Formation of organic alkyl nitrates (RONO₂) during oxidation of volatile organic compounds (VOC) significantly impacts the atmospheric distribution and lifetime of nitrogen oxide radicals (NOₓ), key precursors for tropospheric ozone production. RONO₂ formed from biogenic VOC precursors tend to have short atmospheric lifetimes against deposition and aerosol uptake, and can therefore serve as an important sink for NOₓ, particularly in regions where NOₓ emissions are already low. Meanwhile, short-chain RONO₂ derived from anthropogenic VOCs (e.g., methane, ethane, and propane) have lifetimes of weeks to months and are therefore potentially important reservoir species that could serve to export NOₓ from major source regions to the NOₓ-limited remote troposphere. However, the chemistry, budgets, and NOₓ impacts of both anthropogenic- and biogenic-derived RONO₂ remain uncertain. In this talk, I will describe implementation of a new RONO₂ chemical scheme in the GEOS-Chem global chemical transport model and its evaluation against a range of recent and historic aircraft campaigns across the world. I will use the new simulation combined with newly available measurements to identify the precursors responsible for observed RONO₂. Finally, I will use the model to quantify the impacts of RONO₂ formation (and resultant NOₓ removal, export, and/or release) on the NOₓ budget in diverse environments.