Abstract
Geosynchronous satellites (orbiting in the same revolution period as the Earth) offer a unique perspective for studying environmental factors, and for those in the geostationary orbit (geosynchronous equatorial orbits, nearly 35,700 km above the surface) 24 hour imaging is possible. This paper describes survey data for NASA's satellite program called the GEOCAPE mission to address essential and air pollution events in geostationary orbit, complementing similar initiatives by the South Korea in Asia, and by ESA in Europe, effectively covering the northern hemisphere. Commercial communication satellites are envisioned to provide a platform for instruments capable of viewing the GEOCAPE environment. The Tropospheric Emission: Monitoring of Pollution (TEMPO) will measure atmospheric pollution covering most of North America, and at high spatial resolution from geostationary orbit. The NASA Earth Venture instruments will take advantage of a GEO host spacecraft to impose emission inventories, monitor population exposure, and enable effective emission-control strategies for reducing the impact of human activities on the environment.

This paper addresses the results of a NASA study to explore observation strategies to fully exploit both unique observing viewpoints and new technologies enabling the rapid acquisition and delivery of environmental data products sufficient to understand natural hazards and supporting the disaster management life cycle.

Study Objectives
The goal of the GEOCAPE ocean observations optimization feasibility study was to research options for an overall observing strategy to maximize the ocean science return. This study identifies key scientific benefits such as improved time and quality of observations, and compared costs and benefits of potential strategies. Specifically:

- Examine and develop needs analysis driving ocean instrument operations concepts
- Determine ways to optimize observations with respect to cloud avoidance
- Describe the high-cost/benefit tradeoff for candidate observation strategies

Instrument Scheduling Environment Assumptions

Cloud Forecast Scheduling Concepts

Example FR Survey Schedule with Cloud Thresholds generated on the ground
- FR scenes fail cloud threshold
- Green scenes pass - scheduled
- Orange scenes are marginal and are acquired for more evaluation onboard
- Red marginal scenes are acquired, and nullified cloud detection is employed to determine if cloud threshold is met; if so, observation is deleted if not meet to reduce data handling costs

Onboard Cloud Detection Algorithms

- Landsat 7 bands: 2, 3, 4, 5, and 6 (Thermal IR) for 30m resolution cloud detection
- GOES bands: 2, 3, 4, 6, 8, and 10 for 4km resolution cloud detection
- EO-1 Hyperion bands: 21, 31, 51, 110, 123, 150, 30m
- Thermal bands distinguish clouds from ice
- SWIR band 1375um (used by EO-1 / Landsat-8) is the most critical to detect high cirrus clouds that contain scenes especially in coastal areas

Key Findings
Hosted payload operation concepts are still evolving. While offering 24/7 monitoring at high resolution, data handling may be a cost driver to mitigate with onboard processing. GSCF's GEO-CAPE Observations Simulator demonstrated the feasibility and benefits for several intelligent observables strategies:

- Daily (or 6 hour) forecast scheduling: cloud threshold settings and forecast constraints; marginal scene handling
- Onboard processing all cloud detection to only downlink observations that pass cloud thresholds; thus reduce data handling costs
- Cost-effective onboard processing available with technology emerging

References