Maths formula leads researchers to source of pollution

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The leaking of environmentally damaging pollutants into our waters and atmosphere could soon be counteracted by a simple mathematical algorithm, according to researchers.

Presenting their research in IOP Publishing's journal *Inverse Problems*, the researchers, from Université de Technologie de Compiègne, believe their work could aid efforts to avoid environmental catastrophes by identifying the exact location where pollutants have been leaked as early as possible.

In the event of an oil spill across a region of the sea, researchers could collect samples of pollutants along certain sections of the body of water and then feed this information into their algorithm.

The algorithm is then able to determine two things: the rate at which the pollutant entered the body of water and where the pollutant came from.

This isn't the first time that mathematical algorithms have been used to solve this problem; however, this new approach is unique in that it could allow researchers to 'track' the source of a pollutant if it is moving or changing in strength.

Co-author of the study, Mr Mike Andrle, said: "In the unfortunate event of a pollutant spill, either by purposeful introduction into our waters or atmosphere, or by purely accidental fate, collaboration with scientists and engineers and application of this work may save precious moments to avert more environmental damage."

The algorithm itself is modelled on the general transport of a pollutant and takes three phenomena into account: diffusion, convection and reaction.

Diffusion is where the pollutant flows naturally from high concentrations to low concentrations and convection is where other factors cause the pollutant to displace, such as a current in the sea. A pollutant may also react with other materials in the water or settle on a seabed or lake floor: this is classified as 'reaction'.

The researchers add that other terms could also be added into the algorithm to account for the properties of different pollutants; for example, oil may not dissolve entirely in water and may form droplets, in which case the buoyancy and settling would need to be accounted for.

Their theoretical results have already shown that the result is unique; that is, the solution found is the only possible one given the observable data. The results were also shown to be very robust, which is extremely important in practice where such measurements often have relatively large errors associated with them.

Mr Andrle continued: "Growing up on Lake Erie, I heard of the previous shape it had been in where industry resulted in much of the lake being declared dead at one time. Though I was not alive to see it at its worst, I did witness how lots of legislation and new policies had turned its fate around.

"I saw a chance to contribute to research that may help mitigate causes of similar future events. We hope that the results of this work are substantially circulated so that those involved in pollution spill localisation and clean-up are aware of this solution."

The paper's second author, Professor Abdellatif El-Badia, said: "Inverse problems are very important in science, engineering and bioengineering. It is very interesting that we've been able to apply this topic to the very big problem of pollution."

More information: M Andrle and A El Badia 2012 *Inverse Problems* 28 075009 doi:10.1088/0266-5611/28/7/075009

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