

# **Calibrating hydrological models through satellite observations of small reservoirs**

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Frank Annor (KNUST)

**tiger2871.shorturl.com  
www.smallreservoirs.org**

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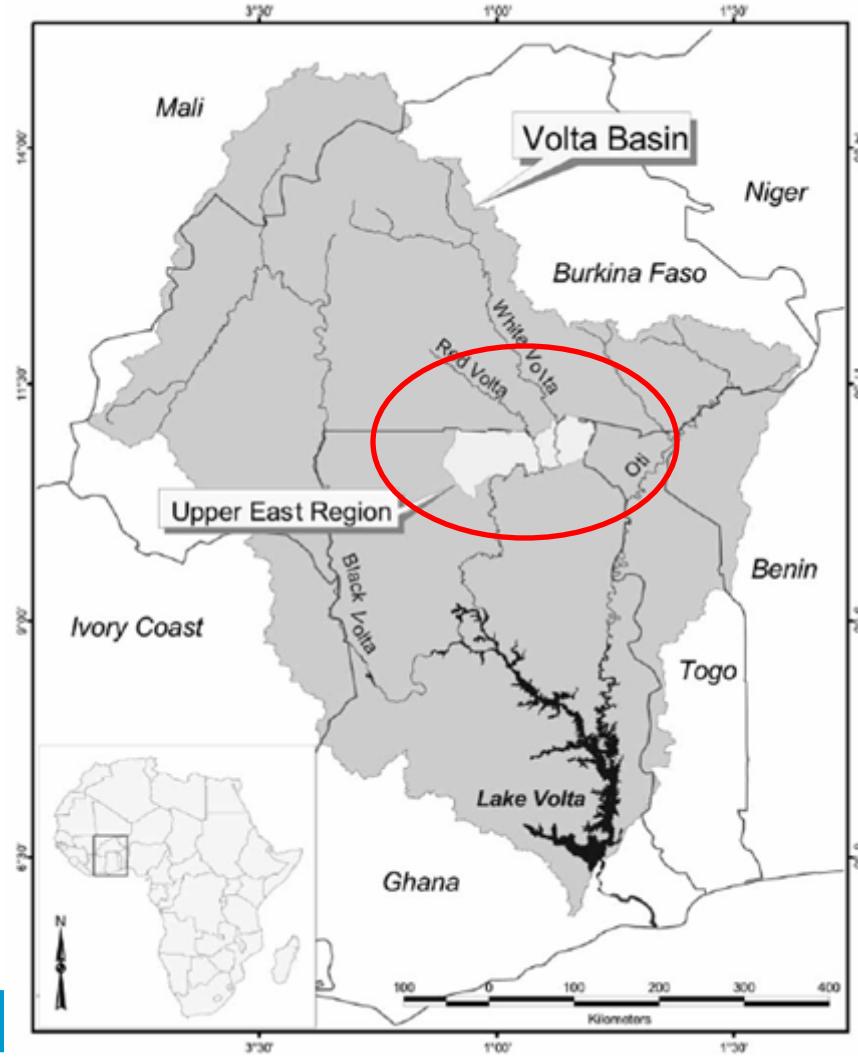
# **Small Reservoirs, West Africa**

## **Outline**

- Small reservoirs
- Surface – area relations
- Envisat
- Calibration

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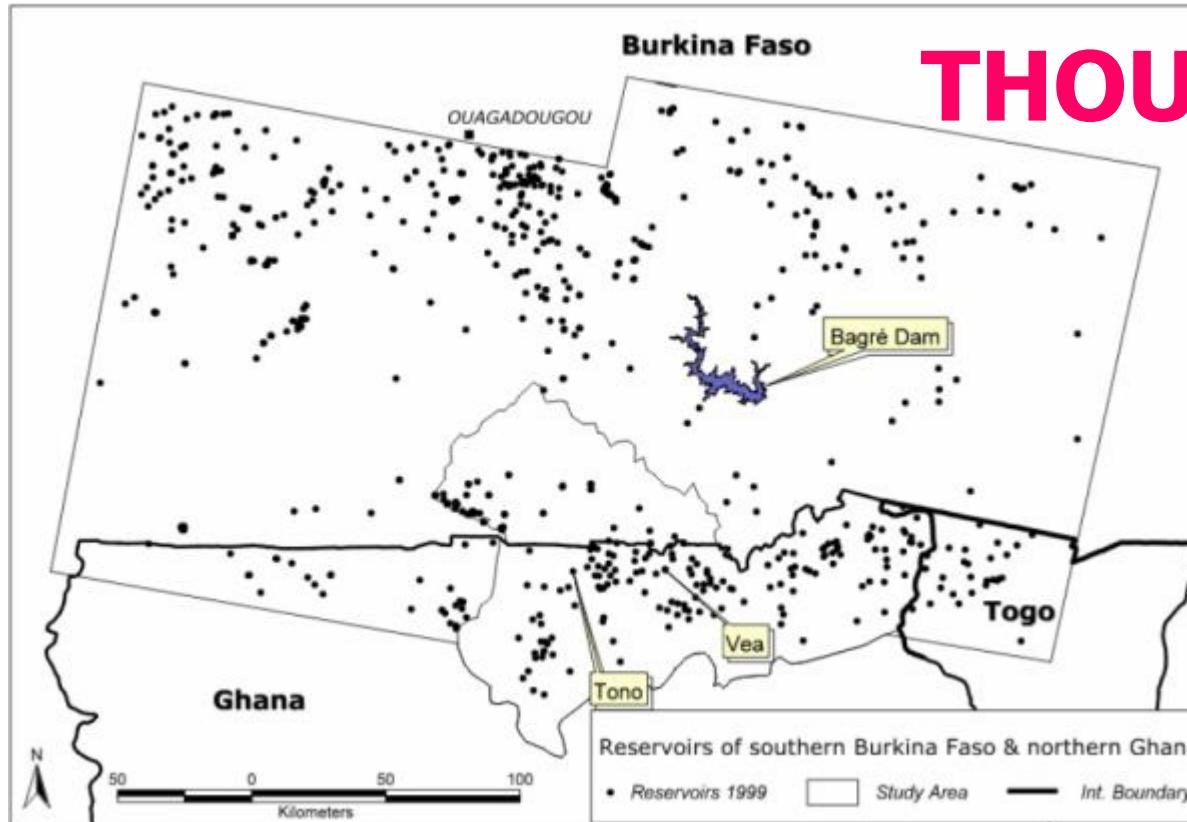
# Small Reservoirs, West Africa



**Study area  
in Volta Basin**

3

# Small Reservoirs, West Africa



**THOUSANDS!**

	1984	1999
# Dams	302	710
ha Reservoirs	4134	31200

4

# Small Reservoirs, West Africa



Village level irrigation development

5

# Small Reservoirs, West Africa



Multiple use - Cattle

6

# Small Reservoirs, West Africa



Multiple use - Fishing

7

# **Small Reservoirs, West Africa**



**Large socio-economic impact**

Multiple use – Household water

8

# **Small Reservoirs, West Africa**



**SMALL RESERVOIRS PROJECT**  
VOLTA • LIMPOPO • SAO FRANCISCO

**Ensemble  
impact ?**

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RS in WRM

20 May 2009

**TU**Delft

# Small Reservoirs, West Africa



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Ensemble  
impact ?

**ESA AO 2781**  
**Satellite**  
**monitoring**

10

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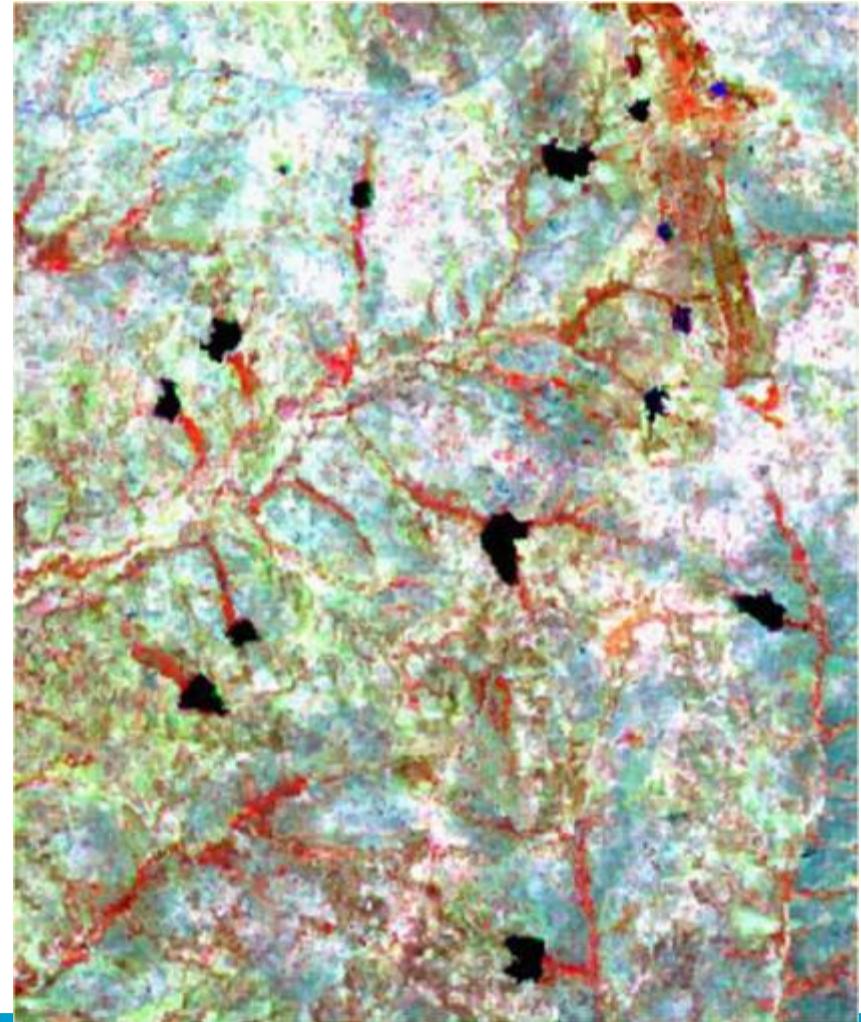
The TU Delft logo consists of the letters "TU" in a bold, black, sans-serif font, with a small orange flame icon positioned above the "T". To the right of "TU" is the word "Delft" in a smaller, black, sans-serif font.

# Storage mapping

Step 1:

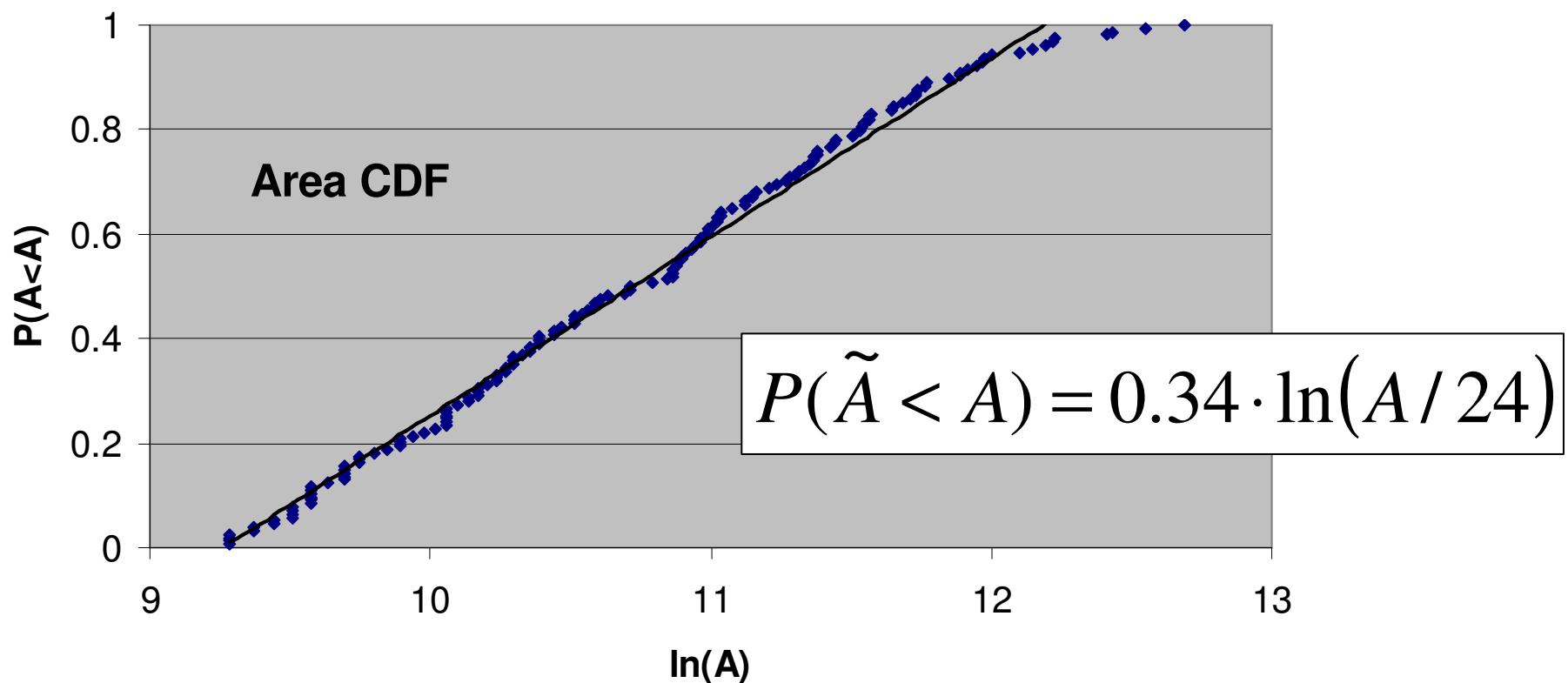
Map all reservoir areas with satellites:

**Landsat**



# Storage mapping

## Step 1: Results, Pareto distribution



# Storage mapping

## Step 2: Bathymetry



Bathymetric survey – Jens Liebe

Physics and Chemistry of the Earth, 30: 448–454

13

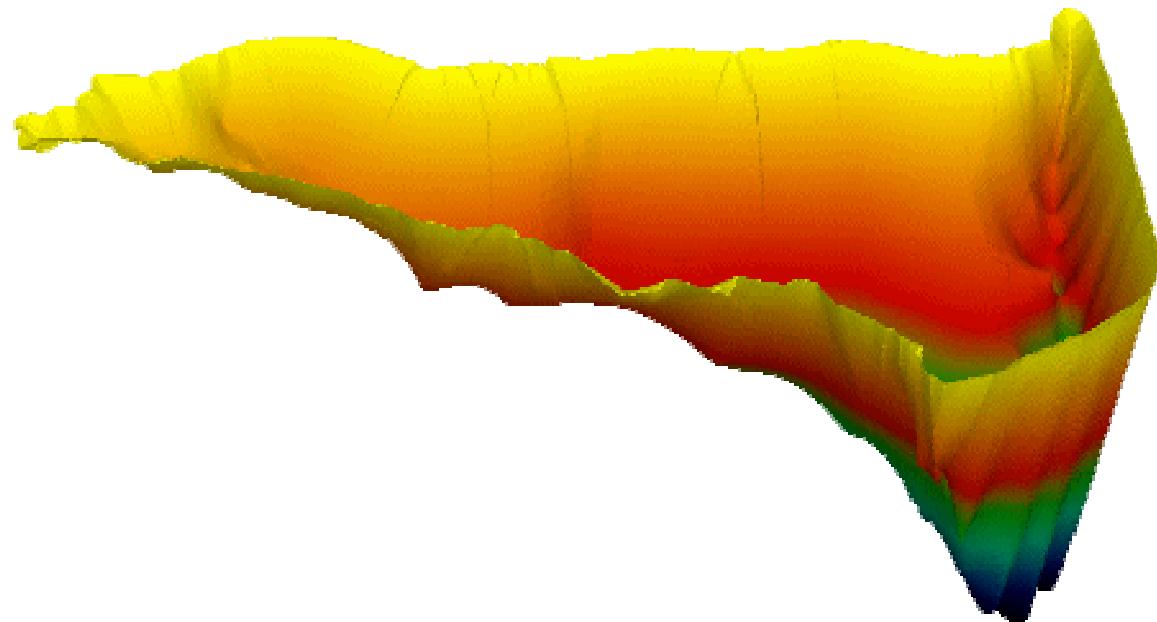
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# Storage mapping

## Step 2: Bathymetry



Bathymetric survey

Physics and Chemistry of the Earth, 30: 448–454

14

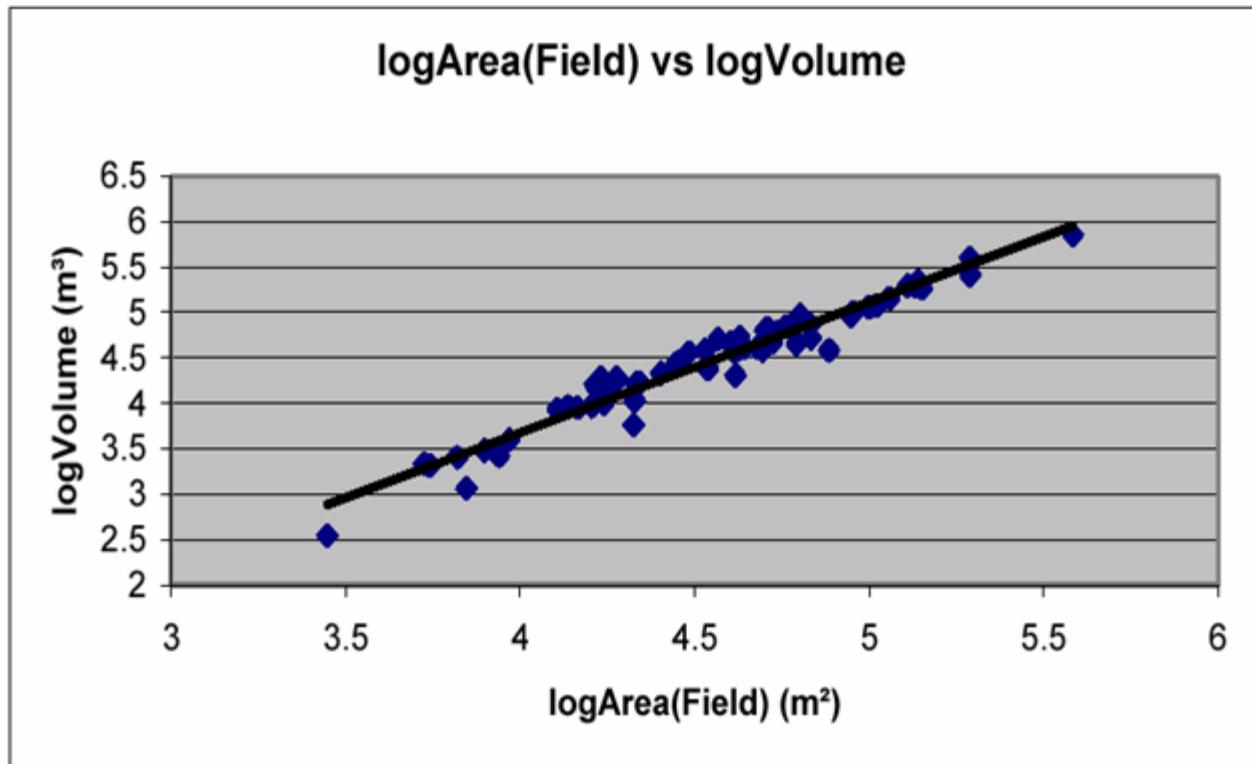
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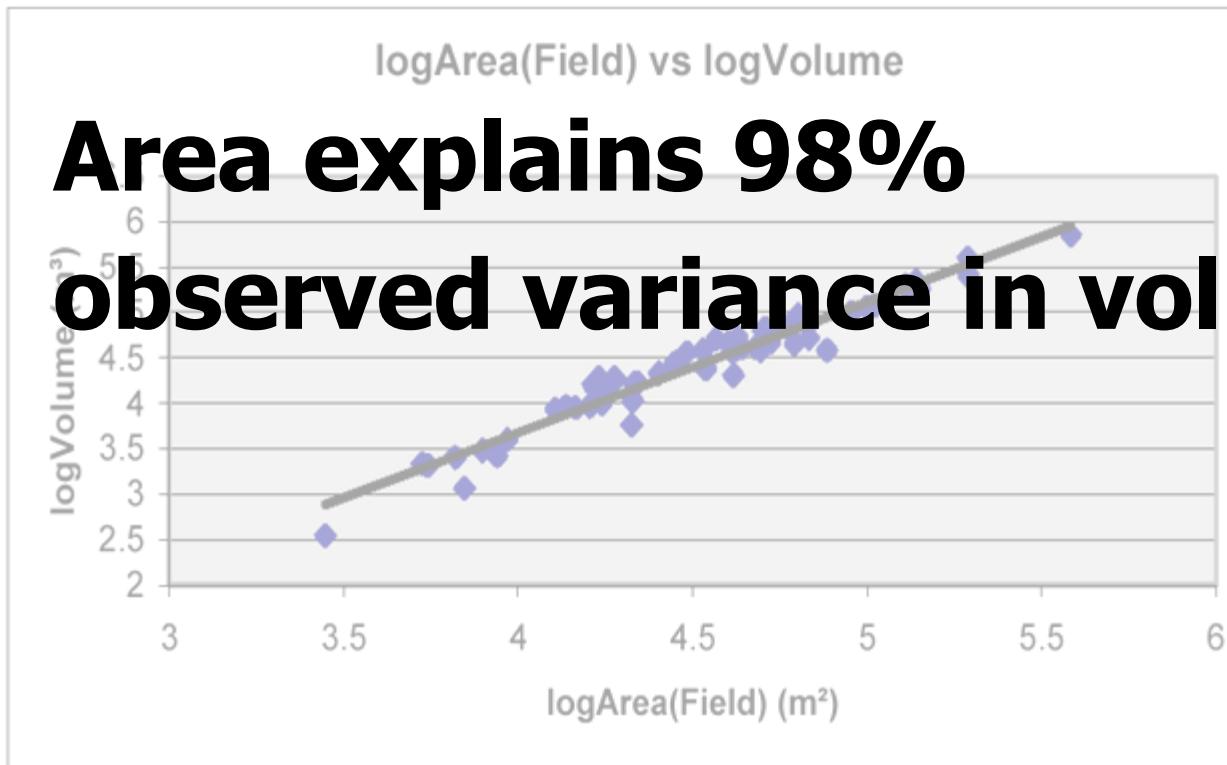
# Storage mapping

## Step 3: Relate surface to volume



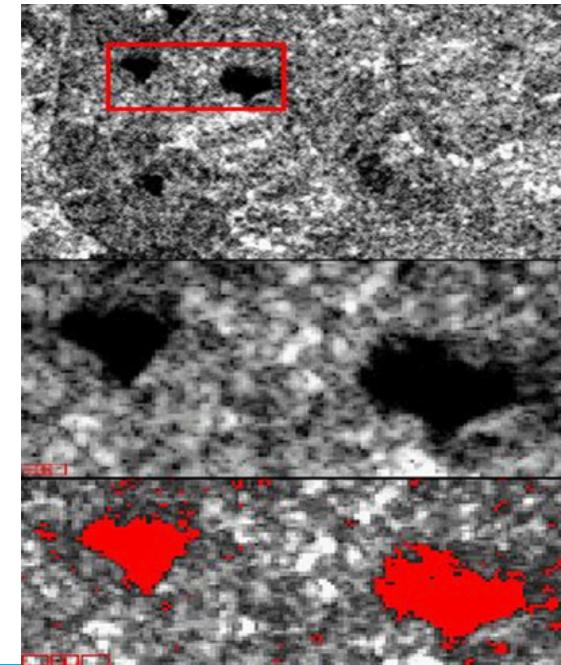
# Storage mapping

Step 3: Relate surface to volume



# Envisat

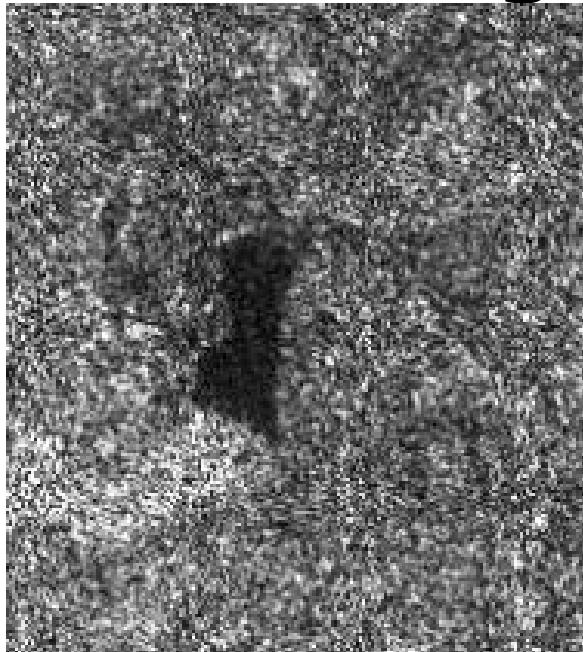
- Cloud cover
- Open water (easy)
- Difficulties



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# Envisat

## No wind, contrasting environment



Physics and Chemistry of the Earth, 30: 448–454

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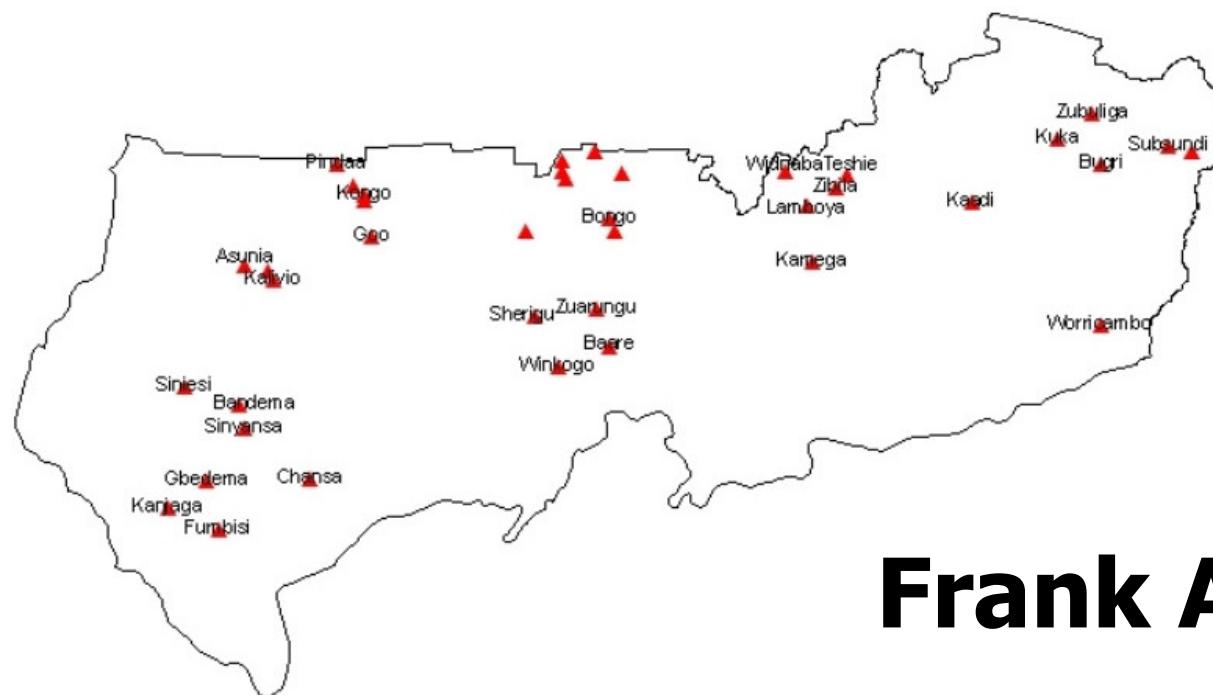
20 May 2009

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# Envisat

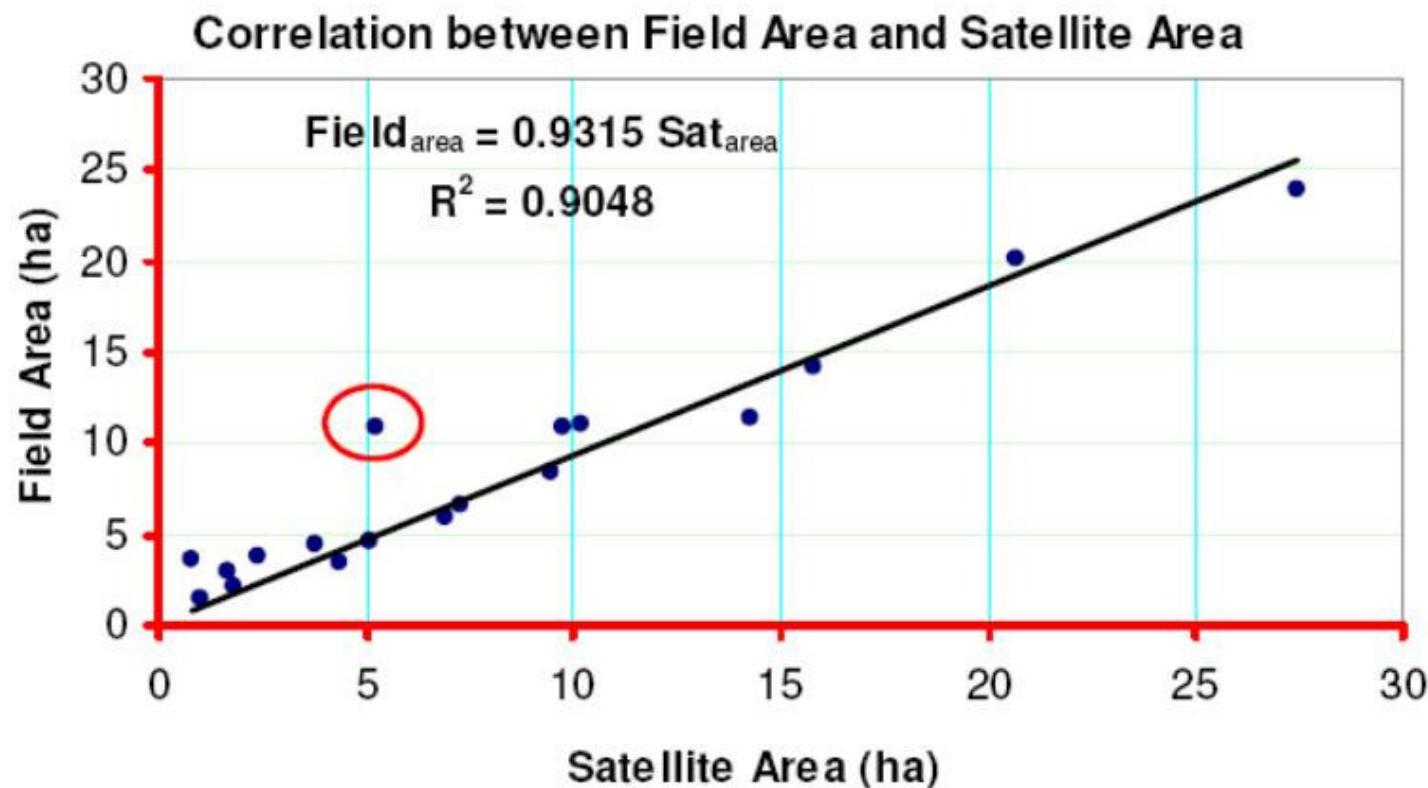
## Ground truth



Frank Annor

# Envisat

## Good results



# Envisat

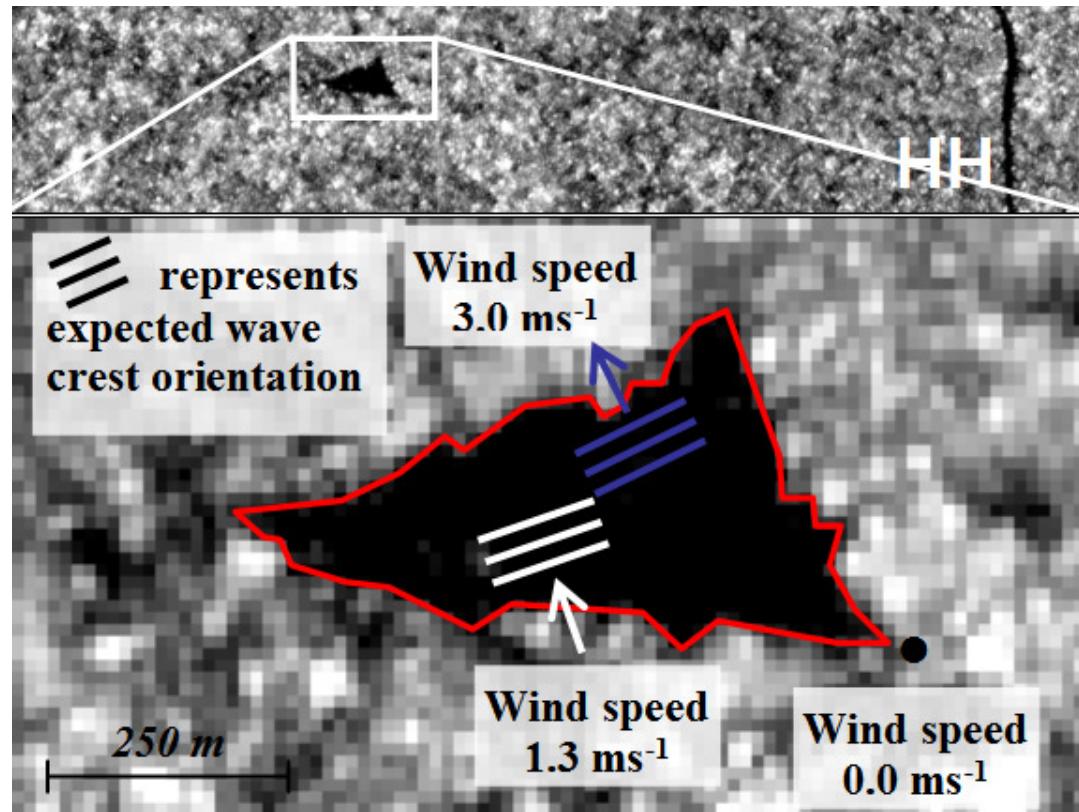
## Outlier



# Envisat

## NRT monitoring

No Bragg  
(2 Sep)



IEEE TGRS 47(5):1536-1547

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RS in WRM

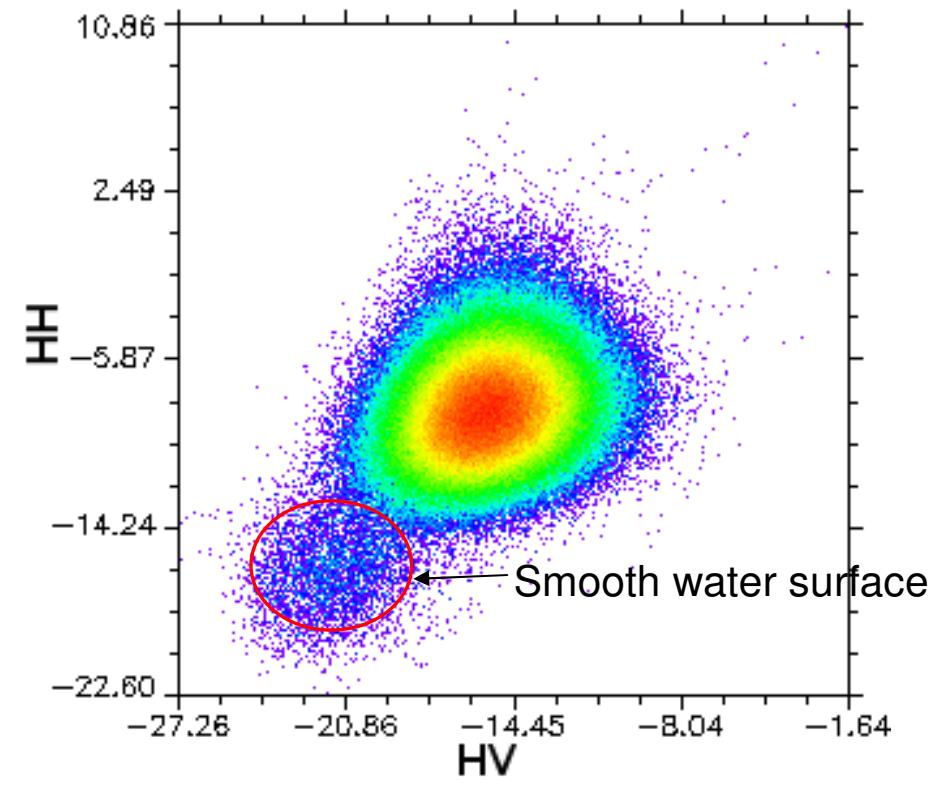
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# Envisat

## NRT monitoring

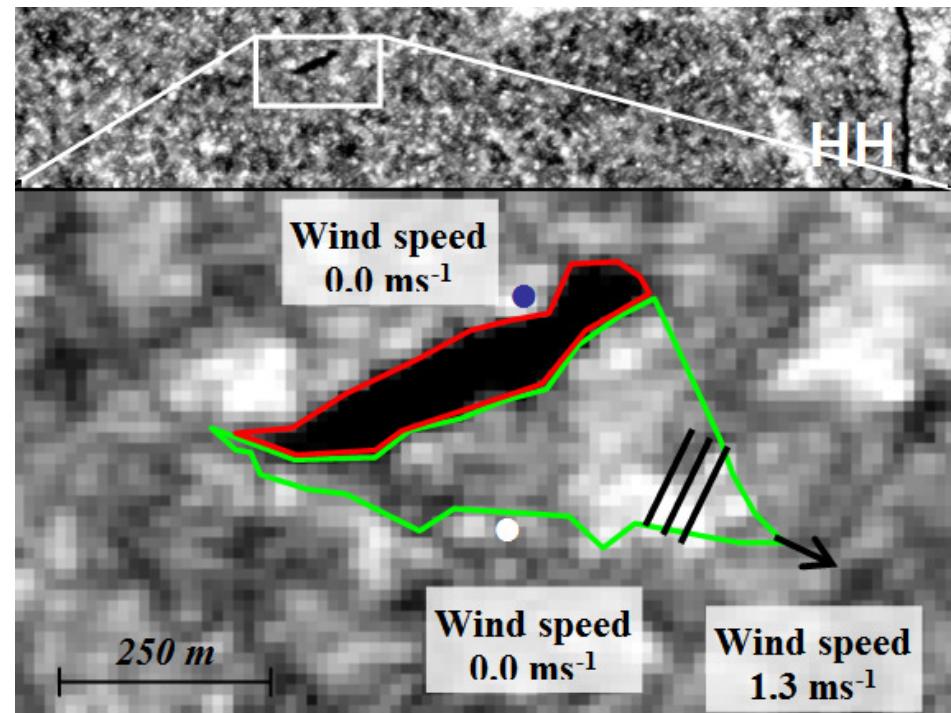
No Bragg  
(2 Sep)



# Envisat

## NRT monitoring

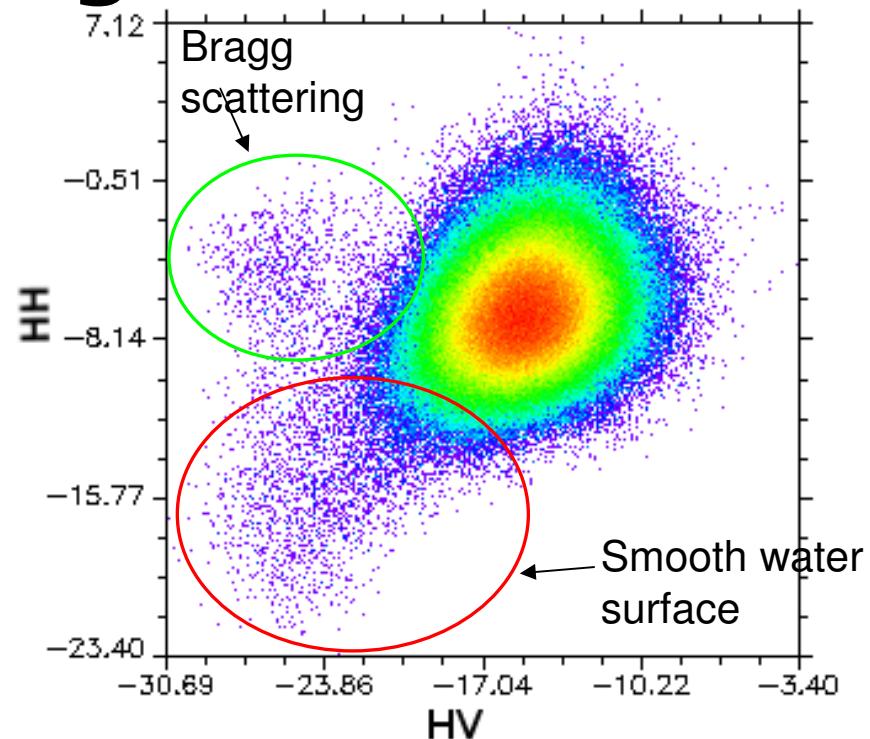
Bragg  
(19 Sep)



# Envisat

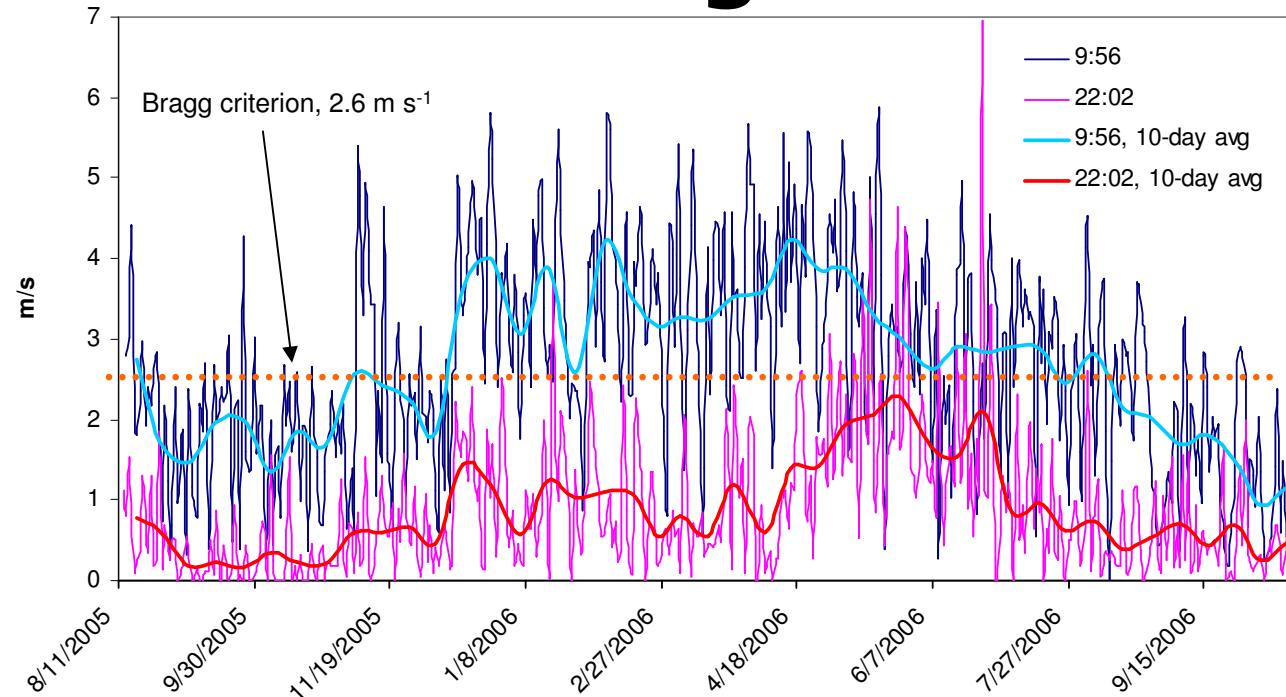
## NRT monitoring

**Bragg**  
(19 Sep)



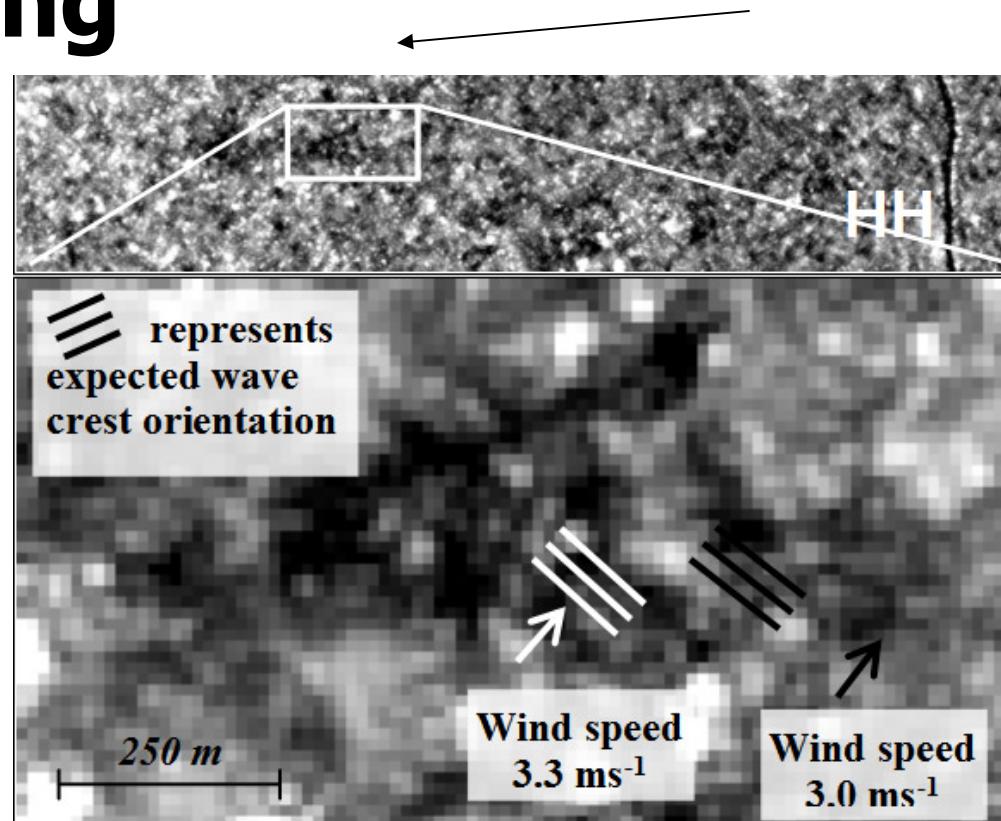
# Envisat

## NRT monitoring



Wind (night time)

# Envisat NRT monitoring



Wind & low contrast environment...

IEEE TGRS 47(5):1536-1547

27

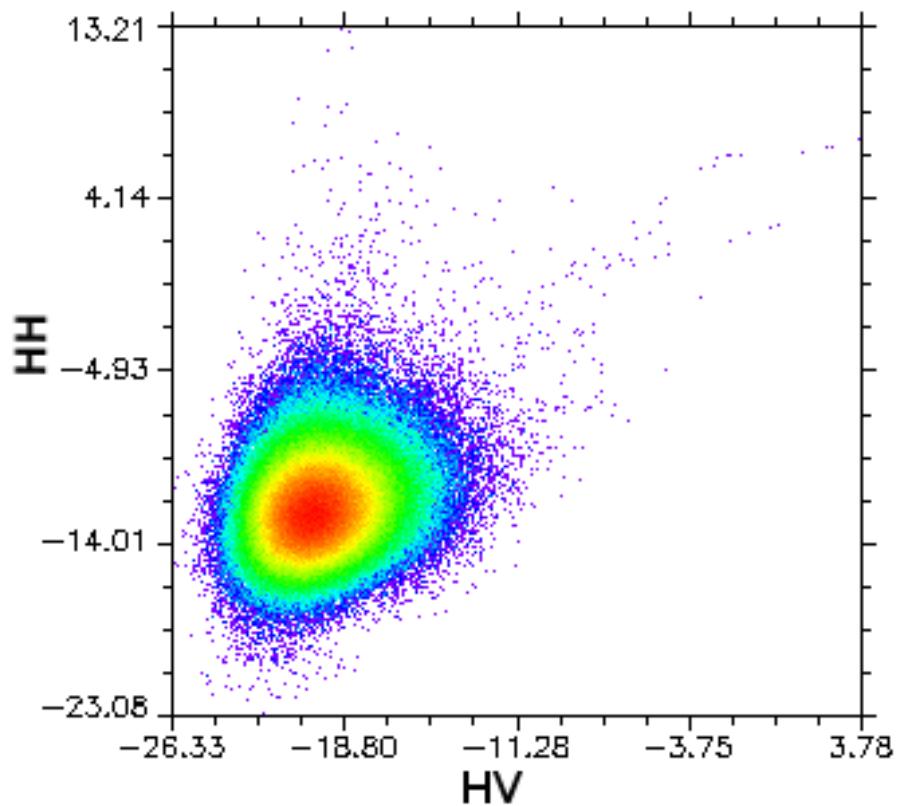
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# Envisat NRT monitoring

Bad luck...



Wind & low contrast environment...

IEEE TGRS 47(5):1536-1547

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RS in WRM

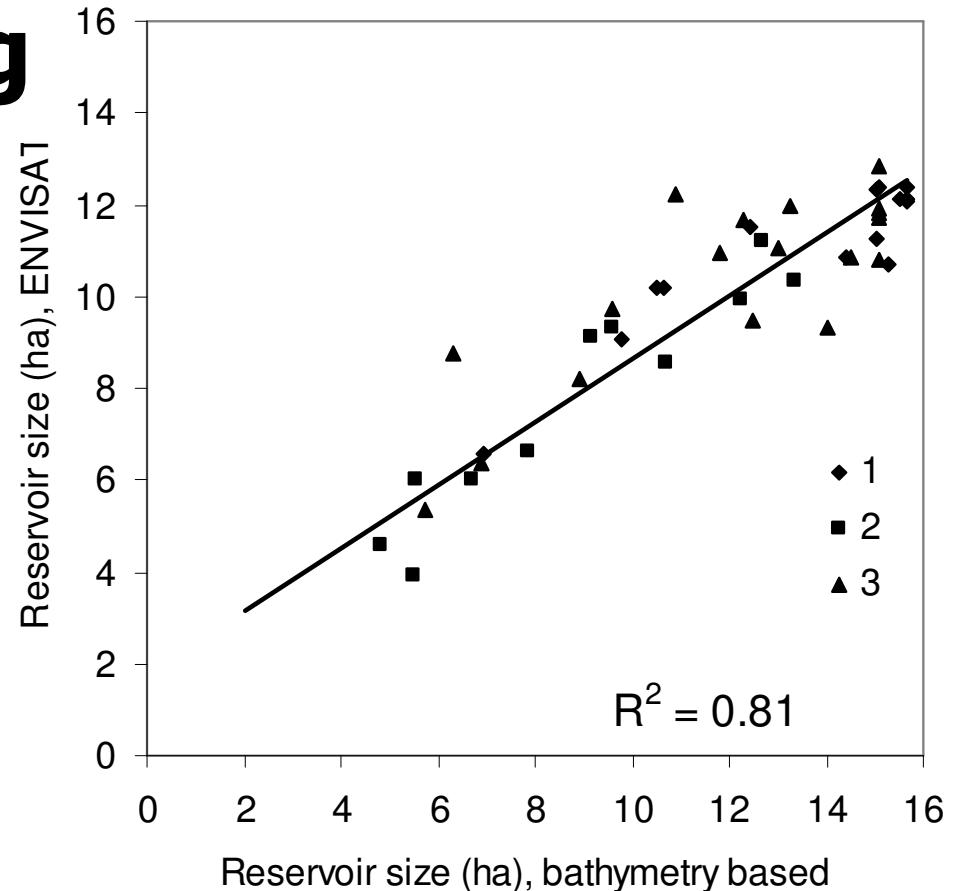
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# Envisat

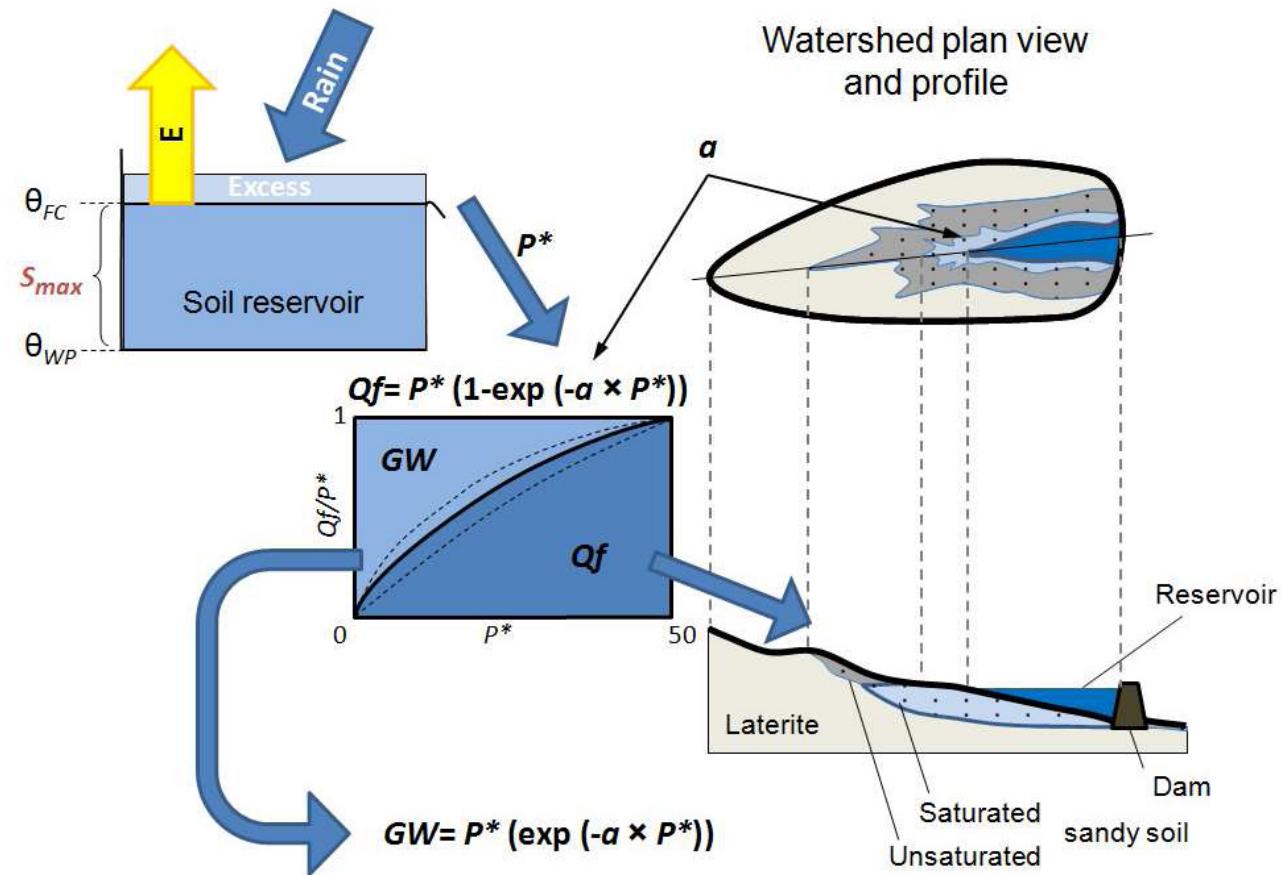
## NRT monitoring

Acceptable  
or noisy?

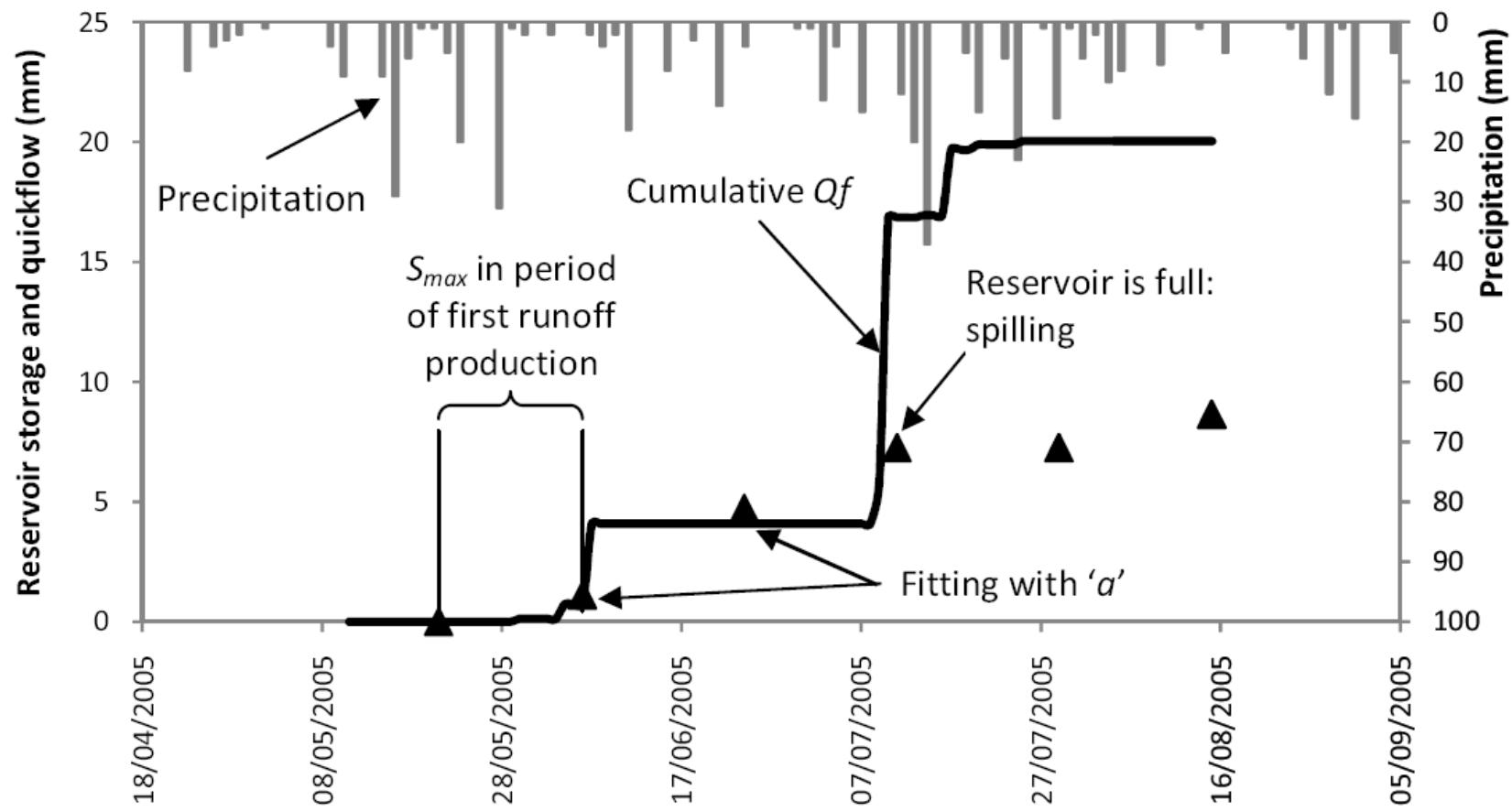


# Calibration

## Model



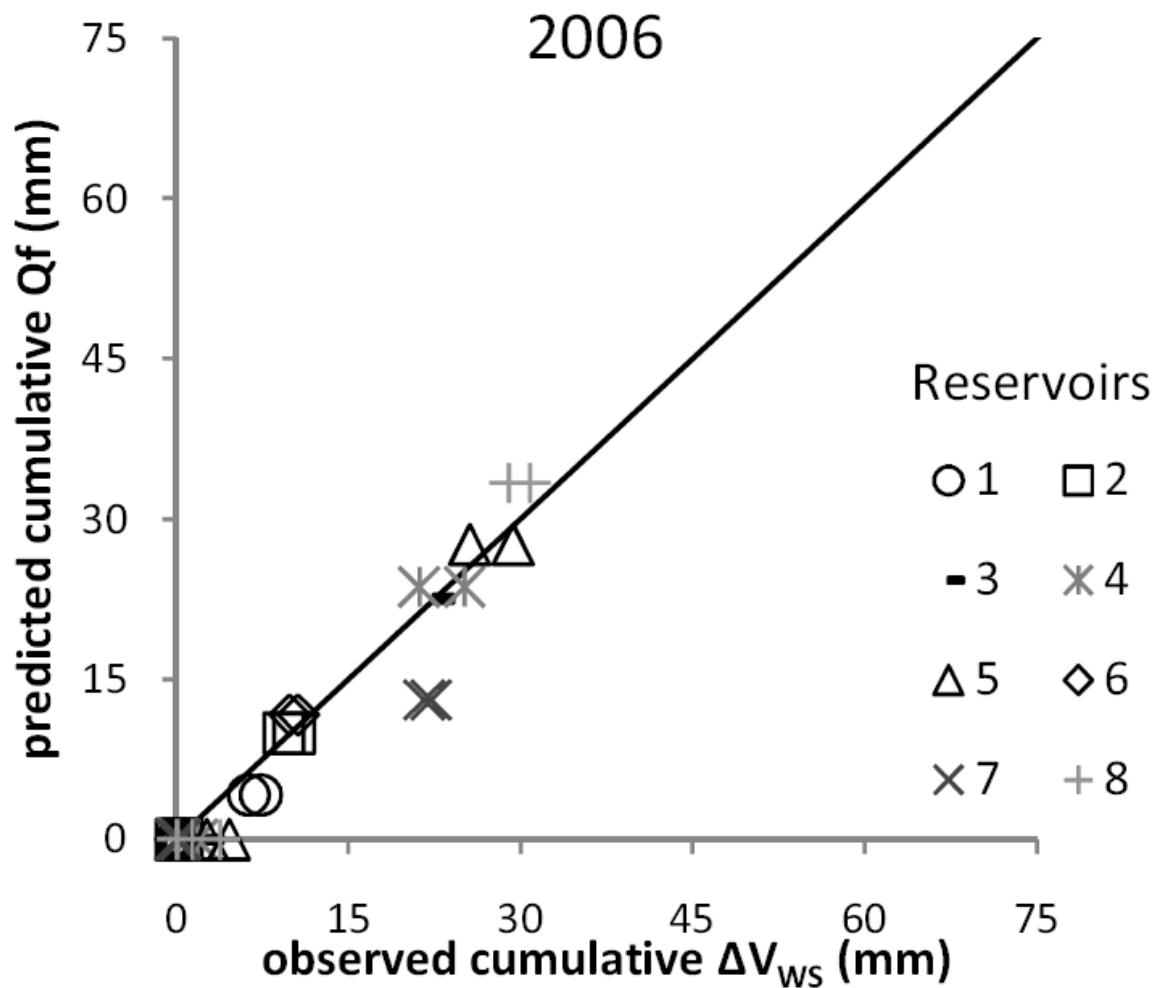
# Calibration



# Calibration

## Validation

$$r^2=0.92$$



# Conclusions

- Good correlation area-volume
- ASAR Envisat works
- Simple models can be calibrated

# Thank you for your attention!



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