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VeSchN – A Literature Review

WP1 - Referenzdaten

Edberto Moura Lima, Gunther Liebhard, Thomas Weninger

1. Sitzung des Fachbeirates - Projekt Verdunstung Schilf Neusiedler See VESCHN

Eisenstadt, Datum 19.06.2026

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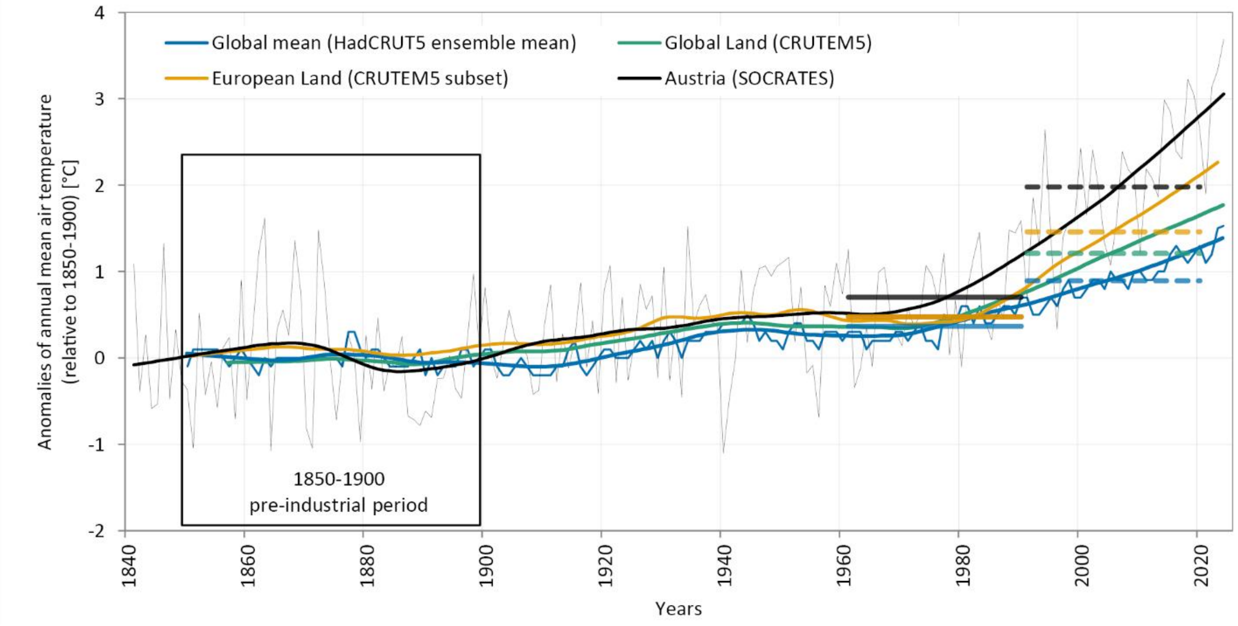
Hydro-Climatic trends – AAR2 on Climate Change



Time series of annual mean air temperature deviations from the pre-industrial mean: Global mean, global land areas, European land areas (bounding box 25 °W – 40 °E, 34 °N – 72 °N) and Austria for the period 1841–2024 (2023 for European land areas). Note that Austrian data is based on 7 homogenized stations and that the global datasets only start in 1850. Thin lines show annual values (for clarity only shown for Austria and the global mean). Thick lines are smoothed with a 42-year LOESS filter. Horizontal lines show the mean values of the 30-year climate normals (1961–1990, solid; 1991–2020, dashed) (Data sources: Geosphere Austria; Auer et al., 2007; Morice et al., 2021; Chimani et al., 2024).

Source: Formayer, H., et al. (2025). Chapter 1. Physical and ecological manifestation of climate change in Austria. Second Austrian Assessment Report on Climate Change | AAR2 - Full Report. Apcc. Wien, Verlag der Österreichischen Akademie der Wissenschaften: **1–82.**

Hydro-Climatic trends – Annual Temperature

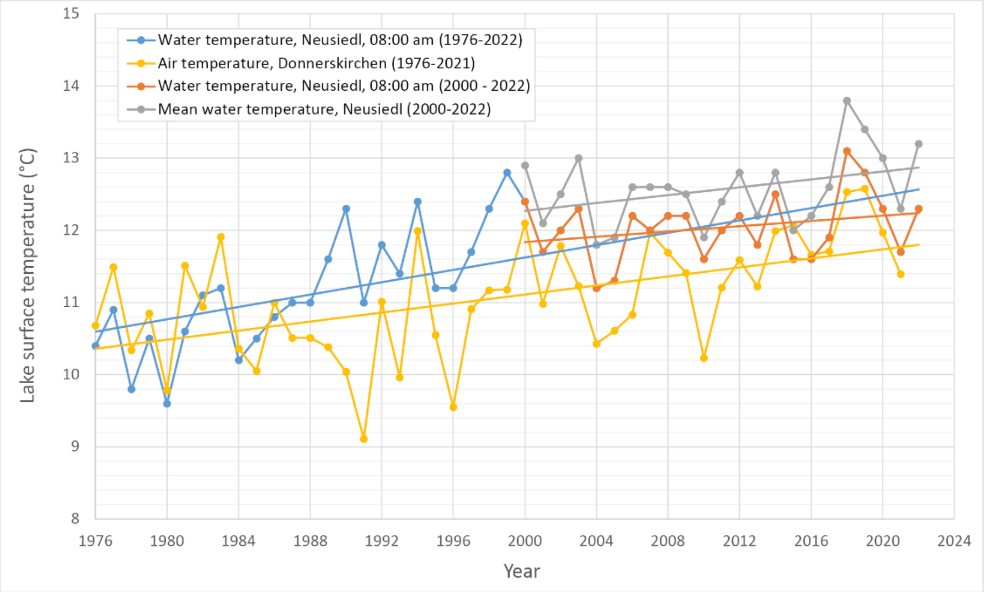
Index	Value	Range
Mean Annual Temp (1985–2025)	+0.5°C/decade	—
Frost Days	↓ 2–3 days/decade	10–180 days/year
Summer Days (≥25°C)	↑ 1–2 days/decade	80–150 days/year

Frost days declining → Longer snowmelt season → Earlier streamflow peak
Summer days increasing → Higher evapotranspiration → Reduced recharge season
Warm extremes amplifying → Heat stress on vegetation → Reduced plant water uptake → Altered runoff coefficients
Consequence: Seasonal water availability shifting from winter/spring (snow) to autumn (rain), creating supply-demand mismatch for agriculture.

Hydro-Climatic trends – Annual Precipitation

Metric	Value	Range	Interpretation
Mean (1985–2025)	650 mm	522–877 mm	Below historical average
Trend	Neutral	±9%	No significant change
Wet Years		9 years >700 mm	1995, 2013, 2023
Dry Years		6 years <550 mm	1989, 2001, 2002, 2018, 2021, 2024
CV (Coefficient of Variation)	16%		**High variability**

Hydro-Climatic trends - Neusiedl



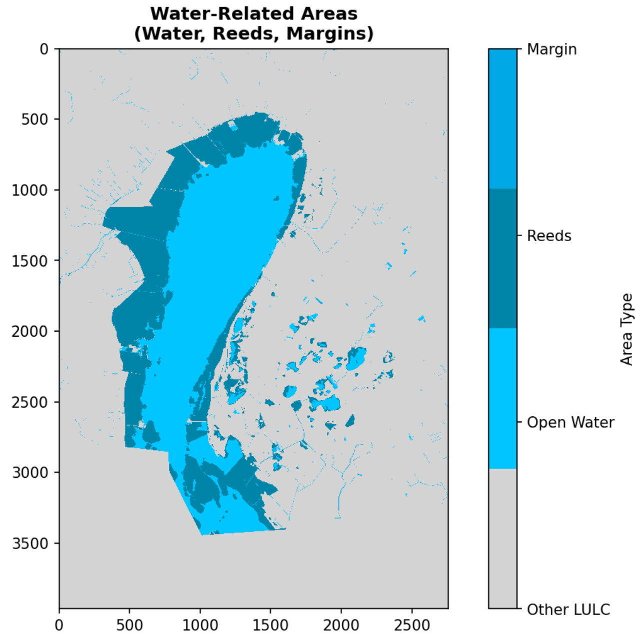
Mean annual changes in surface water temperatures of Lake Neusiedl. From 1976 to 2022, the water temperature has increased by 1.9°C (data source: Hydrographischer Dienst Burgenland, wasser.bgld.gv.at/).

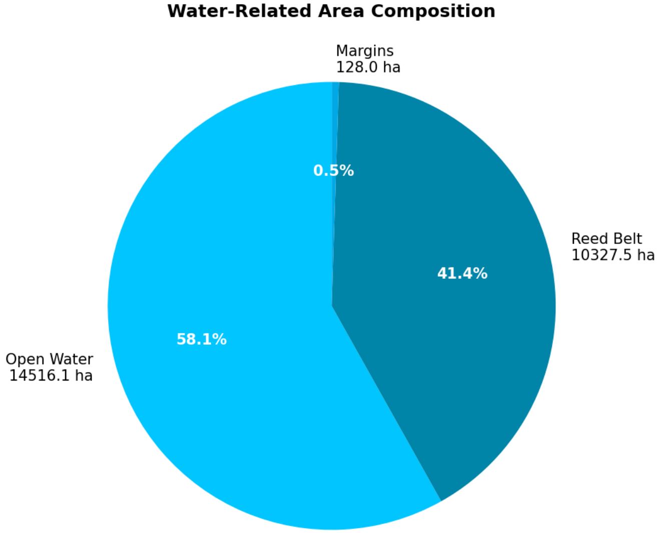
Lake Neusiedl Water Balance

- Dependent on direct precipitation
- The lake has little to no groundwater inflow (hydrologically disconnected)
- Water loss is mainly driven by:
    - High evaporation rates due to rising temperatures
    - Decreasing precipitation
- In 2022, lake level was 10–50 cm below the long-term average (115.5 m a.s.l.)
- Indicates increasing climate-driven water stress

Source: Formayer, H., et al. (2025). Chapter 1. Physical and ecological manifestation of climate change in Austria. Second Austrian Assessment Report on Climate Change | AAR2 - Full Report. Apcc. Wien, Verlag der Österreichischen Akademie der Wissenschaften: **1–82.**

Why Quantify Reed Transpiration?

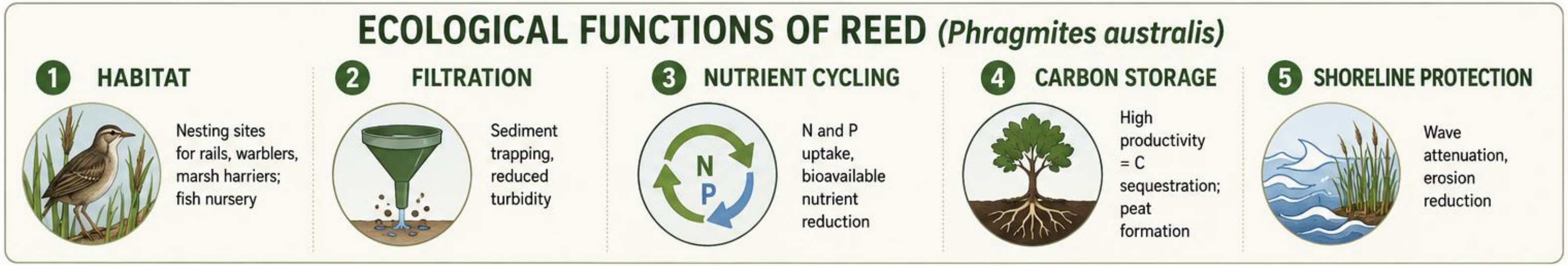




Phragmites australis (Cav.) Trin. ex Steud.

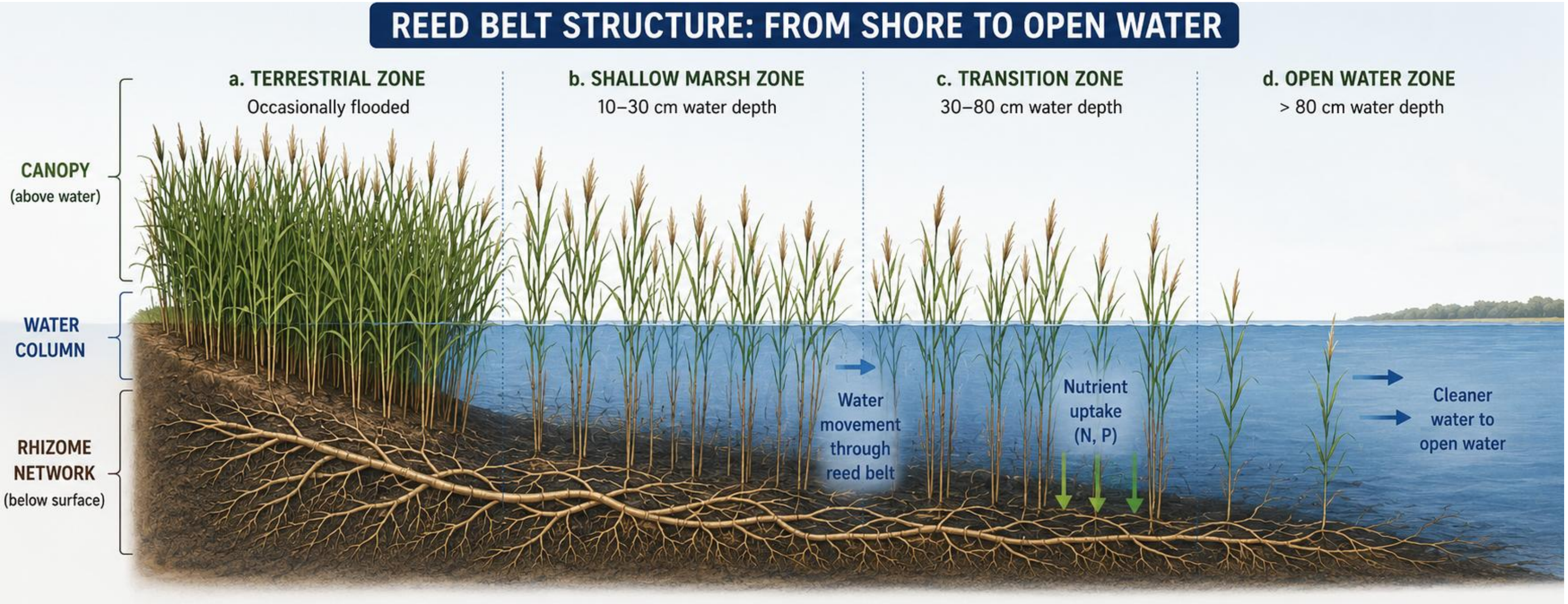
- **Common Name**: Common Reeds
- **Habitat:** Riverbeds and wet places
- **Distribution:** Cosmopolitan - Widespread and worldwide.

Source: https://worldfloraonline.org/taxon/wfo-0000890172



Source: Image generated by artificial intelligence (AI).

Why Quantify Reed Transpiration?



Source: Image generated by artificial intelligence (AI).

A Literature Review

- Quantitative measurements or model estimates of ET/transpiration
- Studies on *Phragmites australis* or related reed species
- Research in freshwater wetlands, shallow lakes, or reed-dominated systems
- Studies providing explicit ET values (mm day^{-1}, mm $season^{-1}$, or equivalent)
- Publication date: 1980-present

Title and abstract screening:

Reviewed ~200 records, identified ~80 potentially relevant studies

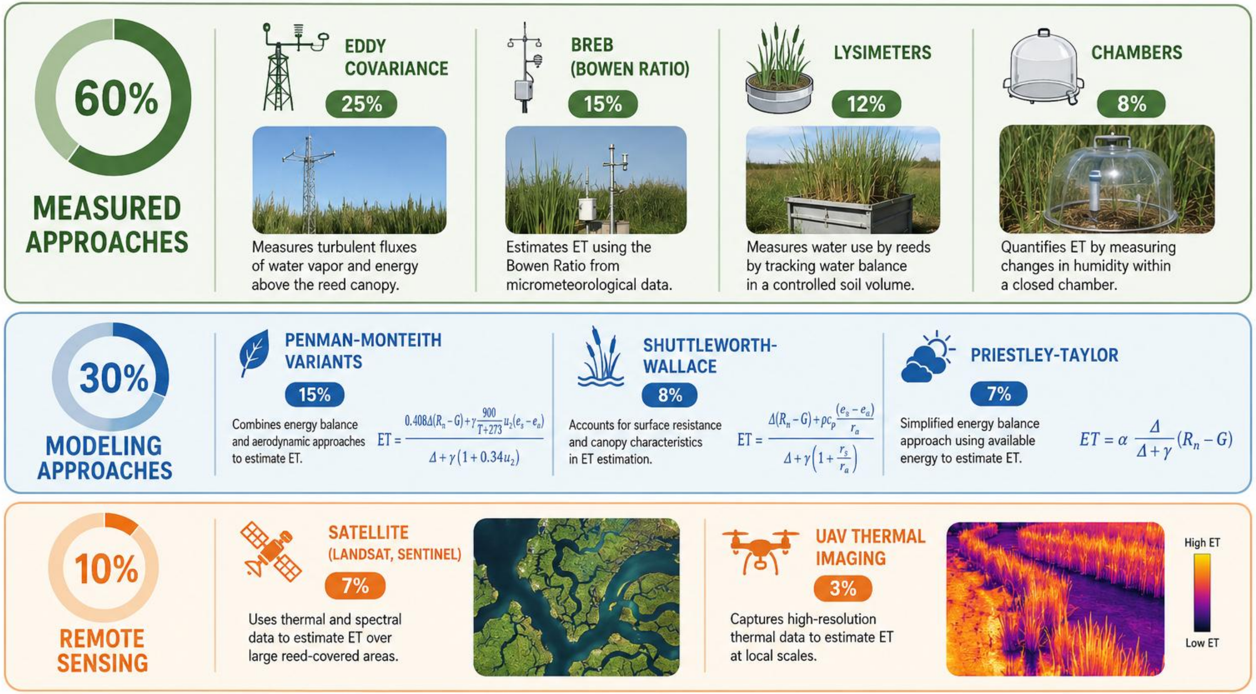
Selected:

~35-45 studies with quantitative ET data

What Have Studies Found?

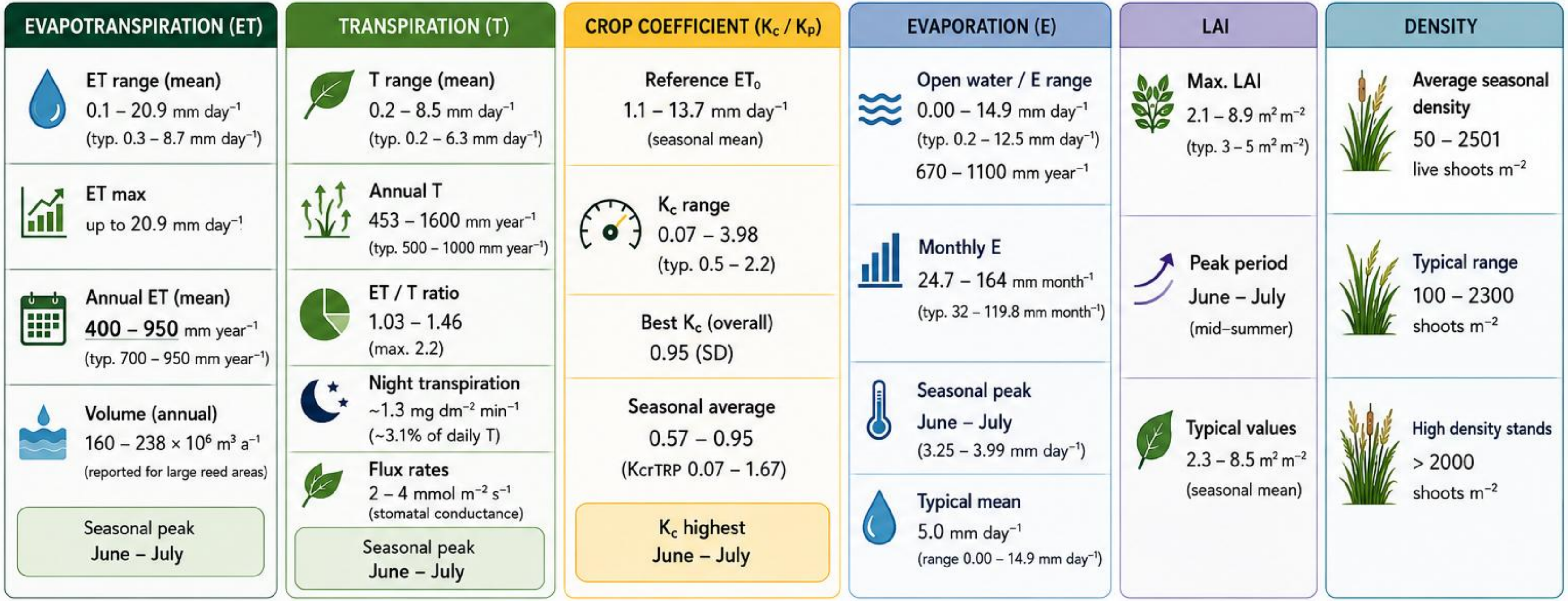
- Study period: 1986–2025
  - → 65% of studies published after 2005
- Geographic coverage: 12 countries across three climate zones
  - Temperate (45%)
  - Mediterranean (35%)
  - Subtropical (20%)
- Measurement scales:
  - Plot-scale experiments
  - Field-scale installations
  - Landscape-scale remote sensing

How Do We Measure Reed Evapotranspiration?



Source: Image generated by artificial intelligence (AI).

What Have Studies Found?



Source: Image generated by artificial intelligence (AI).

Can Reed Management Reduce Water Loss?

1. Reed harvesting/cutting
   - Reduces transpiration by 30-50% in first season post-harvest – **summer season cut**
   - Regrowth typically restores ET to 80-90% of pre-harvest levels within 12-18 months
   - Potential water savings: Modest (50-100 mm yr^{-1}) and temporary
2. Controlled burning
   - Winter burns: Similar effects to cutting, with faster regrowth in spring
   - Spring burns: Potentially more disruptive; may delay vegetation development
3. Water level manipulation
   - Lowering water table: Increases water stress, reduces ET by 10-30%
   - Raising water table: Increases available water, may increase ET by 10-20%
   - Effects interact with seasonal timing and antecedent moisture
4. Grazing/herbivory
   - Reduces LAI and canopy structure
   - ET reduction: 20-40% proportional to biomass removal
   - Recovery variable (1-3 years)

Key Takeaways

1. **Reed transpiration is substantial** (550-950 mm yr^-1) and dominates water loss (T/E > 1.5)
2. **Solar radiation is the primary control** across all climates; water availability has threshold effects
3. **Measurement method matters**: 15-20% difference between plot and field-scale estimates
4. **Research gaps limit management options**: Quantified management effects are minimal; climate change responses uncertain
5. **Water balance integration is critical**: ET quantification essential for lake management under climate change

Danke für Ihre Aufmerksamkeit!

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Reference

ASCE Environmental and Water Resources Institute. (2025). Evapotranspiration Terminology and Definitions. Journal of Irrigation and Drainage Engineering, 151(5), 06025003. ASCE Technical Note. https://doi.org/10.1061/JIRDI.IRHD-i0491

Crundwell, E. M. (1986). A review of hydrophyte evapotranspiration. Rev. Hydrobiol. Trop., 19(3-4). Retrieved from https://horizon.documentation.ird.fr/exl-doc/pleins_textes/cahiers/hydrob-trop/25121.pdf

Fermor, P. M., Hedges, P. D., Gilbert, J. C., & Gowing, D. J. G. (2001). Reedbed evapotranspiration rates in England. Hydrological Processes, 15(4), 621-631. https://doi.org/10.1002/hyp.174

Moro, M. J., Domingo, F., & López, G. (2004). Seasonal transpiration pattern of Phragmites australis in a wetland of semi-arid Spain. Hydrological Processes, 18(2), 213-227. https://doi.org/10.1002/hyp.1371

Packer, J. G., Meyerson, L. A., Skalova, H., Pysek, P., & Kueffer, C. (2017). Biological Flora of the British Isles: Phragmites australis. Journal of Ecology, 105(5), 1123-1162. https://doi.org/10.1111/1365-2745.12797

Sanchez-Carrillo, S., Angeler, D. G., Sánchez-Andrés, R., Alvarez-Cobelas, M., & Garatuza-Payán, J. (2004). Evapotranspiration in semi-arid wetlands: relationships between inundation and the macrophyte-cover:open-water ratio. Advances in Water Resources, 27(6), 643-655. https://doi.org/10.1016/j.advwatres.2004.02.018

Yu, W., Zhou, G., Chi, D., He, Q., & Zhou, L. (2008). Evapotranspiration of Phragmites communis community in Panjin wetland and its control factors. Acta Ecologia Sinica, 28(9), 4594-4601. Retrieved from https://www.researchgate.net/publication/

Zhou, L., Zhou, G., Liu, S., & Sui, X. (2010). Seasonal contribution and interannual variation of evapotranspiration over a reed marsh (Phragmites australis) in Northeast China from 3-year eddy covariance data. Hydrological Processes, 24(8), 1039-1047. https://doi.org/10.1002/hyp.7545