Introducing the *Canopy Fuel Stratum Characteristics Calculator*

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Abstract. The regression equations developed by M.G. Cruz, M.E. Alexander and R.H. Wakimoto (2003. *International Journal of Wildland Fire* **12**, 39-50.) for estimating the canopy base height, bulk density and fuel load in ponderosa pine, lodgepole pine, Douglas-fir and mixed conifer fuel types based on three stand characteristics (average height, basal area and stand density) have now been programmed into an excel spreadsheet.

Additional keywords: canopy base height, canopy bulk density, canopy fuel load, crown fire, basal area, stand density, stand height.

Introduction

Canopy fuel stratum characteristics determine to a large extent the behavior of crown fires. By linking an extensive forest stand database with foliage dry weight allometric equations. Cruz *et al.* (2003) were able to develop regression equations for estimating canopy base height (CBH), canopy fuel load (CFL), and canopy bulk density (CBD) that are compatible with Van Wagner's (1977) models of crown fire initiation and propagation. Three inputs are required: average stand height, basal area and stand density. Equations are available for four broad coniferous forest fuel types commonly found in western North America (i.e. ponderosa pine, lodgepole pine, Douglas-fir, and mixed conifer). The purpose of this paper is to describe a software application of the Cruz *et al.* (2003) equations, called the *Canopy Fuel Stratum Characteristics Calculator* (Fig. 1).

Overview of software

The main features of the *Canopy Fuel Stratum Characteristics Calculator* are:

- Given three user inputs (i.e. stand area basal area, average stand height and stand density), CBH, CFL and CBD are automatically calculated for one of the four fuel types.

- Provides for both SI or metric and English unit inputs/outputs (Figs. 2 and 3).

- Cautionary 'pop-up' messages (Fig. 4) for input values that exceed a maximum reliable value or variable range (Table 1).

A copy of the *Canopy Fuel Stratum Characteristics Calculator* software is readily available for downloading from the FRAMES website (**http://frames.nbii.gov/cfis**).

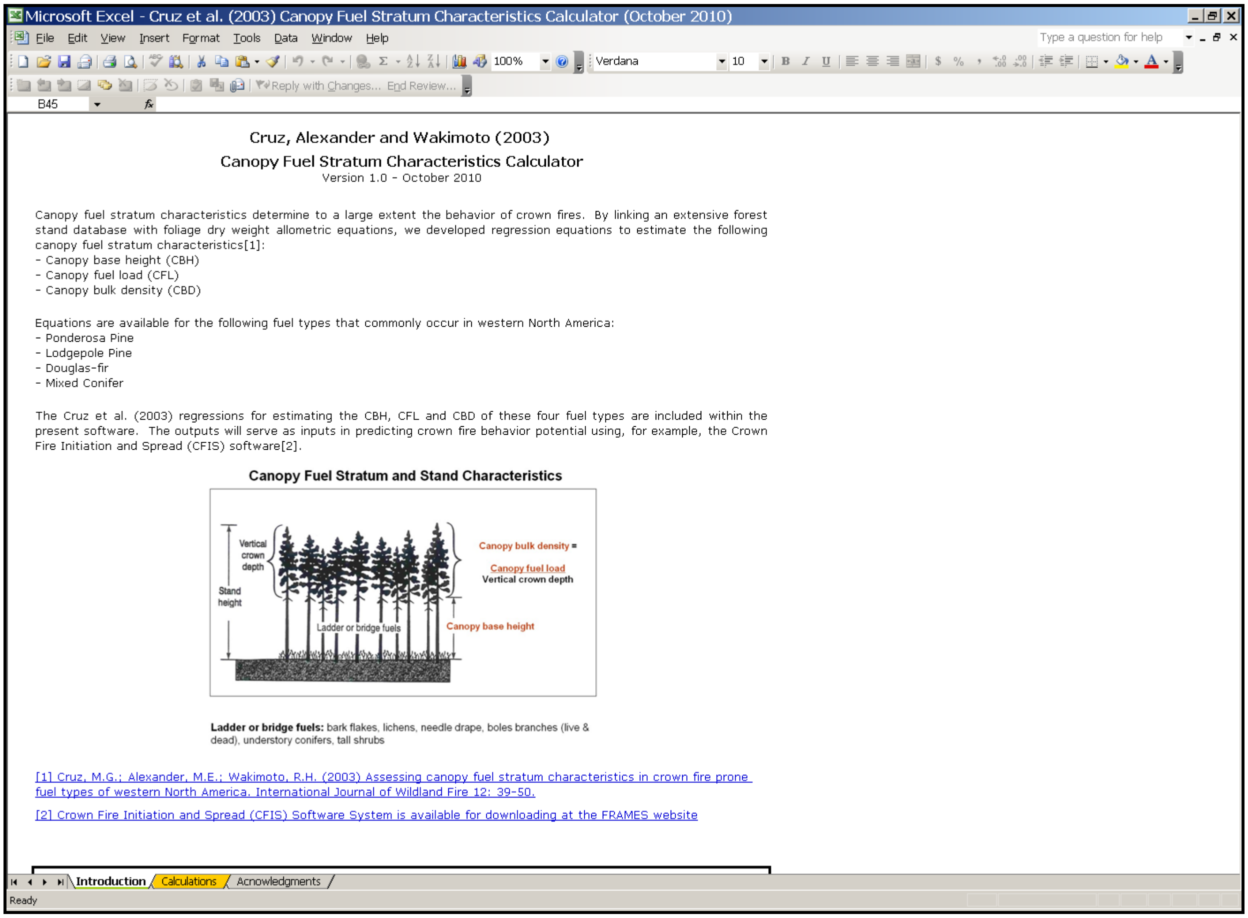

Fig. 1. Screen of the *Canopy Fuel Stratum Characteristics Calculator* tab.

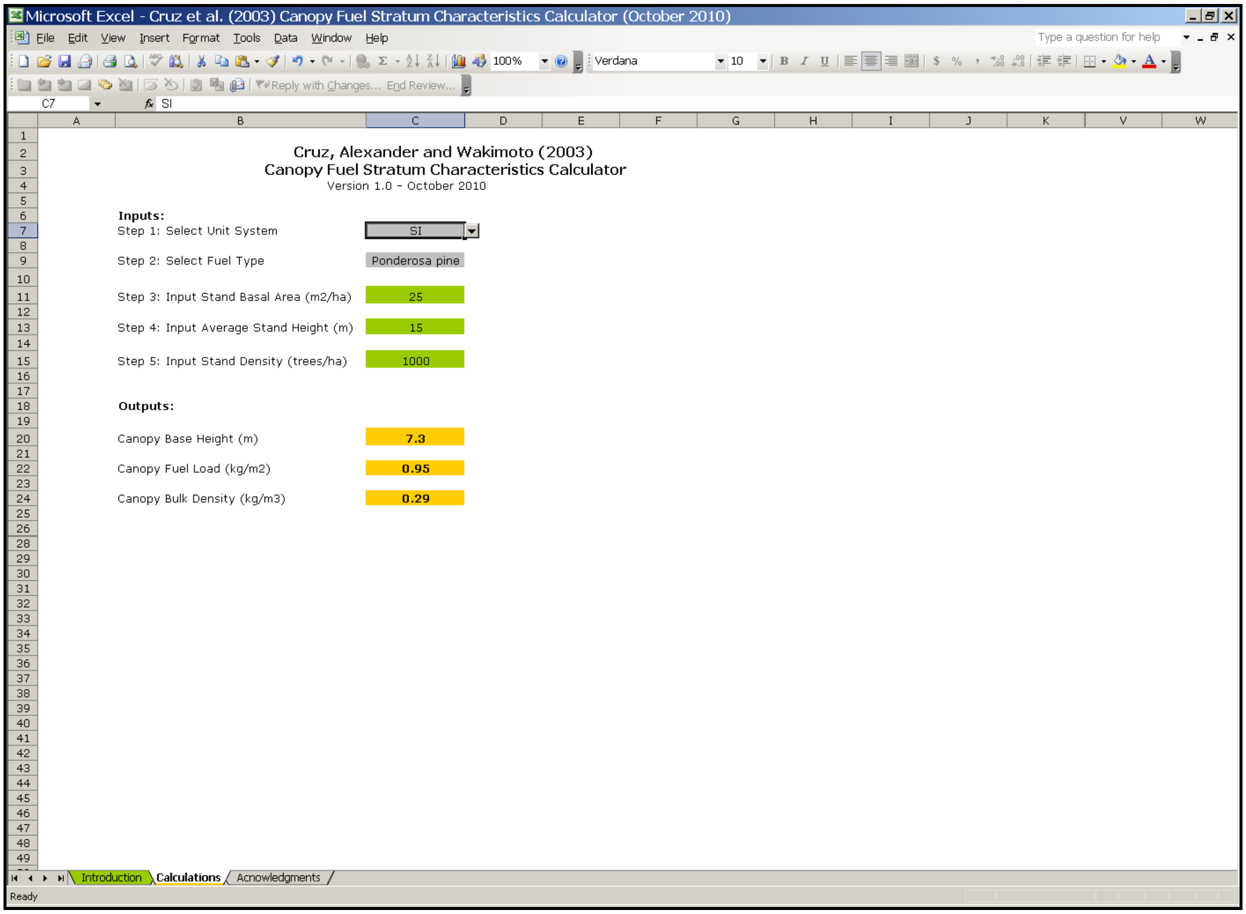

Fig. 2. Screen of the *Canopy Fuel Stratum Characteristics Calculator* SI unit calculation tab.

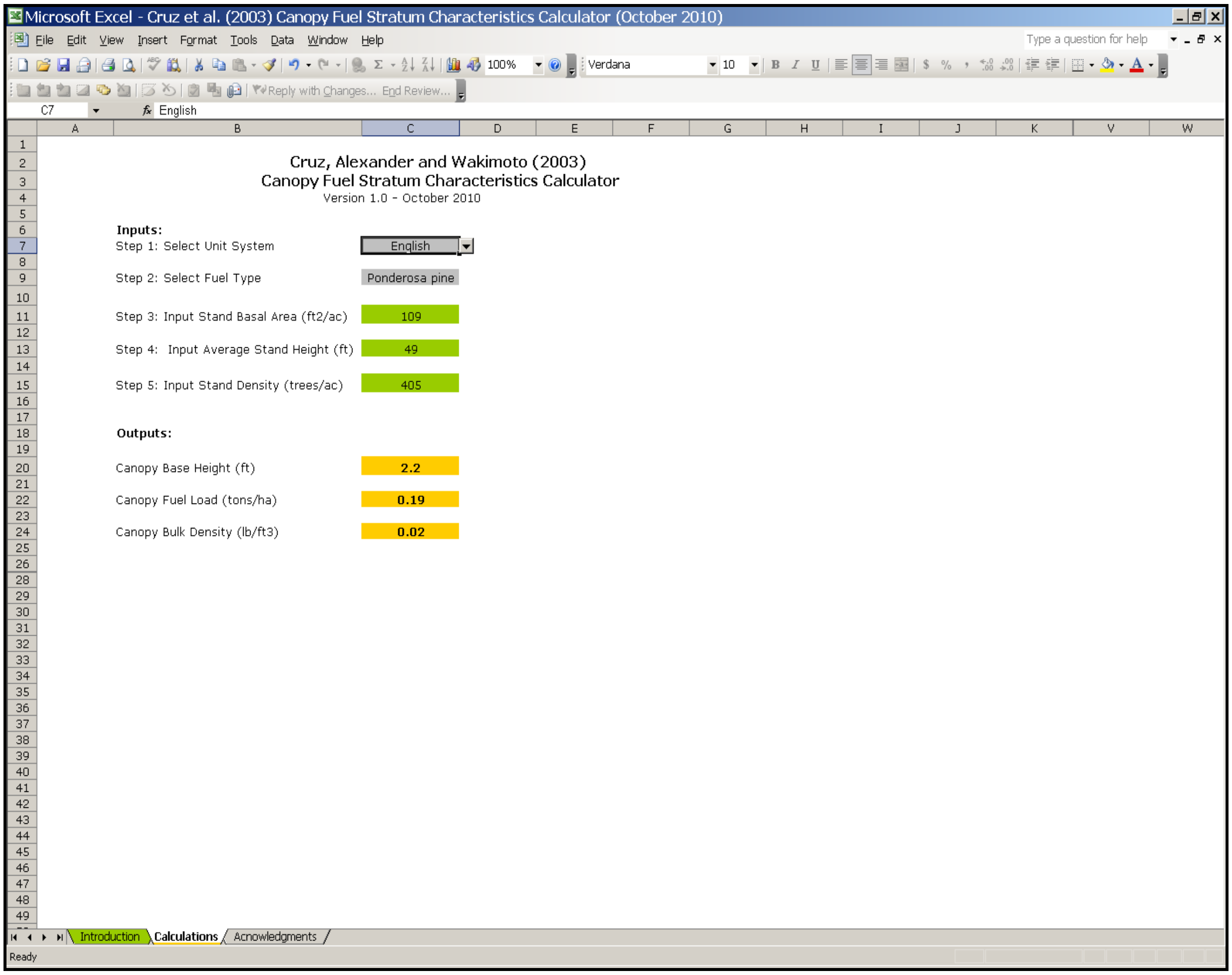

Fig. 3. Screen of the *Canopy Fuel Stratum Characteristics Calculator* English unit calculation tab.

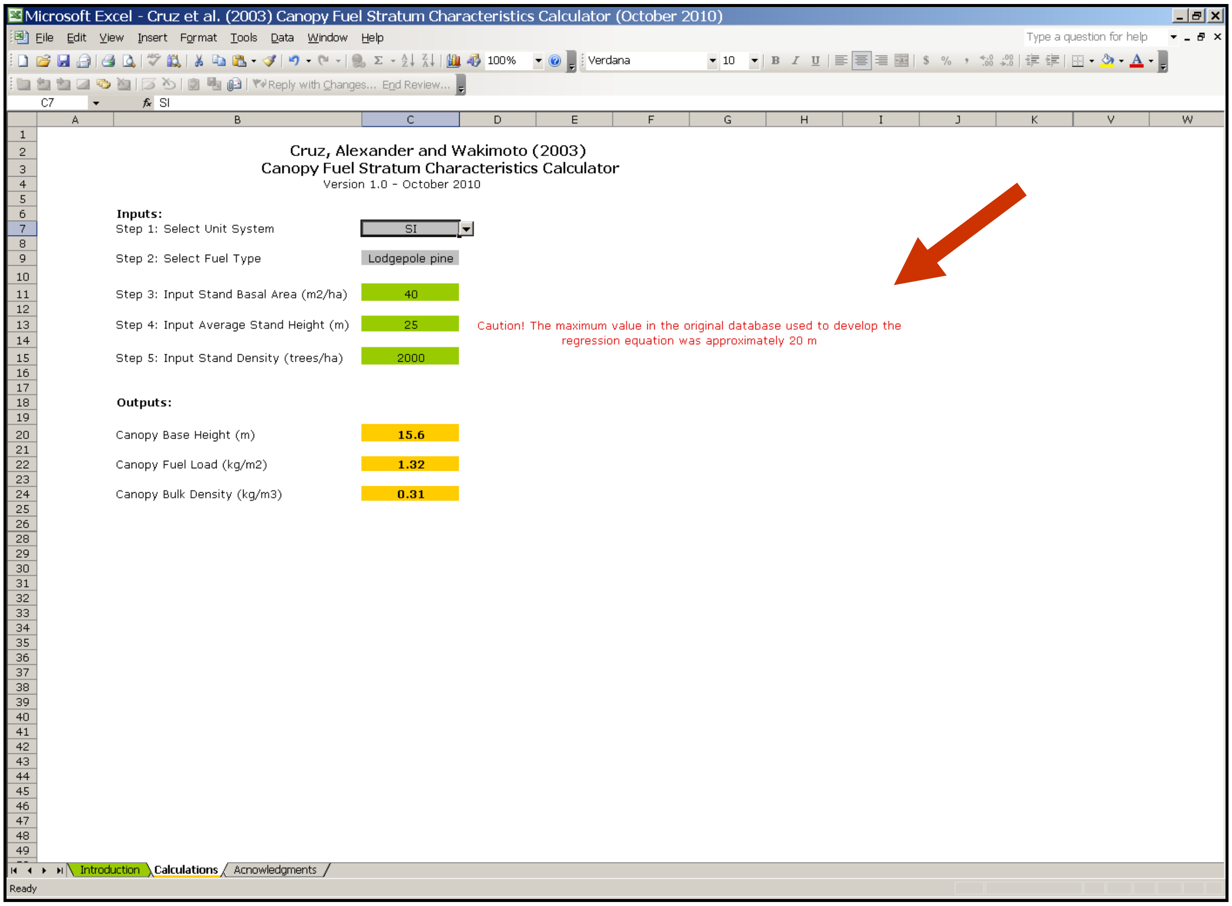

Fig. 4. Screen of the *Canopy Fuel Stratum Characteristic Calculator* cautionary note example.

Table 1. Maximum reliable values and/or reliable range of the three stand inputs used in the *Canopy Fuel Stratum Characteristics Calculator*

Conifer fuel type	Basal area		Stand height		Stand density	
	$m^2\ ha^{-1}$	$ft^2\ acre^{-1}$	m	ft	trees ha^{-1}	trees $acre^{-1}$
Ponderosa pine	40	175	1-20	3-65	3000	1200
Lodgepole pine	50	220	3-20	10-65	4000	1600
Douglas-fir	55	240	2-25	7-80	3000	1200
Mixed conifer	70	300	3-25	10-80	4000	1600

Feedback received todate

The *Canopy Fuel Stratum Characteristics Calculator* was informally tested by a group of undergraduate students at the University of Idaho, Moscow, in April 2010 as part of a fire management course exercise. According to their instructor, Chad Hoffman, 'The class really liked the calculator. They thought it was easy to use and very straight forward … Several of the students decided to recommend this approach in the fuels inventory plan they are developing'.

Recent developments of note

The Cruz *et al.* (2003) regressions for estimating canopy fuel metrics were recently evaluated for their performance. The results as reported on by Cruz and Alexander (2011) were very encouraging. The evaluation consisted of comparing observed and predicted values for two different data sets. The first test involved a simulation of two low thinning regimes (i.e. 25 and 50% basal area reduction) based on a random selection of stand data used in the original Cruz *et al*. (2003) study, and was undertaken in direct response to a perceived shortcoming of the CBH regressions models (Cruz *et al.* 2010). The second test involved a direct comparison against independently collected data for ponderosa pine in the Black Hills of South Dakota by Keyser and Smith (2010).

Acknowledgement

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