

## **Astronomy Talk 18<sup>th</sup> June 2024**

### **Astronomical Causes of Climate Change**

This hybrid Zoom talk was given in person by James Fradgley. 9 attended in the hall and 66 on Zoom, making 75 in total.

First, we looked at long term solar output, from Snowball Earth to boiling oceans. We then moved on to short term solar variations from the 11-year cycles to 100,000 years. These are measured by the proxies Carbon-14 and beryllium-10.

Away from astronomy we covered geological factors, such as oceanic circulation, distribution of the continents, especially that most of the land is in the northern hemisphere, and large volcanic events such as Tambora and Toba.

Discussion of orbital factors included the Sun's journey round the galaxy, and the possible effects of interaction of the solar system with galactic dust clouds.

We then looked at the Milankovitch cycles. Earth's orbital eccentricity changes over several cycles, the dominant ones being 95,000 and 400,000 years. These are caused principally by Jupiter and the mechanism was discussed. Earth's axis precesses over a period of about 26,000 years. The mechanism is not steady, so it wobbles about a bit. Lastly axial tilt or obliquity varies over 41,000 years. The mechanism was looked at, and the Moon's current damping effect. Long term lunar resonance problems will make it unstable.

Earth's orbit bobs up and down relative to the invariant or Laplace plane, and there will be more interplanetary dust obscuring the Sun when it's in the plane.

In conclusion, astronomical effects are significant even in the short term, but are dwarfed by anthropogenic effects.