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Remote Sensing-Based Water Balance Assessment of the Syr Darya and Amu Darya Basins

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INTRODUCTION & AIM

The Syr Darya and Amu Darya river basins are among the most critical freshwater sources in Central Asia. However, hydrological monitoring across the region remains challenging due to the limited availability of ground-based observations. As a result, understanding long-term changes in water storage and availability has become increasingly difficult.

Aim

This study aims to quantify and evaluate basin-scale water balance dynamics in the Syr Darya and Amu Darya catchments from 2003 to 2024 using a fully remote sensing-based approach. This approach provides a solid framework for supporting water resource management and offers new insights into how climate variability affects water availability in Central Asia.

METHOD

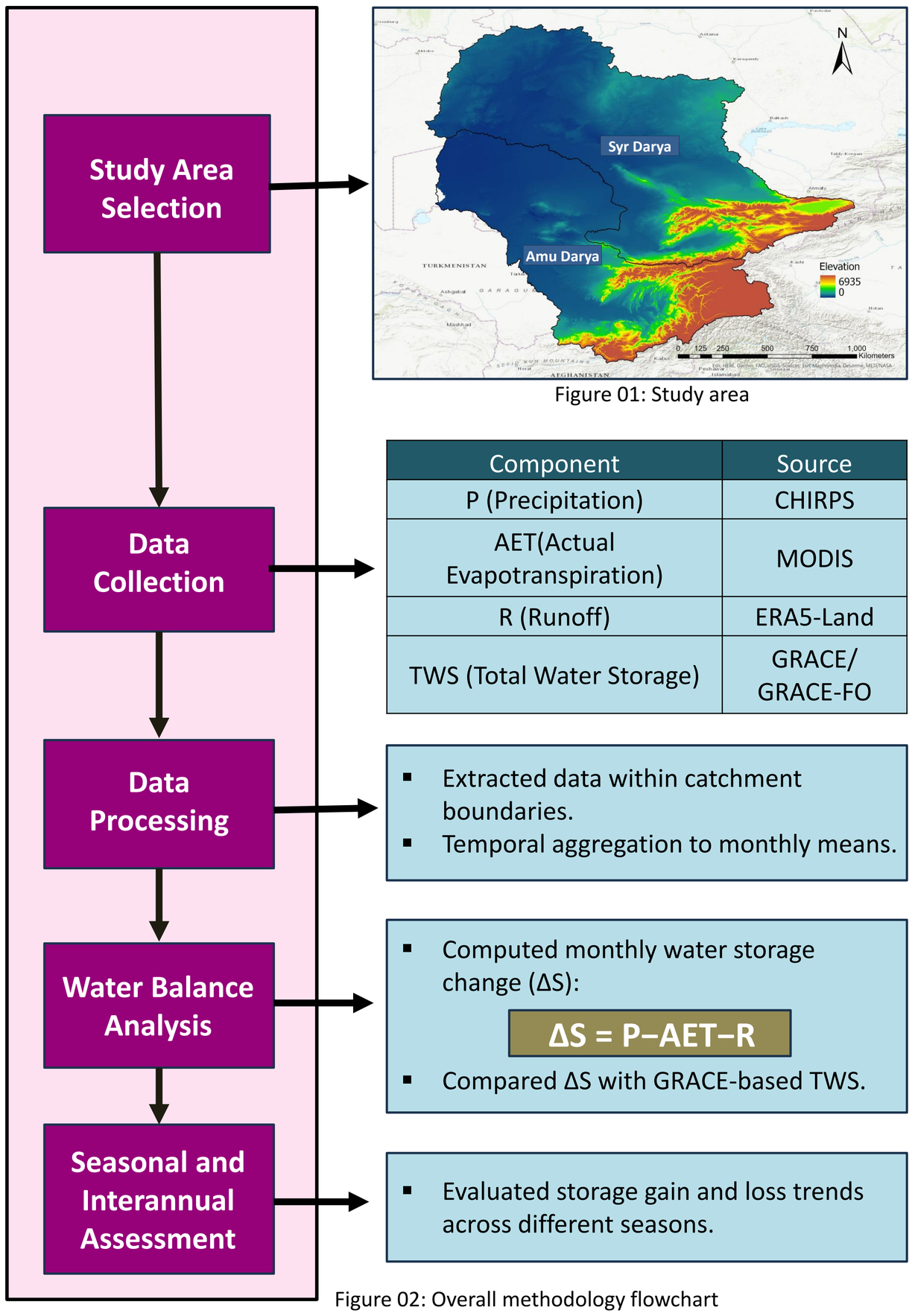

Figure 01: Study area

Figure 02: Overall methodology flowchart

RESULTS & DISCUSSION

Overall Basin-Scale Patterns

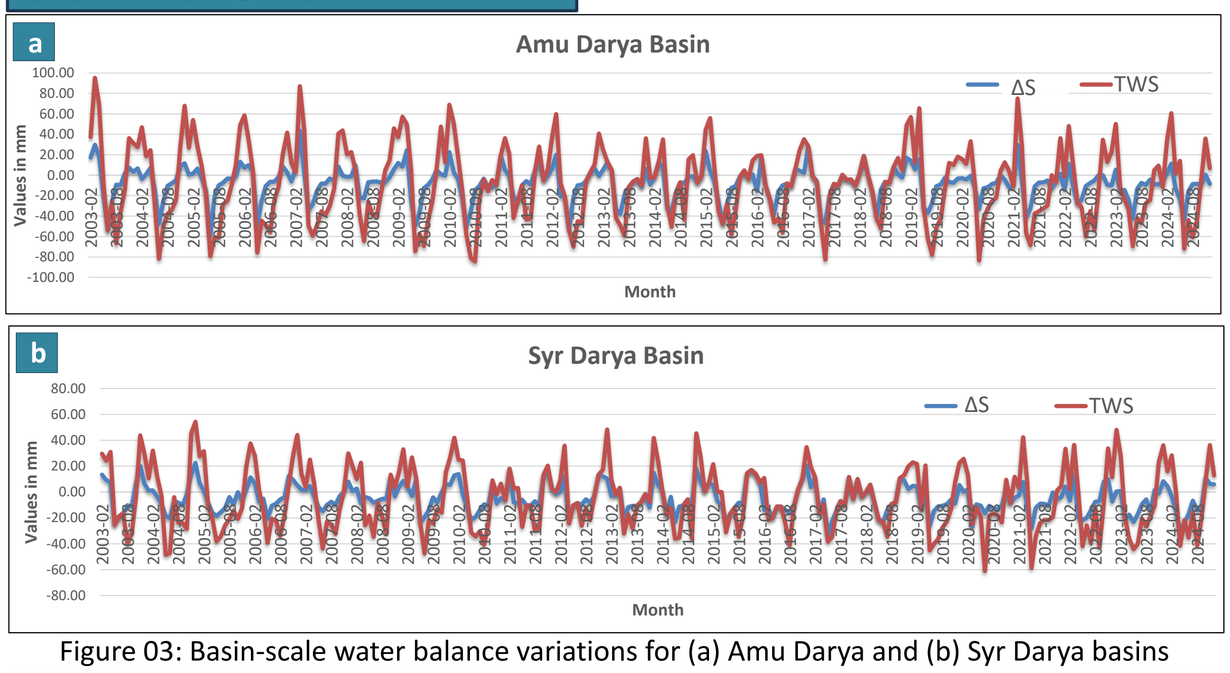

Figure 03: Basin-scale water balance variations for (a) Amu Darya and (b) Syr Darya basins

The GRACE-derived TWS Anomaly show strong correlation with the ΔS, confirming that remote sensing data effectively capture large-scale hydrological variability in both the Syr Darya and Amu Darya basins.

Seasonal Water Balance Dynamics

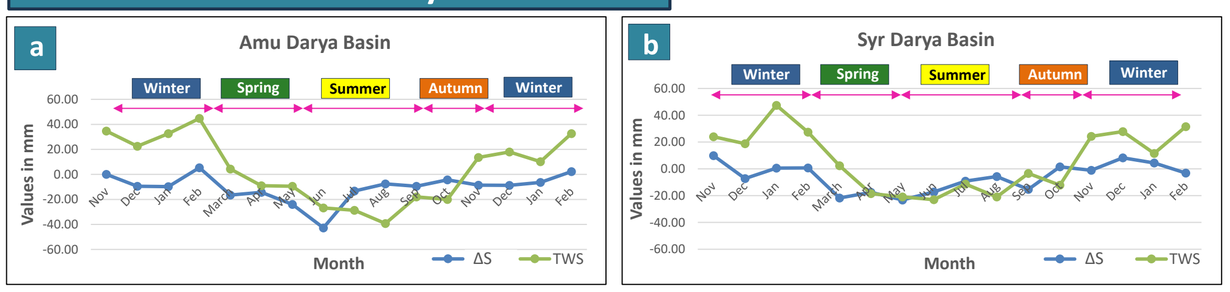

Figure 04: Seasonal water balance variations for (a)Amu Darya and (b)Syr Darya basins

Winter	Higher TWS values indicate storage gain, mainly from precipitation and snow accumulation.
Spring	Rapid storage depletion occurs as snowmelt and rising temperatures increase evapotranspiration and runoff.
Summer	Lower values due to intense evapotranspiration and agricultural water withdrawals.
Autumn	Gradual increment in storage linked to reduced evapotranspiration and the onset of precipitation.

CONCLUSION

Multi-satellite datasets offer a robust approach for monitoring basin-scale water balance dynamics and capturing seasonal hydrological variations across Central Asia, underscoring their importance for sustainable water management in data-scarce regions.

FUTURE WORK

Future work will include LULC (Land Use and Land Cover) and drought index analysis to refine the understanding of the water balance.

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