EXTRA PROBLEMS
Feb 10, 2016

1. Calculate the fraction of the surface of Earth illuminated by the Sun. Take atmospheric refaction into account. The radius of the Sun is $696{,}000$ km, the radius of Earth is 6400 km, and the distance between Earth and Sun is 150 million km.

2. Proxima (α Cen) is our second nearest star. Its equatorial coordinates are $\alpha = 14^h39^m36^s$ and $\delta = -60°50'07''$.

   a) From where on Earth will we see the superior culmination on Apr 1, 2016, at 20^h Greenwich local time at the $20°$ altitude? Do not forget to take atmospheric refraction into account.

   b) After what time will Proxima set? At what azimuth will that be?

   Find the Greenwich sidereal time at midnight UT in the almanac.

3. We are observing Altair (α Aql) from Ljubljana (I had to use it so that you good people learn how to spell my home city :p) on Sep 22, 2016. At 9pm we see it at a $15°49'23''$ altitude and a $273°32'14''$ azimuth. Geographic coordinates of Ljubljana are $\varphi = 46°02'37''$ N and $\lambda = 14°31'38''$ E.

   a) Compute equatorial coordinates if you neglect atmospheric refraction.

   b) What is the error in equatorial coordinates because you neglected atmospheric refraction?

   c) What is the change in right ascension and declination of Altair due to precession in one year?

4. From the Mauna Kea observatory in Hawaii ($\varphi = 19°45'32.4''$ N and $\lambda = 67°34'52.5''$ W) we are observing a star with declination $67°34'52.5''$ precisely on the northern horizon. What is the elevation of Mauna Kea? What is the increase in percentage of the visible sky from Mauna Kea?

5. On the reverse side of this sheet you will find a sky map. Assuming we are observing from Villanova ($\phi \sim 40°$ N, $\lambda \sim 75°$ W), mark the part of the sky that is visible on the automnal equinox. Assume that the visibility is determined by the mathematical horizon, i.e. you may neglect any atmospheric corrections or geographic obstacles.