The use and usability of probabilistic forecasts

Emerging themes from an interdisciplinary study

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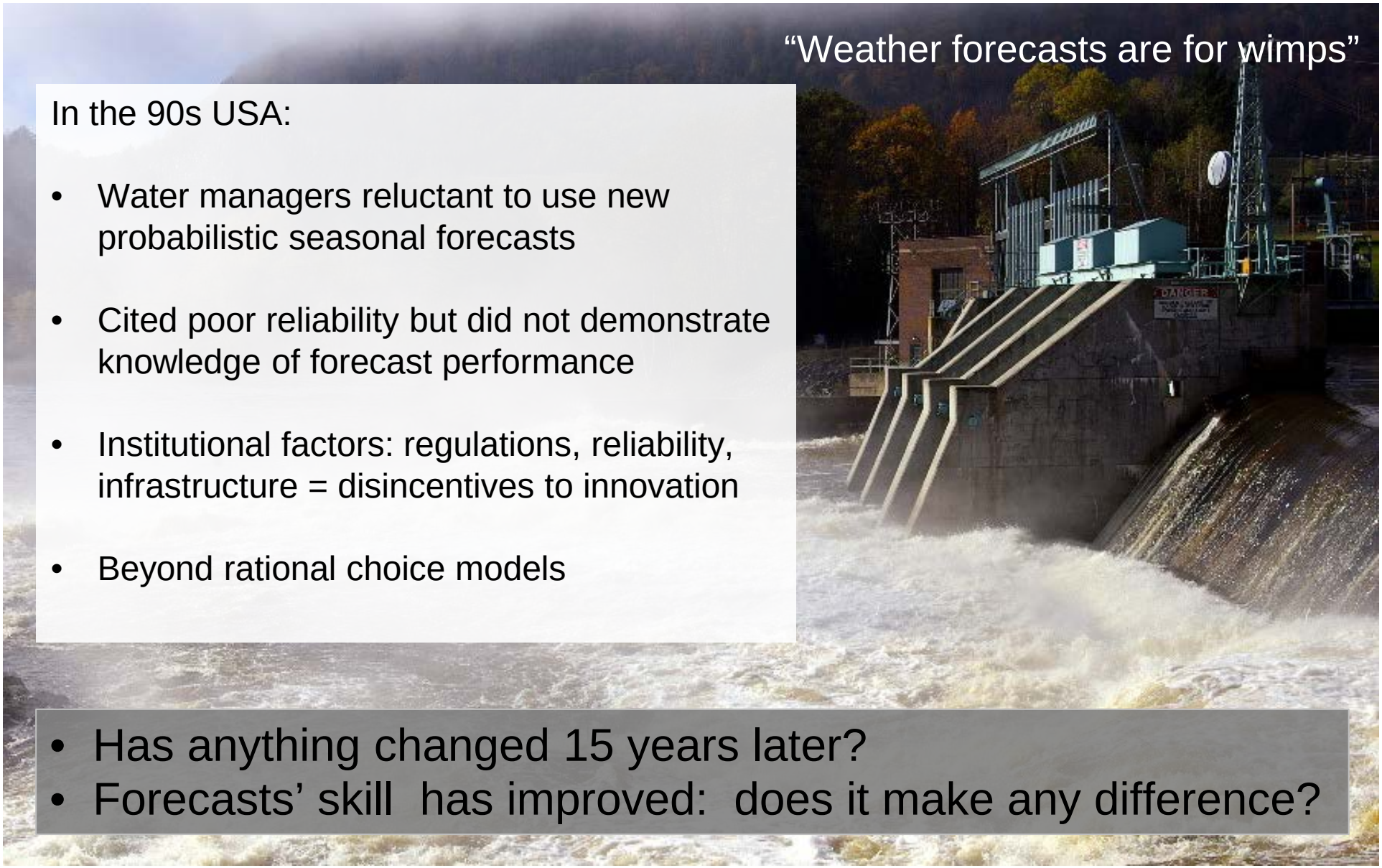
Oxford Martin Programme on Resource Stewardship (OMPORS)

- Sciences, social sciences & humanities
- Aims to deliver a framework, accountable to future generations, that will create actionable input on critical global issues
- Rethinking how we monitor, manage, maintain and allocate globally important resources
- Understandings of individual and collective behaviour and current institutional practice

Outline

- Motivation.
- Methodological approaches.
- Work in progress and preliminary findings.

Motivation



"Weather forecasts are for wimps"

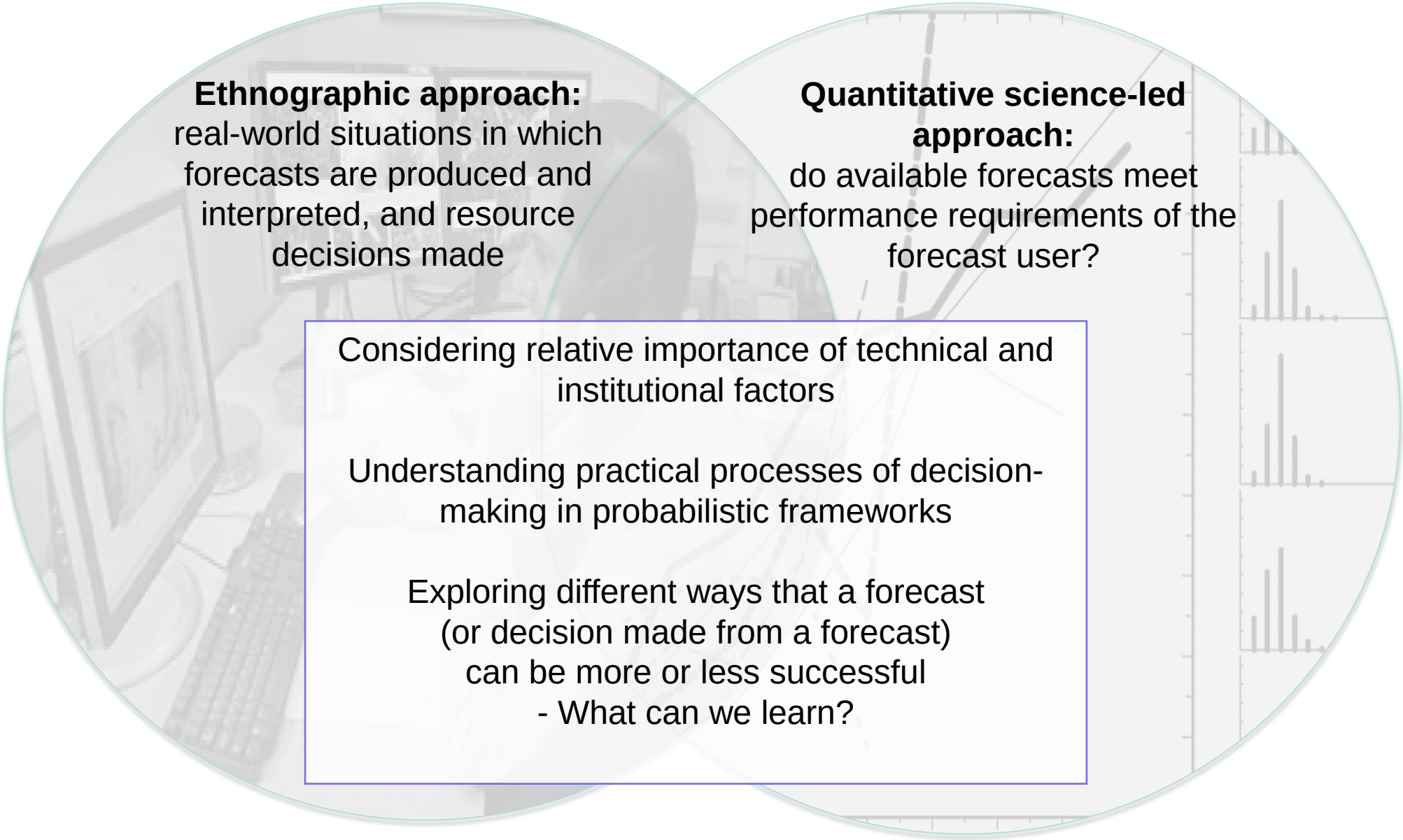
In the 90s USA:

- Water managers reluctant to use new probabilistic seasonal forecasts
- Cited poor reliability but did not demonstrate knowledge of forecast performance
- Institutional factors: regulations, reliability, infrastructure = disincentives to innovation
- Beyond rational choice models

- Has anything changed 15 years later?
- Forecasts' skill has improved: does it make any difference?

Rayner, S., Lach, D. and Ingram, H. (2005) Weather forecasts are for wimps [...] *Climatic Change*, **69**:197-227.

Methodological approaches



Ethnographic approach:
real-world situations in which forecasts are produced and interpreted, and resource decisions made

Quantitative science-led approach:
do available forecasts meet performance requirements of the forecast user?

Considering relative importance of technical and institutional factors

Understanding practical processes of decision-making in probabilistic frameworks

Exploring different ways that a forecast (or decision made from a forecast) can be more or less successful
- What can we learn?

Case studies and qualitative approach

Case studies (public & private sector, NGOs)

- Modellers and forecasters
- Water resources & floods
- Public health
- Civil contingencies
- Finance & insurance
- Energy supply and demand
- Disaster risk reduction

Interviews and ethnography

- Organisational and individual goals, roles, decision-making
- Measures of success (formal/informal)
- Definitions of weather/climate sensitivities
- Accessing and using weather/climate information

Quantitative approach

Forecast's attributes

criteria

- Variables: temperature thresholds, precipitation amounts, wind speeds, etc.
- Rationale: potential to cause damage, evidence based or experience, etc.

Probability of event

- Over a threshold
- Deciles
- Terciles

Lead times

- Early warnings and alerts : time to respond?
- Planning

Understand how thresholds and lead times are chosen.

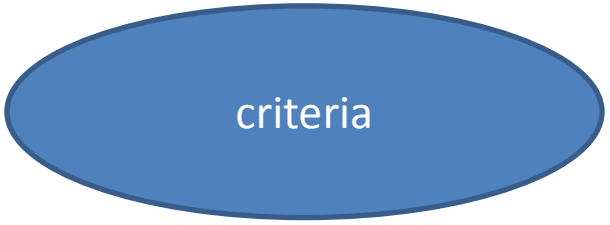
- Do they depend on the forecast quality? Is forecast value a criterium?
- If there was skill to change thresholds or lead times, would that affect the decision making?

Forecasts for Extreme Events

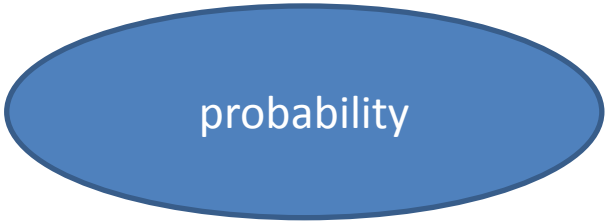
- NSWWS
- Flood Alerts
- PHE cold weather and heat wave alerts

- Alerts < 24hs
- Warnings >24 hs
- Advice: up to 5 days
- 48 hs (cold-heat)

Based on time to respond



- Evidence based: epidemiological studies (temperature for heat wave)
- Potential to cause damage(wind, rain)
- Pragmatic (temperature for cold)



- > 60% for heat-cold
- Ranges for SWW alerts:

< 20%, 20-40%, 40-60%, > 60%
(forecaster decision)
(before was only > 60%)

Monthly to seasonal forecast

- Climate outlook forums
- DRM

Lead time

- Time to plan

or

- Dictated by availability of information

criteria

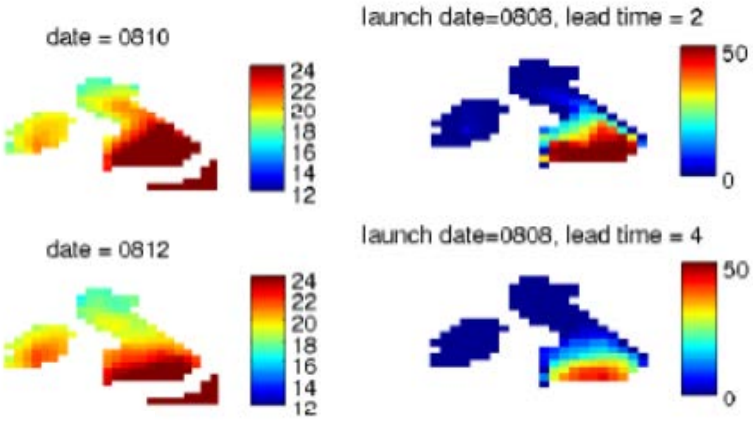
- No threshold, mostly for planning
- Based on available information

probability

Terciles:
Higher than normal
Average
Lower than average

Work in progress 1

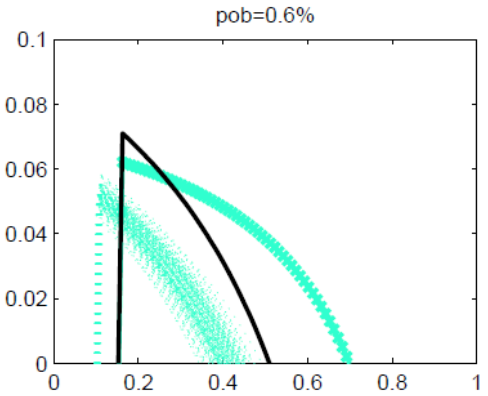
Forecasts of extreme temperatures and impacts on health (PHE).



	observed	Not observed
forecast	C	C
No forecast	0	L

Level 2	**Heatwave is forecast – Alert and readiness** *60% risk of heatwave in the next 2–3 days*
Level 3	**Heatwave Action** *Temperature reached in one or more Met Office National Severe Weather Warning Service regions*

Level 2	**Severe winter weather is forecast – Alert and readiness** *Mean temperature of 2°C and/or widespread ice and heavy snow are predicted within 48 hours, with 60% confidence.*
Level 3	**Response to severe winter weather – Severe weather action** *Severe winter weather is now occurring: mean temperature of 2°C or less and/or widespread ice and heavy snow.*

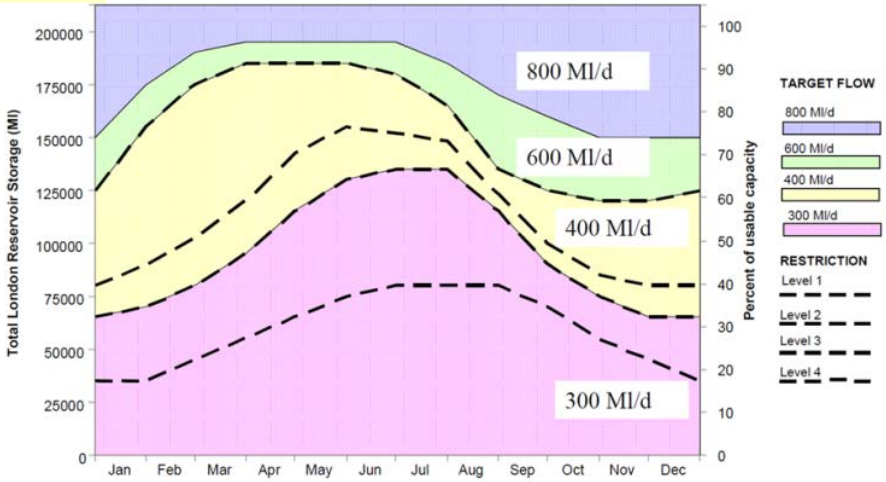


Forecast value/evaluation: skill of model output vs skill of alert-warning/how do we relate quality of model output ('objective' evaluation) with warning/alert ('subjective' evaluation)?
What's the relevance of predefined met extremes for particular users/applications?

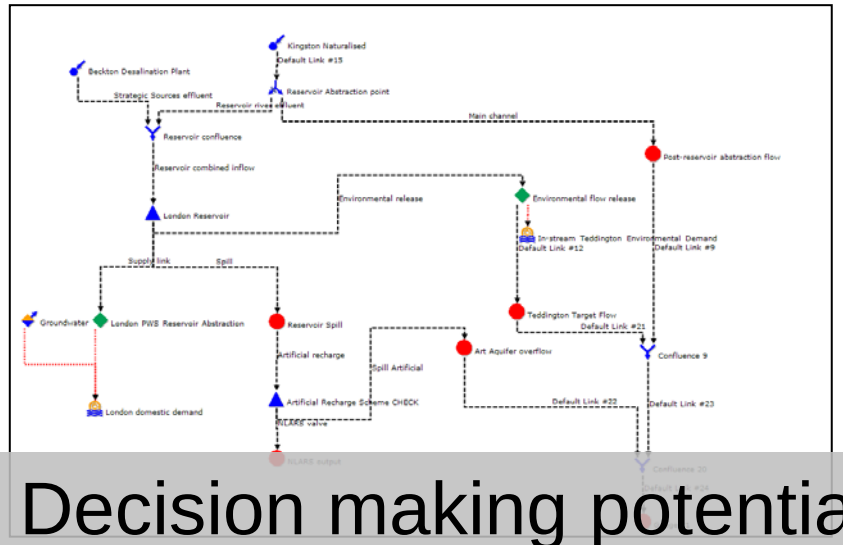
Work in progress 2

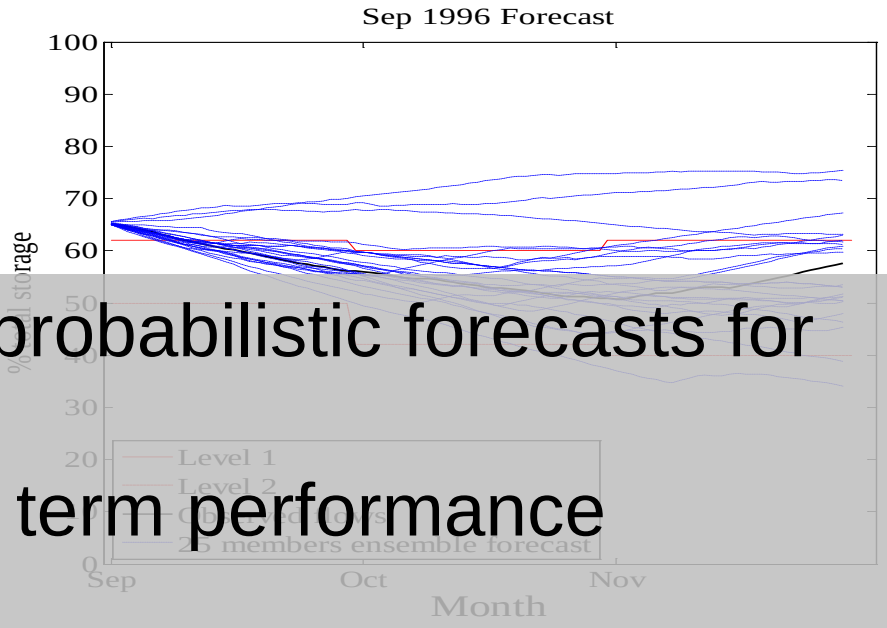
Forecasts for reservoir management (EA + water companies).

Lower Thames Operating Agreement.
Source: http://www.thameswater.co.uk/about-us/15145.htm



London Water Resources Zone model





. Decision making potential of probabilistic forecasts for dynamic reservoir management.

. Potential use to improve long term performance (for climate change adaptation)

What makes a ‘successful’ forecast?

- Defining forecasts and predicting impacts
- Linking forecast lead time/uncertainty and response
- Forecast quality and evaluation
  - ‘Forecast’ vs impact-based warnings
  - Reflexive uncertainty (Hulme & Dessai 2004)
  - False alarms vs missed events
  - Credibility, legitimacy, salience

    (Funtowicz & Ravetz 1993; Cash et al 2006)

What makes a successful forecast?

- Opportunities and constraints
  - Regulations and established practices, approaches to risk
  - Big (weather) events catalysing change
  - Forecasting partnerships (Haines & Stephens, forthcoming)
    - Development
    - Distance
    - Dialogue

Ongoing discussions

- Explore decision making approaches: how could they incorporate probabilistic forecasts?
- What are the variables of interest?
- What other information/knowledge is relevant?
- Find out about events/organisational changes that facilitate/trigger incorporation of new scientific information into decision making
- Identify “appropriate” ways to use probabilistic forecasts, and examples of best practice

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Thank you for listening.

Your questions, comments and feedback on any aspect of this research are appreciated.

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