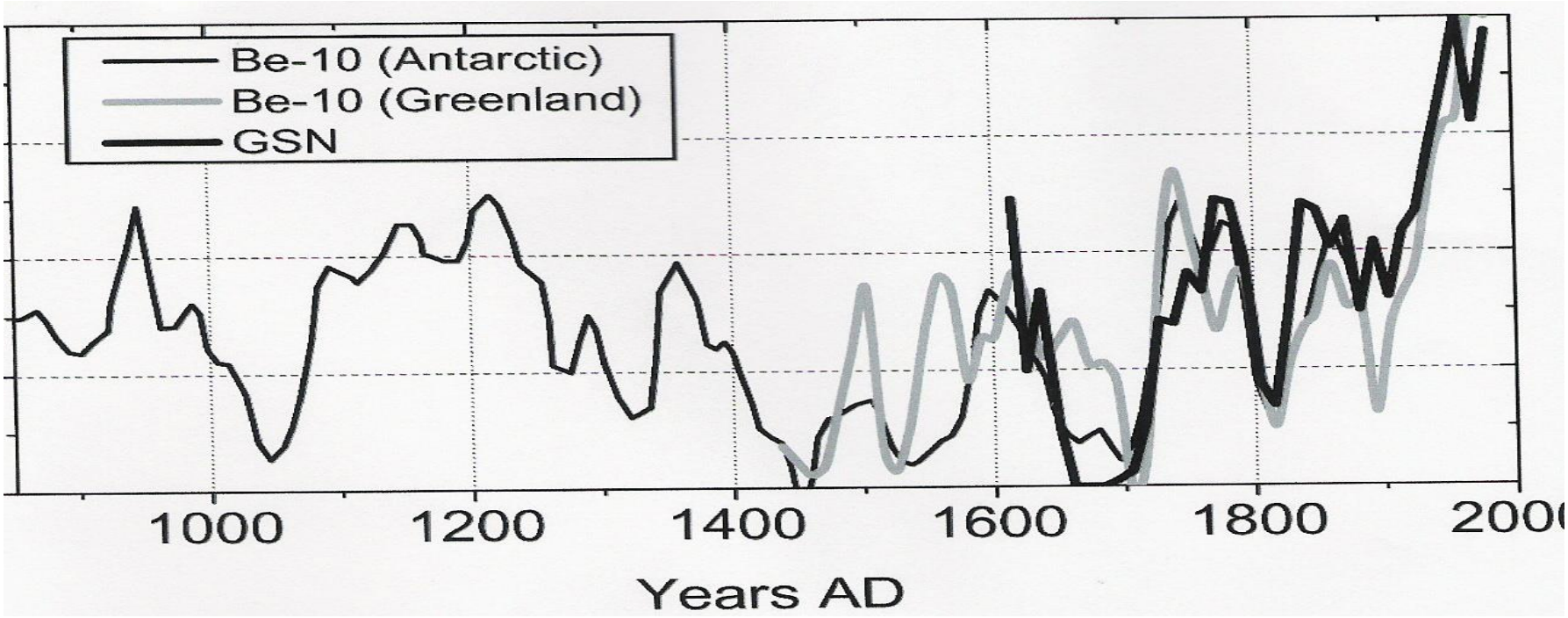
Some observation of solar variation in the Holocene

Accurate observations of the solar activities are available by the satellites over 30 year. Beforehand reasonable reliable measurements about solar variation only are possible by the observation and counting of the sunspot numbers (SN), which is done since 1610 in observations by telescopes in Europe and in China perhaps somewhat earlier. Also historical reports about the Northern light can give some indications for sun variations perhaps over 2000 year. Within the framework of the geology and paleoclimatology (the history of the climate on Earth) these are extreme short periods and definite insufficient for a good insight in the effects of solar variability on the climate on Earth. The solar activity from the more remote past can only be studied with indirect data from isotopic research.

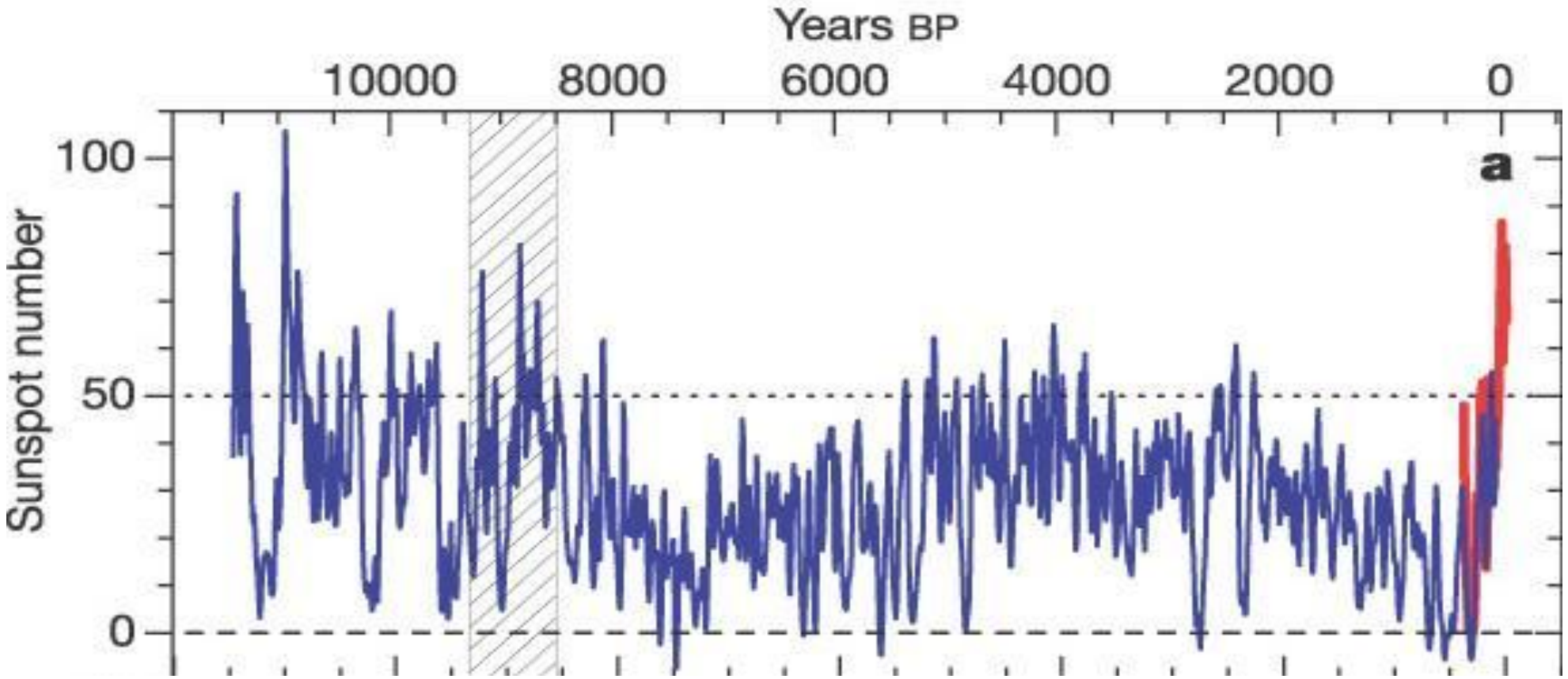
FIG 4b (see footnote 11; from zon en klimaat, prof de Jager, copy with admittance)



The results on **FIG 4b** indicate that these European observations with telescopes (GSN) show a picture that is about in accordance with the isotopic researches (Be-10). There were lows in the activities of the sun about 1450 and 1530, in the period 1650-1710 and about 1810. In the period 1900-1970 the activities has risen sharply. The low of the second half of the 17th century we can see here in the different curves is called the Maunder minimum. This is related to the so called little ice time. In this period, but also somewhat earlier, the climate in the Netherlands was much colder than it is now, so that horses with sledges were sometimes for months in the winter the normal transportation means over the froz en

salt water of the Zuiderzee and Waddenzee[Litt 1] [1]. There also was then much ice in the North sea. But by the tides current the sea was not totally frozen over, so that you cannot find stories about people that went to England on the sledge and also was the tour by sledge mostly impossible over places of the Waddenzee with much current. Now however is the Southwest coast of Svalbard ice-free in the winter. This coast

FIG 5 (free copy from wikipedia)



[1] See: J. Buisman, volume 4 of 'Duizend jaar weer, wind en water in de lage landen'.

is ±3000 km North of Amsterdam and only 1200 km South of the North Pole. The climate differences, however, between now and the 16th and 17th century and the possible relation with the Sun come out to be more complicated than FIG 4b indicates: the winters were indeed much colder than now, also were the summers cooler but here the differences are probably smaller. The most severe cold in the Netherlands was already around the year 1600, so more than 50 year before, the Maunder minimum. There also are some indications that the climate was more wet then, which could be caused by more cloud forming by more GCR and less magnetic solar activity.

Over the short time that data are available already are climate changes that do have possible relations with variation of the Sun. So it is important trying to describe by research the differences in solar activity and climate over a longer time. The proxies for the parameters of the magnetic solar activity on a longer term are the seldom instable isotopes, that arise by the cosmic radiation in the atmosphere. This very powerful cosmic radiation (GCR) bombs the atmosphere and causes a lot of nuclear and chemical reactions. By this 'normal' nitrogen atoms can be changed in ^{14}C and oxygen and nitrogen atoms can be split down, so that many atoms arise, as ia. ^{10}Be. Many products arise, but some as these are more easy to be find in the traces. These ^{14}C and ^{10}Be are instable and thus radioactive isotopes of C (carbon) and of Be (beryllium). The ^{14}C has a physical half-live of 5730 year and the ^{10}Be will be disintegrated for the half only in 1,5 my (million year) [2]. In periods with a strong solar wind less cosmic radiation can reach the Earth and so arise less ^{14}C and ^{10}Be [3]. The measurements of the variations in these isotopes must be accompanied by a good dating back because of the disintegration of these isotopes in the course of time. S.K. Solanki [Litt 2] of the Max Planck Institut [4] did connect the examination with ^{14}C with the annual rings in wood and so they figured out the intensity of the solar wind and the sunspot number over a period of 11400 year. The results (**FIG 5**) show that the sun in 1940 - 2000 is very active and that is an important indication for global warming (also) by the Sun in this time, at least if the connection between the Sun and the climate is realistic. Following **FIG 5** the sun was very active and increasing steeply at the end of the last glacial (ice-time) and at the start of the warmer era in which we are living now, the Holocene, afterwards the Sun became more constant. Further the activity was diminishing since about 2200 year ago, ending in lows on 500 and 350 year ago. Now according to the authors **the Sun is again as active as it was in the time that the large ice caps in Europe and North America melted and the Holocene began, 11400 year ago.**

As described **in FIG 8b** I think the large maximum of 1957 AD is a little less large in the field of the total Holocene but it is still large in the last 8000 years and this datum is anyhow a very important issue. Although some details are debated this research of S.K. Solanki ea is generally accepted among scientists and it is also confirmed by the research of R.C. Finkel ea [Litt 3] on the other proxy of solar variability, ^{10}Be, as described at **FIG 8a** and **b** on this site. This research give stuff for further examination of the influence of solar variations on the climate on Earth, so is done for instance by prof C. de Jager, [Litt 4]see www.cdejager.com/sun-earth-publications

[2] Because the atoms of these isotopes disintegrate in the course of time following an exponential process with the physical half-live as a measure for the intensity of the exponential process the isotopes are used for dating back the matter in which they occur. Main condition in this dating is of course that these isotopes arise constant in time by a constant cosmic irradiation. It now comes true that this radiation is not totally constant by the variable solar activity. Thus also for the reliability of these important dating scientists must know everything about the variations in the magnetic activity of the Sun.

[3] Only the magnetic activity of the Sun is measured, because in the atmosphere the 14C and the 10Be production is caused by the GCR and the GCR is negative modulated by the Sun. The variations in the Sun's irradiation energy are not to be measured by this.

[4] S.K. Solanki et al. Unusual activity of the Sun during recent decades compared to the previous 11,000 years. *Nature*, Vol. 431, No. 7012, pp. 1084 - 1087, 28 October 2004. Their curve of FIG 5a also is described in wikipedia.

Literatuurlijst:

1 Buisman, J : ‘Duizend jaar weer, wind en water in de lage landen’, Volume 4.

2 S.K. Solanki et al. Unusual activity of the Sun during recent decades compared to the previous 11,000 years. *Nature*, Vol. 431, No. 7012, pp. 1084 - 1087, 28 October 2004. Their curve of FIG 5a also is described in wikipedia.

3 Finkel, R.C. and K. Nishiizumi, 1997, Beryllium 10 concentrations in the Greenland Ice Sheet Project 2, ice core from 3-40 ka. Journal of geophysical research 102: 26699 – 26706

4 Jager de, prof C: Zon en klimaat, http://www.cdejager.com/sun-earth-publications