Environmental Health: Air Quality Monitoring on ISS

Paul Mudgett, SK4/NASA-JSC

Managing Air Quality in Spacecraft and Submarines TIM

NASA-JSC

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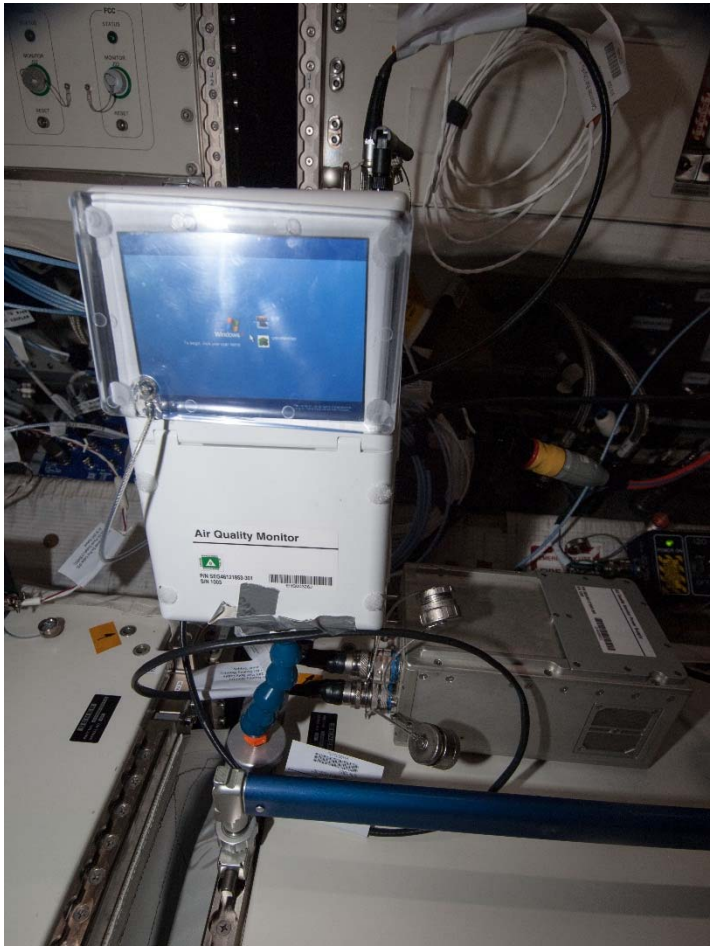
Archival Sampling

Routine Real-time Monitoring



Non-Routine Gas Monitoring on ISS

Carbon Dioxide Monitor

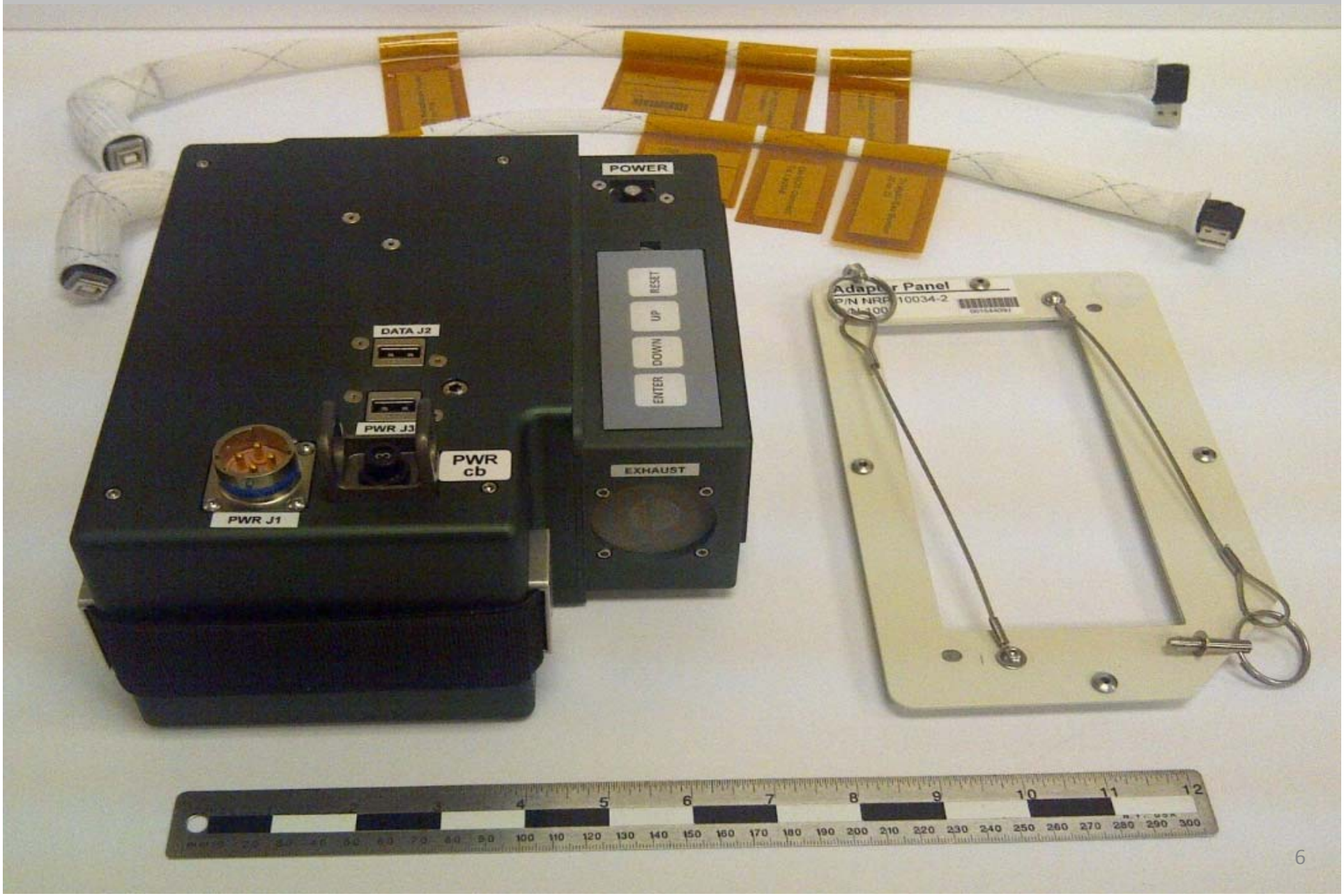
Combustion Product Monitor

Unexpected Events affecting Air Quality on ISS

- **Crew sickened by stale air/CO2 in FGB -- poor ventilation**
- **Freon 218 leaks from SM air conditioner**
- **USOS METOX canister regeneration release**
- **Formaldehyde drifted above limit (debris restricted ventilation)**
- **Smoldering: Elektron oxygen generator & galley equipment**
- **Odor from Service Module illumination light panel**
- **Transient chemical odors**
- **HTV-1 odors caused crew headaches**

• Crew sickened in FGB during a period of poor ventilation, probably from rebreathe of exhaled air/CO2 (Flight 2A.1)
• Freon 218 (perfluoropropane) leaks from Service Module (SM) air conditioner (Apr 01 to Mar 02)
• Extremely high methanol in a sample of FGB air; exact source never determined (Aug 01)
• EVA metal oxide (METOX) canister regeneration inside USOS caused noxious air with many pollutants (Feb 02)
• Formaldehyde periodically exceeded long-term limits, when debris restricted intermodule ventilation (mid 02 to Feb 03)
• Strong solvent-like odor from the Elektron oxygen generator after repair work (Mar 04)
• Potential acid preservative aerosol escape from SM urinal problem (Exp 10/Feb 05)
• Electrical odor traced to lamp (Exp 10/Mar 05)
• "Triol" coolant leak from fittings in SM (Exp 14/Aug 06). Triol is a water solution of glycerine with certain additives.
• Elektron oxygen generator overheating incident; CSA-CP detected CO up to 7 ppm, and HCL, HCN above 1 ppm; smoke & solvent smell reported (18 SEP 06); polymeric bushing on a bracket was smoldering.
• Freon 218 leak of about 600 grams occurred during servicing of SM air conditioner (30 APR 08), this event was detected & followed by ESA's FTIR payload "ANITA", 2 other minor leaks were detected in same time period.
• Crew reported smoke emitting from SM galley water tap area and an odor (10 Oct 08); equipment housing was hot; CSA-CP deployed; 5 ppm CO; acid gases all zero. ORU replaced.
• Transient odor in Japanese Experiment Module (JEM) occurred 3 Dec 08, described as acetone or formaldehyde smell; CSA-CP found no combustion products; Grab sample collected; odor completely dissipated by the next day. Identity/source not found.
• Crew complained of odor from US Lab urine processor; Gas-liquid separator evidently does not have odor filter (15 Dec 08).
• 9-12 Feb 09 Artificial CO2 event: Lab CO2 removal assembly (CDRA) was turned off to monitor capacity of SM Vozdukh to control CO2 in preparation for 6 crew. CO2 rose to 6 mmHg before test was terminated and CDRA reactivated. Flight rule limit is 5.3 mmHg. CO2 was measured by both MCA and CDM.
• 25 Feb 09 GMT 56/06:17 both the Node 2 Accumulator Vent Valve and Nitrogen Introduction Valve opened uncommanded. An estimated 0.276 kg (0.6 lbm) of N2 was released into cabin. Quantity is insignificant.
• Start of 6 crew era on ISS 29 May 09 GMT 149, an expected event that increases VOC load on air revitalization systems.
• 10 Jun 09 2:30AM Houston time, RS EVA hatch cover insulation brought inside, disintegrated upon repress of PKO airlock, cloud of debris. Crew donned masks, cleaned up using vacuum cleaner/ventilation. NASA materials experts conclude an aramid fabric (Nomex-like, not fiberglass) disintegrated due to the vacuum UV light.
• 10 Jul 09 GMT 191/22:11 CDR called down to report smelling a burning odor and smoke coming out of the SM galley, which was then powered off. Over a 1.5 hour period the crew took CSA-CP readings with 2 units and reported the highest CO reading in the cabin near the galley over the sampling time was 4-5 ppm CO. The crew took Draeger tube readings and reported a reading of 30 ppm when a tube was placed in the galley fireport and a reading of 0 in the open atmosphere.
• 6 Aug 09 GMT 218/20:01 The crew reported a minor leak of Freon 218 during SM air conditioner work.
• HTV-1 hatch open 18 SEP 09 CSA-CP readings taken at first entry: CO at 5 and 7 ppm with one pocket of 10 ppm that dispersed. No acid gases detected.
• HTV-1 (docked to ISS from 18 SEP to 31 Oct 09) evidently had a perceptible odor inside that gave certain crewmember(s headache(s). Foam suspected? Investigation is on going..

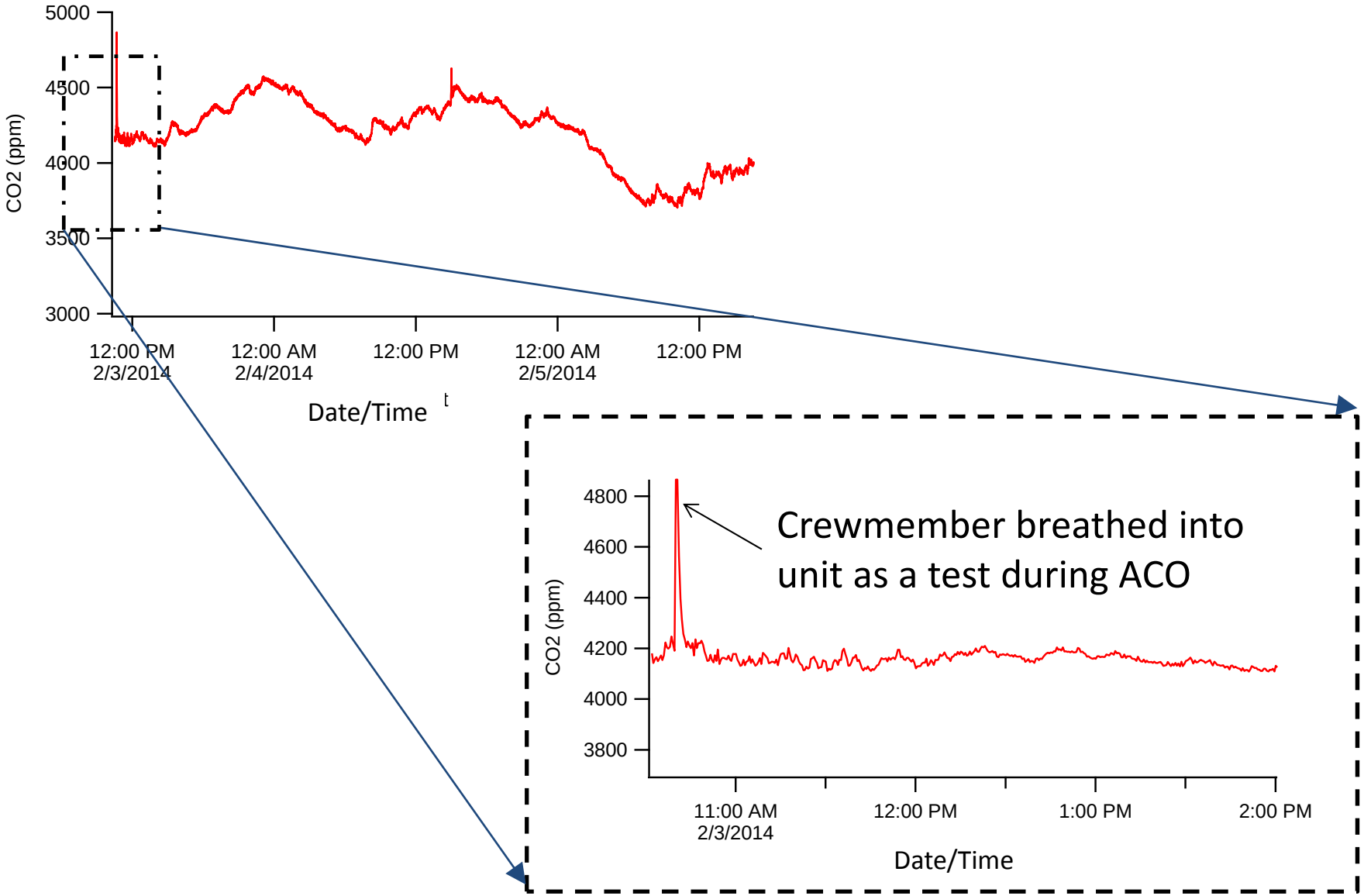
Multi Gas Monitor Technology Demonstration



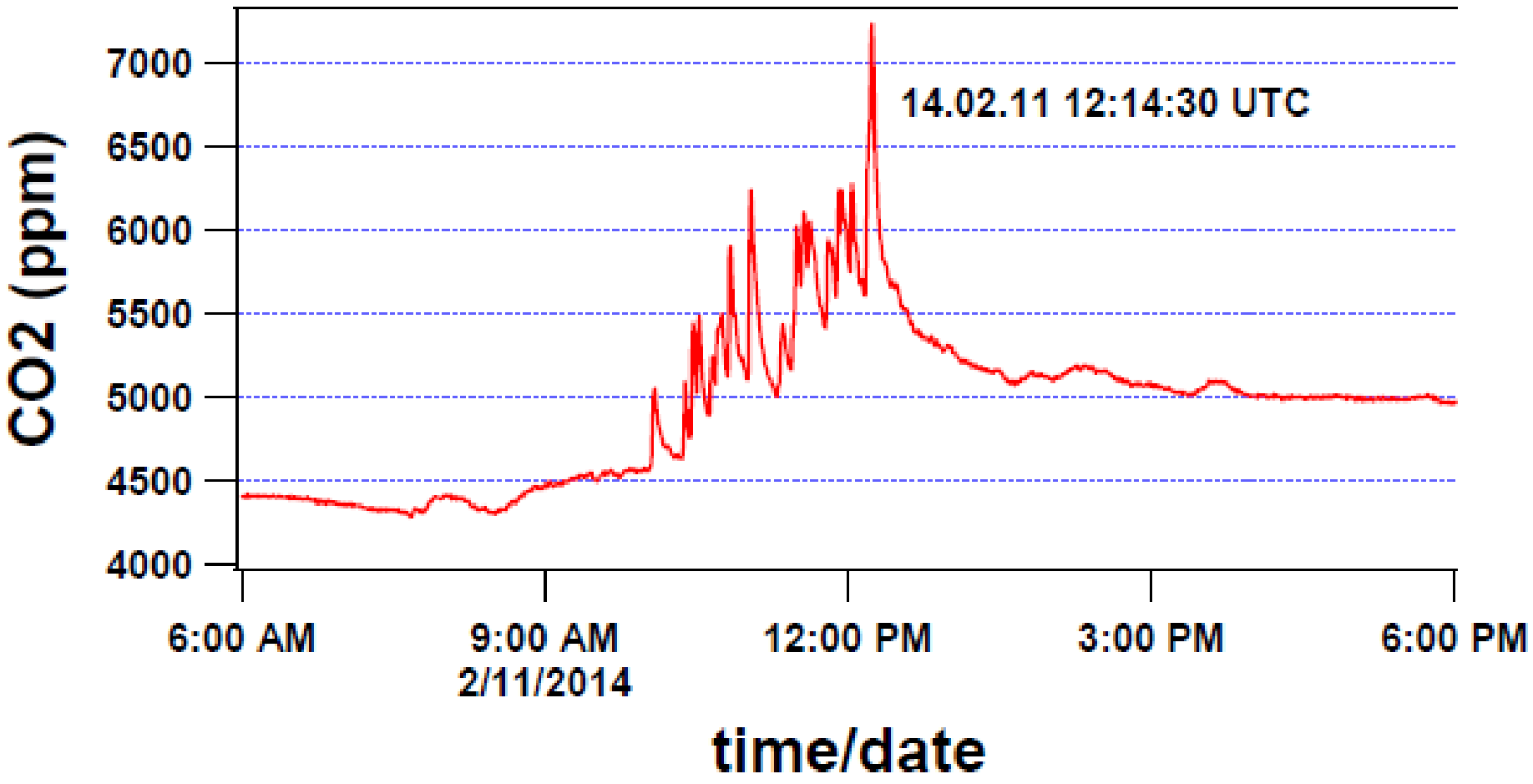
Multi-Gas Monitor Activation & Checkout

MGM Display—1st Results

Multi-Gas Monitor Initial Results for CO2

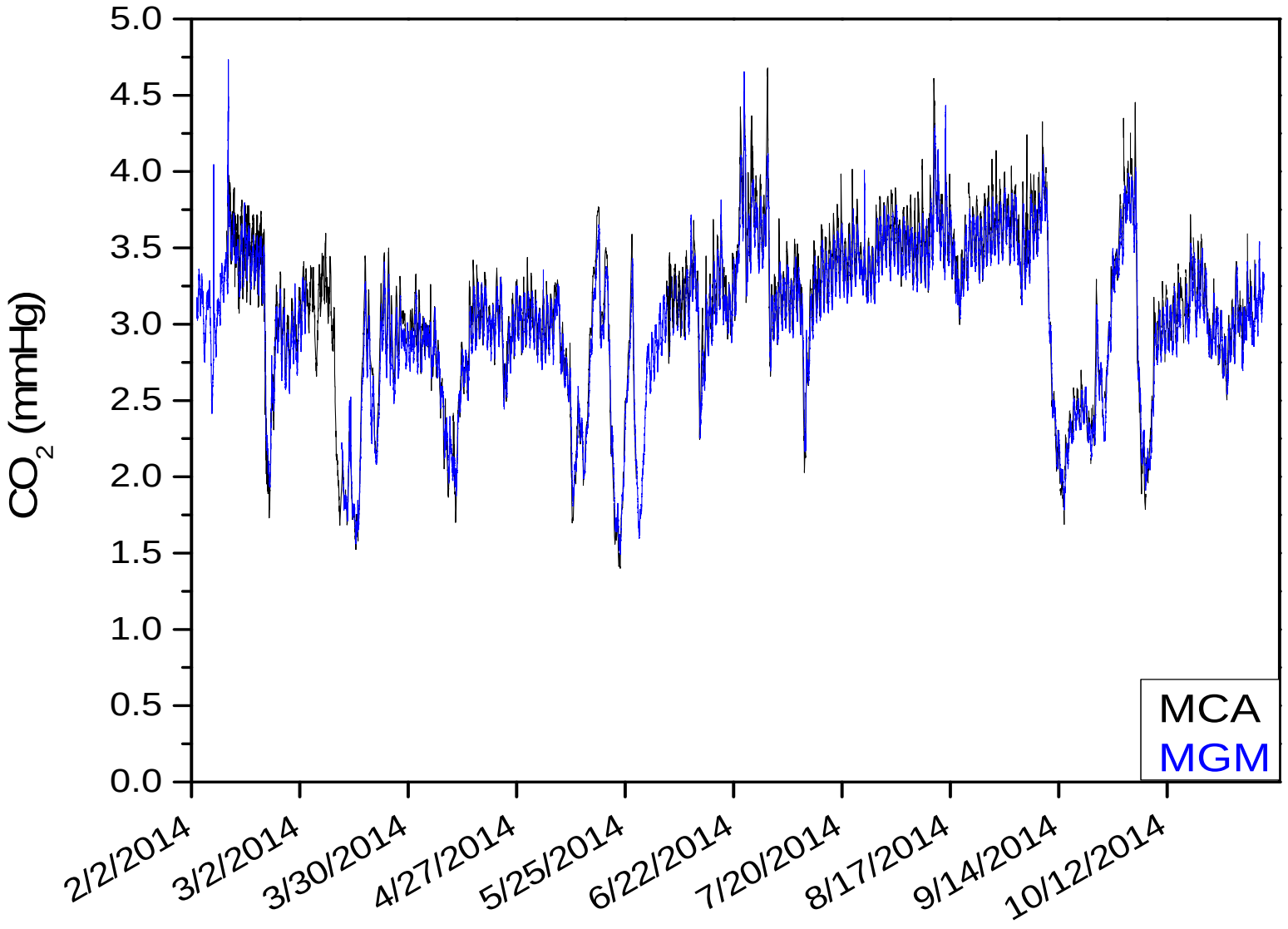


Puzzling Data from JEM

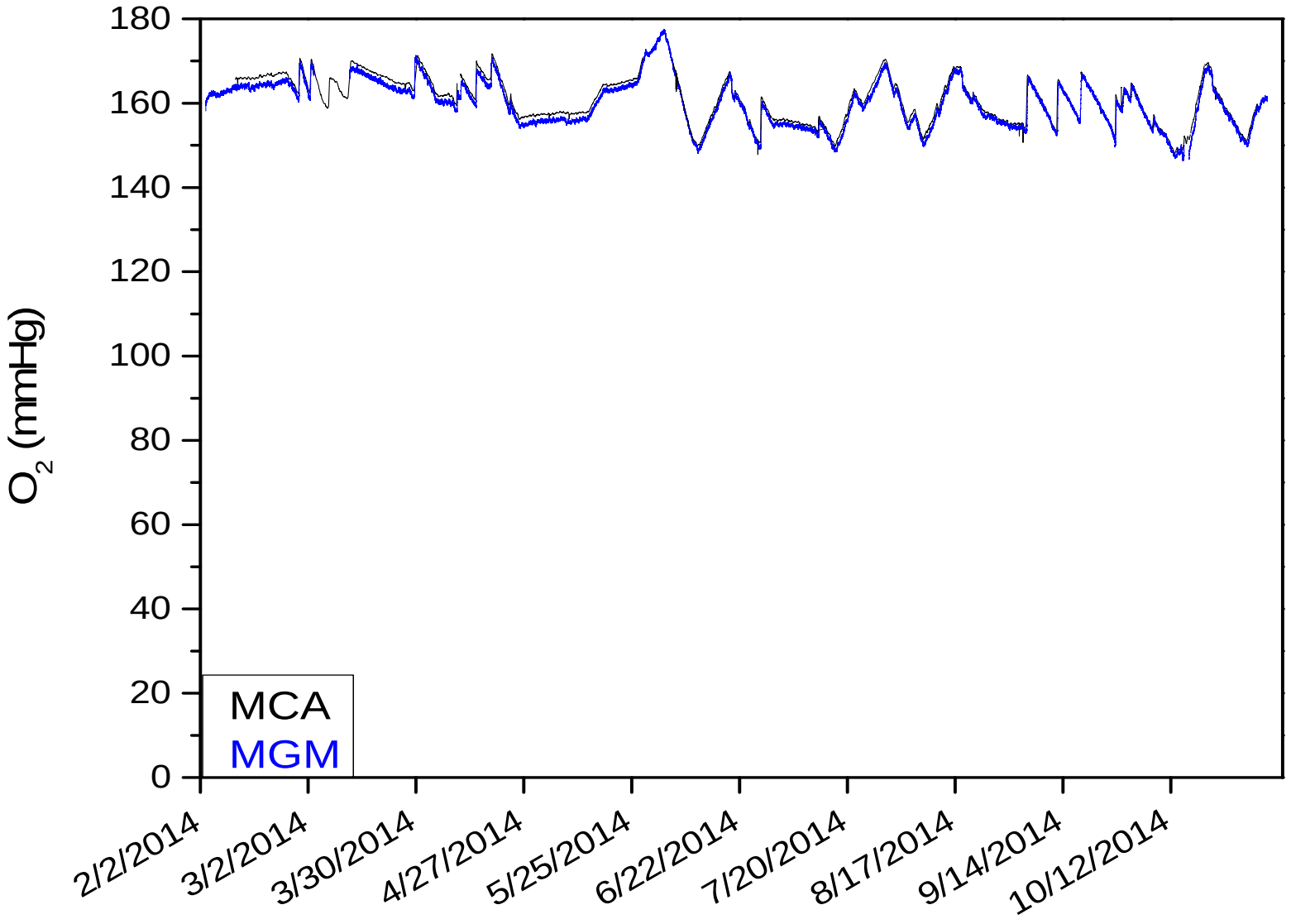


SPHERES/RINGS operating in JEM

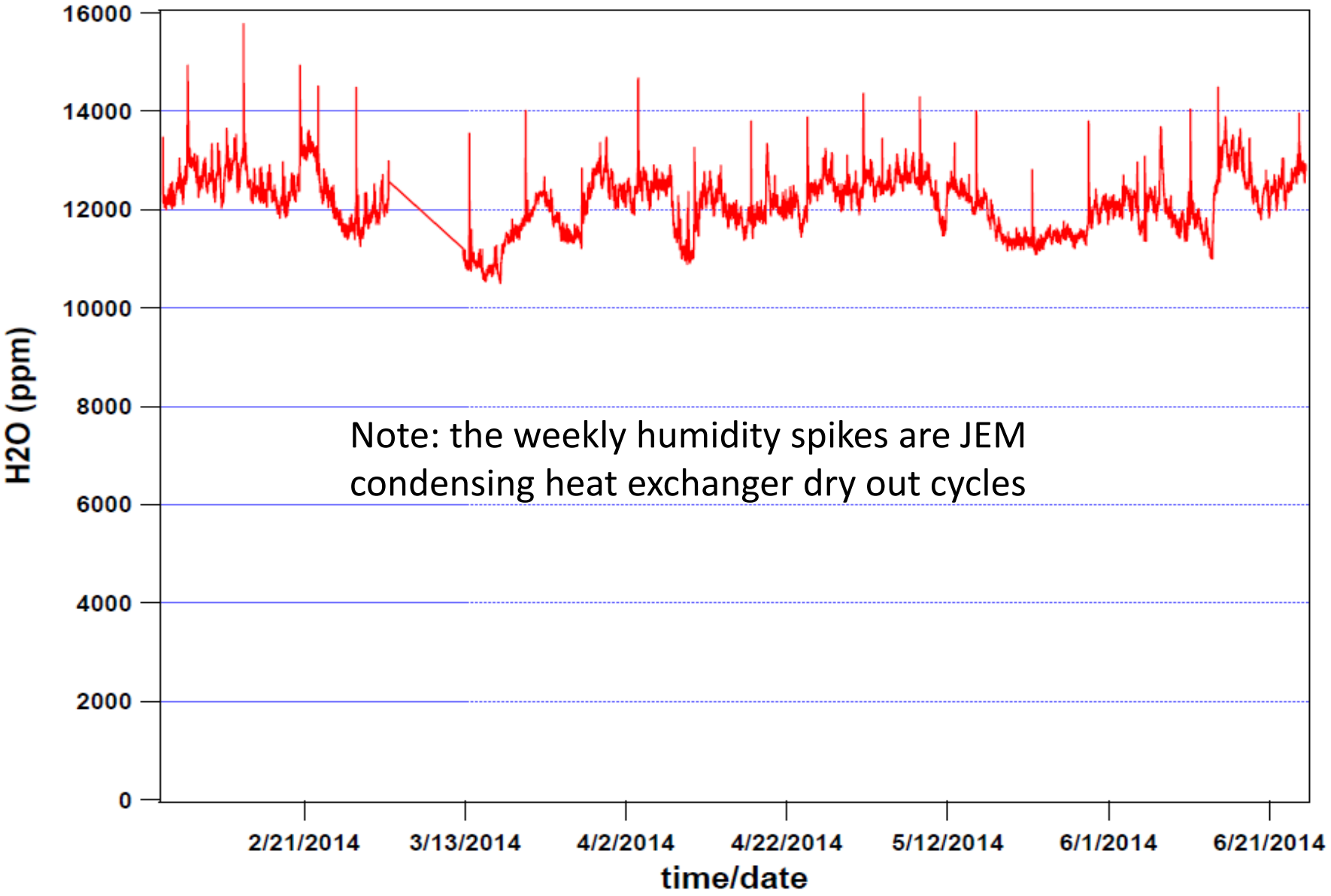
CO2 Data vs. MCA



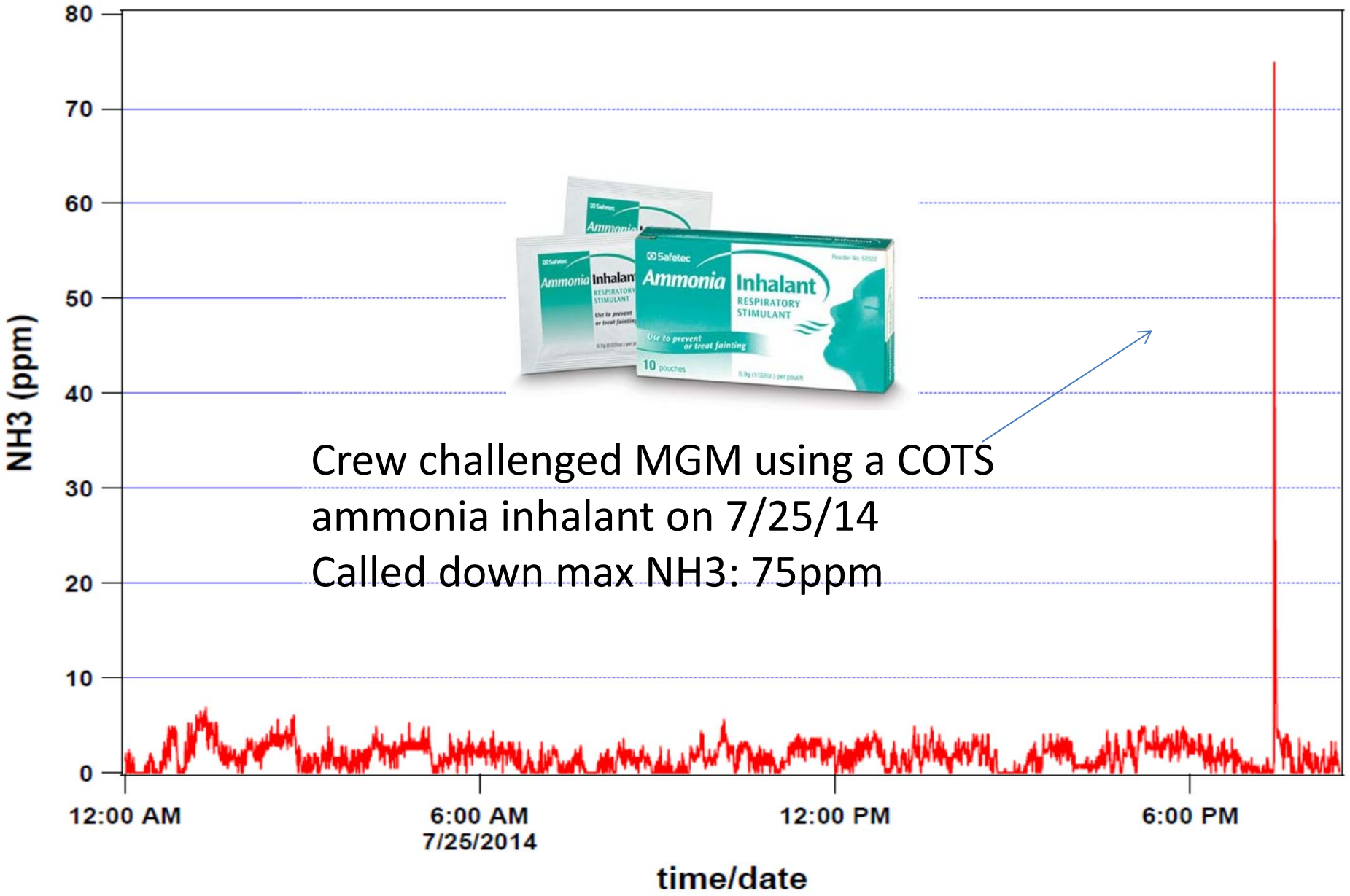
O2 Data vs. MCA



Water Vapor Data



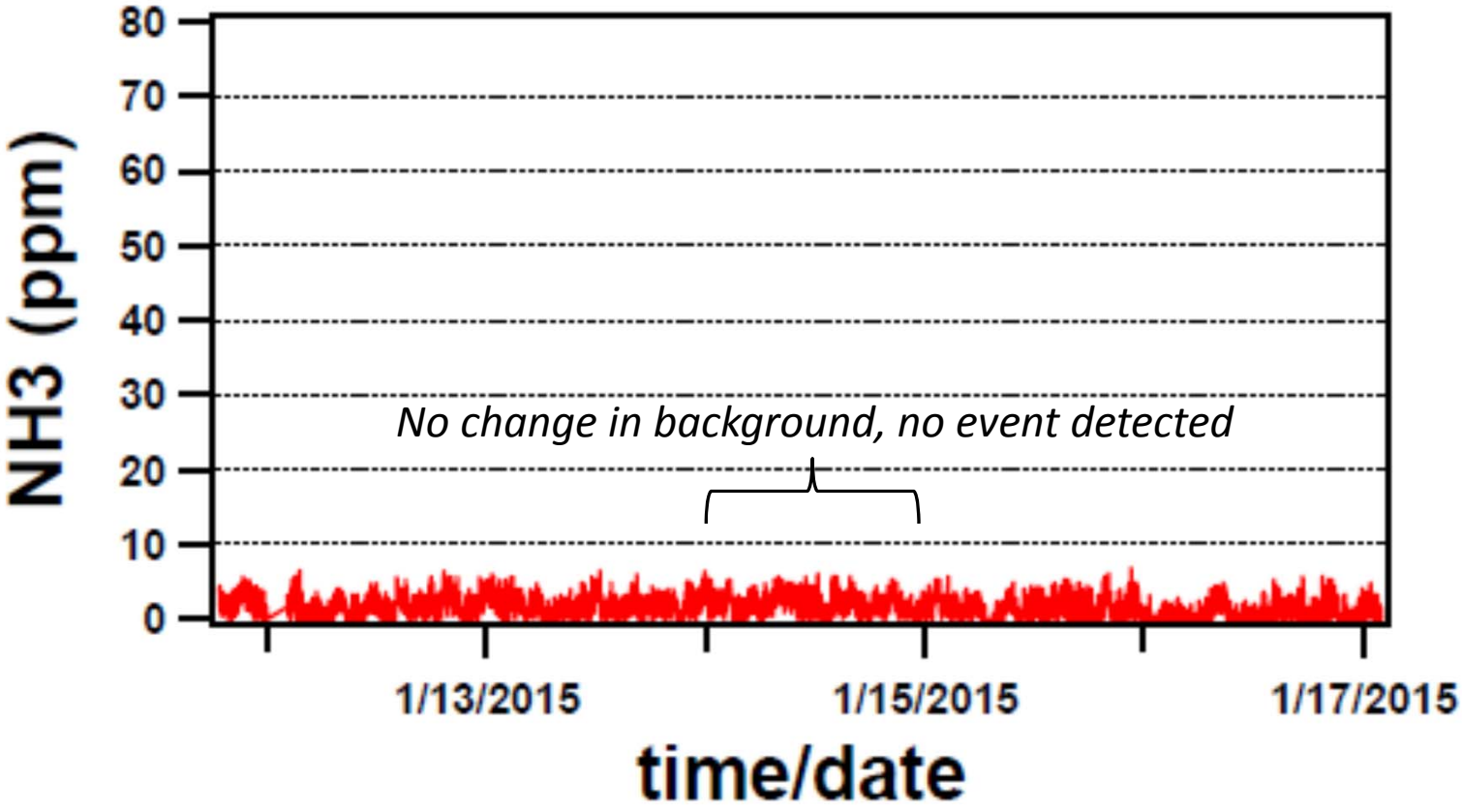
Ammonia Challenge



Crew challenged MGM using a COTS ammonia inhalant on 7/25/14

Called down max NH3: 75ppm

MGM Data collected during NH3 leak false alarm on Jan 14



Future Directions