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Pedestrian road weather at FMI

Road Weather Event Week

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11.12.2019

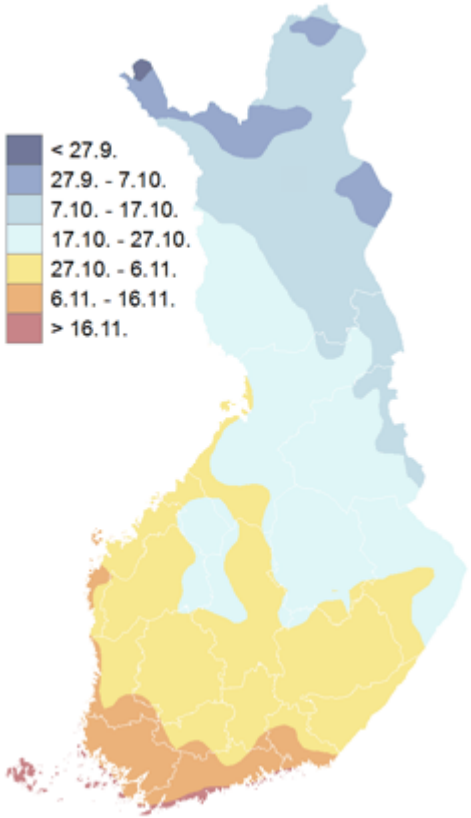
Content of the presentation

1. Background
   - Snowy season in Finland
   - Slippery cases
   - Statistics of the slipping injuries
   - Sidewalk maintenance in Finland
2. FMI's sideway condition model and warnings of slippery sidewalk condition
   - Model description
   - Problems and problematic cases
   - Weather warnings
3. Monitoring slipperiness on the sidewalks
4. What has been done in other countries
5. Conclusions
   - How to prevent slipping injuries

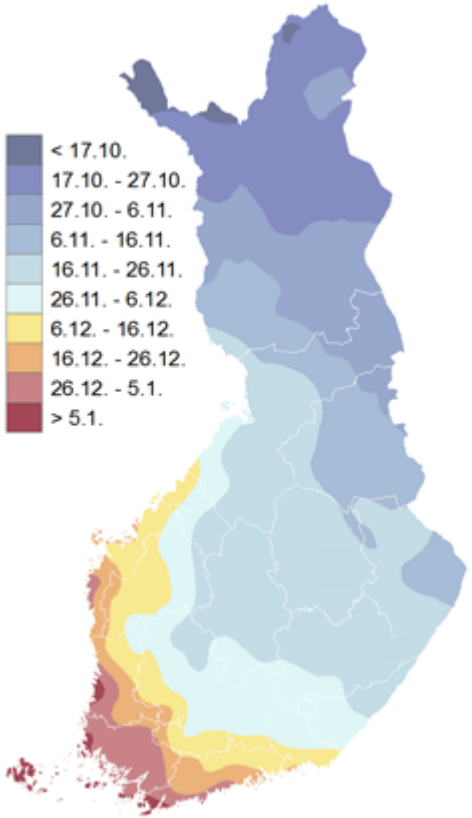
Background

Snowy season in Finland
Slippery cases
Statistics of the slipping injuries
Sidewalk maintenance in Finland

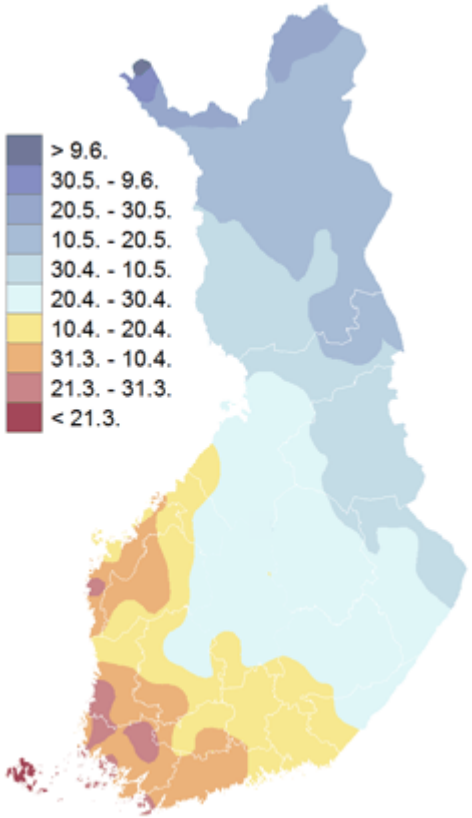
Snowy season in Finland



Average date of first snow cover (1981-2010 normal period)



Average starting date of permanent snow cover (1981-2010 normal period)



Average ending date of permanent snow cover (1981-2010 normal period)

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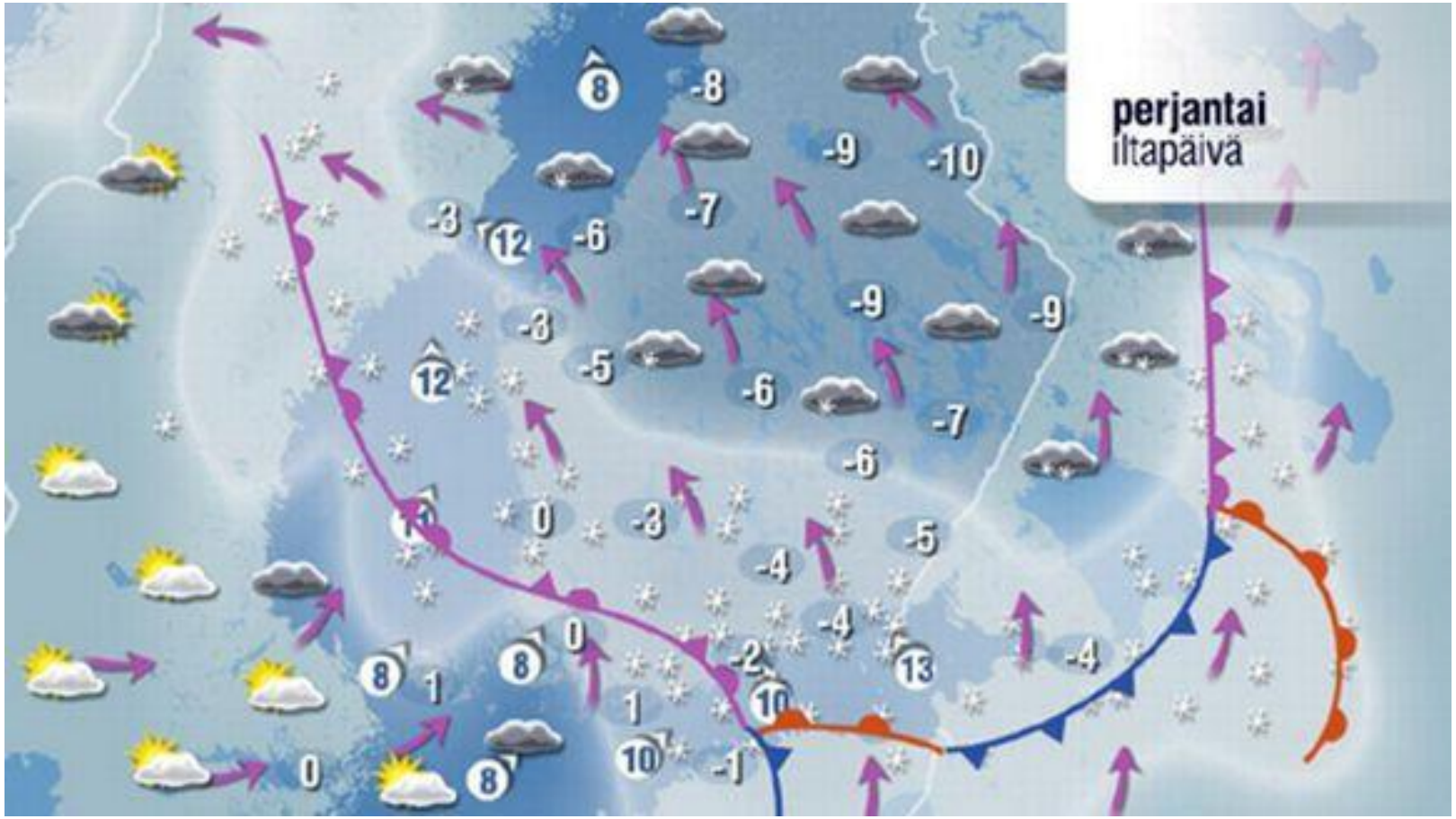
Snow on the ground typically 3 – 6 months

Typical weather map for Finland on winter time



Slippery

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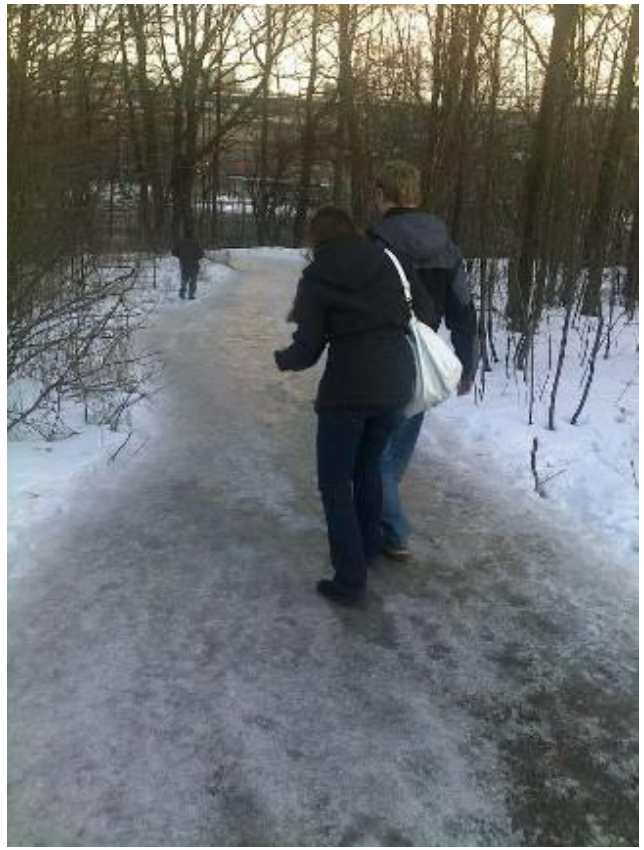
Very slippery



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Extremely slippery

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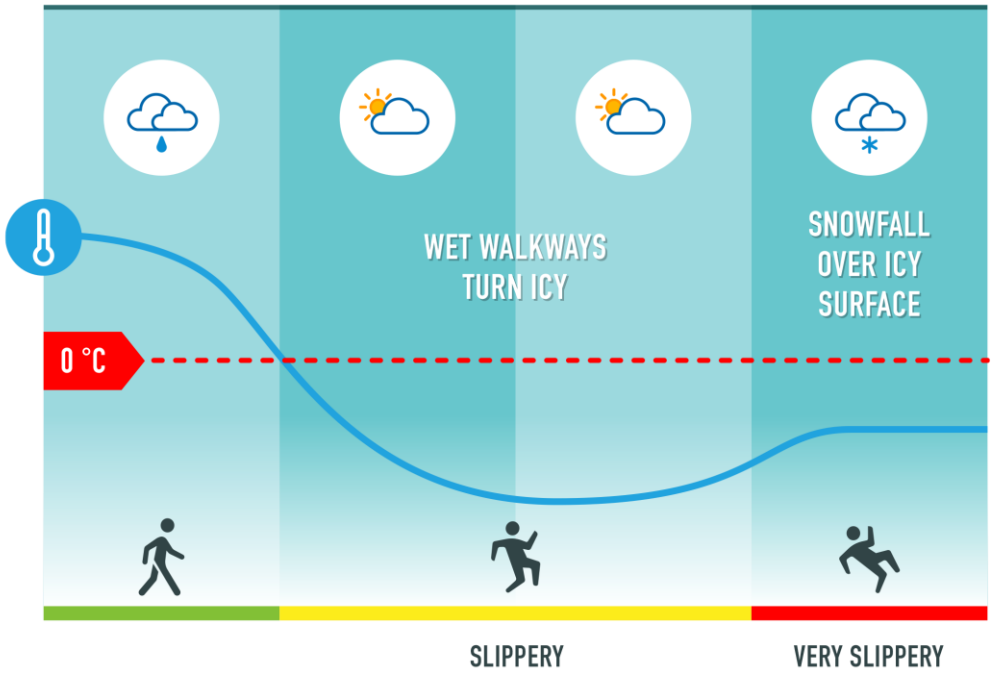
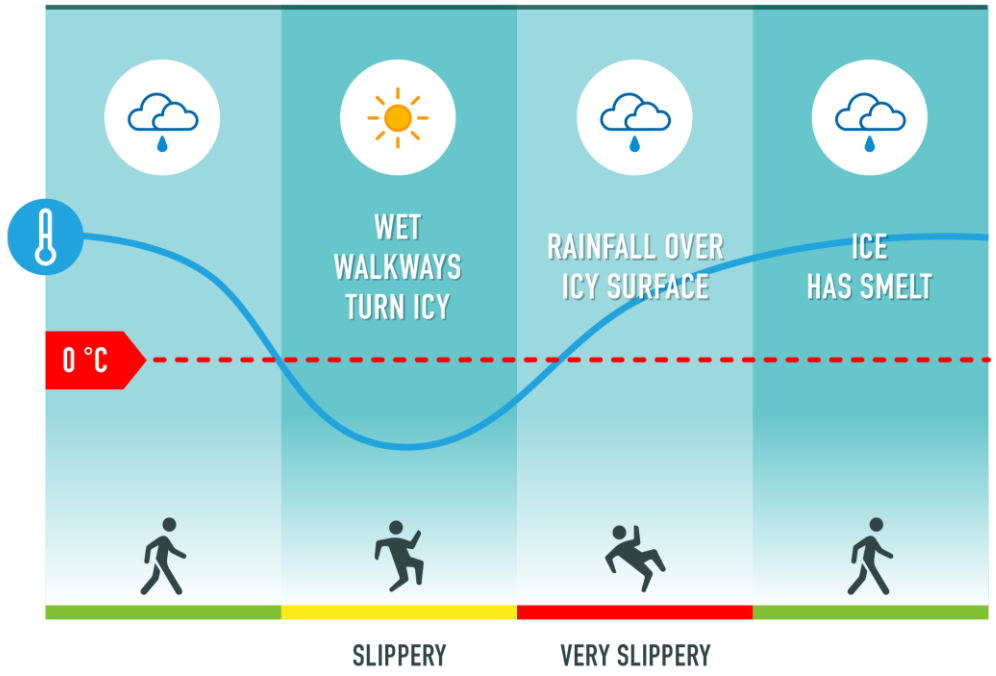
Slippery sidewalk condition

- Car traffic has typically problems in case of snowfall → low visibility and reduced friction
- New snow means often good grip for pedestrians (if no ice below the snow)
- The most difficult sidewalk conditions are:





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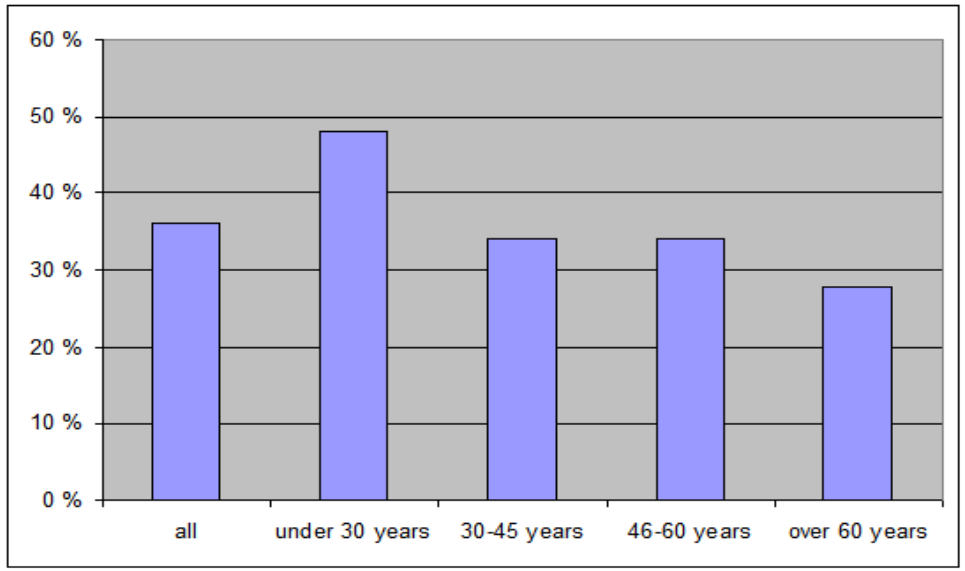
Who use to slip?

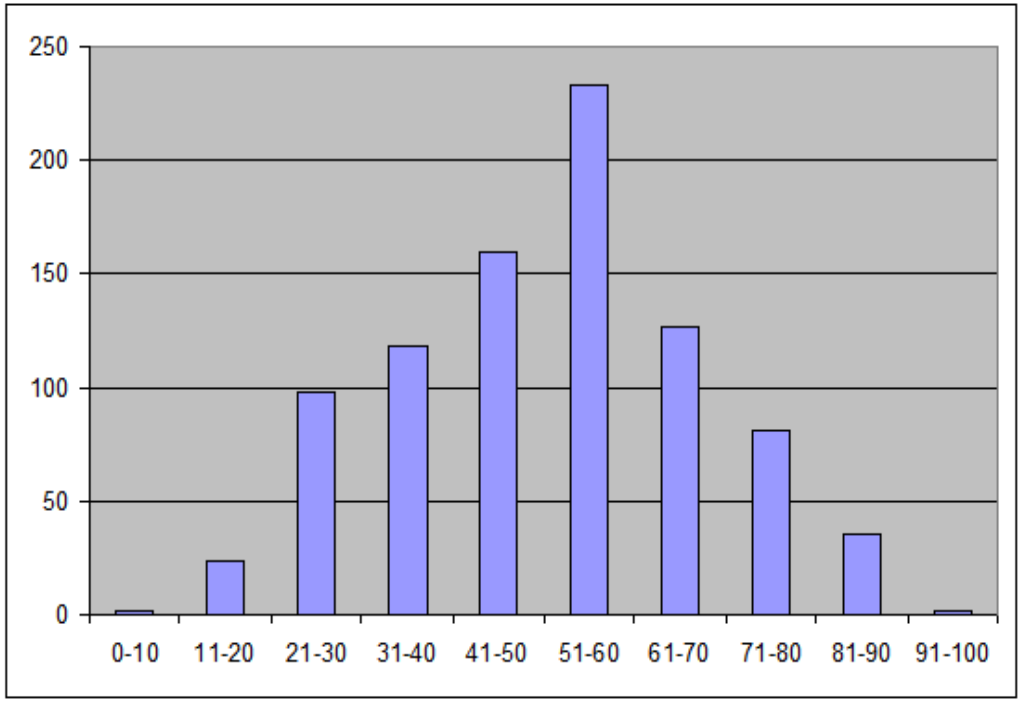


Wintertime slipping statistics – age distribution

People use to slip regardless of age and gender.

Young people (under 30 years) use to slip more often than older people

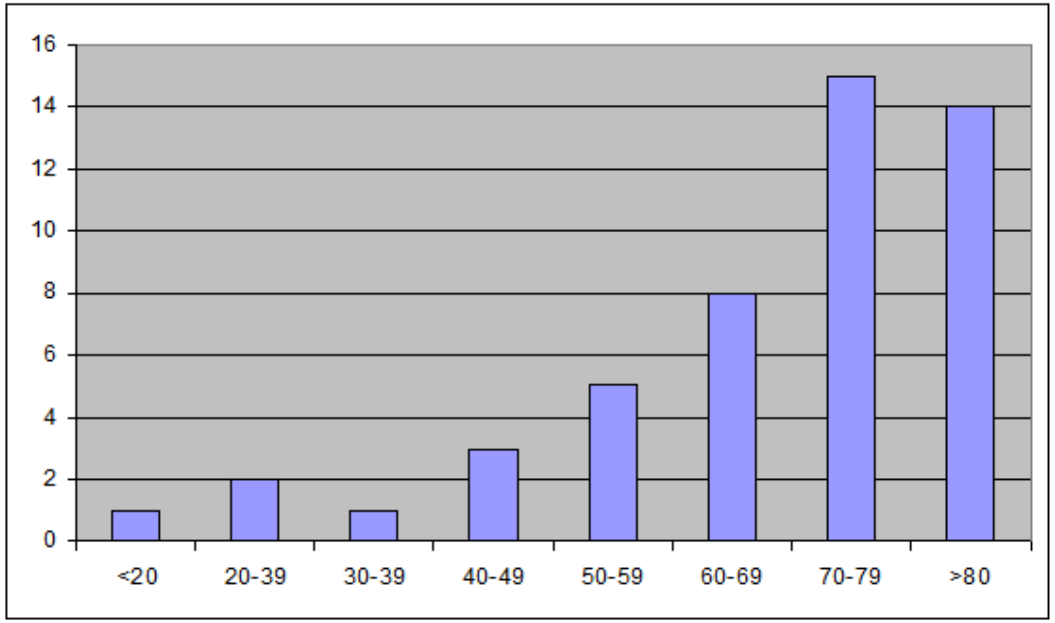
Who use to hurt him/herself when slipping?



The number of slipping injury patients and different age ranges in Helsinki (Töölö) Hospital Emergency on years 2003-2006 (winter)

People between ages 40 and 70 need most often medical attention.

Age distribution of patients with hip fracture due to slip or fall injuries

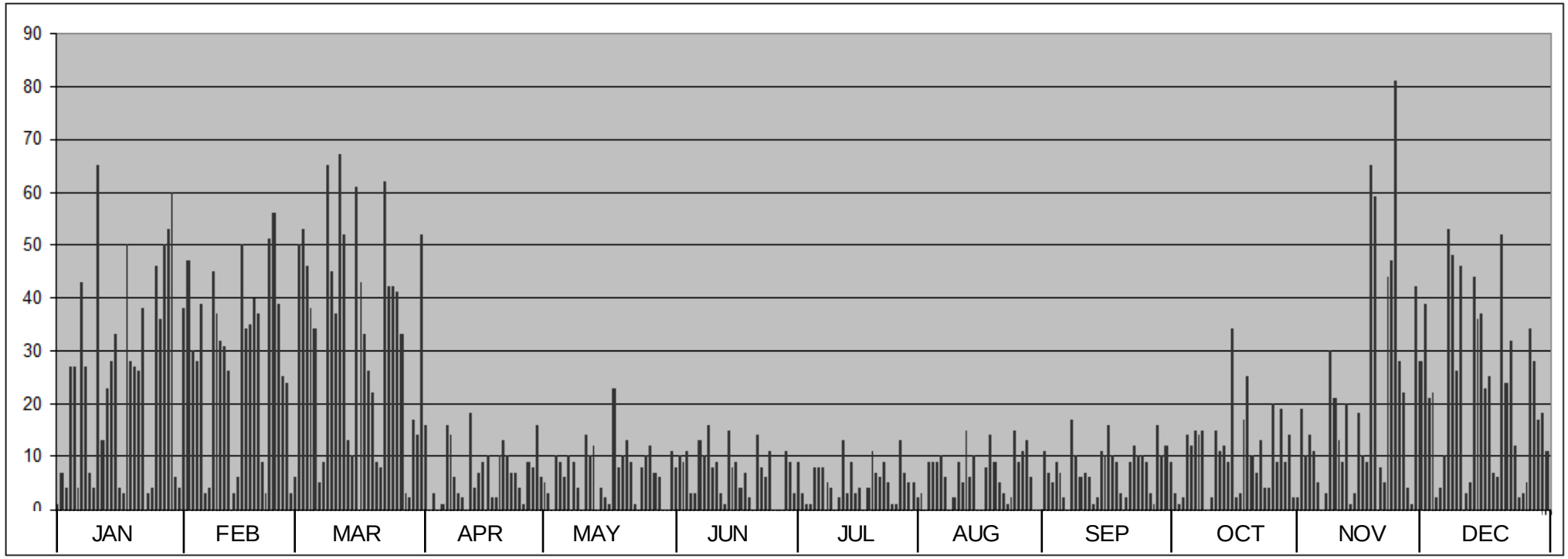


The number of slip injury patients and different age ranges with hip fracture due to slipping injuries in Töölö Hospital Emergency on years 2003-2004

Slip injuries are the most harmful for elderly people because they may get hip or other fracture more often than younger people when falling or slipping.

The cost of one hip operation is 20 000 – 40 000 euros

Slipping statistics, year 2010



Number of daily pedestrian slipping injuries happened on the way from home to work or vice versa. Data includes injuries happened on Uusimaa province between 1.1.2010 and 31.12.2010. Source of data: Federation of Accident Insurance Institutions.

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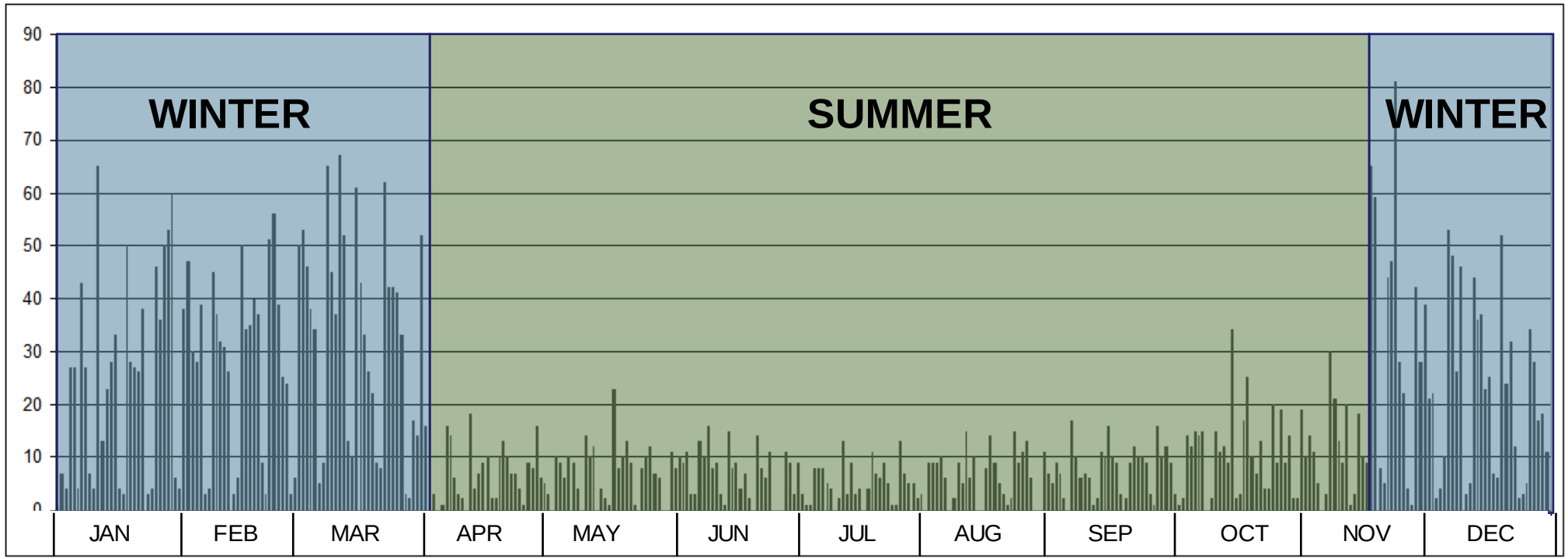
Slipping statistics, year 2010



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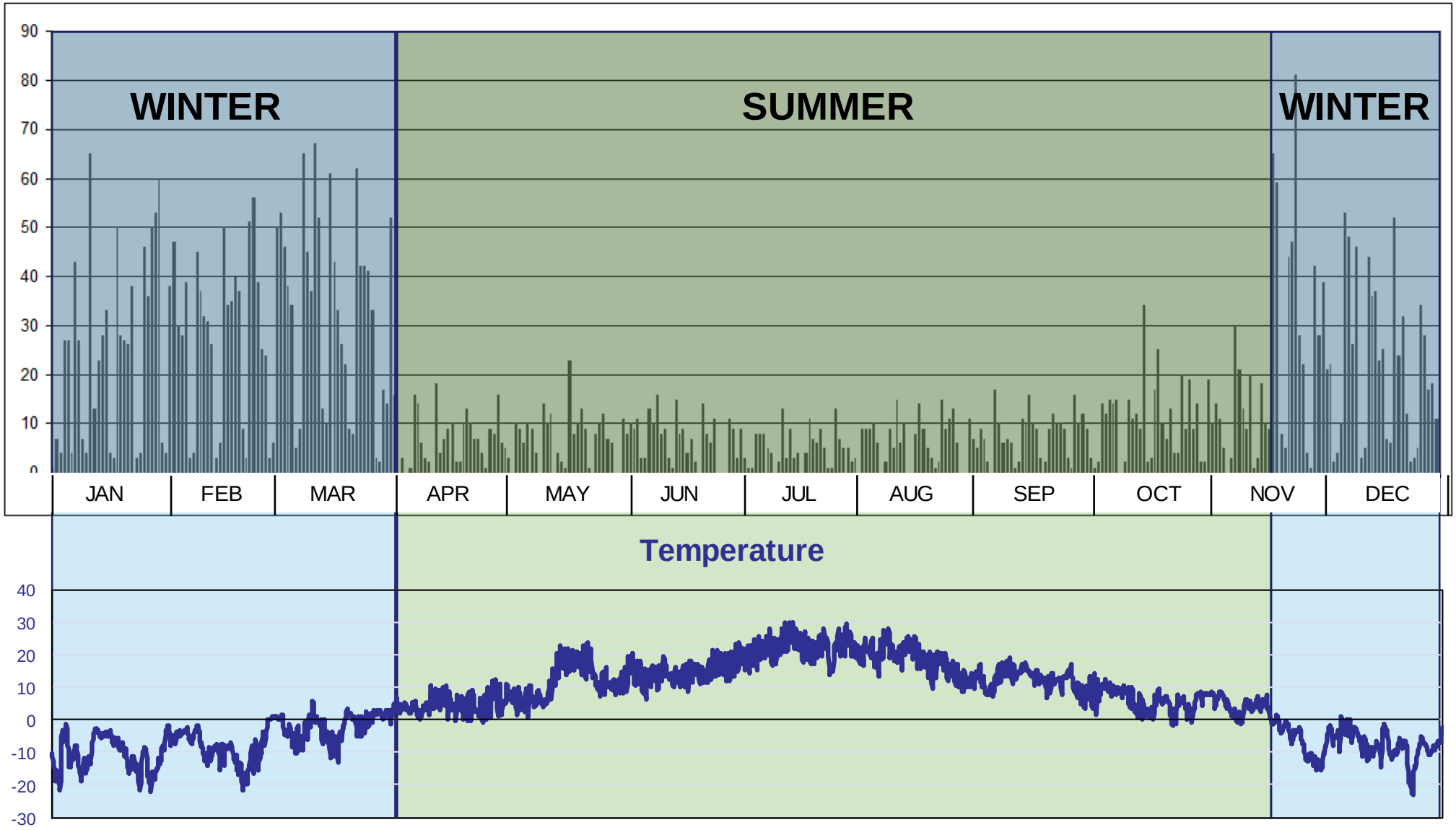
Slipping statistics – Temperature correlation



Temperature from Kaisaniemi, Helsinki

Numbers and costs of annual slipping injuries

- During wintertime occur about 50 000 pedestrian slipping injuries with serious consequences
  - Incidence of **1/100** in Finnish population
  - 2/3 of the injuries happen when sidewalk is icy and/or snowy
- 5000 bed patient, totally 30 000 days annually
- Slip injuries cost about 420 million euros per year
  - According to another study the costs are 2400 million €
  - Including costs in health care, lost-workdays and welfare

→ **Lots of potential to reduce the amount of injuries and costs**

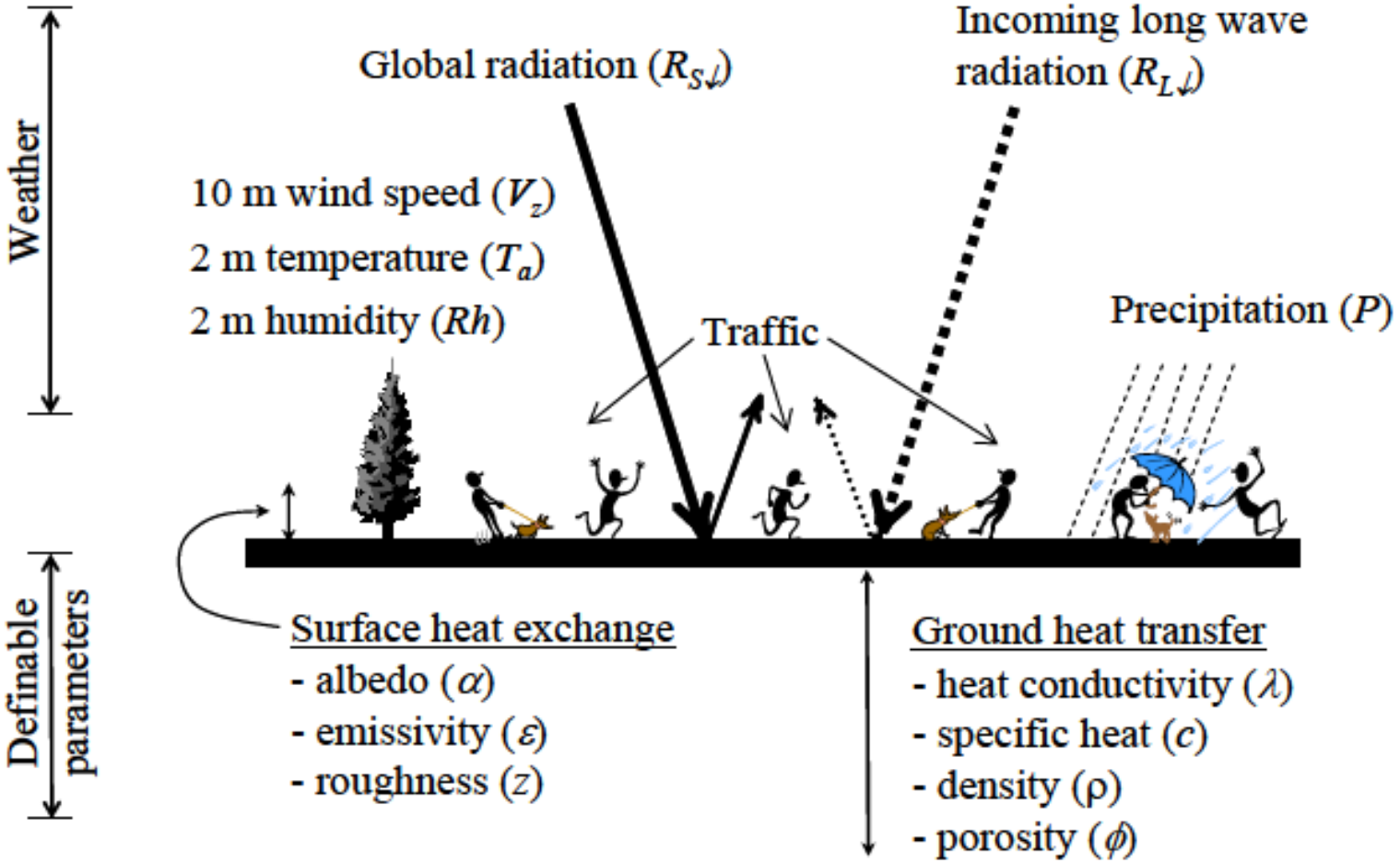
Sidewalk maintenance in Finland

- Calcium chloride (salt) mainly not in use
  - Only on critical places like stairs or on some most busiest ways
- No clear rules for sidewalk maintenance, e.g. snow removal, roughening or sanding/gritting (compare: very tight rules for highway maintenance)
  - Different rules in different cities
- Streets and roadways are maintained before pedestrian sidewalks in many cities

FMI’s sideway condition model and warnings of slippery sidewalk condition

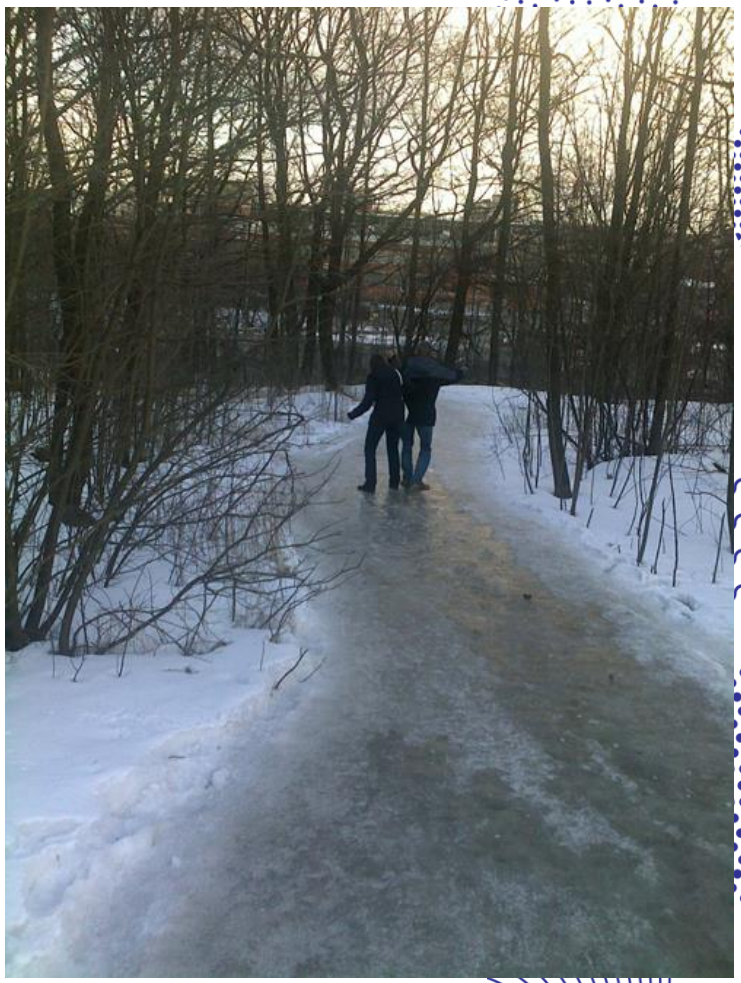
Model description
Problematic cases
Weather warnings

FMI's sidewalk condition model



Model details

- **Past, present and forecasted weather**
  - Observation part: input weather observations (4 days)
  - Forecast part: input numerical weather prediction model (2 days)
- **Model have storages for water, snow, ice and frost**
  - Weather has an impact for storages
  - Storages are interacted with each other
- Two types of model run:
  1. ice on the surface
  2. no ice on the surface
- **Output: Slipperiness index**
  - **normal**
  - **slippery**
  - **very slippery ← warnings are given**



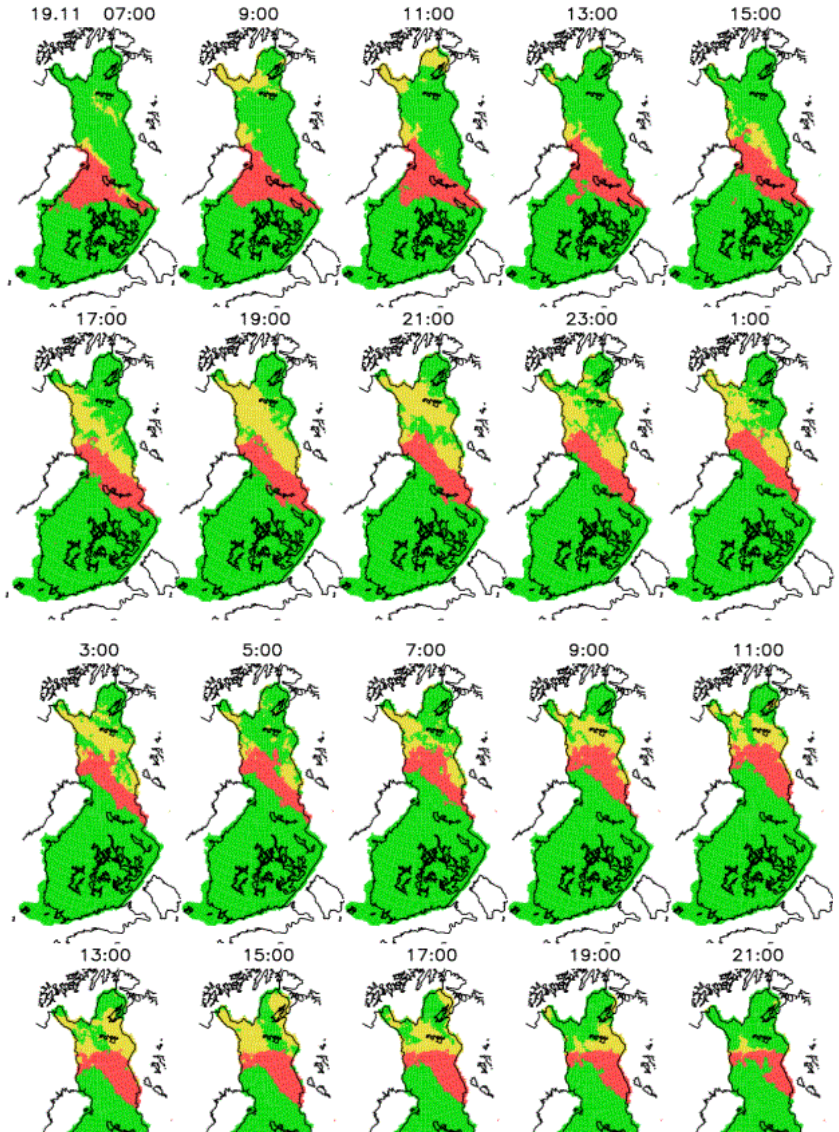
Slipperiness classification

5 different slipperiness classes

1.	No slipperiness	normal
2.	Slippery	difficult
3.	Packed snow	
4.	Water above the ice layer	very difficult
5.	Snow above the ice layer	

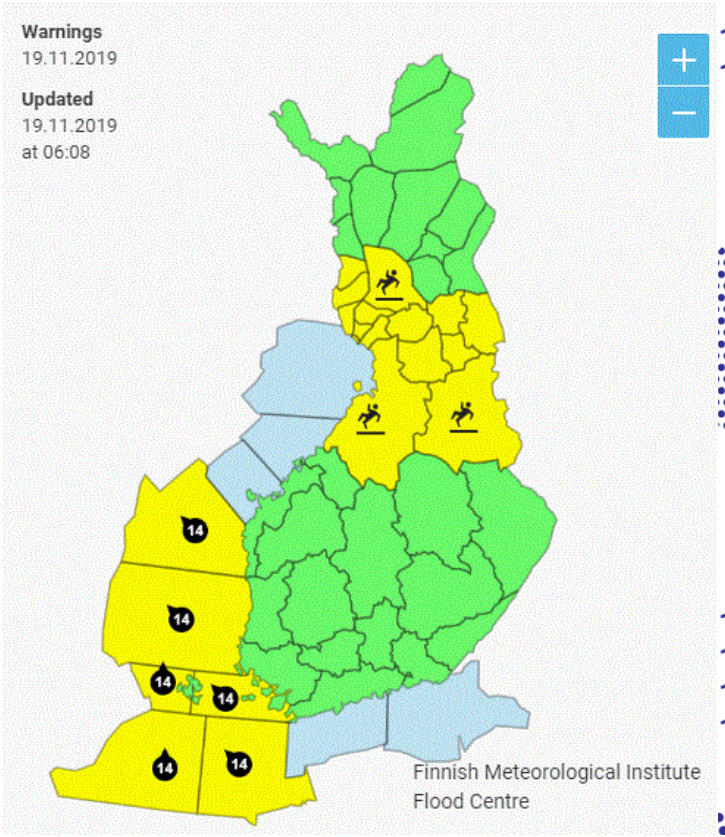
- Warning given in case of classes 4 and 5 (sometimes 3)
  - Normal walking is difficult and the risk of slipping injuries increase
- Very slippery days typically 5-15 per winter

Model outputs



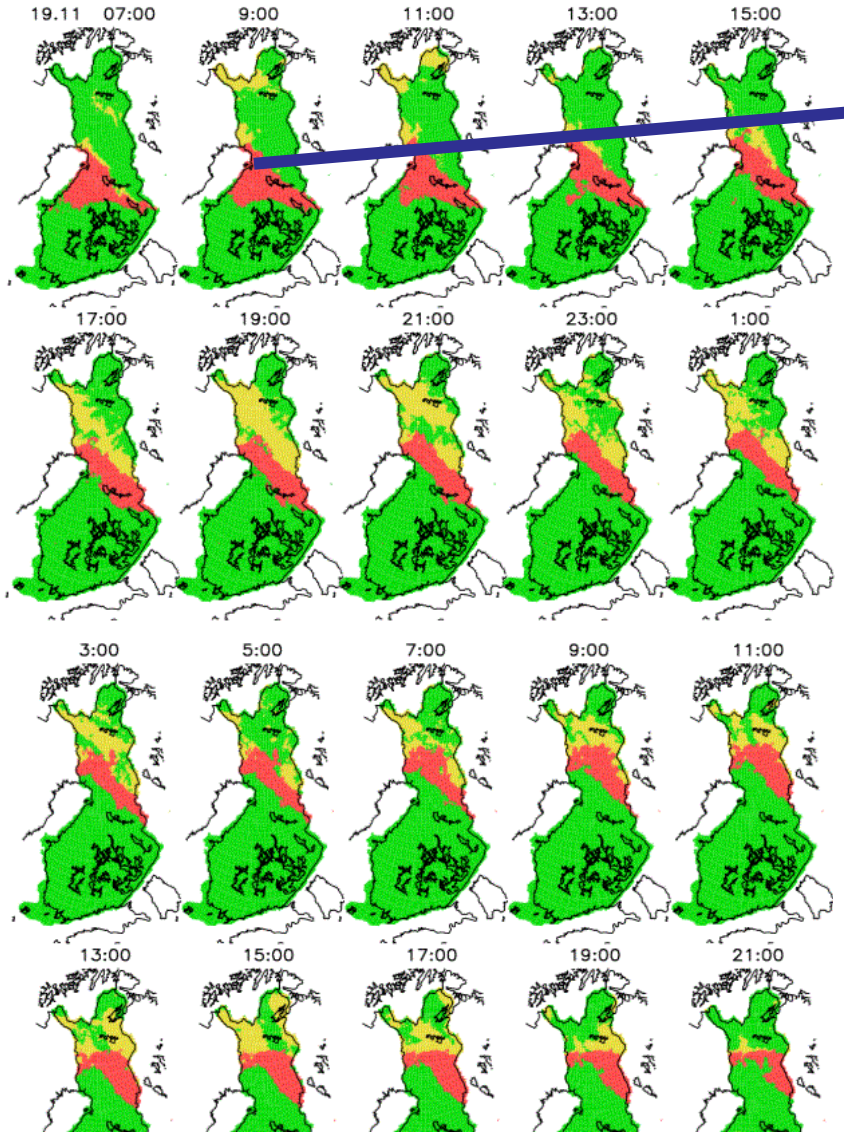
An example of FMI's sidewalk condition model output

- Normal
- Slippery
- Packed snow
- Water above ice
- Snow above ice



Weather warning map provided by Finnish Meteorological Institute

Model outputs



An example of FMI's sidewalk condition model output

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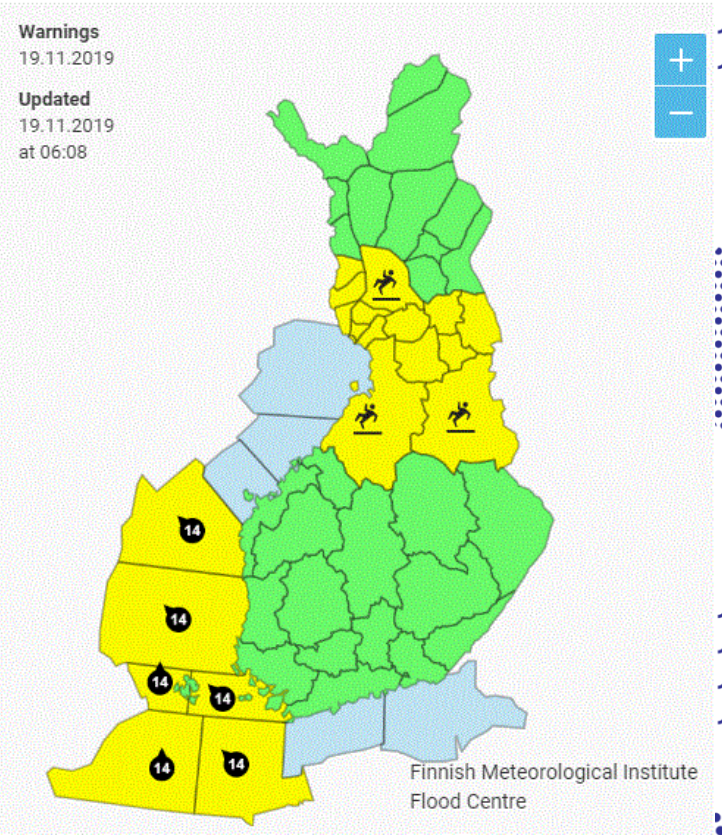


Weather warning map provided by Finnish Meteorological Institute

Problems and problematic cases

- No observations available
- Slipperiness can be local
- Phenomenas like the amount of pedestrians, sidewalk maintenance, local parameters (shadows etc) have a great impact to local slipperiness
- Input data can be wrong
- Sometimes slipperiness is very difficult to predict
  - We want to give warnings only when the sidewalks are very slippery – not to give warnings too often

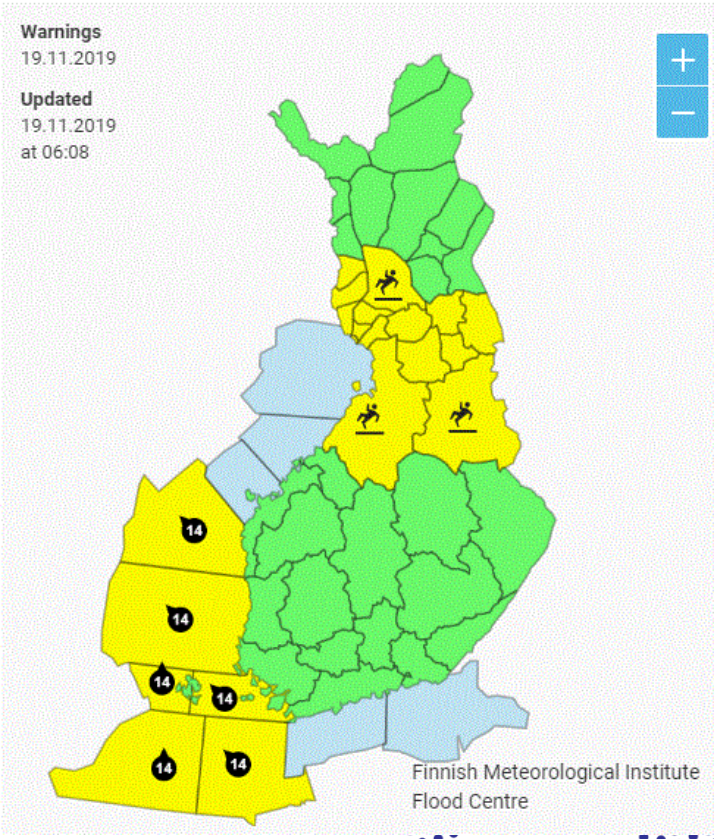
Co-operation with hospitals

- ”Hot line” between FMI weather service and some hospitals
  - FMI can warn hospitals if very slippery sidewalk condition is expected
  - Hospitals can call to FMI if several patients have come because of slip due to slippery sidewalk condition

Services and applications

- FMI is giving warnings when slippery sidewalk condition is expected
  - Warnings can be checked from FMI's internet site or from FMI weather app
  - TV news and some local radio stations are presenting/reading warnings
  - SMS service
    - Available for cities and companies
    - SMS is sent automatically if very slippery sidewalk condition is expected and warning has been given to area

- Services for road maintenance companies
  - Information about snowfall, road surface temperature, friction etc



Warning map by Finnish Meteorological Institute

Monitoring slipperiness on the sidewalks

Friction measurement devices

FMI has tested two devices to measure slipperiness on sidewalks

Vaisala DSC111 optical sensor

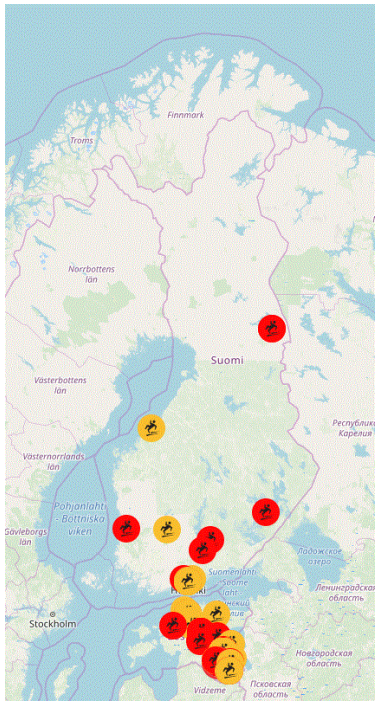
- Developed to measure the friction on highways
- 4 devices on Helsinki area to measure the friction of sidewalks
- Gives continuously very low values for friction in case of lots of ice of snow on the surface
  → Doesn't see the roughness of the surface

Slipmeter developed by Finnish Institute of Occupational Health

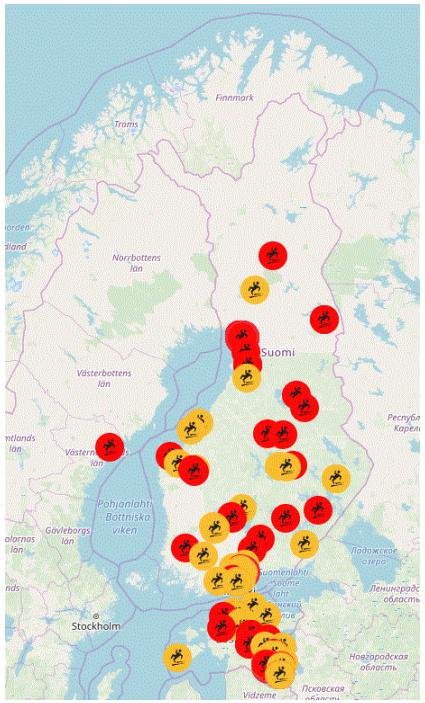
- For case studies

Crowdsourcing Observations with FMI Weather App

Slippery pedestrian weather one of the observed phenomena



One week observations



One month observations

More observations needed

What has been done in other countries

What has been done in other countries

- Finland
  - http://www.liukastumisvaroitus.fi/index.php/en/home
  - Slipping warning service for some Finnish cities (sms service)
- Japan
  - http://tsurutsuru.jp/english/index_e.html
  - Walk Smart website, which provides tips for not falling on icy roads
  - Sapporo area
- Canada
  - SureFoot service in Winnipeg was running on years 2012 – 2013 giving information about the slipperiness
  - http://pcag.uwinnipeg.ca/Prairie-Perspectives/PP-Vol18/Sylvestre.pdf

Conclusions

How to prevent slipping injuries

How to reduce the number of slipping injuries?

1. **Improve winter maintenance of sidewalks**

2. **Awareness of slipperiness**
   - timing and route of walking
   - way of travelling (walking, public transport, car)
   - decision of travelling

3. **Foot wear with good grip**
   - shoes with good grip, non-slip device

Warnings of slippery sidewalk conditions would help both pedestrians and winter maintenance work

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Thank You for Your Interest!

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