

# DAIRYBUSINESS

## Researchers differ on impact of ammonia sources in California's South Coast Air Basin

**By Ron Goble**

Research and related publicity suggesting both automobiles and dairy cows contribute heavily to southern California's ammonia air emissions has drawn skepticism from dairy researchers and industry leaders in the West.

The study, "Ammonia sources in the California South Coast Air Basin and their impact on ammonium nitrate formation," was published as a Geophysical Research Letter, a geosciences journal by the American Geophysical Union (AGU). Visit

[www.agu.org/pubs/crossref/2012/2012GL051197.shtml](http://www.agu.org/pubs/crossref/2012/2012GL051197.shtml). The report was summarized in a Washington Post article and distributed by Reuters News Service.

John Nowak, lead author on the study, is principal investigator with the Cooperative Institute for Research in Environmental Sciences, University of Colorado-Boulder, and Chemical Sciences Division, Earth System Research Laboratory, National Oceanic and Atmospheric Administration (NOAA), both at Boulder, Colo. In May and June 2010, a research team used an aircraft to quantify ammonia (NH<sub>3</sub>) emissions from automobiles and dairy facilities in the California South Coast Air Basin (SoCAB) and assess their impact on particulate ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>) formation.

"To form ammonium nitrate aerosol, you need both nitric acid and ammonia," Nowak explained. "Nitric acid comes from the automobiles. Automobiles with the three-way catalytic converters can release ammonia. And you also have ammonia source in the region from agricultural activity. So we were looking at which source contributes more ammonia to the equation."

The airborne measurements were used to estimate automobile NH<sub>3</sub> emissions (62 metric tons/day, plus or minus 24 metric tons/day), and dairy facility NH<sub>3</sub> emissions (33 to 176 metric tons/day, plus or minus 16-88 metric tons/day).

"On the airplane we measured gas phase ammonia and gas phase nitric acid, particle ammonium and particle nitrates," he continued. "In the atmosphere NO<sub>3</sub> emitted from automobiles is transformed into nitric acid in the gas phase, which can react with ammonia in the gas phase and condense to form ammonium nitrate particles. That's not smog. It's particulates as monitored by the U.S. Environmental Protection Agency (EPA), which is part of the PM (Particulate Matter) in the basin."

According to the study report, emission inventories agree with the observed automobile NH<sub>3</sub>:CO emission ratio, but substantially underpredict dairy facility NH<sub>3</sub> emissions. Conditions observed downwind of the dairy facilities were always thermodynamically favorable for NH<sub>4</sub>NO<sub>3</sub> formation due to high NH<sub>3</sub> mixing ratios from the concentrated sources. Although automobile emissions generated lower NH<sub>3</sub> mixing ratios, they also can thermodynamically favor NH<sub>4</sub>NO<sub>3</sub> formation.

"The dairy farms are more geographically concentrated," Nowak said. "The aircraft measured ammonia mixing ratios immediately upwind (i.e. downwind from downtown Los Angeles) and then downwind from those dairies. The downwind mixing ratios were much higher, and this difference allowed the dairy emissions to be estimated."

"The ammonia emissions we determine are based on what was measured in the air, not modeled estimates based on the number of cattle and an emission per cow per day estimate," Nowak explained.

As a result of the study, Nowak said an aerosol control strategy addressing the dairy NH<sub>3</sub> source would have the larger impact on reducing SoCAB NH<sub>4</sub>NO<sub>3</sub> formation.

Dairy leaders disputed the conclusion, and how it was reported.

**Ying Wang, with the Innovation Center for U.S. Dairy**, said a previous study, involving EPA, found the average ammonia emissions per cow per day are about 60.9 grams.

“When you take 60.9 grams and multiply them by 298,000 cows in the eastern basin (as cited by the University of Colorado and NOAA researchers), you get 18.15 million grams per day, which is about 18 metric tons. Yet, the University of Colorado/NOAA study blamed cows for 33 to 176 metric tons per day. Look even further; there aren’t that many cows – at least not dairy cows. The Milk Producers Council in Ontario, Calif., says there are about 100,000 mature dairy cows ‘milking and dry’ in the area. The area once had a fairly sizeable dairy cow population, but that is no longer the case. Beef cattle have never been a factor. So, suddenly, if you only have 100,000 rather than 300,000 cows from the report, you only have one-third of the animals the researchers based their study on. That puts ammonia emissions at 6 metric tons, rather than 33 to 176 metric tons.”

**Frank Mitloehner**

**Frank Mitloehner, professor and air quality specialist at the University of California, Davis**, pointed out “the number of cows used in the study was about three times more than what actually exist in this region. Secondly, they haven’t measured anything directly from cows. They’ve measured small particles from an area using an aircraft while flying over Southern California. So they’ve taken cow numbers that they thought were accurate – and they were not – and they have modelled how much ammonia would come from these 300,000 cows. Then they have basically modeled how the ammonia from 300,000 cows would combine with the NO<sub>3</sub> from all the cars.



“Finally, the media took the study out of context and made it into a smog issue, when indeed fine particles were measured,” he continued. “The combination of incorrect animal inventories and inflated ammonia estimates per cow with the inappropriate framing by the media caused some confusion that could have been easily avoided.”

**Michael Marsh, executive director, Western United Dairymen**, said he “recalled prevailing winds in the LA basin are west to east. Freeways, most of the people and the cars are in the west. The dairies are in the east. CDFA’s 2010 stats show about 134,000 cows in Southern California. That includes San Diego and Imperial Counties, too. Dairy numbers have shrunk since 2010. (I’m not sure how many feedlots or cow/calf operators are in LA. I can’t see that pencilling out well. The story notes almost 300,000 cows in the basin. It seems like an attempt to make ammonia an issue it isn’t.”

**Rob Vandenheovel**

**Rob Vandenheovel, general manager, Milk Producers Council**, in Southern California, said the “number of cows in LA basin is significantly less than cited in the article. We have about 100,000 milking/dry cows left in the Chino/Ontario/San Jacinto regions, with another 80,000 young stock. Chino/Ontario sits about 40 miles east of Los Angeles, east of most of the L.A. suburban population. With the prevailing winds in the region blowing toward the east, how exactly are the dairies able to impact the air quality over LA?”



“Looking at the map of the study, it appears that they don’t even factor in the San Jacinto dairies, just the area surrounding the Chino/Ontario dairies,” he continued. “That’s home to about 70,000 milk/dry cows and 60,000 young stock (a far cry from 298,000 head).

It's also worth noting that the dairies sit surrounded by suburban populations of people, not to mention major freeways (I-15, I-10, 71 freeway, 91 freeway, 60 freeway). So not only is the wind blowing from Los Angeles toward the dairies, but the suburban population is also driving to their homes in Chino/Ontario/Corona/Norco/Eastvale/etc. It would seem to be pretty difficult to differentiate all these variables by simply flying over the area."

**Robert Hagevoort, Extension dairy specialist, New Mexico State University, Ag Science Center at Clovis, N.M.**, once lived in the Southern California basin and is very familiar with the smog issues in that region.

"Anybody that has ever lived in the IE (Inland Empire), which is anything east of LA, knows that prevalent winds in the LA basin are westerly, and the smog from LA moves into the IE and clouds the sky," he said. "Much less today as maybe 10-20 years ago, but nevertheless. The only days this is reversed is when Santa Ana winds blow from east to west and clear out the basin. If you happen to be fishing that day at Catalina Island – you're in the smog. To suggest that cows are a major contributor is just as fine a piece of research as the (United Nation's) Food and Agriculture Organization's infamous "Long Shadow" report, (which implicated livestock as a primary source of global greenhouse gas emissions).

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