

Summer Course on Sustainability, River Basin Management and Climate Change in the Baltic Sea Region

Global warming and Climate change

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Introduction

Global warming is one of the pressing questions of a modern life of a planet the Earth. It discussed at different forums the significance of which was United Nations Climate Change Conference in Copenhagen, Denmark, December 7-18, 2009. Copenhagen Accord underline that “...that climate change is one of the greatest challenges of our time. We emphasize our strong political will to urgently combat climate change in accordance with the principle of common but differentiated responsibilities and respective capabilities” (*Decision -/CP.15*, 2009).

1 Global warming

Global warming is the increasing in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Global surface temperature increased at 0.74 ± 0.18 °C (1.33 ± 0.32 °F) between the start and the end of the 20th century (Fig.1, Fig.2). The Intergovernmental Panel on Climate Change (IPCC) has concluded that most of the observed increasing in average global temperatures since the middle of the 20th century is very likely (>90% probability of occurrence) caused by increasing concentrations of greenhouse gases resulting from human activity such as fossil fuel burning and deforestation. The IPCC has also concluded that variations in natural phenomena such as solar radiation and volcanism had a small cooling effect after 1950. These basic conclusions have been endorsed by more than 40 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries (http://ru.wikipedia.org/wiki/Файл:Instrumental_Temperature_Record.svg)

Climate model projections summarized in the latest IPCC report indicate that the global surface temperature is likely to rise a further 1.1 to 6.4 °C (2.0 to 11.5 °F) during the 21st century. The uncertainty in this estimate arises from the use of

models with differing sensitivity to greenhouse gas concentrations and the use of differing estimates of future greenhouse gas emissions. Most studies are focused on the period up to the year 2100. However, warming is expected to continue beyond 2100 even if emissions stop, because of the large heat capacity of the oceans and the long lifetime of carbon dioxide in the atmosphere.

An increasing in global temperature will cause sea levels to rise and will change the amount and pattern of precipitation, probably including expansion of subtropical deserts. Warming is expected to be strongest in the Arctic and would be associated with continuing retreat of glaciers, permafrost and sea ice. Other likely effects include increases in the intensity of extreme weather events, species extinctions, and changes in agricultural yields. Warming and related changes will vary from region to region around the globe, though the nature of these regional variations is uncertain.

Political and public debate continues regarding global warming, and what actions (if any) to take in response. The available options are mitigation to reduce further emissions; adaptation to reduce the damage caused by warming and more speculatively geoengineering to reverse global warming. Most national governments have signed and ratified the Kyoto Protocol aimed at reducing greenhouse gas emissions. One of the most evident processes connected with global warming is a thawing of glaciers.

For the last half a 20th century the temperature in the southwest of Antarctic, on Antarctic peninsula, has increased on 2,5 °C. In 2002 from Larsen's ice shelf the area of 3250 km² and thickness over 200 meters, located on Antarctic peninsula, the iceberg with the area over 2500 km² has broken away that actually means glacier destruction. All process of destruction has occupied only 35 days. Before this accident the glacier remained stable during 10 thousand years from the end of last glacial age. Throughout millennia capacity of a glacier decreased gradually but

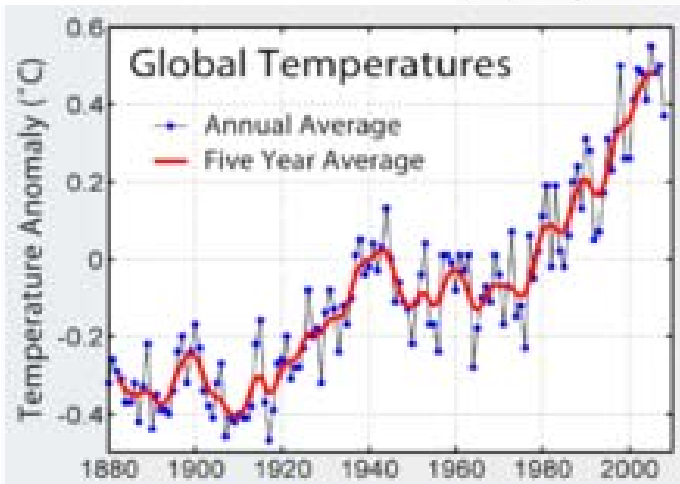


Fig 1. Global mean surface temperature difference relative to the 1961–1990 average (www).

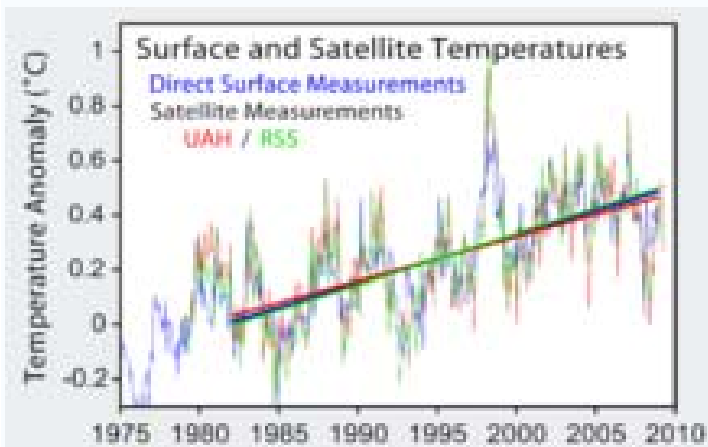


Fig.2. Comparison of ground based (blue) and satellite based (red: UAH; green: RSS) records of temperature variations since 1979. Trends plotted since January 1982

(http://ru.wikipedia.org/wiki/Файл:Glacier_Mass_Balance_Map.png)

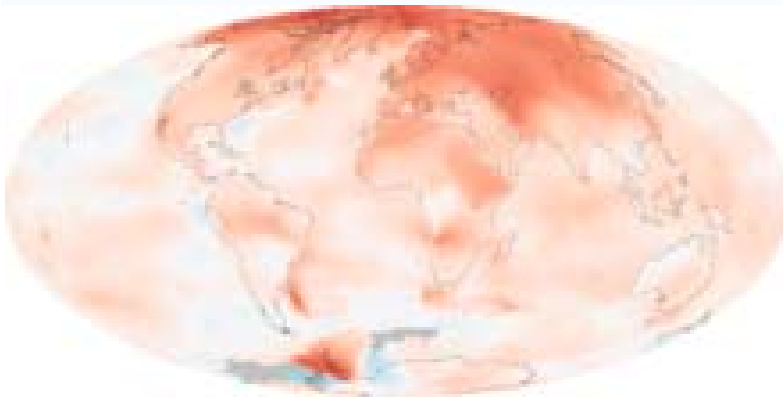


Fig.3. Mean surface temperature change for the period 2000 to 2009 relative to the average temperatures from 1951 to 1980.

(http://en.wikipedia.org/wiki/File:GISS_temperature_2000-09_lrg.png.)

speed of its thawing has essentially increased in second half of 20th century. Glacier thawing has led to emission of a considerable quantity of icebergs (over thousand) in Weddell Sea.

Acceleration of process of degradation of permafrost is noted. From the beginning of 1970th years the temperature in the area of frozen condition of ground in Western Siberia has raised on 1.0 °C, in the central Yakutia — from 1 to 1.5 °C. In the north of Alaska from the middle of 1980th years the temperature of the top layer of frozen breeds has increased on 3 °C. On the Fig.4 the changing of mountain glaciers thickness is shown.

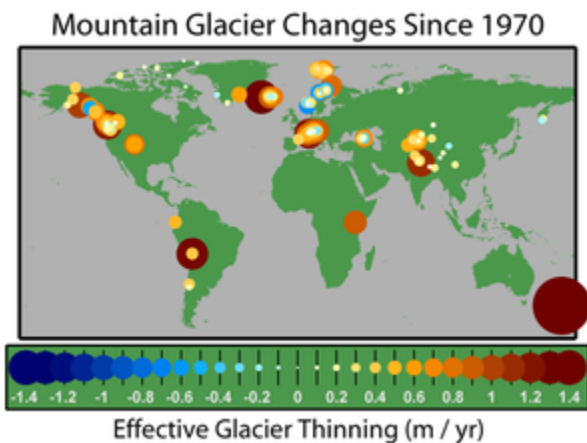


Fig.4. Card of change of a thickness of mountain glaciers since 1970. Decreasing of thickness shown in orange and red colours and increasing — in dark blue

(http://ru.wikipedia.org/wiki/Файл:Glacier_Mass_Balance_Map.png)

2 Major results of researches of climate change

Sharp increase in emissions of the gases aggravating "hotbed effect":

In 2008 emissions of carbonic gas due the using of fossil kinds of fuel were almost on 40 % above than in 1990. Even if world gas issues are stabilized at present level the probability of that in 20 years warming will exceed 2°C makes 25 %. Even at zero level of issues after 2030 every year delay and inactivity increases chances of that warming will exceed 2°C.

Global temperatures show now that warming is connected with activity of the person:

Throughout last 25 years every decade air temperature raises on 0.19°C that completely corresponds to predictions based on "hotbed effect" aggravation. Within last ten years the tendency to warming proceeds despite falling of solar activity. Natural short-term fluctuations of temperatures are usually observed too but it does not render considerable influence on the basic tendency to warming.

Acceleration of process of thawing of ices, glaciers and ice caps:

Numerous satellite researches and measurements of an ice cover, no doubt, prove that ices, both Greenland and Antarctica, lose weight in increasing rate. Thawing of glaciers and ice caps in other parts of globe also was considerably accelerated since 1990.

Sharp reduction of a sea ice cover of Arctic regions:

Summer thawing of the Arctic sea ice has considerably surpassed expectations of climatic forecasts. In 2007-2009 the area of thawing of sea ice almost on 40 % has exceeded predictions of the climatic changes presented in «IPCC AR4» (<http://sites.google.com/site/copenhagendiagnosisru/rezume>).

Underestimations of present rising of sea level:

The considerable global rising of sea level fixed by satellites (on the average - 3.4 mm/year for last 15 years) on 80 % exceeds last forecasts «IPCC AR4». Such accelerated rising of sea level it is connected with the water inflow which has doubled as a result of thawing of glaciers, ice caps and sea ices of Greenland and the Western Antarctica.

Predictions for rising of sea level are reconsidered:

By 2100 the sea level possibly will be twice above than was predicted by the first working group «IPCC AR4»; in summary uncontrollable gas issues, rising of sea level can quite surpass 1 meter. The highest established limit – rising of sea level on 2 meters by 2100. After stabilization of global temperature the rising of sea level will proceed some centuries and it is necessary to expect its growth on some meters within the next centuries.

Delay in actions conducts to threat of an irreversible damage:

Some vulnerable components of climatic system (as that: continental ices, rainforests of Amazon, the West African monsoons, etc.) can undergo to sharp or irreversible changes if current century warming proceeds as the ordinary phenomenon. In connection with occurring climatic changes, the risk of crossing of "critical thresholds» («critical points») sharply increases. Thus expectation of more profound scientific understanding of questions can lead to crossing of "critical thresholds» before they are established.

Turning point should come soon:

If global warming is limited by the maximum mark in 2°C exceeding pre-industrial temperatures then world emission of gases should reach peak in 2015-2020 and then - sharply to be reduced. To stabilise a climate in this century it should be created carbonless world community with almost zero emission CO₂ and other gases promoting "hotbed effect". Speaking more particularly, by 2050 mid-annual emissions of gases should make less than 1 metric ton CO₂ per capita. This indicator on 80-95 % more low than emission of gases of per capita developed countries in 2000.



With interest for me I wish to underline also such theme as which in my opinion the Baltic region can mention «the Extreme phenomena» or has already concerned.

3 The extreme phenomena

- The increasing in frequency extremely high and decrease in frequency of extremely low temperatures proceeds and strengthening of these tendencies are expected.
- Anthropogenous climate change, predictably, will lead to the further increasing heterogeneity in loss of deposits, both strong downpours, and droughts.

- Though the future changes in activity of tropical cyclones cannot be simulated yet the new analysis of the given supervision confirms that intensity of tropical cyclones has increased for last three decades in correlation with ocean rise in temperature in tropics.

Many of consequences of climatic fluctuations and climate changes for a society, environment and ecosystems arise because of changes of frequency and intensity of the extreme weather and climatic phenomena. In the Fourth report IPCC it is specified that considerable changes are noted in the extreme weather and climatic phenomena with 1970 as a part of process of warming in climatic system. More frequent hot days, nights and heat waves concern them; smaller quantity of cold days, cold nights and frosts, more frequent intensive deposits; more intensive droughts in wider areas; increase in activity of tropical cyclones in Northern Atlantic in the absence of the visible tendency in total number of tropical cyclones.

Strong downpours and droughts

Researches after the Fourth report IPCC also have shown that rains became more intensive in already rainy areas in process of growth of quantity of water steam in atmosphere (Pall et al. 2007; Wentz et al. 2007; Allan and Soden 2008). These conclusions confirm results of earlier researches and are expected proceeding from reasons of thermodynamics of atmosphere. However last changes occur faster than predicted some models of a climate raising probability that the future changes will be more serious, than it was supposed.

It is possible to see examples of recent increase in quantity of strong deposits in the United States where area with much bigger, than usual add days with an extreme amount of precipitation has considerably increased. Though these changes in strong deposits are according to warming in climatic system, it is not obviously possible to carry them to consequences of anthropogenous climate

change with high confidence in connection with very big variability. (CCSP 2008a; Meehl et al. 2007b; Alexander and Arblaster 2009)

Conclusion

It would be desirable to note that thanks to such programs Baltic University Programm Summer Course Above specified themes do not remain in the shadow and developed methods on struggle against these problems in HAW Hamburg

The information specified in the given work was mainly received from the Internet.

References

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(Pall et al. 2007)

(Wentz et al. 2007)