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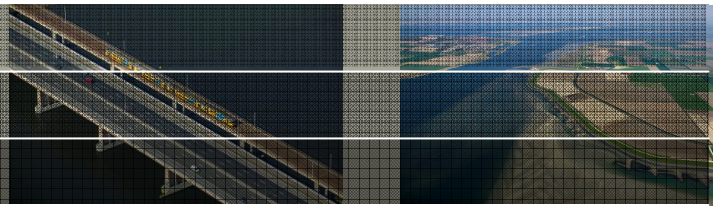
Enabling Delta Life

Use of satellite data in operational hydrological applications

Albrecht Weerts, Jaap Schellekens, Rogier Westerhoff

Outline



- Introduction
- RS & Monitoring / Operational Water Management
- RS & Forecasting / Operational Water Management
- Conclusions

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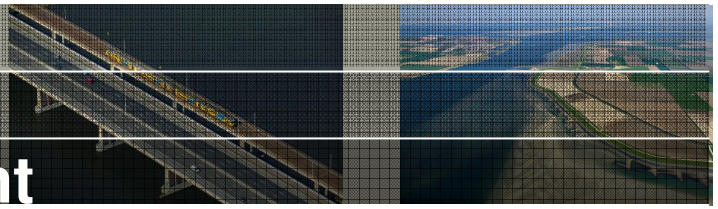
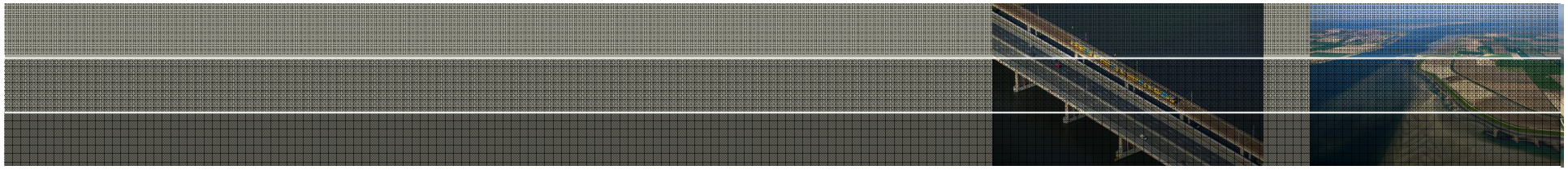
Introduction
RS & operational watermanagement



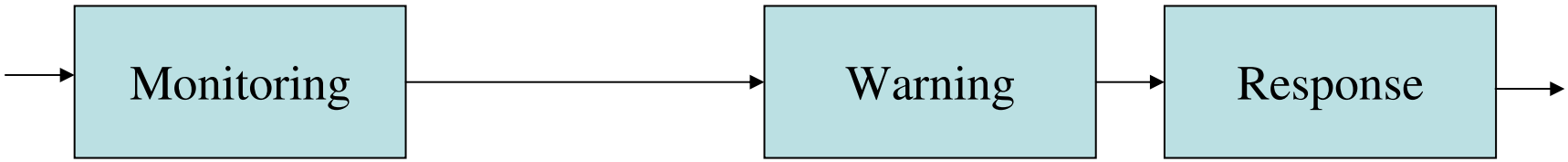
- Use RS Measurements to monitor
  - Calibration/Validation models
  - Water accounting (monthly/yearly budgets)
  - Snow, Ice & Flood Extent

- Use RS Measurements to drive hydrological model
  - TRMM
  - Radar
  - ..

- Use RS Measurements to update hydrological model state
  - of land surface schemes for improving NWP
  - ?



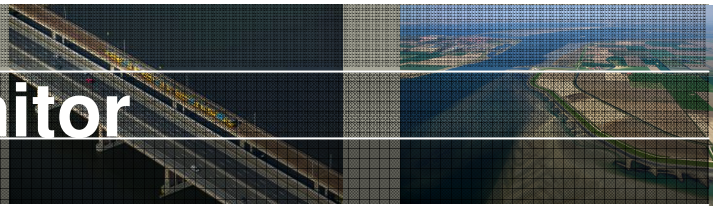
Flood Forecasting as a part of the flood forecasting, warning and response process…



after Haggett, 1998

(Flood) Forecasting – increase warning lead times

Use RS Measurements to Monitor



- Dike Strength Monitoring (FC2015)
- Soil Moisture (Strategic Research/DiD)
- Flood Mapping (FC2015)

- Evapotranspiration (?)
- Rainfall (TRMM, Radar)
- Snow Cover (Sistan project)

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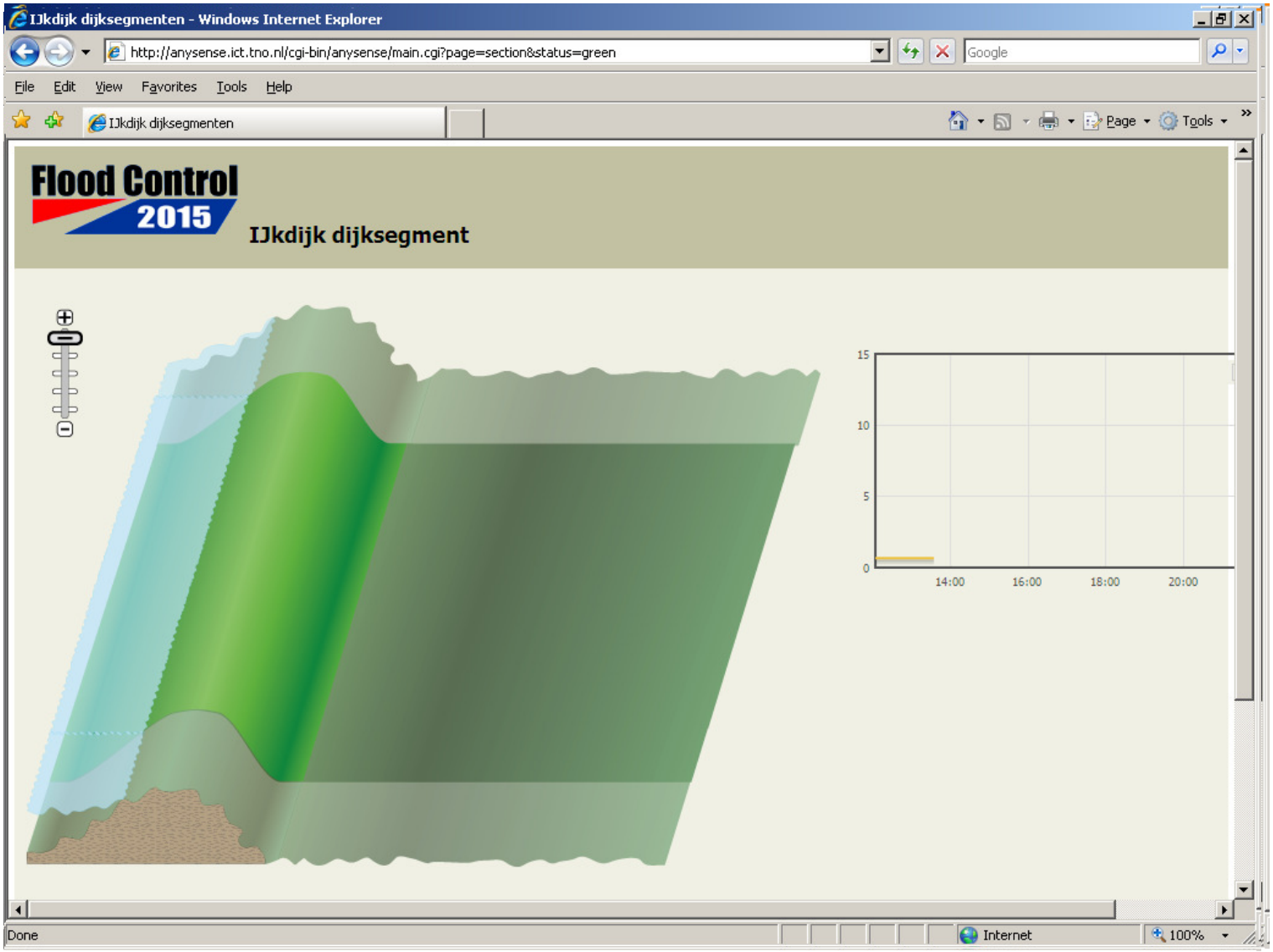
Dyke strength monitoring



In-situ

Soil moisture

Deformation

Temperature

Potential EO

InSAR

Multispectral

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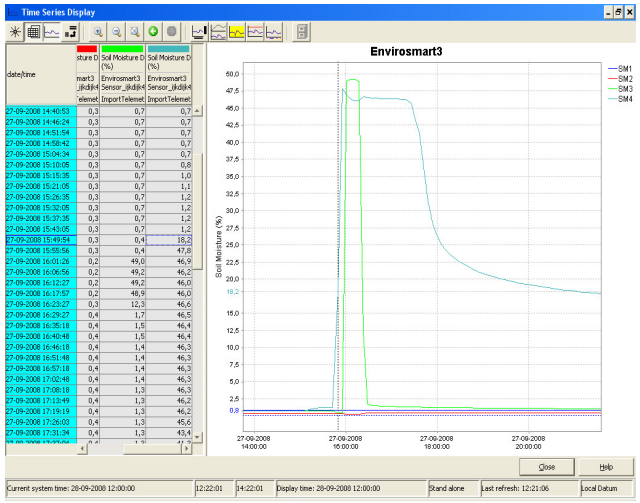
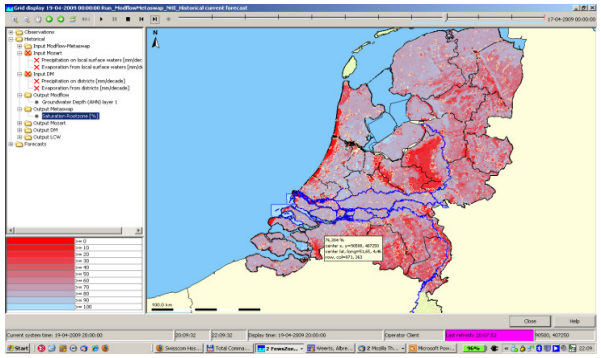
Soil moisture

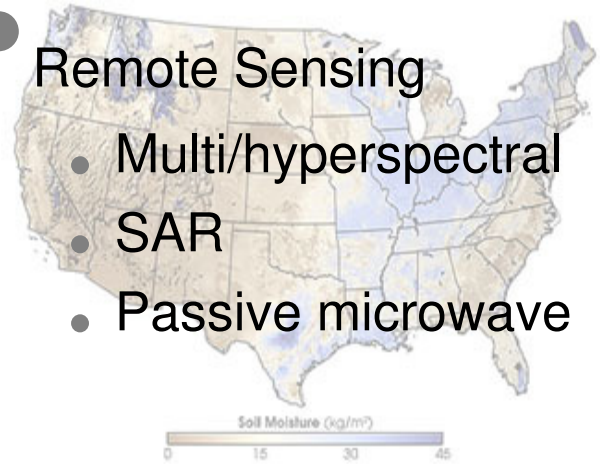
In-situ sensors



- Model



- Remote Sensing
  - Multi/hyperspectral
  - SAR
  - Passive microwave



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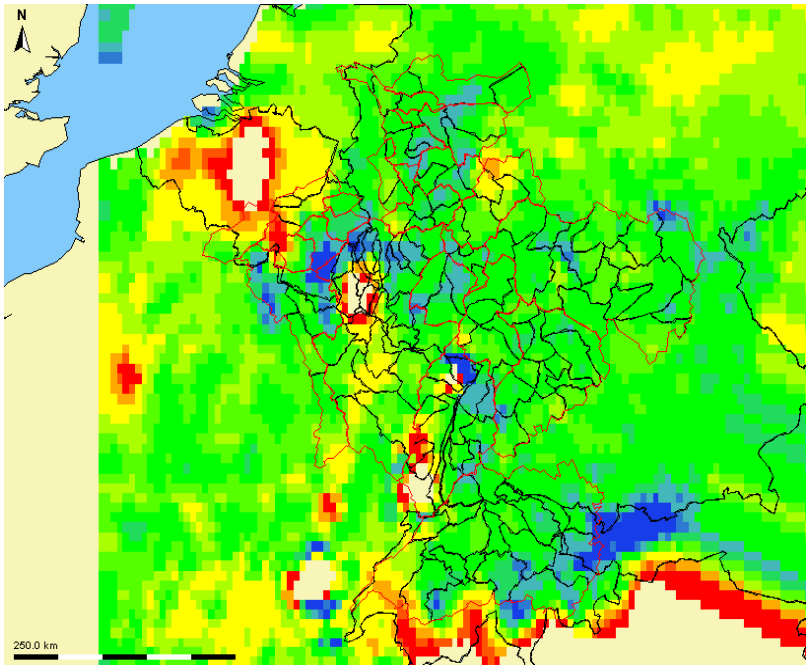
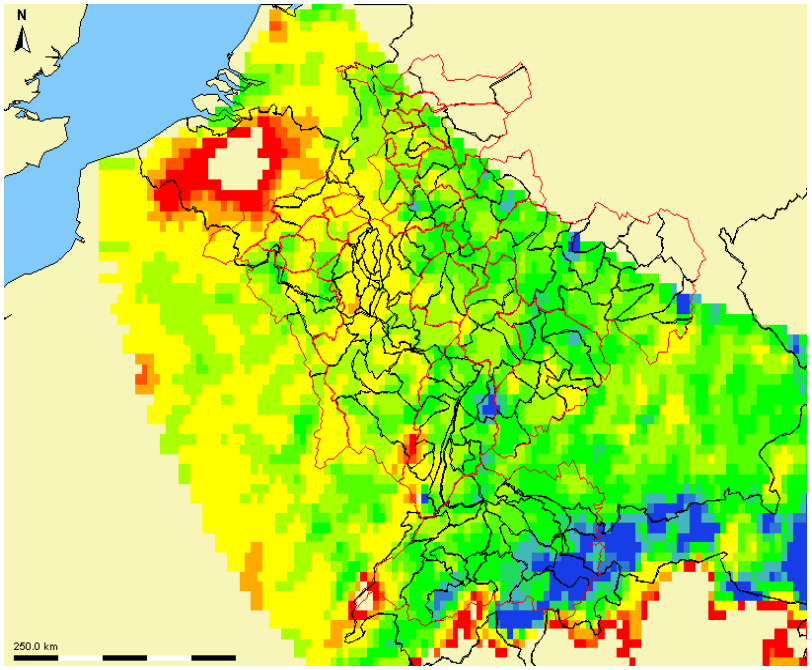
Derived Soil moisture maps Rhine basin

(Nationaal Programma Gebruikers Ondersteuning (NIVR-SRON, Min V&W)





•Near Real-time soil moisture maps for the Rhine visualized in operational Delft FEWS Rhine forecasting system

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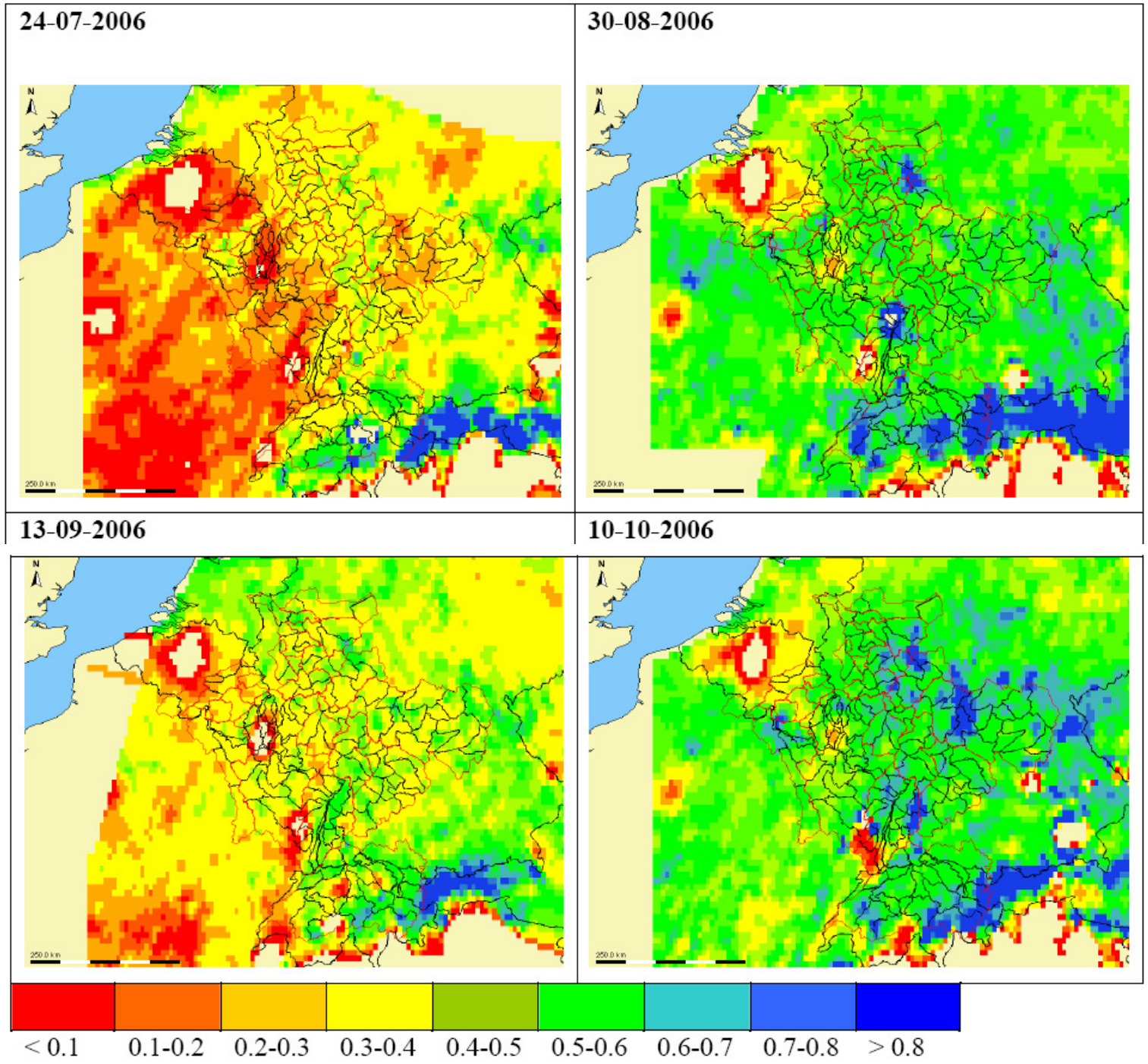
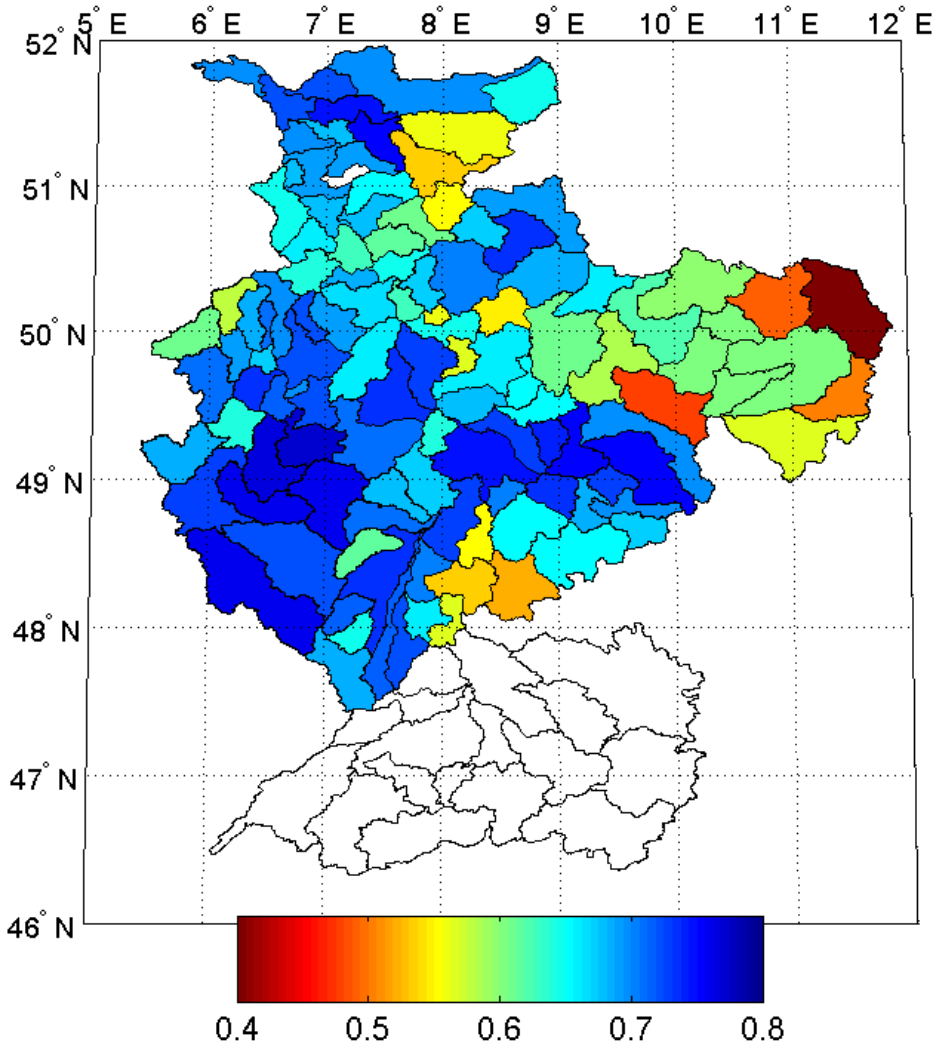
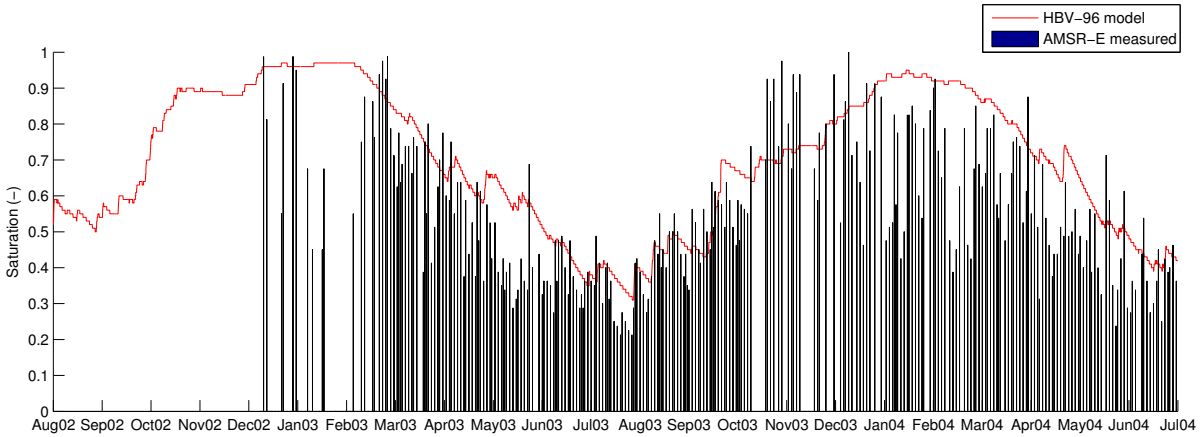
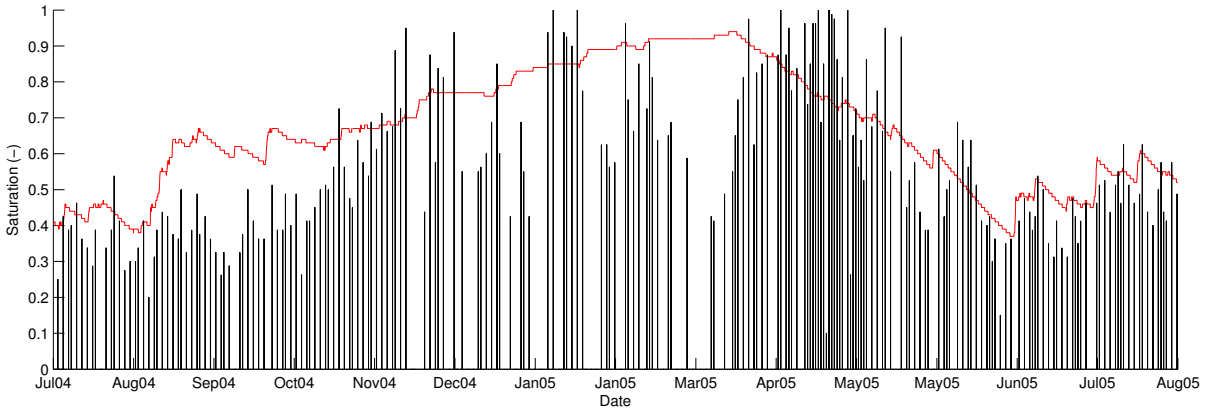

24-07-2006
30-08-2006
13-09-2006
10-10-2006
< 0.1
0.1-0.2
0.2-0.3
0.3-0.4
0.4-0.5
0.5-0.6
0.6-0.7
0.7-0.8
> 0.8

Compare with Hydrological model Results



Comparison at basin level





Flood Monitoring

- Many possible techniques
- Combination of all available platforms
- Co-operations:

DFO (US)

Fugro

HKV

Royal Haskoning

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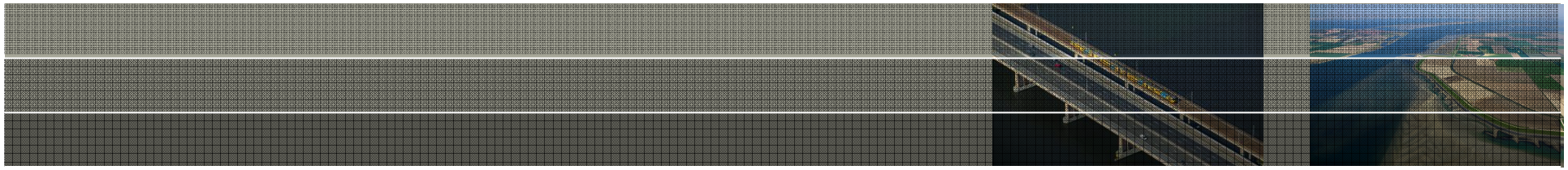
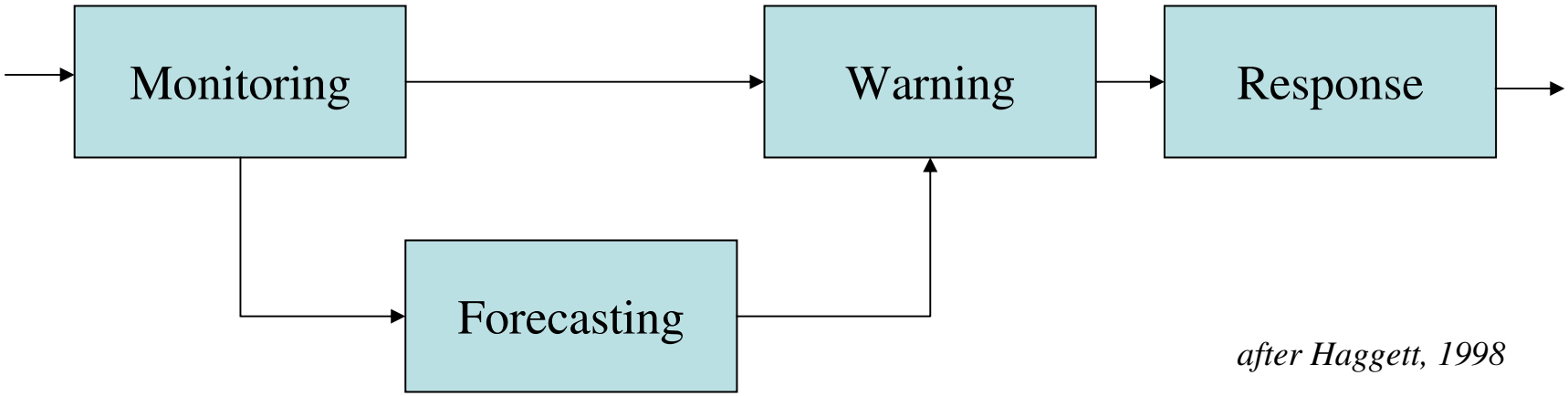


Flood Forecasting as a part of the flood forecasting, warning and response process…



after Haggett, 1998

(Flood) Forecasting – increase warning lead times

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Remote Sensing to drive hydrological Models: Peat fire forecasting systems

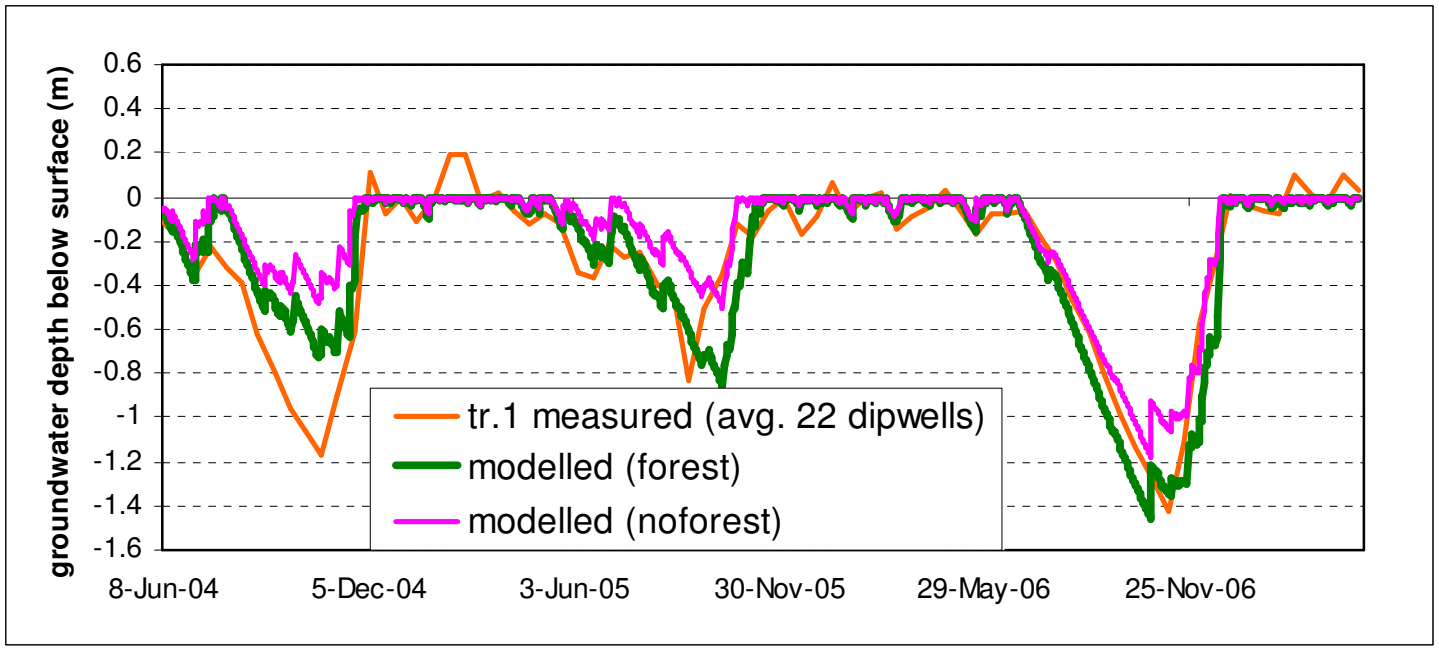
- Current fire forecasts are short-term and arguably of little use: no fire fighting response possible.
- Long-term forecast would allow some sort of fire prevention response. ….but this requires a far longer warning time than can be provided by current systems.
- At the same time global medium-term climate forecasts have improved a lot in recent years, and appear to now beat statistical methods
- GW Level as an indicator for peat fire risk

(1) Can the TRMM precipitation estimates be used to reliably (as good as the simulations with the ground based data) simulate peatland groundwater levels in the selected areas in Kalimantan?

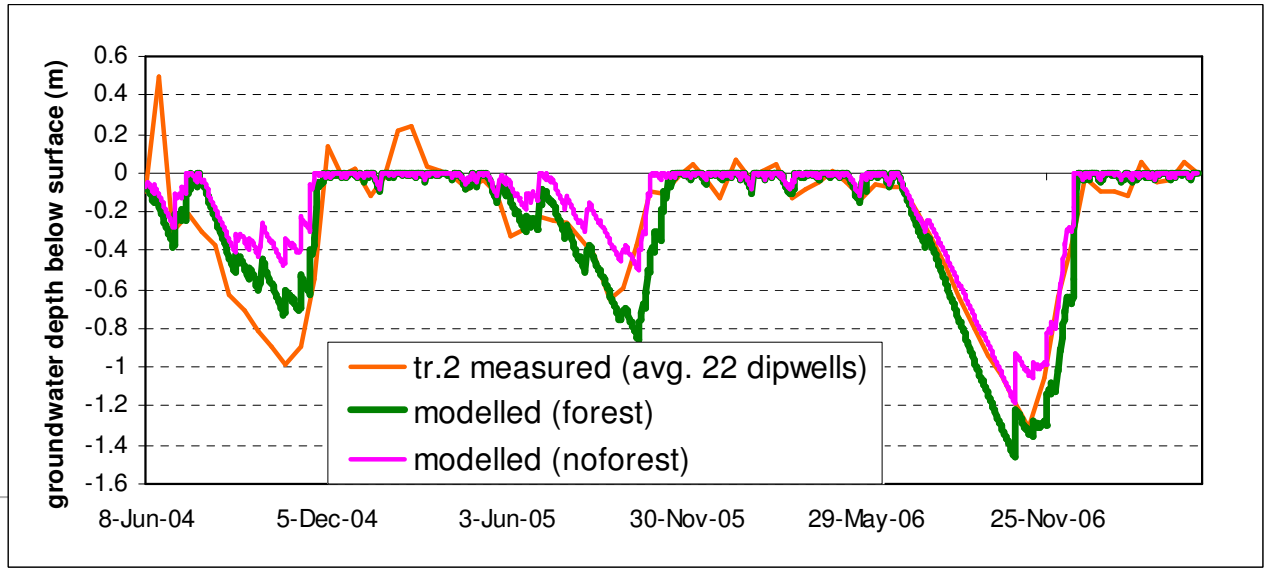
(2) Can a freely available seasonal forecast system (NCEP CFS) be used to drive the groundwater model and what is the maximum lead time for which the peat fire risk can be forecasted?

(3) Can Delft-FEWS be used to set-up a near real-time hydrological peatland fire risk forecasting system based on the available data?

Simple water budget groundwater level model

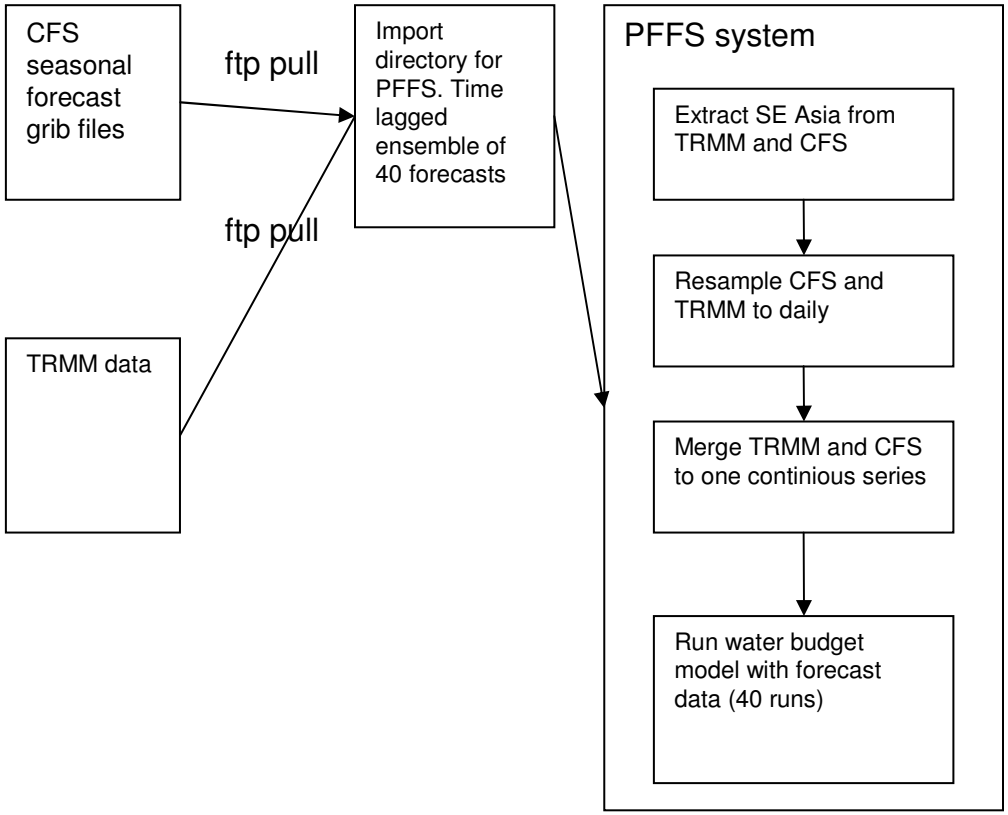


Model written in pcraster environment embedded in delft-fews. Allows gridded operation over SE Asia (only grid cells with peat land-cover)



Making a system

- Setting up the Operational environment using Delft-Fews
  - Reading TRMM, CFS, Climate data for bias correction
  - Data processing
  - Real time reports (web-based)



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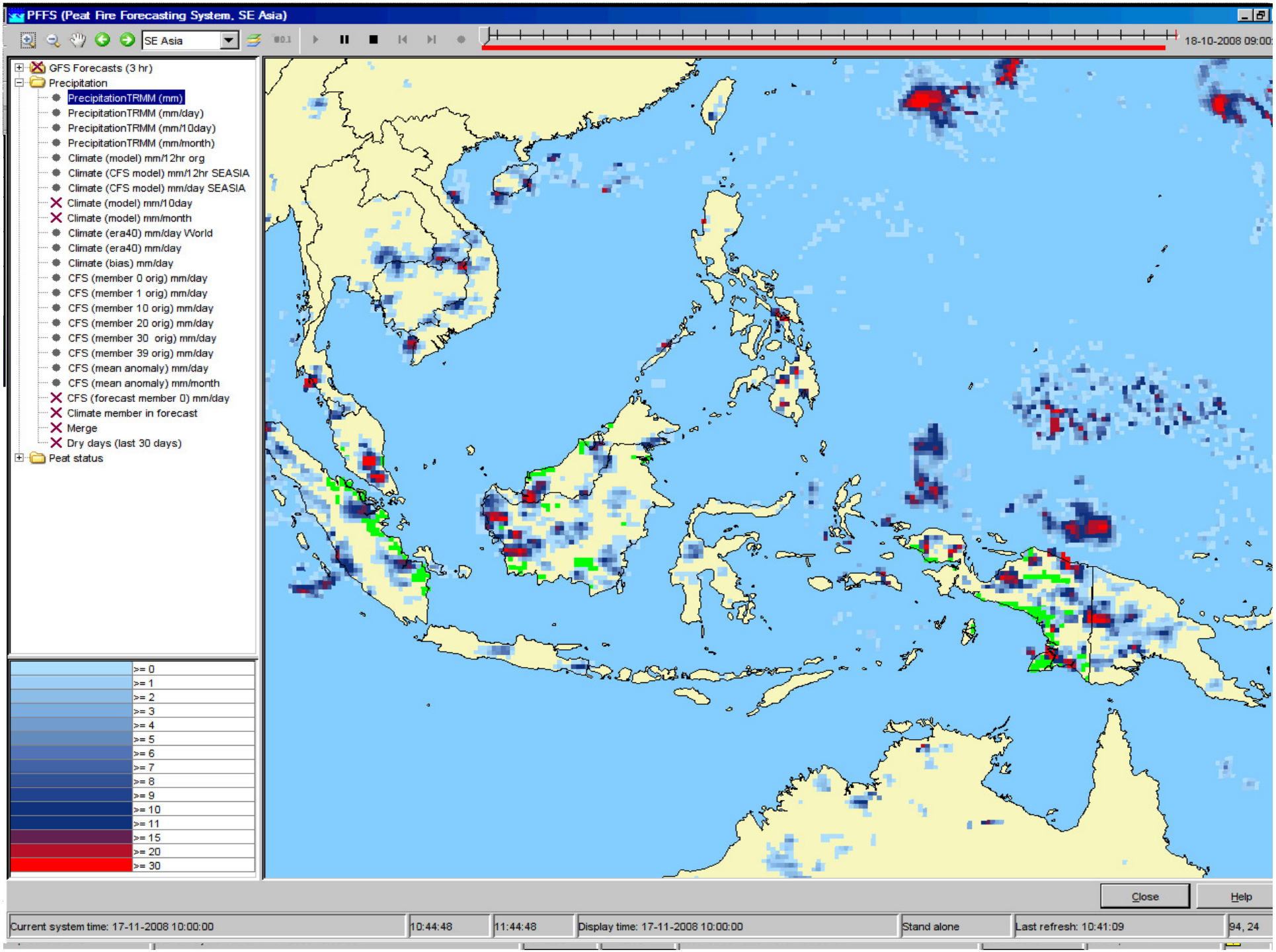

PFFS (Peat Fire Forecasting System, SE Asia)
SE Asia
18-10-2008 09:00
GFS Forecasts (3 hr)
Precipitation
PrecipitationTRMM (mm)
PrecipitationTRMM (mm/day)
PrecipitationTRMM (mm/10day)
PrecipitationTRMM (mm/month)
Climate (model) mm/12hr org
Climate (CFS model) mm/12hr SEASIA
Climate (CFS model) mm/day SEASIA
Climate (model) mm/10day
Climate (model) mm/month
Climate (era40) mm/day World
Climate (era40) mm/day
Climate (bias) mm/day
CFS (member 0 orig) mm/day
CFS (member 1 orig) mm/day
CFS (member 10 orig) mm/day
CFS (member 20 orig) mm/day
CFS (member 30 orig) mm/day
CFS (member 39 orig) mm/day
CFS (mean anomaly) mm/day
CFS (mean anomaly) mm/month
CFS (forecast member 0) mm/day
Climate member in forecast
Merge
Dry days (last 30 days)
Peat status
>= 0
>= 1
>= 2
>= 3
>= 4
>= 5
>= 6
>= 7
>= 8
>= 9
>= 10
>= 11
>= 15
>= 20
>= 30
Close
Help
Current system time: 17-11-2008 10:00:00
10:44:48
11:44:48
Display time: 17-11-2008 10:00:00
Stand alone
Last refresh: 10:41:09
94, 24

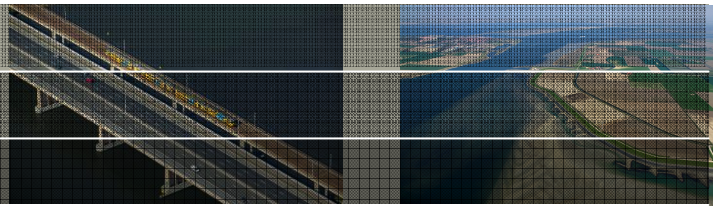
Use RS Measurements to Update Hydrological Model State

- For flood forecasting unlikely to be effective (not available real-time, evaporation normally not important, discharge measurements are more readily available)

- For drought forecasting interesting (initial state is important/determines the skill at longer lead times)

- Make use of lessons learned from meteorological community for assimilating RS measurements into operational hydrological models: assimilate what is measured and not derived products (like for instance soil moisture, but instead assimilate brightness temperature etc)?

Conclusions



Deltares focuses on improving terrestrial operational water management by EO

Monitoring:

- Soil Moisture measurements (insitu + EO)
- Dike Strength (FC2015 also insitu + EO)
  - InSAR
  - Multispectral
- Calibration/Validation of our models
  - Combination multispectral and microwave
- Flood Extend, Reservoirs
- Water Accounting ->work together with CSIRO

Forecasting:

- data assimilation by developing generic data assimilation software that can be used within Delft-FEWS Algae Bloom forecasting system, Drought/Water Supply forecasting Netherlands, etc
- Use of TRMM data (in the future GPMM…)
- Radar
- Drought forecasting
  - Multispectral
  - Microwave