International Journal of the Physical Sciences Vol. 7(4), pp. 660 - 663, 23 January, 2012
Available online at http://www.academicjournals.org/IJPS
DOI: 10.5897/IJPS11.1194
ISSN 1992 - 1950 © 2012 Academic Journals

Full Length Research Paper

Correlations between ocean water temperature and related parameters from the Victoria experimental network under the sea (VENUS) and geomagnetic activity: Implications for climate change

Noa Gang[1] and Michael A. Persinger[1,2]*

[1]Department of Biology, Laurentian University, Sudbury, Ontario, P3E 2C6, Canada.
[2]Biophysics Section, Biomolecular Sciences Program Laurentian University, Sudbury, Ontario, P3E 2C6. Canada.

Accepted 04 January, 2012

Factor analyses of sample daily variables of temperature, conductivity, density, oxygen concentration and salinity of sea water from the Victoria Experimental Network Under the Sea (VENUS) project reflected a single factor. Once temporal (serial) effects had been removed, the residuals for this factor were significantly and positively correlated (r=0.60) with the global geomagnetic activity during the days of and before and after the measurements, but not for the second and third days before or after the measurements. These results suggest that increased geomagnetic activity can influence the shared recondite sources of variance within sea water that affect temperature and associated basic parameters. The slope for the significant correlation between increased global geomagnetic activity and increased water temperature revealed changes that were consistent with the empirical measurements.

Key words: Geomagnetic activity, sea water, temperature, climate change, Victoria Experimental Network Under the Sea (VENUS) project.

INTRODUCTION

The seminal work of El-Borie and Al-Thoyaib (2006) indicated that the approximately 1.1°C increase in the global mean temperature since the year 1877 is unlikely to be the total product of internal climate variability. They found that approximately one-quarter of the variance in global temperature could be accommodated by the gradual increases in intensity of geomagnetic and solar activity. Commensurate with this observation is the expansion of the solar corona (outer atmosphere composed of ionized gas) that has doubled during the same period (Lockwood et al., 1999). Persinger (2010) argued that the increased surface temperature on the Earth and Mars in recent years suggests an interplanetary factor rather than an exclusively terrestrial source. A discrete increase of 1 nPa in dynamic pressure was equivalent to about 16 nT magnetic intensity which was the average increased geomagnetic activity over the last century (Persinger, 2009). If increased global geomagnetic activity has contributed to increased global mean temperature, then a variant of this association should be evident in the sea water, which covers about 70% of the globe (Sadrzadeh and Mohammadi, 2008). Indeed, Levitus et al. (2005) showed that world ocean temperatures up to a depth of 3000 m rose slightly over a 50 year period. That a relationship between static geomagnetic field values and ocean parameters exists has been suggested by Ryskin (2009) although his model indicates that the flow of sea water affects the rate of secular variation in adjacent continental magnetic values. The correlation between rates of ocean water flow and changes in geomagnetic secular variation since 1970 were remarkably congruent. However, these analyses did not include the increased magnitudes of solar-driven geomagnetic activity.

*Corresponding author. E-mail: mpersinger@laurentian.ca. Fax: 01 705 671 3844.

MATERIALS AND METHODS

To test the potential quantitative association between global geomagnetic activity and the basic global-temperature and biologically-relevant variables, water data were obtained from the Victoria Experimental Network Under the Sea (VENUS) coastal observatory network with arrays of sensors located at a depth of 97 m in Saanich Inlet (48° N, 123° W) and in the southern Strait of Georgia between Vancouver Island and the mainland of the British Columbia coast. At each VENUS node, there is a standard instrumental platform containing a variety of oceanographic instruments. The variables extracted from this database were temperature (°C), conductivity (S/m), density (kg/m^3), pressure, (decibars), oxygen concentration (ml/L) and salinity (psu). The mean values for each of these six measures were obtained from minute-to-minute (n=1,440) values per day.

On the bases of estimates of effect size (explained variance) derived from the magnitude of the average correlation between larger intervals of geomagnetic-temperature correlations, we selected randomly 27 days where the global geomagnetic activity (K-index) was low (≤ 2), medium (= 5) and high (≥ 15). The time period considered included January to April of 2011. Each day was considered a separate case, and there were 9 cases per geomagnetic activity condition. Global daily averages of geomagnetic activity measured in nT (the aa, or average antipodal indices) were obtained from the British Geological Survey for each key day (the day of the water measurements) and for each of the 3 days before and after the key day. We report here a moderately strong association between increased geomagnetic activity and increased temperature, salinity and conductivity but decreased oxygen concentration.

RESULTS

The means and standard deviations (in parentheses) for the fundamental parameters for the 27 days sampled over 4 months of daily values (n=1440/day) were: temperature, 8.64 (.35)°C; conductivity, 3.26 (0.04) S/m; density, 1024.19 (.03) kg/m^3; pressure, 95.08 (0.10) decibars; oxygen concentration, 1.76 (0.56) ml/L; salinity, 30.64 (0.11) psu. The means and standard deviations (in parentheses) for global geomagnetic activity (aa indices) for the day of the measurements and for each of the 3 days before and after the measurements ranged between 11.7 (8.7) to 18.9 (16.8) nT. Repeated measure analysis of variance for the 7 days showed no statistically significant [$F(6,144)=1.36$, $P>0.05$] differences across days. However, the pre-selection criteria for geomagnetic activity (in nT) for low (M=4.1, SD=1.3), medium (M=11.3, SD=4.4) and high (M=41.1, SD=7.8) activity on the key days did differ significantly [$F(2,24)=126.3$, $p<0.01$] as expected by selection. There were no significant differences (all Fs <3.20, p >.05] for any of the other days before or after the key days as a function of the ordinal geomagnetic conditions (low, medium and high).

There were no statistically significant differences [Fs(2.24) <1.85, p >0.05] between the three geomagnetic conditions (low, medium and high) for any of the sea water measures. However, there were significant changes (all dfs=3.23, all p <0.001) over the 4 months for conductivity [F=29.52; Ω^2=82%], temperature [F=30.78; Ω^2=78%], pressure [F=14.09; Ω^2=65%], density [F=16.69; Ω^2=67%] oxygen concentration [F=21.01; Ω^2=72%] and salinity [F=15.15; Ω^2=65%].

Factor analyses after varimax rotation, indicated that all but pressure loaded significantly (all r's 0.89 to 0.98) on the same factor (Eigen value=4.28) that explained 71% of the variance. Factor analyses for the 7 days of geomagnetic activity indicated that the first factor, explaining 25% of the variance, was loaded significantly (r >0.60) by the activity on the key day (0.79) and the days before (0.66) and after (0.69).

Symmetrical partial correlation analyses after the slope for the factor scores with seasonal change was removed, revealed a clear and significant relationship between sea water variables and daily global geomagnetic activity (Figure 1). The residuals for the factor composed of sea water variables (conductivity, temperature, density, oxygen concentration and salinity) were positively correlated with geomagnetic activity the day of and the day before and afterwards, but not for days more distal. The first factor that emerged when the geomagnetic activity for all 7 days was analyzed was loaded significantly (r >0.80) by only the activity on the key day and the day before and day afterwards.

The zero-order correlation between the factor score for the sea water variables and this primary geomagnetic variable was 0.45, but after covarying for the monthly trend, the correlation was 0.68 (Figure 2). None of the secondary factors associated with the other days of geomagnetic activity were significantly correlated with the sea water factor. The importance of removing the monthly trends was emphasized by the results of analysis of covariance. The absence of statistically significant differences between the three classes of days (low, medium and high geomagnetic activity) became significant (all dfs=1.23), when the monthly drift was first covaried, for temperature [F=4.57, p <0.05], electrical conductivity [F=4.00, p <0.05] and density [F=4.55, p <0.05] but not for pressure or oxygen concentration.

These results indicated that some shared source of variance is associated with: 1) changes in sea water temperature, salinity, oxygen concentration and conductivity, 2) the variance shared with geomagnetic activity during a 3-day interval that includes the day of the measurements and the day before and after. This association, which explained almost 50% of the shared variance, was only evident when the serial correlation associated with months was first removed. The relationship between the increased intensity of the geomagnetic activity on the day of the measurements and the increased factor scores for sea water variables (except pressure) was hidden within the likely seasonal variations.

Although the major effect was recondite and required removal of trends, the zero-order correlations were still statistically significant for water temperature with the mean of the geomagnetic activity of the day of measurement

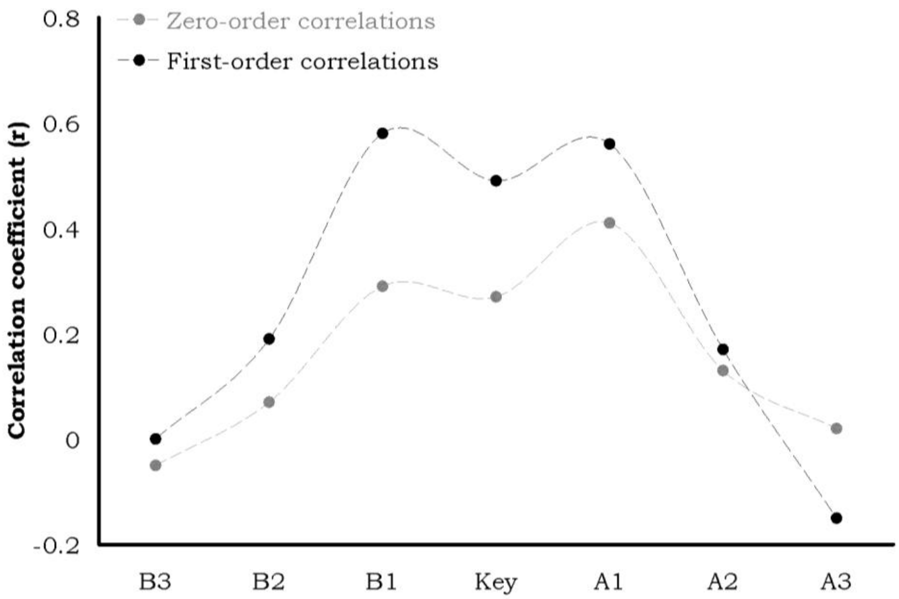

Figure 1. Zero- and first-order partial (after trend removal) correlations between the major sea water factor scores involving temperature and the global geomagnetic activity of 3 days before (B), during (key) and 3 days after (A) the 24 h period of sea water measurements ($r > 0.40$, $p < 0.05$; $r > 0.45$, $p < 0.001$).

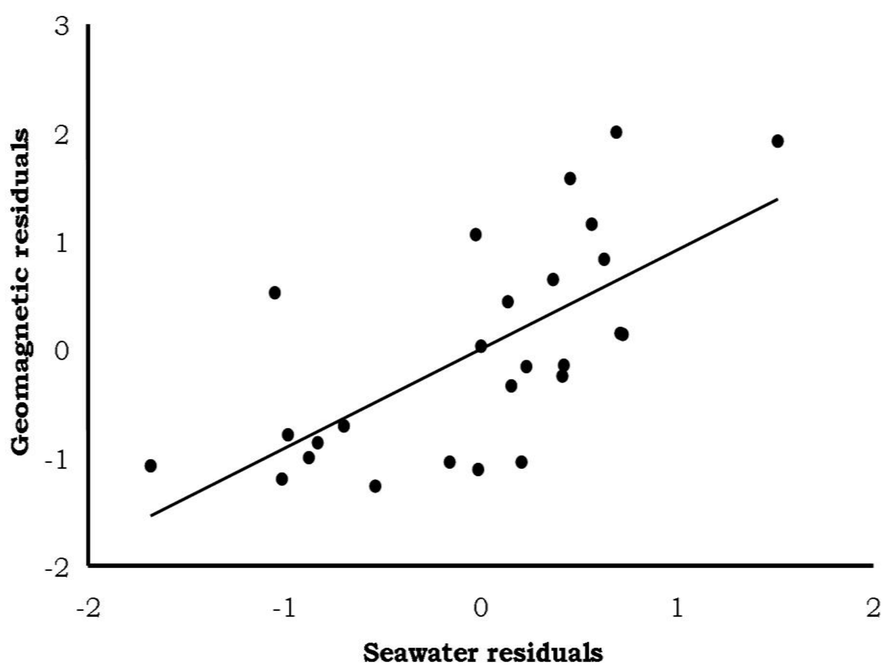

Figure 2. Correlation between geomagnetic activity and seawater property residuals after covarying for seasonal change ($r = 0.68$, $p < 0.05$).

and the days before and after. The correlation was 0.37 ($p < 0.05$; one-tailed test) and the slope was 0.012. This indicated that for every 10 nT increase in geomagnetic activity, the water temperature increased 0.1°C. Over the range (2 nT to 45 nT) of the geomagnetic activity, an average net increase of ~ 0.4°C would be expected. Given the standard error of the estimates, this change is well within the 1°C range recorded during this period.

DISCUSSION

We examined several physical models to accommodate the relationship between increased geomagnetic activity and increased water temperature in the research area between Vancouver Island and the main coastline of British Columbia. The most congruent potential mechanism would involve energy dissipation as heat through hydronium ions or a species that is similar in properties. Assuming a frequency of ~1 MHz for geomagnetic oscillations of 40 nT, the voltage across 1 cm^2 would be 4×10^{-8} T/1000 s·10^{-4} m^2 or 4×10^{-15} V. For every 1 cc or 1 g (10^{-3} L) of water, there would be 110 M (mols)/L ·6.023×10^{23} molecules/M of hydrogen atoms. With an average of 4×10^{-8} M of free H+ in water (DeCoursey, 2003), there would be ~2×10^{15} of these charges (C). The energy (V·C) would be about 8 J or in the order of 2 calories. Given that 1 calorie is the amount of energy required to raise 1 g of water 1°C at STP (Walker, 2004), the solution for 2 calories would be more congruent with the lower sea water temperature (~8°C). Whether or not the maintained elevation in geomagnetic intensity over the last 40 years could affect the whole global ocean temperature remains to be verified. It might be considered through non-traditional heating. The magnetic diffusivity ($\mu_o \sigma$) for sea water where σ is 3.2 S/m, and $\mu_o = 4 \cdot \pi \cdot 10^{-7}$, is about 500 m^2/s (Ryskin, 2009). With an estimated 10^{14} m^2 of surface area for the oceans (Lutgens, 1992), about 7 to 10 years would be required. This is within the latency range for elevated temperature from solar-geomagnetic variables reported by El-Borie et al. (2011).

Although there are alternative hypothesis, such as exclusively anthropomorphic causes, concerning fluctuations in global warming and climate change (Aizebeokhai, 2009), there is compelling evidence that a third factor affects both human behavior and global surface temperature (Persinger, 2010) and that indices of atmospheric concentrations of carbon dioxide are epiphenomena. The spectral analyses of global surface temperature by El-Sayed Aly (2010) revealed a strong 21.3 year peak that is remarkably congruent with changes in the polarity of the main solar magnetic field during the full cycle. That this likely macrocosmic causation would be reflected within the microcosm of local oceanographic measurements is expected.

REFERENCES

Aizebeokhai AP (2009). Global warming and climate change: realities, uncertainties and measures. Int. J. Phys. Sci., 4: 868-879.

El-Borie MA, Al-Thoyaib SS (2006). Can we use the aa geomagnetic activity index to predict partially the variability in global mean temperatures? Int. J. Phys. Sci., 1: 67-74.

El-Borie MA, Abdel-Halim AA, Shafik E, El-Monier SY (2011). Possibility of a physical connection between solar variability and global temperature change throughout the period 1970-2008. Int. J. Res. Rev. Appl. Sci., 6: 296-301.

DeCoursey TE (2003). Voltage-gated proton channels and other proton transfer pathways. Physiol. Rev., 83: 475-579.

Levitus S, Antonov J, Boyer T (2005). Warming of the world ocean, 1955-2003. Geophys. Res. Letters, 32: 1-4.

Lockwood M, Stamper R, Wild MN (1999). A doubling of the sun's coronal magnetic field during the past 100 years. Nature, 399: 437-439.

Lutgens F (1992). Essentials of Geology MacMillan, New York, p. 269.

Persinger MA (2009). The possible role of dynamic pressure from the interplanetary magnetic field on global warming. Int. J. Phys. Sci., 4: 44-46.

Persinger MA (2010). The cosmology of climate change: intercorrelations between increased global temperature, carbon dioxide and geomagnetic activity. J. Cosmol., 8: 1957-1969.

Ryskin G (2009). Secular variation of the Earth's magnetic field: induced by the ocean flow? New J. Phys., 11: 1-23.

Sadrzadeh M, Mohammadi T (2008). Sea water desalination using electrodialysis. Desalination, 221: 440-447.

El-Sayed Aly N (2010). Spectral analysis of solar variability and their possible role on global warming. Int. J. Phys. Sci., 5: 1040-1049.

Walker JS (2004). Physics 2nd Ed. Person Education Inc., New Jersey, p. 513.