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1. INTRODUCTION

Space weather is an area of growing interest due to the significant impact that space storms can have on the earth. With this increased awareness comes the need to educate.

The Cooperative Program for Operational Meteorology, Education and Training (COMET[®]), and the National Center for Atmospheric Research's (NCAR) High Altitude Observatory (HAO) have teamed up to develop a new web-based learning resource titled *Physics of the Aurora: Earth Systems*. The two primary audiences for this module are undergraduate science students and professors who teach space weather-related classes (astronomy, physics, meteorology, etc).

Teachers of undergraduate science are often confronted with the difficult challenge of explaining abstract physical concepts in ways that are both comprehensible and enlivening. The goal of drawing talented learners into the atmospheric and space sciences can be thwarted by the rigors of wading through dry theoretical abstractions.

2. PHYSICS OF THE AURORA: EARTH SYSTEMS MODULE

This learning resource is designed to support a flexible range of teaching activities, including lecture-support, out-of-class assignments, and independent study projects.

We've developed an integrated multimedia module, which is composed of numerous stand-alone "learning objects." These self-contained components range from mini-lessons on general physics topics such as "Charged Particle Motions" or "Magnetic Force" to animations, 3D visualizations, simulations, and interactive exercises. These are all built into the main learning module, but can be accessed independently as well.

Another feature of the design is its tri-level presentation. Each main topic is covered by a

short narrative presentational overview, written to the level of a general audience. Each overview block also connects to a more detailed and technical level of related elaborative content and interactive exercises, which are written at a higher level for the science majors in our audience. In addition, there is a linked set of "in-depth" mini-lessons, which explore some of the theoretical underpinnings of the other sections. These in-depth topics are presented at an even more technical level, including mathematical derivations and physical laws. The intent of this tri-level design is to broaden the module's audience and range of application.

3. SCIENCE CONTENT

Physics of the Aurora: Earth Systems is composed of sections on the Magnetosphere, Thermosphere/ Ionosphere, and the Aurora. A team of HAO researchers worked to refine these sections into the following topics appropriate for the undergraduate audience, which are focused on the Earth part of the Sun-Earth system.

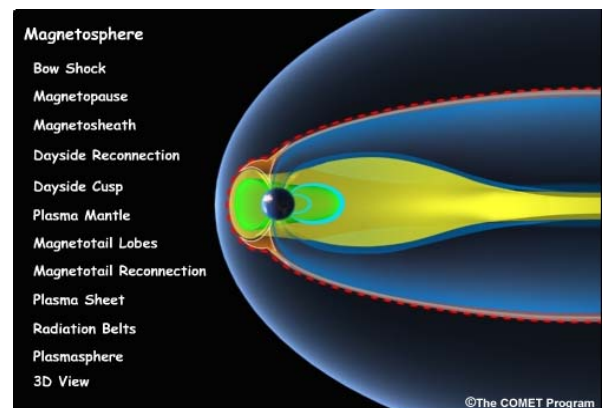


Figure 1. An example of an interactive page from the Magnetosphere section of the module.

Magnetosphere

- Structure and formation of the magnetosphere
- Reconnection-driven magnetospheric and ionospheric convection
- Magnetospheric regions
- Magnetosphere-Ionosphere current systems

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- Magnetospheric particle precipitation and the auroral oval

Thermosphere-Ionosphere

- Formation, structure and variability of the thermosphere
- Formation, structure and variability of the ionosphere
- Thermosphere-ionosphere coupling
- Solar irradiance and its variability
- Thermospheric and ionospheric physical processes

Aurora

- The Aurora oval
- Types of Auroral displays and colors
- Upper atmosphere particle precipitation and its effect on the thermosphere and ionosphere
- Processes associated with high-latitude electric currents
- Atomic processes (ionization, dissociation, excitation, emission)

In-Depth Mini-Lessons

- Charged Particle Motion
- Magnetic Force
- Frozen Field Theorem
- Static Atmospheres

4. FUTURE TRAINING PLANS

COMET's future training plans include working closely with Space Environment Center (SEC) and NWS to develop appropriate materials in support of training. The first is to be an introduction of SEC briefly describing the center and their mission. The second will focus on the space environment, as well as products and services SEC provides to fulfill the needs of the customer. The second project is in the planning stage but should be delivered during fiscal year 2005.

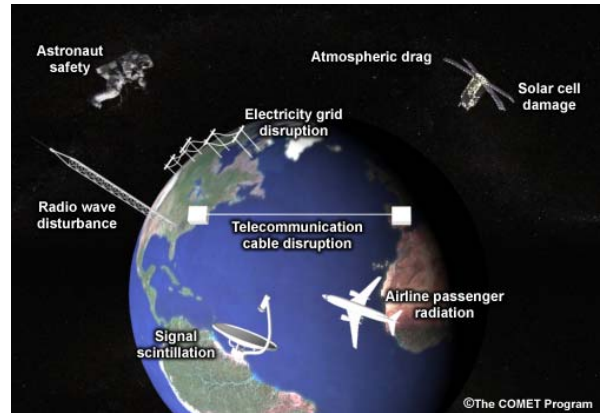


Figure 2. An illustration of space weather impacts on human activity.

5. SUMMARY

Space weather is an area of growing interest not only as a topic but also how it affects life on earth. With this growing awareness, steps must be taken to train and inform. With the *Physics of the Aurora: Earth Systems* module and the collaborative effort that will be done between COMET, the SEC and the NWS, a useful product will be available to fill this need. This module is freely available via the HAO and COMET websites (<http://meted.ucar.edu/ha0/aurora/>) and has been released on CD-ROM. A related module, focusing on the sun side of the sun-earth system, is being considered.

6. ACKNOWLEDGEMENTS

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