"Local" NIRS PLS Model vs Multi Species Model for Basic Density of Eucalyptus Solid Wood and Influence on Spectral Data by Moisture Content Variability

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Topic: Agriculture and food

Wood basic density (BD) is mainly controlled by the ratio of fibre and the cell-wall thickness which is related to pulp yield and most physical and mechanical properties influencing wood end-using. Accordingly, BD is an important criterion for selection in tree breeding program which requires screening of large number of trees. Associated to non-destructive sampling as cores, NIRS can be used to estimate the BD. In this objective, we built global NIRS models for basic density by using Eucalyptus multispecies datasets, issued of Brazilian wood samples representing different end-using purposes (pulp and paper, timber, charcoal, pole). We tested moisture content (MC) variability during the NIRS measurement to incorporate this parameter in the model, and built plastic NIRS model. We collected wood disks on 8 to 25 year-old Corymbia maculata, E. grandis, E. resinifera, and E. cloeziana trees (10 per species). Diametric bands cut from the disks were divided in 15 x 20 x 20 mm samples. They were theoretically stabilized at 8, 10, 12, 14, 16, and 18% of MC. At each MC, we measured spectra on the same sanded longitudinal face. Spectra were measured under diffuse reflection using integration sphere of a Bruker MPA spectrometer, each spectrum constituted of 32 scans. Spectral analysis was performed within the 9,000–3,500 cm^{-1} range at 8 cm^{-1} resolution. BD, the mass of oven-dry wood per unit of volume of green wood, is expressed in grams per cubic centimeter. Corrected MC was calculated by taking into account the dry weight data. We used Unscrambler software 10.3 (Camo, Norway) for PLS regression of BD at different MC, for all species or separately. Cross-validations with 5 groups of random samples were performed to compare models. Thanks to the low number of group-validation, the RMSECV and RMSEP were very close. Here, the RPD is the ratio between the standard deviation and RMSECV. The BD range was comprised between 0.390 and 0.898 g/cm3. The corrected MC d varied from 9 to 22 %, showing bias with the theoretical MC, according to the species. Global models including the 4 species and MC variability, showed RMSECV = 0.041 g/cm3 and RPD = 3.86. As expected, models developed with spectra of theoretical MC were less efficient than the model developed with spectra selected at corrected MC. For example at 12 % for MC, values of RMSECV and RPD for multispecies model were respectively 0.040 g/cm3 and 3.94 for theoretical MC, and 0.035 and 5.07 for corrected MC. For the BD model of E. grandis, considered separately because of the lowest BD compared to the other species, we obtained RMSECV and RPD of 0.013 g/cm3 and 4.08 including all MC. The values obtained with the other three species were 0.015 g/cm and 3.46. The "local" models were generally more reliable than the global model in term of RMSECV, even if the last showed a higher RPD. It is the same principle and results than for the local model procedure for which the regression is based on the most similar spectral neighbors.

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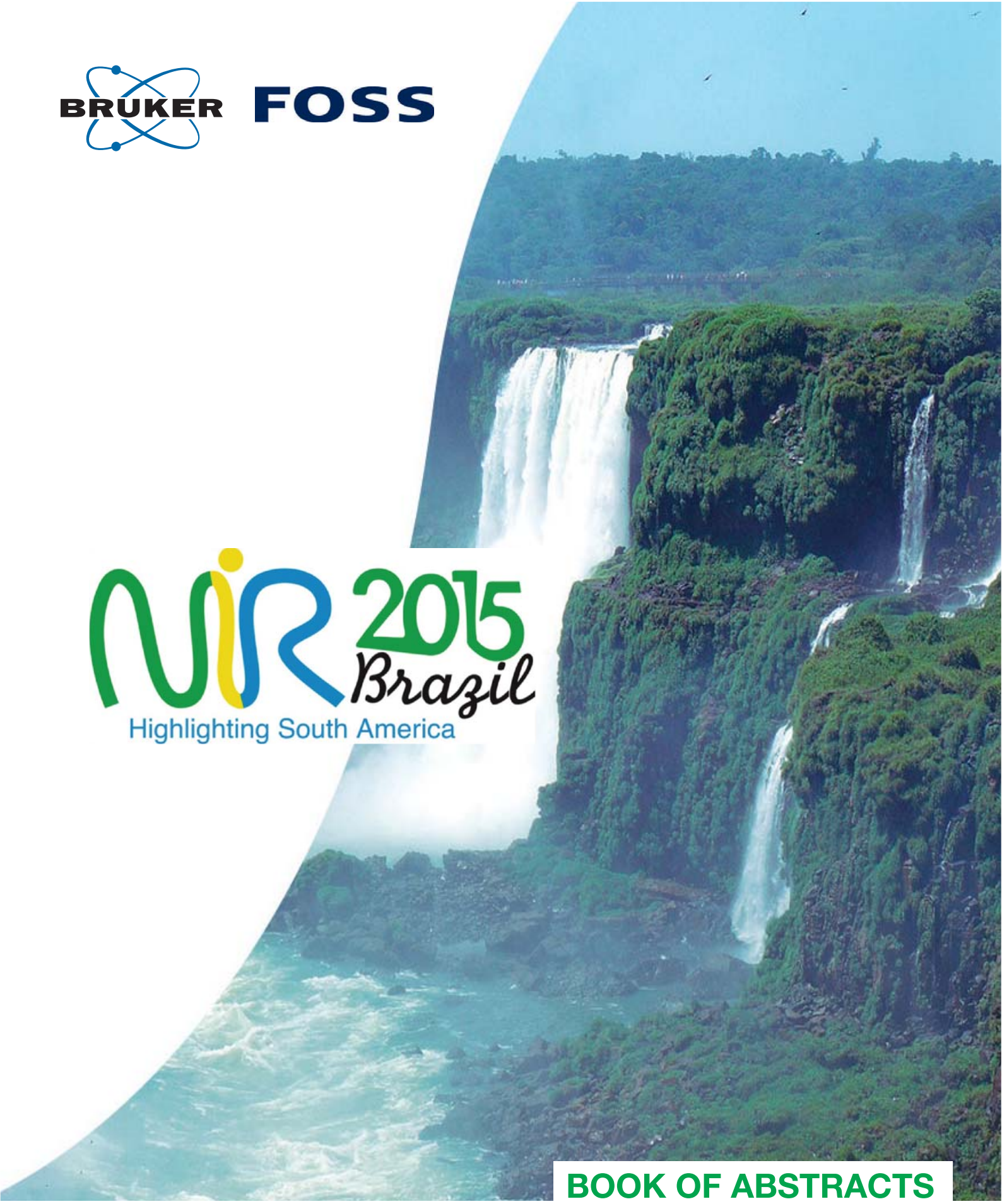

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