

Latitude / longitude distance and bearing.

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I have two locations, call them 'a' and 'b' .

- Altitude of a and b (call them alt_a and alt_b).
- Latitude of a and b (call them lat_a and lat_b)
- Longitude of a and b (call them long_a and long_b)

'a' and 'b' are fairly close together (10 – 20 km) and in line of sight distance. (Two mountain peaks).

I want to find

- The straight line distances from a to b. (*Not* the distance along the circumference of the earth, which I can get from the Haversine formula)
- The bearing of 'a' when viewed from 'b'.
- The vertical angle – i.e how many degrees above the horizon is 'a' when viewed from 'b'. (alt_a > alt_b).

If the distances were sufficiently large, the location with the higher altitude could be below the horizon when viewed from the one with lower altitude, but in this case, the distances are small. so the location with the higher altitude is well above the horizon of the location with the lower altitude.

I am willing to assume the earth is spherical. The distances involved are not huge (a few tens of km), and are in Europe (Latitude is North, Longitude is East).

I asked this on 'Dr. Math' and someone suggested I worked in spherical coordinates (rho, theta, phi) then transferred to rectangular.

I've done that and found the points x_a, y_a and z_a using

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rho_a=EARTH_RADIUS+alt_a;  
theta_a=long_a;  
phi_a=M_PI/2.0-lat_a;
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Transferred to cartesian coordinates

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x_a= rho_a*cos(theta_a)*sin(phi_a);  
y_a = rho_a*sin(theta_a)*sin(phi_a);
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$$z_a = \rho_a \cdot \cos(\phi_a);$$

so I get the points x_a , y_a and z_a relative to the point 0,0,0 which is the centre of the earth.

I did likewise for location b, to get x_b , y_b and z_b .

Then I computed

$$dx = x_a - x_b$$

$$dy = y_a - y_b$$

$$dz = z_a - z_b$$

The radial distance between a and b, which is one of the 3 parameters I need, is

$$r = \sqrt{dx^2 + dy^2 + dz^2};$$

But I'm stuck as how to find the other two parameters – the bearing the angle above the horizon.

I'm aware of this page:

<http://www.movable-type.co.uk/scripts/latlong.html>

which has formula for the bearing between two locations, but there is nothing there about altitude, which I suspect might mean the formula are not valid.

Any thoughts?

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Dave (from the UK)

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It is always of the form: month-year@xxxxxxxxxxxxx

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