# Parametrization of the Do3Se ozone flux model for *Terminalia arjuna, Azadiracha indica, Ficus religiosa, Syzgium cumini* and *Polyathia longifolia*

Gobinder Singh

MS13125

*A dissertation submitted for the partial fulfilment of BS-MS dual degree in Science*


**Indian Institute of Science Education and Research Mohali**

**April 2018**

# Certificate of Examination

This is to certify that the dissertation titled "**Parametrization of the Do3Se ozone flux model for *Terminalia arjuna, Azadiracha indica, Ficus religiosa, Syzgium cumini* and *Polyathia longifolia***" submitted by **Mr. Gobinder Singh** (Reg. No. MS13125) for the partial fulfilment of BS-MS dual degree programme of the Institute, has been examined by the thesis committee duly appointed by the Institute. The committee finds the work done by the candidate satisfactory and recommends that the report be accepted.

Dr. Vinayak Sinha Dr. Sugumar Venkataramani Dr.Baerbel Sinha

(Supervisor)

Dated

# Declaration

The work presented in this dissertation has been carried out by me under the guidance of Dr. Baerbel Sinha at the Indian Institute of Science Education and Research Mohali.

This work has not been submitted in part or in full for a degree, a diploma, or a fellowship to any other university or institute. Whenever contributions of others are involved, every effort is made to indicate this clearly, with due acknowledgement of collaborative research and discussions. This thesis is a bonafide record of original work done by me and all sources listed within have been detailed in the bibliography.

Gobinder Singh

(Candidate)

Dated:

In my capacity as the supervisor of the candidate's project work, I certify that the above statements by the candidate are true to the best of my knowledge.

Dr. Baerbel Sinha

(Supervisor)

# Acknowledgment

I owe a great many thanks to a great many people who helped me during this one year in completing the project. This project has been a very good experience and I learnt a lot of new things.

First and foremost I would like to thank my supervisor, Dr. Baerbel Sinha, who guided me and corrected me at each every step and helped me do everything, the best I could.

Thanks and appreciation to all the lab members who helped and guided me a lot.

I would thank Department of Science and Technology, India for funding the project and Indian Institute of Science Education and Research Mohali for providing all the facilities and equipment required.

I extend a heartiest thanks to my family and friends.

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# Notation (Abbreviations)

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|---|---|
| $DO_3SE$ | deposition of ozone for stomatal exchange |
| $AOT_{40}$ | accumulated ozone exposure over a threshold of 40 ppb |
| $POD_y$ | phytotoxic ozone dose above the threshold of Y |
| VOC | volatile organic compounds |
| ROS | reactive oxygen species |
| VPD | vapour pressure deficit |

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# Abstract

Troposphere is the layer of atmosphere extending from the ground to a height of 6-10km. Ozone is majorly present in the stratosphere layer of atmosphere which is present just above the troposphere. But there is a minimal amount of ozone presence in troposphere as well, termed as the tropospheric or ground-level ozone. This ozone is not harmful upto certain threshold, after which it acts as a greenhouse gas and becomes damaging to the living forms. The toxic effect of ozone to plants include yield loss, leaf injury etc.. To determine an O3 dose/plant response relationship different type of ozone metrices like Mx, W125, AOT40 are used. During this work, we are looking at a new metric known as PODy (Phytotoxic Ozone Dose) developed by Emberson and co-workers. This metric was developed based on the stomatal flux measurements as a measure of ozone that enters the stomata of a leaf. We measured stomatal conductance using a Decagon SC-1 Leaf Porometer and for Ozone measurements we used UV absorption photometry. Stomatal conductance measurements were taken on the leaves of 5 different tree species namely, Arjun, False Ashoka, Jamun, Neem and Peepal in IISER Mohali during summer and post monsoon season.

When performing a paired t-test on measurements taken on the top and bottom side of the same leaf, the t value for the test for every tree except ashokha comes higher than the t-critical value. But t value which is higher than the t-critical value suggests us that the bottom side has significantly higher stomatal conductance.

When applying a paired t-test on the measurements of unshaded younger and older leaves growing on the same branch of the same tree, for some species t-value comes under t-critical and for others the value is higher than t-critical. So, we are not sure about significant difference between the pair of younger and older leaves. Significantly higher conductance on old leaves was found on peepal, no difference between young and old leaves was found on false ashoka and jamun and a higher conductance of young leaves was found on neem and arjun.