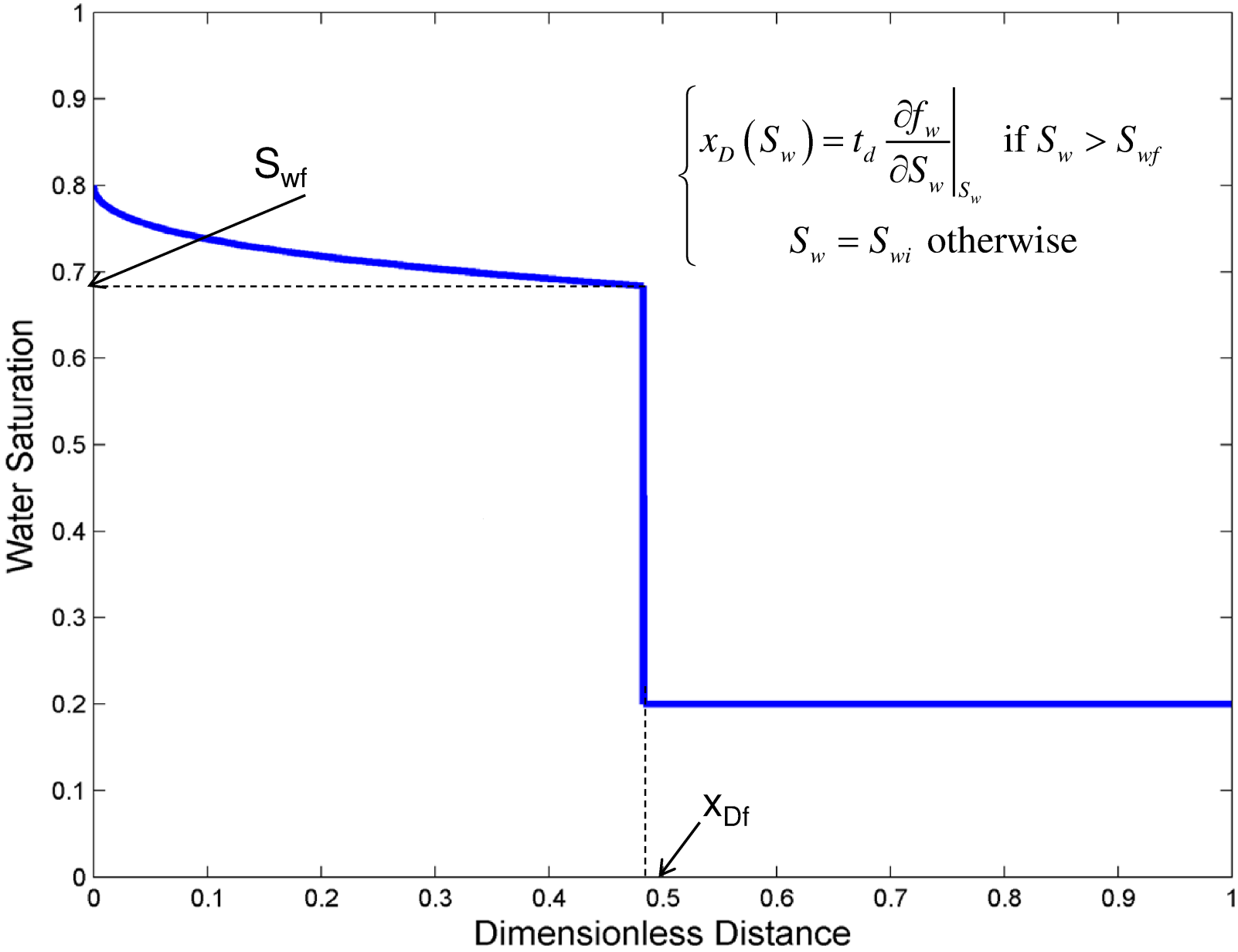
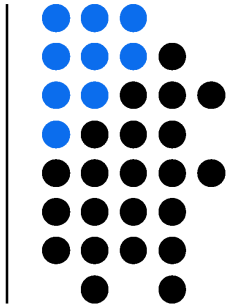
Water Saturation Profile from BL Theory



Steps in Reservoir Initialization (P_w, P_o, S_w)



1. Identify the water pressure at a reference point, e.g. the WOC

$$P_w = P_{w,WOC} \quad @ \quad z = WOC$$

2. At the WOC, $P_c = P_D$(the "capillary entry pressure"):

$$P_o = P_{w,WOC} + P_D \quad @ \quad z = WOC$$

3. Compute P_o and P_w at various depths (grid block centers) using the hydrostatic head

$$P_o^i = P_{o,WOC} + \rho_o g \left(z^i - z_{WOC} \right)$$

$$P_w^i = P_{w,WOC} + \rho_w g \left(z^i - z_{WOC} \right)$$

1. Compute P_c at all depths: $P_c^i = P_o^i - P_w^i$

2. Use the computed Pc's and the Pc curve to compute saturations at each depth

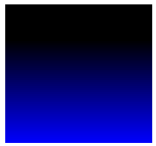
$$P_c^i = f\left(S_w^i \right)$$

Initial Conditions for Multiphase Flow

Gas cap (oil/water at residual sat, only gas is mobile)

Gas-oil transition zone (Water at residual sat, gas and oil depend on capillary pressure. $P<P_b$)

Oil zone (Water at residual sat, gas in solution $P>P_b$, Only oil is movable)

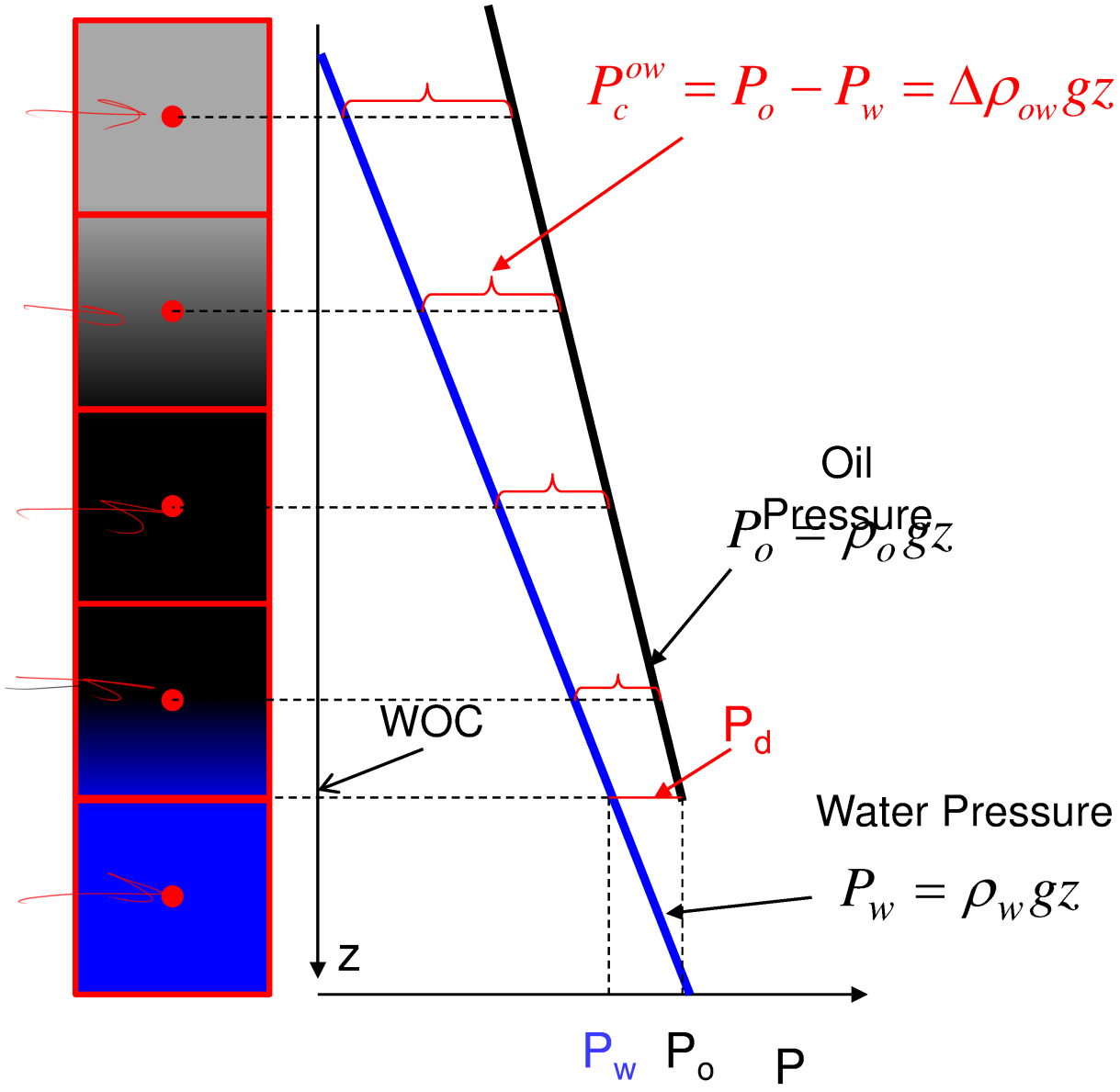


Water-oil zone (Water and oil are movable, saturation depends on capillary pressure)

Water zone (Below water-oil contact)

- **Goal:** determine Pw, Po and Sw as a function of depth
- Oil migrated to rock displacing water. This is drainage
- Pc @ WOC determined from Pc drainage curve. Called displacement pressure P_d
- Starting point is the water-oil contact (WOC); $S_w=1$
- No oil at or below WOC
- Cap pressure calculated from density difference

Pc Found Using Density Differences



1. Identify P_w at a reference point, e.g. the WOC

$$P_w = P_{w,WOC} \quad @ \quad z = WOC$$

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4. Compute P_c at all depths:

$$P_c^i = P_o^i - P_w^i$$

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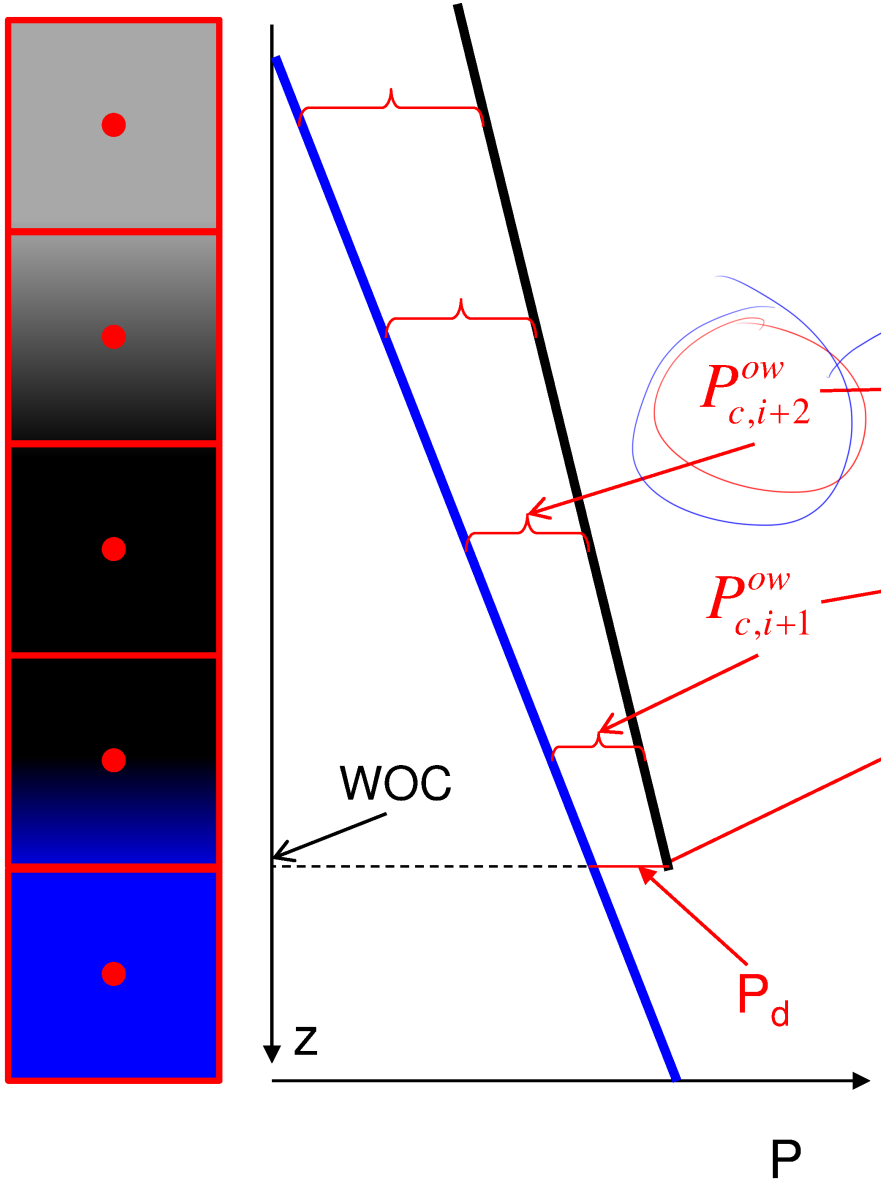
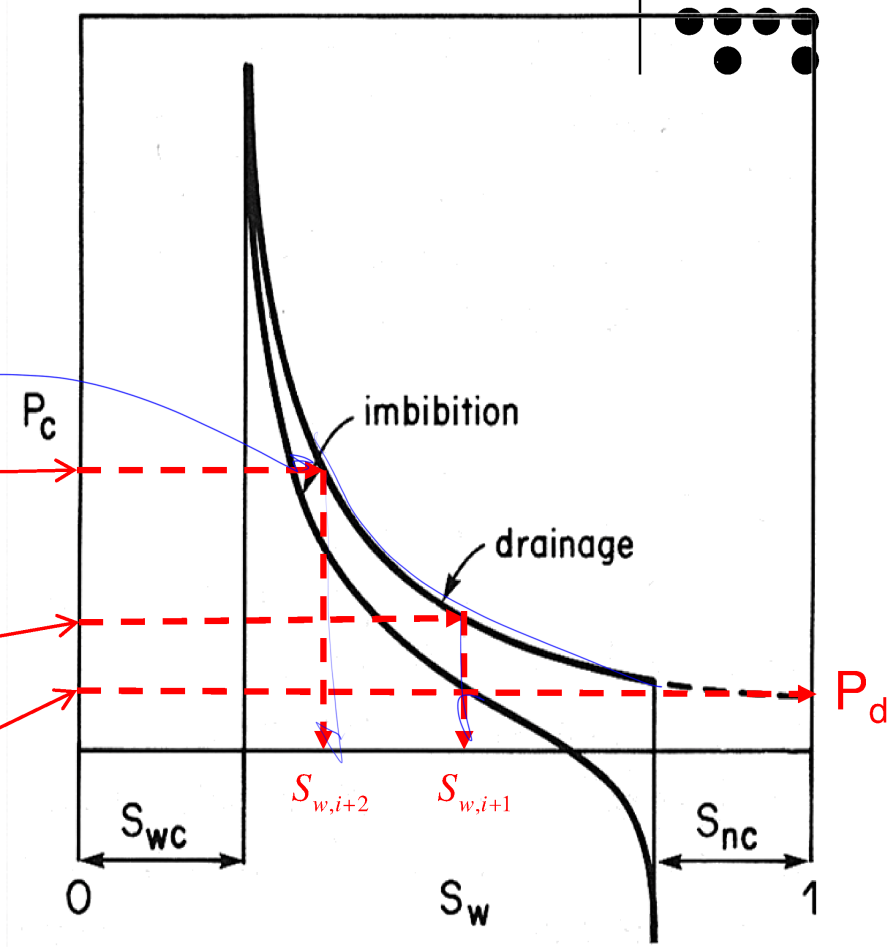




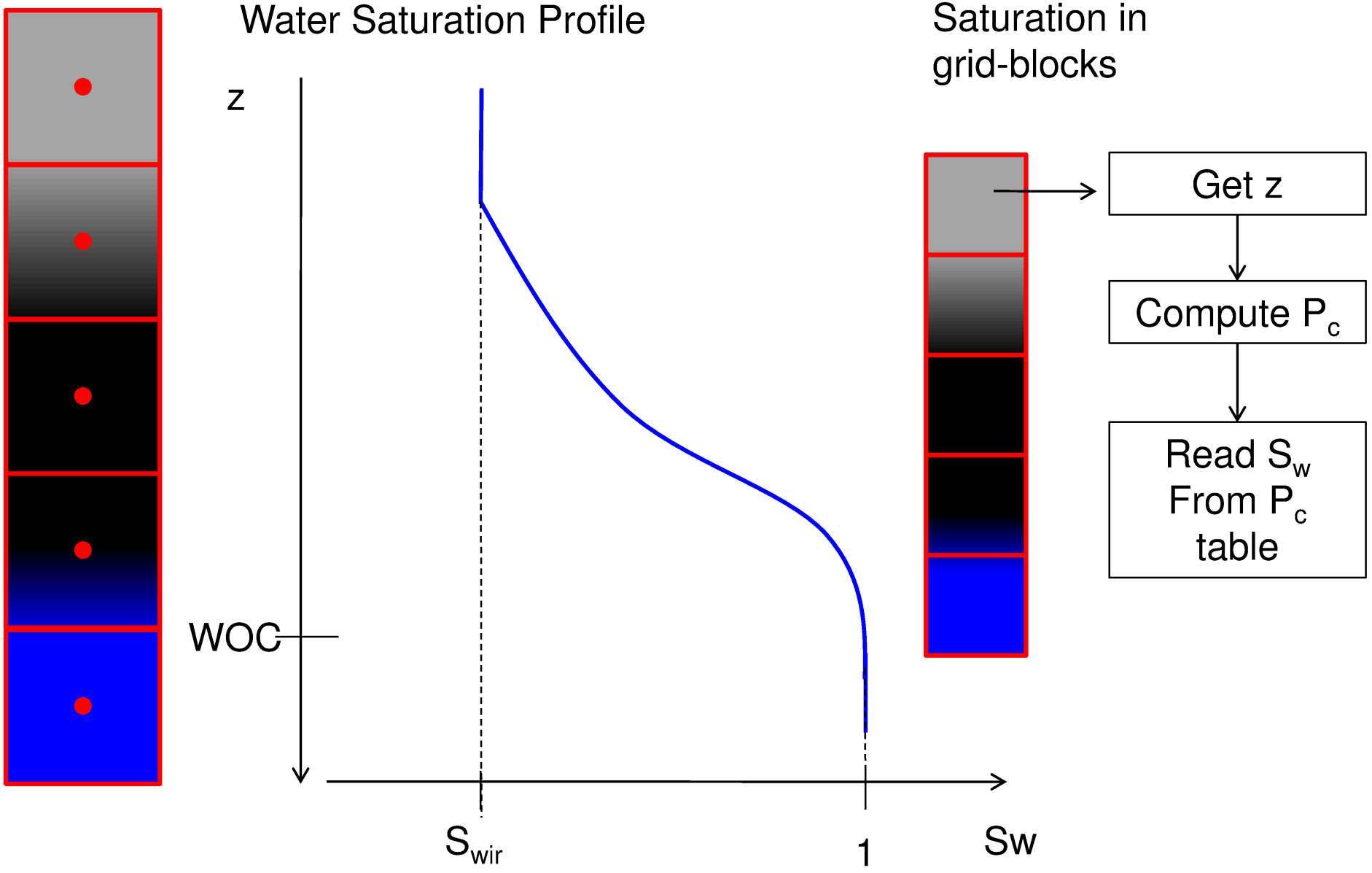
$P^{ow}_{c,i+2}$

$P^{ow}_{c,i+1}$

5. Use the computed Pc's and the Pc curve to compute saturations at each depth

$$P_c^i = f\left(S_w^i\right)$$

Saturation Profile with Depth



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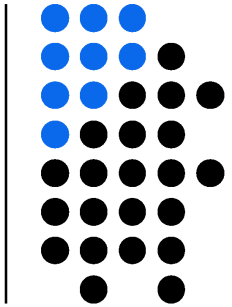

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