Real time soil water measurement technology for improved irrigation management in arid environments

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 Irrigation is by far the largest consumer of water in many arid regions, including the Gulf.

•Achieving high irrigation water productivity requires good on-farm irrigation management, which requires balancing water demand (ET) with water supply (soil water).

•Good measurements of both are important, but technology to measure soil water content (and salinity) has lagged behind that required to estimate ET.

#### http://www.biosaline.org/weather/DailyData.mht



ET<sub>0</sub> (mm/day)



### Estimated Daily ET<sub>0</sub> at ICBA

# Soil water content

Has been measured for a long time using various techniques

Electronic, computer, and communication technology is opening the door to new ways to measure and use soil water data

However, its important to understand what is being measured, what the data means, and what are its limitations.



100m



Sensors based on the dielectric properties of soil (Frequency Domain, Time Domain) exploit the relatively large difference in permittivity between soil water and the other soil constituents (air, minerals)

Dielectric permittivity is affected by:

- Soil water content
- Soil water conductivity
- Soil temperature

SWC =  $0.0000043P^3 - 0.00055P^2 + 0.029P - 0.053$ Topp et al (1980)

### Saturated

Dielectric permittivity is maximum Bulk conductivity is maximum Large pores drained. Small pores have water. Reduced dielectric permittivity Bulk conductivity is lower Only very small pores have water. Permittivity and bulk conductivity are near minimum.

# 15 cm







#### Website





# Soil water content















### 13 July



### 30 July





#### Soil Water Content 0-60 cm

#### Change in soil water content during daytime (ET?)

Soil Water Content 0-60 cm



## Soil water content

## **Soil electrical conductivity**

## Soil temperature



### Bulk electrical conductivity vs soil water content

### 0 dS/m



### Bulk electrical conductivity vs soil water content



**Actual SWC** 

#### Temperature at 30 cm





# Soil water content and electrical conductivity at 30 cm Irrigated at 100% ET with water of EC 10 dS/m



Applications

 On-farm monitoring of irrigation performance and diagnostic analysis

Irrigation research

 Development, calibration and verification of research and management models

