Nedbørradar og nedbørkorrektion

Flemming Vejen[1] og Xin He[1,2]

[1]Danish Meteorological Institute
[2]Department of Geology and Geography, KU
HOBE – Center for Hydrology

Oversigt

❑Nedbørmængde vha. radar (QPE)

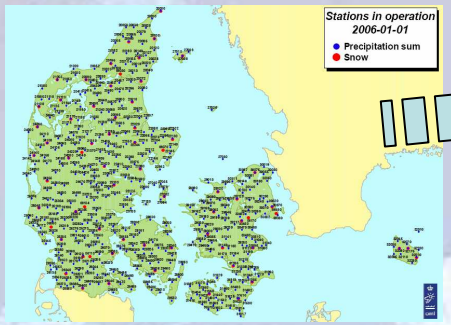
- måleprincip
- Fejlkilder og beregningsmodel
- Evaluering
- Anvendelse i hydrologisk modellering

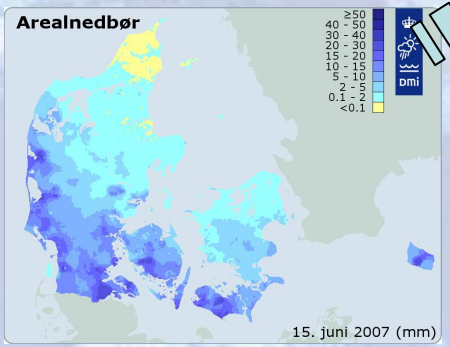
❑Nedbørkorrektion

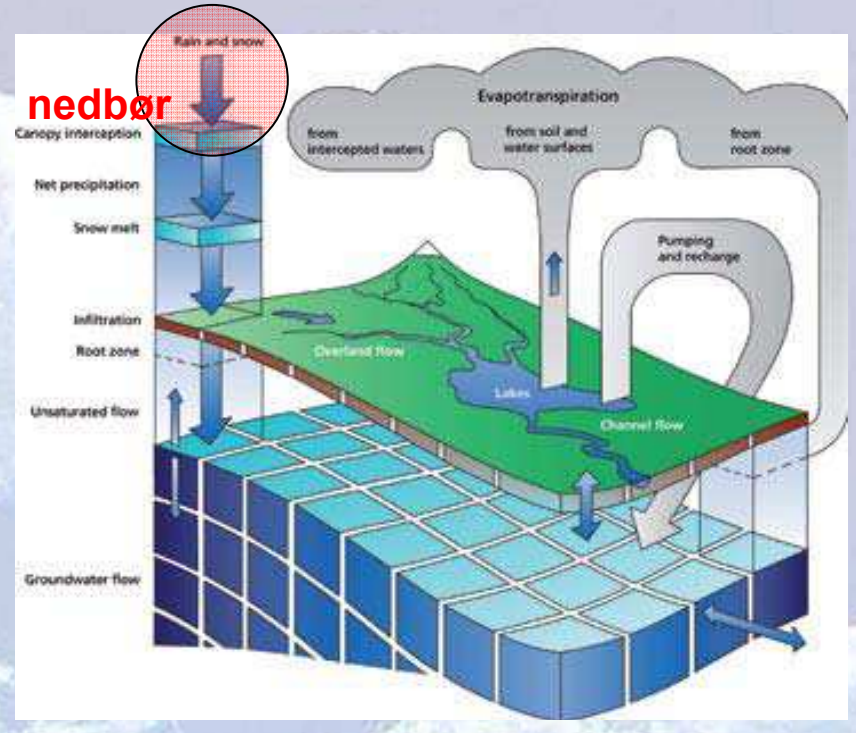
- Problemstilling, testfelt og analyser

❑Konklusion

Teste nedbørdata i hydrologisk modellering







Giver det mening?
Kan radardata bidrage til en ”nøjagtigere” vandbalance?
Hvorfor?
Hvorfor ikke?
Hvad kan vi gøre bedre?

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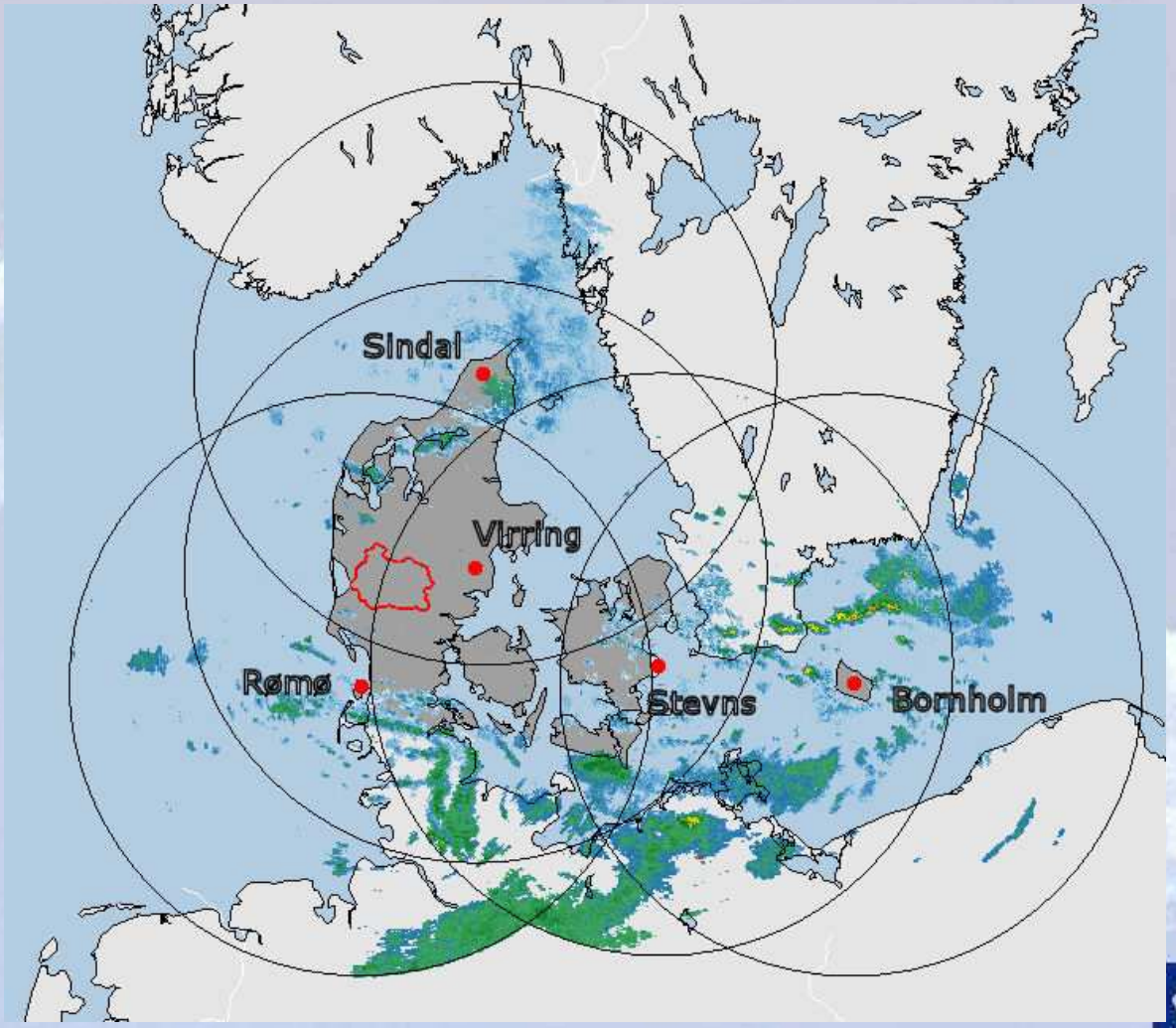
DMI's radar netværk



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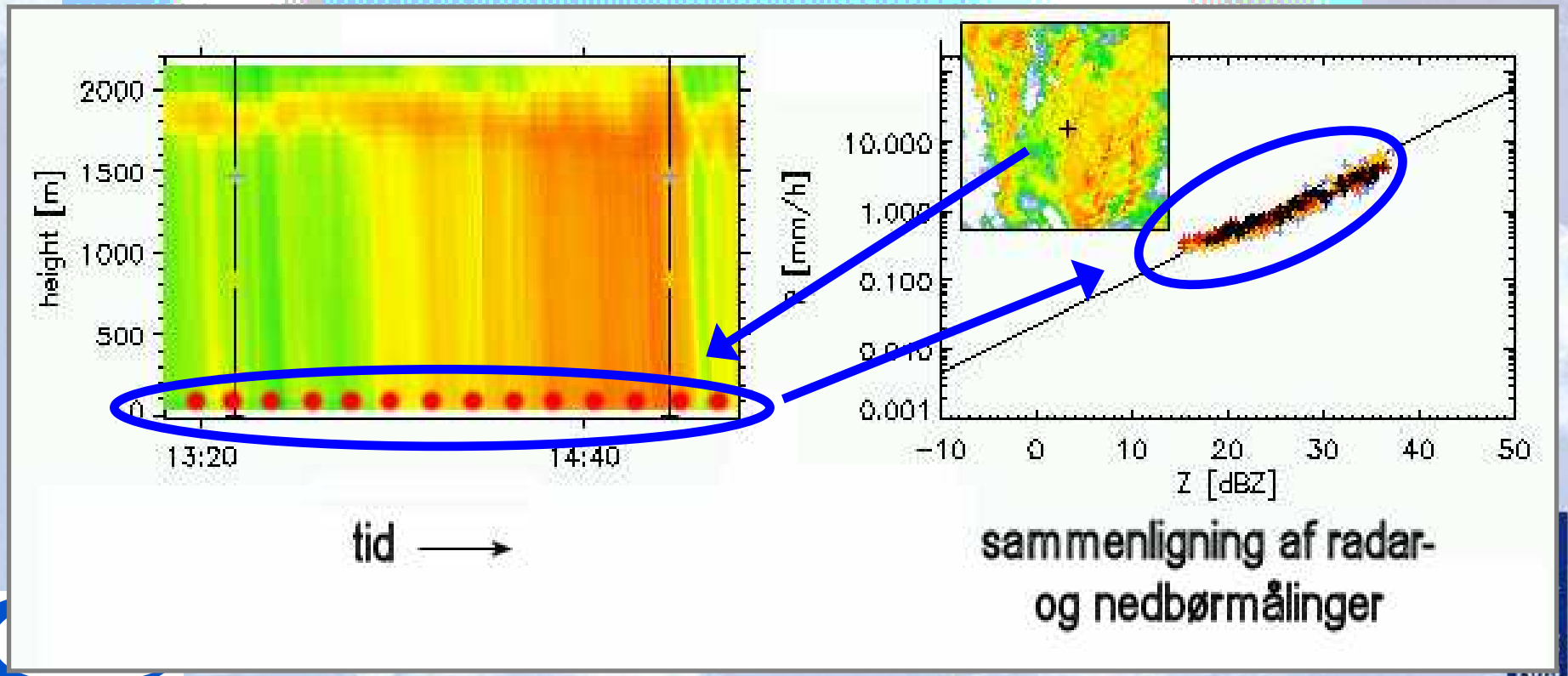
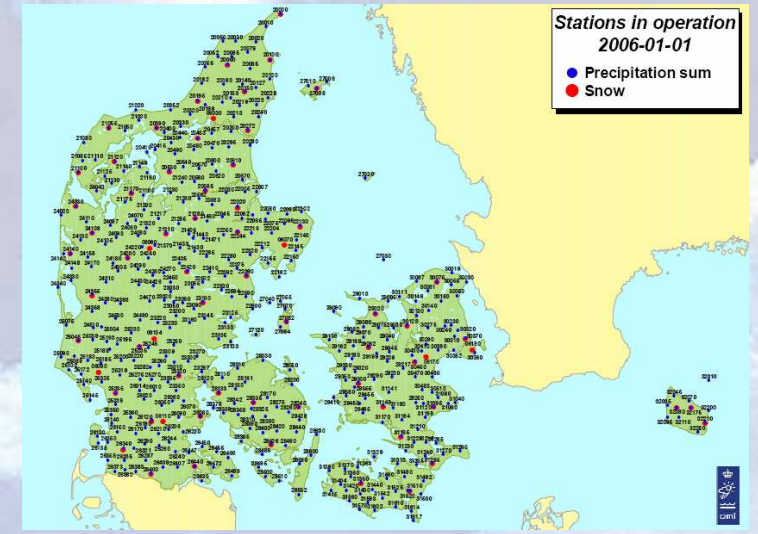
1. *Radaren udsender elektromagnetiske pulser i smal stråle*
2. *Radarstrålen reflekteres af nedbørpartikler o.a.*
3. ***Signalet omregnes til nedbørintensitet og nedbørmængde***

Short survey on radar data problems:
What does a radar measure ?



Radarnedbør QPE … hvordan?



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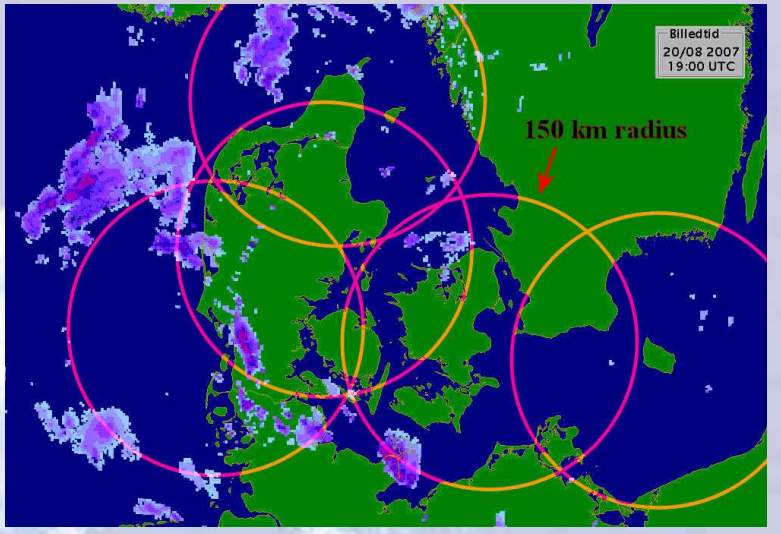
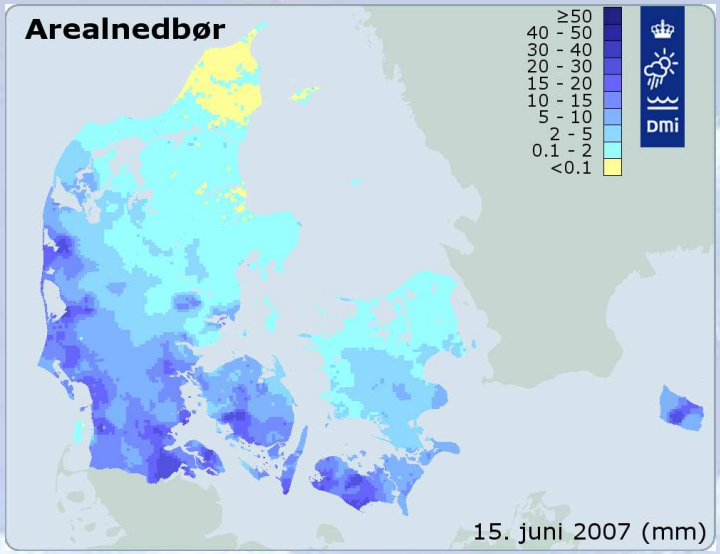


Forbedret beregning af nedbør vha. radardata

Input til hydrologisk model



Marshall-Palmer

$$Z = A \cdot R^b$$

BALTEX method

$$R_{r(i,j)} = R_{(i,j)} \cdot 10^{\bar{F}(i,j)}$$

$$F_g = \log\left(\frac{G_g}{R_g}\right)$$

$$F_{r(i,j)} = a + b \cdot r + c \cdot r^2$$

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En af de store udfordringer: radardata kvalitet

Hvor kommer radarsignalerne fra ?

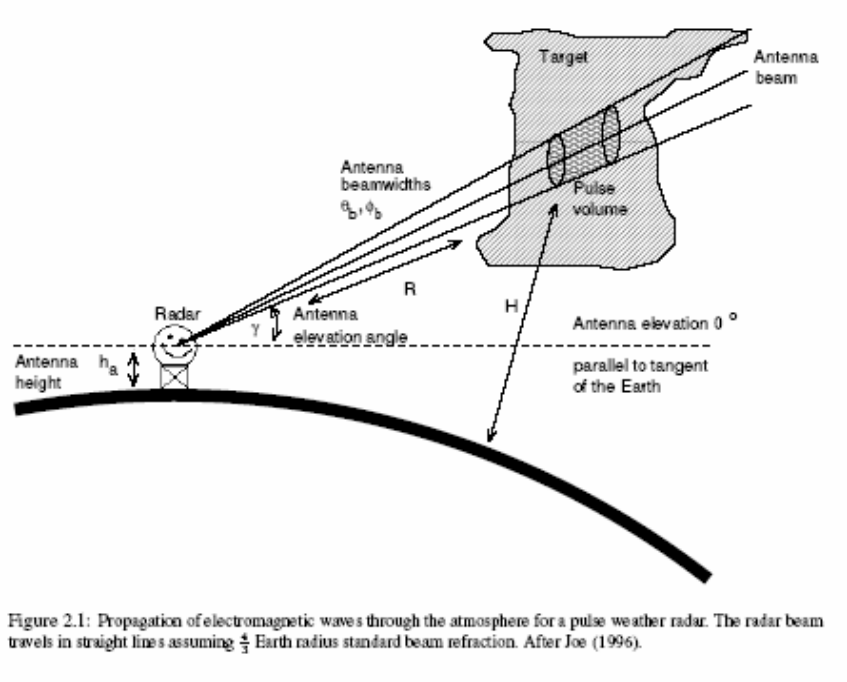

Figure 2.1: Propagation of electromagnetic waves through the atmosphere for a pulse weather radar. The radar beam travels in straight lines assuming $\frac{4}{3}$ Earth radius standard beam refraction. After Joe (1996).

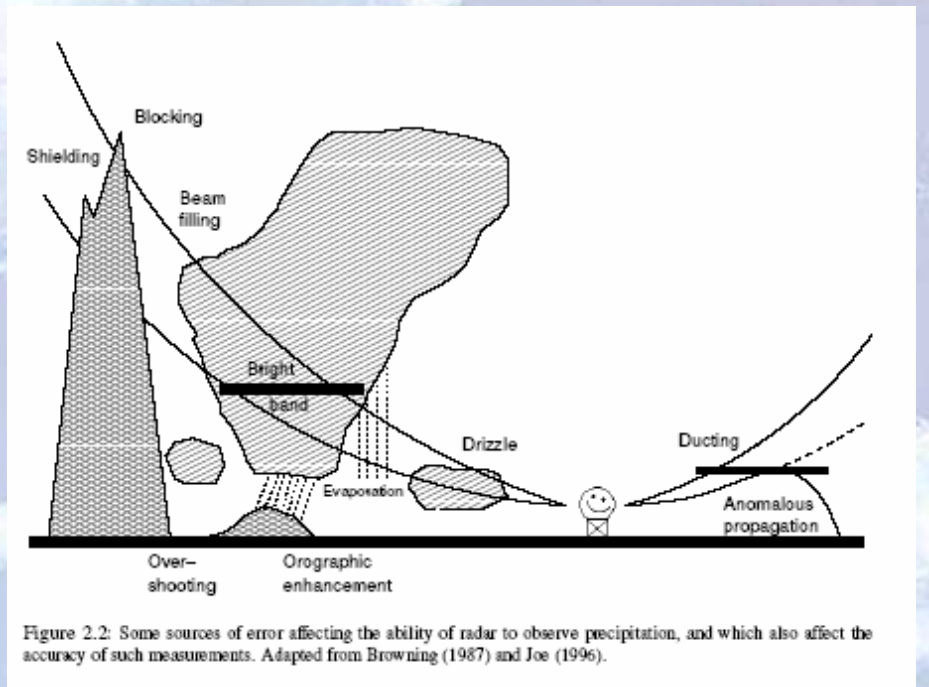

Figure 2.2: Some sources of error affecting the ability of radar to observe precipitation, and which also affect the accuracy of such measurements. Adapted from Browning (1987) and Joe (1996).

Det er vi ikke sikre på !

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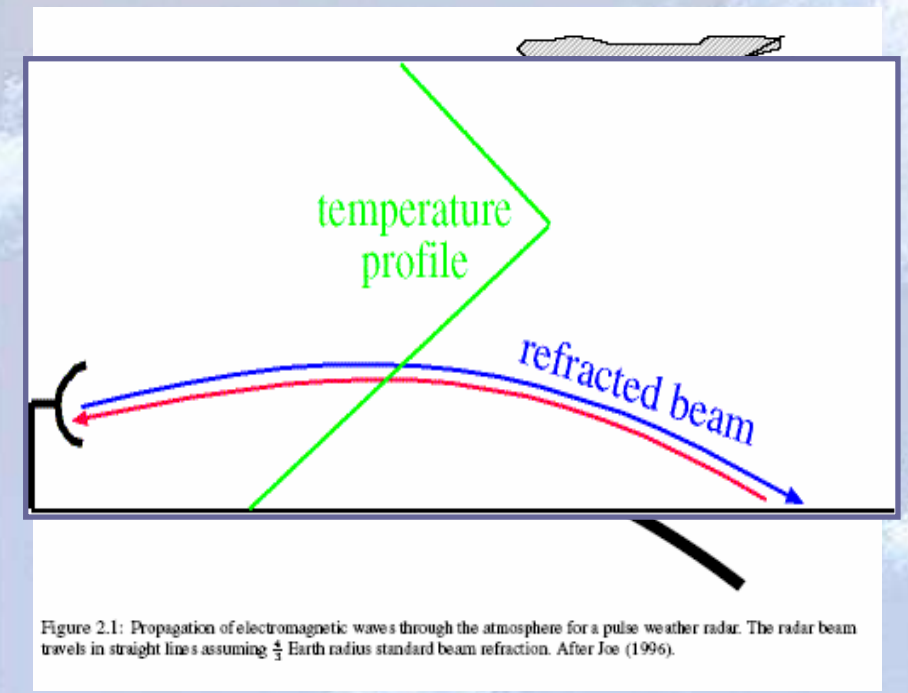
En af de store udfordringer: radardata kvalitet

Hvor kommer radarsignalerne fra ?



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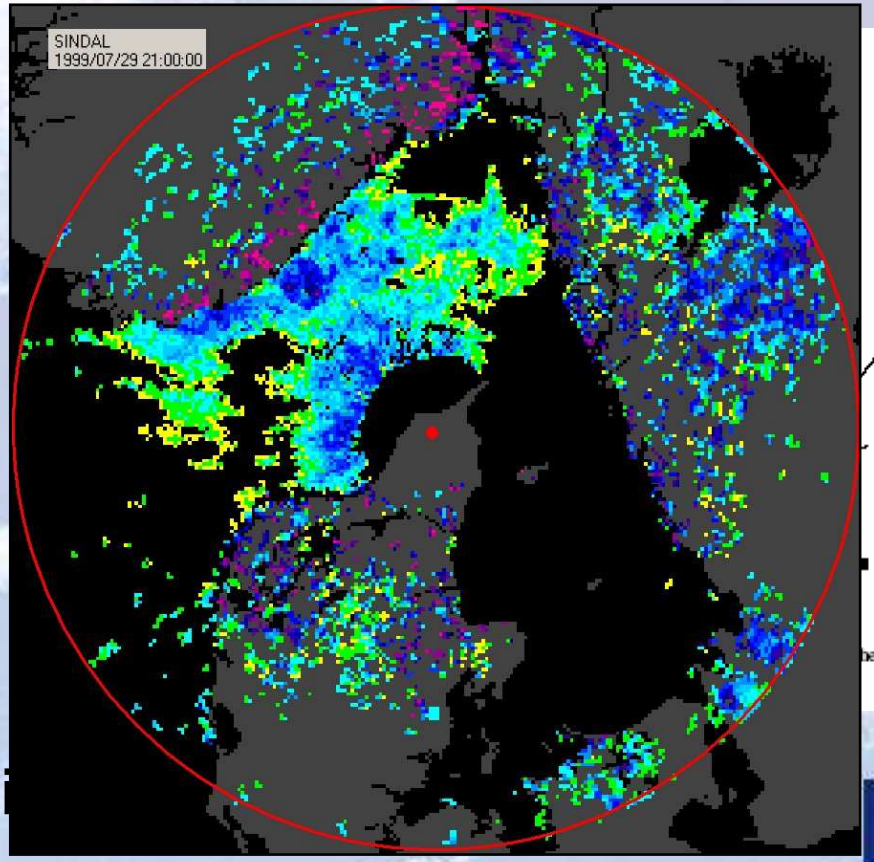
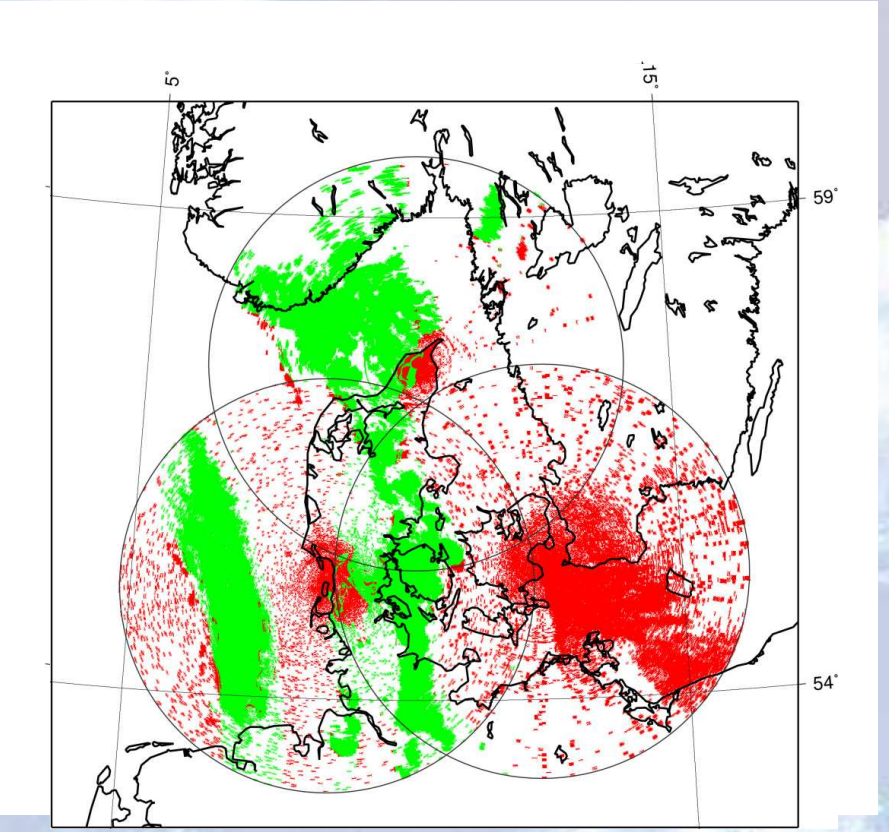
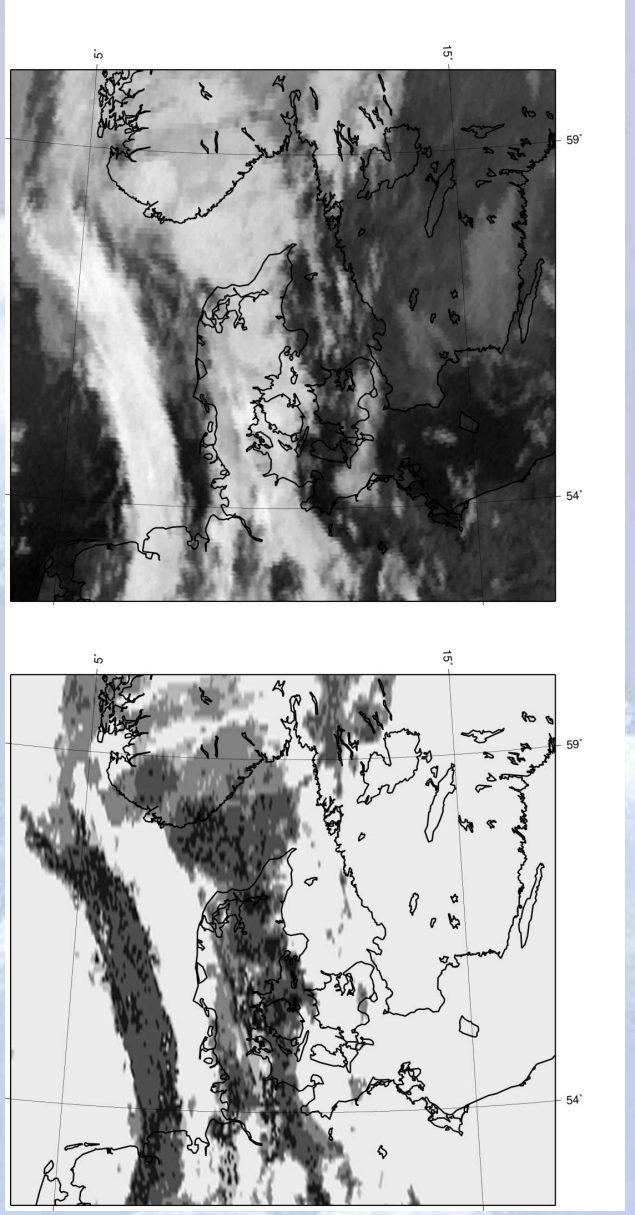


Det er vi i

PhD ved DMI: clutter klassifikation (Thomas Bøvith)





MSG

SAF
Now casting

Relevante metoder til fjernelse af clutter:

- Datafusion: satellite + radar
- Rumlig-tidslig metode: texture analyses + optical flow

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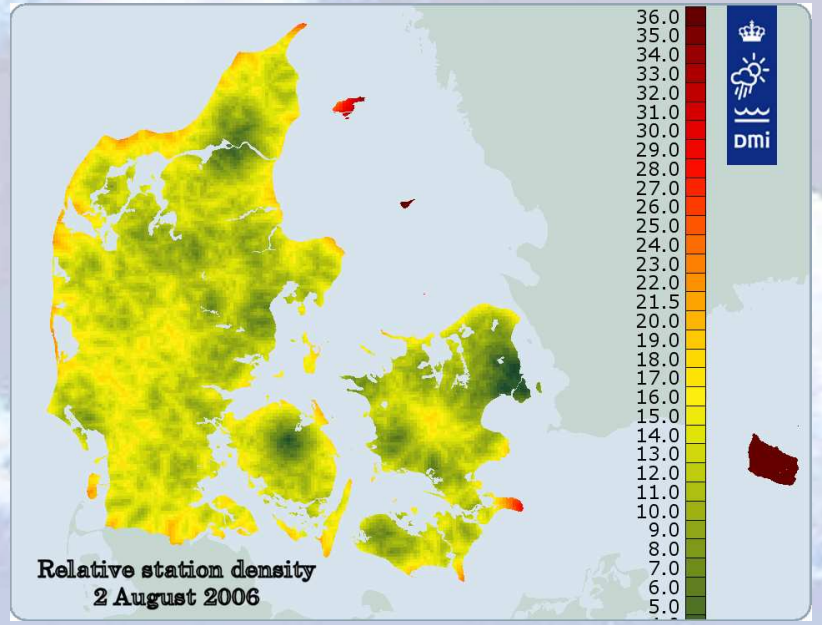
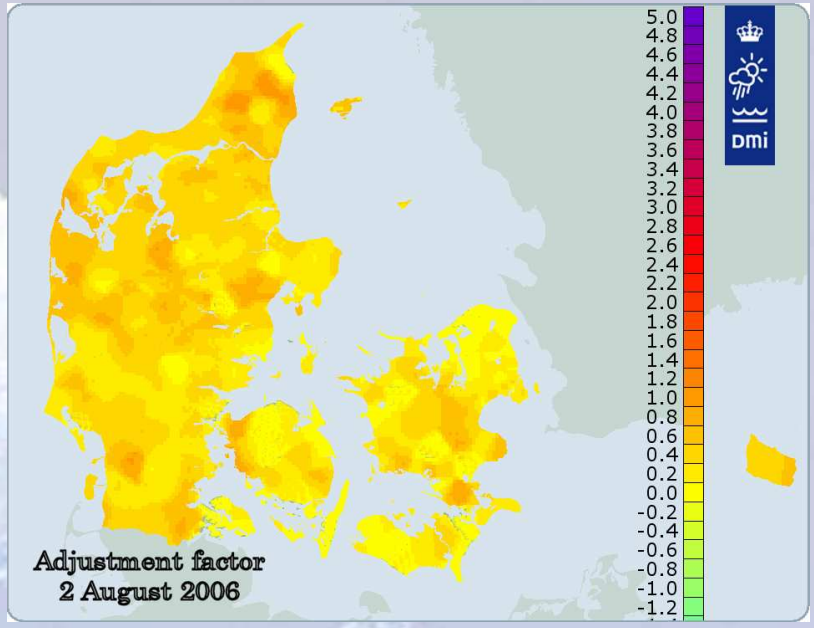
nedbørmålernet (2006)

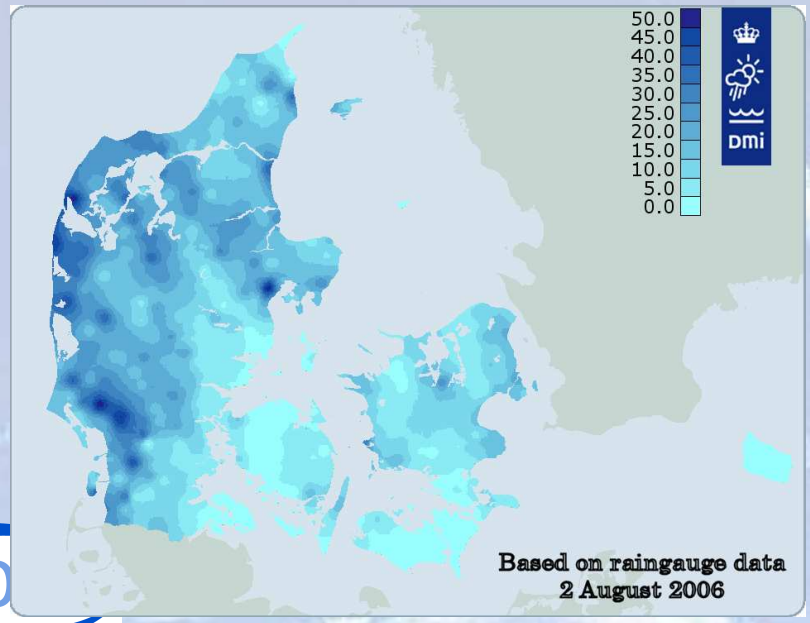
Til justering af radardata

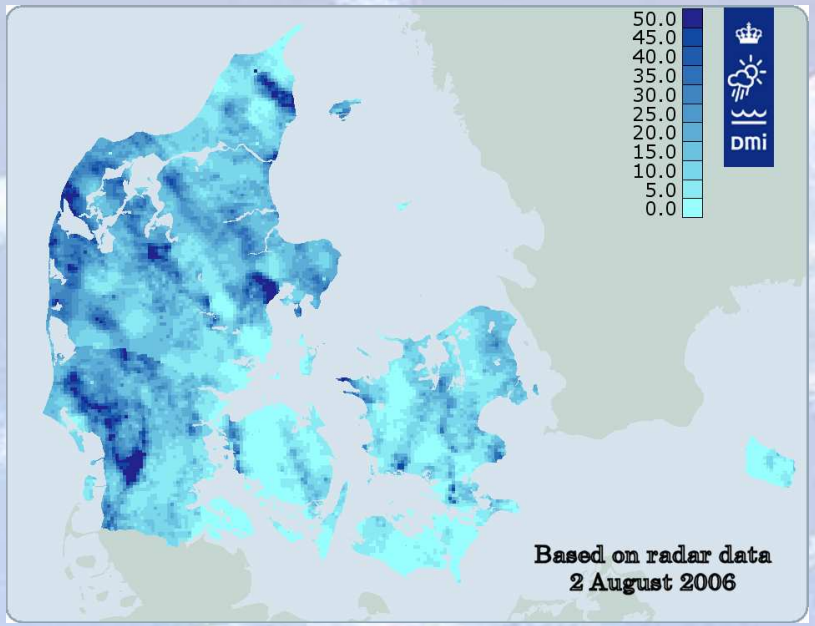
til validering

Example: 2 August 2006









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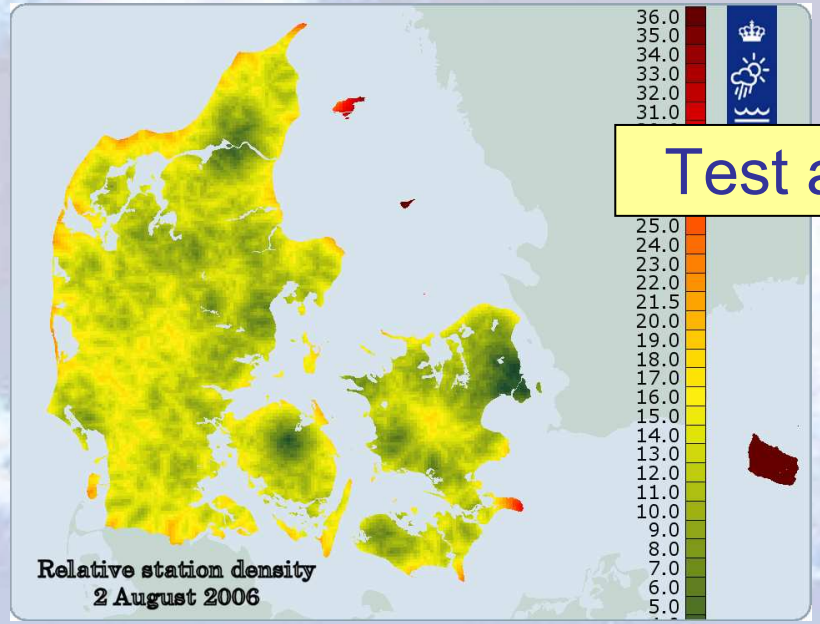
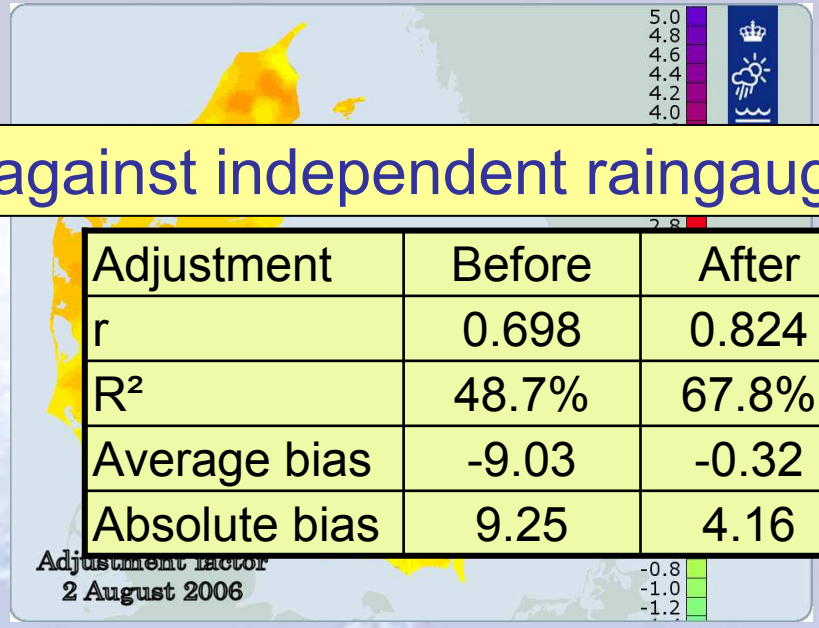
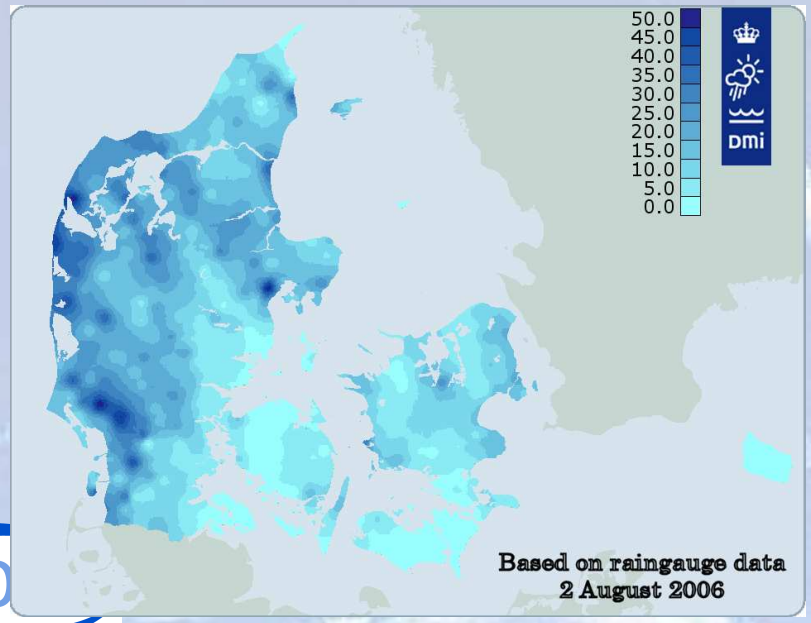
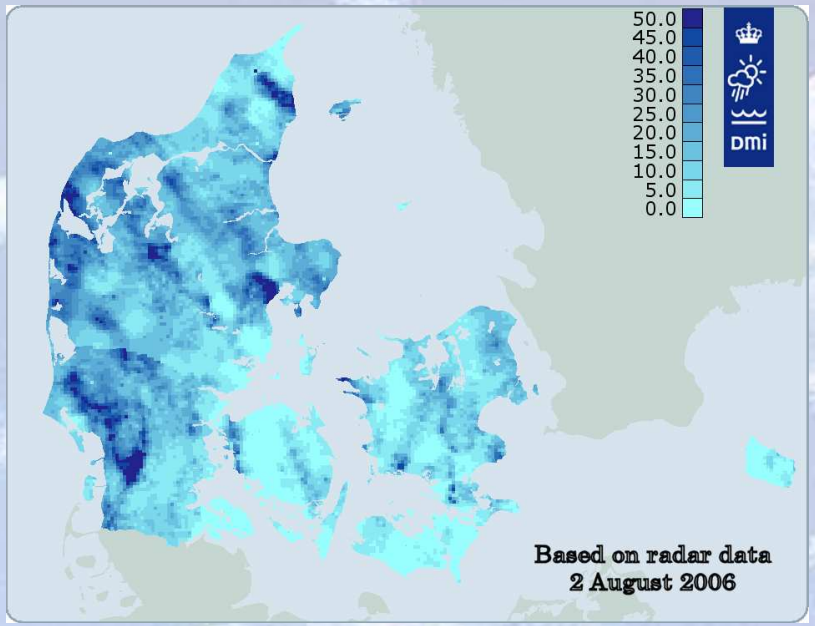




Test against independent raingauges

Adjustment	Before	After
r	0.698	0.824
R^2	48.7%	67.8%
Average bias	-9.03	-0.32
Absolute bias	9.25	4.16





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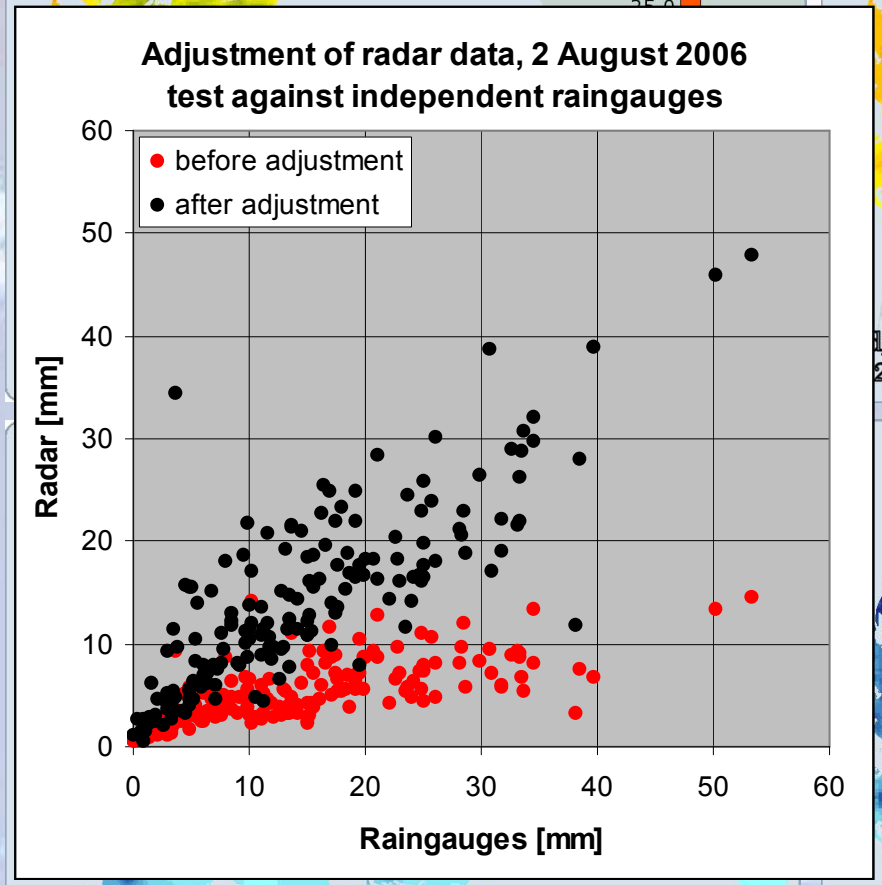
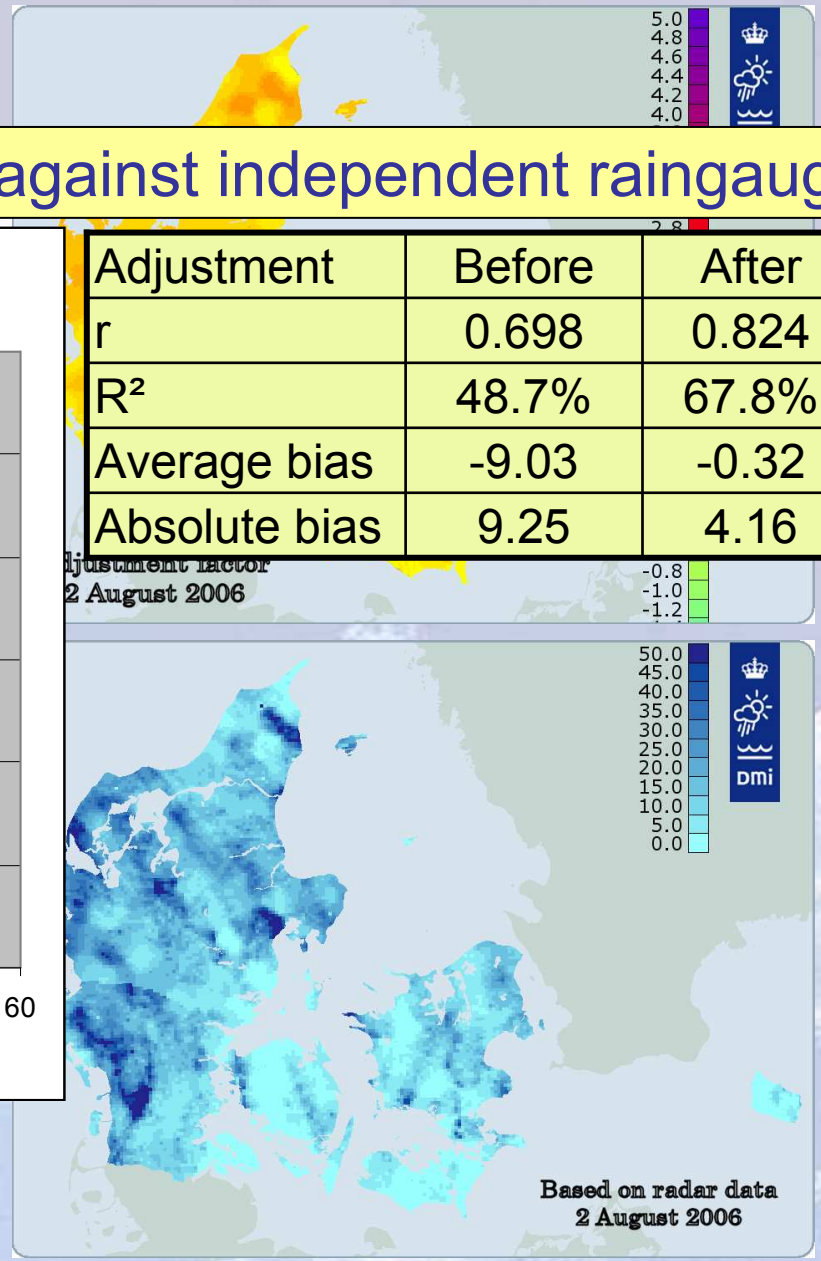
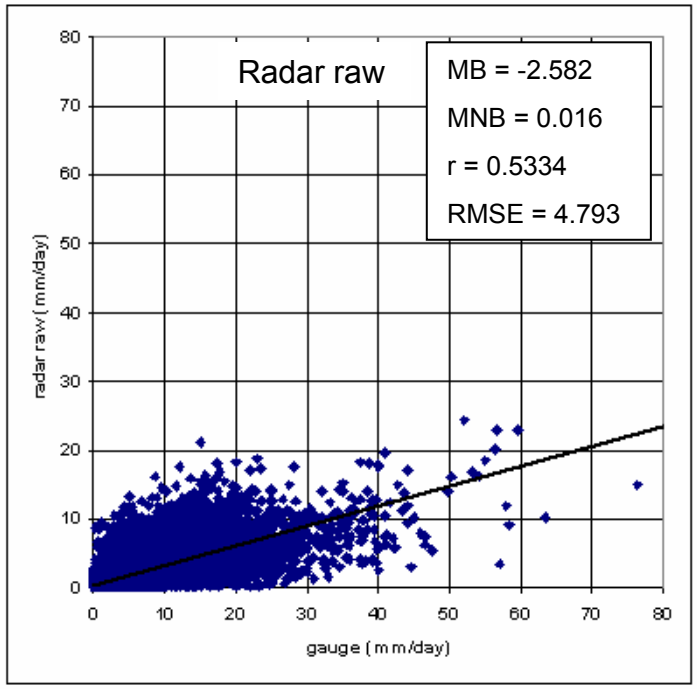
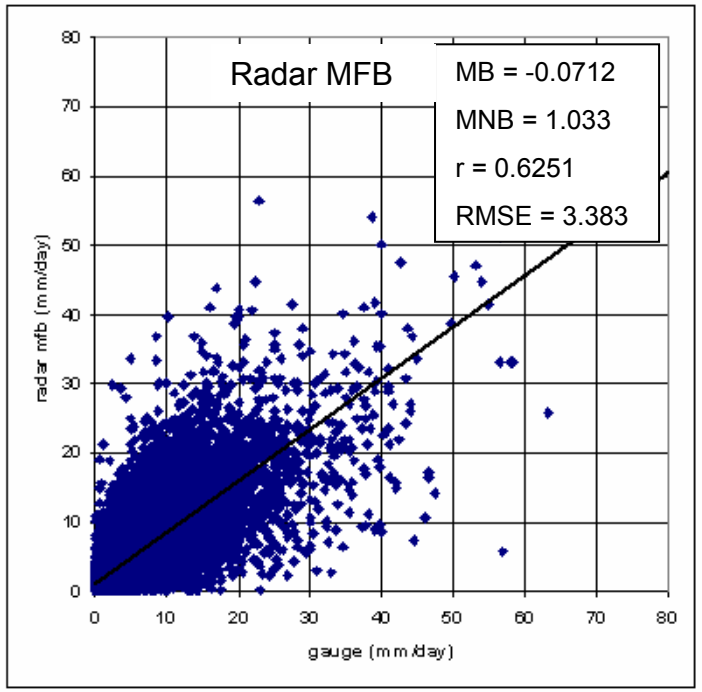
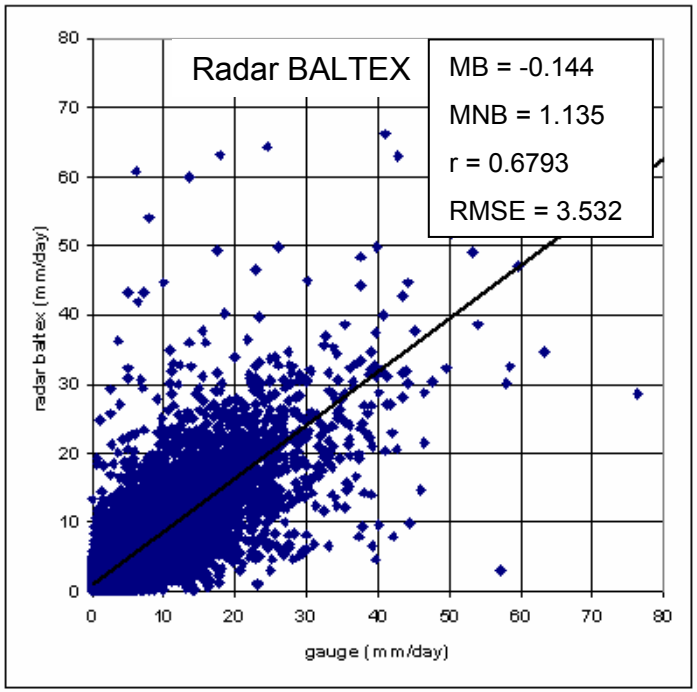


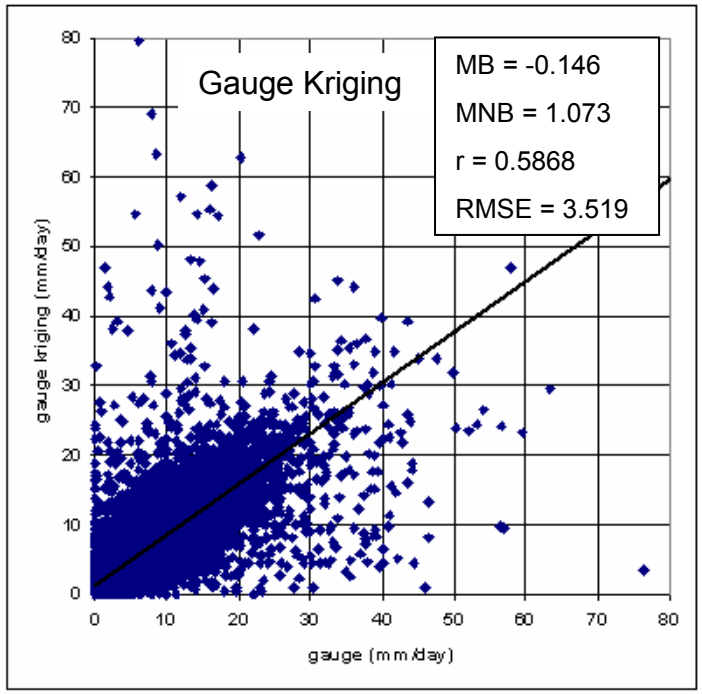


DMI


Radar raw
MB = -2.582
MNB = 0.016
r = 0.5334
RMSE = 4.793
radar raw (mm/day)
gauge (mm/day)


Radar MFB
MB = -0.0712
MNB = 1.033
r = 0.6251
RMSE = 3.383
radar mfb (mm/day)
gauge (mm/day)

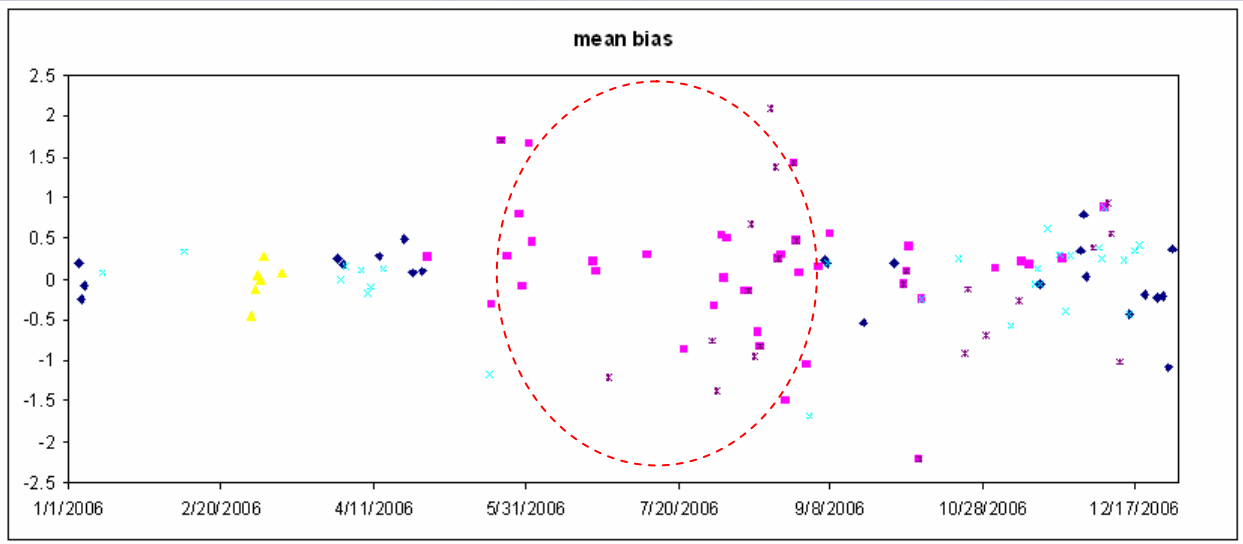

Radar BALTEX
MB = -0.144
MNB = 1.135
r = 0.6793
RMSE = 3.532
radar baltex (mm/day)
gauge (mm/day)

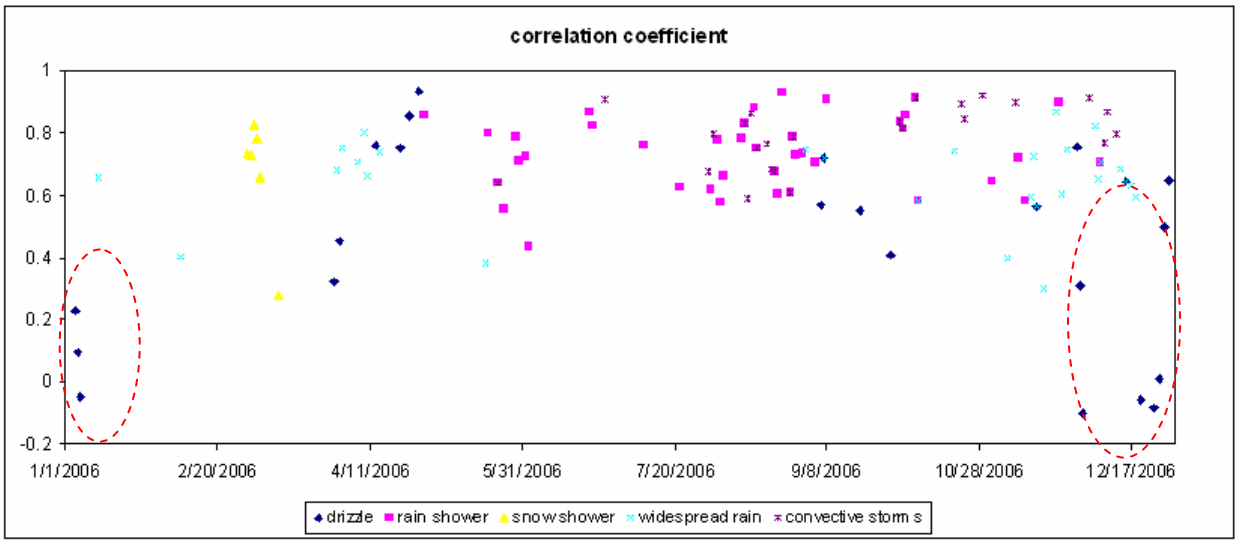

Gauge Kriging
MB = -0.146
MNB = 1.073
r = 0.5868
RMSE = 3.519
gauge kriging (mm/day)
gauge (mm/day)

Klassifikation af vejrtyper

finregn 23 døgn		observation af finregn >= 15% 2 mm <= vådeste station <= 10 mm Filter benyttes Sept – April
snebyger 6 døgn		observation af sne >= 20% Standardafvigelse >= 1
regnbyger 39 døgn		observation af regn >= 30% vådeste station >= 10mm Standardafvigelse >= 2
Udbredt regn 28 døgn		observation of rain >= 50% standard deviation < 3
konvektive storme 24 døgn		observation af regn >= 50% Standardafvigelse > 5

Resultater af beregninger af radarnedbør ved forskellige vejrtyper



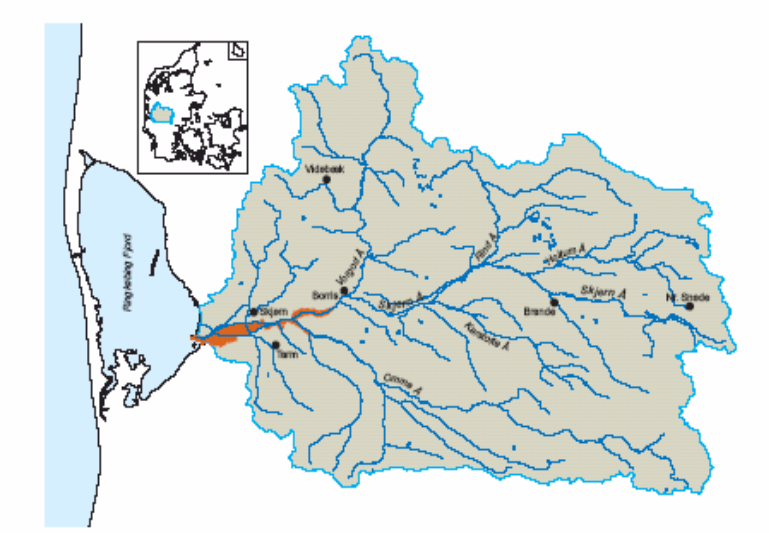


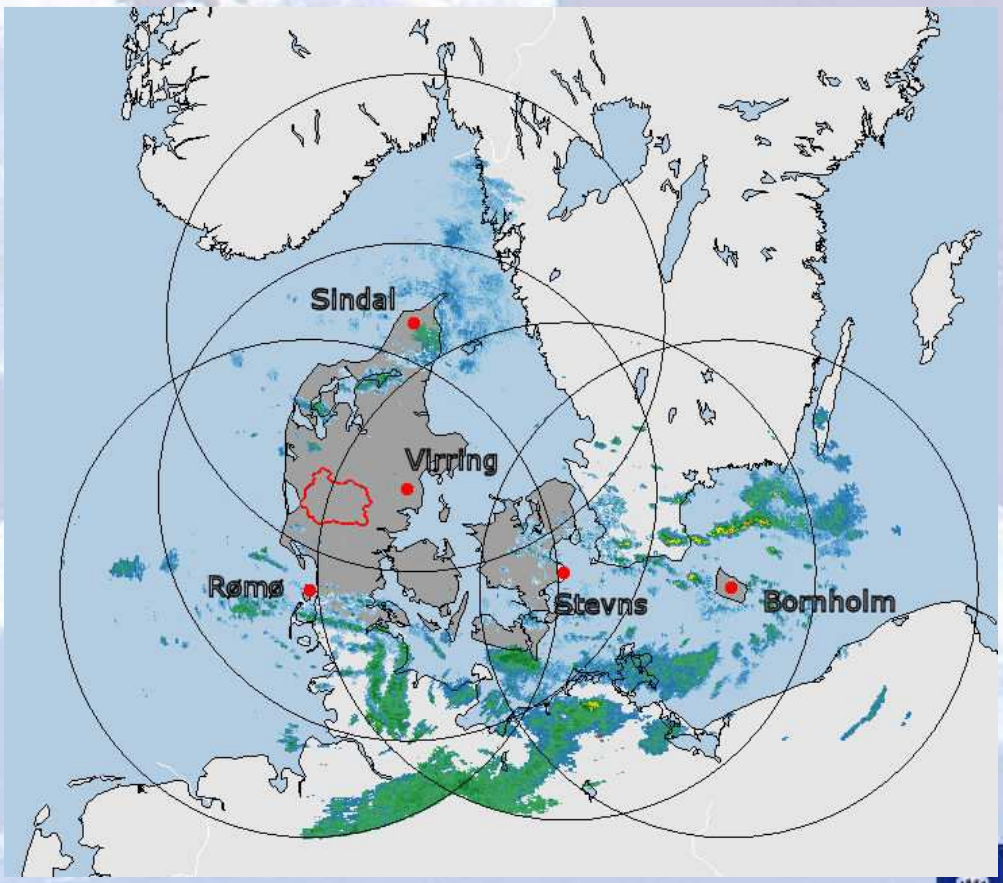
Hydrologisk modellering

hvad er konsekvensen af at benytte radar QPE?

HOBE: Skjernå opland

Area: 1500 km²





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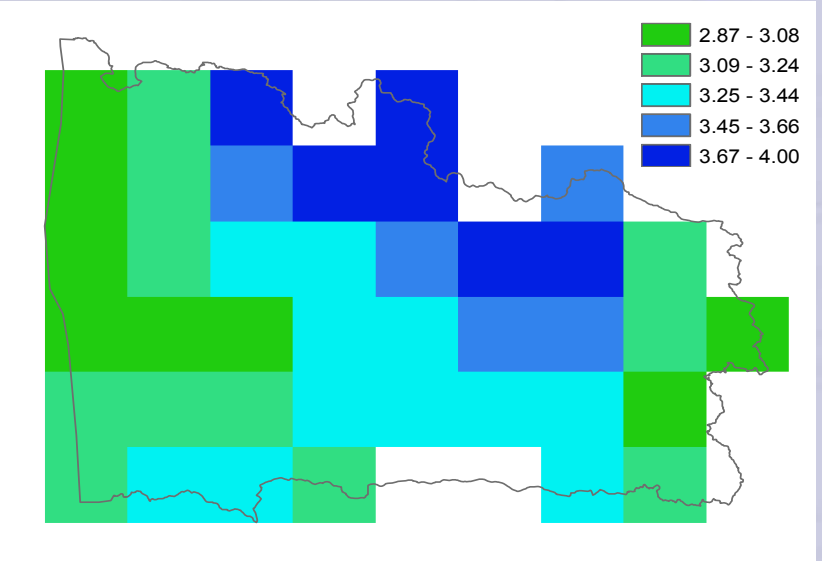
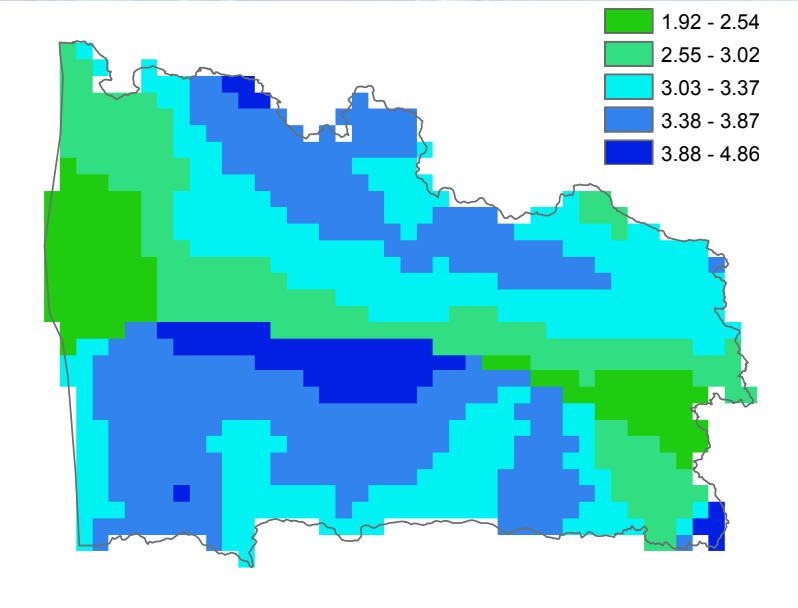
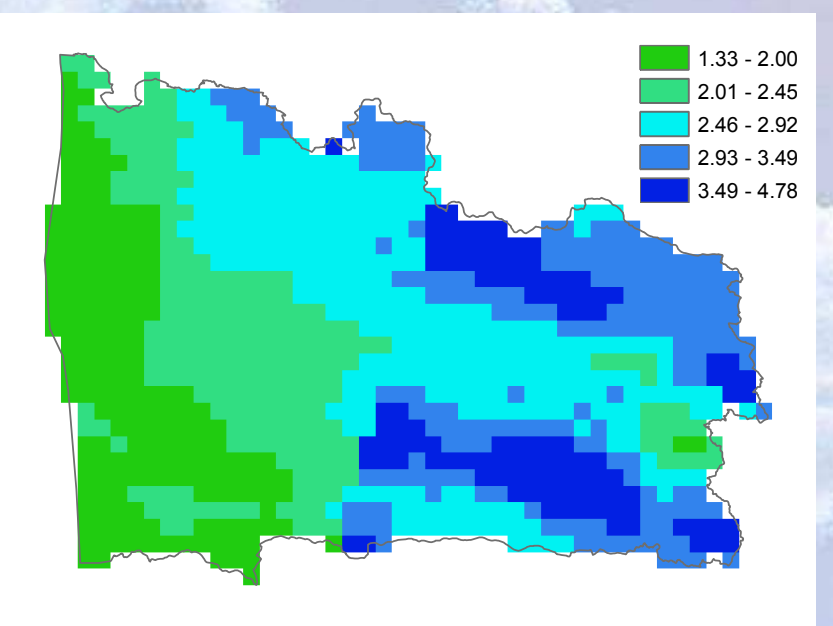
Input af nedbør til MIKE-SHE middel for hele 2006



DMI 10 km grid



Rømø radar (2 km)



Sindal radar (2 km)

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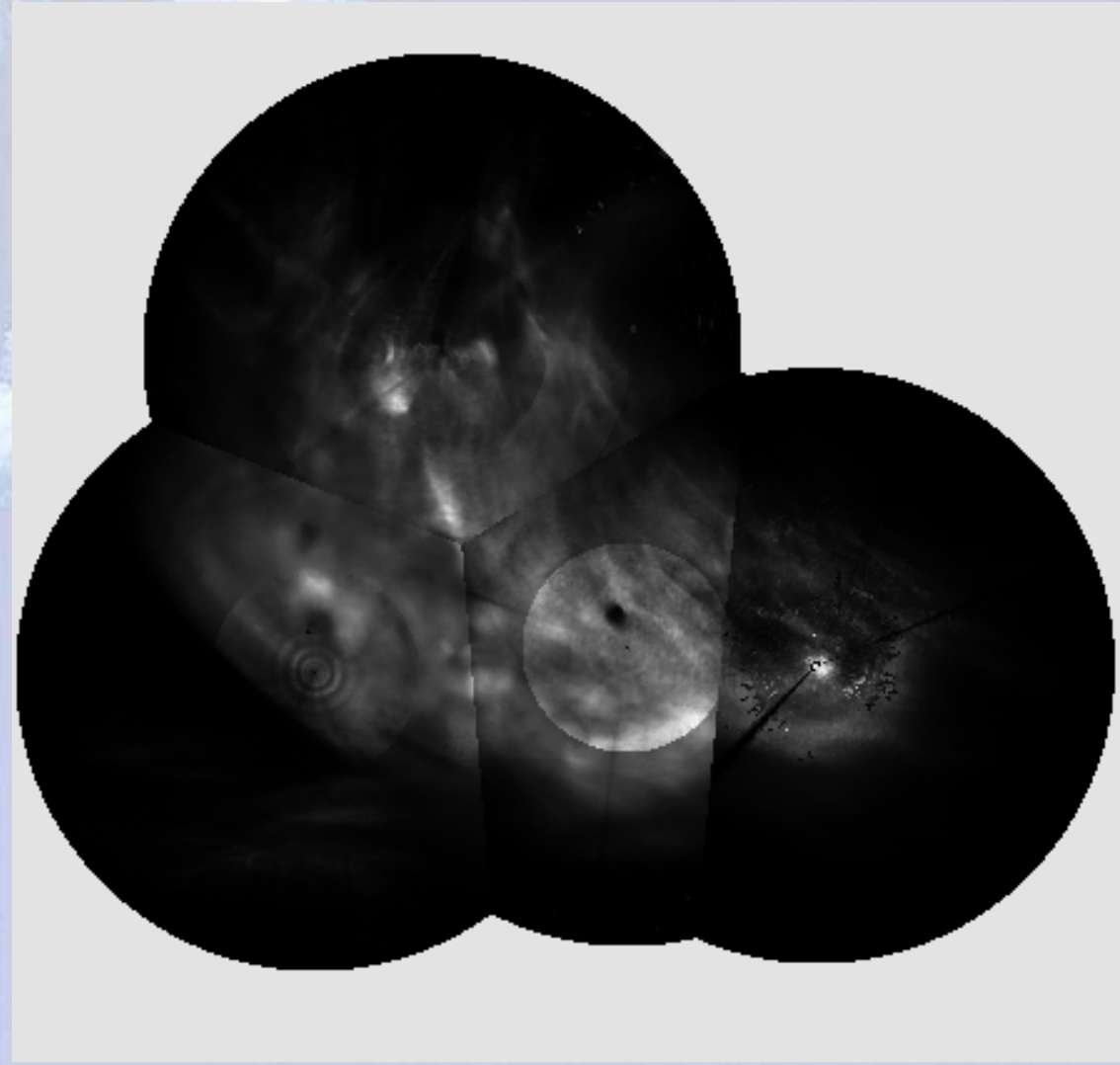
Problemet og dets løsning



Genberegning af radarbilleder vha. nye metoder

Alle gamle data gen-processeres:

- Volumendata (rå)
- Genskabe billeder
- Cirkler forsvinder

Vi har rå-data tilbage til 2004 (alle radarer)

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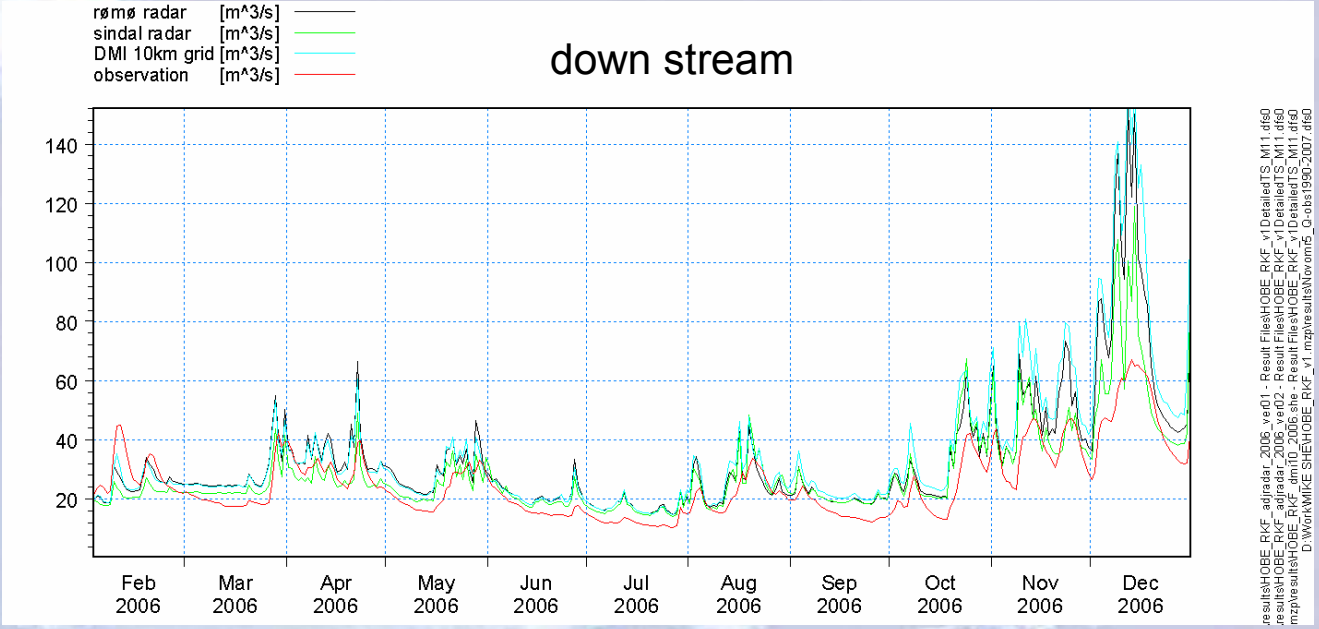
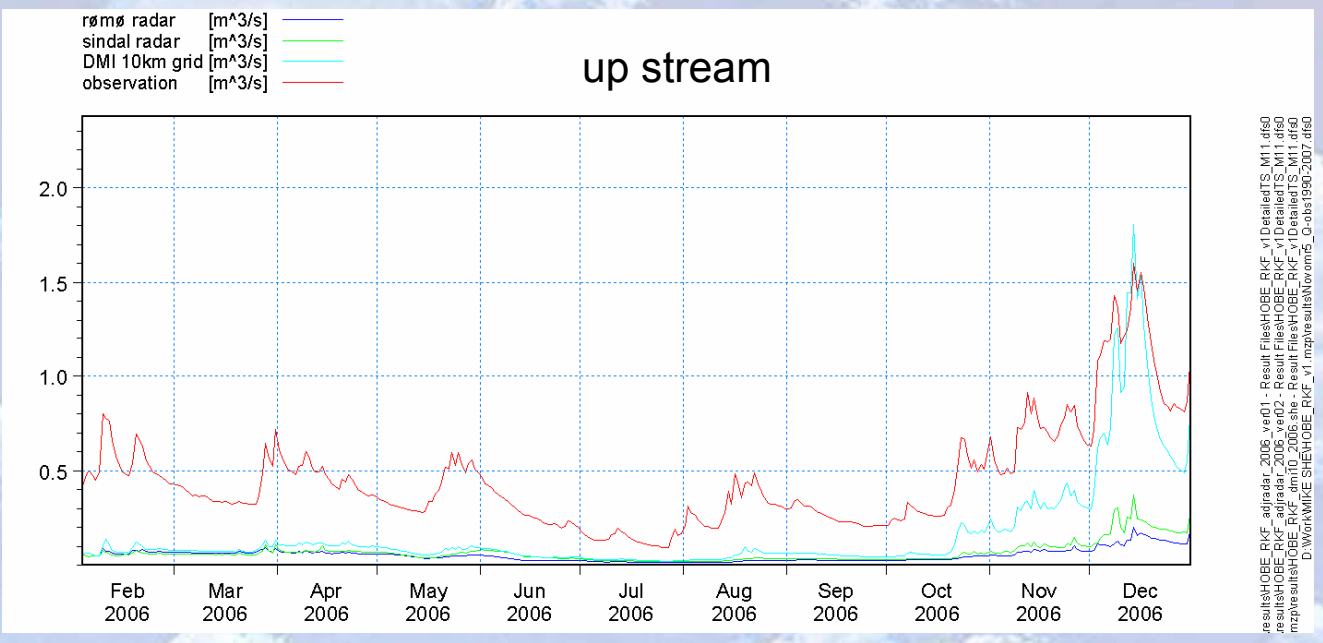
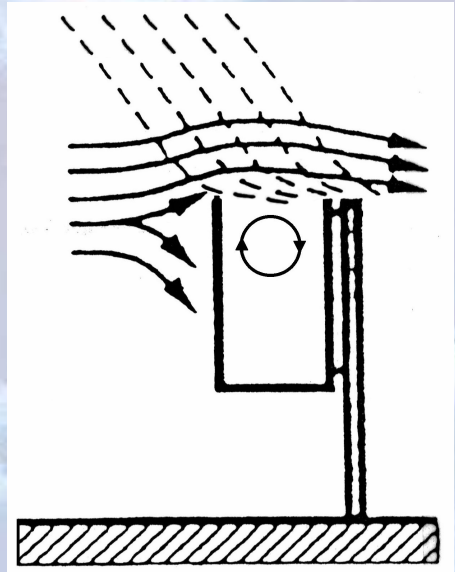
Afstrømning

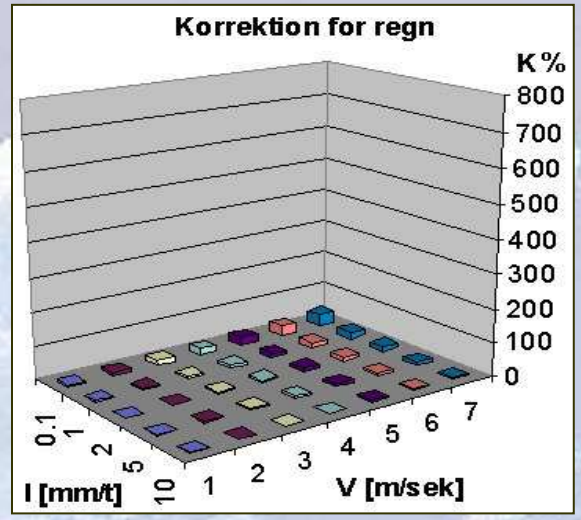




Nedbørkorrektion

Målefejl på nedbør: turbulens





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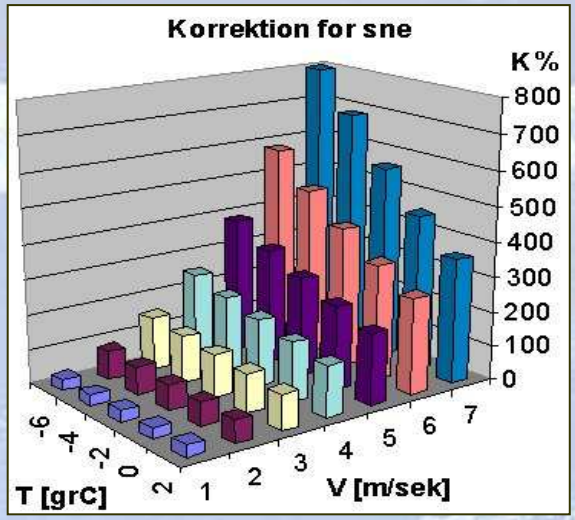

En samlet korrektion

NOGET TYDER PÅ, AT VI REGNER GALT FOR SNE:
Der er for meget nedbør !

HOBE:
Vi er på jagt efter årsagerne og deres løsning

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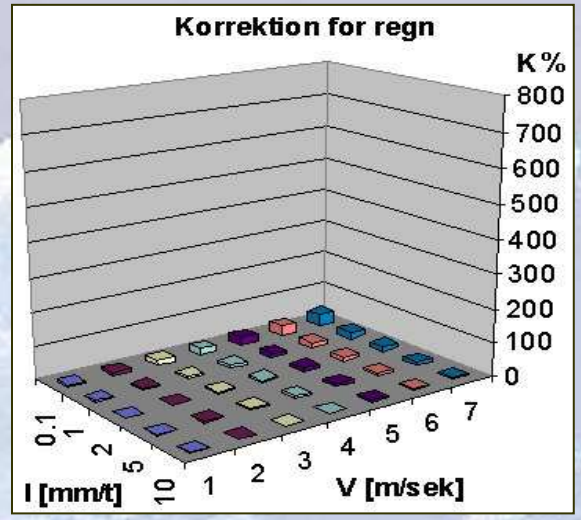
Målefejl på nedbør: turbulens

Korrektionsmodel kræver informationer om:

- **Vindhastighed under nedbør**
- **Temperatur under nedbør**
- **Regnintensitet**
- **andel af nedbør som sne**
- **læforhold**



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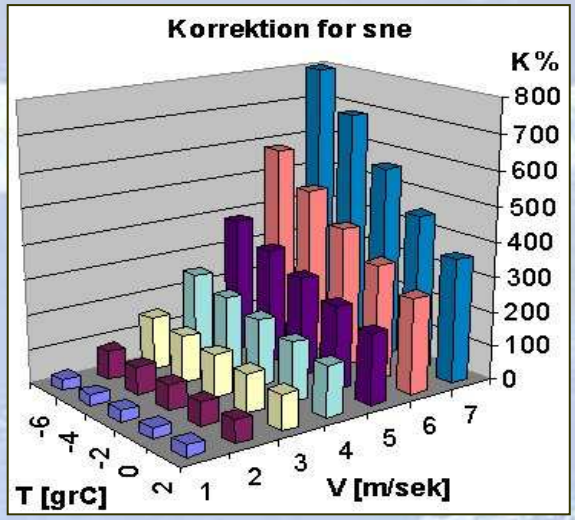

En samlet korrektion

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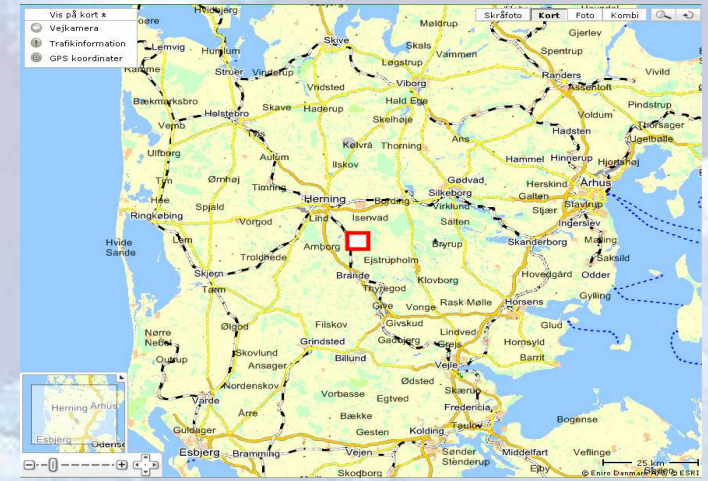
Testfeltet i Voulund



November 2008

Status april 2009

Forbedring af beregningsmetoder

Genberegne standardværdier:

- Større datasæt: 20 år, flere stationer

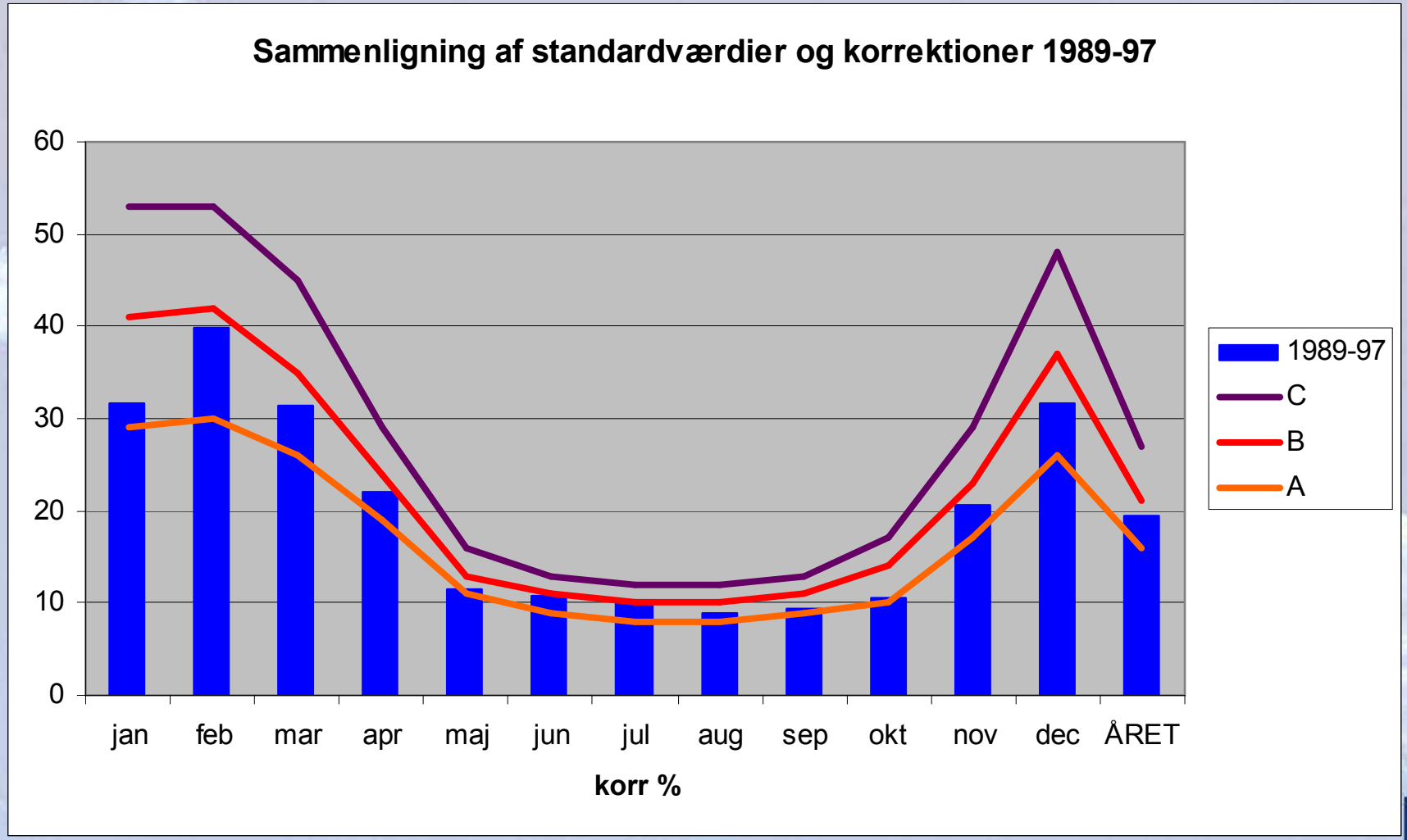
Forbedring af korrektionsmodel for SNE:

- Validere snemodel for danske klimaforhold
- Udvide gyldighedsområde: sne V>7 m/sek
- Arbejde på løsninger for snefygning
- Re-analyse af længere dataserie fra Finland

Forsøge forskellige beregningsmodeller:

- Andre datakilder: radar, grid af vind/temperatur/…
- Sneprocent vha. observationer
- Praksis for lækorrektion

Eksempel på hvad beregningsmetode kunne betyde



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Konklusion

- Anvendelse af radarnedbørberegninger i hydrologisk modellering har stort potentiale
- Radarberegninger viser lovende resultater, men estimering begrænses p.t. af datakvaliteten
- Klassifikation af nedbørtyper har stort potentiale for forbedring af radarnedbør
- Der er flere muligheder for at forbedre korrektion af nedbørmålinger

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Tak for opmærksomheden!