

(1) If every car and truck in the U.S. were driven 300 miles north and left there, by how much would the length of a day be changed?

Shifting mass  $m$  northward by a small distance  $s$  on a sphere of radius  $r$  reduces its moment of inertia about the sphere's axis by  $2msr \sin \theta \cos \theta$ , where  $\theta$  is the latitude. Over most of the U.S.  $\sin \theta \cos \theta$  is close to  $1/2$ . For the moment of inertia of the Earth I'll use that of a uniform sphere of mass  $M$ ,  $0.4 Mr^2$ . The fractional change resulting from the shift of mass is therefore  $5ms/2Mr$ . I estimate  $m$  as  $1.5 \times 10^{11}$  kg ( $10^8$  vehicles averaging 1.5 tons each). Then with  $M = 6 \times 10^{24}$  kg and  $s/r = 300/4000 = 0.075$ , the fractional decrease in moment of inertia is  $5 \times 10^{-15}$ . That will shorten the day by about 0.4 nanoseconds.