Measuring gap size distribution and beyond-shoot clumping at Järvselja RAMI (RAdiation transfer Model Intercomparison) test sites

Jan Pisek[(1)], Tiit Nilson[(1)], Krista Alikas[(1)]

[(1)]Tartu Observatory, Tartu Observatory 61602, Tõravere, Tartumaa, Estonia
email: jan.pisek@utoronto.ca (Jan Pisek)

RAdiation transfer Model Intercomparison (RAMI) is an on-going mechanism to benchmark radiation transfer (RT) models used to simulate the transfer of radiation at or near the Earth's terrestrial surface, i.e. in plant canopies and over soil surfaces [1]. For the next (fourth) phase of intercomparisons, one of the goals is to investigate the potential of RT models to reproduce in situ measurements of transmitted light by various methods such as Tracing Radiation and Architecture of Canopies (TRAC) instrument or hemispherical photography.

Three sample plots in the Järvselja Training and Experimental Forestry District, Estonia, were preliminarily selected for a set of RAMI fourth phase experiments. In July 2009, TRAC measurements were acquired for 175 transects under various angular configurations at the three stands. Our findings include: 1) the gap size distribution and beyond-shoot clumping is very stable across the stands for the solar zenith angle range from 30 to 60 degrees. Beyond this range the changes of beyond-shoot clumping with solar zenith angle might differ from results of previous studies in northern ecosystems [2]; 2) the highest correlation between different ways of quantifying the beyond-shoot clumping was achieved for CC [3] and CLX [4] methods. The results are comparable with results of [5]; however, separate relationships need to be applied for coniferous and deciduous stands; 3) the illustration of the canopy structure effect on differences in measured clumping and gap size distribution with changing height.

The compiled data extend the original parameter dataset [6] to be used in the next phase of RAMI for different benchmark tests and reflectance modeling experiments, and contribute toward systematic validation efforts of radiative transfer models, operational algorithms, and field instruments, as promoted by the Comittee on Earth Observation Satellites (CEOS).

References

[1] J.-L. Widlowski et al., "Third Radiation transfer Model Intercomparison (RAMI) exercise: Documenting progress in canopy reflectance models," *Journal Geophys. Res*., vol. 122, doi: 10.1029/2006JD007821, 2007.

[2] J.M. Chen, "Optically-based methods for measuring seasonal variation in leaf area index of boreal conifer forests," *Agric. For. Meteorol*., vol. 80, pp. 135–163, 1996.

[3] S.G. Leblanc, "Correction to the plant canopy gap-size analysis theory used by the Tracing Radiation and Architecture of Canopies instrument," *Applied Optics*, vol. 41(36), pp. 7667-7670, 2002.

[4] S.G. Leblanc, J.M. Chen, R. Fernandes, D.W. Deering, and A. Conley, "Methodology comparison for canopy structure parameters extraction from digital hemispherical photography in boreal forests," *Agric. For. Meteorol*., vol. 129(3-4), pp. 187-207, 2005.

[5] A. Gonsamo, and P. Pellikka, "The computation of foliage clumping index using hemispherical photography," *Agric. For. Meteorol.*, vol. 149, pp. 1781-1787, 2009.

[6] M. Lang, A. Kuusk, J. Kuusk, A. Eenmae, T. Lull, M. Mottus, M. Rautiainen, and T. Nilson, "Järvselja test site for the next RAdiation transfer Model Intercomparison (RAMI)," *ForestSat Conference 200*7, 4-7 November, Montpellier, France, 2007.