A FRAMEWORK FOR UNDERSTANDING THE PHYSICS OF SPRITES

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Abstract Submission Form

2004 National Radio Science Meeting

Abstract: triplett4539

Date Received: September 23, 2004

The breakdown processes that lead to sprite formation are still being debated. Are sprites formed through conventional breakdown, runaway breakdown, or a combination of both? If it is a combination of both, can one predict when each process will dominate based on the parent lightning characteristics, the upper atmospheric conductivity profile, the geometry of the discharge, the measured brightness and spectrum of the sprite, or some other metric? The purpose of this study is to provide a framework for discussing what underlying physics is revealed, or not revealed, by current measurements and to stimulate discussion in the sprite community, both on how to refine this framework and what future measurements would be useful.

We will start with a brief overview of conventional and runaway breakdown processes. Next, we will take a two-pronged approach to understanding the underlying physics. First, we will discuss photometer and parent lightning measurements as a function of morphology of the sprite. We will then present what underlying physics may or may not be discerned from these measurements. The measurements will be separated into three bins: those that can be explained by conventional only, those that can be explained by runaway only, and those that could be explained by either (i.e. either both present or the measurements are not yet to the point where we can differentiate). Time will not permit an exhaustive discussion of all measurements and all physics; therefore, the goal of this talk will be to provide a framework for continuing the discussion.

Our second approach will be to show results from a fully 2-D electromagnetic model (UNIMAX) and optical model (POEM) for both conventional and runaway breakdown processes. We will compare two runs with different parent lightning characteristics and show that different measurements are predicted. We will then present two runs in which runaway is turned off and show how this affects the results. We will compare the model results to measurements and separate out the results into the three bins discussed above. We will also discuss the effects of spatial and temporal averaging on the comparison of modeling results to measurements. We will conclude with our suggestions for future measurements and solicit input from the community on how to refine this framework and refine future measurements.

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2. G - Ionospheric Radio and Propagation

3. (a) G/H Lightning and Sprites

4. I - Invited Paper, Program chair: Elizabeth Gerken and Steve Cummer

5. G/H Lightning and Sprites¡br¿