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Plausibility, validation and intercomparison of clumping index maps derived from MISR, MODIS, POLDER, and DSCOVR EPIC Earth observation data over European ICOS Research Infrastructure forest ecosystem sites

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Vegetation foliage clumping significantly alters its radiation environment and therefore affects vegetation growth as well as water and carbon cycles. The clumping index (CI) is useful in ecological and meteorological models because it provides new structural information in addition to the effective LAI retrieved from mono-angle remote sensing and allows accurate separation of sunlit and shaded leaves in the canopy. Global and regional scale CI maps have been generated using different approaches from a diverse set of Earth Observation multi-angle datasets across wide range of scales: Multi-angle Imaging SpectroRadiometer (MISR) data at 275 m resolution, the Bidirectional Reflectance Distribution Function (BRDF) product from Moderate Resolution Imaging Spectroradiometer (MODIS) at 500 m resolution, POLarization and Directionality of the Earth's Reflectances (POLDER) data at ∼6 km resolution, and most recently from Deep Space Climate Observatory Earth Polychromatic Imaging Camera (DSCOVR EPIC) at 10 km resolution. In this presentation, we characterize and intercompare five available CI products over 20+ forest ecosystem sites, organized within the European Integrated Carbon Observation System (ICOS) research infrastructure, representing diverse forests with different canopy structures. The intercomparison procedure was defined to comply with the best practices proposed by CEOS (Committee on Earth Observation Satellites) Land Product Validation (LPV) sub-group. It corresponds to Stage 1 validation as defined by the CEOS. We illustrate that the vertical distribution of foliage and especially the effect of understory needs to be taken into account while validating foliage clumping products from Earth Observation data with values measured in the field. Satellite measurements respond to the structural effects near the top of canopies, while ground measurements may be biased by the lower vegetation layers. Additionally, caution should be taken regarding the misclassification in land cover maps as their errors can be propagated into the foliage clumping maps. Our results indicate that select datasets can provide good quality clumping index estimates at pertinent scales for modeling local carbon and energy fluxes.