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Locating seepage in water courses in polders in The Netherlands by distributed temperature sensing

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In this work we demonstrate the use of distributed temperature sensing (DTS) by fiber optic cable to locate seepage zones in ditches and canals in three polders in the Netherlands. Sometimes it is known that seepage occurs in certain water courses, but its exact locations might not be known.

The method, making use of a laser light that is transmitted and reflected in a glass fiber optic cable, enables to monitor temperature in relatively high resolution in time and space over periods as long as defined by the user. This proves to be a great advantage of the method, as seepage by temperature sensing is not necessarily always noticeable. The experiments showed that the temperature effect of seepage zones can vary in extent, or temporarily even completely vanish. Atmospheric heating and cooling can disturb the seepage signal by initiating turbulent processes or just by causing minimum temperature differences. When a discharge in the water course occurs seepage zones can even completely disappear from the temperature signature.

The results demonstrate that with the DTS technique the total ensemble of temperature effects on canals and ditches is recorded, and hence further analysis and common sense is required to confirm seepage. In most cases this can be solved by visual inspections of suspected seepage zones in search of other plausible explanations. Drainage pipes, side ditches and conducts are the most common features that give seepage like signatures.

For the temperature sensing technique by fiber optics a pulsing laser light is transmitted into a glass fiber optic cable, in our case of 1300m length that was positioned on the bottom of the water courses. The reflected signal received is then analyzed

for deformations of frequency and amplitude (the so-called Raman backscatters) that relatively simple can be related to temperature. The applied Sensornet system (Sentinel DTS-LR, London, England) delivers a mean temperature every meter, and when averaged over 10 minutes with an accuracy better than 0.1 ˚C