



The Ammonia CASTNET CSN Study – Overview and Test Phase Results

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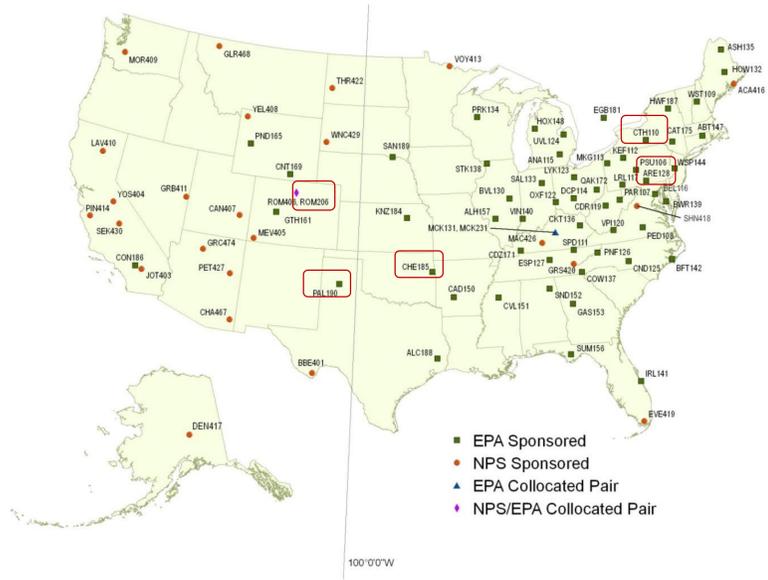
The primary purpose of the Ammonia CASTNET CSN Study (ACCS) is to conduct an inter-comparison study of sulfur and nitrogen containing compounds at five CASTNET sites for one year. Currently, the traditional open face CASTNET 3-stage filter pack captures only particulate ammonium (NH_4^+) and nitrate (NO_3^-), which only represents a portion of the total nitrogen dry deposition budget. Therefore, it is desirable to explore possibilities, including using a modified CASTNET-style filter pack, for collecting measurements of other total nitrogen components.

Using duplicate annular denuder systems (ADS) with a $2.5 \mu\text{m}$ size cut as the reference method, the goals of the ACCS are to:

1. Assess the precision, accuracy, and bias of passive ammonia samplers,
2. Test a traditional CASTNET filter pack with an additional fourth stage filter impregnated with phosphorus acid (H_3PO_3) to collect atmospheric NH_3 and any volatilized NH_4^+ (open face - $\sim 10 \mu\text{m}$ effective size cut),
3. Characterize Met One SuperSASS mini-parallel plate denuders for NH_3 collection ($2.5 \mu\text{m}$ size cut), and
4. Compare Met One SuperSASS ion module species collection with traditional CASTNET 3-stage filter pack ($2.5 \mu\text{m}$ size cut for SuperSASS).

Site selection was based on proximity to predicted or known ammonia emissions sources, site operator capability, and collocation with the National Atmospheric Deposition Program (NADP) Ammonia Monitoring Network (AMoN). Sites selected and measurements scheduled to be performed:

| | |
|------------|---|
| CTH110, NY | ⇒ AMoN passive sampler |
| PAL190, TX | ⇒ single denuder ("short") NH_x only ADS |
| | ⇒ 4-stage CASTNET filter pack |
| ARE128, PA | ⇒ AMoN passive sampler |
| CHE185, OK | ⇒ two denuder ("long") ADS |
| | ⇒ 4-stage CASTNET filter pack |
| ROM206, CO | ⇒ SuperSASS mini-parallel plate denuder for NH_x |
| | ⇒ SuperSASS CSN ion module |



Test Study Details

Prior to the start of field sampling, three test studies were conducted at the Gainesville, FL MACTEC facility. All sample types that would be analyzed by the MACTEC laboratory were included in the tests:

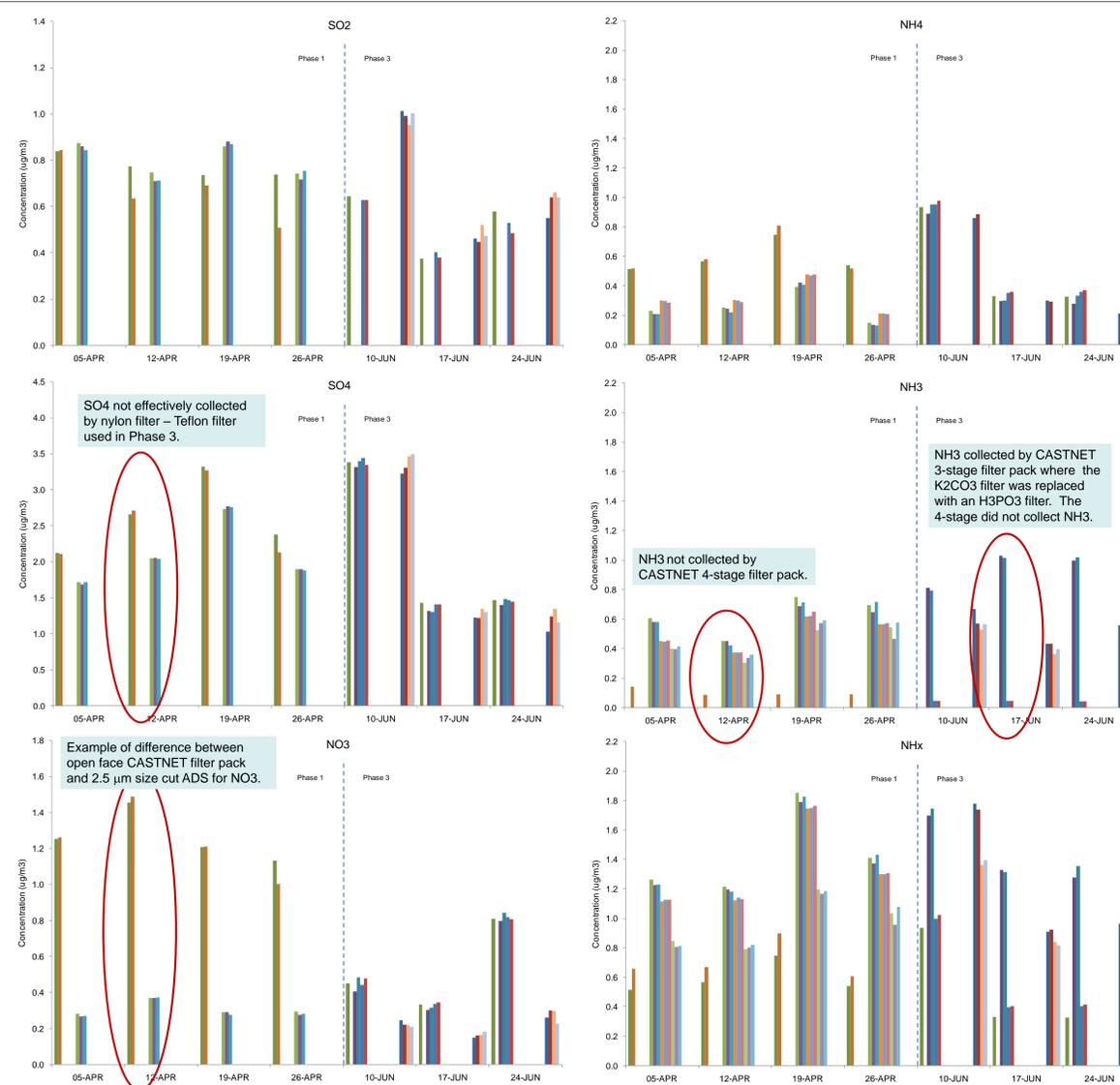
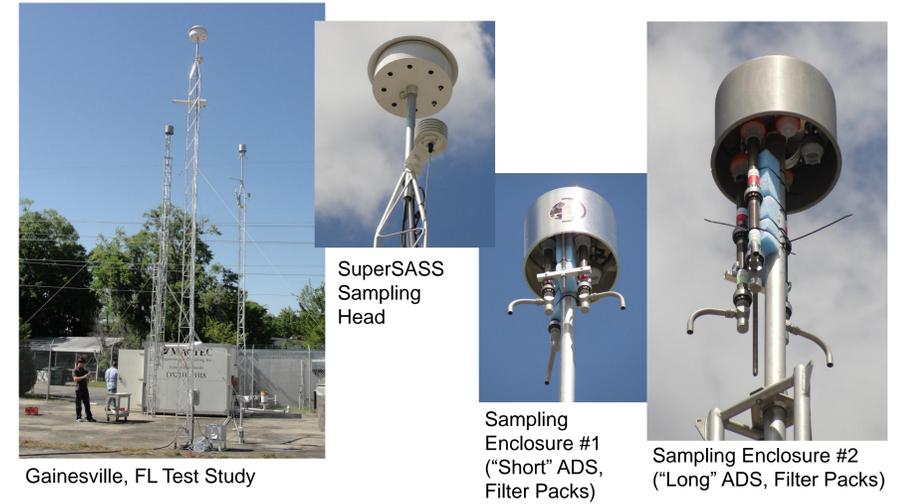
- 4-stage CASTNET filter pack
- "Short" ADS
- "Long" ADS
- SuperSASS MPPD

Two problems were encountered during Phase 1 of the testing. First, the initial ADS design featured a nylon filter for the collection of particles, which proved to be inadequate as there was evidence of particle breakthrough. For Phase 3, a Teflon filter was added to the ADS for the collection of particles, and results improved.

The second problem involved the 4-stage filter pack. Expected results were not obtained. No NH_3 was collected by the H_3PO_3 impregnated filter. It appears

that in high humidity environments use of a 4-stage filter pack is not viable. The NH_3 may react with SO_2 collected by a hydrated potassium-carbonate (K_2CO_3) impregnated filter prior to encountering the H_3PO_3 impregnated filter. Additional testing of the 4-stage filter packs was performed in Phase 2 of the study, but those results are not included in this poster because no additional information was obtained. In Phase 3, a 3-stage filter pack with the K_2CO_3 filter replaced with a H_3PO_3 filter was successfully used to collect NH_3 . Also, a 4-stage filter pack using citric acid instead of H_3PO_3 was deployed, but the same results were obtained (no NH_3 was collected).

Because of this issue, 4-stage filter packs will not be included during the first several ACCS sampling periods. Additional testing of other configurations will be performed, and it is hoped that a modified CASTNET filter pack will join the study by its midpoint.



| Legend | Phase | Comment |
|-----------------------|---------|--|
| 3-stage | 1 and 3 | Standard CASTNET filter pack |
| 4-stage (nyl) | 1 | 4-stage CASTNET filter pack - nylon filter extracted using DWI, phosphorus acid filter in 4th spot |
| 3-Stage (TNP a) 1 | 3 | 3-stage CASTNET filter pack - cellulose filter replaced with phosphorus acid filter in 3rd spot |
| 3-Stage (TNP a) 2 | 3 | 3-stage CASTNET filter pack - cellulose filter replaced with phosphorus acid filter in 3rd spot |
| 4-stage 1 | 3 | 4-stage CASTNET filter pack - nylon filter extracted using standard extraction fluid, citric acid filter in 4th spot |
| 4-stage 2 | 3 | 4-stage CASTNET filter pack - nylon filter extracted using standard extraction fluid, citric acid filter in 4th spot |
| ADS-NYL LONG1 | 1 | 2-denuder ADS, nylon filter used for particle collection |
| ADS-NYL LONG2 | 1 | 2-denuder ADS, nylon filter used for particle collection |
| ADS-NYL LONG3 | 1 | 2-denuder ADS, nylon filter used for particle collection |
| ADS-NYL SHORT1 | 1 | 1-denuder ADS, NH_3 and NH_4 only, nylon filter used for particle collection |
| ADS-NYL SHORT2 | 1 | 1-denuder ADS, NH_3 and NH_4 only, nylon filter used for particle collection |
| ADS-NYL SHORT3 | 1 | 1-denuder ADS, NH_3 and NH_4 only, nylon filter used for particle collection |
| SASS 1 | 1 | SASS MPPD with phosphorus acid backup filter for NH_x |
| SASS 2 | 1 | SASS MPPD with phosphorus acid backup filter for NH_x |
| SASS 3 | 1 | SASS MPPD with phosphorus acid backup filter for NH_x |
| ADS-TEF LONG1 | 3 | 2-denuder ADS, Teflon filter used for particle collection |
| ADS-TEF LONG2 | 3 | 2-denuder ADS, Teflon filter used for particle collection |
| ADS-NYL LONG1 CNETSTA | 3 | 2-denuder ADS, nylon filter used for particle collection, nylon filter extracted using standard extraction fluid |
| ADS-NYL LONG2 CNETSTA | 3 | 2-denuder ADS, nylon filter used for particle collection, nylon filter extracted using standard extraction fluid |

Study Schedule

ACCS field sampling began at all five sites on August 31. To match the 2-week exposure time of the AMoN passive sampler (which will run throughout the study on the standard AMoN schedule), ACCS samples will run for two sequential 1-week sampling periods at every six weeks for one year. Standard 3-stage CASTNET filter packs will continue to run each week throughout the study.

Before the end of the year, MACTEC will test other configurations for the CASTNET 4-stage filter pack and make a decision along with other partners about the deployment of a modified filter pack for ACCS. Possibilities include:

- Using a different arrangement of impregnated filters (switch the K_2CO_3 and H_3PO_3 filters)
- Use a different acid for impregnating the filter for NH_x collection
- Deploy a 3-stage filter pack with the K_2CO_3 filter removed and replaced with an H_3PO_3 filter (tested during Phase 3)

Acknowledgements

The ACCS is a collaborative effort among multiple groups at EPA:

- Office of Air and Radiation (OAR) / Clean Air Markets Division (CAMD)
- Office of Research and Development (ORD) / National Exposure Research Laboratory (NERL)
- Office of Air Quality Planning and Standards (OAQPS) / Air Quality Assessment Division (AQAD)
- Labs participating: MACTEC, CAL, and RTI