Gridded Wind Data: What is it and How is it Used?

Fire Sciences Laboratory
Fire Behavior Project
Missoula MT
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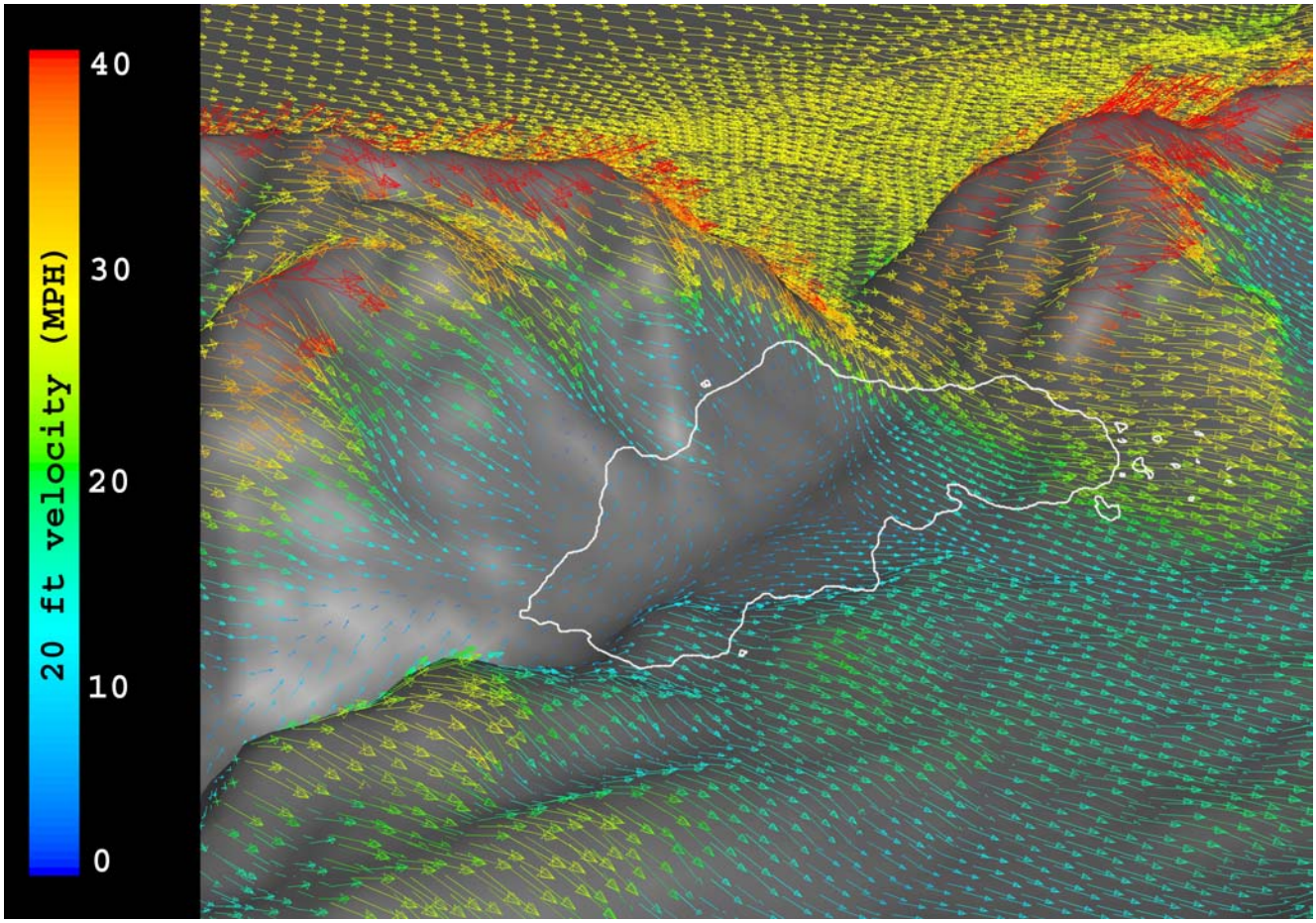

Gridded Wind

What is it?

Gridded wind is a method that can provide information about the effect of topography on local wind flow at the 100-300 ft scale (Fig. 1). Wind information at this detail is not available from the weather service. The wind simulations are not forecasts but rather simulations of what the wind flow would be under different general (synoptic) wind speed and direction scenarios. The *User* can essentially pick the scenario they want to simulate, it might be based on forecasts, local observations or historical weather patterns. This high resolution wind information has been used to identify areas and/or conditions that may produce high fire intensity and spread rates and for identifying locations where fire spotting might occur. It also increases the accuracy of FARSITE predictions.

How is it produced?

The process of producing the gridded wind data is straightforward. It occurs in three steps. First detailed information about the terrain is needed. This is obtained in the form of digital elevation model (DEM) files. It is useful to think of the next step as the process of building a box. The DEM file forms the floor of the box and represents the terrain surface for an area 10 to 40 miles square. The sides of the box are 3 to 5 miles high and the roof of the box represents the atmosphere 3 to 5 miles above the earth's surface. The sides and roof of the box allow air flow into and out of the box. The box or domain is then divided into small cubes or cells that are 100 to 300 feet long on each side. The result is a big box made up of approximately one million small boxes.

The next step is to simulate the flow of air through the domain. The user specifies the general flow and direction of air into the box and using the laws of physics the software calculates the flow everywhere within the box. The result

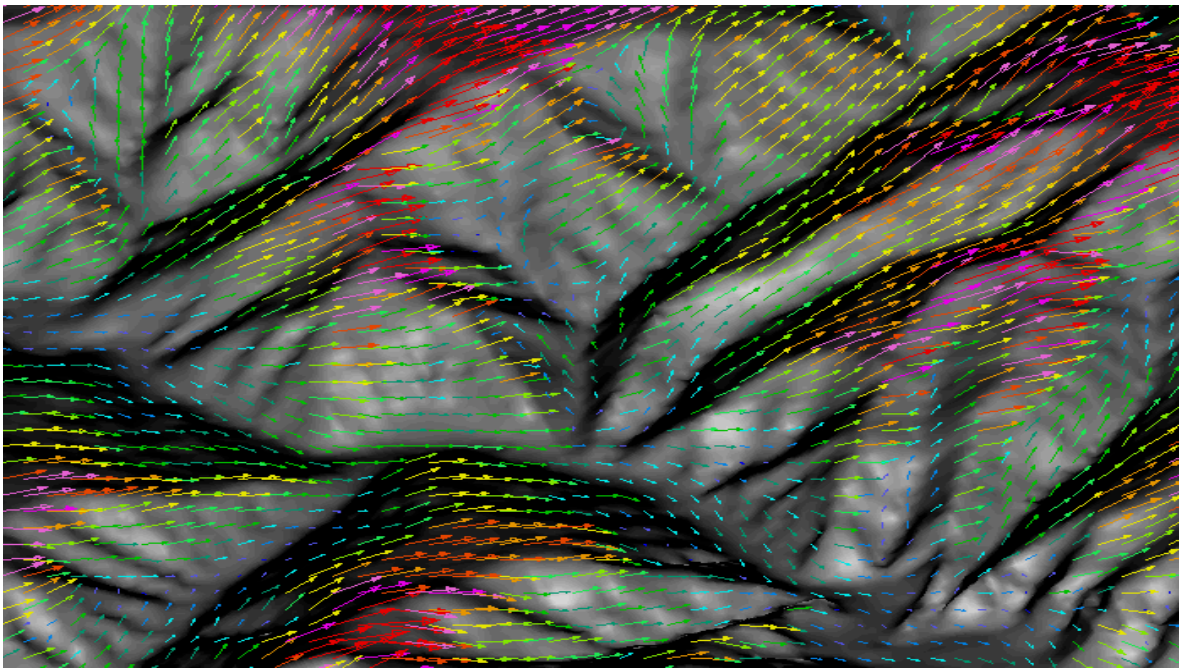

Figure 1--Wind vector map.

Contact Bret Butler at 329-4801 or Jason Forthofer at 329-4874 for more information.

from this set of calculations is a predicted wind speed and direction in every cell from which a map of surface wind speed and direction can be produced.

How accurate are these wind speeds?

We are still working to quantify the accuracy of the simulations, but we have made some comparison against data collected by others, the results indicate that our wind speed predictions are generally close to reality (see figure 2). We also believe that the relative difference between ridgetop, midslope and valley should be representative of reality. These simulations assume a neutrally stable atmosphere, meaning that they do not take into account density driven flows (diurnal winds and fire induced winds). Neglecting these flows introduces some error (especially at low wind speeds); however as the upper air wind speed increases the relative magnitude of this error decreases. In short the predictions are most accurate for winds that are greater than 5 mph at the ridgetops such as cold fronts, foehn (Santa Ana), onshore/offshore winds, etc.

The accuracy of FARSITE fire spread predictions is improved in all cases where

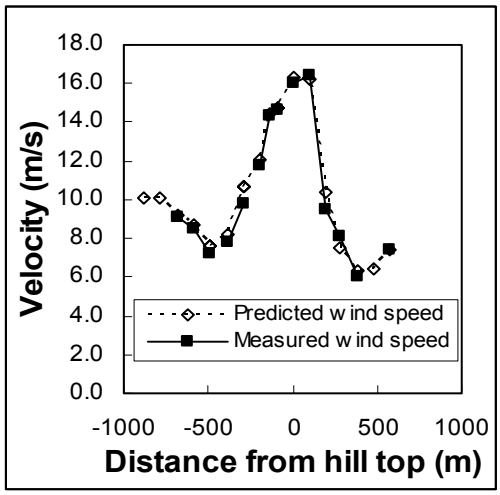

Figure 2--Comparison of measured and predicted wind speeds from Askervein Hill data

gridded winds have been used. Figure 3 is a FARSITE simulation assuming a uniform wind field (no terrain effect), figure 4 is the same simulation using gridded wind data. The white lines represent 10 minute fire growth perimeters. The effect of the hill in blocking the wind is clearly shown in the FARSITE fire growth predictions. The difference in the perimeters is

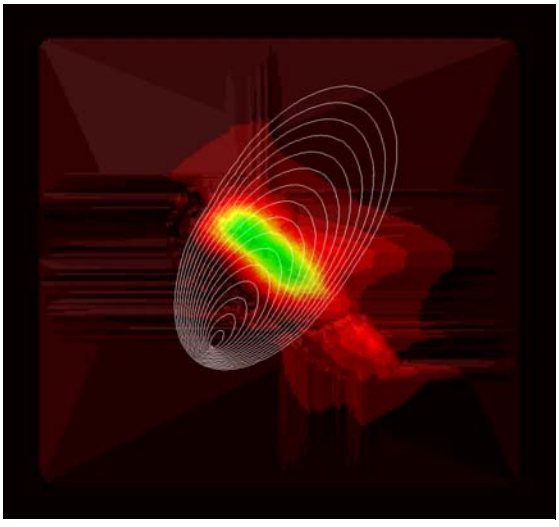

Figure 3—FARSITE simulation of fire spread over a hill in the presence of uniform winds. Simulation assumed Fuel Model 2, and fire growth perimeters are based on 10 minute intervals. Color represents terrain elevation

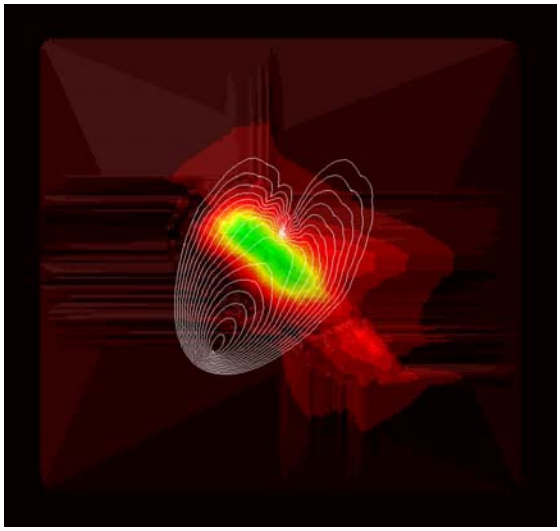

Figure 4—FARSITE simulation of fire spread over a hill using gridded winds. Simulation assumed Fuel Model 2, and fire growth perimeters are based on 10 minute intervals.

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significant, suggesting that accurate simulations depend on accurate wind information. Figures 5 and 6 compare simulations from the Price Canyon fire with and without gridded winds clearly showing the improved accuracy in fire spread predictions with gridded wind.

How to use the wind data:

One nice aspect of this process is that a set of simulations can be completed for a range of wind speeds and directions prior to the arrival of a wind event, sort of a "library" of wind data, then depending on the forecast wind speed and direction, the user selects whichever simulation most closely matches the forecast. The products that can be produced include maps of the surface winds (see image on the title page and also in figure 1), FARSITE gridded wind files that can be read directly into FARSITE and essentially assign a unique wind speed and direction to every position along the fire perimeter, and GIS data layers for use in producing custom maps.

Even if the information is not used for FARSITE simulations, it is readily apparent that the gridded wind maps provide information about the local winds that will be present in and around a fire. Such information is not possible to obtain from any other source. The wind information is a useful aid in visualizing and understanding the impact that wind can have on fire and in identifying potentially unsafe conditions and locations.

How to obtain the wind maps?

Gridded wind maps can be created for a range of wind directions and speeds. It is our intent to develop a software package that will allow anyone to run simulations of wind flow on a laptop computer. This package is not yet available, currently we are working with the software developer to specify and develop the software package. Our intent is to distribute 10 beta versions of the software during June or July of 2004. Users will provide feedback that will be used in the development of the final standalone computer package. A full version of the software is planned for distribution sometime during the winter of 2004/2005 at a cost of around $950 per license. This will provide the user with the capability to run wind simulations anywhere anytime. The software will take the user through the entire process of loading the DEM, building the mesh, running the wind simulation and selecting what outputs are desired. All can be accomplished on a laptop computer.

Until the beta copies are available, wind simulations are being run at the USFS Rocky Mountain Research Station's Fire Sciences Laboratory in Missoula, Montana. Those interested in obtaining custom wind simulations just need to submit a request. A typical request should include the fire name, a list of wind speeds and directions, and the requesting person's name and contact information (for example: Trapper Creek Fire, Lat 38°45.698'Long 114°13.34', Ridgetop winds at 5, 10 and 25 mph for the West and Southwest, Jim Hutton, 503-222-9989). A request form is included below. The process can be shortened if the requesting person can also supply a DEM of the fire area. A set of 10 simulations can typically be completed in about 5-8 hours. The product passed to the requesting person will be a set of jpeg files showing the wind vectors overlaid on a shaded relief of the area. Input wind files for use in the FARSITE fire area simulator and GIS data layers can also be created. For additional information or to request wind information for your specific fire location contact: Bret Butler (406-329-4801 cell 406-239-3665) or Jason Forthofer (406-329-4874).

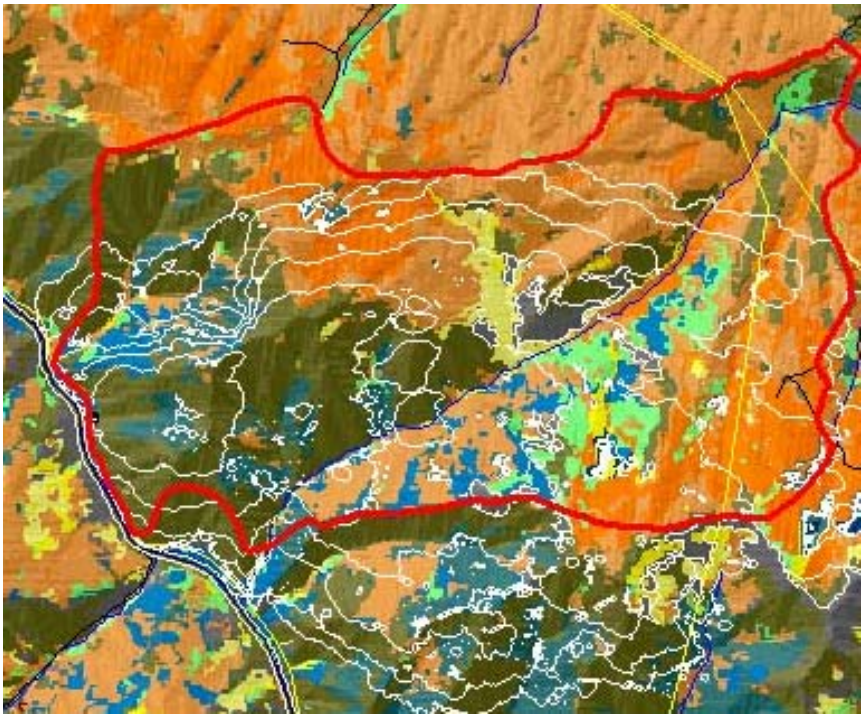

Figure 5—FARSITE simulation of Price Canyon Fire using uniform winds. Red line represents final fire perimeter, white lines represent predicted fire progression, note underprediction of fire spread in top left and overprediction along lower boundary of fire.

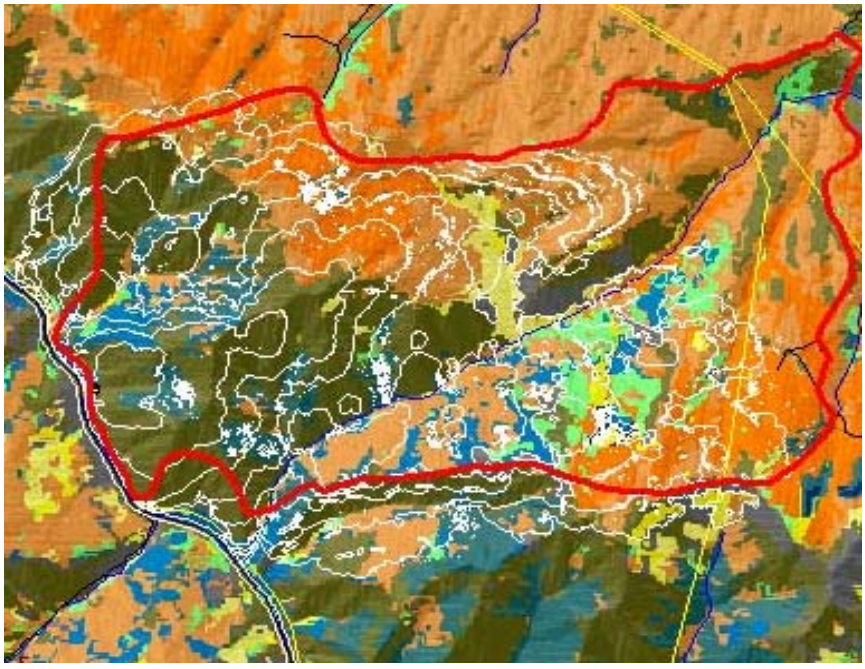

Figure 6—FARSITE simulation of Price Canyon Fire using gridded winds. Red line represents final fire perimeter, white lines represent predicted fire progression, note much closer match between actual and predicted perimeter (underprediction in top right is due to burnout operation and was not simulated in FARSITE).

Contact Bret Butler at 329-4801 or Jason Forthofer at 329-4874 for more information.

Gridded Wind Model Request Form

Incident Name_____Date_____

Location_____Latitude/Longitude_____

Dominant Fuel Model_____

Data Available from the Incident:

Digital Elevation Model Available? Yes___ No___

Fire Perimeter Shape Files Available? Yes___ No___

Where and how can these data be obtained_____

_____Contact:_____

Phone:_____ Email:_____

Please write the wind speeds and directions in the table below. If you would like input data for FARSITE please check the appropriate box. Do the same if image files (*.jpg) are needed.

Wind Speed	Direction	Farsite Wind Files Needed?	Image Files Needed?

For questions or comments contact:

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