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Chemical Characterization of Highly Functionalized Organonitrates Contributing to Night-time Organic Aerosol Mass Loadings and Particle Growth

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Reactions of volatile organic compounds (VOC) with NO_3 radicals, and of reactive intermediates of oxidized VOC with NO_x, can lead to the formation of highly functionalized organonitrates (ON). We present quantitative and chemical information on ON contributing to high night-time organic aerosol (OA) mass concentrations measured during July–August 2016 in a rural area in southwest Germany. A Filter Inlet for Gases and AEROsols coupled to a high-resolution time-of-flight chemical ionization mass spectrometer (FIGAERO-HR-ToF-CIMS) was used to analyze the molecular composition of ON in both the gas and particle phase. We find larger contributions of ON to OA mass during the night. Identified ON are highly functionalized, with four to twelve oxygen atoms. The diel patterns of ON compounds with five, seven, ten, or fifteen carbon atoms per molecule vary, indicating a corresponding behavior of their potential precursor VOC. The temporal behavior of ON after sunset correlates with that of the number concentration of ultrafine particles, indicating a potential role of ON in night-time new particle formation (NPF) regularly observed at this location. We estimate an ON contribution of 18–25% to the mass increase of newly formed particles after sunset. Our study provides insights into the chemical composition of highly functionalized ON in the rural atmosphere, and the role of anthropogenic emissions for night-time SOA formation in an area where biogenic VOC emissions dominate.