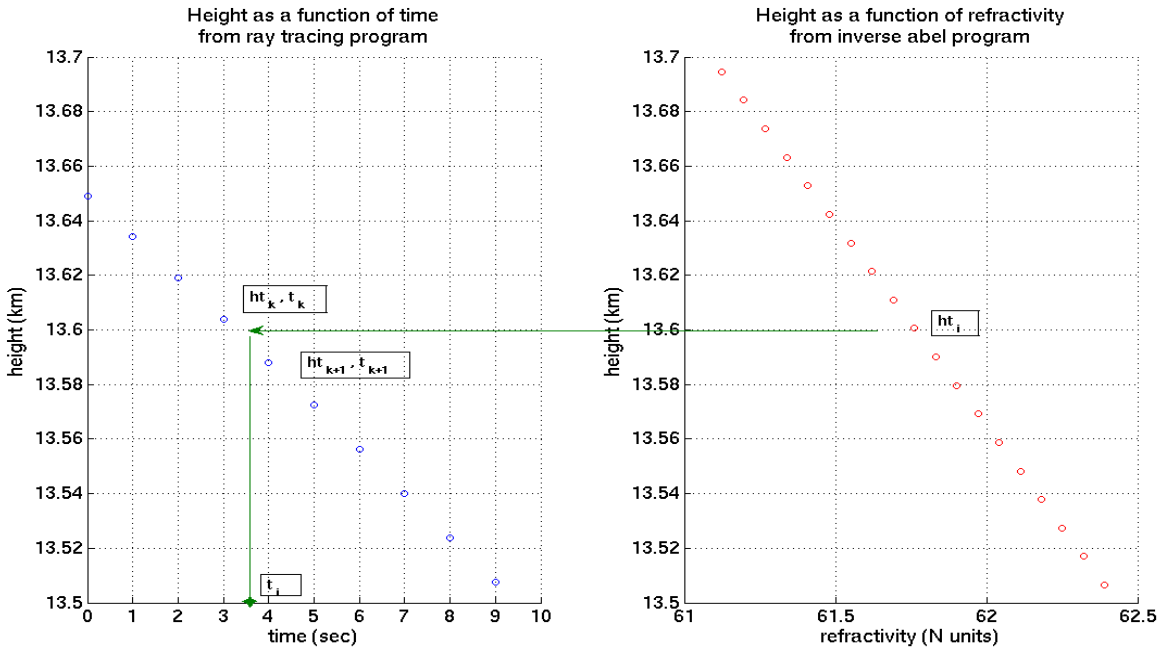
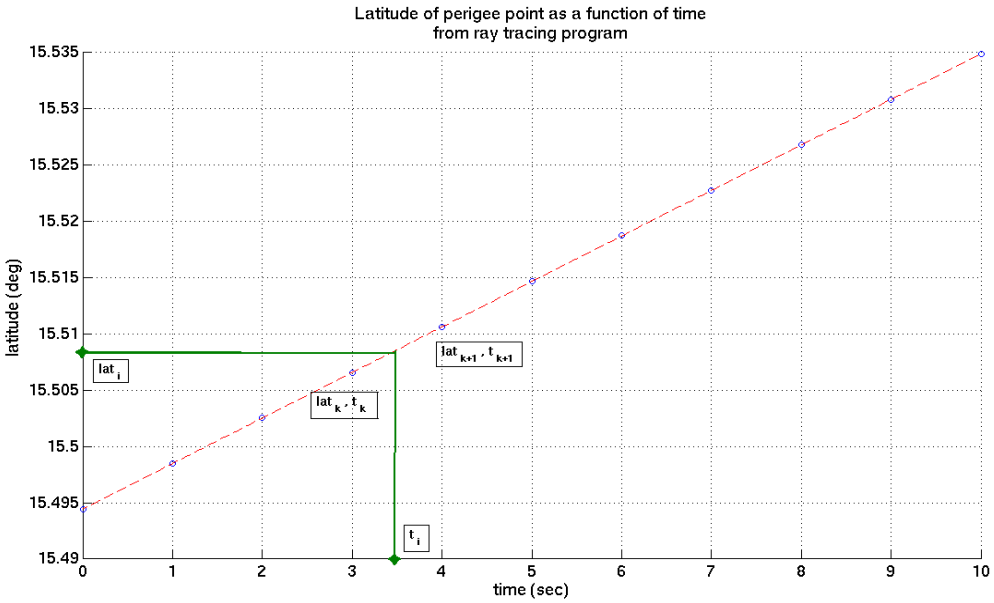
Time: In the output of the abel inversion program, the tangent point height, ht_i, is given for each refractivity value, N_i. From the output of the forward simulation ray-tracing using this refractivity profile, the tangent point is calculated as a function of time. Since the ray-tracing program tangent point height as a function of time, I can use this dataset to interpolate time values at the tangent point heights of the refractivity profile output by the inverse abel program. All other parameters needed in the atmPrf file, e.g. latitude and longitude, are calculated in the ray-tracing program as a function of time, so they can be interpolated at times corresponding to tangent point ht_i of the refractivity file in order to associate a location (lat_i , lon_i) with a refractivity value N_i.

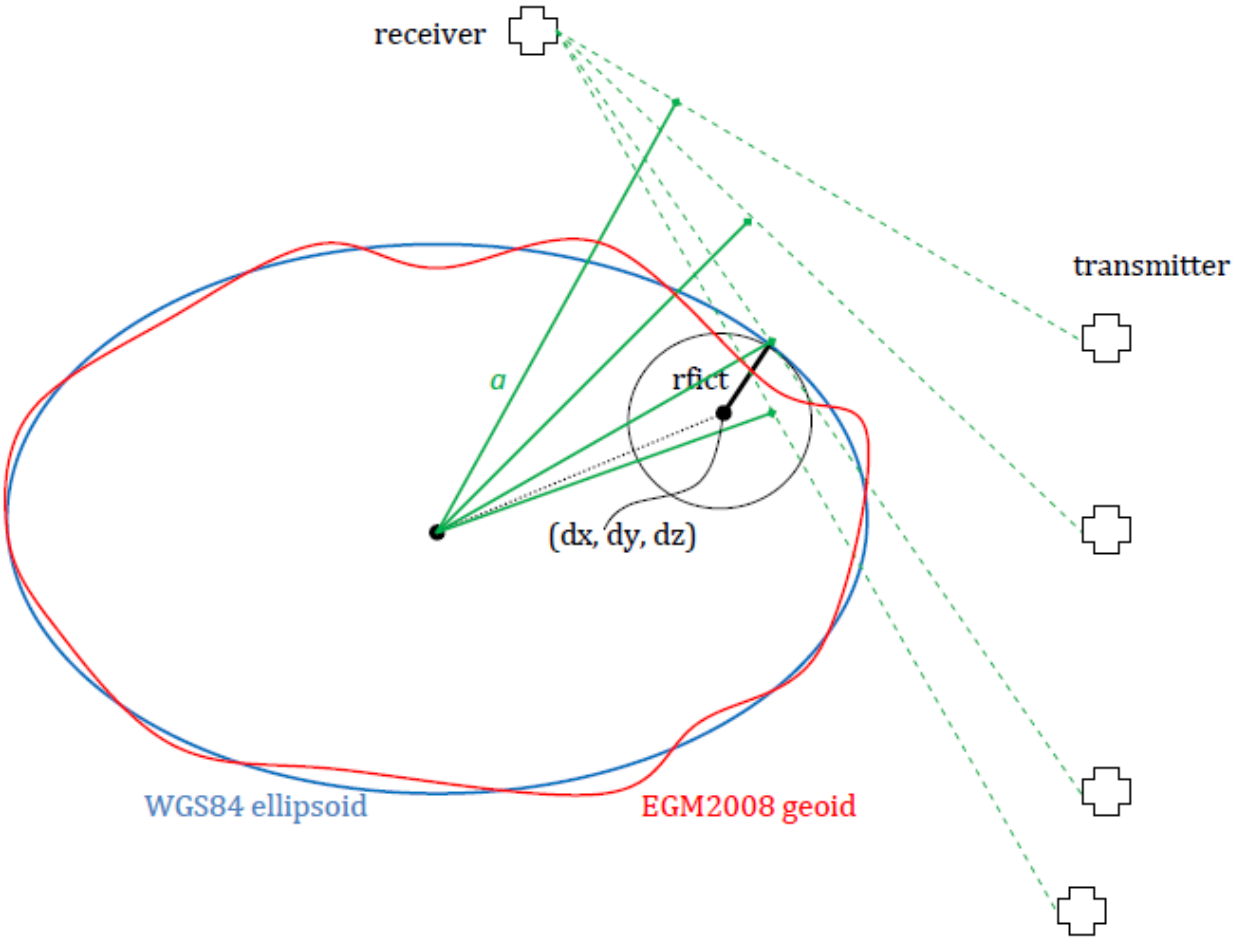


$$\text{linear interpolation: } t_i = t_k + \frac{(t_{k+1} - t_k)}{(ht_{k+1} - ht_k)} \cdot (ht_i - ht_k)$$

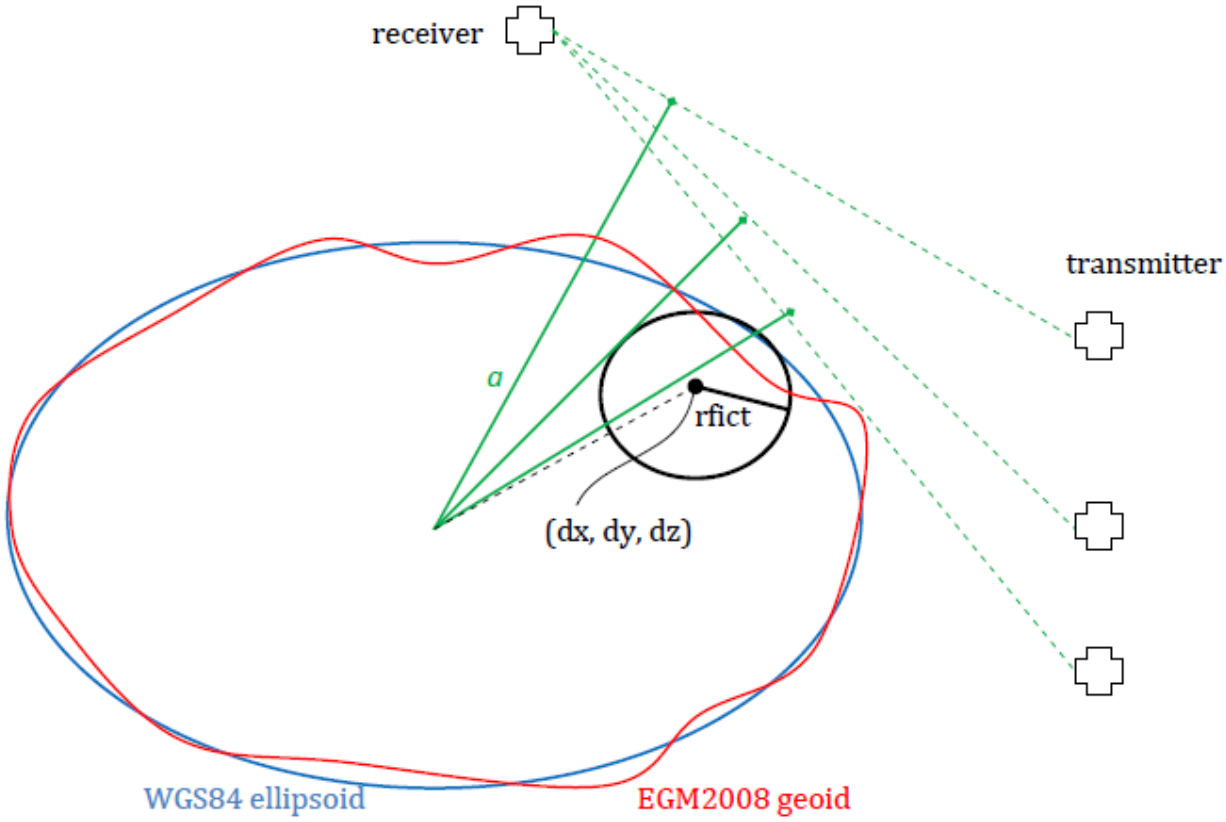


Global variable rgeoid: rgeoid is the geoid height of location where rfict is calculated.

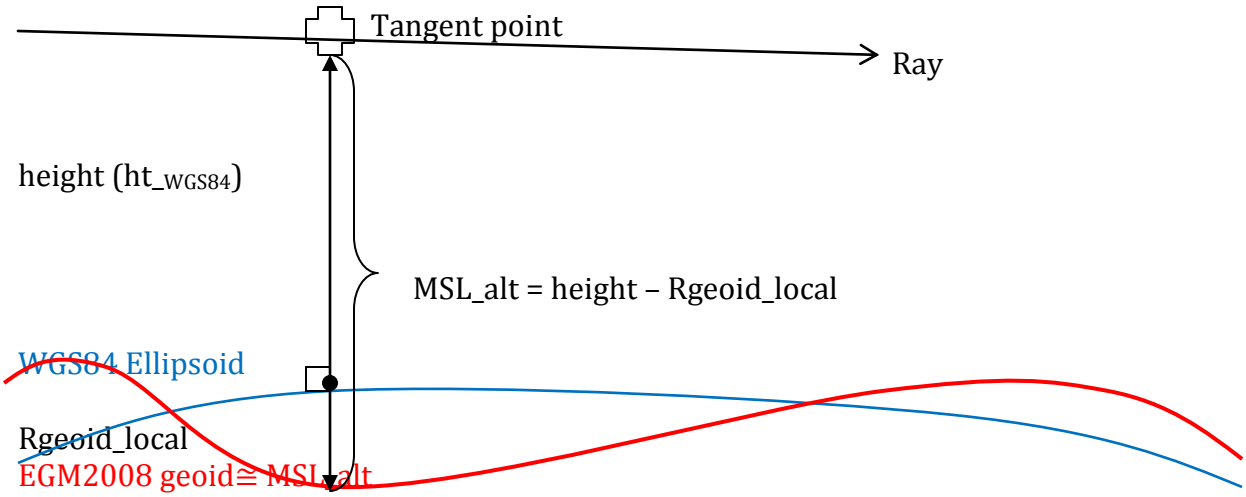
Sketch 1: rgeoid is the height of the geoid above the WGS84 ellipsoid at the geodetic location where the radius of curvature for the occultation (rfict) is chosen. The radius of curvature is the radius of a spherical surface tangent to a point on the ellipsoid which best matches the curvature of the ellipsoid at that same point. *a* is the perpendicular distance from the Earth center to the straight line joining receiver to transmitter and defines the location of the straight line tangent(perigee) point of the line at that time. The radius of curvature (rfict) for the occultation is chosen at the point where the distance *a* is equal to the distance from Earth center to the ellipsoid surface at that location. The straight line distance equal to the ellipsoid radius is found by starting with the time point of lowest elevation in the occultation and moving up in elevation until the length of *a* just exceeds the distance from Earth center to the ellipsoid at that location. If the satellite elevation is never that low during the recorded occultation, the geodetic location of the straight line tangent point that is closest to the ellipsoid is chosen as the point where rfict is calculated.



If *a* is greater than the distance from Earth center to the ellipsoid at the lowest elevation, the radius of curvature at the location of the tangent point of the lowest elevation straight line distance is chosen as rfict.



Local variable MSL_alt: altitude above mean sea level.



Sketch 2: The EGM2008 geoid is the equipotential surface that best fits sea level, or where sea level would be in the absence of topography. The WGS84 ellipsoid is the best fitting ellipsoid to that equipotential surface. The geoid height is the height of the geoid above the WGS84 ellipsoid. Rgeoid_local refers to the geoid height at the location of the tangent point. We neglect the deviation of the vertical (perpendicular to geoid) from the perpendicular to the ellipsoid. The altitude above sea level (MSL_alt) of a point that is located at height ht_{WGS84} above the WGS84 ellipsoid is $MSL\_alt = ht_{WGS84} - Rgeoid\_local$.