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Establishing parameter value distributions for SWAT and SWAT+ models

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SUSTAINABLE DEVELOPMENT GOALS

Background and problem statement

- SWAT is a comprehensive catchment process modelling system
- Integrated with topographic, land use and soil data
- Widely used both in research and practice
- Has a **large number of parameters often requiring some level of calibration**
- **Parameter value distributions are often unknown** but usually assumed a uniform in calibration/uncertainly assessment

Objective and method

- Establish parameter value distributions from literature data
- Over 100 published papers were studied. Data from over 40 papers with over 60 globally distributed case studies/scenarios were used in the abalysis.
- The literature sources include JH, JH-Regional Studies, HESS, WRR, HP, SOTEN, etc.
- 15 parameters are considered. These are most commonly used parameters in SWAT model calibration.
- Parameter distributions are derived from the calibrated values reported in the case studies.
- Cross-correlations are analysed and the significance of the correlations are tested.

Parameters considered

CN2.mgt_r	SCS runoff curve number
SOL_AWC.sol_r	Available water capacity
SOL_K.sol_r	Saturated hydraulic conductivity (mm/h)

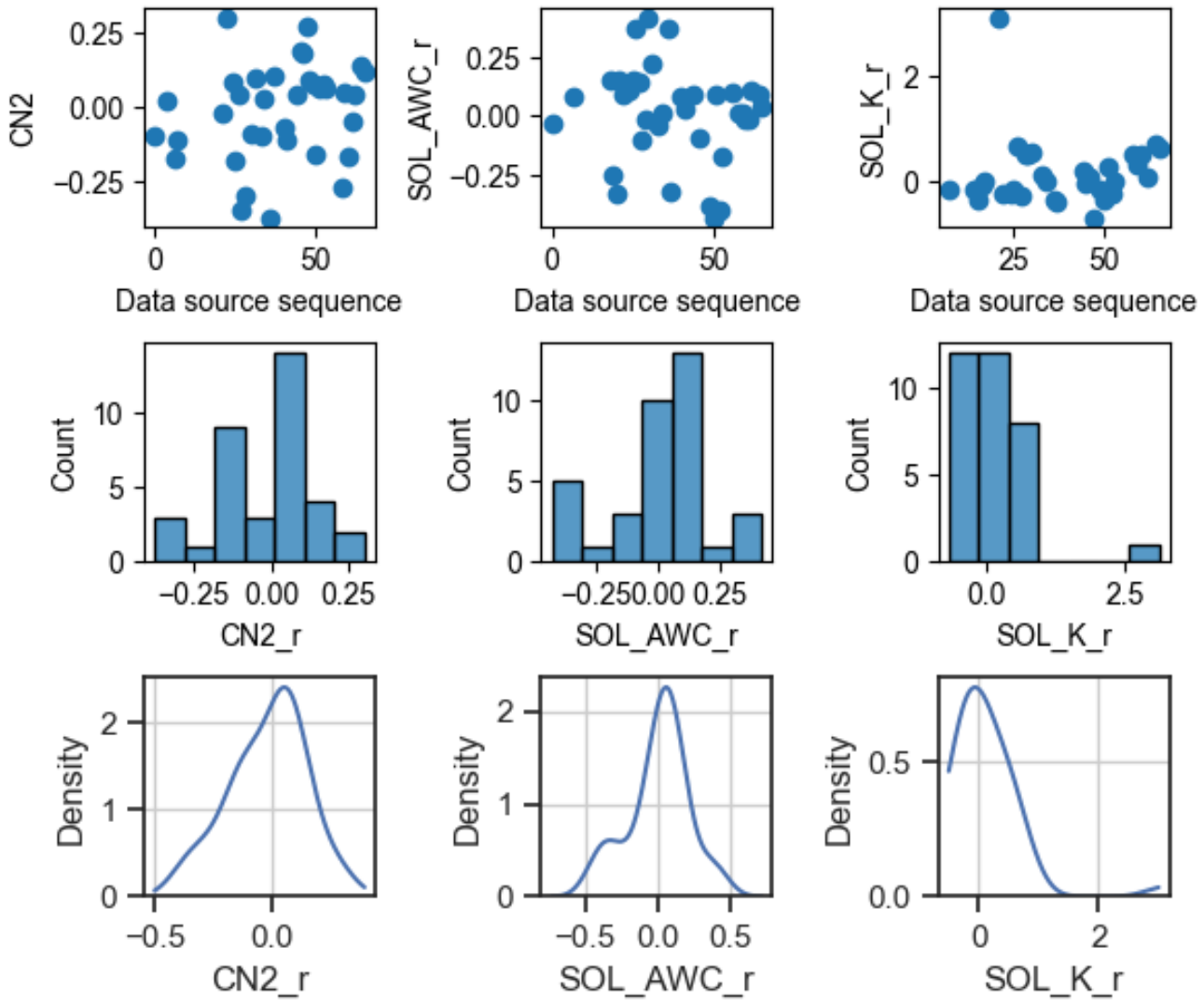
ALPHA_BF.gw	Baseflow alpha factor (days).
GW_DELAY.gw	Groundwater delay (days).
RCHRG_DP.gw	Deep aquifer percolation fraction.
GWQMN.gw	Water depth in the shallow aquifer for return flow to occur (mm).

GW_REVAP.gw	Groundwater "revap" coefficient.
REVAPMN.gw	Threshold depth of water in shallow aquifer to "revap" occur (mm).
ESCO.hru	Soil evaporation factor.
EPCO.hru	Plant uptake compensation factor.
CANMX.hru	Maximum canopy storage (mm).

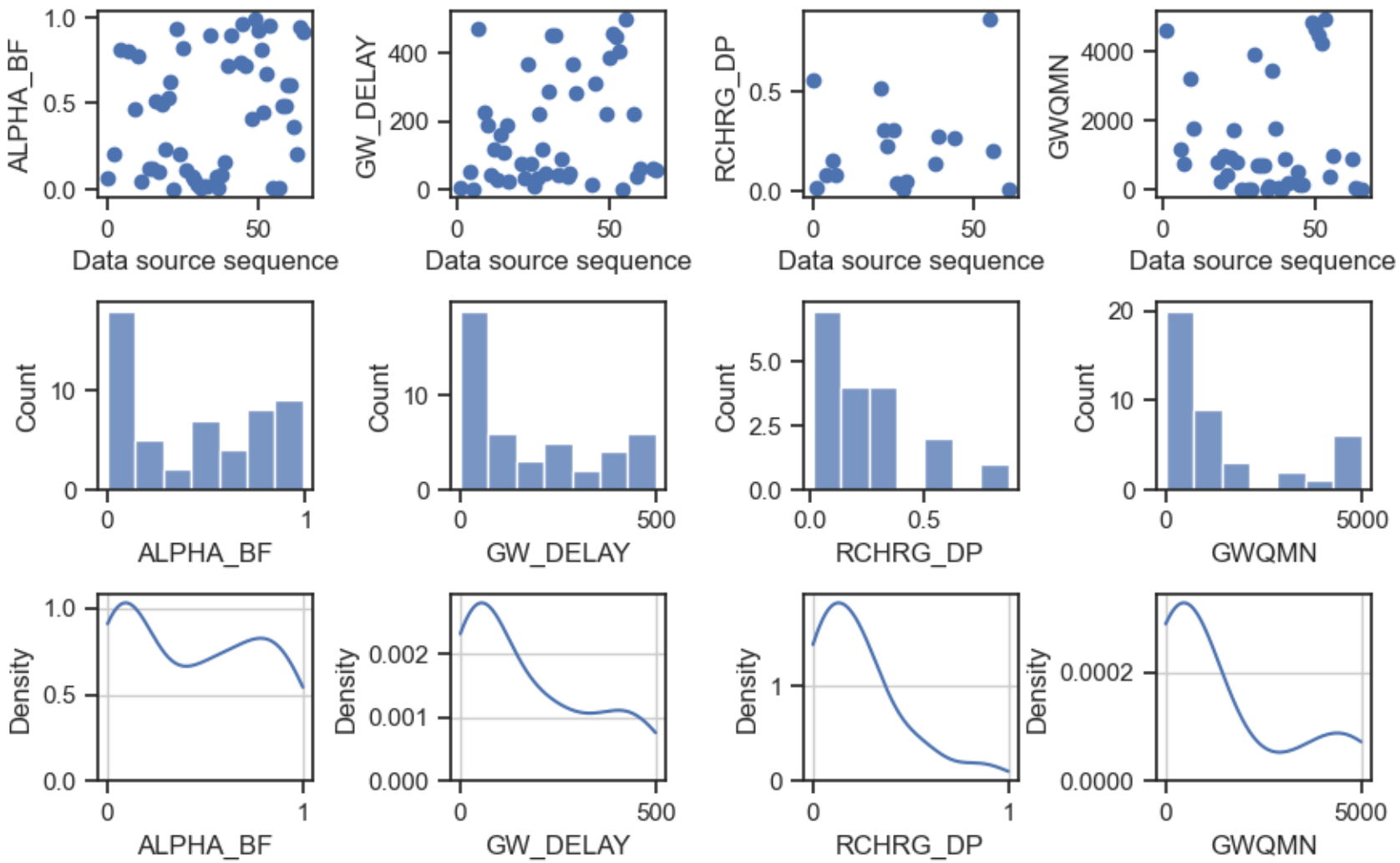
SURLAG	Surface runoff lag coefficient
CH_N2.rte	Manning’s n value for the main channels
CH_K2.rte	Effective hydraulic conductivity in the main channel (mm/h)

Preliminary results

- Almost all parameters showed starkly non-uniform distribution.
- For most parameters, most likely value ranges are smaller than the default / initial value ranges often used.



Preliminary results



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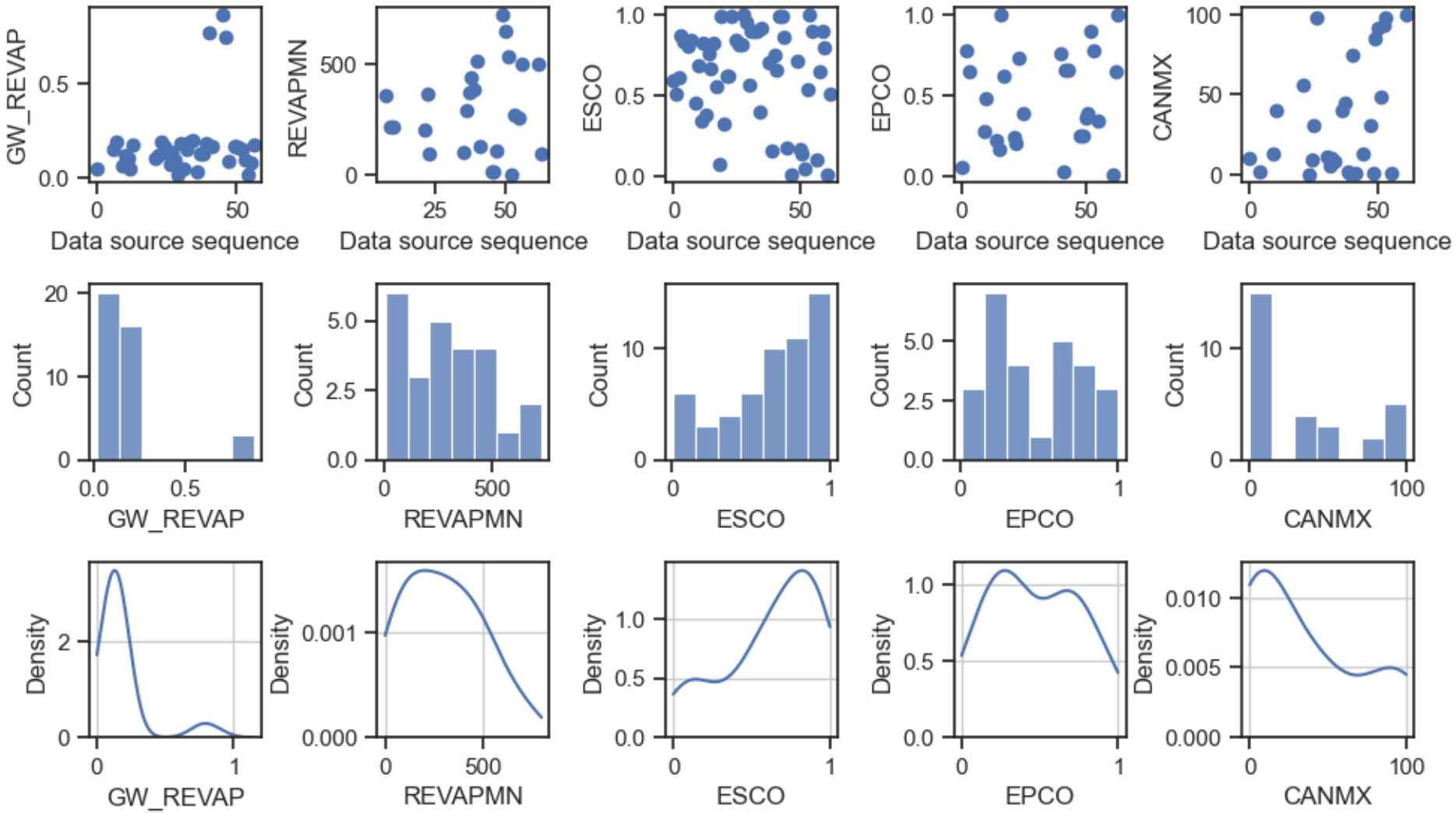

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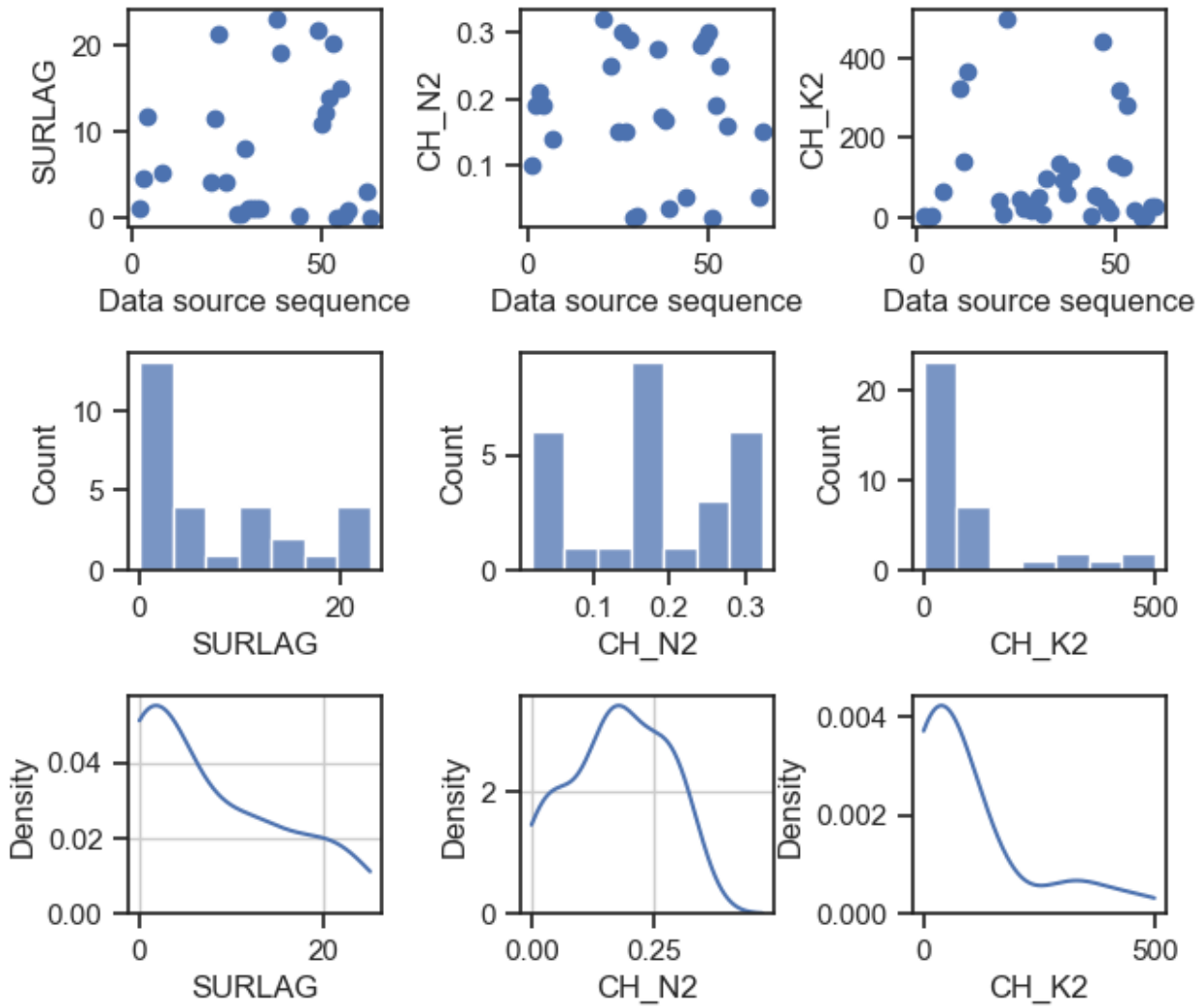
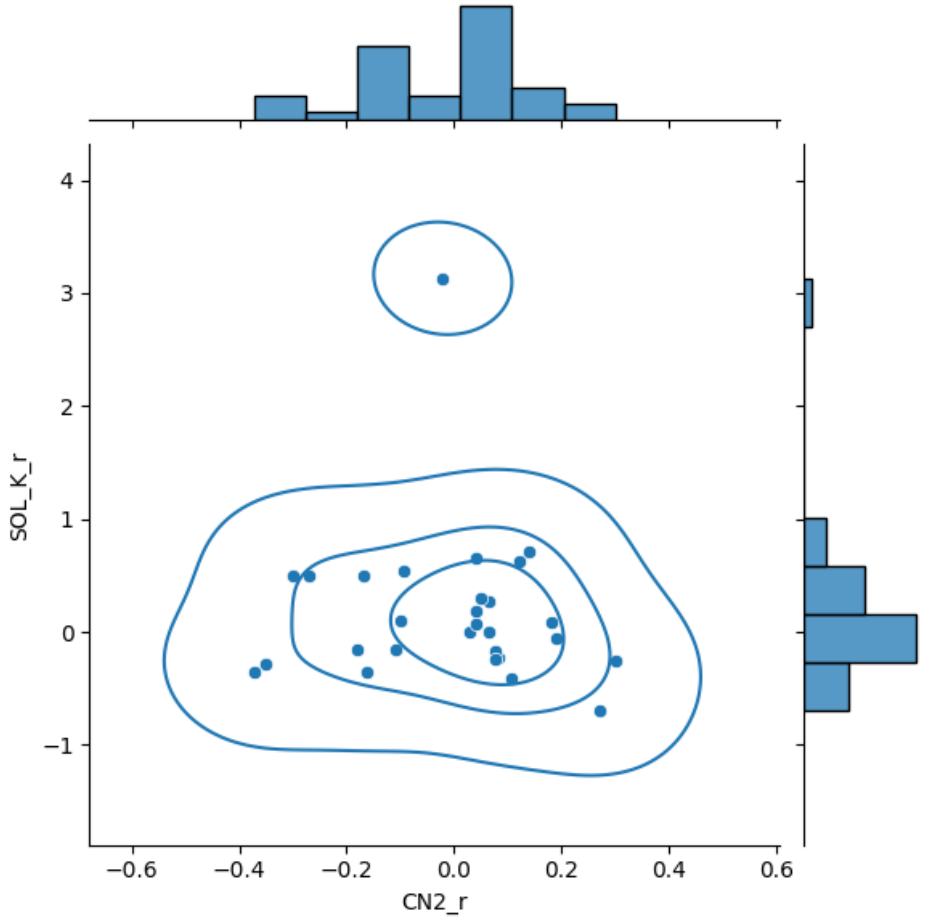


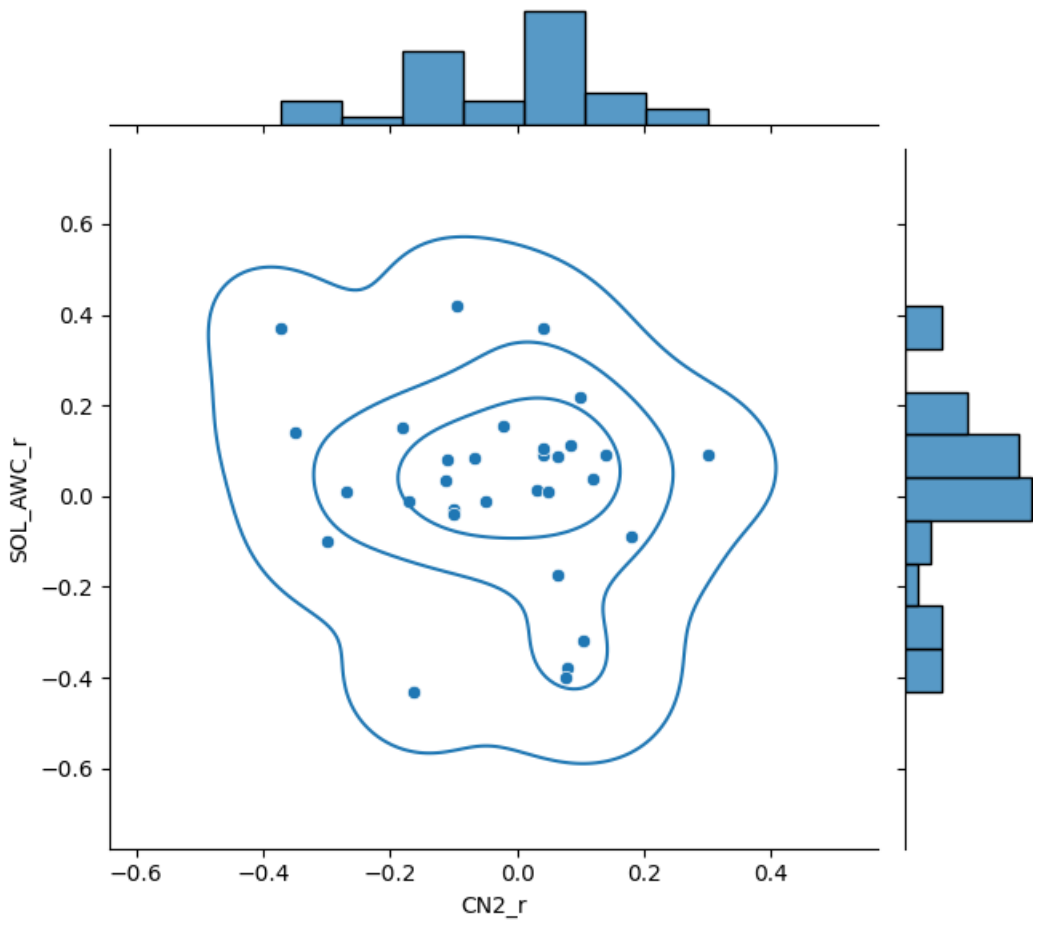
Preliminary results

- Several parameter pairs showed statistically significant correlations (negative or positive) with $p <= 0.05$ or $p <= 0.10$. Some examples include:

  - CN2_r vs ESCO (-ve correlation)
  - SOL_AWC_r vs SURLAG (+ve correlation)
  - SOL_AWC_r vs GWQMN (-ve correlation)
  - SURLAG vs GW_DELAY (+ve correlation)
  - GWQMN vs REVALMN (+ve correlation)
  - GWQMN vs CANMX (+ve correlation)
  - ESCO vs CH_K2 (-ve correlation)

Preliminary results





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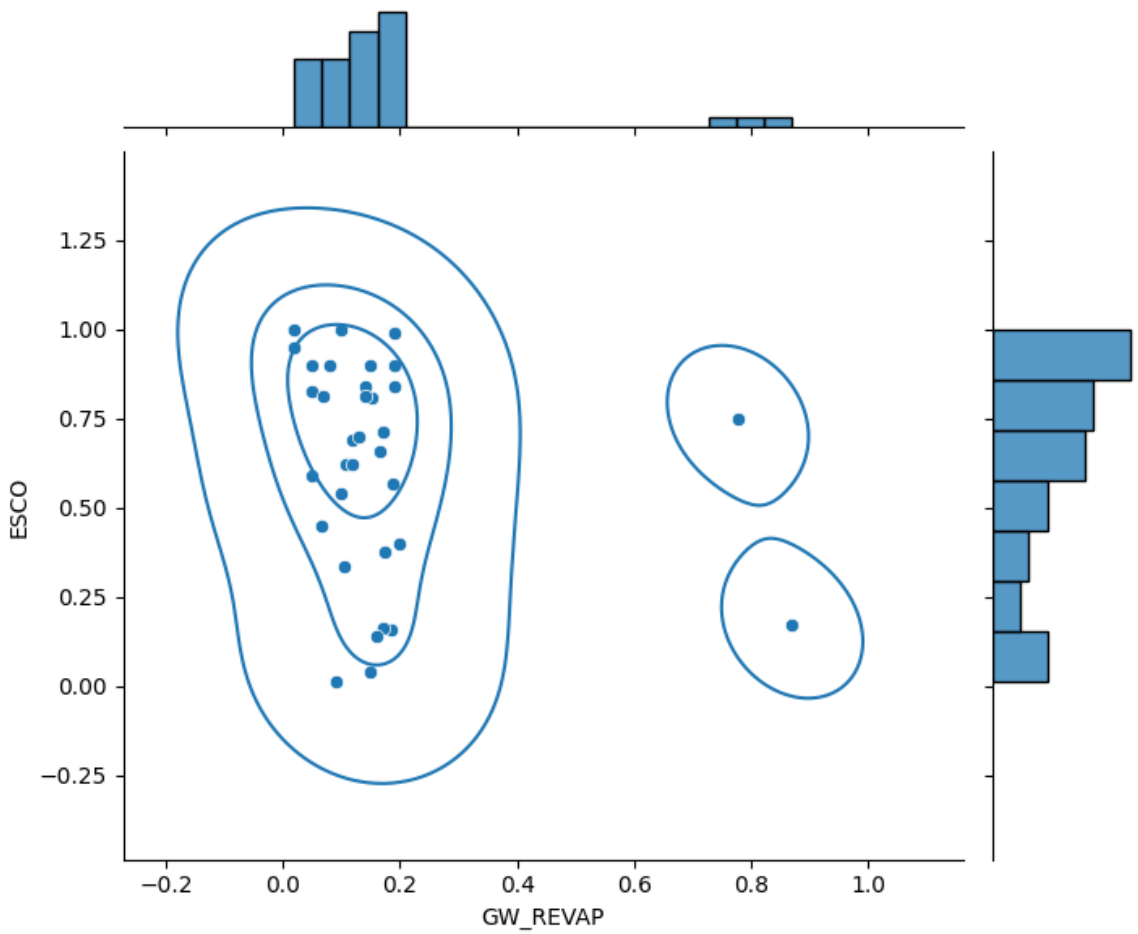

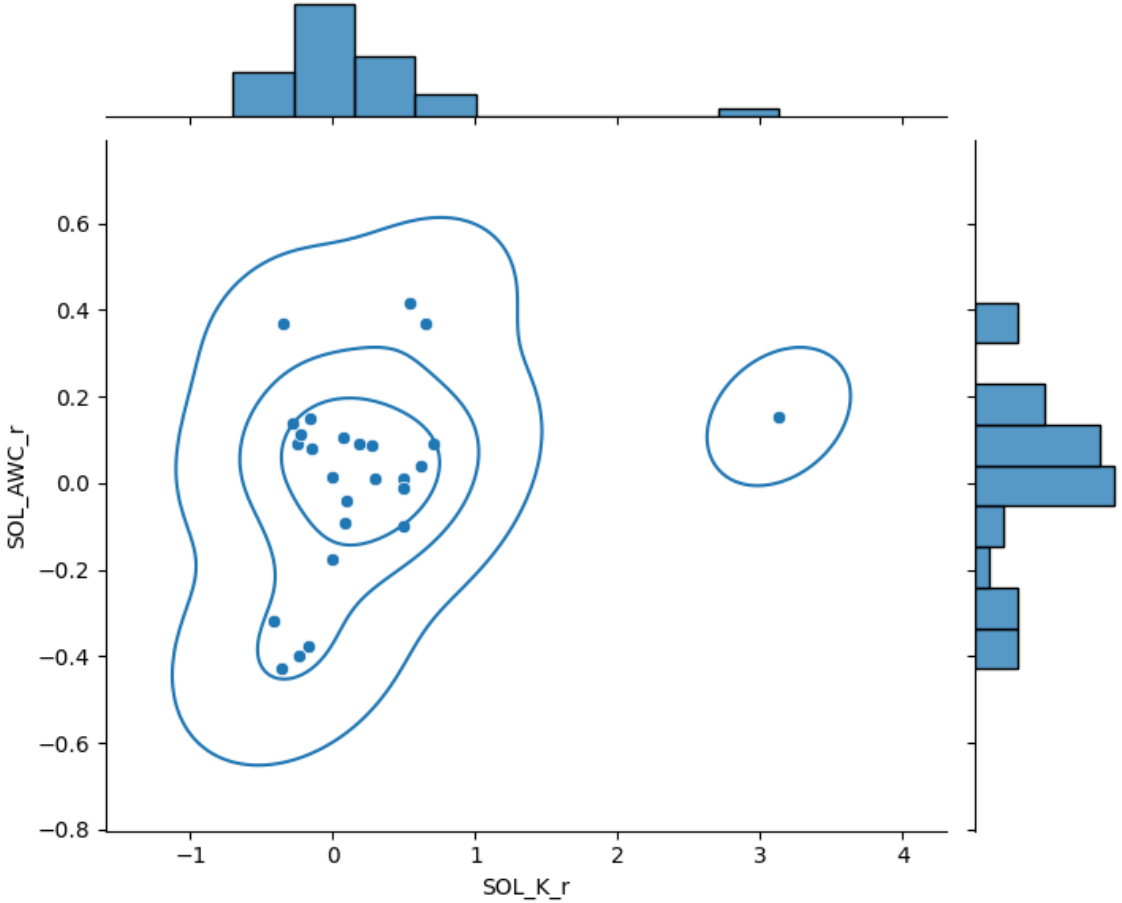

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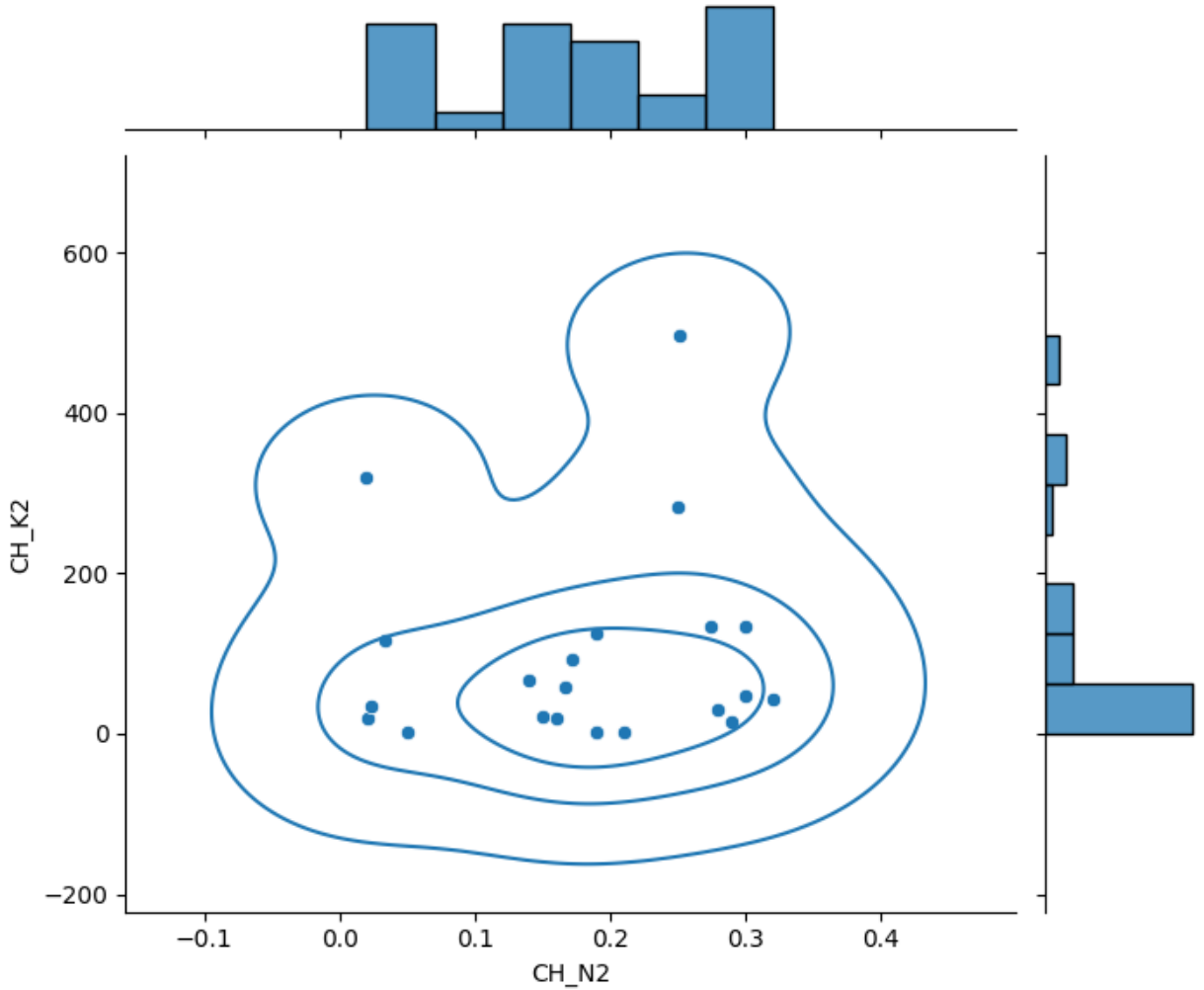

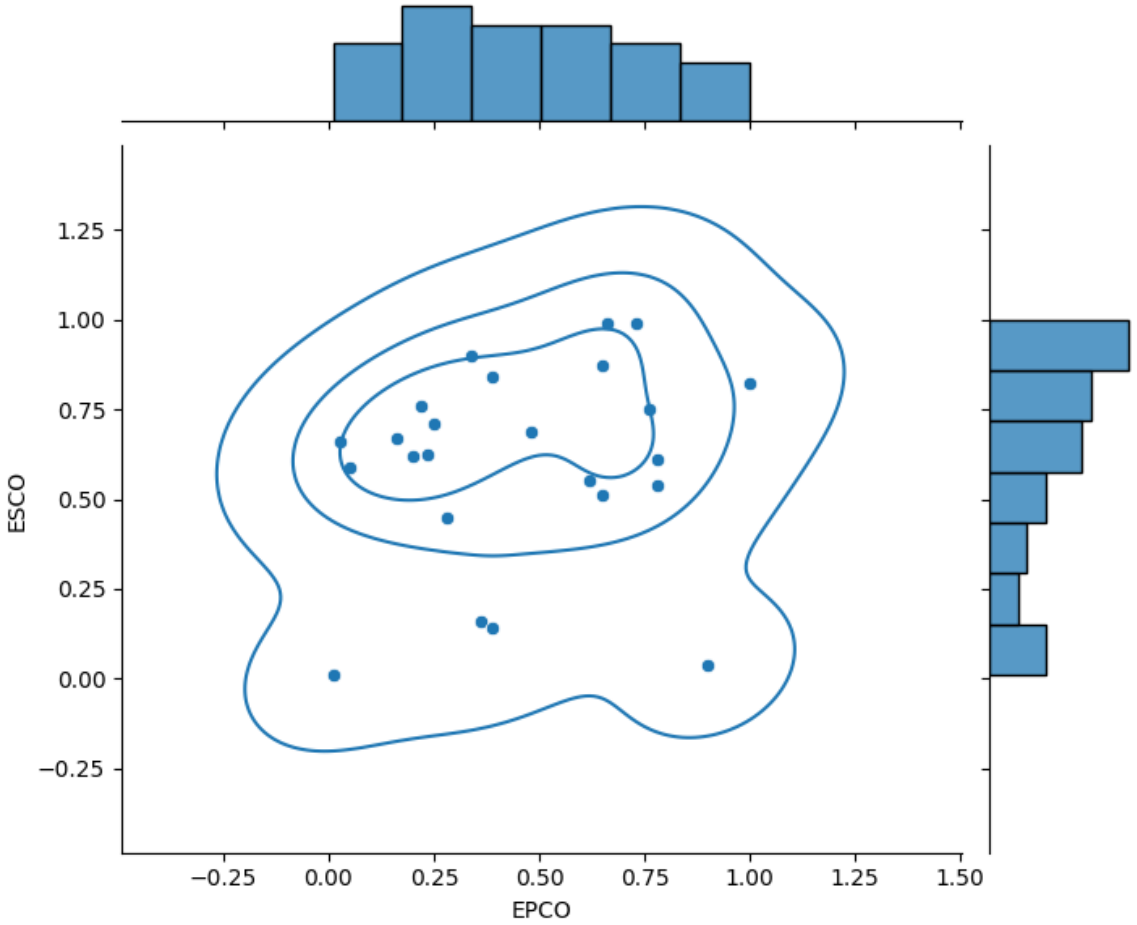

Preliminary conclusions

- These findings have potential to improve calibration efficiency by reducing search space and improving parameter sampling
- The correlation information between parameters supports the use of joint parameter distributions in calibration