Additional file 2 Hydrodynamics of the CD

The surface of circular truncated cone of the length L is

A = π (r1 + r2) x [(L2 + (r2 – r1)2]½ (II.1)

The total area available for water absorption is the surface of three quarters of the CD length. From eq.(II.1) with r1 = 1.75x10-5 m, r2 = 4x10-5 m and L = 2.025x10-2 m, this surface is

A(tot) = 3.656x10-6 m2

The surface available for water absorption in a distance L from the beginning of the CD is

A(L) = π (2.75x10-5 + 1.111x10-3 L)(L – 6.75x10-3) m2 (II.2)

90% of the liquid entering the CD at night, i.e. 0.9 x 1.63x10-10 = 1.467x10-10 m3 s-1, must be reabsorbed through A(tot), this is 1.467x10-10 /3.656x10-6 = 4.01x10-5 m3 m-2 s-1 of water must be reabsorbed through unit surface of the CD. The volumetric flow rate in a distance L from the beginning of the CD is

Q(L) = 1.63x10-10 – A(L) x 4.01x10-5 m3 s-1 (II.3)

Combination of eqs. (II.2) and (II.3) gives the volumetric flow rate Q(L) in a distance L from the beginning of the CD

Q(L) = 1.86x10-10 – 1.40x10-7 L2 – 2.52x10-9 L m3 s-1  (II.4)

The average volumetric flow rate in the CD is

0.027

Ave[Q(L)] = [1 / (0.027 – 0.00675)] **∫**Q(L) dL = 7.58x10-11 m3 s-1

0.00675

The transit time of liquid through the CD is V(CD) / Ave[Q(L)] = 0.8 s.

The average linear flow rate in the CD is

uav = (r23 – r13) /{3 (r2 – r1) x Ave[Q(L)]} = 3.45x10-2 m s-1