UNIVERSITY of HOUSTON

Edgar A. Bering, III
Physics Department
617 Science and Research I
University of Houston
Houston, TX 77204-5005

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U.S. IPY Planning Committee

Dear IPY Planning committee:

A coordinated study of the Global Electric Circuit provides an ideal project for the 2007/08 IPY. In our view, it is an essential element in any comprehensive scientific attack on the overarching theme, *"Understanding Change at the Poles."*

The geoelectric circuit links weather and solar activity. It remains an open and a scientifically achievable goal to determine whether or not this linkage is passive or involves active coupling.

Thunderstorm activity and its relatively direct association with rainfall has more direct influence on human activity than temperature. Published evidence exists that global thunderstorm activity has a multiplicative dependency on equatorial temperatures. Measuring global circuit variables provides a sensitive method to monitor globally integrated thunderstorm activity (and thus a very sensitive method to monitor an integrated measure of equatorial temperatures). Simultaneous measurements of the DC circuit and of power in the Schumann resonance bands may possibly provide independent proxy monitors for both global temperature and global rainfall.

Present research indicates that the best place to measure the global circuit is the Antarctic plateau (high, dry, relatively meteorologically stable). The Greenland plateau provides an ideal northern hemisphere site. Coastal polar sites, in winter, when the sea-ice is frozen and the land is snow-covered, may also provide valuable data.

The relatively poor nature of our understanding of the geoelectric circuit is demonstrated by the fact that we still refer to the Carnegie measurements of the early 20th century as the representative 'fair-weather' measurements of the global circuit. By making measurements at a number of sites in both Polar Regions over the IPY we could readily replace this longest surviving (archaic!) scientific standard of geo-physical parameters, and provide a major baseline standard for future reference.

The geoelectric circuit still provides a viable means via which solar variability may affect weather and climate. At present, this topic is an important area of active scientific controversy. With sufficient effort, hopefully engendered by this field of research being selected as a focus project for the IPY, we could resolve that issue or at least quantify the magnitude of any possible influence.

Cost effective, quality instrumentation for measuring air-earth current and the vertical electric field in Polar Regions is presently being developed and tested. Vertical electric field and air-earth current measurements, while possible at coastal regions in both polar regions in winter, are best conducted at high-altitude sites well away from meteorological and biological variability. A focus on this field of research would give an impetus to establishment and development of polar plateau and high-altitude, arctic sites. Such sites are significantly less common than coastal sites.

Oleg Troshichev (USSR), Edgar Bering (USA) and Gary Burns (Australia) are intending to deploy AECM (air-earth current meters) and EFM's (Electric Field Mills) at Vostok, Dome C (Concordia) and

South Pole. We also know that Martin Jarvis (UK, British Antarctic Survey) is seeking scientific endorsement for a proposal to deploy three sets of autonomous geoelectric field instrumentation on the Antarctic Plateau in West Antarctica.

Accurate measurements of Schumann Resonance intensities in the Polar Regions are desirable because we need to accurately measure global thunderstorm activity. In addition, the developing global coverage of ELF/VLF lightning detection/location instrumentation is vital. Polar deployments of these instruments will fill holes in existing coverage. Groups in New Zealand, Israel, Germany, the UK, and the US are actively involved in this work. VLF and ELF thunderstorm related, global deployments are relevant to a coordinated study of the global circuit.

There has been some excellent satellite detection of lightning activity, but up to now it has been low orbit, small-instantaneous-region-of-coverage stuff. Scientists interested in this field have plans for monitoring global coverage of lightning activity from geostationary orbit. If the planned instruments function as designed, many useful correlation studies with polar, ground-based geoelectric instruments can be envisioned.

Most of the non-satellite instrumentation discussed is relatively cheap to develop and can involve many nations. Coverage of both Polar Regions is important.

In order to quantify any possible 'Sun-Weather' linkage it is essential to measure/estimate global atmospheric conductivity with at least hourly resolution. We need to involve the well-established Cosmic Ray community in this. Theoreticians are needed to model the global effects of varying thunderstorm activity coupled with solar variability of atmospheric conductivity (principally by solar wind modulation of cosmic ray flux). It is feasible to model a passive interaction of solar variability on the geoelectric circuit and we should be able to tell if the thunderstorm response is or is not passive (i.e. the extent to which a solar variability influence on weather and climate is possible via the geoelectric circuit). We could realistically set an aim to at least quantify the magnitude of the uncertainty.

With all the proposed data sets, we will be able to better quantify the contributors to the global fair-weather circuit and determine to what level of accuracy the ground-ionosphere potential difference is in fact the same over the globe.

With multiple polar-plateau geoelectric field measurements, we will also be able to contribute to the understanding and monitoring of polar convection patterns. Ground-based geoelectric instrumentation on the Antarctic Plateau has recently been used to demonstrate what has been theoretically known for some time, that broad-scale (>200km scale size) polar convection potentials can be measured independent of the existence of ionisation or irregularities. That would be of interest to the space weather community, and provides a neat link of the IPY 2007/08 with a principal focus of the IGY.

We think it would be possible to enthuse and educate the public and students about the geoelectric circuit via thunderstorms, sprites, the measurement/monitoring of 'enhanced' climate change (i.e. thunderstorms are multiplicatively enhanced by temperature change) and the quantification of a solar variability & weather/climate hypothesis. We have an advantage that the public presently does not know much about the geoelectric circuit.

Sincerely,

Edgar A. Bering, III, Ph.D.
Professor of Physics and ECE, University of Houston

Gary Burns, Ph.D.
Australian Antarctic Division