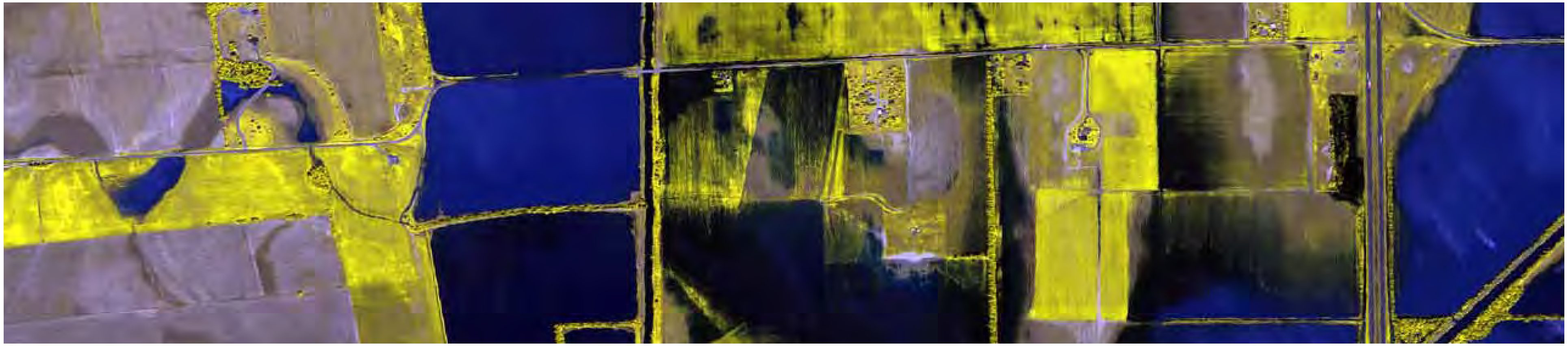
Remote Sensing til estimering af nedbør og fordampning



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GRAS A/S

How can remote sensing assist assessment of hydrological resources?

-with special focus on input to hydrological models

-Test and further development of existing products and methods at different geographical locations

Inputs to hydrological models

Traditionel:

Stations-baseret:

- Nedbør
- Etpot / Etref
- Solar indstråling

Fra kort:

- Areal-klassifikation
- højdemodel

Vanding specificeret per arealklasse

Daglig - månedlig

Delvis rumlig:

Remote sensing input:

- Nedbør
- Etpot / Etref
- Højdemodel
- Areal-klassifikation (statisk)
- Evt. solar indstråling

Vanding specificeret per arealklasse, evt. med ”crop-coefficient” justeret via vegetations info fra RS

Daglig - månedlig

SVAT:

Remote sensing input:

- Nedbør
- Højdemodel
- Areal-klassifikation (dynamisk)
- LAI
- Vegetation height
- ….

Evt med assimilering af:

- Evapotranspiration
- Temperatur

~ hver time

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ssimilering af:
otranspiration
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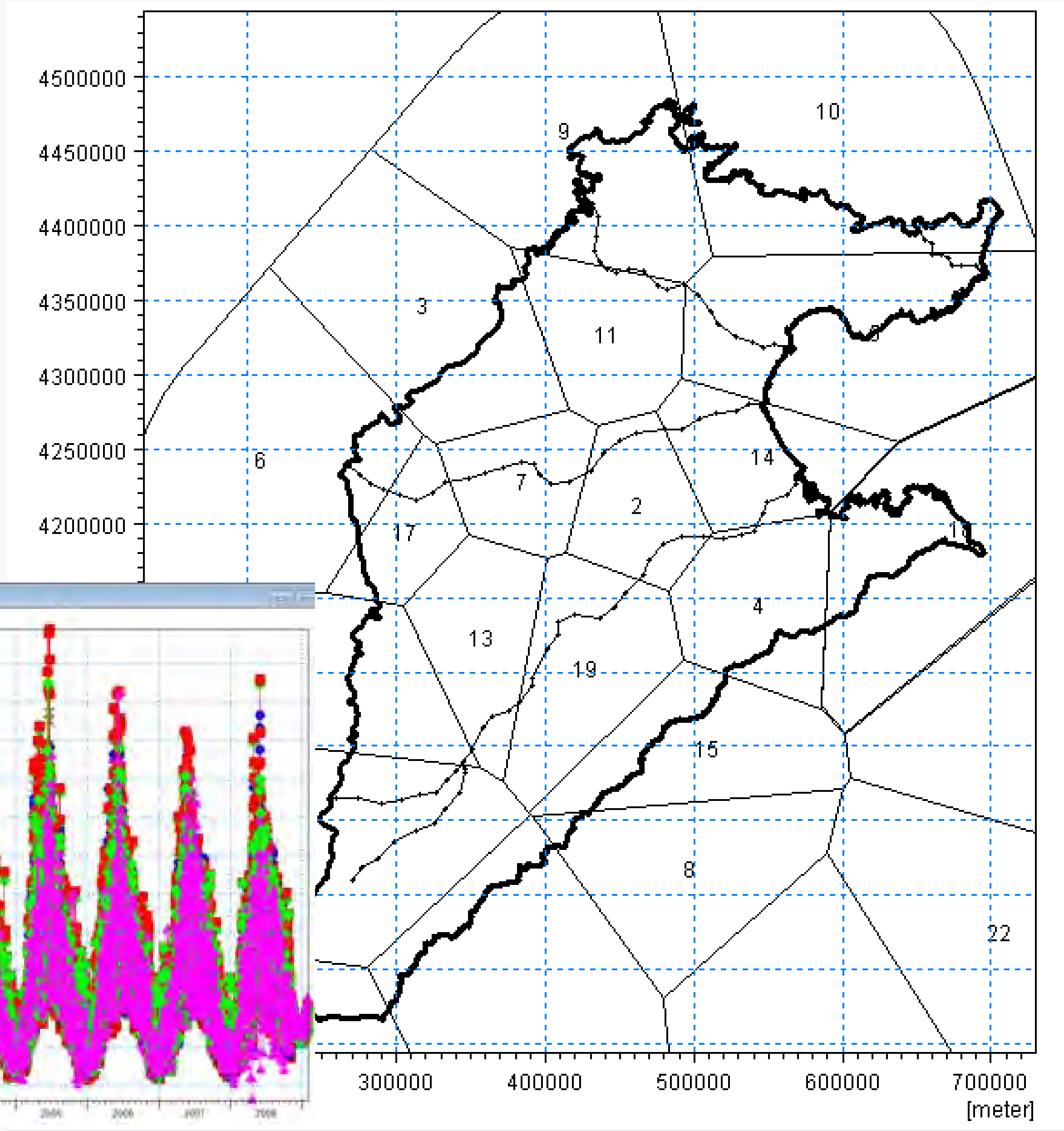
Kompleksitet
Input data
Detaljerede resultater

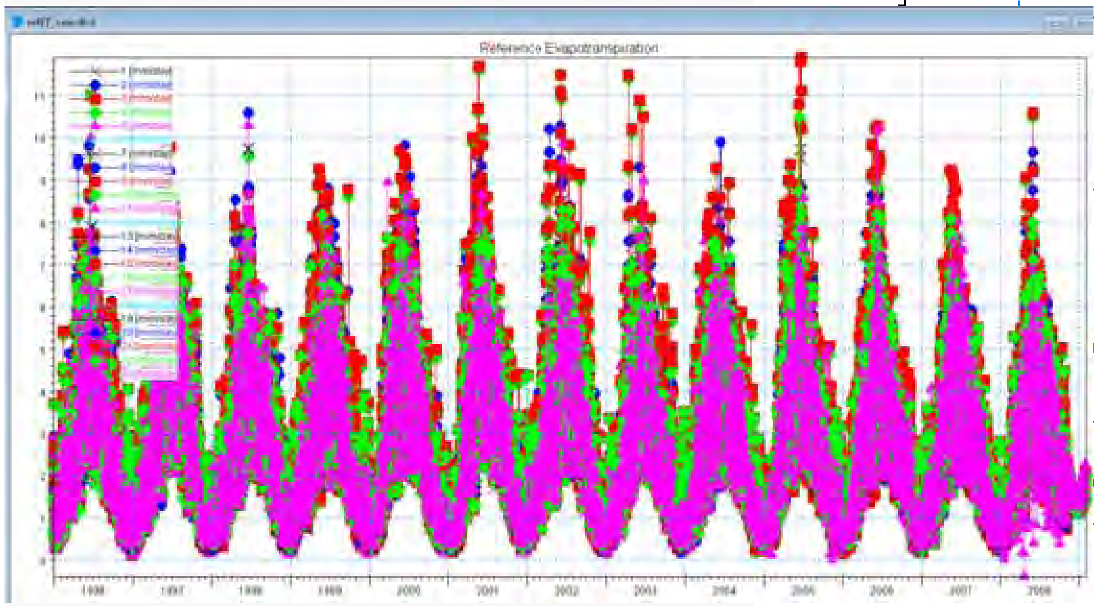
Relevant products:

- Spatial estimates of precipitation
- Evapotranspiration
- Temperature (land surface skin temperature)
- Land cover / land use
- Vegetation parameters
  - Leaf Area Index
  - Total biomass
  - Canopy height
- Soil moisture
- ….

Traditional setup

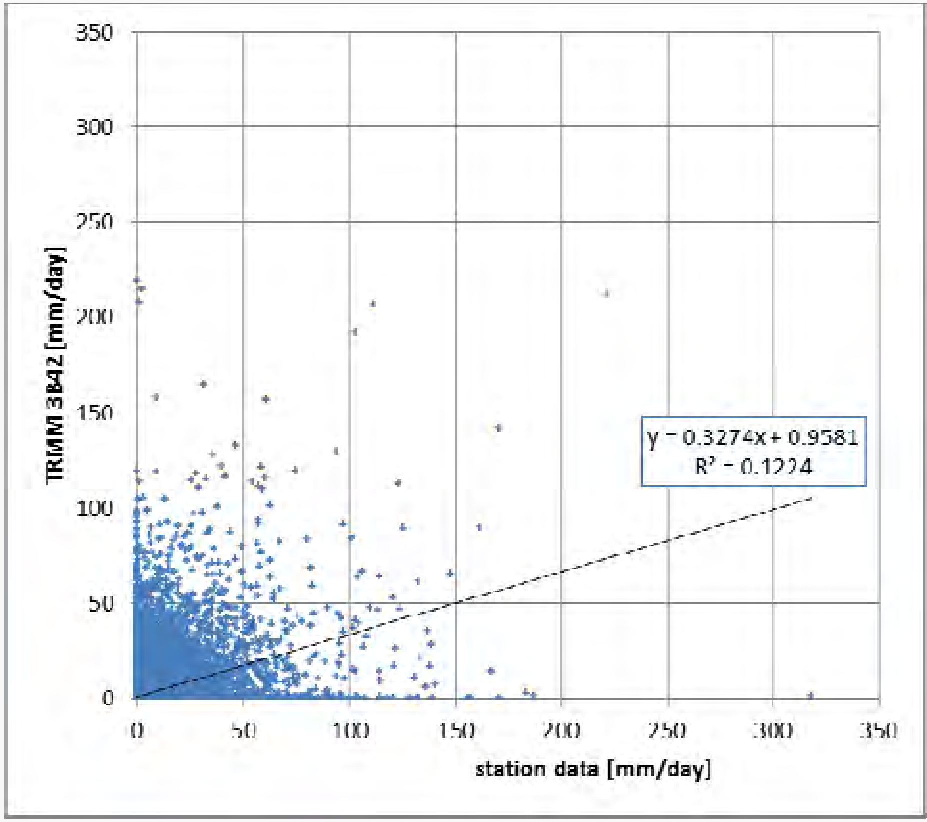
- Station-based
- Thiessen-polygons or interpolated

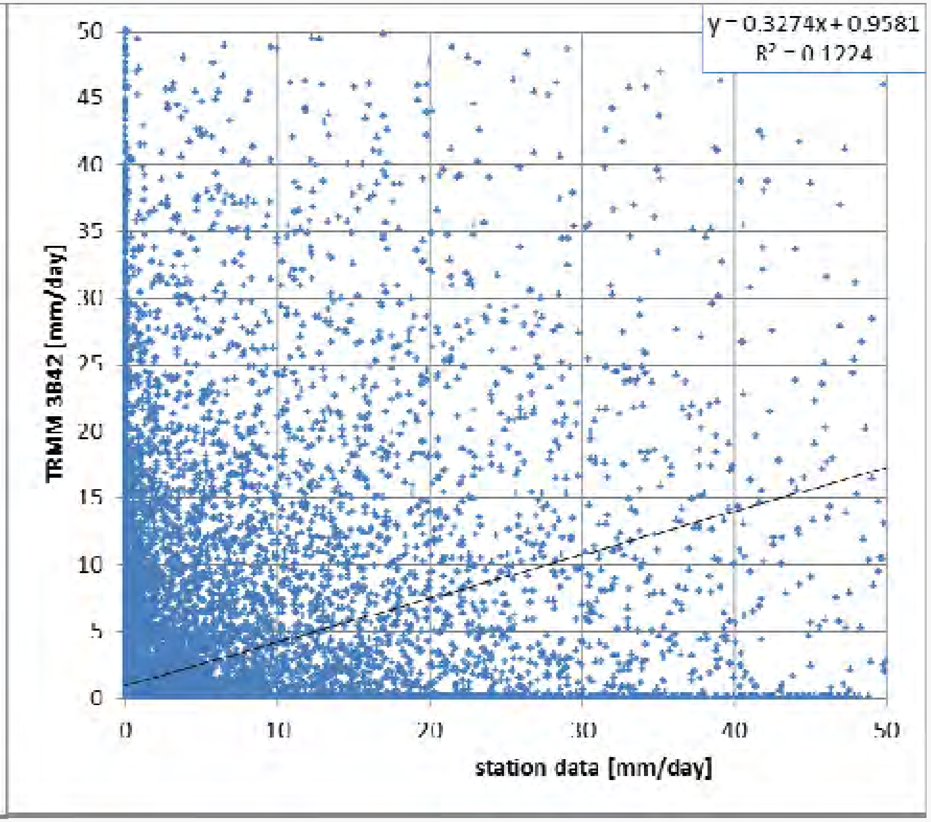




Precipitation

Station-based versus standard product, daily scale, 25km



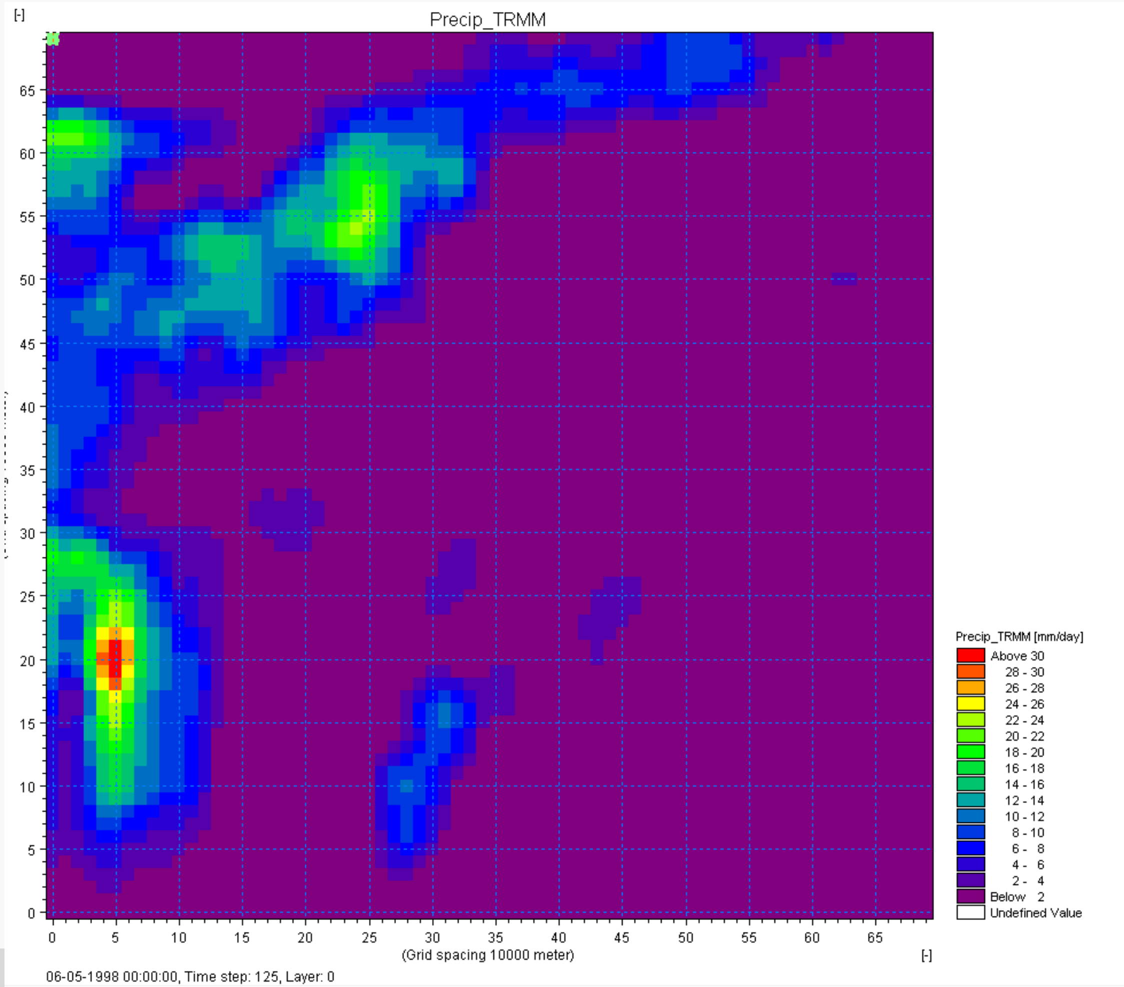


North China Plain setup

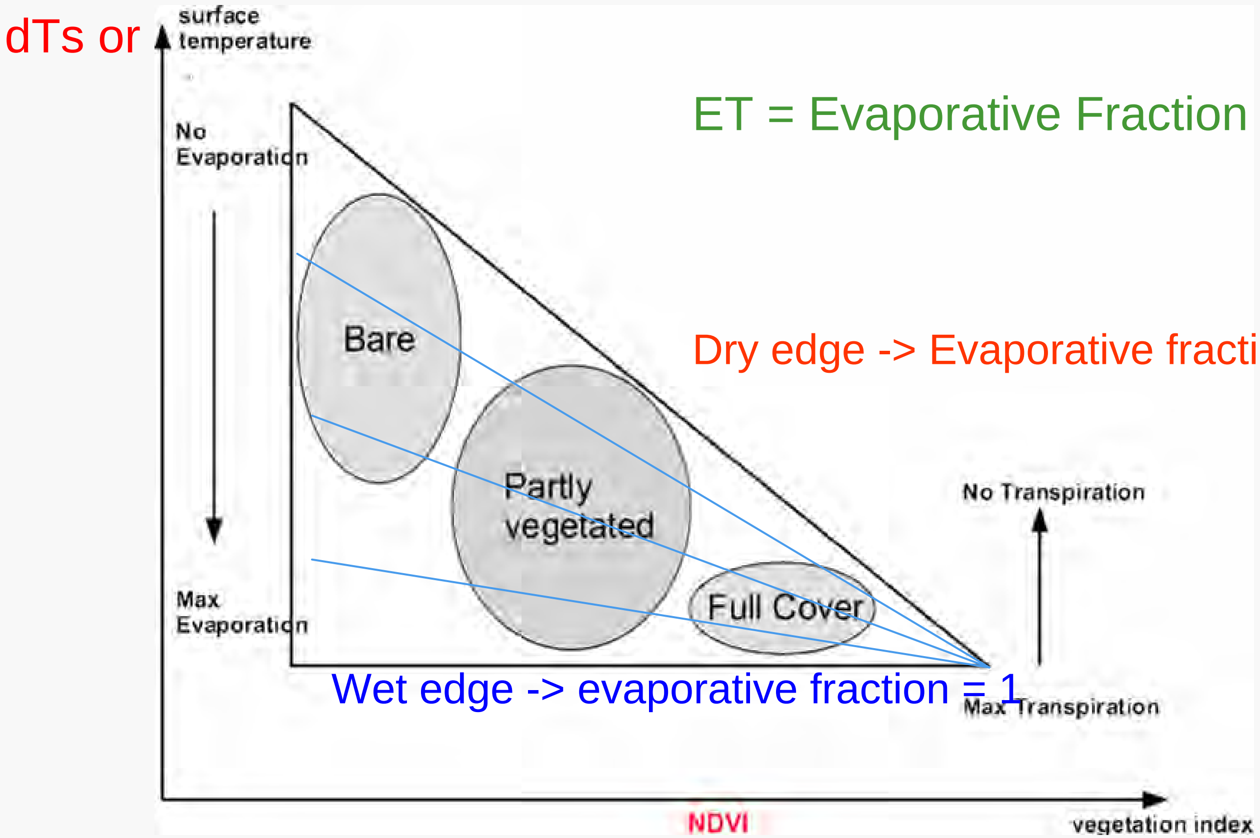
Spatial estimates of precipitation based on standard products:

- Daily estimates
- 25 km resolution (better resolution not needed!)
- Downscaling method

do not work in NCP



Evapotranspiration, - a physically based, empirical approach



ET = Evaporative Fraction * Available energy

Dry edge -> Evaporative fraction = 0

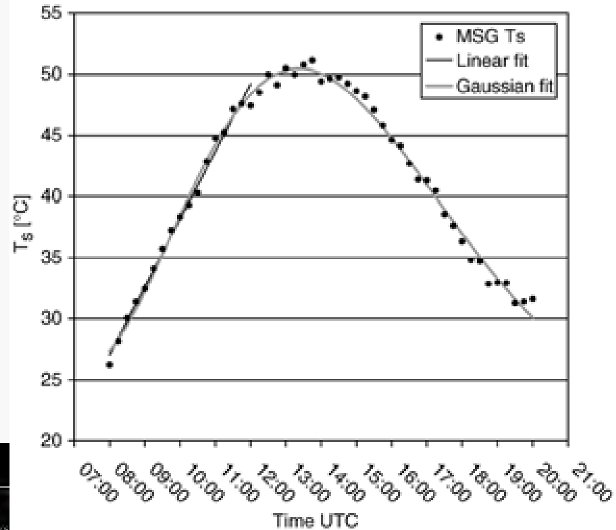
A simple interpretation of the surface temperature/vegetation index space for assessment of surface moisture status

Inge Sandholt[a,*], Kjeld Rasmussen[a], Jens Andersen[b]

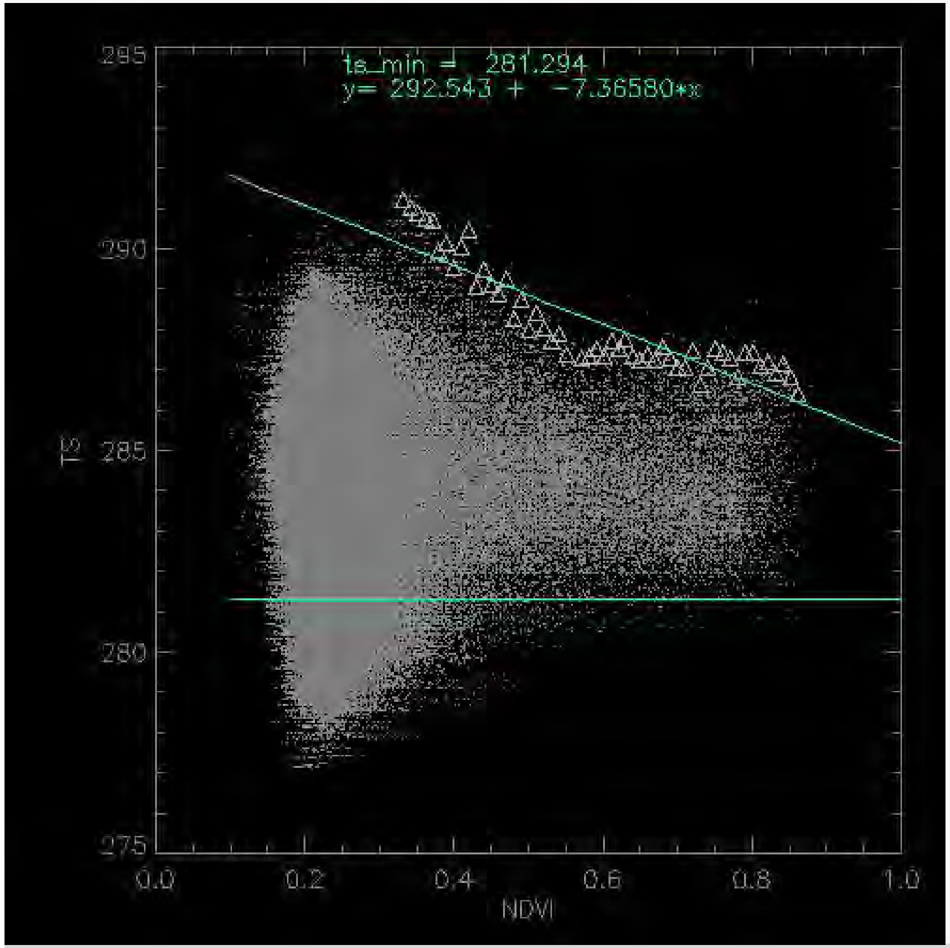
al, 2007

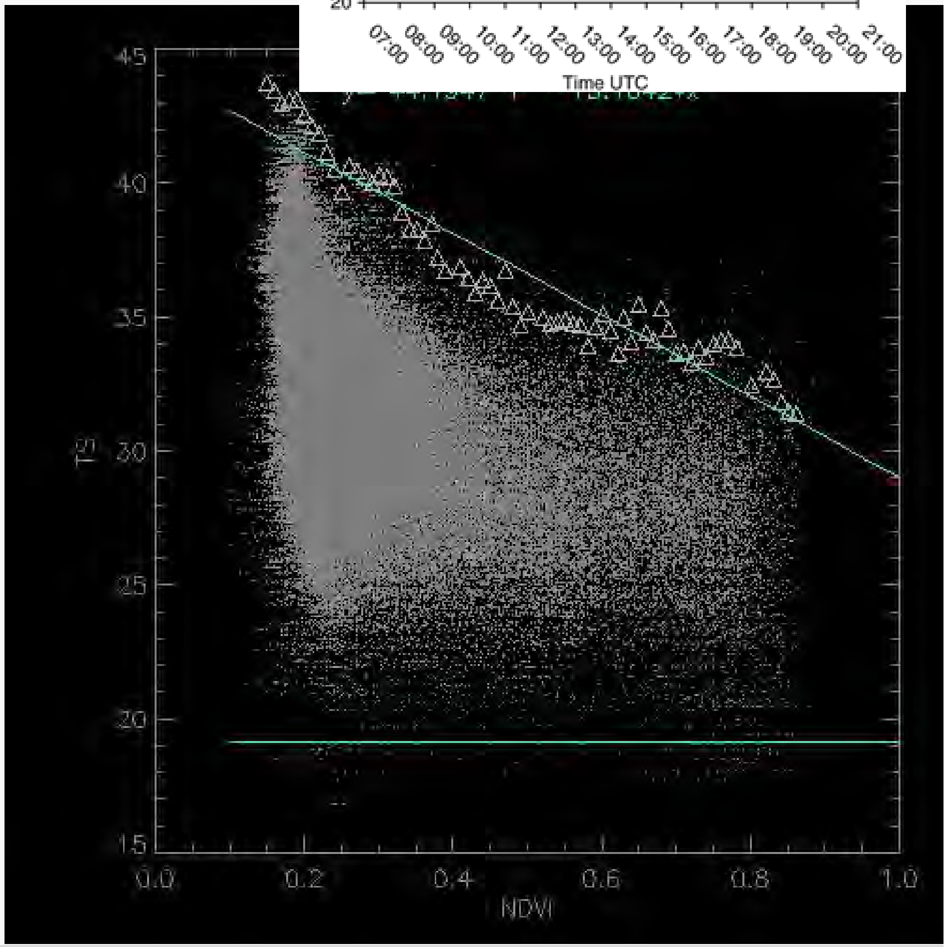
Triangles – examples

Stisen et al. 2008



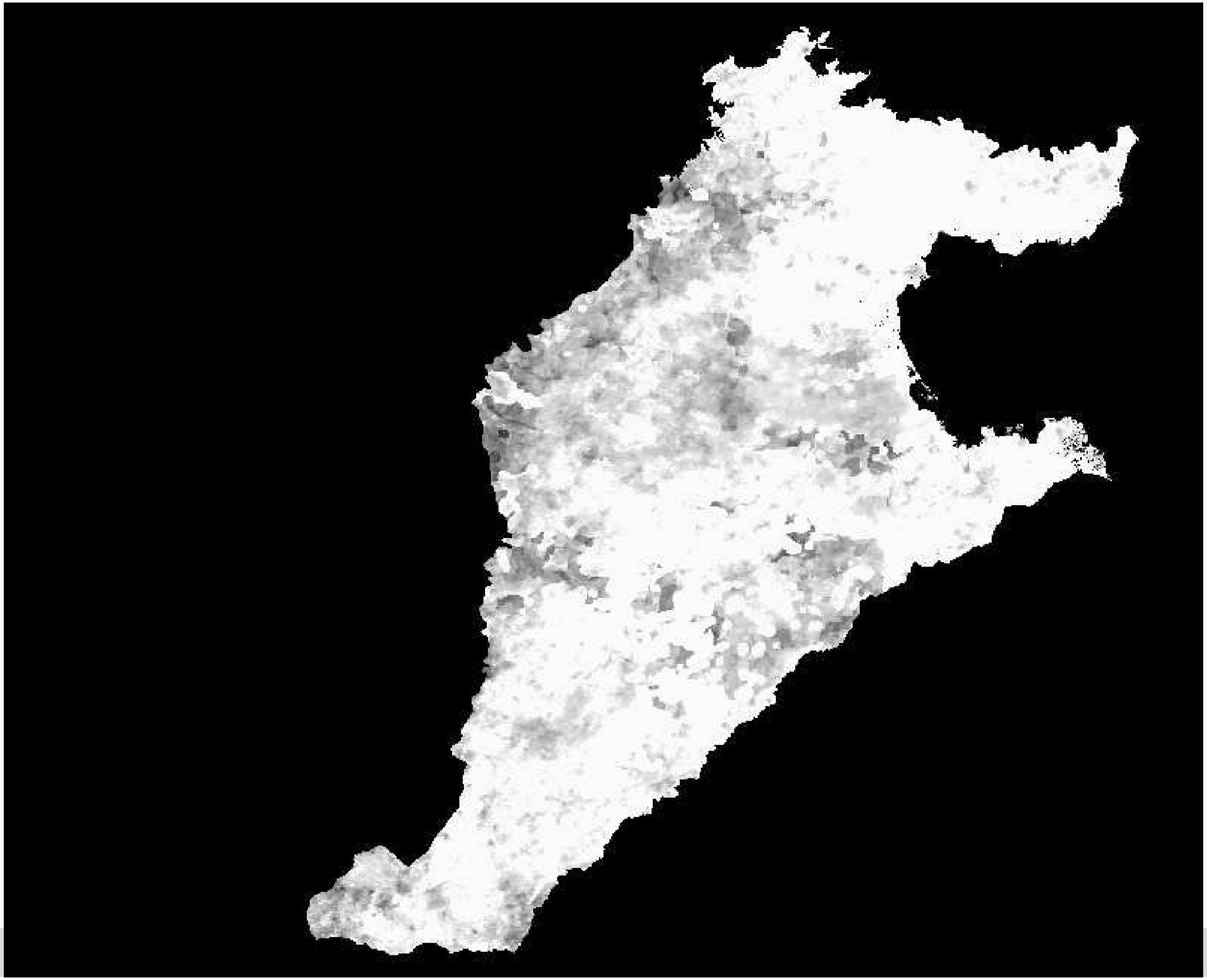
- Day 2006-041
  - LST
  - dTs





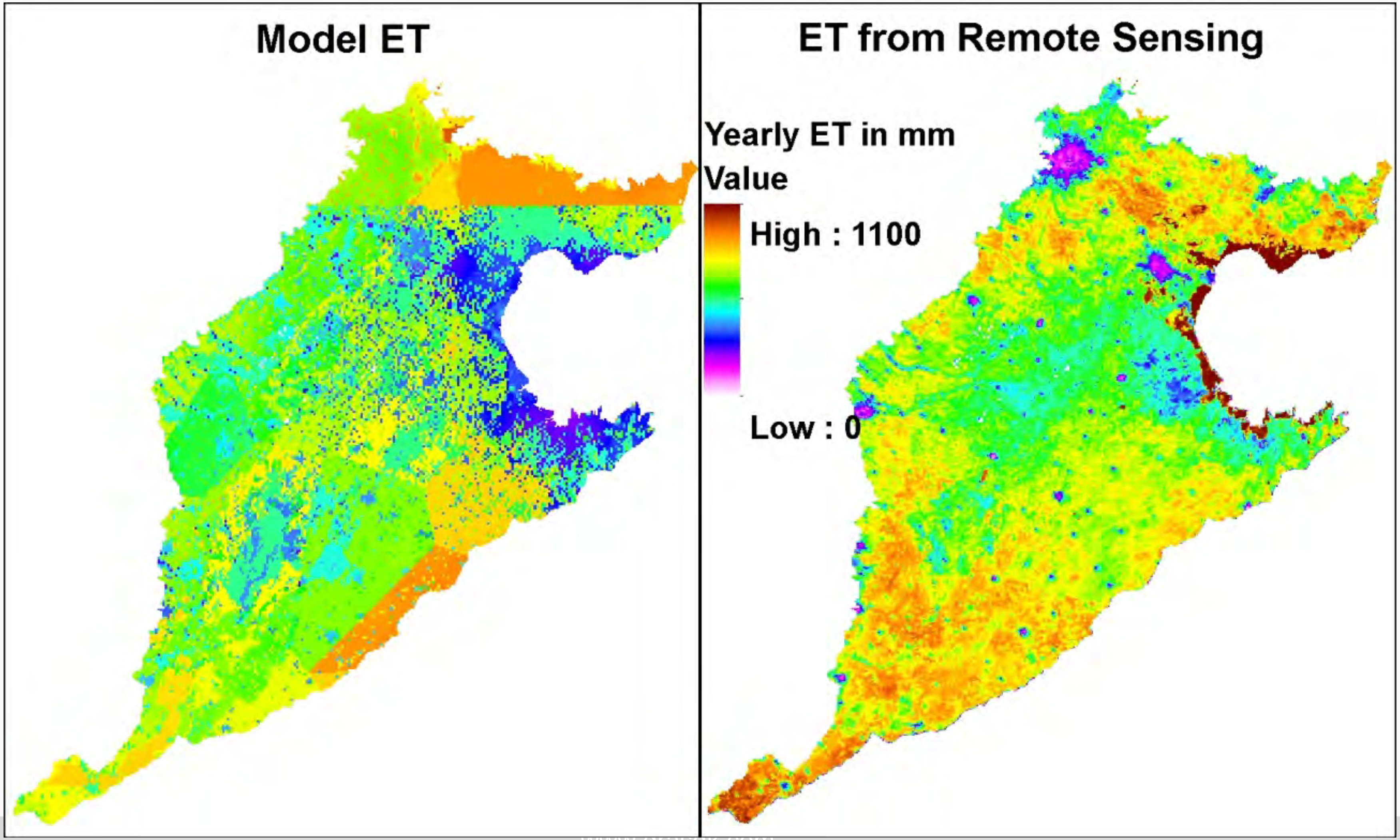
Evapotranspiration – per måned

Fra 2005-07 til 2008-12



Evapotranspiration

- NCP-model: ”semi-distributed” due to ETref being station based and coarse land cover mapping



State of the art

Fully coupled SVAT module (Overgaard 2007)

-Physically based equations for all exchanges of water and energy between the soil, vegetation and atmosphere

-Requires extensive data on

vegetation and climate

– at hourly scale or similar!

Benefits:

- Detailed results on ET, LST etc.
- No need for a priori information on management practices (e.g. irrigation schemes)

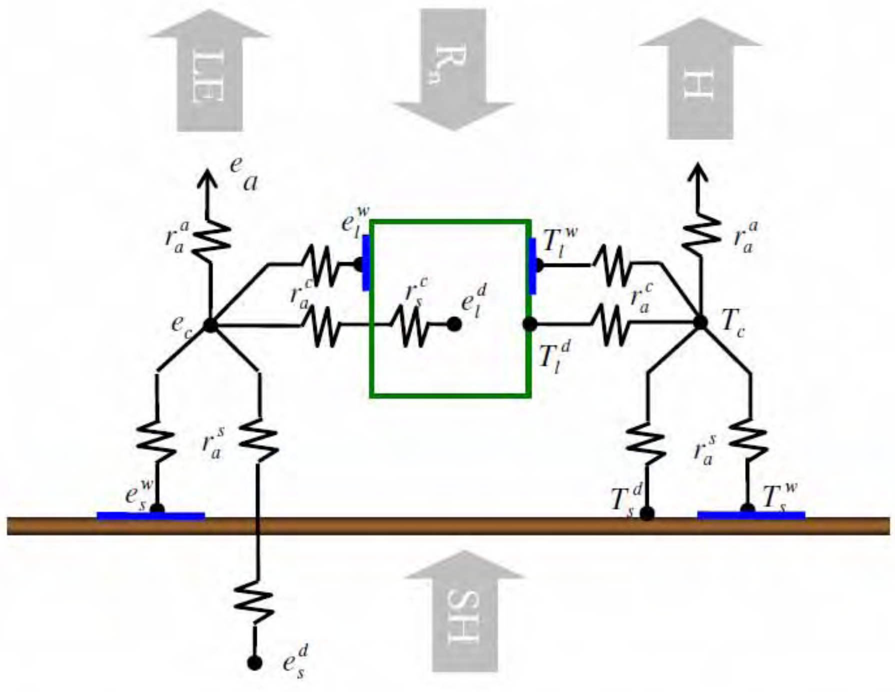


Figure 2 Model structure. The box illustrates a leaf and the blue lines are water on the soil and leaf surfaces. Temperatures and humidities at the wet and dry (superscript w and d, respectively) surfaces (subscript l: leaf surface; s: soil surface; c: mean canopy level) are denoted T and e. The transport of latent heat (LE) and sensible heat (H) is illustrated on the left- and right-hand side of the figure, respectively. R_n is net radiation, and SH is soil heat flux. The resistances are denoted r.

State of the art

Example from Nørgaard et al.
using a MIKE SHE SVAT model

Many input parameters can be derived from remote sensing data:

- Solar radiation
- Precipitation
- Albedo
- Vegetation parameters

Parameters to be used as input or for validation:

- Land surface temperature
- Evapotranspiration

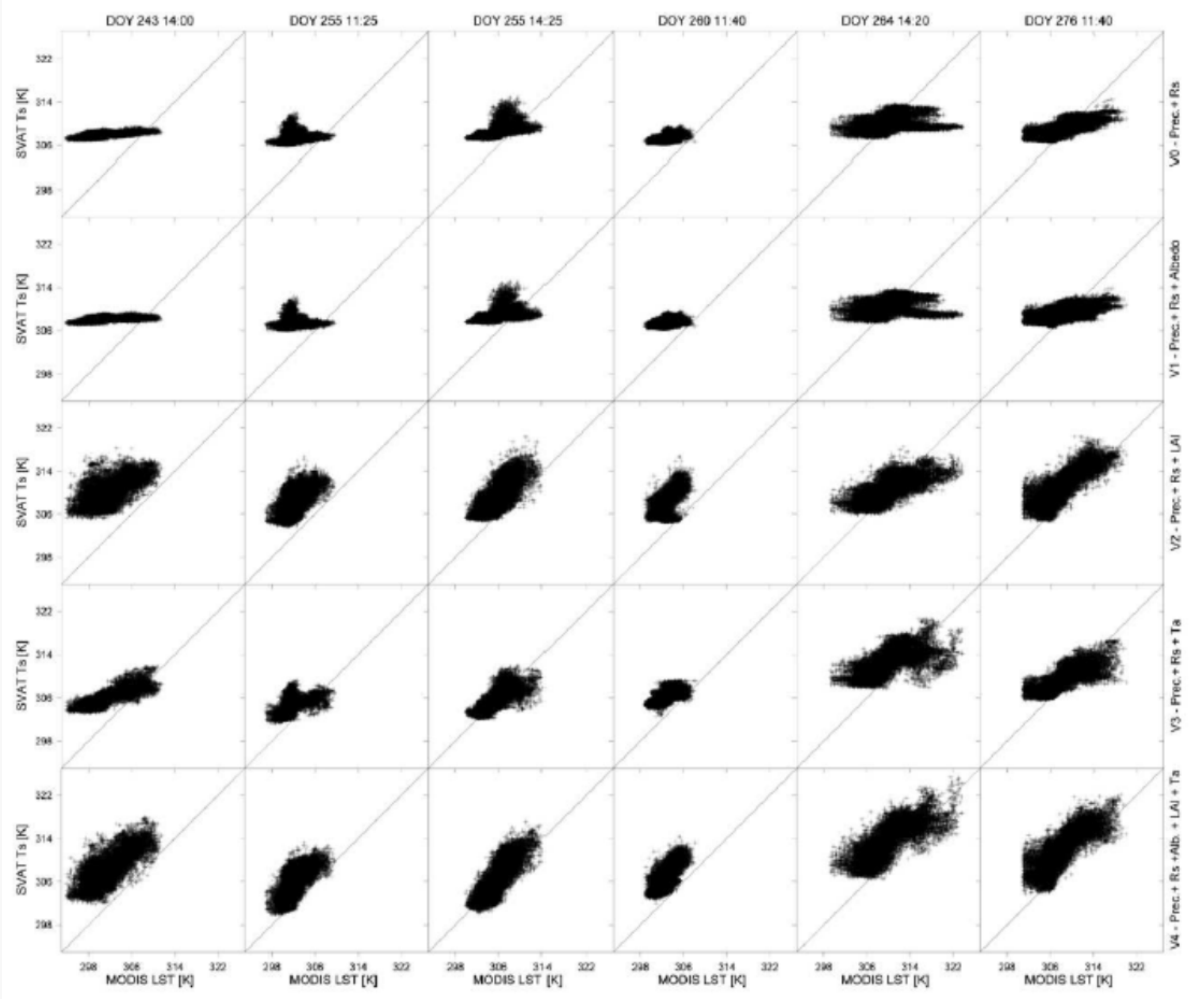
Table 3
List of input variables and parameters.

	Values	Unit	Source
Meteorological forcing variables			
Solar radiation	-	[W m^{-2}]	METEOSAT-7
Air temperature	-	[C]	in situ/MSG
Air humidity	-	[%]	in situ
Air pressure	1013	[hPa]	constant
Wind speed	-	[m s^{-1}]	in situ
Precipitation	-	[mm d^{-1}]	TAMSAT
Surface variables			
LAI	-	[m^2 m^{-2}]	MODIS
Albedo	-	[-]	MODIS
Surface roughness	0.2	[m]	in situ
Vegetation height	0.7	[m]	in situ
Leaf width	0.005	[m]	calibration
Minimum stomatal resistance	50	[s m^{-1}]	calibration
Extinction coefficient	0.4/0.6	[-]	literature, calibration
Root depth	0.6	[m]	in situ
Interception coefficient	0.0001	[mm]	model default
Root distribution coefficient	0.25	[-]	model default
Soil parameters			
Wilting point	4.2	[pF]	model default
Field capacity	2	[pF]	model default
Saturated moisture content	0.37	[m^3 m^{-3}]	calibration
Residual moisture content	0.02	[m^3 m^{-3}]	calibration
Van Genuchten a	0.0436	[1 a^{-1}]	calibration
Van Genuchten n	2.2	[-]	calibration
Van Genuchten shape parameter	0.5	[-]	calibration
Saturated hydraulic conductivity	5.77E-05	[m s^{-1}]	calibration

Validation

Remote sensing derived parameters can also be used for comparison/validation of model output:

- Evapotranspiration (NCP case above)
- Land surface temperature



Konklusioner

Remote sensing kan assistere overvågning og modellering af hydrologiske parametre på mange punkter, f.eks.:

- Nedbør
- Højdemodeller
- Arealklassifikation
- Overflade temperatur
- Jordvand
- Evapotranspiration
- Vegetations parametre
- Solar indstråling
- ….

Der er dog geografiske forskelle i hvad der er muligt hvor!

Tak for opmærksomheden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HYACINTS