Physics and Numerics options

Runtime options are specified via the `&SIMULATOR` namelist group. Brief descriptions of how various parameters influence physics options are presented below. See the ELMFIRE Technical Reference for details.

Elliptical dimensions

In ELMFIRE, every point along the fire front behaves as an independent elliptical wavelet (Huygens principle). However, since the underlying surface fire spread model only provides the rate of spread in the head fire direction, the assumed elliptical fire shape is used to calculate spread rates in other directions. A key parameter is the ellipse's length to width ratio, which is estimated as a function of wind speed from an empirical correlation. The maximum allowable value of the length to width ratio is specified with the keyword `MAX_LOW` (default value of 8). Setting this to a lower value can prevent cigar shaped fires under high winds.

Crown fire

The keyword `CROWN_FIRE_MODEL` can be used to enable or disable crown fire initiation and spread. By default, `CROWN_FIRE_MODEL=1` and crown fire spread rate is calculated from Cruz et al. 2005. Crown fire can be disabled by setting `CROWN_FIRE_MODEL=0`. In certain cases, crown fire spread rates may be over-predicted, so an upper limit on spread rate can be specified via `CROWN_FIRE_SPREAD_RATE_LIMIT`, which has a default value of 250 ft/min. Since crown fire may not always propagate in discontinuous canopies, the keyword `CRITICAL_CANOPY_COVER` is used to specify the minimum canopy cover at which crown fire occurs. The default value is 0.39 (note that this is a fraction, not a percent).

Wind fluctuations

Wind fluctuations, disabled by default, can be enabled by setting `WIND_FLUCTUATIONS = .TRUE.`. Doing so directs ELMFIRE to perturb the wind field (speed and direction) in every cell in the computational domain every `DT_WIND_FLUCTUATIONS` seconds. The wind speed perturbation is the current wind speed multiplied by `WIND_SPEED_FLUCTUATION_INTENSITY` multiplied by a randomly generated floating point number between -0.5 and +0.5. As an example, if the current wind speed is 10 mph and `WIND_SPEED_FLUCTUATION_INTENSITY` is 0.2, then the perturbed (post-fluctuation) wind speed will be between 9.0 mph and 11.0 mph. Wind direction fluctuations are implemented similarly, except that

`WIND_DIRECTION_FLUCTUATION_INTENSITY` specifies the maximum magnitude of the wind direction fluctuation in degrees. For example, if the current wind direction is 90 degrees and `WIND_DIRECTION_FLUCTUATION_INTENSITY = 20.0`, then the perturbed (post-fluctuation) wind speed would be between 80-100 degrees. Essentially, `WIND_SPEED_FLUCTUATION_INTENSITY` is a relative value whereas `WIND_DIRECTION_FLUCTUATION_INTENSITY` is an absolute value in degrees.

Miscellaneous inputs

Fire front expansion calculations are performed only in voxels/grid cells surrounding the fire front (narrow band level set method). The number of voxels on either side of the fire front is controlled by the parameter `BANDTHICKNESS` (default value of 2). It is normally unnecessary to adjust this parameter.

The parameter `RANDOMIZE_RANDOM_SEED` controls the seed used to initialize the random number generator. By default, `RANDOMIZE_RANDOM_SEED = .FALSE.` and the random number generator is initialized using the `SEED` value as specified in the `&MONTE_CARLO` namelist group. If `RANDOMIZE_RANDOM_SEED` is set to `.TRUE.`, then the random number seed is generated from the system clock.