Ammonia measurements from space with the Cross-track Infrared Sounder (CrIS): characteristics and applications

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Satellite data are helping to fill monitoring gaps in order to better inform decision makers and assess the impact of ammonia-related policies. Presented is an overview demonstrating the current capabilities of the ammonia (NH₃) data product derived from the CrIS satellite instrument for monitoring, air quality forecast model evaluation, dry deposition estimates, and emissions estimates. This includes examples of daily, seasonal, and annual observations of CrIS ammonia that demonstrate the spatiotemporal variability of ammonia globally. These results further demonstrate the ability of CrIS to observe regional changes in ammonia concentrations, such as spring maximum values over agricultural regions from the fertilizing of crops. Also shown is the importance contribution of wildfires, especially in regions where there is little or no agriculture sources, such as the northern latitudes in North America during summer. Initial comparisons of CrIS NH₃ satellite observations with air quality model simulations show that while there is general agreement on the spatial distribution of the anthropogenic hotspots, some areas are markedly different. Some key findings are that dry deposition estimates of NH₃ and NO₂ from CrIS and the Ozone Monitoring Instrument (OMI), respectively, indicate that the NH₃ dominates over most regions across North America. Their 2013 annual ratio shows NH₃ accounting for ~82% and ~55 % of the combined reactive nitrogen dry deposition from these two species over Canada and the U.S. Furthermore, we show the use of CrIS satellite observations to estimate annual and seasonal emissions over Concentrated Animal Feeding Operations (CAFOs). These results are used to evaluate the seasonal and temporal emissions profiles used in bottom-up inventories over an agriculture hotspot, which are often underreported.