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2800 MHz SOLAR FLUX AND DANUBE RIVER FLUX, I

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Abstract. Spectral decomposition theorem has been applied to assert that exists a certain influence of solar activity, measured in Solar flux density at the frequency of 2800 Mhz, to water flux in Danube river at a station. A 7 years lag after maximal solar activity has been found using cross-correlations. Chi square test has been used for obtained results signification.

0. INTRODUCTION

Data analysis has shown that many hydrologic variables demonstrate an oscillatory character. Water supplies are of essential importance in everyday life as well as in agriculture, industry and economical planing.A precise prediction of their abundance or lack could be of enormous profit to the mankind. But no one does exactly know, yet, the precise mechanism of the hydrological cycle. One may only suppose what are the reasons of many phenomena occurance. Therefore a statistical or a probability investigation may be of some help.

In previous papers of mine I used Greenwich total sunspot areas, umbrae or penumbrae total areas and faculae total areas as promotors of river level or river flux variations. But, collecting of such solar activity data has been abandoned . Why, I could not find

the reasons. Or, I could not get them after the year 1992., in spite of my efforts of looking after them.

So, I turned myself to the use of data which are available : to the 2800 Mhz solar flux. The series of them are not so long as the previous ones, but I had to be satisfied with that what I could acquire.

1. DATA AND DATA PROCESSING

One station on the Danube river has been schoosen following the idea of Jean-Claud Pecker (1987), and experience of mine in more then ten year long investigations, that the use of many stations, at the same time, may distort instead to ameliorate the results.

For the solar activity parameter I choosed the Solar flux density at the frequency of 2800 Mhz, from the entire solar disc,in units of 10 to 22 Joules/second/square meter/ Hertz. Each number has been multiplied by 10 to supress the decimal point. Three sets of fluxes - the observed, the adjusted and the absolute - are summarized. Of the

three, the observed numbers are the least refined, since they contain fluctuations as large as 7% that arise from the changing Sun-Earth distance. In contrast, adjusted fluxes have this variation removed; the numbers which I have used equal the energy flux received by a detector located at the mean distance between Sun and Earth; the adjusted values are multiplied by 0.9o to compensate for uncertaintes in antenna gain and in waves reflected from the ground.

Following data notations have been used:

time series for *solar activity* (yearly means)::

OTTA - adjusted 28oo Mhz Solar Flux Density at the frequency 28oo MHz, expressed in Joules/second/square meter/Hertz, published by the National Geophysical Data Center, Boulder, Colorado, USA

time series for *Danube River Flux* (yearly means)::

BEVQ - Maximal River Flux, expressed in m3/s, published by the Federal Meteorological Bureau

BENQ - Minimal River Flux, expressed in m3/s, published by the Federal Meteorological Bureau.

I had, at my disposal, OTTA series starting by the year 1947 to 1997 (daily observations), and river flux series since 1931 to 1996 (monthly means).

The computer processing program limited my investigations, in the case of OTTA series, to the section between 1947 and 1996, as well as the series BEVQ and BENQ.

I used the Spectral Decomposition Theorem,which states that the energy,or variance, of any time series can be broken down into the contribution of statistically independent oscilllations of different frequencies (periods), for periodogram construction. Each peak in the spectral periodicity function graph has been standing for a harmonic. The most outstanding one points toward the *Major Frequency (Period),* and the next ones toward *Higher Harmonics,* toward the so-called *Overtones.*

Search for paired up independent oscillation, with the same periods (frequencies), in both correlated series, has been carried out.

The next supposition was that we have to do with two stationary time series, *Xt* ,and *Yt,* and that we wish to asses the extent to which we can use the past of *Xt* to predict *Yt*; cross-correlations have been used as a criterion of evaluation. If the processes are zero mean, we define them, by means of cross-correlation, the *expected* value of *Yt.* Fourier series residuals have been calculated for significance level evaluation. In the continuation a comparision of such frequency histogram with normal distribution function has been constructed. *Chi-square test* has been used as a conclusion.

2. RESULTS

The highest cross-correlations value has been obtained for the lag of seven years in the case of OTTA4796 versus BEVQ4796, or *2800 Mhz Solar flux density* influence to Maximal *river flux*, meaning that maximal river flux may follow, after a 7 year lag,the maximal 2800 Mhz solar flux.

The periodogram for OTTA series shows that there are seven independent fundamental oscillations - seven peaks. The major frequency has a period of 10.00 years (and 90 % of the total energy or variance), the first overtone of 5.55 years (3%), the second of 2.08 years (1.7%), the third of 3.13 years (1.7%), the fourth of 4.55 years (1.5%), the fifth of 2.5 years (0.9%), and the sixth overtone a period of 3.84 years (0.6 % of the the whole energy).

Periodogram for BEVQ series has eight peaks - eight independent fundamental oscillations. The major frequency has a period of 10,00 years (23% of the total energy or variance), the first overtone of 2.27 years (16 %), the second of 3.33 years (16%), the third of 5.55 years (14%), the fourth of 2.63 years (13%), the fifth of 50.00 years(7%), the sixth of 4.16 years (5%) and the seventh overtone a period of 2.08 years (4% of the whole energy)

As we may see three harmonics of the OTTA series have their responses in the BEVQ series. To the major period of the first corresponds as well as the major period of the second, to the first overtone the third,and to the second overtone of the first corresponds the seventh overtone of the second series. That means that in both phenomena there are three simple oscillations with corresponding equal periods. so we may suspect that solar flux rules over 40 % of river flux fluctuations.

Chi-square test for OTTA series' three of seven just mentioned independent frequencies gives the value of 1.06132 with 2 degrees of freedom and a significance level of 0.588217.

Chi-square test for the three of eight BEVQ independent frequencies gives the value of 3.58024 with 1 degree of freedom and a significance level of 0.0584706.

The application of the same programm to the BENQ series shew a periodogram with nine

peaks. The major frequency has a period of 7.14 years (34% of the whole energy), the first overtone of 2.38 years (15%), the second of 50.00 years (12%), the third of 3.13 years (9%), the fourth of 5.00 years (8%), the fifth of 2.77 years (6%), the sixth of 3.85 years (5%), the seventh of 12.50 years (5%), and the eighth overtone has a 2.17 years period (2% of the whole energy).

There are only two corresponding componental oscillations. The third overtone of OTTA series has a response in the third overtone of the BENQ series, and to the sixth overtone of the first series corresponds the sixth overtone of the second series.

Chi-square test for two of seven independent frequencies of the OTTA series gives a value of 7.82511 with 3 degrees of freedom and a significance level of 0.0497678.

Chi-square test for two of nine independent frequencies of the BENQ series gives a value of 2.29391 with 2 degrees of freedom and a significance level of 0.317603.

3. CONCLUSION

According to periodograms and corresponding cross-correlations, the spectral decom-

position theorem, applied to the **adjusted 2800 Mhz solar flux density**, series **OTTA**, expressed in Joules/second/square meter/Hertz, as a parameter pictureing one kind of Solar activity, from one side, and **maximal Danube river flux on a station**, series **BEVQ**,expressed in m3/s, from the other side, we got a right to announce that, in statistical sense, the Solar activity may influence, with the accuracy given, the maximal river flux in such a way that, after seven years of maximum solar activity a maximum flux,may occur at that station on Danube river.

4. LITERATURE

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