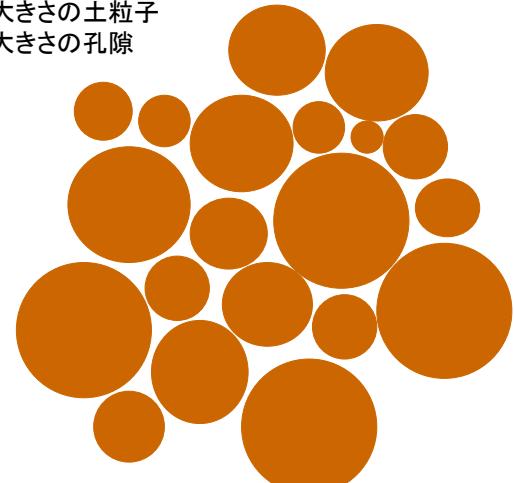


### 土壤(粒子)の模式図

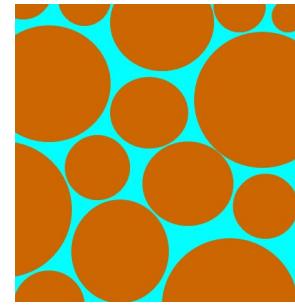
様々な大きさの土粒子  
様々な大きさの孔隙



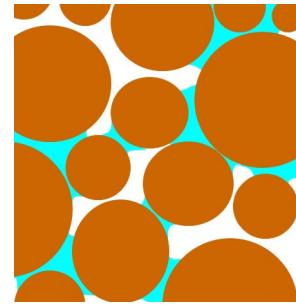
1

### 含水量

飽和



不飽和

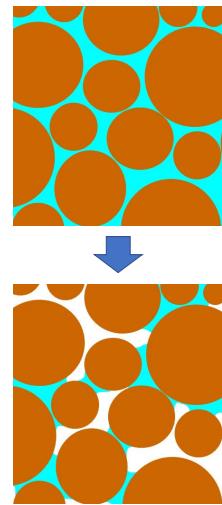


$$\text{体積含水率 } \theta = \frac{V_w}{V_s + V_a} \quad \theta_{sat} = \frac{V_a}{V_s + V_a}$$

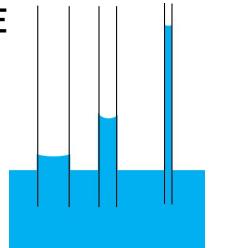
$$\text{質量含水率 } w = \frac{m_w}{m_d} \quad \rho_d = \frac{m_d}{V_s + V_a} \quad \theta = \frac{m_d / (V_s + V_a)}{m_w / V_w} \frac{m_w}{m_d}$$

2

### 飽和から不飽和へ



### 毛管圧

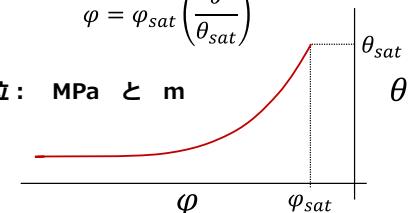


水はどこから抜けていく？

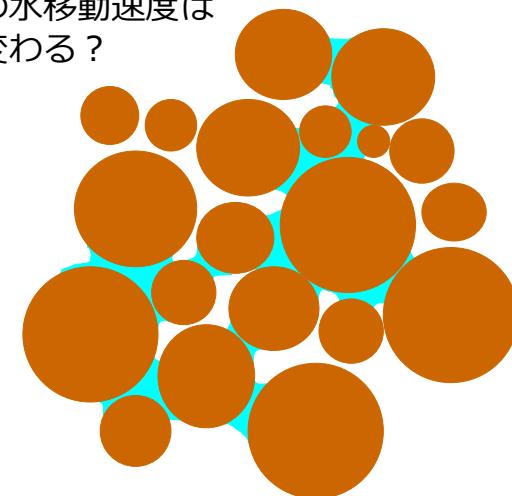
### 土壤水分特性曲線

$$\varphi = \varphi_{sat} \left( \frac{\theta}{\theta_{sat}} \right)^{-b}$$

単位： MPa と m

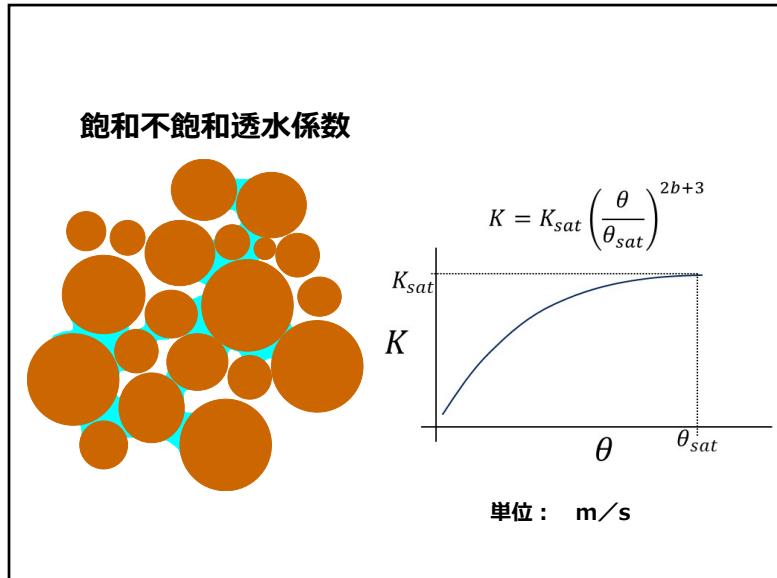


不飽和：土が乾いていくと  
土中の水移動速度は  
どう変わる？



3

4



5

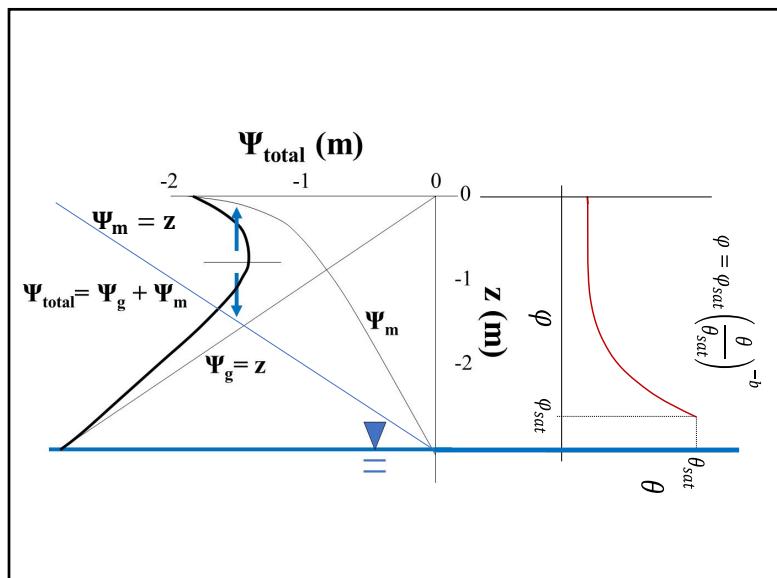
**Darcyの法則**  $F = -K_s(\psi) \frac{\partial(\psi + z)}{\partial z}$

**連続条件**  $\frac{\partial \theta}{\partial t} = -\frac{\partial F}{\partial z}$

**Richards方程式**

$$\frac{\partial \theta}{\partial \psi} \frac{\partial \psi}{\partial t} = \frac{\partial}{\partial z} \left[ K_s(\psi) \left( \frac{\partial \psi}{\partial z} + 1 \right) \right]$$

6



7



8