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Visualization of the Dynamic of Soil Moisture in Terraced Paddy Fields by Using Geoelectrical Resistivity Tomography

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Terraced paddy fields





Onishi, T., et al. Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering (Japan) (2003).



- High groundwater level during the irrigation
- The Fields and slopes were almost saturated during the irrigation period.

Rain[mm d ⁻¹]

Fig.1 調査地区の概要 Description of the study area

Onishi, T., et al. Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering (Japan) (2003).



Horizontal Distance[m]

Onishi, T., et al. Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering (Japan) (2003).



- High groundwater level during the irrigation
- The Fields and slopes were almost saturated during the irrigation period.
- Optimize modeling parameters by fitting simulated groundwater level to observations
- The simulation demonstrated the subsurface return flow (to surface of the next step)



Liu, et al Journal of the American water resources association, 2004



- Simulation the subsurface flow based on terraced fields condition in Northern Taiwan
- Considering the soil conditions in Northern Taiwan
- Assuming that the initial groundwater
 table is 180 cm below the surface

Liu, et al Journal of the American water resources association, 2004



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- Beneath the bund, the groundwater level increases.
- Groundwater level does not reach to the field surface



Liu, et al Journal of the American water resources association, 2004



Pressure head bund lmeter bund lmeter

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- Considering the soil conditions in Northern Taiwan
- Assuming that the initial groundwater table is 180 cm below the surface
- Beneath the bund, the groundwater level increases.
- Groundwater level does not reach to the field surface
- Field water contributes to the groundwater
- Little subsurface return flow

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Our study **2D simulation (steady state)**

- Steady and homogeneous conditions
- Topology given from the study area (A-A' line)

- The subsurface return flow exists; and the groundwater reaches to the field surface.
- Not flow back to the surface of the next step (different from Onishi's result)
- Inclined flow path
- Field water infiltrates from a part of the field surface





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Method

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Geoelectric Resistivity Tomography

(ERT) Survey -> clarify subsurface flow





Electrical resistivity tomography (ERT)



Electrical Resistivity Imaging (ERI)

- A geophysical technique for imaging sub-surface structures from electrical resistivity measurements made at the surface
- Electrical Resistivity reflects soil texture, electrical conductivity, and water content



ERT change \rightarrow flow path

ERT image at Time 1 (before infiltration)



ERT image at Time 2 (after infiltration)



Geoelectric resistivity ↓ because of increasing soil moisture, or high liquid conductivity

Resistivity change implies the subsurface flow path

Electrical resistivity tomography (ERT) Date of Test



Results and Discussions ERT image on Mar-12



Results and Discussions ERT images in April





- ho near the filed surface decreased
- The pattern of ρ did not change a lot
- ⇒ Shallow groundwater might not increase rapidly



B2

Results and Discussions Change percentage comparing to 4/9



Results and Discussions Change percentage comparing to 4/9



Results and Discussions Change percentage comparing to 4/9



Results and Discussions Possible subsurface flow path



Results and Discussions Possible subsurface flow path



Inclined flow path \rightarrow Asymmetry ρ decreasing area Return flow \rightarrow this area accounts the partial field





A symmetry ρ decreasing area fully accounts the field \rightarrow downward infiltration, and little subsurface return flow



Conclusions

1. ERT can demonstrate the moisture change, and the influence of the resistivity of the infiltration liquid.

2. Flow path was pictured by the resistivity change.

3. In the study area, the subsurface return flow was little under unsaturated situation.

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Thank you for your attention



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Liu, et al Journal of the American water resources association, 2004





Electrical resistivity tomography (ERT)



ERT images Change comparing to 4/9







