Hydrological Modelling - Assignment 1

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Questions

Solution 1: Area (A) = 1 km^2, surface inflow (I) = 10 $Ha\ m$, outflow (O) = 20 $Ha\ m$, pan evaporation (E) = 12 cm, precipitation (P) = 3cm. Decline in height (ΔS) = 20 cm. Calibrated pan factor = 0.7. To find seepage loss (SL) in Ha m. So, working equation will be:

$$I + P = SL + \Delta S + O + E$$

$$\begin{aligned} P &= 3\ cm = 3\ cm * 1000^2\ m^2 \\ &= 3000000 * 10^{-2}\ m^3 = 30000\ m^3 \\ P &= 3\ Ha\ m \end{aligned}$$

$$\begin{aligned} \Delta S &= 20\ cm = 20\ cm * 1000^2\ m^2 \\ &= 20000000 * 10^{-2}\ m^3 = 200000\ m^3 \\ \Delta S &= 20\ Ha\ m \end{aligned}$$

$$\begin{aligned} E &= 12\ cm * 0.7 = 8.4\ cm \\ &= 8.4\ cm * 1000^2\ m^2 = 84000\ m^3 \\ E &= 8.4\ Ha\ m \end{aligned}$$

So using the equation,

$$\begin{aligned} I + P &= SL + \Delta S + O + E \\ 10\ Ha\ m + 3\ Ha\ m &= SL - 20\ Ha\ m + 20\ Ha\ m + 8.4\ Ha\ m \\ SL &= 13\ Ha\ m - 8.4\ Ha\ m = 4.6\ Ha\ m \end{aligned}$$

So seepage loss (SL) is 4.6 $Ha\ m$

Solution 2: Basin Area = 2500 mi^2, Annual precipitation = 25 in/yr and Average annual streamflow $R = 650\ cfs$. Now, using water budget equation:

$$Annual\ Precipitation\ (P) = Average\ annual\ streamflow\ (R) + Evapotranspiration\ (E) \quad (1)$$

$$\begin{aligned} \textit{Annual precipitation } (P) &= 25 \ in/yr \\ \textit{Average annual streamflow } (R) &= 650 \ cfs \\ &= 650 \ ft^3 * 365 * 86400/yr = 20498400000 \ ft^3/yr \end{aligned}$$

Now given basin area, the average annual streamflow per area would be:

$$\begin{aligned} R &= \frac{20498400000 \ ft^3/yr}{2500 \ (mi)^2} \\ &= \frac{20498400000 * (12^3) \ in^3/yr}{2500 * (63360)^2 \ in^2} \\ &= 3.529 \ in/yr \end{aligned}$$

Hence, using the equation,

$$\begin{aligned} P &= R + E \\ 25 \ in/yr &= 3.529 \ in/yr + E \\ E &= 25 \ in/yr - 3.529 \ in/yr \\ &= 21.471 \ in/yr \end{aligned}$$

So answer is 21.471 in/yr.

Solution 3: Given Area (A) = 1750 km^2 received 1250 mm of precipitation and average flow = 25 m^3/sec to calculate runoff. The following equation can be used:

$$\begin{aligned} \textit{Precipitation } (P) &= 1250 \ mm \\ (P) \textit{ in volume} &= 1250 \ mm * 1750 \ km^2 \\ &= 1250 * 1750 * 1000 \ m^3 = 2187500000 \ m^3 \end{aligned}$$

$$\begin{aligned} \textit{Precipitation } (P) &= 1250 \ mm \\ (P) \textit{ in volume} &= 1250 \ mm * 1750 \ km^2 \\ &= 1250 * 1750 * 1000 \ m^3 = 2187500000 \ m^3 \end{aligned}$$

$$\begin{aligned} \textit{Average Flow } (AF) &= 25 \ m^3/sec \\ &= 25 \ m^3 * 365 * 86400/yr = 788400000 \ m^3/yr \end{aligned}$$

Hence average runoff is 788400000 m^3 or $788.4 * 10^6$ m^3 in the year.