
Annex I – THRUST 5 – UNCERTAINTY AND STOCHASTIC MOBILITY MAPS

Note: This Annex appears in its original format.

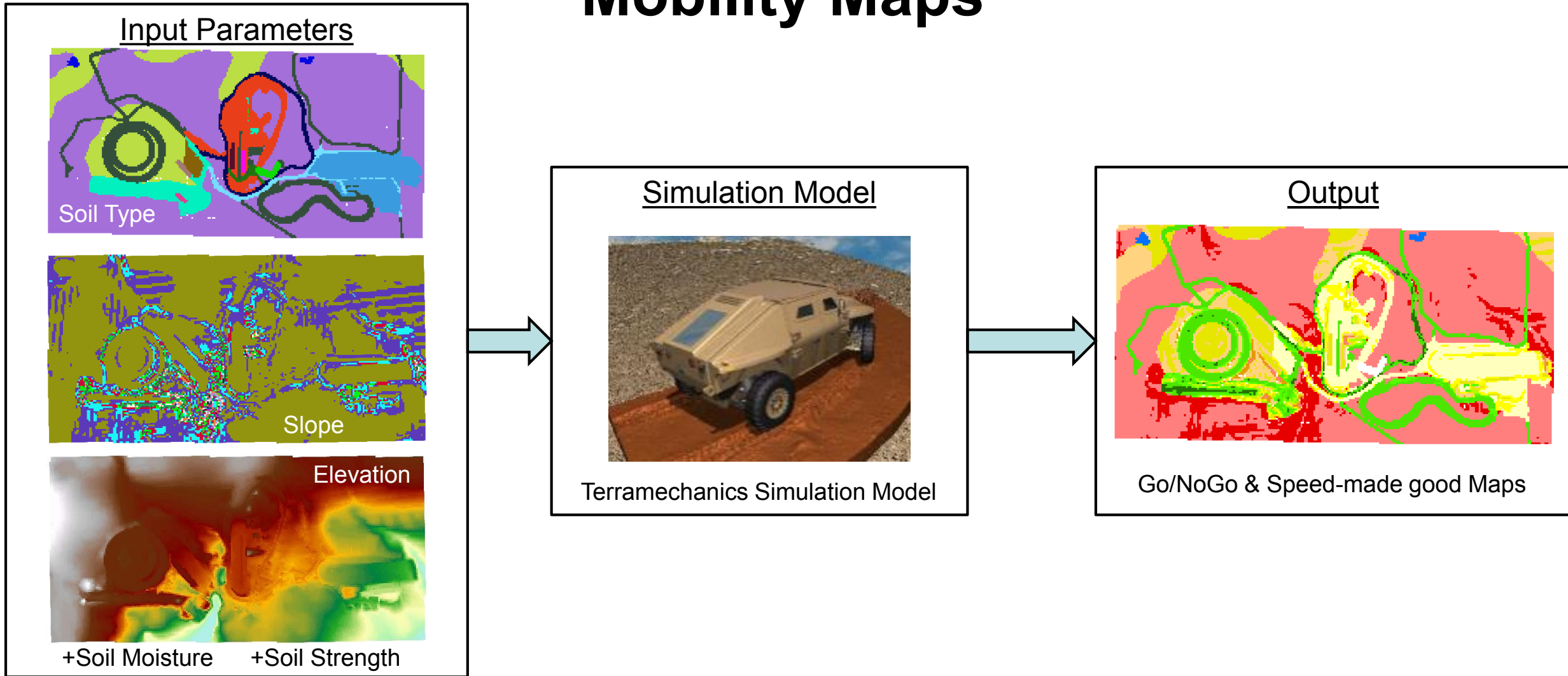


Thrust 5: Uncertainty & Stochastic Mobility Maps

*CDT Meeting
KRC, Houghton, MI*

Nicholas Gaul, Kyung Choi on behalf of the AVT-248 and AVT-308 teams

Mobility Maps



Path Planning on Mobility Maps

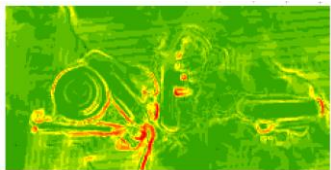
Inputs



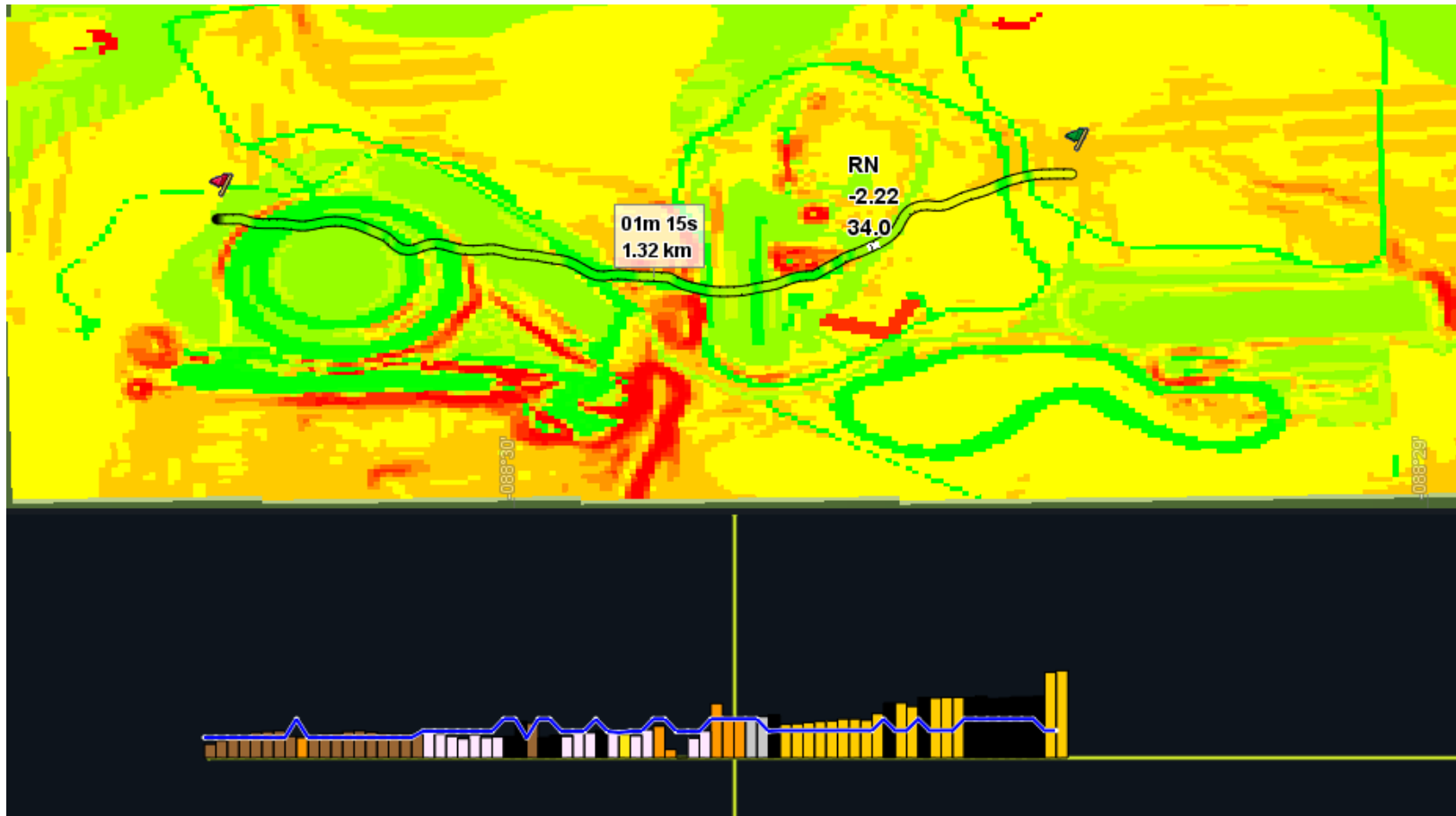
Vehicle Capabilities



Soil Data

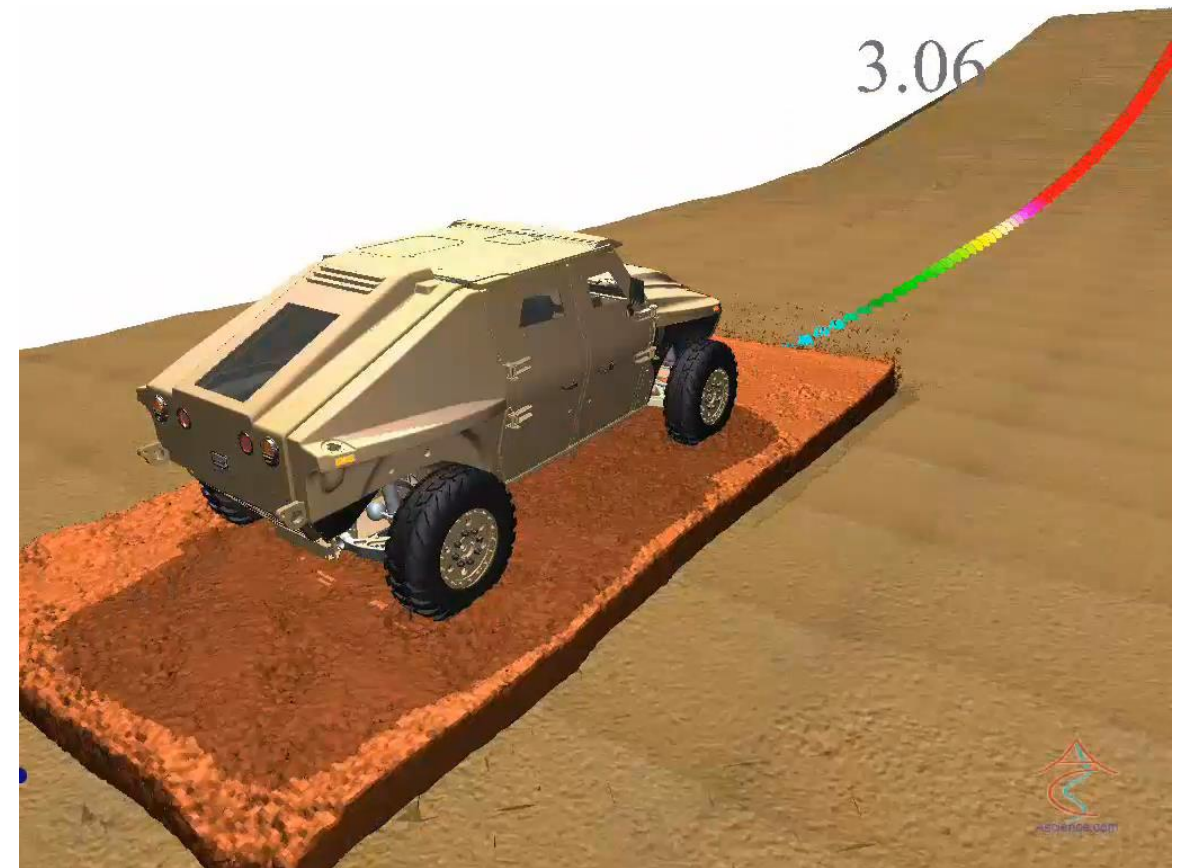


Elevation

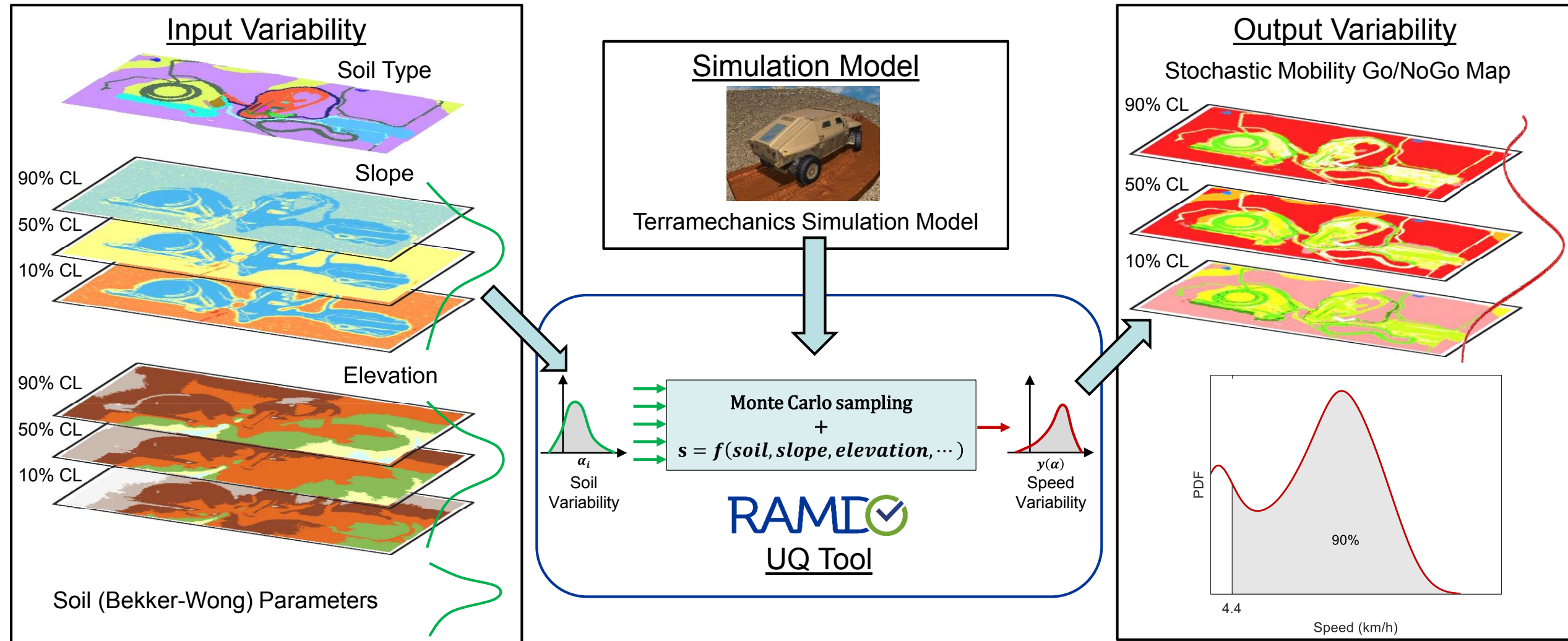


- Speed Map output
Route accounts for:
- Soil
 - Travel Direction
 - Vehicle capabilities

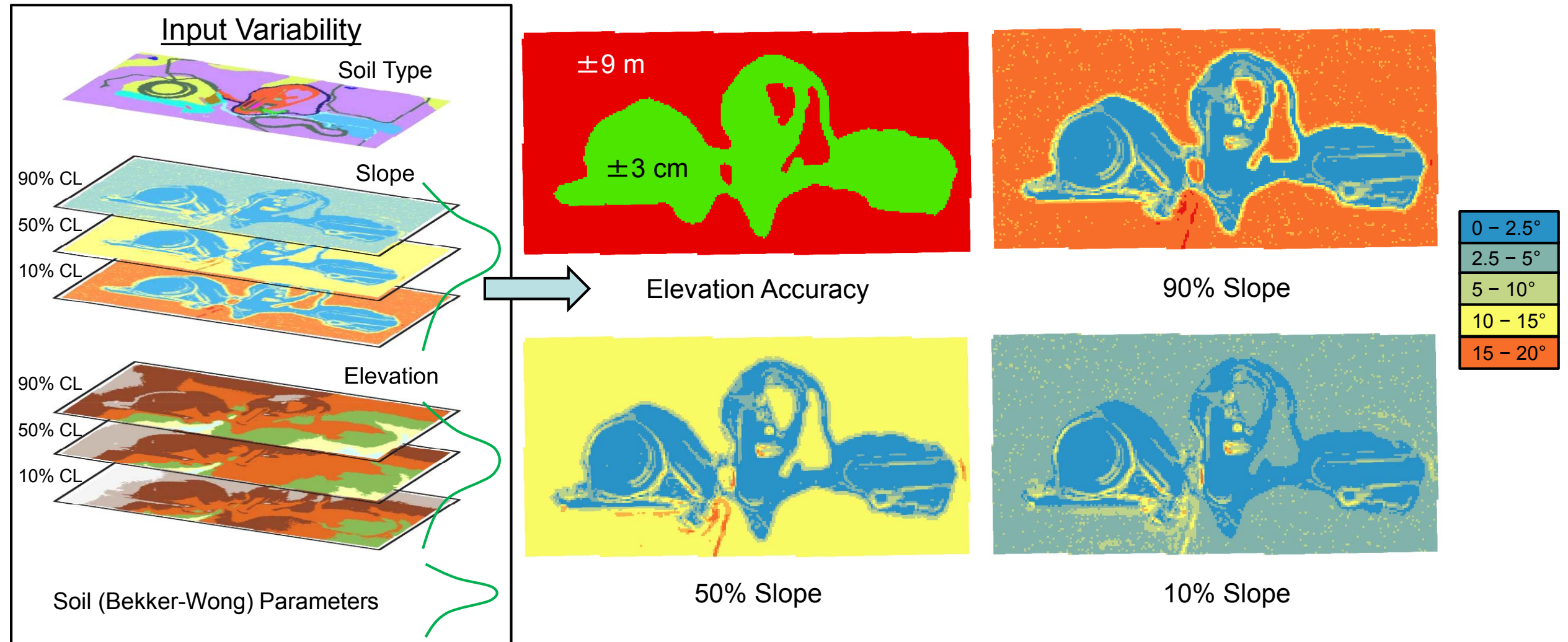
Importance of Variability



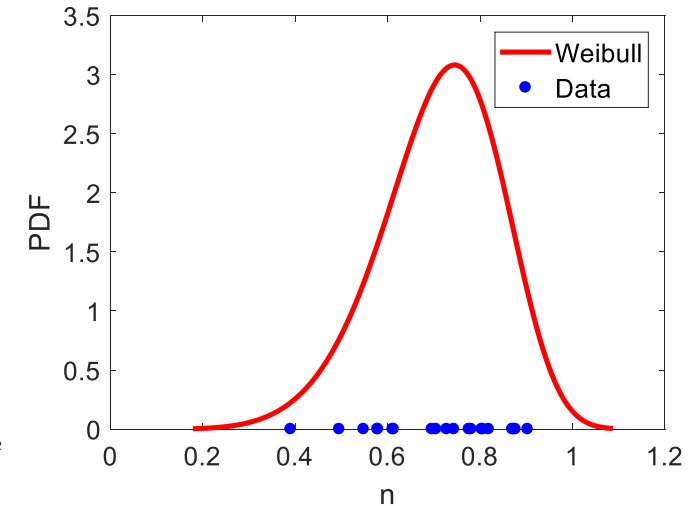
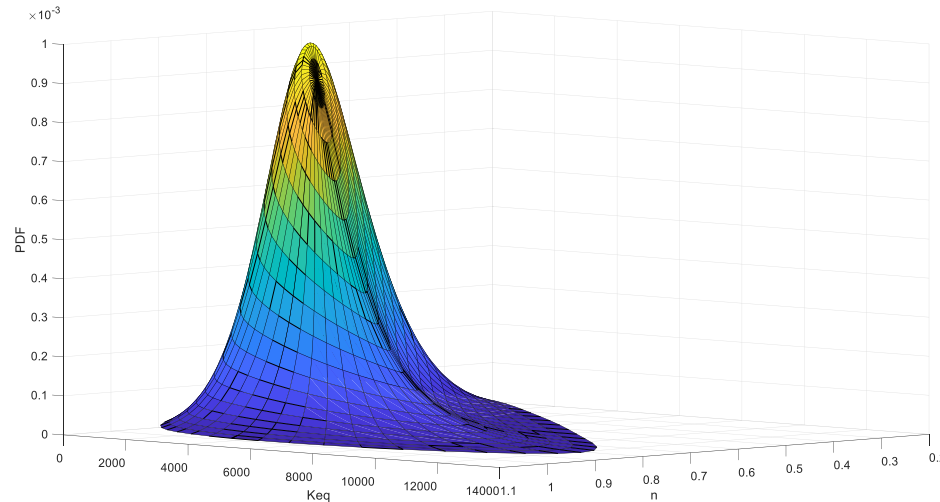
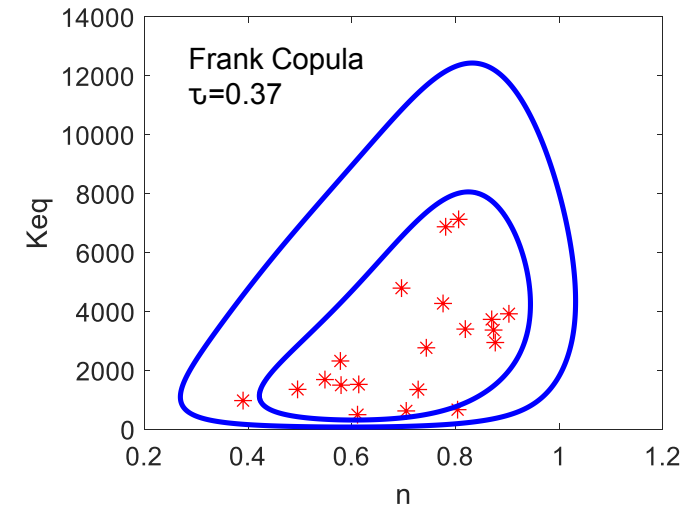
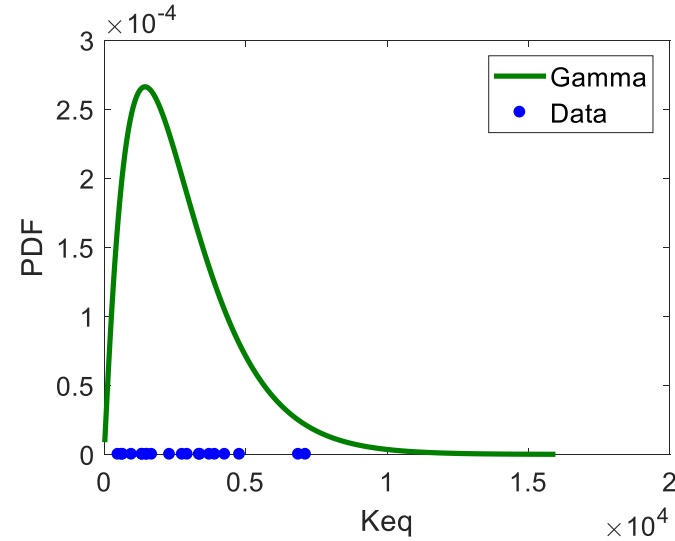
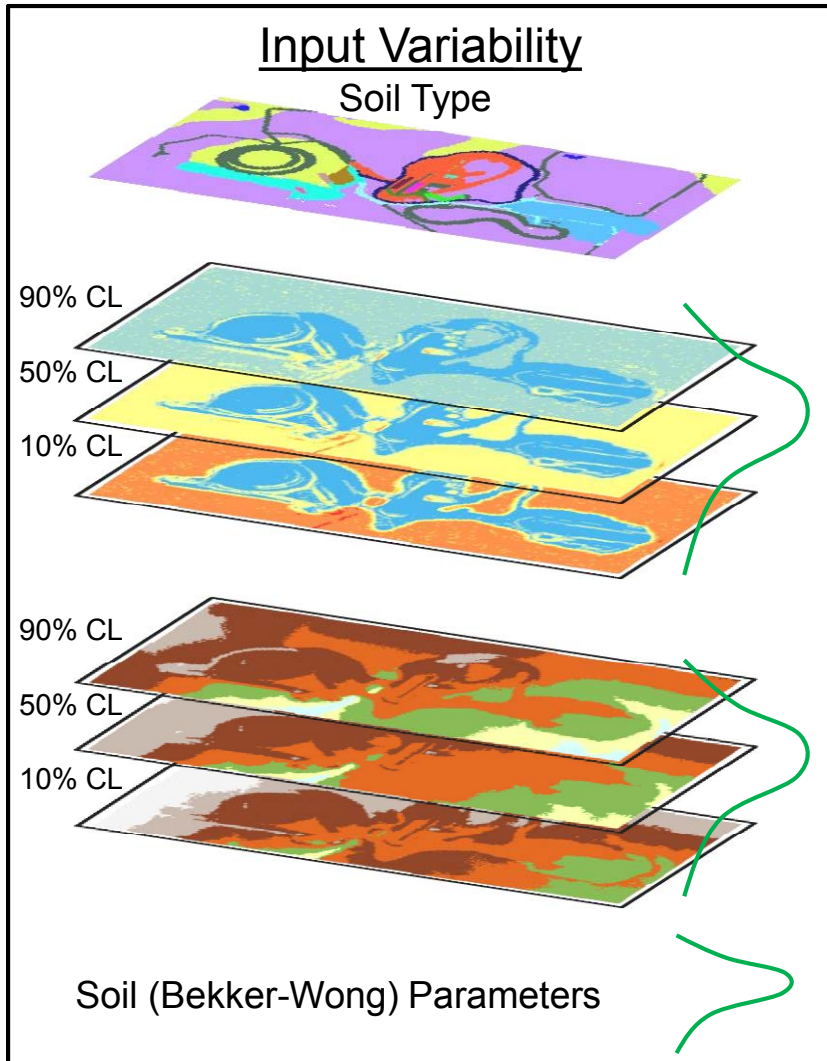
Uncertainty Quantification Process



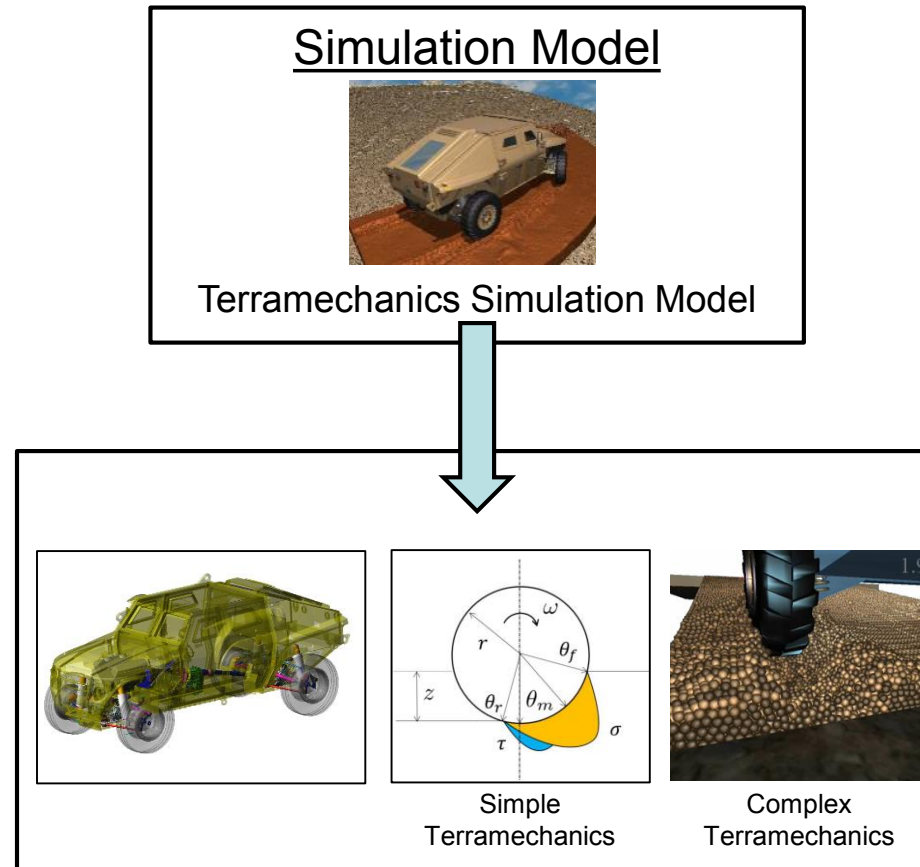
Slope Variability



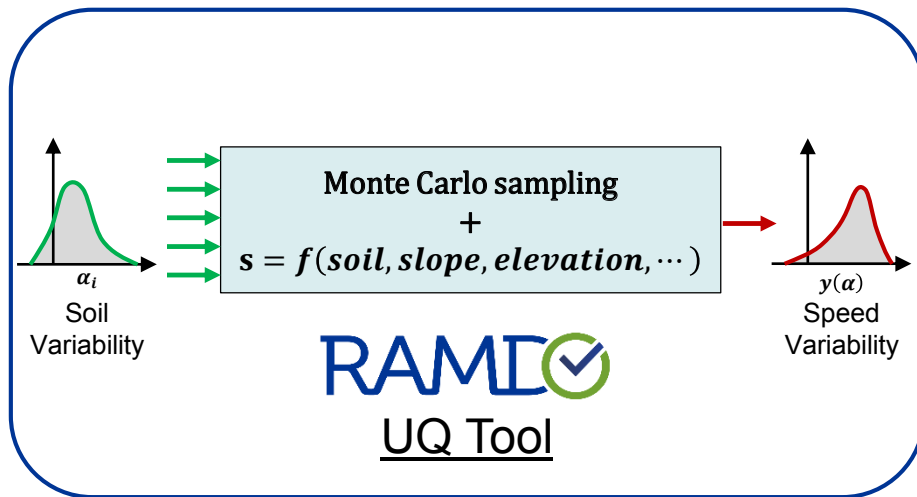
Soil Variability



Simulation Model



Uncertainty Quantification Tool



1

Surrogate Modeling

- Run simulation model at select combinations of soil, slope, etc.
- Requires **several days or weeks** to build surrogate.

Completed During Vehicle Production

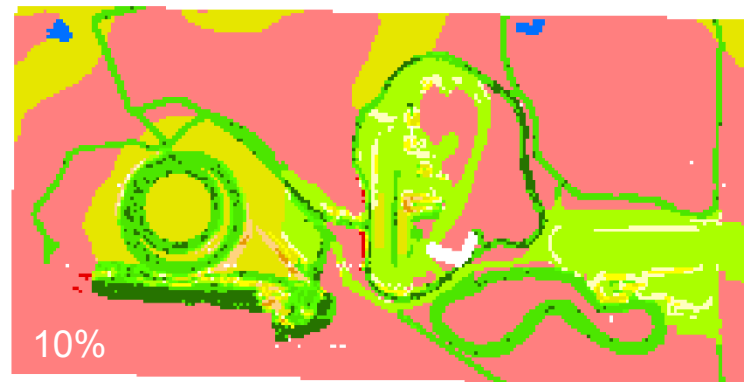
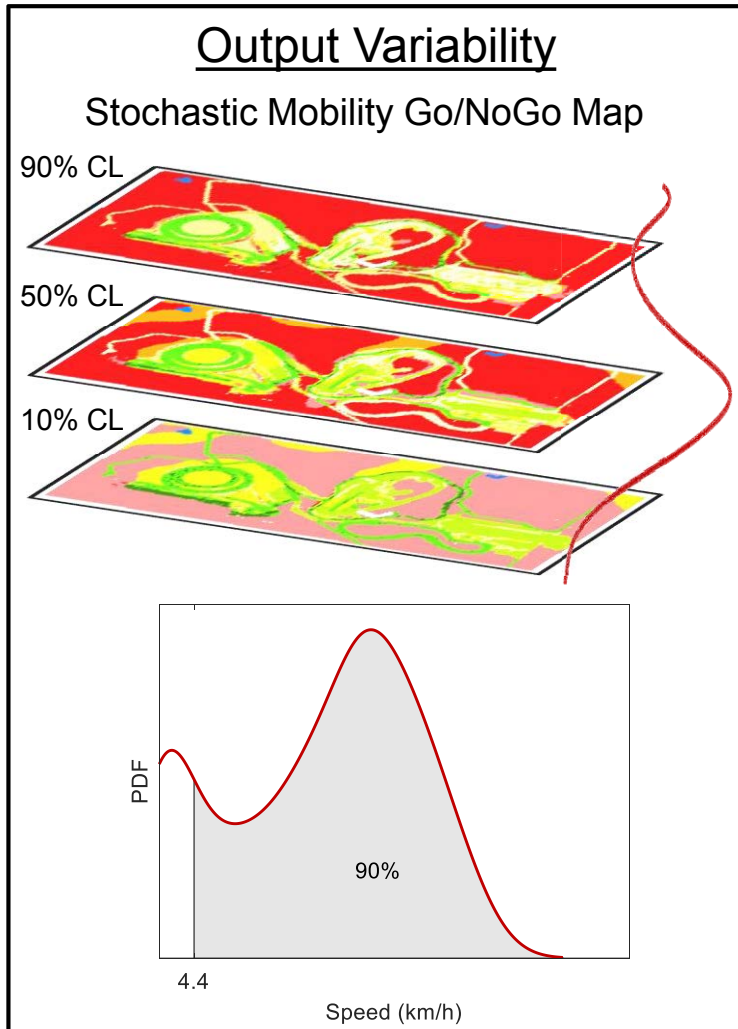
2

Monte Carlo Sampling

- Carry out Monte Carlo sampling using surrogate model.
- Requires only **minutes or hours** to complete.

Completed Before or During Operational Use

Speed Variability

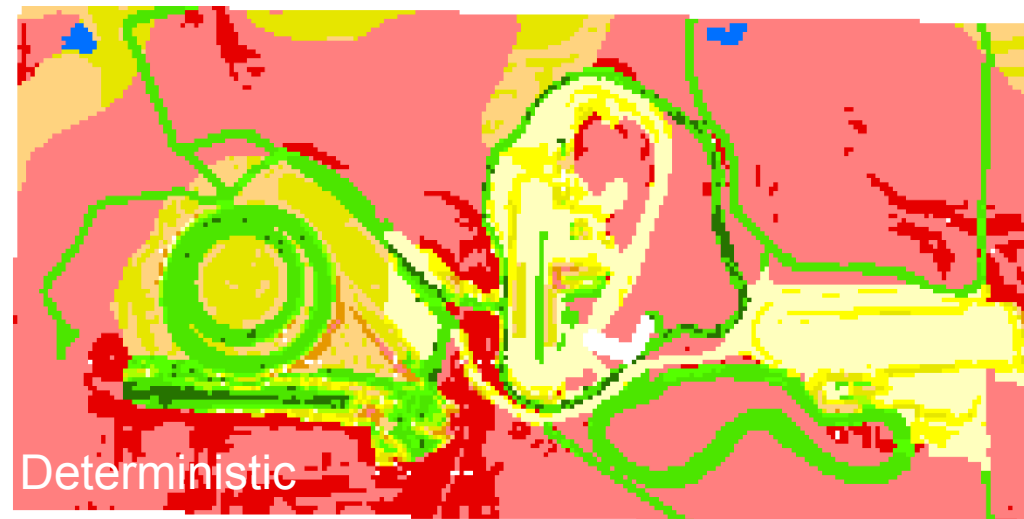
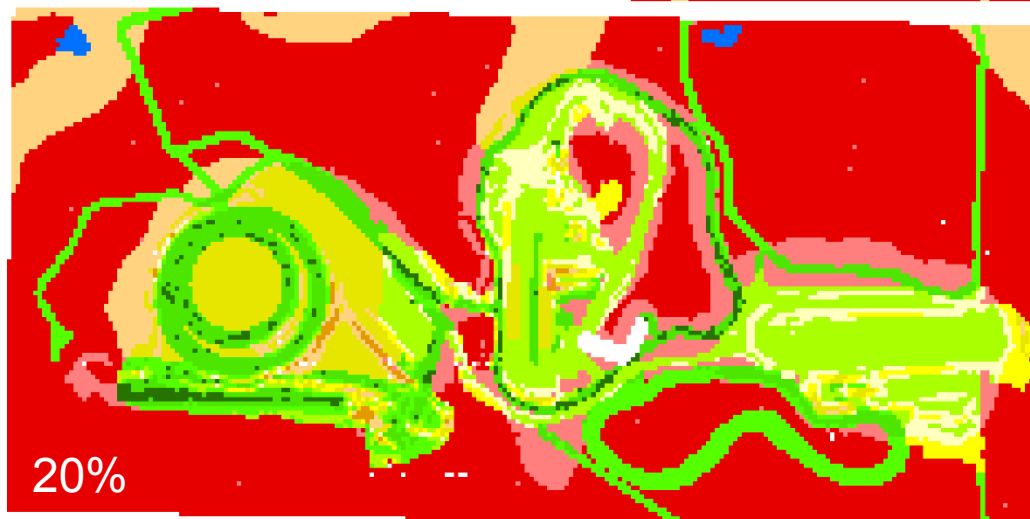


0 – 10 km/h
10 – 20 km/h
20 – 30 km/h
30 – 40 km/h
40 – 50 km/h
50 – 60 km/h

- 90% map means 90% confidence will obtain at least the speed shown in the map or higher
- Higher Confidence → Lower Speed
- Higher Speed → Lower Confidence

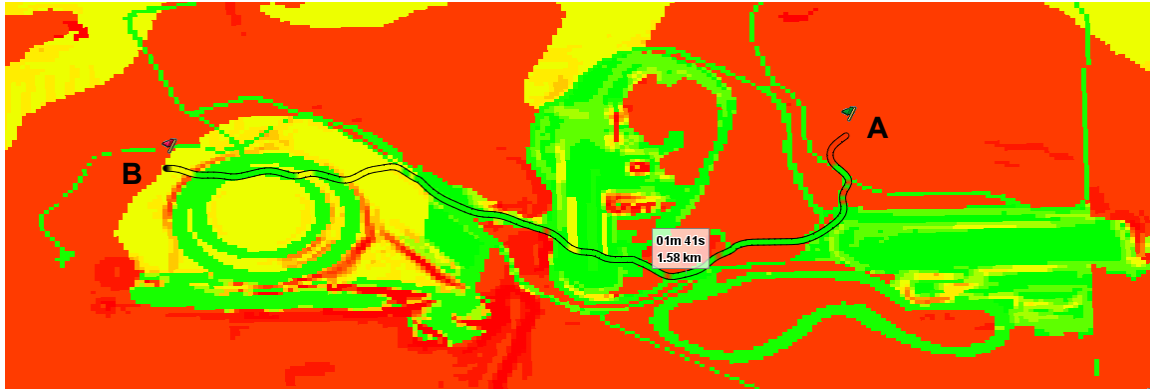


Stochastic Maps

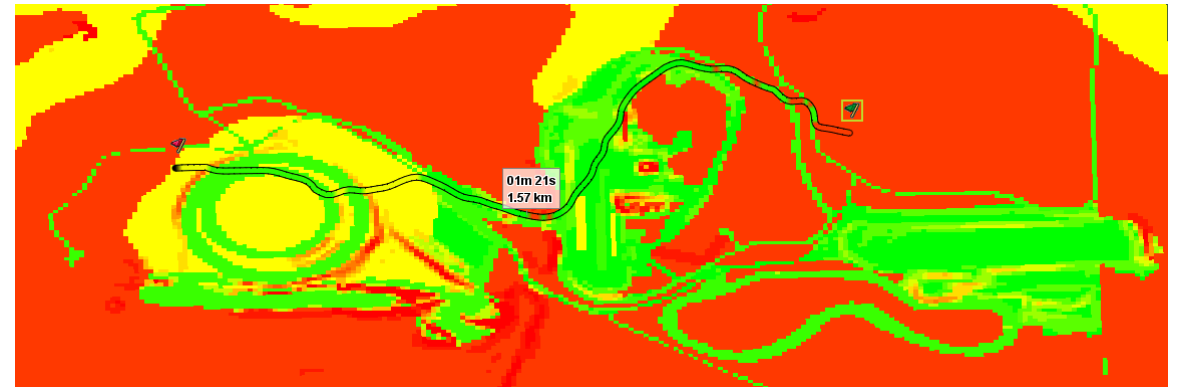


Path Planning on Stochastic Maps

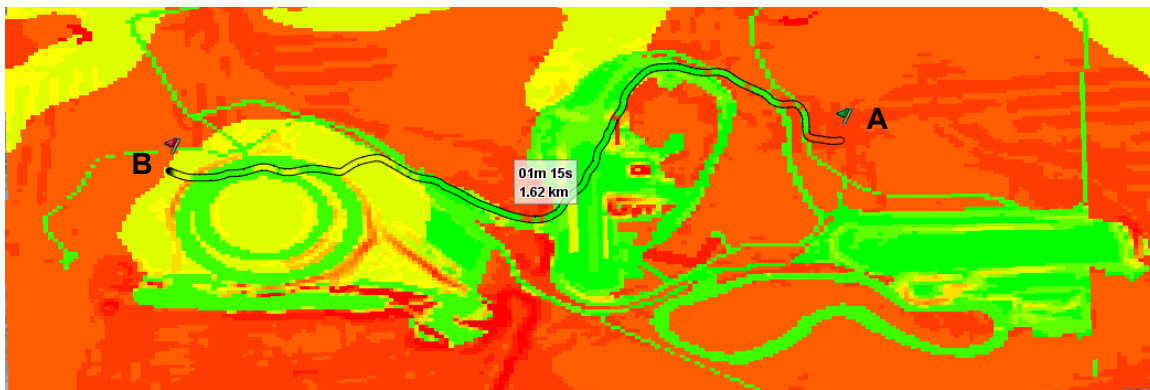
90% Route



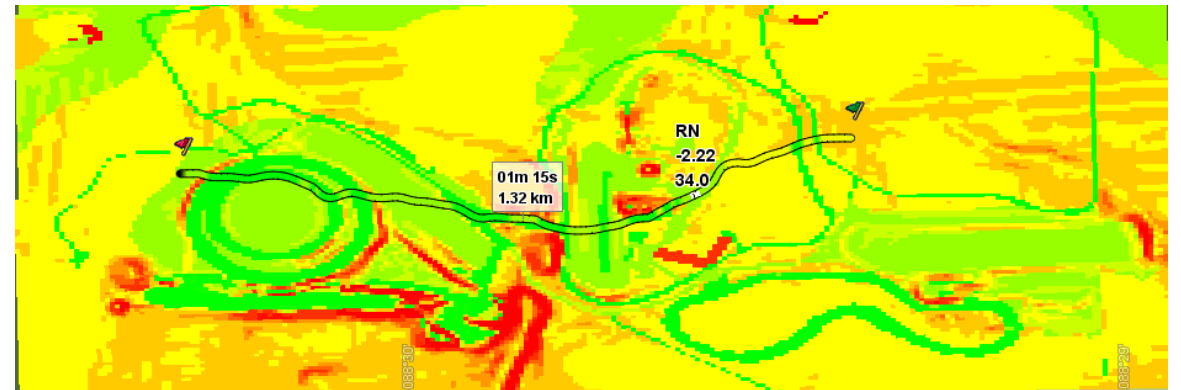
50% Route



20% Route



Deterministic Route



Summary & Conclusion

- **It was shown how the terrain and soil variability together with the terramechanics simulation model, and UQ tool can be used to generate the stochastic mobility maps.**
- **It was shown how the confidence level the deterministic map is unknown and can vary between 0-100% confidence.**
- **The UQ process is a two-step process that makes UQ computationally affordable and practical for live operational use.**
- **The stochastic mobility maps provide more information to decision makers that will help with mission planning and achieving mission success.**

