

The present and future of ephemeral freshwater

in the Kavango-Zambezi Transfrontier Conservation Area

Margaret Swift, Robin Naidoo
Savanna Science Network Meeting
Skukuza, South Africa
04 March 2025

KAVANGO ZAMBEZI

TRANSFRONTIER CONSERVATION AREA (KAZA TFCA)

ANGOLA

ZAMBIA

NAMIBIA

KAZA

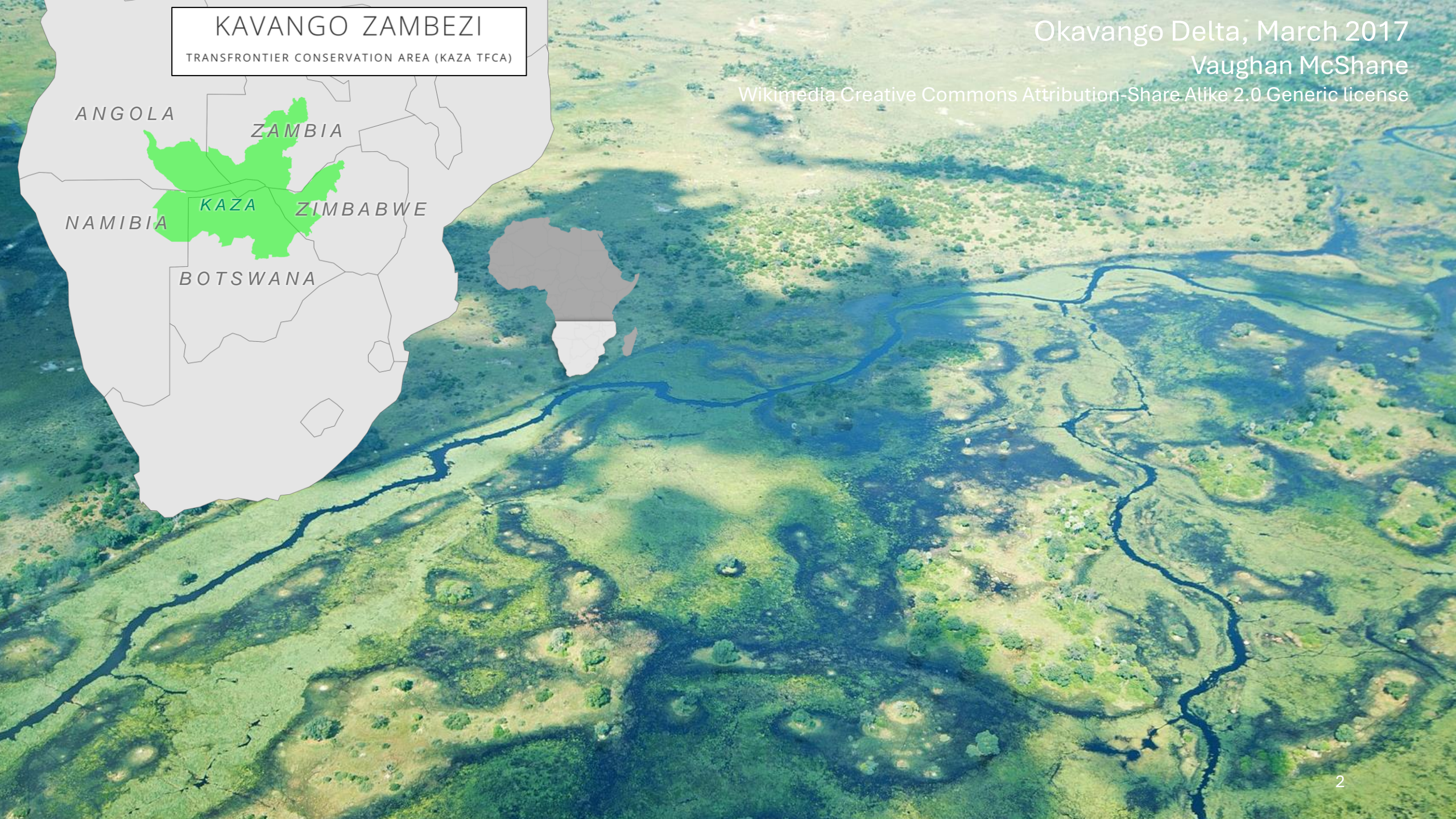
ZIMBABWE

BOTSWANA

Okavango Delta, March 2017

Vaughan McShane

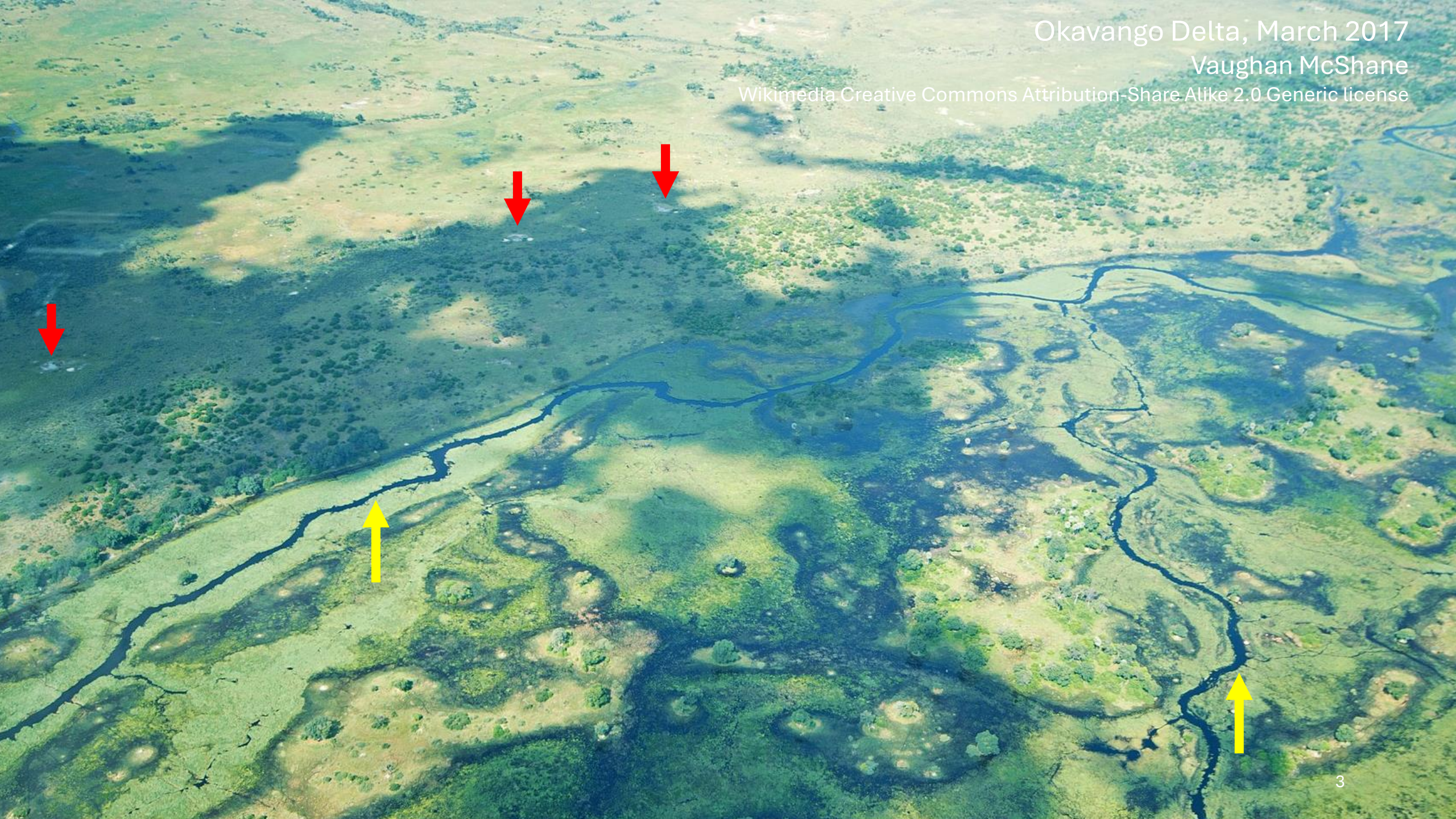
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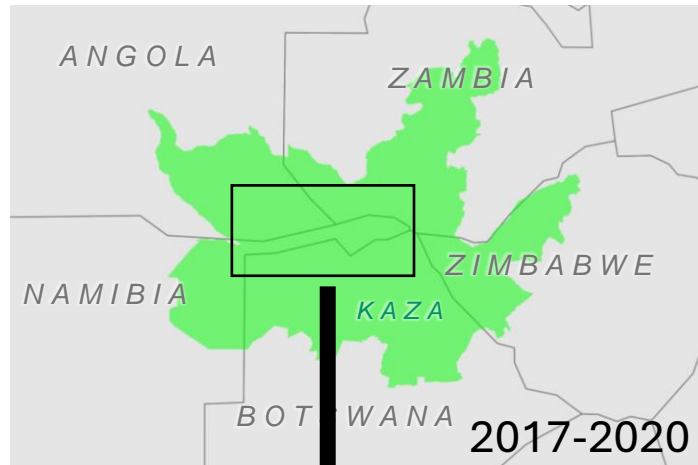
Okavango Delta, March 2017

Vaughan McShane

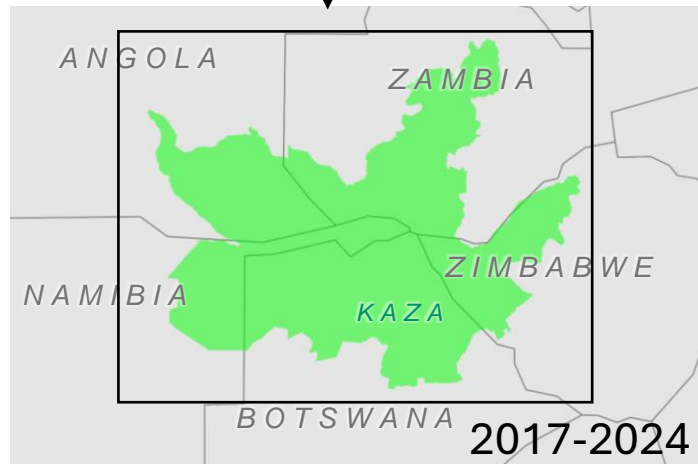
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2022



2025



520,000 km²

ENVIRONMENTAL RESEARCH LETTERS

LETTER • OPEN ACCESS

Tracking a blue wave of ephemeral water across arid southern Africa

Danica Schaffer-Smith¹ , Margaret Swift¹ , Allison Killea¹, Angela Brennan^{2,3} , Robin Naidoo²  and Jennifer J Swenson^{4,1} 

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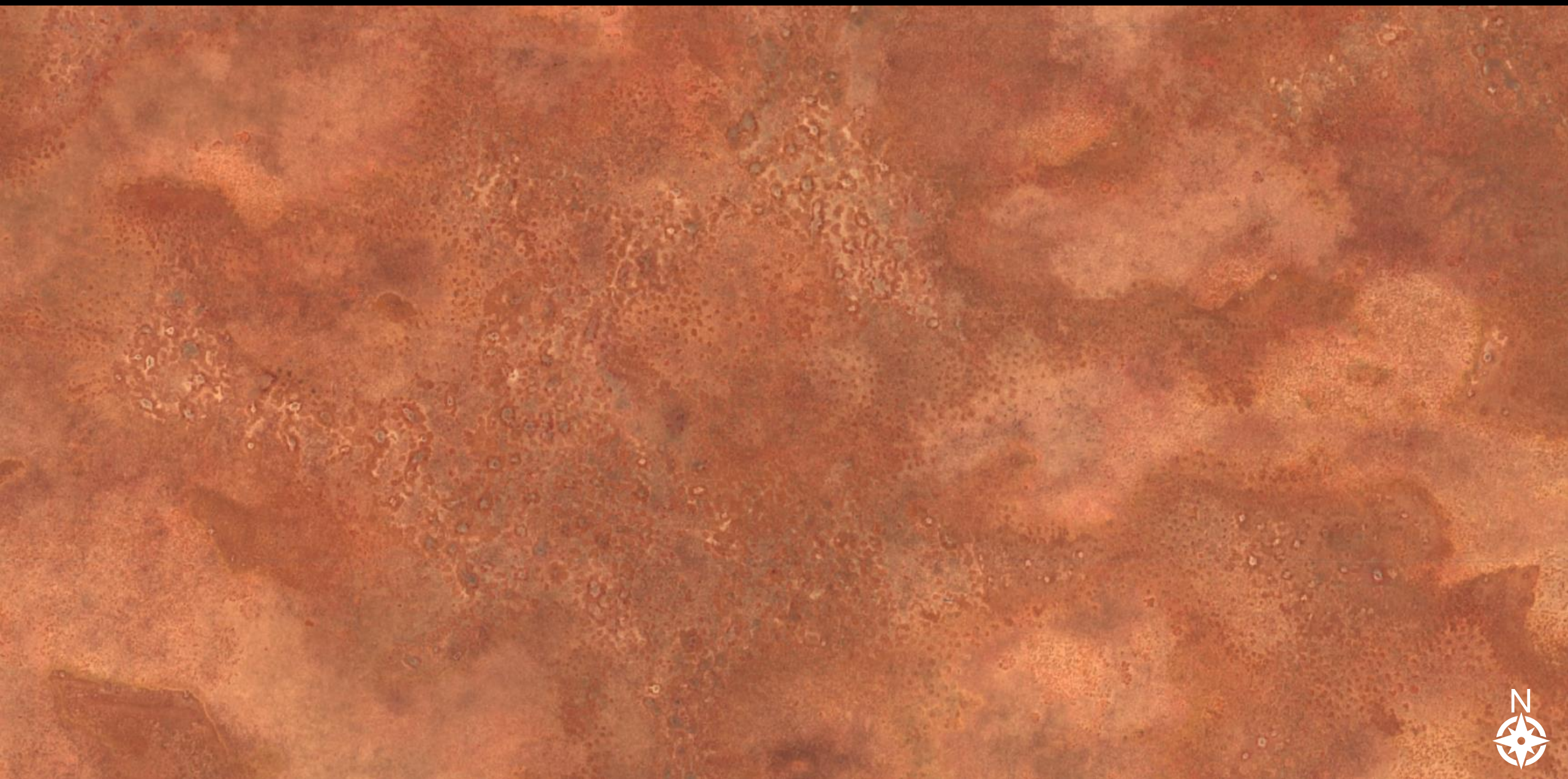
[Environmental Research Letters](#), Volume 17, Number 11



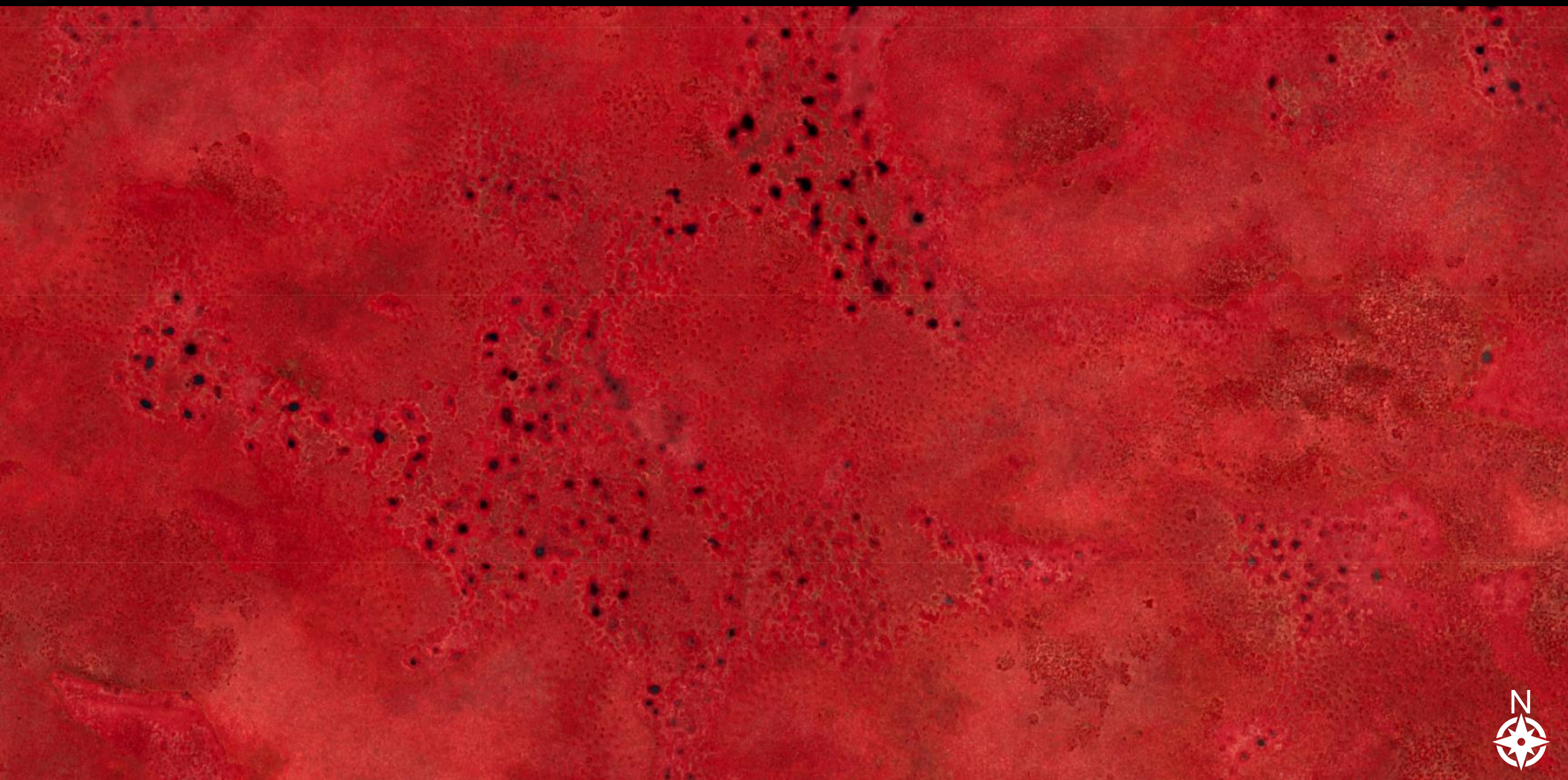


(22.64339, -18.41179) at 10m/px





Sentinel-2 (10m) false-color NIR/R/G : Feb-May 2021



(22.64339, -18.41179) at 10m/px



Sentinel Multi-Band Water Index = $B2 + (2.5 * B3) - 2 * (B8 + B8A + B9) - B11 - B12$

Feb-May 2021

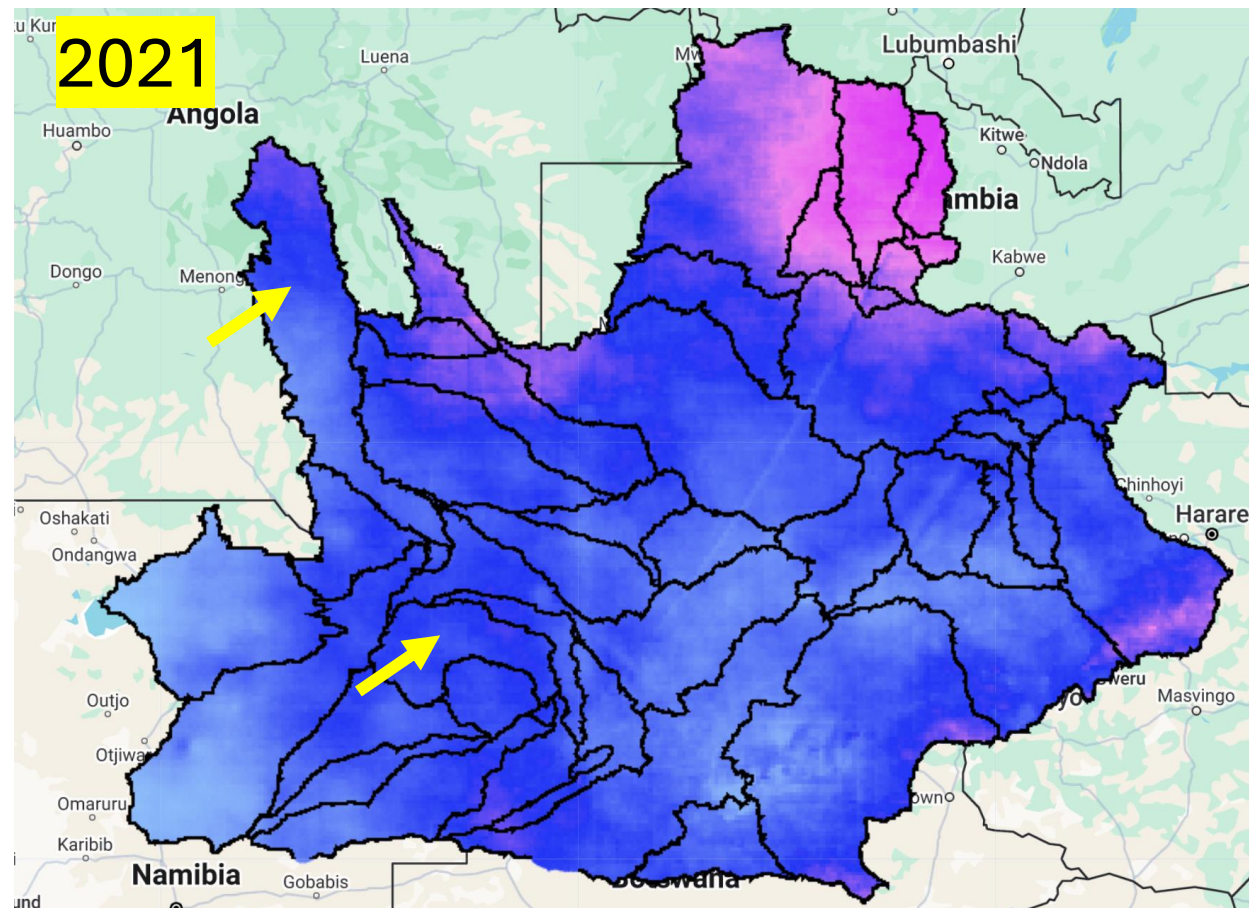
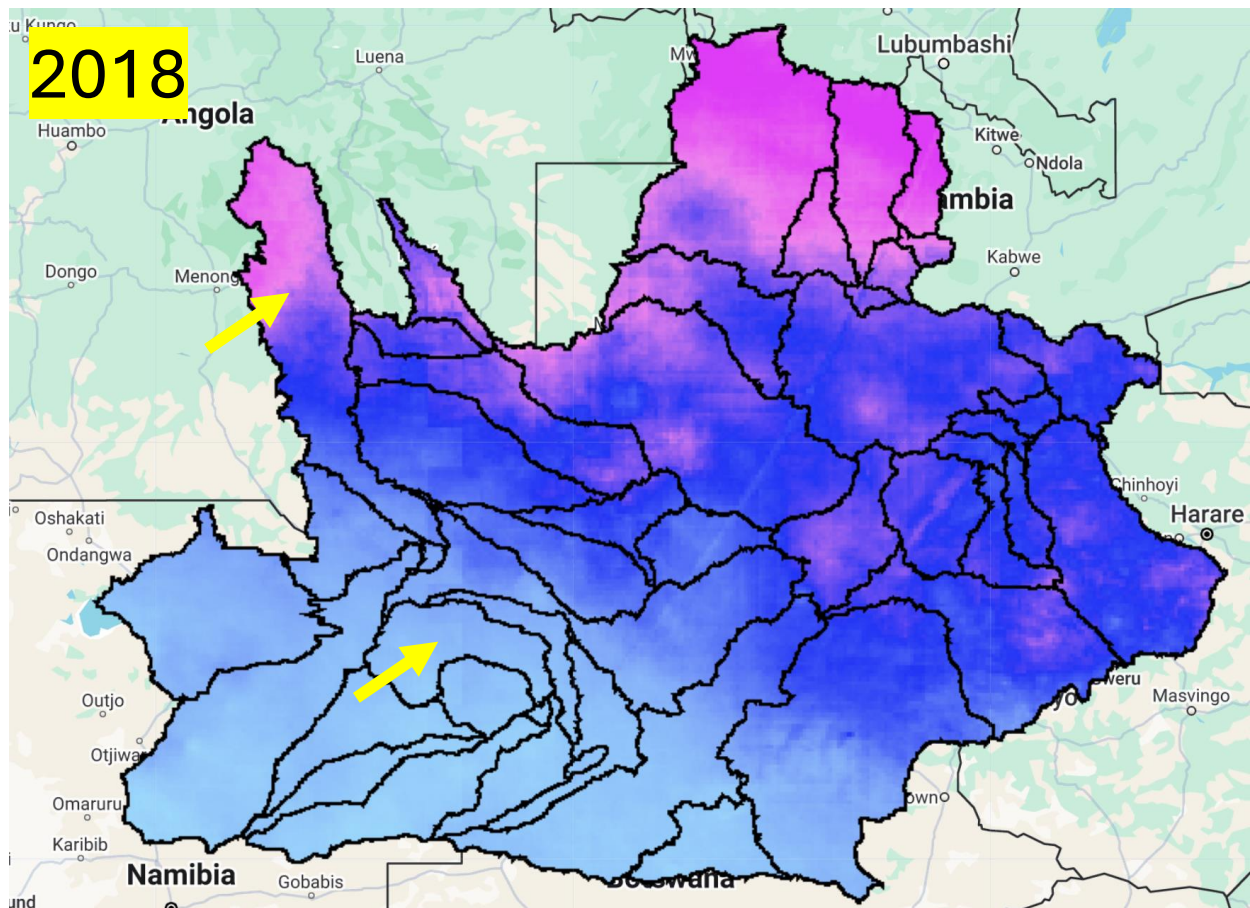
Yu et al Remote Sensing of Environment (140) 2024.



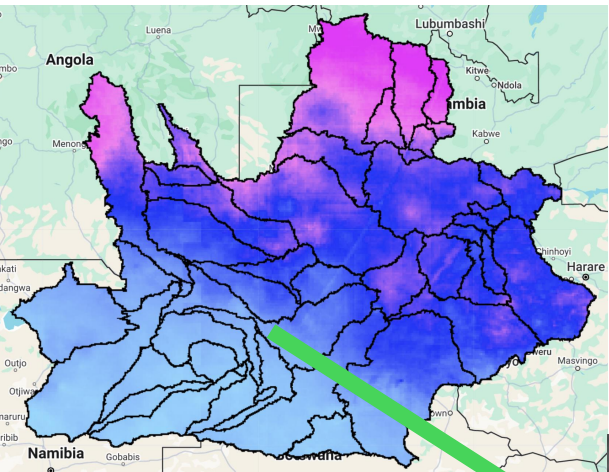
8 2km

(22.64339, -18.41179) at 10m/px

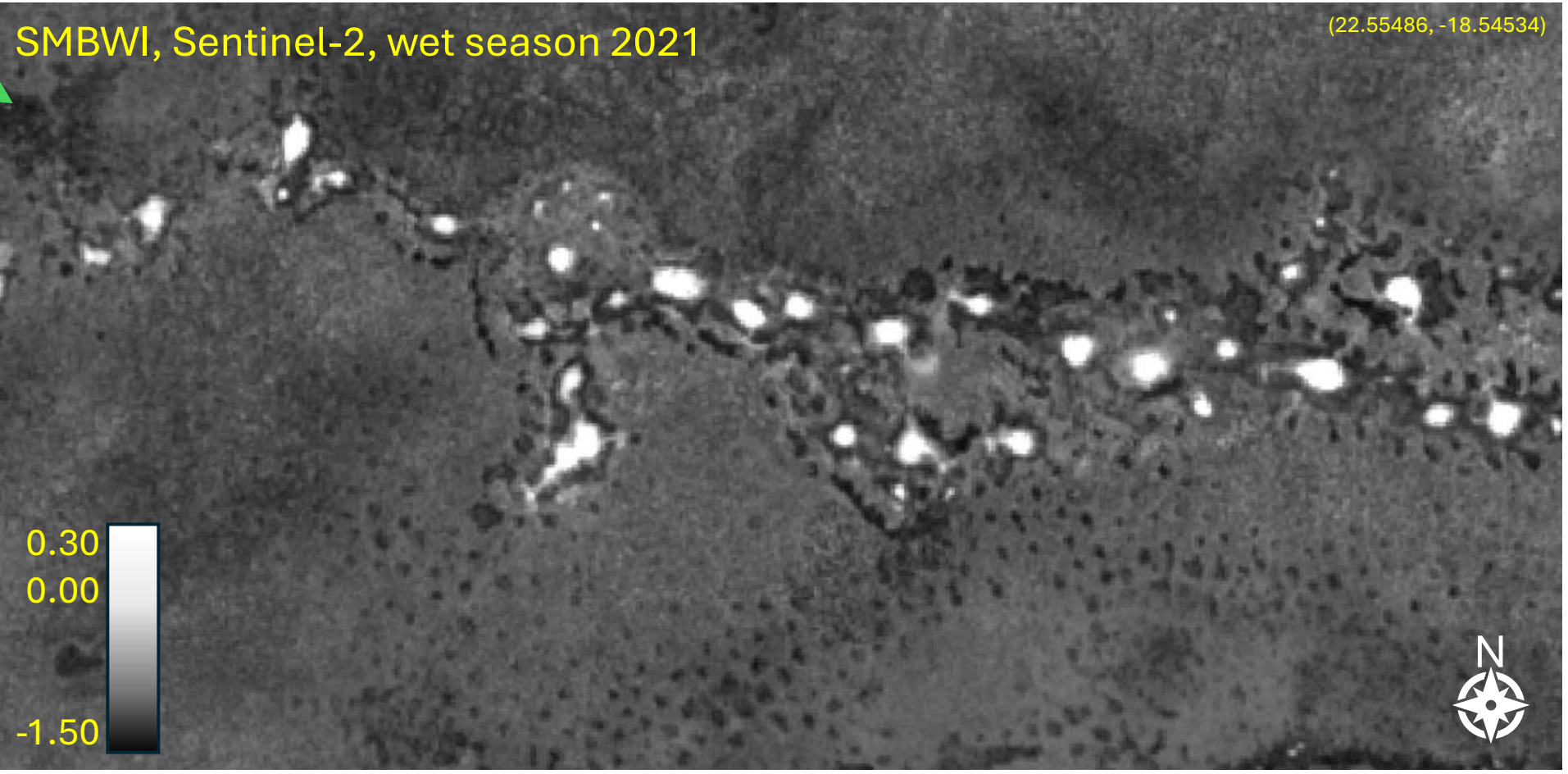
CHIRPS wet-season
rainfall estimate (mm)



HydroSHEDS has been developed by the WWF Conservation Science Program in partnership with the U.S. Geological Survey, the International Centre for Tropical Agriculture, The Nature Conservancy, and the Center for Environmental Systems Research of the University of Kassel, Germany.

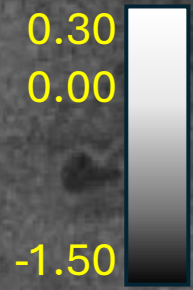


Sentinel Multi-Band Water Index = $B2 + (2.5 * B3) - 2 * (B8 + B8A + B9) - B11 - B12$
Yu et al Remote Sensing of Environment (140) 2024.



SMBWI, Sentinel-2, wet season 2021

(22.55486, -18.54534)

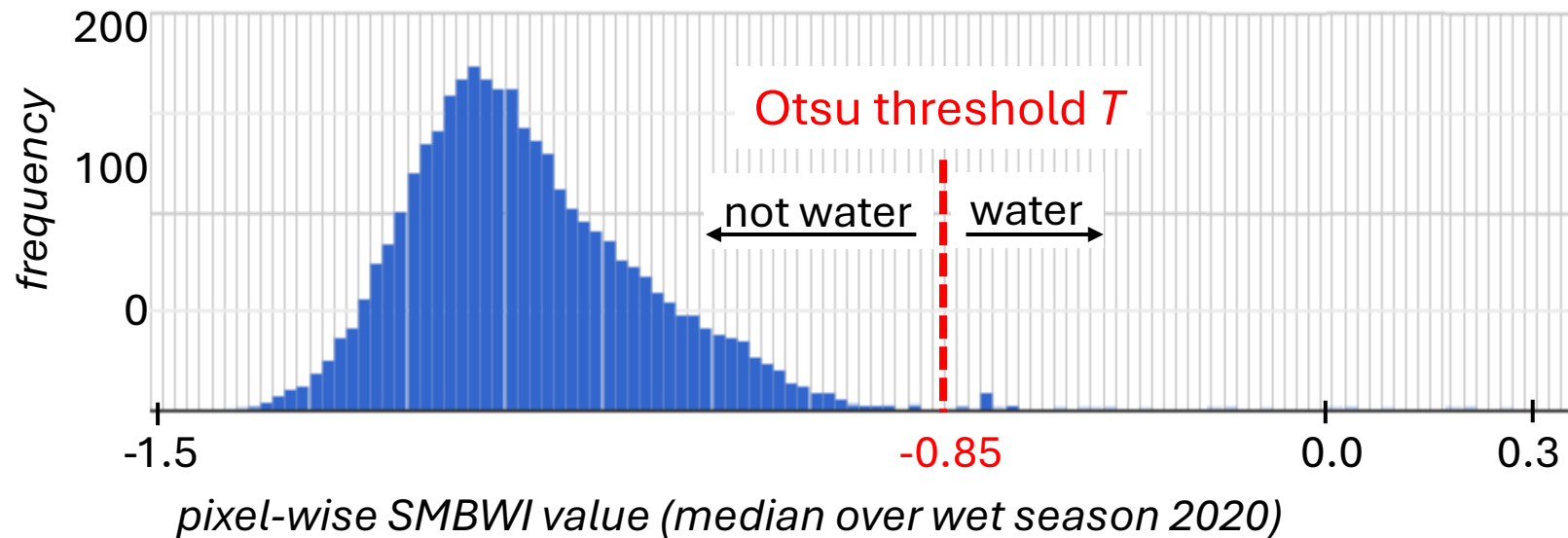


0.5km

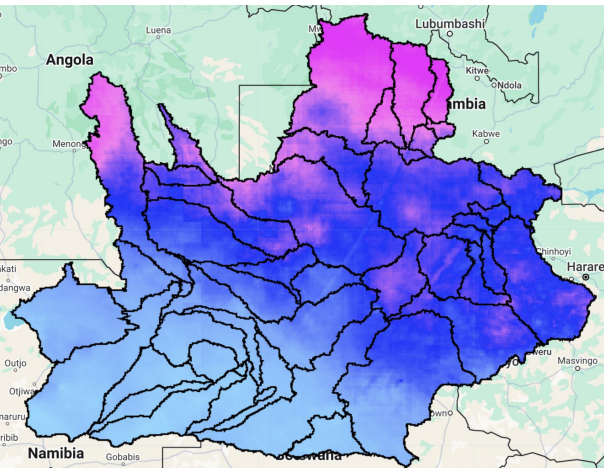


$$\text{Sentinel Multi-Band Water Index} = B2 + (2.5 * B3) - 2 * (B8 + B8A + B9) - B11 - B12$$

Yu et al Remote Sensing of Environment (140) 2024.



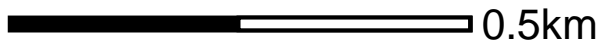
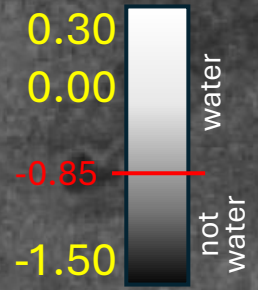
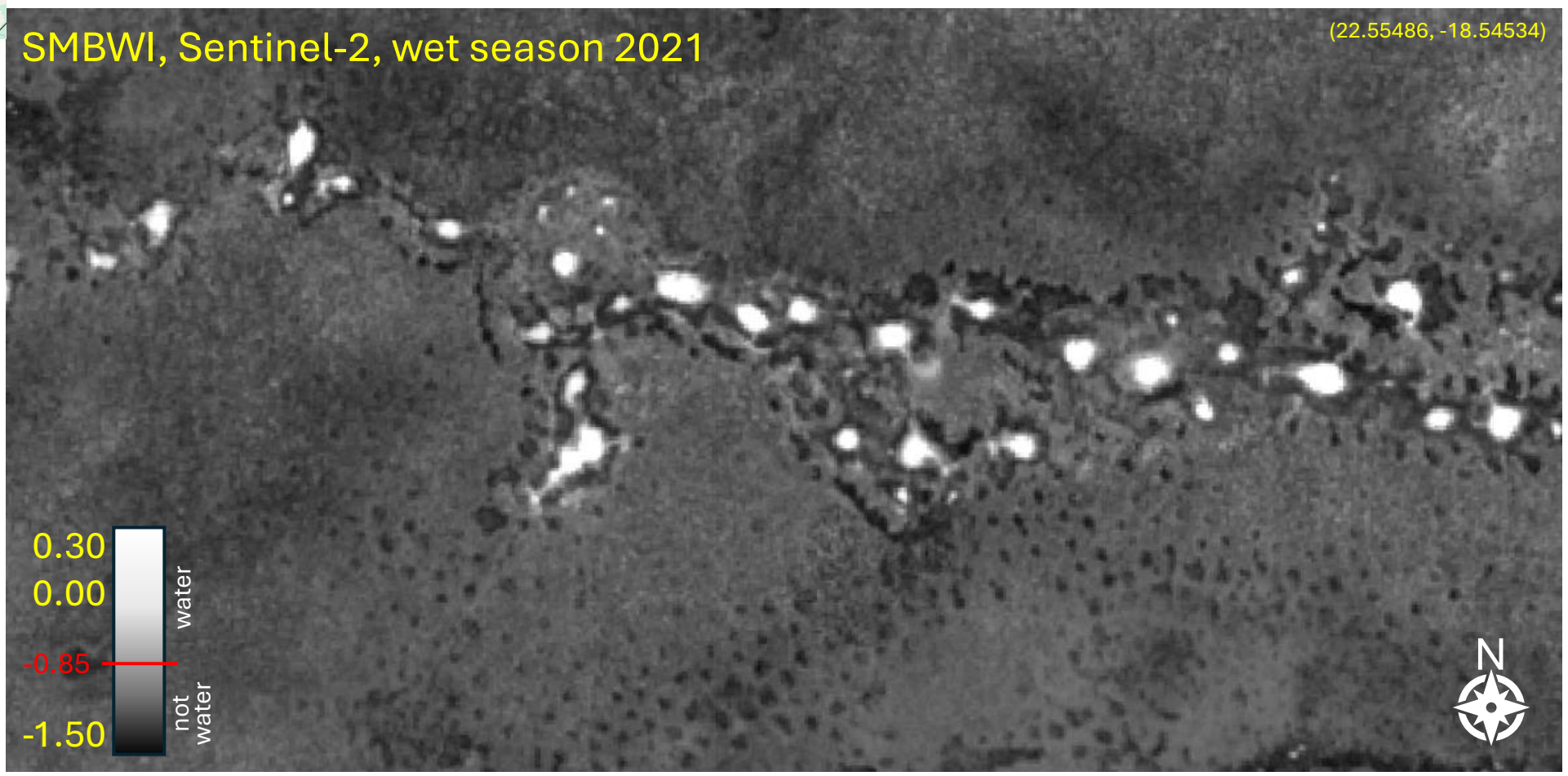
Otsu algorithm
maximizes the difference
between two groups.

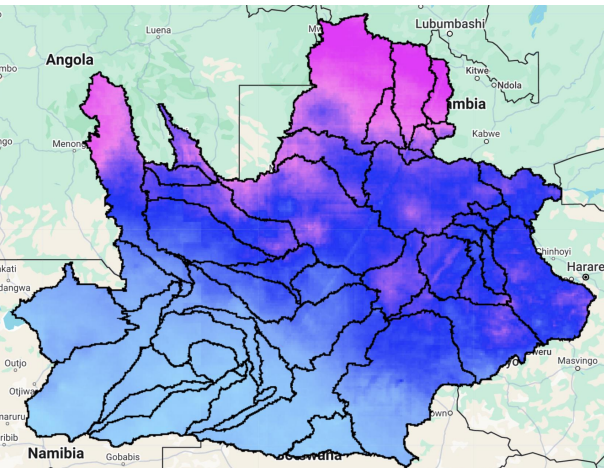


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Yu et al Remote Sensing of Environment (140) 2024.

SMBWI, Sentinel-2, wet season 2021

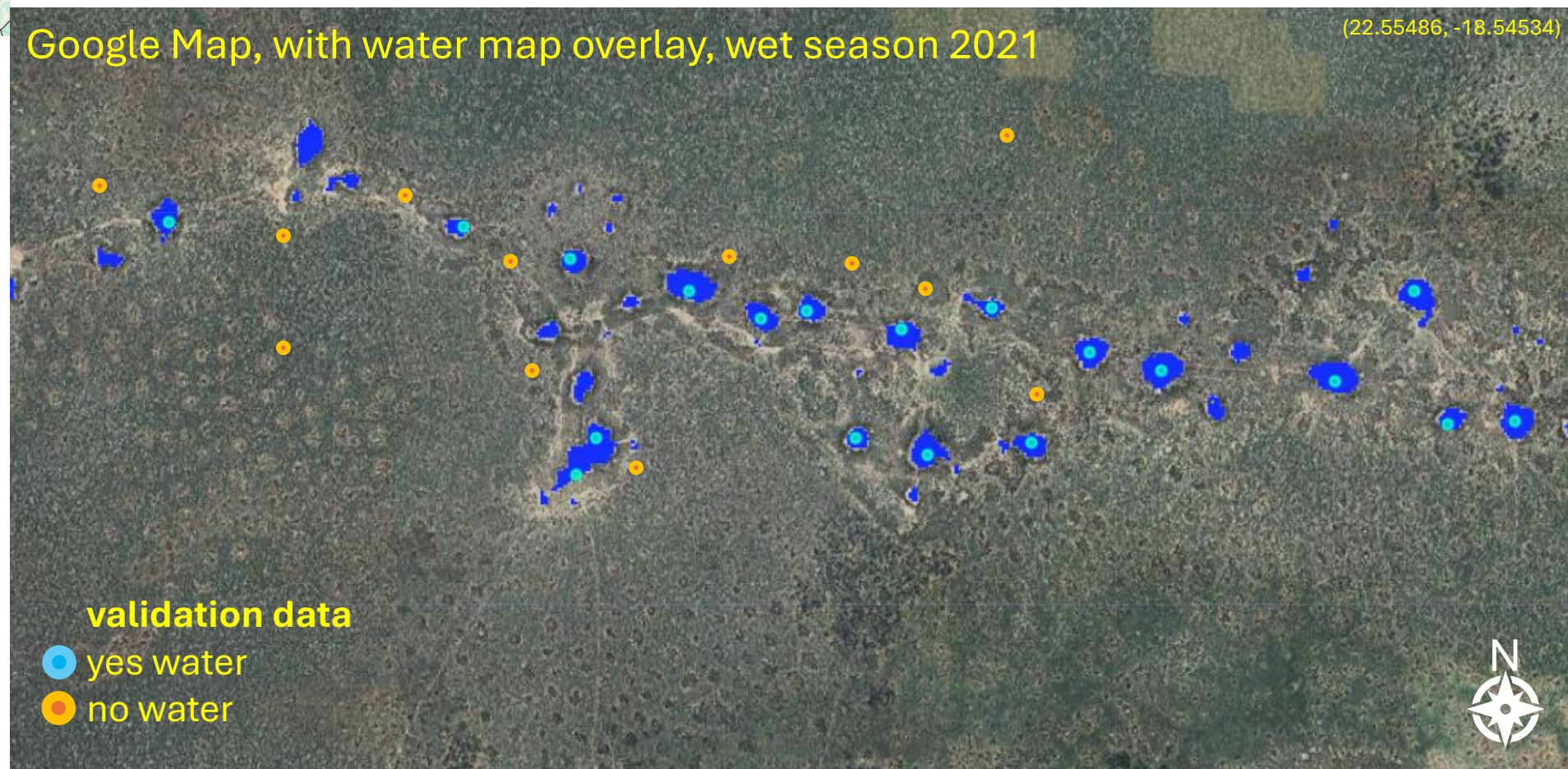
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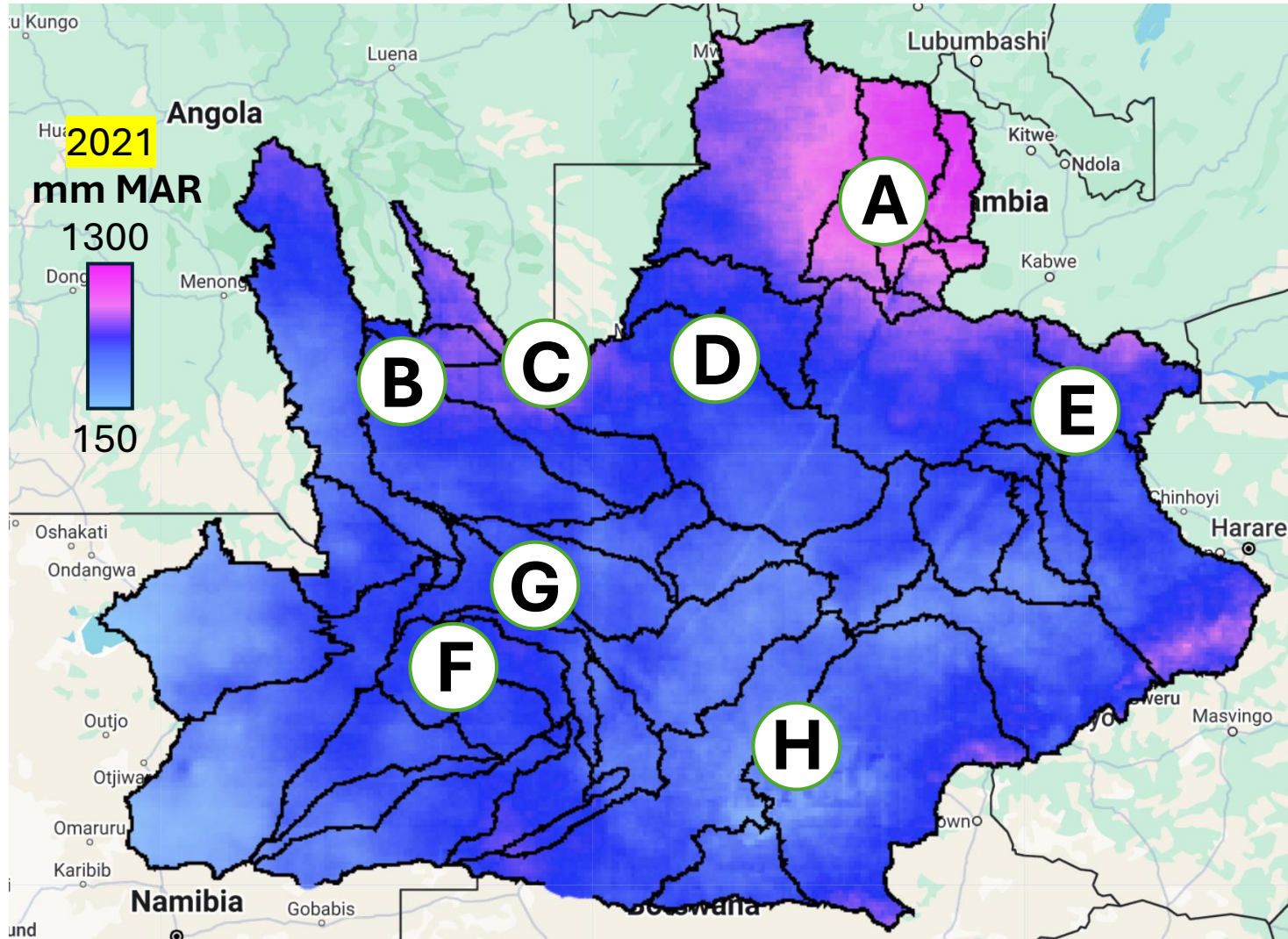


Google Map, with water map overlay, wet season 2021

(22.55486, -18.54534)



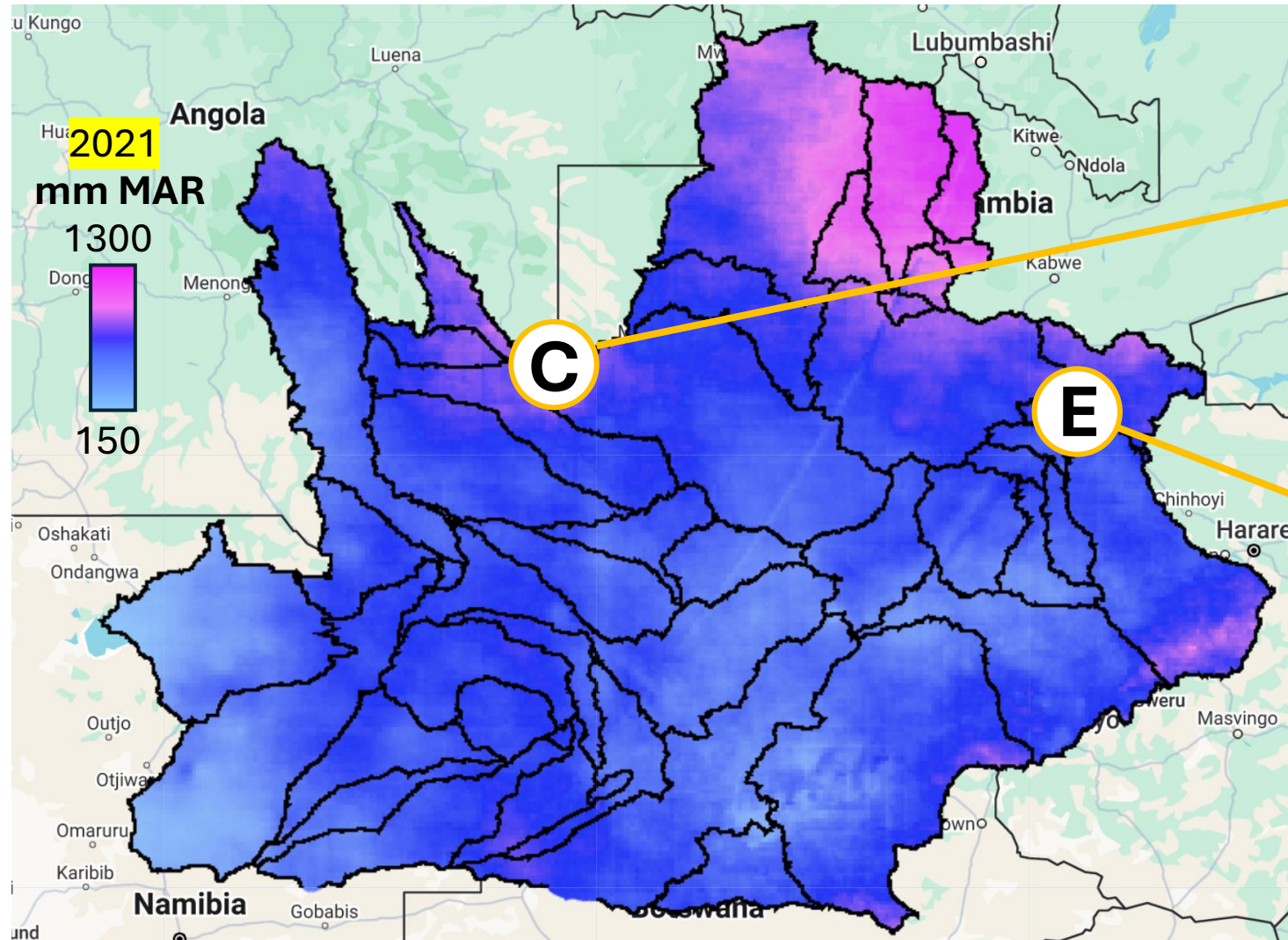
0.5km



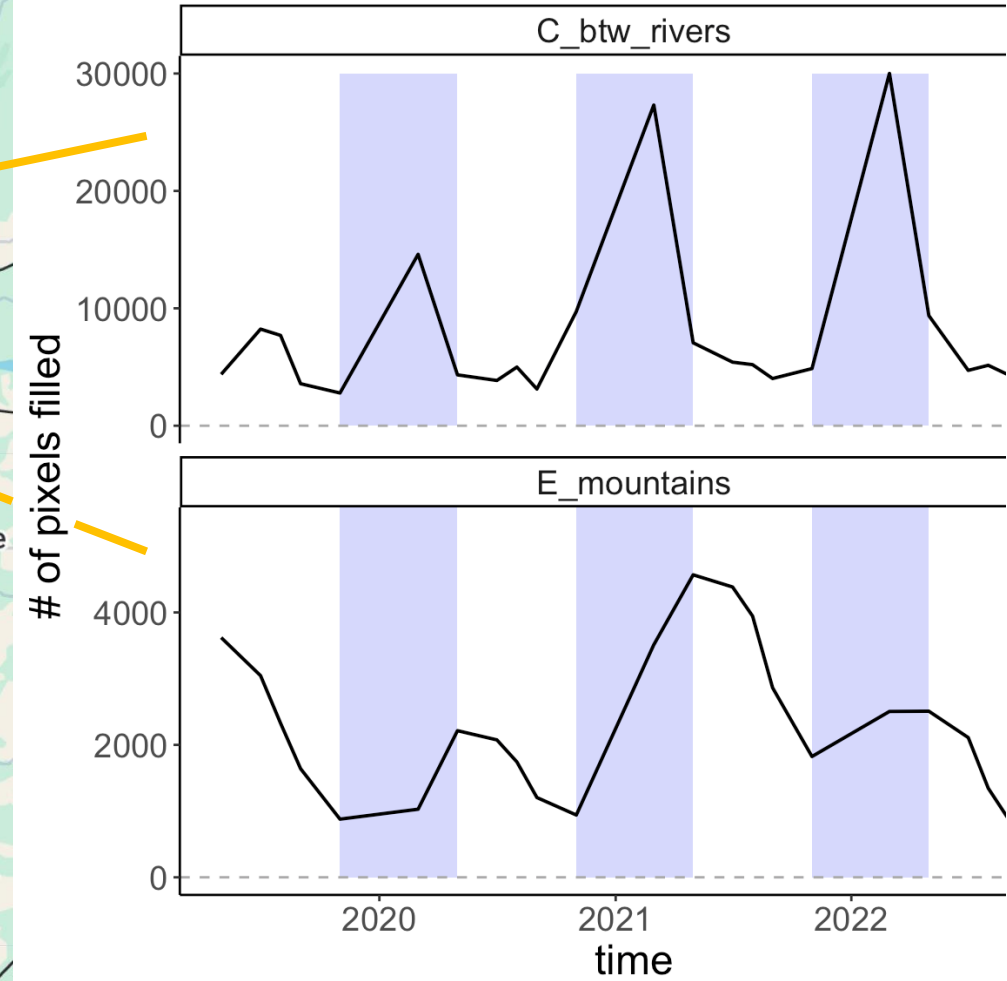
validation accuracy

	water	not water	accuracy
A	76	100	Good
B	64	100	Fine
C	100	95	Excellent
D	46	100	Poor
E	98	100	Excellent
F	80	99	Good
G	98	100	Excellent
H	99	40	Poor

Peak fill times and magnitudes vary by region and year

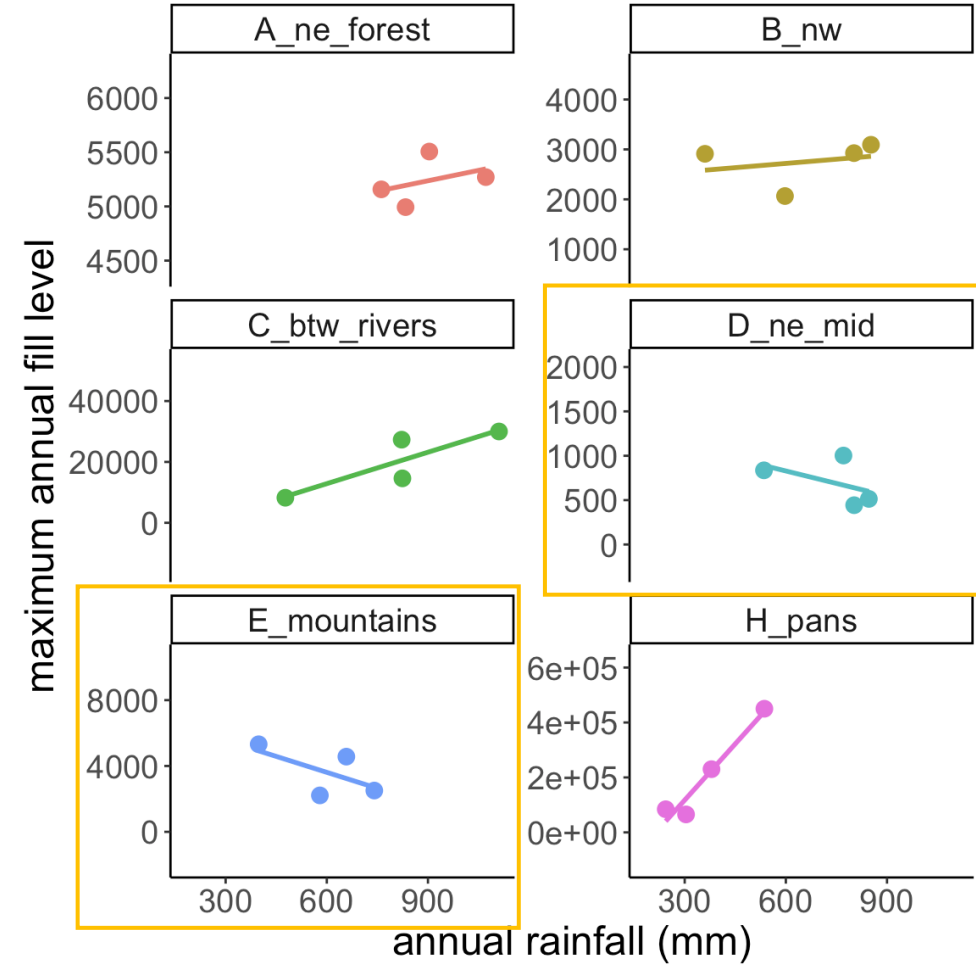
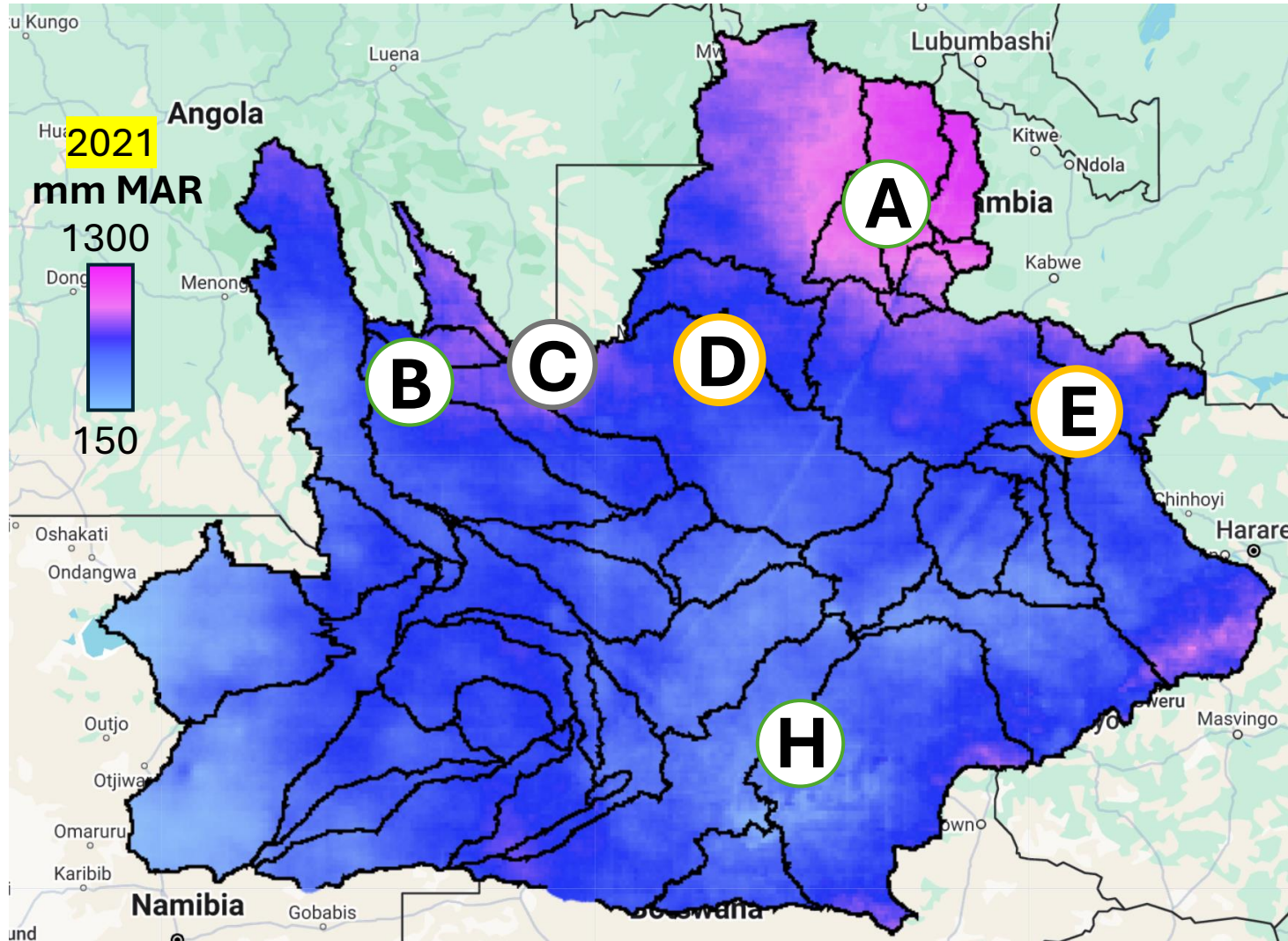


Change in surface water fill over time



wet season *Nov - April*
dry season *May - Oct*

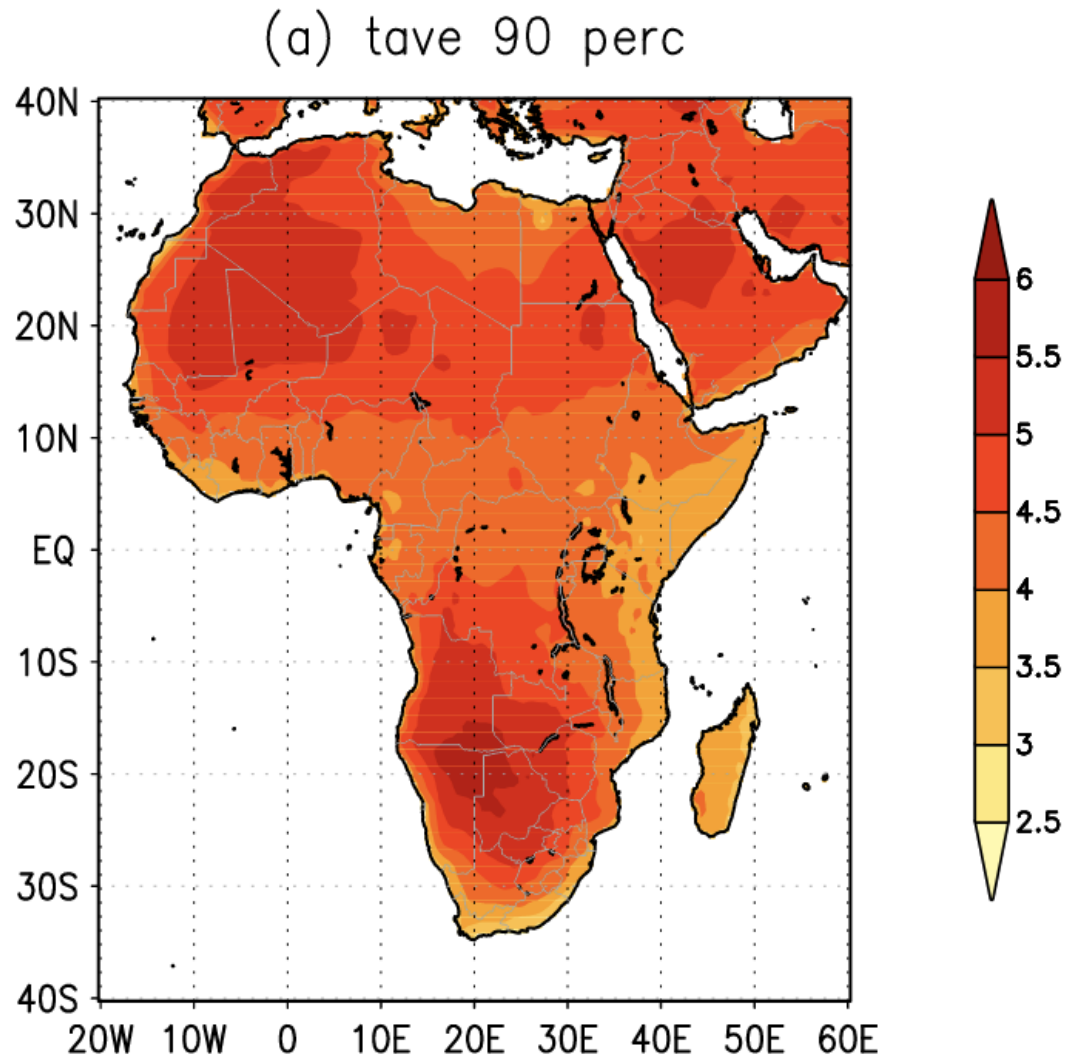
Surface water fill trends generally follow rainfall



LMM : maximum annual fill ~ annual rainfall (mm) + (1 | region)

→ Main effect: 50px of water gain per mm of rainfall gain

Next step:
Estimate
fine-scale
surface water
dynamics under
climate change

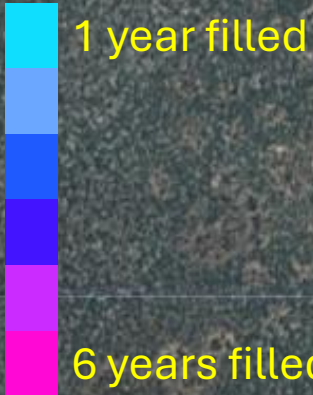


Projected change in annual-average temperature (°C) over Africa
2071–2100 relative to 1961–1990.

Engelbrecht et al 2015; Figure 5.

Google Earth image with water fill frequency overlay

(22.55486, -18.54534)



water fill calculated for each wet season of 2019-2024 (6 years)



0.5km











Thank you!

- Steve Osofsky
- Robin Naidoo
- Shirley Atkinson
- Danica Schaffer-Smith
- Jennifer Swenson
- Allison Killea

margaret.swift@cornell.edu

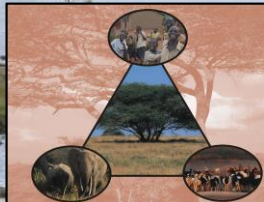
www.maggie.earth

wildlife.cornell.edu



Cornell University

Cornell K. Lisa Yang
Center for Wildlife Health



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