IMPACT OF EVAPOTRANSPIRATION PROCESS REPRESENTATION ON RUNOFF PROJECTIONS FROM CONCEPTUAL RAINFALL-RUNOFF MODELS

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Assessing impacts of potential climate change is important for water resource systems.

- Increase in temperature
- Reduction in average rainfall
- Increase in the frequency and intensity of extreme rainfall

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Conceptual rainfall-runoff (CRR) models are useful to assess climate impact on water resource systems.

Projected climate change with 11 GCMs, 2 emission scenarios (Example: Christensen and Lettenmaier, 2006).

Impact on water resource systems: Projected average probability of no supply shortage and level-3 shortage under 2 emission scenarios.
The performance of CRR models can be limited under a changing climate.
Study objective:
To assess the impact of alternative ET process representations within CRR models on runoff projections under a changing climate.

- ET process representation in CRR models
  - Possible changes in PET
  - Projected runoff under change

1. How big is the impact of ET process representations?
2. What causes the impact of ET process representations?
3. How can we evaluate alternative of ET process representations?
Understanding the impact of ET process representations in CRR models on runoff projection

**ET process representation in CRR models**

Three structurally different CRR models

**Possible changes in PET**

**Projected runoff under change**

1. How big is the impact of ET process representations?

2. What causes the impact of ET process representations?

<table>
<thead>
<tr>
<th>Climate variable to perturb</th>
<th>Perturbation range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T$</td>
<td>0 to +8°C</td>
</tr>
<tr>
<td>RH</td>
<td>-10% to +10%</td>
</tr>
<tr>
<td>$R_s$</td>
<td>-10% to +10%</td>
</tr>
<tr>
<td>$u_z$</td>
<td>-20% to +20%</td>
</tr>
</tbody>
</table>
Evaluation of alternative ET process representations in CRR models

3. How can we evaluate alternative ET process representations?
Three structurally different CRR models – **GR4J**, **AWBM** and **IHACRES_CMD**

**GR4J**
- Defining dry/wet
- $E_n = P - PET$
- $E_t = \frac{K}{S(t)}(S + E_t)$
- $P_t = \frac{K}{S(t)}(P - PET)$
- $AET = P + E_t$
- $S = P - P_n - P_s$

**AWBM**
- Defining dry/wet for each store
- $S_i + P - PET - P_{r,i}, i = 1, 2, 3$
- $E_{s,t} = PET$
- $AET = \sum E_{s,t}$
- $P_{r,i} = \text{excess from } S_i$

**IHACRES_CMD**
- Defining dry/wet
- $CMD - g > 0$
- $CMD - g < 0$
- $P_r = \frac{K}{S(t)}(CMD/d, PET)$
- $AET = (CMD/g) * PET$
Q1: How big is the impact of ET process representations on runoff projection?

% change in average PET (solid) and Q (dashed)
Q1: How big is the impact of ET process representations on runoff projection?
Q2: What causes the impact of ET process representations on runoff projection?
Q2: What causes the impact of ET process representations on runoff projection?
Q3: How can we evaluate alternative ET process representations?

**Alice Springs**

- **Observed**
- **Simulated - GR4J**
- **Simulated - AWBM**
- **Simulated - CMD**

**Wagga Wagga**

- **Observed**
- **Simulated - GR4J**
- **Simulated - AWBM**
- **Simulated - CMD**
• Different ET process representations in CRR models can have substantial impacts on the sensitivity of runoff projection under a changing climate.
• AET observations are useful tools to verify the realism of ET process representations in CRR models.
• Need for an improved understanding of physical processes to better infer the potential changes in rainfall-runoff relationships under climate change, and thus to facilitate better modelling of future water resources