Components of a Global System for Earth Observation

**Vantage Points**

**Far-Space**
- U/L2/HEO/GEO
- Sentinel satellites for continuous monitoring

**Near-Space**
- LEO/MEO
- Active & passive sensors for trends & process studies

**Airborne**
- Suborbital
- In situ measurement in research campaigns & validation of new remote sensors

**Terrestrial**
- Surface-Based Networks
- Ocean buoys, air samplers, strain detectors, ground validation sites

**Capabilities**

- **Permanent**
  - U/L2/HEO/GEO
  - Sentinel satellites for continuous monitoring

- **Deployable**
  - LEO/MEO
  - Active & passive sensors for trends & process studies

- **Information Systems**
  - Data management, data assimilation, modeling & synthesis
NASA Earth Science

Purposes for Airborne Platforms

Scientific

• Make important scientific measurements not possible from satellite or surface-based platforms
• Calibration and validation of satellite remote sensing observations and models

Programmatic

• Develop new remote sensing and in-situ instruments
• Develop early career investigators
• Develop leadership skills in promising early and mid-career investigator
NASA Earth Science Research Capable Aircraft

Red indicates ASP funded
C-AIR microradiometer instruments are COTS systems designed to help retrieve aquatic normalized exact water-leaving radiance for satellite-based ocean color research. A microradiometer consists of a microprocessor, photodetector, preamplifier with controllable gain, 24-bit analog-to-digital converter, and a serial port, all on one small circuit board assembly. The brass sleeve provides support and isolation from electronic noise. Aggregators are used to bundle clusters of microradiometers and auxiliary sensors as would typically exist in individual instrument heads. They have on-board power control, and additional sensors including tilt angles, input voltage and current, internal humidity and temperature. C-AIR sensors feature:

- Spectral range: 320-1640 nm with 10 nm FWHM bandwidth; 15 Hz data rate;
- Very wide dynamic range (10 decades), will not saturate with Sun glint;
- Radiance (2.5° FAFOV) and irradiance configurations;
- NIST traceable calibrations.

Fight requirements: flight track within the solar principal plane

Needed: application specific GUI software development

References:


POC:
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Korea - United States Air Quality (KORUS-AQ) Study: A Cooperative Air Quality Field Study in Korea

Dates: 1 May – 15 June 2016
Location: Osan Air Base, South Korea
Participants:
Korea - Ministry of Environment, National Institute of Environmental Research, and Korean Universities
US - NASA, EPA, NCAR, and Universities

Airborne Platforms:
• NASA DC-8 (with 6 Korean research groups)
• LaRC King Air (TEMPO airborne simulator, GeoTASO, and MOS ocean color imager)
• Hanseo University King Air (HCHO instrument from the U.S. team)

Surface Network and Ships:
• Extensive network of ground sites operated by Korean air quality agencies and universities
• NASA contributions included a network of ground-based remote sensors (Pandora and AERONET), multiple lidar and ozonesonde sites.
• A companion ship-based collaboration examining ocean color (KORUS-OC) is being conducted by NASA and KIOST

Science:
Better understanding of the factors controlling air quality to enable improved capability for satellite remote sensing and model simulation of air quality

International Collaboration:
Develop relationships that will enhance the global air quality satellite constellation of geostationary air quality observations from TEMPO (NASA), GEMS (KARI), and Sentinel-4 (ESA).

Capacity Building:
Develop a stronger airborne science community in Korea through direct experience on the NASA DC-8 and participation in the planning of research flights
MISSION TOOLS SUITE (MTS)
NASA AIRBORNE SCIENCE PROGRAM

• Tactical decision-making and distributed
team situational awareness

• Real time position and instrument telemetry
ingest and visualization for single- and multi-
asset campaigns

• Access to low latency satellite, radar, global
lightning and other meteorological and
mission products

• Communication and collaboration tools
including document sharing and turn-key
chat solutions

• Satellite pass prediction and swath
visualization

• Mission operation and planning tools

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MULTISPECTRAL IMAGING, DETECTION AND ACTIVE REFLECTANCE
MiDAR 7-CHANNEL PROTOTYPE

NASA AMES
LABORATORY FOR ADVANCED SENSING

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**MiDAR Transmitter - LED Array**

- N-channel, narrowband structured illumination, $\varphi_{\text{LED}}(\lambda)$ and embedded data stream at $bN/r$ bits/s

**MiDAR Receiver - FluidCam NIR**

- Panchromatic high-frame-rate computational imager records frames $I[x,y,t]$

**MiDAR Multispectral Reconstruction**

- Automated MiDAR color signature identification $\varphi_{\text{color}} = \text{NIR, R, G, B, UV}, \ldots$
- Ambient radiance calibration, intensity normalization and embedded data decoding

Data Transmission

Multispectral Video

3D Structure
MiDAR SCIENCE APPLICATIONS

1. Multispectral Mapping
2. Atmospheric Correction
3. Mineral Detection
4. Underwater Imaging
1. Motivation

Our group is interested in designing and building an LED array for enhanced aerial UAV and underwater mapping missions. The first phase of this report will focus on ultraviolet LED arrays (350 - 420nm) for remote sensing UAV applications. The second will outline equivalent LED array modified for use in submersible vessels. There are a number of prospective applications for this technology, including UV luminescence of for coral detection [ToDo: CITE], and mapping of air and water columns [ToDo: CITE].

2. Atmospheric Solar Blackbody Irradiance Matching.

The spectral irradiance was calculated across a portion of the UV region of the atmospheric solar blackbody curve. This was done using spectral data collected by Georgia State University and the National Renewable Energy Laboratory (NREL). The specific spectral irradiance was calculated using wavelengths between 350 and 420nm, which falls within the UV range of the spectrum. A surface power density of $42 \text{ W/m}^2$ is used for reference. We'd like our LED arrays to emit approximately half that power. The spectral irradiance curves are shown below, with the integrated UV region highlighted in green.

Figure 1. Solar Blackbody (spectral irradiance) data from the National Renewable Energy Laboratory (NREL) and Georgia State University (GSU). The integrated region to calculate spatial power density is highlighted in green.
NASA AMES LAS - EPA/ARMY PLUME SAMPLING 2016-2017
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