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Interannual and seasonal variation of momentum exchange at a midlatitude mixed deciduous forest

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Seasonal variation of leaf state affects momentum exchange between forest and the atmosphere. Nearly continuous 10 Hz sampling of relevant variables yielded half-hourly estimates of turbulent fluxes above and below the canopy of a predominantly red oak forest at Harvard Forest (42.53° N, 72.19° W, north central Massachusetts USA) during 2002-2011 period. These fluxes are used to assess seasonal and daily variation of momentum flux above forest, within and below the forest crown.

The impact of leaf emergence and leaf fall on momentum flux transfer within the forest can be traced by comparing normalised flux values within and below the crown. Seasonal variation of mean midday momentum flux above and within the canopy illustrates how leaf emergence reduces turbulent transfer. Nearly constant values of momentum flux within the crown during fully leafed season illustrates that momentum flux is severely limited.

Daily variation of momentum flux just above the canopy exhibits highest values in March and April when trees are leafless and the mean wind speed is near its annual peak. During this leafless period with increasing solar elevation, buoyant plumes rise that in air space between the surface and the measurement height above forest, promotes shear stress on stems and branches (Staebler and Fitzjarrald, 2005).