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Notice for the PhD Viva Voce Examination

Mr Prasanth S, Registration Number: 2190029, PhD Scholar at the Department of Physics and Electronics, School of Sciences, CHRIST (Deemed to be University) will defend his PhD thesis at the public viva-voce examination on Wednesday, 25 March 2026 at 11.00 am in Room No. 044, Ground Floor, R&D Block, CHRIST (Deemed to be University), Bengaluru - 560029, Karnataka, India.

Title of the Thesis	:	**Role of Wildfire Aerosols on the Stratospheric Chemistry and Ozone Depletion**
Discipline	:	**Physics**
External Examiner - I	:	**Dr T Narayana Rao** Scientist Head of Cloud and Convective Systems Group National Atmospheric Research Laboratory Gadanki, Tirupati - 517112 Andhra Pradesh
External Examiner - II	:	**Dr Shibesh Kumar Jas Pacif** Director Pacif Institute of Cosmology and Selfology (PICS) Sagara, Sambalpur - 768224 Odisha
Supervisor	:	**Dr Kenath Arun** Associate Professor Department of Physics and Electronics School of Sciences CHRIST (Deemed to be University) Bengaluru - 560029 Karnataka
Co-supervisor	:	**Dr Subin Jose** Assistant Professor Department of Physics Newman College, Thodupuzha – 685585 Kerala

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva–voce examination.

Registrar (Academics)

Place: Bengaluru
Date: 17 March 2026

ABSTRACT

Extreme wildfire events amplify global warming by emitting greenhouse gases and destroying carbon sinks while causing economic damage through property destruction and even fatalities. One such event, the 2019/2020 Australian Black Summer, injected large amounts of aerosols and gases into the troposphere and stratosphere making its impact global. This study provides a comprehensive investigation of the genesis of the Black Summer event and its impact on the troposphere and lower stratosphere carried out using in-situ, multi-satellite, reanalysis, and model simulation. For the first time, the observational evidence for the role of hydrological drought in the genesis of the Black Summer event is provided. A strong correlation was observed between the depletion of total water storage (surface and sub-surface) due to hydrological drought and the burnt area in southeast Australia. The decadal low in total water storage in December 2019 highlights the critical role of hydrological drought in this event. The assimilated aerosol optical depth (AOD) indicates that the Black Summer event raised aerosol loading to values up to 0.5, exceeding the previously reported MODIS-based value of 0.3. The amplified aerosol backscattering, coupled with the increased surface albedo due to the prevailing drought, led to a significant surge in outgoing shortwave flux and contributed to regional cooling. Additionally, co-emitted carbon monoxide enhanced tropospheric ozone production, further degrading regional air quality.

Furthermore, this event injected PyroCbs into the high latitude of the lower stratosphere leading to increased stratospheric aerosol loading in early 2020. An analysis from Aura's microwave limb sounder revealed these aerosols provided additional surface area for a heterogeneous chemical reaction known as dinitrogen pentoxide hydrolysis leading to increased production of nitric acid (HNO3) gas. Despite this, nitric acid containing polar stratospheric clouds (PSCs) known as liquid-Nitric Acid Trihydrate (NAT) mixture exhibited strong negative anomaly, whereas water ice PSC exhibited strong positive anomaly. Lagrangian backward trajectory analysis and chemical box model simulations revealed that wildfire aerosols, alongside stratospheric background aerosols, acted as nuclei for the formation of liquid-NAT mixture PSCs which rapidly converted into ice particles and resulted in negative anomaly of NAT and positive anomaly in ice PSC. Following these changes, anomalously strong and prolonged ozone depletion is observed in the Antarctic polar region during Austral Spring 2020. However, the model simulation of ozone as a passive tracer revealed that ~123 dobson units of ozone are lost due to chemical reaction which is comparable to the year-to-year variability. This suggests that despite increase in stratospheric aerosols, and PSC following the Black Summer event, there was no significant chemical ozone loss during 2020 as previously speculated; instead, enhanced ozone depletion is attributable to the dynamical changes in the lower stratosphere. These findings provide critical insights for predicting extreme wildfire events and significantly enhance our understanding of their impacts on stratospheric chemistry and ozone depletion, contributing to improved climate and wildfire modeling.

Keywords: *Wildfire, Aerosols, Ozone depletion*

Publications:

1. **Prasanth, S.**, Anand, N., Manoj, M. R., Arun, K., Jose, S., Satheesh, S. K., & Moorthy, K. K. (2025). A New Perspective on the Genesis of the 2019/2020 Australian Bushfire and Its Atmospheric Radiative Impacts. Journal of Atmospheric and Solar-Terrestrial Physics, 106558.
2. **Prasanth, S.**, Anand, N. S., Sunilkumar, K., Jose, S., Arun, K., Satheesh, S. K., & Moorthy, K. K. (2025). Australian bushfire emissions result in enhanced polar stratospheric clouds. Atmospheric Chemistry and Physics, 25(13), 7161-7186