**Cell DEVS Model Data Form**

*Title:* MODELLING AND SIMUATION OF SMOG OVER NORTH-WEST INDIA DUE TO STUBBLE BURNING USING CELL DEVS CELLULAR AUTOMATA MODEL IN LOPEZ SIMULATOR

*Type:*  (using state variables in **Lopez Simulator**)

*Acronym/Short name:*  x

*Purpose for which Developed:* To model and simulate the formation of smog over North-West India due to stubble burning of crops using state variables and to imitate the crop sowing pattern under the influence of south-west monsoon and the various crop growth phases in farming.

*Other Applications for which it is Suitable*: x

*Date Developed/Implemented*: 21/12/2017

*Domain*:

*Description* (including characteristics):

In this project, the CELL DEVS cellular automata model for the simulation and modeling of smog formation over North West India due to stubble burning of crops has been implemented. The CELL DEVS formalism approach using the state variables has been employed in Lopez Simulator for the implementation of the proposed models for smog modelling. The project clearly illustrates through the various test model implementations and simulations that the smog formation in the North-West India is because of extensive stubble burning by the farmers. The smog has been major problem in Northern part of India in the past few years and the smog formation has peaked in November 2017 leading to the least air quality index. The proposed models also take into account the effect of south west monsoon on the crop sowing pattern through the formation of zones in Lopez Simulator along with the use of state variables i.e. the crops are sown first in the south-east and north-east India followed by the crop sowing in the south-west and north-west India because the monsoon arrives earlier in the south-eastern part of India. It is to be noted that the random crop sowing pattern in the simulation follows a normal or gaussian distribution. The various phases of crop growth in farming – crop sowing, reproductive phase and ripening phase followed by crop harvesting have also been taken into account and implemented in the proposed models. The total simulation time for the various test models have been taken into account and compared.

*Links to Related Documents (References):*

[1] <https://en.wikipedia.org/wiki/Smog>

[2] <https://en.wikipedia.org/wiki/Smog_in_Delhi>

[3] <https://visibleearth.nasa.gov/view.php?id=75053>

[4] <http://www.financialexpress.com/photos/business-gallery/926389/delhi-pollution-nasa-photos-show-smoke-clouds-heading-from-punjab-haryana-to-delhi-see-horrific-visuals/>

[5] <http://indianexpress.com/article/india/india-news-india/post-diwali-pm-shoots-up-10-times-more-than-the-safe-limit-3730200/>

[6] <http://www.cbc.ca/radio/thecurrent/the-current-for-november-13-2017-1.4397572/new-delhi-s-toxic-smog-poses-serious-health-threat-warns-doctor-1.4397897>

[7] <https://visibleearth.nasa.gov/view.php?id=64765>

[8] <https://wildcardweather.com/2014/09/07/monsoons-and-the-north-american-monsoon/>

[9] [M. Marı́n,](http://www.sciencedirect.com/science/article/pii/S0927025600000975" \l "!) [V. Rauch,](http://www.sciencedirect.com/science/article/pii/S0927025600000975" \l "!) [A. Rojas-Molina,](http://www.sciencedirect.com/science/article/pii/S0927025600000975" \l "!) [C.S López-Cajún,](http://www.sciencedirect.com/science/article/pii/S0927025600000975" \l "!) [A. Herrera,](http://www.sciencedirect.com/science/article/pii/S0927025600000975" \l "!) [V.M Castaño](http://www.sciencedirect.com/science/article/pii/S0927025600000975" \l "!), *“Cellular Automata simulation of dispersion of pollutants”,* Computational Material Science, ELSEVIER, vol. 18, Issue 12, pp. 132-140, August 2000.

[10] [Giorgio Guariso](http://www.sciencedirect.com/science/article/pii/0266983892900102" \l "!), [Vittorio Maniezzo](http://www.sciencedirect.com/science/article/pii/0266983892900102#!), “*Air quality through cellular automata model",* Environmental Modeling and Software, ELSEVIER, vol. 7, Issue 3, pp. 131-141, 1992.

*Short Title*: x

*URL*: <https://www.sciencedirect.com/science/article/pii/S1877750311000512>

*Description:* x

*Keywords* : Cell DEVS formalism, crop-sowing, Lopez Simulator, monsoon, normal distribution, smog, state variables, ploughing, reproductive phase, ripening phase, stubble burning

*Developer(s):*

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**Comments:**

All the Cell DEVS models using the state variables have been successfully implemented, complied (build) and simulated in Lopez Simulator. The output files - .ma files, .xml files, .pal files, .stvalues files and .log01 files have been generated and the corresponding output has been recorded in .avi files in the form of video. It has been observed that all the models are working correctly.