U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Stochastic Mobility Framework for Next Generation NATO Reference Mobility Model

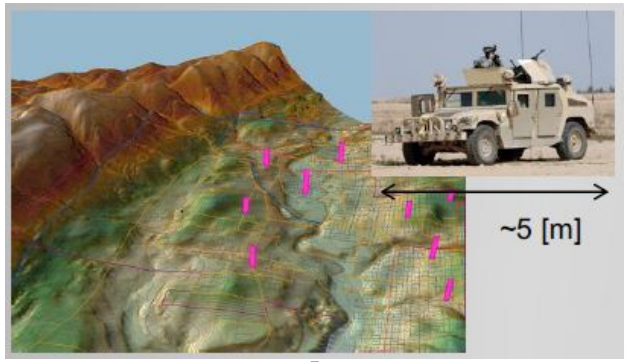
Paramsothy Jayakumar, U.S. Army TARDEC

K. K. Choi, University of Iowa
Nicholas Gaul, RAMDO Solutions, LLC

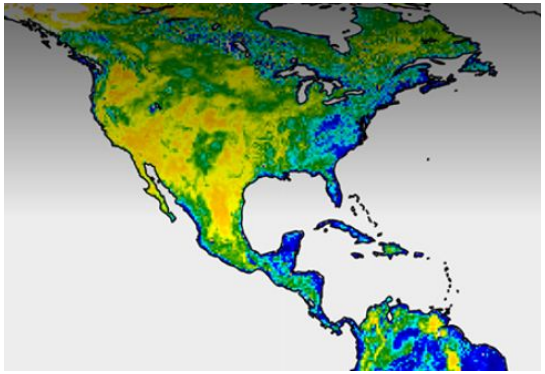
Tamer Wasfy, Advanced Science & Automation Corp.
Matthew Funk, Esri, Inc.

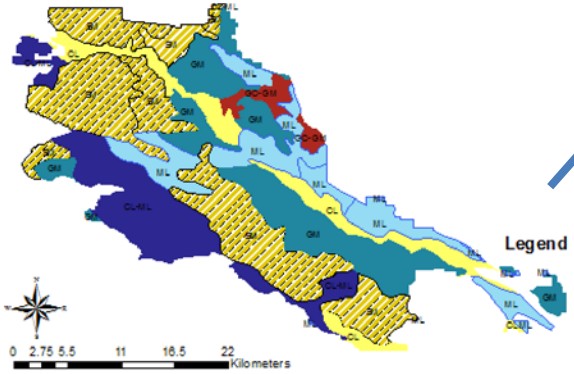
NATO AVT-248 Objective: NextGen NATO Reference Mobility Model

Terrain Elevation Map



Soil Moisture Map

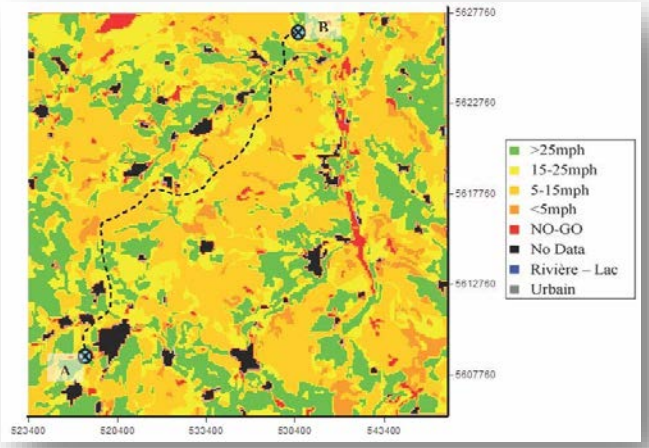




Soil Type

Physics-Based M&S

Mobility Go/NoGo Map



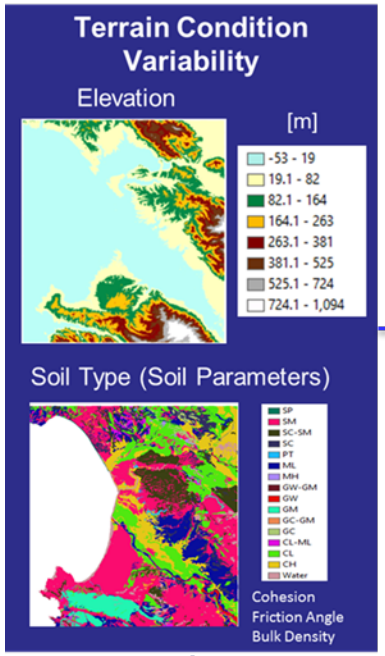
Qualitative — NRMM — NG-NRMM

1970 — 2020

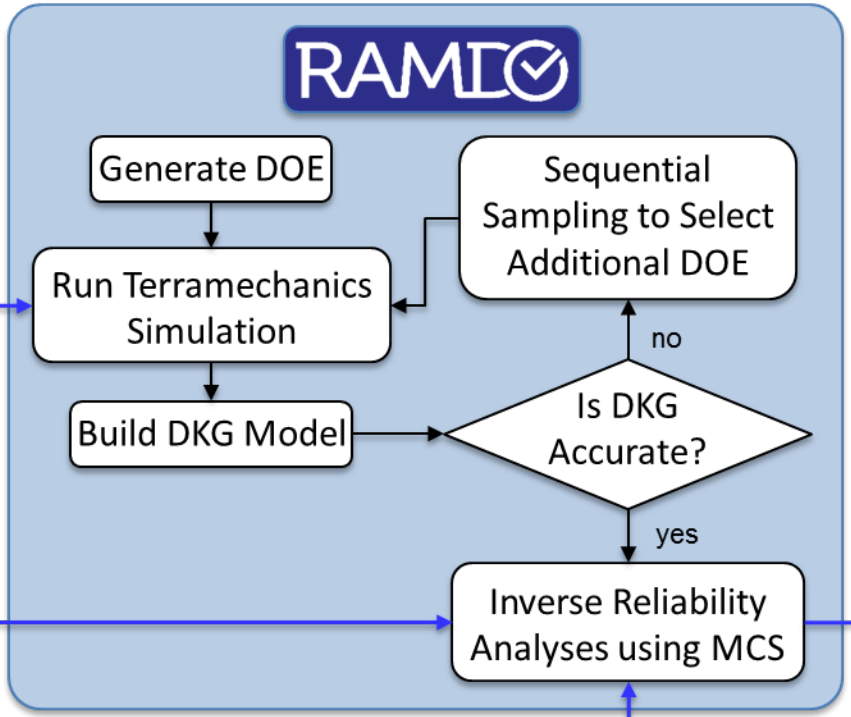
Motivation

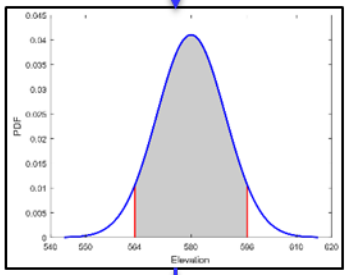
- Traditional **deterministic** NRMM mobility map could be unreliable since off-road operational environment is far from certain.
- Need **stochastic** mobility maps in NG-NRMM for mission planning of NATO forces and selection of capable vehicles.
- Objective is to develop framework for generation of stochastic mobility maps.
- Stochastic mobility map requires stochastic knowledge of terrain properties and terramechanics modeling capabilities.

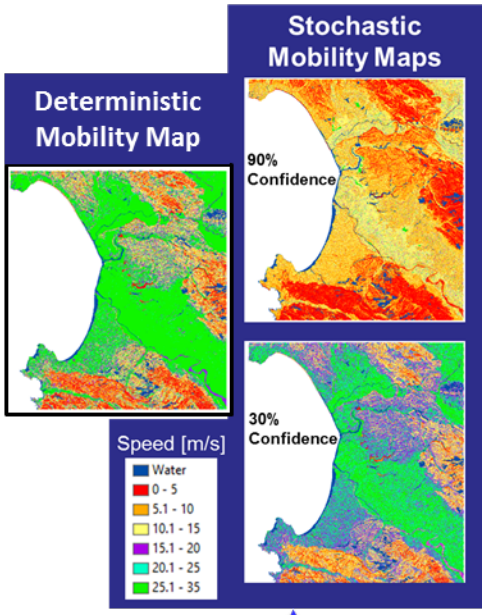
Thrust Area 5, UQ: Stochastic Mobility Framework

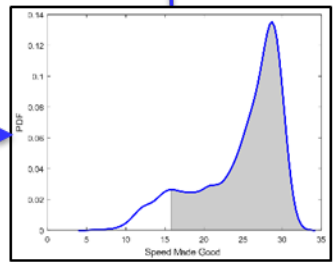


DOD HPC: Excalibur

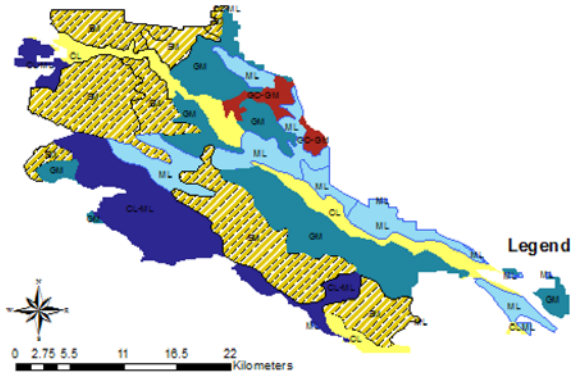




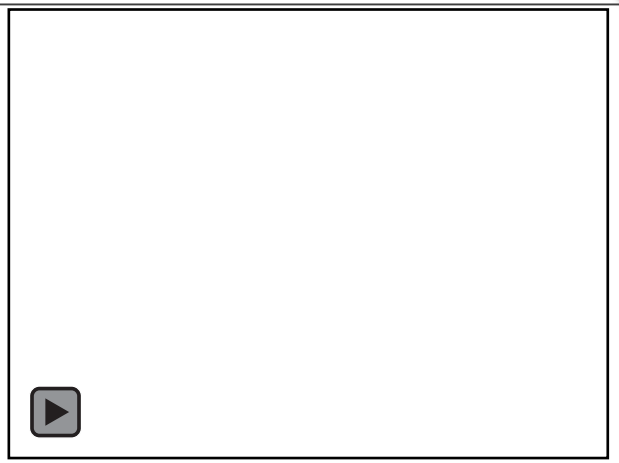




Complex Terramechanics Simulations



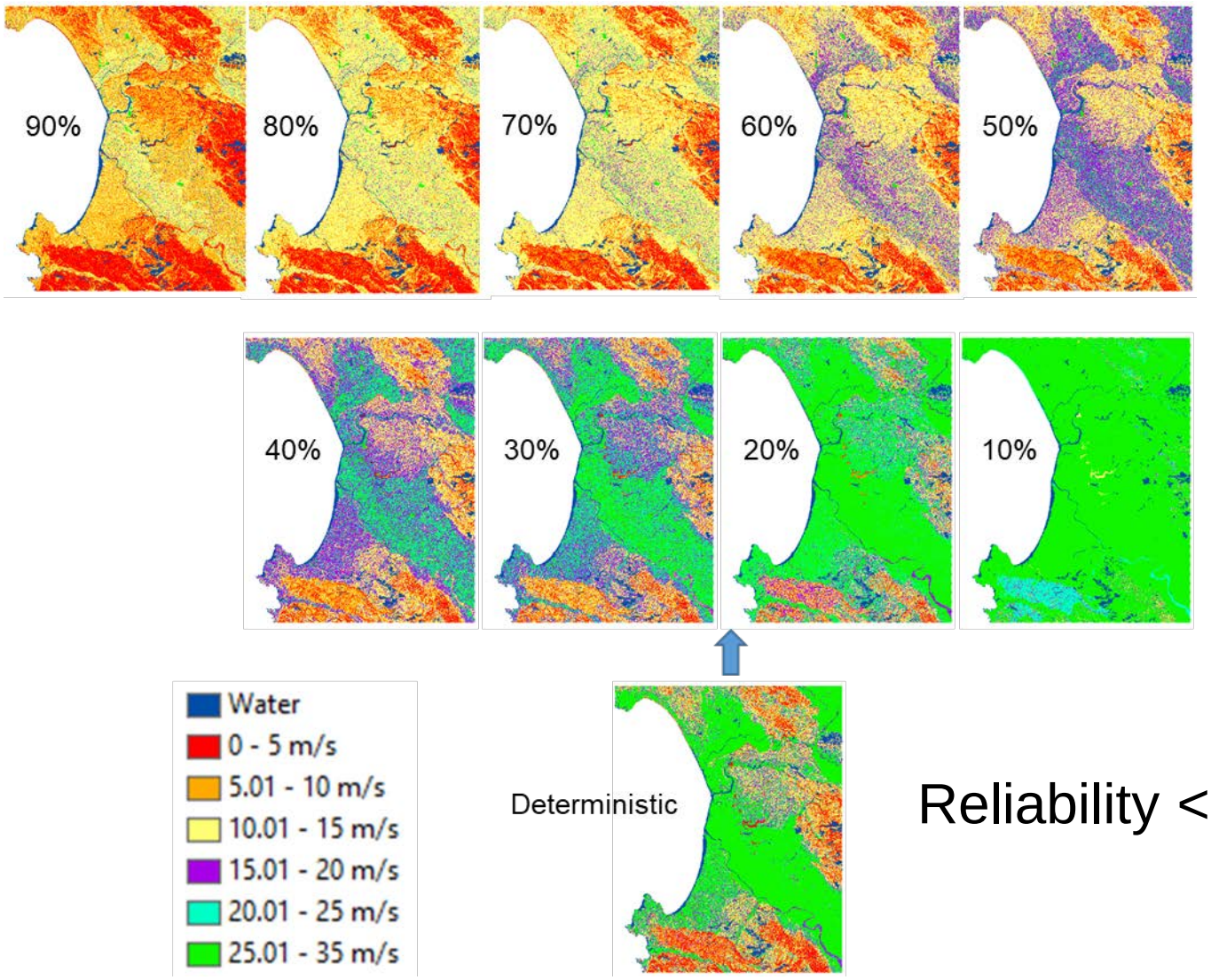
Monterey, California



DEM Simulations of NATC Wheeled Vehicle Platform

- Stochastic input variables: slope, bulk density, soil cohesive strength, and soil friction angle.
- Multiple and sequential DOE runs were used to create a dynamic kriging model (DKG) for the four-variable problem. Each DOE run takes 5-7 days on ARL Excalibur HPC (Cray XC40).
- DKG surrogate model along with Monte Carlo simulations is used to generate stochastic Speed-Made-Good map.

Reliability-Based Speed-Made-Good Mobility Maps



Reliability < 30%