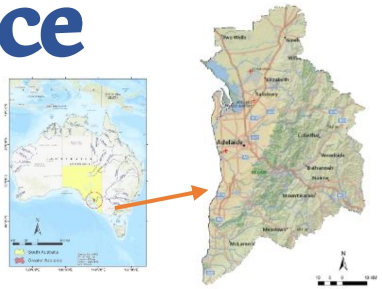
The impact of drought on urban green space

Sattar Chavoshi[*1], Hamideh Nouri[2], Pamela Nagler[3], Neda Abassi[2], Biswajeet Pradhan[4], and Alfredo Huete[1]

[1]*Faculty of Science, University of Technology Sydney, Ultimo, NSW 2007, Australia*
[2] Department of Crop Sciences, Division of Agronomy, University of Göttingen, *Germany*
[3] U.S. Geological Survey, Southwest Biological Science Center, 520 N. Park Avenue, Tucson, AZ 85719, *USA*
[4] School of Civil and Environmental Engineering, University of Technology Sydney, NSW 2007, *Australia*



EGU General Assembly 2022

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To attain a water-resilient city, we need to overcome challenges associated with water scarcity (e.g., drought). While the impact of drought on forestry, agriculture, and riparian corridors has already been studied, this study is one of the first to assess the effect of drought on the Urban Green Space (UGS). In this study, we suggest a sustainable approach toward a green, livable city under climate change by optimizing the water footprint of UGS. The changes in greenness and water requirement (evapotranspiration) of UGS in Greater Adelaide is studied to evaluate the impact of drought on urban greenery from 2000 to 2020.

Supportive background

As the following table shows, this study is based on the results obtained from previous studies on evapotranspiration estimation using optical remote sensing techniques in a 10-hectare public park, Veal Gardens, in Adelaide (2010) and later expanded to a 720 hectare, Adelaide Parklands in South Australia (2020).

Methodology

Evapotranspiration will be estimated using 4 vegetation indices (NDVI, NDVI*, EVI and EVI2). Time series of the drought index will be analysed and finally, the relationship between the drought index and water footprint will be obtained.

Veal Gardens (2010)	Adelaide Parklands (2020)	Greater Adelaide (2022)
10 ha	720 ha	326000 ha
• **EOS-1, Aqua** (MODIS sensor with 36 bands, spatial resolution of 250m for the red and NIR bands, 500m for the remaining land bands, and 1km for all other bands) • **WorldView 2** (8 bands, spatial resolution of 0.46m panchromatic and 1.85 m multispectral)	• **EOS-1, Aqua** (MODIS) • **Landsat** (ETM+ and OLI sensors with 11 bands, spatial resolution of 30m) • **WorldView 2** (8 bands, spatial resolution of 0.46m panchromatic and 1.85 m multispectral)	• **Landsat** (ETM+ and OLI sensors with 11 bands, spatial resolution of 30m)

$$EVI = G\frac{NIR - R}{L + C1R - C2B + 1} \qquad EVI2 = 2.5\frac{NIR - R}{NIR + 2.4 \times R + 1}$$

$$NDVI = \frac{NIR - Red}{NIR + Red} \qquad NDVI^* = \frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}}$$

$$ET = ET_0 \times 1.65\left(1 - e^{-2.25 \times EVI(or\ EVI2)}\right) - 0.169 \qquad ET = ET_0 \times NDVI^*$$

Partitioning water footprint into green & blue

$$ET_g = \left(\frac{S_g}{S_g + S_{b,I} + S_{b,CR}}\right)ET$$

$$ET_{b,I} = \left(\frac{S_{b,I}}{S_g + S_{b,I} + S_{b,CR}}\right)ET$$

$$ET_{b,CR} = \left(\frac{S_{b,CR}}{S_g + S_{b,I} + S_{b,CR}}\right)ET$$

Results

Preliminary results show that the water footprint of Adelaide's urban green space is the highest in December with the highest rate of heat-wave and the lowest in June.

Selected references

-Nagler, et al. 2013. Estimating riparian and agricultural actual evapotranspiration ..., Remote Sensing, 5: 3849–3871.

-Nouri, H., et al. 2019. The blue water footprint of urban green spaces..., Landscape and Urban Planning, 190,103613.

UTS UNIVERSITY OF TECHNOLOGY SYDNEY

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