Royal Netherlands
Meteorological Institute
Ministry of Infrastructure
and Water Management

A reconstruction of the August 1st 1674 thunderstorms over Holland

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Introduction

source: Utrecht City Archive
www.werkaandemuur.nl

Introduction

- August 1 1674, violent storm destroyed Dom Cathedral
- Dom tower unharmed
- many churches, spires and houses damaged in the city and surroundings

H. Saftleven, Utrecht City Archive

Observations

- Newspaper articles
- Written accounts in city & church archives
- Account of Gerrit Jansz. Kooch
- Drawings (>60) of Herman Saftleven

- the storm lasted just 15 min.
- very strong wind gusts
- huge amounts of rain
- large hail stones

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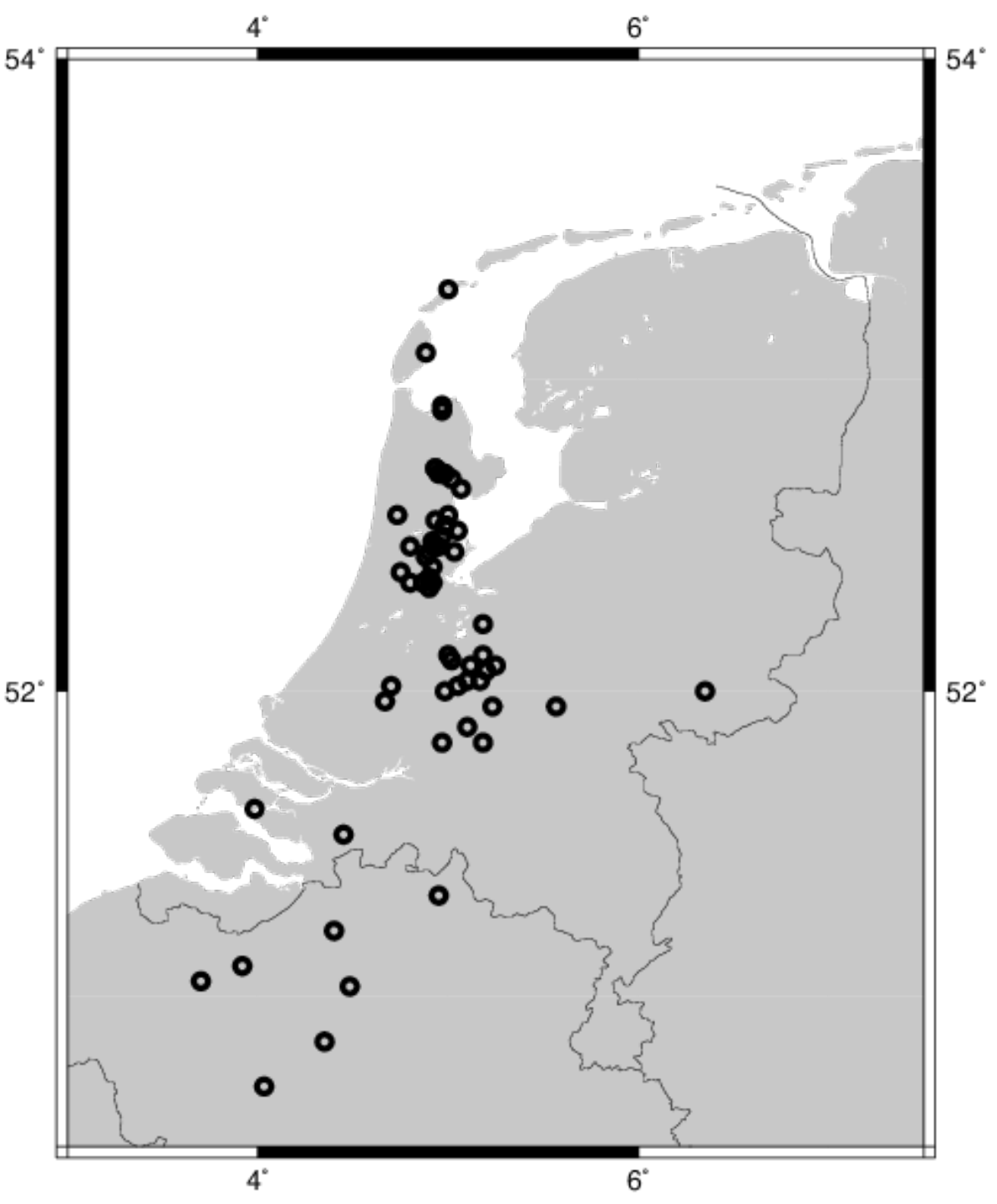
Damages of the storm

Damages from northern France to the Frisian Islands

- much damage in central and westen parts of Holland
- *no* damage in towns near the North Sea coast

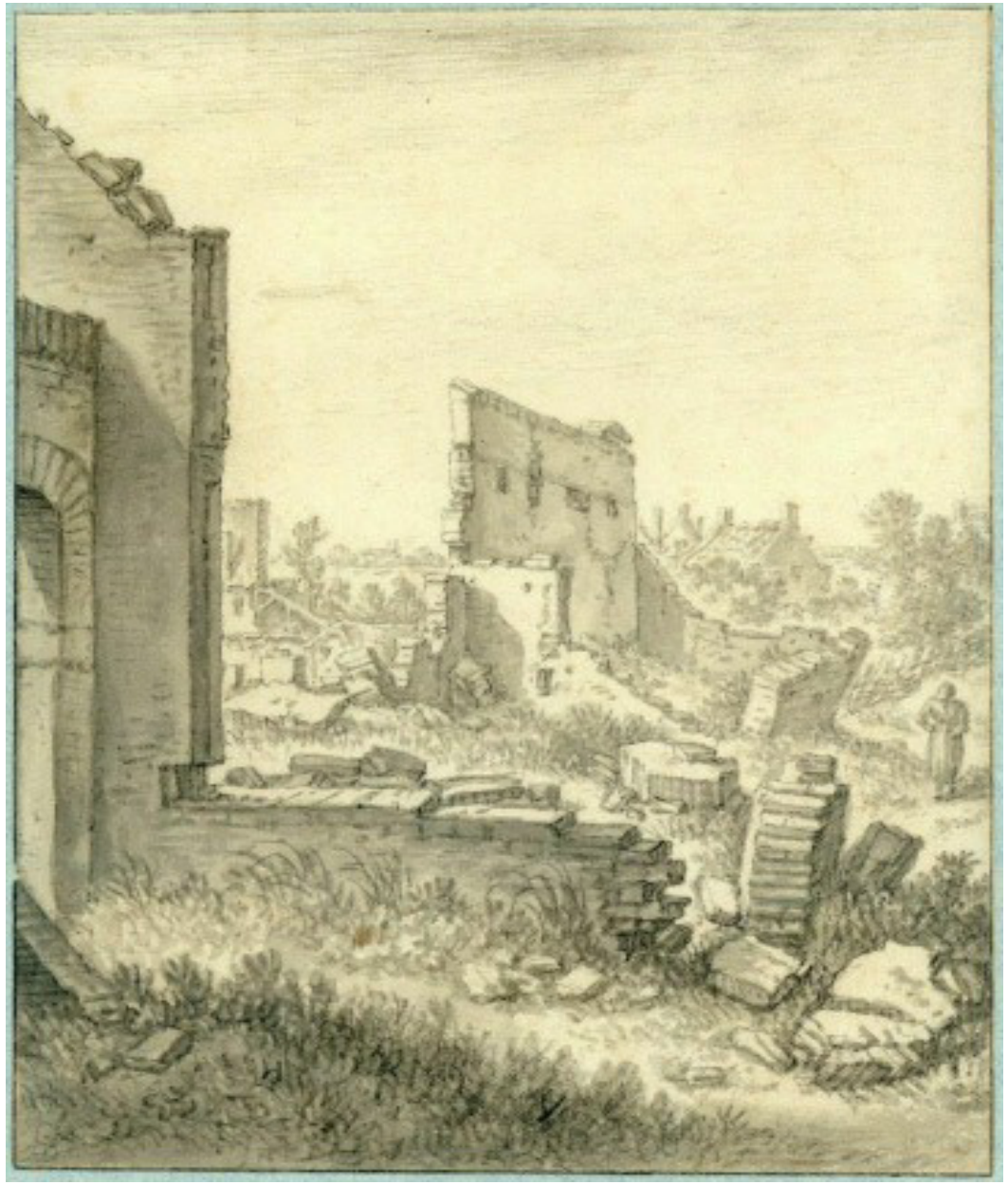


Damages of the storm

The wind took the hay in its flight
Floating like plumes in the air
When the farmer regained his calm
After having lost all his senses
He did not recognize his own land
Since all hay piles were gone

He thought this is very spooky
Am I sleeping or am I dreaming
It doesn’t look here as it just did
I don’t see hay on the land
And there are no trees along the border of the land
And in the distance, I also miss a tower

Source: Gerrit Jansz. Kooch (1674)



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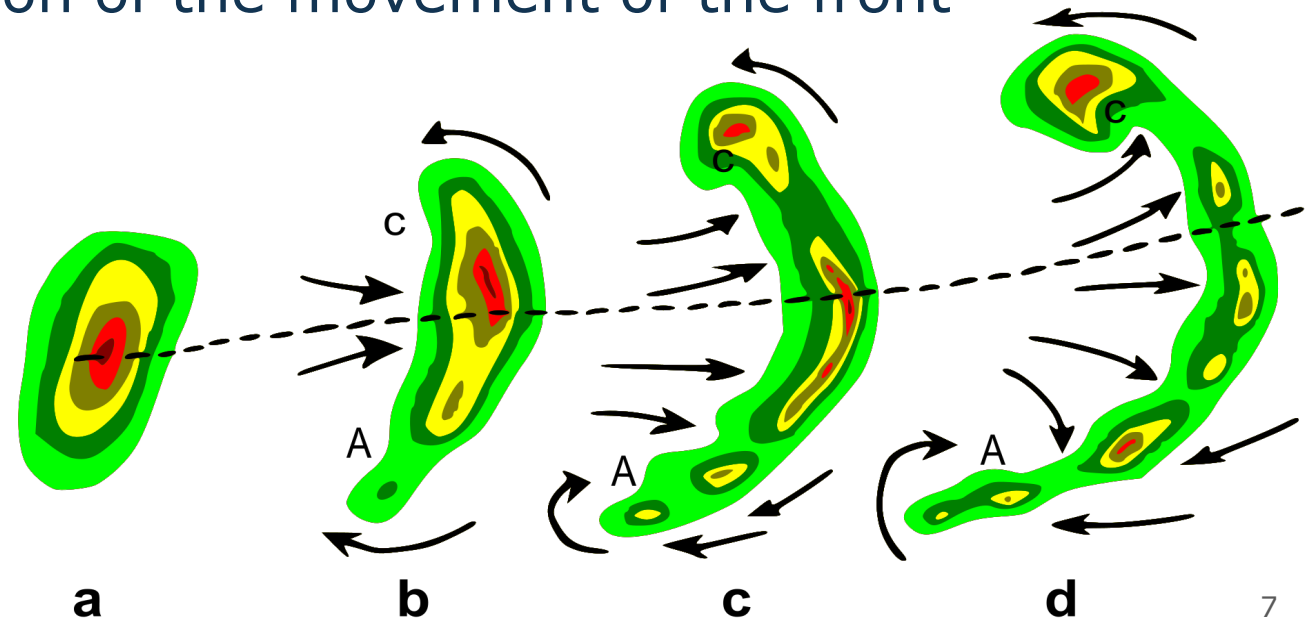
Bow echo

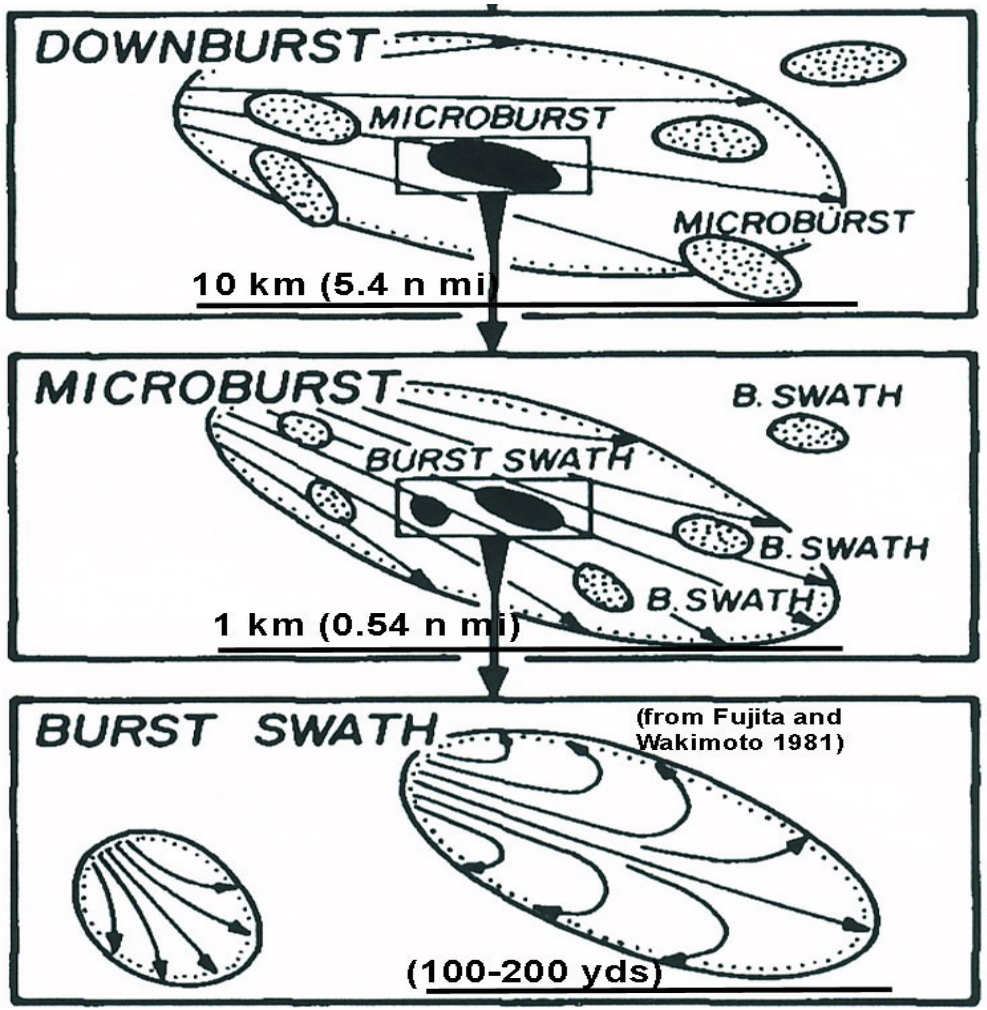
storm was an active cold front, developed into a bow echo

- based on the time when the front passed major cities
  - central part (over Utrecht) travelled faster than more western part
- strong contrast in damages at the western flank of the front
  - book-end vortex accelerates wind at its east side, decellerates wind at the west
- much of debris fell in the direction of the movement of the front
  - straightline winds
- storm took ≈ 15 mins. to pass
- strong convective activity



Source: NOAA

Why does the Dom tower still stand?



Fujita & Wakimoto (1981)

- small-scale structure in downbursts
- could explain the large contrasts in damages

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Evidence of vortices?

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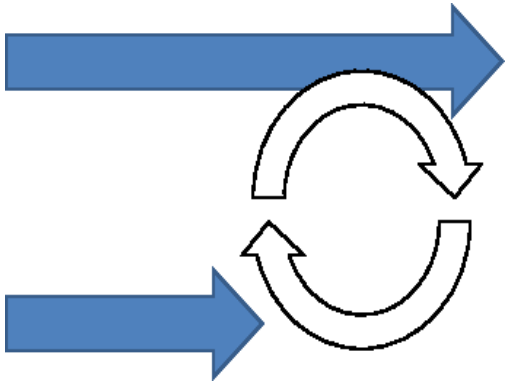
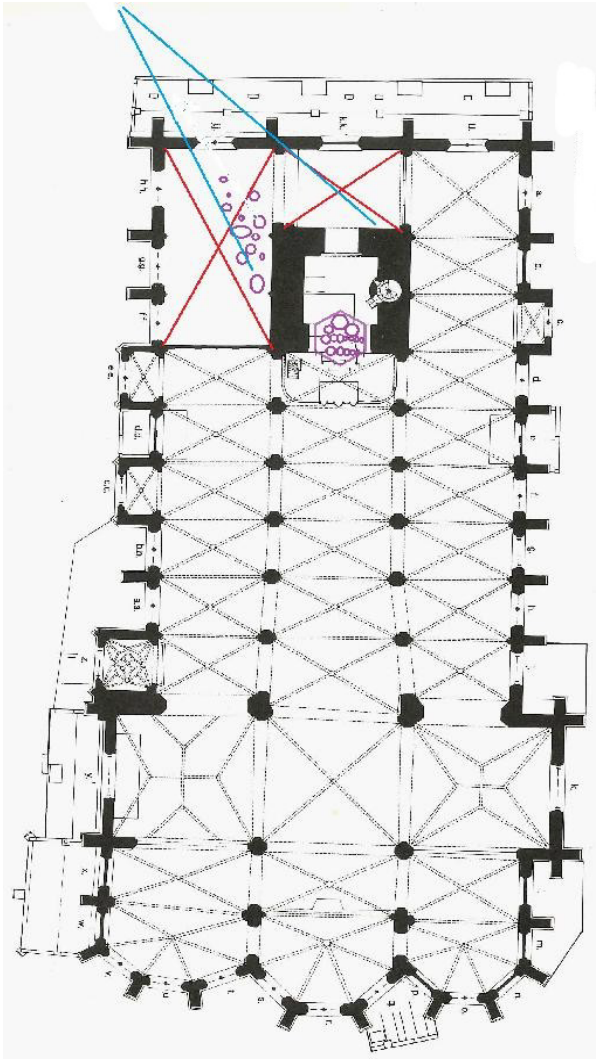




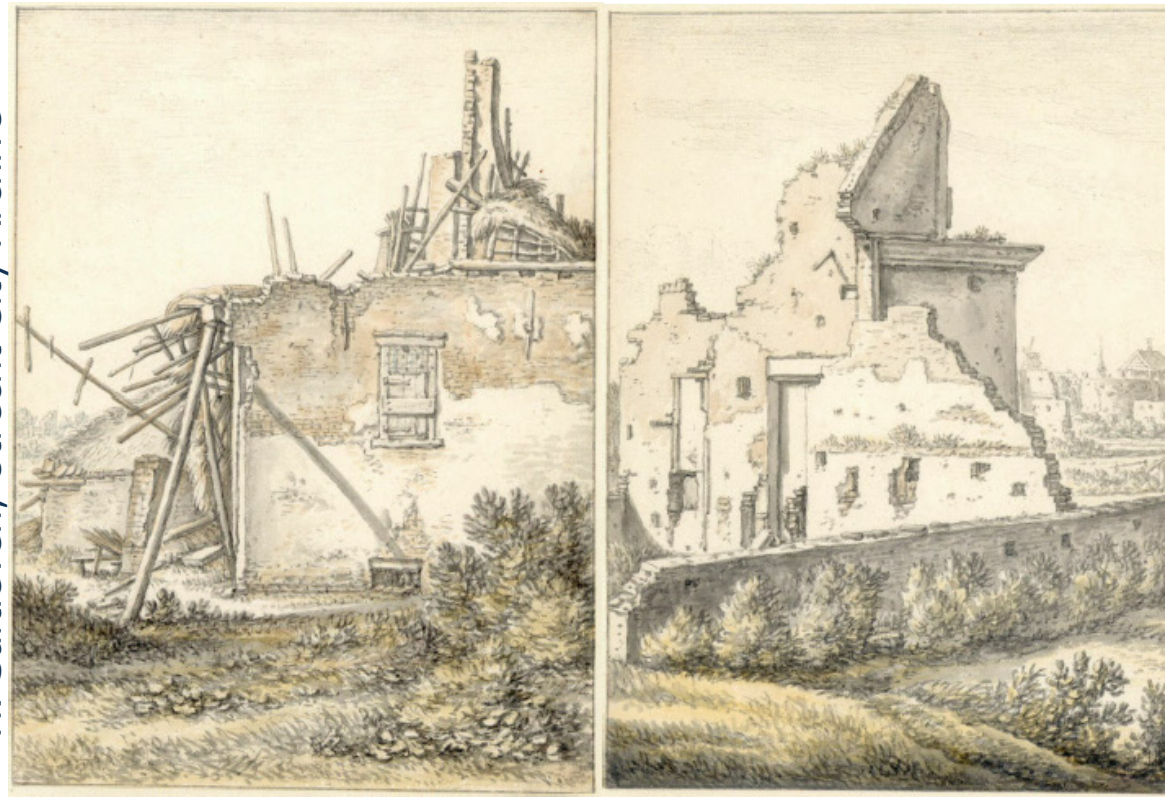
F. Kipp (1974)

- two examples where damages are *not* consistent with straight line winds
- fall directions: east & southwest
  - due to horizontal shear, embedded vortices will develop

Strength of wind gusts

Fujita scale for F2:

- roofs torn off frame houses
- large trees snapped or uprooted
- light-object missiles generated
- cars lifted off ground



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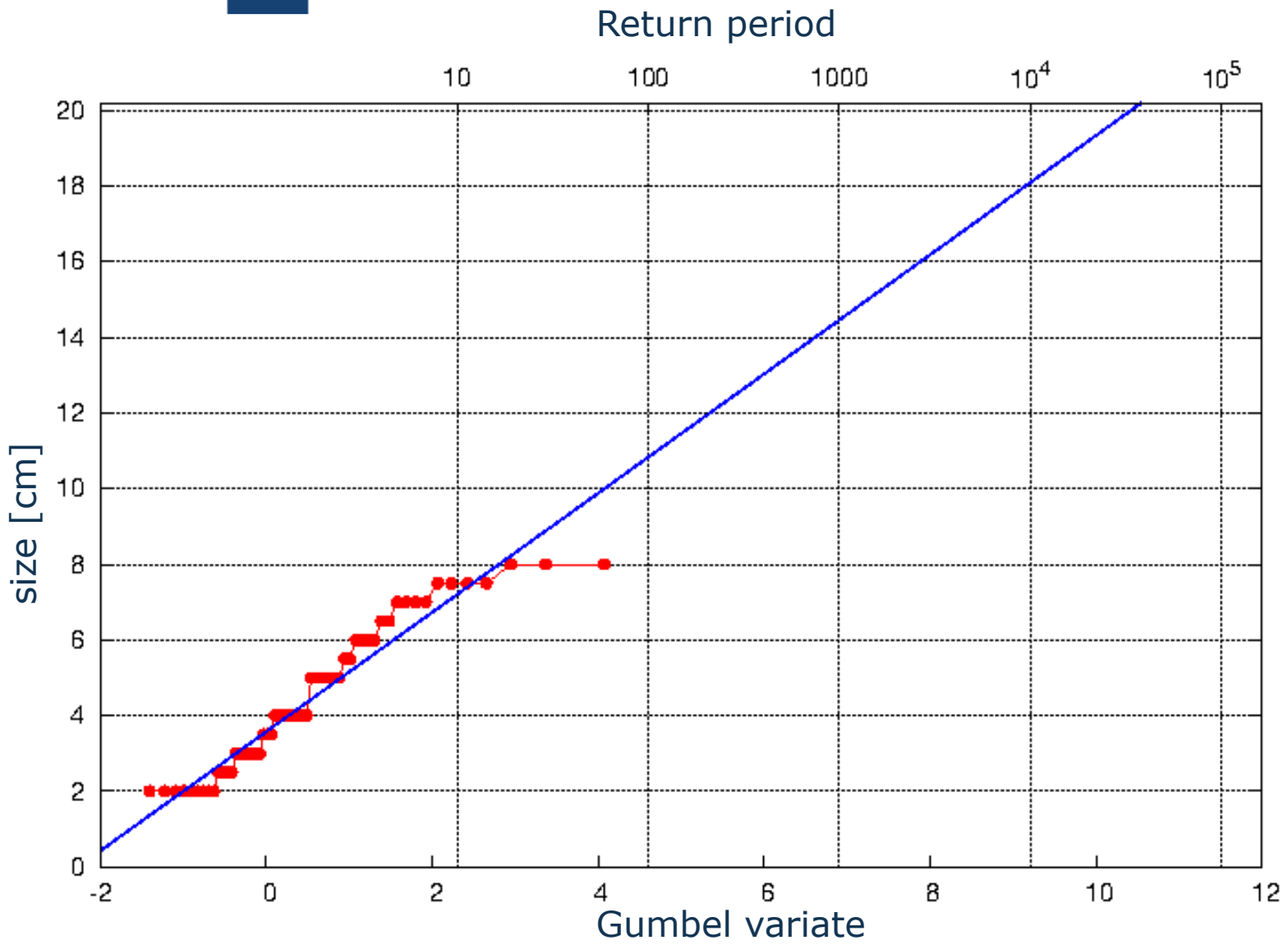
Fujita scale for F3:

- roofs and some walls torn off well-constructed houses
- most trees in forest uprooted
- heavy cars lifted off the ground and thrown

Würmann & Alexander (2005): 5 sec wind gusts ± 85-90 m/s

Return period - hail

- hail climatology of southern Finland (Tuovinen et al. 2009)
- estimate return period in Gumbel plot
- account of largest hail in Strassbourg: as large as ’a childerns head’



Data source: Tuovinen et al. (2009)

Conclusion

- Summer storm on August 1 1674
- Exceptional damages in the Low Countries
  - City of Utrecht was hit hardest
- cold front with strong convective activity
- developed into a bow-echo, travelling in NNE direction
- embedded vortices
- gusts up to ≈ 85 m/s
- return time 1000 - 10,000 yrs.

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