

Improved Nowcasting of Heavy Precipitation Using Satellite and Weather Radar Data

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IMPROVED NOWCASTING OF HEAVY PRECIPITATION USING SATELLITE AND WEATHER RADAR DATA

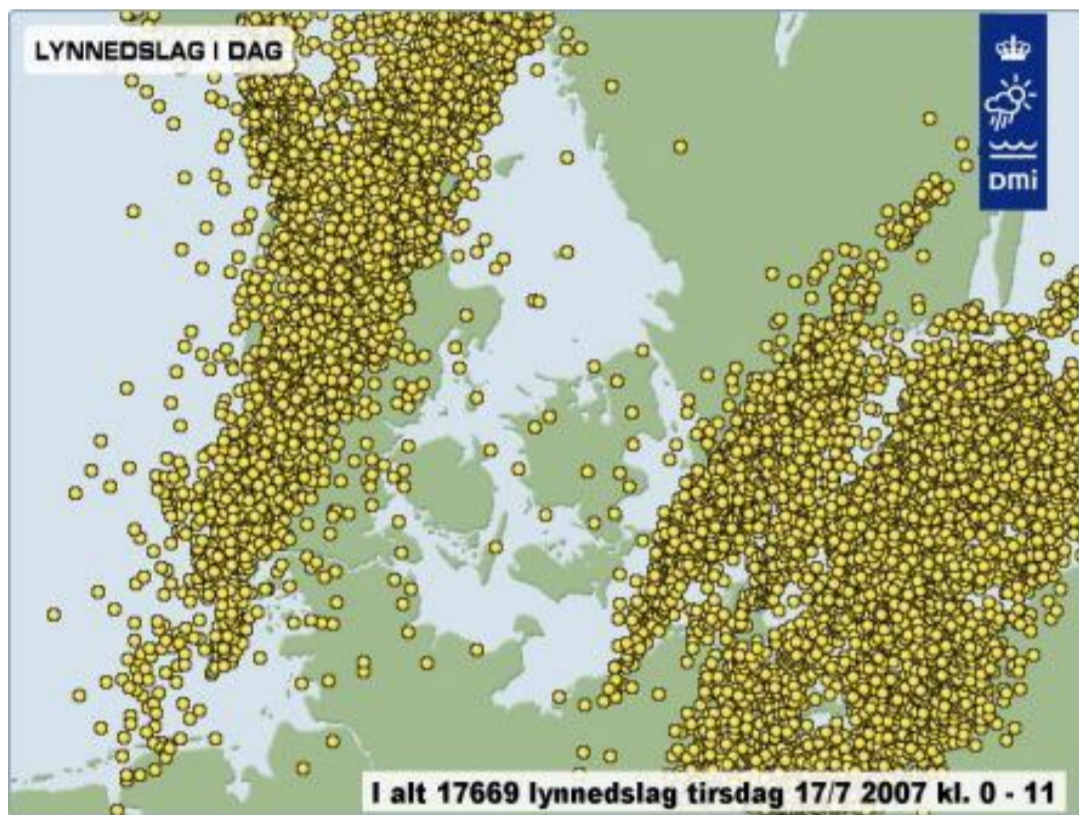
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Recent heavy rainfalls in Denmark



May 18th 2005 On this day in May 2005, thunder was built from an unstable layered troposphere, where the required temperature for instability release came from the sun's heating of the ground. A multi cell convective system developed over the northern part of Jutland causing hail, thunder and even a small tornado was observed. A squall line is formed in the cold air moving in from the southwest and is maturing during the afternoon, before it results in precipitation and disappears over water northeast of Jutland at approximately 19.00, eight hours later.

As with other cold air thunder scenarios, the downpour intensity does not quite reach that of the heat thunder scenarios. This is due to the fact that warmer air can contain more moisture and thereby deliver more precipitation.



July 16th – 17th 2007 After a period with many powerful squalls, a heavy rainfall hit Jutland on the night between July 16th and 17th. Heat thunder storms developed in front of a cold front moving in from the southwest of Jutland at approximately 22.00 and left the northeastern Jutland about 6 hours later.

On its passing, it had caused downpour intensities above 50mm per hour, hail and lightning frequencies of up to 50 lightnings per minute. The lightning intensity in the cold front is what makes this event especially exceptional: 5000 cloud-to-earth and as many cloud-to-cloud lightnings were recorded, causing reports of damaged crops and cars.

Lightning activity is often a part of weather systems bringing heavy downpour.



August 11th 2007 Warm and moist air over the eastern part of Denmark and southern Sweden developed into heat thunder on August 11th 2007. While most of the convective system was situated over Sweden, downpour intensities up to 60mm per hour were recorded in northern Zealand. Thunder and lightning activity was also recorded, but the downpour intensities were the most significant part of the event.

Locally, the cloudbursts lasted approximately 2 hours and the entire convective system had a lifetime from about midday until 19.00, during which it had caused floods in several locations.



August 20th 2007 This is probably the most infamous of the scenarios in the data ensemble. Also, it is the only scenario studied here, where the downpour has been described as *extreme*. The heat thunder system developed in the moist, warm air in mid-August and is described as a multi cell convective system. The thunder system spontaneously develops from one of many precipitating clouds coming from northern Germany and matures over Sønderborg, where it stays for approximately 2 hours and further matures causing heavy precipitation. While lingering over Sønderborg and Gråsten, multiple cells are formed on the sides of the matured and precipitating cells.

The entire precipitating event passed in about 3 hours, from 20.00 to 23.00, where downpour intensities up to 88.32 µm/sek over a 10 minute interval were recorded. This corresponds to approximately 53mm in this 10 minutes time window alone! The spatial extent of this event was very small, constrained to the area around Gråsten in southern Jutland and very isolated, i.e., not part of a front or a larger system.



July 3rd 2011 The most severe downpour is also the most recent. This day of July heavy thunderstorms developed on the eastern side of Copenhagen and delivered massive amounts of water, especially on Østerbro. Several basements were flooded and the items stored there were soaked in sewer water. This thunderstorm has been expensive for residents and even more so for stores; entire inventories were ruined and insurance claims are still being processed.

As seen on the graph to the right, the downpour intensities were well above the limit for cloudbursts (25mm/30min) several times during the time frame.

This event, combined with the very wet summer of 2011, has increased the focus in the media and the research community. It is expected that the frequency of these events will increase due to the global climate changes, wherefore the desire to understand them – as well as predict them – has increased.

Sources: www.dmi.dk, vejret.tv2.dk

Fun and facts

Is the heavy precipitation in Denmark increasing? How much does it cost each year? And how much does it need to rain in order to be "heavy" rain? The answer to the last question: 25mm/30min qualifies the shower to be a cloudburst.

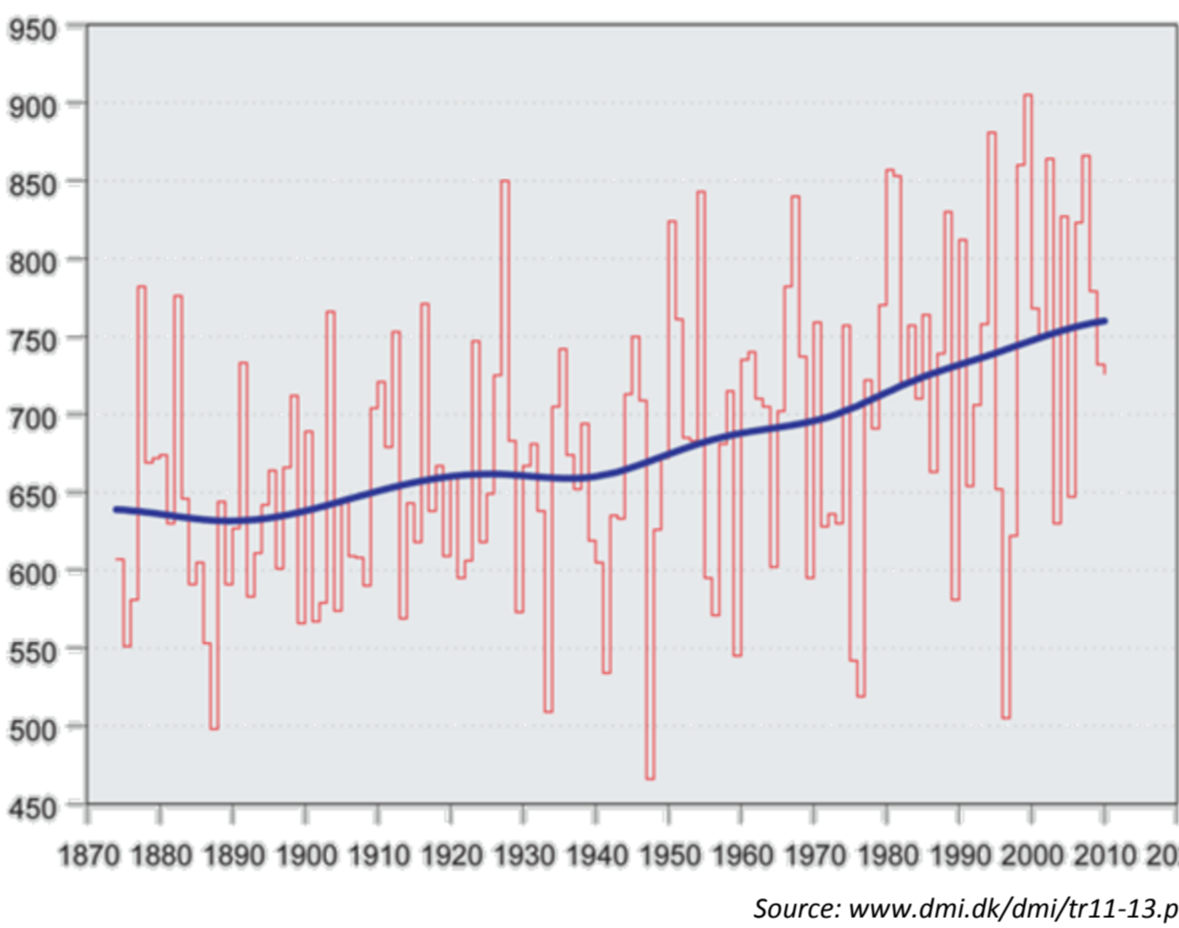
Presented below are a few numbers and graphs quantifying some of the answers to these questions.

Wet records around the world

Source: Global Weather & Climate Extremes, World Meteorological Organisation.

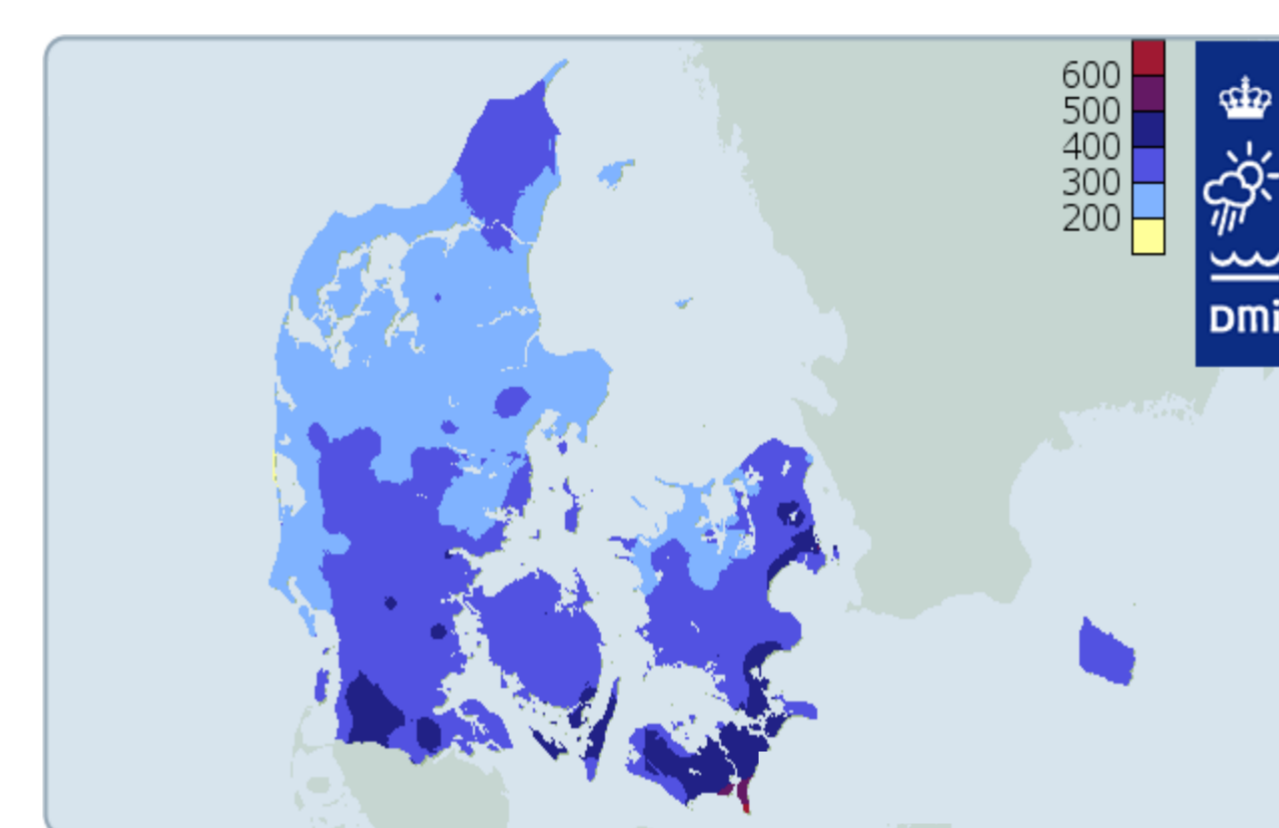
- Most in one minute: 31.2 mm; Unionville, Maryland, United States, 4 July 1956.
- Most in 60 minutes: 305 mm in 42 minutes. Holt, Missouri, United States, 22 June 1947.
- Most in 12 hours: 1,144 mm; Foc-Foc, Réunion, 8 January 1966, during tropical cyclone Denise.
- Most in 24 hours: 1,825 mm; Foc-Foc, Réunion, 7–8 January 1966 during tropical cyclone Denise.
- Most in 48 hours: 2,467 mm; Aurère, Réunion, 8–10 January 1958.
- Most in 72 hours: 3,929 mm; Commerson, Réunion, 24–26 February 2007.
- Most in 96 hours: 4,869 mm; Commerson, Réunion, 24–27 February 2007.
- Most in one year: 26,470 mm; Cherrapunji, India, 1860–1861.
- Highest average annual total: 11,872 mm; Mawsynram, India.

Denmark, annual precipitation 1874-2010



Source: www.dmi.dk/dmi/tr11-13.pdf

Denmark, precipitation sum – Summer 2011 (mm)



Source: www.dmi.dk/dmi/den_vaete_sommer_2011

Top 10 wet summers in Denmark

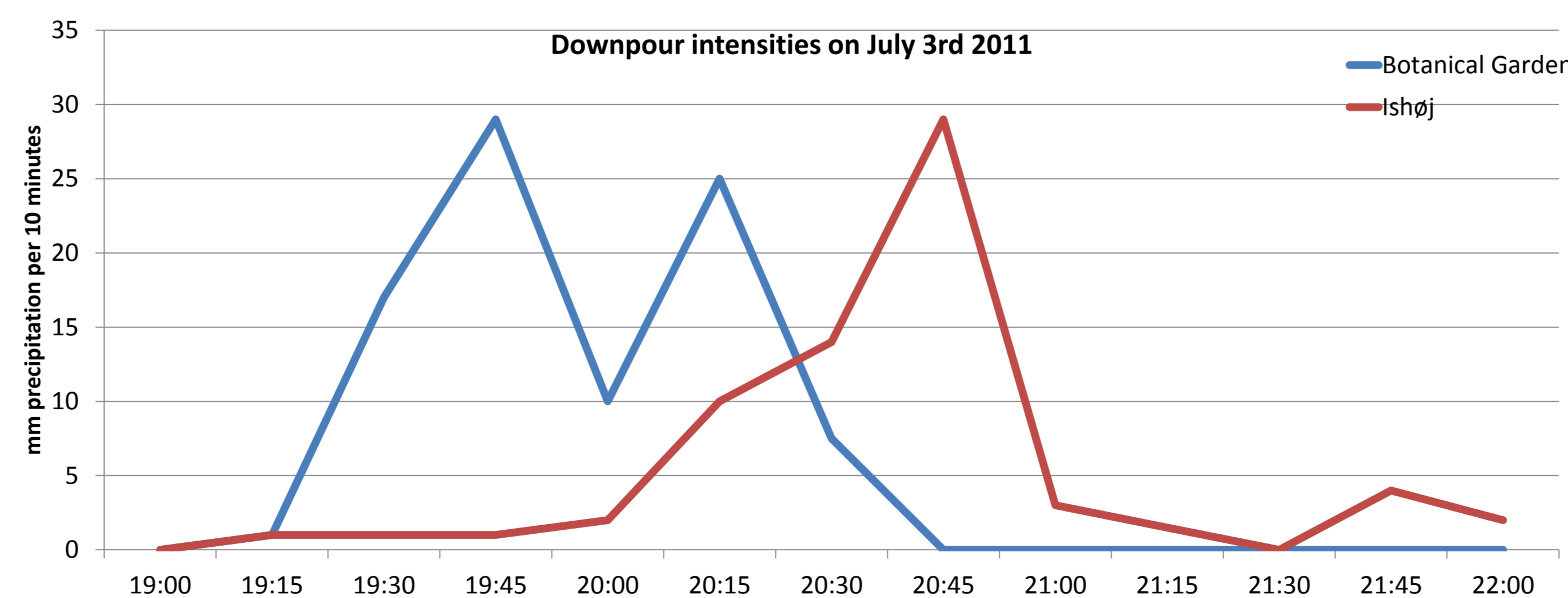
1. 1980, 323 mm
2. 2011, 321 mm
3. 1870, 317 mm
4. 2007, 310 mm
5. 1927, 299 mm
6. 2002, 287 mm
7. 1891, 286 mm
8. 1882, 285 mm
9. 1953, 284 mm
10. 1877, 278 mm

Insurance claims due to heavy rain

- 2010: 997 mio. kr
- 2009: 193 mio. kr
- 2008: 881 mio. kr

"Unfortunately last year's cloudbursts showed that it is often the same areas getting hit year after year. Only the customers are there to pay the bill and a consequence hereof is that some companies have notified of increased insurance premium for people living in areas with flood risk. Some companies even said that they will not insure against raindamages in some parts of the country," says Riccardo Krogh Pescatori of Forsikring & Pension.

Source: www.klimaupdate.dk



Media scrapbook

The intensified frequency of heavy rain has caused an increased interest from the media. This means that warnings from DMI is spread faster and that the risk of extreme downpour is starting to be a more integrated part of people's everyday life.

Below are a few recent headlines from different internet media concerning heavy rain.

Kraftig regn og skybrud sluttede våd juli af
Den særdeles våde juli 2011 indledte fredag en regnfuld slutspurt med kraftig regn til Bornholm, og fløjtede af med skybrud til Jylland og Sjælland søndag.

OP til 30 grader og vildt regn
Fredag bliver et rigtig godt eksempel på, hvordan den danske sommer har været, nemlig en dag med meget omskiftende var og måske en vejrekord. Tid til en kold afslutning? Foto: Erik Røffler

POLITIKEN.DK
Ekstrem regn skaber trafik kaos i hovedstadsområdet
Togdriften er forsinket, og motorveje er spærret.

AVIS-ENLUND
Kraftig regn gav travlhed
Massive regnskyl landet over betød dagen igennem travlhed for politiet og Falck, der måtte redde trafik og oversvømmede kælder.

POLITIKEN.DK
Kraftig regn rammer Danmark
Den kraftige regn, der allerede skaber trafikale problemer på Fyn, vil drive mod Sjælland.

DMI: Kraftig regn rammer Sjælland torsdag
Torsdag morgen kan trafikken på Sjælland blive besværet, idet DMI varsler om helt op til 40 mm regn på seks timer fra morgenstunden.