Review of a manuscript of V. A. Tartakovsky
«Synchronicity as an essential property of solar-terrestrial relations. Latent components »,

First of all, it should be noted imperfect English of the manuscript, making it difficult to unambiguous understanding the text. I apologize in advance for possible misinterpretation related with that.

The author proposes a statistical method for correlating series of observations. He affirms that the method is able to reveal a cause-effect relationships between the observed parameters. The method («s-decomposition") consists in discrete Fourier transform of each of two compared series of observations and subsequent distribution of components of the Fourier decomposition into two groups according to the coincidence and difference of signs of the same order component coefficients of the expansions. As a result, each of the two series of observations is associated with a pair of inverse Fourier transforms: CS - with components of the Fourier expansion with the same signs, and NS - of components with the opposite signs. The author consider a CS-component as a characteristic of causal link between the series of observations. Application of the method is illustrated by correlation series of Wolf numbers with the series of temperature measurements in the northern hemisphere.

<u>Page 3, line 5.</u> The author formulates the concept of synchronicity solar-terrestrial relations as: *«Exaggerating the observed facts, we shall have to formulate the principle:"external forcing inherently initiates and synchronizes elementary processes in the geospheres … that is manifested in the coincidence of their essential signs, which it is necessary to define reasonably"»*.

1. What does *«Exaggerating the observed facts»* mean? I can only understand it as the recognition by the author of his partiality or bias.
2. The terms *«inherently initiates»*, *«synchronizes»*, *«elementary processes in the geospheres»*, *«coincidence of their essential signs»*, *«define reasonably»* should be clearly defined. In the meantime, the reader can only guess what the author has in mind.
3. The author substantiates his statement by the existence of seasonal and diurnal variations in weather and meteorological parameters that completely confuses a reader, because these variations are results of mechanical motion of the Earth around the Sun and its axis, rather than that of the solar activity.
4. More important, however, is that the principle formulated the does not correspond to current basic concepts of the Earth's climate dynamics nature: the non-linear nature of the climate system causes its own dynamics, not directly related to, and certainly not synchronized with an external influence. Authors should justify the reasons why he ignores the non-linear nature of the climate system.
5. Since the main thesis of the author is essentially based on the assumption of the linearity jf the climate system, the author's desire to publish the manuscript exactly in this journal not quite justified.
6. The rest of the introduction consists of a very general and trivial statements like *«progress can be expected in the way of sophisticated analysis of observational data, but in terms of some basic physical principles»*, and excursus to the area of component factor analyzes not directly related to the subject of the manuscript. The introduction contains no characteristics of the current state and problems of the field of studies of solar-climate links. The author also does not points out the advantages/disadvantages of its method in comparison with existing ones and tasks for which it can be useful.

2 Selected set decomposition

In this part, the author formulates a mathematical apparatus of his method.

7. As the author is not interested in periodicities of the parameters under consideration, his choice of exactly harmonic functions (rather than orthogonal polynomials, for example) for a discrete decomposition of the series is not obvious. Authors should justify the choice of the basis functions.

8. Page 4, line 3. Is the terms «*not complex*» equivalent to a «*real*»? If not, it is necessary to clarify what is meant.

9. As I understand, the realness of the expansion coefficients is a key condition of the s-decomposition. Otherwise, the concept of the sign of the coefficient does not make sense. Author must bring proof of this property of the expansions and/or give the a corresponding reference.

Page 4, line 7. The author claims «*Conservation of the signs of the Fourier coefficients can be interpreted as a manifestation of the deterministic relationships between the series within certain limits, and the stochastic variability has an opportunity to be reflected in absolute values of these coefficients. Therefore, we define the signs of the Fourier coefficients as the essential signs, and we shall use them for implementing the synchronous analysis*».

10. What does the author mean by saying the «*conservation*», rather than "coincidence"? How can we talk about "*conservation*" if the author specially selected members of the decomposition with the same signs?

11. Furthermore, the statement again contains the terms, e.g. «*certain limits*», which are not clearly defined (see. also the remark 1)

12. The author should somehow justify this strong statement, because the strength of connection is characterized by the absolute value of a correlation coefficient, rather than its sign. A strong anticorrelation points to a connection between two parameters, as well as a strong correlation.

13. The author interprets a coincidence of the coefficients signs of the decomposition coefficients, as a manifestation of a causal relationship between the corresponding parameters and did not interpret the case of their difference. Following the logic of the author, the latter should mean a lack of such a relationship. The author should explain the relation between these two cases.

14. S_k in equation (2) is not defined

3 Properties of CS- and NS-components

The complete correlation coefficient r and those $\hat{r}_l$, $\tilde{r}_l$ for CS and NS components are defined and their properties are considered.

15. Page 6, line 9. «*From these expressions, it follows that s-decomposition extracts from a pair of series x_{kl} and the s_{kl} components with extreme correlation for each index l: CS-components with positive correlation and NS-components with a negative one. These properties are also the reason for the choice of signs of the coefficients of the Fourier transform as the essential signs to describe the synchronicity.* » This result is obvious, since the correlated pairs of rows, are artificially composed in such a way to maximize the correlation/anticorrelation. The author needs to explain what physical characteristics correspond to those maximal absolute values. In this connection, it is useful to discuss a physical meaning of the terms of the full correlation coefficient in the eq. (7).

16. Page 6, line 24. «*It can be concluded that there are two sets of values of the index l. In one of these sets, the averages of the CS-components are equal to the average values of the original*

series, and the averages of the NS-components are equal to zero. In the other set of values of the index l, the CS- and NS-components are interchanged. If the temperature scale has the zero value, the CS- and NS-components ($\hat{x}_{kl}$ and $\tilde{x}_{kl}$) form on average the zones delimited by a zero-isotherm, where the weather stations with positive or negative average temperatures are located. There is one-to-one mapping of average temperatures and average values of their components. What is more, the CS- and NS-components of the Wolf numbers ($\tilde{s}_{lkl}$ and $\hat{s}_{kl}$) are constant within the designated zones, - either zero or non-zero.» How does this result relate to the subject of the paper? The temperature 0°C is only the origin on the appropriate temperature scale and in terms of solar-climate relationships in no way special (compare with the Kelvin scale).

4. Data series, consolidating grouping

The description of the data used and their preliminary reduction for calculation of CS and NS components are described.

17. What the author's confidence is based on that the procedures used do not distort the information contained in the original series? How can they ensure the realness of the Fourier expansion coefficients?

5 Results and discussion

5.1 Correlations of solar activity and temperature data

18. Fig. 1 shows the dependence of the correlation coefficients $\hat{r}_l$ and $\tilde{r}_l$ of CS and NS component on the total correlation coefficient r. Noteworthy the same, apart from the sign, dependence of $\hat{r}_l$ and $\tilde{r}_l$ on r: value of $\hat{r}_l$ ($\tilde{r}_l$) increases (decreases) with the increase (decrease) of the total correlation coefficient r. i,e. simply repeats its course. This result can be interpreted as the fact that the CS and NS components do not contain any specific information being compared with the initial series. This contradicts to the author's idea of special properties of the CS and NS components. I would have guessed that an applying of s-decomposition to a pair of white noise rows resulted to the same result as in Fig.1 for r close to 0.

5.2 Distributions over the temperature intervals

19. In connection with the above, a result presented in Figure 2 is completely unexpected. It demonstrates very different behavior of the CS and NS components. The author should explain the origin of the sharp peaks of the NS-components at 0°C, since this temperature is specific only to that is the Celsius scale starting point (compare with the Kelvin scale) and not specific in terms of solar-terrestrial relations.

20. The sense of the results presented in the figure would be more understandable if the figure demonstrates also the complete correlation coefficient r of the initial series.

21. Page 10, line 9. "*Thus, the CS- and NS-components of the temperature series have a quite clear physical meaning – the distribution of the components on temperature intervals coincides with the same distribution of the original temperature within the above-mentioned ranges*". It is quite possible that the author put it not quite clear, but I understood this phrase as evidence that CS- and NS-components do not have any special properties compared to the original series. So, what kind of a latent essence the author repeats about all the time? Moreover, CS- and NS-components proved to be equivalent in the physical sense, contrary to the author's main thesis about the special properties of CS-components.

5 Results and discussion

5.1 Correlations of solar activity and temperature data

22. The text about distribution moment dependence on the weather station geographical location is quite difficult to understand. This material should be explicated more consistently and deployed with an explanation of the physical meaning of mathematical operations and shall be provided with more graphic illustration, for example, projecting the results on a geographic map.

23. Page 12, line 9. «*For this reason, the relationship between CS-components can be interpreted as an energy inflow from the Sun, and between the NS-components as an energy outflow*». The result, again confirming that the CS- and NS-components are quite permutable (see remark. **21**).

24. Page 12, line 20. «*These components are the latent essence of the phenomenon*»,

    Page 13, line 9. «*The results are convincing that the things," which are seen ", sometimes do not reflect the essence of the phenomenon; it may be helpful to look at latent things, "which are not seen" and are novel at least.* » What does "latent essence/characteristic" of a phenomenon mean? How does it differ from its common essence? Such pseudo-philosophical speculations about perceptible and non-perceptible essences does not seem to be quite appropriate in the context of a scientific article. This also applies to the epigraph (why in Latin?) from the Bible, and some passages of introduction.

25. Page 13, line 7. The author claims that «*This new approach is informative; it describes the manifestation of the forcing and corresponds to the known concepts of natural and climatic processes. It deserves wide application and the search for other matches or mismatches. The results are convincing that the things, "which are seen", sometimes do not reflect the essence of the phenomenon; it may be helpful to look at latent things, "which are not seen" and are novel at least* ». Which "*known concepts of natural and climatic processes*" the approach used corresponds to? What does mean "*informative*" approach"?

Considering the presented material in the context of the current state of the solar-climate relation research one can resume that the author offers one more correlating method of series of observational data. Unfortunately, the method is based on the dubious hypothesis of "*synchronicity solar-terrestrial relations*." According to the author the method allows to detect the presence of causal relationships between phenomena. However, the arguments coerced by the author are not sufficient to claim that his method is something fundamentally different from the common correlation.

Given all the above, I consider the publication of an article in its current form undesirable. The author should substantially revise article considering his ideas in the content of the current state of the solar-climate relation researches, and more clearly explain the physical essence of the method proposed and the results obtained.