A 1,470-Year Astronomical Cycle and Its Effect on Earth's Climate

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Abstract

Earth's millennial climate cycle has been studied by scientists for decades, but its cause has been lacking. It warms the Earth for several hundred years and melts some of the ice sheets in Greenland and Antarctica. My analysis discovered that it is caused by the astronomical conjunction of the planets Jupiter, Saturn and Neptune. This paper describes the observations that led to its discovery and explains how its 1,470-year spin-orbit resonance cycle warms the Earth with geothermal heat. The current cycle started warming the Earth in the year 1791 and will probably reach peak temperature in year 2060 at the next Jupiter, Saturn and Neptune conjunction. Then it will cause cooling oscillations for the rest of the cycle.

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Key Points:

- A 1,470-year astronomical cycle is currently causing the Earth to warm for several centuries.
- Increased geothermal heat from Earth's spin adjustment during the cycle is melting the polar ice sheets and heating the oceans.
- Earth's current warming should continue to the year 2060 and then will start to cool for the rest of the cycle.

Abstract

Earth's millennial climate cycle has been studied by scientists for decades, but its cause has been lacking. It warms the Earth for several hundred years and melts some of the ice sheets in Greenland and Antarctica. My analysis discovered that it is caused by the astronomical conjunction of the planets Jupiter, Saturn and Neptune. This paper describes the observations that led to its discovery and explains how its 1,470-year spin-orbit resonance cycle warms the Earth with geothermal heat. The current cycle started warming the Earth in the year 1791 and will probably reach peak temperature in year 2060 at the next Jupiter, Saturn and Neptune conjunction. Then it will cause cooling oscillations for the rest of the cycle.

1 Introduction

Scientists generally agree that Earth's long-term Milankovitch (Crucifix et al., 2007) and seasonal (annual) temperature cycles are caused by astronomical orbital changes. They have also identified a millennial temperature cycle (Roe & Steig, 2004; Yu et al., 2003; Ganopolski & Rahmstorf, 2001) but have not, until now, determined its physical cause. My analysis discovered that a 1,470-year astronomical conjunction of the planets Jupiter, Saturn and Neptune is its cause. The millennial temperature cycle is recorded in temperature proxies from ice cores in Greenland and Antarctica, as well as many other sources. The cycle is very obvious in Greenland (Figure 1), especially at the left of the figure where there are very large temperature increases.

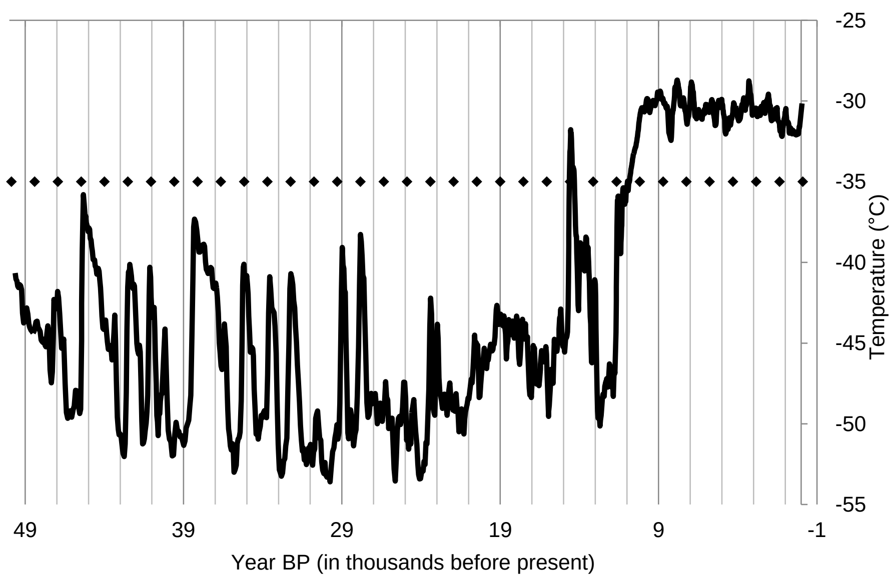

Figure 1. Greenland Temperature from GISP2 Ice Cores (Alley, 2004). Millennial temperature peaks (line peaks) correlate very well with the 1,470-year astronomical cycle conjunctions (small diamonds). The correlation is most noticeable where there are large temperature increases. (Note: NOAA dataset was updated to include year 2010 temperature).

During the last glacial period (left part of Figure 1), the cycle warmed Greenland's temperature by an average of 6.4°C per cycle (and a maximum of 13.5°C). During the most recent 10,000-year interglacial period (right side of Figure 1), it warmed the temperature by an average of 1.3°C per cycle (and a maximum of 2.6°C). For both periods, the average duration of warming was 231 years (and a maximum of 427 years). Each warming ends by cooling off for the rest of the cycle. The current cycle has warmed Greenland by 1.8°C (since year 1791) and the duration is 229 years, so far. Although it is more difficult to see the cycle during interglacial periods (right side of Figure 1), an ice-rafted debris study (Bond et al., 1997) confirms there is no significant difference in the pacing of the cycles between the current interglacial and the glacial period. Temperature increases in some cycles may seem to almost disappear but, when they return, they always return at the correct pacing (as can be seen very clearly at year 14,590 BP and 11,650 BP in Figure 1).

The cycle also occurs in Antarctica (Figure 5), but the rapid temperature increases there are much smaller (maximum increase of 4°C, compared to 13.5°C for Greenland) so they are more difficult to see. This is probably because there is less geothermal activity in Antarctica, than Greenland.

2 Astronomical Spin-Orbit Resonance Cycle

Since the pacing of the temperature cycles repeats almost like clockwork, it suggests that an astronomical cycle is causing the warming. The most likely suspect is a 1,470-year conjunction cycle of the giant planets Jupiter, Saturn and Neptune (Jovian planets). Their conjunction occurs after 124 orbits of Jupiter, 50 orbits of Saturn and 9 orbits of Neptune. As they approach the conjunction, their gravitational forces adjust Earth's orbit and spin. This paper proposes that the torque stresses of Earth's spin adjustment causes increased geothermal heat in its molten-core and that warms the Earth. The warming is similar in concept to how a microwave oven warms food, except the energy source for warming Earth is gravitation. The next conjunction will be in year 2060, when Earth's warming should reach its peak. After that, there should be cooling oscillations for the rest of the cycle.

The temperature peaks in Greenland are correlated very well with the cycle conjunctions (small diamonds in Figure 1). The pacing of the temperature peaks can have phase shifts of• ± 350 years, due to planet elliptical orbital alignments. The average temperature cycle phase shift is 33 years (better than the resolution of the temperature data) so it is an exact match.

The year 2060 conjunction will be an unusual event because it will also conjunct with several other planets (Venus, Mercury and Mars). Uranus (the other Jovian planet) is not part of the conjunction in the year 2060, but joins the conjunction every other cycle (every 2,940 years).

There are other shorter-term astronomical conjunction cycles that affect Earth's temperature and cause the temperature to oscillate during the millennial cycle. Some of them are: 4-year (Earth's spin and orbit conjunction), 19.9-year (Jupiter and Saturn orbit conjunction), 59.6-year (three conjunctions of Jupiter and Saturn orbit where they return to their starting alignment), 179.2-year (nine conjunctions of Jupiter and Saturn where they cause the sun to complete one orbit around the center-of-mass of the solar system). The study of these shorter-term conjunctions is beyond the scope of this paper.

3 Analysis Confirms the Cycle Is Warming the Earth

3.1 Temperature Is Correlated with Earth's Spin Adjustments

A study (De Michelis et al., 2005) determined that global temperature is correlated with Earth's excess length of day and geomagnetic declination data. This means that when the cycle adjusts

Earth's spin (length of day), it is changing its temperature. Another study (Tattersall, 2013) determined that Earth's length of day is correlated with the z-axis motion of the center of mass of the solar system relative to the solar equatorial plane. The z-axis motion is primarily caused by the Jovian planets. This means that their gravitation is the primary cause of Earth's spin adjustment and the temperature change.

3.2 Not Caused by Irradiance or Magnetic Changes

The gravitation from the Jovian planets is so powerful that it moves the sun in a slight orbit and causes changes in the sun's irradiance and geomagnetic field. However, observations of its irradiance and geomagnetic field do not show correlation with the 1,470-year cycle (Usoskin et al., 2006).

3.3 More Warming in Polar Regions

There is more warming in the Arctic and Antarctic regions (dark areas in Figure 2) than in lower latitude locations. This is because the spin adjustment causes the mass at Earth's equatorial areas to accelerate sooner than mass at the poles (Varghese, 2014), causing more tidal friction and geothermal heat in the Polar Regions.

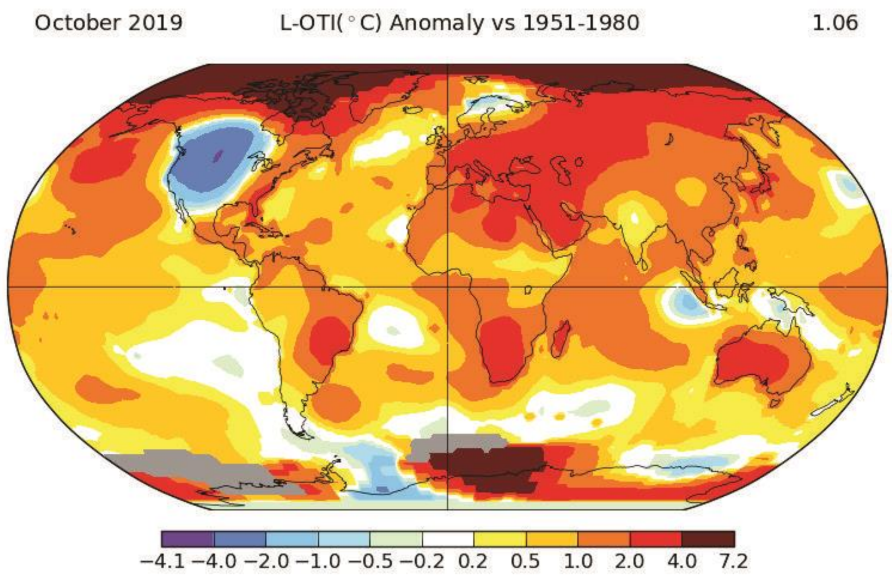

Figure 2. Global Air Temperature Change (GISTEMP Team, 2020). The temperature has increased more in the Arctic and Antarctic regions (dark areas) where there is increased geothermal heat. Map shows temperature change (°C) from 1951-1980 average to October 2019.

3.4 Ice Shelf Melting

In Greenland, a study (Rysgaard et al., 2018) found that there are many regions of ice shelf basal melt that is being caused by increased geothermal heat flux. Another study (Fahnestock et al., 2002) indicates that the flux under the ice sheet is 15 to 30 times greater than normal flux. Another study (Somavilla et al., 2013) found that the Greenland Sea deep water is warming ten times faster than global oceans. In Antarctica, most of the ice shelf basal melt is occurring in west Antarctica (Scott et al., 2019) where there are known geothermal hotspots (Jordan et al., 2018; Shepherd et al., 2019; Tedesco & Monaghan, 2009; Rignot et al, 2013). Conversely, in east Antarctica at Mawson the temperature trendline has not increased since the year 1955 (Figure 3) because there are no geothermal hotspots there.

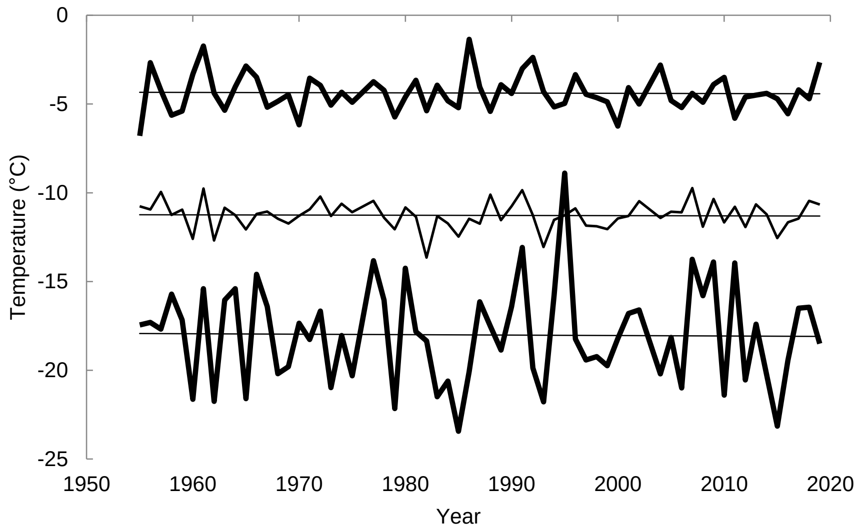

Figure 3. East Antarctica Air Temperature at Mawson (GISTEMP Team, 2020). There has been no warming at Mawson since the year 1955, because there are no geothermal hotspots there. Top line: July temperature. Middle line: annual mean temperature. Bottom line: February temperature.

3.5 More Warming in Winter

Greenland is warming more in the winter than in the summer (Figure 4) because geothermal heat has much more effect in the winter. Since the year 1880 at Nuuk, the February (winter) temperature trendline increased by 5.1°C, while the July temperature trendline only increased 1.5°C.

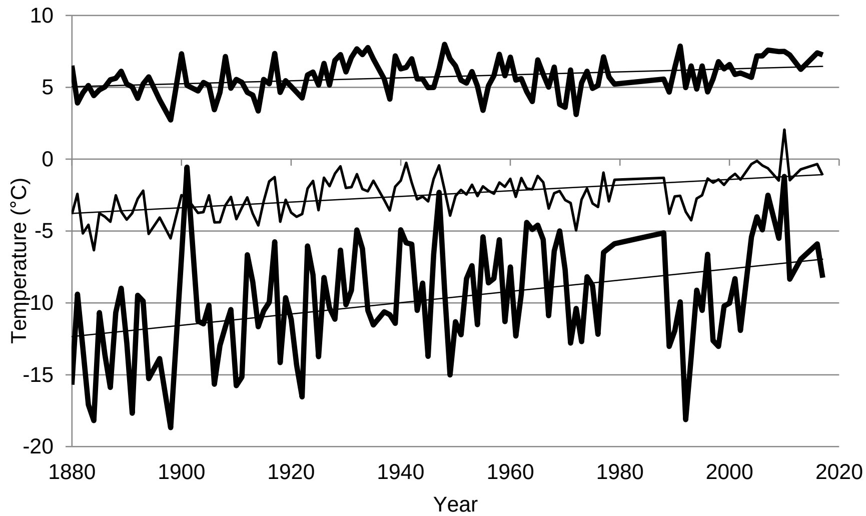

Figure 4. Greenland Air Temperature at Godthud Nuuk (GISTEMP Team, 2020). Geothermal heat is causing more warming in winter (bottom line: February), than in summer (top line: July). Middle line is annual mean temperature.

3.6 Other Conjunctions Also Cause Geothermal Warming

The winter temperature in Nuuk (Figure 4) appears to have a very short-term cycle with a 4-year pacing due to geothermal heat variation. A spectral analysis confirmed that this can be seen in winter temperatures in Greenland, Iceland, Alaska, Russia and probably other locations where there is geothermal activity. The pacing correlates with the pacing of the 4-year conjunction of Earth's spin and orbit. That conjunction is where the spin and orbit return to their same relative starting alignment (where the spin-orbit ratio is a whole number). This is where a spin adjustment occurs. It is interesting to note that the average *El Niño* also has an average pacing of 4 years and might be caused by the 4-year conjunction (Qian et al., 2011).

3.7 Not Caused by Carbon Dioxide

The cycle is not caused by carbon dioxide. Carbon dioxide changes have always lagged behind cycle temperature changes, as can be seen in Antarctica (Figure 5). In other words, temperature change is the cause and carbon dioxide change is the effect. This is because of a known and experimentally proven relationship of how much carbon dioxide can be contained in water at different temperatures. Historical data shows that this relationship continued until approximately 4,000 years ago. At that time, the carbon dioxide level began to increase, but temperature did not increase. Then after the year 1837, there has been a rapid increase in carbon dioxide level, but again temperature did not follow the rapid carbon dioxide increase. There is no longer a relationship between carbon dioxide and temperature. This suggests that the carbon dioxide warming theory is probably incorrect or insignificant.

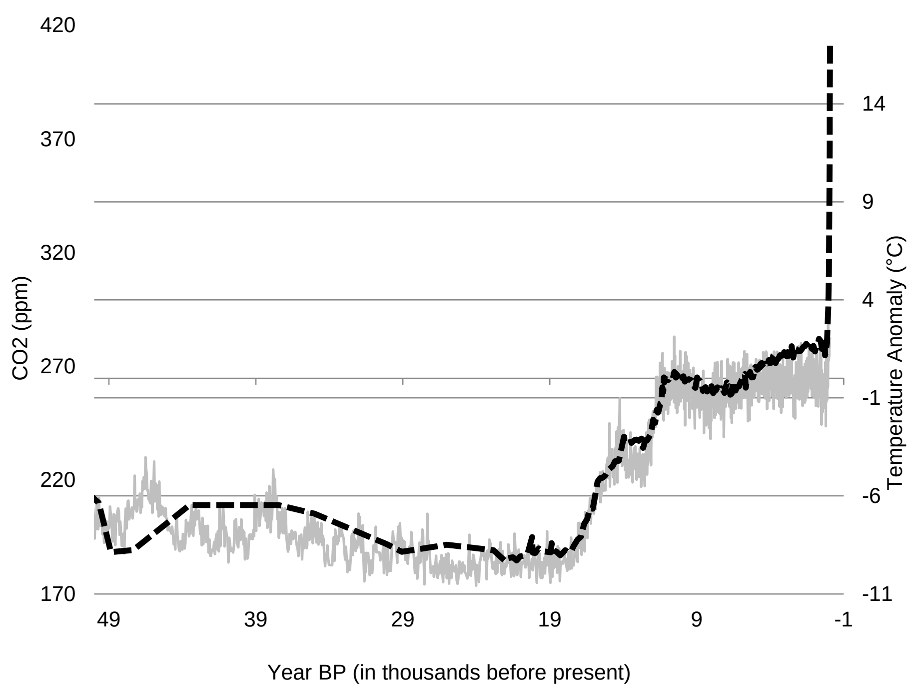

Figure 5. Antarctica Temperature and Carbon Dioxide from EPICA Dome C Ice Cores (Jouzel et al., 2007; Luthi et al., 2008). Carbon dioxide (dashed thick line) followed temperature

(thin line), until 4,000 years ago. After that, carbon dioxide has not been correlated with temperature. (Note: NOAA dataset updated to include 2019 data.)

4 Geothermal Warming Mechanism

Historical temperature data (Figure 1) confirms that the cycle is warming the Earth. But how does the cycle transfer warming energy to Earth? Is it by gravitation, solar irradiance or magnetism? The second analysis (Section 3.2) in this paper showed that it is not solar irradiance or magnetism. So the most likely energy source is gravitation and this is confirmed by the historical analysis (Section 3) that shows the cycle causes an increase in geothermal heat.

The following explains how the warming mechanism probably works. To avoid solar system chaos, the solar system is a gravitationally choreographed dance of the orbit and spin of the planets (Scafetta, 2014). Orbital resonance (Semi, 2009) and spin-orbit resonance stabilize the orbits and spins of planets. As the 1,470-year conjunction approaches, the gravitational pull of the Jovian planets and the sun have a tug-of-war to control Earth's orbit and spin (to be more accurate, it controls the Earth-Moon system). That gravitational tug-of-war adjusts Earth's orbit and spin to their correct (stable) synchronization. This adjustment occurs during the quadrant of the cycle where it approaches the conjunction and gravitational pull increases. That is why Earth's warming occurs during 10 to 30% of the cycle (approximately a quadrant of the cycle).

When gravitation accelerates Earth's rate of spin, Earth's angular momentum tries to resist the spin adjustment (angular momentum is the tendency of an object to continue to rotate). The resistance causes tidal friction (Correia and Laskar, 2009) and oscillations in Earth's molten outer-core (Dehant et al., 2017), and increases Earth's geothermal heat. This is similar in concept to the way friction heats a tire when a race car driver presses the accelerator to spin smoke from the tires. The amount of geothermal heat and temperature increase for a cycle varies significantly (Figure 1), depending on the amount of spin adjustment needed. There are other forces that de-accelerate the spin, so the net effect is Earth's length of day loses approximately 2.3 milliseconds per century.

Because Earth's mantle is a good insulator, the geothermal heat rises upward through hotspots in the global deep oceans at ridges and plumes where the mantle is thinner. That heat is circulated globally through the oceans by convection and advection (ocean currents) and warms the oceans and the atmosphere. The flow of geothermal heat to the surface is irregular (not immediate), because heat takes time to find its way through the mantle.

The cycle is very unusual because it causes spin-orbit resonance (Alfvén and Arrhenius, 1976). Since Earth's mass distribution is asymmetric, the asymmetry produces a varying gravitation that is causing Earth's spin to couple in resonance with the Jovian planet's orbit. This resonance amplifies the amount of oscillations, tidal friction and geothermal heat in Earth's molten outer-core. That powerful amplification at certain harmonic frequencies is similar in concept to the amplification of oscillations that occur during an earthquake.

How do we know the cycle is causing resonance? A study (Tattersall, 2013) determined that there appears to be a quantization of spin and orbit into simple ratios involving the largest planet in the solar system (Jupiter), the sun and the inner planets. It found that the spin ratios of Earth and Mars have a 2 to 1 ratio with Jupiter. That low, whole number ratio (2:1) implies that there is resonance.

Spin-orbit resonance cycles produce a very unique temperature wave pattern. The wave consists of a rapid increase in temperature over several hundred years (approximately 25% of the cycle), followed by cooling for the rest of the cycle (as can be seen in Figure 1). Non-resonance cycles, such as orbital changes that affect insolation look totally different; they produce a normal sine wave pattern.

To increase the global temperature by 1.8°C since the year 1791, it required an increase of approximately 14.7 terawatts of global geothermal heat flux (calculation shown below). A study (Davies and Davies, 2010) estimated that current global geothermal heat flux is 47 ± 2 terawatts, so there is more than enough geothermal heat flux to have warmed the Earth.

There is another study (Beszczynska-Moeller et al., 2011*)* that found that oceanic heat flux was 36 ± 6 terawatts through just one location, Fram Strait (between Greenland and Svalbard). This is almost as large as the other study's estimate of total global flux, so apparently the current understanding of geothermal heat flux in the deep oceans is very limited and probably underestimated. So the best way to evaluate the cycle's warming ability is that historical temperature data confirms that the cycle can produce enough flux to warm Earth by up to 13.5°C (Figure 1).

The following is the calculation of the global geothermal heat flux that was needed to warm the atmosphere and top 1% of the oceans by 1.8°C from year 1791 to 2020 (229 years or $7.22669 \text{x} 10^9$ seconds). The global estimate is simplified and approximate because it assumes that all other heat flow parameters are steady state.

$$\boldsymbol{Geothermal\ Heat\ Flux} = \frac{\boldsymbol{Mass} \times \boldsymbol{Specific\ heat} \times \boldsymbol{Change\ in\ temperature}}{\boldsymbol{Change\ in\ time}}$$

$$\text{For global air} = \frac{5.1480 \times 10^{18}\ \text{kg} \times 1006\ \text{Joules (kg C)} \times\ 1.8°\text{C}}{7.22669\text{x}10^{9}\ \text{seconds}} = 1.28994\text{x}10^{12}\ \text{watts}$$

$$= \ 1.2899\ \text{terawatts}$$

$$\text{For global top 1\% of oceans } = \frac{1.4\text{x}10^{21}\text{kg} \times 3850 \text{ Joules (kg C)} \times 1.8°\text{C} \times 1\%}{7.22669\text{x}10^{9} \text{ seconds}}$$

$$= 1.34252\text{x}10^{13} \text{ watts} = 13.4252 \text{ terawatts}$$

$$\text{For both} = 1.2899 \text{ terawatts} + 13.4252 \text{ terawatts } = \mathbf{14.7\ terawatts\ (TW)}$$

Per global meter^2 = 28.82 milliwatts / meter^2

5 Conclusions

Earth's temperature appears to be correlated with the 1,470-year astronomical cycle. The cycle causes resonance that significantly amplifies the warming. The cycle's increase in geothermal heat flux was shown to be a feasible explanation of the recent global climate change and ice sheet melting in Greenland and Antarctica. The cycle has warmed Greenland (and probably global temperature) by 1.8°C from the year 1791 to 2020. The warming should continue to the year 2060 (when the next conjunction of Jupiter, Saturn and Neptune occurs) and might warm Greenland and the Earth by another 0.8°C by then. Then it will start to cool for the rest of the cycle. The warming might have a slight pause every 20 years, or so, after each Jupiter-Saturn conjunction. Since the warming is astronomically forced, it probably can't be stopped.

Data Availability Statement

Datasets for GISP2 and Dome C are available online (https://www.ncdc.noaa.gov/paleo-search/?dataTypeId=7). Datasets for air temperatures are available online (https://data.giss.nasa.gov/gistemp/).

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