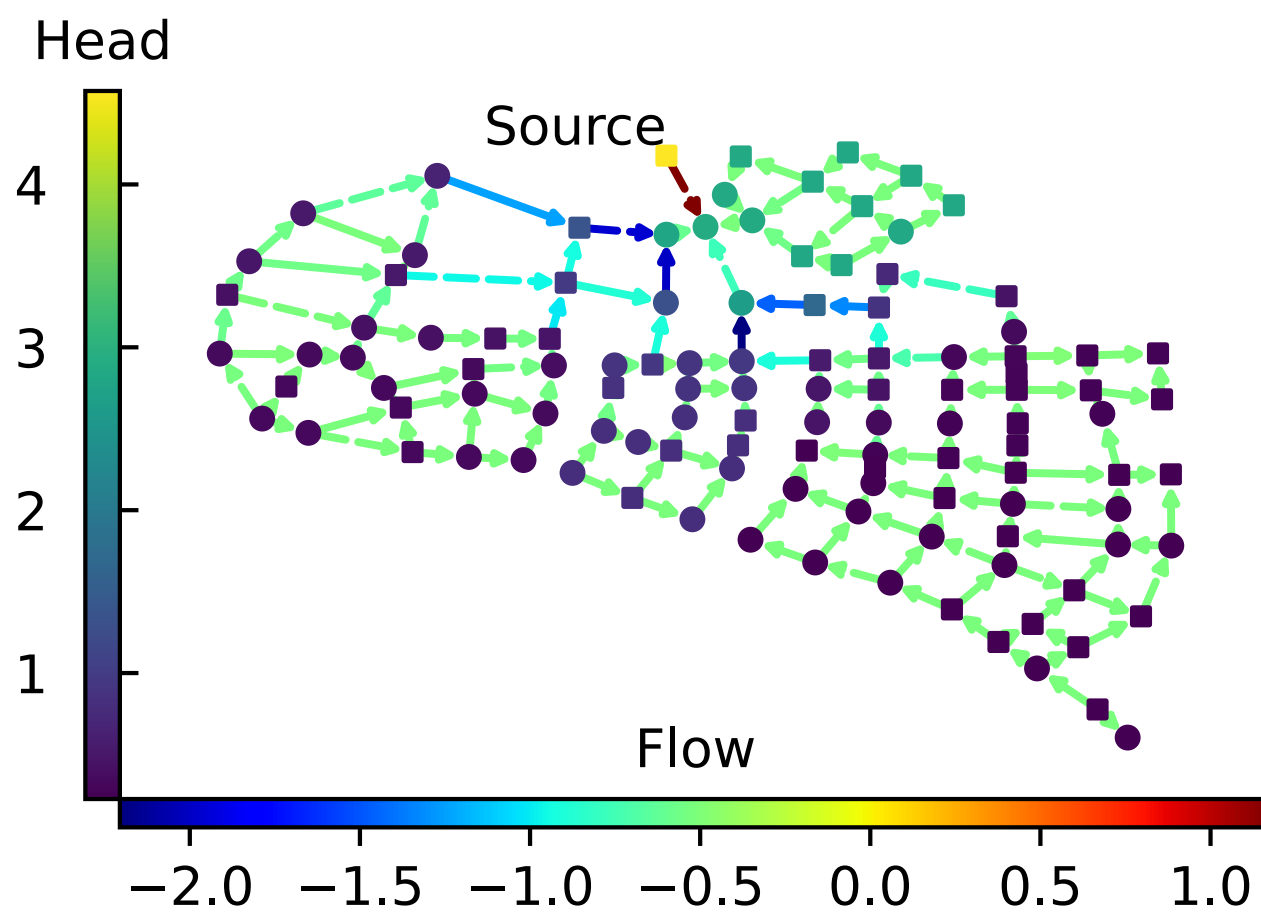
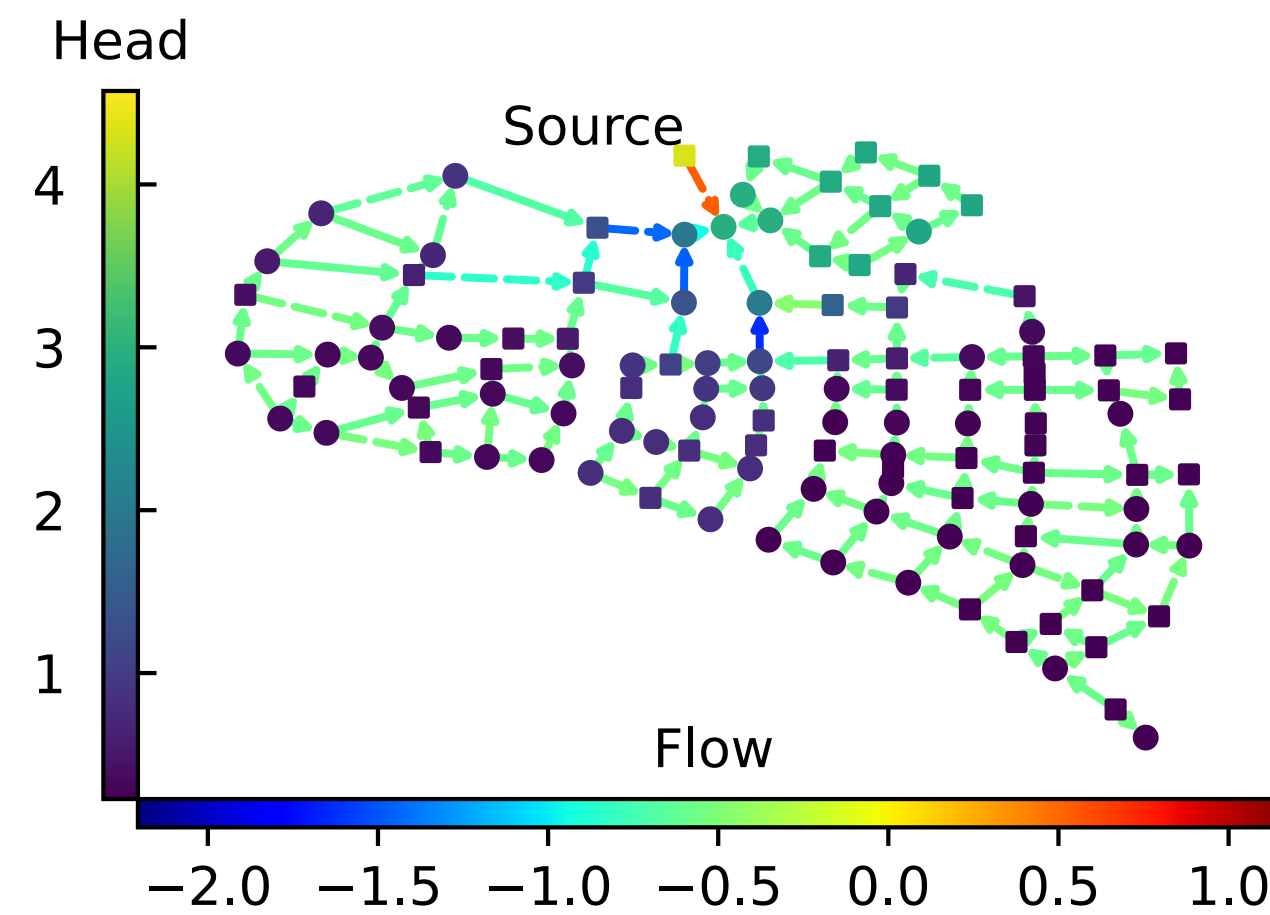


# State estimation in water supply networks

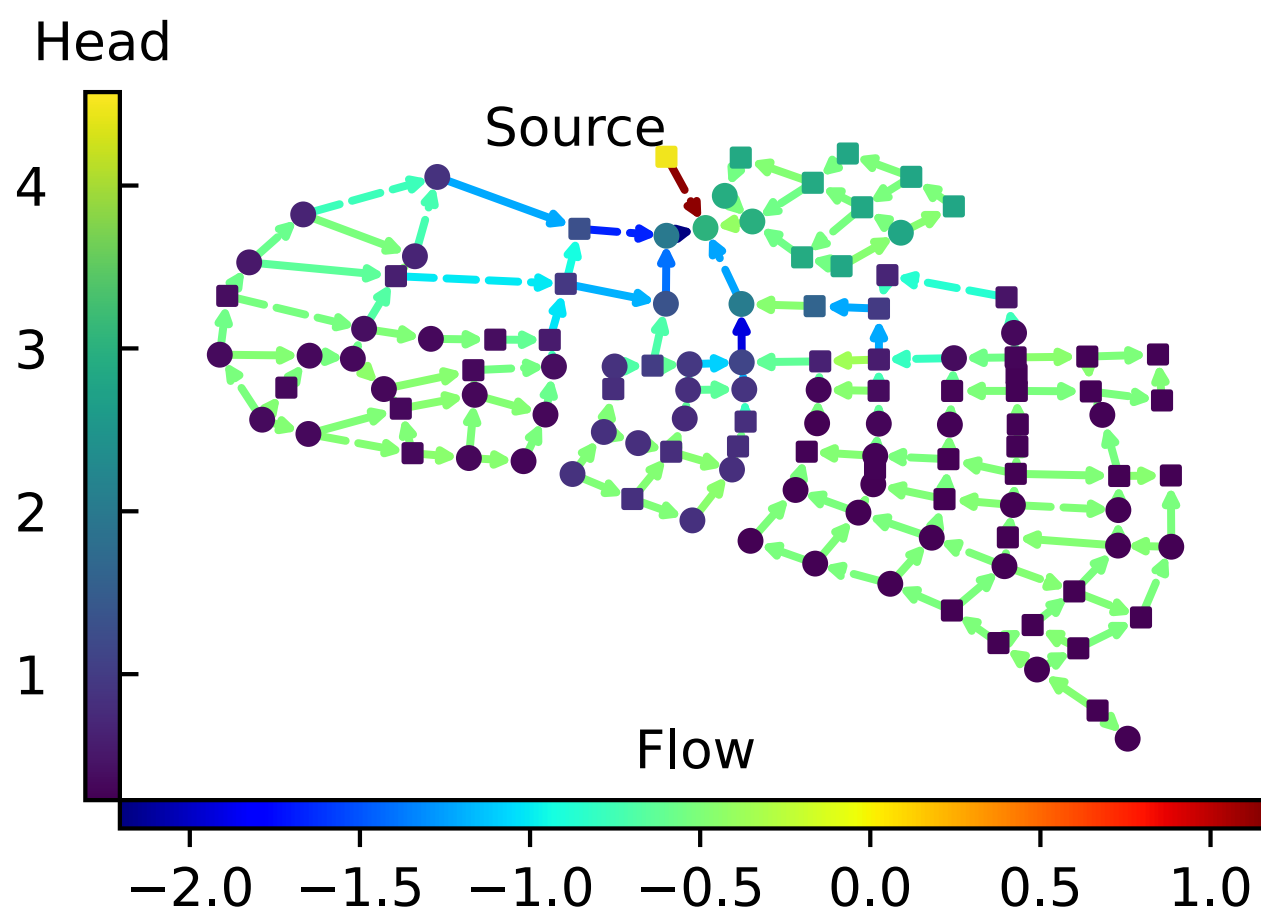
Based on the node-edge joint GPs



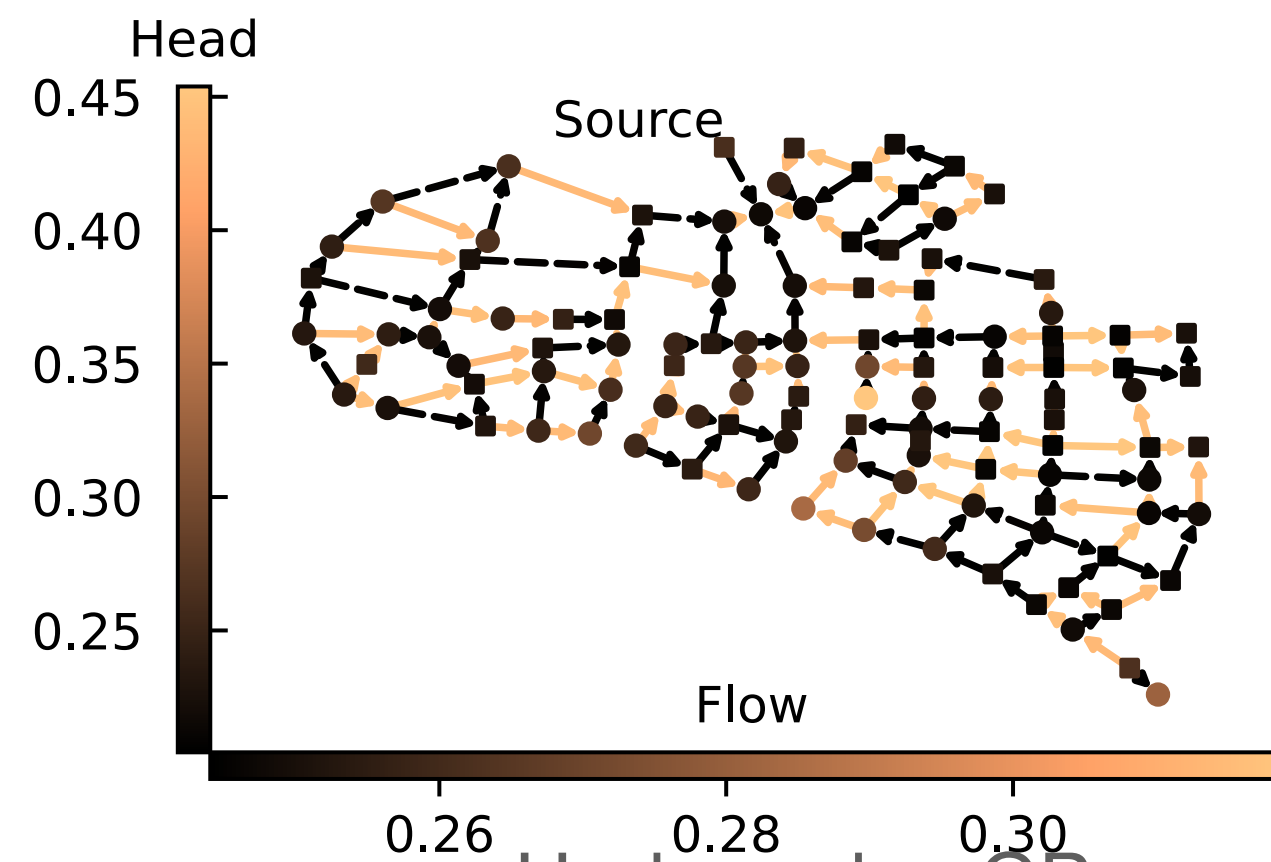
Original



non-Hodge edge GP



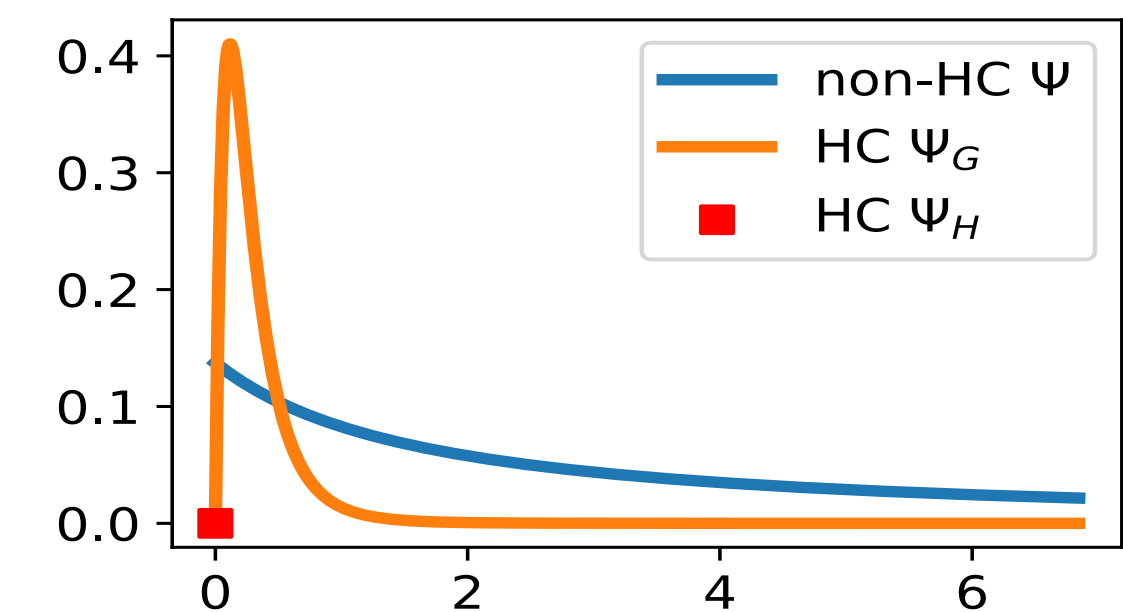
Hodge edge GP



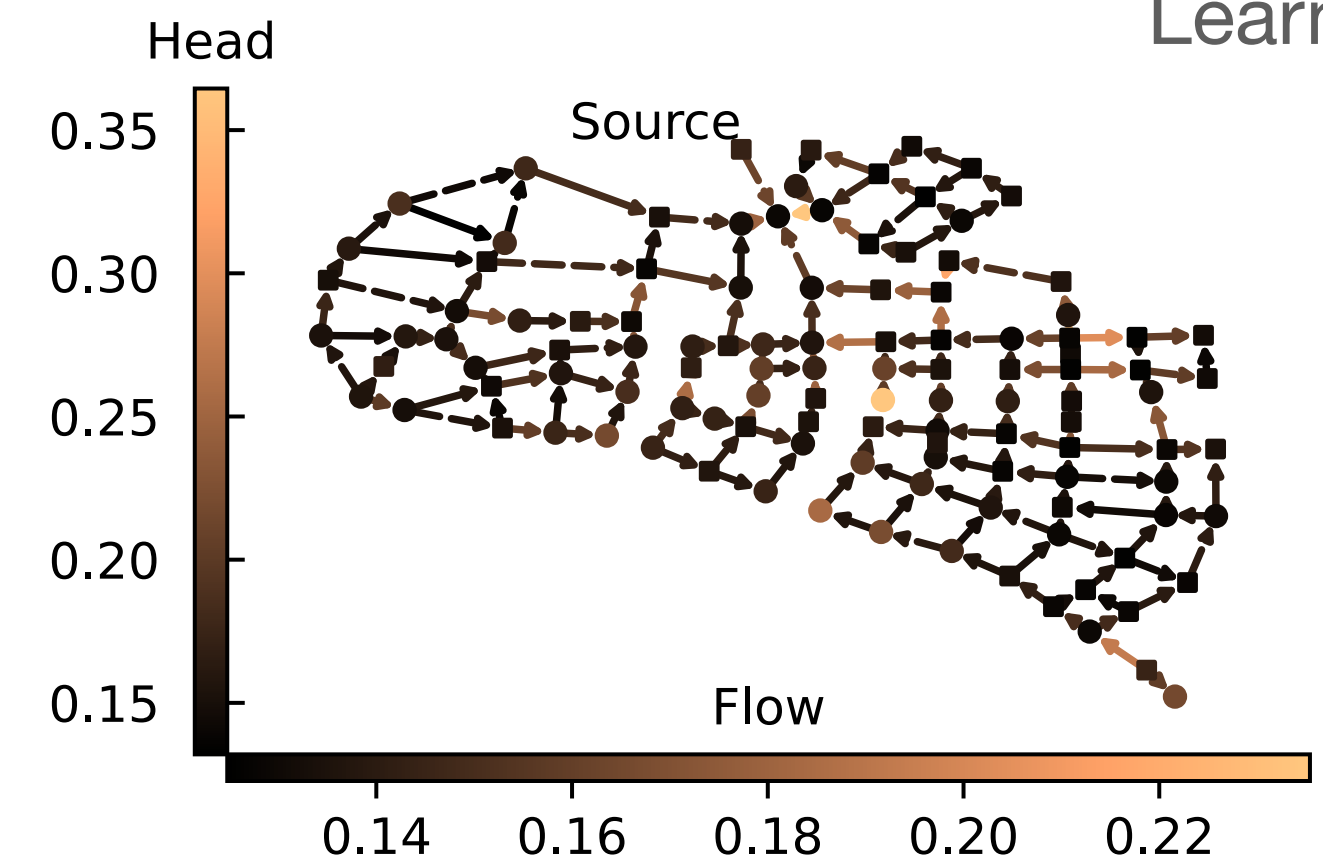
non-Hodge edge GP, var

$$\mathbf{B}_1^\top \mathbf{f}_0 = \bar{\mathbf{f}}_1 := \text{diag}(\mathbf{r}) \mathbf{f}_1^{1.852}$$

$$\begin{pmatrix} \mathbf{f}_0 \\ \bar{\mathbf{f}}_1 \end{pmatrix} \sim \text{GP} \left( \mathbf{0}, \begin{pmatrix} \mathbf{K}_0 & \\ & \mathbf{K}_1 = \mathbf{B}_1^\top \mathbf{K}_0 \mathbf{B}_1 \end{pmatrix} \right)$$



Learned kernel



Hodge edge GP, var

# Conclusion

- How to generalize GPs to non-Euclidean domains? SDE framework
- What is a good edge GP? Edge dependency + Hodge decomposition
- Node-edge-triangle joint GPs Alain et al. 2023
- Continuous version: Euclidean VF Berlinghieri et al. 2023; Manifold VF Robert-Nicoud et al. 2024

Thank you!

Paper  
Code

