For the calculation of the required inventory, estimated fire duration and estimated burned area, multiple formulations has been derived. All the formulations has been based on the previously mentioned resources.

A table that shows the range of all the coefficients can be seen below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Coefficient | Parameter | Condition-1 | Condition-2 | Condition-3 | Condition-4 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Highly Flammable | Moderately Flammable | Low Flammability | – |
| **vegetation\_coeff** | **vegetation** | 1.5 | 1.2 | 0.7 | – |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | 0 <=  **wind\_speed**  <= 5 | 5 <  **wind\_speed**  <= 15 | 15 <  **wind\_speed**  <= 30 | 30 <  **wind\_speed** |
| **wind\_coeff** | **wind\_speed\*** | 1 | 1.2 | 1.5 | 2 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | 0 <=  **temperature**  <= 10 | 10 <  **temperature**  <= 25 | 25 <  **temperature**  <= 35 | 35 <  **temperature** |
| **temp\_coeff** | **temperature (°C)** | 0.5 | 1 | 1.2 | 1.5 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **dewpoint**  < 0 | 0 <=  **dewpoint**  < 5 | 5 <=  **dewpoint**  <= 10 | 10 <  **dewpoint** |
| **dewpoint\_coeff** | **dewpoint (°C)** | 2 | 1.5 | 1.2 | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **rh**  < 20 | **rh**  > 50 | else | – |
| **humidity\_coeff** | **rh (%)** | 1.3 | 0.8 | 1 | – |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **pressure**  < 1000 | 1000 <=  **pressure**  < 1015 | **pressure**  >= 1015 | – |
| **pressure\_coeff** | **pressure (hPa)** | 1.5 | 1.2 | 1 | – |

**\* given: (wind\_u, wind\_u) wind\_speed= 3.6\*√(wind\_u^2+ wind\_v^2)**

**1. Required inventory:**

Given the initial fire size (initial\_fire\_size), the number of required inventory has been calculated as follows:

total\_people = floor((initial\_fire\_size \* ppl\_coef \* cumulative\_weather\_coef \* **vegetation\_coeff**)\*0.8)

engine = ceil(initial\_fire\_size \* eng\_coef \* cumulative\_weather\_coef \* **vegetation\_coeff**)

helicopter = floor((initial\_fire\_size \* heli\_coef \* cumulative\_weather\_coef \* **vegetation\_coeff**)/2)

plane = floor((initial\_fire\_size \* heli\_coef \* cumulative\_weather\_coef \* **vegetation\_coeff**)/4)

backing\_engine = floor(initial\_fire\_size \* backing\_eng\_coef \* cumulative\_weather\_coef \* **vegetation\_coeff**)

Where,

ppl\_coef = 1.2

eng\_coef = 0.075

heli\_coef = 0.013

backing\_eng\_coef = 0.08

cumulative\_weather\_coef = (**wind\_coeff** + **temp\_coeff** + **dewpoint\_coeff** + **humidity\_coeff** + **pressure\_coeff**) / 5

**2. Burned Area**

Given the duration of the fire (fire\_duration), the total burned area has been calculated as follows:

spread\_rate = **rate** \* wind\_coeff \* temp\_coeff \* dewpoint\_coeff \* humidity\_coeff \* pressure\_coeff \* vegetation\_coeff

estimated\_total\_damage = FIRE\_SIZE \* math.exp(spread\_rate \* fire\_duration)

Where,

|  |  |  |  |
| --- | --- | --- | --- |
|  | **fire\_duration**  < 48 hours | 48 hours <=  **fire\_duration**  < 96 hours | **fire\_duration**  >= 6 |
| **rate** | 0.05 | 0.04 | 0.023 |

**3. Fire Duration**

Given the initial fire size (initial\_fire\_size), the estimated duration of the fire has been calculated as follows:

base\_days = initial\_fire\_size/15

est\_time = base\_days \* wind\_coeff \* temp\_coeff \* dewpoint\_coeff \* humidity\_coeff \* pressure\_coeff \* vegetation\_coeff \* 12