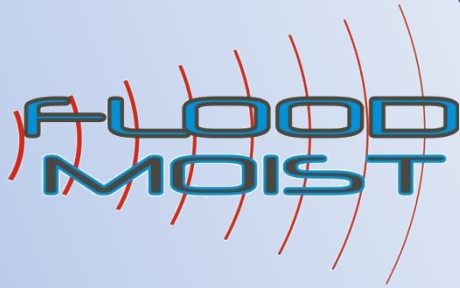


# Using SAR observations of floods in inundation modelling



... some results from FLOODMOIST



NIKO VERHOEST

SAR backscattering:

- very sensitive to flooding
- independent from clouds

SAR imagery ⇨ flood mapping

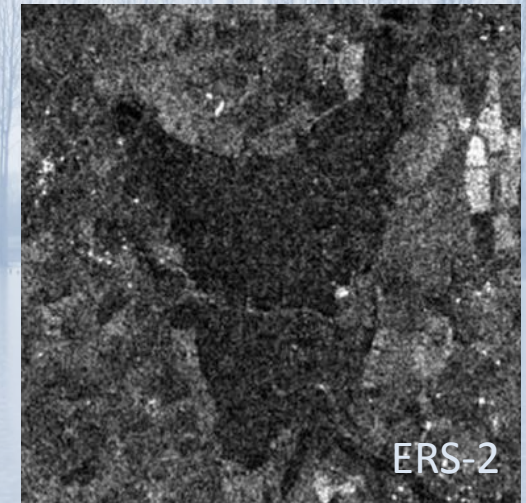
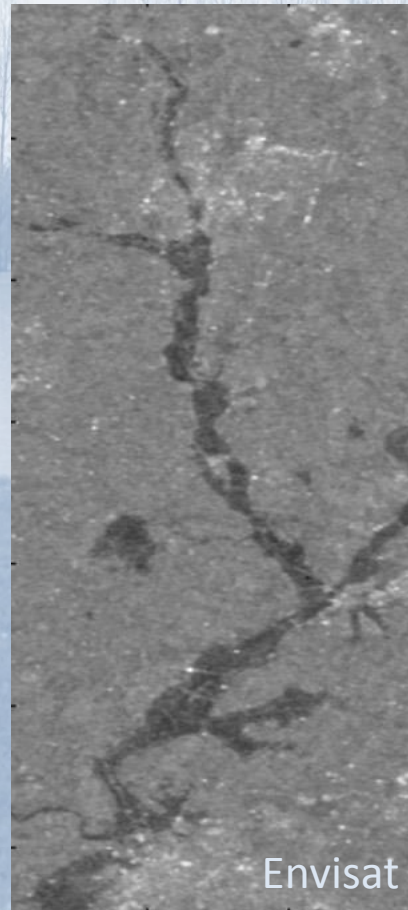
**But ...** only one instant in time

**While ...** flood risk management requires time series of the flood event and predictions...

⇨ Flood inundation models!



How to use SAR observations in inundation modeling?





How to use SAR observations in inundation modeling?

Two options:

1. Use the derived flood map for calibration

THIS PRESENTATION

hydraulic roughness parameters of floodplain and channel

2. Use the derived flood map for state updating  
updating water level heights in model

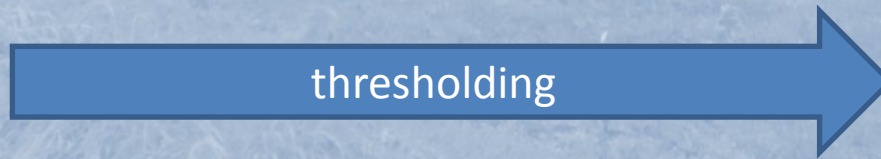
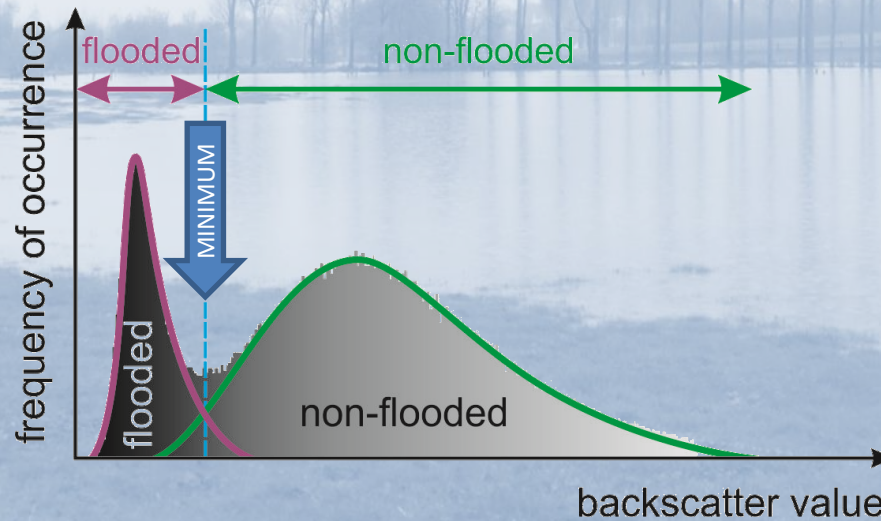
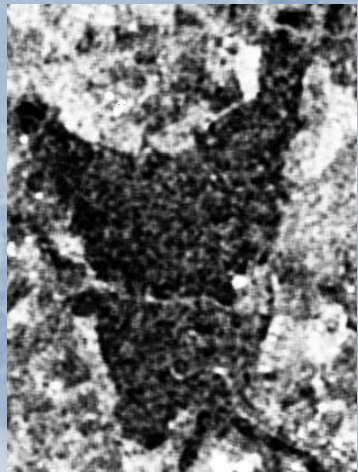


QUESTIONS

- How should one derive a flood map given the uncertainty due to speckle?
- Does a flood map allow for calibrating a flood inundation model?

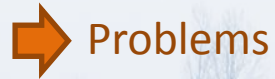
Question 1: How should one derive a flood map given the uncertainty due to speckle?

Principle of flood mapping



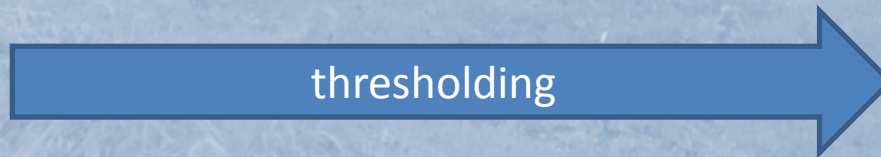
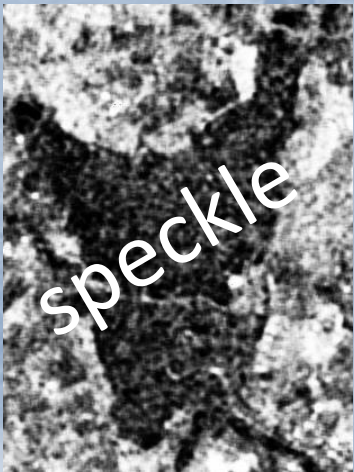
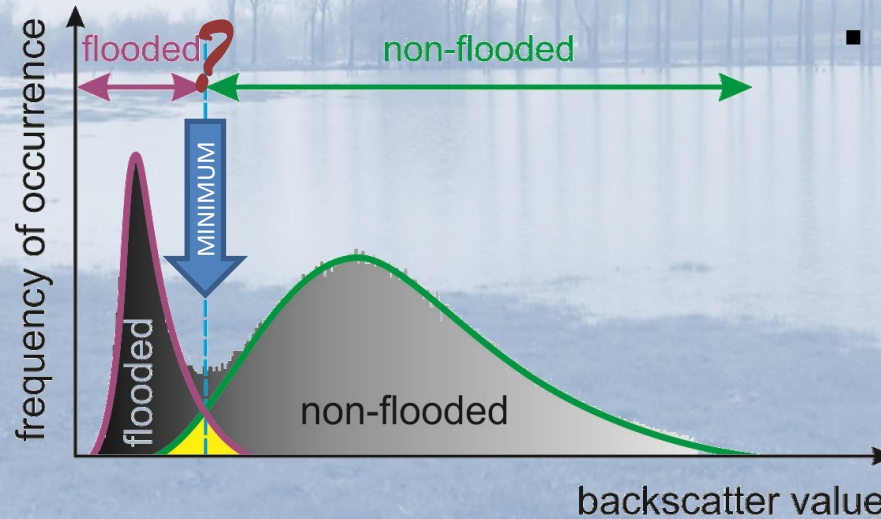
Question 1: How should one derive a flood map given the uncertainty due to speckle?

Principle of flood mapping



Problems

- wrongly classified pixels
- what threshold to use?
- speckle



Question 1: How should one derive a flood map given the uncertainty due to speckle?

Principle of flood mapping

➔ Problems



Solution

(1) 'clever' thresholding scheme was applied<sup>(\*)</sup>

✓ makes use of statistical descriptions of distributions

➔ set the threshold

✓ makes use region-growing techniques and change detection

➔ reduce the wrongly classified pixels

(\*) developed in frame of HYDRASENS:

Matgen et al., Towards an automatic SAR-based flood monitoring system. Lessons learned from two case studies. Phys. Chem. Earth 36 (7-8), 241–252., 2012

Question 1: How should one derive a flood map given the uncertainty due to speckle?

Principle of flood mapping

➔ Problems

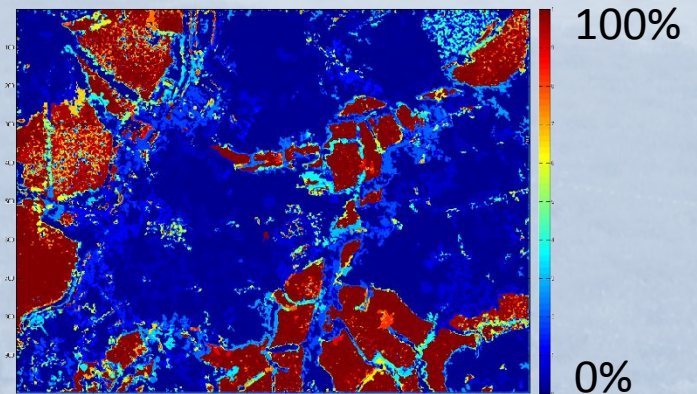


Solution

(2) make use of speckle statistics to generate large number of synthetic images<sup>(\*)</sup>

➔ assess uncertainty in flood map due to speckle

Case study: Tewkesbury flood event (July 2007)



(\*) developed in frame of FLOODMOIST:

Giustarini et al., Accounting for image uncertainty in SAR-based flood mapping. Int. J. Appl. Earth Observ. Geoinform., 34, 70–77, 2015

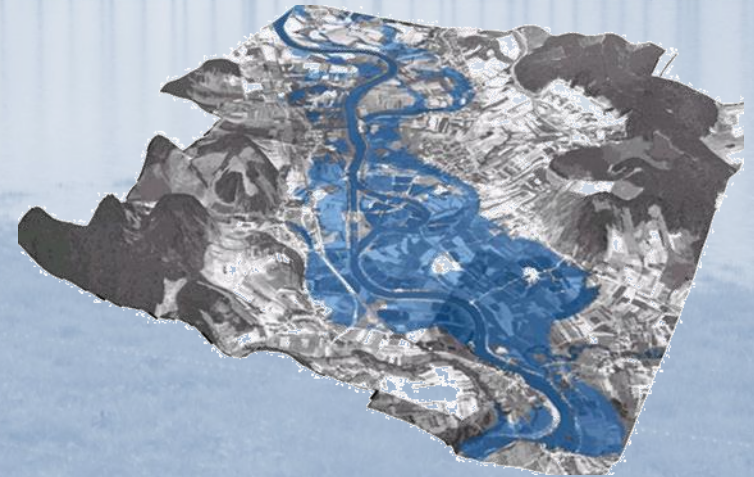
Question 2: Does a SAR-based flood map allow for calibrating a flood inundation model?




Hydraulic model that simulates the flow through the main channel AND the floodplain

main parameters:

- channel Manning coefficient  $n_{ch}$
- floodplain Manning coefficient  $n_{fp}$



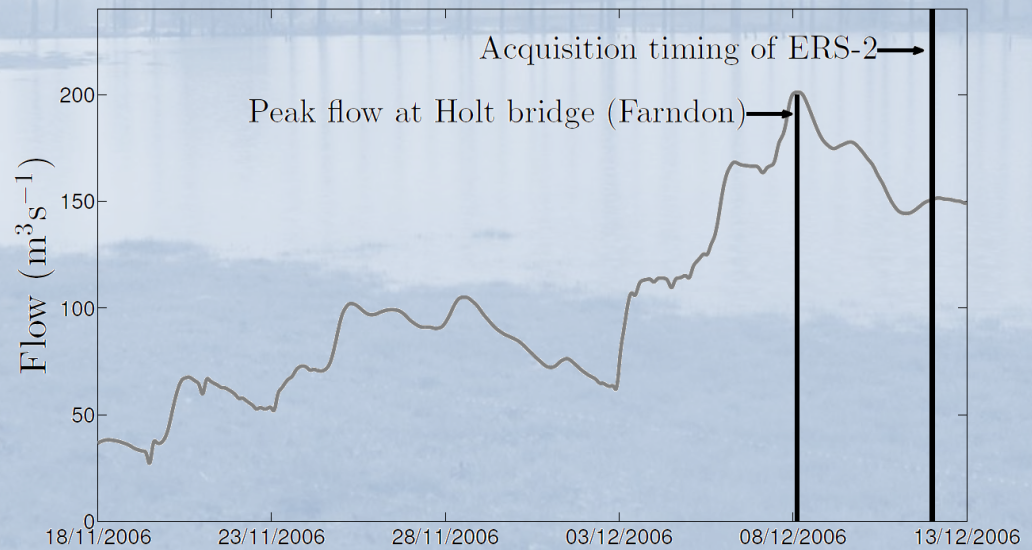
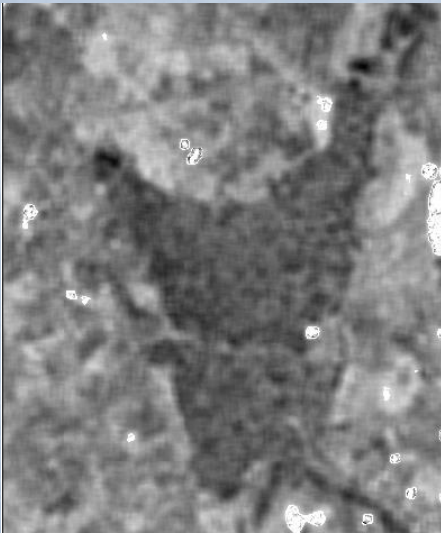
 objective:

Identify values for  $n_{ch}$  and  $n_{fp}$  such that modelled and observed flood extent match



Question 2: Does a SAR-based flood map allow for calibrating a flood inundation model?

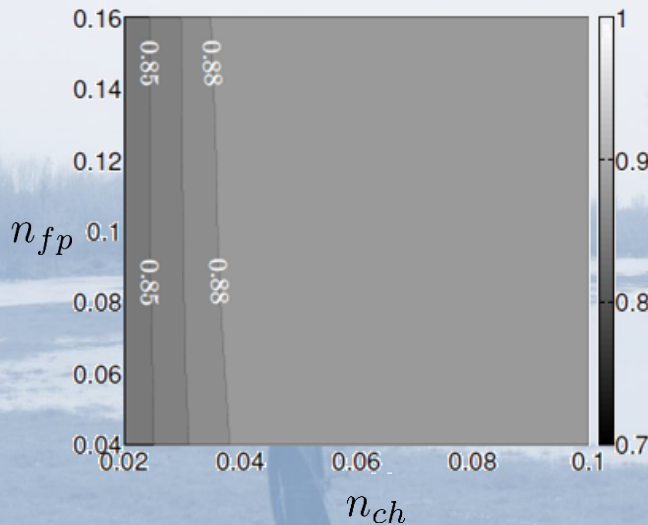
## Case study: River Dee flooding (December 2006)<sup>(\*)</sup>



(\*) performed in frame of FLOODMOIST:

Gobeyn et al., Impact of the SAR acquisition timing on the calibration of a flood inundation model. J. Hydrol., submitted, 2014

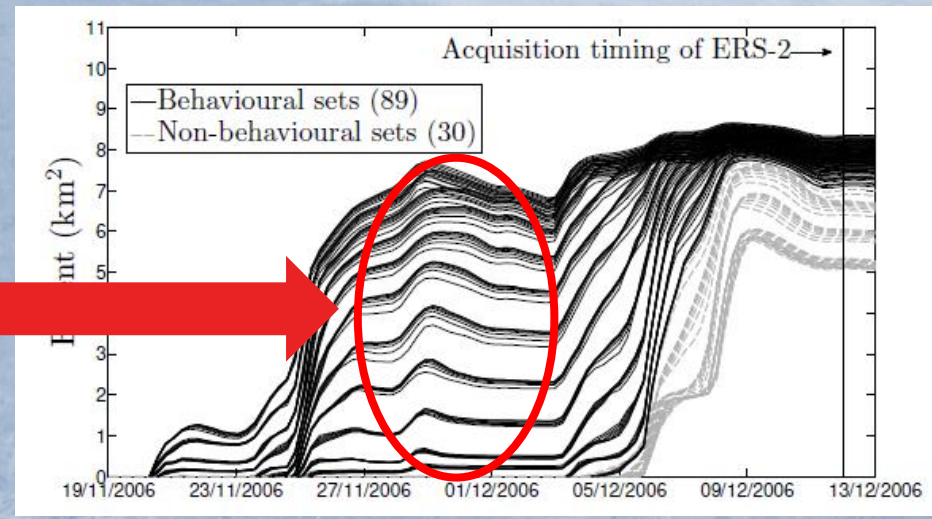
Question 2: Does a SAR-based flood map allow for calibrating a flood inundation model?



119 (17 x 7) parameter combinations assessed

- 89 performed best (statistically the same)
  - ➔ behavioural
- 30 performed less
  - ➔ non-behavioural

**!** Not able to sufficiently constrain parameter space:  
 large prediction uncertainty in extent of upcoming flood event



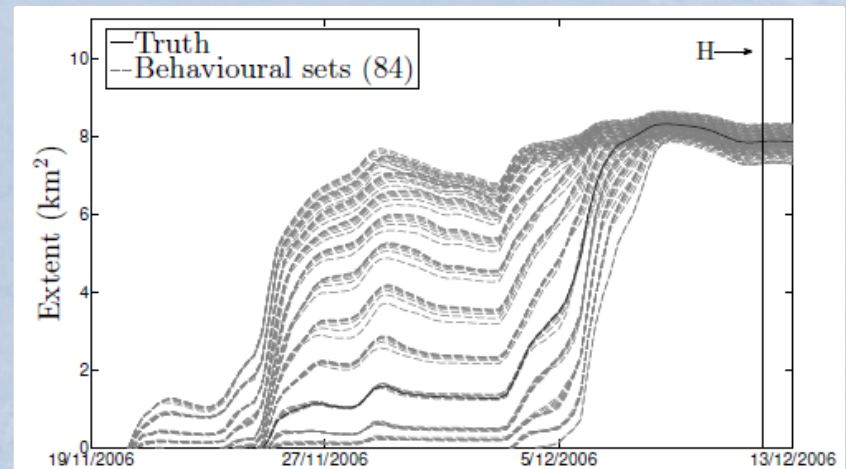
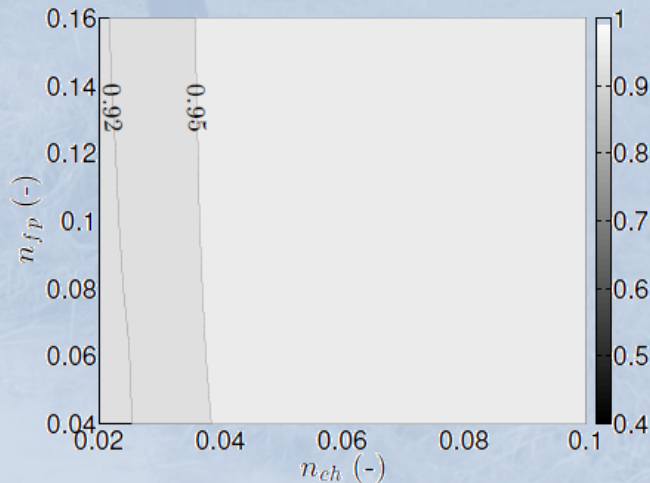
Question 2: Does a SAR-based flood map allow for calibrating a flood inundation model?

? Would a SAR-observation during upcoming event be more 'informative'?

➔ Synthetic experiment

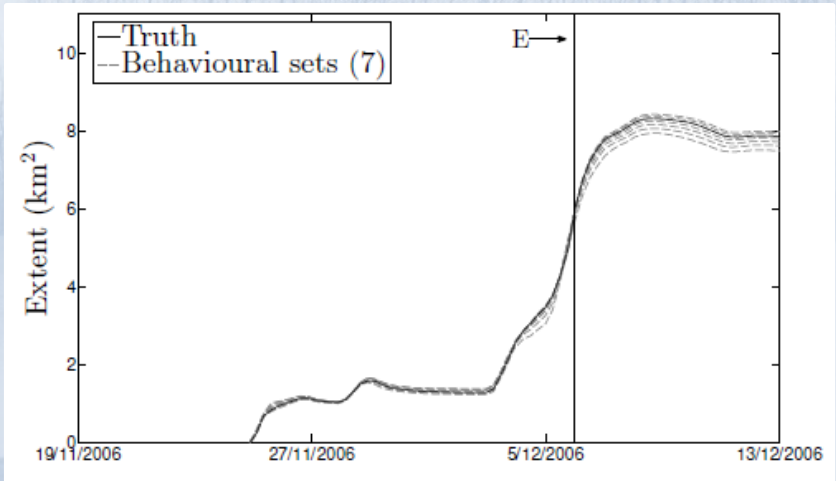
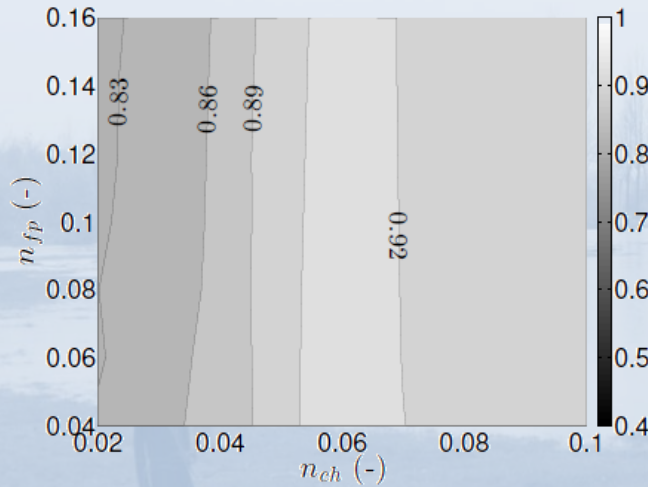
create synthetic SAR images at several instances during flood event

AFTER PEAK

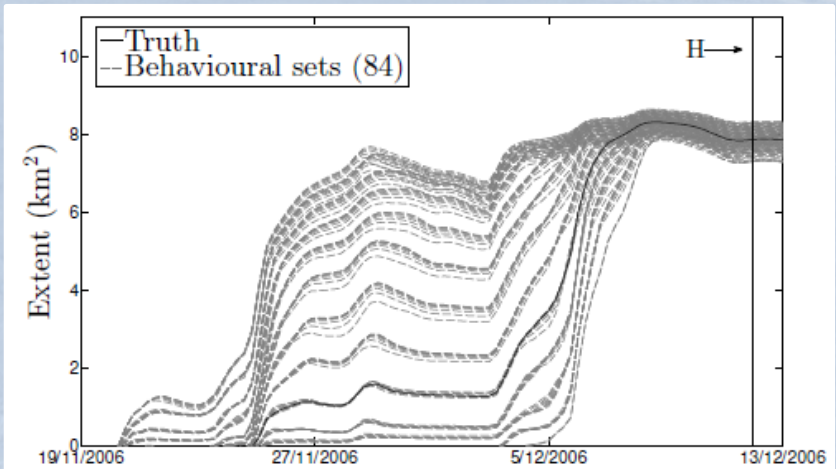
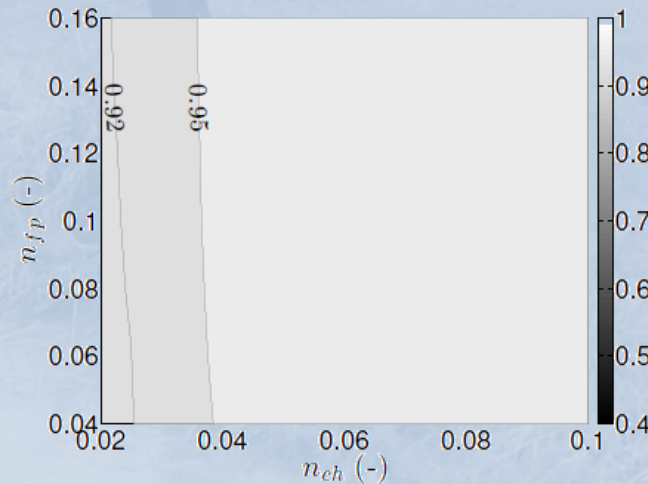


Question 2: Does a SAR-based flood map allow for calibrating a flood inundation model?

BEFORE PEAK



AFTER PEAK



# Using SAR observations of floods in inundation modelling?

## 1. for deriving flood maps

- method needed to set classification threshold and for reducing wrongly classified pixels
- account for uncertainty due to speckle in image

## 2. for calibrating flood inundation model

- best to have pre-flood peak observations when using scene for calibration
- preferably calibration method that does not require a classified SAR image (not shown)

## 3. for updating states in flood inundation model (not shown)

- preferably together with soil moisture maps

FLOOD  
MOIST

thank you!

