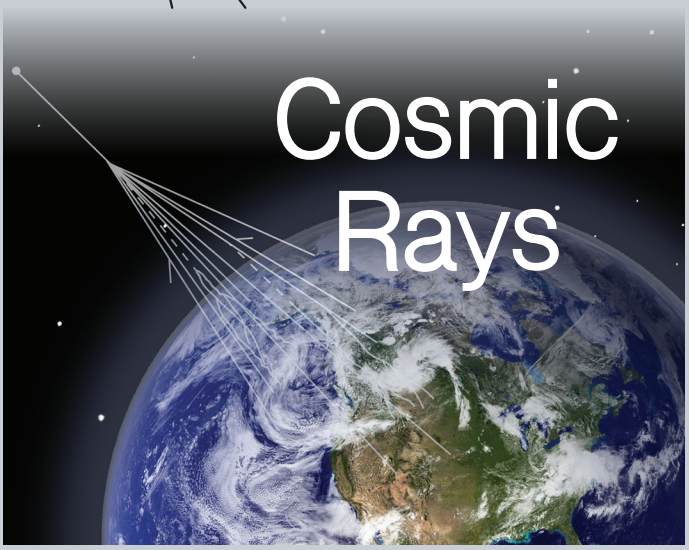
THE
ATMOSPHERICRESERVOIR
Examining the Atmosphere and Atmospheric Resource Management



By Mark D. Schneider

Sounding like something from a science-fiction movie, *cosmic rays* are actually bombarding the Earth's upper atmosphere. Also known as cosmic radiation, the American Meteorological Society (AMS) glossary states that these rays are primarily made up of high-energy protons originating from our Milky Way galaxy and places beyond. A small (but significant) portion of cosmic rays come from our sun and can be measured by diurnal variations.

At sea level, humans are exposed to a very small amount of cosmic radiation. When climbing a mountain or flying in an airplane there is a significant increase in radiation exposure because Earth's upper atmosphere is thinner and provides less protection. For example, airline pilots and flight attendants experience 40 to 70 times the natural radiation that the rest of us experience on the ground each day. Cosmic rays can penetrate through concrete several feet in thickness, thus the fuselage of an airplane provides little protection. According to the Spaceweather.com website, The International Commission on Radiological Protection (ICRP) actually classifies pilots as occupational radiation workers, in the same category as nuclear power plant engineers.

The measurement of cosmic rays has a long history dating back to 1909 when Theodor Wulf, a German physicist, invented an electrometer and recorded radiation levels at both the base and top of the Eiffel Tower. Wulf's electrometer measured the rate of ion production and he was able to conclude that the ionization rate of the air increases with height.

Today we can measure radiation using sensors mounted to commercial aircraft making approximately 1,400 flights daily! This radiation data is used in conjunction with the Empirical RADiation model or E-RAD, to predict the amount of additional radiation (within 15% accuracy) a passenger receives by traveling on a commercial airline flight over the U.S. The E-RAD model takes the measured data and then interpolates between those values to calculate the exposure amounts for all U.S. domestic flight routes and altitudes.

An organization called the Earth to Sky Calculus launches space weather balloons containing the same radiation sensors that commercial airliners use. These measurements are fed into the E-RAD model and help increase the accuracy of predicted radiation levels at various altitudes. Researchers have discovered that cosmic radiation levels have been intensifying recently (by 18% since 2015) and two explanations include a weakening of the Earth's magnetic field and an approaching Solar Minimum. Surprisingly, a Solar Minimum allows more cosmic rays from our sun to enter the Earth's upper atmosphere. This is because Coronal Mass Ejections (CMEs), which actually suppress cosmic rays, are abundant during Solar Maximums.

How does exposure to higher levels of radiation effect human health? The World Health Organization (WHO) International Agency for Research on Cancer (IARC) has stated that ionizing radiation can cause cancer and reproductive problems. There are studies linking cosmic rays to cardiac arrhythmias and sudden cardiac death. Some medical patients with Implantable Cardio-verter Defibrillators (ICDs) have experienced disruptions in their devices while on commercial airline flights and cosmic radiation is a well-known cause.

Unlike the old sci-fi movies where people get caught up in mass hysteria over extraterrestrials and cosmic rays, humans just need to be aware of the potential effects of radiation exposure. By understanding our atmosphere and the conditions that exist within it, we are able to make more educated decisions.

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