

# Anticipatory Water Management

3<sup>rd</sup> HEPEX Workshop, Stresa, 2007

## RIJNLAND CASE STUDY: ANTICIPATORY CONTROL OF A LOW-LYING REGIONAL WATER SYSTEM

Anticipatory water management



UNESCO-IHE  
Institute for Water Education



# Anticipatory Water Management

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# Improve operational water management

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- Hydrological extremes, floods and droughts
- Reduce impact and damage by early warning and anticipatory control
- Enhance use of precipitation forecasts



Delfland Water Board

# Challenges using precipitation forecasts

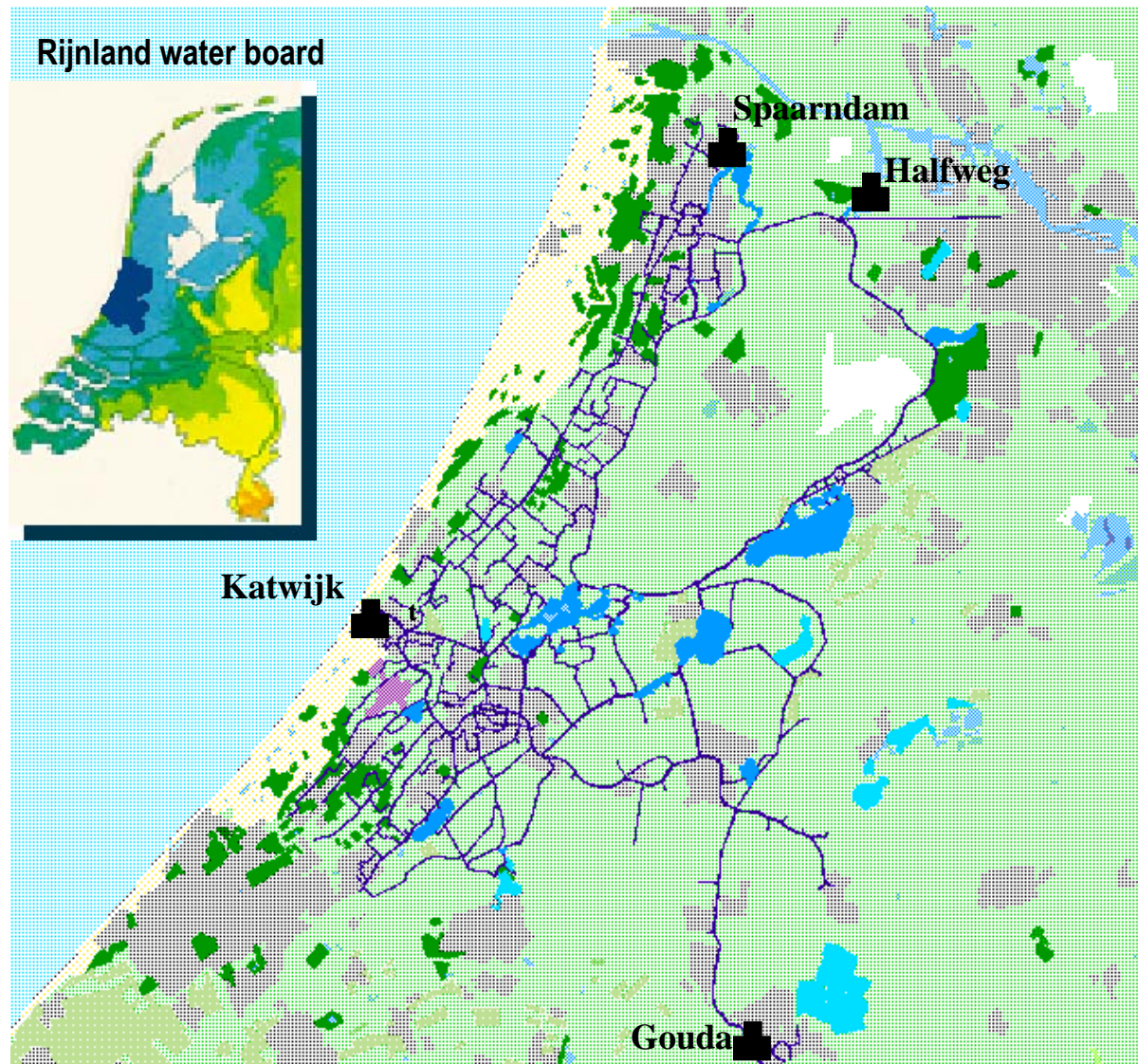
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- Time frame
- Deterministic/Single precipitation forecasts: false certainty or unknown uncertainty
- Information about local quality of forecast product  
(*present research*)
- Water managers need to be able to test meteorological products, specifically for their catchment and for a specific application (e.g. flood control)

Looking at probabilistic precipitation forecasts: ECMWF Ensemble Prediction System (EPS)

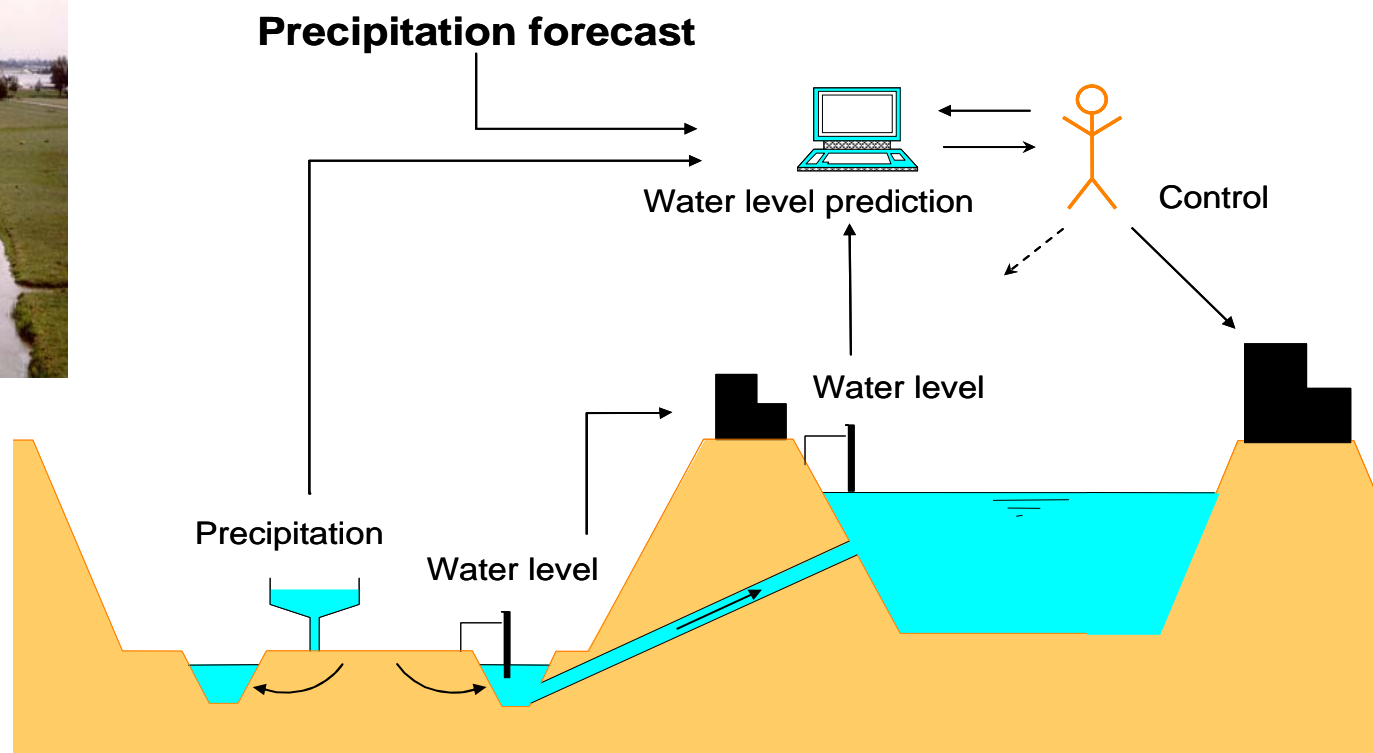
# Case study: Rijnland Water Board

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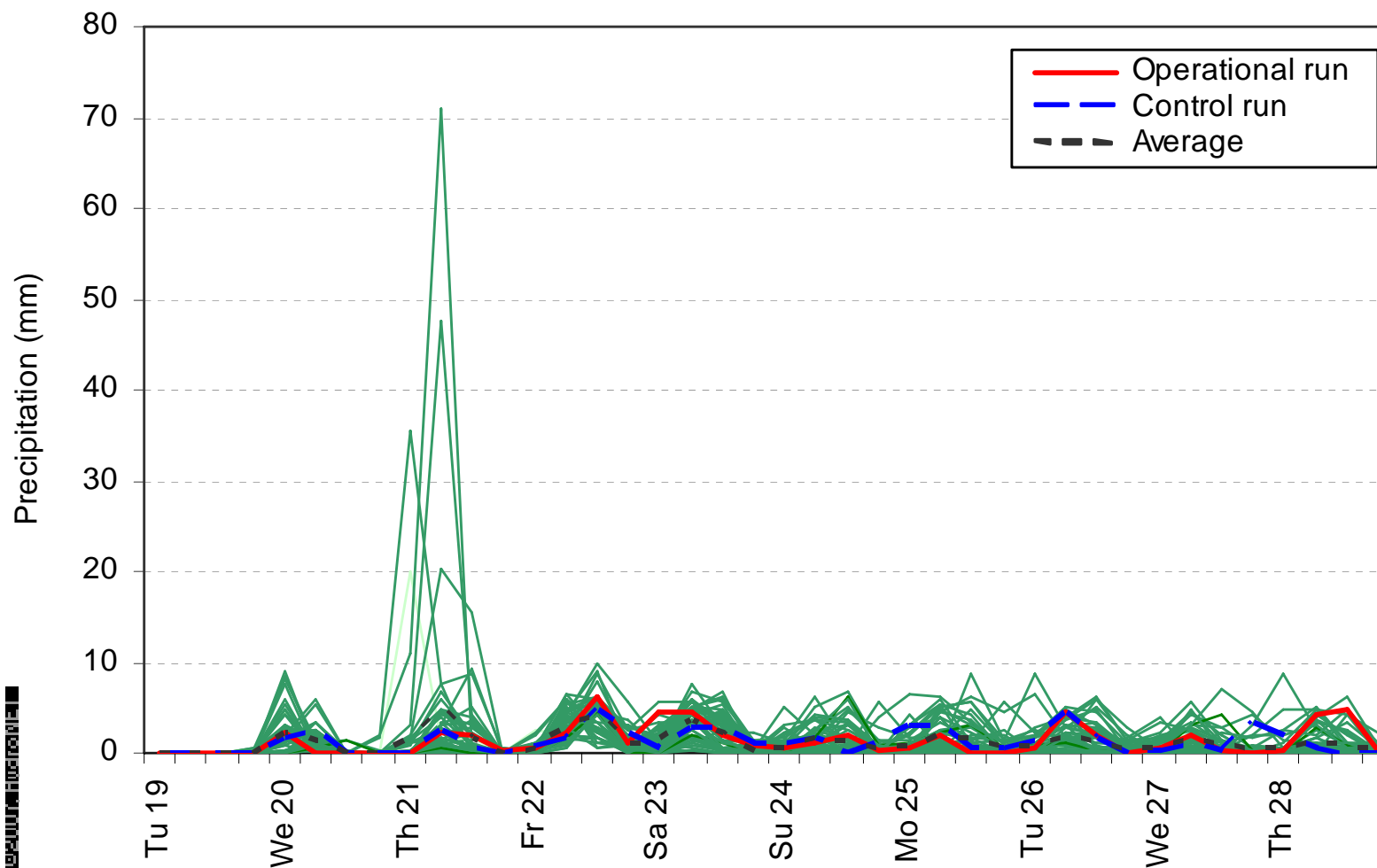


- Anticipatory flood control: Early pumping
- Allow lower water level temporarily to increase storage capacity
- Increase forecast horizon from 1 to 3 days
- Risk of missed events and false alarms

# ECMWF EPS Precipitation

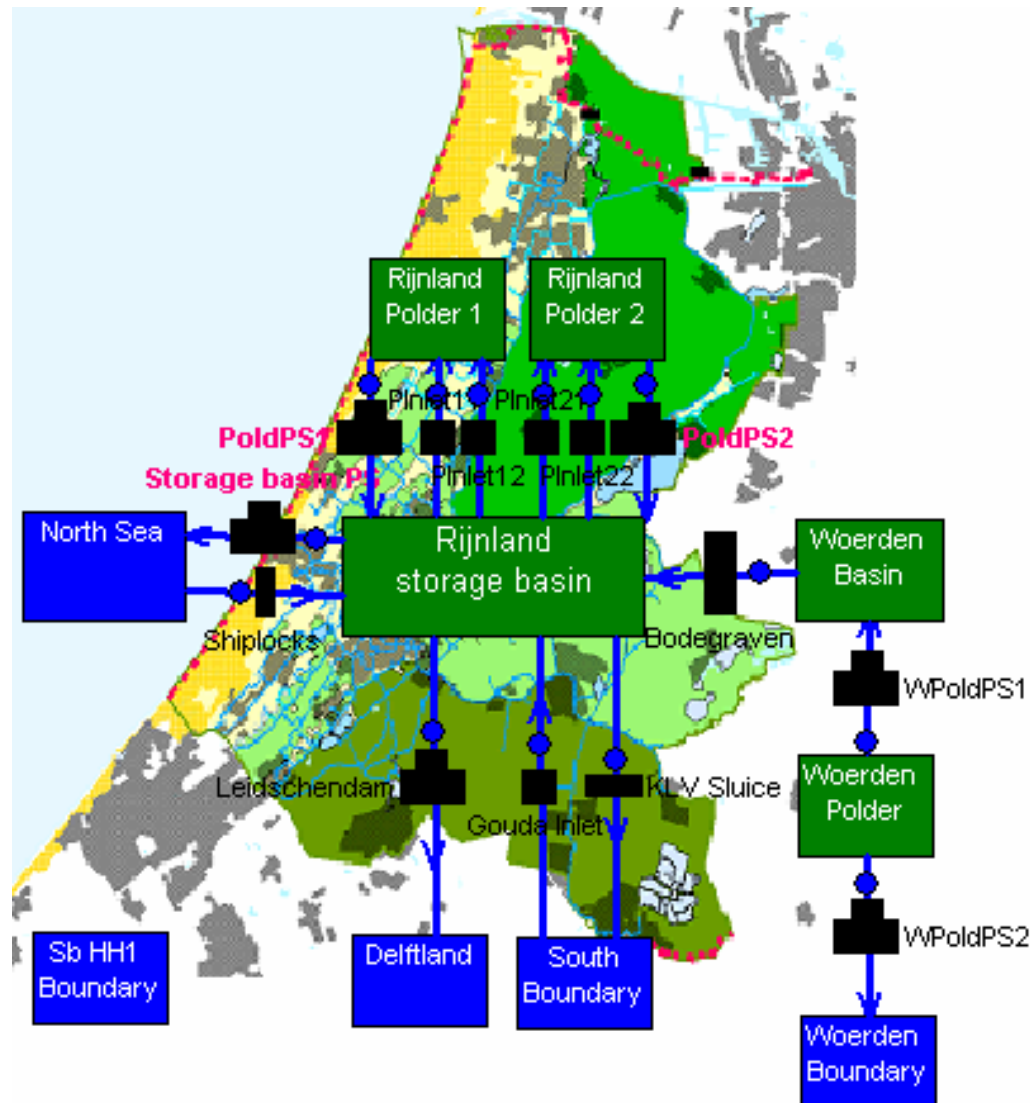
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EPS plume (6-hourly) for De Bilt at 19-6-2007, 0 hr (UT)



# Water-system control model

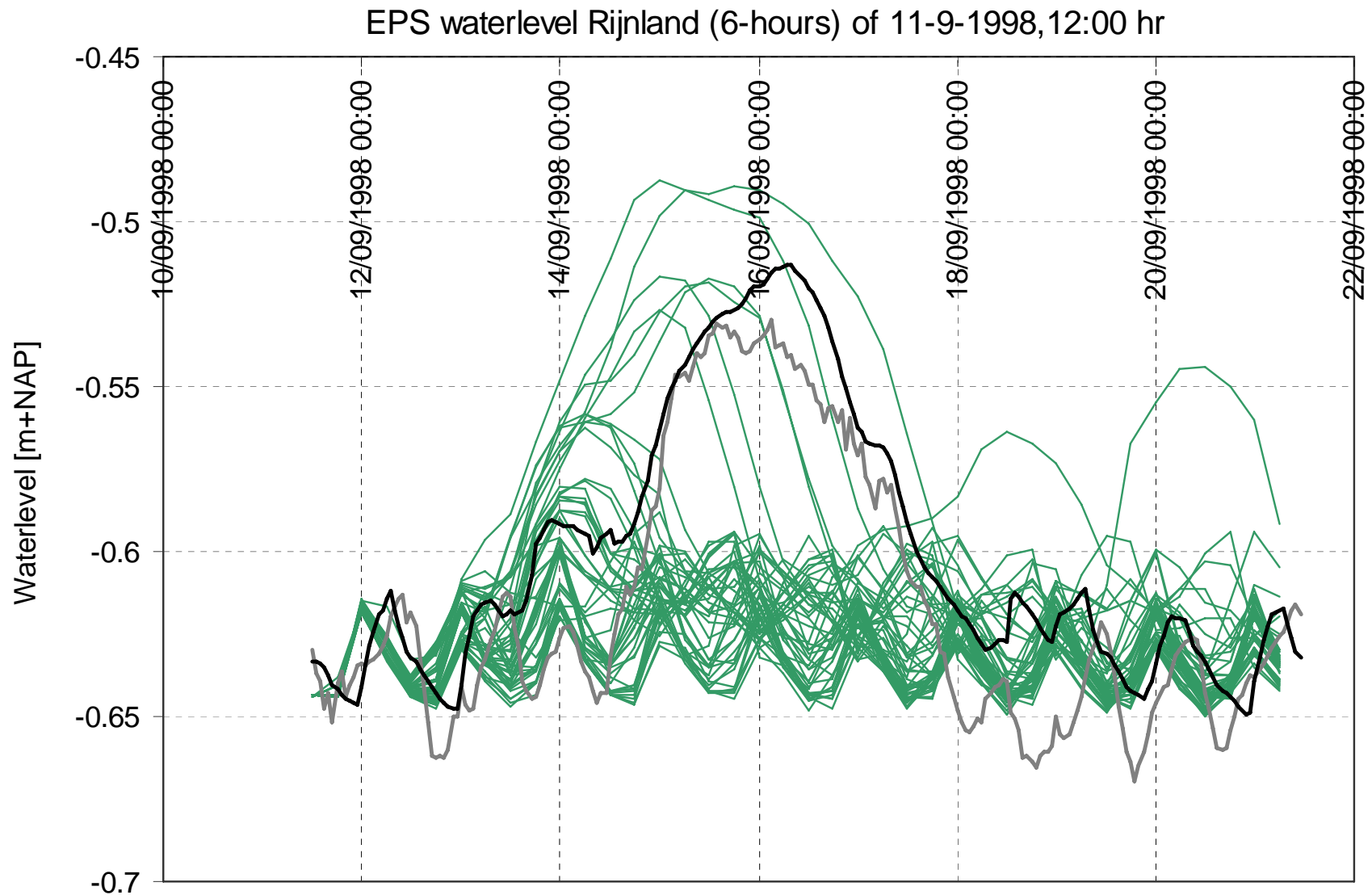
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Yufeng, 2003

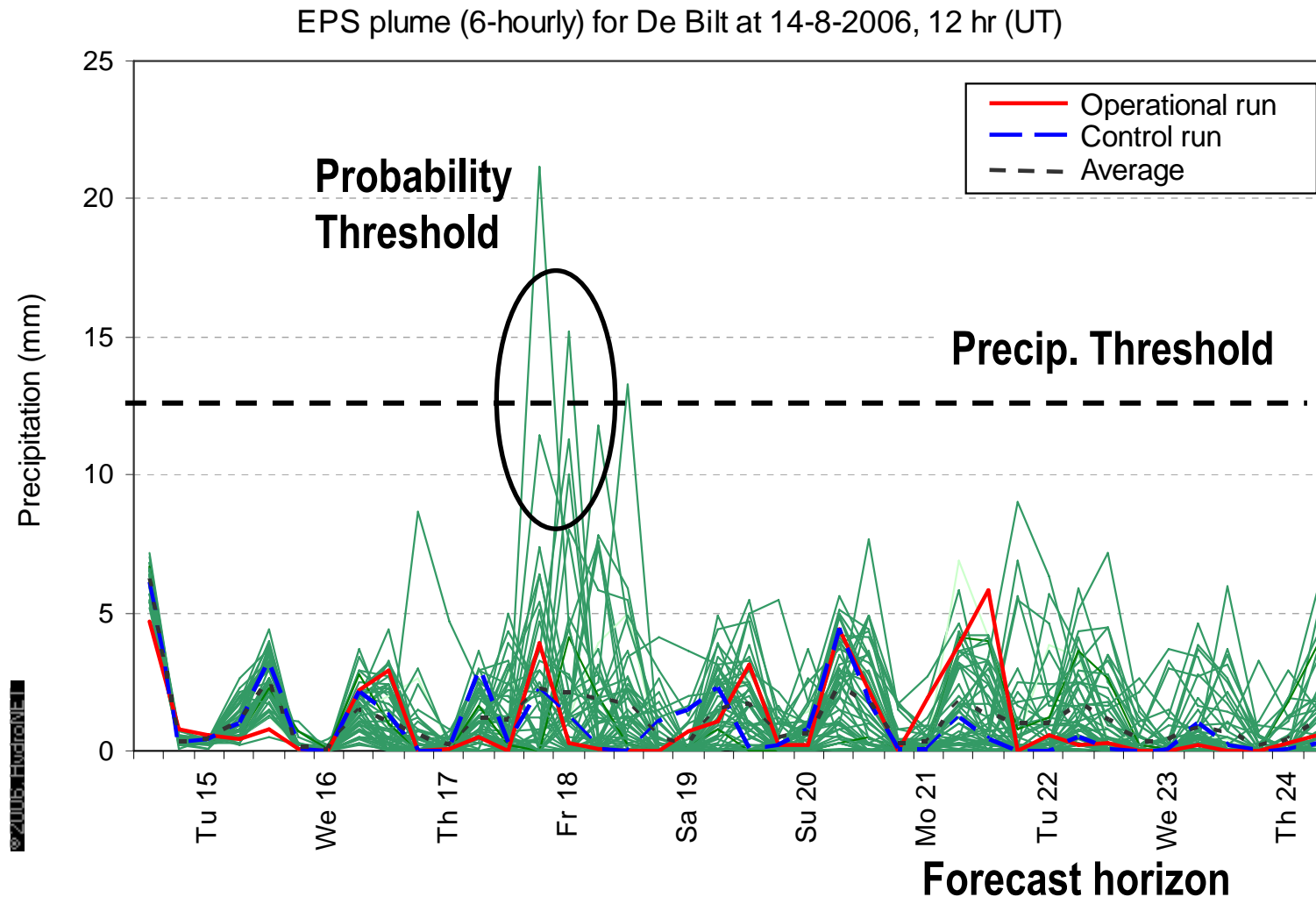
# Ensemble water level forecasts

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# Threshold-based decision rule

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Many choices, information about local quality is needed

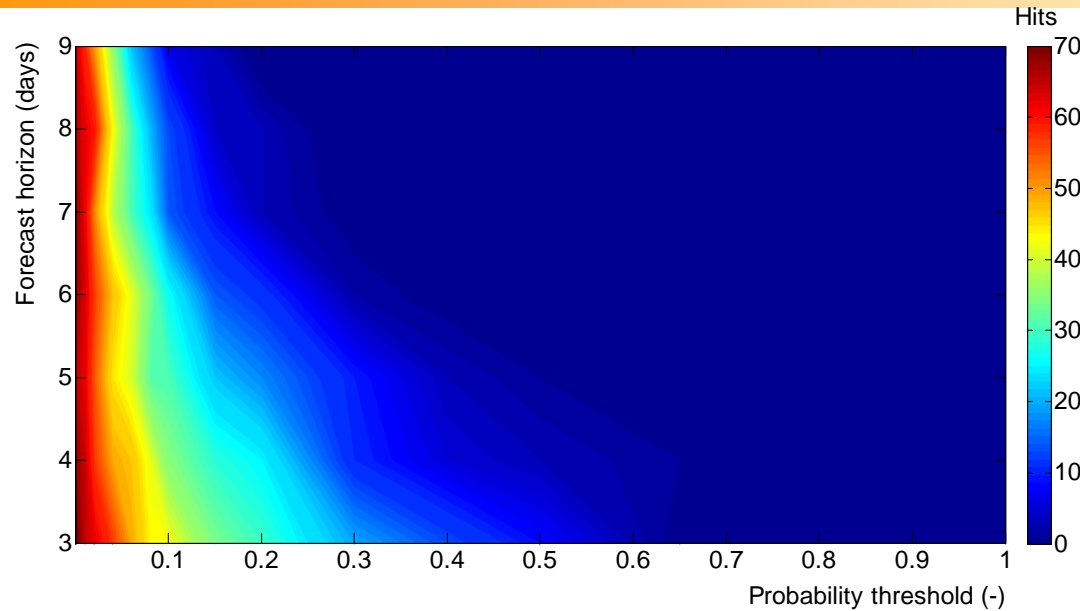
# Long term verification analysis

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- 7.5 years ECMWF EPS precipitation forecasts for “De Bilt” (80 km \* 80 km)
- 7.5 years KNMI ground station precipitation measurements Rijnland area ( $\approx 1$  station per 100km<sup>2</sup>)
- Precipitation events defined by the Rijnland Water Board (15 mm/day) and by historic data analysis
- High water level events defined by historic data analysis
- Comparison of start of forecasted and measured events
- Number of hits, missed events and false alarms have been determined for combinations of probability threshold and forecast horizon

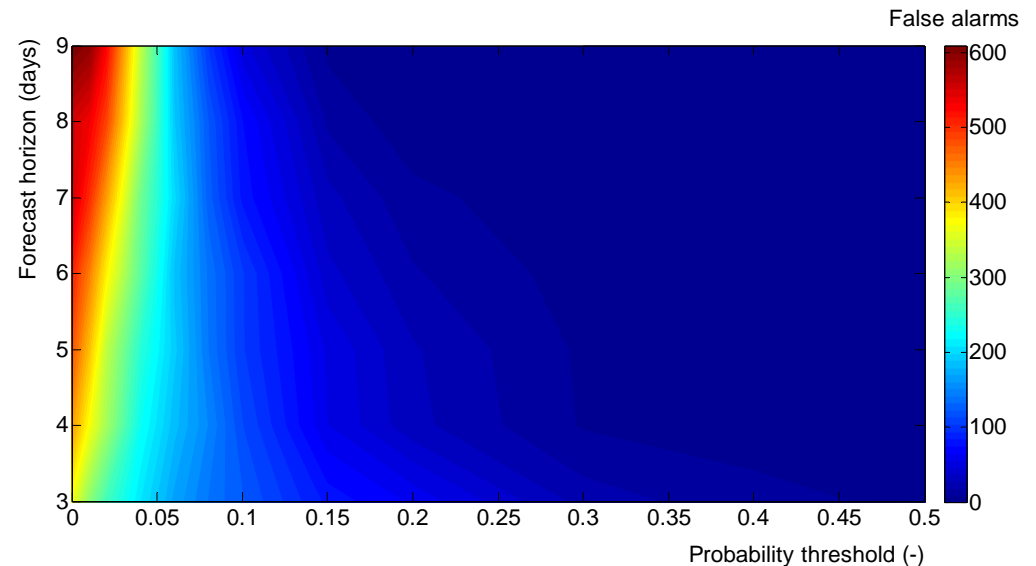
# Hits and false alarms

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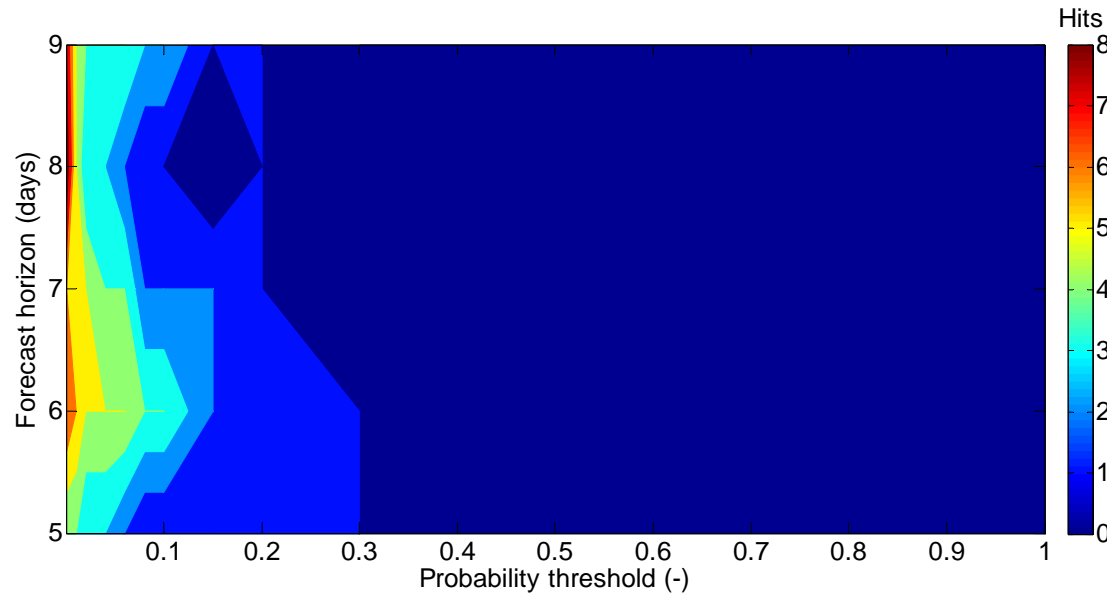
83 events

- Hit rate up to 85% for 15 mm/d
- Decay of hit rate with increasing forecast horizon
- Decay of hit rate with increasing probability threshold
- Too many false alarms

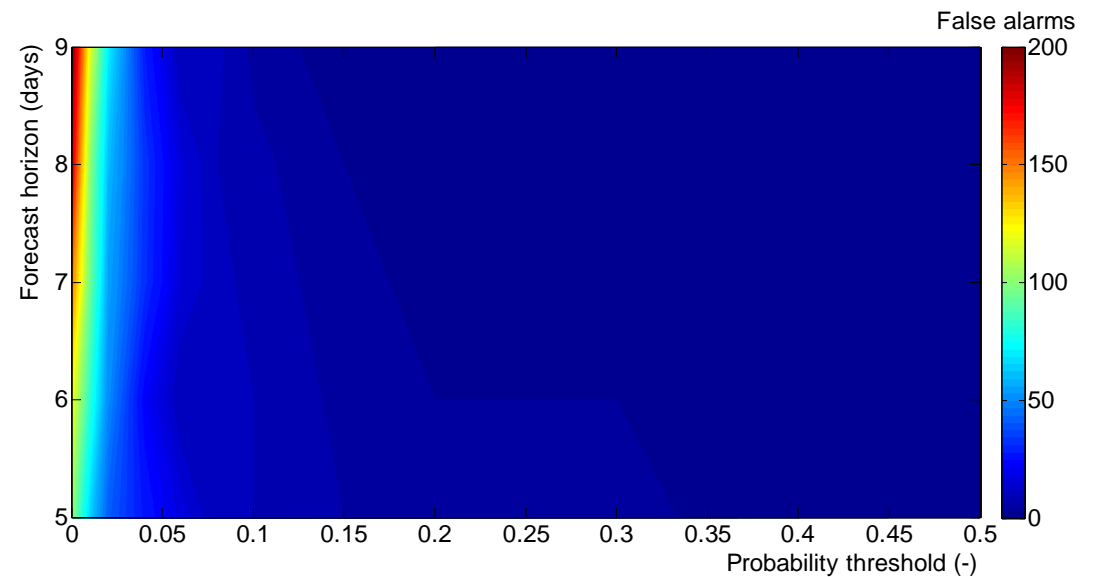


# Extreme events, fewer false alarms

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9 events

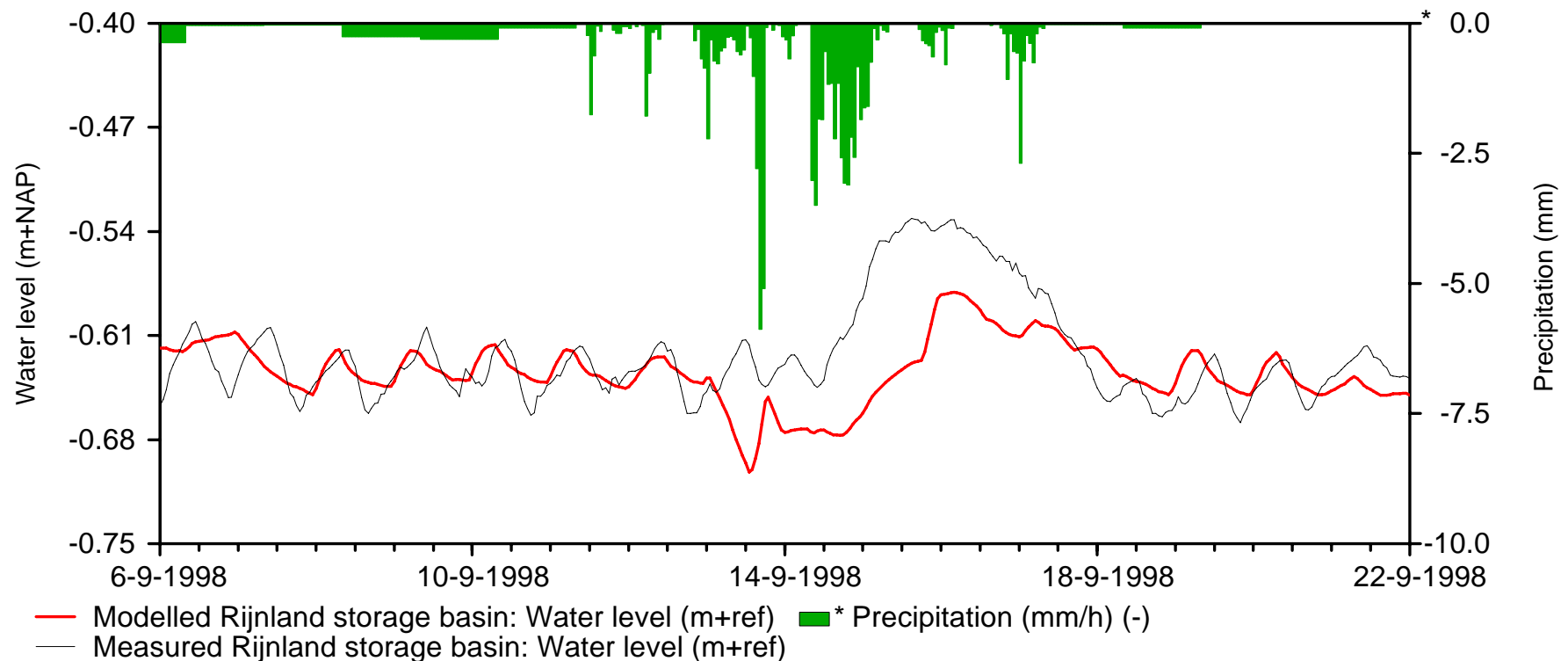


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## Early pumping. Modelled with actual forecasts

- Decision horizon : 3 days
- Forecast horizons EPS water levels included: 3, 4, 5, 6, 7 days
- On the basis of maximum values of each of the EPS forecasts
- AWM control action started 1 day before forecasted exceedance of -0.5 m+NAP.



# Conclusions

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- There is useful information in global ECMWF EPS precipitation forecasts for regional water system control
- Long term local verification analyses are important for determining control rules.
- Water authorities can determine control rules using this type of verification analysis
- Ongoing work:
  - Cost/benefit analysis

**Thank you.**