


Groundwater monitoring: reconciling cost effectiveness, legal requirements and enforcement realities

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Outline

1. Background
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3. Evidence in court
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Aims of this research:

- To understand how regulators can balance legal standards for monitoring against the cost of developing and maintaining the requisite networks, while still producing observable improvements in water and ecosystem quality backed by legally enforceable sanctions for breaches.
- Particular focus on groundwater: on basis that this is particularly vulnerable to the quality of monitoring networks and the models used to interpret their data

Aims of this research:

Understand inter-relationships between:

- legal standards for monitoring networks;
- Monitoring network coverage;
- Data availability and modelling frameworks for interpreting observed data / simulating expected behaviour; and
- Use of potentially divergent models in Evidence

At what point does the quality of the monitoring network push a regulator from being able to enforce decisions to impotence?

Background:

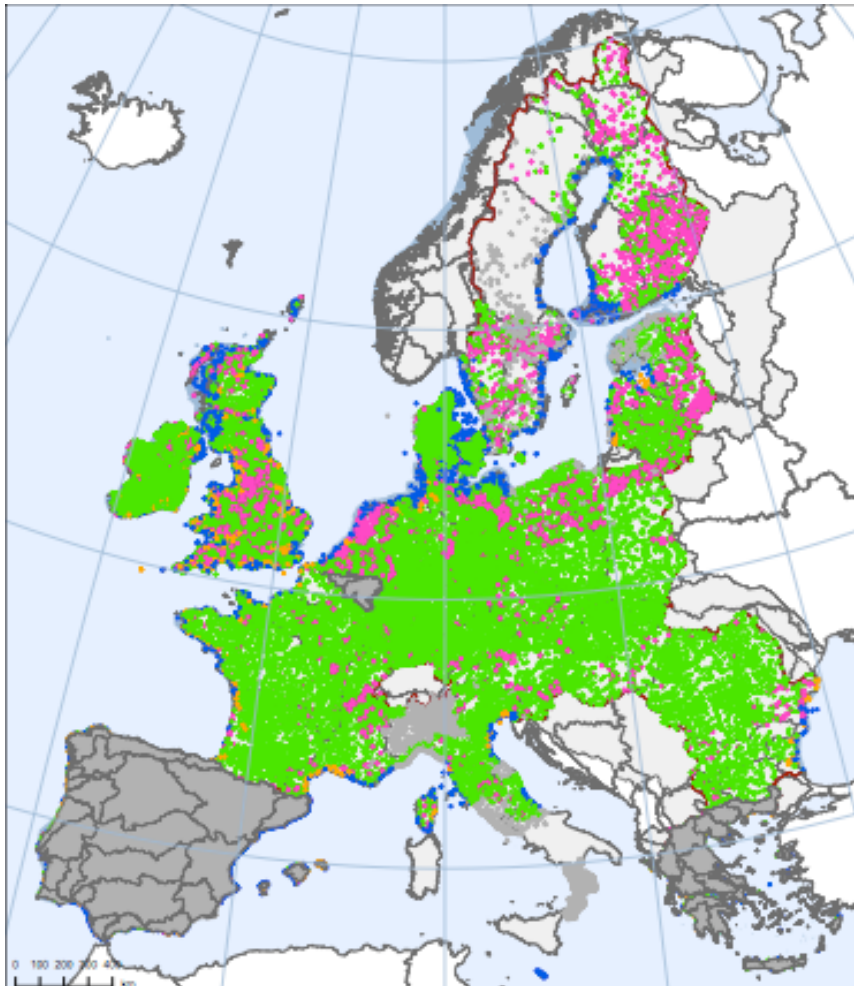
- Evidence from some countries suggests that the powers of environmental regulators are critically undermined by poor water monitoring networks
 - e.g. Kyrgyzstan (UNECE); China (OECD).
 - When enforcing standards in court, regulators risk having data challenged on basis of inadequate monitoring network (lack of credibility); and
 - Lack the resources to follow up through available appeals cycle
- Increased focus on creating intensive monitoring networks for water management in developed countries – e.g. Australian water accounting efforts

Background:

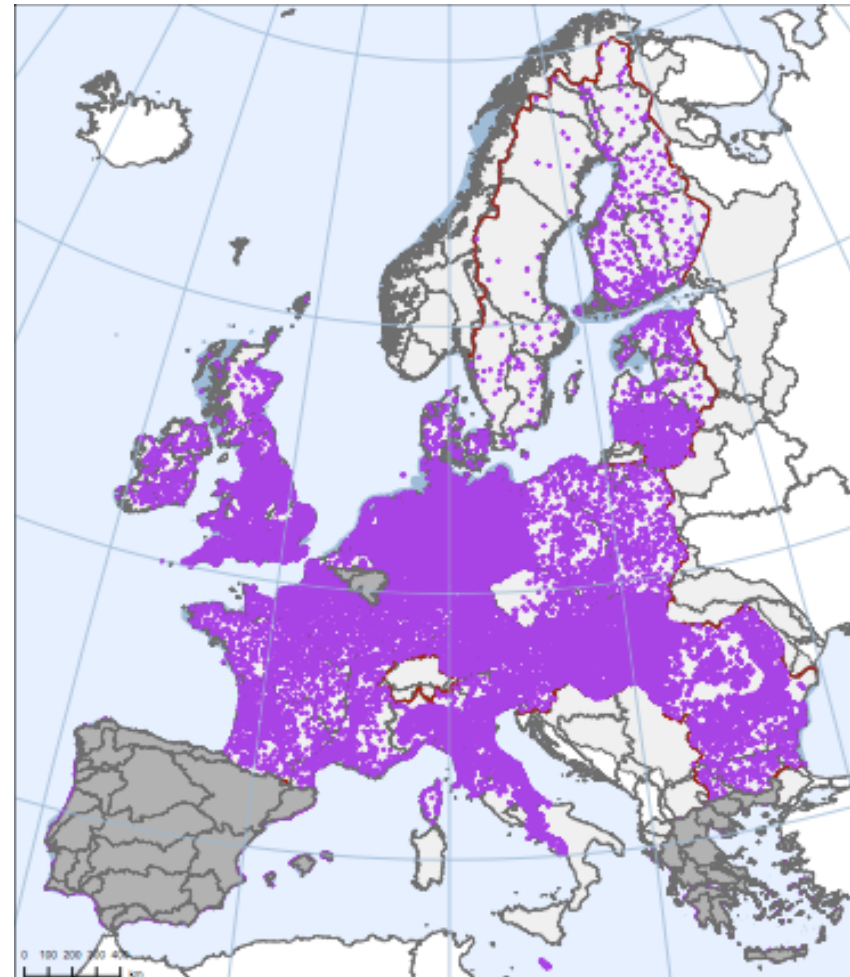
- In Scotland, SEPA has been criticised for adopting a risk-based compliance framework in response to financial pressures that has resulted in less testing and a reduction in routine water sampling
- EU criticism of some northern states (e.g. Finland) in WFD implementation reports with re. density of monitoring network – Finland had lowest density of ground and surface water monitoring sites in EU (respectively 0.2 per 1000km², compared with an average of 13.7; and 0.6 per 1000km², compared with an average of 12 across 25 member states)
- Is this reckless or an acknowledgement of the real risks? How can we tell? Is it the equivalent of having an air bag that doesn't work in a car crash (cf. VaR)

EU water monitoring stations

Surface:



Ground:



Legal frameworks:

- Groundwater is especially difficult to regulate (e.g. timing between cause and effect, access, uncertainty, visibility).
- In some jurisdictions, land owners have virtually unfettered rights of use of groundwater – monitoring impact on water table / related surface waters is tricky, exacerbated potentially by unhelpful institutional fragmentation.
- Extent of water use rights may be driven by impact – where existing rights holders observe impact on current use, this can work, but where legal standards relate to biophysical elements, dedicated monitoring network will be needed (e.g. Finland)

Sources of uncertainty re. management of groundwater:

- Variation in Natural environment
 - Spatial, temporal, scale
- Sampling design
 - Location of sampling points
 - Density of network
 - Frequency of monitoring
 - Sampling error / unrepresentative of random sampling
- Sampling process
 - Collection and storage
- Model design, parameterisation and testing
- Statistical aspects
- Transferring results / typologies across catchments, time and space

Problems arising:

- In sparsely populated areas, can an impact-led use allocation system hope to function properly without a comprehensive unmanned monitoring network, especially in relation to assessing water / ecological quality parameters?
- Compliance framework must balance cost against risk, while still adhering to legal standards
- Must regulators also balance these factors against risk that a court will refuse to accept evidence derived from low density monitoring network?
- For regulator, cost of putting ideal monitoring network in place would be enormous – disproportionate? – especially in context where waters are in generally good condition, and population is very low. Who would bear this cost?



Legal standards

EU: Groundwater

Water Framework Directive (Annex V):

- Groundwater quantity: *The monitoring network shall be designed so as to provide a reliable assessment of the quantitative status of all groundwater bodies.....including assessment of the available groundwater resource (para.2.2)*
- Density of monitoring points: *sufficient representative monitoring points to estimate the groundwater level in each groundwater body*
 - And for bodies at risk, *sufficient density ... to assess the impact of abstractions and discharges on the groundwater level*
- But bear in mind that surface water monitoring requirements are also relevant because of inter-connections

EU Groundwater (continued)

Water Framework Directive (Annex V):

- Groundwater quality: *designed so as to provide a coherent and comprehensive overview of groundwater chemical status within each river basin and to detect the presence of long-term anthropogenically induced upward trends in pollutants* (para.2.4)
- *Estimates of the level of confidence and precision of the results provided by the monitoring programmes to be given in the RBMP*
- Results to be aggregated for the whole GWB – problems with inconsistent aggregation across MS (see e.g. Scheidleider, March 2012). Aggregation across long time periods (e.g. up to 9 years) can be highly misrepresentative

Scotland:

Water Environment and Water Services (Scotland) Act 2003, s.8:

SEPA must, in relation to each river basin district—

(a) carry out, or secure the carrying out of, monitoring of the status of the water environment and relevant territorial water adjacent to the district, and

(b) analyse, or secure the analysis of, the information obtained under paragraph (a).

SEPA must prepare a programme for monitoring (whether by SEPA or other persons) the status of the water environment and relevant territorial water (a “monitoring programme”).

Finland



Monitoring networks must provide

- ***“a consistent and diverse overall picture”*** of all classified waters. For e.g. GW, network must comprise ***“a sufficient number of monitoring points in order to provide a reliable assessment of the quality of groundwater, groundwater levels and their fluctuation, whether natural or caused by human activity”***

Conclusions re. legal standards:

- Rather vague in content – unwillingness to set out e.g. sampling point density and sampling frequency standards in order to give full flexibility to relevant authorities.
- Need to be able to take account of varying degrees of hetero- and homo-geneity in the physical environment, differing use patterns and environmental tolerances
- But what if responsible authorities do not exercise that flexibility properly at the local scale, for e.g. financial reasons? How can standards as vague as these be enforceable, and who would want to enforce them anyway?



Evidence in court

Admissibility:

For expert evidence to be admissible i.e. considered by court, a particular standard will be in place. In e.g. US, normally use Daubert standard re. 'reliability and relevance':

- Has scientific evidence (and methodology behind its derivation) been tested (and how);
- Has information been subjected to peer review or publication;
- Is the actual / potential rate of error known; and
- Is the evidence generally accepted by the scientific community.
- Are standards for controlling operation of the technique in place?

Debate ongoing as regards stage at which reliability of evidence is judged – at admissibility (by judge), or in assessment of facts (juries) – see e.g. 123 Harv. L. Rev. 2021 2009-2010

Frye-type test of acceptability may be more widespread, but comparison of different jurisdictions is needed.

Admissibility:

- Note that above debate relates primarily to expert witnesses, rather than scientific data presented through a model, for example, but Expert witness will be needed to present model conclusions
- Assessment of the use of modelling software especially is much less evident in the literature, compared with e.g. use of satellite imagery.

Quality of evidence:

- If evidence from monitoring network is admitted, next question relates to the quality of that evidence.
- Lawyers for other side may seek to undermine data through leading expert witness who can challenge hydrological / hydrogeological data, and poke holes in uncertainties that arise within modelling and GIS processes.
- Statistical evidence by itself may not be enough to allow court to reach a conclusion – may need to be more that relates to the immediate case.
- Doesn't seem to have been done in environmental / water context so far (research still under way on this), but suggestion that it has taken place in context of medical cases.

Balancing of models:

- Practice (in the UK civil cases at least) suggests a battle of the models, with judge favouring most plausible model (and most credible witness?)
- In absence of long term data sets and in situ monitoring points, models based on comparative geological / land use typologies are used
- Process v. Statistical?



Conclusions, thoughts and issues for
discussion / further research

- Are legal standards with respect to monitoring networks enforceable? Have they ever been the subject of legal action?
- Have there been any instances where groundwater cases have been revisited and decisions overturned as a result of better data / modelling?
- What conclusions can be drawn from the fact that legal standards for monitoring networks could potentially be so vague as to make evidence derived from them inadmissible in court?

- Would an analysis of cases over recent years show that most were taken against companies that failed to adhere to their own procedures, or that most were against ‘fly’ polluters? How would that compare to the pollution problems / incidents that had actually been recorded (i.e. are there many gaps in the latter where environmental damage was caused but the source was never identified?)

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