2. Situations where accidents caused by snow and snowmelt occurred

(1) Classification of causes of accidents due to weather, etc.

As mentioned above, from October 2001 to March 2024, a total of 404 accident investigation reports have been published. Of accidents covered by these reports, 87 cases were caused by weather or related factors, accounting for about 20% of the total. Looking at the breakdown of weather-related factors, etc. (Figure 1), snow and snowmelt (hereinafter referred to as "snow, etc.") accounted for a total of 34 cases, accounting for about 40%, indicating that these phenomena have a major impact on railway operations and require attention. In addition, other factors include rain (23 cases: rockfalls and slope collapses due to rain, rise in river water levels, etc.), weathering (12 cases: rockfalls and slope collapses, etc.), and earthquake (10 cases). Wind-related factors are relatively few, totaling six cases for strong winds and gusts such as tornadoes.

In the 10-year period from 2013 to 2022, the total number of accidents investigated was 168 cases, of which 27 cases were attributed to weather or related factors, accounting for about 16% of the total, which is relatively few. However, looking at the breakdown of weather-related factors, etc., those caused by snow, etc., totaled nine cases, remaining the most common, followed by rain with eight cases.

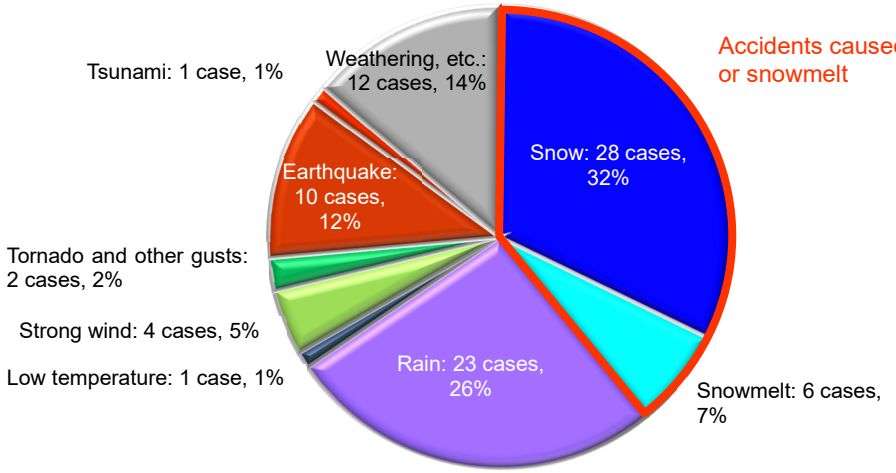

Figure 1: Breakdown of weather-related factors, etc.

(2) Classification of situations where accidents caused by snow, etc. occurred

Looking at the breakdown of accidents caused by snow, etc., by accident type (Figure 2), about 90% were train derailments, and, for the causes of train derailment accidents (Figure 3), 90% were due to flange climbing. The objects that were climbed up (Figure 4) were most frequently caught snow (snow accumulated around bogies and underfloor equipment after accumulating on the track and being picked up by the running train) and compacted snow at level crossings (compacted snow in flangeways, gaps between closely adjacent rail heads through which wheel flanges pass, of a level crossing), both of which fall under the factor of "snow" in Figure 1.

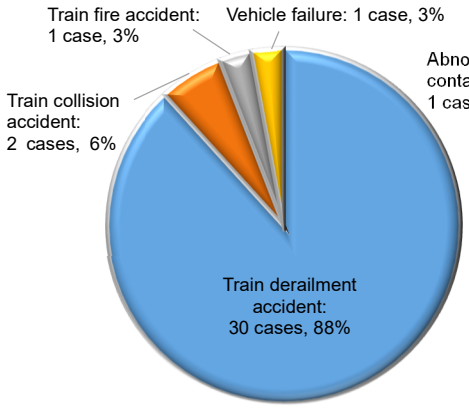

Figure 2: Breakdown of types of accidents

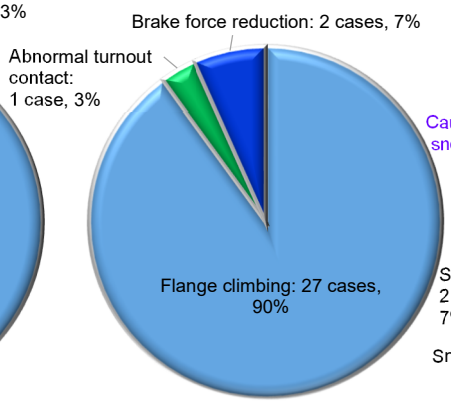

Figure 3: Breakdown of causes of derailment accidents

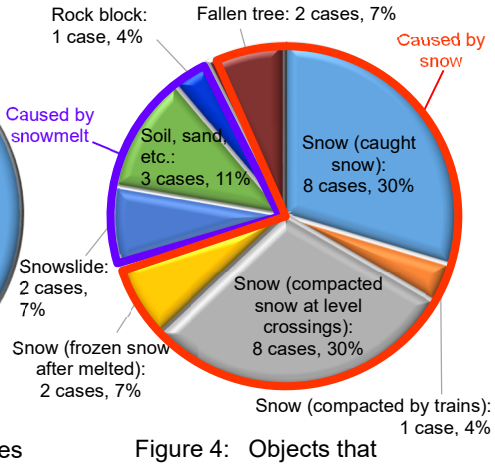

Figure 4: Objects that were climbed up

(3) Situations where accidents occurred by cold-season-centered year and by month

Looking at the number of accidents caused by snow, etc., (34 cases in total) by cold-season-centered year (Figure 5), there is a tendency for the number of accidents to particularly increase in years with heavy snowfall. During the 2006 heavy snowfall (the heavy snowfall from December 2005 to early January 2006), which brought record-breaking heavy snow over a wide area, accidents occurred in many places from Hokkaido to the Hokuriku region. In addition, in the cold-season-centered year of 2012 when Hokkaido experienced heavy snowfall, accidents were concentrated in the areas that had heavy snow, including areas outside Hokkaido. Looking at the classification of situations where accidents occurred, although since the cold-season-centered year of 2014, there have been no accidents caused by caught snow, accidents due to compacted snow at level crossings account for about 30% of all accidents, and the most recent occurrence was in 2022 (see page 6 for compacted snow at level crossings).

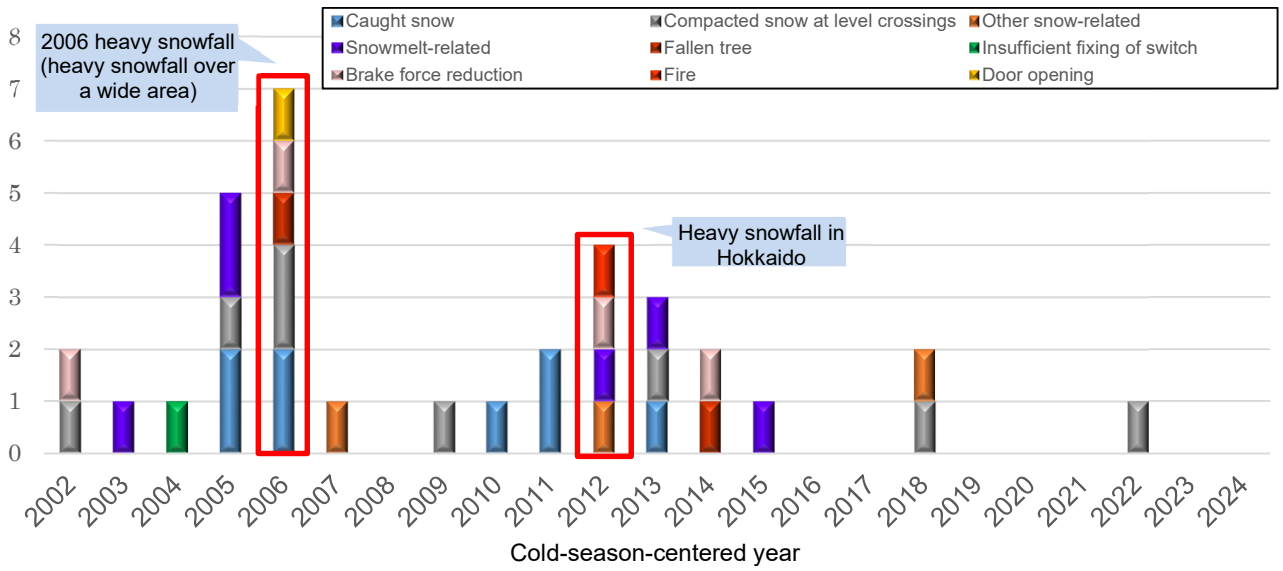

Figure 5: Situations where accidents caused by snow, etc. occurred by cold-season-centered year

As for the number of accidents by month (Figure 6), accidents caused by snow occur frequently in January and February, while accidents caused by snowmelt are concentrated in March and April. Since accidents caused by compacted snow at level crossings begin to occur in December, caution is required from early in the snowfall season.

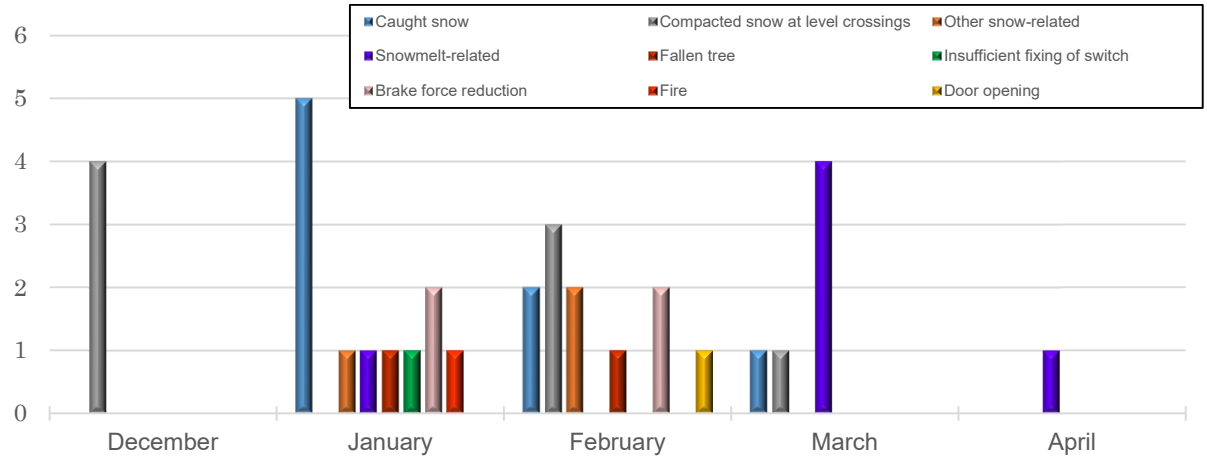

Figure 6: Situations where accidents caused by snow, etc. occurred by month

(4) Locations, situations, etc. where accidents occurred

About 90% of the accidents caused by snow, etc., occurred in heavy snowfall areas or special heavy-snowfall areas (areas designated under the Act on Special Measures concerning Countermeasures for Areas of Heavy Snow, hereinafter referred to as "heavy snowfall areas, etc.") (Figure 7). Four accidents occurred even in areas other than heavy snowfall areas, etc. (hereinafter referred to as "low-snowfall areas"), and three of them occurred in areas that experienced record or near-record heavy snowfall from the day before to the day of the accident. In such areas, because accidents caused by snow, etc., are themselves rare, accidents that occurred in the past are considered to be important lessons for preventing recurrence in the future (see page 10).

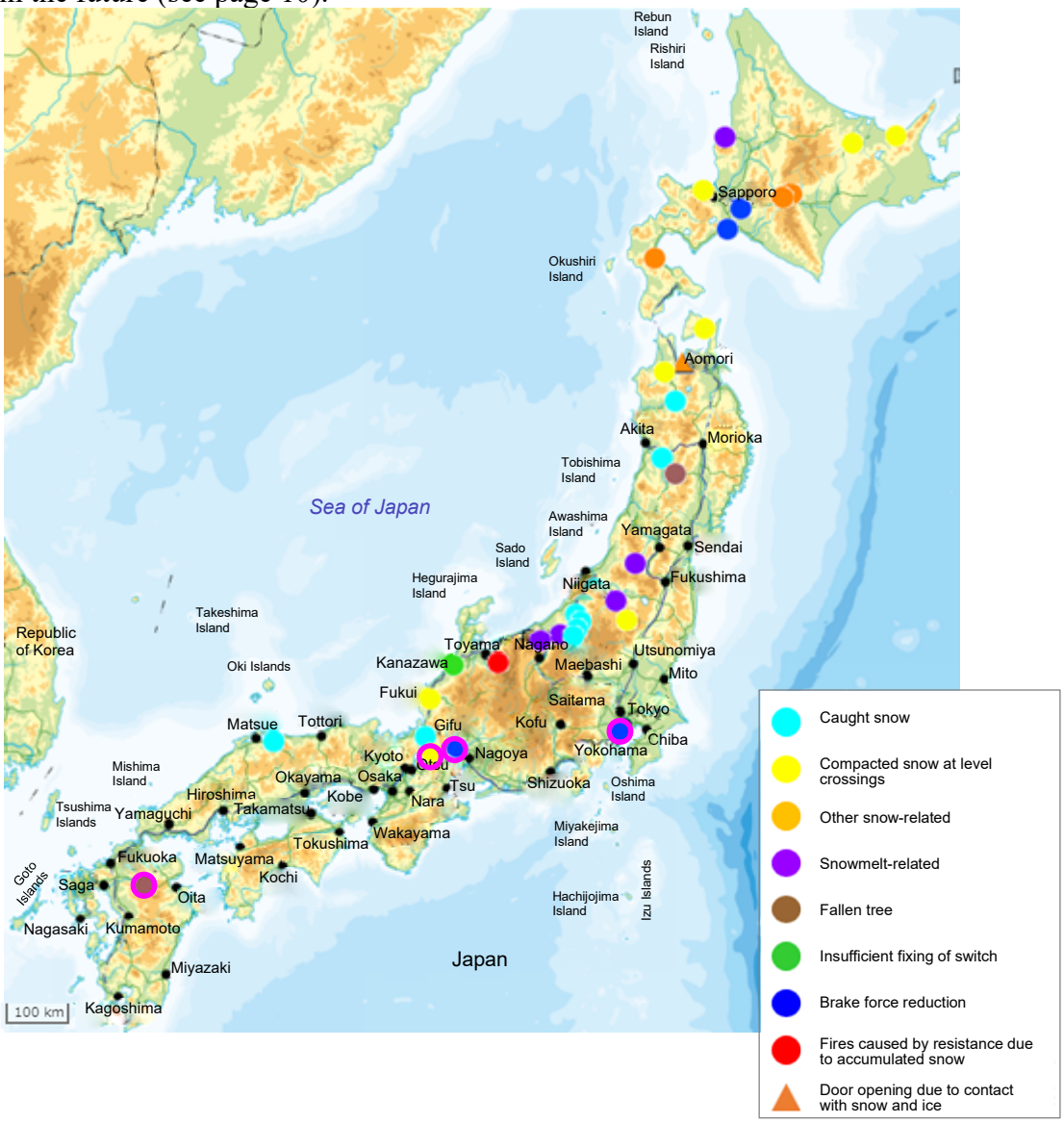

Figure 7: Locations where accidents caused by snow, etc. occurred

Created using the Geospatial Information Authority of Japan's GSI Maps (web maps).
Pink circles (○) indicate accidents that occurred in low-snowfall areas.

Among the accidents caused by snow, etc. (34 cases in total), there were cases in which human and/or organizational factors were also involved. To cite some examples, there were eight cases where human factors related to organizational problems in snow removal, decisions on its implementation, etc., were involved (see page 12), four cases related to slope inspections, measures against falling rocks, temporary slope inspections (enhanced train patrols, etc., when temperatures continue to rise when snow has been accumulated), etc., and three cases where human factors such as inappropriate use of snow brakes by a driver when the train was running (see pages 5 and 12) were involved.

Column

Measures for the prevention of railway operation accidents during snowfall and snow accumulation, etc.

Railway operators have made numerous efforts related to snowfall and snow accumulation to prevent railway operation accidents caused by snow. We spoke with East Japan Railway Company about their efforts, which are introduced below.

Major efforts at East Japan Railway Company

(1) Efforts for safe and stable transportation during snowfall and snow accumulation

In the Tokyo metropolitan area, there is a risk that switches fail to operate after snow has accumulated in the gaps of switches during snowfall. To prevent this, trains are operated at regular intervals. In addition, after the last scheduled service, we run deadhead trains (freezing-prevention run: a temporary operation for such a purpose) and railway motor cars to prevent overhead contact lines from freezing and snow accumulating on rails. If heavier snowfall is expected, we make efforts to maintain safe and stable transportation by, for example, changing to temporary timetables that eliminate the need for switch operation or temporary timetables with reduced service frequency so that impacts of heavy snowfall are minimized.

Drivers use snow brakes during snowfall and snow accumulation. A snow brake is a device that brings brake shoes and the wheel into contact in advance to prevent snow from entering the gap between them and causing the brake to fail to function properly. When using snow brakes, because they behave differently from normal brakes, drivers operate the brakes more cautiously than they would under normal conditions. Although the operation control center, for example, issues instructions to start using snow brakes, the specific timing is determined by each driver. In the case of heavy snowfall, drivers may be strongly informed and encouraged to use snow brakes. Furthermore, each year as the snowfall season approaches, during driver training we convey past snow-related accidents and their countermeasures, the importance of snow brakes, and other points to drivers to raise their awareness of accident prevention.

In heavy snowfall areas, snow-removal vehicles are used on a planned basis to remove snow so that train operations are not affected. Moreover, because snowslide may occur, locations at risk of snowslide are monitored for snow depth along the railway route using snow-depth gauges, and staff members riding in train cabs observe the snow surface for any cracks, to predict snowslide and take preventive measures to avoid accidents.

(2) Structural countermeasures

The countermeasures implemented in response to past railway operation accidents caused by falling or accumulated snow have been extended to other necessary routes and locations. For example, following a train derailment accident caused by snow accumulating in the gaps of level crossing rails and being compacted by passing vehicles, we have installed snow-melting devices in the rail gaps of level crossings to prevent snow from being compacted. At level crossings prone to snowdrifts, snow-melting devices have also been installed in locations other than between rails to avoid similar accidents. In addition, at sites where slope collapses occurred because of rapid snowmelt, we have implemented grating crib works and other works. Not limited to snowmelt, we have been implementing works on slopes with a high risk of inflow of soil and sand, making efforts to reduce the risk of railway operation accidents.

Figure 8: Example overall view of a location where a level crossing snow-melting device has been installed. There is little snow on the road near the level crossing. (From the East Japan Railway Company website)

(3) Relationship with other operators

We regularly exchange views with various railway operators across Japan and share efforts to prevent accidents and issues in maintaining safe operations. In some cases, we have adopted useful accident countermeasures used by other railway operators.