Canadian Space Agency   Agence spatiale canadienne

RADI-N2: graphical representation of radiation across Canada

David Saint-Jacques explains radiation in CSA video. (Credit: CSA.)

THE CHALLENGE:

Help Canadians visualize and/or interpret data on radiation. (1) Integrate the contribution of neutron radiation (quantity) among all other known ionizing radiations to which we are exposed on Earth. (2) Create an interactive graphical interface to inform the general public on radiation sources, levels and known effects in the atmosphere.

Access the dataset:
ftp://ftp.asc-csa.gc.ca/users/OpenData_DonneesOuvertes/pub/Space%20Apps%20Challenge%202019/RADi-N2/

THE ISSUE

To help Canadian learn about radiation experiments conducted at the International Space Station (ISS) during Canadian astronaut missions, the CSA has partnered with Let's Talk Science. During David Saint-Jacques' last mission, Let's Talk Science gave dozens of schools across Canada a neutron dosimeter resembling the kind found on the ISS. Students from those schools were able to collect terrestrial radiation data at the same time as similar data were being collected on the ISS. The students had access to the other schools' data as well as data collected by the ISS. However, these data were not interpreted or explained in plain language.

THE NEEDS

1. Assess the neutron field's contribution to overall radiation in various Canadian cities (at a defined time).

Potential outcome

An integrated dataset.

Develop an integrated dataset that groups together data from various types of radiation in various Canadian cities at defined times. Assess their contribution to overall radiation in these areas.

The final format (CSV, JSON, etc.) is your choice.

How to get started

- Check the key and supporting data provided for this challenge.
- List the various factors that affect the data's quantitative radiation values, then quantify this effect.

2. Create an interactive graphical interface for the various types of radiation on Earth.

To further develop the involvement and interest of the Canadian students who participated in the "Radi-N2 and You" project through Let's Talk Science, we suggest you create a graphical interface.

Potential outcome

- Develop a tool (application or other visual interface) that can depict and/or interpret the neutron radiation data collected in schools as part of the Radi-N2 and You project. The tool could potentially incorporate a comparison with similar data collected on the ISS.

How to get started

- The goal of this challenge is to create a graphical representation of radiation in different parts of Canada, and compare it with the radiation on the International Space Station inhabited by astronauts during David Saint-Jacques' C2 mission.
- To grow the content of the interface and the public's interest, add educational content to the visual interface. For example, by including the interpretation of average annual radiation exposure measurements.
- As a next step, it would be interesting to allow users to alter the factors that affect radiation (altitude, latitude, exposure time, etc.). This would make the tool more interactive.

BACKGROUND

1. Ionizing radiation versus cosmic radiation

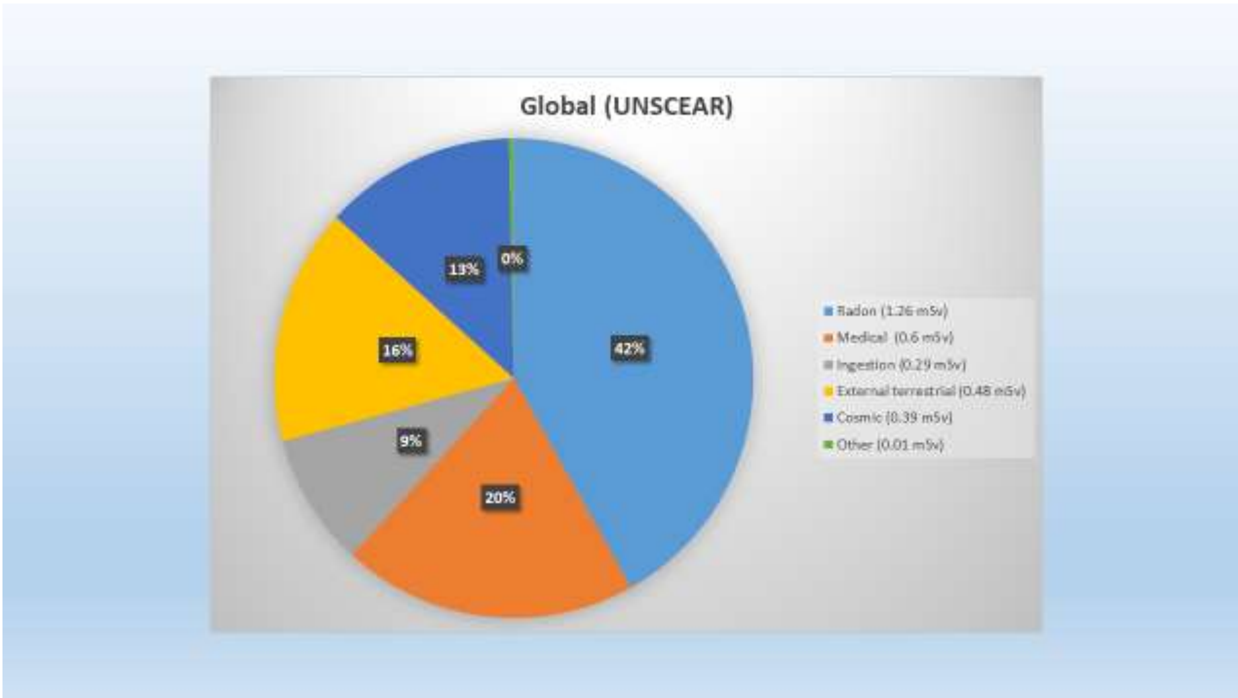
The amount of ionizing radiation that exists in space is far greater than the amount we are exposed to on Earth. For example, the amount of radiation an astronaut absorbs during one day on the space station is equivalent to the amount of radiation we absorb on Earth from natural sources in the course of a year (excluding radon). This can be explained by the fact that one of its components—cosmic radiation—is far more intense in space, and a much smaller portion of this radiation reaches the Earth's surface.

The atmosphere and the Earth's magnetic field form a protective barrier that blocks most cosmic radiation. So, at ground level, cosmic radiation represents on average only 13% of the ionizing radiation to which individuals are exposed.

Natural terrestrial sources contribute to the ionizing radiation on Earth, which amounts to an average annual dose, per individual, of 2.4 mSv (source UNSCEAR), although this dose varies according to region. The main source is a gaseous descendant of natural uranium: radon. The water and food we ingest also contain radioactive elements. Terrestrial radiation is also given off from surface rocks, especially granite. Surface rocks contain radioactive elements, such as uranium, and date back to the formation of our planet. Lastly, there is also

internal radiation, i.e. the radiation that emanates from our own bodies because of the naturally present potassium-40 in our tissues.

Unnatural sources of radiation—induced by human activity—also add to our ionizing radiation exposure.



Average annual effective dose from different sources of radiation (UNSCEAR, 2008)

2. Characteristics of cosmic radiation and its intensity

The permanent component of cosmic radiation is from the galaxy. It consists in very highly charged particles that are ejected by gigantic explosions of supernovas, which are massive stars that have reached the end of their lives. Galactic cosmic radiation is isotropic, meaning it is the same in all directions. As a result, the Earth's entire surface is constantly exposed to it. The sun is the source of cosmic radiation's random component. It continuously ejects particles at varying intensity throughout an 11-year cycle. These particles contribute to galactic radiation. Unlike stable galactic radiation, the particles from solar flares do not disperse evenly around the Earth's surface. The particles that end up reaching the ground contribute to ambient ionizing radiation, but only to a very small degree (approximately 11% to 13%). However, the relative proportion of cosmic radiation varies according to certain exposure factors, increasing rapidly with an increase in altitude, latitude and duration of exposure (air travel), for example.

Neutron radiation results from the collision between primary cosmic particles and material particles, such as from spacecraft or the molecules in our atmosphere. It is therefore a form of cosmic radiation.

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OTHER RELEVANT INFORMATION

Workshop by CSA expert

Radi-N2 – CSA

Radi-N2 and You CSA Activity

Radi-N2 and You – Let's Talk Science (school project)

- Curriculum connections
- Radi-N2 & You – Instructional Design at a glance
- Neutron dosimeter

Bubble Technology Industries (BTI) Bubble Dosimeter

Information on radiation - Canadian Nuclear Safety Commission

Radiation Units

Radiation dose chart

We thank Bubble Technology Industries and Let's Talk Science for their collaboration in setting up this challenge.