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Effects of nuclear chimney on climate

Gao Suhua[1], Ding Yihui[1], Pan Yaru[1] and Zhang Qingchen[1]

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Abstract— In this paper, according to the data from several single nuclear explosion experiments of an equivalent to magnitude of million tons, and combined with meteorological data, their effects on the regional climate have been analysed.

Keywords: nuclear chimney; nuclear explosion; temperature change.

Ten years ago, the research on climatic effects of atmospheric aerosol is an important topic in the global climatic research plan. The results of some researches showed that the chimney sprayed from volcanic eruption in historical data influenced on mean holospheric temperature. Since 1980s, the hypothesis about "Nuclear Winter" was put forward again in many countries. At first, Crutzen and Birks (1982) pointed out that the chimney caused by a large number of nuclear explosion trapped sunlight and made noon dim like dusk. Afterwards, many scientists have developed the topic researches.

The research showed that a large number of dust and smoke entered into atmosphere because of nuclear explosion and most part of solar radiation in the atmosphere was absorbed by the dust, and the upper air temperature was raised. Because the solar radiation arrived at ground declining markedly, it made the ground temperature decrease rapidly. The temperature change can cause disastrous consequence to human activity. If this event occurs in the growth season, the mean temperature decreases about 1–5°C, so that the agricultural yield would drop seriously.

Certainly, the effects of nuclear chimney on climate is a complicated scientific problem. Our analysis is only an initial exploration.

EFFECTS OF NUCLEAR CHIMNEY ON TEMPERATURE

Effects of nuclear chimney on temperature in winter

[1]Academy of Meteorological Science, State Meteorological Administration, Beijing 100081, China.

Generally, the drop of temperature caused by nuclear chimney in winter started on the 2nd day after explosion. Fig. 1 shows the surface temperature changes in winter at 4 stations after the explosion in the sky. It is shown in Fig. 1 that before 27 Dec., the mean temperature at 4 stations was higher than multi-year mean temperature (about -10°C), the temperature was from -9°C to -11°C on 27 Dec. and decreased markedly after that day. From 29 Dec. to 5 Jan., it was a period in which the fall of temperature range was the greatest, e.g. from about -10°C to -14– -17°C. It is 4–7°C lower than that before explosion. After 5 Jan., the temperature rose gradually. After 19 days, the temperature returned to the normal. That is to say, the temperature after 19 days of explosion was higher than that of the explosion day and multi-year mean temperature.

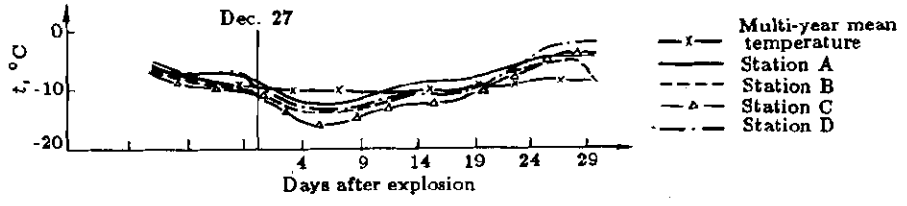

Fig. 1 Temperature change in winter

The surface (0 cm) temperature change was similar to air temperature change (Fig. 2). The drop of temperature range is about 6°C to 7°C and lasted for 16–17 days. It is noticed in Fig. 2 that the drop of temperature range at station D is smaller, about 3°C, and sustained 11 days.

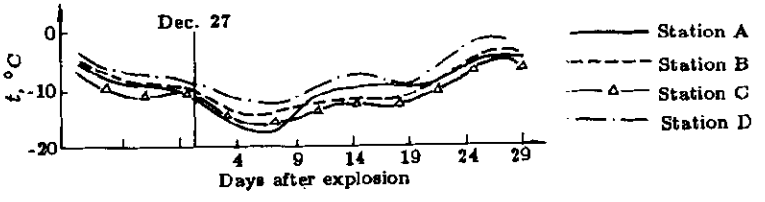

Fig. 2 Surface (0 cm) temperature change

Besides, the mean square errors between the temperatures and multi-year mean temperature in some stations for four periods have been calculated and shown in Table 1.

Table 1 RMS for different periods at four stations

Time period	Station			
	B	C	D	A
11 days before explosion	3.56	3.17	4.08	4.16
1–9 days after explosion	4.65	5.86	4.54	3.23
10–19 days after explosion	2.86	2.93	2.47	1.88
20–30 days after explosion	4.58	4.53	6.13	4.47

From Table 1, RMS with about 3–6 at four stations were the greatest at 2nd stage (1–9 days after explosion). It is indicated that the temperature was effects markedly because of the effects of chimney after explosion.

The change of temperature in vertical: the temperature changes at the different levels of 700, 500, 300, 200 hpa were given in Fig. 3.

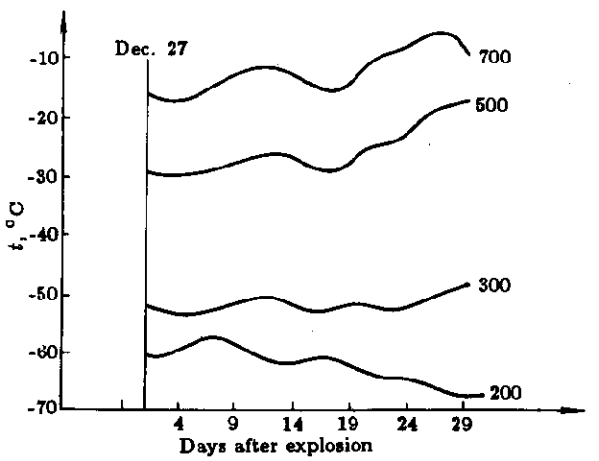

Fig. 3 Temperature change at different levels in winter

Fig. 3 shows that there were two drop processes at the level of 700 hpa; the drop range was about 2°C, and the temperature returned to the normal after 2 weeks. But at the level of 500 hpa, there was only one drop process that is synchroneous with the 2nd stage at the level of 700 hpa, and returned to the normal after 4–5 days. The change of temperature at the level of 200 hpa was opposite to that near the ground. The temperature rose (about 1–3°C) in a week after explosion and then the temperature dropped. It might be the clouds made of dusts and smokes absorbed the solar radiation.

Effects of nuclear chimney on temperature in summer

Fig. 4 shows the effects of nuclear chimney in summer on temperature. It is found in Fig. 4 that because of the effects of chimney after explosion, the marked drop of temperature

occurred at each station. In general, the drop of temperature ranges comparable with that before explosion were about 3–6°C, the sustained period was about two weeks. Afterwards, the temperature returned to the normal.

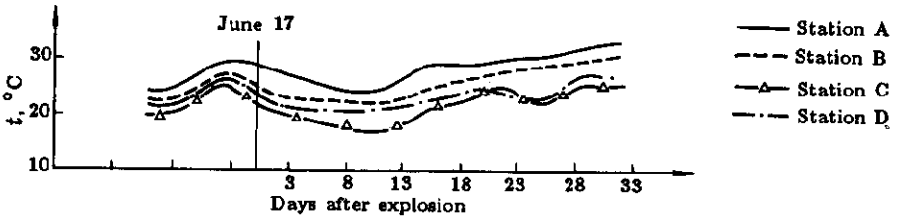

Fig. 4 Temperature change in summer

The mean square errors have been calculated for three periods at each station and shown in Table 2. It is interesting to notice in Table 2 that the mean square errors with 3–5 were the greatest in the two weeks after explosion. It means that the temperature was dropped markedly in this period.

Table 2 The RMS for three periods in summer at three stations

Time period	Station		
	B	C	A
11 days before explosion	2.72	3.31	2.52
1–13 days after explosion	3.53	4.89	2.86
14–28 days after explosion	2.29	2.15	2.61

Fig. 5 shows the temperature change at each level. At the level of 700 hpa, the temperature dropped markedly, the drop range was from 2°C to 4°C and sustained two weeks. At the level of 500 hpa, the temperature dropped very little. At the level of 200 hpa, the temperature rose in 1–2 days after explosion, and then the temperature dropped.

EFFECTS OF NUCLEAR CHIMNEY ON SUNSHINE

Fig. 6 gives the sunshine change after the nuclear explosion in winter. It is noticed in Fig. 6 that the change of sunshine was not as marked as that of temperature. At the initial stage, the change appeared with a wave pattern, and then, it dropped obviously beyond about 20 days after explosion. The number of hours for sunshine decreased by about 3–4 hours compared with that of multi-year mean or explosion ago.

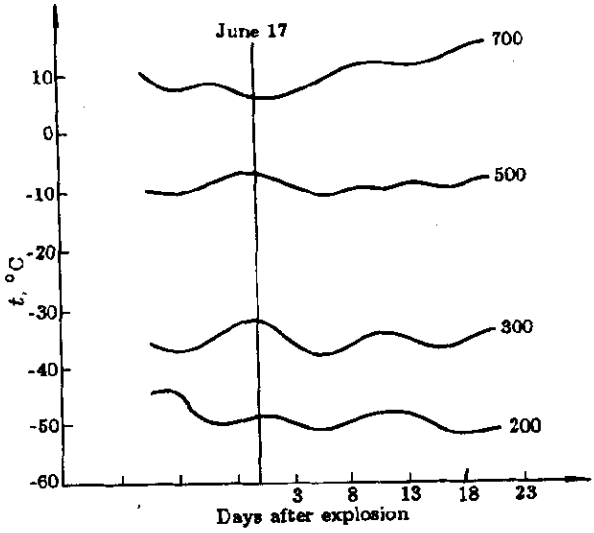

Fig. 5 Temperature change in different level in summer

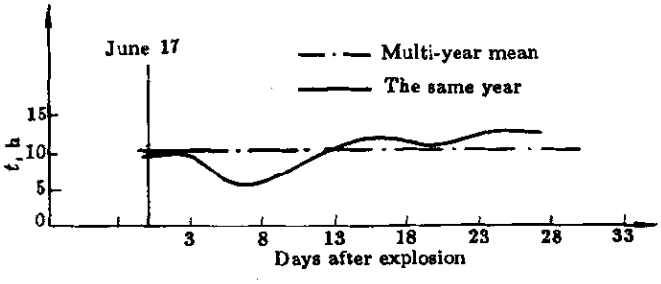

Fig. 6 Sunshine change in winter

The sunshine in summer is shown in Fig. 7. The effects of nuclear chimney on sunshine in summer was very obvious. After explosion, the number of hours for sunshine reduced by about 3–5 hours per day, and this situation sustained for 7–14 days.

SUMMARY

As mentioned above, the nuclear explosion chimney for a single equivalent magnitude of million tons, whenever it occurred in winter or in summer, it caused the drop of temperature in a short period. But there was a great difference in the respects of effect scale and extent.

Effects on temperature in winter: The air temperature dropped by 3–7°C and sustained for 2 weeks. At the same time, the wind direction mostly was southwesterly. The temperature

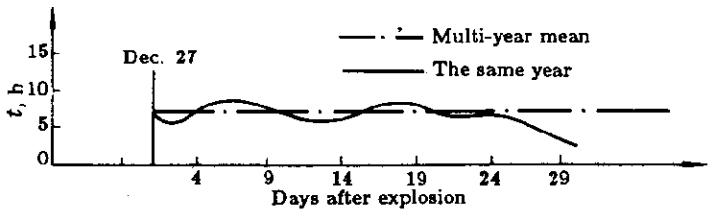

Fig. 7 Sunshine change in summer

at ground dropped by about 6–7°C and sustained for 16–17 days.

Effects on temperature in summer: The change of temperature at 700 hpa was similar to that at near ground, but the drop range was about 2°C only. The temperature between the tropopause layer and lower stratosphere rose by about 1–3°C.

Effects on sunshine: It is more obviously in summer than that in winter. The number of hours for sunshine reduced by about 2 hours in winter and 3–4 hours in summer.

There have been few published paper about the climatic effect of single nuclear explosion. Our analysis is only an initial exploration. Some problems on "Nuclear Winter" will go further into the research.

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