AN ALTERNATIVE HYPOTHESIS FOR THE O(^{1}D) QUENCHING COEFFICIENT ADJUSTMENT DERIVED FROM SIMULTANEOUS OPTICAL AND INCOHERENT SCATTER RADAR MEASUREMENTS DURING IONOSPHERIC MODIFICATION EXPERIMENTS.

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Abstract:

Ionospheric modifications (High Frequency – HF) experiments inducing intensification of airglow emissions at 6300 and 5577 (red and green lines, respectively) from the two lowest excited states of O(1D) and O(1S) have been done at Arecibo Observatory (AO) since the early seventies. The last generation of HF facility at AO was commissioned in November 2015, and since then several campaigns have been conducted with the participation of scientists all over the world. Before the AO platform collapse on December 1, 2020, the system consisted of six transmitters, each connected to one of six dipole elements, and each capable of continuous wave (CW) operation at a nominal power of ~100 kW. The HF transmitter system had two available frequencies, 5.125 MHz and 8.175 MHz, with 130 kHz and 100 kHz bandwidths, respectively.

In this work we are analyzing the excitation of the red line airglow emission (3600Å) by high-power radio waves at ~5.125MHz of 28 HF pulses of 5 minutes intercalated by 5 minutes of no HF interaction. The chosen periods were the pre-sunrise and post-sunset periods of June 5, 2016. The first experiment started at 00:00 LT and finish at 04:30 LT (due to problems with the transmitter in the end of the experiment, we are using 18 pulses until 03:35LT), and the second experiment from ~21:40 to ~23:30LT. Coincidentally, a small geomagnetic storm occurred during these observations. The first experiment started along the initial phase of this disturbance and the second experiment in the end of the main phase.

Until the closing of the call for this conference, our main finds were:

1. Assuming that the modified red line emission comes from a narrow height range in the vicinity of the reflection height, for a first approximation and considering that all of the excess emission

comes from a single height (which corresponds to the height where the plasma frequency is equal the transmitted frequency), it was detected that the lifetime of the O(1D) might varies with altitude with a peak close to the red line emission altitudes.

2. Considering a fix lifetime value for all the altitudes, it was detected that the N2 quenching coefficient O(1D) varied with altitude. Such variation could be a miss determination of the N2 neutral concentration from the NRLMSISE-00 Atmosphere Model.

3. As a practical outcome, our study shows that the 5 minutes off between the excitations is not sufficient for the exited region to return to the previous quiet condition. Our computations show that pulses of three minutes intercalated by at least 6 minutes off are more appropriate.

Acknowledgment: The Arecibo Observatory is a facility of the National Science Foundation operated under cooperative agreement (AST-1744119) by the University of Central Florida in alliance with Yang Enterprises, Inc., and Universidad Ana G. Méndez (UAGM). A.M. S.V. thanks the support of Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP and Conselho Nacional de Desenvolvimento Científico e Tecnológico- CNPq for the financial support under grants 2015/25357-4 (FAPESP) and 65743/2020-4 (CNPq).

Session: Ionosphere and high atmosphere.

Oral or Poster: Poster.