Assessing climate change impacts on drought severity in Mediterranean islands using the Standardized Precipitation Evapotranspiration Index (SPEI)

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Introduction

• Climate change and drought
• Drought and impacts on surface water availability
• Need for drought analysis and monitoring taking into account precipitation and potential evapotranspiration (PET)

• Aim of the study:
  ✓ Assessing the impacts of climate change on drought events in Crete, Cyprus and Sicily by estimating the SPEI
  ✓ Investigating correlation between SPEI values & dam water availability
Standardized Precipitation Evapotranspiration Index (SPEI)

• A **drought index** based on climatic data (Vicente-Serrano et al., 2010)
• Extension of the widely used Standardized Precipitation Index – SPI
• Determining intensity, magnitude, duration of drought conditions **with respect to normal conditions**
• SPEI captures **precipitation and temperature fluctuations** and trends
• Estimated based on the difference between **precipitation and PET**
• Represents a **simple water balance**
• SPEI<0 indicate **dry** periods
Methodology

• Implementation areas: mainly near dams used for irrigation purposes
• Studied period: 1972-2098
• SPEI R Package (Begueria and Vicente-Serrano, 2017)
• Climatic data for the period 1972-2004: gridded observational data from the EOB-S dataset
• Climatic data for the period 2005-2098: RCA4 Regional Climate Model, driven by the Hadley Centre Global Environmental Model version 2 Earth System of the Met Office Hadley Centre (MOHC)
• RCP scenarios: 4.5 & 8.5
SPEI variation under the pressure of climate change

Reference period: 1972-2004

Future period: 2005-2098

$\Delta$SPEI:
$\text{SPEI}_{(2031-2060)} - \text{SPEI}_{(1972-2000)}$
Implementation areas in Crete

(a) Faneromeni Dam area

(b) Ayia area
Results - SPEI evolution from 1972 to 2098 in Crete

**Faneromeni Dam**

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<thead>
<tr>
<th></th>
<th>RCP 4.5</th>
<th>RCP 8.5</th>
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<tbody>
<tr>
<td>ΔSPEI</td>
<td>0.2</td>
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**Ayia**

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<tr>
<td>ΔSPEI</td>
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<td>-0.7</td>
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Implementation areas in Cyprus

(a) Asprokremos Dam area  (b) Kiti Dam area  (c) Kouris Dam area
Results - SPEI evolution from 1972 to 2098 in Cyprus

Asprokremos Dam

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Kiti Dam

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<td>-0.2</td>
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Results - SPEI evolution from 1972 to 2098 in Cyprus

Kouris Dam

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- RCP 4.5
- RCP 8.5
Implementation areas in Sicily

(a) Poma Dam area

(b) Moganazzi area
Results - SPEI evolution from 1972 to 2098 in Sicily

Moganazzi

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Poma Dam

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<td>-0.7</td>
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Results - SPEI and dam storage

SPEI (in blue/red) and real storage (in grey) of Asprokremos Dam (1988-2004)
Conclusions

• A significant **decline** of SPEI is observed in representative areas in the Mediterranean basin.

• A long base period (30-50+ years) should be used.

• The correlation within reservoir storage and SPEI may consist a tool for a **preliminary impact assessment** of future droughts events on reservoirs storage.
References


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Thank you for your attention.