# **Projected climate change in severe freezing rain events**

**EXWE:** Occurrence of severe freezing rain (WP1, T1.2)

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**EXWE Stakeholder group meeting** 









#### Background

- Previous years in freezing rain studies of EXWE:
  - Application of simple freezing rain detection algorithms to temporally coarse climate model output
  - Limited testing and validation of the methodology
  - Main results: occurrence of freezing rain was projected to
    - INCREASE in Northern Europe
    - DECREASE in Central Europe







### What happened in 2015 in EXWE?

- Major efforts were directed to generation of new methodology with increased capability of identifying the freezing conditions in the atmosphere
  - A new method was borrowed from weather prediction models of FMI .
  - Denser vertical, spatial, and time resolutions compared to methods in previous years .
  - The method was calibrated using a large number of weather station observations from Europe .
  - Several statistics of freezing rain occurrence were calculated for 1979-2014 using historical . reanalysis data

weather

1979-2014

station









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### What happened in 2015–2016 in EXWE?

- The manuscript was published 18 Aug 2016 as 'discussion paper' in *Natural Hazards and Earth System Sciences* (http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-225/)
- Currently receiving comments from referees
- Based on comments, the paper will be tuned and published later (if not rejected)
- $^{\circ}$  ... manuscript represents a substantial contribution to the climatology of freezing rains in Europe ...  $^{st}$
- ... method ... is appropriate and ensures spatial and temporal cohesion of the results, despite some uncertainties ... "
- ... overall presentation is well structured, clear and easy to understand by a wide and general audience ... "

Download statistics of the discussion paper (21 Sep 2016)

<u>Country</u>	<u>Views</u>	<u>%</u>
China	24	23
USA	19	18
Canada	14	13
Finland	13	12
Netherlands	5	4

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# A method to estimate freezing rain climatology from ERA-Interim reanalysis over Europe

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### What happened in <u>2016</u> in EXWE?

- A new manuscript was started in 2016
  - Focus in severe freezing rain events
  - In addition to the <u>reanalysis</u> data, highresolution CORDEX <u>regional climate</u> <u>model (RCM)</u> data is used
    - to better estimate present-day variability and
    - to evaluate the effect of climate change on freezing rain
  - Cumulative sums of freezing rain <u>amounts</u> over 1 day and 5 days to somehow estimate the impact of events



2005-11-27

1996-01-25

High-impact historical freezing rain events as seen by SYNOP weather stations (red dots) and ERA-Interim reanalysis (color shading).

Size of dots ~ number of 6-hourly records during past 5 days.

Color shading intervals ~ amount of freezing rain, in mm, during past 5 days.

2010-12-27

2010-12-02



## What happened in **2016** in **EXWE**?

- Two impact thresholds were selected:
  - 5 mm/1 day for estimating impacts on transportation
  - 25 mm/1 day for estimating impacts on critical infrastructure



Annual probability of freezing rain > 25mm/24hr (1981-2010), ERA-Interim



Annual probability of a 25mm/day freezing rain event (in per cents), as seen by reanalysis.

Projected end-of-century change in 5mm/day freezing rain annual probability (in percentage points), as seen by regional climate models.

Significant change denoted with dots.



## What happened in 2016 in EXWE?

- Results were presented in a poster in the EMS conference (September 2016, Trieste)
- http://meetingorganizer.copernicus.org/EMS2016 /EMS2016-399-1.pdf







tructure. EMS Annual Meeting Abstracts, 2015 URL http://neetingorganizer.copernicus.org/EMS2015. EMS2015-388.pdf.

(available at https://data.4tu.nl/repository/collection ab70dbf9-ac4f-40a7-9859-9552d38fdccd)

adaptation for critical infrastructure.



## What plans for 2017 in EXWE?

- Alternative possibilities:
  - Further increasing the accuracy of methodology → own climate model runs?
  - 2) Development of IMPACT indices
    - Modelling of accreted ice amounts based on wind speeds and precipitated freezing rain amounts
    - Classification of events based on accreted ice amounts
  - Expanding the scope from freezing rain to include more severe winter phenomena, such as accretion of <u>rime</u> on structures



A preliminary analysis of known severe freezing rain events using ICE SEVERITY INDEX



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