Celestial mechanics. Problems

Part 1

In  following calculations assume

- GEO orbit height = 35800km;
- Earth radius = 6400km;

1.1) Estimate maximum spatial error in position on Earth surface if UTC is used instead of UT1

1.2) Calculate period of a satellite X1 on near circular orbit with altitude 500км

1.3) Calculate mean velocity of the satellite X1 and mean velocity of its subsatellite point

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1.4) Calculate longitudinal distance (km) between two successive ground tracks for X1. a) at equator b) at 55d. latitude

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1.5) How many imaging GEO satellites are required to cover Earth without gaps in equatorial belt ?

Part 2

- For next problems select one satellite from a list: AQUA,TERRA, RADARSAT-2.
- Fetch and use a fresh TLE from www.celestrak.com
- Ground station and imaging target are located at 55N.latitude, 37 E.longitude unless specified otherwise
- Reference or start of scenario time is 2019-01-30T00:00:00UTC

2.1) Calculate satellite position at reference time (Cartesian, lat-lon-alt , topocentric(az,el,range)

2.2) Calculate AOS/LOS events for first contact with the ground station (min. elevation level 10deg)

2.3) Calculate first pass culmination event time and culmination elevation.

2.4) Calculate first 5 imaging events schedule for the target. Imaging incidence angle < 30deg.

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2.5) ** Simulate TLE sets for constellation of 4 satellites flying in 4 equally spaced orbital planes. Use an existing set as a reference. Calculate first 5 imaging events schedule for the simulated constellation

2.6) *** Select one of provided TLE files with one year coverage and investigate increase of propagation error vs epoch age