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Apophis Observation by JAXA Operational Satellite

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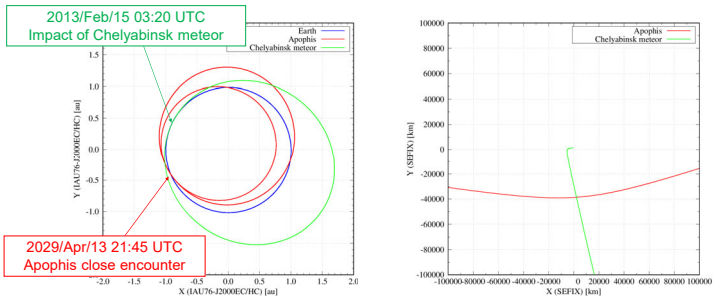
The close Earth approach of the Apophis is the first event in which 300 m size asteroid flybys with the altitude lower than GEO ring and the exciting event for mankind. Since the flyby occurs only 4 years later, the development of a new spacecraft for the Apophis observation is very challenging from the perspective of both cost and the development duration, the Japan Aerospace Exploration Agency (JAXA) is studying about the possibility of Apophis observation in space by using the JAXA operational satellites i.e., 12 satellites and 1 future GEO mission.

Orbit of Apophis

The estimated size of Apophis is c.a. 300 m and it will pass the Earth inside a GEO ring.



Left : The orbits of Apophis (red) and Chelyabinsk (green) described in Heliocentric ecliptic inertial frame.
Right: The orbits of Apophis (red) and Chelyabinsk (green) described in Geocentric Sun-Earth fixed frame.

Table. Perigee information of Apophis

Terms	Value	Unit
Perigee epoch	2029/Apr/13 21:45	UTC
Perigee Alt.	32735.9	km
Latitude	28.5N	deg
Longitude	43.0W	deg

List of JAXA operational satellites

JAXA currently has 14 operational satellites as following:

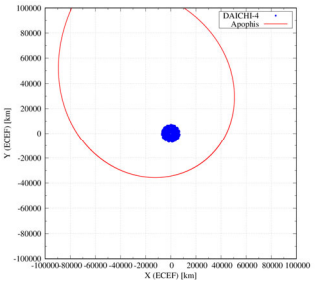
Table. List of JAXA Satellites

Name	Orbit type
XRISM	ACO inclination = 30 deg
Hinode	SSO
Arase	HEO
Reimei	Quasi-SSO
Shikisai	SSO
Daichi 2	SSO
Ibuki 2	SSO
GPM-CORE	ACO inclination = 65 deg
Shizuku	SSO
Ibuki	SSO
Daichi 4	SSO
LUCAS	GEO
ETS-9 (plan)	GEO

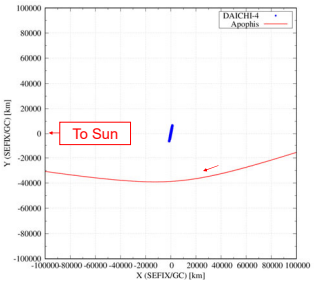
JAXA is operating 2 Almost Circular Orbit (ACO) satellites with inclination of 30 deg and 65 deg, 1 High Elliptical Orbit (HEO) satellite, 7 Sun-Synchronous Orbit (SSO) satellites and 2 Geostationary Orbit (GEO) satellite, 13 satellites in total including future mission.

Example of Observability Analysis

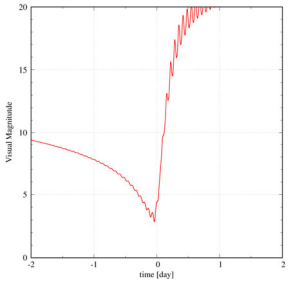
Observation from SSO (Daichi 4)



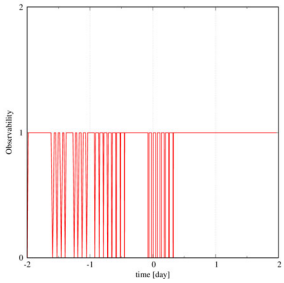
XY plane (ECEF)



XY plane (SEFIX)

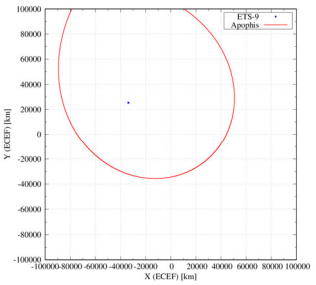


Visual Magnitude

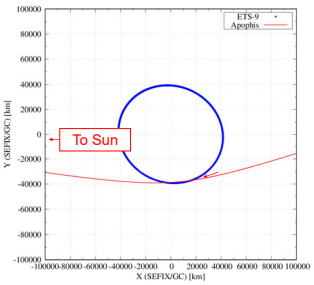


Observability

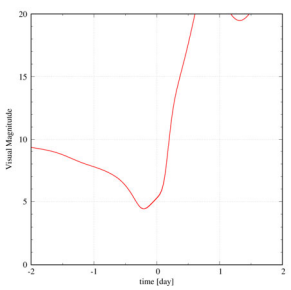
Observation from GEO (ETS-9)



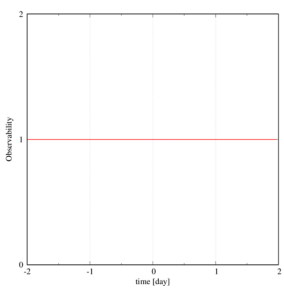
XY plane (ECEF)



XY plane (SEFIX)



Visual Magnitude



Observability

Since SSO is polar orbit, it has good observability when the Apophis direction is near the normal vector of the orbital plane (Daichi-4). GEO has the best observability (1: observable. 0: non-observable) in the 4 types orbits. JAXA is studying on the possibility of Apophis observation by ETS-9 and also consulting with Japan Meteorological Agency for the use of Himawari, Japanese GEO weather satellite.