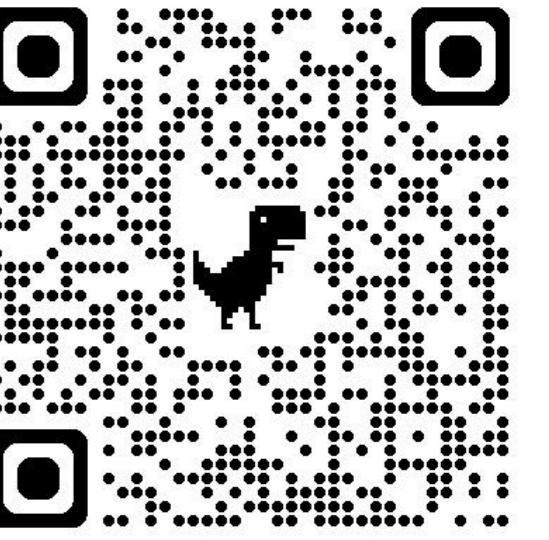


A Fast, Versatile, and User-friendly Plugin for Kernel Density Analysis



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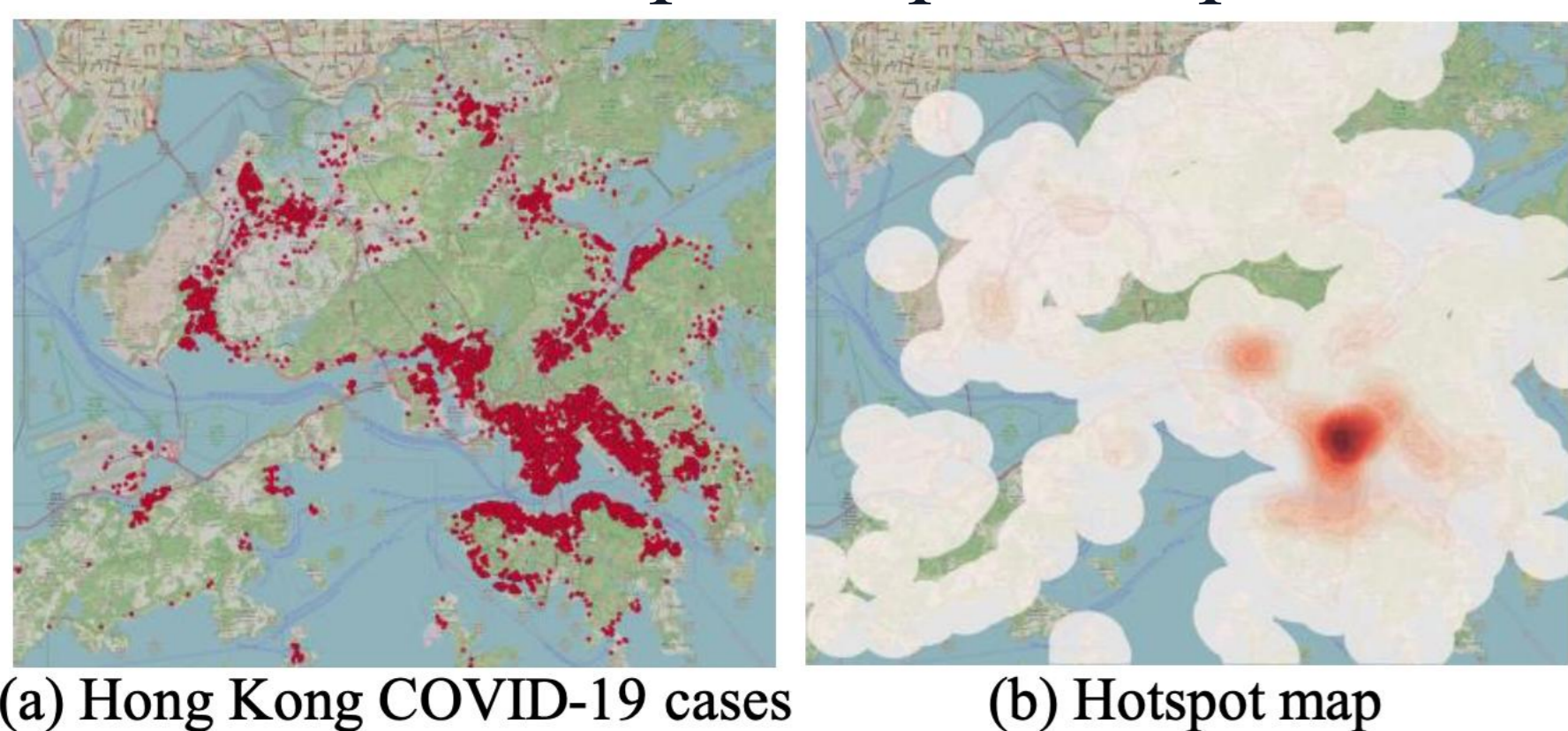
[¶]Co-first authors

1. MOTIVATION

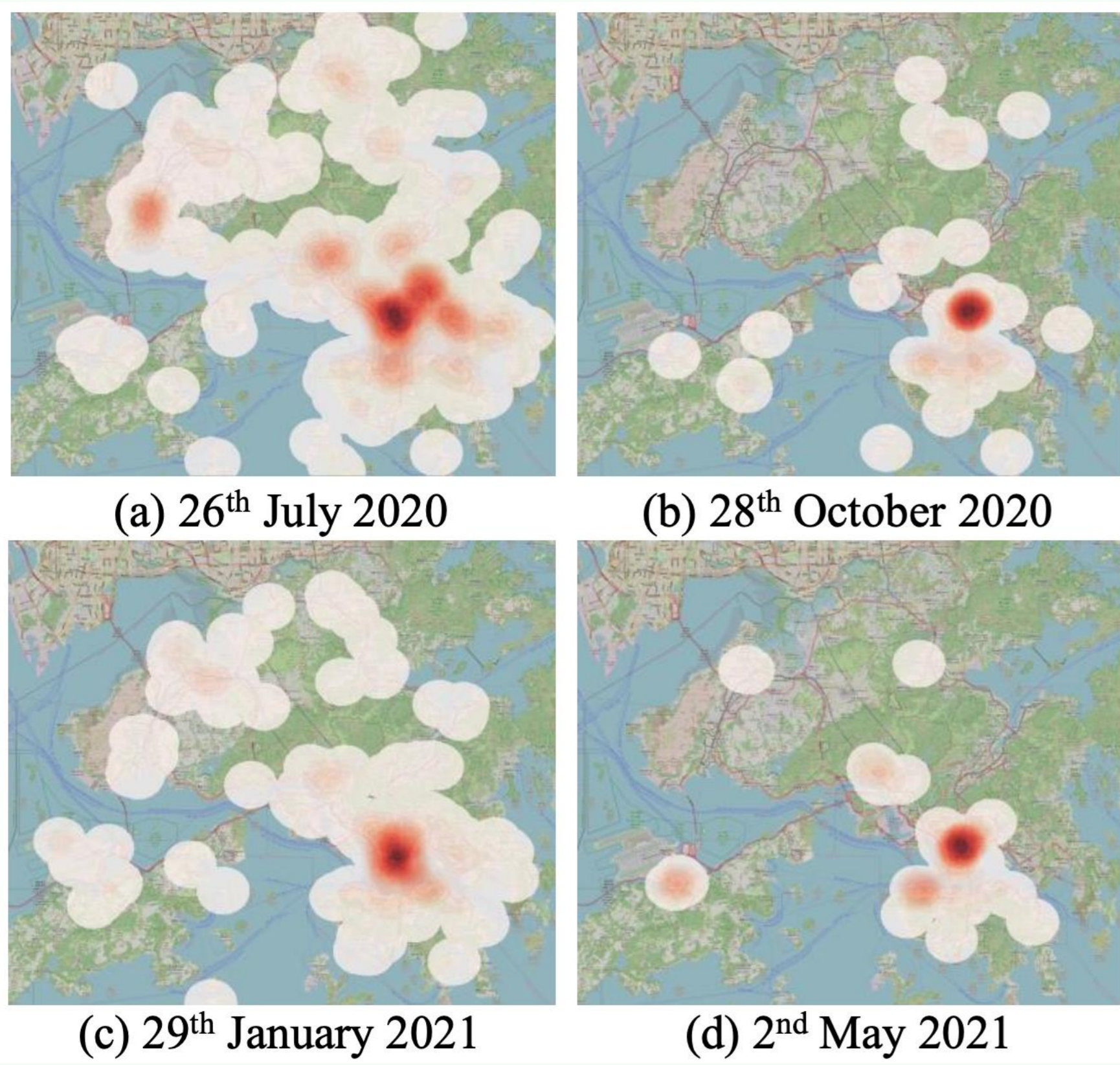
- Kernel density analysis (KDA) is important for hotspot analysis in epidemiology, crime, traffic, and urban analytics.
- Existing tools are often slow, fragmented, or require programming skills.
- Domain experts also need spatiotemporal KDA (STKDA) and network KDA (NKDA).
- We present Fast Density Analysis, a QGIS plugin that is efficient, versatile, and easy to use.

2. SUPPORTED TASKS

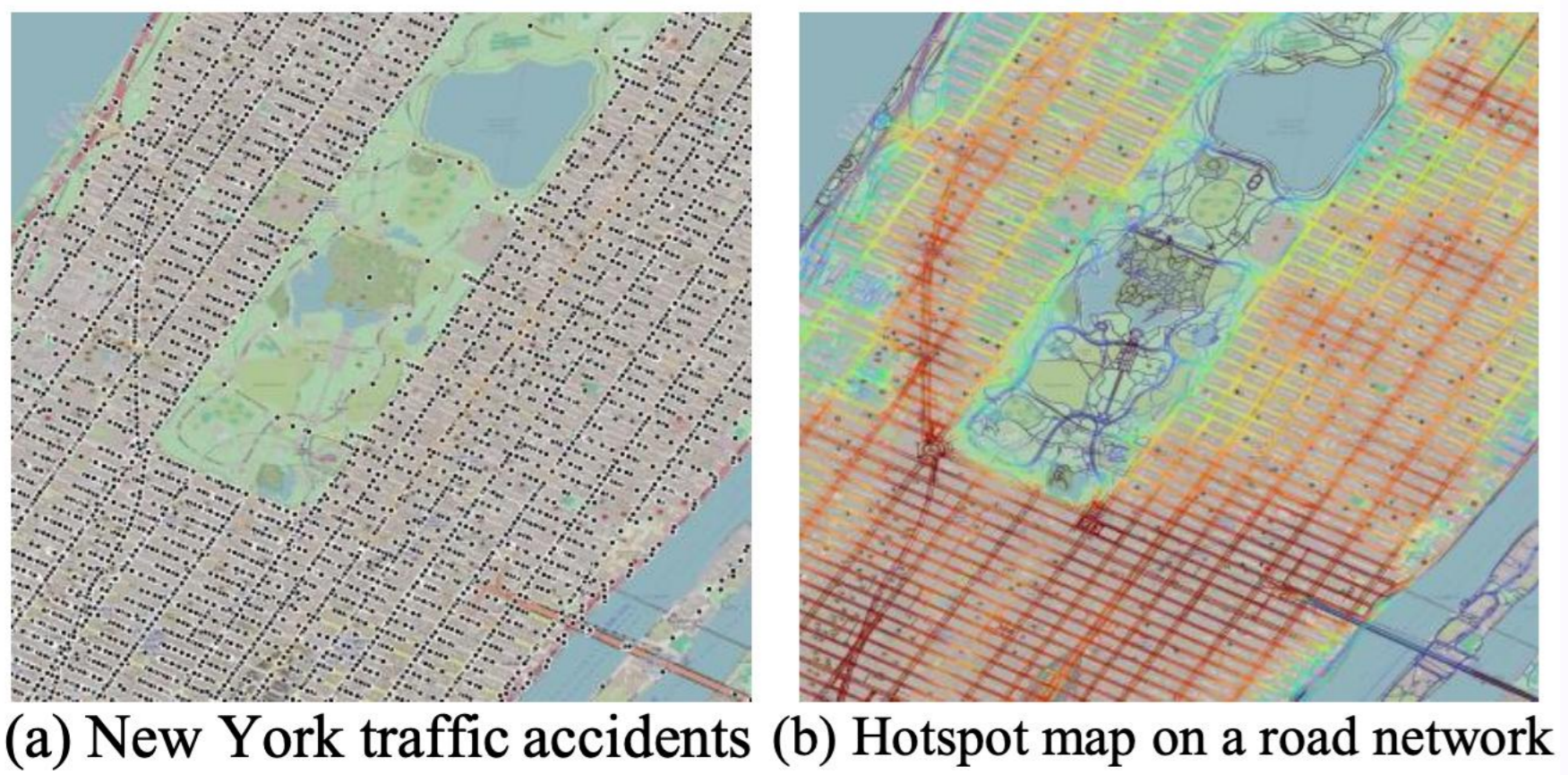
KDA Hotspot maps on a plane



STKDA Time-dependent hotspot maps



NKDA Hotspot maps constrained to a road network.



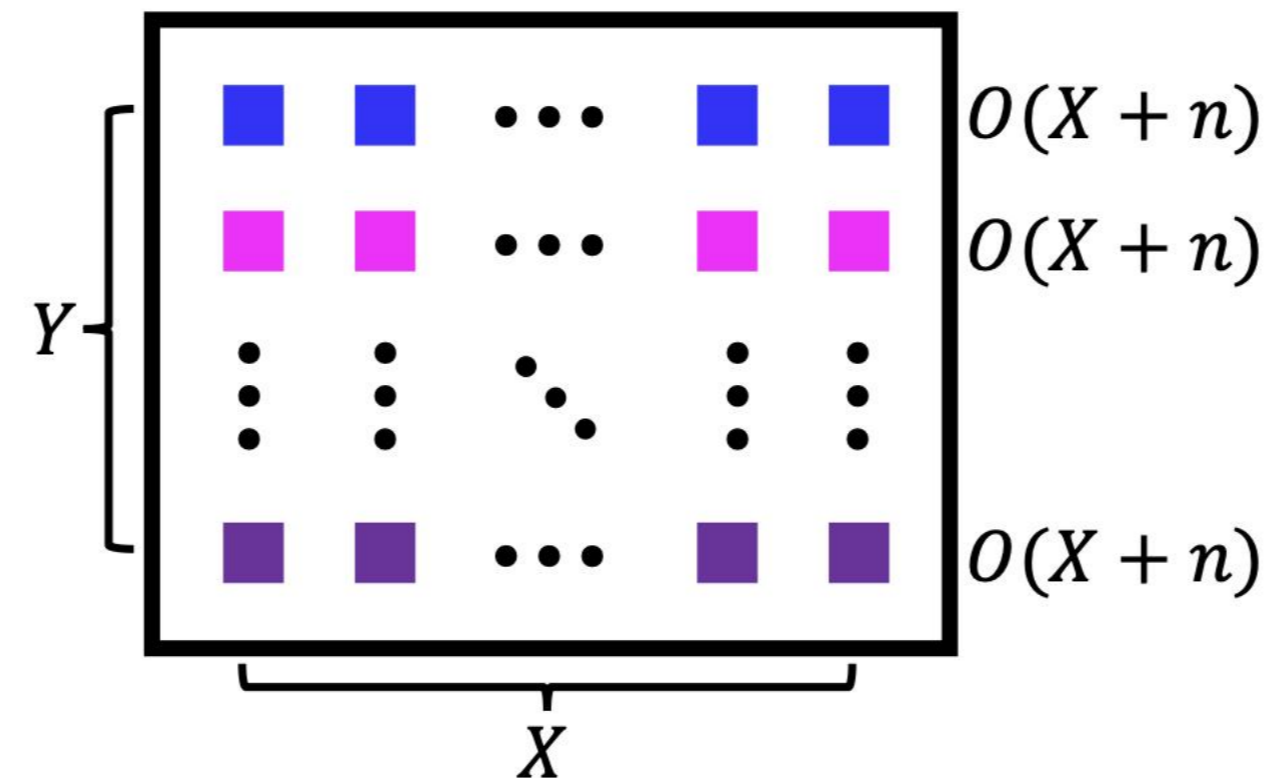
3. SOFTWARE COMPARISON

Software package	KDA	STKDA	NKDA	Prior skill
QGIS	slow	n.a.	n.a.	no
ArcGIS	slow	n.a.	n.a.	no
PySAL	slow	n.a.	n.a.	python
spatstat	slow	n.a.	n.a.	R
spNetwork	n.a.	n.a.	slow	R
LIBKDV	fast	medium	n.a.	python
PyNKDV	n.a.	n.a.	fast	python
Fast Density Analysis (ours)	fast	fast	fast	no

• n.a.: not available • Fast: optimized algorithms

4. TECHNICAL OVERVIEW

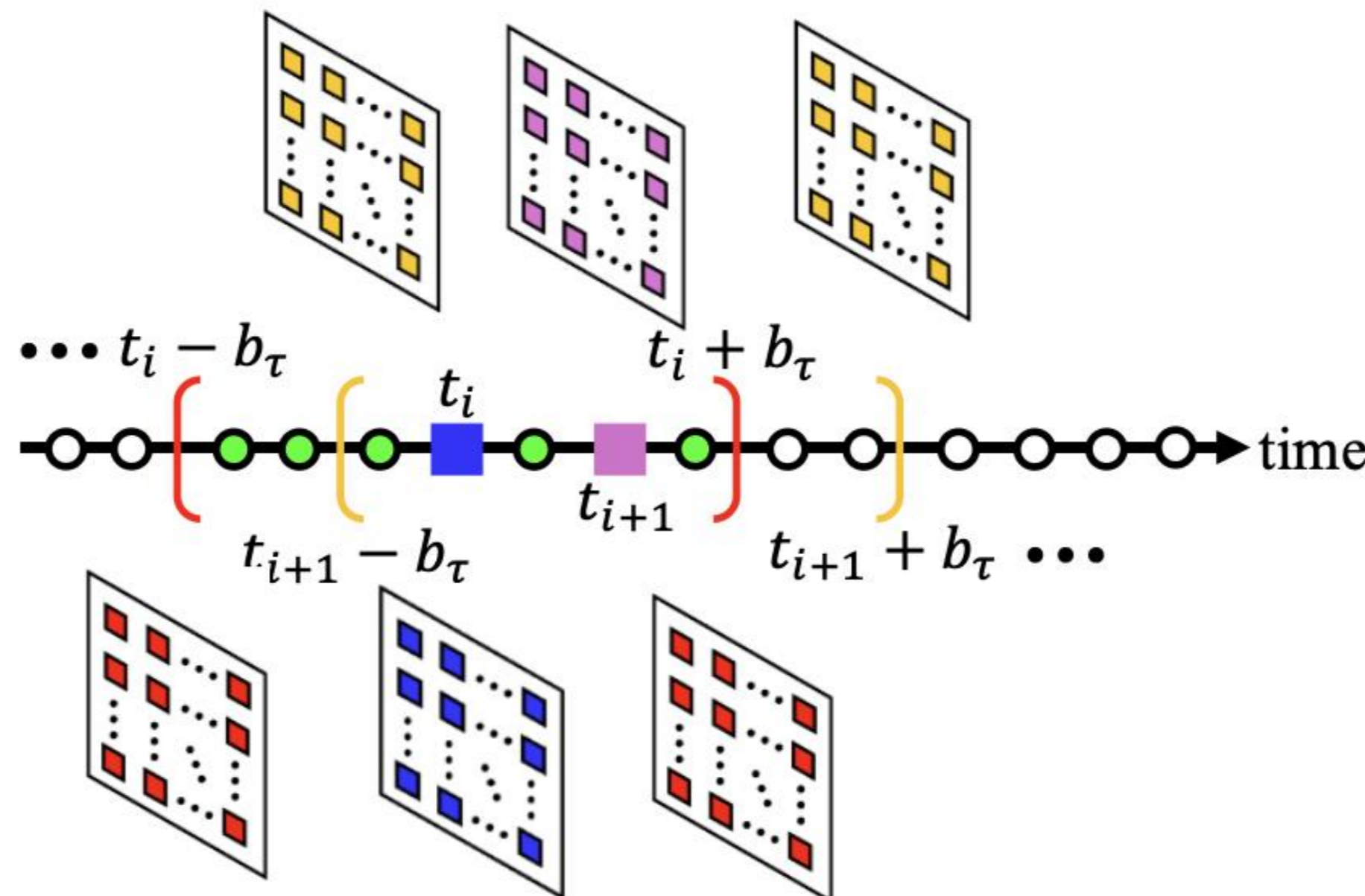
SLAM for KDA



An Overview of SLAM

- Converts the row-wise KDA problem into the interval stabbing problem.
- Adopts the sweep line algorithm to handle this problem in $O(X + n)$ time.
- Complexity: $O(Y(X + n))$

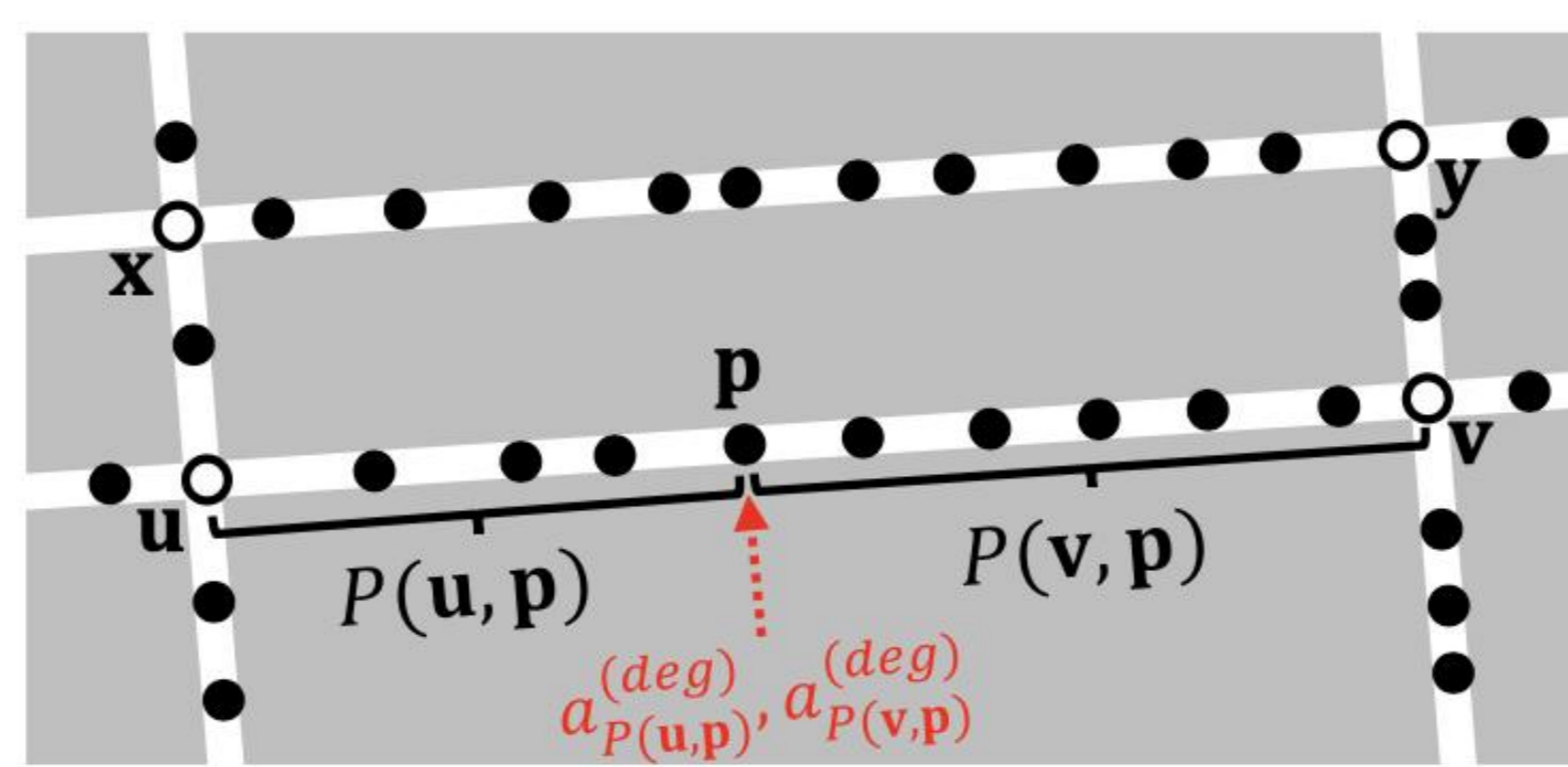
PREFIX for STKDA



An Overview of PREFIX

- Builds prefix statistical matrices along the time axis.
- Computes the statistical matrix of each temporal window by matrix subtraction.
- Complexity: $O(XYT + Yn)$

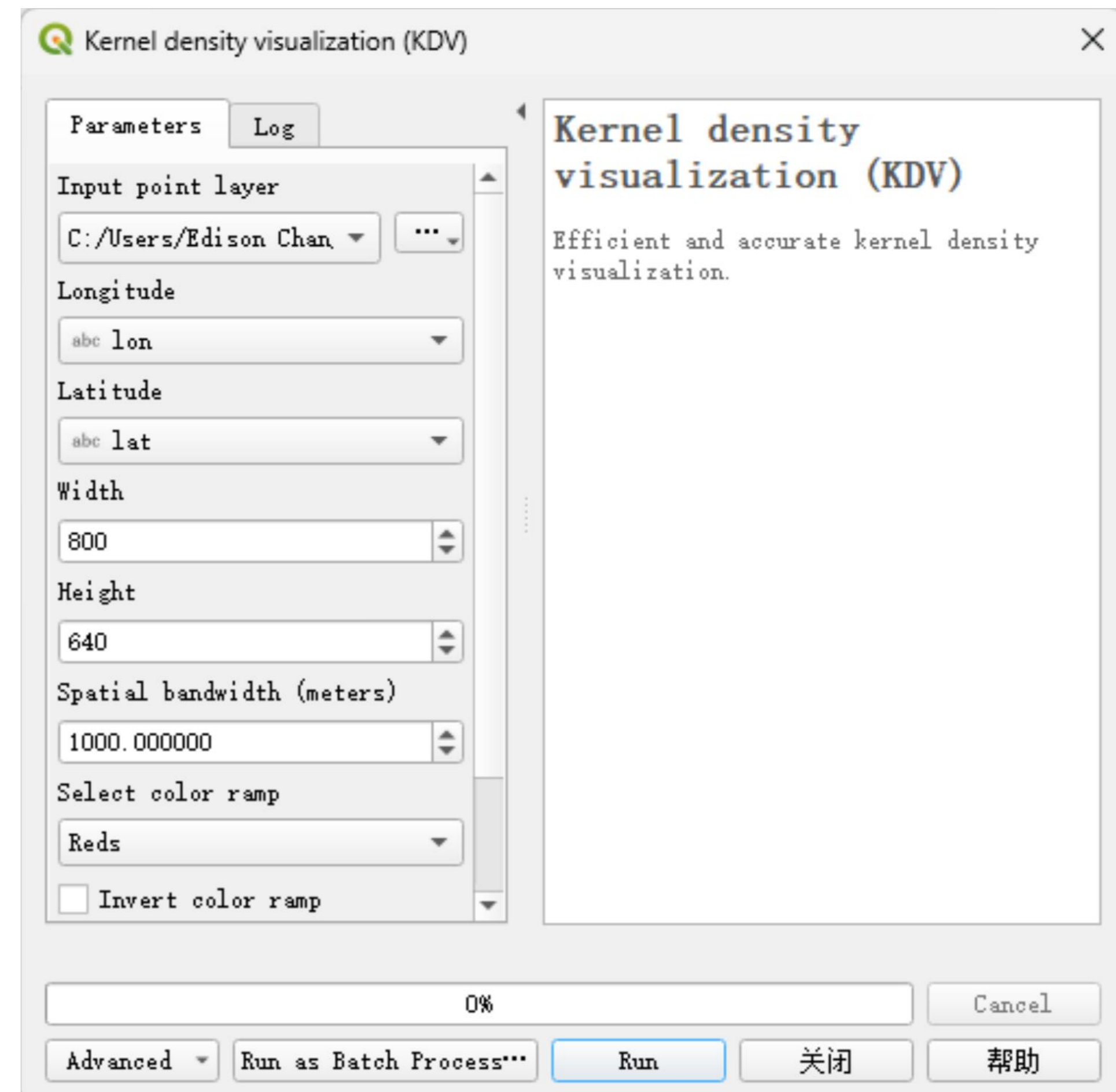
ADA for NKDA



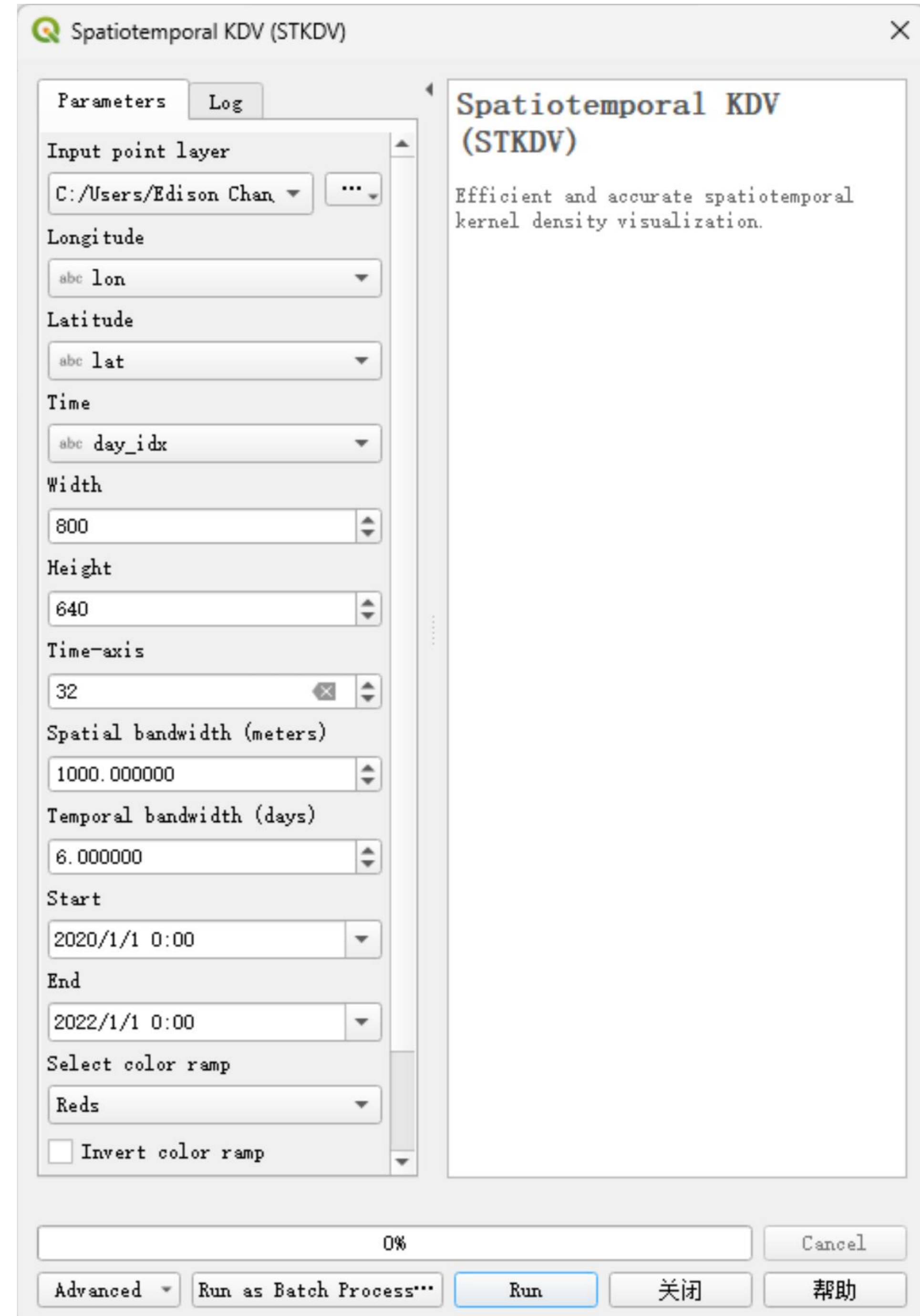
An Overview of ADA

- Computes aggregate distance terms on each network edge in advance.
- Reuses augmented terms for fast lixel density evaluation.
- Complexity: $O(|E|(T_{SP} + L \log(\frac{n}{|E|})))$

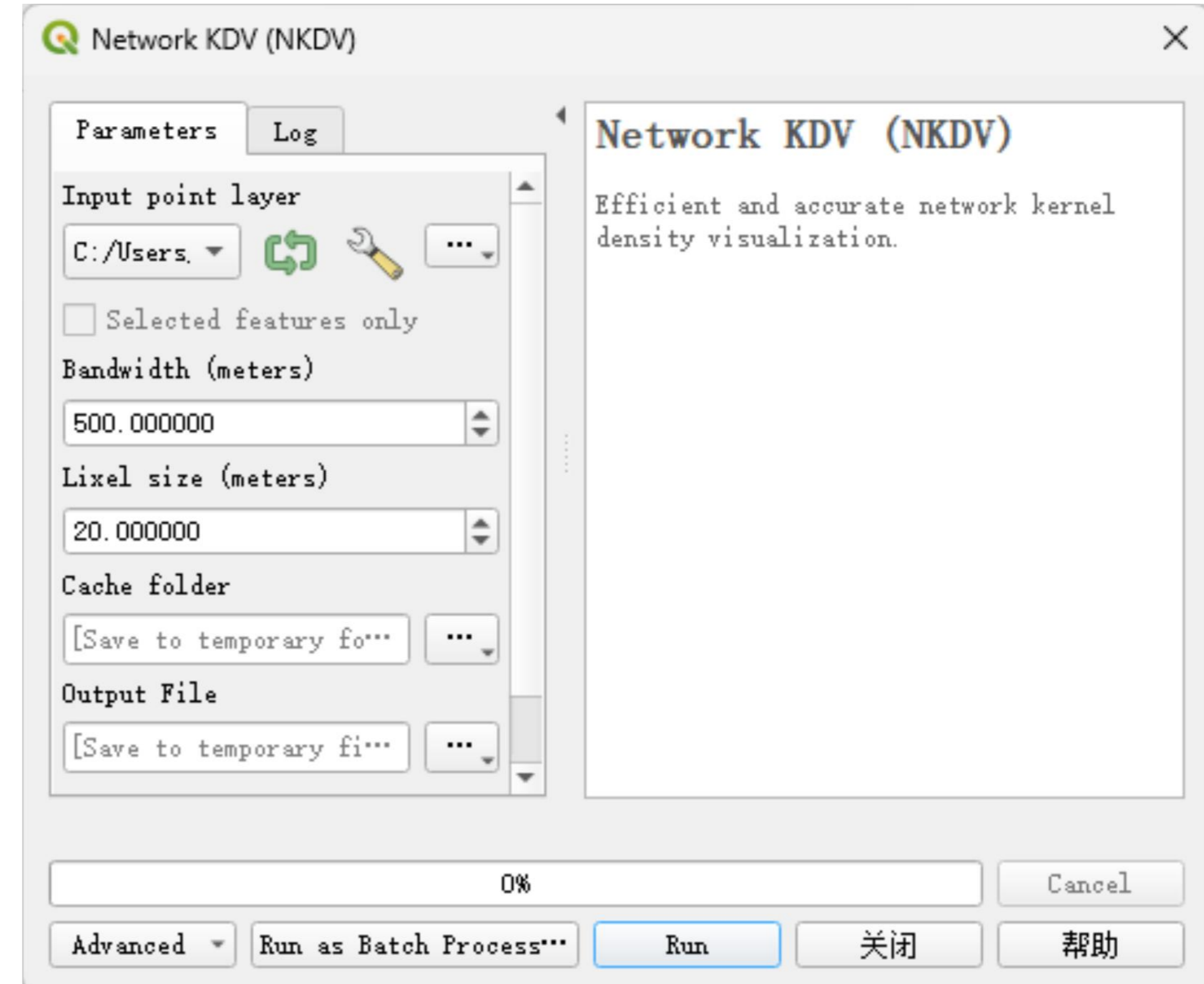
5. QGIS USER INTERFACE



KDA



STKDA



NKDA

6. KEY ADVANTAGES

- ★ Fast Density Analysis brings efficient KDA, STKDA, and NKDA into an easy-to-use QGIS plugin, enabling scalable hotspot analysis without programming expertise.

Fast Density Analysis by LibKDV Group

A fast kernel density visualization plugin for geospatial analytics

2025年12月14日 ★★★★★ (133)

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