

## SUN, CLIMATE AND THEIR CHANGES IN TIME

Boris P. Komitov

*Bulgarian Academy of Sciences –Institute of Astronomy , 6003-Stara Zagora-3,POBox 39,  
[b\\_komitov@sz.inetg.bg](mailto:b_komitov@sz.inetg.bg)*

### *1. The ‘global warming’ in 20<sup>th</sup> century: Is there an alternative of the ‘antropogenic greenhouse effect’?*

The 70's years beginning of 20<sup>th</sup> century is marked by the rising of different ecological theories and social movements. In a significant degree it is connected with the rising of the ‘antropogenic greenhouse effect ‘ theory. According to the last one the observing warming of Earth climate during the last ~100 years in range of ~1°C is caused by the human industrial activity and mainly –by the large quantity emissions of CO<sub>2</sub> and hydrocarbons. The mentioned gases are good absorbents of infrared /thermal/ radiance. By last one there is an increasing of the near surface air temperature.

The ‘antropogenic greenhouse effect theory’ become a very large social resonance. It is a power point for important international documents such as the ‘Kiotto protocol’. To the present moment the abovesaid theory is on the base of the ecological politics of European Union. However on other side there is the official US opposition of the ‘Kiotto protocol’ by arguments that the ‘antropogenic global warming’ theory is based on doubtful scientific statements.

The last one is a serious fact if we taken into account that United States is the country with the most developed scientific potential in the world and especially in the field of geophysics, climatology and meteorology. Moreover there are indications that after 2000 AD the ‘antropogenic global warming ‘ theory is under pressure by many scientists from different countries.

The all abovesaid led to the following interesting questions: 1. Are there some alternative explanations for the present global warming of climate outside the antropogenic global warming theory?; 2. What are the climatic scenaries according these alternative theories for the near future?

As a first step to obtain the answers of these questions an analysis of paleoclimatic data is necessary. An estimation of amplitude variations as well as their behaviour, i.e. are they cyclic or there are some long trend tendencies, must be included. A comparison between present climatic tendencies and the large scale changes in the past can give an answer of the question : Is the present climate warming by his parameters ‘contained’ inside limits of such changes in past or not?

In the case of ‘containing inside’ an searching for alternative explanations of the present climate behaviour is strong necessary. However , in other case, if by his parameters the present global warming is an unique phenomena it need to include a quite new for the Earth climate history factor. In the second case there is a very high probability that the human activity is the same factor and the ‘antropogenic global warming theory’ can not be have a real competition.

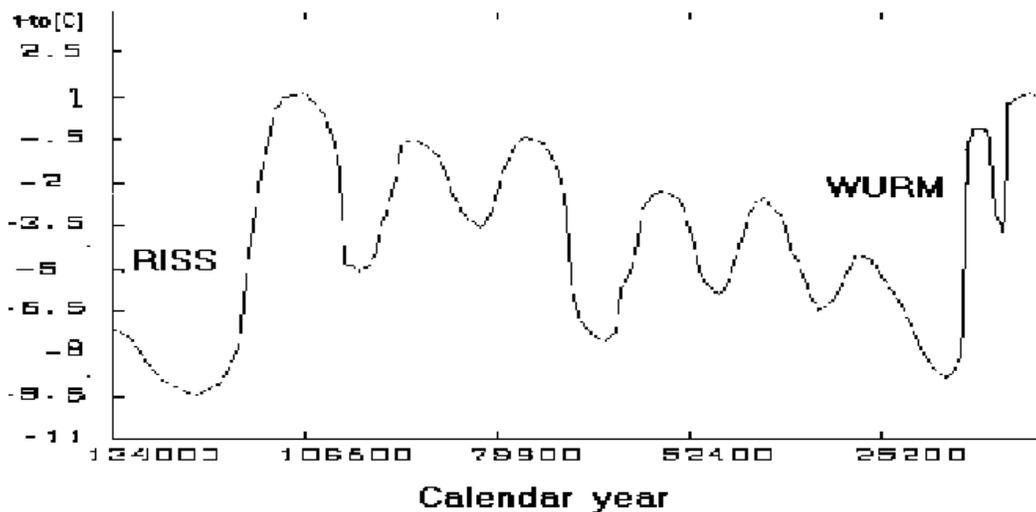
In table 1 the mean planetary nearsurface air temeperature variations during the last ~600-800 million years /geological time scale/ are shown. The value for 1900<sup>th</sup> as ‘zero-level’ is taken.

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*Table 1 The Climate Changes in Geoplogical Time Scale*

Years [BP]	$t - t_{1900}^{\circ}\text{C}$
~ 600- 800 millions /the end of Protherosoi/	-15
~ 300 millions /Carbon/	+10
~230 millions /Perm/	-10 to -12
~150 millions /Jura/	+10 to +15
15 000 /Wurm Ice Epoch/	- 8

The mean planetary nearsurface air temperature variations during the last 130 000 years /prehistorical time scale '1', the last ~23 000 years /prehistorical time scale '2' / and the last 1200 years are shown on fig 1 a-c.



*Fig1a. The mean planetary nearsurface air temperature in prehistorical time scale '1' /the last ~134000 years/.*

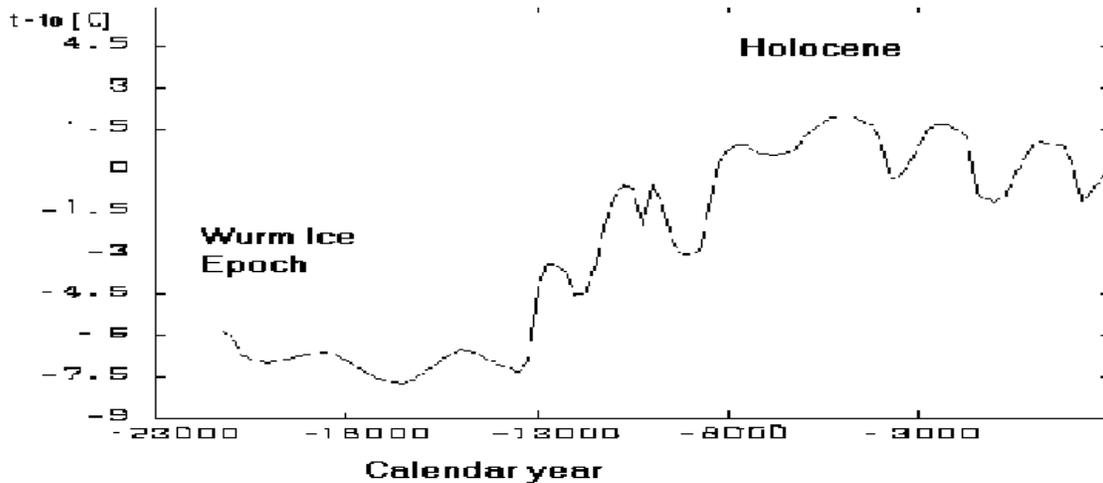
On the base of presented in table and figures data the following more important conclusions can be made:

1. The Earth nearsurface air temperature amplitude variations are in the range of ~30°C in geological time scale and 10°C – in both prehistorical time scales '1' and '2' . During last 5000 years /the historical epoch/ the mean planetary temperature variations are in the range of 2°C /the right part of fig1b/. The amplitude variations during last 1200 years are similar /fig 1c/.

Cyclic tendencies in every one from the all three time scales are shown. In geological scale they are of about ~200 million years. In prehistorical time scale '1' oscilations of 25-3000 years as well as longer quasy 100 000 –year cycle separated the deepest phases of both Riss and Wurm 'great ice epochs' are well shown. In prehistorical time scale '2' quasy-cyclic 2200-2500 years temperature variations with amplitude of 2 °C are clear

visible. Their minimums are labeled as 'litle ice epochs'. The last such period has been during the second half of 17<sup>th</sup> century, i.e. only 300 years ago. There is a long-term increasing temperature tendency started after 1700 AD and close to the end of 20<sup>th</sup> century. The last one is temporary stopped in the first half of 19<sup>th</sup> century. On fig.1 c /the last 1200 years/a quasy-cyclic variations by duration of ~200 are clear shown. Their minimums in odd calendar centuries has been occurred. They are marked as 'O','W','S','M' and 'D' correspondly.

3.No long-term general tendencies /trends/ in the all time scales are visible.



*Fig1b. The mean planetary nearsurface air temperature in prehistorical time scale '1' /the last ~23000 years/.*

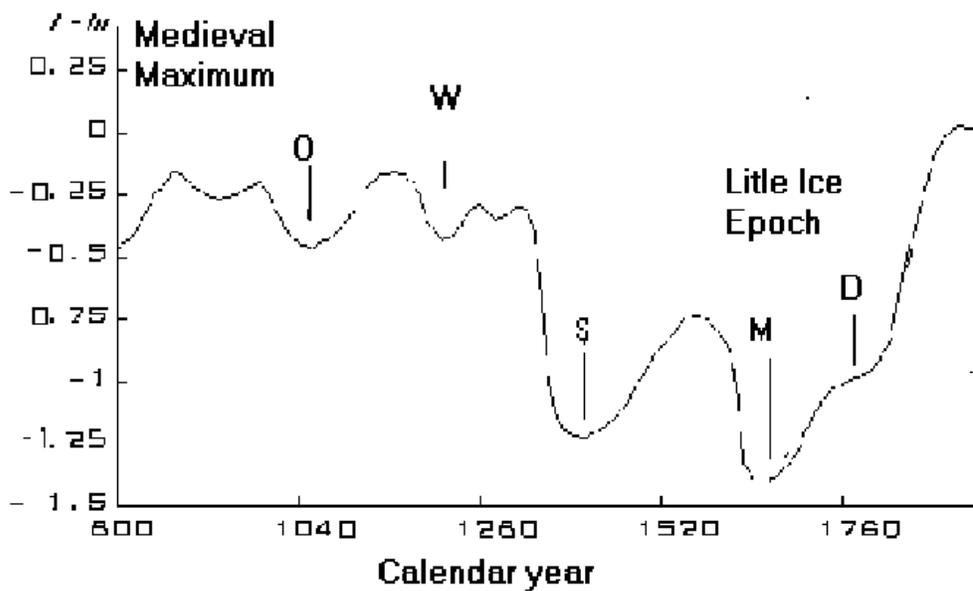
It is clear visible from the abovesaid, that the present global warming is a part of a long-term rising tendency, which has been started at the beginning of 18<sup>th</sup> century. As result an increasing of the mean planetary Earth temperature of 1.5°C during the period 1700-2000 AD has been occurred. It is ~1° for the interval 1850-2000 AD.

Namely the last one value is the 'power point' of the 'antopogenic global warming theory'.

However it is clear, that the value of this rising is essentially smaller as the caused by natural factors variations in all discussed time scales. There are not arguments to doubt that this factor are stop to proceed during the present epoch.

Moreover: The temperature changes dynamics after 1700 AD both by phase and amplitude is containing inside behaviour of climatic 2200-2400 year cycle. In prehistorical scale '2' the last one 9-10 times is tracking. The present climate warming correspond to initial rising phase of this cycle, which last minimum is the 'litle ice epoch' in 17<sup>th</sup> century.

That is why on the base of plaeoclimatic data it can made conclusion, that to present moment the human activity give not some essential visible yield to the climatic changes and, especially, to these of near surface air temperature. This sign, by our opinion, that the real climatic change factors are mainly of natural origin and the 'antropogenic warming theory' is excessive if only to the present stage. From all natural factors it must concentrate over these with quasy-cyclic behaviour. Only by this way it can to explain the observed quasy-cyclic climate variations.



*Fig1c. The mean planetary nearsurface air temperature during the last ~1200 years /historical scale/.*

## *2. The solar activity and its cyclic behaviour*

The idea, that the quasicyclic climate variations can be due to space factors is not new. Its dated from 19<sup>th</sup> century. Generally then they have targeted to explanation cyclity of interleaving of climate coolings and warmings in the limits of prehistorical time scale '1'/fig1a/ the first data for which are from this time. All they are related to different changes of Earth's rotational axis or orbital around Sun movement. This group of so called 'astronomical theories' are developed by Ademar and Croll in 19<sup>th</sup> and mainly by M.Milankovich during the first half of 20<sup>th</sup> century [1]. It is taken that the Milankovich theory is explaining very exactly the quasicyclic climate variations in range of 20 000- 40 000 years.

However as D.Imbree and C.Imbree [1] note, this theory as well as all astronomical theories can not explain the quasy 100 000 years climatic cycles of the 'great ice epochs', the more shorter 2000-2500 years cycles, as well as the large number cyclic climate parameters oscilations in the range of 2 to 2000 years, which can to show in regional or global scales.

Searching for additional factors to explain the climate quasicyclic variations, many researchers point out to te complex of phenomenas on theSun, labeled as 'solar activity'. In the middle of 19<sup>th</sup> on the base of H.Schwabe's observations and R.Wolf's analysis the sunspot cyclic behaviour has been established. Its main oscilation is by duration of ~11.04 years /Schwabe-Wolf's cycle/[2]. By instrumental observations analysis it has been found that the last one is observing very stable after 1720 AD as well as during the period of 1610-1640 AD, i.e. at the beginning of instrumental observations. The Schwabe-Wolf's cycle amplitude is strongly varied, while its duration changes are in the range of 30% to the mean value of 11.04 years.

During the so called 'Maunder's minimum' /1640-1720 AD/ the Schwabe-Wolf's cycle is strong damaged. Some researchers even doubt about its existence in this time [3,4,5]. However by our opinion the viewpoint of other authors is more realistic. According last one during Maunder's minnimum and generally very low sunspot activity levels, the Schwabe-Wolf's cycle has been existed ,but it was very weak during this time [6,7,8].

The British scientist D. Schöve on the basis of a large number of historical documents analysis have successfully tracked the Schwabe-Wolf's cycle existence during the last ~2600 years [9]. His results are generalised in so-called 'Schöve's series'. The last one is continuous after 296 AD.

Due to analysis of sunspot activity data after 1749 AD /the 'Zurich series' /, Gleissberg found the existence of a cycle by duration of ~80 years. The last one is modulated by amplitude the Schwabe-Wolf's cycle, i.e. led to an interleaving of higher and lower 11-year cycles during this quasycentennial oscillation. The Schöve's series analysis as well as other indirect solar activity data in preinstrumental epoch /before 1610 AD/ show, that there is not only one stable cycle, but a series of competitive one to other oscillations by durations in range of 60 to 130 years.

In 50's years of 20<sup>th</sup> century Schöve, Anderson and Bonov by independent ways found the existence in active processes on the Sun of 'quasy-bicentennial' cycle [9,10,11]. Especially Schöve obtained, that during the odd calendar centuries after 1000 AD the mean solar activity level is essentially lower as in the even ones.

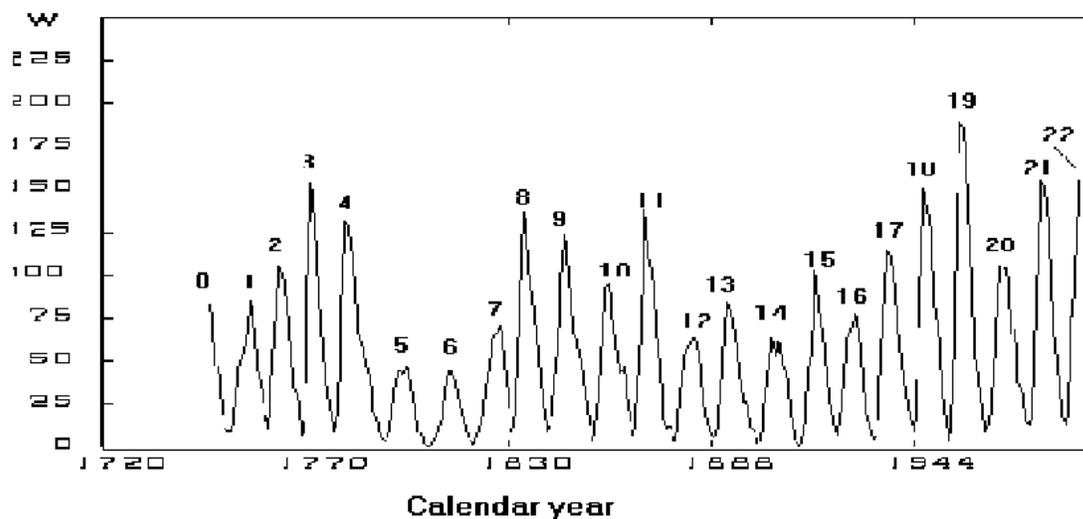


Fig2. The 'Zurich series' (1749-2000 AD) : The mean annual values of Wolf's number /the most known sunspot activity index/

The invasion of spectral methods in observing astronomy to the end of 19<sup>th</sup> century give the possibility for study the Sun's magnetic activity. As a result the American astronomer G. Hale obtained the periodical change of sunspot groups magnetic polarity by duration, which is equal to the double Schwabe-Wolf's cycle, i.e. 22 years. As a result the sign of total quasydipole solar magnetic field is changed by the same period. This quasy 22-year /Hale's/ cycle is somewhat visible in sunspot activity processes due to so-called 'Gnevishv-Ohl's rule' too. The last one sign the tendency for interleaving of weaker 11-year cycles with even numbers /in Zurich series/ by higher ones with odd numbers. By the Zurich series 'zero moment' in 1749 close to 1986 AD /i.e. cycle numbers from 0 to 21/ this rule is violated only two times, for the pair cycles with numbers 4-5 and 8-9 /fig.2/. There is also a third violation of this rule – for the pair cycles 22 and 23 /the present Schwabe-Wolf's cycle/. In §5 the possible cause for this phenomena will be discussed.

After the 2<sup>nd</sup> World War a qualitative new and high progress of technics and methods of astronomical observations, including those of the Sun is beginning. This also includes the space researches, which start at the end of 50s. It has been clearly visible that the Schwabe-Wolf's cycle is presented not only in the sunspot activity, but in many other

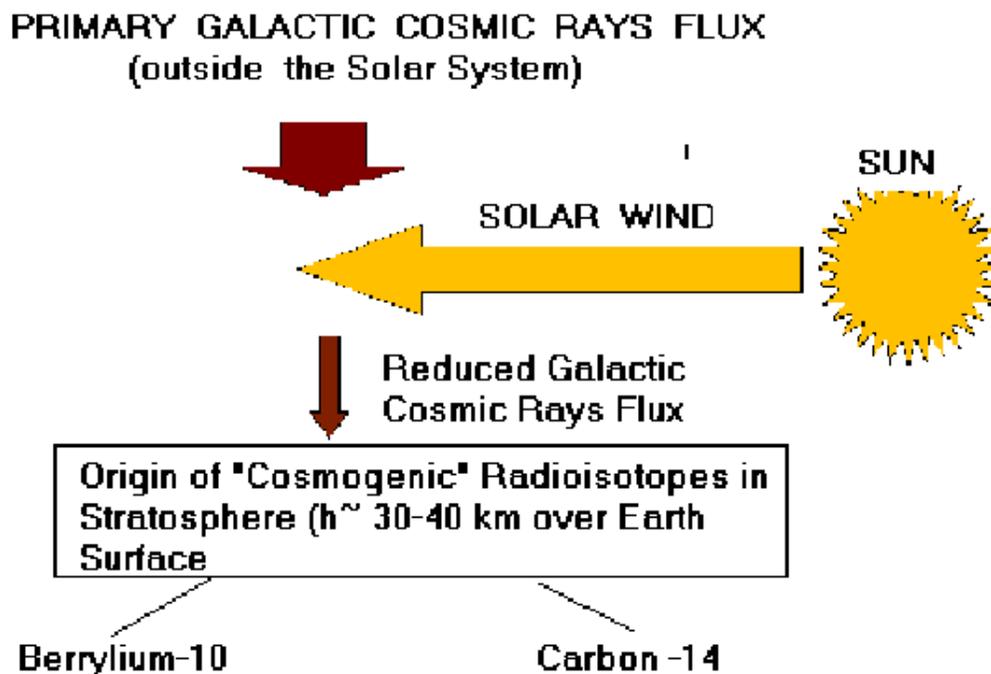
solar phenomenas too: the solar flares , coronal phenomenas, the X and UV-radiation fluxes etc.

The escaping most outside solar atmpsphere regions charge particles flux /'solar wind'/ is affected very strong by the general solar activity level. During the solar 11-year cycle maximums it is meanly 10 times larger as in minimums of the last one.

The solar wind fills the near solar space including the all planet zone. That is why the coming from the far space to the Earth high energy particles / galactic cosmic rays GCR/ are absorbed stronger or weaker by the solar wind in dependence of solar activity level. The GCR flux reduction is stronger during the solar maximum epochs. This phenomena is named as "Forbush –effect". Turned out to be that it is a key for solar activity variations study in the far historical epochs, including in the prehistorical time scales '1' and '2'.

The penetrated in Earth atmosphere galactic cosmic rays are absorbing by atmospheric gases. The process is most intensive at altitudes of 35-40 km over Earth surface, i.e. in stratosphere. As a result of this interaction a large number of radioactive isothopes atoms  $^{14}\text{C}$ ,  $^{10}\text{Be}$ ,  $^{18}\text{O}$  etc are originated /fig.3/. Because of cosmic origin of these compounds the last ones are called as 'cosmogenic radioisothopes'.

The so originated in stratosphere 'cosmogenic radioisothopes' atoms are included in specific for correspondig chemical elements physico-chemical processes. The radiocarbon atoms are interacted with the atmospheric oxigen and included in  $\text{CO}_2$  molecules. After that by differrent ways they are going into the structure of alive organisms and carbonatic rocks.



*Fig3. The origin of 'cosmogenic' isothopes in Earth atmosphere*

The analysis of content of this isotope in differrent ring and layer structures /tree rings ,stalactite samples etc/ is an object from special research interest. It is relative easy to made time callibration of such samples and ,consequently –to estimate the corresponding epoch. A time correction for the radioactive destruction is necessary to take into account and , finally the  $^{14}\text{C}$  concentration for the epoch of its including into the sample will be derived. However the last one on GCR flux is depended and , due to

'Forbush effect'- on the solar activity level. The 'resident time', i.e. the moments difference between generation in stratosphere and including in the structures and tree and stalactite samples must taken into account too. The last one is essentially large for  $^{14}\text{C}$ - in range of few decades.

On base of radiocarbon tree rings contents data for a large number of samples a reconstruction of large time scale solar activity dynamics during the last 10-12000 years /the postglacial epoch ,Holocene/ has been made [12,13,14]. The Wurm ice epoch data are relatively not enough exactly known. The last one is caused by the short lifetime of radiocarbon atoms (~5700 years).

Unlike  $^{14}\text{C}$ , the radioactive  $^{10}\text{Be}$  'resident time' is very short and its atoms reach the Earth surface only for 1-1.5 years after its generation in stratosphere. Consequently, the measured contents of last one can almost directly related to the same solar activity levels and even to approximately same phases of Schwabe-Wolf's cycle as in the moments of  $^{10}\text{Be}$  atoms generation. The 'half destroying time' is very large (~ 1 million years). The  $^{10}\text{Be}$  contents are successfully measured in Greenland and Antarctic vertical ice columns, as well as in North Atlantic Ocean sediment rocks. On base of the last one a reconstruction of solar activity in all range of prehistorical time scale '1' reaching to 300-400 000 years in past has been made.

The most generalised results about large scale solar activity time variations, obtained on the base both of 'cosmogenic isothopes' and Schove's series studies are the following:

1. A powerful and relatively stable 2200-2500 years cycle in solar activity processes has been detected. The last one is very stable during the last ~7000 years and relatively unstable at the beginning of Holocene. There is a high probability that the last one is caused by a large time scale solar activity regime change during this transition epoch. The minimums of abovesaid quasybimillennial cycle are corresponding of Maunder-type solar activity minimums /the last one in 17<sup>th</sup> century/.
2. In large scale solar activity time variations a quasybientennial cycle by duration of 200-210 years is visible. The minimums of last one during the last ~1000 years are shown on fig 1c. They are marked by symbols 'O','W','S','M' and 'D'/ the minimums of Oort, Wolf, Spoerer, Maunder and Dalton/. The amplitude of quasybientennial cycle is modulated by 2200-2500 years oscillation. The last one is most powerful during the decreasing phases and minimums of quasybimillennial cycle and it is weaker near to his maximums.
3. In supermillennial solar activity dynamics an extraordinary powerful ~100 000 year cycle has been detected. The last two minimums of same one are ~ 15000-20000 and 130 000 years ago.

### *3. Solar-climatic relations*

Cycles by duration of 10-11 and 20-22 years of pressure, temperature, rains, air humidity and other climatic data for many regions of Earth by analysis mainly after 2<sup>nd</sup> World War has been obtained. Many other climatic oscillations, which are considered as analogs of solar and geomagnetic activity cycles has been obtained too. Detailing descriptions of these studies and their results are given in the reviews [15,16]. Shorter the same ones are described in [17]. The author's studies and results, concerning the solar activity influence over climate of Bulgaria from the beginning and middle of 80s are presented in [18,19,20].

The generalized conclusions about the solar 10-11 and 20-22 year cycles effects over Earth climate are:

1. Quasi 11-year oscillations are observed in many climatic parameters, but mainly in temperatures. They can be tracked in climatic data series of separated stations as well as in planetary scale. These cycles are relatively better expressed in winter as in summer and mainly on middle and high geographic latitudes.
2. For the atmospheric circulation the quasi-20-22 year oscillations are typical. As a result from 20-22 year cycle influence over Iceland baric minimum position and activity, the same cyclonicity in rains and pressure over South-East Europe and particularly over Bulgaria is observed [17,18].

Unfortunately during the 70s years the World Meteorological Organization (WMO) demonstrate a very negative position to the results of these studies. As a result after 1975 all solar-climatic studies results are ignored and this is labeled as a 'forbidden' area for all scientific conferences and symposiums under the aegis of WMO [21]. This is the cause why on the field of solar-climatic relations during the last ~30 years mainly space physics specialists, but not meteorologists are working.

The absence of statistically significant total solar irradiance variations, caused by Schwabe-Wolf cycle was one of the arguments against solar-climatic relations close to the beginning of 1990s. An analysis of very precise satellite observations, which are provided after 1978 however point that such variations are really existing. The last ones are in the range of 0.1%, which is by climatic viewpoint a significant value. The total solar irradiance (TSI) reach to his maximal values near to maximal phases of 11-year sunspot cycles.

There is a climate effect of  $\sim 0.1^{\circ}\text{C}$  over the mean Earth temperature, caused by these TSI variations.

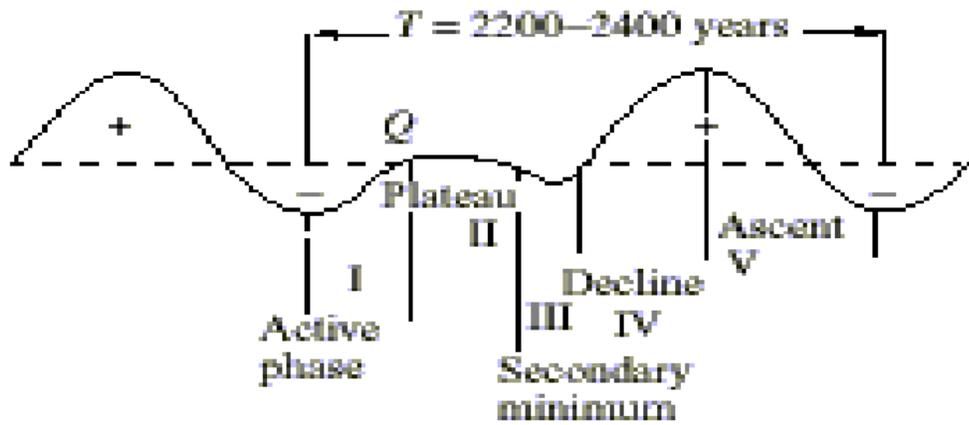
A very good coincidence between the solar bicentennial cycle minimums and temperature minimums during odd calendar centuries after 1000 AD is well shown on fig 1c. The temperature variations in this case are in range of  $0.5-1^{\circ}\text{C}$ . The coincidence by time between the last 'little ice epoch' during 17<sup>th</sup> century and present 2200-2400 year solar cycle Maunder's minimum is clearly shown too.

The relation between Sun active processes and climatic 2200-2400 year climatic cycle is previously assumed by discoverers of the last one (Denton and Carlen) else at the end of 60s years. In this time the large scale solar activity knowledge was in very initial phase and there was no information about existing of solar 2200-2400 year cycle. The last one at the end of 80s and beginning of 90s has been certainly established [12,22]. As is pointed in [22] there is a coincidence between the Maunder-type solar activity minimums in Holocene and all five 'little ice epochs' during the same time. An evidence that quasi-bimillennial solar activity oscillations are observed although with smaller amplitude in Wurm ice epoch too, is given by Damon and Sonett [12].

The 2200-2400 year solar cycle structure is for first time given by Dergachev and Chistyakov [22]. As a result of additional analysis the author by itself [17] and with V. Kaftan together [23] have put some details in the last one. It is shown on fig.4.

It is shown on the same one that every 2200-2400 year cycle start with a Maunder-type minimum, which correspond a climatic 'little ice epoch'. After that begin an initial active phase by duration of 300-350 years. Simultaneously with the abovesaid process a climate warming is running and to the end of this phase the global temperature is  $1.5 - 2^{\circ}\text{C}$  higher as during the 'little ice epoch'.

A relatively quiet epoch ('plateau') is the next phase of the quasi-bimillennial solar cycle. Its duration is  $\sim 500$  years. The supercentennial increasing of active solar processes level is stopped. The amplitude of Schwabe-Wolf's cycles is predominantly high. On other hand there are also subcentennial, quasycentennial and relatively weak bicentennial oscillations. The Earth enter in 'climatic optimum', i.e. continuous epoch of relatively warm climate. The supercentennial warming tendency is stopped and climatic cycles by duration of  $\leq 200$  years are available.



*Fig.4 The 2200-2400 years structure according Komitov and Kaftan (2003)[23]*

The 'plateau' is breaking due to forming of secondary minimum which duration is about 300 years. This is the end of 'climatic optimum' and the climate stays temporarily cooler by  $\sim 1^{\circ}\text{C}$ . The existence of secondary minimum in 2200-2400 year cycle structure point, that the last one is a double wave, containing two 1100-1300 year oscillations [17,23].

The main active phase of quasybimillennial cycle is about of 300-400 years. The climate stays warmer again and the mean planetary surface temperature reaches to its maximal values in the range of 2200-2400 year cycle. The last similar epoch was between 8-11<sup>th</sup> centuries. All existing data point that the last one has been essentially warmer as present. In 875 AD the vikings reach to Greenland. This island has been named 'green land' by the rich flora /grasses and shrubberies/ which are covering the south and nearbeach regions in this time.

The last /decreasing/ phase of 2200-2400 year cycle is by duration of 600-700 years. The quasybimillennial cycle stays more powerful and a cooling climate tendency begins. Finally a new 'little ice epoch' occurs in coincidence with the corresponding Maunder-type solar minimum.

A new study in 2003-2004, provided by Komitov et al [24] shows, that the quasybimillennial cycle has been temporary almost unavailable between 10 000 -7000 BC. The last one indicates that during transition phase between Wurm Ice Epoch and present climate the solar activity oscillations regime has been essentially changed. That is why a such supermillennial solar activity regime change is a very probable cause for the sharp climate warming during transition 'Wurm-Holocene'.

To similar conclusion led also the  $^{10}\text{Be}$  oceanic sediment rocks data analysis results [25]. They show that a very powerful quasy 100 000 year solar activity cycle exists and the 'great ice epochs' are corresponding to minimums of last one.

It is usually taken that the astronomical Milankovich's theory explains successfully the climatic cycles by duration of 20 000- 40 000 years. However the lunar rock samples data analysis show an existence of quasy 25 000 year cycle in GCR fluxes variations [22] and consequently, in solar activity too. This is why the possibility for existing of significant solar signal in 20 000-40 000 year climatic oscillations is full real.

It must be said in conclusion of this paragraph that there are many facts to this moment, on the basis of which it can be confirmed for the large coincidence between the solar and climatic cycles during the last  $\sim 300\text{-}400\ 000$  years, i.e. the historical and both

prehistorical time scales '1' and '2'. In geological scale the situation may be is some different: Except the solar activity and luminosity changes there can be are influences by tektonic processes, inner Earth termal source variations, geomagnetic field sign changes, Solar system arround Milky Way center motion etc. However on this stage it is very difficult to estimate the participation of every one of these factors.

#### *4. Helosociology*

Principally the human social development is considered as an upward /rising/ process. However there are many cases in history when some economical, political or spiritual events have analogues near or far in the past. On other hand there are many evidences for simultaneous similar social processes in China and Mediterranean during Antique [26]. It is necessary to remember, that the communications between both civilization regions are negligible in this epoch.

It seems that over historical processes is a influence of factors with cyclic and , may be, planetary nature.

According to all present popular theories for causes of the changes in social relationships must search in the field of economics.

There are two questions: 1. Is possible that the economical relations changes are caused by natural factor and is last one the climate? 2. Is possible that cyclic historical processes are determined by cyclic behaviour of solar-climatic relations?

There are many antic and medieval writing messages for crop production and agriculture prices variations with close to Schwabe-Wolf's and Hale's cycles duration. Because of the limited volum of this paper even short commentaries of the same ones there are unossible . However we will note that large number of this messages have been added and described by A. Chijevskii [27]. Obviously similar relations 'solar activity->economics' are realizing by the mean of solar-climatic mechanisms .

Undoubtely that climate is the most important enviromental component , which relate to human society operation. The last one is very directly connected to agriculture sectors and ,consequently , to food and cloths production, home facilities, energy production and consumption, transport etc. All these key activities are under a strong influence of climatic conditions changes. Consequently, the climatic changes can to activate social processes in one or other course and social-economical relationships change.

The first ideas in the field of heliosociology are proposed by A.Chijevskii[28]. They are dated from 20s and 30s of 20<sup>th</sup> century. However during last 70-80 years many new knowledges especially in the field of old history and supercenturial solar activity dynamics has been accumululated. The last ones are on base for a new understanding of the relation 'Sun->climate->human society'.

An analysis in this course is provided by author in his book 'The Cycles of Sun, Climate and Civilization' [17]. According offered model the solar –climatic 2200-2400 year cycle play the most important role for social-economical processes during Holocene.

The cold and dry climatic tendencies during transition to a Maunder-type minimum of the abovesaid cycle lied to a lack resources and demographical excess on north latitudes as well as in cenrtal Euroasia regions too. This is the cause for large – scale migrations of nordic /aryan/ population in north-south as well as nomads in east-west direction to the Mediterranean . The aryan conquestadors pressure occur to be predominant. The last ones have time to build states , mainly of police type, in South Europe. The power during this initial stage is in hands of generic aristocracy, under the direction of which the South Europe conquest has been provided.

Near to Maunder-type minimums /resp. 'litle ice epochs'/ the newformed aryan conquestadors states because of deepening deficit resource are running a 'great sea expansion'. By the last one an territorial expanding of the civilization in coincidence

with intensive scientific, technological and spiritual development /Renaissance/ occur . The goods-money relations are in rising. To the end of this phase innercivillization wars between generic aristocracy and trade-craft classes begin.

The climate warming during initial active phase of 2200-2400 year solar cycle led to a resources excess into the society. With one side it create conditions for an intensive material and spiritual progress , but on other- to conflicts for redistribution of excesses. Appear the teachings socialist and communist type, as well as are done attempts for forcible reforms in this course. Wars between the states of civilization generality for excesses redistribution are starting.

The Sun transition to the next phase /'plateau'/ stop the climate warming and a 'climatic optimum' begin . This led to a relative resource deficit in society. Tendency to stop the innercivillization conflicts begin. An power elite union in all states of civilization generality occur and a 'universal state' /empire/ is formed. In society life begin and increase the stagnation processes. The spiritual decay , which continued a few centuries is a typical feature of empire phase. As a result oppositional to the power religious teachings are formed and developed.

The 2200-2400 year cycle secondary minimum caused new 'great transmigration' from north and east to empire territory. The last one is destroyed and many 'barbarous' states are formed.

The next climate warming begin and conditions for new stability are formed. This is in coincidence with new attempts for the old empire rebuilding. However the last ones are stopped by the new long-time cooling and transition to next 'little ice epoch', which correspond to start of new civilization cycle.

The proposed model is in very good accordance with Arnold Toynbee's 'civilization theory'[28]. It explain good the historical processes in Euroasia during the last ~5000 years , as well as in other regions of world too.

## 5. Discussion

It followed from all abovesaid, that the new scientific data led to a conclusion : The solar activity is a dominant climate change factor in nongeological time scale (<1 million years). The last one is competed in geological time scale with other factors-tektonical processes, Solar system rotation around Milky way center etc.

In the most popular present climatic theory /'antropogenic greenhose effect'/ the last 100-150 year data series are absolutised. However this theory is ignored and , may be say is in contradiction with paleoclimatic data. The observed present climate warming can full successfully to explain on base of 'Sun-climate' relation and its caused by present large-time scale level of solar activity processes [17,29]. As is shown in [17] and [23] during the second half of 20<sup>th</sup> century the solar activity level has been the highest for the last 800-1000 years. It is a result by superpositions of few quasycenturial and supercenturial solar oscillations maximums. Amongst them the quasybicenturial cycle, which last minimum has been occurred near to 1850 AD , play the most important role. As is clear from statistical analysis of solar and climatic data series the climate warming during period of 1850-2000 AD is completely containing in limits of the solar-climatic statistical model [17].

There are two questions.

The first one concern the physical mechanisms of solar activity influence on the climate.

As is already point in &3 there are strong evidences for ~0.1% total solar irradiance variations during the 11-year Schwabe-Wolf's cycle. It has been also noted that such solar irradiance changes can to caused ~0.1°C mean planetary temperature variations ,as well as to explain the quasy 11-year cyclity in many climatic parameters time series. However provided on this base estimations given for the conditions during

Maunder's minimum in 17<sup>th</sup> century /resp. the 'little ice epoch'/ a decreasing of 0.4°C relatively to the present mean planetary temperature. On other hand the real difference is about 4 times larger and statistical analysis point that the deficit of 70-75% is caused by solar factor too. What is the nature of this one?

A more precise analysis of the 'greenland beryllium series' data show, that there are strong oscillations, which are not typical for the sunspot activity indexes by durations of 14.5, 65-67 and 115-120 years [30]. In tree rings width time series these cycles also has been obtained [31]. It is appropriate that the last ones are good indicator for climatic changes. However the 'cosmogenic isothopes' time series are a reflection of solar wind parameters fluctuations. Consequently, the so observed cyclic climate variations most probably are caused by solar corpuscular irradiation and Sun's magnetic field changes both in short- and supercentennial time scales. In this course must search about the cause for existence of 20-22 year solar-climatic cycle. It can be realized by the Earth magnetic field intercession and after that due to influence over Earth rotation speed microfluctuations, stratospheric energy balance, cyclogenesis and total atmospheric circulation. There is a very high probability that Sun's corpuscular irradiation changes are source of the abovesaid 70-75% 'temperature climatic excess'.

The second question concern the possible scenario for solar activity and climate in near future.

Else in 1997 author on the base of Schöve's series analysis was predict a Gnevishchev-Ohl's /G-O/ rule violation for the pair zurich cycles with numbers 22 and 23 [32]. As it has been already noted this forecast is confirmed by observation of solar activity dynamics during the present 23<sup>rd</sup> Schwabe –Wolf's cycle. An additional analysis provided by Komitov and Bonev [33] show that during last ~1700 years /the continuous part of Schöve's series/ the G-O rule violations pre-indicate the supercentennial solar minimums coming. If taken into account that present epoch /~2000 AD/ is near to beginning of 2200-2400 year cycle 'plateau'-type phase /the point 'Q' on fig.4/ it may conclude, that the supercentennial minimum in 21<sup>st</sup> century will be not very deep and by his parameters will be similar to Dalton's minimum /1790-1830 AD/. The extrapolations of Komitov and Kaftan's models for Schöve's and "greenland Be-10" data series are confirming the forthcoming of such supercentennial minimum [30].

An independent confirmation of abovesaid forecast on the base of Holocene tree rings radiocarbon data series has been obtained [29]. According authors of this study there is 92% probability to begin a supercentennial solar minimum before 2050 AD. More than 99% is the probability for such event before 2100 AD.

It is possible to expect that supercentennial solar minimum in 21<sup>st</sup> century will overcome the global warming tendency. As a result near to 2050 AD the mean Earth nearsurface air temperature will be at ~1°C lower as present. The warming will start again at the beginning of 22<sup>nd</sup> century when for a very short time the level from the end of 20<sup>th</sup> century will be reached.

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