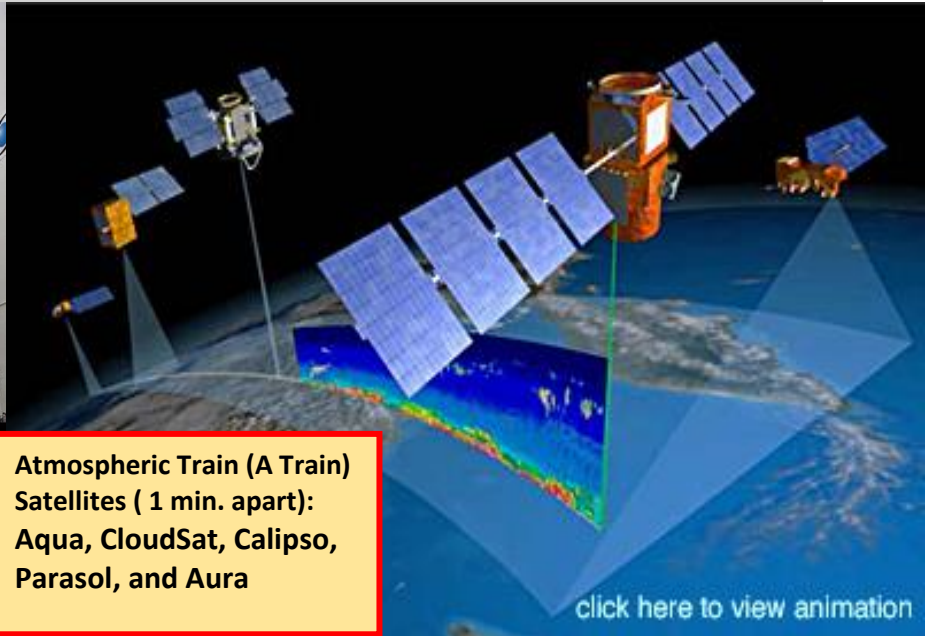


# CENTRIPETAL FORCE & GRAVITY

Units 14 & 8 , Dr. John P. Cise,

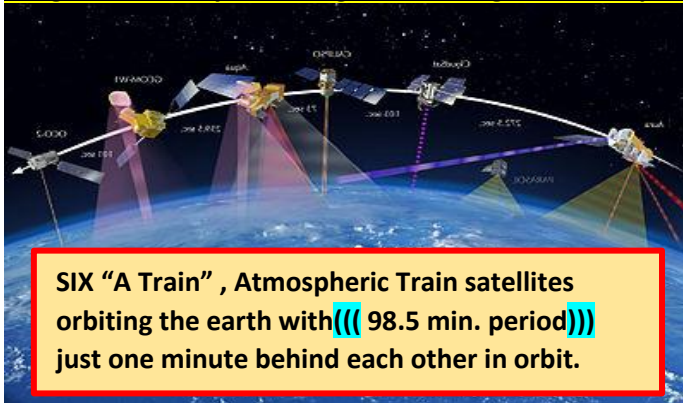
Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 & New York Times , April 10, 2017 by Henry Fountain. Dedicated to my Roger Bacon High School Math teacher Mr. Peters at Roger Bacon High, St. Bernard, Ohio, 1958

## Scientists Fear Climate Data Gap as Trump Aims at Satellites



Atmospheric Train (A Train) Satellites ( 1 min. apart): Aqua, CloudSat, Calipso, Parosol, and Aura

The Deep Space Climate Observatory, or DSCOVR, spacecraft, before launching in 2015. **The Trump budget would end a climate-related aspect of the mission.** Among the sweeping cuts in the Trump administration's 53-page [budget blueprint](#) released last month, one paragraph stood out to climate researchers. It proposed eliminating four of NASA's climate science missions, including instruments to study clouds, small airborne particles, the flow of carbon dioxide and other elements of the atmosphere and oceans. The blueprint is as much a political document as a fiscal plan, in this case designed to send a message that the administration intends to pursue a long-sought goal of some conservatives: to clamp down on NASA's study of [Earth](#) rather than space. But Congress may have other ideas, especially since the projects are not very costly. The savings from eliminating the earth science programs, which include the missions, would total \$102 million out of a proposed agency budget of \$19 billion. But for other missions where no replacement is in development, researchers have to seek workarounds. The **Terra and Aqua satellites, for example, carry imagers that make moderate-resolution images over many wavelengths, covering the entire planet every day or two.**



SIX "A Train", Atmospheric Train satellites orbiting the earth with (98.5 min. period) just one minute behind each other in orbit.

**INTRODUCTION** : Calipso is one of six atmospheric data collection satellites in almost perfect circular orbits around the earth at height H. The purpose of this application is to confirm NASA fact that these satellites are in orbit 436 mi. above earth surface = H. Satellites are held in orbit by gravity. Gravity supplies the required centripetal force:  $GmM/R^2 = m v^2/R$ , but  $v = R\omega$  Where  $\omega = 2\pi f = 2\pi/T$ , since frequency  $f = 1/T$ (period). Thus rearranging terms:  $M_{EARTH} = [4\pi^2/G][R^3/T^2]$  This is called Kepler's 3<sup>rd</sup>. law. ,  $G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$  G = called gravitational constant.

**QUESTIONS:** (a) Convert 98.5 min. period T to seconds? (b) Find R? R = distance(in meters) from earth center to Calipso and other A train satellites. (c) Find H height(in m.) above earth of calypso satellite?,(d) Convert H in meters to miles?,(e) How well does competed H compare to known 436 miles of all the A train satellites?

**HINTS:**  $M_{EARTH} = 5.97219 \times 10^{24} \text{ kg.}$ ,  $R_{EARTH} = 6363 \text{ km.}$   
 $R = R_{EARTH} + H$ , 1.62 km. = 1 mile , 60 s. = 1 min.

**ANSWERS:** (a)  $T = 5910 \text{ s.}$ ,(b)  $R = 7.0635 \times 10^6 \text{ m.}$   
 (c)  $H = 710.58 \text{ km.}$ , (d) 438 miles, (e) Very close, happiness!