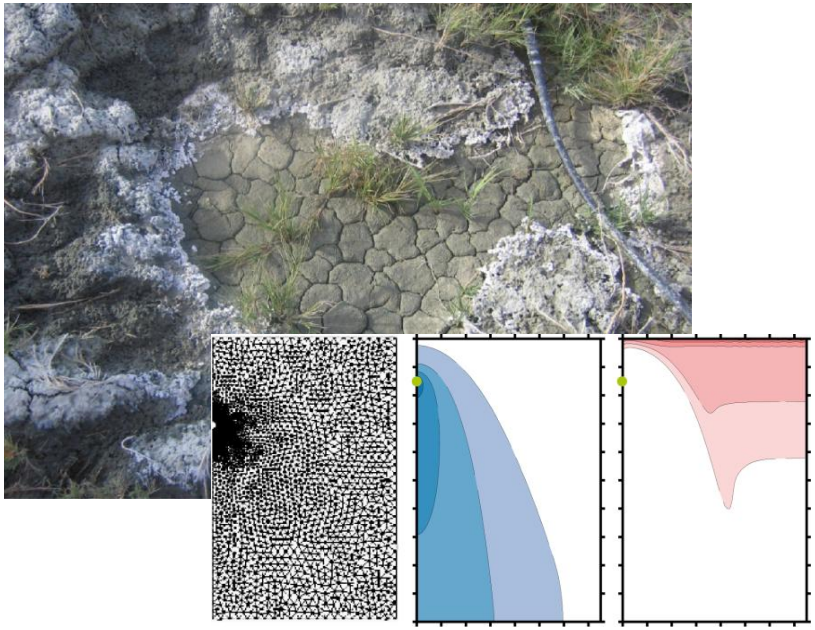
ICID2015
26th ERC & 66th IEC

TECHNISCHE UNIVERSITÄT DRESDEN

Optimal layout and salinity management of drip irrigation systems



Issam Khaddam
Issam.Khaddam@mailbox.tu-dresden.de

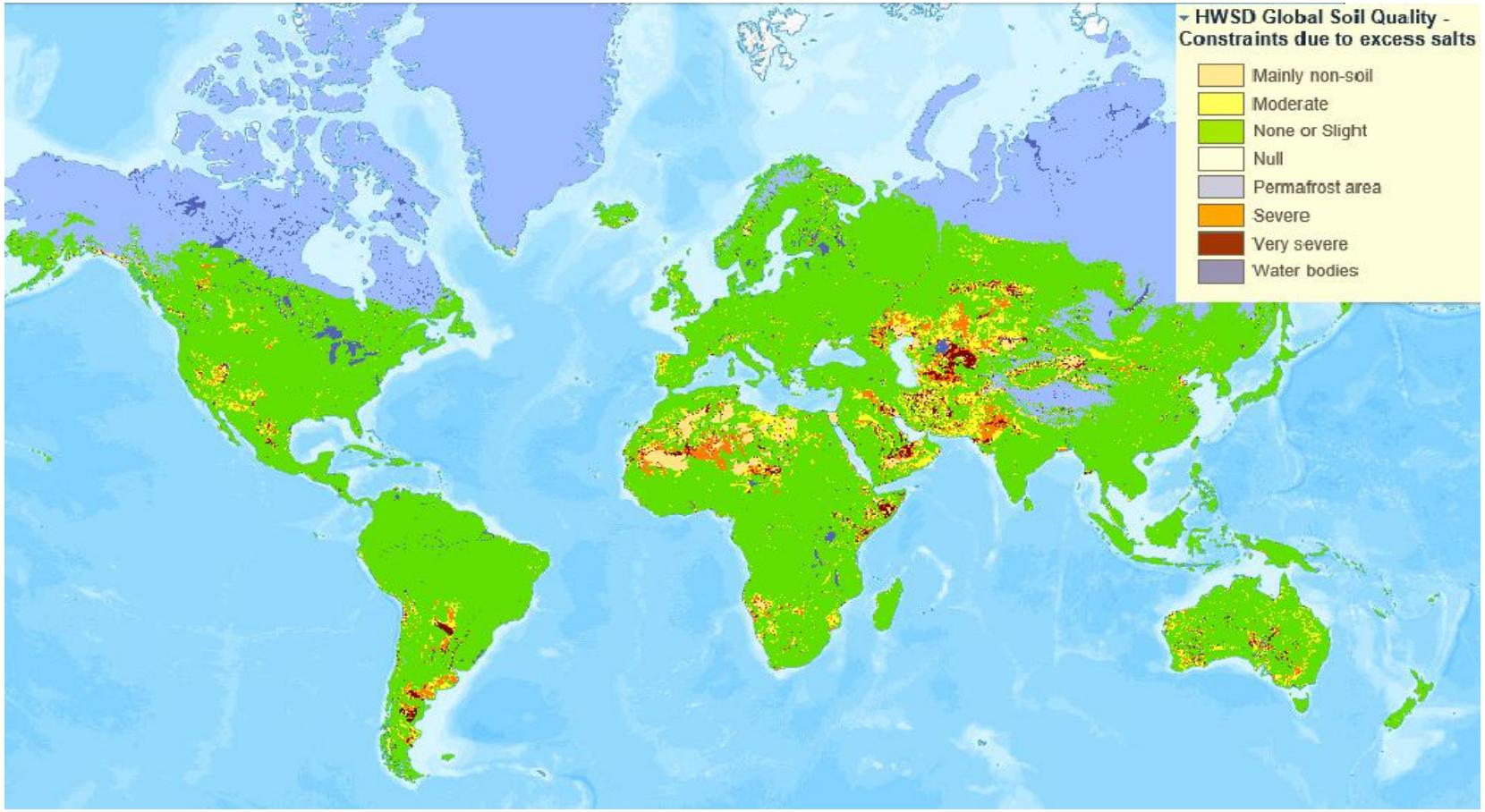
ICID2015
26th ERC & 66th IEC

Presentation outlines

1. Introduction
2. Background
3. Materials and Methods
4. Results
5. Conclusions

ICID2015
26th ERC & 66th IEC

Introduction



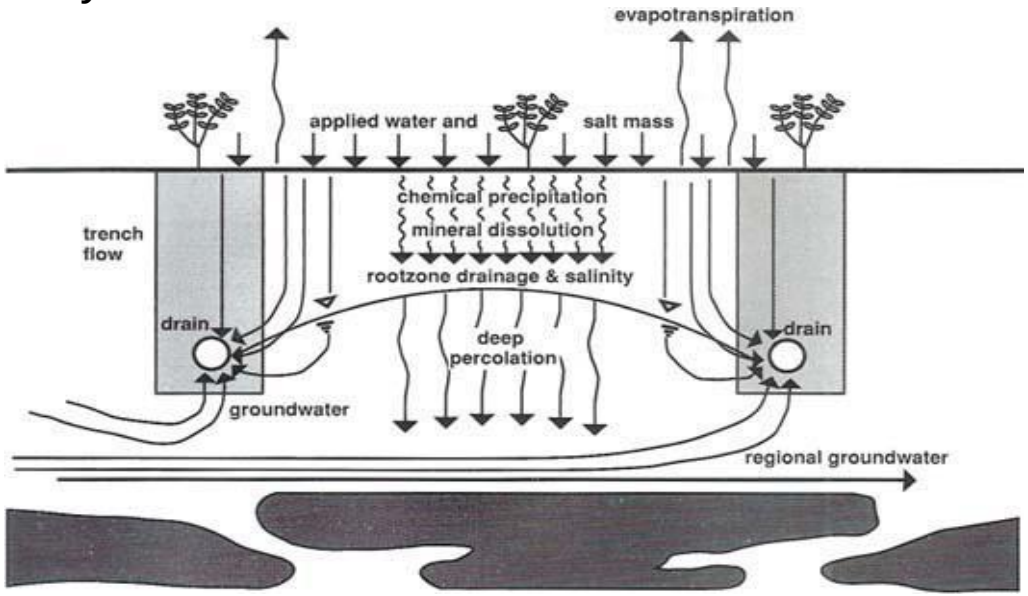
Global distribution of salt-affected soils (GAEZ. Rome, Italy: FAO, 2012. Internet resource)

Background

Solution → Leaching

Leaching prerequisites → Water availability, Drainage.

Challanges → Water Scarcity



Flow of water through soil with respect to salt leaching and root zone drainage. (Grismer. M. E., 1990)

Materials & Methods

HYDRUS-2D (Šimůnek et al., 1999):

• A numerical modeling software for simulating water flow, solute and heat transport

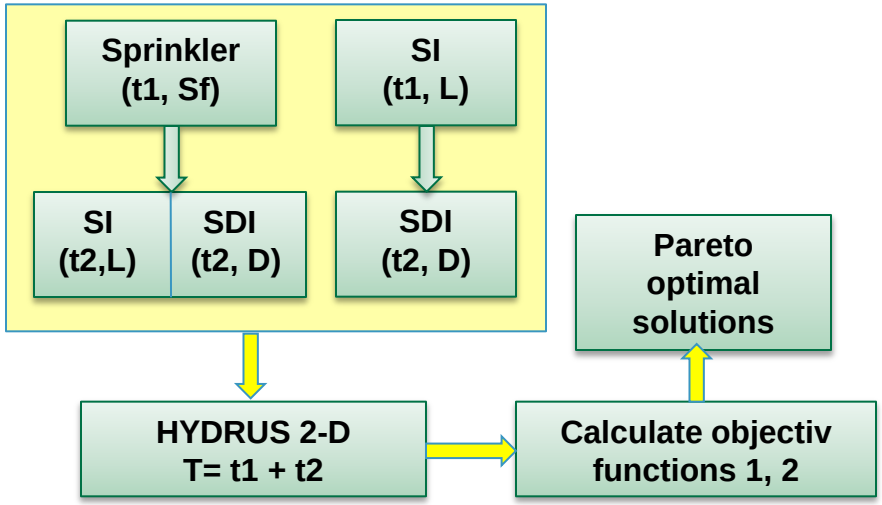
•Investigated systems:

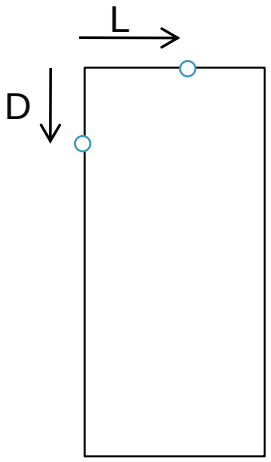
- Sprinkler (S)
- Surface drip irrigation (SI)
- Sub-surface Drip (SDI)

• Soil textures: Sand, loam, and silt.

Materials & Methods

Optimization Framework:





$$OF_1 = \frac{AW - AW_{min}}{AW_{max} - AW_{min}} \qquad OF_2 = \frac{SM}{SM_0}$$

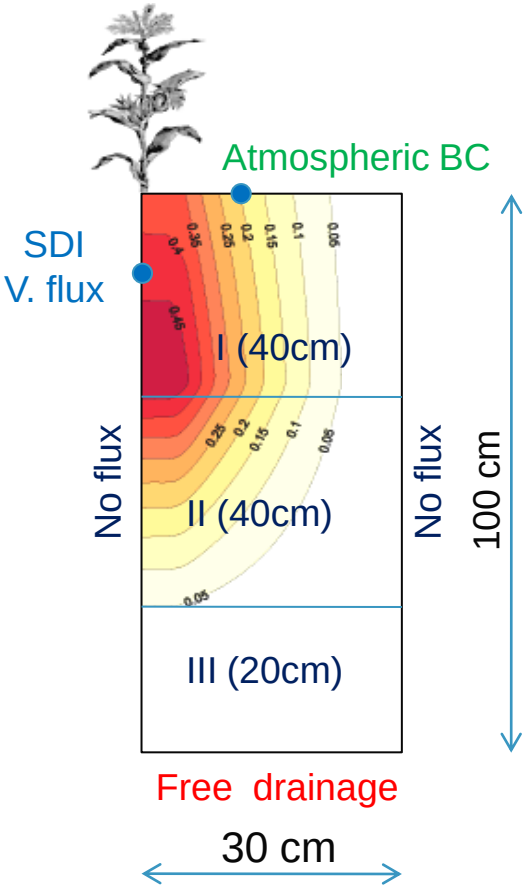
- D: drip-line depth [cm].
- L: drip-line distance from the plant [cm].
- t1: operation time of the sprinkler or SI [h].
- t2: operation time of the SDI or SI [h].
- Sf: sprinkler flux [cm/h].
- T: the simulation final time [h].

- $AW_{min, max}$:The maximum and minimum applied water [L].
- SM: The final total salt mass in the root zone [M].
- SM_0:The initial total salt mass in the root zone [M].

Materials & Methods

Conceptual Setup:

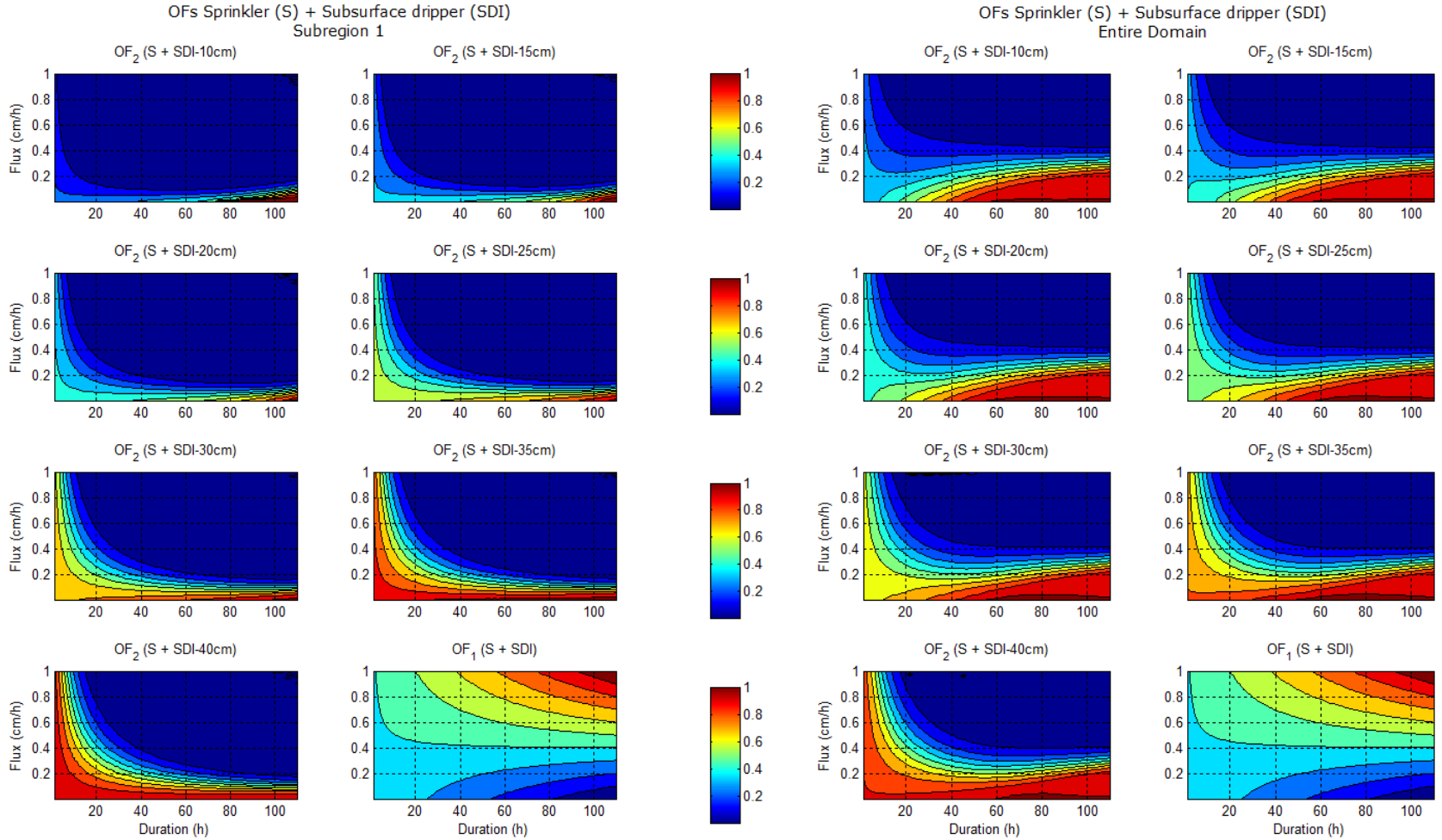
- D drip-line depth: 10 : 5 : 40 cm.
- L drip-line distance: 5 : 5 : 20 cm.
- t1 operation time of sprinkler or SI (h): [0-110] for loam, and [0-240] for silt.
- Sf sprinkler flux (cm/h): [0-1] loam, [0.01-0.25] silt.
- T the simulation final time (h) = 120 loam, 250 silt.
- t2 operation time of the SDI or SI = T- t1.



ICID2015
26th ERC & 66th IEC

Results

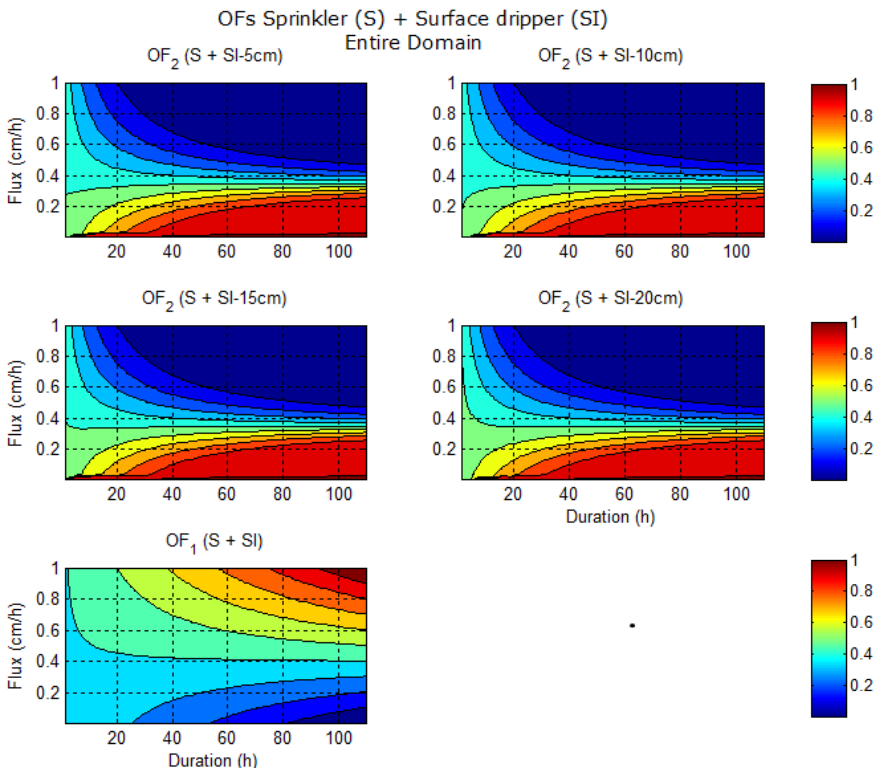
Loam:

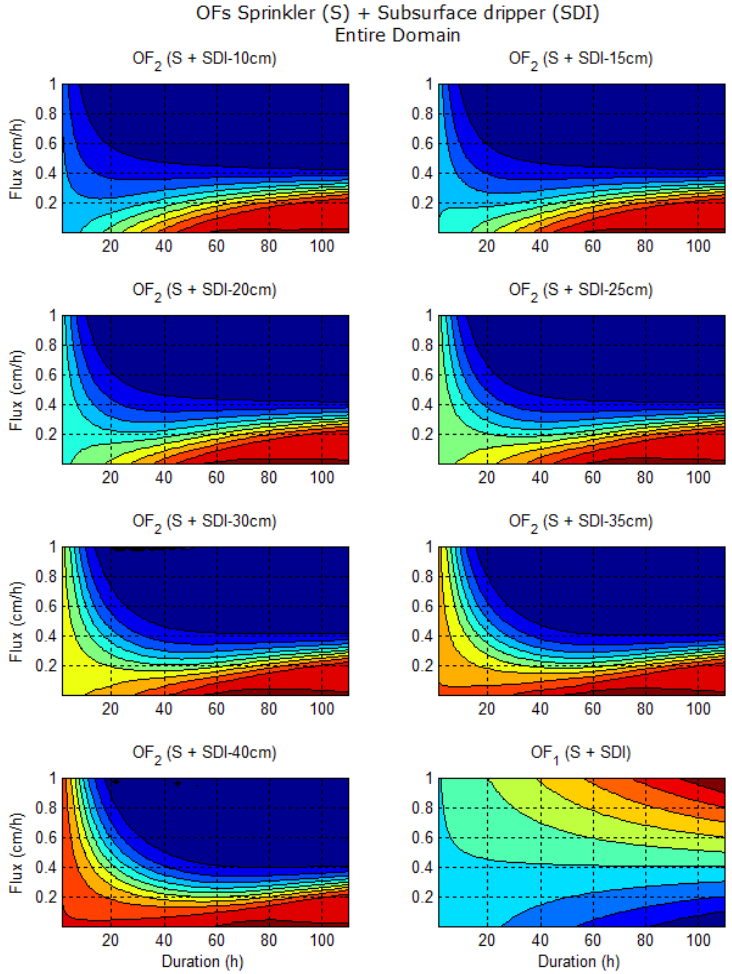


ICID2015
26th ERC & 66th IEC

Results

Loam:

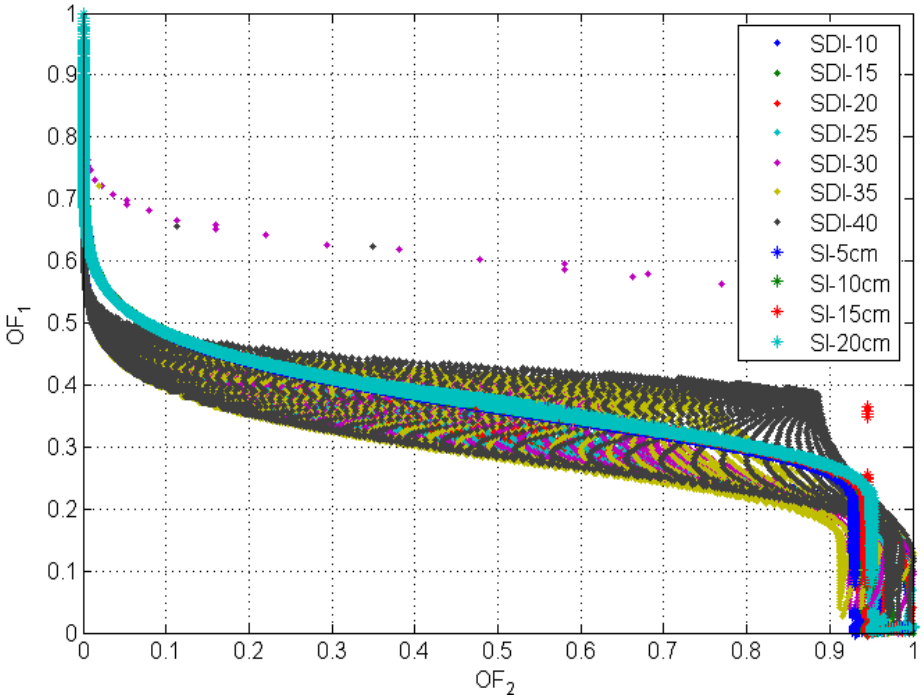




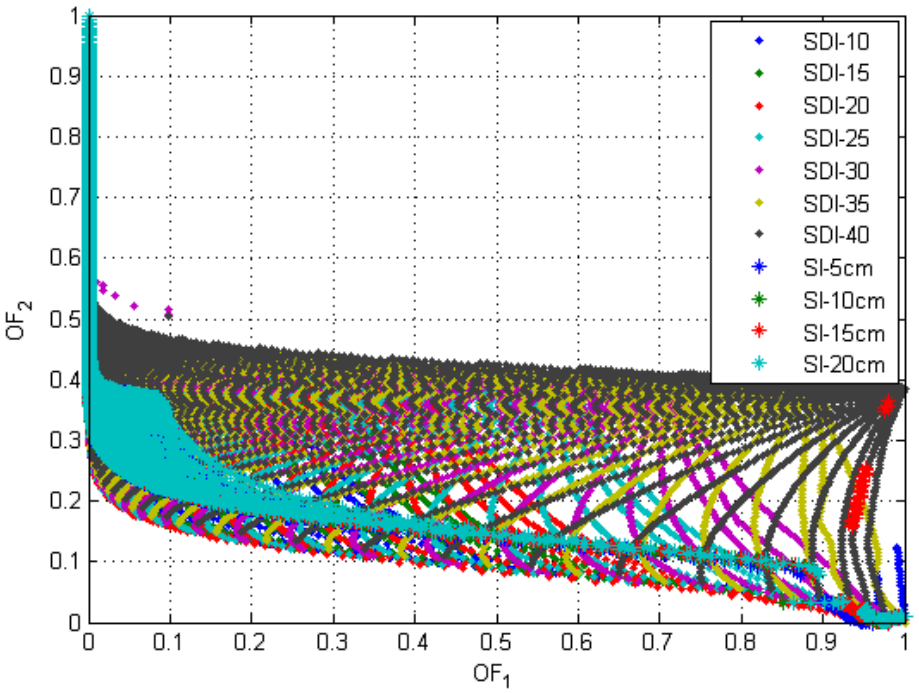
Results

Loam:

Entire domain



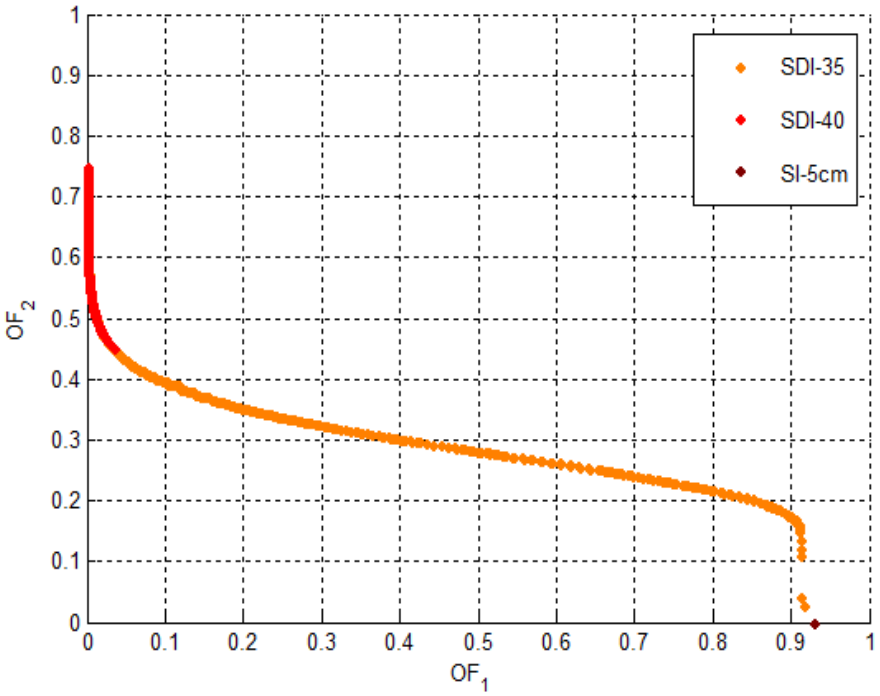
Subregion 1



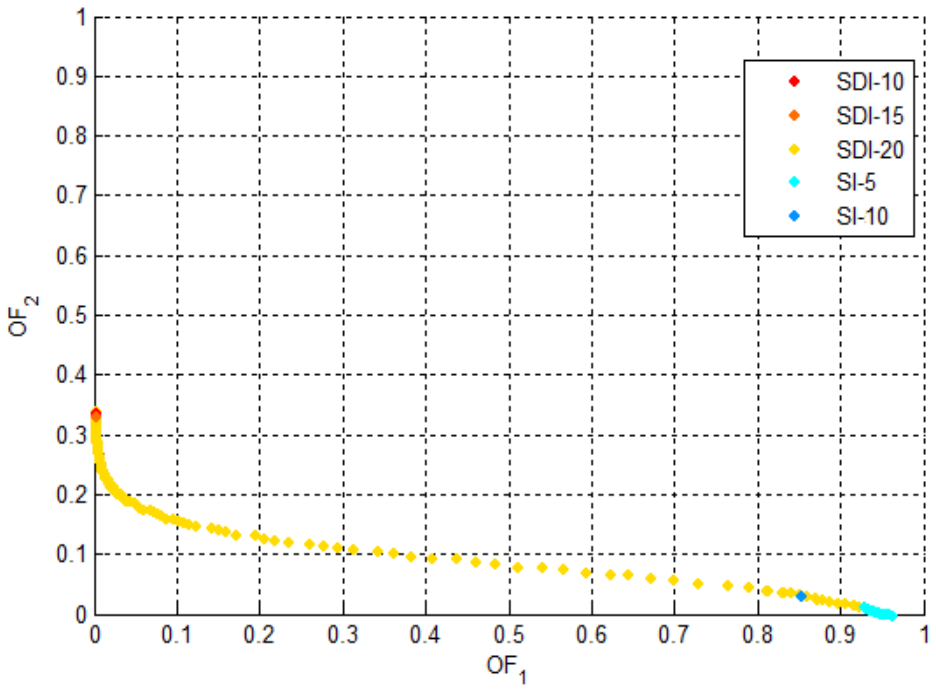
Results

Loam:

Entire domain

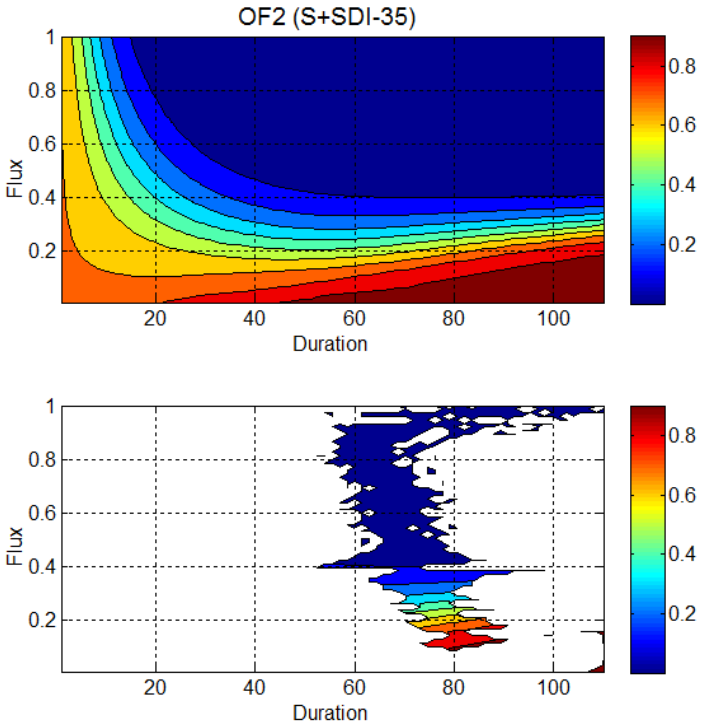


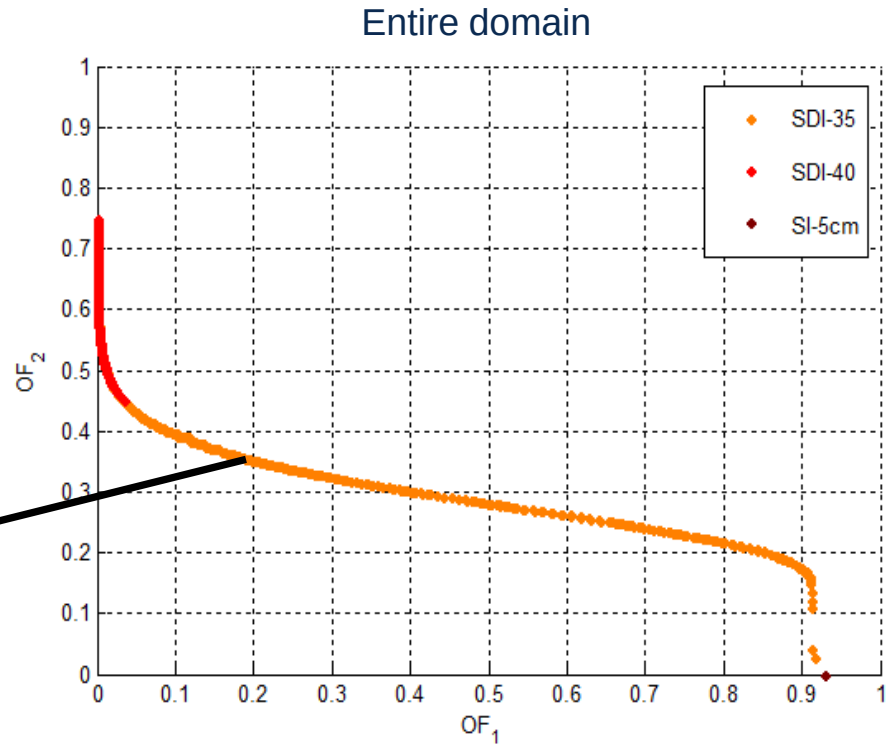
Subregion 1



Results

Loam:





Conclusions

- The depth of SDI have a significant effect on leaching efficiency.
- The SI location has no influence.
- The framework can be expanded to cover more options (intermittent apply…)
- The framework needs to be validated.
- Numerical modeling is very useful tool.

Conclusions

Thanks for your Attention