POLAR AXIAL TILT AND PRECESSION AND THE DEGLACIATION OF NORTH AMERICA

In AD 1170, the passage of Earth at aphelion (outermost point from the Sun) in its orbit around the Sun coincided with the northern summer solstice, an occurrence that has moderated seasons in the northern hemisphere, and conversely exacerbated seasons in the southern hemisphere, all other variables being fixed. In 2017, the passage at aphelion occurred 12 days after the summer solstice. The eccentricity of the orbit being 1.6%, the sun radiates 6.5% more energy at perihelion (closest point to the Sun) than at aphelion, quite a significant difference. The date of the passage at aphelion and perihelion varies cyclically, according to Earth's axial precession, which is also called precession of equinoxes, with a period of 25,772 years.

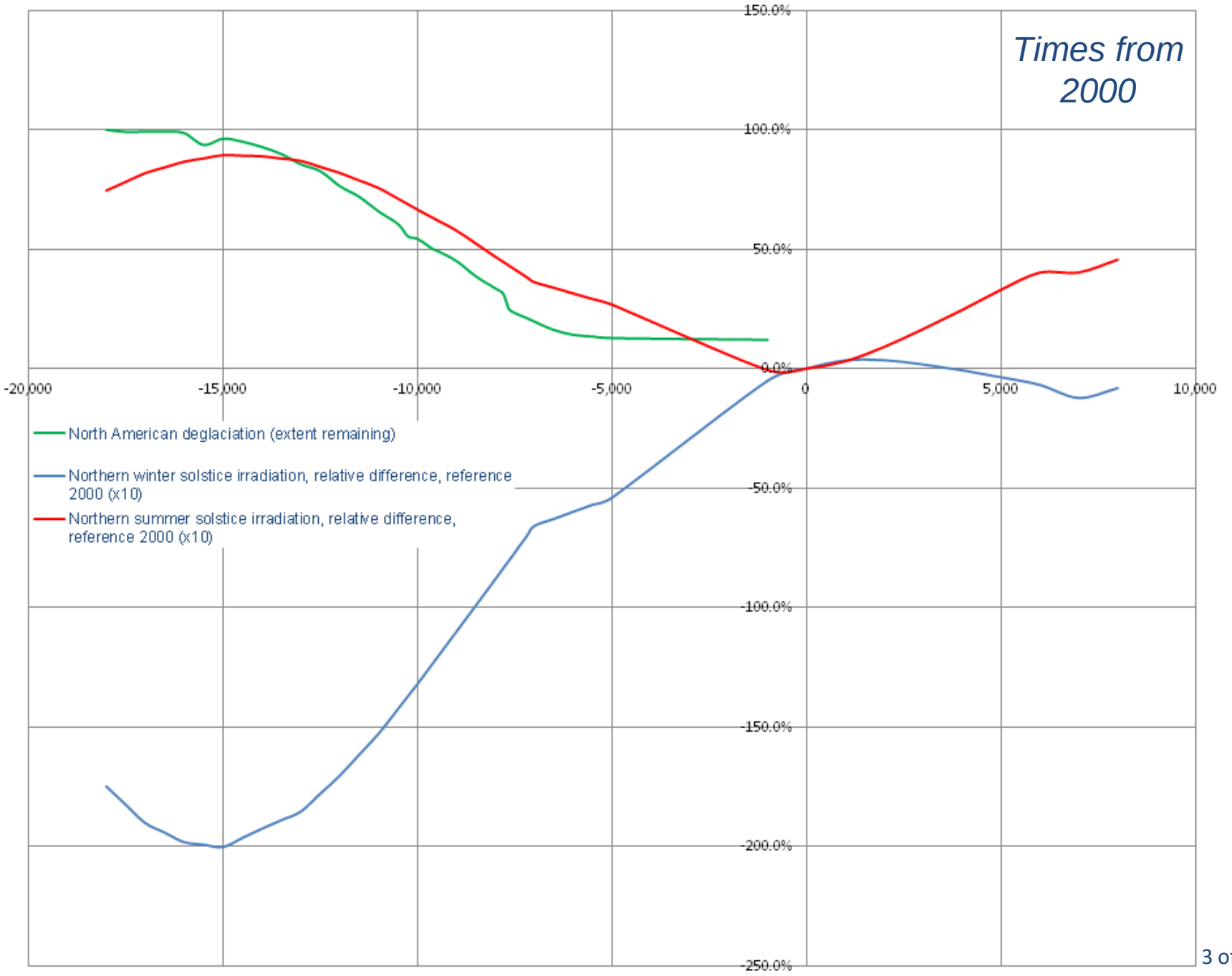
In addition there is also an axial tilt oscillation, which means the maximum elevation of the sun on the day of the solstice is not a constant, but varies with a pseudo-period of about 40,000 years. The phenomenon affects the declination of the sun at the solstices by as much as 3 degrees.

The combination of the two phenomena indicates that the northern hemisphere (at 50 degrees northern latitude) received 9% more irradiation on the day of the summer solstice 15,000 years ago than currently, and 20% less irradiation on the day of the winter solstice. At that latitude, winter solstice irradiation at noon is currently less than a third of what it is around the summer solstice, and days are half as long. It is more than probable that although winters were then colder in the northern hemisphere, the 9% additional summer irradiation was prevalent over the winter deficit.

It so happens that the deglaciation of North America appears to have started 15,000 years ago, around the time of maximum summer solstice irradiation, and tapered off about 6,000 years ago when, coincidentally or not, the extra irradiation had decreased from 9% to 2 or 3%.

The minimum of northern summer solstice irradiation was reached around AD 1200 and has since increased by only about 0.06%. It will take 15,000 years before in increases by another 9% or so.

Northern winter solstice irradiation has also increased, by about 0.5%.


Times from 2000
150.0%
100.0%
50.0%
0.0%
-50.0%
-100.0%
-150.0%
-200.0%
-250.0%
-20,000
-15,000
-10,000
-5,000
0
5,000
10,000
North American deglaciation (extent remaining)
Northern winter solstice irradiation, relative difference, reference 2000 (x10)
Northern summer solstice irradiation, relative difference, reference 2000 (x10)