The great circle distance

Teacher notes

Why use this resource?

This resource offers an opportunity to practise trigonometric manipulations and the use of identities in a real-world context. It follows on from Have a sine and Lost but lovely: the haversine, and gives students a structured opportunity to derive the haversine formula for great circle distances. With a suitable introduction, the resource could also be used without exploring the earlier resources.

Four different approaches are offered, and the third of these (spherical trigonometry) provides an opportunity to develop mathematical comprehension: students are given a small piece of (probably) unfamiliar mathematics and asked to make use of it to derive a result.

The final part of the resource ("Why use haversines?") offers one way to introduce the idea of small angles, through seeing the different behaviours of $\cos x$ and $\sin x$ when x is small, and the impact that has on our ability to calculate.

Preparation

Students would benefit from looking at Lost but lovely: the haversine prior to engaging with this resource, as it gives some historical context.

Possible approach

Students could be given copies of the printable version of the resource to work through in pairs. This has pointers to "Look online to check your answer". The second approach (vector scalar products) may be unfamiliar, depending upon whether students have studied this yet; it could be skipped without impacting on the rest of the resource.

Key questions

- Why is rotating the sphere helpful? What would the calculations look like if we didn't do this?
- Why use the haversine formula rather than the apparently simpler cosine formula?

Possible support

- What identities do you know for trigonometry that might be useful here?

Possible extension

Are there any situations in which the cosine version would work better than the haversine one?