

2800 MHz SOLAR FLUX AND DANUBE RIVER FLUX, II

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ABSTRACT. Application of spectral decomposition theorem to solar activity influence search, expressed in 2800 MHz radiation, to Danube river flux on a station, followed by cross-correlations, points to the conclusion that there is a lag of six years between solar radiation maxima and minimal as well as maximal Danube river flux. Chi-square test has been applied to obtained results evaluation. It is interesting that another program application gives a lag of two years. One may say that both results are in accordance because one may assume that the second one is a result of a more delicate process ($6 = 3 \times 2$).

1. ORIGINS

There exist several natural phenomena in the Universe, as well as on our Earth, which have an oscillatory character, so, that they may be predicted, with more or less accuracy. We may call them quasiperiodic events. Solar activity, water level, water flux, in riverbeds have also fluctuations which may be measured and compared.

In practical sense it would be of great benefit if we could be able to foresee the maximal or the minimal quantity of water whatever the case may be.

So I tried, first, Wolf relative numbers, then areas of whole sunspots, their umbrae, penumbrae and faculae, as solar activity parameters, from one side, and Danube or Sava river level as well as Danube river flux, on one hand, to compare. But, after 30th June 1992 observing and collecting of mentioned solar data has been abandoned for, to me, no apparent reasons [1] – [18].

Then I turned my attention to 2800 MHz solar flux data observed from the beginning of the year 1947, in Ottava [19].

Thanks to the friendly help of Dr . Edward H. Erwin, from the National Geophysical Data Center, NOAA, USA, I got the observed and adjusted monthly solar flux data, 1947 – 1997, as well as the same daily data, 1991-1997, for which I am very grateful to him.

1. DATA AND DATA PROCESSING

My opinion that the simultaneous use of data, observed at numerous stations along a river, in the case of solar - terrestrial influence study, may lead to distortion instead of correlations improvement, has been confirmed by J.-C. Pecker [20]. So, I used always data observed only on one station.

Following data notations have been used:

Time series for SOLAR ACTIVITY (yearly means)::

OTTA – SOLAR RADIO FLUX 2800 MHz (10,7 cm) from the entire solar disc, corrected to within a few percents for factors such as antenna gain, atmospheric absorption, bursts in progress, and background sky temperature, in units of 10 to – 22 Joules/second/square meter/Hertz. Each number has been multiplied by 10 to suppress the decimal point, published by the National Geophysical Data Center, Boulder, Colorado, USA,

Time series for DANUBE RIVER FLUX (yearly means)::

BOQV - MAXIMAL RIVER FLUX, expressed in m³/s,

BOQN - MINIMAL RIVER FLUX, expressed in m³/s.

I had at my disposal OTTA series starting by the year 1947 to 1997 (daily observations), and river flux series since 1941 to 1996 (monthly means).

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

SPECTRAL DECOMPOSITION THEOREM, which states that the energy, or variance, of any time series can be broken down into the contribution of statistically independent oscillations of different frequencies (periods), has been applied 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 the HIGHER HARMONICS, toward the so-called OVERTONES.

Looking for paired up independent oscillations, with the same periods (frequencies), has been carried out.

The next supposition was that we have to do with two stationary time series, X_t , and Y_t , and that we wish to assess the extent to which we can use the past of X_t to predict Y_t ; cross-correlations have been used as a criterion of evaluation. If the processes are zero mean, we define then, by means of cross-correlations, the expected value of Y_t .

For some practical reasons I took 40 years long time series sections and searched for the highest cross-correlation values, between solar influence and maximal or minimal river flux.

Fourier series residuals have been calculated for significance level evaluation. In the continuation a comparison of such frequency histogram with normal distribution function has been constructed. Chi-square test has been used as one more significance evaluation.

3. RESULTS

The periodogram for OTTA series shows that there are eight independent fundamental oscillations. The major period has 10 years (85,91%), the first overtone has the period of 25 years (4,42%), the second of 5,5 years (2,81%), the third of 2,08 years (1,87%), the fourth of 3,12 years (1,78%), the fifth of 4,5454 years (1,55%), the sixth of 2,5 years (0,94%), and the seventh the period of 3,84 years (0,72%).

The periodogram for BOQV series has again eight independent fundamental oscillations.. The major period has 10 years (25,29%), as well as OTTA periodogram, the first overtone has 7,14 years (13,68%), the second 2,38 years (15,36%), the third 3,57 years (13,46%), the fourth 4,5454 years (11,38%), as well as the fifth in OTTA periodogram, the fifth has 50 years (8,94%), the sixth 2,17 years (6,78%) and the seventh the period of 2,7 years (5,1%).

Comparing the periodograms for OTTA and BOQV series we may conclude that there are two independent oscillations in the last one corresponding to two in the first one. The major period of the first series has its response in the major frequency of the second, and the fifth overtone of the first has its echo in the fourth overtone of the second series. .87,46 % of the radiation influences 36,67% of the Danube maximal river flux. The cross correlations show that there exists a lag of six years between OTTA and BOQV series (STATGRAF program). In the WORD program the lag is only two years. Does it mean that the second has a more delicate sense because the second result is contained in the first $6 = 3 \times 2$?

The highest cross-correlations' value corresponds, as we said, to the lag of 6 years, in the case of OTTA4796 versus BOQV4988 (STATGRAF program) . So, 2800 MHz solar flux influences the MAXIMAL DANUBE RIVER FLOW, meaning that maximal river flux may follow, after a 6 year lag, the maximal 2800 MHZ solar flux. We may conclude the same, using the WORD program, but with a lag of 2 years, keeping in mind the remark in previous passage.

Chi-square test for two of eight frequencies gives the value of 5,687540 with 3 degrees of freedom and a significance level of $P=0,1278652$.

And finally the periodogram for BOQN has nine independent fundamental oscillations, one more than the two previous. Its major period has 50 years (21.22%), the first overtone has a period of 10 years (17,29%), the same as the major period in OTTA series, the second of 2,38 years (16,22%), the third of 7,14 years (13,05%), the fourth of 3,57 years (10,07%), the fifth of 4,5454 years (12,88%), , the same as the fifth overtone in OTTA series, the sixth of 2,17 years (3,69%), the seventh of 2,63 years (3,28%), and the eighth the period of 3,12 years (2,29%), the same as the fifth in OTTA series.

Three correspondent independent oscillations are existing in OTTA and BOQN series. The major period has its echo in the first overtone of the second series, the fifth overtone in the fifth overtone, and the fourth overtone in the first has its correspondent in the eighth overtone of the second series. 89,24% of the solar radiation influences 32,46 % of the minimal Danube river flux. The cross correlations show that there exists a lag of six years between OTTA and BOQN series (STATGRAF) as well as a two years lag (WORD). The remark as to the influence of OTTA to BOQV still stands

MINIMAL RIVER FLUX shows a similar picture of influence. According to the cross-correlations' table for OTTA4786 and BOQN4988 series, minimal Danube river flux will statistically follow, after a lag of 6 years, the maximal 2800 MHZ solar flux.

Chi-square test for three of nine independent frequencies gives the value of 8,600568 with 3 degrees of freedom and a significance level of $P=0,0351173$.

4. CONCLUSION

The spectral decomposition theorem, according to constructed periodograms and calculated corresponding cross-correlations, for the index of solar activity known as

ADJUSTED 2800 MHz SOLAR FLUX, radiating from the whole solar disc, corrected to within a few percente for antenna gain, atmospheric absorption, bursts in progress and background sky temperature, expressed in units of 10^{-22} Joules/second/sqare meter/Hertz, OTTA series, on one hand and MAXIMAL DANUBE RIVER FLUX series, BOQV, expressed in m³/s, observed on a station, on the other , entitles us the to announce that, in statistical sense, the solar activity may influence, with the accuracy given, the maximal Danube river flux, with a six years lag, and the MINIMAL DANUBE RIVER FLUX, after a lag of 6 years.

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