# Can streamflow observations constrain snow mass reconstructions?

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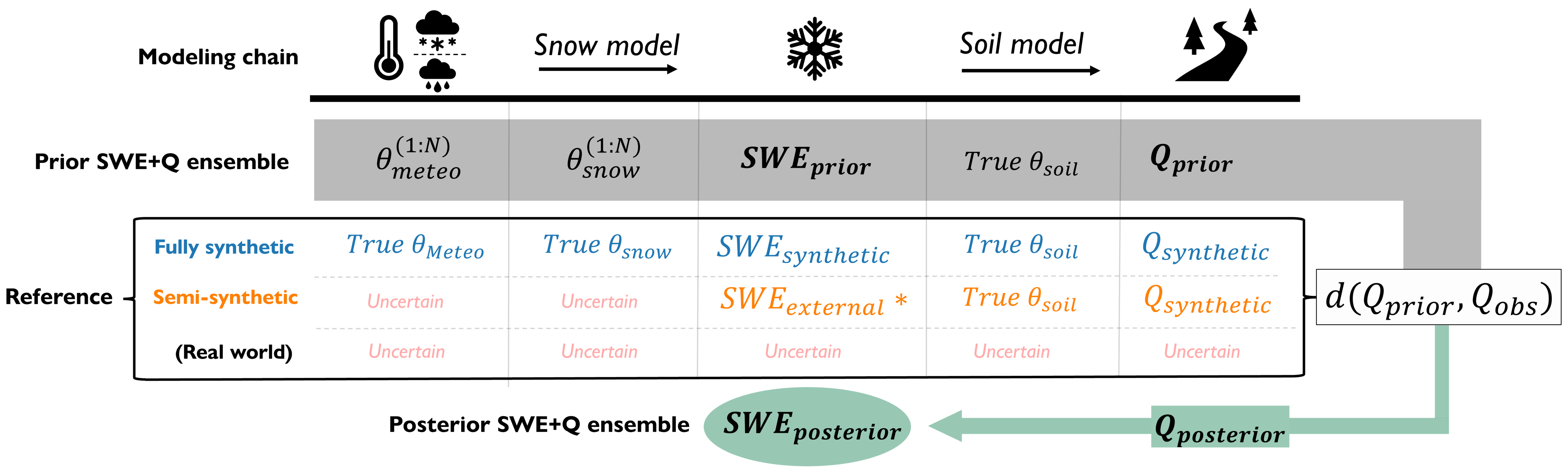
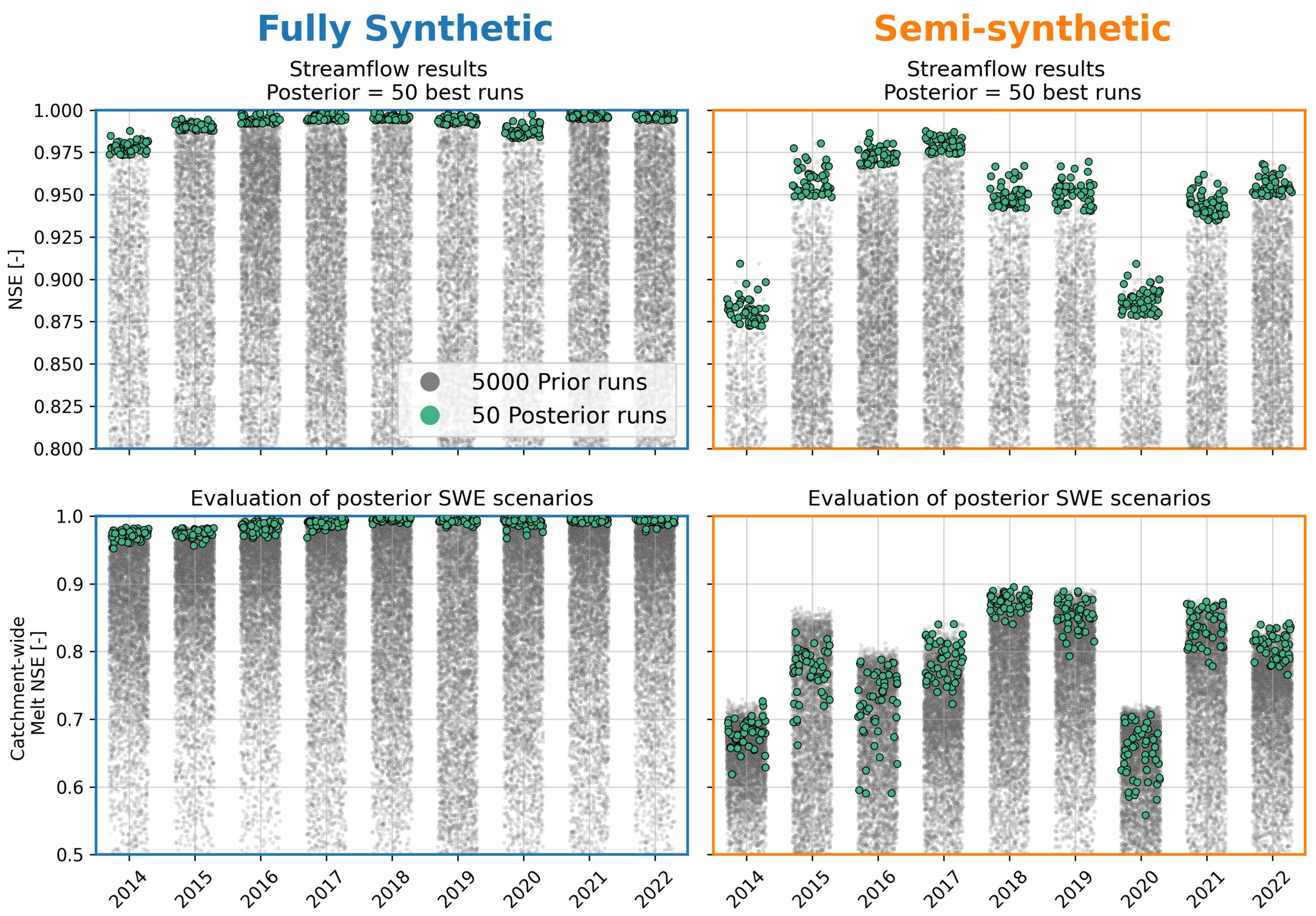
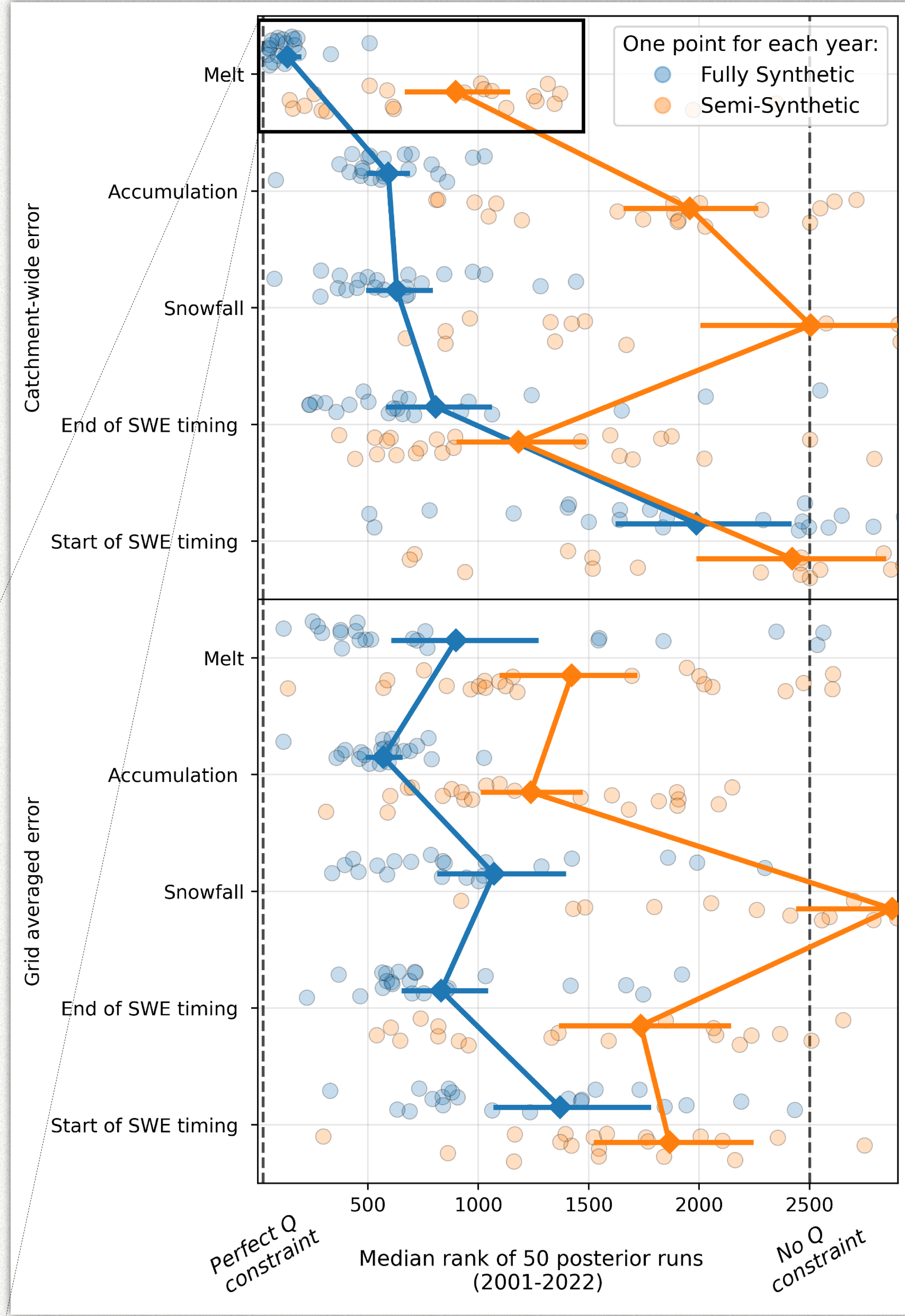
## Methods

We test the title question using **inverse hydrological modeling** in **two synthetic experiments**.
From 5000 **prior** snow water equivalent (SWE) + streamflow (Q) scenarios,
we select the top 1% scenarios that best match observed Q as the **posterior.**
We then evaluate whether these runs also reproduce the true SWE, **across multiple snow metrics**.
The ***Fully Synthetic*** experiment tests the theoretical constraining power of Q on SWE.
The ***Semi-synthetic*** experiment quantifies the decrease in constraining power under **partial uncertainty**.




$\theta^{(1:N)}$ = N samples of parameter distribution $\theta$
* Operational snow-hydrological modeling for Switzerland, Mott et al. 2023




*Streamflow has the most constraining power on catchment-wide melt error*

*For other metrics the streamflow constraint is better than random, but not perfect either*

*Melt rate error is better constrained on the catchment scale, Accumulation error is better constrained on the grid scale*

*Already under partial uncertainty, streamflow has no constraining power on snowfall rates*

*Meteorological + snow model uncertainty decrease the constraining power of streamflow across all snow metrics*

## Conclusions

In theory **yes**, but the constraining power depends on:
- What the target snow metric is
- On what spatial scale that metric is calculated
- The amount of uncertainty in the inversion

These conclusions are drawn in absence of soil model and streamflow observation uncertainty. Future work will explore the constraining power of streamflow on snow mass reconstructions under real-world uncertainty.