

# Atmospheric hypotheses' of Earth's global warming

Vladimir Shaidurov\*

## Abstract

Two hypotheses are presented, outlining a new cause for global warming. We propose that the crucial factor in global warming is the amount and position of water vapour through the atmosphere. The purpose of this report is to open the debate and to encourage discussion among scientists.

When analyzing the mean-year trend of the Earth's surface temperature for the past 140 years (see for Figure 1(a)) one can discern two sections of monotone linear increase of temperature during two last industrial centuries. The first one begins somewhere in the period 1906-1909. The previous segment demonstrates a weak decrease in the temperature trend, not increase (see for Figure 1(b)), though this includes the beginning of industrial period, with a subsequent increase in production of greenhouse gases. If we suppose that it is not only greenhouse gases that launched global warming, then what could be an additional cause of the comparatively sudden change of mean-year trend of the Earth's surface temperature? We should look for a phenomenon of cosmic scale during this time which could have given rise to beginning of global warming with a significant probability. On the 30th June 1908 Tungus meteorite crossed almost all of the atmosphere and exploded. Instrumental measures with numerical modelling reconstruct an explosion of the power of approximately by 15 Mt TNT at an altitude approximately of 10 km. Such an explosion could cause considerable stirring of the high layers of atmosphere and change its structure.

---

\*Institute of Computational Modeling of Siberian Branch of Russian Academy of Sciences, shidurov@icm.krasn.ru. Visited Leicester in April 2005.

**Hypothesis 1.** The Tungus meteorite considerably changed the thermo-protective properties of the Earth's atmosphere and turned out to be one of the agencies which launched global warming.

From our point of view, water vapor plays a more important role in Earth's thermal regime than other gases. The point is that additionally to the usual accumulation of heat because of increasing temperature, water vapour (as molecules of  $\text{H}_2\text{O}$ ) possesses three more significant properties in the real range of pressure and temperature in the lower layers of atmosphere: liquid-gas transition, solid-liquid transition, and dissociation into ions ( $\text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^-$ ). At constant temperature each of these transitions consumes heat, and the opposite transitions give the same heat that is more often greater than energy due to moderate changes of temperature. Moreover, the considerable heat capacity of water in comparison with the atmospheric gases makes the World Ocean a very important accumulator of heat and source of vapour. Together, the complex of atmosphere, land surface, and ocean, assimilates 25% of the solar radiation incident on the Earth. After all stages of reradiation 97% of this energy goes out of Earth. Of the components of this complex, changes in amount of water vapor form the primary influence on assimilation of solar radiation.

For a rough estimate for the influence of increase or decrease of primary assimilation of solar energy, let us look at the minimal temperature reached at the Earth's surface:  $-89^\circ$  in the Antarctic. Thermal processes inside the Earth do not lead to significant temperature differences at the surface in the absence of solar heating. Other parts of the Earth's surface are at greater distance from center and liquid core owing to the Earth's shape. Having an average temperature of land surface and ocean of about  $+15^\circ$ , we see that the increase of assimilation of solar energy by 1% would entail an increase of temperature by more than  $4^\circ$  in stationary regime.

But the real dynamic regime intensifies this effect. The point is that the average increase of land and ocean temperature produces higher average absolute humidity. In its turn, this raises the assimilation ability of the atmosphere even at constant content of carbon dioxide. But increasing the average ocean temperature is responsible for lower water solubility of carbon dioxide, which then arrives in the atmosphere. Moreover, increase in land temperature is responsible for growth of bogs, at least in Northern Russia, due to the removal of permafrost deep down. The rise in area and activity of bogs leads to more active production of methane. Thus, a self-stimulated

process was launched for the increase of average temperature of the Earth's surface. Therefore the rise of greenhouse gas concentration is more a consequence of warming but not a main reason.

**Hypothesis 2:** The above mentioned variant of self-stimulated process (with a permanent rise of average absolute humidity, and resulting concentration of carbon dioxide and other greenhouse gases) was launched in 1908 after the atmosphere reconstruction due to the Tungus meteorite.

Following a further examination of the curve in Figure 1(a), one can see oscillatory behavior in the period 1945 - 1976. What was happened in this time? The 16th July 1945 saw the first explosion of a nuclear bomb, and this heralded the period of nuclear bomb tests. From the standpoint of atmosphere hypothesis the nuclear tests in the atmosphere are opposite to consequences of the Tungus meteorite. When a nuclear charge explodes at the Earth's surface or in the atmosphere, the shock wave vents water vapor from the troposphere to the stratosphere through tropopause. For some period ( $\approx 3$  years) water vapor in the stratosphere and aerosol, and dust in the troposphere and stratosphere suffice for the defense of the Earth from solar radiation. But then all gradually settled, and global warming continued. All nuclear explosions above the ground and the sea together gave rise to tendency for decreasing the global temperature of Earth's surface. The last nuclear test in open atmosphere was on the 16th October 1980. All subsequent nuclear tests were under the ground or the sea, which does not generates the shock wave reaching the stratosphere. But the tendency of global warming recommenced earlier, approximately in 1977. Discordance between beginning of second period of warming and the finish of nuclear tests in the open atmosphere may be attributed to superposition with cyclic variations of temperature, which were apparent before 1908 too.

Now let us raise a question about some regulation of the protective properties of the atmosphere. In the first instance we have the previous consideration of nuclear explosions in the open atmosphere. But this gave a comparatively short-term effect because of the gradual subsidence of ice in pearl clouds through the tropopause, due to their greater density when compared with air. However, clouds reflect the significant part of solar radiation. But in the mesosphere there is one more type of clouds, the so called silver clouds. They persist much longer. The distinction is the following. Almost the whole of the stratosphere and mesosphere consists of molecular oxygen  $O_2$  and molecular nitrogen  $N_2$ . Also ozone  $O_3$  is formed in comparatively

small quantities with the help of solar radiation. The first distinction is the temperature gradient: temperature grows with altitude in the stratosphere, approximately from  $-55^{\circ}$  to  $0^{\circ}$  and diminishes in the mesosphere, from about  $0^{\circ}$  to  $-95^{\circ}$  (see Fig. 2). The second distinction consists in the different pressure and density, which are several times less in the mesosphere than in the stratosphere. Therefore, water vapour in the troposphere (such as is formed during atmospheric nuclear tests), comes to a temperature below freezing point almost everywhere except its upper border. Thus it forms crystals having greater density than the ambient gas. In rapidly moving flows the crystals migrate down through the tropopause into the troposphere. High speeds and agitation do not end this process quickly; it may continue for months depending upon the tropospheric humidity in the test region.

But water vapour in the mesosphere is another matter. At a pressure hundreds of times less than at atmospheric pressure at sea level, the freezing point of water vapour shifts to a vastly negative temperature without the intermediate liquid state (see Fig. 3). Therefore there exists a sizable layer spanning the higher part of the stratosphere and lower part of the mesosphere where water is in the gas state. The mesospheric composition is slightly distinct from the stratospheric one at significant, with less density of gases. The gaseous state of water vapor has lower density than the ambient gases (atomic masses of  $\text{H}_2\text{O}$ ,  $\text{O}_2$ , and  $\text{N}_2$  equal 18, 32, and 28, respectively). Therefore it has some tendency to move up in rapidly moving flows with some stirring against the background of diffusion. When it migrates, gas climbs to a temperature below freezing point, crystallizes and migrates down. There it evaporates missing the liquid state, and the process repeats. Thus, mesopause with a strongly negative temperature of around  $-95^{\circ}$  prevents water vapor leaving beyond the upper bound of the mesosphere.

From these discussions the following idea results about some deceleration and possible ceasing of global warming. With this purpose it is possible to start reconstruction of the protective layer in middle part of mesosphere, which consists of water vapor. For this it is enough to transport and combust molecular hydrogen,  $\text{H}_2$  in the appropriate part of the mesosphere. The ambient quantity of molecular oxygen and ozone is enough to generate water vapor, which will be 9 times greater by weight than the transported hydrogen. Along with this, the density of molecular hydrogen is small enough in comparison with that of the ambient gases over the region of transport that it induces lift. Therefore hydrogen may serve as a means for transport itself.

Modern technical tools seem to be sufficient to realize such a transport in

small parts and to observe the consequences. In addition, modern mathematical and computational modeling are at level when more detailed quantitative estimates are possible both for the immediate effects of such intervention as well as its influence on global climate.

Note the obvious environmental safety of this suggestion since the combustion of hydrogen in higher level of atmosphere can generate water vapor only. Combustion of small amounts gives the possibility of observing any change before it becomes too dramatic.

**Acknowledgements:** In conclusion I express my gratitude to Professor J. Levesley and Professor A. Gorban for the invitation to visit the University of Leicester and for fruitful work and discussions.

## References

- [1] *Climate Change 2001: Working Group I: The Scientific Basis*. [http://www.grida.no/climate/ipcc\\_tar/wg1/Footnote](http://www.grida.no/climate/ipcc_tar/wg1/Footnote).
- [2] *Windows to the Universe*. The Regents of the University of Michigan. University Corporation for Atmospheric Research (UCAR). <http://www.windows.ucar.edu>.
- [3] *Phases Diagrams* University of Waterloo. <http://www.science.uwaterloo.ca>.
- [4] *U.S. Standard Atmosphere, 1976*. U.S. Government Printing Office, Washington, D.C.

## Variations of the Earth's surface temperature for:

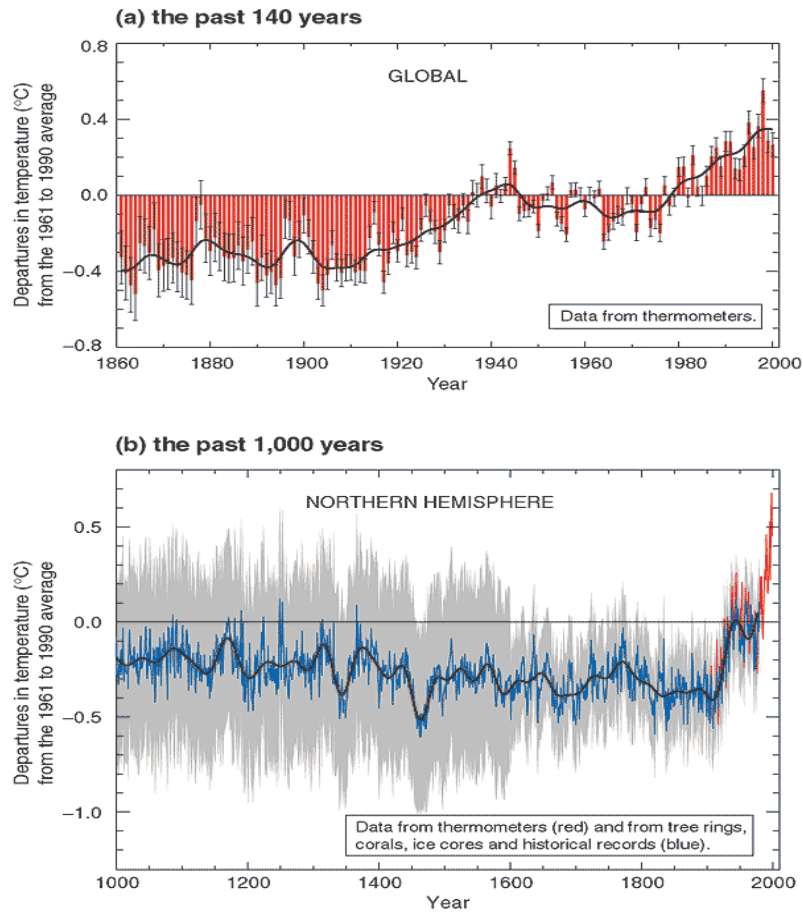


Figure 1: (a) The Earth's surface temperature is shown year by year (red bars) and approximately decade by decade (black line, a filtered annual curve suppressing fluctuations below near decadal time-scales). There are uncertainties in the annual data (thin black whisker bars represent the 95% confidence range) due to data gaps, random instrumental errors and uncertainties, uncertainties in bias corrections in the ocean surface temperature data and also in adjustments for urbanization over the land. Over both the last 140 years and 100 years, the best estimate is that the global average surface temperature has increased by  $0.6 \pm 0.2$ . (b) Additionally, the year by year (blue curve) and 50 year average (black curve) variations of the average surface temperature of the Northern Hemisphere for the past 1000 years have been reconstructed from "proxy" data calibrated against thermometer data (see list of the main proxy data in the diagram). The 95% confidence range in the annual data is represented by the grey region. These uncertainties increase in more distant times and are always much larger than in the instrumental record due to the use of relatively sparse proxy data. Nevertheless the rate and duration of warming of the 20th century has been much greater than in any of the previous nine centuries. Similarly, it is likely that the 1990s have been the warmest decade and 1998 the warmest year of the millennium. (The figure is reprinted from [1].)

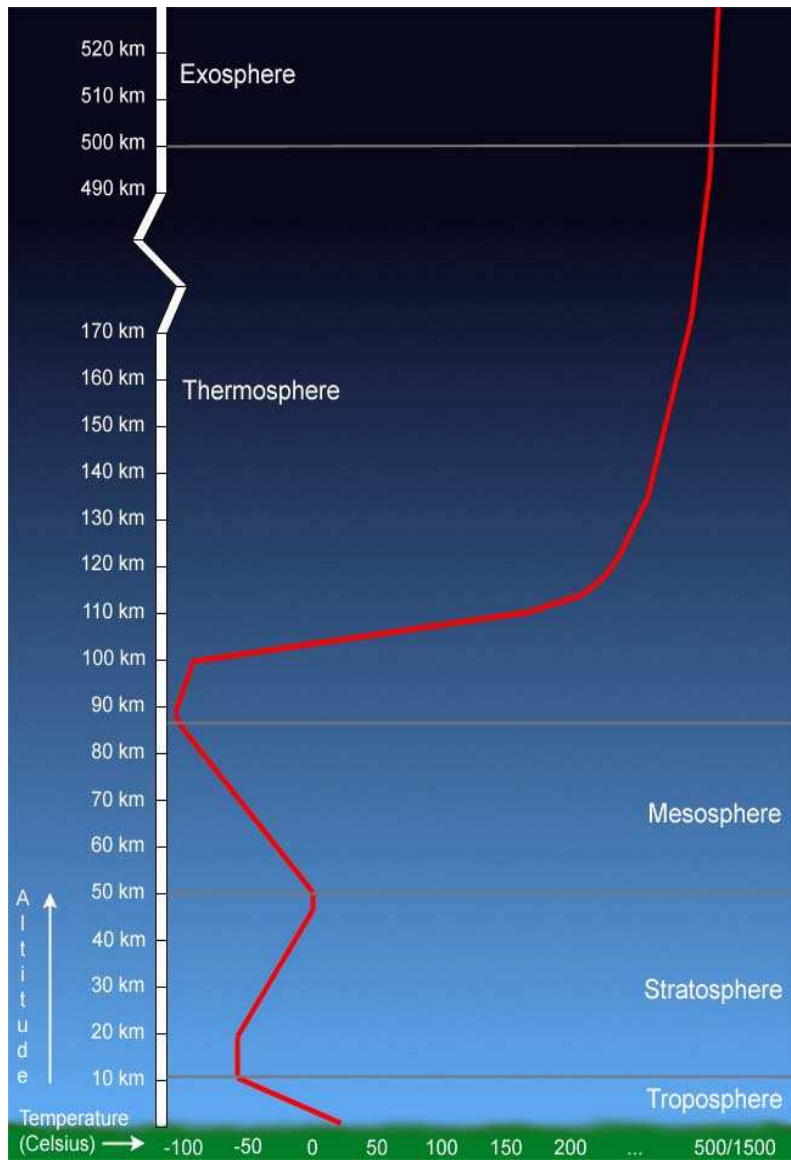


Figure 2: The average temperature profile through Earth's atmosphere. (The figure is reprinted from [2].)

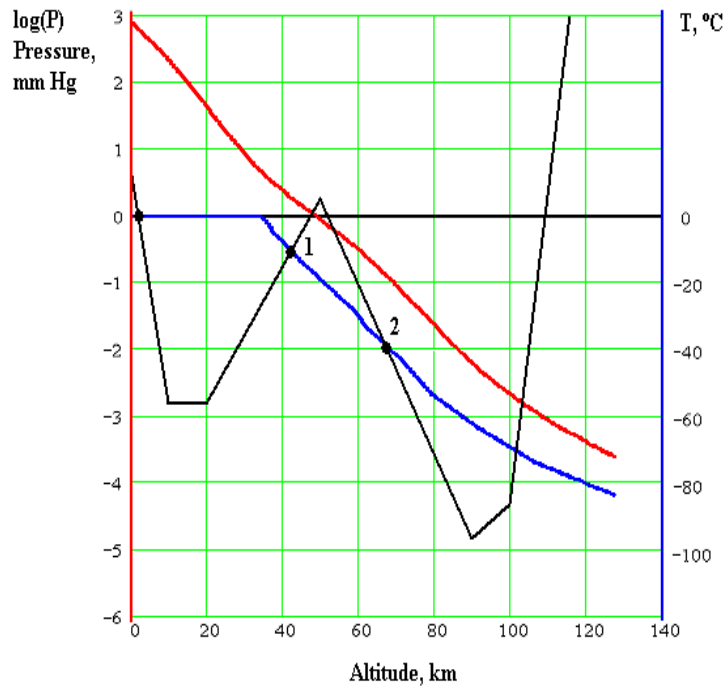


Figure 3: The pressure, the freezing point of water vapor, and the temperature of average atmosphere depending on altitude. (The data are taken from [2], [3], [4].)

The abscissa is the altitude in km. The pressure is plotted at left ordinate as logarithm of mercury column in mm. The temperature is plotted at right ordinate in Celsius degree.

The red line gives an estimate of the pressure at corresponding altitude. The blue line gives the freezing point of water vapor depending on pressure (at corresponding point). The black line demonstrates the temperature of average atmosphere at corresponding altitude and copies the analogous graph from Figure 2 in some different form.

The node of intersection 1 indicates the point of formation for pearl clouds; the node 2 does for silver ones. Between them the water vapor is in gas state. Near above and near below it is in solid state.