Government
Office for Science

What do we know about the future of rainfall capture in the UK, how it affects general hydrology, and the consequences for supply?
Meeting note from roundtable chaired by Patrick Vallance, Government Chief Scientific Adviser
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1. What is the current picture?

1.1 Rainfall trends:

- Winter: much variability year on year with an increase of 15% in winter accumulations, attributable to climate change. Every year there is a one in three chance for unprecedented rainfall in one region of UK. The signal is concentrated in North-West England and Scotland, while the picture is less clear in South-East England.
- Summer: no detectable climate change signal because of variation. Now expect summers to be drier, with episodes of more intense rainfall.
- Observable increases in evaporation, particularly in spring.
- Hot summers are now driving leakage outbreaks.
- Overall annual rainfall is increased. There is an increase in intensity, significant variation in local effects, and a risk of compound effects
- There are longer dry spells with more intense rainfall at other times. Current hydrology models are not well designed for this.

1.2 Models in use:

- Detail of local simulation models for rainfall has improved, but still based on a relatively small number of simulations.
- Most modelling through UKCP18 (UK climate projection 18) has been ten-year time slices. But now have the capability for long transient runs e.g. 1950-2100.
- Meteorological modelling, including soil processes, has improved.
- NERC (Natural Environment Research Council) has invested in upgrading modelling capability. Particularly to bring together surface water and ground water.
- Ofwat's national modelling system is early stage, but has helped test possible opportunities. Improvements could help governments to inform policy and companies to direct investment where it is needed.

2. What are the current unknowns?

2.1 Extremes:

- There is tentative new evidence from km-scale modelling that future increases in extreme rainfall might be larger and with greater intensity than previously thought.
- There is currently a tension in how to balance computational resource between the high-resolution modelling and the large ensemble data sets.
- This leads to a lack of understanding regarding impacts and probability of extreme events including multiyear drought and rapid supply failure.
- These events could be caused by single high-level stressors or a sequence or synchronicity of multiple discrete low-level stressors (e.g. heatwaves, droughts, fires, surface water flooding).

- Storyline methodology – using counterfactuals to estimate climate impacts under various scenarios – could help identify these issues. Also facilitates inclusion of human elements more easily.
- Regional/national water supply system models could be used to scrutinise the combinations of conditions that lead to water supply system failure. This would help identify the most uncertain factors that are driving system failure and reveal research priorities.

2.2 Drought and water availability

- A problematic length of drought depends on critical duration. For places such as the Lake District, a very dry 6-9 months is a problem. For very large reservoirs and most groundwater, the critical duration is longer, sometimes 2-3 years. Current modelling is not clear on how climate change will affect such droughts/high pressure blocking events.
- It is necessary to understand the probability of different types of failure and what public/political appetite for risk is (i.e. how often is it acceptable for reservoirs to empty).
- Policy choices are critical. Climate adaptation policies will dictate water supply, and activities of water companies – there is current uncertainty over how much to leave in the environment.
- Water companies do understand where rapid system failures are prone to occur, as they all have system simulation models and have carried out assessments under the Drought Variability Framework.
- Transition mechanisms from drought to flood are poorly understood. When in a drought, it is valuable to know how long it is going to persist.
- Some of the environmental and water flow issues are as much about quality (pesticide/nutrient content etc) as quantity. Algae has affected reservoirs in recent summers.
- Companies are starting to look at re-use and desalination of water. There is no membrane that is approved by the drinking water inspectorate.

2.3 Human interactions:

- The water system is highly modified by human interaction – particularly with respect to agriculture.
- Farmers rely on taking water out of the environment and suffer in drought.
- Technology to simulate public water supply systems is mature but groundwater/surface interactions are not integrated. Data on abstractions and impacts on river flows is low quality.
- Baseline for supply and demand is unclear. More to do with social factors than with weather.

2.4 Biodiversity:

- Generally limited understanding of the effect of climate change and additional water sources on biodiversity.
- Rivers will be warmer, affecting cold-water species.

2.5 Dry ground run off:

- Not completely proven that dry ground rejects water across the whole UK.

3. What are the data issues?

3.1 Accessing data:

- Industry regularly shares data, apart from Critical National Infrastructure locations. The difficulty is that the data is held in different places, by different organisations. It takes effort to bring together and reconciling into a form that facilitates analysis.
- Abstractors' data is often unreleased or not measured well. Discharge volumes are rarely measured. Some measured discharge is actually rainfall (storm overflows).
- The Environment Agency efforts to integrate data sets through open-source APIs has been well received.

3.2 Data collection:

- Much abstraction (e.g. agriculture) is not monitored on a daily basis. This should be possible with cheaper sensors.
- There is insufficient investment in innovative tech such as drones for sensing.
- Soil monitoring network - traditional networks have been declining due to low investment.
- Earth observation and crowdsourcing etc would help plug information gaps.

3.3 Digital twin potential:

- A DT might expose where knowledge gaps exist, such as gaps in coverage in the observational network and fusion with modelling systems.
- Water companies already employ variations of DTs within their areas, but they could be better integrated with weather and climate data.

Participants

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