

Computing a Groundwater Sustainability Index for coastal aquifers in Portugal and California to foster sustainable groundwater management

Introduction and Study Area

Coastal aquifers in Mediterranean climate zones are susceptible to inter-annual and seasonal water storage fluctuations linked to climate forcing and drought. Due to water security concerns in these regions, this comparative study computes a groundwater sustainability index across aquifer systems in Portugal and California using reliability (REL), resilience (RES), and vulnerability (VUL) performance indicators.

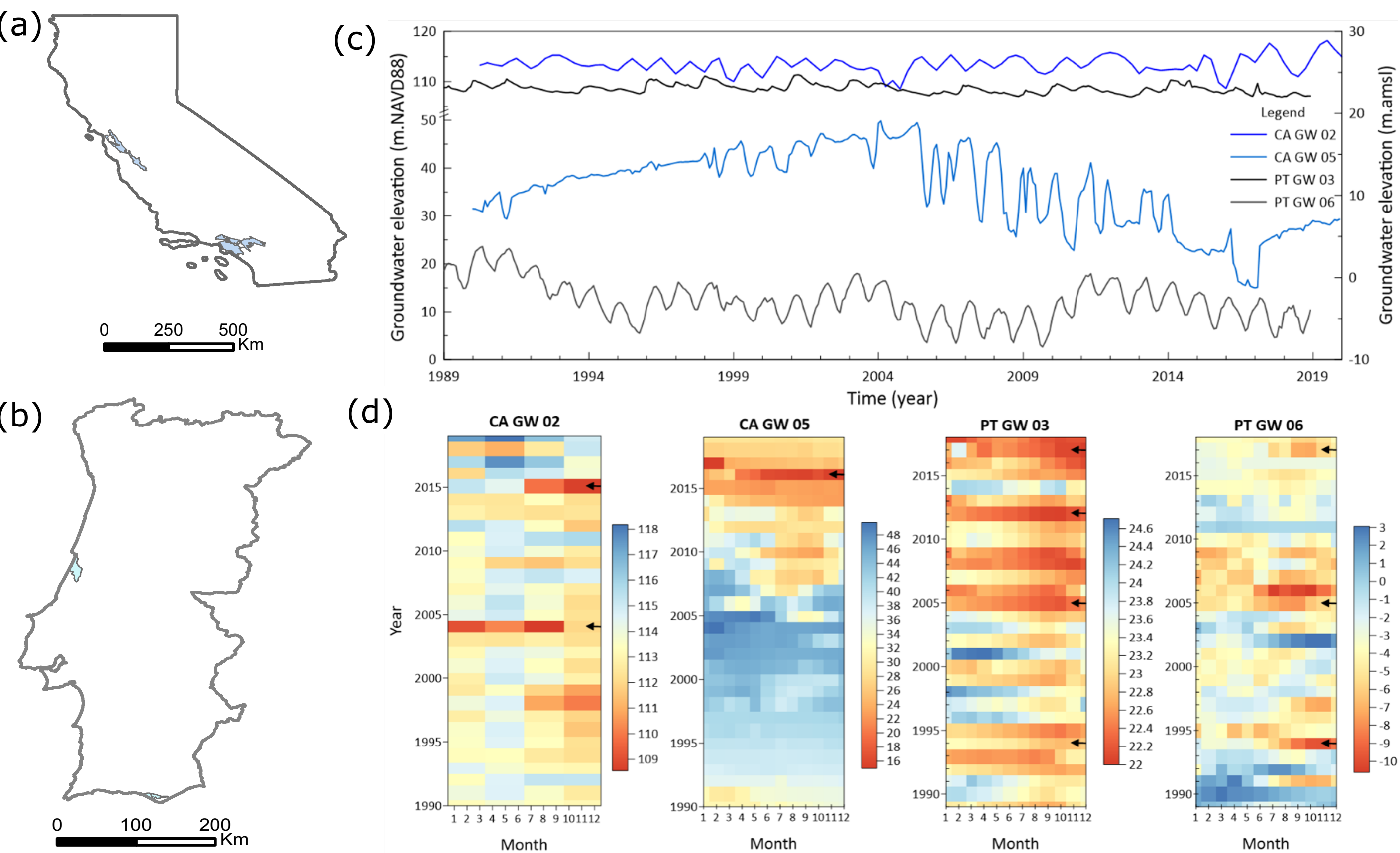


Figure 1 (a) Map showing the location of select aquifers in the California Coastal Basins aquifer system and (b) Portugal's coastal aquifers. (c) Groundwater level time series of observation points: CA GW 02 in Napa, CA GW 05 in Santa Barbara, PT GW 03 in Leirosa (249/4) and PT GW 06 in Campina de Faro (606/647). (d) 30-year time series of groundwater level evolution. Arrows indicate major droughts (USGS Water Science Center, 2020 and IPMA, 2020).

Sustainable Groundwater Management

Groundwater is predominantly a renewable freshwater resource, when managed properly. Both California and Portugal have ratified legislative acts to ensure the long term provision and sustainability of groundwater resources through the Sustainable Groundwater Management Act (SGMA) in California and the River Basin Management Plan (RBMP) in Portugal.

Methodology

REL, RES, VUL performance indicators and a groundwater sustainability index is computed applying methods from Thomas et al (2017) using piezometric levels, which are then analyzed with a point-wise approach to provide an index-per-piezometer.

Results

Performance indicators and the sustainability index provide a clear indication of how well (or poor) an aquifer can withstand drought conditions.

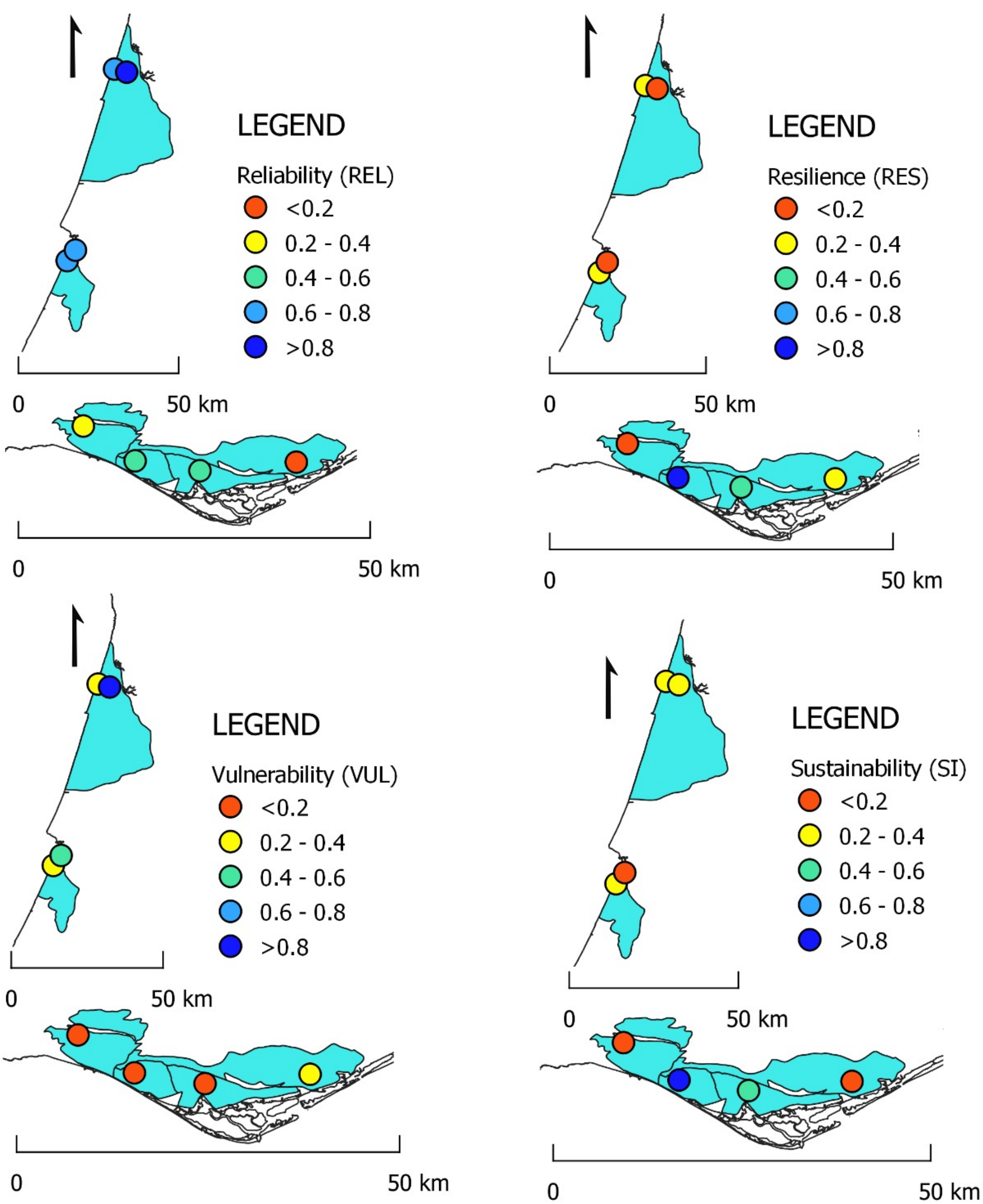


Figure 2 Results of normalized REL, RES, VUL and GSI for groundwater wells in Portugal's coastal aquifers.

Aquifer resilience is the leading performance indicator determining the overall classification. Aquifers with low resilience were in southern California and northern Portugal.

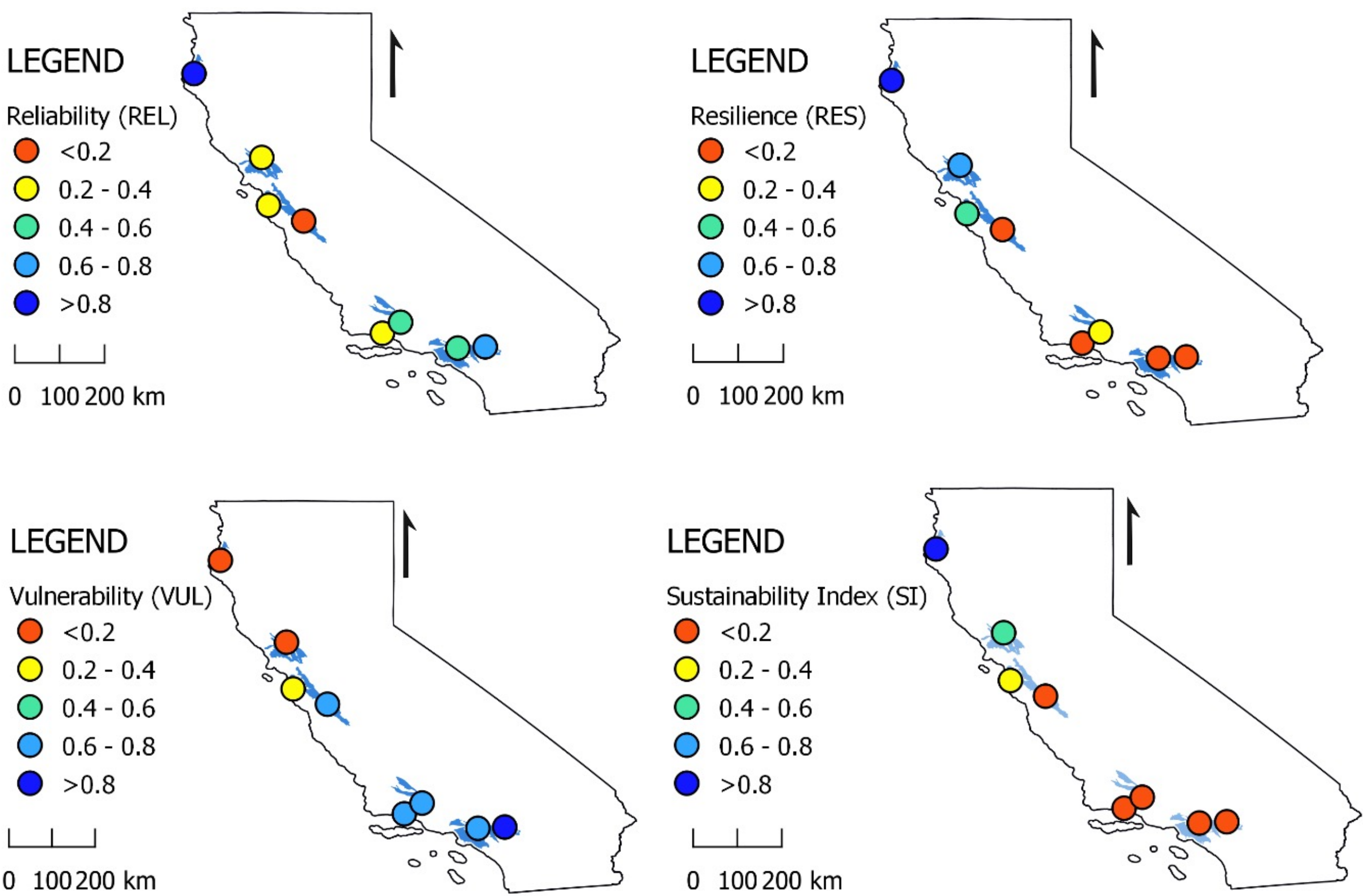


Figure 3 Results of normalized REL, RES, VUL and GSI for the observation points in the California Coastal Basins aquifers.

Conclusion

Comparing the sustainability index classification with basin prioritization from SGMA and RBMP can help identify aquifer systems that may need an immediate policy, conservation, or mitigation interventions.

References

IPMA. (2020). Instituto Português do Mar e da Atmosfera [Portuguese Institute ofSea Atmosphere]. <https://www.ipma.pt/>
USGS Water Science Center. (2020). USGS. <https://ca.water.usgs.gov/california-drought/california-drought-comparisons.html>
Thomas, B. F., Caineta, J., & Nanteza, J. (2017). Global Assessment of Groundwater Sustainability Based On Storage Anomalies. *Geophysical Research Letters*, 44(22), 11,445-11,455. <https://doi.org/10.1002/2017GL076005>

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RESULTS

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CONCLUSION

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