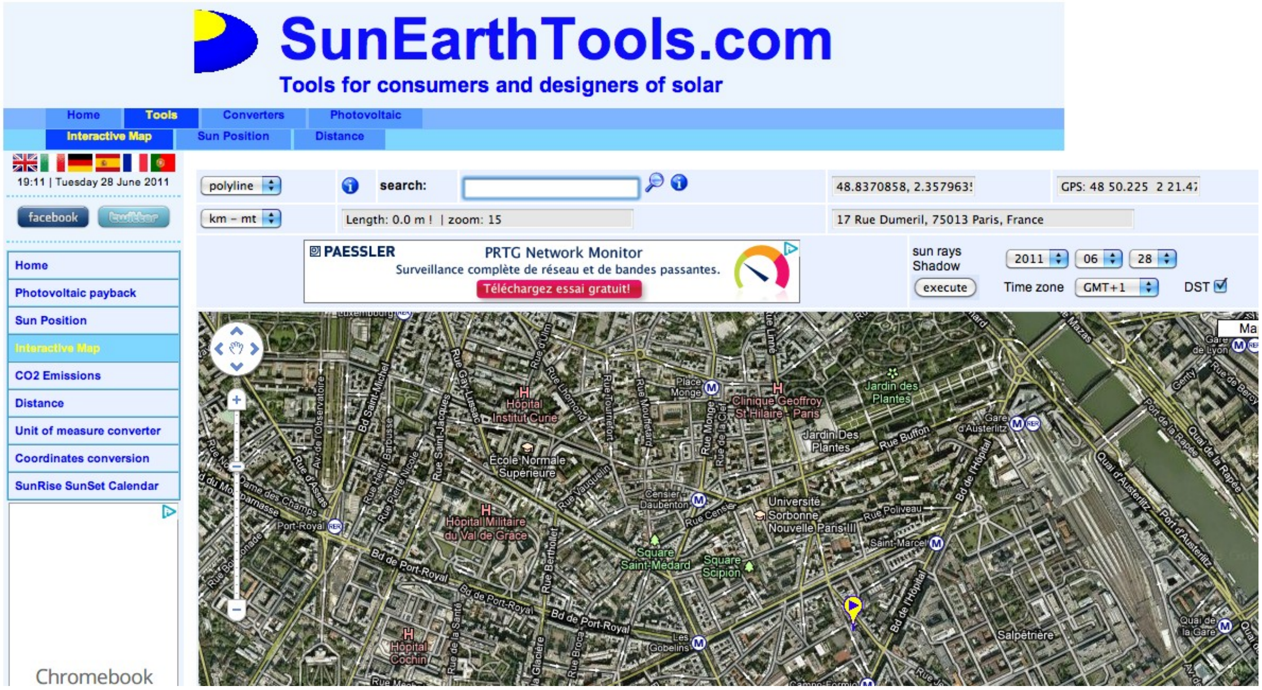
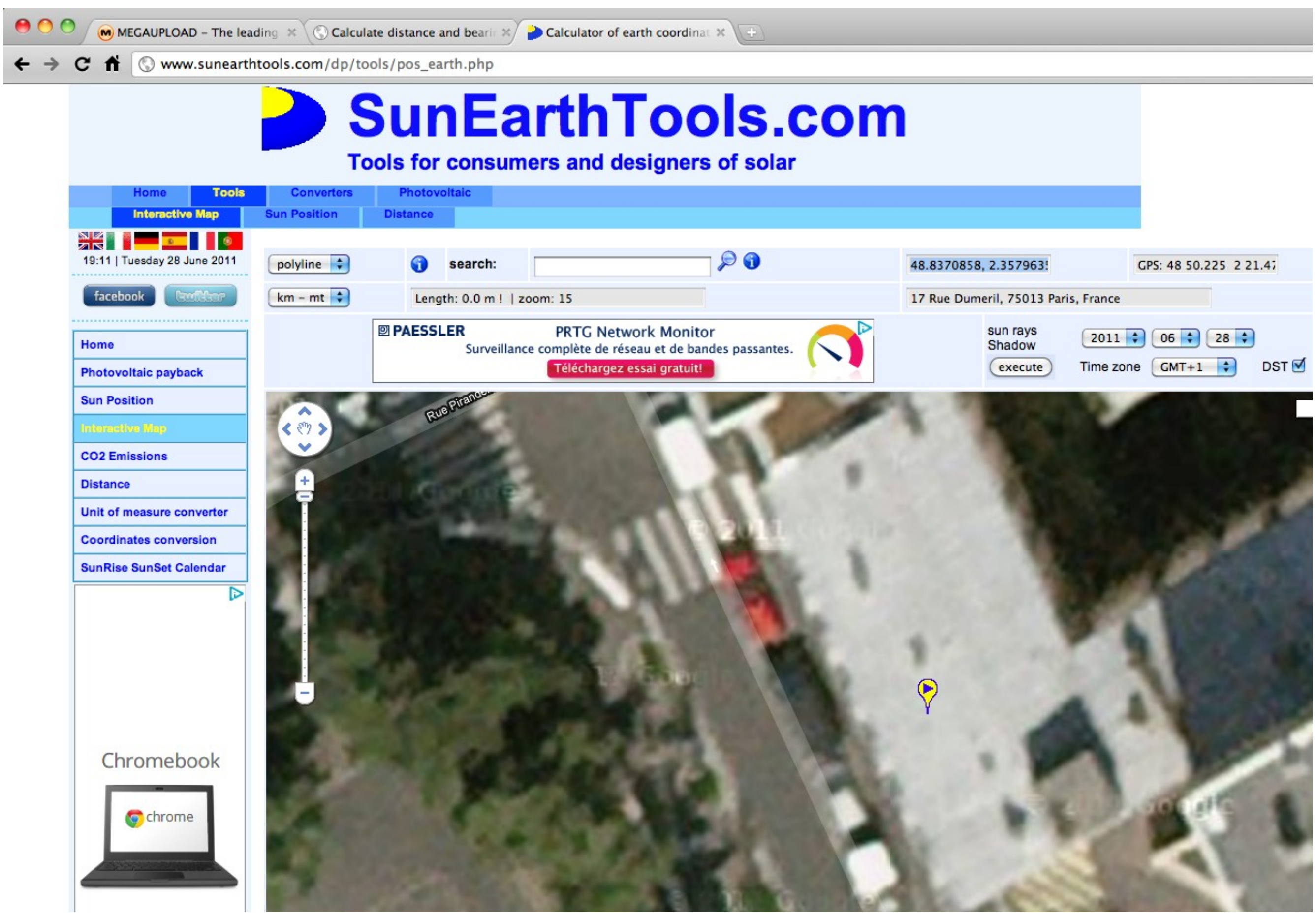
Data information center / How to calculte distances



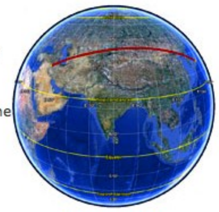


(lat/lon in radians!)

This uses just one trig and one sqrt function – as against half-a-dozen trig functions for cos law, and 7 trigs + 2 sqrts for haversine. Accuracy is somewhat complex: along meridians there are no errors, otherwise they depend on distance, bearing, and latitude, but are small enough for many purposes* (and often trivial compared with the spherical approximation itself).

Bearing

In general, your current heading will vary as you follow a great circle path (orthodrome); the final heading will differ from the initial heading by varying degrees according to distance and latitude (if you were to go from say 35°N,45°E (Baghdad) to 35°N,135°E (Osaka), you would start on a heading of 60° and end up on a heading of 120°!).



Baghdad to Osaka

This formula is for the initial bearing (sometimes referred to as forward azimuth) which if followed in a straight line along a great-circle arc will take you from the start point to the end point:[1]

Formula: $\theta = \text{atan2}(\ \sin(\Delta\text{long}).\cos(\text{lat}_2),\ \cos(\text{lat}_1).\sin(\text{lat}_2) - \sin(\text{lat}_1).\cos(\text{lat}_2).\cos(\Delta\text{long})\ )$

JavaScript:
```
var y = Math.sin(dLon) * Math.cos(lat2);
var x = Math.cos(lat1)*Math.sin(lat2) -
        Math.sin(lat1)*Math.cos(lat2)*Math.cos(dLon);
var brng = Math.atan2(y, x).toDeg();
```

Excel:
```
=ATAN2(COS(lat1)*SIN(lat2)-SIN(lat1)*COS(lat2)*COS(lon2-lon1),
       SIN(lon2-lon1)*COS(lat2))
* Note that Excel reverses the arguments to ATAN2 – see notes below
```

Since atan2 returns values in the range -π ... +π (that is, -180° ... +180°), to normalise the result to a compass bearing (in the range 0° ... 360°, with -ve values transformed into the range 180° ... 360°), convert to degrees and then use (θ +360) % 360, where % is modulo.

For final bearing, simply take the *initial* bearing from the *end* point to the *start* point and reverse it (using θ = (θ+180) % 360).

Midpoint

This is the half-way point along a great circle path between the two points.[1]

Formula: $Bx = \cos(\text{lat}_2).\cos(\Delta\text{long})$
$By = \cos(\text{lat}_2).\sin(\Delta\text{long})$