioenergy system emissions to be equal to those of the alternative energy system; and the cost effectiveness of using bioenergy to reduce GHG emissions. The authors concluded that (1) forest sector mitigation options need to be assessed rigorously from a systems perspective to avoid the development of policies that deliver no net benefits or substantially delayed benefits to the atmosphere, (2) alternative uses of the harvest residues need to be considered in the analysis, and (3) displaced emissions result in mitigation benefits that continue to accumulate, thereby increasing their importance over time.

**Inclusion of carbon cycle and albedo in life cycle assessment for bioenergy.** Soldal, E., Rørstad, P. (*Norwegian University of Life Sciences, Norway*; *ellen.soldal@nmbu.no*; *per.kristian.rorstad@umb.no*).

Bioenergy is promoted as part of the solution for climate change. Comprehensive and thorough methods are needed to evaluate the effect of climate change mitigation measures. Four different methods for accounting of biogenic CO<sub>2</sub> and two methods for inclusion of albedo were addressed in this paper. The methods were applied to two case studies in Norway: bioethanol used for heavy-duty transport and chips-fired district heating. Global warming potential (GWP) was used as a metric. A method was developed which includes carbon emissions and sequestration in the forest. In the boreal forest, which is snow-covered part of the year, albedo is an important climatic driver. As the forest is harvested and re-grown, the albedo changes. Both factors were included in this method and converted to the GWP metric, which can be used for life cycle assessment. Results show that the accounting of biogenic CO<sub>2</sub> is important. When addressing bioenergy from forests as slow growing as the boreal forest, the time horizon for analysis is particularly important. Over the short term (20 years), the albedo has an important cooling effect and the carbon has a warming effect. Over the longest time horizon (500 years) the GWP of the bioenergy (excluding fossil emissions tied to production) approaches zero.

**Comparing methodologies for assessing forest ecosystem services in South Korea.** Song, C., Lee, W., Choi, H., Moonil, K. (*Korea University, Republic of Korea*; *cholhosong@korea.ac.kr*; *leewk@korea.ac.kr*; *sosobot@korea.ac.kr*, *windy7up@naver.com*).

The ecosystem services that forests provide are indispensable for maintaining human activities. Many studies have attempted to evaluate ecosystem services in South Korean forests. However, the validity of early evaluation methodologies needs to be verified. For example, the most used indicator for valuing the water purification function of forests relies on precipitation, so the value of forests fluctuates yearly. To solve this problem, previously widely used methods should be functionally compared with other models that could potentially be adopted for South Korean forests. By comparing results, the authors will be able to suggest more accurate approaches for valuing forest ecosystem services. In addition, mapping ecosystem services is one of the key elements for improving decision-making and implementing ecosystem services, but it has not yet been done. Therefore, the results of the comparisons in this study will be described spatially. Using these comparisons and GIS, the applicability of models to South Korea at the national and local level can be analyzed. Furthermore, links are suggested between economic valuation and the quantification of results of ecosystem functions, and additional direction is provided based on the applicability of models.

**Growth dynamics of silvertop ash regrowth forests in East Gippsland in response to contrasting thinning and fertiliser applications: A twenty-year evaluation.** Soraya, E. (*Australian National University, Australia*; *emma.soraya@anu.edu.au*).

Various silvicultural treatments have been applied for more than two decades in East Gippsland, Australia, to increase silvertop ash's wood productivity and value by shortening sawlog rotation. However, reports published mainly short-term results. This study aimed to update the report of the growth dynamics of silvertop ash regrowth forests in East Gippsland in response to different thinning and fertiliser applications 20 yr after treatment. Data for this study came from experiments established by CSIRO and the Victorian Department of Sustainability and Environment. All stands are almost pure and were naturally regenerated following harvesting and burning. There were 13 treatment combinations between thinning and dosage of N and P fertilizer application. Results showed that 20 yr since treatment, mean basal area (BA) of individual trees in thinned plots was relatively bigger than that of the unthinned plots. However, because there were more trees in unthinned plots than in thinned plots, total BA/ha in unthinned plots was higher. Trees in thinned and fertilised plots showed increased BA/ha. About 13–20% of all retained stems in thinned plots were in the sawlog size class compared to only 4% in unthinned plots.

**Carbon stock and dynamics of pioneer and non-pioneer forest species in an undisturbed forest in the Brazilian Amazon.** Souza, C.R., Azevedo, C., Rossi, L.B. (*EMBRAPA, Brazil*; *cintia.souza@embrapa.br*; *celso.azevedo@embrapa.br*; *marcelo.rossi@embrapa.br*).

Great attention has been given to the effects of global climate change, and it is known that tropical forests play an important role in this issue. However, most research has considered the forest as a whole, with no distinction between the different ecological

groups and their influence on carbon dynamics. This study was conducted in an area of primary forest belonging to EMBRAPA Western Amazon, using data from three forest inventories conducted in 2005, 2007, and 2010, which measured all trees with DBH  $\geq 10$  cm. The aim of this study was to evaluate carbon dynamics in pioneer and non-pioneer forest species in an area of unmanaged forest, between 2005 and 2010, in order to determine the contribution of pioneer species (which have fast growth, and therefore absorb more carbon from the atmosphere) to the carbon balance of the area. Results showed that the pioneer species did not contribute significantly to the volume or to the carbon stock in the forest studied; only 13% of the local carbon stock was related to the pioneer species.

**Contribution of Sapotaceae, Burseraceae, and Lecythidaceae families to carbon sequestration in an unmanaged forest in the Brazilian Amazon.** Souza, C.R., Azevedo, C., Rossi, L.B. (EMBRAPA, Brazil; [cintia.souza@embrapa.br](mailto:cintia.souza@embrapa.br); [celso.azevedo@embrapa.br](mailto:celso.azevedo@embrapa.br); [marcelo.rossi@embrapa.br](mailto:marcelo.rossi@embrapa.br)).

Tropical forests play an important role in the issue of global climate change. This study was conducted in an area of primary forest belonging to EMBRAPA Western Amazon, in Manaus/Amazonas. In this area, most species (approximately 40%) belong to the Lecythidaceae, Sapotaceae, and Burseraceae families. Data were used from three forest inventories that measured all trees with DBH  $\geq 10$  cm in 2005, 2007, and 2010. Considering the large representation of individuals of these families in the study area, the goal of this project was to evaluate the contribution of species in these three families to the carbon balance of the area between 2005 and 2010. The results showed that 31.3% of the timber volume of forest species studied was related to the selected families. The same can be observed in the case of carbon stock: 32% of the total carbon stock of the unmanaged area came from the three families studied. This contribution is significant but was expected, given that these families account for a large proportion of the forest species on the site.

**Contribution of forest management to carbon sequestration in the Brazilian Amazon.** Souza, C.R., Azevedo, C., Rossi, L.B. (EMBRAPA, Brazil; [cintia.souza@embrapa.br](mailto:cintia.souza@embrapa.br); [celso.azevedo@embrapa.br](mailto:celso.azevedo@embrapa.br); [marcelo.rossi@embrapa.br](mailto:marcelo.rossi@embrapa.br)), Santos, J., Higuchi, N. (National Institute of Amazonian Research (INPA), Brazil; [joca@inpa.gov.br](mailto:joca@inpa.gov.br); [niro@inpa.gov.br](mailto:niro@inpa.gov.br)).

The Amazon forest has received increased attention as global discussions consider the role of forests in global climate change. Burning or thinning forests can increase greenhouse gas emissions. On the other hand, carbon can be absorbed from the atmosphere through the growth of the stand. This study analyzed data from three forest inventories to evaluate the contribution of forest management to carbon sequestration, by quantifying carbon stocks and dynamics in a Central Amazon forest. No difference was found between logging treatments after 23 years of application. The control treatment (without logging) showed the highest carbon stocks. The carbon stocks in the forest equaled the existing stocks in 1986, prior to the experimental logging, indicating total recovery of the forest in terms of biomass. Nevertheless, the area may not be ready for harvest again, mainly due to the high number of pioneer species still existing in the managed area. In other words, the forest has recovered in terms of biomass but not in terms of species composition.

**Modeling bark thickness and volume for Norway spruce (*Picea abies* [L.] Karst) in southwest Germany.** Stängle, S., Brüchert, F., Nakou, A., Sauter, U. (Forest Research Institute Baden-Wuerttemberg, Germany; [stefan.staengle@forst.bwl.de](mailto:stefan.staengle@forst.bwl.de); [franka.bruechert@forst.bwl.de](mailto:franka.bruechert@forst.bwl.de); [Aikaterini.Nakou@Forst.bwl.de](mailto:Aikaterini.Nakou@Forst.bwl.de); [udo.sauter@forst.bwl.de](mailto:udo.sauter@forst.bwl.de)).

Precise bark thickness estimates are important to calculate log diameters inside bark from measurements outside bark and to assess the availability of bark biomass. National forest inventories usually are based on diameter measurements outside bark, so wood volume can only be calculated with precise bark thickness estimates that should reflect regional conditions. In Central Europe the wood volume that is relevant for trade agreements between forest owner and wood buyer, can be calculated with modeled inside bark diameters using outside bark measurements. Another use for bark models is in bucking optimisation software for harvesters. Bark has become a valuable fuel, and bark components can be extracted for high-value biomaterial production. Thus, the assessment of available bark biomass is important to estimate the potential of such technologies for generating additional income for the forestry sector. Existing bark models have shown that bark thickness is strongly influenced by site conditions. Changing climate and increased nitrogen deposition, as well as changing silvicultural practices, might therefore have influenced relative bark thickness in the study area. This paper presents the results of modeling bark thickness for Norway spruce based on easy-to-measure tree variables, such as stem height, as well as seasonal changes, regional variation, and genetics.

**Perspectives on integrating multi-phenological and multi-sensory remote sensing data into operational forest management.** Stoffels, J., Hill, J., Mader, S., Sachtleber, T. (Trier University, Germany; [Stoffels@uni-trier.de](mailto:Stoffels@uni-trier.de); [hillj@uni-trier.de](mailto:hillj@uni-trier.de); [mader@uni-trier.de](mailto:mader@uni-trier.de); [sachtl@uni-trier.de](mailto:sachtl@uni-trier.de)), Langshausen, J. (Rhineland-Palatinate State Forest Administration, Germany; [Joachim.Langshausen@wald-rlp.de](mailto:Joachim.Langshausen@wald-rlp.de)).

In the Federal State of Rhineland-Palatinate (Germany), local forest management plans are currently based on databases comprising attributes of various forest stand characteristics. Due to the prohibitive costs of traditional inventory concepts, there is a strong interest in exploring remote sensing as a replacement or complementary strategy. Emphasis is placed on detailed forest cover maps that, beyond their direct information content, can be used as stratification layers for reducing or optimizing field sampling efforts. Remote sensing-based forest inventory methods have to meet high quality requirements because of the high variation in forest communities and forest structure and the fragmentation of the Central European forested area. The aim of this study was to classify the main tree species and development stages of the total forest area in Rhineland-Palatinate (>800 000 ha) using multi-temporal ASTER, SPOT-5, and RapidEye data. To overcome current limitations in achieving acceptable mapping results within topographically heterogeneous and structurally complex forest systems, a spatially adaptive classification approach has been developed. The quality of the derived maps complies with the requirements of the state forest service. Further work will be focused on complete integration into forest management operations. Additionally, a conceptual framework will be presented for using Sentinel-2 data to support an optimized integrated inventory design.