The sun, climate change and the expansion of the Scythians after 850 BC

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<table>
<thead>
<tr>
<th>Peat type</th>
<th>Period</th>
<th>Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unhumified <em>Sphagnum</em> peat</td>
<td>Sub-atlantic</td>
<td>Cool and wet</td>
</tr>
<tr>
<td>Humified <em>Sphagnum</em> peat with pine</td>
<td>Sub-boreal</td>
<td>Warm and dry</td>
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<tr>
<td>Unhumified <em>Sphagnum</em> peat</td>
<td>Atlantic</td>
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</tr>
<tr>
<td>Humified <em>Sphagnum</em> peat with pine</td>
<td>Boreal</td>
<td>Warm and dry</td>
</tr>
<tr>
<td>Hydroseral peat</td>
<td>Preboreal</td>
<td>Warm and dry</td>
</tr>
<tr>
<td></td>
<td>Glacial</td>
<td>Cold</td>
</tr>
</tbody>
</table>

Fig. 4.3 Diagrammatic generalization of the Blytt–Sernander scheme of climatic periods during the post-glacial (Holocene, Flandrian).
cosmic rays: protons

variable solar wind partly protects earth against cosmic rays

Protons captured in atmosphere
Ionization stimulates cloud formation
Production of $^{14}\text{C}$ and $^{10}\text{Be}$
$p \rightarrow n + ^{14}\text{N} \rightarrow ^{14}\text{C} + p$
$\rightarrow ^{10}\text{Be}$
$^{14}\text{CO}_2$

biosphere
ocean

deposits
818 eikeboom gekapt
FRAXINUS wiggle match dating excavation Bernisse
SUN

Energy radiated by the sun

Electromagnetic emission

Solar luminosity

UV variations

Corpuscular emission

Solar cosmic rays

Solar wind variations

Galactic cosmic rays

Modulation of cosmic ray fluxes

Stratosphere

Variations of optical properties and radiation balance of the atmosphere

Troposphere

ozone aerosols veil clouds

Variations of the solar radiation, atmospheric circulation, precipitation and temperature near the Earth's surface

Geomagnetic field intensity
14C-dates of the ‘Terp’-phase of West-Friesland
wood and charcoal from ditches, pits and wells

2760 ±35 BP
2745 ±30 BP
2745 ±30 BP
2740±40 BP
2710±35 BP
2690±25 BP
2685±30 BP
2650±30 BP
2620±20 BP

This phase represents ca 140 14C-‘years’, but probably only ca 60 calendar years. This is the period of a fast increase of delta 14C, and also the period of the start of the ‘Younger Sphagnum Peat’. (S. imbricatum: oceanic conditions)
Fig. 10. Distribution of Middle Iron Age pottery (types RWI and RWII) in the northern Netherlands. Arrows suggest possible routes for transhumance and colonization. The site of Middelstum-Boerdamsterweg (see fig. 11) is indicated by the letter M.
Dates of Excavated Trackways from Ireland (see also Table 1, Page 423)
Plate 51. Time chart of Irish togheirs. Dendrochronological dates red and calibrated radiocarbon dates black (1σ) and white (2σ).
Comparison between the curve of the solar activity proxy $\Delta^{14}C$ with climate proxies among the recorded fossils in the Pančavská Louka sequence for the Subboreal-Subatlantic transition.
Solar-forced 2600 BP and Little Ice Age highstands of the Caspian Sea


......... evidence from ... lagoonal deposits in highstand coastal barrier complexes along the western Caspian shore that the last major highstands occurred ~2600 BP and ~300 BP. Both highstands coincide with a worldwide period of cool and wet climate, marking the beginning of the Subatlantic and the Little Ice Age respectively. As both periods of global cooling coincide with well-known minima in solar activity, solar forcing is so far the best explanation for Late Holocene sea-level changes in the Caspian Sea.

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Abrupt environmental change and depopulation of Upper Volga lowland, Central Russia, around 2,600 BP

Raisa Gracheva

.... It is shown that around 2,600 BP economical activity of the human society within the Upper Volga lowland was interrupted by rapid and total flooding.

.... flooding caused the depopulation and collapse of economy through vast lowland area bordered on Klin-Dmitrov Heights.

.... evidences of rapid environmental change, which can be considered as a regional catastrophe ....
Fig. 6. Preliminary young Quaternary lake level fluctuations of Bayan Nuur and Uvs Nuur.
12. Doorsnede van kogelan 5 van Pozjirik met weergave van de verzakte en met stenen gevulde schacht van de grafouvers en met aanduiding van de grootte van de permafrost onder de heuvel, naar Rudenko.
Fig 1 : Localisation du Cameroun
Pollen diagram Lac Ossa  (core OW4)  
(selection of taxa)
Acknowledgements:
Bas van Geel and other members of the research team got financial support from:
- The Netherlands Organization for Scientific Research (NWO 047.009.005; ALW 750-19-812).
- INTAS (project 03-51-4445),
- EU 5th Framework Programme, Energy and Environment (ACCROTELM project; EVK2-2002-00166).

Illustrations used in the powerpoint presentation:
2: Blytt-Sernander scheme from Birks and Birks, 1980.
3: Map of southern Norway (van Geel, 2004), based on an map by Blytt (1882).
4 and 22: Raised bog profile in Bargerveen area (northwest Netherlands; photo B. van Geel). The arrow in 4 points to the Subboreal-Subatlantic transition.
6 and 7: Details of leaves of Sphagnum cuspidatum and Sphagnum imbricatum (photo B. van Geel).
8: Selection of macrofossil data from raised bog profile Engbertsdijksveen-I (van Geel, 1978).
11: Radiocarbon calibration curve (Stuiver et al., 1998).
12: From De Jong et al., 1979.
18: From van Geel et al., 1999.
23 and 25: after van Geel et al., 1996.
24: Aerial photograph showing soil marks from Bronze Age settlement in West-Friesland, The Netherlands (photo W.H. Metz, IPP, UvA).
26: Ruinen-Wommels pottery type (photo BAI, RuG).
27: Migrations in the northern Netherlands at the Subboreal-Subatlantic transition (from Waterbolk, 1966).
28: Cartoon showing development of landscape in northern Netherlands (after van Geel et al., 1998).
32: From Raftery (1990) with relevant part of 14C calibration curve and delta 14C added by Bas van Geel.
33: Bog oak from Diemen, The Netherlands (photo B. van Geel).
34: Dutch bog oak record and delta 14C (van Geel, Jansma and van der Plicht, in prep).
35: After Speranza et al. (2002).
36: Abstracts by Kroonenberg et al., and Gracheva (for references see van Geel et al., 2004).
37 and 38: from Grunert et al., 2000 (for reference see van Geel et al., 2004).
39 and 40: Excavation scythian burial mount Arzhan-2, Tuva (photo H. Hooghiemstra).
41: Scythian kurgan 5 from Pazaryk, after Rudenko.
43: White Lake near Arzhan-2 in Tuva (photo H. Hooghiemstra).
44: Pollen diagram Kutuzheko Lake (for interpretation see van Geel et al., 2004).
45: Radiocarbon dates from archaeological sites in Khakassia and Tuva (see van Geel et al., 2004).
50, 51 and 52: see Magny (1993a,b).

REFERENCES:


