Decadal Survey Tier 2 Mission Study
Summative Progress Report

Geo-CAPE
Instrument Design Lab Study
Coastal Ecosystem Dynamics Imager (CEDI)

Antonio Mannino
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Optics

✧ CEDI design is a modification of the previous IDL design of the MDI instrument in 2006 (250m spatial resolution).

✧ Assuming threshold 375m spatial resolution per pixel which allowed implementation of a 0.5 m Primary and shrinking of optical layout reducing the volume.

✧ Telescope focal length set for 1:1 Offner Spectrograph designs

✧ Effective focal length = 1717.728 mm, F/3.44 focal ratio

✧ UV-VIS-NIR split into 2 bands

✧ 345 nm to 600 nm

✧ 600 nm to 900 nm (up to 1100 nm achievable but QE of detector is very low at >1 micron)

✧ SWIR band - 1225 to 2160 nm

✧ All detectors have 18 µm pixels
Volume Comparison of MDI and CEDI

Geo-MDI
15.3 cubic meters
(includes calibration assy. Volume)

Multi-Disciplinary Imager (MDI)
IDL Fall 2006

Geo-CEDI
7.5 cubic meters
(includes calibration assembly volume)

Coastal Ecosystem Dynamics Imager (CEDI)
IDL January 2010

Note: dimensions in millimeters
### Summary of Geo-CEDI

#### Instrument Concept
- Enables scientific objectives of coastal ocean and atmospheric retrievals.
- Capable of pointing anywhere on Full Disk.
- Spatial Resolution: 375 m x 375 m (nadir)
- Employs three focal planes
  - (1) 345-600 nm, (2) 600-1100 nm
    - Two Teledyne custom HyViSi ROIC: 1k (spectral) x 2k (spatial) detectors (UV-A or NIR coating)
  - (3) 1225-2160 nm
    - One HgCdTe Hawaii-2RG ROIC: 2k x 2k detector (SWIR)
- Spectral Resol: 0.5 nm (UV-NIR) and 2.5 nm (SWIR)

#### Instrument Characteristics
- Volume - 7.5 m$^3$
- Mass - 621.4 kg
- Power - 392 W
- Data Rate - 88.4 Mbps
- Scene: 750 km N-S x variable E-W
- Scene Integration Time: 10-17 min
- Pointing - ~0.5 arc-sec
- Lifetime - 3 yr (design); 5 yr (goal)

#### Technology Development Needs
- Scan Mirror mechanism is on the edge of what is achievable. Further studies are necessary
- Dedicated effort required to investigate, characterize, and mitigate all sources of disturbances to scan mirror.
- 100Hz Attitude Determination may exceed existing proven technologies (133MHz BAE Rad750).
CEDI Scanning Plan

• U.S. Coastal Waters
  • East Coast – 4 scenes (3x / day minimum)
  • Gulf Coast – 4 scenes (3x / day minimum)
  • West Coast – 3 scenes (3x / day minimum)
  • Puerto Rico – 1 scene (1 to 3x / day)
  • Great Lakes – 4 scenes (1 to 3x / day)

• Regions of Interest
  • North, Central and South America
  • Anywhere within Field of Regard (50N / 45S Lat; ~160W / ~35 W Long)

• >72 scenes per day (~750x375 km at nadir)
  • Approximately 18 hours of operation per day
  • Approximately 4 scenes per hour (15 minutes)
  • 1024 iFOV scans per scene
Conclusions

- Geo-CAPE Oceans STM requirements are achievable with CEDI or similar class of instrument.
- Scan mirror mechanism is at the edge of what is achievable.
  - Further design study is required.
  - Dedicated effort required to investigate, characterize, and mitigate all sources of disturbances to scan mirror.
- Additional design studies recommended
  - To reduce instrument size and cost
  - To extend design to meet goal requirements for temporal and spatial resolution

2010 IIP Proposed Instrument Concepts
- Ball: multi-slit Offner spectrometer
- APL/GSFC: CEDI pointing stabilization system
- others?
EXTRA SLIDES
**Radiometry Requirements & Results**

**70° SZA case**

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**Challenge to overcome ocean requirements of high sensitivity (SNR) without saturating the detectors.**
Ltyp = ~TOA Radiances at 70° SZA*

Total integration time = ~17.1 min per scene
0.8 sec integration time per scan line
Co-add 2 frames for UV-VIS-NIR & 46 for SWIR
Ltyp & Lmax equivalent to SeaWiFS values

Total integration time = ~10.3 min per scene
0.4 sec integration per scan line
Co-add 3 frames for UV-VIS-NIR & 23 for SWIR
Saturation of 1245 and 1640nm bands possible for extremely bright scenes.
Lmax(Barnes) based on SeaWiFS data, only 0.2% of pixels saturated
Aperture & Calibration Covers Opened

2-Sided Diffuser plate

Solar Calibration View

Lunar Calibration & Nadir Science Views

Scan mirror mechanism