MODELO BALANSAL
(MODELO HIDRICO SALINO DE SUELOS BAJO RIEGO)
M.Sc Ing. Carlos M. Mirábile- Cdor. Luis Fornero
CENTRO REGIONAL ANDINO - INA
Belgrano (oeste) 210 (5500) Mendoza, Argentina

OBJETIVOS:

Cuantificar la dinámica de la salinidad y humedad del suelo en función de un balance hídrico salino que tiene en cuenta la modalidad y láminas de riego aplicadas.

El cálculo de las láminas de riego y el requerimiento de lixiviación / lavado, necesarias para satisfacer la demanda hídrica de los cultivos y desalinizar o mantener constante la salinidad del suelo.

Permitir la programación y adecuación de los riegos, para la obtención de un determinado objetivo.
Datos de Entrada:

$W_{fc}$ = Contenido de humedad del suelo, a capacidad decampo, de la zona radical, expresada en (mm).

$CE_e$ = Conductividad eléctrica inicial del suelo (dS/m)

$f$ = Factor eficiencia del lavado

$CE_e^*$ = Conductividad eléctrica objetivo del suelo (dS/m)

$Evapot$ = Evapotranspiración mensual (mm)

$Precip$ = Precipitación efectiva mensual (mm)

$Riego$ = Láminas de riego mensual (mm)

$CE$ agua = Conductividad eléctrica del agua de riego (dS)
Datos de Salidas:

$CE_e$ = Conductividad eléctrica final del suelo (dS/m)

**Cambio** = Variación de la salinidad del suelo (dS/m)

$R$ = Percolación operada (mm)

**Riego** = Lámina de riego necesaria para obtener la CE objetivo (mm)

$DL$ = Lámina percolada necesaria para obtener la CE objetivo (mm) -Lámina de lavado-

$W$ = Humedad del suelo en (mm)
### Modelo Balansal

**Cultivo:**

**Tipo de suelo:**

**Est. Meteo.:**

**Datos suelo:**

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\[ f = 0,5 \]

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<th>CE (dS/m)</th>
<th>Cambio (dS/m)</th>
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<th>CEe (mmohs)</th>
<th>Cambio (mmohs)</th>
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**Total:** 825 50 1091 -0,002 1119 329 329

ALT-G para gráfico    ALT-M para menú
**Modelo Balansal**  
Carlos Mirábile - Luis Fornero  
e-mail carlosmirabile@hotmail.com

**Estancia Ojo de Agua- San Pedro Chico**

**Cultivo:** Maiz 97-98  
**Tipo de suelo:** Franco Arcilloso  
**Est. Meteo.:** Balcarce

**Datos suelo:**  
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Estancia Ojo de agua
Evolución de la Salinidad del Suelo Simulada y Medida

Correlación Entre los Valores Simulados y Medidos

\[ y = 0.8779x + 0.047 \]
\[ R^2 = 0.9831 \]
$\text{Med} = 0.943 \times \text{Sim} + 0.0384$

$R^2 = 0.9384$

$p = 0.0000..1$

$n = 26$
### Campo: Ojo de agua  Lote: San Pedro grande

**Diferencias de Salinidad entre Valor Medido y Simulado**

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<th>Mes/año</th>
<th>Valor Medido microS/m</th>
<th>Valor Simulado microS/m</th>
<th>Diferencia Porcentual</th>
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**Corrida Mensual Contínua-Periodo 1997-2001**

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### Campo: Santa Ida

**Diferencias de Salinidad entre Valor Medido y Simulado**

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**Corrida Mensual Contínua- Periodo 95-96**

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Maíz+ Rast.

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### Cultivos:
Maíz 97-98, Trigo 98, Maíz 99-00, Trigo 00 y Maíz 01-02

### Tipo de suelo:
Franco Arcilloso

### Est. Meteo.:
Balcarce

### Datos suelo:
- \( W_{fc} = 187 \text{ mm} \)
- \( CE_e = 0.235 \text{ (dS/m)} \)
- \( f = 0.3 \)

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<th>Riego (mm)</th>
<th>( CE_e ) (dS/m)</th>
<th>Cambio R (mm)</th>
<th>W (mm)</th>
<th>Cumple Umbrales con W (mm)</th>
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Conclusiones

- El modelo funciona satisfactoriamente, siendo la media de las diferencias porcentuales entre simulado y medido del orden del 8,6 % en valores absolutos y su mediana 0.

- El análisis de frecuencia determina un error estándar del 11% y que el 76% de las comparaciones realizadas están dentro de una dif.de ± 10%.

- El coeficiente de determinación presenta un valor alto ($R^2 = 94$) con un valor de p (probabilidad observada) muy pequeño de 0,00000...1

- La pendiente de la recta (≅1) y la ordenada al origen extremadamente baja indican un correcto funcionamiento del modelo.

- La buena superposición de la recta con respecto a la normal indica que el modelo, en gral, no produce sub o sobre estimaciones importantes.

- El modelo es sensible al valor del factor de eficiencia de lavado por lo que se aconseja determinarlo o ajustarlo localmente.
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- $W_{fc} = 234$ mm
- $CEe = 0.425$ mmol
- $f = 0.6$

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