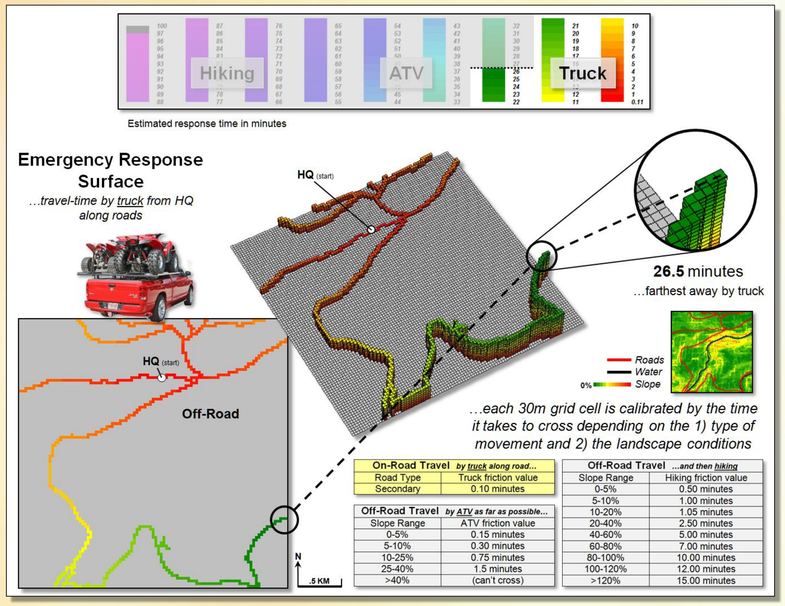
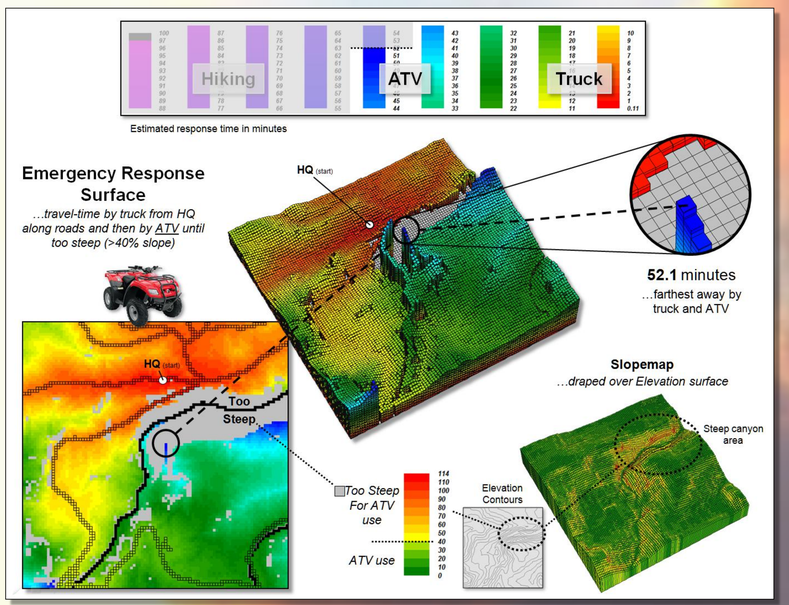
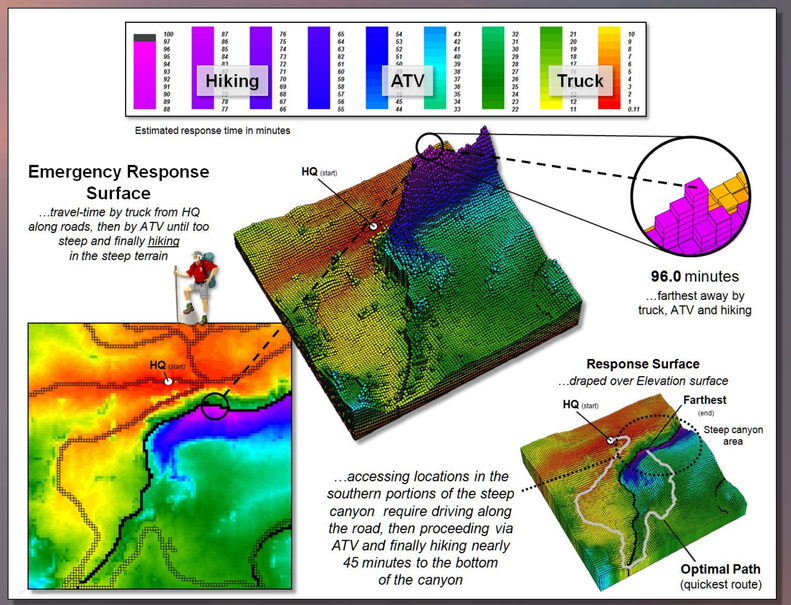
Backcountry Emergency Response: *Extending E911 Beyond the Roads*

One of the most important applications of geotechnology has been Enhanced 911 (E911) location technology that enables emergency services to receive the geographic position of a mobile phone. The geographic position is automatically geo-coded to a street address and routing software is used to identify an optimal path for emergency response. But what happens if the call that "I've fallen and can't get up" comes from a backcountry location miles from a road? The straight-line distance to the closest road location "as the crow flies" is rarely the quickest route in mountainous terrain. A **grid-based continuous space solution** is a bit more complex than traditional network analysis as the relative and absolute barriers for emergency response are scattered about the landscape. In addition, the intervening conditions affect modes of travel differently— a "**stepped accumulation surface**" approach is needed that characterizes **effective distance** …"as the crow walks."



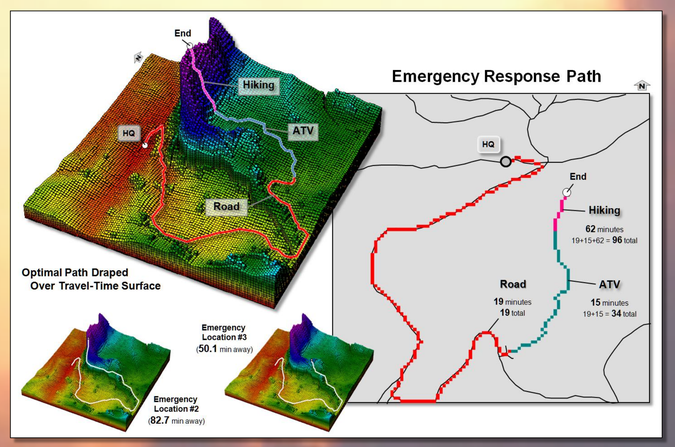




Calculating On-Road Travel-time. The on-road travel-time (TT) surface from headquarters uses friction values for each grid cell that calibrates the time it takes to cross it (0.1 minute). The result is an estimate of the shortest travel-time to reach any road location forming a "rollercoaster-like surface" with the lowest point at Headquarters (TT = **0.0** min away) and increasing to the farthest away location of **26.5** minutes.

Calculating Off-Road ATV Travel-time. Note that the combined Truck and ATV travel-time surface extends the movement off the roads while retaining the bowl-like shape. The grey areas in the figure identify locations that are too steep for ATV travel and the "escarpment-like" feature in the center treats the river as an additional absolute barrier. The farthest away location accessible by truck and then ATV is **52.1** minutes.

Calculating Hiking Travel-time. The emergency response surface is completed by continuing to accumulate Hiking time from where the accumulated travel-time by Truck and ATV stopped. Note the very steep rise in the surface (blue tones) resulting from the slow movement in the steep terrain of the canyon area. The farthest away location accessible by truck, then ATV and hiking is estimated at **96.0** minutes.



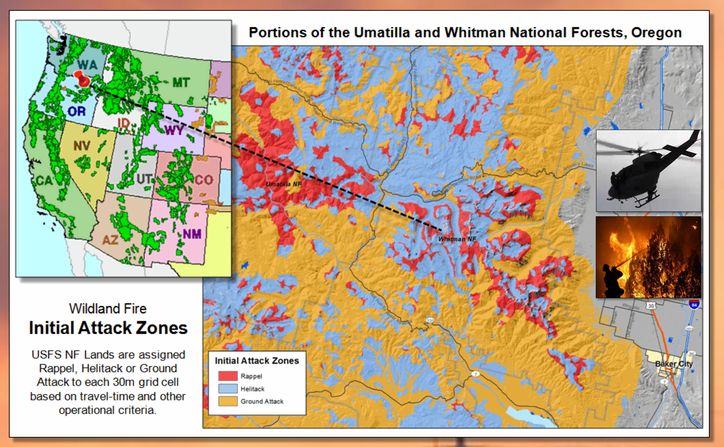
Identifying Optimal Paths. The steepest downhill path over the TT surface identifies the "quickest route." The first segment routes the truck travel (red= **19** min), then ATV's are move off-road (cyan= **15** min) and then the rescue team hikes the final segment (violet= **62** min) for a total time of **96** minutes (19 + 15 + 62 = 96).

Class exercise developed by J.K. Berry for an open enrollment graduate course in GIS Modeling using freely distributed MapCalc software
…contact Joe Berry, jberry@innovativegis.com for more information

…from classroom theory and experience to practical application

USFS funded wildfire attack project using ArcGIS™ developed by Fire Program Solutions, LLC
…contact Don Carlton, DCARLTON1@aol.com for more information

Wildfire Attack Zones. Three separate travel-time surfaces are developed. The **Ground Attack** model is similar to the classroom exercise except just a single friction surface is used for on- and off-road travel-times. The **Helicopter Landing** model considers elevation ceilings, terrain steepness, cover types and glide paths to determine potential "Landing Zones." The **Helicopter Rappelling** model considers elevation ceilings, terrain steepness and cover types to identify locations suitable for rappelling attack. The three travel-time surfaces are compared to identify the attack mode with the minimum response time and the differential times for alternative attack modes for all of the western U.S. Forest Service lands at a 30m (1/4 acre) resolution …an emergency response map composed of millions and millions of locations.



Online References. A more detailed discussion of "Backcountry Emergency Response" is available in the online book Beyond Mapping III posted at www.innovativegis.com/basis/MapAnalysis/, Topic 29, "Spatial Modeling in Natural Resources," sections 4-6; sections 9-10 describe the "Wildfire Attack Zones" project. A comprehensive discussion of the *Spatial*STEM approach for teaching grid-based map analysis concepts, modeling and applications is posted at www.innovativegis.com/Basis/Courses/SpatialSTEM/. This approach is designed for developing spatial reasoning skills through a map-*ematical* framework extending traditional quantitative data analysis concepts commonly taught in the science, technology, engineering and math disciplines that resonates with both GIS specialists and non-GIS students. All of the royalty-free instructional materials to include lecture PowerPoints, readings, exercises and MapCalc software supporting a variety of teaching environments are posted.

Poster prepared by J.K. Berry

High Park Fire outside Fort Collins, June 2012 – Photo by J.K. Berry