Tôhoku Geophys. Journ. (Sci. Rep. Tôhoku Univ., Ser. 5), Vol. 36, No. 4, pp. 462-465, 2003

High Ignition Probabilities of Lightning Caused Forest Fire in Alaska (Extended Abstract)

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(Received December 20, 2002)

Abstract: Recent trend of lightning-caused forest fires and lightning in Alaska are obtained by analyzing last about ten years of data for lightning-caused forest fire, lightning and weather observation data. Recent fire trend will help us to understand the role of lightning-caused forest fire on boreal forest succession and permafrost.

Major results are summarized in the following items:

1. Number of Fires and Lightning Flashes

Average annual number of lightning-caused forest fires and lightning flashes in Alaska are about 210 and 27,000 respectively as shown in Fig. 1.

Apparent ignition probability (IPap=(Number of Forest Fires)/(Number of Lightning Flashes $\times 0.9) \times 100$ (%)) is around 0.78 %. This value is very small. This is because the above-mentioned lightning data contains lighting data for non-forest area. In other words, lightning will strike everything such as a rock, sand, and even water in a lake. This makes ignition probability small.

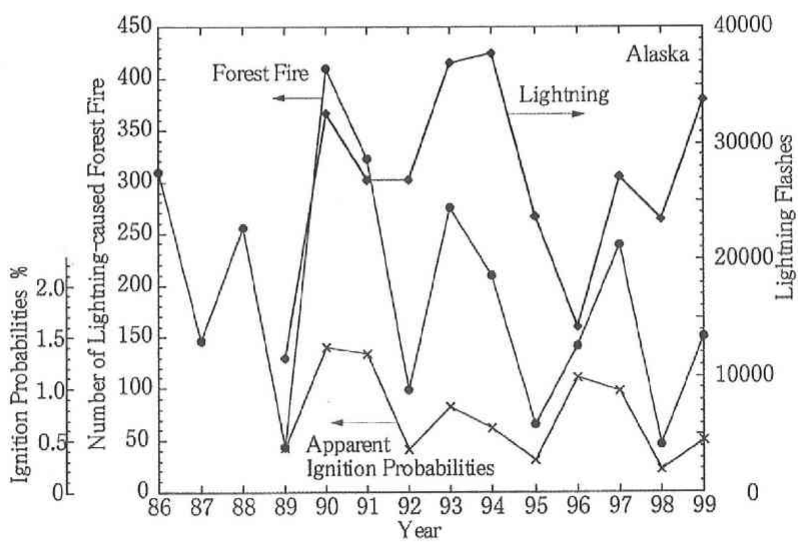

Fig. 1. Recent trend of forest fires and lightning

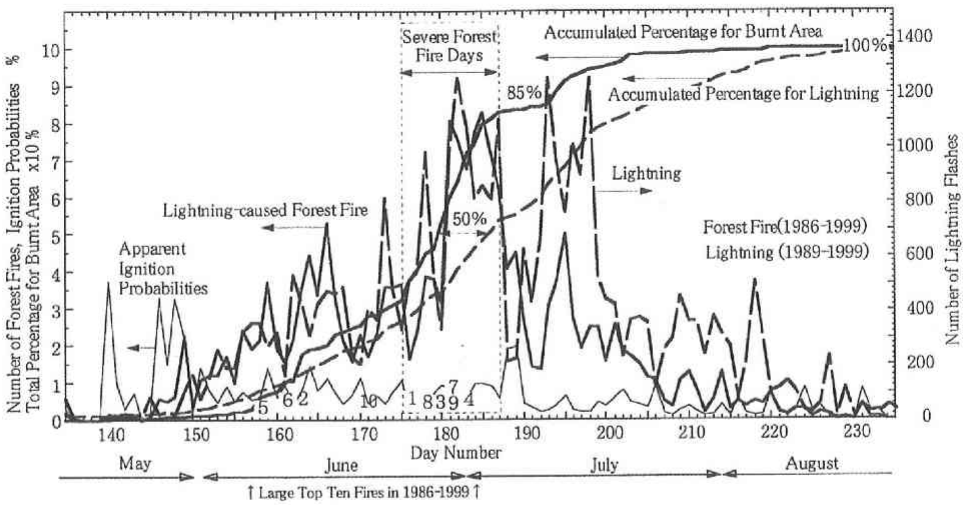

Fig. 2. Average occurrence of forest fire and lightning

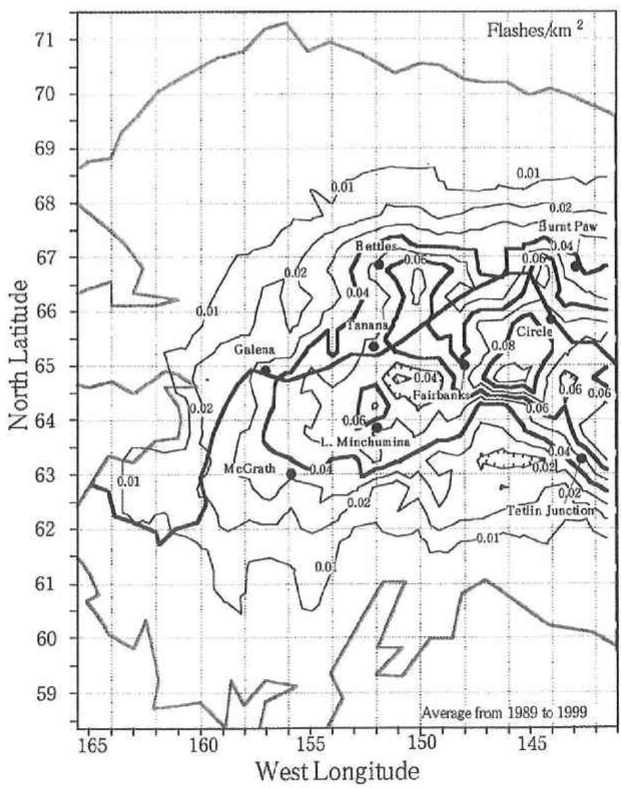

Fig. 3. Contour map of lightning density

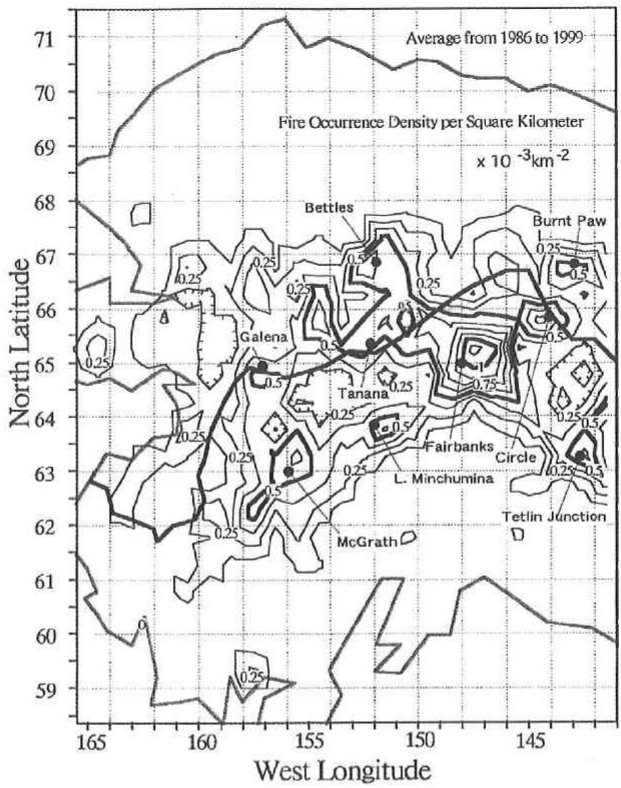

Fig. 4. Contour map of lightning-caused forest fine density

2. Mean occurrence trend of forest fire and lightning

Severe forest fire starts from day number of 175 (end of June) and ends around 187 (top of July) as shown Fig. 2. This period is the fire season for Alaska. In the fire season, lightning occurs frequently and forest fire follows. Maximum burnt area rate reaches 217 km²/day. After this fire season, vigorous occurrence of lightning continues about one more week. On the other hand, forest fires decrease rapidly. This may be due to precipitation.

3. Contour map of lightning density

Contour map of lightning density for Alaska clearly shows high lightning density area as shown in Fig. 3.

From Fig. 3, the high lightning density region (>0.06 strikes/km²) is located in the middle of Alaska or interior Alaska. In the area of east Fairbanks, lightning density becomes over 0.08 strikes/km².

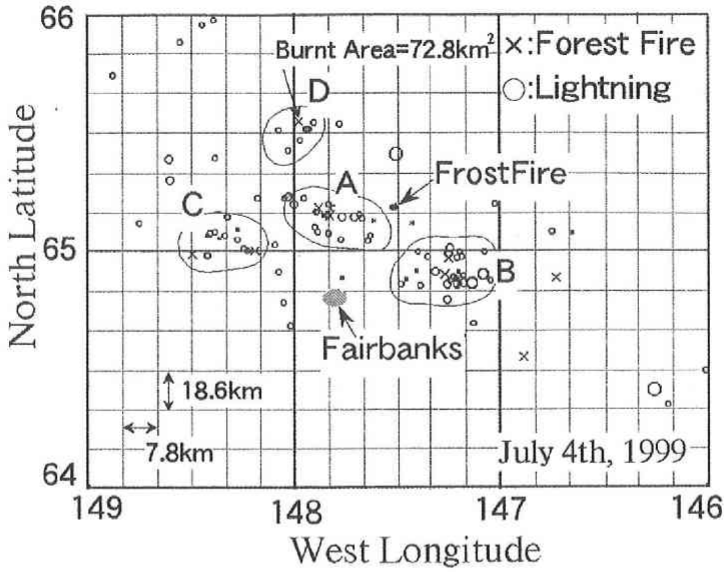

Fig. 5. lightning and forest fire map in the vicinity of Fairbanks

4. Contour map of fire density

Contour map of fire density for Alaska clearly shows high fire density areas as shown in Fig. 4. From Fig. 4, the high fire density areas ($>0.5\times10^{-3}$ km^{-2}) are mainly located in the middle of Alaska. The high fire density areas may have something in common with each other. Their landscapes are basin like and valley like where cumulonimbus cloud is frequently formed because upward air stream occurs easily near basin and valley.

5. High Ignition Probabilities near Fairbanks

If we can extract lightning data that strikes forest area from whole lightning data, true ignition probability will be obtained. Equation for true ignition probability will be : IPt=(Number of Forest Fires)/(Number of CG Lightning Flashes to Forest)×100 (%).

From Fig. 5, the daily and local ignition probabilities for the forest in the vicinity of Fairbanks are around 10%. These probabilities may be close to Ipt because areas, from A to D shown in Fig. 5, are in the forest. Their ignition probabilities are ten times higher than the annual and average apparent ignition probabilities. This difference directly shows that lightning is a major igniter of the boreal forest in Alaska.