Assimilation af remote sensing data i vejrforudsigelsesmodel

Forskningscenter Risø

Charlotte Bay Hasager, Niels Otto Jensen, Poul Astrup, Ebba Dellwik

Danmarks Meteorologiske Institut

Niels Woetmann Nielsen, Jens Hesselbjerg Christensen

Geografisk Institut

Henrik Søgaard, Eva Bøgh, Michael Schulz Rasmussen

Indhold

Indledning

Assimilation i HIRLAM vejrforudsigelsesmodel af

Overfladeflux modellering

Konklusioner

SAT-MAP-CLIMATE projekt

Satellite-based bio-geophysical parameter **map**ping and aggregation modelling for **climate** models

Bevilling

Forskningsstyrelsen, ESA-følgeforskning, 1999-2002

MOTIVATION

At forbedre vejrforudsigelse og regional klima model ved at introducere satellite-baserede kort af

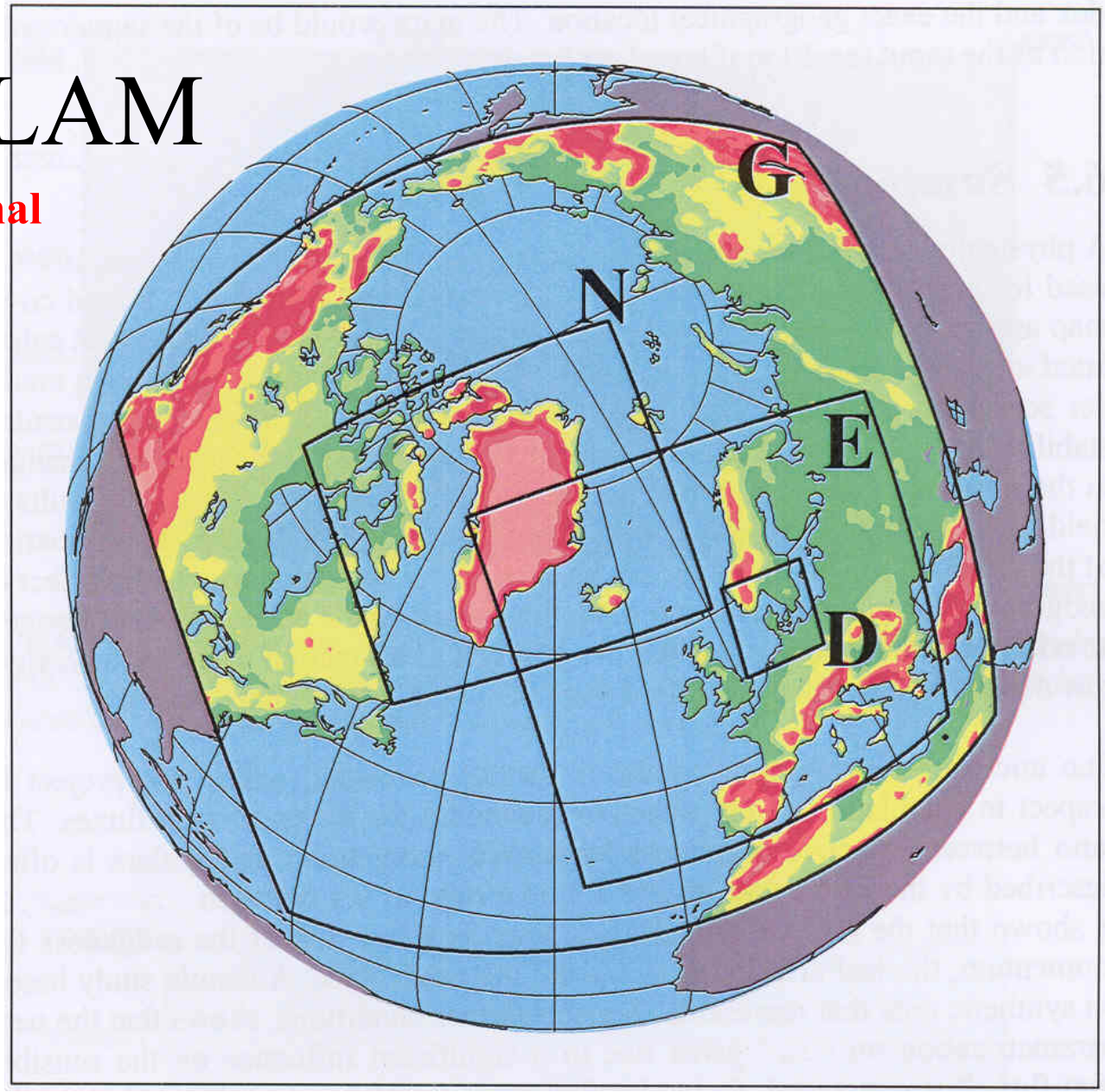
- albedo
- overfladetemperatur
- ruhed
- land klasser
- blad areal

Overfladeflux modellering

HIRLAM

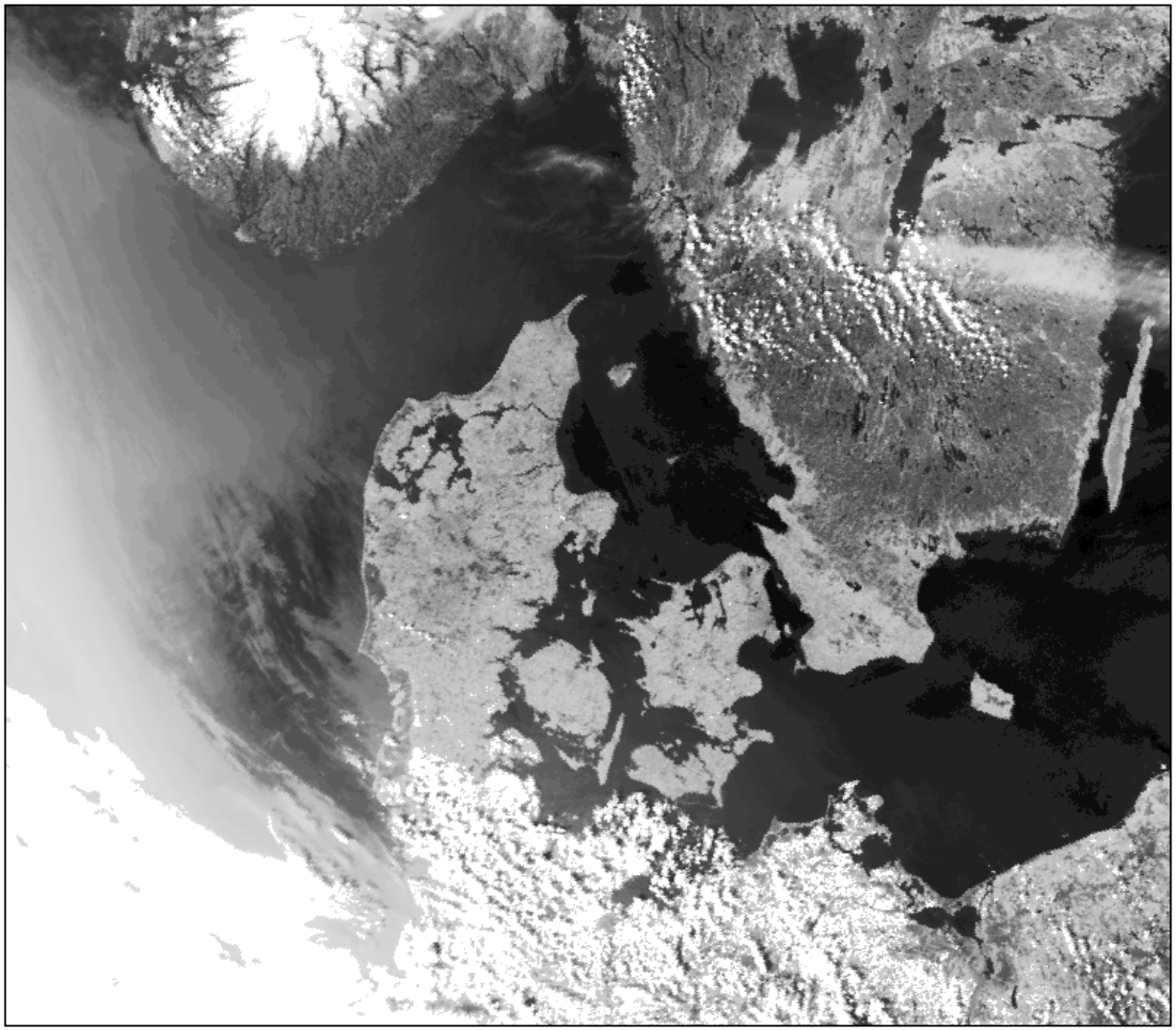
Operational vejr model

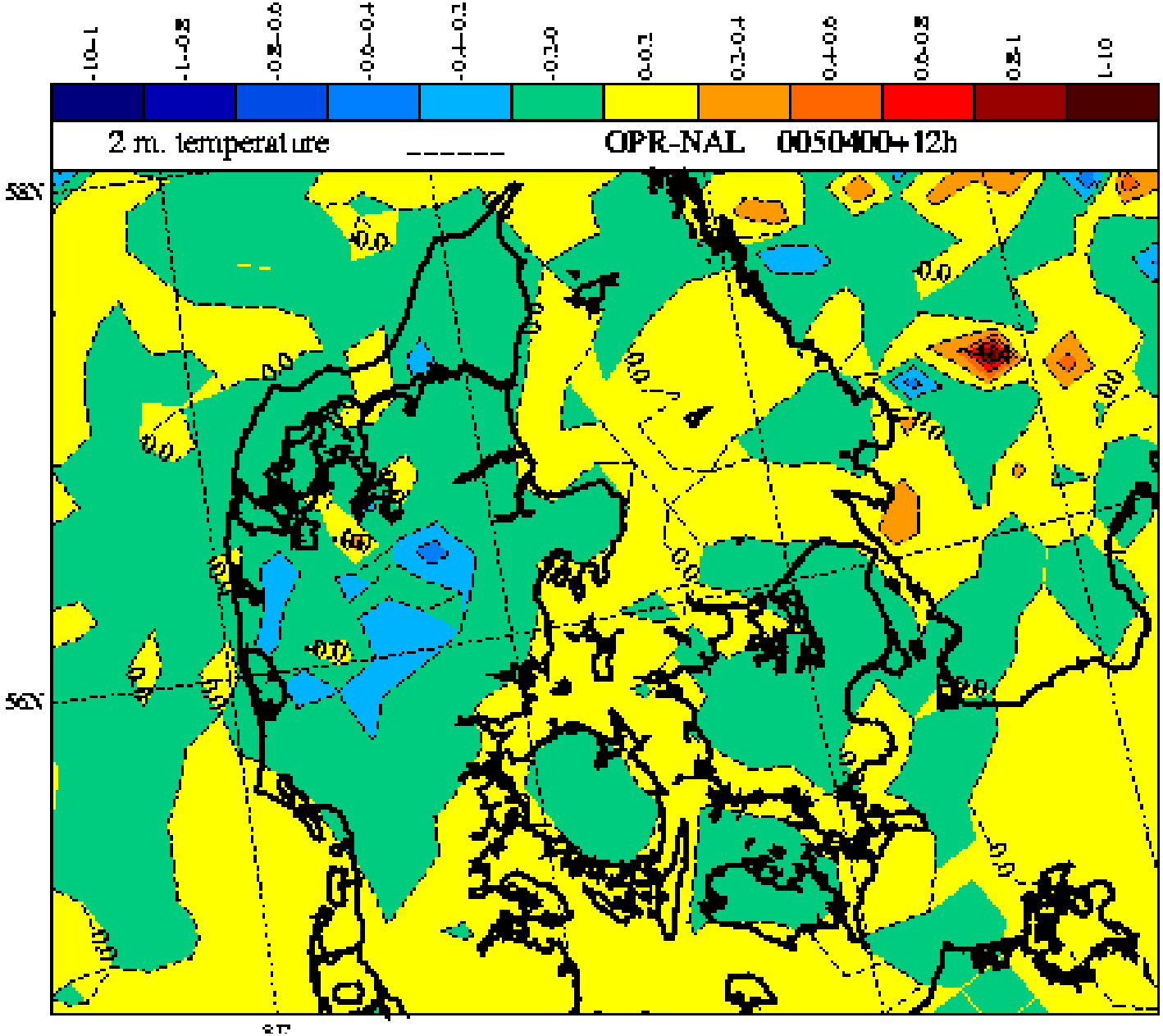
Danmark
Sverige
Norge
Finland
Spanien
Irland
Holland



RISØ

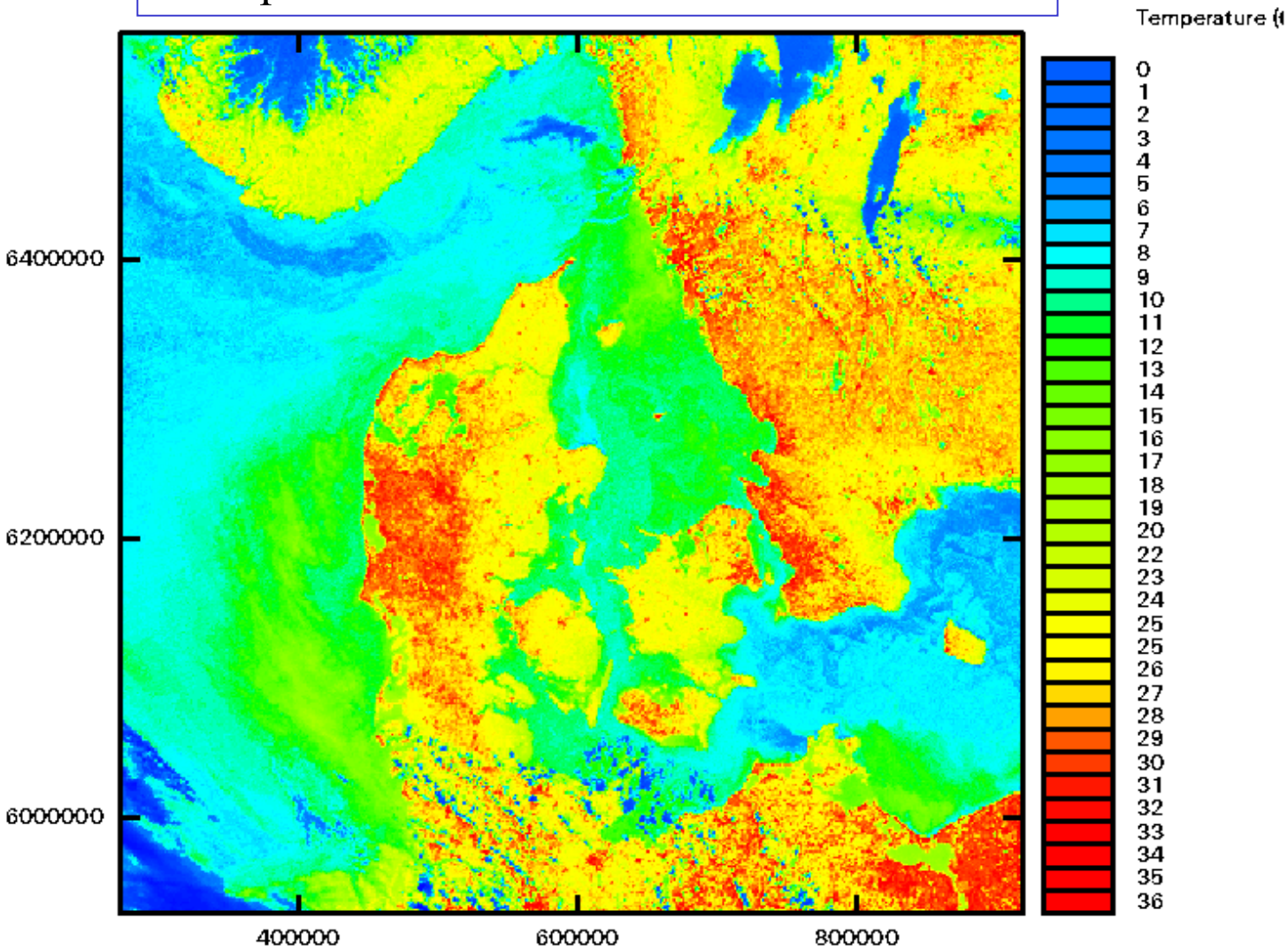
Albedo kort map fra NOAA AVHRR
29 April 2000

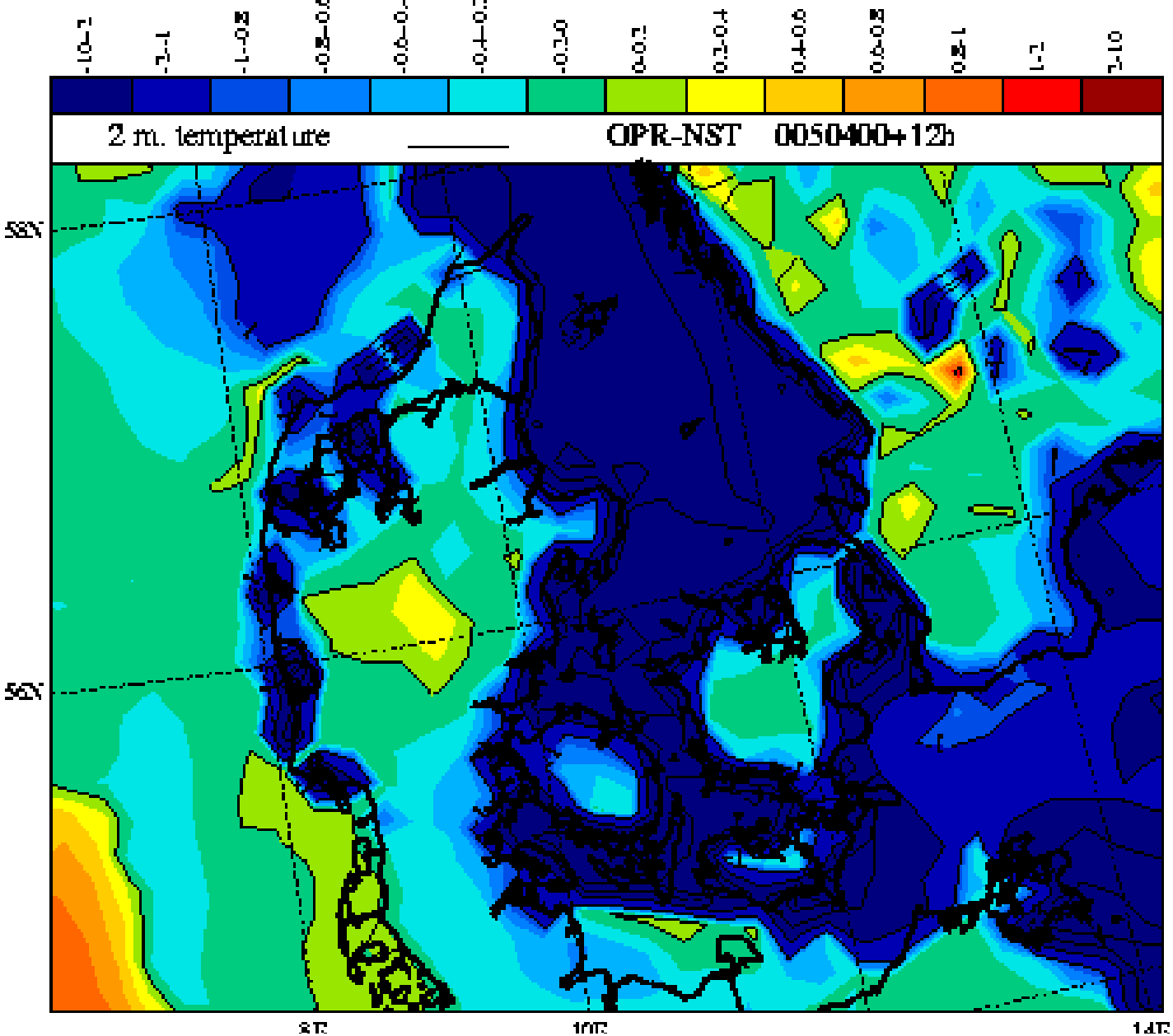




HIRLAM 12 timer vejrforudsigelse af lufttemperatur. Kort af forskelle mellem input af klima-middel albedo og aktuel fra NOAA AVHRR.

NOAA AVHRR land- og havtemperatur kort 29. April 2000





HIRLAM 12 timer vejrforudsigelse af lufttemperatur. Kort over forskelle mellem klimatologisk input og aktuel havoverflade temperaturer fra NOAA AVHRR.

Areal Information System (AIS) http://www.dmu.dk/ais

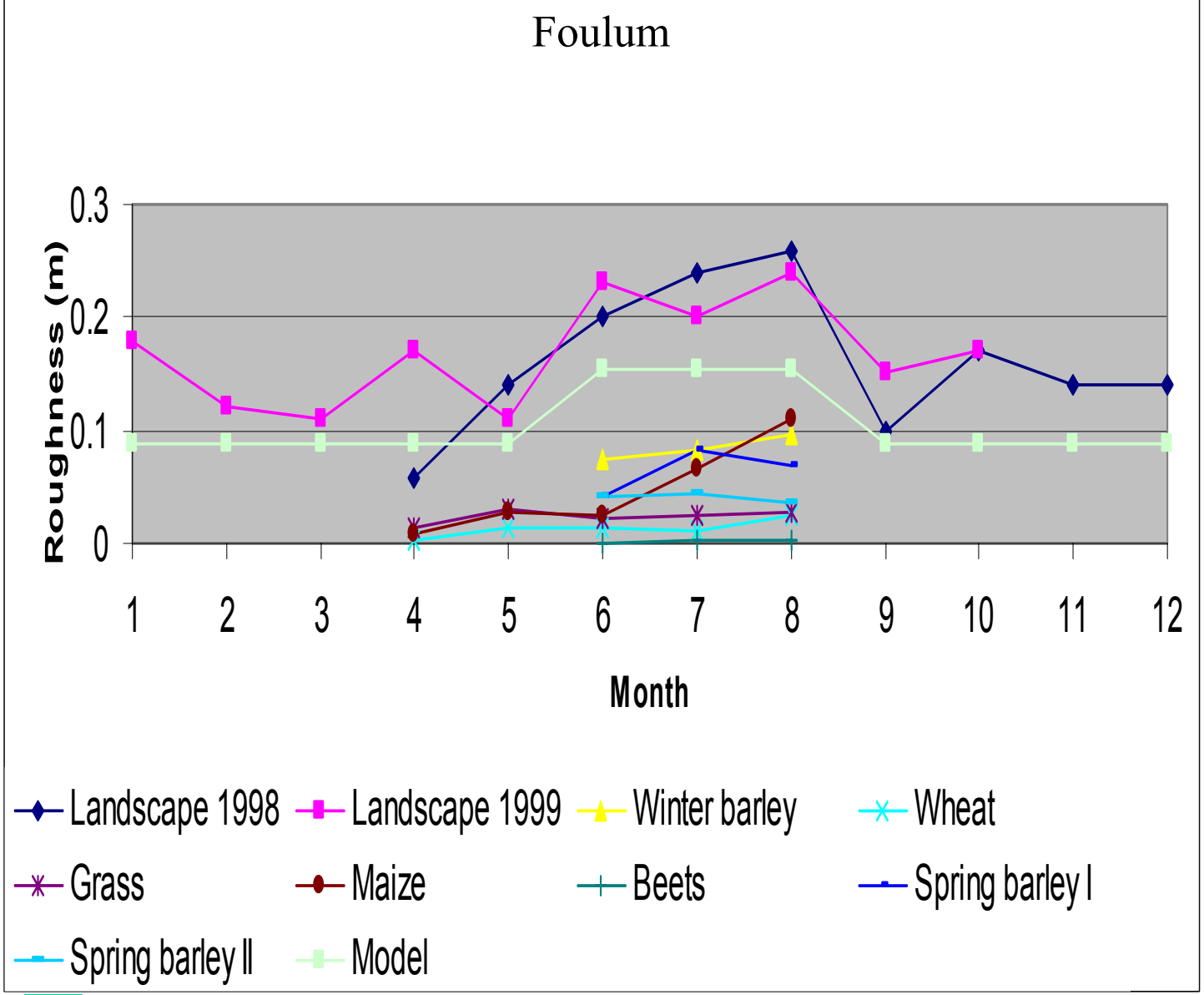
RISØ

25 m pixel opløsning

Land cover type	Roughness
Water	0.001
Sand	0.03
Marsh	0.08
Grass heath	0.08
Permanent short grass	0.03
Grazing	0.08
Meadow	0.08
Bush/grass heath	1
Bush/heather	1
Bush/forest	1.8
Deciduous forest	1.8
Coniferous forest	1.8
Meadow	0.08
Agriculture	0.05
Discontinuous urban	0.5
Continuous urban	1.2
Beech forest	1.8
Young forest	1.8
Spruce plantation	1.8
Mixed forest	1.8
Mountain pine	1.8
Oak forest	1.8
Lark forest	1.8
Clearing	0.3
Sparse coniferous	1.8
Heather	0.08
Peat bog	0.08
Set-aside	0.08
Juniper heath	0.08
Heathland	0.08
Agriculture/grassland	0.05

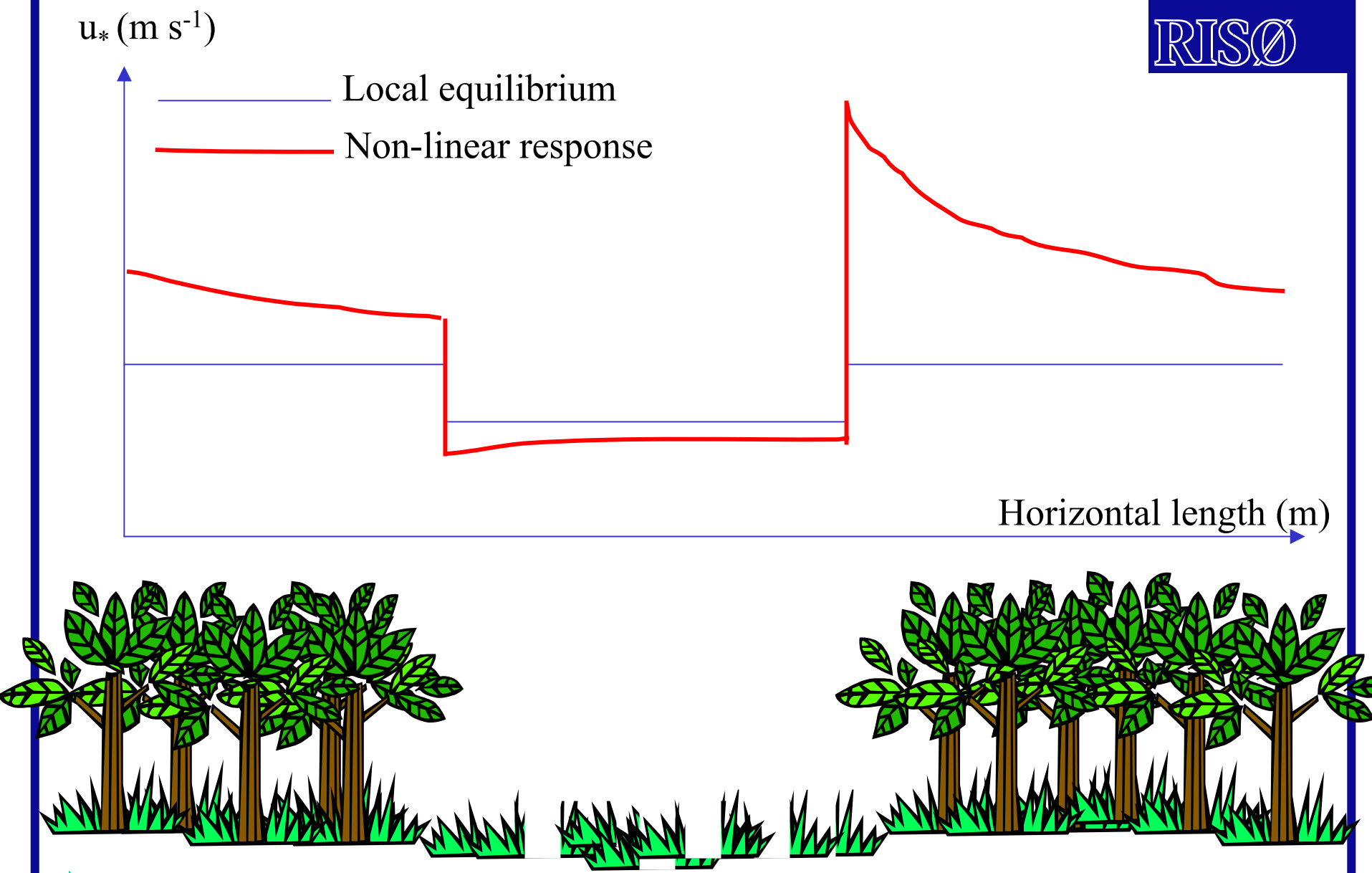
Position af høje meteorologi master

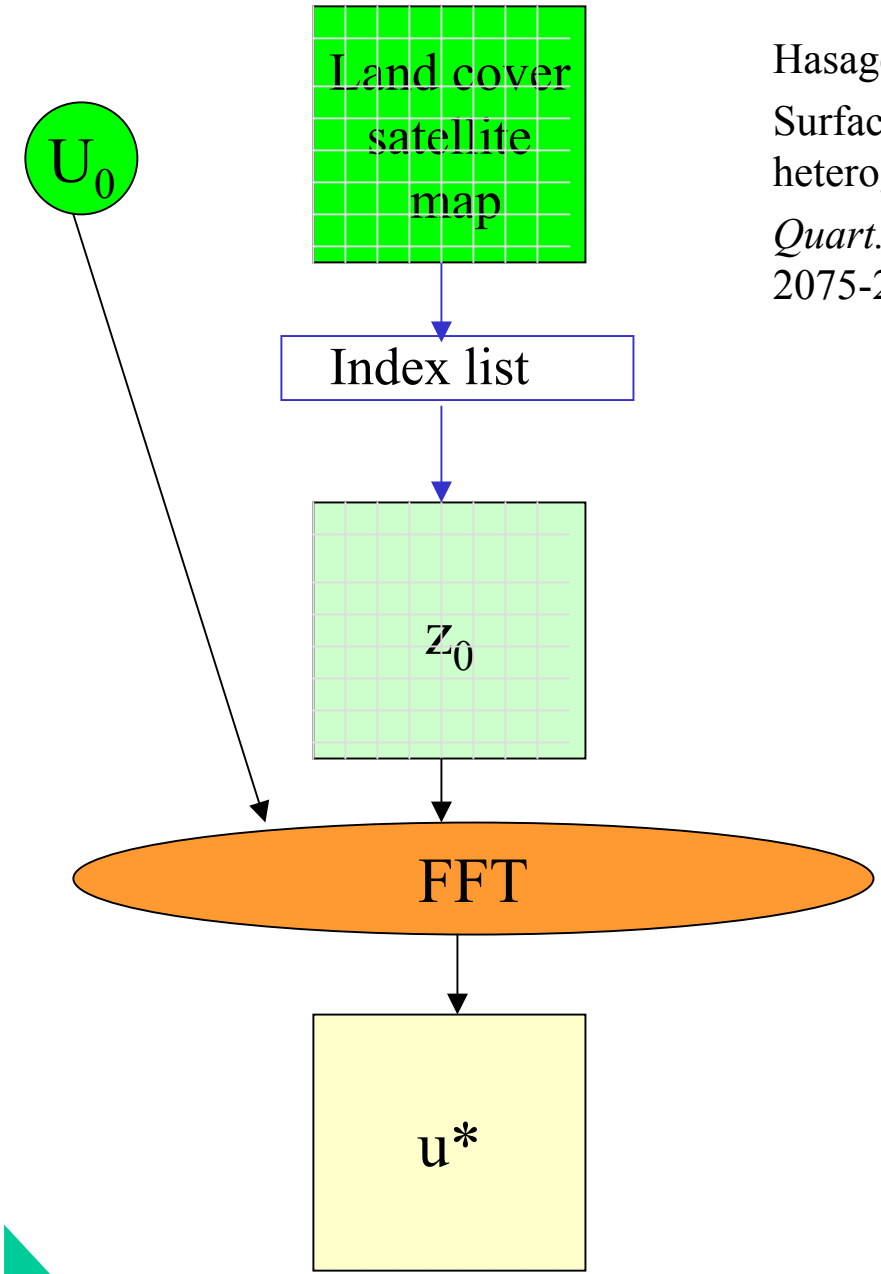
Data fra RS-model projektet



En 48 m høj mast

Syv små master


u* (m s-1)
Local equilibrium
Non-linear response
Horizontal length (m)



Hasager C.B. and N.O.Jensen, 1999

Surface-flux aggregation in heterogeneous terrain

Quart. J. Royal. Meteorol. Soc. **125**, 2075-2102

Skalering

via

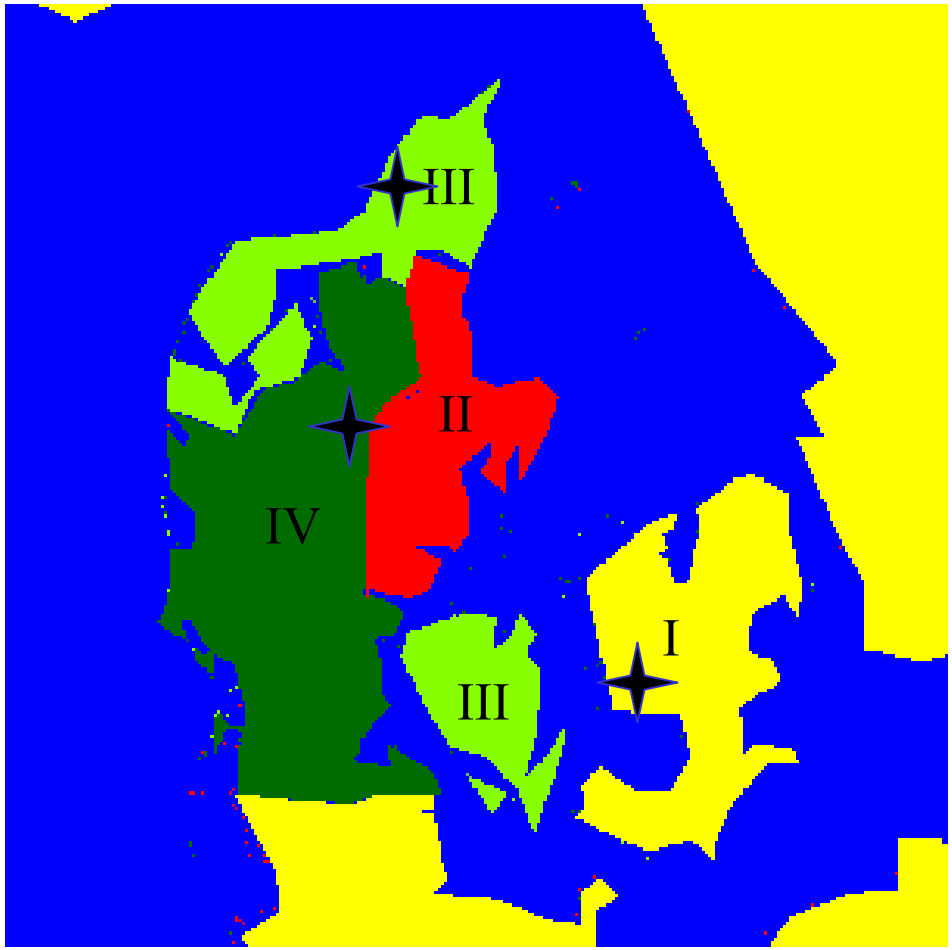
$$U \frac{\partial u}{\partial x} = K_x \frac{\partial^2 u}{\partial z^2}$$

og remote sensing kort med ruhedsværdier i 25 m * 25 m pixels

op til storskala model ruhedsværdier i grid af f.eks. 15 km * 15 km

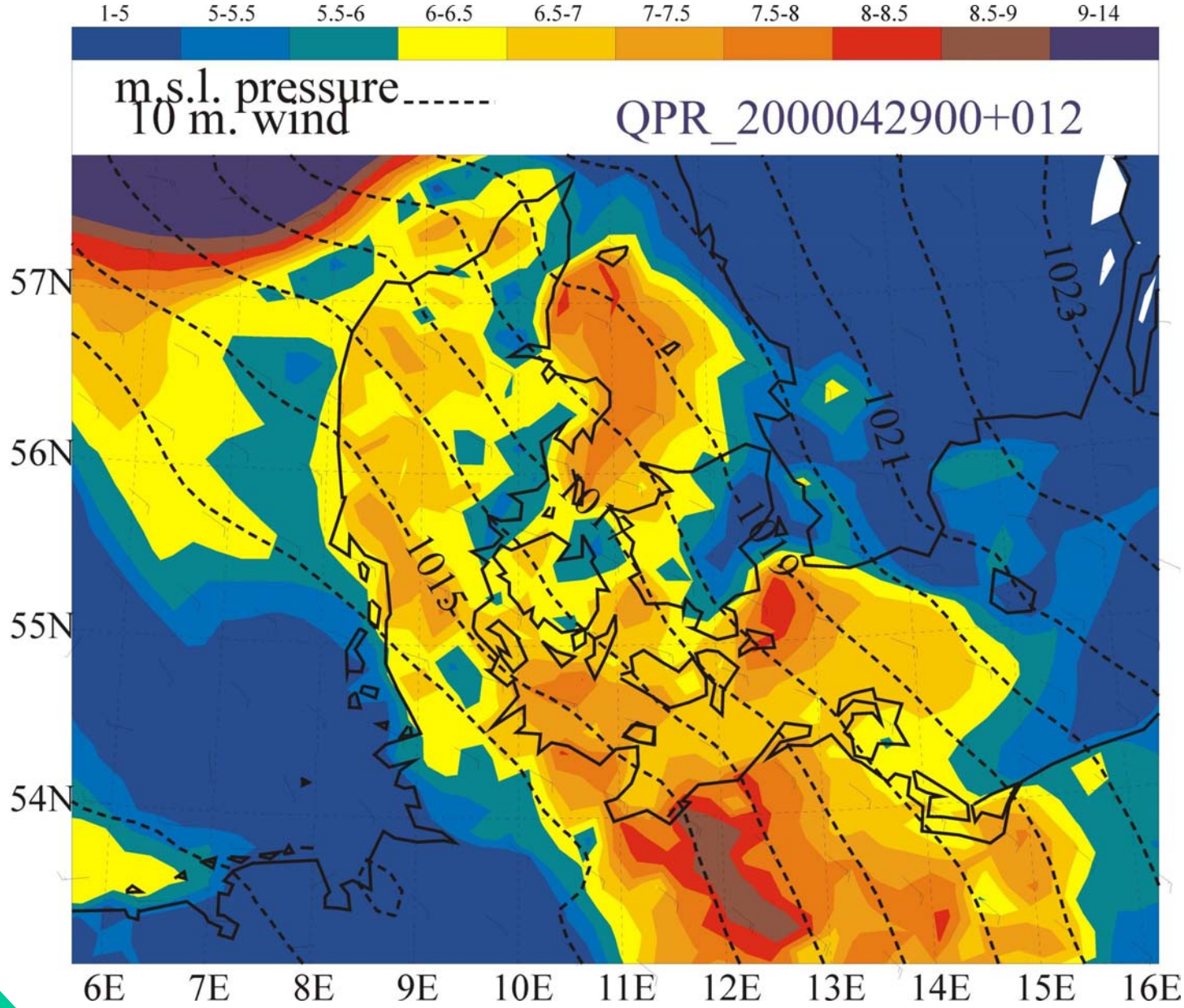
Foulum området set fra den 48 m høje mast

Regioner med forskellig tæthed af hegn i Danmark

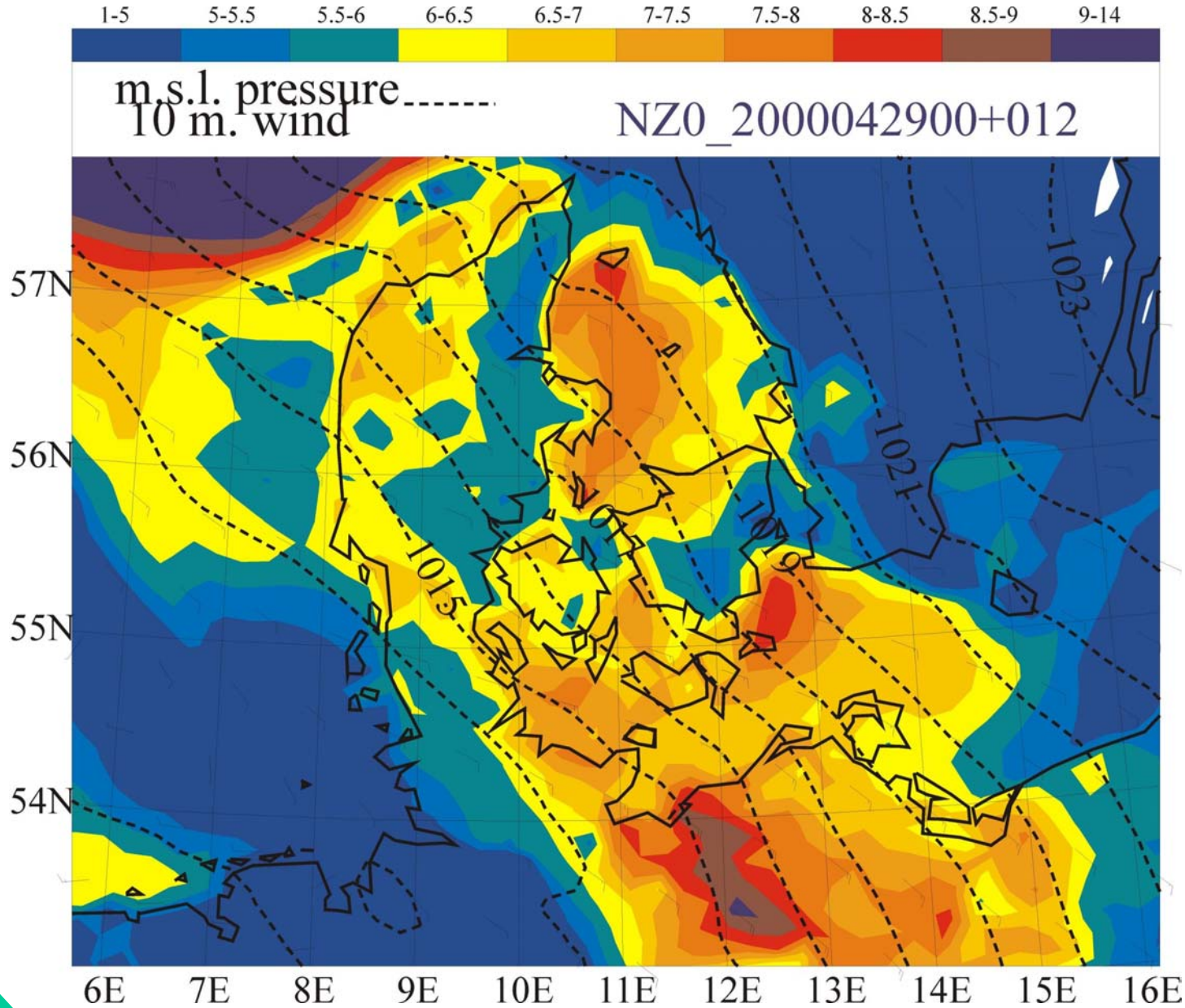


Region	Distance (m)	Roughness summer (m)	Roughness winter (m)
I	841	0.050	0.040
II	650	0.053	0.043
III	423	0.056	0.046
IV	296	0.060	0.050

Høje meteorologi master brugt til validering


1-5
5-5.5
5.5-6
6-6.5
6.5-7
7-7.5
7.5-8
8-8.5
8.5-9
9-14
m.s.l. pressure------
10 m. wind
QPR_2000042900+012
1023
1021
1019
1015
57N
56N
55N
54N
6E
7E
8E
9E
10E
11E
12E
13E
14E
15E
16E

RISØ


1-5
5-5.5
5.5-6
6-6.5
6.5-7
7-7.5
7.5-8
8-8.5
8.5-9
9-14
m.s.l. pressure
10 m. wind
NZ0_2000042900+012
1023
1021
1019
1017
1015
57N
56N
55N
54N
6E
7E
8E
9E
10E
11E
12E
13E
14E
15E
16E

RISØ

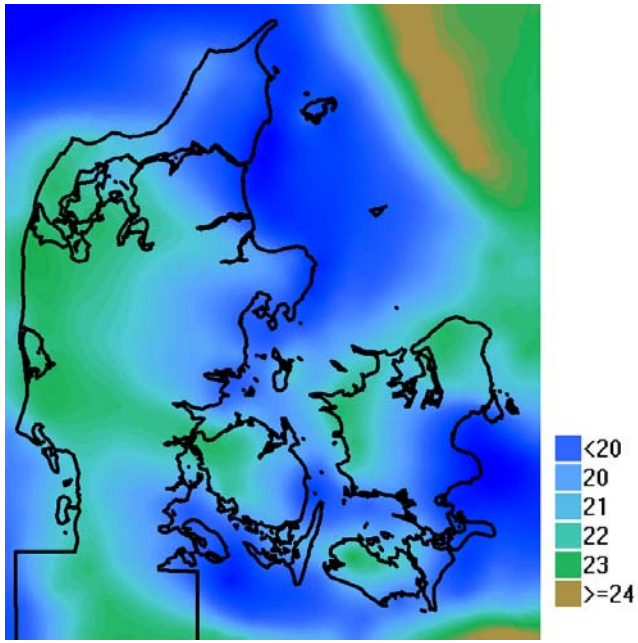
Evapotranspirationen er beregnet med en metode fra Bøgh et al. (2002).

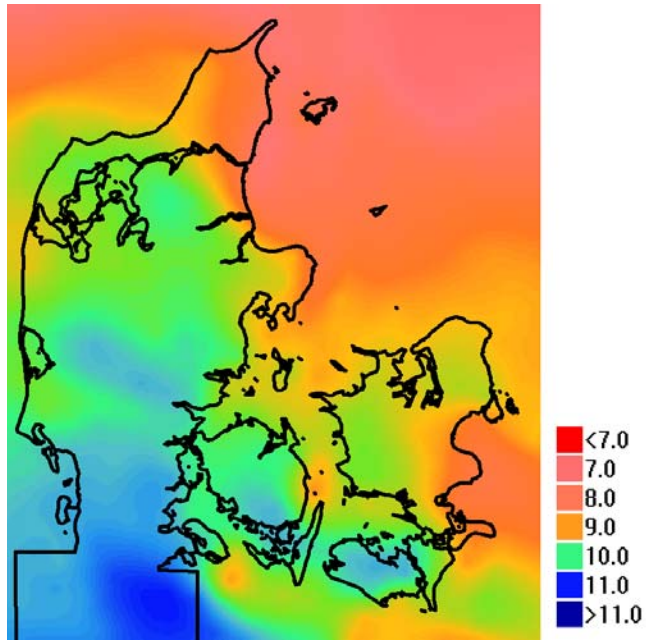
Input fra HIRLAM

- lufttemperatur
- luftfugtighed

Input fra satellite

- overfladetemperatur
- nettostråling

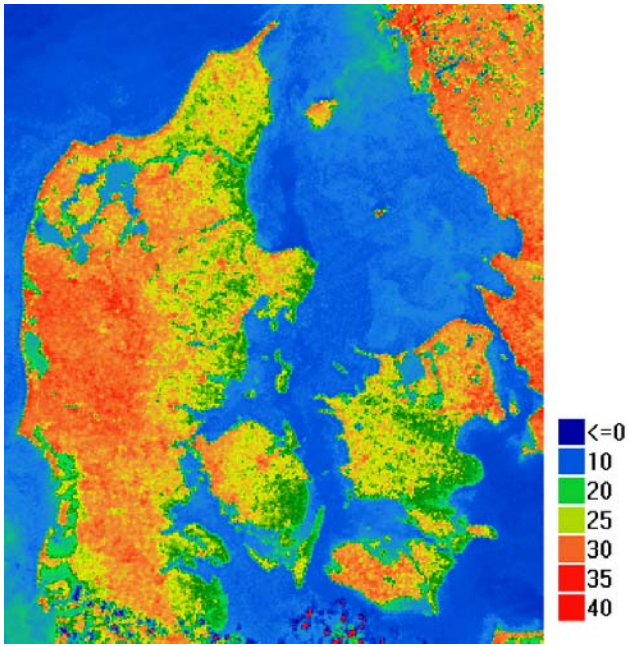


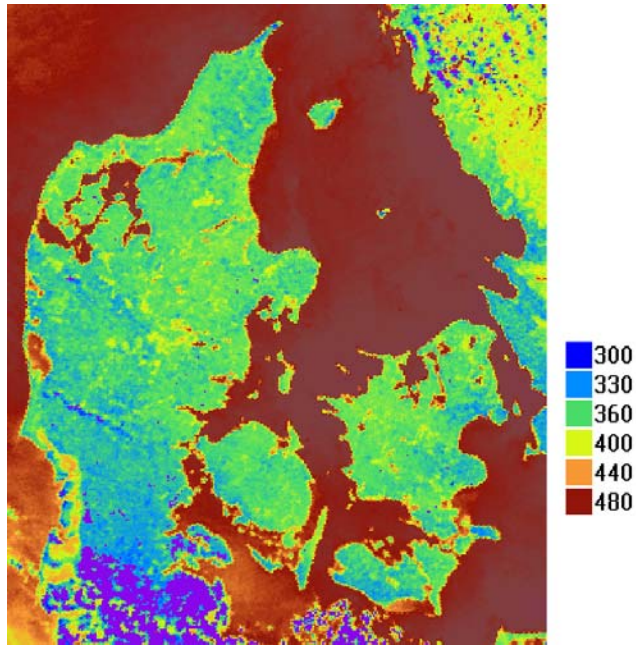


Lufttemperatur (Cel) Luftfugtighed (g m^3)

HIRLAM

29th April 2000 at 12.00 GMT

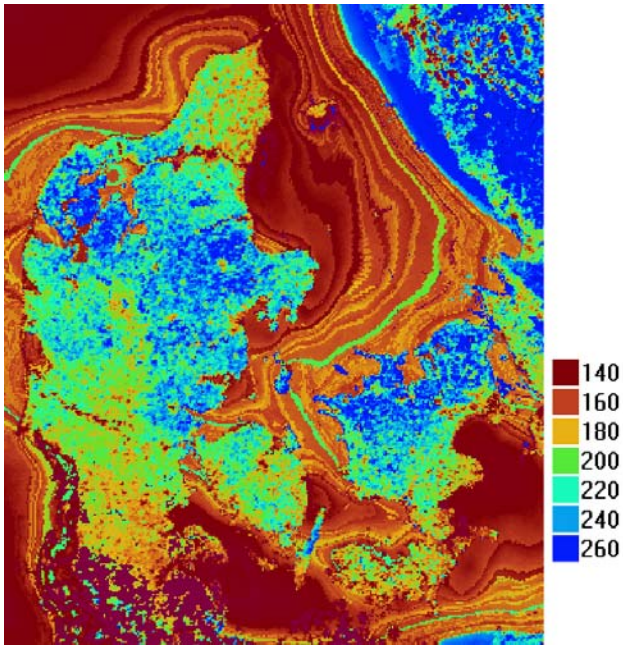




Overfladetemperatur (Cel) Nettostråling (W m^{-2})

NOAA-AVHRR

29th April 2000 at 14.00 GMT.

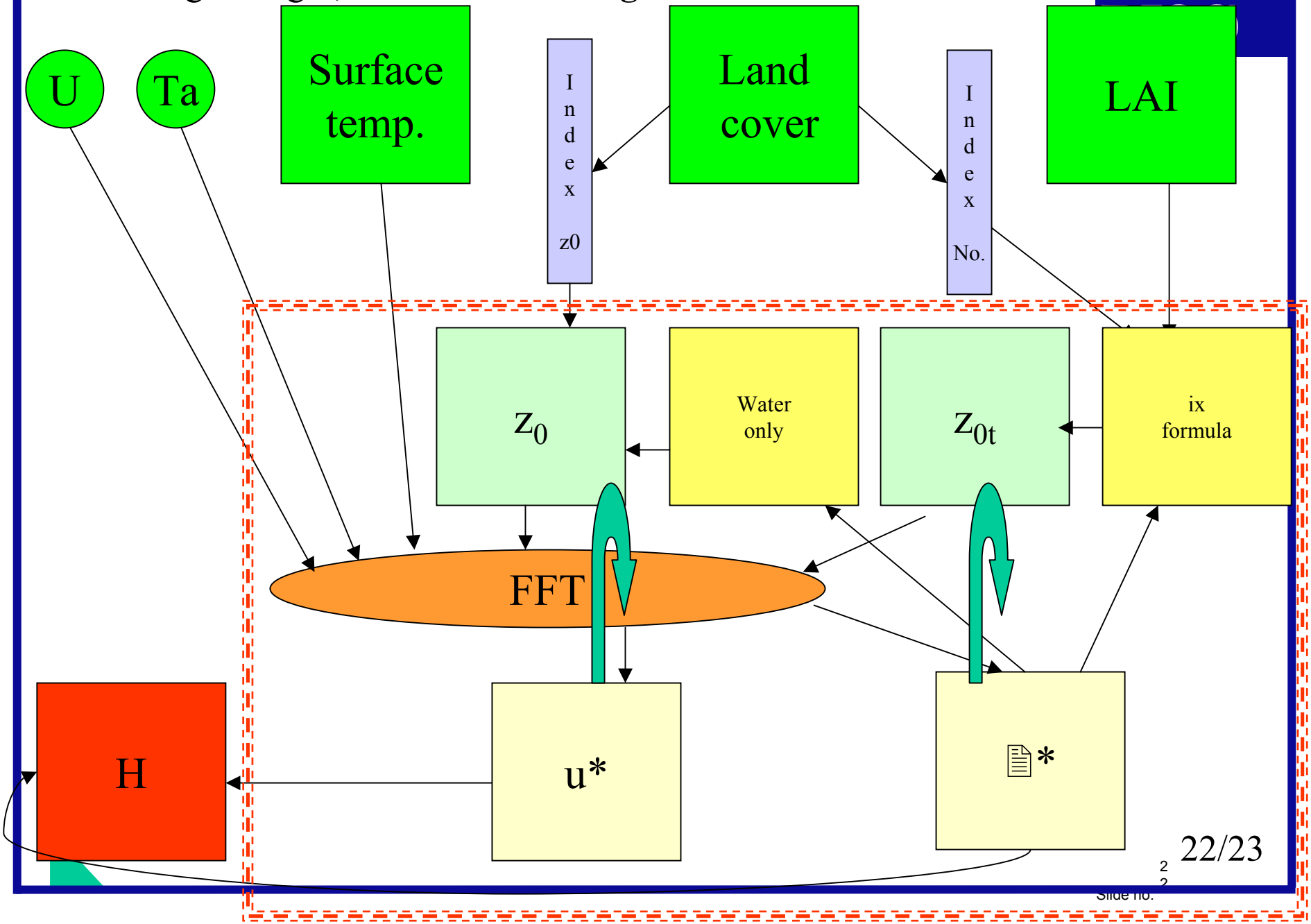


Evapotranspiration rater (W m^{-2})

29th April 2000 at 14.00 GMT.

En empirisk funktion for vanddampstrykket ved overfladen er introduceret for at give en løsning for atmosfærisk modstand, overflade modstand og fordampningsrater

Jensen og Hasager, 2002 **Modellering af sensibel varmeflux**



Konklusioner

NOAA AVHRR albedo ligner operationel albedo, så for HIRLAM lille betydning:---------→ strålingsbudget i HIRHAM klima-model kan forbedres

NOAA AVHRR havoverflade temperatur forskellig fra operationel, så for HIRLAM stor betydning:----------→ bedre land-sø brise

Landsat TM/aggregering ruhedskort mere ru, så for HIRLAM betydning for vind:----------→ bedre vind over land

Evapotranspiration kombineret NOAA AVHRR og HIRLAM:---→ lovende

Sensibel varmeflux/aggregering flydata/SPOT:------→ validering lovende