1. **Supplementary Material: Derivation of Fréchet Integrals for *Tx* and *Ty***

Following Knight and Kluitenberg we work in the Laplace transform domain. The Laplace transform variable is *p*. The Laplace transform of a time-dependent variable such as *h* (i.e. drawdown in a well) is denoted as . We begin by subdividing into a “primary” contribution from a homogeneous medium and a “secondary” contribution that arises from hydraulic property anomalies in the medium. Thus:

(S1)

Hydraulic properties *S*, *Tx* and *Ty* can be expressed in terms of their background, homogeneous values and their local, anomalous values as:

(S2a)

(S2b)

(S2c)

For ease of expression, we omit specific indication of spatial dependency (i.e. dependency on *x, y*) in the following equations unless necessary. Where convenient, we use the vector **x** to signify (*x*, *y*).

In similar fashion to equation (5) of Knight and Kluitenberg, but taking the directional-dependence of transmissivity into account, we can characterise groundwater flow in a homogeneous medium as:

(S3a)

When the presence of hydraulic property anomalies is taken into account:

(S3b)

If the terms of (S3b) are multiplied out, and then terms of (S3a) are subtracted, we obtain:

(S4)

In similar fashion to equation (20) of Knight and Kluitenberg we adopt a Green’s function to solve this equation:

(S5)

Three integrals are implied in equation (S5). Let us write this equation as:

(S6)

Let us focus on I2.

(S7)

This is a two-dimensional integral. Note that a bold **x** in this equation indicates (*x*,*y*), while d**x** is d*x*d*y*. We re-write this equation using (*x*, *y*) explicitly:

(S8)

We focus on the internal integral first, that is the integral with respect to *x*. Denote this as *I2x*. Thus:

(S9)

Now integrate by parts. Recall that integration by parts exploits the identity:

d(*uv*) = *u*d*v* + *v*d*u* (S10)

Applying this to the integrand of equation (S9), and noting that:

when *x* is (S11)

*I*2 becomes:

(S12)

A similar logic can be turned to the evaluation of the *I3* integral of equation (S6), so that (S5) becomes:

(S13)

In a similar fashion to the way that Knight and Kluitenberg derive an equation for , we can obtain from (S13) expressions for the Fréchet kernels for *Tx* and *Ty* separately:

(S14)

(S15)

We now use equations (29) and (30) of Knight and Kluitenberg to transform back to the time domain under the assumption of a constant pumping rate *q0*.

(S16)

Similarly:

(S17)

Note that *FTx* and *FTy* add up to *FT* as expressed by equation (35) of Knight and Kluitenberg.