Small geostationary science satellite proposal, GOAL (Geostationary Observation of Atmospheric chemistry and Lightning)

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1. Introduction

There are several important scientific targets in troposphere: 1) Air Quality, 2) Climate Radiative Forcing, 3) Oxidation Capacity of Atmosphere, and 4) O3 Depletion/UV-B. These over-arching science issues are not only cross-relating but also strongly required from Kyoto Protocol, Long-range Air Pollution International Treaty, and Montreal Protocol. It have been well recognized that current measurement requirements on these 4 issues are far beyond the existing observing system (satellites and other observations). There is strong demand to consolidate new integrated observation/science using revolutionary high temporal/spatial resolution satellite observations, with better accuracy and for new observation targets. New scientific satellite observations should be integrated with airborne and ground-based observations and assimilation/analysis/model studies. In the present paper, we propose a small (150 kg class) geostationary science satellite (GOAL: Geostationary Observation of Atmospheric Chemistry and Lightning), which enables us to observe earth's atmosphere with far better temporal/spatial resolution.

2. Scientific issues and instruments

The GOAL satellite will carry four instruments (60 kg), which have Japanese heritage, on 150 kg class small satellite. It is presumed that the development is based on common (ISAS System) lead by few scientist in University/Space Agency. This proposal has sensor and component level similarity/heritage with on-going ISAS Planet-C program targeting Venues in 2008. There are several on-going similar geostationary proposals in USA and Europe, and it is already discussed to have collaborations; 1) 4 geostationary satellite (2 US, 1 EU, 1 Asia/Japan), 2) sensor provision, and 3) science collaborations.

UV-Visible Spectrograph: Imaging spectrograph to observe 1D spatial (1000 pixels) with 270-440 nm, 0.5 nm resolution. 10 km x 10 km IFOV and 60 minutes interval. Solar diffuser, Moon, and Lamp calibrations. Targets; SO2, NO2, HCHO, BrO, OClO, O3 column, O3,tropospheric column, UV absorbing (Black-C, dust) aerosols, for 1) large scale air pollution, 2) biomass burning, and 3) tropospheric chemistry.

UV-Visible Imager: 1000x1000 CCD camera with 18 deg IFOV for earth disk, with 10 minutes interval. 10 bands (position/width in nm, 317.5/1, 325/1, 340/5, 388/5, 393.5/1, 443/10, 551/10, 645/10, 869.5/15, 906/15) targeting O3/SO2 column, UV absorbing aerosols over land, aerosols on ocean (Visible bands), cloud top height, water vapor. Radiative forcing of aerosols, dust (Kosa) observation, upper troposphere/stratosphere meteorology/dynamics, trial on early detection of volcanic eruption.

CO Imager: 2/4 micron gas correlation spectrometer similar to MOPITT, with 10 km IFOV, 1000x1000 imaging of 18 degree earth disk in 10 minutes. Component level heritage from Planet-C IR-2 camera using 65K cooled 1000x1000 camera. CO map with vertical information contents, anthropogenic (industrial/agricultural) and biomass burning CO emission/transport/reaction.

Lightning Sensor: TRMM/LIS lile. 10 km IFOV, 2500x2500 km FOV (256x256), 4 ms resolution, 777.07 nm (O I), onboard lightning event detection, 100 kbps, 20 kg. To be developed by U. Tohoku/U. Pref. Osaka using development heritage of lightning sensor for Planet-C. NOx formation by lightning in background atmosphere (70% estimated contribution). sciences on rainfall/latent heat capacity, trial on early warning to air traffic control.

3. Feasibility of small geostationary satellite

This proposal assumes 150 kg small satellite with 60 kg payloads (science instruments/X bands transmission etc) to be launched as piggy bag of commercial geostationary launch. It is expected that 60 kg instrument payload is possible from research heritage of planetary science programs (Planet-C). It is assumed to use commercial small satellite bus will be available, in time (Smartsat-1 for example).