General Characteristics		
1	**Abstract of Model Capabilities**	CCSL calculates wind fields and other planetary boundary layer parameterizations (e.g., temperature, U_*, Richardson number, P-law exponent) over complex terrain and above and within vegetative canopies.. Vertical profiles of the wind are also calculated within and above canopies, and above open terrain at each x,y coordinate point. The model/code can provide high resolution inputs to wind-influenced applications such as the transport and dispersion of aerosols, emergency response/HAZMAT situations, aerosol spray events, wildfire events, downwind transport of spores, etc
2	**Sponsor and/or Developing Organization**	Ronald M. Cionco US Army Research Laboratory (ARL) 2800 Powder Mill Road Adelphi, MD 20783 (301) 394-1794 (301) 394-4797 **Fax** rcionico@arl.mil **sponsoring organization** rcionco@arl.mil **developing organization**
3	**Last Custodian/ Point of Contact**	Ronald M. Cionco US ARL Attn: AMSRL-IS-EE 2800 Power Mill Road Adelphi, MD 20783 (301) 394-1794 (301) 394-4797 **Fax** rcionico@arl.mil **primary individual**
4	**Life-Cycle**	PRE-1974: USA ASL, WSMR developed a canopy wind flow model for a wide variety of agricultural and tree canopies. 1974: USA ARL, WSMR facilitated the development of a wind model of flow over complex terrain . 1978/80/82: USA ARL, WSMR further improved the flow physics and added more analyses including turbulence parameters and calculating the vertical profiles of wind at each x,y coordinate. 1989/92: Evaluated model/code with two data bases. Recent enhancements: Adding flow in and about and over clusters of buildings.
5	**Model Description Summary**	CCSL is an integrated diagnostic, two-dimensional, micro-alpha scale, surface layer wind simulation model that calculates the horizontal wind field and vertical profiles of wind. The model produces high-resolution grided calculations of airflow, as well as turbulence properties over a limited area, taking into account the airflow's interaction with changing terrain and land morphology features and thermal structure. CCSL applies Gauss' Principle of Least Constraints to mass and momentum conservation accounting for terrain configuration and thermal forcing upon the wind field and Cionco's canopy flow analysis for discrete vegetation domains. Based upon an initial objective estimate, results are obtained by direct variational relaxation of the wind field in the surface layer to minimize the constraints imposed by changing terrain, thermal structure, and airflow continuity. The canopy flow subroutine imposes an exponential decay of the canopy wind with depth to modify the ambient flow field. This procedure requires the forces to be minimized in order to satisfy the equations of motion. The initialization of the code requires, as a minimum, wind speed and wind direction, temperature, and pressure from one local surface station at 10 meters and one upper air sounding of temperature- pressure/height profiles to estimate the atmospheric stability of the domain as well as digitized terrain elevation and digitized morphology types and their heights. The code output consists of u,v wind components and their vector field, derived streamline fields, air temperature, friction velocity, Richardson number, power law exponent, and vertical profiles of wind at x,y coordinates etc.
6	**Application Limitation**	Limited to domains about 20 km x 20 km and vertically up to about 100 m. Accurate , digitized, high resolution vegetation data is not readily available, and you may have to create it yourself. Can provide winds for the transport of all types of aerosols, emergency response/HAZMAT situations, agricultural/ forestry aerial spray events, studies of the spread of spores, disease, etc., crop environment, forest environment, wildfire events, and many other wind-influenced events, processes, and conditions.
7	**Strengths/ Limitations**	**Strengths:** Easy to initialize. Fast running. Evaluated very well. **Limitations:** Limited to microscale.
8	**Model References**	Contact R.M. Cionco for a list of references.

9	**Input Data/Parameter Requirements**	Data from one meteorological station at 10 meters: - wind speed and wind direction - air temperature - air pressure (2 meters or 10 meters) One upper air sounding: temp versus height/pressure Digitized terrain elevation Digitized vegetation type and heights (other land morphology features such as buildings)
10	**Output Summary**	x,y coordinate fields with nominal 100-meter resolution: - u,v components, vector field, and derived streamlines - temperature - friction velocity - Richardson number - Power law exponent - vertical profiles of wind at each x,y coordinate, and contoured terrain map with land morphology features
11	**Applications**	CCSL (and HRW) was run real-time during the MADONA Field Study at Porton Down, Salisbury, United Kingdom - a domain of rolling hills with canopies, grass, and clusters of buildings. CCSL has since been evaluated with two data bases (Project WIND). CCSL has been successfully exercised for a wide variety of terrain configurations including morphology features.
12	**User-Friendliness**	Data reader that extracts terrain data from CD-ROM (DMA). Code that creates digitized terrain data file for input. Code that prepares input file of meteorological data. Graphics package to plot and view x,y fields. Plot routine to plot vertical wind profiles. Grid size can be 40m to 400m.
13	**Hardware-Software Interface Constraints/ Requirements**	**Computer operating system:** DOS and UNIX **Computer platform:** Pentium PC and SGI Reality Engine **Disk space requirements:** About 2 MB **Run execution time** (for a typical problem)**:** About one minute. **Programming language:** FORTRAN 77 **Other computer peripheral information:** No information provided.
14	**Operational Parameters**	**Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** There are some diagnostic messages. **Set up time for: Typical times are:** ***first-time user:*** 2 h ***experienced user:*** <20 minutes
15	**Surety Considerations**	**All quality assurance documentation:** User Guide. **Benchmark runs:** Yes **Validation calculations:** Yes **Verification with field experiments that has been performed with respect to this code:** PROJECT WIND; MADONA Field Study
16	**Runtime Characteristics**	50 MHZ, 486 Lap Top PC: About 2:00 minutes. 166 MHZ Pentium PC: About 20 seconds. SGI Reality Engine - one processor < 20 seconds.

Specific Characteristics

Part A: Source Term Submodel Type

A1	**Source Term Algorithm?**	__YES ✔ NO

Part B: Dispersion Submodel Type (No Information Provided.)

Part C: Transport Submodel Type (No Information Provided.)

Part D: Fire Submodel Type (Not Applicable)

Part E: Energetic Events Submodel Type (Not Applicable)

Part F: Health Consequence Submodel Type (Not Applicable)

Part G: Effects and Countermeasures Submodel Type (Not Applicable)

Part H: Physical Features of Model (No Information Provided.)

Part I: Model Input Requirements (See Item 9.)

Part J: Model Output Capabilities (See Item 10.)

Part K: Model Usage Considerations (No Information Provided.)