Collecting Ideas for a Educational Aircraft Campaign

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- There are still considerable barriers to young and/or inexperienced investigators to propose an experiment using NSF aircraft because they have no guidance on how to plan an aircraft deployment, how to efficiently use an aircraft, let alone be a mission scientist.

- Currently the pool of PIs leading aircraft campaigns is fairly narrow, largely represented by R1 institutions, not inclusive.

- Even if successful in getting an aircraft proposal funded, lack of know-how in flight planning, instrument preparation, communication with facility providers, pilots, RAF staff has caused some hiccups and frustration.

- Informal "training" or PI support during flight campaigns both during test flights and also for the entire duration of the campaign.

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- There have been several successful educational “tag-ons” in existing field laboratories or before and after ground-based or aircraft campaigns funded by NSF.
- We envision a dedicated educational flight campaign/program the primary purpose of which is to teach young/inexperienced investigators what they need to know to lead a field project using NSF aircraft.
- Opportunity to increase diversity and inclusivity in leading field campaigns.
- Deployments would also be used to train students and individual young PIs about the particular requirements to develop and deploy aircraft instrumentation.
- Deployments would provide opportunities for students / classes to be directly involved in mission planning, execution, and data interpretation and university/college faculty to develop and teach specific courses in applied atmospheric sciences.
- Possibility to combine and educational flight program with a new edition of a instrument test program (“ARISTO 2.0”).

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COPACABANA (Carbon Oxidation Processes in the Atmosphere: Chemistry of Aromatics, Biogenics, and Alkanes as a Function of NOx Availability) is a narrowly focused aircraft campaign with a primary educational component.

The science focus is on the atmospheric lifetime and sequestration pathways of NOx as a function of VOC composition and initial NOx concentration.

We would fly downwind of a large, continuous NOx source in environments that are dominated by
Biogenics, Aromatics, or Aliphatics

The science can be accomplished with a smaller payload leaving ample room for additional seats for educational purposes.

Flight planning is relatively straightforward and therefore is well suited for teaching inexperienced PIs how to conduct research flights successfully and train students and young investigators around airborne instrumentation

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Science Questions:

- What is the fate of atmospheric NOx as a function of initial mixing ratio and VOC composition?
  - How does the fate of NOx differ between air masses dominated by biogenic, aromatic, or aliphatic VOCs ?
  - How does the pathway of VOC oxidation change as a function of NOx concentration?
  - What is the fraction of recyclable versus non-recyclable oxidized nitrogen (both gas- and particle phase) and how does it depend on air mass composition and NOx mixing ratio?
  - What are the expectations for future trends as a result of emission reductions and climate change?

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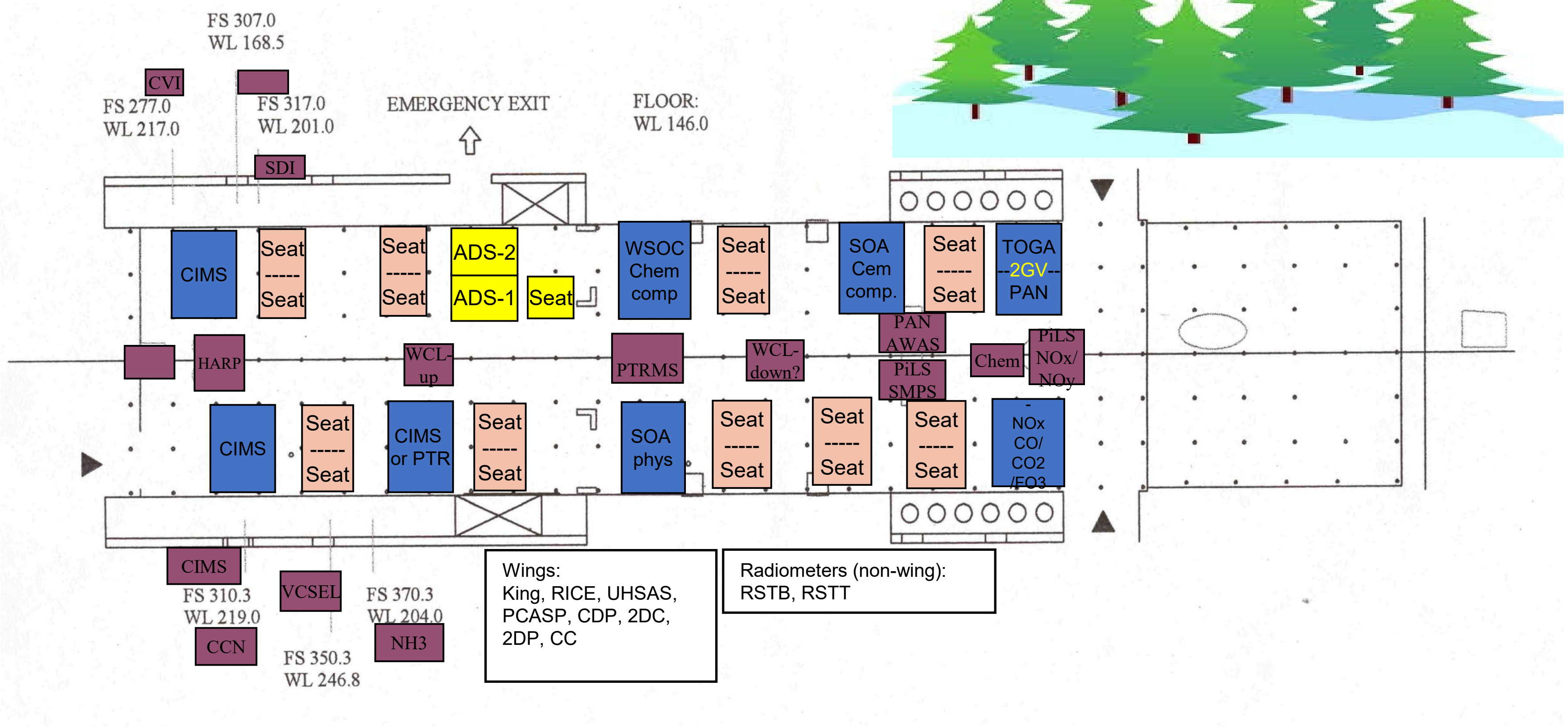
Domestic Deployment(s) on C-130

Carbon-centric photochemistry payload



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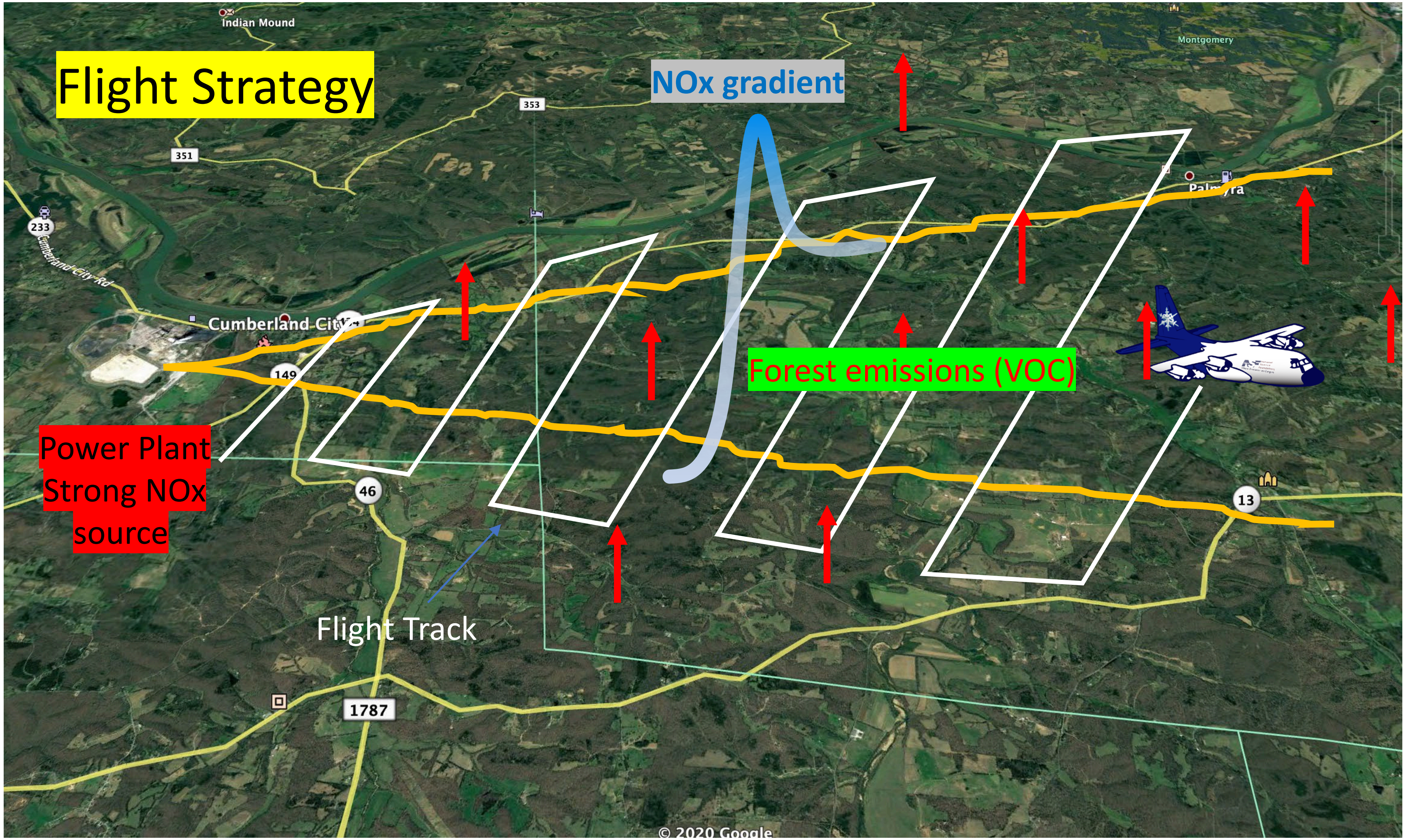

BVOC dominated forest downwind of a moderate or strong NOx source

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Aromatics / Aliphatics dominated VOC source co-located with a strong NOx source

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Aliphatics dominated area downwind of a moderate or strong NOx source

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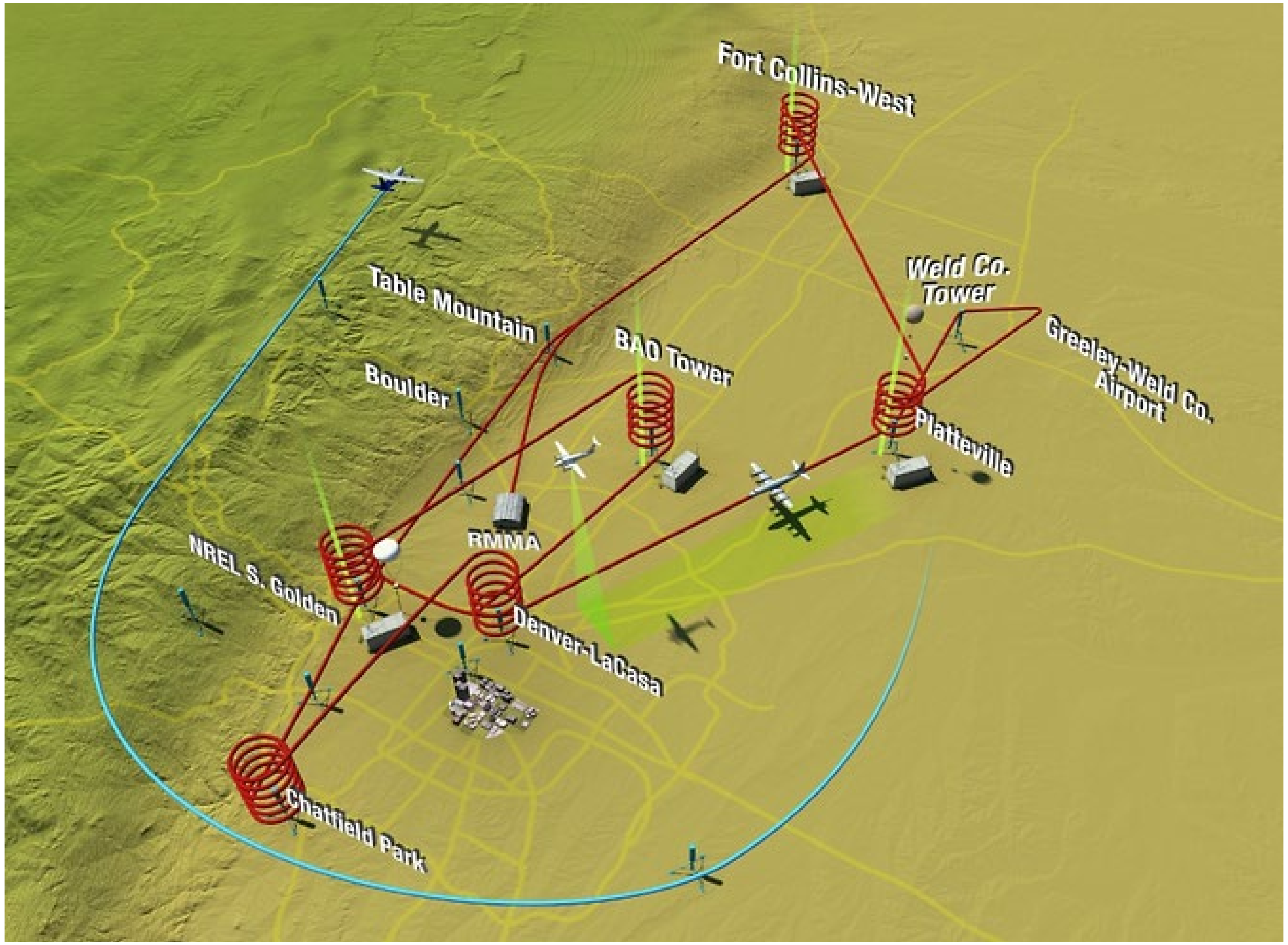
Atmospheric profiling



Opportunities

- Meteorlogical observations
- PBL behavior
- Emission validation
- Ozone deposition

- Flux measurements (single altitude ovals)

Hourly atmospheric pollution from geostationary Earth orbit

PI: Kelly Chance, Smithsonian Astrophysical Observatory
Instrument Development: Ball Aerospace
Project Management: NASA LaRC
Other Institutions: NASA GSFC, NOAA, EPA, NCAR, Harvard, UC Berkeley, St. Louis U, U Alabama Huntsville, U Nebraska, RT Solutions, Carr Astronautics
International collaboration: Mexico, Canada, Cuba, Korea, U.K., ESA, Spain

Selected Nov. 2012 as NASA's first Earth Venture Instrument

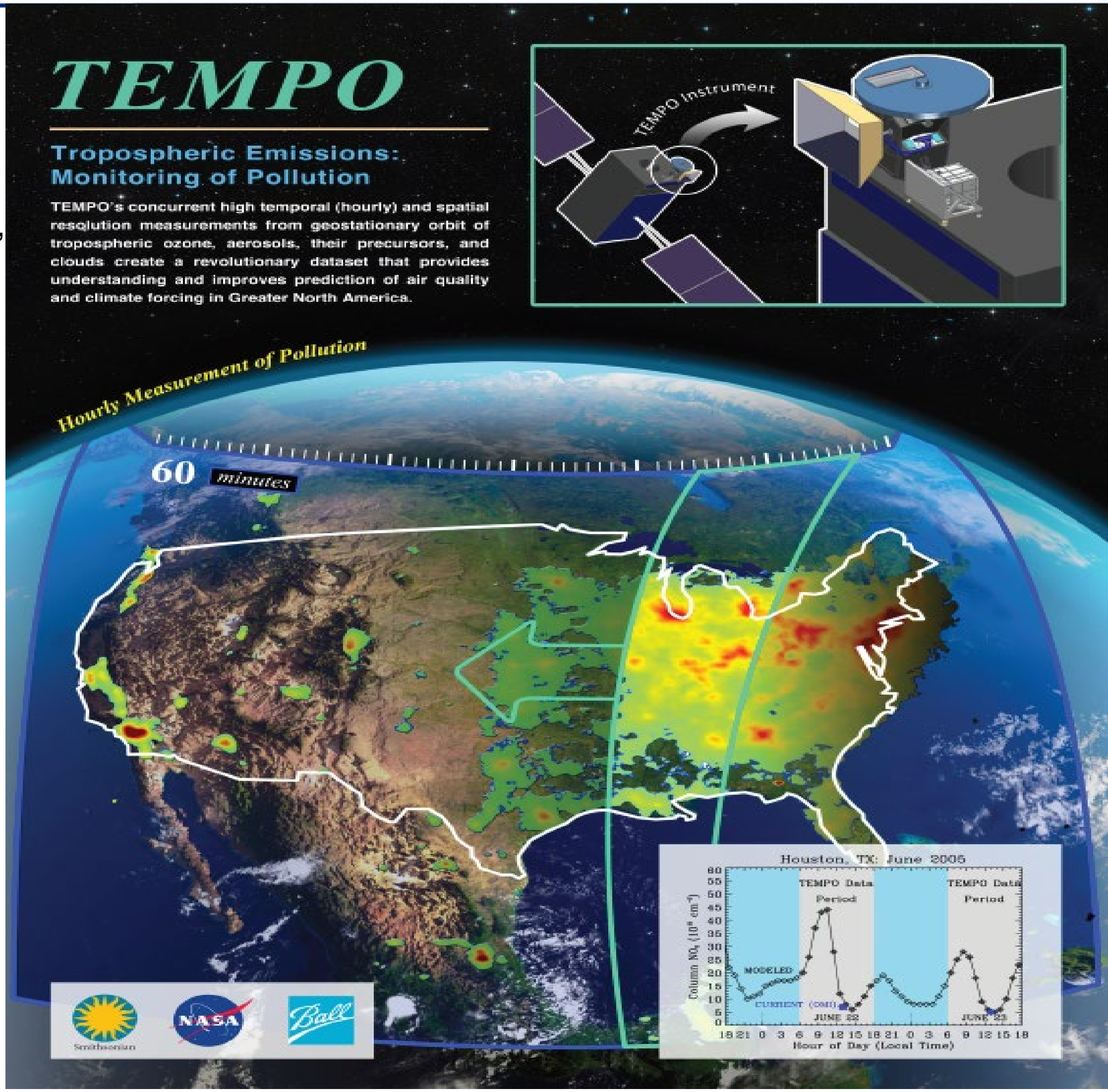
- Instrument delivered and integrated on Intelsat (by Maxar) Nov. 2021
- launch expected March 2023

Provides hourly daylight observations to capture rapidly varying emissions & chemistry important for air quality

- UV/visible grating spectrometer to measure key elements in tropospheric ozone and aerosol pollution
- Distinguishes boundary layer from free tropospheric & stratospheric ozone

Aligned with Earth Science Decadal Survey recommendations

- Makes many of the GEO-CAPE atmosphere measurements
- Responds to the phased implementation recommendation of GEO-CAPE mission design team



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Primary Target Areas
- USA-LosAngeles
- USA-Atlanta
- USA-Boston
- ESP-Barcelona
- ITA-Rome
- ZAF-Johannesburg
- ISR-TelAviv
- ETH-AddisAbaba
- IND-Delhi
- CHN-Beijing
- TWN-Taipei

Secondary Target Areas
- USA-Hilo
- PAC-OceanStCu
- USA-SanFrancisco
- USA-Phoenix
- USA-Denver
- MEX-MexicoCity
- CAN-Toronto
- PER-Lima
- CHL-Santiago
- PRI-SanJuan
- BRA-SãoPaulo
- SEN-Dakar
- GHA-Accra
- ATL-OceanStCu
- NGA-Lagos
- ZAF-CapeTown
- SRB-Belgrade
- KEN-Nairobi
- ETH-Harar
- KWT-KuwaitCity
- PAK-Karachi
- IND-Chennai
- BGD-Dhaka
- THA-Bangkok
- VNM-Hanoi
- MNG-Ulaanbaatar
- RUS-Yakutsk
- KOR-Seoul
- AUS-Sydney

Calibration/Validation Target Areas
- USA-RailroadValley
- MRT-Mauritania1
- NAM-Gobabeb
- LBY-Libya4

MAIA Primary/Secondary Target Areas

MAIA Instrument:
- Two spectropolarimetric cameras on a two-axis gimbal
- 14 filters, UV-SWIR
- ~700 km orbit (TBD)
- ~230 m pixel (at nadir)
- 1km data products
- 600 km swath
- 3 days for global coverage

Many other possibilities

- Cloud chemistry and physics
- Urban PBL dynamics
- Local air pollution and source attribution
- Radiation in polluted environments
- Wildfire influence on urban areas
- Carbon emission measurements
- …

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- Shadowing opportunity for aspiring PIs (Emily Fischer)
  - Tag-on option for funded field programs
  - Start pilot during SLC flight campaign summer ‘24?
  - Need to develop a selection process depending on level of interest

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Looking for Collaborators

Please contact Brigitte or Frank at

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