

Feedbacks in the World Climate Supercirculation and Their Interacts

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Абстракт

Энэ бүтээлд Дэлхийн ерөнхий уур амьсгалд шийдвэрлэх нөлөө үзүүлдэг зарим гол эргэх холбоонуудыг шинээр тодруулж, тэдгээрийн хоорондын харилцан үйлчлэл, механизмийг тодорхойлсон болно.

Introduction

In course of the latest 50 years the global average temperature increases strongly by human activities in result of which ice-sheet of polar region, permanent snow of high land melt, and sea level increases. So, many cities, agricultural regions of coast margins are faced with climatic or water hazards. Therefore, the steering of the warming, its stabilization in a fix level, mitigation, and controlling are present most critical problem of mankind. The successful solution of these complex problems depends how the present scientific concept and public

understanding of climate change, glaciation, and climate fluctuation. The problems connecting the climate change are well studied, and born multitude theories, but these have remained insolubly until present.

I like to cite from book of Brian, S.J., [1979] wrote: "One of the critical problems of Earth Science is to determine exactly the many feedback mechanisms, chain reactions, their interactions, limitation of each other, to reveal the trigger mechanism and reason of the long-term existence".

So, in this paper I attempt to determine some main feedbacks and their interactions.

Feedbacks


The feedbacks are necessary to steer the self-excited process of World Climate Supercirculation (WCS), to confine and stabilize the chain reactions. There are some main feedbacks:

Insolation-Cloudiness ¹ ,	Figure 1,
Ice/snow-Albedo ¹ ,	Figure 2,
Insolation-Water Vapor,	Figure 3,
Insolation-Evaporation,	Figure 4,
Insolation-Albedo ¹ ,	Figure 5,
Isotherms of heliogeothermosphere-Global average temperature of planet,	Figure 6,
Glaciation-Cooling,	Figure 7,
Mass flow in Crust-Permafrost,	Figure 8,

Terrain height-Cooling,
Volcanic activity-Warming,
Cooling-Precipitation,

Figure 9,
Figure 10,
Figure 11

Ratio of areas between Continent and World Ocean, so
¹ by Houghton, J.T., [1987]

 Houghton, J.T., [1987] wrote: "Interaction in climate system is characterized by many feedbacks. Some of these are strengthened the oscillations of the internal system (positive feedbacks) and others are weakened them (negative feedbacks). We adduce some examples of simple feedbacks:

1. Ice-Albedo feedback. Surface of ice and snow reflect practically all the incoming solar radiation which throws into further cooling of surface. When the snow cover and ice sheets melts, the albedodiminishes, consequently, development of solar radiation absorption of the earth surface or water contributes to melt (positive feedback),

2. Water vapor-Insolation. Increasing of the surface temperature drives to gain the water vapor content, and since water vapor keeps off infrared radiation, therefore, the future increasing of surface temperature takes place. (positive feedback).


3. Cloudiness-Insolation feedback: Increasing of the surface temperature leads to strengthen the water vapor content of atmosphere, therefore, to gain the cloudiness by increasing of the


cloudiness decreases the solar radiation falling to earth surface. It drives to fall the surface temperature (negative feedback).

..Must be clear, of course, that increasing processes and feedbacks in the climate system appear very complicated. So, any process does not to be separately. Global stability of climate system as we know, must be results of interaction of all the internal processes, which are not studied completely by us“

The energy of the Sun is changed by impacts of all the physical, chemical processes of the Sun. This change is sensed on the upper atmosphere of the Earth, for example, ionosphere of the Earth intensifies during solar activity. But the falling solar radiation across the atmosphere to earth surface is less than on upper atmosphere by intervals of electromagnetic wave, and its intensities. During the solar activity the ionization process increases in the ionospheric layers and at the earth surface also at some intervals of electromagnetic wave. Nevertheless, insolation-cloudiness can play the decisive role for existence of the Earth's climate oscillation and biosphere. This feedback is the cause for the beginning, formation, and finishing of the glaciation, as feedback in ratio between the areas of Ocean-Continent, which is described in the following section i.e. when the incoming insolation increases, since the evaporation, cloudiness gain too, but as result, the earth surface is restricted from solar radiation, so, cooling follows near the surface, as

well glaciation. Cloudiness is a blanket which protects living on the Earth from losing heat too rapidly to the space beyond the atmosphere and incoming of excess. For a long time, this process the glaciation has not additional precipitation resource, the cloudiness decreases, then the solar radiation falls directly to earth surface, the glaciation is exterminated. (Figure 3) In the result of insolation-cloudiness feedback, firstly, the incoming solar radiation and temperature are limited or stabilized in a constant level. So, biosphere, geospheres, geographical objects and Earth's thermal field defend from diverse cosmic hazards (Figure 1), secondly, this feedback is a thermoregulator which plays main role for stabilization of the Earth's surface thermal regime in a certain level.

 Yasmanov, A., [1985] wrote: "In tropic regions with large cloudiness the summer average temperature is lower than arid, semiarid zone"

 Brooks, C.E.P., [1949] has determined: "If average cloudiness equals 0.1 (Present value is 0.5) the main temperature of planet decreases by 10%".

The geographical relief is changed constantly during the Earth evolution history, but it is held from a period of WCS to other. It plays main role to form the trade wind, evaporation and precipitation regimes. Furthermore, relief changes the altitude of sun on a given point of surface and is linked with the isotherms of low temperature of heliogeothermosphere. Thus, it impacts strongly to the

climate particularly, is existed the geographical altitude-isotherms of heliogeothermosphere feedback (Terrain height- Cooling feedback) which is strengthened the glacial stage. The relief is not only delivered from a period

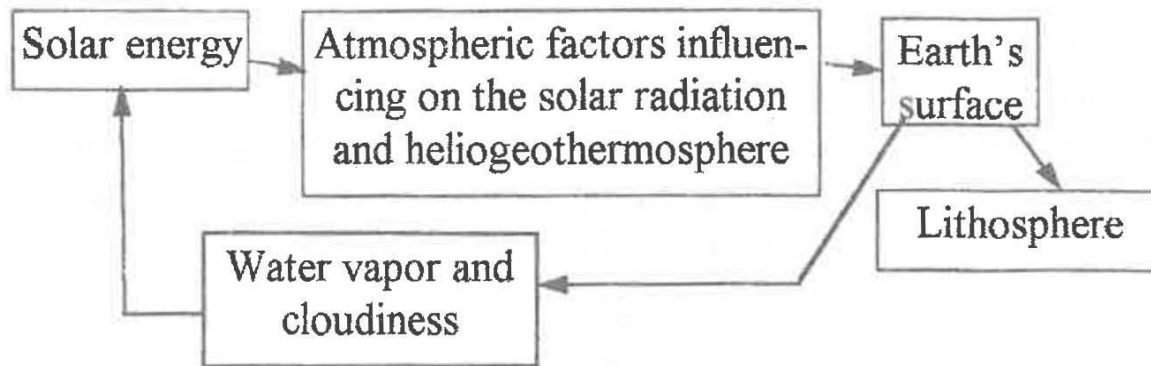


Figure 1. Negative feedback of solar radiation-cloudiness to other, but its impact always in every stage of WCS. (Figure 9)

The albedo-glaciation feedback plays decisive role for delivering to the glacial epoch. At the polar region solar ray falls by 0° - $43^{\circ}54'$, on the other hand, dry snow albedo equals 80-95%, consequently, after the first snow, the earth surface cools strongly, and glaciation increases powerfully too.(Figure 7) By the impact of this feedback the glaciation expands rapidly from polar region to middle latitudes (Figure 5).

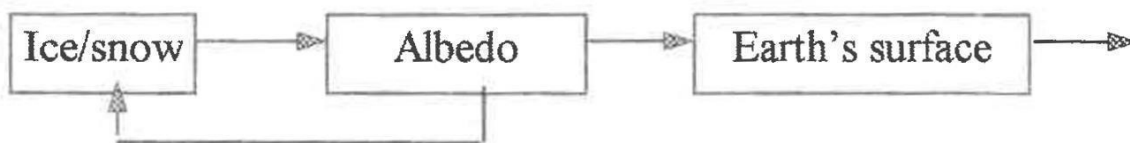


Figure 2. Ice/snow-Albedo feedback

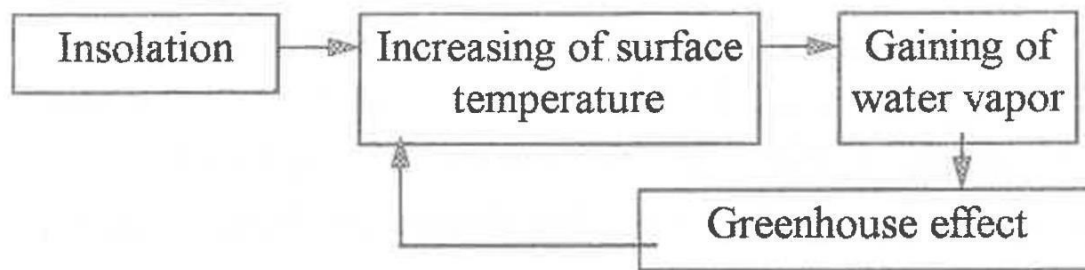


Figure 3. Insolation - Water Vapor feedback

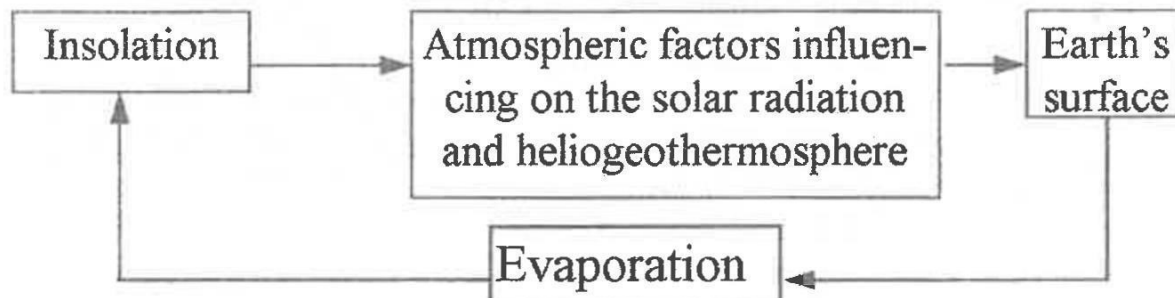


Figure 4. Feedback of the Insolation-Evaporation

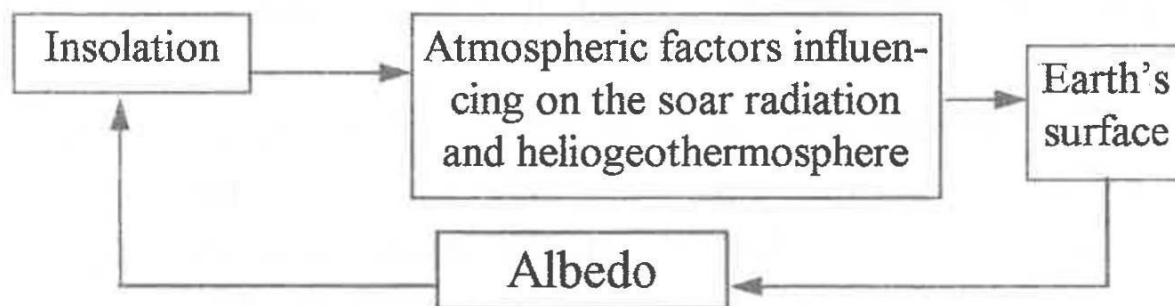


Figure 5. Insolation-Albedo feedback

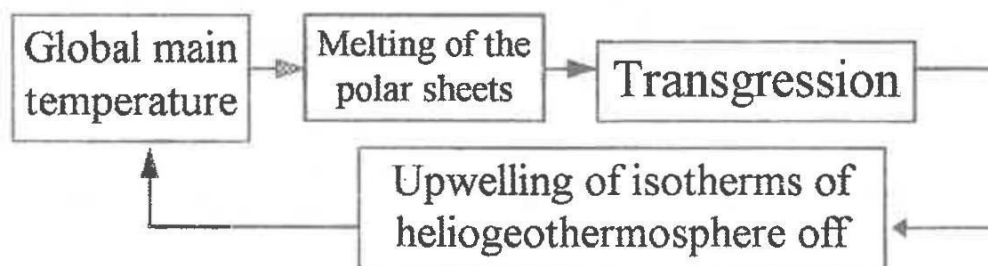


Figure 6. Feedback between Isotherms of Heliogeothermosphere and Global average temperature of planet

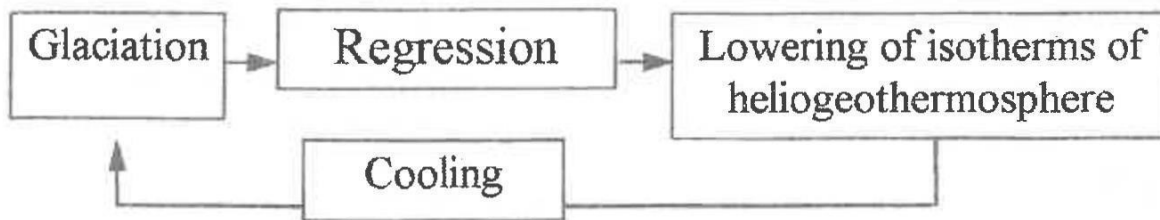


Figure 7. Glaciation-Cooling feedback

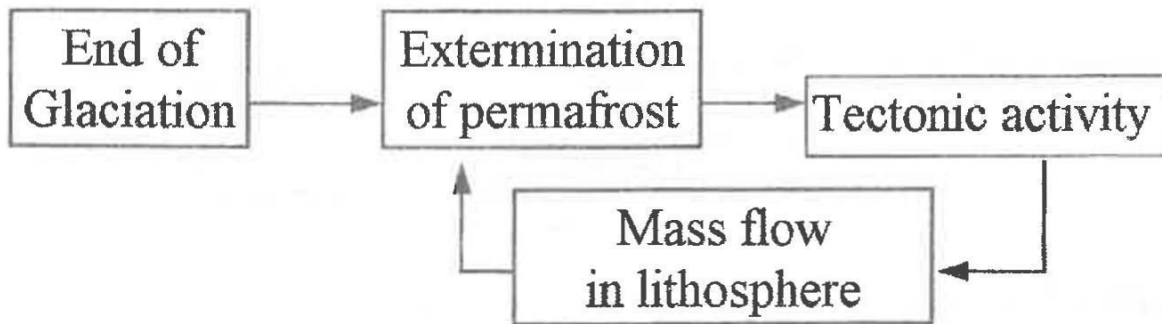


Figure 8. Feedback on mass flow in Lithosphere-Permafrost

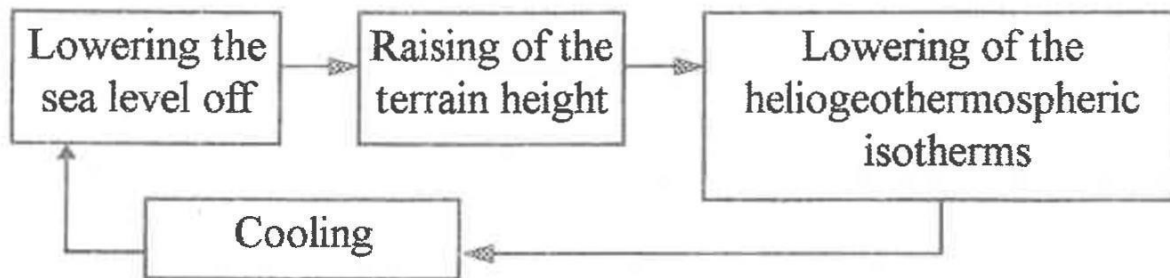


Figure 9. Terrain height-Cooling feedback

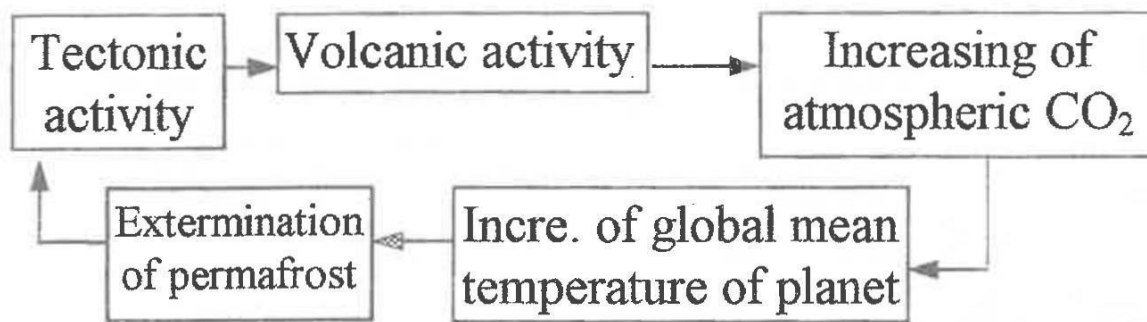


Figure 10. Feedback of Volcanic activity-Warming

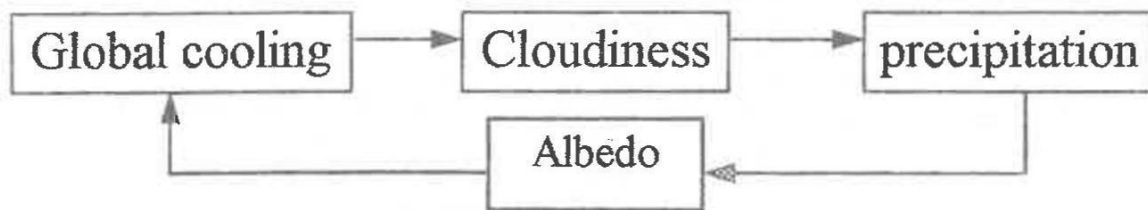


Figure 11. Cooling-Precipitation feedback

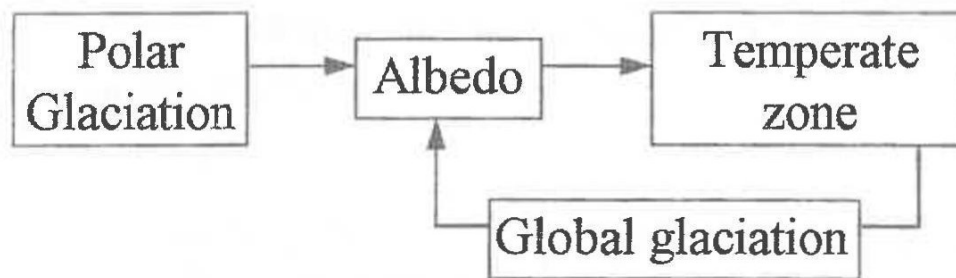


Figure 12. Glaciation-albedo feedback as like Figure 1.

The earth surface, geographic objects, lithosphere, ocean and atmosphere lie still under the influences of the Earth's centripetal force and gravitation, consequently, continuous mass flow exists in upper lithosphere. But during the glaciation in the glacial and permafrost zones the mass flow is late by a long time or only stop, than the other territories of the Earth's surface. In other word, at neighboring regions of the permafrost zones the mass flow


is delivered constantly from high latitudes to the direction of equator (Figure 8), (Figure 12) and therefore, after glaciation spatial and densital deficits exist at the glacial and permafrost regions. When the glaciation, then permafrost are exterminated the tectonic movements are strengthened by impact of above deficits. Orogenic and volcanic activities follow, great scale CO₂ content is liberated in atmosphere. As result, the thermal effect exists, average temperature of planet increases (Figure 10). Thus, after glaciation the tectonic movement is active, the warming increases rapidly. When the glaciation on the whole is exterminated, the transgression follows, the isotherms of heliogeothermosphere upwell, average air temperature of planet increases again.

Sea level-Average temperature of planet positive feedback mechanism is strengthened the cooling process during the regression (Figure 7, Figure 9, Figure 11).

Ratio of areas between Continent-World Ocean is a main feedback of WCS

The physical climatology is faced constantly with the next opened question: When does the glaciation stop or begin? But my questions are followings: What the ratio of areas between the Continent and Ocean would be for condition of glaciation stopping or beginning? What interval does oscillate the ratio of areas between Continent and Ocean? Unfortunately, Until present there is no any study about this ratio.

Researchers explained the transgressions, regressions and their periodicities by the oceanic and land surface vertical motion or by the continental drift.

 Yasmanov, N.A., [1985] wrote: "Last 10-years appear ideas about the connection between transgression and regression, consequently, the fluctuations of World Ocean level with volume change of oceanic hollows. Formation of the New Global Tectonics and theoretical calculations as determined by Sorothini, O.G. gives an opportunity for connection of the transgression and regression development with the depth of the crust middle oceanic mountain range and speed of the movement in the rift zones. Summarized curve of transgression and regression developments in general on the Earth shows that during Phanerazoic history by constant increasing volume is realized the steady regression".

I believe that the end or beginning of glaciation is linked with the ratio of areas between the Ocean-Continent.

One of the important feedbacks of WCS is the ratio of areas between the Ocean and Continent. Polar glaciation intensified by the impact of the glaciation-albedo positive feedback extends to the temperate zones. When this process continues for a long time the land surface is free from flood. Nevertheless, oceanic evaporation, water vapor content in atmosphere increase, the glaciation stops because it has no resource.

According to my studies of WCS this phenomenon is connected with the World Water Supercycle (WWS) during which the major portion of world water resource is accumulated in polar regions, high latitudes and high land (regression), and then it returns to world ocean because of global warming (transgression). Of course, the vertical motion of crust influences certainly on the transgression and regression too. However, it is absolutely unfounded for explanation of the sea-level variation by 60-300 m, because it must oscillate in a certain time interval.

We live today at the finish of primary glaciation. If the world climate would not changed by man-made hazards the sea-level must lower by 150 m than present.

According to the Political and Economic Map of World [1979] today the ocean and sea take up the area of $361.1 \cdot 10^6$ square km, but the land surface equals $149.4 \cdot 10^6$ square km, ratio of which shows 1:2.417.

If sea-level falls by 150 m at the polar regions 54165000 cubic km of water will accumulate but it becomes in solid form (ice, snow) the volume of which increases by 1.1-times i.e. it equals 59581500 cubic km. In this case the area of the glacial sheet may be described by next formulae:

$$S = 4\pi R^2 \cdot \cos^2 \varphi \quad (1)$$

Where R denotes the average radius of the Earth, $R=6371.8$ km, φ denotes the geographical latitude

To look general picture about glacial sheet expansion on the earth surface we think up the glaciation extends on the area (S). The thickness of glaciation (h) may be written as follows:

$$h = \frac{V}{S} = \frac{59581500}{4\pi R^2 \cdot \cos^2 \varphi} = \frac{0.11678}{\cos^2 \varphi} \quad (2)$$

If the great primary glaciation expands to 50 degree of geographical latitude the thickness of the snow cover (h) would equal 141.3 m of altitude at two Hemisphere by our rough approach. Nevertheless, the major portion of glaciation predominates near the poles maximum of which reaches 3-5 km of altitude of snow cover. Of course, its thickness decreases to the direction of the low latitudes.

According to the Political and Economic Map of World [1979] if the sea-level lowers by 150 m England and Scotland contact with Central Europe by land surface which depends on the relieves of oceanic floor. The areas of Adrian, Mediterranean, Black Sea, Caspian decrease by 5%-80% of their present area in consequence of which the territory of Europe increases by 30%. The North and East Asia, regions of oceanic coasts, low lands are free from flood then Asia would linked with Alaska, so, Bering Isthmus is destroyed as happened before 18 thousands of years. The area of South East Asia gains too. So, the territory of Asia increases approximately by 24% as present European territory.

In addition, in aspect of land surface extends in Africa by 5%, at North and Central America by 10%, at South America by 60%, in Australia and Oceania by 40%, in Antarctic by 60%, which, of course, a rough calculation as shown in Table 1. Table 1. shows that the ratio of area between the Continent and Ocean equals 1:1.8 at 150 m-regression.

At the natural conditions this ratio is approximately 1:1.5 because the 150 m-depth does not begin from coast of ocean and sea.

At 200 m-transgression increases the major part of Europe, 1/3 of South America are flooded, Oceania is destroyed.

Table 1. Continental area during 150 m-regression

N	Continents	Present area [Ref.,1984]	Increasing		Total land surface at regression
			(%)	(squ.km)	
1	Asia	43883000	23.9	10496800	54379800
2	Europe	10498000	30.0	3149400	13647400
3	Africa	30284000	5.0	1514200	31798200
4	North and Centr. Amer	24228000	5.0	1211400	25439400
5	South America	17850000	10.0	1785000	19635000
6	Australia and Oceania	8557000	40.0	3422800	11979800
7	Antarctic	14100000	60.0	8460000	22560000
	Total	149400000		30039600	179439600

Looking to the Table 2 when the sea-level increases by 200 m the ratio of area between the continent and ocean is 1:3.18, which shows that approximately 1:4 of the Earth's surface engaged the land surface.

Table 2. Continental area during 200 m-transgression

N	Territories	Incr (%)	Present continen. area	Continental area during transgress.	Total land surface
1	Asia	20	43883000	8776600	35106400
2	Europe	60	10498000	6298800	4199200
3	N & C. Amer	10	24228000	2422800	21805200
4	S. America	25	17850000	4462500	13387500
5	Africa	8	30284000	2422720	27861280
6	Australia and Oceania	30	8557000	2567100	5989900
7	Antarctic	3	14100000	423000	13677000
	Total		149400000	27373520	122026480

All of these feedbacks consisting of chains are linked with each other and interact constantly in space-time. (Layout #1)

Conclusion

The ratio feedback of area between Continent-Ocean takes place as a catalizator. When the ratio reaches 1:4.0 the glacial stage finishes, and it equals 1:1.5 the interglacial stage begins as finisher of glaciation i.e. the

between 1:1.5 and 1:4.0. All of these we may conclude that the living world oscillates constantly as WCS.

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