Influences of in-forest canopy chemical processing on regional air quality

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In regions such as the eastern United States, forests emit numerous reactive hydrocarbons whose fluxes often exceed the anthropogenic emissions. Because of tall nature of most forests and reduced atmospheric turbulence within the canopy, in-canopy air parcel residence times can at times exceed the lifetime of certain hydrocarbons. Such conditions could promote substantial chemical processing within canopies. To estimate oxidant and aerosol formation from biogenic hydrocarbons, forest emissions are required in regional air quality models. For this presentation, two modeling experiments were done using one-dimensional and regional air quality models to investigate the influences of in-canopy chemical processing of biogenic hydrocarbons on air quality. The one-dimensional model estimated the amount of chemical processing that took place in selected forests where air chemistry measurements were made. One-dimension model outputs were included in the regional air quality model to estimate oxidant and secondary aerosol formation. In one experiment, hydrocarbon emissions were reduced based on the amount of chemical processing estimated to occur within canopies. In the second experiment, all estimated hydrocarbons emitted by forests were included in the regional air quality model. Results indicated that in-canopy chemical processing can only reduce oxidant formation by less than 10 percent. In contrast, in-canopy chemical processing can reduce secondary organic aerosol formation by more than 100 percent. Differences in the results can be explained in terms of the types of hydrocarbons effectively reacted within canopies. Terpenes are the most effective precursors to form secondary aerosols and can rapidly undergo reactions within canopies. Therefore, estimates of secondary organic aerosol formation are sensitive to the amounts of terpenes removed within canopies before they enter the regional domain considered in the air quality model. During the presentation we will explain the implications of the results obtained as part of the numerical modeling studies.