Scientific Research Publishing

Open Journal of Geology, 2018, 8, 1167-1194
http://www.scirp.org/journal/ojg
ISSN Online: 2161-7589
ISSN Print: 2161-7570

Historical Course Follows Climate Change: Patterns of the Northern Hemisphere

— From Peoples' Migration until the Industrial Revolution (3rd-18th Century)

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How to cite this paper: Schneider, W. and Salameh, E. (2018) Historical Course Follows Climate Change: Patterns of the Northern Hemisphere—From Peoples' Migration until the Industrial Revolution (3rd-18th Century). *Open Journal of Geology*, **8**, 1167-1194.
https://doi.org/10.4236/ojg.2018.813071

Received: November 27, 2018
Accepted: December 26, 2018
Published: December 29, 2018

Abstract

This paper relates to the statement that the so-called "Little Ice Age" (RCC 6: 1.350-1.800 A.D.) represents—besides the 8k-Event (8.200-8.000 yr cal. B.P.)—the fastest and strongest onset in Holocene History [1]. Its intention focuses on the correlation of interplaying natural processes (*i.e.* solar energy variation, aerosols, oceanic currents, volcanism as part of plate tectonics, heat flow) with social/political evidence through the time-span of Peoples' Migration until Industrial Revolution (3rd-18th Century). The time-span comprises the cool/wet/respectively dry climate phase of the P.M. (260-550), a Climate Optimum (600-1.100 A.D.) owning a final Thermal Maximum (1.100-1.260 A.D.) and the "little Ice Age" (1.350-1.800 A.D.), the latter intercalated by the Spörer Minimum (1.460-1.550 A.D.) and the Maunder Minimum (1.650-1.720 A.D.). Thereby, an average temperature difference of 1.0˚C - 2.0˚C seems sufficient for incising climatic/cultural consequences [2]. It has become obvious that a Climate Optimum primarily provides constructive life conditions; however with a problematic final as the following "Effect-Chain" tells: balanced agricultural/cultural population growth → rich harvests → satisfying nourishment → health, encouragement → overpopulation under favorable materialistic conditions → increasing stress → lack of food, high prices → revolts → migration. In contrast, cool/wet/resp. dry conditions originate destructive/depressive conditions (see Peoples' Migration) which initiate the following "Effect Chain": bad agricultural conditions → poor/no harvesting → famine → disease, growing death rate → social, political revolts, wars → human cruelties with psychic/religious background (inquisition, witch-combustion → general chaos (30 yr-war) → death, migration (maritime endeavors, colonization). Furthermore, it should be stressed that volcanic aerosols play besides the solar influx variation—an important role on climate/cultural change [3].

However, the effects of oceanic currents' heat flow of Mid-Oceanic Ridges and Hot Spots, as well as Earth-Magnetism and Sun/Earth Geometry are poorly understood in this context (Example: Iceland as hot spot situated on the Mid-Atlantic Ridge having been working since 40 Ma). The Chapter-introducing citations play a challenging role in regard to Science Criticism and touch the so-called 95% Confidence line (accepted realm of causal interrelation and according recommendation to Society [4]).

Keywords

Little Ice Age, Climate-Change, Social/Political Concern, Psychic/Spiritual Implication, Volcanism, Plate Tectonics, Peoples' Migration, Northern Hemisphere, Natural/Cultural, Effect-Chains, Science Criticism

1. Introduction

Wise Sayings:

Unsere Wahrnehmung der Umwelt wird von Teilen des Gehirns erzeugt, zu denen wir keinen Zugang haben, und dieses Prinzip des unzugänglichen Apparats und der vielfältigen Täuschung trifft nicht nur auf unser Sehen und unsere Zeitwahrnehmung zu, auch höhere Funktionen wie Denken, Fühlen und Glauben arbeiten nach dem Muster.

"Our perception of environment is being originated by part of the brain to which we do not have any access. And this principle of an inaccessible apparatus and manifold disillusion meets not only our seeing and our time perception, also higher functions of thinking, feeling and belief are based on this pattern".

David Eagleman, Neurologist, 2012 [5] (Trans. Sch.).

Originally stimulated by the discovery of the meteorite crater Jebel Waqf as Suwwan, Eastern Jordanian Desert [6] [7] [8], the authors focused their interest on whether major impact and super-volcanic activity might possibly have initiated climate effects on Neolithic and Bronze Age Cultures in the Near/Middle East and in Central Europe as well [9] [10].

By using the Holocene climate data of Majewski *et al.* [1], a surprisingly high coincidence of rapid climate changes (RCC 1 - 6) with rise and fall of the relevant cultures becomes obvious. The analytical data are based on the commonly applied gases (CO_2, CH_4, SO_2, NO_X) and isotopes (^{14}C, ^{18}O, ^{10}Be) recovered from ice-core samples of Greenland (GRIP, GISP 2), paleontological data, aerosol and impact-events (**Figure 1**).

Among the six RCCs (11.500 yr cal. B.P.-1.800 A.D.) the latter (1.350-1.800 A.D.) represents—besides the early 8k-Event (8.200-8.000 yr cal. B.P.)—the fastest and strongest onset during the Holocene ("Little Ice Age") [1].

Because of the low availability of differentiated records, missing recent sections, and complex anthropogenic output, the authors [1] limited their investigations onto the beginning of the Industrial Revolution. Thus, modern time data

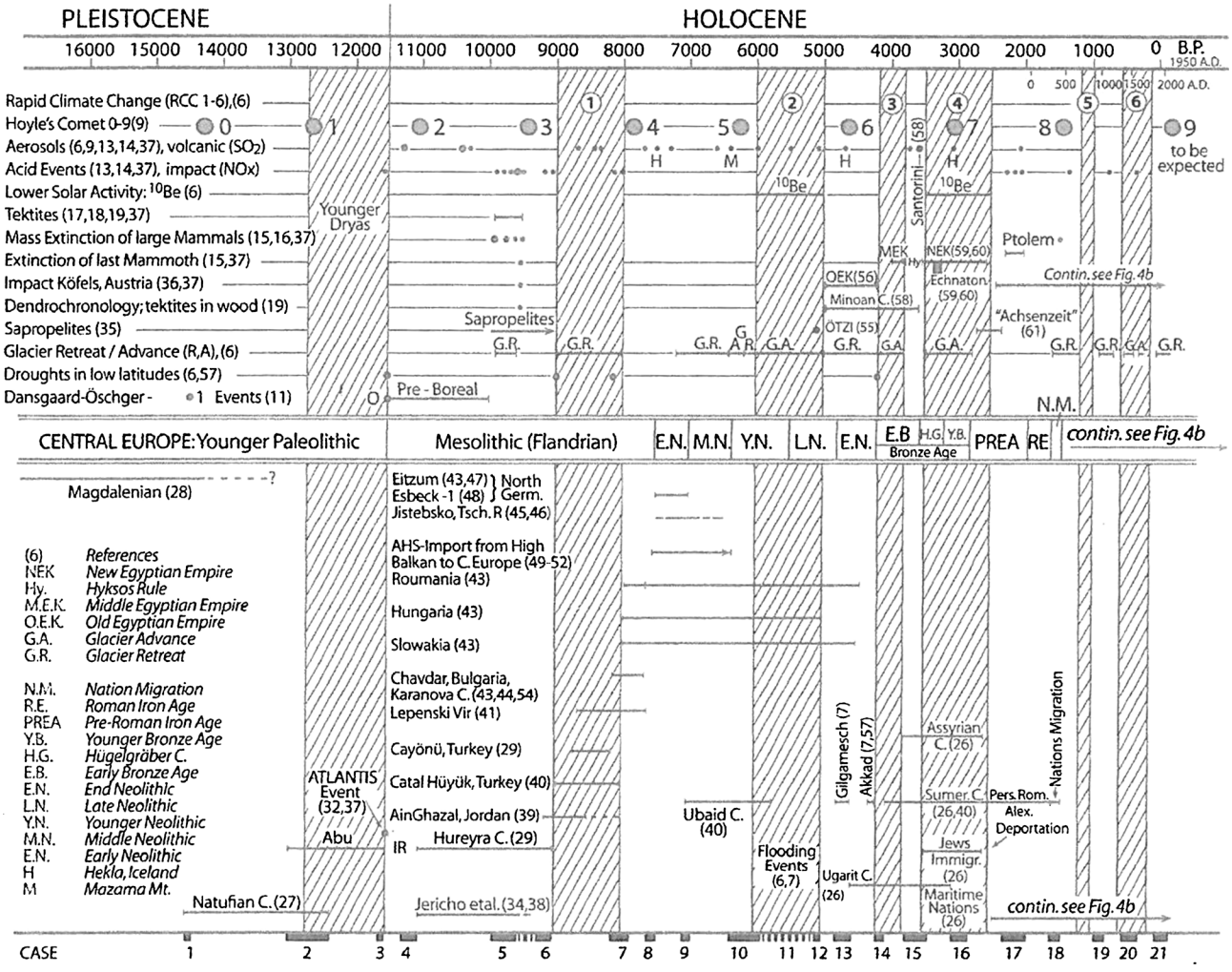

Figure 1. Rise and fall of human cultures in the Near/Middle East and in Central Europe throughout Holocene with preference of Neolithic and Bronze Age Cultures; in correlation with natural events like RCCs [7], mega-volcanism, impacting, and others [6].

are to be referred *i.e.* to Schellnhuber [2].

Accordingly, this paper deals with the time-span 3rd-18th Century whereby both RCC 5 (750-950 A.D.), RCC 6 (1.350-1.800 A.D. = "Little Ice Age"), and the Great Thermal Maximum (1.100-1.250 A.D.), are of special interest [11] (**Figure 2**).

The publications of Clube & Napier [12], Hoyle [13], Hsü [14], and Schellnhuber [2] intensified our interest on this subject, since a few of them even keep—beyond the climate/culture-interrelationship—the influence of RCCs and "Rare Events" on psychic/religious effects for possible [12] [13].

2. Methods

"The only defense against wrong hypotheses is poor logic, curiously enough". Fred Hoyle, 1993, Astrophysicist [13].

Majewski *et al.* used the following parameters for Holocene climate analysis [1].

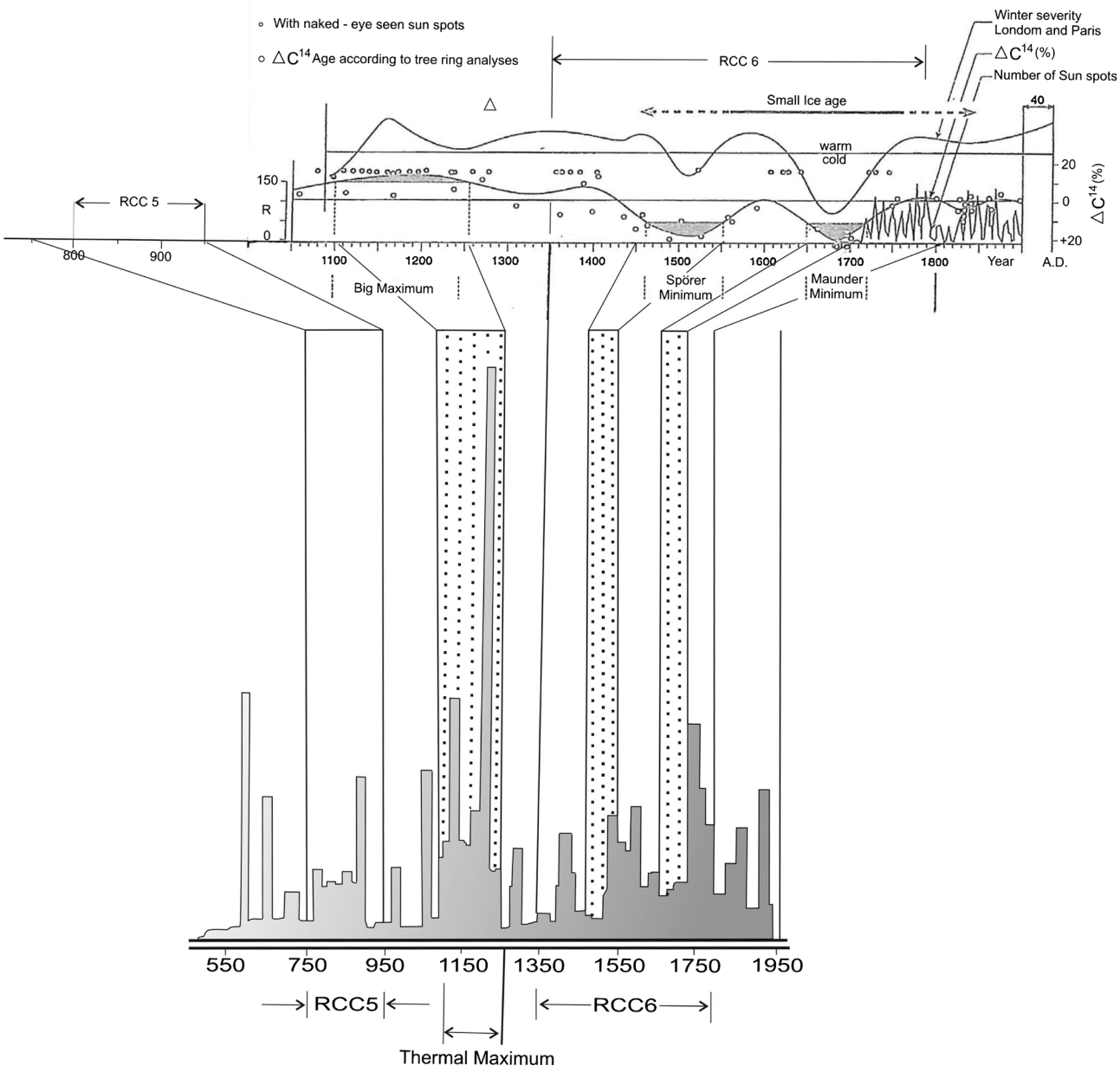

Figure 2. Solar Activity (based on eye-recorded Sun Spots, Δ^{14}C-data) and Aerosol-level (volcanic SO_4—residuals) throughout the time-span 750-1.800 A.D. [9] including both RCC and RCC6 [7]. See characteristic distribution of Sun Spots and Aerosol-levels with regard to the Thermal Maximum (1.100-1.255 A.D.) and both Spörer Minimum (1.460-1.555 A.D.) respectively Maunder Minimum (1.650-1.720 A.D.) ("Little Ice Age").

- Ice-core GISP 2: SO_4-residuals, volcanic aerosols.
- Antarctic CO_2, Taylor Dome.
- Ice-core GRIP: CH_4.
- ^{14}C-residuals, 200 yr smoothing in connection with the number of sun spots (eye-observed).
- Summer and winter insolation.
- Global glacier advance.
- Ice-core GISP 2: Na^+ (200 yr smoothed).

- Ice-core GISP 2: K^+ (200 yr smoothed).

Moreover, the number of eye-observed sun spots was used for the interval 1.100-1.800 (9: Figure 2).

Generally spoken, the following causes and theories concerning RCCs are commonly accepted [*i.e.* 2].

- Variation and cycles of solar energy-influx on the earth's surface.
- Cosmic radiation impulse.
- Solar activity and Earth Magnetism, variation of the Earth's Magnetic Field.
- Migrating interplanetary dust clouds.
- Change in the Earth/Sun Geometry.
- Aerosols (SO_4-particles) originated by volcanism, hot spots.
- Major Impacts [15].
- Plate Tectonics (plate movement, earthquakes, volcanism [3] [16].
- Heat Flow of diverse Volcanic Provinces (Mid-Oceanic Ridges, Subduction Zones, and Hot Spots).
- Oceanic Currents.

- Anthropogenic causes for RCC predominantly concern the time-span since the beginning of the Industrial Revolution in England after 1750 [2] [17]:

- Enrichment of atmospheric Green House Gases (CO_2, CH_4, etc.).

- Variability of the physical, chemical, and biological conditions of the Earth Surface by the exploitation of resources, forestry, agriculture etc. and pollution of global scale.

Nevertheless, since the beginning of the Medieval Climate Optimum (600 - 1.255) there took already place a signification influence on the Northern Hemisphere by increasing agriculture and varying wood-clearing that approximately produced some 200×109 tons of CO_2 [2].

3. Interplay/Interdependence and Correlation of Parameters Applied [1] [11]

"Wenn der Zusammenhang von Ursachen und Wirking sich als nur statistisch gültig bzw. als nur relativ wahr herausstellt, dann ist auch das Kausalprinzip in letzter Linie nur relativ zur Erklärung von Naturvorgängen verwendbar und setzt eben damit das Vorhandensein eines oder mehrerer anderer Faktoren, die zur Erklärung notwendig wären, voraus. Das heisst soviel, als dass die Verknüpfung von Ereignissen unter Umständen von anderer als kausaler Natur ist und ein anderes Erklärungsprinzip verlangt".

"If the coherence of cause and effect represents itself as merely statistically valid resp. as relatively true, then the principle of causality works finally only relatively useful to explain natural processes and presumes the existence of one or more other factors being necessary for analysis. That means the interconnection of events appears as of other causal nature and therefore, demands another explanation principle".

Carl Gustav Jung, Psychologist 1990 [18] (Trans. Sch.).

The Sun Spot-diagram (Figure 2) represents the "Great Thermal Maximum" (1.100-1.255 A.D.) in the final stage of a longer lasting "Medieval Climate Optimum" (600-1.255 A.D.). The Great Thermal Maximum itself owns an environment of Sun Spots.

RCC 5 (750-950 A.D.) falls into the time-span of the Climate Optimum. Indeed, it appears less significant throughout the Holocene climate course. However, it reveals telecommunication of global scale in the Northern Hemisphere, week wind activity over the North Atlantic and Siberia while the production of Atlantic deep water increased [1]. There is also an increase of CO_2, solar activity variation, and glacier retreat in the Swiss Alps (Figure 2, Figure 3).

The RCC 6-Interval (1.330-1.800 A.D.) yields the most significant RCC known as "Little Ice Age" characterized by the Spörer Minimum (1.650-1.720 A.D.)

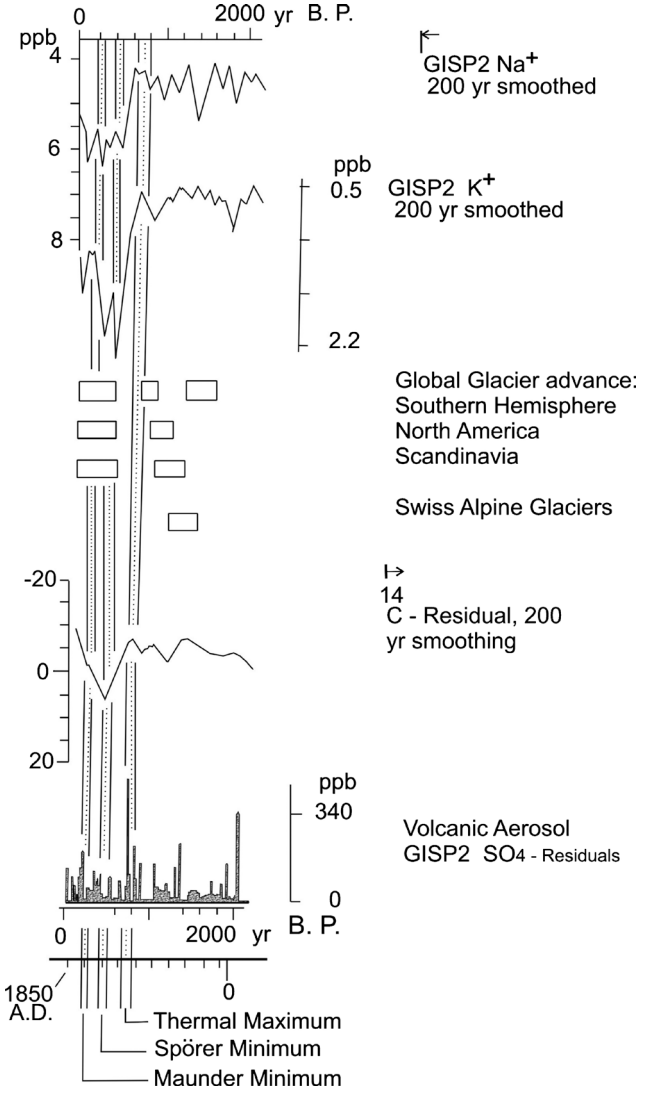

Figure 3. Climate-related patterns recovered from Greenland Ice-Cores GISP2 and GRIP: Volcanic Aerosol, $\Delta^{14}C$-residuals (200 yr smoothed), Global Glacier Advance/Retreat, Na^+ and K^+-contents (both 200 yr smoothed) throughout the relevant time span [7]. See correlation with the Thermal Maximum and both temperature minima.

and the Maunder Minimum (1.650-1.720 A.D.) and between both a distinct temperature increase (**Figure 2**, **Figure 3**).

The RCC 6-Interval in general, shows dominant cool poles, wet tropics, and glacier advance in middle latitudes, CO_2—decrease, CH_4—increase, and strong aerosol-variation are typical. ^{14}C and ^{10}Be-data underline rapid Solar Activity-variation causing strong climate patterns (**Figure 2**, **Figure 3**). There are distinctly delimitated aerosol-maxima during the RCC5-Interval (755-950 A.D.) and during the Great Thermal Maximum (1.100-1.255 A.D.) as well as during the time-span between both Spörer Minimum (1.460-1.550 A.D.) and Maunder Minimum (1.550-1.650 A.D.) and finally after 1730 (comp. [3]).

Both temperature-minima reveal low aerosol levels. Obviously, the aerosol-distribution positively correlates with subaerial volcanism predominantly related to the Greenland-Iceland-Faeroe Ridge/North Atlantic Volcanic Province (**Figure 4**).

Between the 13th and 17th Century the number of high-tide-floods along the North Sea Coast was enormously growing up. Records register more than 50 flood-events of whom the Marcellus-Event (1362) and the Burchardi-Event were outstanding [[19] **Table 1**].

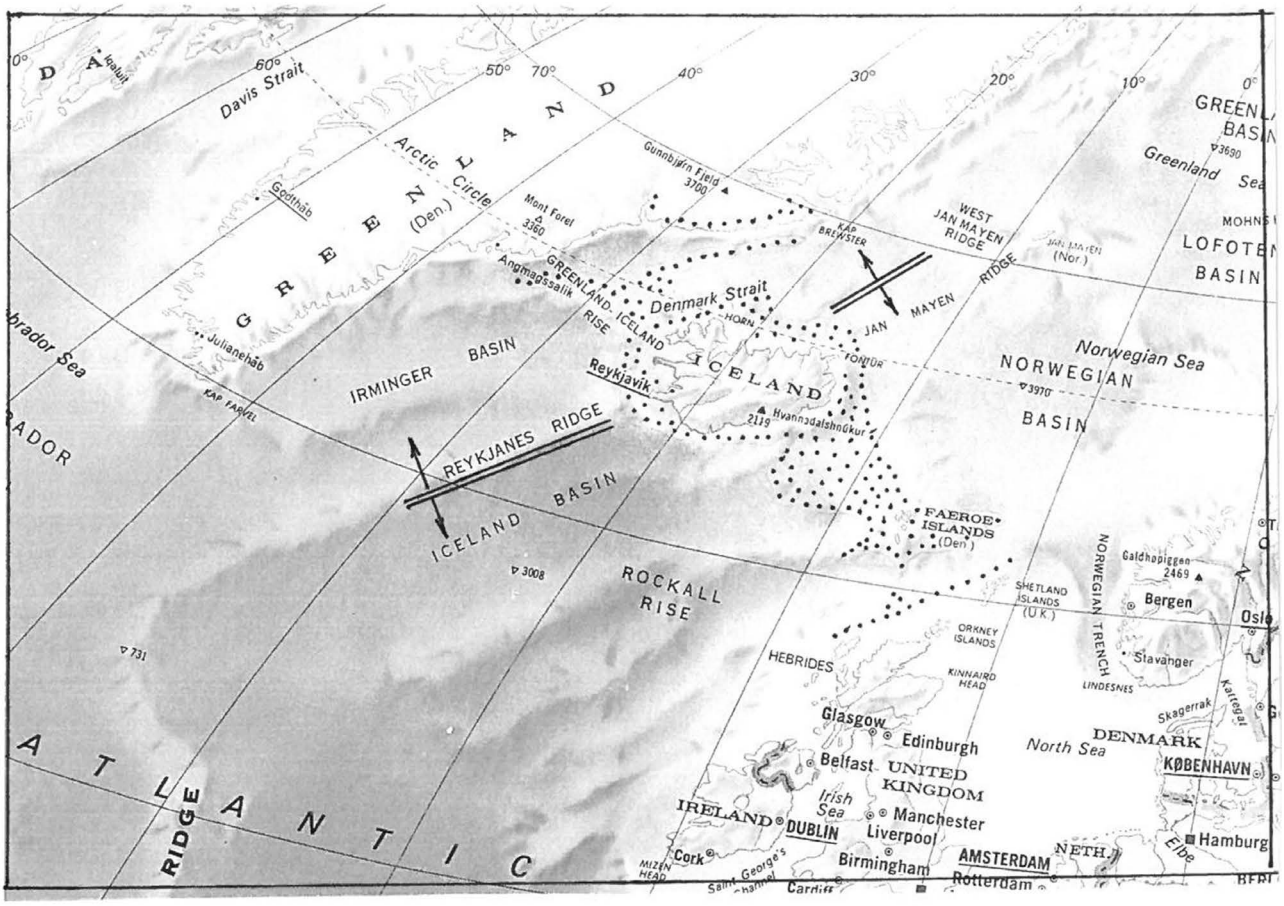

Figure 4. Greenland-Iceland-Faeroe Ridge (dotted) developed since 40 Ma Hot Spot Activity below the Mid-Atlantic Ridge. Spreading-rate: 1 - 2 m/a [14].

Table 1. Storm high-tides along the North Sea coast through the time-span 1200-1825 [18].

Years	Remarks
1204/1216	10,000/30,600 people died
1218	
1230/1287	Friesland, flooded
1300	Destruction of 28 Kirchspiele
1313/16/34	Wet years, strong storm high-tides
1338	Extreme cold and wet summer, destruction of Uthlande
1341/42	Storm high-tides, heavy rainfall
1347	Coldest summer since 700 years
1350/51	Pestilence, no harvest, majority of the population died
1354	2.000 dead people
1362	Marcellusflut = Grosse Mandränke, famine, pestilence, wars, 10,000 people died
1380/82	Walpurgis event, darkness, extreme destruction, death
1387/91	dto.
1393/95	dto.
1400	Comet
1402	Star in western direction
1404	Elisabeth Flood
1405	Spring Flood
1406	St. Viths Day
1412	Cecilien Flood
1421	Elisabeth Flood
1426/27	MichaelisFlood
1434/36	1. St. Gallen Flood
1471	Dreikönig Flood
1474	2. St. Gallen Flood
1476	3. St. Gallen Flood
1477	4. St. Gallen Flood
1479	Barbara Flood
1480	Walpurgis Flood
1483	5. St. Gallen Flood
1532/33/36	Allerheiligen Floods, extremely strong
1570	November Flood, dto.
1573	Strong storm
1602/1603	Storm high-tides, pestilence
1612-1615	Several storm events, 300 dead people
1617/22/24	Several strong high-tides
1619-1627	Heavy rainfall, vermin, bad harvest

Continued

1630	Epidemic
1631	Flooding
1634	Burchardi Flood, 8000 - 15,000 people died, worst living conditions, famine, wars
1717	
1718	Broken dams, high-tides with ice-flow
1720	
1756	Broken dams, destruction
1791/1792	High-tides with ice-flow
1794/1796	High-tide storms
1825	High-tide storm

The Na^+ and K^+—maxima of GISP2 (1) coincide with both Spörer and Maunder Minimum, positively correlating with global glacier advance and negatively with the aerosol-level, stressing they do not relate to subaerial volcanism (**Figure 2**, **Figure 3**).

Since magmatic gases lack of Na^+ and K^+, both typical ions in sea water (Na^+: 10.770 ppm, K^+: 380 ppm) and in evaporate deposits, their significant occurrence may be explained by sea water—vaporization during submarine volcanism across the North Atlantic Volcanic Province, Mid-Atlantic Ridge, predominantly on the hot spot of the Greenland-Iceland-Faeroe Ridge [[16] **Table 2**]. Furthermore, submarine basalt spilitization by seawater accompanied by zeolite-mineralization (Na^+, Ca^{2+}), cannot play any role as K^+-source.

Both Spörer and Mauder Minimum positively correlate with ^{14}C-residuals. Increased values are interpreted by lower solar activity [1].

All temperature maxima (1.100-1.255, 1.350-1.460, 1.650-1.700, after 1.740 A.D.) coincide with aerosol maxima whose subaerial volcanic contribution may mainly relate to the North Atlantic Volcanic Province (**Figure 4**).

An outstanding volcanic event was the eruption of the Laki Fissure, Iceland in 1783 that produced a deadly ash and gas cloud (SO_2, HF, HCl, H_2S) migrating southward via North and Central Europe and brought extreme hazard on life conditions just shortly prior to the French Revolution (1789) [20].

4. Discussion of Interdepending Causes Relating to Climate Change

4.1. Solar Energy Variation

"Der Einfluss der solaren Strahlungsdichte ist von der Wissenschaft bis vor kurzem unterschätzt worden. Wenn wir der Sonne den Platz einräumen, der ihr gebührt, so heisst das nicht, dass wir uns unserer Verantwortung gegenüber GAIA entziehen. Das Wissen sollte uns bescheiden machen. Wir sind nicht einmal in der Lage das Wetter zu bestimmen, unsere Regentänze tragen wenig dazu bei, eine Dürreperiode zu beenden…. Wir wissen wenig über die Launen von Helios".

Table 2. Major sub-aerial and submarine volcanic events (874-1.896 A.D.) on/off Iceland [25].

Events	Remarks
Sub-aerial:	
874-930 A.D.	30 - 40 active volcanoes
1104	Hekla-Eruption (worst!)
1783	Laki-Fissure, 12 km^3, ~100 crater, hazy famine
Submarine	
1211	
1226	
1231	
1238	
1240	
1422	On Submarine Ridge southwest of Reykjanes
1583	Peninsula
1783	
1830	
1868	Off north coast of Iceland
1879	Off Reykjanes Peninsula
1896	Earthquakes and fire flashing on south coast

8000 yr B. P.: Strongest fissure eruption; Last 5000 yr: 200-300 volcanoes' formation; Past 11 Centuries: around 150 eruptions.

"The influence of solar radiation density has been recently underrated by science. If we grant the importance to the Sun it deserves, it does not mean we do neglect our responsibility to Gaia. Knowledge should make us unpretentious. We are just not in the position to direct the weather; our rain dances scarcely give contribution to terminate a drought… We do know rather little about Helios' caprices".

K.J. Hsu, 2000, Geologe und Klimaforscher [14] (Trans. Sch.).

In their critical and profound work [21] Hoyt and Schatten stress the major role of the Sun with special regard to natural climate change on Earth in time scales of decades and centuries as function of solar radiation density. The authors took the time-span prior to the beginning of the Industrial Revolution into focus, too, in order to avoid the influence of massive anthropogenic impact.

Accordingly, sun-induced climatic cycles comprise intervals of 8 a, 12 a, 18-23 a, 40-50 a, 80-92 a, and 300-334 a.

There do exists both positive and negative correlations of Sun Spots with global average temperature (W. Koppen cit. in [14] **Table 3**).

Besides this non-linear solar influx the Albedo-effect may play another important role in the Earth's surface-temperature discussion [17].

4.2. Solar Activity and Earth-Magnetism

In 1989 Canada was without electricity by an overload of national grid caused by

Table 3. Correlation of Sun Spot numbers and temperature [12].

Time-Span	Correlation
1600-1700	-
1720-1800	+
1800-1840	-
1840-1880	+
1880-1920	-
1920-1965	+

a strong solar outbreak [17]. Nowadays such sun eruptions disturb telegraphy, radar, satellite communication, GPS etc. if the Earth Magnetic Field would be too weak which is increasingly working.

The electromagnetic radiation of the Sun Wind is screened by the Earth magnetic Field and turned out via its magnetic poles. The magnetic poles of our planet continuously change their position as the magnetic field changes its intensity what happens 10^6 times faster as plate tectonic processes work (mm-cm/a) [17].

The intensity of the Earth Magnetic Field steadily decreases since records started some 150 yr ago showing a significant minimum across the Southwest Atlantic (**Figure 6**). Thereby, Earth might lose its bimodal magnetization approaching a reversal pole change recovered for all > 10,000 resp. Ma (15) (**Figure 5**).

These processes may challenge the question up to what intensity fauna and flora may be concerned. Is there any definite proof of such effects on climate, historical course, biological and psychic aspects? This is a challenge the scientific community is asked to deal with.

4.3. Changes in Earth-Sun Geometry

The Croll-Milankovitch hypothesis tells that the gravity attraction between Sun, Earth, and the other Planets (especially the Moon) generate three long term cyclical perturbations. If synchronized global climate is concerned [17]:

- Distance variation between Sun and Earth change the Solar Influx on Earth (period: 96.000 a).
- Change of obliquity of the Earth's axis varies on 21˚, 8˚ - 24˚, 4˚, at present about 23.5˚ (period: 40.000 a).
- The third cycle originates from the precession of the equinoxes, *i.e.* the manner in which the Earth "wobbles" as it spins on its axis. This cycle comprises another variation of distance between Earth and Sun once again changing the solar irradiance on the Earth's surface (period: 21.000 a).

4.4. Influence of Aerosols Predominantly Originated by Volcanism

Aerosols originate from magmatic gases like HCl, HF, H_2S and SO_2. Reacting with water of the atmosphere they produce the relating acids. Other atmospheric

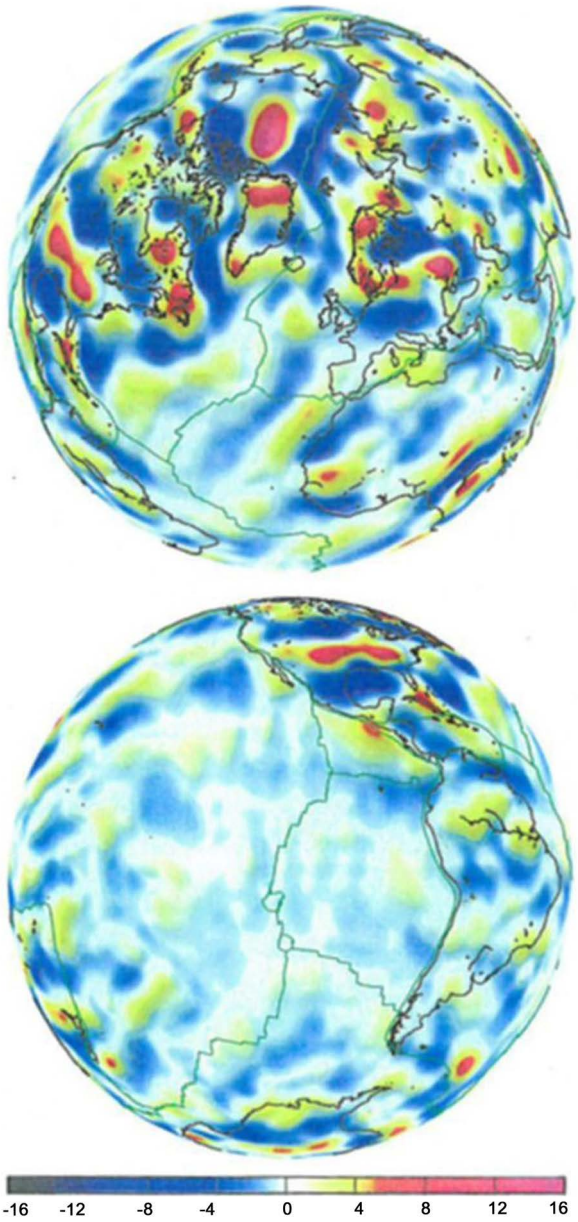

Figure 5. World Map of Magnetic Anomalies (Champ). Data in Nanotesla See magnetic high of the Lithosphere Field around the North Pole and weak magnetization of South America/Southwest Atlantic. Source: Earth-Magnetism. Auf der Spur der Wechselwirkungen-Helmholtz-Zentrum. Deutsches Geoforschungs-Zentrum Potsdam, 22nd ed., 2008, Potsdam.

aerosols are hygroscopic condensation nuclei as dust blown up from the Earth, volcanic ash, soot particles, sea salt ejected into air with air bubbles (0, 001 to over 10 μm in diameter) [17].

The publication of Siegl *et al.* [3] provides a profound insight into the climate-influencing role of subaerial volcanic output by filtering the sun-light that cause global temperature decrease with all climatic and anthropogenic consequences.

4.5. Plate Tectonics (Magmatism, Hotpots, Earth Quakes, Hydrothermalism, Heat Flow along Mid-Oceanic Ridges)

Regarding the climate data recovered from Greenland ice-core (GISP2) (see **Figure 3**), the question is whether Iceland located on the mid Atlantic Ridge (MAR) as Hot Spot [16], has had climatic influence on the adjacent land masses by its tremendous heat-flow (**Table 2**).

As part of the North Atlantic Province and as one of the largest hot spots on Earth, Iceland owns a diaper-cap of ~1000 km in diameter and a basaltic crust-thickness measuring ~20 km. The diapir and its MORB-source define the high level of Iceland as part of the Greenland-Faeroe Ridge (GIFR) situated on the MAR [16]. The MAR passed the Mantle-Diapir during Eocene (~40 Ma) where the GIFR developed by a low spreading rate (~1 cm/a) on both sides of the Rift Valley.

Up-doming of the Asthenosphere and crust-extension have been accompanied by MORB-Volcanism that initiated heat-flow, additionally strengthened by the Iceland Hot Spot-Activity [22].

Hydrothermally originated White Smokers (100˚C - 300˚C) and Black Smokers (~350˚C) are associated with the basaltic melt periodically effused along the rift axis by ~1.100˚C.

In general, on Mid-Oceanic Ridges an increased thermal gradient and conductive heat transfer generate in average a heat flow of ~100 mWatt/m^2 where some 21 km^3 of magmatic rocks are being crystallized per year [16] [23] [24].

Episodic lava production occurs through a time-span of some 10,000a followed by the next cycle of re-effusion along the subsequent dike-generation (magnetic stripe patterns).

Such "Heat Power Stations" located along the world-embracing system of Mid-Oceanic Ridges have had a tremendous impact on temperature, chemistry, and Oceanic Currents and thereby on climate implications, hitherto scarcely analyzed [15] [16] [17] [23] [24].

Own studies on the East Pacific Rise (13˚ - 21˚ South) reveal how hydrothermally precipitated metalliferous ooze is asymmetrically deposited some 40 km west of the EPR-Rift Valley (source area) by westerly directed oceanic currents [25], compare the contrasting sedimentary patterns around the Brine Deeps of the Red Sea Rift-System [26].

4.6. Oceanic Currents (Figure 6)

As part of the World-Oceans' connecting system of Oceanic Currents, the Gulf Stream/North Atlantic underlies the Coriolis-Effect moving clock-wise under thermohaline circulation and modifies the climate of the adjoining land masses with a warm/wet climate tendency [27]. Owning an effective capacity of 1.5 Petawatt (according to two Mio modern Atomic Power Stations) by a speed of ~2 m/sec, it has had an important influence on NW European Climate and on anthropogenic activities like Maritime Trade [2].

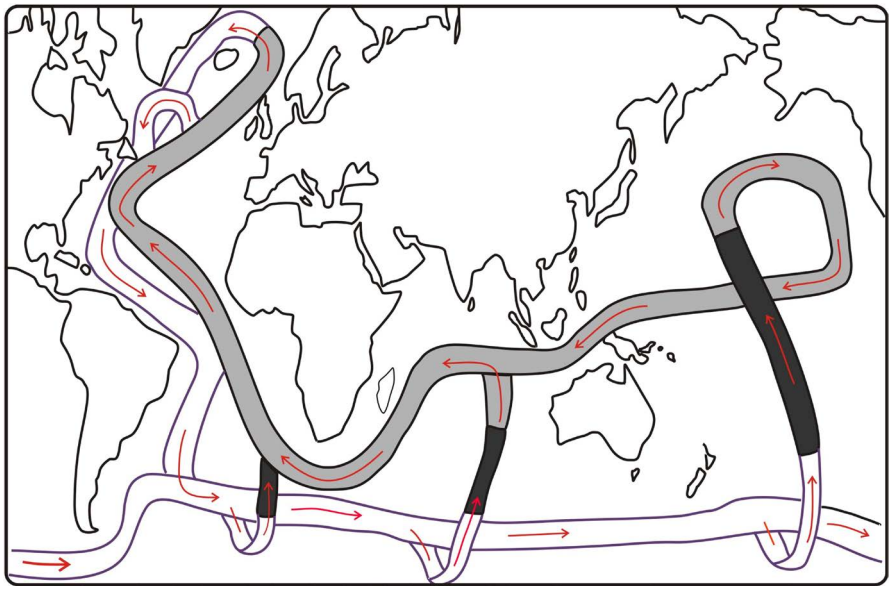

Figure 6. Oceanic Current belt: Warm surface current (grey), Antarctic Circumpolar current (white), intermediate waters (black). Source: Natural Environmental Research Council (Redrawn) [15].

The recent cooling of the Gulf Stream by melting glaciers of Greenland and the Arctic may initiate a climate change to being rather cool/ wet in NW-Europe. However the Albedo-effect caused by increasing surface of recently ice-uncovered basement rocks may regionally (North/Central Europe) originate high pressure areas owing a dry/warm climate.

4.7. Major Impacting

There is no hint on major impacts and related effects through the time-span concerned. However, let us keep in mind Hoyle's Comet [13].

5. Cultural Events Relating to Climate Change (Figure 8)

"Das Gehirn sucht nach Mustern im Chaos und will Konsistenz. Unsere Gehirne sind meisterhafte Erzähler. Sie verstehen es ausgezeichnet, sogar aus eklatanten Wiedersprüchen eine stimmige Geschichte zu spinnen. Mit Hilfe von Geschichten ergeben verwirrende Informationen einen Sinn. Das "ICH" ist so ein Märchen, eine vom Gehirn aus Zweck-Pragmatismus erfundene Fiktion".

"The brain focuses on patterns in chaos and wants consistence. Our brains are masters of narration. They are excellently endowed to tell coherent stories despite severe contradictions. Supported by stories confusing information finally makes sense. The "Ego" is such a fairy tale, a fiction invented by the brain because of object pragmatism".

David Eagleman, Neurologist, 2010 [5] (Trans. Sch.).

5.1. Peoples' Migration Period (260-550 A.D.)

This time-span owns a slight, but nevertheless, significant average temperature

decrease (ΔT = 1˚C - 1.5˚C) and a rise of precipitation throughout Europe that resulted in wet-cold summers [2] (**Figure 7**). Bad harvests, increasing famine, predominantly in Northern Europe, led finally to a progressive migration of Germanic People (*i.e.* Goths) from north to south while the Huns invaded to Central Europe from Central Asia (~375). Both Peoples threatened the Roman Empire.

Precursors of global cooling already appeared in Central Asia during the 1st/2nd Century. However, in contrast to Europe, windy summers developed to being dry-cold that led to barren conditions of Central China's "Dust Bowl" [13]. Like in Northern Europe, peoples therefore, escaped towards South/Southwest by reasons of snowfall in summer, frozen Yangtze River, famine etc.

Under pressure and assault of the migrating Goths, Burgundians, Swebians, Vandals, and Lombardians the Roman Empire fell in disorder during the 5th Century caused by lack of food, stress, pandemies and power [28].

There is obviously no plausible theory from historical side to explain Peoples' Migration versus natural hazards (climate change, volcanic events). Indeed a strong volcanic outbreak occurred on 535 that prevented grape-harvesting across the Mediterranean. Furthermore, a Comet crossed the Earth's Orbit and might have had relating impact effects around ~500 [12] [13].

The Near/Middle East provided cool-dry summers that, in turn, caused bad harvests followed by the decline of the pre-Islamic Empires through Arabia until ~600. The beginning water problems during the first Century at Petra, Jordan

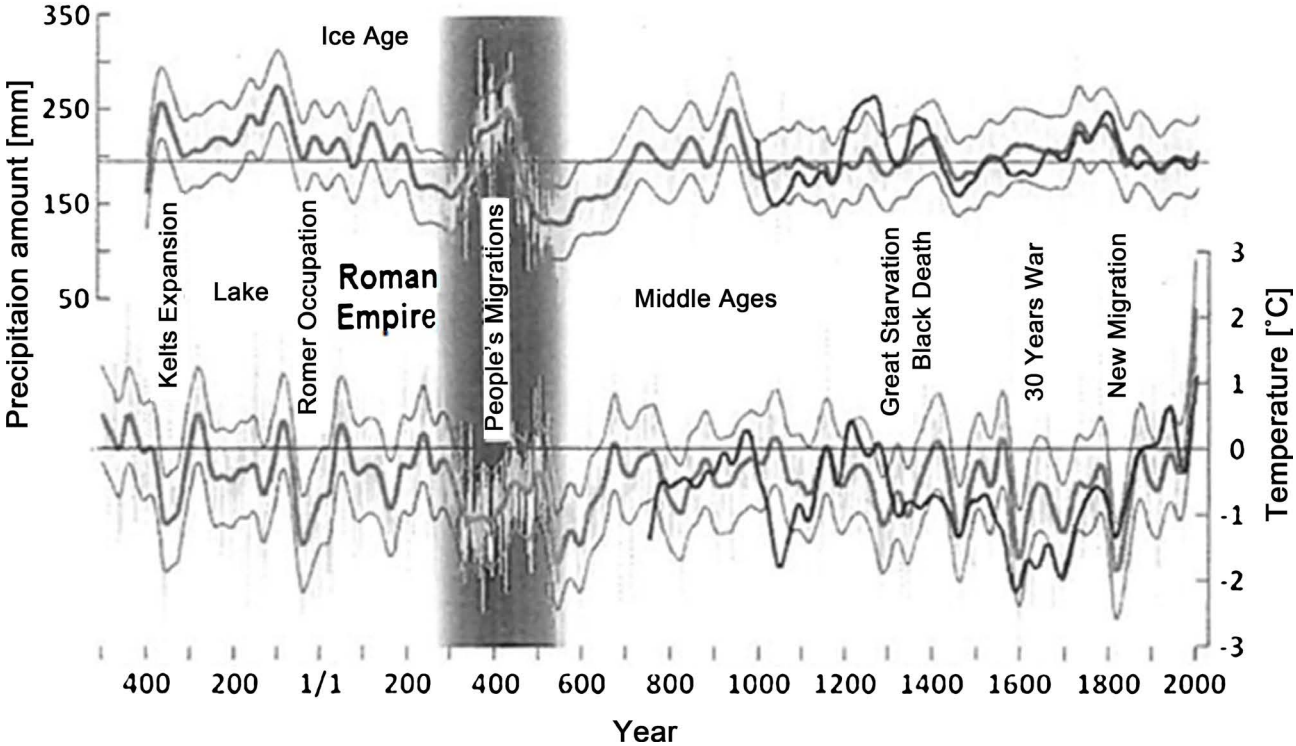

Figure 7. Climate variability (precipitation, temperature) and political/social events for the time span 400 until recent. See significant patterns during Peoples' Migration [8].

initiated, in connection with the Roman occupation, the end of the Nabatean Culture along the Caravan Route Damascus—Mecca/Medina [28].

5.2. Climate Optimum after Peoples' Migration (600-1.100 A.D.) including RCC 5 (750-950 A.D.)

Since the beginning of the 7th Century, the climate of the Northern Hemisphere favorably developed for agricultural ecosystems as well as for cultural/social growth due to an adjustment of a stable combined Atmosphere/Ocean System [2] (**Figure 8**).

Thus, the Merowingers, Franconians, Magyarians, Normanians, and Anglo-saxians spread out by growing population and established their Empires [28]. A sequence of interrelating/interdepending "Effect-Chains" can be recognized as: good climate conditions → rich harvests → satisfying nourishment → health, encouragement → overpopulation under excellent conditions → increasing stress → lack of food → migration. The latter appears in contrast to the migration character of the Germanic tribes from poor climate conditions during Peoples' Migration.

Whether subaerial volcanism and/or the Eldgja-outbreak (875-935 A.D.) on

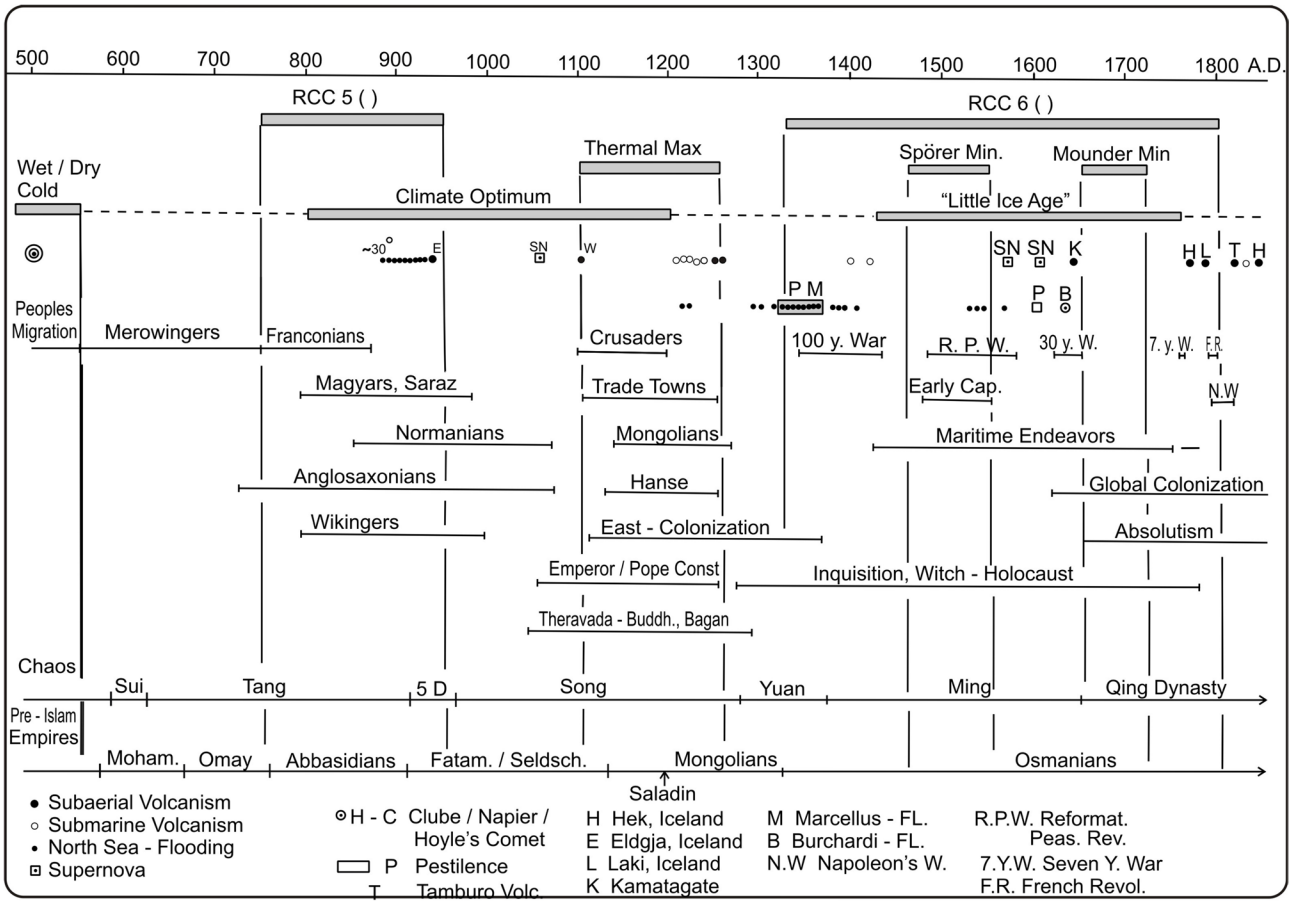

Figure 8. Correlation of Climate Variability and other natural processes (*i.e.* volcanism) with Historical Events from the 3rd until 18th Century in Europe, China, and the Near/Middle East.

Iceland may had forced the end of the Franconian Empire or influenced by its subsequent effects (ash cloud filtering solar influx), may be open [22] as well as the role of the Supernova of 1054 [29] coinciding more or less with the fall of both Normanian and Anglosaxion Empires [28].

Fulminant flourishing Theravada-Buddhism in Asia, mainly at Bagan, Myanmar surprisingly started during the time of this Supernova. Contemporaneously the Emperor/Pope-Constellation in Europe, the Islam-Invasion to North Africa and to southwest Europe took place [28] [30].

The Islam-Era began with Prophet Mohammed (570-632 A.D.) and his followers. They occupied Egypt, Libya, Syria and Iraq and destroyed the Sassanid Empire. The Omayyad (Damascus) conquered the Indian and Iberian Peninsulas [28]. Within one century after Mohammed's death the Arab Empire had been growing up to the largest Empire west of China.

Sufism, a stream of Islamic Mysticism, massively arose during the second half of the 9th Century across the Near/Middle East and later found its way to Spain (Kalifat Cordoba) and to the European Principality Houses [31] [32] [33] [34].

Dependent on ethnic and cultural conditions Sufism spread out between Spain and Afghanistan and modified itself under the influence of Jews, Taoists, and Nestorians (Christians) along the Silk Road.

Sufism still globally works and has been excellently introduced to Western Countries by Idries Shah, co-founder of the Club of Rome, including NASRUDIN'S Stories for teaching Derwishes [33] [34].

Syncretism grew up along the Silk Road during the Tang Dynasty (618-907 A.D.) where peoples and traders of diverse Ethnics and Religions met for a vivid exchange of wares, ideas, philosophy, religion and poetry, *i.e.* at Kashgar, Dunhuang, Kucha, Turfan etc. [35]. Economic growth, irrigation improvement, agricultural land distribution for local farmers led to a constructive development under favorable climatic conditions.

Nevertheless, the final stage of the Tang D. surprisingly exposes chaotic and destructive conditions introducing to the so-called 5 Dynasties and 10 Empires (907-960). This period correlates with a series of volcanic events on Iceland (875-935), possibly causing temperature fall by ash clouds filtering solar influx and initiating cold-dry conditions [see 3].

In the modern climate records [1] the RCC 5-period appears as less outstanding, but of global scale telecommunication, rather weak winds over the Atlantic and Sahara, slight change in solar output, and little CO_2-increase.

During this time-span wood-cutting and agriculture grew up. Estimation tells that during the Middle Ages ~200 tons of CO_2 had been originated [2].

5.3. Thermal Maximum (1.100-1.260 A.D.)

A high number of Sun Spots and strong Volcanic Activity (aerosols) including the most violent Hekla-Eruption in historical times (1104), as well as a series of submarine eruptions off Reykyanes Peninsula, Iceland (**Table 2**) underline the

scenery of temperature rise (Figure 2).

Concerning Europe and adjacent regions, the following historical events occurred more or less contemporaneously within the short time-span of 160 years (Figure 8).

- Crusader activities on the way and in the "Holy Land" (1.096-1.228 A.D.).
- Hanse Towns Endeavors (1.150-1.250-1.282 A.D.).
- East Colonization (since 12th Century until 1.360).
- Continuation of the Pope-Emperor Constellation (1.153-1.250 A.D.).
- Mongolians' Invasion (1.135-1.241 A.D.).
- Shifting of Castles/Principality Buildings from Low Lands to elevated areas (convenient climate)

According to the above mentioned "Effect Chain", Asia progressively recorded a wide-spread expansion of desert peoples. The long-lasting Song D., China fell into ruin at the end of the Thermal Maximum caused by bad harvests after temperature decline. Buddhism continued to flourish in SE-Asia (Bagan, Myanmar).

At the beginning of the Thermal Maximum, the Near/Middle East brought the fall of the Seldschukian Empire by the Mongolians and later the replacement of the latter by the arising Osmanians (since 1317).

The total time-span following (1.260-1.800 A.D.) comprises the so-called "Little Ice-Age".

5.4. Transitional Period (1.260-1.460 A.D.)

Owning less Sun Spots, the first hundred years of this period expose a relatively abrupt temperature fall in Europe whereas the second half was somewhat warmer. Amidst this time-span started RCC 6 (1350) accompanied by strong Hot Spot-activities on Iceland by forming a new Island [22].

Outstanding events through this transitional period were:

- -Overwhelming North Sea High-Tide Floods since 1285 including one of the most deadly one: "Mandtränke" (19, Table 1) (Figure 9, Figure 10).
- -Pestilence epidemics (1.320-1.355 A.D.) when one third of the European population died.
- -100 years' War between France and England (1.340-1440 A.D.) [30].
- -Inquisition of the Catholic Church since 1562 when laws for their protection were published against Heresy after intra-ecclesiastical discussion with rebellious believers. Organized torture application became a common method. Merely the Pope was responsible in cases of Inquisition working under strong secrecy and illegality [36].
- -End of all activities that occurred during the Thermal Maximum except East-Colonization.

The Mongolians installed the Yuan D. in Asia when falling temperatures caused bad life condition, social suppression, peasant revolts [14] [28] coinciding with the beginning of RCC 6. The Ming D. followed on the Yuan D. after warming up.

Figure 9. "STICH" of the Burchardi-Flood, 1634. West Coast of Schleswig-Holstein, North Sea. Contemporary representation, from: [18].

The Osmanians set an end to the Mongolian invasion in the Near/Middle East 1317 continuing to establish their huge Empire.

5.5. Spörer Minimum (146-1.550 A.D.)

Lack of sun spots, continuous North Sea-Flooding, aerosol minima (less volcanic activity), and temperature decrease ($\Delta T = 1.5^{\circ}C/a$ in England) with glacier advance in Europe characterize this time-span. Extremely bad agricultural conditions provided poor harvests, famine, social and religious tension and revolts [28] [30]:

- Peasant revolts in Europe (1525).
- Reformation of Christianity by Luther (1517).
- Witch Persecution [36]: As basic instructive work served the book "Malleus Maleficarium" published in 1486 for witchcraft processes that began during the 2nd half of the 15th Century and continued with varying intensity until 1775 (combustion of the last woman). Most of these women were mid-wife's, experienced in herbal healing superior to men and medical scholars and the scholastic World [36].

Figure 10. Map of the West Coast of Schleswig-Holstein, North Sea after the Burchardi-Flood of 1634, drawn by Johannes Mejer 1651, from: [18].

There does exist no written hand downs of the Catholic Church but estimations tell of several millions of victims (90% women) [36]. For being accused as a witch the following motives were sufficient: accused by neighbors without definite reason, business competition, jealousy, envy, refused affection, good education. Authorities gained the inheritance of rich people and single women (murder with robbery).

The term "Holocaustum" (Greek/Latin) = Extensive combustion, Brandopfer suits to the cruelties that happened throughout the time of Renaissance and Humanism in the barren wet-cold climate period of the so-called "Little Ice Age" in Europe.

1) Large-scale destruction, esp. Human lives by fire, see: Oxford Advanced Dictionary of Current English. Revised, updated (A.S. Horn-by with A.P Cowie)—Oxford University Press, Oxford, 1974.

Generally there is evidence of:

- Rise of Early Capitalism since end of the 15th Century.
- Maritime endeavors, global migration and increasing trade, predominantly by Spain and Portugal to be interpreted as a hopeful option versus the hazardous regional life conditions in parts of Europe (**Table 4**) [6].

During the Ming D. ice and snow in summer caused peasant revolts especially in the famine years 1.458, 1.465, 1.467, 1.478, 1.479, 1.483-1.504, 1.506-1.521 A.D. accompanied by cannibalism [14].

In the Near/Middle East where the climate was rather moderate across the Mediterranean/Levant, the Osman Empire extended westward to the most important Empire in the world. Under Suleyman (1.520-1.566 A.D.) it covered parts of Europe, Near/Middle East, and North Africa and had influence on military/political trends in Central Europe [28].

Table 4. Marine endeavors and voyages through the time span of the "Little Ice Age" (1250-1800) [27].

Navigators, Time	Destination
1405-1433, Zheng He Ming D., China)	India, Arabian Peninsula, Sri Lanka, East Africa
1405-1433, Portuguese	Africa
1451-1506, Columbus, Spain	Central America
1497/98, Cabot, England	North America
1460-1527, Vasco da Gama, Portuguese	India
1519, Magellan, Portuguese	India, South China Sea, Southwest Asia
1520, Verrazano, Italy	Atlantic Route
1532/33, Pizarro, Spain	South America
1584/86/88 Englishmen	East-coast North America
1602-1949 Netherland	Indonesia
1577-1580, F. Drake, Englishman	Around the Globe
1585-1587, J. Davis, Englishman	Arctis, Sea-Route to China

5.6. Spörer/Maunder Transitional Interval (1.550-1.650 A.D.)

This interval owns a slight temperature rise positively correlating with aerosols (volcanism) and with sun spots. Two Super Novas appeared in 1572 and in 1604 [29]. North Sea High-Tide Flooding continued accompanied by the Burchardi-Flood (1634) that provided the topographic frame-work of the modern coast-line (**Table 1**, **Figure 9**, **Figure 10**). The Komagatake-eruption occurred in 1641. Intensive rain and vermin plagues caused spoiled harvests throughout 1.619-1.627 A.D. [19].

Maritime Endeavors continued (**Table 4**) followed by increasing Colonization of the world by Western Empires since 1615 as option versus the desperate situation in Europe [28].

The 30 Years-War (1.618-1.648 A.D.) firstly developed as a religious war between Catholics and Protestants [28]. In its second phase European Empires raised political/territorial claims that brought destruction, chaos, famine and death over millions of people when France finally controlled Central Europe (Peace Agreement of Westfalia). The political/social scenario of this time-span was realistically reworked *i.e.* by Schiller's classic work "Wallenstein" [37] and in the modern novel "Tyll" by Kehlmann [38].

Witch-processing/combustion continued with an absolute climax through 1589-1631 during the time of "Re-Catholization" (since 1570) with an outstanding excess at Würzburg (1.627-1.629 A.D.) where mainly well-educated citizens and children became victims [36].

In China summer snow and ice (1.578-1.598 A.D.) caused agricultural, social, political chaos and death until the end of Ming D. The last King Emperor committed suicide on the Coal Hill of the "Forbidden Town" in Beijing (1644) when revolting peasants assaulted the Emperor Palace during the Manschu-Invasion (Qing D.) [14] [28].

In the Near/Middle East the Osman Empire, furthermore, enjoyed obviously better climatic conditions, and expanded under Suleiman over the Mediterranean [28].

5.7. Maunder Minimum (1.650-1.720 A.D.)

Like the Spörer Minimum, this period is also characterized by an Aerosol-Minimum (less volcanism) and missing Sun Spots, however introduced by the Komagatake-Eruption (38). North Sea-Flooding decreased. Absolutism dominated Europe after the 30 Years-War [28].

Inquisition and witch processes ended during the second half of this time-span [36]. Highly evident is the migration of Europeans to the New England States, North America due to unemployment, lack of food, fast price growth and high population which are mostly economic reasons in their homelands [28].

The Qing D. arose in China at the end of the Spörer-Minimum under chaotic conditions.

Obviously recognizing the favorable situation, the Britain's opened a Trade Office at Guangzhou, China (1685), found access to several harbors (1793) and started their opium-trade that led to the Qing-Policy of "Closed Doors". The Portuguese occupied Macao [28].

The Osmanians continued their expansion in the Mediterranean and in North Africa [28].

5.8. Post-Maunder Minimum (1.720-1.800 A.D.)

Convenient average temperatures, a balanced distribution of precipitation/ temperature-ratio through the vegetation period, regular periods of Sun Spots, a distinct aerosol maximum mainly caused by Iceland-Volcanism (Laki, Hekla), and less North Sea-Flooding provided the natural background for the developing societies underlined by the RCC 6-Period.

As cultural/ political events/currents resulted the rise of Preussen as World Empire, Absolutism, Europeans Age of Enlightenment, growth of citizenship, beginning of the Industrial Revolution in England (1761), Seven Years-War between France and England by colonization animosities in North America (1.756-1.763 A.D.), Napoleon's wars (1.792-1.815 A.D.), and the French Revolution (1.798-1.799 A.D.).

In China the Qing D. continued until 1911 while the Osman Empire found its end with the Sykes-Picot Agreement in 1916.

An excellent example for natural → cultural/political dependence represents the Laki-Fissure-Outbreak, Iceland in 1783/1784 [3] [20] [22]. Ash and gas clouds (HCl, HF, SO_2) spread out over Northwest and Central Europe. Studies by English Historians verify characteristic volcanic features like thick dry acidic fog darkening parts of Europe over months, stop of maritime trade, hail hazards, cold winters and strong storms never experienced before [20].

Social consequences revealed high rates of sick/dead people, poor/missing harvests, extinction of whole villages, 8000 people died during winter-flooding along the English North Sea Coast.

As historians tell this event was simply forgotten and replaced. Some 100 new craters originated then along the Laki-Fissure. The total amount of explosive and effusive products amounts up to 300 Million m^3. Blue fog dominated Iceland's atmosphere and poisoned half of the cattle, 3/4 of the sheep and 20% of the population died by famine and disease (1.783-1.786 A.D.). There was an enormous harvest loss across Europe. Ash clouds filtered sun light even after years. Cold winters and cold summers had their effects on global scale for years [20].

The French Revolution (1.789-1.799 A.D.) immediately followed the Laki-Event. French historical publications (from 1789), indeed mention evidence of financial crises, governmental indebtedness, destructive economy, bad harvests, revolts against growing trouble, high prices for bread and increased living expenses [28]. However, no hints are given in that publication on background data and causes, but they tell that the French Revolution, as part of effect-chain

facts, provided the basics for Napoleon's Wars.

With the Industrial Revolution (2nd half of the 18th Century) started an open time-span (Anthropocene: not definitely fixed) when human behavior massively provided environmental/climatic influence on global scale and let abruptly decrease the index of natural/anthropogenic impact-ratio (see *i.e.* [2]).

6. Conclusions

"Es ist höchste Zeit eine ernsthafte Diskussion draüber zu führen, woher die 95% Konfidenzgrenze kommt (ob der Wissenschaftler von einem Kausalzusammenhang sprechen und Massnahmen empfehlen). Und ob sie in der heutigen, fast kritiklosen Anwendung sinnvoll ist. Sie stellt eine hohe Hürde für eine bestimmte Art von Fehlern dar. Aber in unserem Essay zeigen wir, dass sie viele andere Arten von Fehlern eben nicht verhindert".

"It is high time to perform a sincere discussion on: from where from the 95% Confidence Line originates (If scientists accept a causal coherence and recommend undertaking steps!). And whether it appears meaningful as being applied nowadays in an almost uncritical way? It represents a high hindrance for a special sort of mistakes. But we show in our Essay that it cannot prevent many other kinds of mistakes".

Naomi Oreskes, Geologist, Science Historian, 2015 [4] (Trans. Sch.).

"Hinzu kommt, dass wir in weiten Teilen eine unzureichende Wissenschaft und eine gefährliche Politik haben, obwohl die 95% Konfidenzgrenze allgemein anerkannt ist".

"Furthermore, across extended fields we have an insufficient Science and dangerous Policy though the 95% Confidence Line is commonly accepted".

Eric M. Conway, Wissenschafts-und Technikhistoriker, 2015 [39] (Trans. Sc.,).

Though some interrelations among climatic factors are discussed in this paper, its focus is definitely directed on the climatic → culture dependence. The time-span regarded represents a cyclicity of alternating constructive and destructive Climatic/Historical phases whereby the average temperature change of $\Delta T = 1^{\circ}C/year - 2^{\circ}C/year$ is one of the most important key-parameters [2].

Furthermore, there is no doubt that cultural/political achievements given during more or less longer constructive periods, may be strong enough to have significant influence on the following period despite climatic challenge. However, culture remains a plaything of climate.

Thus, the following climate/cultural patterns may be distinguished.

6.1. Climate Change to Wet/Cold Conditions

Typical examples for this trend are represented by the time-span of Peoples' Migration (200-600 A.D.) and the "Little Ice Age" (1.250-1750 A.D.), the latter intercalated by two cold intervals affecting both Asia and Europe.

Features generally reveal the Effect-Chain: bad agricultural conditions →

poor/no harvests → prices' increase → famine → disease, growing death rates → social/political dissatisfaction → revolts, wars → human cruelties with psychic/religious background (Inquisition, Witch Combustion) → general chaos → migration (Maritime Endeavors, Colonization).

6.2. Climate Change to Dry/Cold Conditions

This is the Asian Analogy to Europe revealing the same patterns (including cannibalism) under the formation of a "Cold Drought" (Chinese "Dust Bowl") throughout both two time spans [12] above cited.

6.3. Climate Optimum (600-1.100 A.D.), a Constructive Period

Balanced temperature/precipitation-ratio through seasons provides favorable agricultural condition for rich harvests, growth of Culture showing less stress situations, general satisfaction, and good time for wise political leaders except the time span 907-960 when strong volcanic activity (Iceland) might has had destructive influence caused by migrating ash clouds filtering solar influx thereby initiating temperature decrease [see 6.1, 6.2].

6.4. Thermal Maximum (1.100-1.250 A.D.), Lemminge-Model

Under the ideal climate conditions during the Climate Optimum (600-1100) the societies grew up and culminated regionally to wealth and over-population.

Thus, the peoples—coming out from convenient living conditions—were more or less confronted with the following change under increasing temperatures: balanced growth → overpopulation → food deficit → rising unemployment → general dissatisfaction → higher prices → bimodal distribution of wealth → revolts, wars → ideological tension of world religions (*i.e.* crusading) → migration, colonization → aggressive trade endeavors.

According to the laws of thermodynamics [17], higher temperatures implies higher availability of energy to be compensated either by physical activities (*i.e.* wars, colonization, adventures) or by psychical activities (*i.e.* fulminant rise of Buddhism at Bagan, Myanmar, animosities among World religions).

6.5. Extreme Hot Droughts

This phenomenon seems less relevant for the time span and regions regarded, possibly except in the Near/Middle East and only for short intervals.

6.6. Volcanic Events

According to Sigl *et al.* [3] and others [13] [39] volcanic ash and gas clouds play an important role in climate change [14] and political/economic/cultural stress through years, decades and even centuries.

The cyclicity of magma-effusion and eruption (~10.000 a) of the Greenland-Iceland-Faeroe-Hot Spot has been hitherto poorly discussed (**Figure 4**) and very probably may play an important role in the Northern Hemisphere heat

flow-scenery since Tertiary [16].

6.7. Major Impacts, Super Novae and Comets

Major impacts do not play any major role throughout the region and during the analyzed time span.

Whether Super Novae mentioned in this paper had really influence on religious/spiritual changes (Rising Buddhism at Bagan, rising Osman Empire) is actually open, although coincidences do exist.

As cited and currently discussed in a former paper [10], (see also **Figure 1**) in this paper, a comet has had repeatedly crossed the Earth's orbit since 14,300 yr cal. B.P. [11] [12].

Its rendezvous with Earth coincidences with some climatic and other natural events (*i.e.* Volcanism) as well as with Rise and Fall of Cultures throughout Holocene; the next meeting is to be expected on 2100 A.D. (**Figure 1**).

The authors postulate that such "Rare Events" may also have had spiritual influence on the "Origin of Religions" [12] resp. on the spiritual psychic state of human beings as well [11]. They tell that in times of hazards dark depressive and destructive processes occur in cultures concerned while in intervals of climatic optimum and well balanced conditions positive constructive processes would develop.

If so, human cruelties during peoples' migration (see Hoyle's Comet 8 in **Figure 1**) and during the "Little Ice Age" (Inquisition, Witch Holocaust) represent such depressive times pans while the Climate Optimum brought out constructive and culture-supporting evidence.

Curiously enough, historical representations, lack in most cases of background information on environmental and climatic causes/conditions (*i.e.* Peoples' Migration) as well as missing hints on volcanic events (Laki, Iceland → French Revolution) and on "Rare Events" (Major impacts) though such natural processes, as influencing factors, have been massively discussed since half a century (see references).

7. Closing Statement

"Thinking, truth may be, seems sufficient. Come along; let us settle where the rose is blooming"

Richard Burton (19th C.), British Sufi, From: Idries Shah: Die Sufis [31].

Acknowledgements

The World Atlas of History was a very valuable help [28] to the authors.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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