A62C-04 1430h

Use of Ground-Based Lightning Observations in a 3-D Coupled Cloud/Chemistry Model

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On July 21, 1998, the development and evolution of a supercell over Southern Germany was observed during the European Lightning Nitrogen Oxides Project (EULINOX). The locations and times of occurrence of cloud-to-ground (CG) lightning flashes were recorded by a Lightning Position and Tracking System (LPATS). Total 3-D lightning activity was detected and located by the ONERA VHF Interferometric Mapper (ITF). A cloud-resolving model and accompanying cloud- scale chemical transport model (CSCTM) are used to simulate the evolution and chemical environment of the storm. The CSCTM includes a new parameterization of lightning NO_x production which utilizes flash lengths derived from ITF data. CSCTM passive tracer simulations including only convective transport and lightning NO_x production are used in conjunction with aircraft chemical measurements in the storm anvil to estimate the amount of NO produced per meter of flash channel. In order to study the impact of lightning NO_x production on ozone mixing ratios during the lifetime of the storm, runs of the CSCTM including chemical reactions as well as transport and lightning are employed. The impact of lightning NO_x on downstream ozone production near the tropopause is computed with a chemistry-only version of the CSCTM. Better understanding of the budgets of NO_x and O_3 in the upper troposphere are needed for assessments of climate forcing.

A62C-05 1445h

The influence of environmental state on lightning and convective parameter distributions

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A merged and highly reduced database of TRMM level 1 (precipitation radar, microwave imager, lightning) and NCEP reanalysis (basic state, radiative and surface flux) data has been assembled for three years of the TRMM mission. This allows direct examination of the dependence of convective spectra (as observed through radar reflectivity, microwave brightness temperature and lightning flash rate) on environmental basic states and anomalies. Such analysis may be more physically justified and instructive than traditional geographic and/or seasonal binning. The dependence of convective spectra on several environmental forcing parameters is presented, including surface Bowen ratio (sensible heat to total turbulent flux), net atmospheric radiative flux convergence and net atmospheric enthalpy flux convergence. The latter are basic drivers of net moisture convergence in simple quasiequilibrium moels of tropical atmospheric convection.

A62D MCC: 125 Saturday 1520h

Global Electrodynamics: From Sprites to Global Circuit I *(joint with SA, AE)*

Presiding: **R H Holzworth,** University of Washington**; W A Lyons,** FMA Research, Inc.**; D Sentman,** University of Alaska, Fairbanks

A62D-01 1520h INVITED

Observations of Sprites above Haiti/Dominican Republic Thunderstorms from Arecibo Observatory, Puerto Rico

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In August-September 2001 an experimental campaign has been conducted in Puerto Rico to perform correlative studies of lightning and lightning-induced ionospheric effects. The campaign, which was sponsored by a Small Grant for Exploratory Research from the National Science Foundation to Penn State University, had a broad range of scientific goals including studies ionospheric effects of thunderstorms, studies of VHF-quiet positive leaders and studies of large scale optical phenomena above ocean thunderstorms in tropics. As part of this program we conducted night time video recordings of lightning and large scale luminous phenomena above thunderstorms using a SONY DCR TRV 730 CCD video camera equipped with a blue extended ITT Night Vision GEN III NQ 6010 intensifier with 40 deg field of view. The intensifier provided a monochrome (predominantly green) image output. The video system was deployed at the Lidar Laboratory on the grounds of Arecibo Observatory, Puerto Rico (18.247 deg N, 66.754 deg W, elevation 305 m above the sea level). In this talk we report results of observations conducted between 01 and 03 UT on September 3, 2001. A total of 7 sprite events have been detected above a large thunderstorm system (cloud area exceeding 10^4 km^2) located approximately 500 km from the observational site above Haiti/Dominican Republic. The observed events exhibited typical sprite features documented in other parts of the globe, including single columns, groups of columns, relatively small horizontal glows confined to higher altitudes, as well as two large and impulsive events with the transverse extent $\simeq$50 km. In this talk we will also report results of preliminary analysis of available ELF electromagnetic signatures associated with the observed events recorded by Stanford University at Palmer Station, Antarctica, Duke University, MIT and Los Alamos Sferic Array in Florida.

Acknowledgments: The GEN III intensifier has been provided by ITT Night Vision Industries. We are grateful to M. Robinson of ITT Industries for support of our program. We thank W. Lyons for useful discussions. We are indebted to S. Gonzalez, Q. Zhou, M. Sulzer, C. Tepley, J. Friedman, E. Robles, A. Venkataraman and E. Castro for support of our observations at Arecibo Observatory.

A62D-02 1540h

Electromagnetic signatures of the Puerto Rico blue jet and its parent thunderstorm

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On September 15, 2001, a spectacular blue jet was observed over an oceanic thunderstorm from a vantage point only 200 km distant at Arecibo Observatory, Puerto Rico (PR) [Pasko et al., Nature, 416, 152, 2002]. Unlike previous blue jets documented on video, the PR jet propagated all the way up from the top of the thunderstorm at 16 km altitude to the base of the ionosphere at 70 km altitude and re-illuminated several times afterwards. Broadband (<1 Hz - 250 kHz) electric field data was recorded by the New Mexico Tech sferic system at Dominguito, PR, only a few kilometers north of Arecibo Observatory, while magnetic field data was continuously recorded by Stanford University at Palmer Station, Antarctica. Several minutes prior to the jet, light-intensified video indicated that the storm had an abnormally high flash rate of roughly one per second. A preliminary analysis of the sferic data indicates that an unusually high percentage of the flashes were intraclouds. The blue jet appearance was preceded less than a second earlier by an energetic positive bipolar event which likely marked the onset of a normal-polarity intracloud (IC) flash which transported negative charge upwards. Numerous IC pulses followed the bipolar event up to and during the blue jet event. A couple of the most spectacular IC pulses after the "first stroke" of the jet to the ionosphere were coincident with dramatic re-illuminations of the jet. The polarity of these waveforms indicated that negative charge was being transported upwards, and possibly into the jet towards the ionosphere. This inferred charge motion was counter to that which establishes the fair weather field between the earth and the ionosphere.

A62D-03 1555h

Gigantic transient luminous events with long duration*

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During the Sprites 2002 campaign in Taiwan, five gigantic transient luminous events (TLEs) were observed to occur over an oceanic thunderstorm. The morphology of these transient luminous events appears to be a hybrid of blue jet and sprite. The upper part resembles a sprite while the lower half is jet-like. These events visually span from the lower atmosphere to the E-layer ionosphere at 100 km. The luminous duration of these events ranges between 200ms to 400ms, which is much longer than that of typical sprites. In this paper, the morphology, temporal evolution, and possible generating mechanism of these gigantic TLE events will be presented.

* This work was supported in parts by research grants NSC91-NSPO(B)-ISUAL-FA09-01 and NSC91-2111-M006-002.

A62D-04 1610h INVITED

1 ms High Speed Observations of Sprites

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Sprites are bright optical phenomena occurring above active thunderstorms that last a small fraction of a second. Sprites take on a wide range of forms, which have been previously classified based only on their overall shape. In the past decade, images of sprites were obtained mainly with television-rate cameras, with relatively slow temporal resolution and a large field of view. In the past five years, better imagery of sprites was obtained in either temporal or spatial domain, but generally not both. In 1999 University of Alaska Fairbanks researchers obtained the best spatially resolved 1 ms data of a variety of optical phenomena above a thunderstorm to date. Imaged phenomena included not only a wide variety of sprites but also elves, halos, and sprite aftereffects.

Examples of sprites are taken from this data set and are used to describe their dynamical and stationary brightness features and the temporal ordering in which these features develop and decay. This forms the first classification of many sprite types based on their component features as opposed to their overall form. Dynamical features of sprites include downward tendrils and upward branches. The stationary features, often responsible for much of the sprite structure as observed by TV-rate cameras, include beads, columns and other shapes of brightness, and puffs forming above branches. The durations of the stationary processes are longer than those of the dynamical processes. The stationary processes are in fact only semi-stationary, and they may slowly transform the shape of the bright feature. Sometimes, secondary processes - for example, a new set of tendrils or branches - may originate from the previously established sprite body, resulting in further transformation and longer lifetime of the light emitting region. We also describe a class of sprite aftereffects which include various kinds of upward moving brightnesses, generically termed crawlers.

A62D-05 1630h

Photometric Measurements of High Altitude Luminous Phenomena: Quantitative Comparison with Charge Moment Estimates Derived from VLF Sferics

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A telescopic imaging system was deployed by Stanford University at Yucca Ridge Field Station near Fort Collins, CO during May - July, 2000. Video, photometric, and VLF recordings were conducted in order to study upper atmospheric lightning-related luminous phenomena (e.g. sprites, elves, and blue jets). The telescopic imaging system consisted of a telescopic video imager (1x1 degrees), a wide field of view video imager (9x12 degrees), a telescopic photometer (1x1 degrees), and a wide field of view photometer (3x6 degrees). A crossed-loop magnetic field VLF antenna at the same allowed simultaneous measurement of the electromagnetic impulses (sferics) generated by the causative lightning stroke. On July 2, 2000, an unusual storm occurred with over 280 transient luminous events in a span of 2 1/2 hours. These events were sprite-like but very faint and more frequent than is common for sprites. Charge moment estimates were derived using the VLF data. By comparison, on July 4, 2000 a "typical" sprite-producing storm occurred with both large and small sprite events. These two case studies are presented with a high time-resolution analysis of photometric data and accompanying video and VLF data. In the July 2, 2000 storm the vast majority of the events are remarkably similar in brightness, charge moment, delay from causative sferic, and temporal duration. In the July 4, 2000 storm, however, a wide variety of sprites was recorded. Delayed sprite currents from this day are observed to coincide with brightness peaks in the photometer data. Charge moment estimates and temporal characteristics such as brightness rise and decay time constants, delays, and number of brightness peaks are found to widely vary from sprite to sprite. Models developed to explain features of sprites such as streamer formation and diffuse glow rely on both the amount of charge lowered to ground in a lightning stroke and the speed at which it is lowered. Our study which contrasts the sprites of a highly variable storm with that of one repeatedly producing similar sferics reinforces the results of these models.

A71A MCC: Hall D Sunday 0830h

Pacific 2001 and Pacific Northwest 2001 Air Quality Studies Posters

(joint with B)

Presiding: **S Li,** Meteorological Service of Canada**; T Jobson,** Pacific Northwest National Laboratory

A71A-0062 0830h POSTER

Airborne Measurements of Hydrocarbons and Aerosols in the Puget Sound Airshed

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In August 2001, a gas and aerosol measurement campaign was undertaken in Puget Sound from south of Seattle north to the Canadian border. The US DOE Gulfstream 1 aircraft was used to measure meteorological parameters, aerosols and their gaseous precursors. The objectives of this study were to better understand the transport and formation of ozone and particulate matter in the Puget Sound airshed and to develop air quality and meteorological databases for evaluating air quality models used in predicting air quality within this area. The study was coordinated with the Canadian Pacific 2001 study. Real time measurements were made of aerosol number distributions from 3 to 3000 nm diameter and of selected gaseous precursors using standard instrumentation as well as a new proton transfer reaction mass spectrometer. Reactive hydrocarbon compounds, nitrogen oxides, sulphur dioxide, carbon monoxide and ozone were measured on horizontal transects and vertical profiles around Puget Sound in morning and afternoon. Using these observations, this paper will highlight common air quality features as well as some of the complexities related to air quality in a mountain-ringed basin.

URL: http://www.pnl.gov/pnw2001/

A71A-0063 0830h POSTER

AIRPACT Air Quality Forecasting for August 2001

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The AIRPACT air-quality forecasting system was operational during the month of August, 2001, and provided daily forecasts of ozone and associated species throughout the PNW2001 period. The AIRPACT (air indicator report for public awareness and community tracking) project was supported by the U.S. EPA through the EMPACT program. The modeling effort within this project resulted in the assembly of a highly automated air quality forecasting system using MM5 meteorology coupled with a regional emissions sub-system, which both drove the CALMET-CALGRID Eulerian air-quality model. Results were posted to the project web-site and distributed via ftp each morning before operations decisions were finalized. Modeling outputs included 24-hour animations of estimated gridded area emissions and predicted gridded hourly average mixing ratios for ozone, among other species. A verification system for comparing AIRPACT results against the Washington Department of Ecology telemetered surface monitor data was in development during PNW2001. The various measurement components of PNW2001, in combination with the Ecology monitoring network, provided an excellent opportunity to compare AIRPACT ozone predictions with ozone observations from multiple measurement schemes, including surface monitors, aircraft sampling, and ozonesondes. The AIRPACT prediction verification against surface monitors at six downwind sites near Seattle, WA for August 2001 resulted in a normalized bias of 15% and a normalized gross error of 51%. Comparisons of AIRPACT predictions against ozonesondes and aircraft measurements are presented graphically in this poster.

URL: http://www.airpact.wsu.edu

A71A-0064 0830h POSTER

The Pacific 2001 Air Quality Study: An Overview

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The Pacific 2001 Air Quality Study was an initiative aimed at providing scientific understandings of the smog problems in the Lower Fraser Valley that straddles the border between British Columbia and the State of Washington. Its main objectives are (1) to determine the horizontal and vertical distribution of fine particulates and ozone in the LFV airshed. In particular, to determine the transition from an emission-dominated regime to a formation-controlled regime in the valley, (2) to determine the physical and chemical characteristics of fine particulates in the LFV airshed, and to determine the changes in these properties in the region, (3) to identify the major physical and chemical processes in the formation of secondary aerosols and ozone, (4) to determine the roles of biogenic and anthropogenic (transportation sector) emissions in SOA and ozone formation. The field study was carried out in August 2001, with five ground sites that aim to address different aspects of the smog problem. The Cassier Tunnel site addresses the emissions from the light-duty transportation sector while a site at the Slocan Park site addresses air quality issues in an urban suburban setting, where a mixture of primary particles and secondary particulate matter is expected. Impact from anthropogenic precursors such as the oxidation of aromatic hydrocarbons is expected at this site. At the Langley Ecole Lochiel site, measurements are aimed at the transition from urban to rural settings and the formation of particulate matter from agricultural practices. The Sumas Mountain site addresses the impact of ammonia emissions in the inner valley east of the Sumas Mountain, the visibility reduction issue, and the interaction between urban pollution and biogenic emissions. A forest site at the Golden Ears Park site to aims to understand the formation process of biogenic particulate matter from precursors such as monoterpenes, and how this process will impact on the PM in the valley overall. At all sites, extensive sets of measurements were carried out, including particle physical and chemical characterization. Two aircraft were deployed to determine the spatial PM distribution in the valley. The measurements have revealed important features of smog problems in the valley and provide a scientific basis for further policy formulation.

URL: http://www.msc.ec.gc.ca/pacific2001