DRAINAGE ESTIMATION AND PROPPANT PLACEMENT EVALUATION FROM MICROSEISMIC DATA

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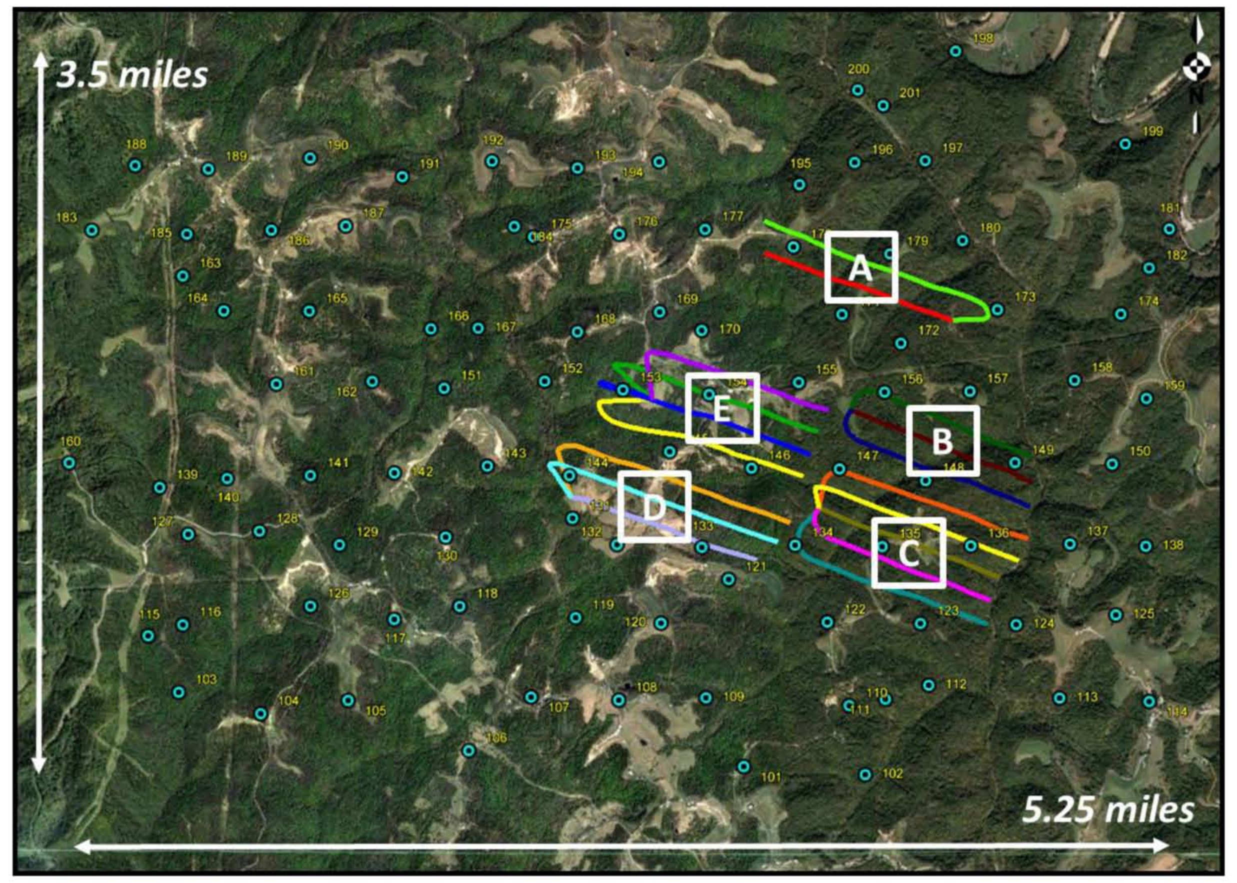
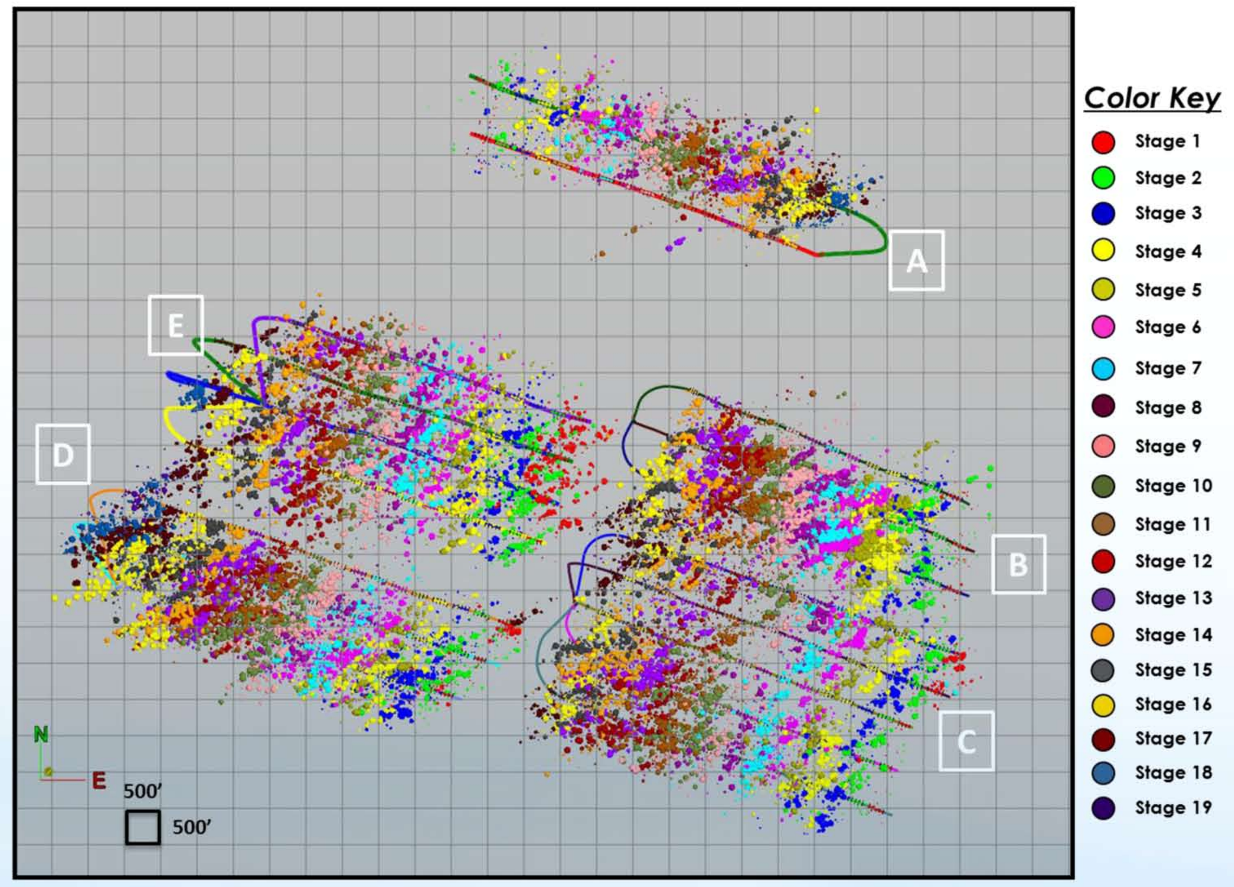
WHERE IS THE PROPPANT?

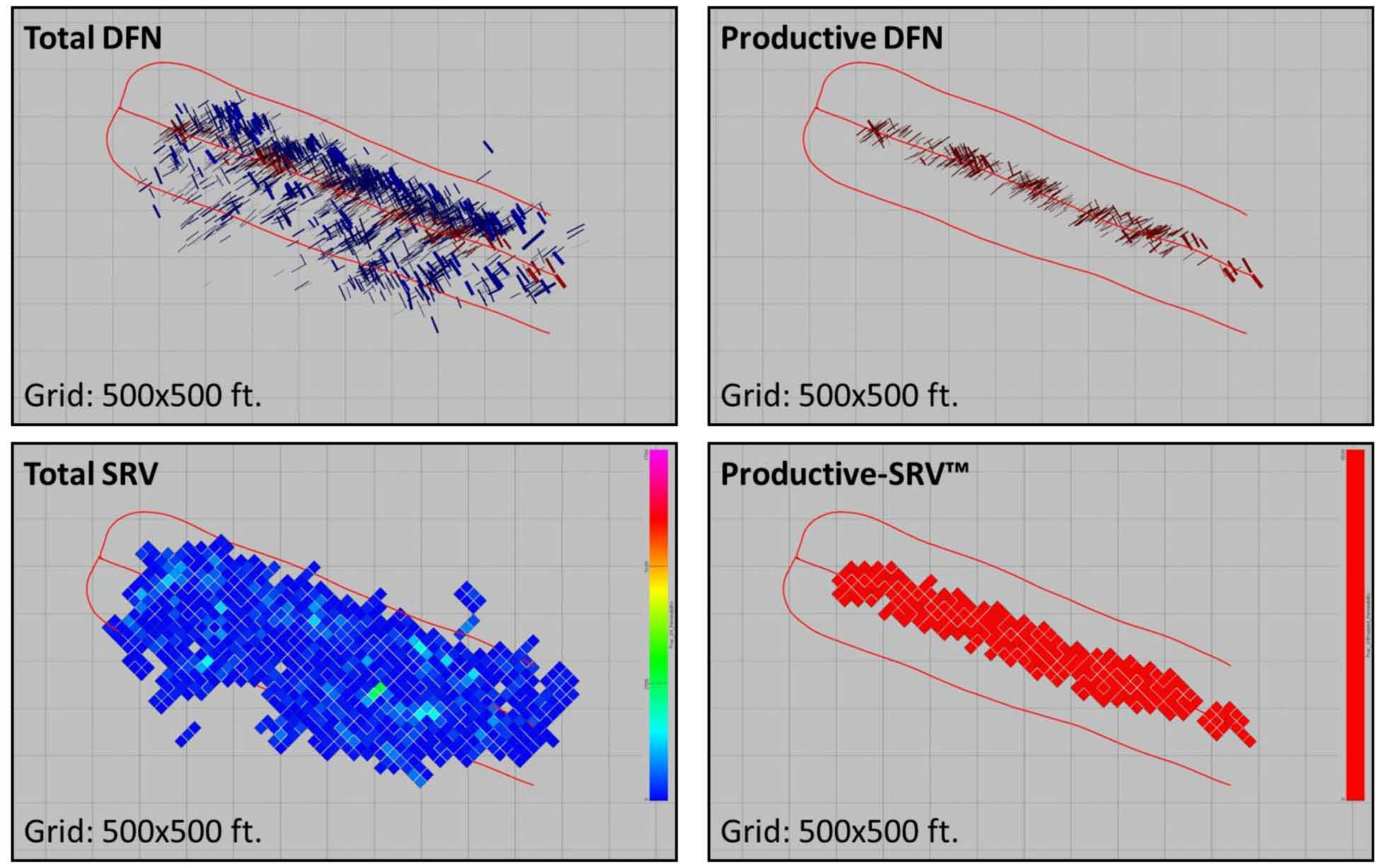
Evaluating the placement of proppant inside the DFN allows for discerning between the part of the stimulated rock volume (SRV) that contributes to production in the long term, and the part of the reservoir that was affected by the treatment but may not be hydraulically connected over a longer period of time. The permeability of the stimulated fracture system can be calculated from the microseismic results. This allows for the evaluation of the drainage volume and estimation of production.



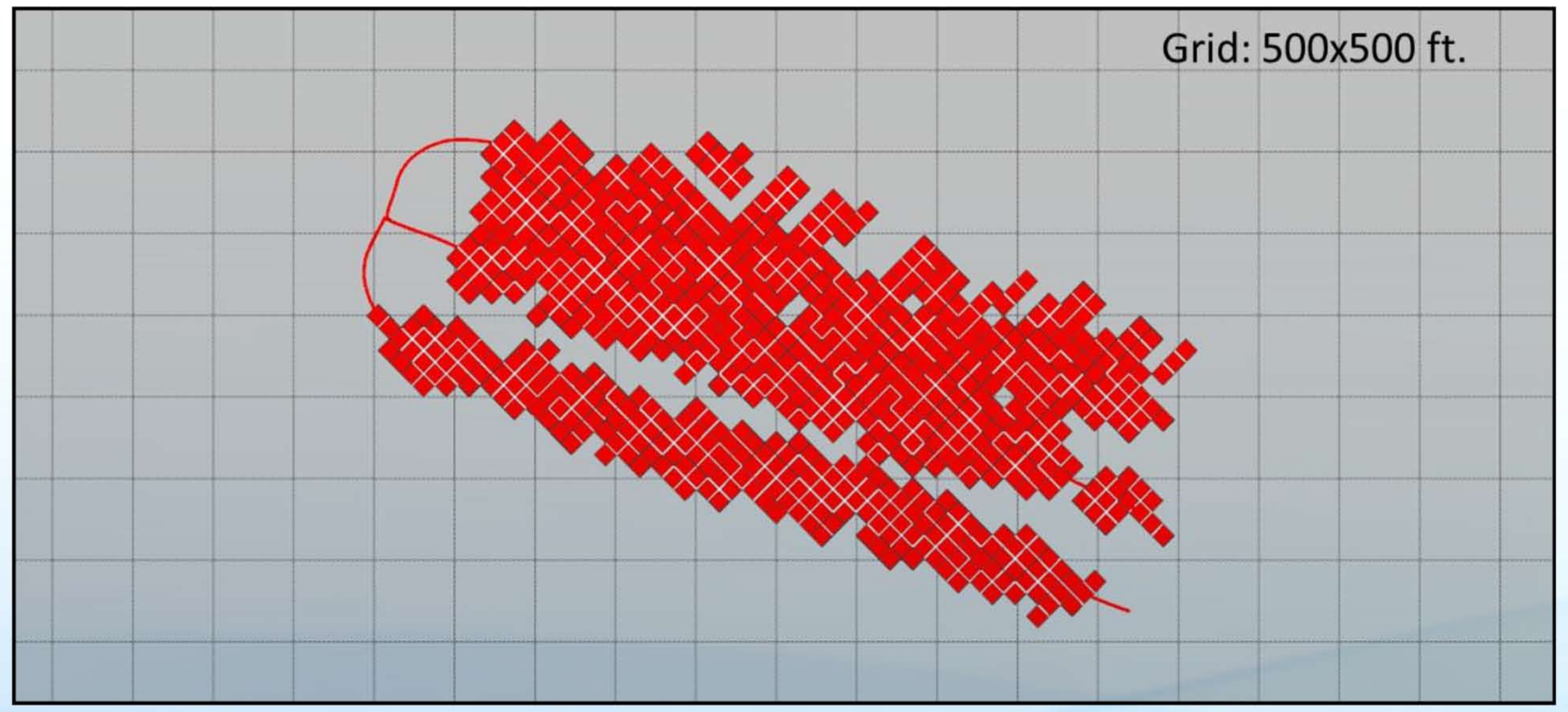


MAGNITUDE CALIBRATED DFN

The basic assumption is that every event is representative of a fracture, which can be modeled and is centered on the event. Through source mechanism analysis, strike and dip of the failure plane are identified for each individual event. The geometry of each individual failure plane is then determined through the magnitude of an event incorporating rock and fluid properties.

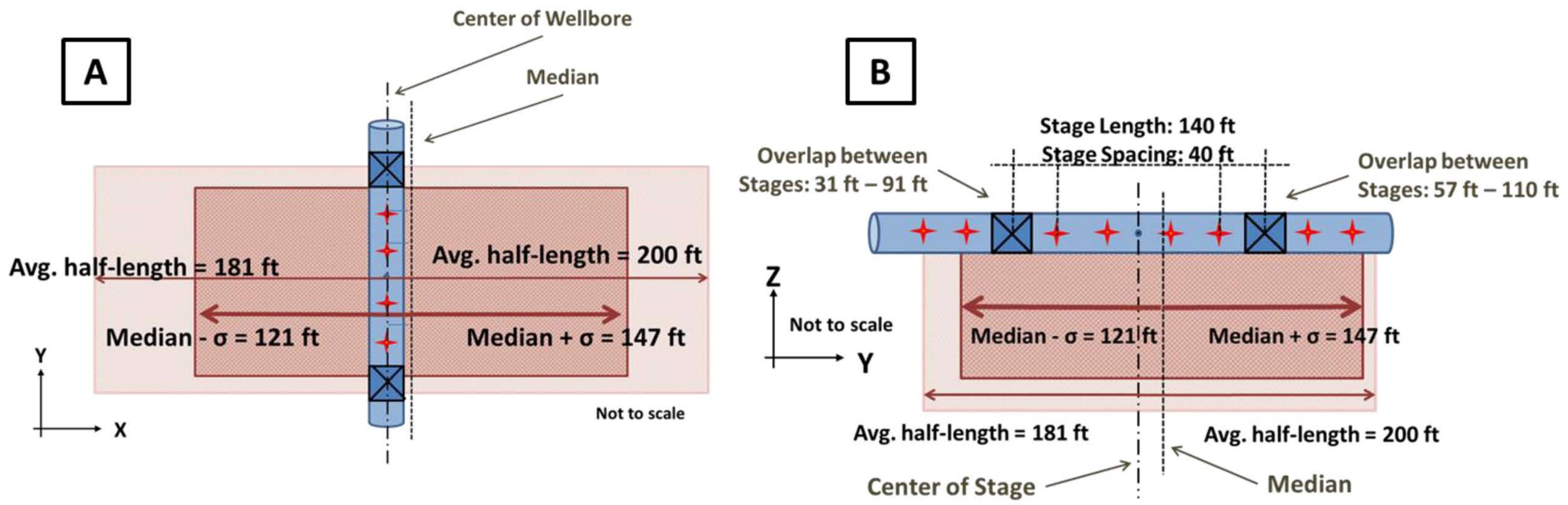


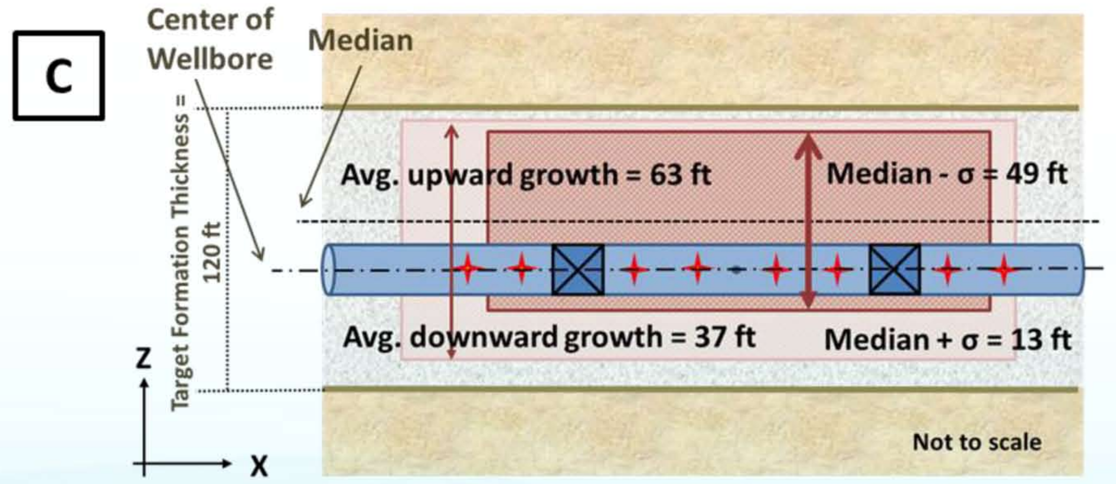
Wellbore spacing may be slightly reduced in order to provide a well-connected propped fracture network without undrained parts between wellbores leaving resources behind.



PRODUCTIVE-SRV™

Estimating the propped half-length is performed by filling the DFN with proppant from the wellbore outward on a stage by stage basis. The packing density of the proppant is variable and can be adjusted based on the specific gravity of the proppant and available hydraulic fracture models. The distance of fractures to the wellbore is measured as the radial distance between the center of the stage and the event the fractures are centered on. Proppant filling is constrained by tortuosity of the flow path by allowing only 50% of the proppant to populate fractures intersecting the prevalent failure plane azimuth at angles of more than 45°. The fracture volume inside the respective stage DFN is filled with proppant until all proppant that was pumped is accounted for. Estimated propped half-lengths are then determined by breaking up the proppant filled fracture distances into a perpendicular horizontal (A), a parallel horizontal (B), and a perpendicular vertical (C) component with respect to the corresponding stage center. The statistical properties (average, median, standard deviation) of the distribution of fracture distances can be used to illustrate the containment of proppant within the DFN to evaluate the optimal wellbore spacing, stage length and spacing, as well as landing depth.





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