2.6 FARSITE WEATHER STREAMS FROM THE NWS IFPS SYSTEM

Chris Gibson *
National Weather Service, Salt lake City, Utah

Carl Gorski
Deputy Chief, Meteorological Services Division
National Weather Service, Western Region Headquarters, Salt lake City, Utah

1. Introduction

The National Oceanic and Atmospheric Administration's National Weather Service (NWS) provides a wide range of fire weather products and services. Over the last several years, NWS Weather Forecast Offices (WFO) have begun to derive these services from a locally created Digital Forecast Database (DFD) as part of the Interactive Forecast Process System (IFPS). The local DFD in turn is used to populate the National Digital Forecast Database.

The DFD allows the flexibility to generate national, regional and local products tailored to the customer or partner who requests it. Products from the DFD can be easily formatted in text, grib, graphical or interactive web based formats. Figure 1 provides an image of the Graphical Forecast Editor portion of IFPS.

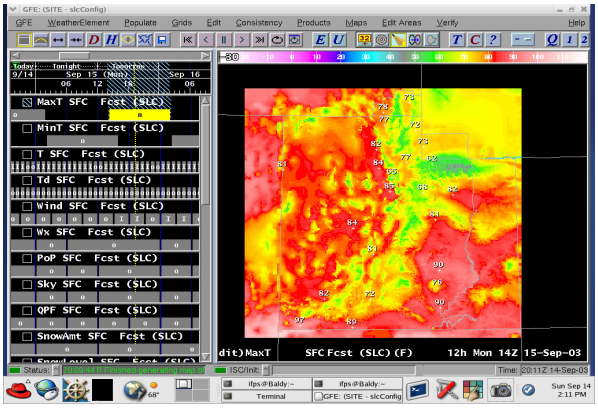

Figure 1 Graphical Forecast Editor

At the NWS office in Salt Lake City (NWS-SLC), the prototype DFD product suite has initially targeted the land management agencies with air quality and flash flood potential forecasts (Gibson 2000). Products can be derived from the DFD in text, grib, graphical or interactive web based formats. This paper describes a demonstration project that creates a tabular text product specifically designed as input for the Fire Area Simulation Model (FARSITE).

* *Corresponding Author Address:* Chris Gibson, National Weather Service, Salt Lake City, UT 84116. email: Chris.Gibson@noaa.gov

2. FARSITE - Fire Area Simulation System

FARSITE was developed by Dr. Mark Finney of the Department of Agriculture's Missoula Fire Lab, Fire Behavior Project. The Fire Area Simulator is a two-dimensional model of fire growth which incorporates existing fire behavior models of surface fire spread, crown fire, spotting, point source fire acceleration and fuel moisture. The fire is modeled assuming the fire front is a row of independent small elliptically shaped fires. The size of each ellipse is determined by the local homogenous conditions of fuel, slope and weather. Spot fires, crowning and acceleration are parameterized. (Finney 1998).

The FARSITE system can be run on a laptop in the field or in an office research environment. The applications of FARSITE vary greatly on scales of space and time. (Finney 2000, for example). FARSITE runs of one to two burning periods may be used to demonstrate how quickly fire can move and threaten wildland-urban interface homeowners. FARSITE is often used for wildfire projections of 1-2 weeks, or longer. The system has been used for assessing the fire behavior potential of the Boundary Water Canoe Area blowdown of 1999 (Finney 2000) and for demonstrating the effects of fuel treatment strategies (Stratton 2003). Very long range projections of potential fire spread can be made if weather stream input can be provided.

3. IFPS FARSITE forecasts

a. Overview

The DFD and IFPS provide a database for creating easily updated FARSITE weather streams. FARSITE requires two files detailing a forecast of five

weather parameters – a "wind" file (WND file extension) and a "weather" file (WTR file extension). IFPS text formatters have been developed to create these files from the DFD.

b. FARSITE input

FARSITE input consists of maximum and minimum relative humidity, maximum and minimum temperature, daily precipitation, wind speed and direction and cloud cover. Data can be supplied in english or metric units. Wind and cloud cover forecasts may be provided at whatever temporal resolution is available. Temperature and relative humidity weather input are needed for each day. FARSITE determines the diurnal temperature and relative humidity curve using a cosine interpolation. An adiabatic adjustment is made from the input elevation to any point on the terrain (Finney 1998).

c. Data

IFPS grids, maintained at the National Weather Service Office in Salt Lake City, Utah, configured at 2.5 km resolution, have been used to generate routine FARSITE weather stream files for select locations since March of 2003. Grids for all needed FARSITE elements are maintained and updated daily as part of the local IFPS database. The FARSITE weather streams are updated automatically when routine products are formatted, such as the (at least) twice daily Fire Weather Forecast (FWF), or Point Forecast Matrices (PFM).

d. Weather stream format

The formatters are set up to create a forecast for one IFPS grid point that can be used to simulate the local weather conditions. Tables 1 and 2 present examples of FARSITE weather streams derived from the local grids. Data in the WTR file (table1) are

```
ENGLISH
8 12 0 600 1700 54 87 50 20 7500
8 13 0 600 1700 52 88 50 20 7500
8 14 0 600 1700 52 88 50 25 7500
8 15 0 600 1700 57 87 50 27 7500
8 16 0 600 1700 56 81 50 23 7500
8 17 0 600 1700 57 81 50 20 7500
8 18 0 600 1700 53 81 50 21 7500
```

Table 1 FARSITE weather stream file (WTR).

month, day, daily precipitation (inches), local time of minimum temperature and maximum relative humidity (%), local time of maximum temperature and minimum relative humidity, minimum temperature, maximum temperature, maximum relative humidity, minimum humidity and elevation in feet for the forecast point. For the WND files (table 2), each line represents month, day, hour (local), wind speed (mph), direction and cloud cover (%). IFPS FARSITE weather streams provide forecast from the current hour through 6-7 days depending on the forecast generation time.

```
ENGLISH
08 12 0000 05 250 50
08 12 0300 01 240 50
08 12 0600 03 210 50
08 12 0900 07 230 50
08 12 1200 09 250 70
08 12 1500 12 250 70
08 12 1800 13 250 70
```

Table 2 FARSITE wind type weather stream file (WND).

e. Dissemination

A web page provides the interface for retrieving the latest FARSITE forecasts (figure 2).

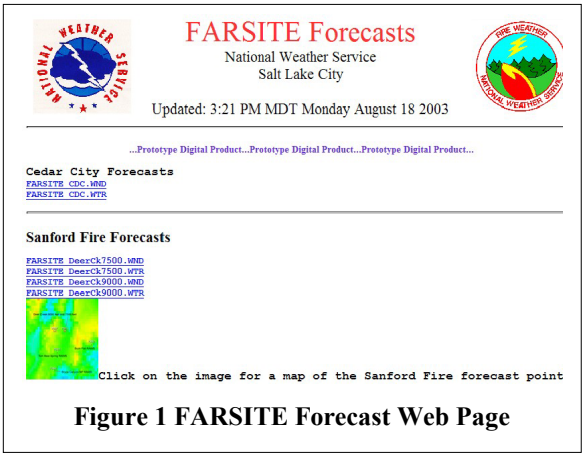

Figure 1 FARSITE Forecast Web Page

The page includes the update time and can provide forecasts for multiple grid points and maps. As a demonstration, forecasts have been provided through the summer of 2003 for the Cedar City airport (ASOS) and two grid points on the Sanford Fire of 2002. The Cedar City grid point FARSITE forecast can be applied to nearby areas for FARSITE runs assuming a well mixed atmosphere utilizing the FARSITE adiabatic temperature and humidity adjustment. For the Sanford fire, FARSITE forecasts have been provided for two areas of Deer Creek, in the northeast portions of the Sanford fire, where the

fire spread has been modeled using FARSITE by Rick Stratton of the Missoula Fire Lab (personal communication, April 2003). Forecasts at the 7500 foot and 9000 foot elevation levels have been routinely generated, allowing testing of the NWS FARSITE file format. Figure 3 shows the domain and GFE grid of the Sanford file area.

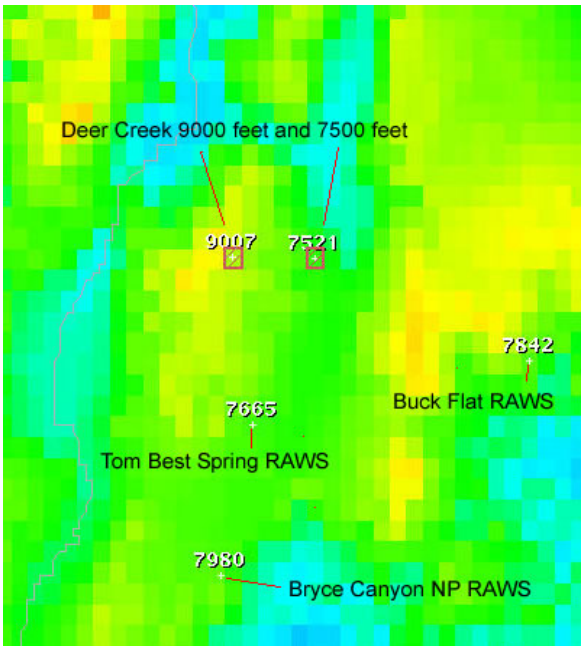

Figure 1 Sanford Fire Domain. GFE Grid Resolution 2.5 km.

f. Using the IFPS weather streams

Users (Incident Meteorologists or Fire Behavior Analysts) simply save the latest weather stream files to their computer through a web browser. A FARSITE "project" can be built to incorporate the NWS IFPS. If this project is loaded after the files have been updated on the local computer, FARSITE automatically ingests them. FARSITE allows for text editing of the forecasts. The weather streams provided by this system are the easiest to use and most current weather input available to the FARSITE modeler in the field.

4. Future efforts

a. Enhanced IFPS grids

IFPS grids are rapidly becoming more sophisticated. State of the art analysis systems such as ADAS (Ciliberti *et al.* 2001, Lazarus *et al.* 2002) can be incorporated into the grids. High resolution model data such as MM5, workstation ETA, etc., are available to assist in deriving the grids. The database can provide constantly updated verification to the forecasters. Techniques to incorporate locally derived climatology and real time customer feedback will be able to fine tune the forecast provided by the NWS forecast offices. Work in the future includes updating short term grids with satellite and radar data and numerical nowcast approaches

b. Improved weather stream format

The methodology of deriving diurnal and hourly variations of temperature and relative humidity in the IFPS grids is rapidly improving. FARSITE could be modified to ingest temperature and humidity data with higher temporal resolution. This would provide more detail to the fuel moisture calculations than the cosine interpolation technique.

c. Grids of FARSITE forecasts over larger fires

FARSITE allows input of multiple weather streams. For large incidents, multiple 2.5 km IFPS grid points could be used to create variations in the base weather streams across the domains. Larger fires will cover many 2.5 km IFPS grid points and IFPS operational resolution should improve to at least 1.25 km over the next few years. The formatter could be expanded to provide grids of multiple or gridded weather streams to FARSITE.

d. Real time testing and evaluation of the IFPS weather streams

During the fire season of 2004 we plan to test the IFPS weather streams on real fire incidents. These incidents could be prescribed fire projects, wildfire use projects, or wildfires. A rapid feedback process between us and FARSITE practitioners and/or Incident Meteorologists would be beneficial. Also, integrating the IFPS weather streams with spot forecasts may be tested.

5. Conclusions

This project has demonstrated that FARSITE weather streams can be routinely generated from IFPS grids. The files are updated automatically and are provided to the land management agencies, or on-site meteorologists via a web-based interface. The mechanism for dissemination has been very reliable and requires no special forecaster attention. The FARSITE forecasts are derived from the same database used to create the suite of NWS products. As the database improves in the future, the IFPS

FARSITE forecasts will inherently improve

Finally, these IFPS FARSITE forecasts are not intended to replace spot forecasts or Incident Meteorologists in the NWS fire weather program. Rather, they may assist in short term prescribed fire planning (0-7 days), assessment of fires used for resource benefit, or as a starting point for ongoing wildfire modeling using FARSITE.

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