Protection of the ocean from climate-induced euxinia

Franz Dietrich Oeste a, Renaud de Richter b, Tingzhen Ming c

a) gM-Ingenieurbüro, Tannenweg 2, D-35274 Kirchhain, Germany, oeste@gm-ingenieurbuero.com; b) Tour-Solaire.fr, 8 Impasse des Papillons, 34090 Montpellier, France, renaud.derichter@solar-tower.org.uk c) School of Civil Engineering and Architecture, Wuhan University of Technology, No. 122, Luoshi Road, Wuhan, 430070, P. R. China. tzming@whut.edu.cn

Problem/Question

Polar ice caps and permafrost are reservoirs of fertilizers and of organic litter. Rapid climate warming events accompanied by increased precipitation mobilize ice and permafrost thawing 16) 17), iceberg drift and former perma-frozen soil. The generated mixtures of melt water, molten soil, mud and plant litter, supply an increased water run-off with high loads of organics and minerals.

Hypothesis/Facts

This provides vast ocean regions with layers of nutrient-rich fresh water spread on their surface (Fig. 1). The stratification effect of these layer-provided regions16) interrupts O2 and CO2 transport from the ocean surface to the bottom. The fertilizer input on the surface layer generating the phytoplankton eutrophies it. This increases the rain of debris and organic litter into the deep ocean.

Currently, worldwide decreasing O2 content in the oceans19) 20) 21) is a result of melt-induced O2 decrease and fertilizer input. In addition, NOx emissions increase 22) and soil run-off from agricultural and excavation land use, causes man-made increased flux of fertilizing substances.

Project presentation/Findings

According to the worst case this may end in depletion of the oxidants O2, nitrate, iron(III), sulfate and CO2 below the fresh water surface barrier and will spread a toxic environment containing H2S, CH4 and N2O 1) 2) 3) 8) 10) 12). In addition the CH4 and N2O GHGs might bubble into the atmosphere and further increase the GHG warming effect.

Variables/Research

During the climate warming event, the velocity increase of the temperature influences the extent of other events, such as the expansion of the ice cap melting and of melting permafrost regions and further changes like the topography of the ocean currents. Two serious examples of past warming events after extended glacial periods are well known: both catastrophic mass extinctions at the Ordovician end 4) 5) and the Permian end 6) 7) 8) 11) 12) had been caused by the warming events after glaciation ends.

Much less problems have been caused by several climate warmings which induced moderate melting events between glacial and interglacial epochs during the last Ice Age (Fig. 2). The mildness of these events might have been due to smaller extension of ice cap melting and permafrost melting.

Table 1

Main properties of an ideal climate engineering method

- GHGs depletion or removal: CO2, CH4, N2O, tropospheric O3, chlorinated and perfluorinated carbons, SF6, NF3, VOCs...
- 2 Depletion of black and brown carbon and HULIS aerosols
- 3 Cloud albedo increase by generation of scattering CCN
- 4 Avoiding health risks and ecosystems damages
- 5 The CE method can be run at lowest costs, investments and expenses
- 6 Is only needed for short period, can be stopped quickly, reversibility is fast

Figure 1

Stratified Ocean surface during an ice and permafrost melt event modified from 4)



Figure 2

Idealized sequence part of the glacial climate interruptions by warm interglacials during the last ice age 15) 23)







Results

The current starting climate warming induced melt event will induce stratified ocean regions16). But current melt might induce stronger eutrophication than last ice age melts because several conditions changed: the current melt run-offs are accompanied by man-made fertilizer and organic litter input from man-made sources. Accordingly, higher specific O2 deficiencies will develop.

Recently O2 depleted regions and signs of a vertical ocean current decrease had been detected 9) 13) 14).

On our globe, with further increasing population, this manmade induced climate heat ocean stratifying experiment must be stopped before it is too late: anoxia and euxinia would destroy huge parts of the essential ocean food base. => Absolute need for an efficient and sustainable CE method.

Conclusions

Among the known CE methods, the Iron Salt Aerosol method (ISA method)18) satisfies and fulfils most of the criteria of table , excepted the depletion or removal of some of the minor GHGs.

BIGING PALACE methods, the ISA method 18) is the most economic.

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