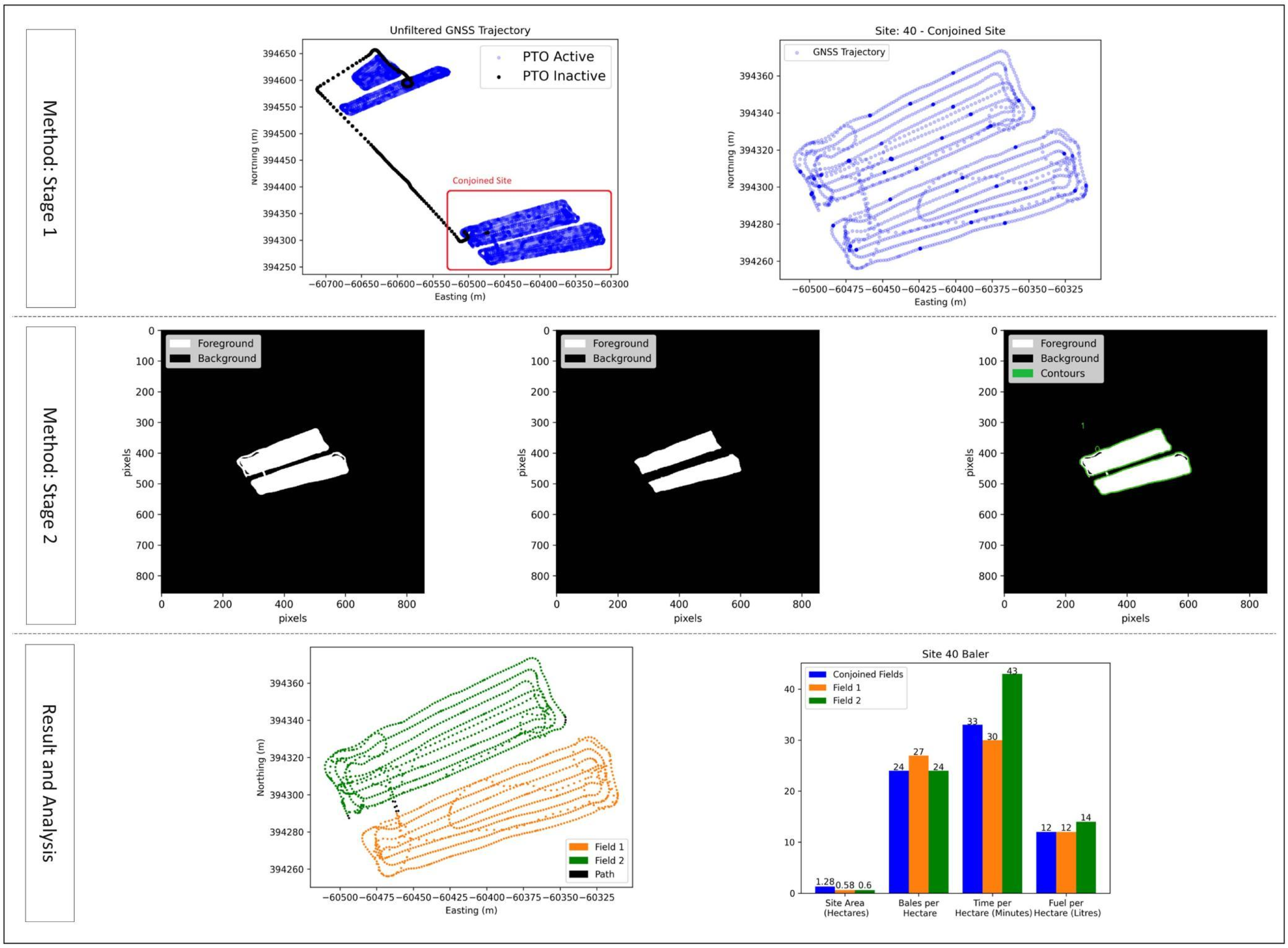

Fig. 1. Algorithm overview. In Stage I data preprocessing, machinery trajectory data are filtered into job sites; by speed and power take-off activity. The conjoined field site, highlighted in red, is passed to Stage II. In Stage II, the algorithm removes pathways between fields and isolates their geometric boundaries. First, the conjoined site is plotted as a sampled image; the pathway pixels are then removed by applying a series of morphological image operations. The segmented fields are shown in the Result and Analysis, where the algorithm has successfully differentiated between this conjoined field use case. A field efficiency analysis of machinery performance is then shown in the histogram plot, where the colors correspond to the detected field boundaries.

be determined when accurate field geometric boundaries are delineated.

Beyond the postprocessing of recorded data, field boundaries may also be applied in activity planning and predictive applications. Examples include farm machinery automation technologies, such as machinery guided navigation systems [18] and path planning algorithms [19]. Field boundaries may also be used to monitor in-field application rates of additive materials recorded from machinery [20]. This is relevant at a time when the EU aims to halve pesticide use by 2030 under the farm-to-fork strategy [21]. Proximal sensing applications on agricultural machinery [14], [22], [23] may play a role in satisfying PA data requirements [5], but the data must first be spatially classified. The required resolution is application dependent, however, isolating machinery data to inside a field geometric boundary is an essential step prior to processing agricultural machinery data.

To segment machinery trajectory data into field boundaries, agricultural data mining algorithms may apply a coarse filter [timestamps, speed, power take-off activation (where present)]. However, the complexity will increase for field-to-field cases, i.e., machinery moves between adjacent fields that share a common boundary. Manual methods may be used for difficult segmentation cases, incurring a significant labor and time cost. However, to make data analysis of agricultural machinery practical for industrial scale application, agricultural machinery trajectory segmentation must be automated [6].

The authors of this article present a novel method to automatically segment machinery trajectory data from farming implements, namely, a silage baler and a mower, into individual field boundaries. Fig. 1 presents an overview of the algorithm's approach to solving for field geometric boundaries. The method is evaluated with geolocation and power take-off (PTO) digital event data obtained from a full harvesting season on machinery operated by a grass silage contractor. Contractors will often visit multiple adjacent fields in a single day, where they continue to activate the PTO, despite traversing into a new field. In the context of this article, a "job site" is a recorded work episode of the operating machinery performing a task in one or several fields of the same crop type. A work episode indicates that the machine is operating and that the PTO shaft is