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Research Paper

Some new Models of Earth's Temperature Anomaly across various Epochs Predicting Present Warming with Ice Age Validity Testing and a Data set Bias examination.

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Abstract— The need for methods to assess earth's temperature anomaly are briefly discussed together with shortcomings of existing climate models. The geomagnetic or Pole shift method of climate sensitivity is briefly reviewed. The hypothesis that the previous two warm periods shared a common driver is tested and proven. Granger causality tests have been made and indicate that Pole Shift is the driver of temperature but is intercorrelated with CO2 with a subsequent delay on emission of CO2 from the oceans. A series of twelve single linear regression analyses is first performed starting with three individual possible drivers of the present warming period (PWP) said period being divided up into pre and post 1979 and said drivers being namely, Pole shift latitude (PS), CO2 and Albedo. Earth's temperature/time record since the last Ice Age or at least the last 14,000 years or so is also fitted by means of a simple polynomial equation, the number of parameters increase in post-industrial times. Earth temperature anomaly from typical Ice Age to Present Day and including Maunder Minimum (LIA) is shown to be fitted by a self-limiting rational equation. Once optimum CO2 has been established it is concluded there are faster acting sinks and mechanisms disclosed which increase in sequestration ability to hold effect, if not value. Reasons for GISTEMP v4 data bias are discussed and validated. Traditional Greenhouse Warming with a maximum effect in the Upper Troposphere is not supported. Apparent 'runaway' warming is a product of Pole Shift induced albedo shift not C02. Earth's temperature stabilizes at an optimum CO2 level around 290-311 ppmv by means of processes which obey a Rational Function of the general form Y = a+bx/1+ cx+dx^2. Addition of further CO2 then appears only to make minimal overall difference to the extension of this function and adds on only about 150 mK at CO2 concentrations of even up to 3200 ppmv. The notion of PS as dominant driver together with adaptive and strengthening CO2 biotic sinks is supported.

Keywords— IPCC, climate sensitivity, climate model, magnetic pole shift, carbon dioxide, CO2, albedo, cloud albedo, paleoclimate, adaptive carbon sink, data set bias, GISTEMPv4, UAH, GHG, Greenhouse Warming, Maunder Minimum, Gaia Hypothesis, Adaptive Iris, biotic sink.

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1. Introduction

1.1 The need for methods to assess Earth temperature anomaly.

The IPCC regards carbon dioxide is the most relevant driver of climate warming and their Sixth Assessment Report (AR6) refines this to a likely range of 2.5°C to 4.0°C and a very likely range of 2.0°C to 5.0°C for climate sensitivity to a doubling of present levels of atmospheric carbon dioxide. Very recently, however, it has been shown that warming over the last two or three decades has been due to albedo and cloud changes. The present author has shown how the movement of earth's magnetic poles can induce such changes and how this reduces effective climate sensitivity to CO2, Barnes (2025)[1-3]. Since these results extend an already very large range of climate sensitivity the need exists both to find a method to better quantify earth's temperature anomaly and to examine possible data set bias. This present paper addresses those needs.

1.2 Shortcomings of climate models.

There are very few estimates of climate sensitivity employing use direct observational methods, most use climate modelling, so called GCM's like the models used for weather forecasting, see Navarro (2021)[4] and consider many parameters and feedback, especially water vapour feedback. However, if such models are under-parameterised or incorrectly parameterised or if the sign and/or magnitude of any feedback is incorrectly specified large errors could occur see Dunbar et al (2021) and Wyant et al (2006)[5,6]. The models are being constantly 'tweaked', see for example, Mehrotra & Sharma, (2015)[7]. Further, although such enhancement helps to provide forward estimates as climate change proceeds it often renders very poor hindcasting, see Sakaguchi et al (2012)[8]. Moreover, in making these models the IPCC do not consider the dramatic effect of the magnetic pole shift climate driver or how it behaved/es past and present. During some Ice Ages for example the magnetic poles 'flipped' and earth's field collapsed, see for example Fernández-Solís (2017)[9]. Magnetic pole shift via its effect on energetic particle precipitation to change all of cloud albedo, upper atmosphere ozone, jet stream and Polar Vortex is expected to mimic the effect of a non-constant climate feedback. Knutti and Rugenstein (2015) discuss modelling problems due to the non-constant feedback [10].

It is clear then that however complex and sophisticated, GCM based models of earth temperature are not only extremely costly because of the vast computational power required but are seen for whatever reasons to be failing and inefficient.

1.3 Simple models linking magnetic parameters and CO2.

The present author has shown that a remarkable insight can be gained into the behaviour of earth's temperature anomaly past and present using either just magnetic parameters or a magnetic parameter combined with carbon dioxide concentration [3]. This present study extends the notion of exploring earth's temperature anomaly in the Medieval Warm and in the Modern day by means of multiple linear regression analysis of known data and further explores and validates the physical reality of the models developed by testing an algorithm on Ice Age Conditions. Sunspot data and other modern-day drivers are also be introduced into the models and their overall effects tested. Regression factor and Granger causality is also employed to confirm the link between magnetic pole shift and albedo change.

1.4 Our geomagnetic climate

It has been suggested several times that earth's climate may be to some extent geomagnetically controlled, see Bucha (1980) [11] and Kerton (2009) [12]. More recently the present author has advanced and explained the mechanism for such control as being the predominant driver of climate, up to some 90% of post industrial temperature increase, and has further showed that this allows seamless modeling of our present modern warm period with previous cold and warm periods as far back as Roman times, this modeling method only being limited by availability of paleomagnetic data, see Barnes (2025) [1]. It has also been shown how the method is not only applicable to global average temperatures, but also with those in latitudinal bands, see Barnes (2025) [2].

In the first paper the author developed a model employing the latitudinal position of the Magnetic Dip Pole alone and estimated a maximum contribution to warming of only about 6% due to CO_2 based on model regression alone. It was, however, pointed out that there existed a strong multi-collinearly of Northern Dip Pole position and atmospheric Carbon dioxide concentration. Predicted amplitudes and epochs for previous cold and warm periods were also evaluated for two models, one with CO_2 included and one without. Of particular interest to this present work is that the model without CO_2 included predicted amplitudes for the medieval warm period very similar to that of our present warm period [1].

In the second paper residuals from a more complex two Pole magnetic model were used in additional linear regressions with known and potentially suspected additional climate drivers including inter-alia, carbon dioxide and sulfur dioxide. The conclusion again broadly in line with the first paper was that CO_2 only produces weak warming corresponding to about 1% of warming or only 2mK per decade, in Northern mid-latitudes and to 5% or 32 mK per decade in Polar regions [2]. This latter figure is not unlike the estimate reached in the first paper. Although a body of evidence exists to suggest that climate sensitivity to carbon dioxide could be low and was discussed at length in the second and third papers [2,3], clearly and nevertheless these values fall well short of traditional expectations. Maybe in this is in view of multi-collinearity. For example, it is known when a logarithmic process and a linear process overlap a seemingly steep curve can be created.

1.5 Pole shift method for estimating Climate Sensitivity.

In the author's third and most recent paper, Granger causality was employed to confirm the validity of the pole shift method and independent paleo-climate data was employed together with the GISTEMP v4 dataset to develop a simple new method to estimate climate sensitivity, which works because carbon dioxide concentration was almost flat in the two warm periods preceding the industrial era. The model yielded a range of climate sensitivities for a doubling of CO_2 between .105K and .318K depending on the date range of the modern warming data set employed. Higher sensitivity occurs post 1970 [3]. However, temperature data set bias could also be a potential issue here, see **section 5.7** below.

1.5 Hypotheses to be tested.

1.5.1 Hypothesis 1 : Ice age testing and model strength.

During Ice Ages CO_2 was very low and there after sometimes magnetic reversals the hypothesis to be tested is that three drivers, namely CO_2, PS (magnetic) and Albedo drivers should feature strongly when modern warming plots are linearly regressed with these drivers back in time. The hypothesis is that regression coefficients should get stronger along with model predictability when data sets are extended into recent glacial period. Based on the author's previous work [1-3] it is expected that if regressed together all three drivers ought to be highly intercorrelated and this will be evident by inspection of the Pearson matrix.

1.5.2 Hypothesis 2: Sulfate aerosol ought to have different effects across different epochs.

Given that during the modern warming period there have been all sorts of additional anthropogenic additions to the climate, a further hypothesis to be tested is that they should have testable effect. In line with the author's earlier work [2] , S02, electricity grid capacity and Aviation (passenger miles) are to be tested. Since SO_2 emissions have reduced in recent years the hypothesis is that there should be a different relationship from the epoch in which they were building up. Moreover, sulfate aerosol was thought to be up to 2.5x greater than today in the Ice Age during large volcanic activity.

1.5.3 Hypothesis 3: The Solar driver should have weaker effects now than in Ice Age or Little Ice Age.

The next hypothesis is that the effect of sunspot number as a driver (SSN) ought to be more relevant in the pre-industrial era and especially due to the presence of known and prolonged historic solar minima.

1.5.4 Hypothesis 4: Testing if CO2 driver follows true logarithmic pattern.

According to radiative absorption theory a logarithmic behavior of temperature with CO2 concentration or with time if additional CO2 is being added linearly ought to be observed, Romps et al (2022)[13]. If it is not directly observable, then perhaps separation algorithms can be created to make the effect of additional post -industrial CO2 clearly observable not only from Pole Shift but from earlier natural CO2 addition? These hypotheses will be tested.

1.5.5 Hypothesis 5: Can modern temperature stabilize by means of excursions in Pole Shift driver?

After Ice Ages, temperature is thought to recover and stabilize after CO2 release from the oceans possibly over extremely long periods of time. One of the mechanisms proposed is silicate weathering, see Lenton & Britton (2006) [14]. In the more recent Natural Warm Periods (RWP/MWP), CO2 is reported to have held remarkably stable at between about 260-285 ppmv, see Berry (2021) [15] and there was also no observation of runaway Global warming, see Chenergy & Hawthorn in the 'Coal Handbook' (2023)[16]. Indeed, CO2 and temperature stabilization and even subsequent cooling seemingly occurs within a few tens or a hundred years, see Saenger et al (2009)[17]. The hypothesis to be tested is that if magnetic Pole Shift, as apparently the main driver both now and earlier, was able to control temperature so effectively and so quickly before perhaps in conjunction with adaptive sinks, then after our present warming period we need to know if the same should hold? Also, can any of these previous temperature excursions or future excursions be related to or tested by Ice Age conditions, as it is known that some, but not all Ice Ages coincide with magnetic reversals.

1.5.6: Hypothesis 6: If the earth adapts for its Biota as per Lovelock or similar there ought to be increasing CO2 sinks or shortening sinking times.

Impulsive sequestration models like the BernSCM tend to include fixed sinks and sinking times. What if these times were adaptive or shortening according to increasing CO2 concentration? This should result in earth's temperature following a 'braking' function with CO2. This will be tested.

1.5.7 Hypothesis 7: Earth's temperature record should be describable by polynomial equations requiring more parameters as time advances.

The earth over its epochs has had multiple climate drivers but in pre-industrial times these were far more limited and natural. Therefore, it is proposed that it ought to be possible to fit earth's temperature/time record since the last Ice Age or at least the last 14,000 years or so by means of a simple polynomial equation, the number of parameters in which ought to increase in post-industrial times. This hypothesis will also be tested.

1.5.8 Hypothesis 8 : Increasing UHI and waste heat ought to be progressively biasing GISTEMPv4 compared with UAH.

It has been proposed that earth-bound thermometer driven data sets such as GISTEMP and Berkely Earth etc. may be showing potential excessive bias, perhaps due to increasing UHI and Waste Heat effects, see Ochoa et al (2024),[18] as compared with Satellite driven data sets, this hypothesis, too, will be tested. If CO_2 is the main or significant driver of climate both types of data sets should show good correlation with CO_2 especially in recent years. Even if CO_2 is not the main driver, the ground-based sets may still correlate CO_2 due to waste heat being mainly dependent on Carbon burning sources whereas the satellite-based data set may not. This hypothesis too will be tested.

1.5.9. Hypothesis 9 : According to GHG theory most warming should take place in the upper troposphere not at earth's surface.

The two data sets GISTEMPv4 and UAH will be examined for evidence to test hypothesis 9.

1.5.10 Hypothesis 10: Latitude 'drive-rate' common process.

In any event, it is an inescapable fact, which simply has to be more than coincidence that every time in recent paleo-history that the earth has warmed quickly, for instance the Roman Warm Period (RWP), The Medieval Warm Period (MWP) and our present Post-Industrial Warm Period (PWP) the earth's dip poles have also moved quickly especially the Northern Dip Pole which in all three periods appears to coincide with a temperature 'drive rate' of some +70 mK/degree of Latitude change to the North when maximum warming was taking place. This hypothesis that the three share a common drive process is supported by the author's previous work and is also to be further tested in this present work by both literature research and by the creation of additional algorithms.

1.6 Remaining layout of the work.

Section 2 of this paper discusses related work. Section 3 deals with the theory, especially causality testing. Section 4 details the proposed experimental procedure i.e. regressions to be tested and algorithms to be devised. Section 5 of the work details all relevant results in tabular and graphical form as appropriate and discussion and implications thereof and developments therefrom. Section 6 of the work details conclusions and possible further work.

2. Related Work

2.1 The search for common warming and cooling causes

To explore earth's temperature anomaly in the manner proposed at 1.1 above, it is necessary to establish that previous mentioned warming and cooling periods have to a greater extent all being linked to a common cause(s).

2.2 Additional feedback

Lindzen and Choi (2011) find hitherto unaccounted negative feedback in relation to SST behavior which reduces climate sensitivity [19].

Crucial to this present work, it is increasingly recognized that clouds and cloud albedo play an important role in climate change and modify water vapor (WV) feedback, see for example Hartmann and Larssen (2002) [20].

For example, the disappearance of ship tracks due to cleaner fuel has caused significant and possibly unexpected heating, see, for example, Gettleman et al (2022) [21].

Clouds, their disappearance and distribution are of course fundamental to the present author's previous and recent work [1,2]. The importance of clouds is elegantly emphasized by Mueller at al (2011) [22]. Interestingly, their data show exactly what was implied by the present author's pole shift hypothesis i.e. warming due to reduced cloud albedo everywhere except over the oceans of the southern hemisphere, especially near to its geomagnetic anomaly, see Barnes (2025) [2].

2.3 Linking the warm periods, common processes

Feng Shi et al (2022) point out that the RWP was warm through the mechanisms of surface albedo and lapse-rate feedback [23]. Low volcanism is postulated as a cause, but the present author's EEP hypothesis was unknown and unexplained at their time of writing and of course yields the same kinds of changes. Chen et al (2011) suggest that the changes in the RWP were cyclic climate changes are linked to the North Atlantic Oscillation and solar forcing as there were warmer sea surface temperatures SSTs [24]. Warmer SSTs in the Northern Hemisphere are also exactly as predicted by EEP hypothesis and low cloud disappearance.

Volpert and Chubara (2021) show that for the modern period 1968-2016 solar heating is not so much due to change in the sun but rather because of non-linear transmission changes in cloud optical density and its amount, except where cloud is heavily entrained with industrial aerosol [25]. Again, this can be explained by the author's EEP process [1,2] and is highly suggestive of the fact that the same process that caused the RWP is also causing modern warming. Hunt (2006) uses the CSIRO MK2 GCM to model and explain the MWP and is unable to do so and hence concludes that 'external forcing must have been involved' [26]. Since the notion and effects of a geomagnetic driver were not built into the model, this conclusion is hardly surprising and does not detract from the present findings.

Reinforcing the present author's assertion of a common geomagnetic driver across all three warm periods, Diodato et al (2025) consider phases of the Atlantic Multidecadal Oscillation.

They suggest that complex dynamics have brought modern warming cloud patterns closer to those observed during the medieval period before c. 1250, exceeding the background variability of the Little Ice Age (c. 1250 to 1849) [27]. Moreover, recent decades have witnessed an unprecedented coupling of intense solar activity, high temperatures, and the lowest cloud cover on record. This lowering of cloud albedo is also confirmed by Nikolov and Zeller (2024) [28]. Allan and Merchant (2025) also confirm that there has been a doubling of Earth's energy imbalance from 0.6±0.2 Wm−2 in 2001–2014 to 1.2±0.2 Wm−2 in 2015–2023 which is primarily explained by increases in absorbed sunlight related to cloud-radiative effects over the oceans. Moreover, that observed increases in absorbed sunlight are not fully captured by ERA5 and determined by widespread decreases in reflected sunlight by cloud over the global ocean [29].

The present author believes that the evidence contained in the above references together with his previous work is sufficient proof that the same Pole Shift (PS) phenomenon and associated reduced cloud albedos are responsible for all three warm epochs, see additionally **section 5.8** below.

Moreover, the author's most recent paper establishes an almost common slope in northern latitude pole shift transit against temperature, of just several tens of mK per degree of latitude [3].

3. Theory/Calculation

3.1 Defining the lags

Following the author's previous work [3], pole shift and CO2 are regarded as the key drivers of earth temperature. Granger causality tests have been made and indicate that Pole Shift is the driver of temperature but is intercorrelated with CO2 with a subsequent delay on emission of CO2 from the oceans. The lag for temperature is circa 1 year and the lag for CO2 is circa 3 years.

3.2 Pole shift and temperature Causality

For Pole shift versus temperature strong causality is shown.

Granger Causality Test: Y = f(X)

p-value 5.47045600672311e-09

Complete model 137

Reduced model 138 DF -1 F = 38.7654361464773.

For CO2, pole shift drives with a delay see Table1.

Table 1: Granger p and F values for CO2 =f (PS)

Lag years	P-value	F-value
1	0.157	2.01
2	2*10^-5	9.08
3	5.5*10^-6	10.01
4	1.08*10^-5	7.85
5	2.7*10^-5	6.35
11	4.9*10^-5	4.1

3.3 Building algorithms, finding and using historic temperature data

To build algorithms multiple linear regression is performed of available data from modern warm period and those from the Medieval Warm Period. The only definitive work with temperature data from the Medieval warm period is in graphical form and is to be found in the book 'The Science of Roman History Biology, Climate, and The Future of The Past Edited by Walter Scheidel, Chapter 1 Kyle Harper & Michael McCormick discuss 'Reconstructing the Roman Climate' and a plot of temperature anomaly is supplied, see Figure 1 [30].

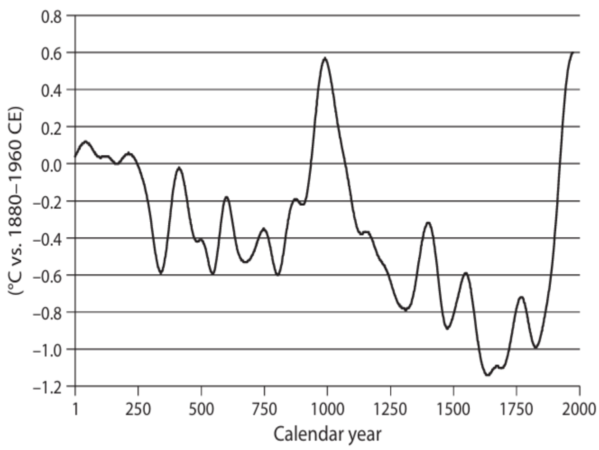

Figure 1: Earth temperature anomaly from reference [30]

4. Proposed Experimental Procedure.

To test hypotheses 1,2&3, a series of twelve single linear regression analyses is first performed starting with three possible individual drivers of the present warming period (PWP) said period being divided up into pre and post 1979 and said drivers being namely Pole shift latitude (PS), CO_2 and Albedo. It should be noted that the author's previous work [2] shows that a better fit to temperature changes in latitudinal bands can be achieved by considering the movement of both North and South magnetic dip-poles. However, no reliable data is available for the position of the South dip-pole prior to 1590 and thus this study employs only the Northern position for PS latitude. All three key drivers are also regressed together across each epoch, and their Pearson matrix investigated. The models are then extended to include The Little Age (LIA) and Roman Warm Period (RWP) and then are further 'validity tested' by including conditions thought to be prevalent at the end of the most recent Ice Age (IA) or most recent period of heaviest glaciation. These twelve models are then built upon by attempt to include firstly a natural driver (namely smoothed average sunspot number (SSN) and then other known or suspected climate drivers also considered in the author's earlier work [2]. The online multiple regressions analyzer at 'Statistics Kingdom' is employed initially operating in 'Manual' mode. Ideally, any variable in the model needs an initial p-value which must be statistically relevant i.e. less than 0.05 but ideally stringently relevant i.e. less than 0.01. Results are not included here in cases where addition of a particular driver into the model did not improve the overall regression factor for the epoch concerned.

In each case the usefulness of any model arising is evaluated based especially on the overall regression factor R^2 but the Q/Q' plots, not shown here, are also inspected for symmetry. The predictive power of the models (PTM) is also shown in the results tables and those of selected models shown graphically.

The test of the predictability of any model is not only forecast but also hindcast. The ultimate test of any model developed is to see if it can hindcast the last Ice Age. For example, it is known that low carbon dioxide levels, believed to have been around 180 ppm, see Hain and Sigman [31], cannot adequately account for the fall of temperature during an ice age. It is known that Earth's albedo maximizes and its magnetic field collapses and reverses during some Ice Ages and did so in the most recent Glacial maximum. This too can be fed into the algorithm for 'Ice Age Validity Testing'. It should be noted that in models other than those with simply CO_2, precise data availability in ice ages, for example sunspot number (SSN) and aerosol load is unknown, although the latter was believed to have been very high when earth's magnetic field collapsed, see Harvey (1988) [32].

All the multiple regression models will be of the same general format, see equation 1.

$$Y= k + a*X1 +b*X2 + \dots \qquad (1)$$

And, where X1=PS (magnetic North Pole latitude degrees), X2= CO_2 (ppm), X3 =SO_2, X4= SSN, X5 = World Electricity Grid Capacity (TW/h) and X6 = Aviation (passenger miles)and X7 =Albedo.

Since PS,CO_2 and Albedo change are so strongly autocorrelated they will not be used in any one model simultaneously hence numerically a model will either contain just one or alternatively five 'X' parameters.

Very recently, several publications show that recent warming is linked with reduced cloud albedo [1-3,28]. The author's magnetic EEP hypothesis explains the same [1,2]. Reliable earth albedo values measured by satellite are available. Best values are from 1959 onwards. A regression analysis of Northern Dip Pole latitude versus Albedo is also made. It is known that the Poles reversed during some Ice Ages, including the most recent glaciation, see Worm (1997) [33], in other words there will be a point at which latitude collapsed to zero. The commonly held hypothesis is that due to orbital and geometric considerations this is where Earth Albedo should be maximized.

Because of the huge intercorrelation of CO_2 with other drivers, an experiment is performed to uncouple its effects along the lines of the author's previous work [3]. A logarithmic plot of the differential data arising is then made to test hypothesis 4.

To test hypothesis 5 the mathematical form of earth temperature anomaly over time against CO_2 concentration is further evaluated by means of several Rational Functions.

To test hypothesis 7 the mathematical form of earth's temperature over time for the last 14,000 years is fitted to several polynomial equations. The number of variables in each equation is determined by a sensible choice of the form and number drivers for each epoch and is expected to increase as time proceeds.

The form of the equations arising from the tests of hypotheses 5&7 is also be used to determine the validity or otherwise of hypothesis 6 together with known literature evidence on the various feedback and biotic sinks involved.

A suite of linear, logarithmic and other regression functions is employed on GISTEMPv4 from 1979 -2020 and likewise for UAH to test hypotheses 8&9.

A plot of temperature anomaly and its changes versus degree of Northern magnetic pole shift for the present warm period (PWP) and the last two historic warm periods MWP and RWP and the regression factor and slope arising allows a test of hypothesis 10.

5. Results and Discussion

5.1 Results and discussion of multiple regression studies

Table 1 shows the models generated based individually on just PS, CO_2 or Albedo. According to coefficients of X_1,X_2 and X_7 across the epoch, there appears to be a decreasing contribution of PS and a decreasing influence of CO_2 in the modern post-industrial era and an increasing contribution of Albedo, however this needs to be viewed with some caution due to the extremely high multi-co linearity explained by the author elsewhere [1-3].

Table 1 : Regression Model information across four epochs: 1. 1979-2020 2. PWP 3. Including LIA/RWP. 4. Including IA. Table includes individual regressions for PS (MAG) driver, CO2 driver and Albedo Driver. Coefficients per equation 1. Key: a) Calc IAT = calculated Ice Average Temperature below present. b) PTM power to test the model.

COEFFS	1979-PRES	PWP	AND LIA	AND I.A
a ALB	20.52	19.2	19.6	14.8
a CO2	-3.3	-3.25	-3.32	-4.77
a MAG	-4.8	-5.35	-5.46	-6.57
X1 MAG	0.066	0.072	0.073	0.088
X2 CO2	0.01	0.01	0.01	0.0145
X3				
X4				
X5				
X6				
X7 ALB	-69.19	-64.6	-66	-49.8
CALC IAT ALB	-21.9	-10.13	-10.1	-7.3
CALC IAT MAG	-4.8	-5.35	-5.46	-6.57
CALC IAT CO2	-1.42	-1.37	-1.44	-1.9
R^2 MAG	0.85	0.893	0.88	0.95
R^2 CO2	0.88	0.893	0.89	0.55
R^2 ALB	0.86	0.85	0.84	0.94
PTM ALB	0.6937	0.9958	0.996	0.9962
PTM MAG	0.6937	0.9958	0.996	0.9962
PTM CO2	0.6937	0.9958	0.996	0.9962

The R^2 for the magnetic model is excellent across all eras and at .95 strongest in the Ice Age when the field collapsed. R^2 for CO_2 on the other hand collapses during the Ice Age. Moreover, the CO_2 algorithm is unable to sensibly predict the Ice age temperature. The R^2 for Albedo is good across all epochs and excellent for the ice Age but apart from the last four decades it is always slightly less than the R^2 for PS, supportive, perhaps, of the hypothesis that PS is the driver of Albedo change [1,2]. The power to test the models is extremely high in all the epochs except the last four decades, presumably because of the smaller data set and because other anthropogenic drivers have influence. Finally, it is instructive to consider if the models display any sort of physical reality. Consider first the albedo model and the coefficient (constant) a'. 'a' represents the temperature if Albedo fell to zero. It is reckoned that the fall of .02 in Albedo in 2023 produced .23 K of warming. Assuming linearity and by extension earth would be on average 34.5 Celsius warmer if it had no Albedo. The constants 'a' for the model span some 15-21 Celsius so are in the correct order. Moreover, calculation of Earth Temperature under Ice Age conditions yields -7.3 C compared with today and this compares favorably with a literature quote of -6C and of -7.2 +/- 1.5 C, so in other words physically very realistic. The CO_2 model has 'a' as a negative constant which would be expected if CO_2 had a warming or GH effect. However, the CO_2 model cannot adequately predict Ice Age temperature and predicts an Ice Age of only 1.9 C lower than today. Another way of looking at this is to suggest that CO_2 may have caused a mere 26% of the warming from the Ice Age until today. However, due to the very strong auto and inter-correlations with the other historic drivers, certainty cannot be guaranteed. The X2 CO_2 coefficient is constant in all epochs except larger in the Ice Age suggestive of a logarithmic effect, see also Figure 3 below. Of all the models, regarding 'a' there is most consistency in the magnetic (PS) model which has 'a' ranging from -4.8 to -6.57, and produces an equivalent Ice Age temperature of 6.57 Celsius lower than today.

Attempts were made to improve the regression value for the post 1979 epoch by addition of SSN and SO_2 singularly and sequentially for PS, CO_2 and Albedo and all failed.

Addition of aviation to the model improved the PS regression factor from .85 to .88. No other combination of drivers in combination with PS could substantially improve this situation. It should be noted however that the power to test the model was only .5. Addition of aviation to the Albedo based model also lifted the regression factor to .88. The CO2 based model showed no change in regression factor, which remained at .88. Expanding aviation emissions will of course be expected to be to some extent correlated with increasing anthropogenic CO2.

An attempt to run the Analyzer in automatic mode to fit the post 1979 era produced a very 'unphysical' model and so was abandoned. Presumably this was because of the very limited data set.

For the whole of PWP the auto Analyzer successfully produced a full 7-parameter model with R^2 = .91, Both the Q/Q' plot and the residuals histogram had excellent symmetry. The power to test the entire model was strong .9327. The temperature anomaly is given by equation (2).

$$\hat{Y} = 0.614399 + 0.00791787\,X1 + 0.00458112\,X2 - 0.0000332343\,X3 + 0.00228736\,X4 + 0.0000513283\,X5 + 6.37875e\text{-}10\,X6 - 9.826722\,X7 \quad (2),$$

Where X1 =PS degrees, X2 =CO2 ppmv, X3 =SO2 X4 =SSN, X5= Aviation, X6 = Power TWh and X7 = Albedo.

The regression value remains at .91 when the LIA and RWP are included but the algorithm changes slightly, see equation 3 .

$$\hat{Y} = 11.05424 + 0.0512811\,X1 - 0.00210715\,X2 - 0.00131232\,X3 + 0.00186682\,X4 - 0.0000332616\,X5 + 6.41881e\text{-}9\,X6 - 48.08685\,X7 \quad (3).$$

The regression factor increases to .97 when the Ice Age is included, see equation 4.

$$\hat{Y} = 3.755735 + 0.0454112\,X1 - 0.00217556\,X2 + 0.0000560843\,X3 + 0.00188583\,X4 + 0.0000440925\,X5 + 5.9693e\text{-}11\,X6 - 22.383768\,X7 \quad (4).$$

The power of the model (equation 4) to predict temperature is high, >.98. The model output is shown in Figure 2 below.

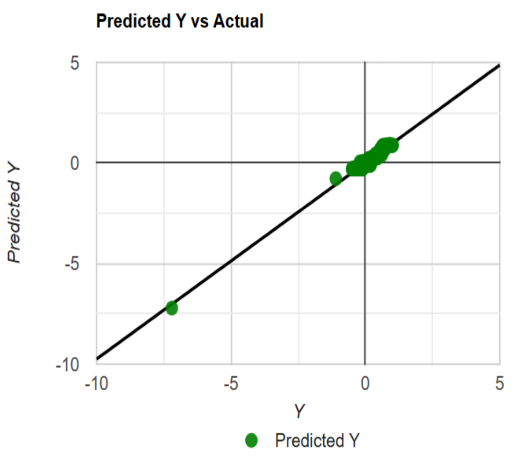

Figure 2: 7 parameter model output all epochs predicted temperature anomaly versus actual.

Despite the incredible predictive power of the model equations 2-4, it should be noted that there are massive multi-collinearities throughout. For example, CO_2/PS/Albedo, SO_2/Electrical Power, Aviation/CO_2/SO_2 etc. It is therefore rather futile to attempt to analyze all these individual predictors together and further. However, it is fascinating to note that equation 4 on substitution yields an Ice Age temperature of minus 6.72 Celsius relative to today which is exactly as expected. Moreover, upon substitution of LIA driver conditions into equation 4 yields -.35 Celsius and substitution of modern-day driver conditions yields +.65 C.

On the other hand, equation 3 yields -2.4 Celsius for the LIA. Whereas equation 2 yields +.29 Celsius for present conditions, more in line with the UAH temperature record. The unphysical nature of the GISTEMPv4 model will be discussed later.

If one inspects a typical X2 line plot from any of the model including 'ice age validation' the very non-linear behavior of CO_2 at initially lower concentrations is seen. CO_2 on earth never actually falls to zero concentration but is reckoned to fall to circa 180 ppmv during Ice Ages [31,34].

An average value across several available references has been calculated by the author to be 188 ppmv. Also, during some Ice Ages, the most recent one included, the earth's magnetic field is known to reverse and collapse [33] by a sort of random fragmentation process, see Kirscher et al (2017) [35]. Thus, the approach used in modelling proposed here is to employ an equivalent point where PS Latitude could be represented by zero. [33] Seltzer et al (2021) give Earth's average temperature as circa 6 Celsius lower than 1960 during the last Ice Age. [36] Coefficient 'k' of the PS/CO_2 model is -6.75. Insertion of ice CO_2 level into the model yields 4.99C lower than 1960 for the average E arth Ice Age temperature which is within the range given by Seltzer.

Because of the huge intercorrelation between CO_2, PS and albedo and because the author sees PS as the natural driver of both the other variables, it was decided to make one more multiple linear regression investigation lumping PS with SO_2 and SSN. In this way hypotheses 4 and 5 can be tested together. The results are as follows. Firstly, for the whole data set including the last glaciation we have

$$\hat{Y} = -6.536263 + 0.084525*\text{PS Lat.} - 0.0004106*\text{S02} + 0.00251322*\text{SSN}. \quad (5)$$

With $R^2 = 0.94$ and PTM .9834

Secondly if the glaciation is excluded by the LIA is left remaining in the data set the algorithm becomes,

$$\hat{Y} = -5.42348 + 0.0706155*PS\ Lat - 0.0000342213*SO2 + 0.00164178*SSN \text{ with } R^2 = .83 \quad (6)$$

And, finally just for the PWP we have

$$\hat{Y} = -5.37899 + 0.0716183*PS\ Lat + 0.00000682221*SO2 + 0.000376865*SSN \text{ with } R^2 = .87 \quad (7)$$

These results elegantly confirm hypotheses 1,2&3. Hypothesis 1 is confirmed because both R^2 and the predictive power of the model including the PS driver is much higher when the glacial period is included.

Hypothesis 2 is confirmed because SO2 is seen as more strongly cooling during the Ice Age and LIA. However, in the PWP the sign of the SO2 driver reverses. At first sight this is somewhat surprising but SO2 has had a negative gradient since its world peak circa 1990. The other possible reason for SO2 now being apparently warming is the fact that low and medium level SO2 nucleated clouds are rarer whereas aviation clouds which are warming [2] are intercorrelated with aviation SO2 emissions.

Hypothesis 3 is elegantly confirmed as there is progressively less influence of SSN when the IA and LIA are not included and other drivers start to dominate.

It has been stated that CO2 reduction alone cannot be responsible for all the cooling during an ice age[34]. The data obtained in Table 1 above of this present study tend to support that notion also. To test this idea independently here, it has been considered that if all or most of Earth temperature change were due to CO2, then there ought to be a logarithmic relationship between temperature from the Ice Age to the present day. The possible criticism of the models developed here is to do with aspects of multi-collinearity. One might wish to search for a more study independent route to explore CO2 behaviour and uncouple the multi-collinearity which could be masking logarithmic and/or saturation style behaviour. One such study independent way to examine functionality of Earth's temperature since the Ice Age is to construct a natural log plot. If CO2 predominantly drives temperature, such a plot would be expected to display a very high correlation coefficient. The correlation is, however, weak and apparently there needs to be another process to produce the additional cooling between the predicted and actual intercepts, see Figure 3

.

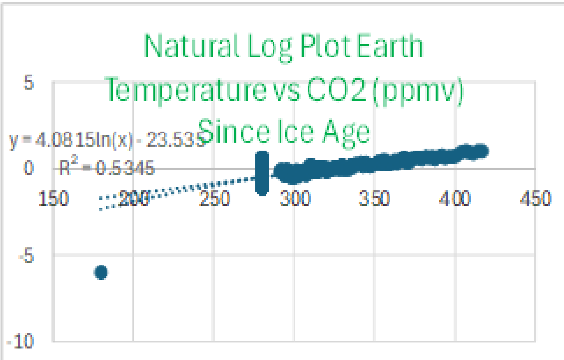

Figure 3. Natural Log Plot of Earth average temperature relative to 1960 -1990 versus CO2 ppmv.

5.2 Uncoupling CO2 and the Pole Shift Driver

The process of uncoupling the two drivers was first discussed in the author's most recent work [3]. Inspection of the plot shows the odd point out at ice age CO2 levels and indicates both that the pole shift driver and albedo made up the difference and that CO2 had much stronger effects at low concentration levels. There is a very apparent vertical band of data at CO2=280 ppm, is that produced by the Roman and Medieval Warm Period.

The logarithmic algorithm produced predicts a very sizeable 3.9 C per doubling which is at the upper end of IPCC estimates and is testament to the fact that present GCMs do not include the magnetic pole shift driver.

Since CO2 was known to have remained remarkably constant during these periods, they are ideal to examine the correlation between North Pole Latitude shift and temperature and hence to create an algorithm to separate out the effects of CO_2 during the modern warming period. A plot of temperature versus North Pole latitude is first created exclusively for the entire RWP and MWP using data from Figure 1. This yields linear equation 8.

$$\hat{Y} = -4.105129 + 0.0464158\ X1\ (PS) \qquad (8)$$

Note that the slope of equation 5 for the entire warm periods is about half that of the places where maximum warming occurred. It is suggested by the present author that we are presently at or close to the point of maximum Pole shift driven' warming right now.

Equation 8 is then applied to all PS latitude values in the post-industrial period to yield an equivalent temperature at 280 ppmv of CO_2. A plot is then made using the difference between the observed and this predicted temperature plotted against the XS and added CO_2 over and beyond 280 ppm, see Figure 4. In this way the modern-day effect of CO_2 is completely isolated from all pre-cursors and the PS multi-collinearity.

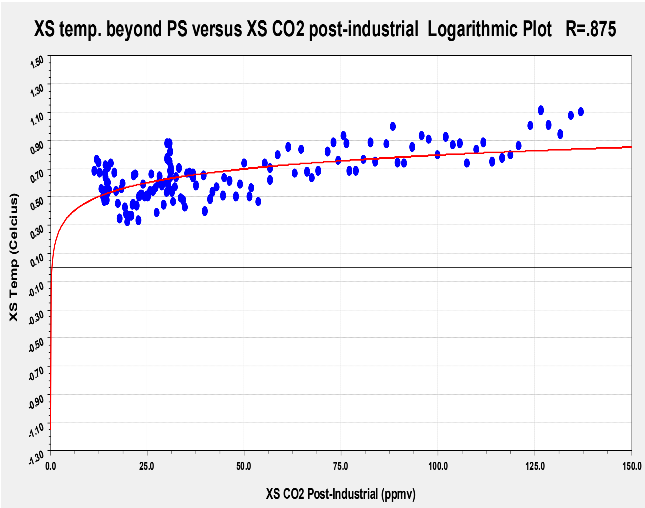

Figure 4: Natural Log Plot of Earth temperature anomaly from CO_2 at 280 ppm Maunder minimum through Modern Warming Period. Plot represents XS temperature after removal of Pole Shift effect versus XS added CO_2 (post-industrial).

It can be clearly seen from Figure 5 that when the data is treated in this unique manner, temperature growth rate quickly flattens. The plot is of the form described by equation 9.

$$y = .147 + .141 \ln x \qquad (9)$$

Where y = temperature change and X =XS CO_2 ppmv beyond 280 ppmv.

It is apparent that most additional warming appears to happen in the early stages of addition XS CO_2 in typical logarithmic manner. Further exploration indicates close to 100 mK per doubling of CO_2, from present levels. This is significantly lower than IPCC estimates, almost in line with the author's previous work [2,3] and indicates that there is perhaps as yet undisclosed additional negative feedback or a concentration dependent increasing sequestration sink(s) in the climate system, see section 2.2 and also section 5.4. Deviation of model and data can only be seen in the last 12 years or so. This is of course coincident with the maximum rate of Pole Shift and the observed drop in cloud albedo.

5.3 Examining C02 stabilization, Rational models.

Thus, a further question arises and that is in connection with the strong stability of CO2 throughout the RWP and MWP when temperature changes as much as today, see vertical data band at 280 ppm in Figure 3. The question to be answered is could the stabilization of CO2 and temperature be a pre-programmed Earth process? Earth's adaptive ability to protect its biota has been suggested by some, see for example Lovelock (1989) [37] and may possibly also happen according to the 'adaptive iris' hypothesis of Lindzen et al (2001)[38]. Although very long-term stabilization between Ice Ages is known and somewhat understood [13,39], short term stabilization is perhaps more unexpected, although shorter term sinks are known, see section 5.4. To further explore and to answer this question other modelling of Earth's temperature as a function of CO2 has been explored, see Figure 5.

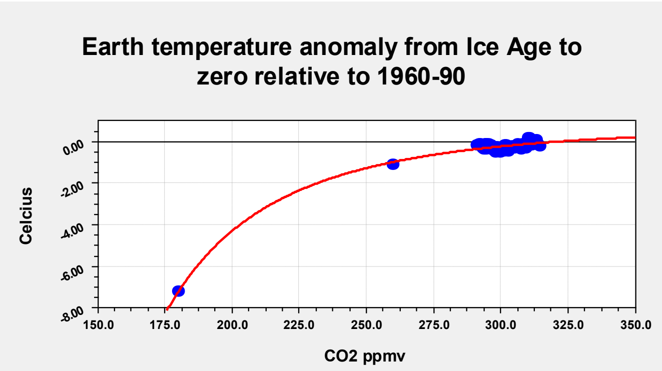

Figure 5: Earth temperature anomaly from last Ice Age to early post- industrial period fitted according to a Rational function of the form Y = a+bx/1+ cx+dx^2 where Y axis is temperature anomaly and x axis is CO2 (ppmv).

The best function that could be obtained was a Rational Function of the form given by equation 10, with R^2= .972 see Figure 5. There is near saturation of temperature with CO2 in the range 290-311 ppmv, in other words the present-day industrial peak was only just commencing.

$$Y = a+bx/1+ cx+dx^2 \quad (10)$$

Table 2: Output of equation 7 column 2 for varying CO2 concentrations column 1.

360	.26
400	.41
600	.58
800	.51
1600	.31
3200	.17

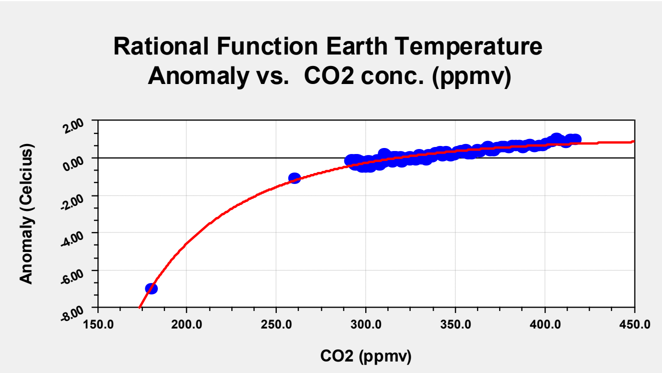

Figure 6 : Earth temperature anomaly from typical Ice Age to Present Day and including Maunder Minimum (LIA) .

Even when much higher post-industrial CO2 levels are sent into the model, it essentially behaves in the same manner, by first flattening and then taking temperature into 'reverse' with ever increasing CO2. A very slight deviation of model and data can only be seen in the last 12 years or so. This is of course coincidence with the maximum rate of Pole Shift and the observed drop in cloud albedo. Indeed, it is this deviation effect and its lack of exposure to and understanding by traditional climate science that has led to claims of runaway warming or 'climate catastrophe' as the temperature time plot appears supra-linear and indeed approximates to a quadratic.

Investigation of the rational function is truly fascinating. Doubling CO2 from 420 to 840 ppm produces a further 170 mK of warming, but thereafter cooling ensues, see Table 3. This figure is very comparable to that produced by equation (3) above and is mid-way within the range of estimates for true 'carbon induced' climate sensitivity as detailed by the author's previous work [3].

Table 3: Output of equation 7 column 2 for varying CO2 concentrations column 1.

360	.44
420	.76
840	.93
1680	.6
3320	.33

5.4 Fast acting feedback?

Considering the results suggests that the notion of undisclosed and possibly quite fast acting negative feedback process(es) is feasible. Impulsive sequestration models like the BernSCM tend to include fixed sinks and sinking times. What if these times were adaptive or shortening according to increasing CO2 concentration? Although it sounds perhaps somewhat farfetched this would effectively be a manifestation of Lovelock's 'Gaia Earth' hypothesis [37]. More likely, there is some manifestation of the adaptive iris mechanism[38]. Other possibilities for increasing and concentration adaptive sinks and faster negative feedback are listed as follows. Naturally this list may not be exhaustive.

1. More pollution, less u/v, less damage to sinks [40]
2. Lightning intensity and primary production [41]
3. Up to 35% greater absorption by C3 crops and vegetation [42]
4. Marine plankton envisioned increasing sink [43]
5. CO2 fixation by algae underestimated, some have up to 94% sequestration efficiency [44,45]
6. Forests for CO2 ever increasing sequestration [46,47]
7. An underestimation in models of NVDI [48]
8. An underestimation of Leaf Area Index (LAI) [49]
9. The cooling effect of wildfire emissions [50]
10. Anthropogenic sulphate aerosol, now falling again [2].

A note of caution is required considering the above arguments, however, in that C02 has been treated as the exclusive and main driver. This is known, however, not to be the case [1-3, 28] but perhaps information can be further corroborated by considering the longer-term evolution of earth. Thus, it is instructive to analyze recovery from the Ice Age is to consider a simple time/ temperature profile. Data must be obtained from a compilation of sources and is shown below, figure 7 [51].

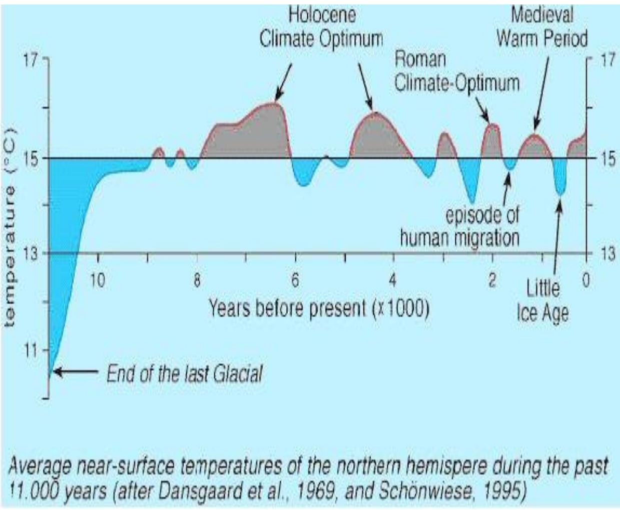

Figure 7: Temperature time plot form end of last glacial period to modern era.

5.5 Temporal Temperature Investigation, 14000 years.

The coldest part of the last Ice Age was about 20,000 years ago. A complex time/temperature plot arises which is not a smooth curve like the above CO2 plots. Polynomial equations are employed to fit these data. Clearly fitting data across many climate epochs there will be both predictable and random drivers, random volcanism and magnetic jerks for example. If climate were driven exclusively by CO2, a logarithmic fit would be expected but this is found not to be the case. The simplest polynomial which gives any meaningful fit to the data is a simple quadratic, not shown here. When applied this model only produces the Holocene climate optimum and is lacking both before and after. A cubic equation, possibly representing the lumped effect of increase water vapor and CO2, Solar changes and Geometric changes, gives a very respectable fit across the range and an R^2 of circa .6, see Figure 8.

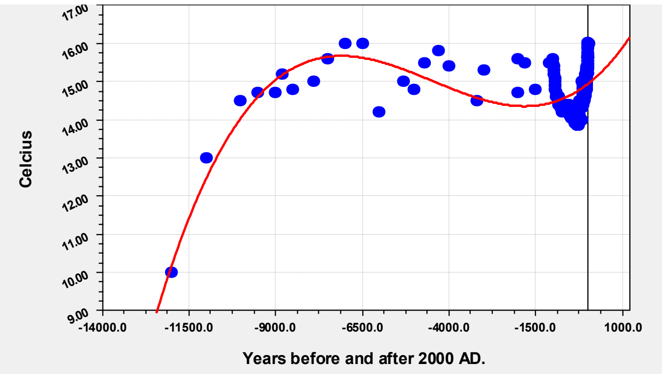

Figure 8 : Cubic fit to earth's temperature from end of last Ice Age to present

At present rates of un- abated emissions, CO2 would double by 2100. The simple cubic model above predicts a mere 55 mK of warming by that date. This figure is about half that predicted by equation 3 and a third of that seen in Table 4. Clearly the three most recent warm periods including modern warming, all dependent on mainly on magnetic drivers/ EEP/albedo shift are inadequately modelled here and hence appear as residuals. It is interesting to note that there appear to be multiple bands of residual warm and cool periods extending back some 10,000 years before the RWP and all of which with similar +/- 1-2 Centigrade amplitudes as with RWP, MWP and, of course, our present warm period (PWP).

5.6 Apportioning some sensible drivers.

Since the simple cubic approximation cannot model these shorter term warm and cool periods, the perhaps a better estimate would be to quantify the required number of parameter for the polynomial in terms of known sensible main drivers according to; a) CO2, b) Solar, c-e) all three Orbital/geometric, f) Volcanic g) Geomagnetic/albedo giving seven such drivers in total, i.e. a 7th Order Polynomial, see Figure 9.

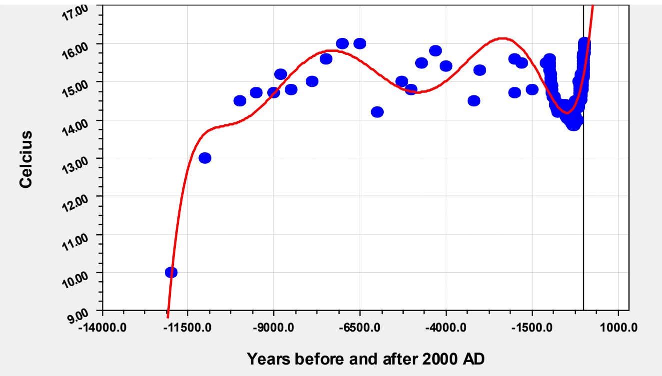

Figure 9 : 14000 years of temperature 7th order polynomial fit.

When treated in this manner both the Holocene Climate optimum and a Roman Warm Period are reproduced. The Medieval Warm Period is underestimated but the Little Ice Age and Modern Warm Period are present. At present rates of un- abated emissions, CO2 would double by 2100. The algorithm arising suggests a temperature increase of .44K for such a doubling. This figure is just over four times that predicted by equation 3 but it must be remembered that when the data is treated in this manner there is no way of uncoupling multi-collinearity.

It has been suggested that the Hunga Tonga Volcanic eruption, having raised Stratospheric Water Levels by over 5% could cause major climate forcing impact in the short term, see Millán et al (2022)[52]. Extending the data above to 2025 requires the addition of extra parameters in the polynomial, not shown, and accordingly produces steep transient warming. This transient nature is also evident in recent UAH satellite data which now also shows attendant and subsequent cooling [53].

The previous two warm periods, MWP and RWP lasted approximately 400 years each. Figure 10 shows an 11th order polynomial fit based on the expectation that the northern dip pole migrates back South to circa 70 degrees North by the year 2270 AD and based on the author's previous maximum prediction of warming for CO2 doubling [3].

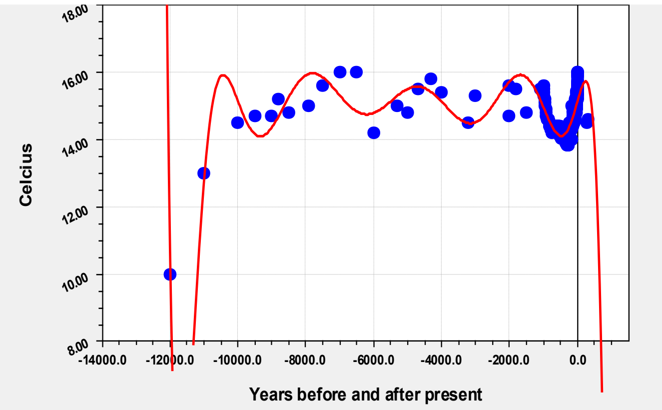

Figure 10: Hypothetical future climate with 350 mK of CO2 warming and 1900 mK of Pole shift cooling by 2270.

Analysis of the polynomial produced under this scenario shows that temperature remains reasonably flat for the next 300 years or so before falling rapidly. Then in 400 years' time there would be about 500 mK fall and in 600 years' time glacial conditions would quickly approach.

5.7 Results and discussion for data set bias.

The results and discussion for data set bias are discussed below.

5.7.1 Critique of GISTEMP V4.

The dataset used in this study for Post-Industrial Temperatures is GISTEMP v4 which uses temperature data primarily from two sources: land-based weather stations and ocean-based measurements from ships and buoys. Specifically, it uses data from NOAA's Global Historical Climatology Network (GHCN) for land temperatures and NOAA's Extended Reconstructed Sea Surface Temperature (ERSST) data for ocean temperature. For such data sets there are potential biases with historical instrument changes, see for example [54].

Dynamic Data Sources is another issue, for example, the number of stations and sea-based observations varies over time (1880–present). Historical data (pre-1960) has sparser coverage, especially for oceans, while modern data (post-1960) is more comprehensive. Also, the ratio of land to sea-based measurements is not explicitly stated. Moreover, any land-based weather stations used in the GISTEMP analysis, like any observational data source, have inherent uncertainties and potential biases that need to be addressed when constructing a global temperature record. These include station-level uncertainties such as measurement errors and adjustments, bias uncertainties such as urban heat island effects, and finally sampling uncertainties due to incomplete spatial coverage.

5.7.2 UHI Issues

Most cities are a minimum of 2C warmer than the surrounding countryside, but urban heat island effects of 5-7 C are common [55] and can in some cases reach a massive additional 10C on thermometer readings, see [56] This heat is not merely solar heat trapped in concrete and tarmac but is also radiated and convected anthropogenic heat [57]. Heat from air conditioning in a city may add at least 1C to the UHI effect, [58] There is also added temperature bias due to UHI as progressively more of the World's population live in Urban areas. [59]. In London most UHI increased between 1949 and 1980 [60]presumably the period in which central heating was being added to most buildings. For example, an anthropogenic heat flux of a few tens of watts per metre squared can add upwards of 1C to a City Temperature. [61]

The present author sees this bias of crucial importance for a significant amount of anthropogenic waste heat on earth will be correlated with CO_2 emission and hence will upwardly distort global warming and climate sensitivity estimates.

5.7.3 The UAH dataset

The UAH satellite temperature dataset, developed at the University of Alabama in Huntsville, infers the temperature of various atmospheric layers from satellite measurements of the oxygen radiance in the microwave band, using Microwave Sounding Unit temperature measurements. It was the first global temperature datasets developed from satellite information and has been used as a tool for research into surface and atmospheric temperature changes. The dataset is published by John Christy et al. and formerly jointly with Roy Spencer.

UAH data from 1979 to the present day has been compared with GISTEMP v4 data from the same date span.

5.7.4 Comparison of the two datasets: Results

When a simple CO2 only regression is made the results yield a staggering 1.6 times as much warming showing in the GISTEMP v4 SET compared wit the UAH. Between 1979 and 2020 GISTEMv4 would appear to have a slope of 192 mK/decade although considerably steeper if the last 5 years are factored in. Over the same period UAH has a slope of 124 mK/ decade. This result is exactly opposite of what is to be expected by Greenhouse theory.

CO2, PS and Albedo change have all three recently been postulated as drivers of recent climate change. When a manually forced linear regression is run with either data set using these three parameters the multi-collinearity values in the Pearson Matrix are almost unity for all three potential drivers. In other words, the regression is stronger driver to driver than it is to temperature. Thus, whereas the predictability of a whole model would have some validity the weighted meaning of individual drivers would remain questionable. It is perhaps more instructive therefore to try single regressions and see the outcome. When treated in this manner the results may be summarised in terms of regression value R^2 and p-value, see Table 4.

	GISTEMP	UAH
ALBEDO p	6.6E10^-16	5.5 E^-8
PS p	0	5.5E^-8
CO2 p	0	4 E^-8
ALBEDO R^2	0.86	0.53
PS R^2	0.85	0.53
CO2 R^2	0.88	0.53

Table 4: p-values and Regression values for three main potential drivers of each temperature dataset.

Clearly the results are very different for each data set. Any of these key drivers only account for 53% of the temperature change in the troposphere. Multiplying .53 by 1.6 yields .848 which is closest to the PS R^2value. The largest R^2 value is CO2 which is most likely reflective of the potential bias described above, supportive of hypothesis 8.

According to ‘traditional greenhouse effect’ and the ‘most robust climate models’, most warming ought to occur in the upper troposphere. Although some models predict more surface than tropospheric warming, it is difficult to square the two completely different results above. Perhaps until that is a recent study by the World Bank highlighted that the severity and frequency of urban heat islands are much higher today than the historical trend, now being 23 times more frequent and 10 times more potent. It is known that a significant proportion of UHI is anthropogenic and due to air conditioning in summer and central heating in winter. Most energy use still depends on fossil fuels and will therefore correlate CO2. Moreover, solar heating of the oceans drives ENSO which will also give a CO2 in/out relationship and lagged correlation.

Several recent studies point to the bulk of recent warming as being due to cloud albedo reduction[1-3,28,62,63,64].

The clear and different bias in the two data sets confirms the hypotheses about causes of bias but also confirms that CO2 is a far weaker driver of tropospheric temperature than previously suggested by mainstream climate science and the IPCC. Indeed, Nikolov and Zeller (2017) indicate that the GSAT (Global Surface Average Temperature) of a planet does not depend on GHGS per se but depends on physical parameters inter-alia Bond Albedo and TSI [65].

The author has also made several statistical tests on the two data sets. Granger Causality confirms that GISTEMP V.4 earth based effectively drives UAH with a single period lag. This is of course to be expected because the sun heats the surface and the oceans and atmosphere response is due to thermal lags, oceanic and atmospheric circulation times.

However, further investigation shows that the relationship is non-linear. GISTEMP V4 is increasing faster than UAH and quadratic, and even exponential functions satisfy that relationship somewhat better than a linear one. Hence the two data sets seemingly are becoming more divergent. Perhaps UHI alone in conjunction with PS may be sufficient to explain this phenomenon.

5.7. Linear extrapolations

A linear extrapolation of GISTEMP V4. shows a minimum of 2.9 C of warming by 2100 at current emissions rates. A quadratic fit produces a staggering 8.5 C of warming. The quadratic behaviour is a pseudo effect of the logarithmic CO2 driver and additional UHI/waste heat components and the linear PS driver and possibly also recent reductions in S02. This should be tempered by the discovery that the bulk of warming is PS and of geomagnetic origin and not due to CO2 and that the Northern Dip Pole is already moving Southwards again.

A linear extrapolation of UAH shows only 1.35 C of warming by 2100. This is closer to, but still some three times that modelled for all cause warming in the present study. Again, we should be aware that a sizeable proportion of up to 90% of that warming is down to Pole Shift [1-3]. The difference is 135mK which is within 4% of that predicted for doubling in the author's previous paper [3].

5.8 Warm periods common process

This is also emphasised in section 5.5 above. Another way of understanding that the same process is responsible for the warming of the RWP, the MWP and our present post -industrial warm period (PWP) is to examine a plot of Latitude shift versus Temperature shift for each era, see Figure 11 below. The only chosen caveats here are firstly that the start of the RWP is not fully documented in reference [30](figure 1) so the steepest downward temperature transition of the period is assumed to be a mirror of its start, secondly that the steepest upward temperature transition of the MWP is employed between about 750 and 1000 AD and finally that the central part of the Maunder minimum has been chosen by the author to represent the start of the PWP.

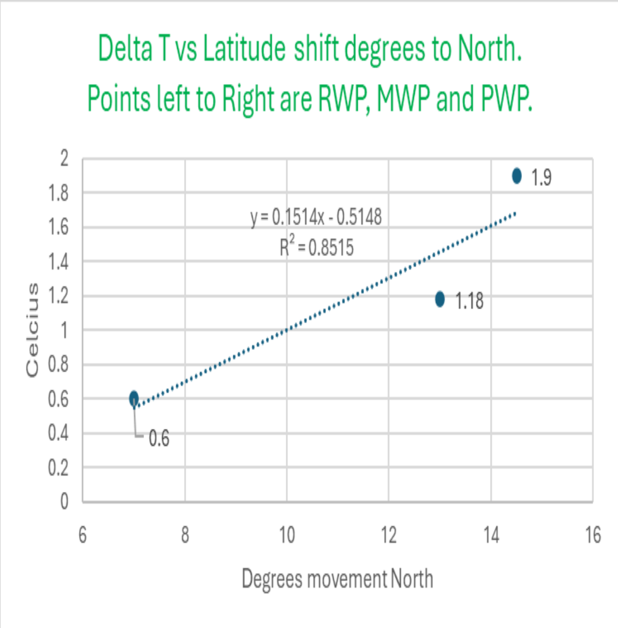

Figure 11: Plot of temperature anomaly change versus degree of Northern magnetic pole shift for the present warm period (PWP) and the last two historic warm periods MWP and RWP.

It is of course highly improbable that such excellent linearity could happen by chance. The small +ve residual on the PWP represents CO2 induced warming which is minimal. It is crucial to bear in mind that the Pole shift effect is a vectorial effect and when it moves south again, clouds return and temperature falls. The modelling in Figure 10 has been evaluated on this basis and on the basis that previous warm periods have had symmetric rise and fall times.

6. Conclusion and Future Scope

Section 5.8 and Figure 11 above confirm hypothesis 10. Moreover, the notion that climate has a geomagnetic driver which drives albedo and dominates and works hand in hand with CO2 as a lesser driver has been tested and validated even back to the last ice age, see discussion and Tables 1and 4, figure 2 and 3 and equation 4 especially. The multi- parameter model predicts an excellent fit and sensible Ice Age temperatures based on the caveat that CO2 was of the order of 180 ppmv and that the earth's magnetic field was minimal, equivalent to latitude zero and that the albedo was of the order of .45. There is literature documented evidence for these caveats. The geomagnetic pole shift component effectively driving clouds and water vapour behaves linearly throughout but linear regression is not the best approach for CO2 and indeed exposes its highly non-linear behaviour with very strong contributions at low ppmv and very quick saturation with temperature.

Limited conclusions can be drawn from the seven-parameter regression model concerning modern drivers because of multiple and strong multicollinearities. In this period the only additional natural driver to have a sensible 'p' value was SSN. The only anthropogenic driver to have a sensible 'p' value was aviation which overall has a warming effect supporting the author's previous conclusion [2]. In cases of multicollinearity individual predictors may often over or underestimate or even change sign but the overall power of the model is unaffected.

R^2 was of the order of .9 throughout and the power of prediction was near on perfect when both the historic warm periods and the Ice Age were included. This confirms hypothesis 1 i.e. the notion in the original that the algorithms ought to be capable of taking in an Ice Age and the additional relevance of PS, CO_2 and albedo therein and have exposed the non -linear behaviour of CO_2 and further investigation showed that temperature effects do not follow a simple log plot as would be expected from infra-red light absorption theory. It has been possible to uncouple CO_2 and Pole Shift effects by creating a Pole Shift only separation algorithm for the RWP/MWP combined, see equation 5. Although hypothesis 4 is not supported in the Ice Age there is however some support in the PWP, the separation algorithm used to allow a discernible log plot for to be created exactly in line with that proposed in the original hypothesis of the form $y = .147 +.141\ln x$, see equation 6. It is further concluded that as with warming from the Ice Age, most additional warming appears to happen in the early stages of addition XS CO_2 but in this case with PS removed, in typical logarithmic manner. Further exploration indicates close to 100 mK per doubling of CO_2, from present levels. This is significantly lower than IPCC estimates, almost in line with the author's previous work, which only used a simple linear approximation [3]. Such a low figure may potentially indicate undisclosed and adaptive additional negative feedback(s) in the climate system, see section 2.2 and also section 5.4. Deviation of model and data can only be seen in the last 12 years or so. This of course coincides with the maximum rate of Pole Shift and the observed drop in cloud albedo.

It is further concluded in support of hypothesis 5 that earth's temperature stabilises at an optimum CO_2 level around 290-311 ppmv by means of processes which obey a Rational Function of the general form $Y = a+bx/1+ cx+dx^2$, see equation 7. Addition of further CO_2 then appears only to make minimal overall difference to the extension of this function and adds on only about 150 mK at CO_2 concentrations of even up to 3200 ppmv. This is only 7% greater than the estimate for doubling given in reference [3] and is 10% greater than the estimate in section 5.7 above.

Clearly, once optimum CO_2 has been established it is concluded there are adaptive and faster acting sinks and mechanisms which hold its effect if not necessarily its value. These are inter-alia with possibly as yet others hitherto unknown.

1. Less u/v
2. Lightning intensity and increased primary production.
3. Up to 35% greater absorption by C3 crops and vegetation.
4. Marine plankton as an increasing sink.
5. CO_2 fixation by algae some have up to 94% sequestration efficiency.
6. Forests with increasing sequestration.
7. An underestimation in models of NVDI
8. An underestimation of Leaf Area Index.
9. The cooling effect of wildfire emissions.
10. Anthropogenic sulphate aerosol.

In the above respects it should be noted that items 1,2,9 +10 in the list will also offset some warming due to PS and albedo in addition to CO2. Moreover, it has very recently been suggested that CO2 residency time could be a lot less than previously assumed, possibly as little as 7 years, see Cohler et al (2025)[66] . Thus hypothesis 6 has thus been tested and confirmed.

The conclusions on CO2 are both academically and physically exciting, however, earth has of course across its various epochs being subject of other and changing climate drivers. It is concluded that a simple cubic model can almost replicate the bulk of Earth's temperature from the Last Ice Age to the Present Day. The parameters most likely representing a mix of GHG, Solar/Albedo and Geometric/Orbital changes. The cubic model, figure 8, however underestimates present warming producing only an addition 55 mK by 2100 and does not replicate the three most recent and magnetically driven short term warm and cold periods of late with circa +/- 300-year durations i.e. RWP, MWP, and PWP.

On the other hand, it is concluded that switching to a seven-parameter polynomial employing sensible main drivers chosen according to the assumption that they may represent; a) CO2, b) Solar, c-e) all three possible Orbital/geometric changes, f) Volcanic and g) Geomagnetic/albedo giving seven such drivers in total, i.e. a 7th Order Polynomial, see Figure 9, not only replicates the outline of the last 22,000 years of warming but .is able to far more closely replicate even the Pole Shift and Solar driven warm and cold periods including the PWP. The algorithm suggests a warming of 440 mK by the year 2100 but we must bear in mind this assumes that PS remains at present rates which is unlikely to happen.

The PS induced Northern Dip Pole latitude has currently started moving slowly South again. An exceptional recent Double Peaked El Nino [67] and the Hunga Tonga eruption have deviated climate in the last four years [68]. It is concluded that if additional parameters are added to account for their rise and fall and an 11 parameter Polynomial is used with sensible values for PS Latitude and CO2 doubling included that temperature remains flat for the next 300 years or so before falling rapidly. Then in 400 years' time there would be about 500 mK fall and in 600 years' time glacial conditions could quickly approach.

The above findings strongly confirm initial hypothesis 7 that polynomial fits of earth's temperature record will require additional parameters in the PWP.

6.1 Conclusions of data set bias and tropospheric warming

When a simple CO2 only regression is made the results yield a staggering 1.6 times as much warming showing in the GISTEMP v4 SET compared with the UAH. It is concluded that the GISTEMP v4 data set overestimates temperatures because of UHI and Waste Heat Bias. Gistemp V4 upon Linear extrapolation yields a massive 2.9 C of warming by 2100. A closer investigation shows the GISTEMP curve to be supra linear and in fact a better fit to a quadratic is obtained yielding a staggering and literally 'scorched earth' 8.5 C scenario. Since this is so totally different from the UAH which measures average tropospheric temperatures yielding 1.35C of warming it is concluded that there is a physical unreality with the GISTEMP v4 data set. This may have come about partly from temperature bias and partly from incorrect feedback modelling in the event of model creators being totally unaware of the PS/Albedo effect and the self -adapting sink effects, the former of which in any event the author's previous work has shown that up to 90% of recent warming has this origin and that subsequent cloud albedo reduction induced. The above confirms huge bias in the Land and Sea based GISTEMP v4 model, but it would be fair to say that because from 1979 to 2020 the warming slope per decade on GISTEMPv4 is 192mK /decade as compared with 124 mK/decade for UAH that hypothesis 8 is partly supported and also the conclusion is that traditional Greenhouse Warming with a maximum effect in the Upper Troposphere i.e. hypothesis 9 ***is not supported***.

It is further concluded that at least with UAH all present warming can be accounted for by PS/albedo shift and TSI (SSN). The magnitudes of warming per decade are certainly comparable to those calculated by the present author for PS in the past [1,2] and by Nikolov and Zeller for cloud albedo loss [29].

As proposed in the original hypothesis the concept of a dominant common driver for the RWP,MWP and now PWP is concluded both from literature evidence, see section 2 above and algorithmic evidence, see Tables 1 and 2 and Figure 10. Of course, prior to the MWP came the LIA when the Northern Dip Pole was much further South than it is today and SSN was close to zero. However, it is important to note that Hunt (2006) have stated that SSN does not account completely for the LIA [26] and thus an additional driver is needed, and this adds further weight to the PS hypothesis [1-3].

Future scope

There is future scope for an extension of this work, but this is highly dependent on the future behaviour of P.S. Although PS induced changes throughout history have been quick in comparison with geological timespans, with transitions of some 20 degrees or so latitude over a period of circa 200 years, they are slow in comparison with a scientific author's lifespan.

There is also potential to further investigate the physical unrealities in some of the earthbound datasets. The author suspects they are being driven by possible multiplication say between a mix of CO_2, PS and Waste Heat and/or between Land and Sea Surface Temperatures and incorrect modelling especially of WV feedback in the light of PS albedo shift.

There are several papers which suggest that CO_2 follows temperature both at long and short timescales. In other words, the old maxim correlation is not necessarily causation. The short-term situation, most relevant to this present work, is explicitly discussed by Nishioka (2024) [70].

The work here is in line with and supports the author's previous suggests that CO_2 is only a very minor driver of climate and that climate models need urgent revision. It is re-iterated that there needs to be an urgent paradigm shift in climate science towards better understanding of earth's magnetic fields and their interplay with Space Weather, upper atmosphere, PS, albedo, TSI, clouds and aerosols.

Data Availability

The postindustrial climate data employed is readily available online and is GISTEMP v4.

The UAH tropospheric satellite temperature data is available at the Earth System Science Center operated by the University of Alabama in Huntsville, USA.

For the position of the magnetic North Dip Pole, data from NOAA [IGRF] was employed. For Paleomagnetic data, reference [69] was employed the only limitation being the need for visual extrapolation from the pole shift diagram. Likewise, for Paleotemperature data reference [30] was employed but only the main peak in the RWP and the main trough in the LIA due to scale and visual interpolation difficulties with the smaller and ill-defined peaks and troughs. This represents a study limitation since given the original scales in the diagram temperature is difficult to estimate to within .1C and date is difficult to estimate to within 20 years and given also that the Paleomagnetic data was only available at 50-year intervals [5]. Also, CO2 levels in the Medieval Warm period are not accurately known and are generally reckoned to vary between circa 260-290 ppm depending on reference used. These limitations introduce a small degradation in the regression factors when considering this period.

Conflict of Interest

None.

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Authors' Contributions

The present and single author is responsible for 100% of the research and authoring.

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