Name of Software Tool: Fuel Characteristics Classification System

Current Version Description/Date: Version 3.0/October 2011

Software Code and History: The software code for the Fuel Characteristics Classification System (FCCS) is from the Fuelbed Application Programming Interface (API), version 1.0.

Software Developer(s) Names, Organization, and Contact Information: Roger Ottmar and Susan Prichard, Pacific Wildland Fire Sciences Laboratory, U.S. Forest Service, Seattle, WA, 206-732-7826, rottmar@fs.fed.us

> **Note to Users: For questions specifically relating to the internal functional operations of this module, contact the developer(s) or help desk resources for this software tool. For questions regarding how this tool is used within IFTDSS, please contact the IFTDSS Team using the Feedback function available on every page of IFTDSS.**

Science Model Contact, Names, Organization, and Contact Information: Roger Ottmar and Susan Prichard, Pacific Wildland Fire Sciences Laboratory, U.S. Forest Service, Seattle, WA, 206-732-7826, rottmar@fs.fed.us

Help desk contact information:

- Phone: (206) 732-7826
- Email: pnw_fccshelp@fs.fed.us
- Website: http://www.fs.fed.us/pnw/fera/fccs/index.shtml

Availability of the Version of Record: The Fire and Environmental Research Applications Team (FERA) maintains the software version of record.

Primary Funding Sources: FCCS was developed with funding from the Joint Fire Science Program under Project JFSP 98-1-1-06. Funding was also provided by the American Recovery and Reinvestment Act of 2009.

Application Purpose (General): The Fuel Characteristic Classification System (FCCS) provides fire and fuel managers with a consistent way to characterize fuels and predict potential fire behavior and effects. FCCS fuelbeds represent managed and wildland fuels throughout much of North America. Users can customize fuelbeds to represent site-specific fuelbeds at any scale of interest. FCCS calculates and summarizes fuel characteristics over six vertical strata including canopy, shrub, herbaceous, woody fuels, litter, and ground fuels. FCCS fire potentials facilitate communication of fire hazard among users and provide an index of the intrinsic capacity of each fuelbed for surface fire behavior, crown fire, and available fuel consumption under dry benchmark environmental conditions. Based on input fuel characteristics and environmental variables, FCCS predicts point-based surface fire behavior including reaction intensity, rate of spread, and flame length. It also reports carbon stores by fuelbed category and

subcategory. FCCS outputs, including fuel loadings and other characteristics, can be used in Consume to estimate fuel consumption and emissions.

FCCS makes point-based calculations of fuel characteristics and potential fire behavior and does not simulate fire spread across landscapes. However, because fuelbeds have no inherent scale, FCCS outputs can be easily mapped in GIS by assigning polygons or raster cells with a unique fuelbed identification number.

As part of the surface fire behavior outputs, FCCS provides a crosswalk to one of the 13 original fire behavior fuel models and one of the 40 standard fuel models. This is a static crosswalk based on predicted surface fire flame length and rate of spread under an input set of environmental variables (fuel moisture, midflame windspeed, and slope gradient). The crosswalk is invalid under any other environmental scenario and is generally not appropriate for simulating fire spread across landscapes (as in FARSITE). Fuel model crosswalks may be used in FlamMap as long as wind, slope and fuel moisture inputs remain the same as in the original FCCS prediction.

Application Purpose (Fuel Treatment): FCCS is used in IFTDSS to (1) represent structural and geographic complexity of wildland fuels, including various fuel treatments and successional stages, (2) evaluate the ability of fuel treatments to mitigate potential fire behavior, and (3) provide inputs to fire effects modules such as Consume and the First Order Fire Effects Model (FOFEM) to predict fuel consumption and pollutant emissions from prescribed burns and wildfires.

User/Application Documentation:

- http://www.fs.fed.us/pnw/fera/fccs/

User Application Guidance: No information available at this time.

Scientific Foundations of the Software Tool:

- Degree of validation/evaluation and availability of written results:
    - The Fuel Characteristic Classification System (FCCS) has been through a rigorous peer review process. In the fall of 2005, a panel of international experts in the field of fire behavior was invited to review draft manuscripts of the FCCS -- an overview paper, and papers on the system's library, calculator, and newly-developed fire potentials. The panel was then invited to a face-to-face review with the authors, moderated by Erik Berg, manager of the Joint Fire Science Program.
    - The Panel Review process was above and beyond the normal peer review process required by refereed journals, and complies with General Accounting Office guidance on review of scientific information used in resource management. This is an additional step that enhances the rigor of peer review, solicits input from technical experts in the international scientific community, and ensures that our research products support management and policy action.

- Written comments were provided by the reviewers: http://www.fs.fed.us/pnw/fera/fccs/draft_papers.shtml

- Publication history:
  - Peer-reviewed publications
    - Berg, Erik. 2007. Characterizing and Classifying Complex Fuels -- A New Approach Canadian Journal of Forest Research. 37(12): 2381-2382. Abstract [.html] Full text [.pdf] 35kb
    - Ottmar, R.D.; Sandberg, D.V.; Riccardi, C.L.; Prichard, S.J. 2007. An Overview of the Fuel Characteristic Classification System – Quantifying, Classifying, and Creating Fuelbeds for Resource Planning Canadian Journal of Forest Research. 37(12): 2383-2393. Abstract [.html]Full text [.pdf] 1MB
    - Riccardi, Cynthia L.; Ottmar, R.D.; Sandberg, D.V., Andreu, A.; Elman, E.; Kopper, K.; Long, J. 2007. The fuelbed: a key element of the Fuel Characteristic Classification System. Canadian Journal of Forest Research. 37(12): 2394-2412. Abstract [.html]Full text [.pdf] 7MB
    - Riccardi, C.L.; Prichard S.J.; Sandberg, D.V.; Ottmar, R.D. 2007. Quantifying physical characteristics of wildland fuels using the Fuel Characteristic Classification System. Canadian Journal of Forest Research. 37(12): 2413-2420. Abstract [.html] Full text [.pdf] 115kb
    - Sandberg, D.V.; Riccardi, C.L.; Schaaf, M.D. 2007. Fire potential rating for wildland fuelbeds using the Fuel Characteristic Classification System**.** Canadian Journal of Forest Research. 37(12): 2456-2463 Abstract [.html] Full text [.pdf] 106kb
    - Sandberg, D.V.; Riccardi, C.L.; Schaaf, M.D. 2007. Reformulation of Rothermel's wildland fire behaviour model for heterogeneous fuelbeds. Canadian Journal of Forest Research. 37(12): 2438-2455.
      Abstract [.html]Full text [.pdf] 337kb
    - Schaaf, M.D.; Sandberg, D.V.; Schreuder, M.D.; Riccardi, C.L. 2007. A conceptual framework for ranking crown fire potential in wildland fuelbeds. Canadian Journal of Forest Research. 37(12): 2464-2478. Abstract [.html] Full text [.pdf] 374kb
  - Non-peer-reviewed publications
    - Zhang, C.; Hanquin, T.; Wang, Y.; Zeng, T.; Liu, Y. 2010. Predicting response of fuel load to future changes in climate and atmospheric composition in the Southern United States. Forest Ecology and Management. 260: 556-564.

- Zhang, X.; Kondragunta, S.; Schmidt, C.; Kogan, F. 2008. Near real time monitoring of biomass burning particulate emissions (PM2.5) across contiguous United States using multiple satellite instruments. Atmospheric Environment. 42:6959-6972.

- Campbell, J.; Donato, D.; Azuma, D.; Law, B. 2007. Pyrogenic carbon emission from a large wildfire in Oregon, United States. Journal of Geophysical Research. 112: G04014.

- McKenzie, D.; Raymond, C.L.; Kellogg, L.-K.B.; Norheim, R.A; Andreu, A.G.; Bayard, A.C.; Kopper, K.E.; Elman. E. 2007. Mapping fuels at multiple scales: landscape application of the Fuel Characteristic Classification System. Canadian Journal of Forest Research. 37(12): 2421-2437. Abstract [.html] Full text [.pdf] 5.4MB

Training Availability: The Fire and Environmental Applications (FERA) Team hosts workshops on the FCCS and other products. Upcoming workshops are listed on the FERA website (http://www.fs.fed.us/pnw/fera) and are also advertized in our monthly newsletter (http://lists.oregonstate.edu/mailman/listinfo/pnw_fire_research_news).