

Why the Gulf Intracoastal Waterway Matters ?

1,100 mi
protected waterway from Florida to Texas

80M tons
of cargo moved on the Texas GIWW (2022)

\$77B
in annual economic output supported
(2020–22)

AIS and Video data Sources Working in Isolation

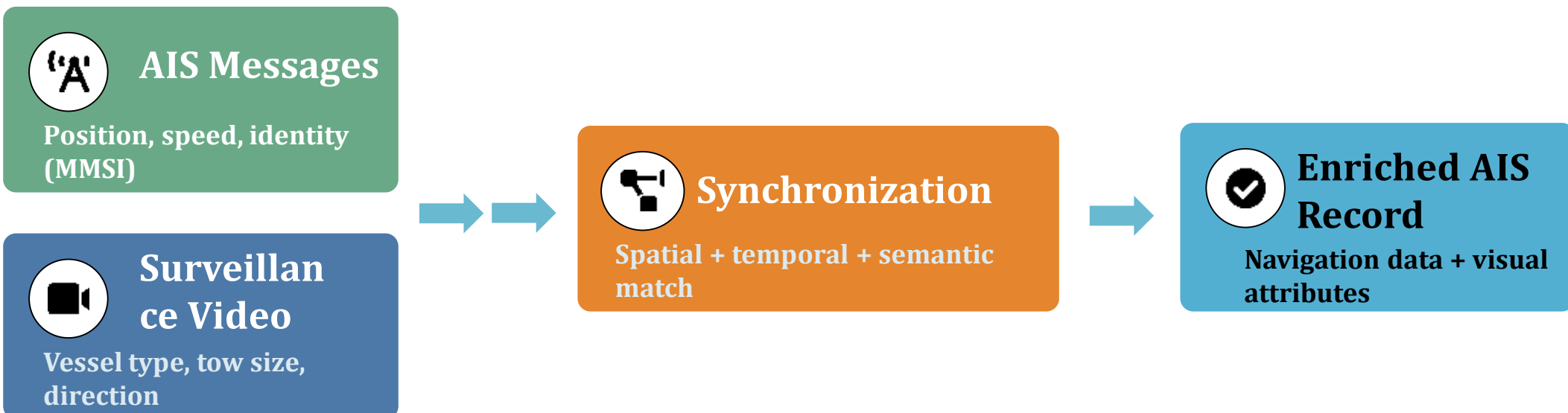
- | | |
|--|--|
| AIS Data <ul style="list-style-type: none">Publicly available, Gives position, speed, and vessel ID.Delayed, intermittent, low update rate.Type is not accurate, Tug/Tow or cargo not differentiateNo visual detail: Load status, Vessel Condition, Number of barges, Barge type.Cannot see vessels that go dark or lack a transponder. | Surveillance Video <ul style="list-style-type: none">Visual detail: vessel type, tow size, direction.Continuous, Real Time.Camera is not EverywhereNo position coordinates or vessel identity.Fog, Rain, Night Visibility |
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Neither source alone gives complete situational awareness — and today they largely stay disconnected.

ABSTRACT

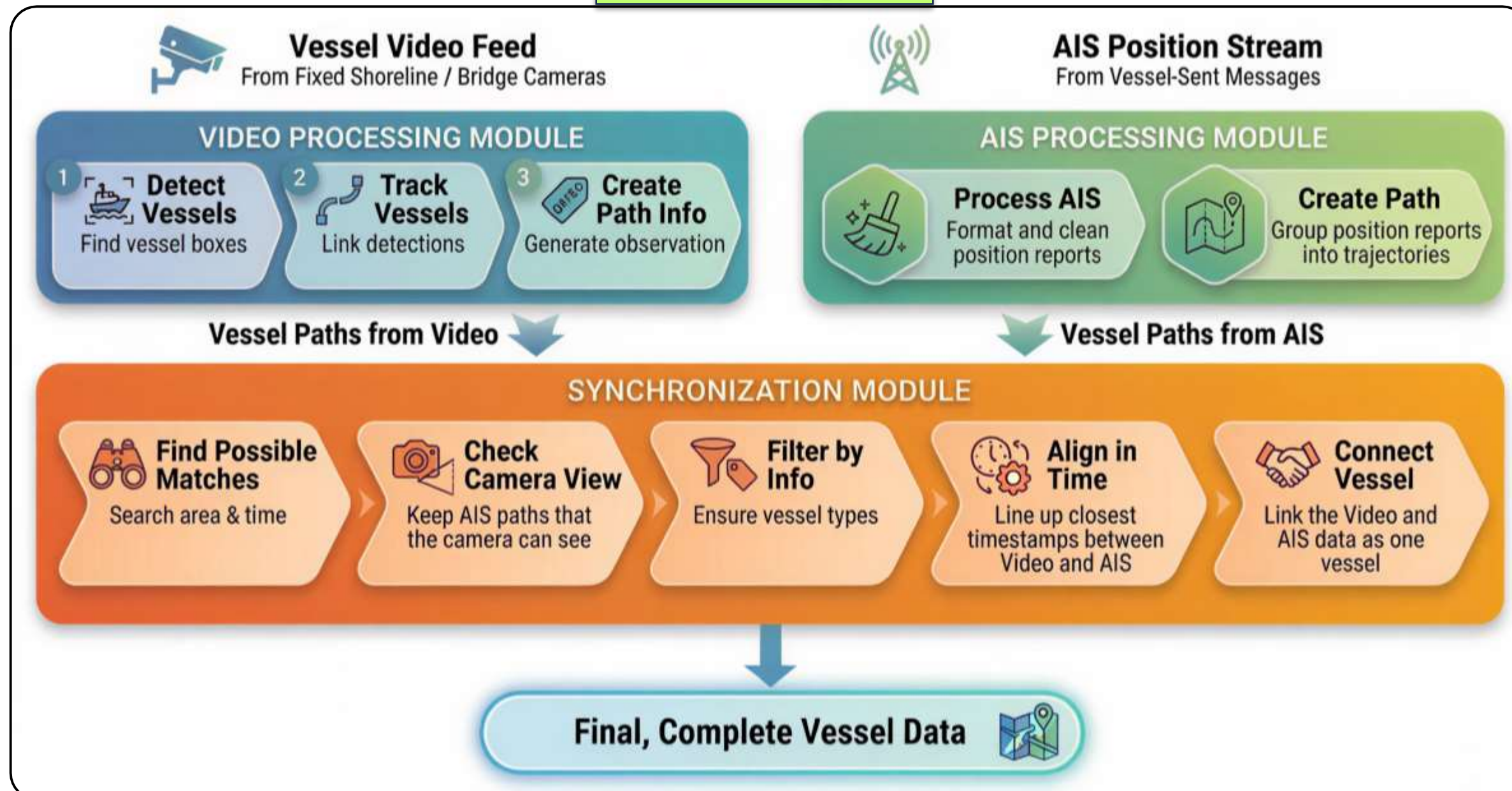
- Synchronize surveillance video with asynchronous AIS records to bridge camera observations with geographic vessel trajectories.
- Preserve vessel identity (MMSI) throughout the enrichment process — never overwriting original AIS data.
- Enrich AIS with visual attributes (tow composition, vessel class, load status) unavailable from broadcast data alone.
- Establish a foundation for intelligent waterway management, traffic monitoring, and anomaly detection.

Synchronizing AIS and Video Data

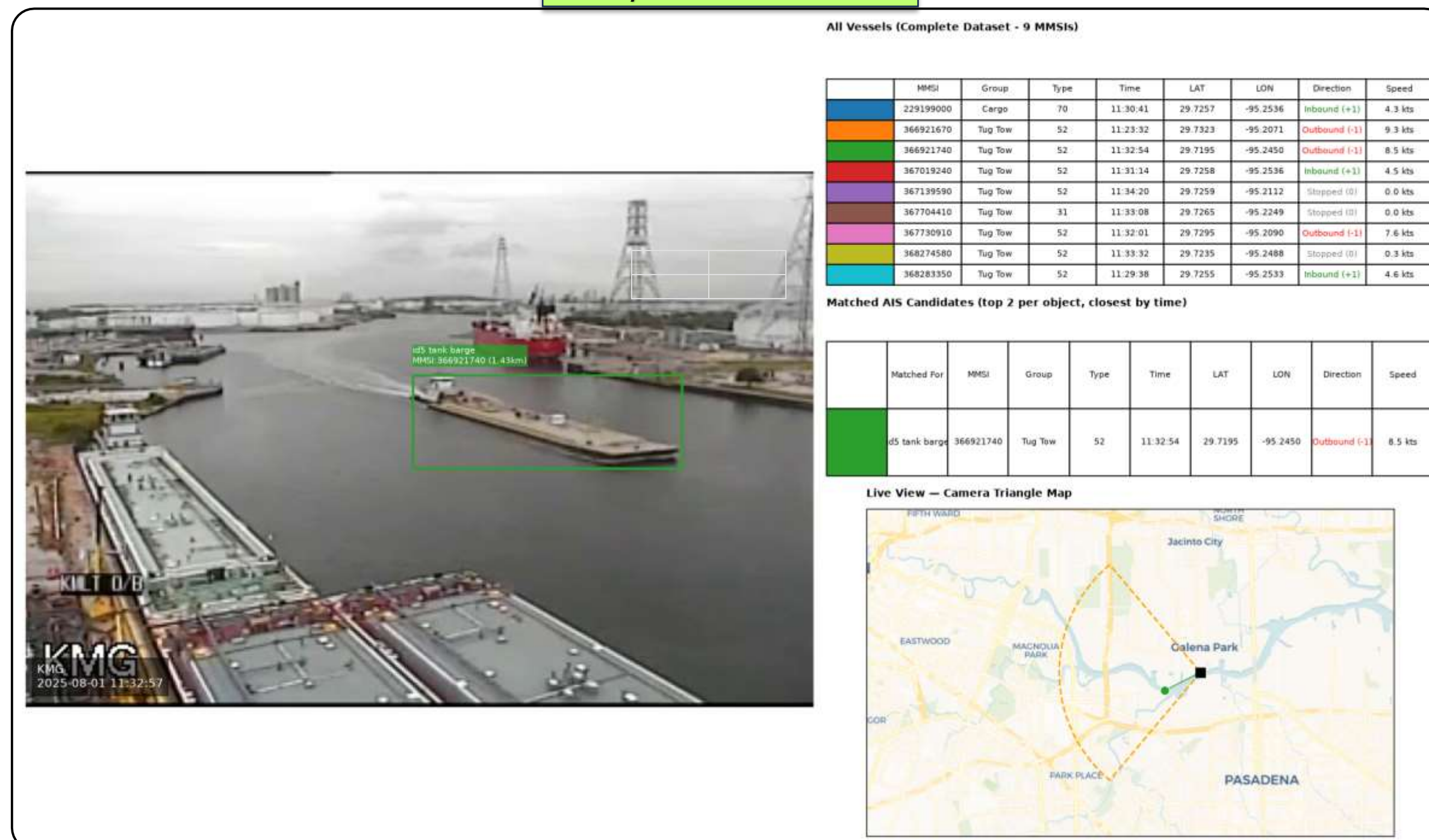


Goal: give every AIS trajectory the visual context a camera can see — without losing the vessel's verified identity to support better traffic management, anomaly detection, and emergency response on the GIWW.

Methodology

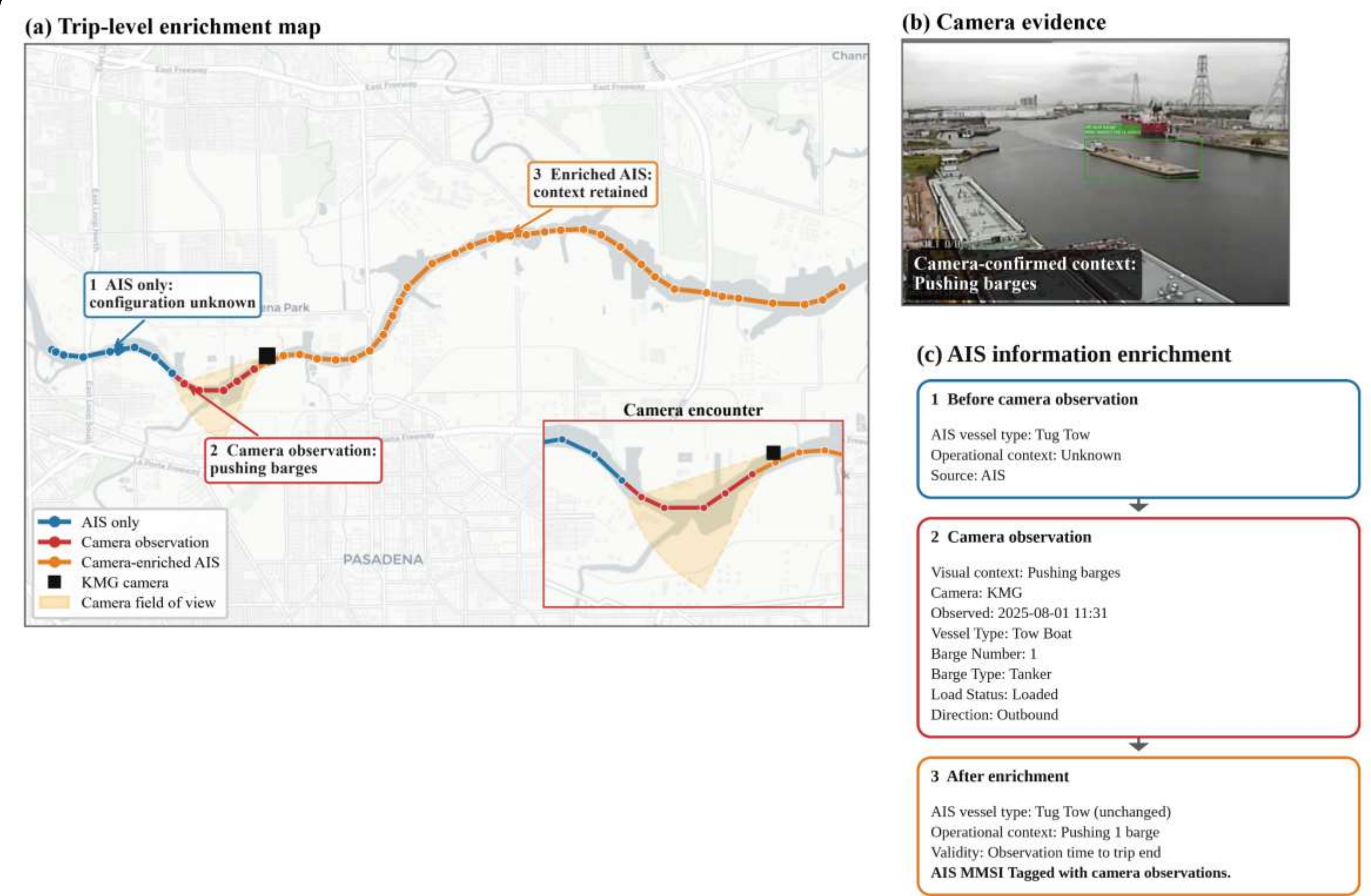


Synchronized Data



Result: Before filtering, the AIS dataset contained nine unique MMSIs. Following the filtering procedure, a single AIS candidate with the highest plausibility was retained. By synchronizing shoreline video with AIS data, the framework accurately tracked the vessel's trajectory and identified its vessel type as a tank barge through detailed visual analysis.

AIS Trajectory Enriched



Conclusion

This study developed a practical framework for connecting shore-based surveillance video with AIS data to create more complete vessel records. The framework combines navigation information from AIS with visual information from real-time video. It identifies vessel types, barge number, tow configurations (wide or long), load status, and movement directions (inbound or outbound) from video and matches these observations with AIS vessel tracks using a systematic spatial and temporal filtering process. Tests conducted on the Gulf Intracoastal Waterway and Houston Ship Channel demonstrated that the framework can effectively remove unrelated AIS records and identify the most likely vessel match. The step-by-step filtering process reduces the number of possible matches while maintaining reliable results. The enriched vessel records provide useful information, such as barge configurations and load status, that cannot be obtained from AIS data alone. Future work will focus on automating camera calibration, improving synchronization accuracy using ground-truth data, and expanding the framework to support multiple cameras for continuous vessel tracking across larger waterway systems.



PROJECT NAME: Beyond the Signal: Synchronizing AIS with AI-Powered Visual Analytics for Intelligent Waterway Management.

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