NEW NOAA/GML TECHNIQUES FOR EVALUATION OF REMOTE SENSING GREENHOUSE AND TRACE GAS RETRIEVALS USING THE AIRCORE

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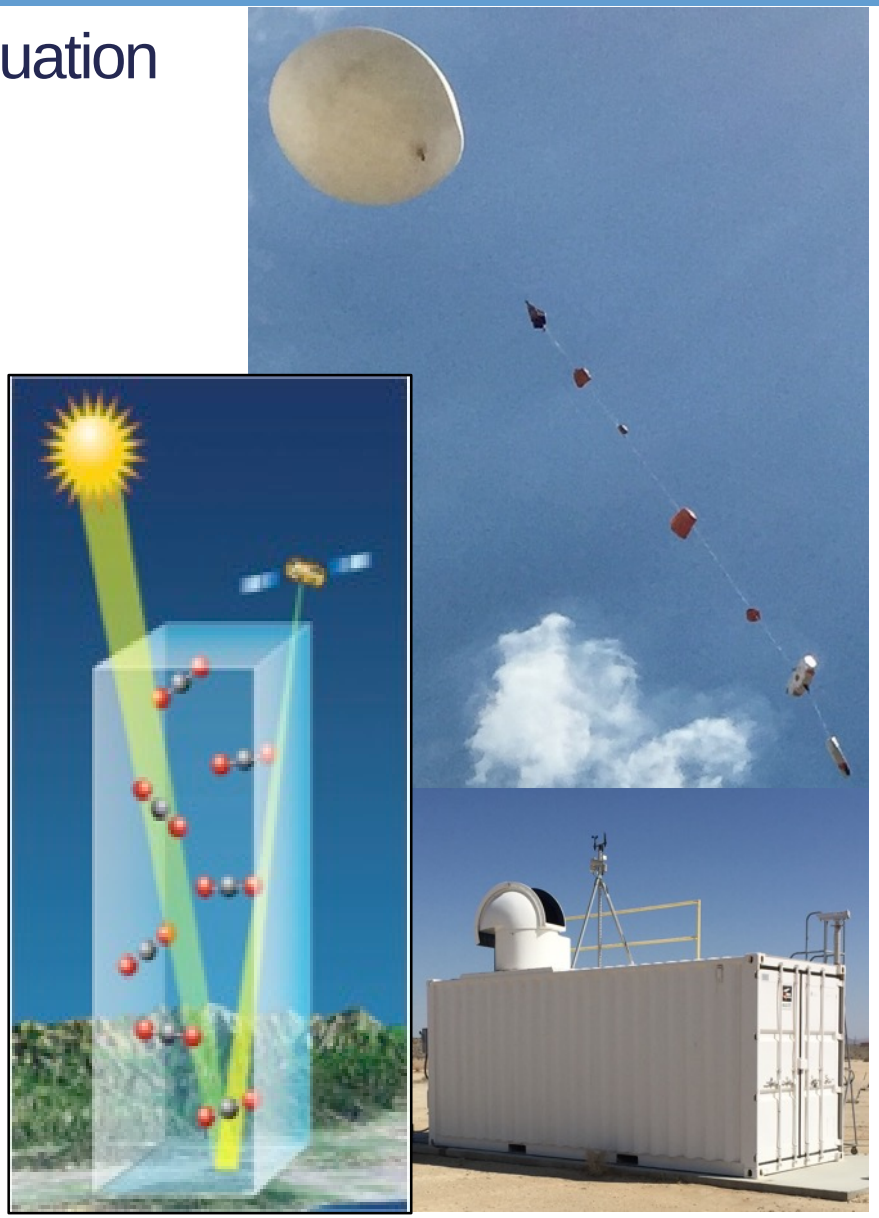
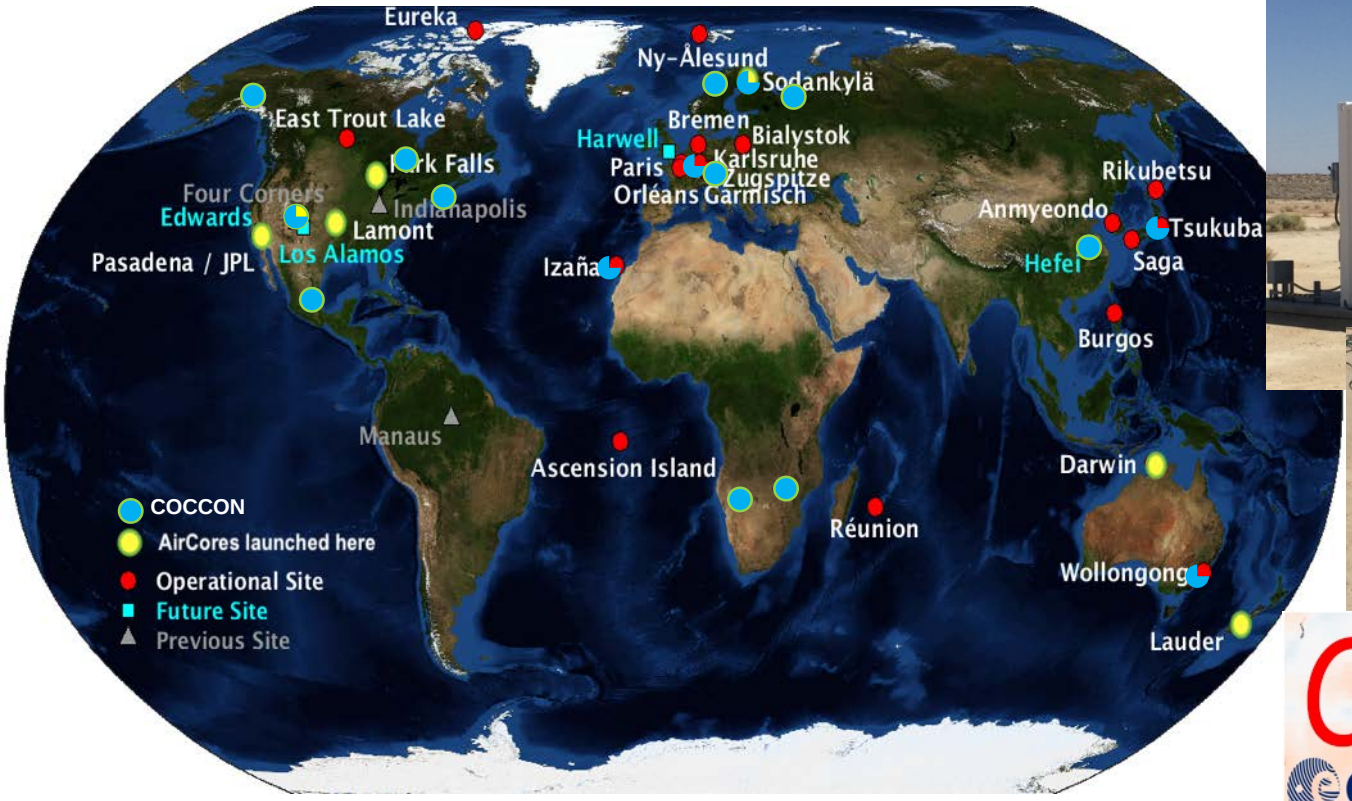
NOAA/GML AirCore and Satellite Evaluation

- Understanding carbon cycle critical for predicting future climate
- Inversions for estimating fluxes are data-limited with current ground-based observing networks
- Satellites offer extended GHG spatial coverage, but added value will only be realized if retrievals are compatible with ground-based observing systems
- AirCore an important remote sensing evaluation tool:
  1. Samples > 98% of total column
  2. Calibrated measurements traceable to WMO
  3. Low operational cost



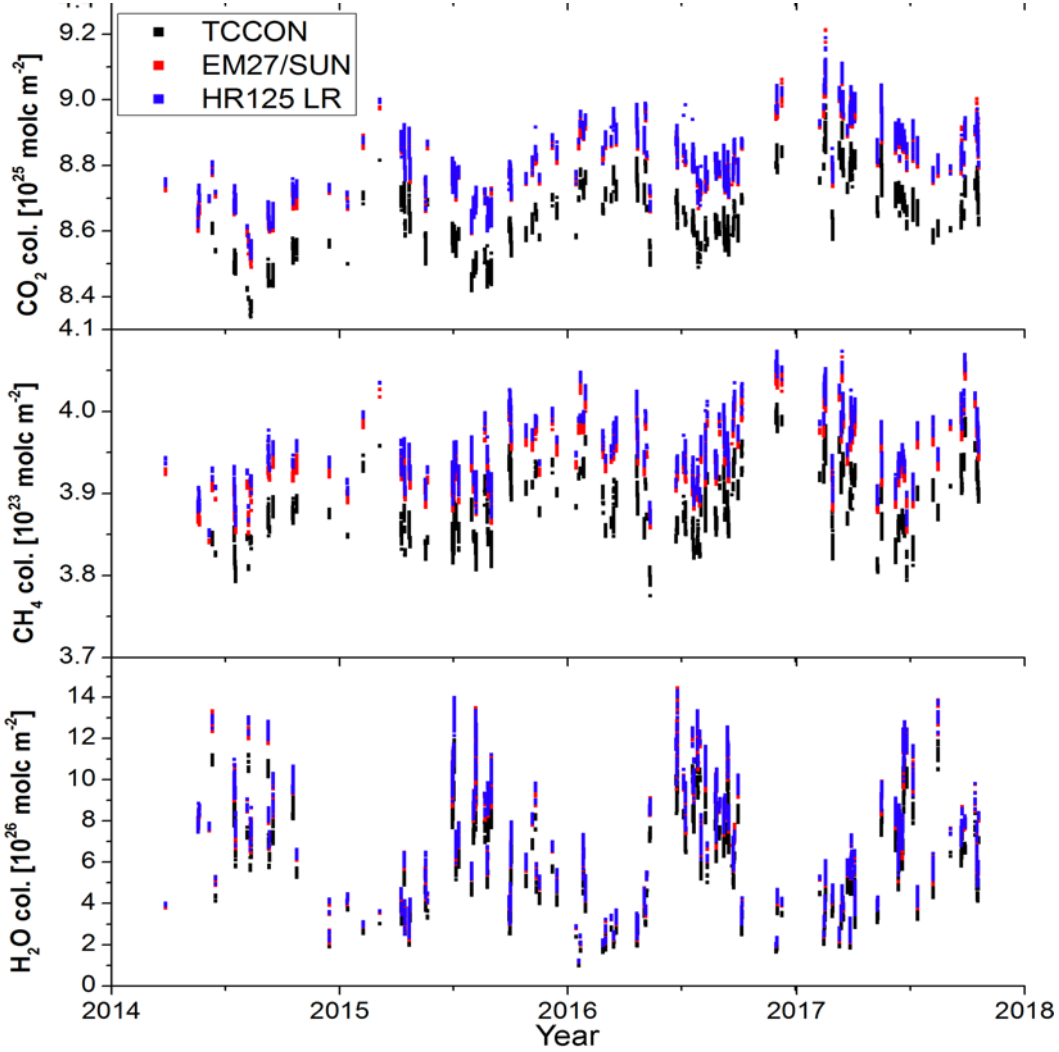
Greenhouse Gas Remote Sensing Networks



CO_2 COCCON
esa
Collaborative Carbon Column Observing Network

- Ground-based, FTS networks a primary resource for satellite evaluation
- TCCON: Bruker125HR FTS, sparse global coverage, $$$
- Circa 2016: new Bruker EM27/SUN portable FTS, $
- COCCON: 18 groups (2019) working to establish collaborative, GHG observing network with EM27s with common instrumental and data analysis procedures
- FTS network retrievals scaled to calibrated aircraft, AirCore measurements

Bruker EM27/SUN Portable FTS



- EM27 lower resolution than TCCON
- Performance consistency demonstrated between EM27s
- Stability of EM27s over time – lends well for supplement to TCCON

Frey et al., 2019

EM27/SUN Operation in NE Colorado

- Monthly AirCore launches in coordination with OCO-2 (16-day repeat cycle) ongoing
- BUT two moving platforms (weather, scheduling also difficult)
- Stationary JPL EM27 with continuous XCO_2, XCH_4, XCO, XN_2O unique opportunity to act as “transfer standard”, bridging coverage gap between AirCore, satellite overpasses

Requirements:

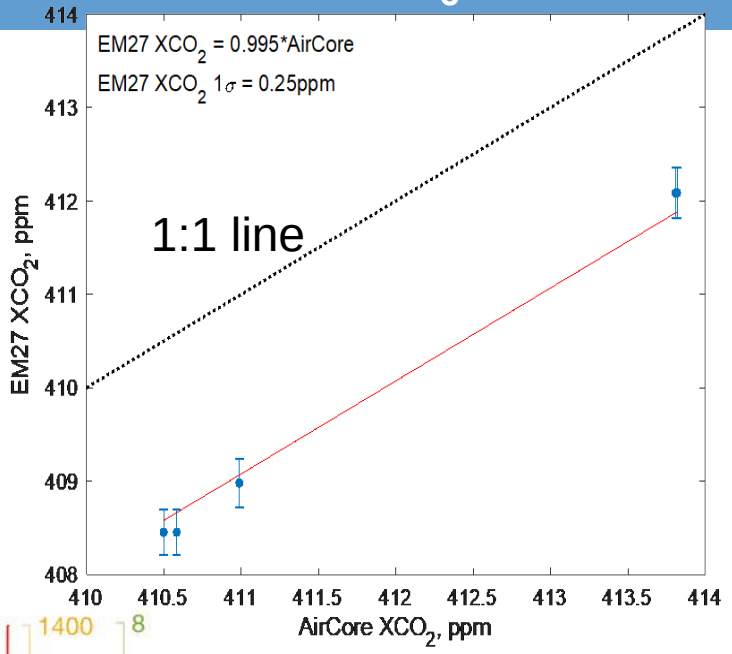
1. EM27 placement at tower site east of NOAA near AirCore landing
2. EM27 proximity to NOAA requires semi-autonomous operation and housing
   - Temperature controlled
   - Met station
   - Waterproof

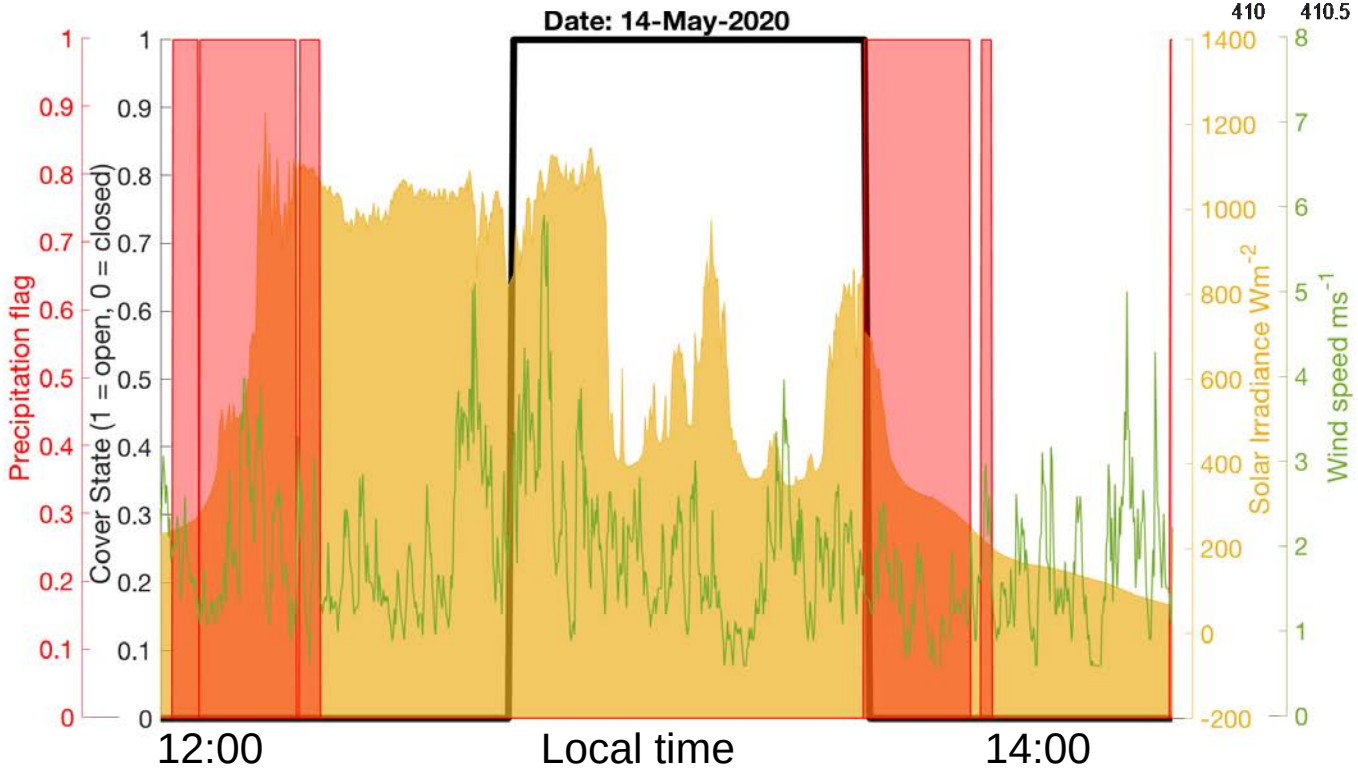
NASA JPL EM27/SUN

EM27/SUN Operation in NE Colorado

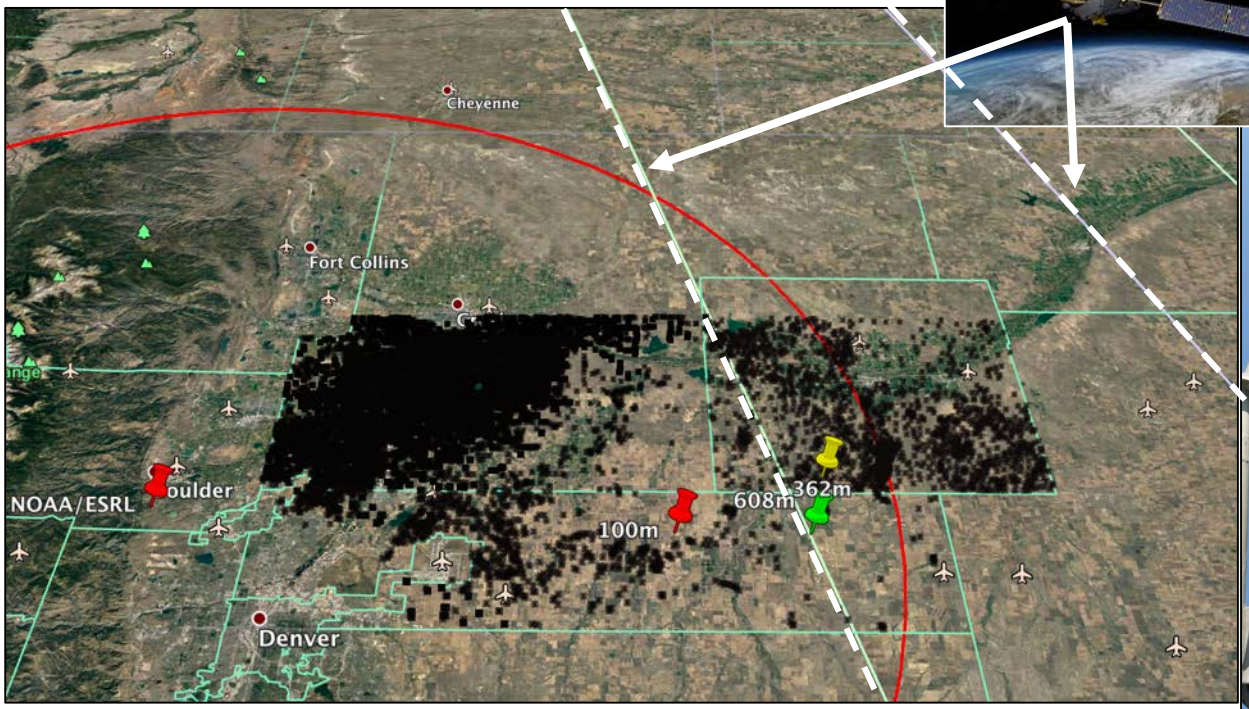
What has been done:

- Enclosure system built and tested with EM27 at NOAA using CR1000 data logger
- First comparisons of EM27 + OCO-2 satellite target mode retrievals + AirCore via day deployments to prospective NECO tower location





Next Step: Long-term evaluation



NOAA/GML working to establish tower “supersite” as replacement for Boulder Atmos. Observatory

- Requirements: proximity to NOAA, OCO-2, high-density active ONG wells; local wind patterns; topography and homogeneous land cover
- Multi-year EM27 retrievals coincident with A-train overpasses can assess retrieval biases, capability for long-term satellite evaluation using these new FTS systems
- Targeted AirCore sampling
- Other instrumentation: continuous GHG analyzers + DLiDAR, flux towers, radiation, (others welcome!) for comprehensive suite of measurements from surface to stratosphere that can characterize ABL processes, carbon exchange

High-altitude AirCore Glider Platform

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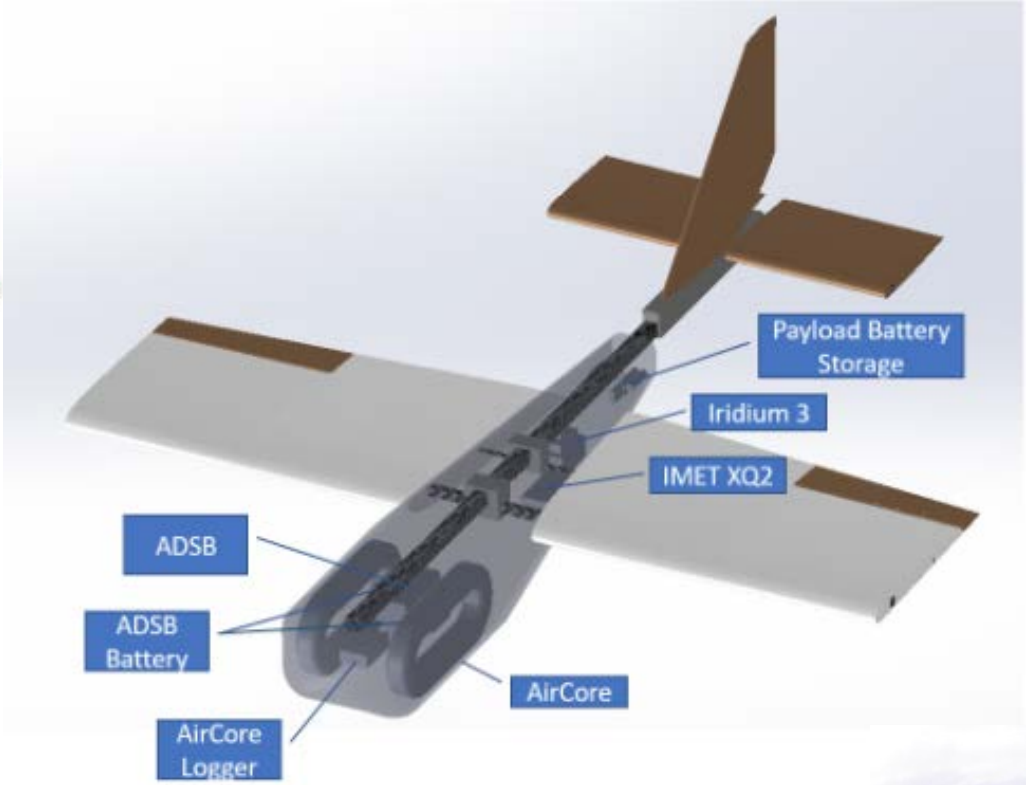
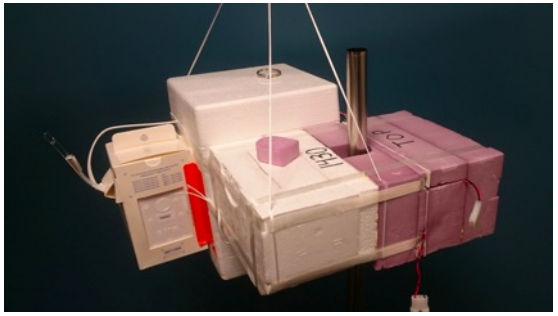
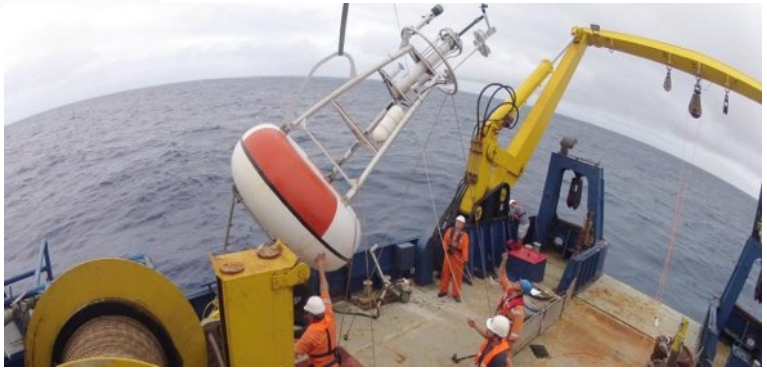




Frost point hygrometer

POPS aerosol sensor



- Portable, balloon-launched, autopilot recovered platform
- High-volume payload capacity for costly sensors useful for satellite and retrieval algorithm evaluation
- High demand for satellite evaluation efforts, observations in tropics: potential for launches at sea

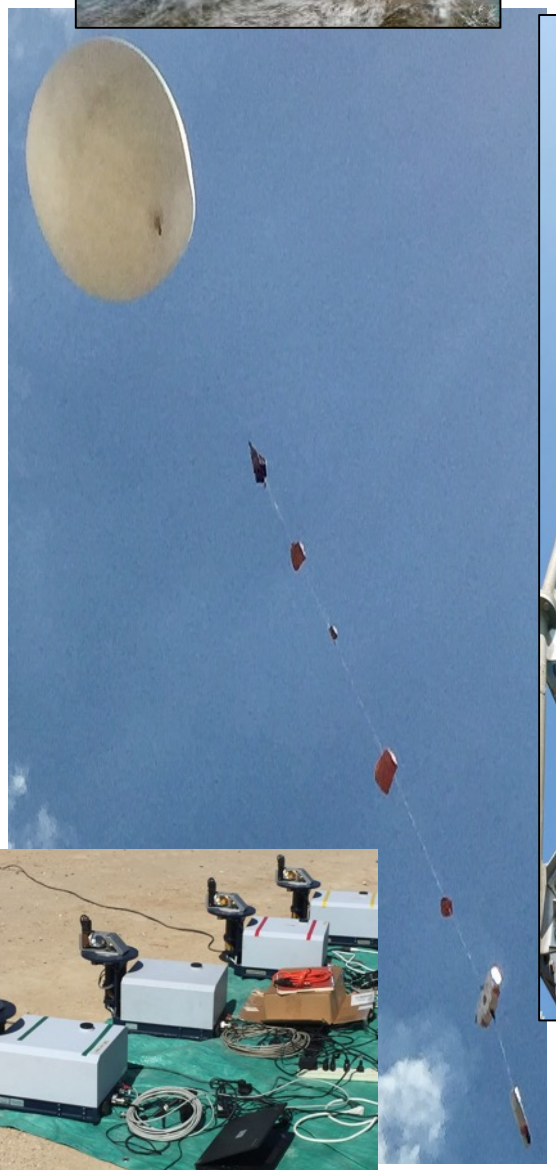
Summary

- AirCore-corrected EM27/SUN retrievals a low-cost operational pathway to improve compatibility between ground-based GHG observations (WMO), ground-based remote-sensing networks, and satellites

- NOAA/GML has unique capability to use AirCore for assessing EM27/SUN retrieval biases, and the long-term capabilities of these new spectrometers

- EM27/SUN will undergo multi-year deployment to tower site in NE Colorado alongside suite of continuous measurements

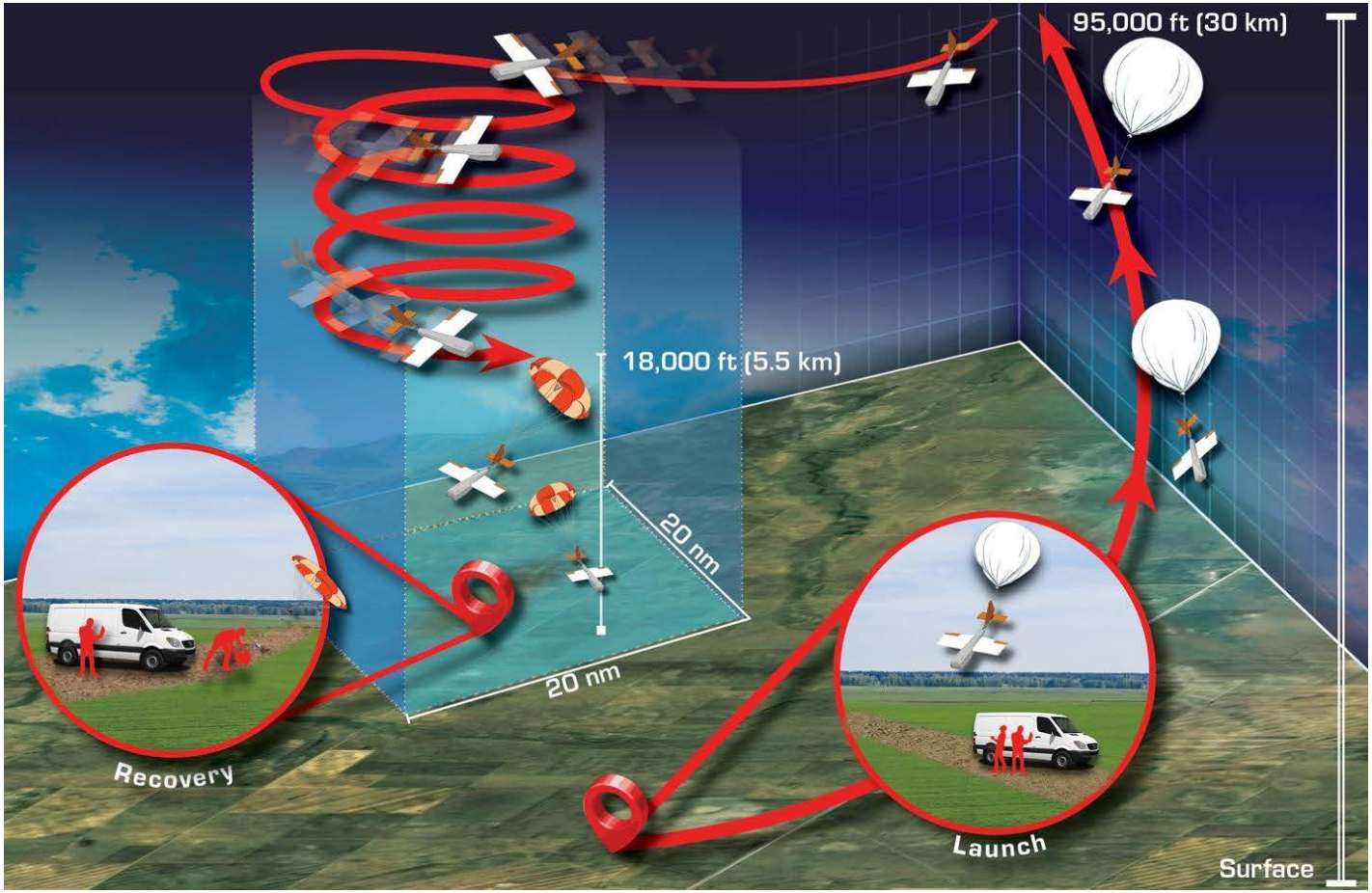
- Glider: potential to expand high-altitude sampling throughout NOAA and satellite evaluation capabilities on land and at sea



Supplemental Slides

High-altitude AirCore Glider Platform

High-Altitude Operational Returning Unmanned System



- Portable, low-weight platform that is balloon-launched and autopilot recovered
- Precise landing capability offers significant expansion of AirCore, atmospheric high-altitude sampling locations
- Platform has been at low altitude for glide characteristics, autopilot testing
- Next: High-altitude feasibility testing in restricted airspace, FAA clearance