

The Conditions of Occurring a Tornado

*Kanna Tsukagoshi¹

1. Yokohama Science Frontier High School

Introduction

Tornadoes are natural phenomena that occur in particular areas. To discover the conditions leading to the occurrence of tornadoes, an experiment of the collision of warm air and cold air was carried out to make a horizontal vortex, which was the cause of a tornado. Then, making a tornado with a horizontal vortex and ascending air was attempted. Furthermore, natural tornadoes in Japan were researched.

Method 1

Experiment 1 Making a Horizontal vortex

1. Make two holes on both sides of a Styrofoam box.
2. Add wind: from right-fog machine's smoke
from left-hair dryer wind passed over ice cubes
3. Observe the movements of the winds.
4. Change the difference of temperature, walls, and cylinder to control the quantity of smoke(Fig. 1).

Experiment 2 Making a Tornado

1. Make two holes on both sides of a cardboard box and another hole on the top.
2. Add the winds: from right - cold wind
from left - warm wind
3. Pull in the wind using a vacuum.
4. Observe the movements of the winds(Fig.2).
5. Change the temperature of wind using something.

Result 1

Experiment 1

-Please find the attached document.

Experiment 2

Tornado did not occur.

- The reasons
- The power of vacuum cleaner was too weak.
- Two types of winds repelled each other.
- The difference of temperature of two types of winds was not enough.

Method 2

1. Accessed web page named "The database of Gusts" of the Japan Meteorological Agency.
2. Downloaded "the reports of the research of tornadoes" from 1st April in 2016.
3. From the reports, collected the data
 - The speed of tornadoes
 - The of damaged area
 - The atmosphere in synoptic scale.
4. Downloaded the aerial photograph of the area where tornadoes occurred from web page of Geospatial

Information Authority of Japan.

Result 2

- The speed of a tornado is proportional to the length of damaged area(Fig.3).
- Where tornadoes occurred were like a fan from the aerial photograph.
- There are three places where tornadoes occurred twice in other day and the weather charts of these time were likely.

Discussion

The conditions of occurrence of tornadoes

- Collision of warm air and cold air whose temperature is much different from each other in a ground level makes a horizontal vortex occurs.
- To pass over the ascending current to the top of the horizontal vortex, a tornado occurs.
- The area where the tornadoes occur more frequently is changed by atmosphere in synoptic scale.

Future View

- Repeat experiment 2 to make a tornado by measuring the temperatures of two types of air with a thermocouple.
- Use upper-level weather charts and AMeDAS data, continue researching the data of tornadoes

Keywords: Tornado

Table 1 The result of experiment 1

	Ice cube (piece)	Wall	Result
1	1 0		×
2	1 0	①	×
3	2 0	①	△
4	2 0	① + ②	○

①: A wall ②: A box
×: Not observed
△: Start to occur
○: Observed

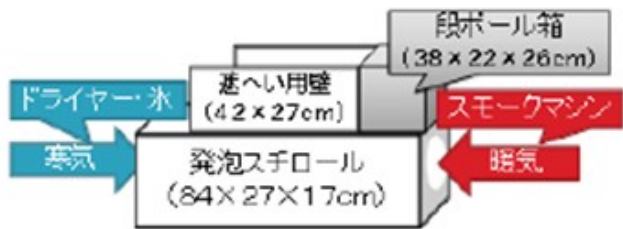


図1 実験1の装置概観



図2 実験1の様子

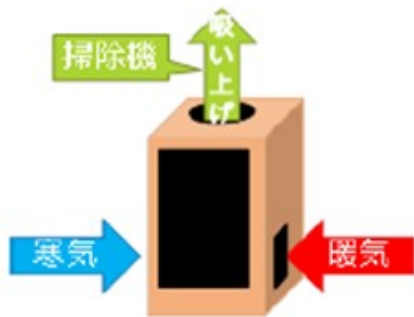


図3 実験2の装置概観



図4 実験2の様子

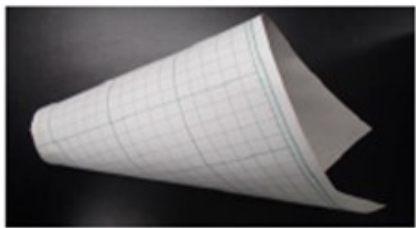


図5 実験で利用した煙調節筒

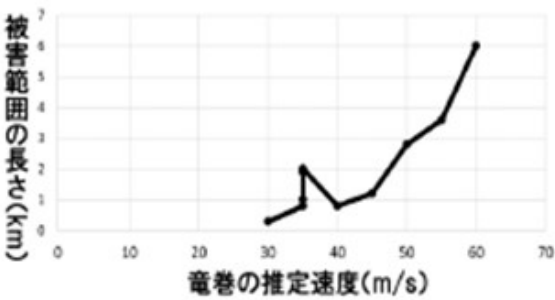


図6 竜巻の推定速度と被害範囲の長さ