

The Environmental Data Application for Analysis of Space Telemetry Data

Ryan T. Scott

KBR | Science Lead

NASA Ames Life Sciences Data Archive

NASA Open Science Data Repository

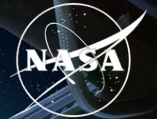
F.2.1 Committee on Space Research 2024

Tuesday, July 16, 2024, 11-11:20a

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Jamie Bales, Danielle Lopez, Lauren Sanders,
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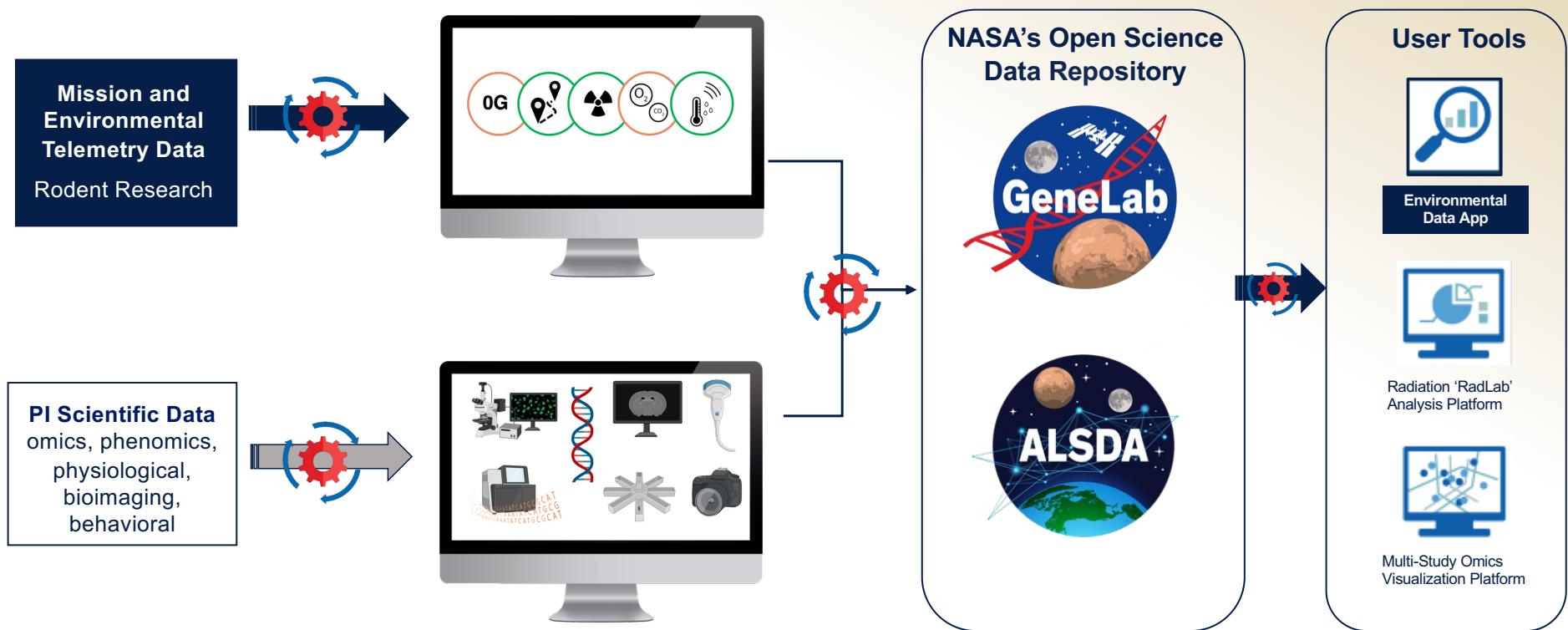
National Aeronautics and
Space Administration



BPS
Biological & Physical Sciences



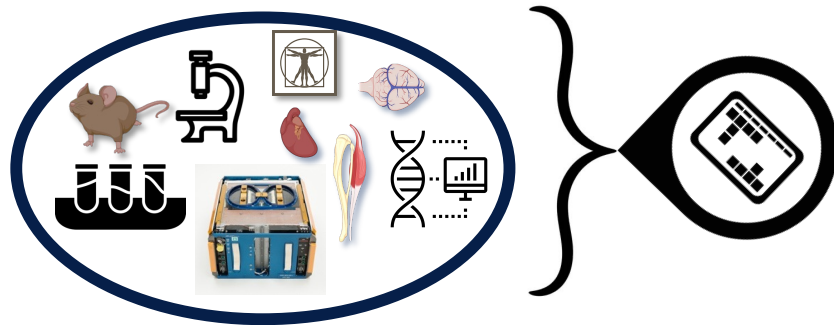
Mission and Principal Investigator Science Data



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Environmental Data Essential for Biomedical Knowledge

Provides Scientific Context for Biology

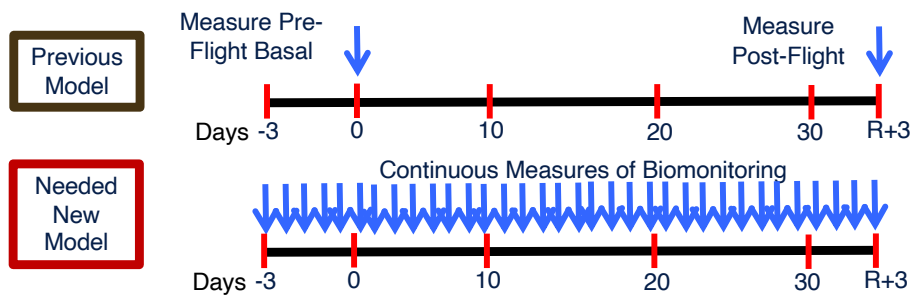


Enables Analysis Across Missions

- RR1 vs RR6 vs RR10 vs RR23
- Accumulated vs Total vs GCR vs SAA
- CO₂ vs O₂ vs RH vs Temperature

Able to Explain Anomalies?
 Connected to Anything Seen in Biology/Health?
 Was it Microgravity or Some Other Experiment Stressor?
 Other Science Questions Uncovered? New Hardware Needed?

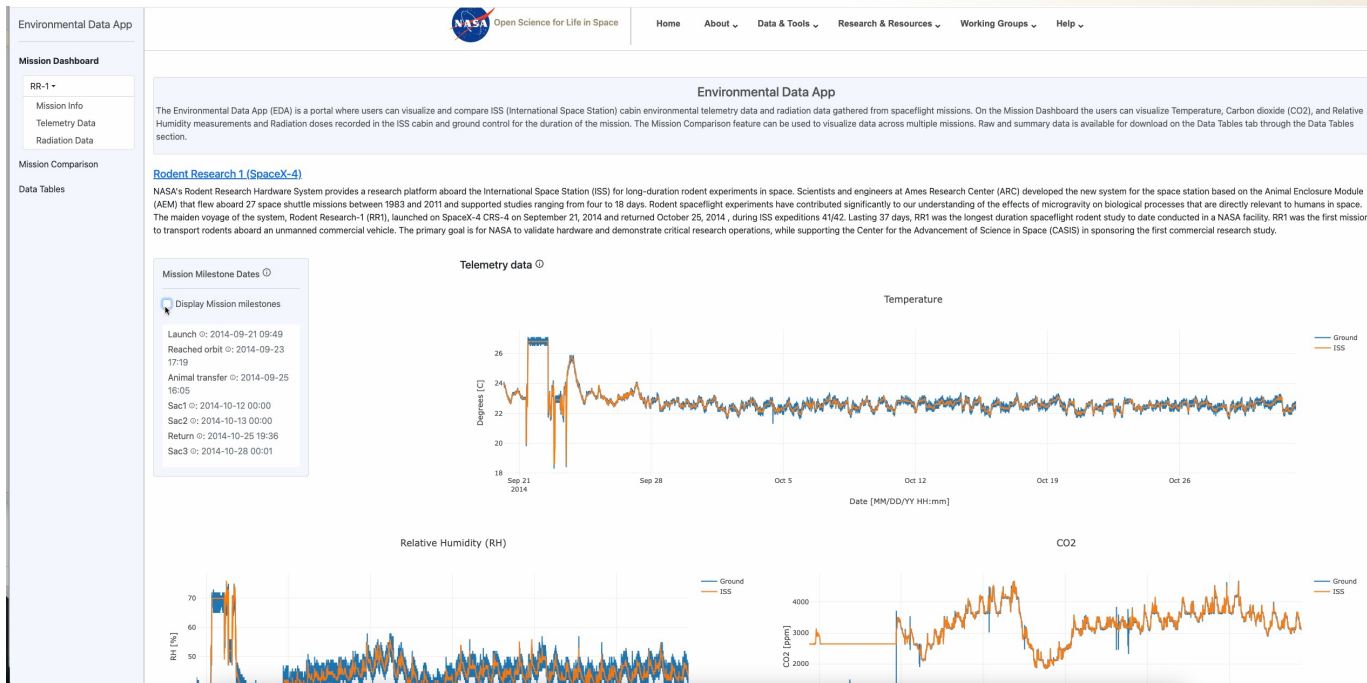
Allows Longitudinal Analysis/Comparisons



Countermeasure & Platform Development

- Health Pharmaceuticals
- Nutritional Supplements
- Shielding & Material Sciences
- Novel Sensors

Environmental Data App Overview



- Telemetry and radiation data collected on the ISS and ground platforms for Rodent Research Missions
- Interactive plots
- Data comparison between missions
- Export data

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Mission Dashboard

Link to OSDR Payload

Rodent Research missions available

Environmental Data App

Mission Dashboard

- RR-1
- RR-3
- RR-4
- RR-5
- RR-6
- RR-8
- RR-9
- RR-12
- RR-17
- RR-19

The Environmental Data App (EDA) is a portal where users can visualize spaceflight missions. On the Mission Dashboard the users can visualize ground control for the duration of the mission. The Mission Comparison Tables tab through the Data Tables section.

[Rodent Research 1 \(SpaceX-4\)](#)

NASA's Rodent Research Hardware System provides a research platform. The Ames Research Center (ARC) developed the new system for the space station supported studies ranging from four to 18 days. Rodent spaceflight experiments directly relevant to humans in space. The maiden voyage of the system, Rodent Research-1 (RR-1), launched on SpaceX-4 on September 21, 2014, and returned October 25, 2014, during ISS expeditions 41/42. Lasting 37 days, RR1 was the longest duration spaceflight rodent study to date conducted in a NASA facility. RR1 was the first mission to transport rodents aboard an unmanned commercial vehicle. The primary goal is for NASA to validate hardware and demonstrate critical research operations, while supporting the Center for the Advancement of Science in Space (CASIS) in sponsoring the first commercial research study. Ten mice were flown to the ISS and transferred into habitat. Five mice were wild type (WT) and identified by an ear notch and the remaining mice, called "Knockouts" had no ear notches. Ten mice were used as ground controls.

PI: Novartis Pharmaceuticals
The mission objectives of the validation flight:

- The addition of the rodent research system expands the utilization of ISS for research on the effects of microgravity on rodents.
- The demonstration of the hardware capability to support rodent research for long-duration missions on ISS is accomplished.
- A validation of the operational capabilities of the hardware to support rodent research provides valuable information applicable to future long-term space missions.
- Validate that the Rodent Research Hardware can deliver and maintain healthy animals.
- Validate that on-orbit activities to support hardware operations can be performed.
- Validate that a limited set of generic on-orbit operations can be performed to support future science objectives including but not limited to euthanasia, gross dissection and sample preservation.

Physiological systems of interest for human exploration of space are targeted at the following systems:

- Bone loss
- Muscle loss
- Immune system changes
- Cardiovascular system changes
- Nervous system changes.

Mission Milestone Dates

Display Mission milestones

- Launch ☉: 2014-09-21 09:49
- Reached orbit ☉: 2014-09-23 17:19
- Animal transfer ☉: 2014-09-25 16:05
- Sac1 ☉: 2014-10-12 00:00
- Sac2 ☉: 2014-10-13 00:00
- Return ☉: 2014-10-25 19:36
- Sac3 ☉: 2014-10-29 00:01

Telemetry data

Degrees [C]

— Ground
— ISS

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Mission Dashboard Telemetry Data

Temperature, Relative Humidity and CO2 plots

ISS vs Ground data

Mission Milestone Dates ⓘ

Display Mission milestones

Launch ⓘ: 2018-08-14 16:33
animal transfer to ISS : 2018-08-18 15:43
undock : 2018-09-16 08:43
Return ⓘ: 2018-09-17 14:13



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Mission Dashboard Telemetry Data

Galactic Cosmic Ray, South Atlantic Anomaly, Total Radiation (GCR + SAA), Accumulated Radiation



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Mission Milestones

Milestones are displayed on all plots

[Rodent Research 9 \(SpaceX-12\)](#)

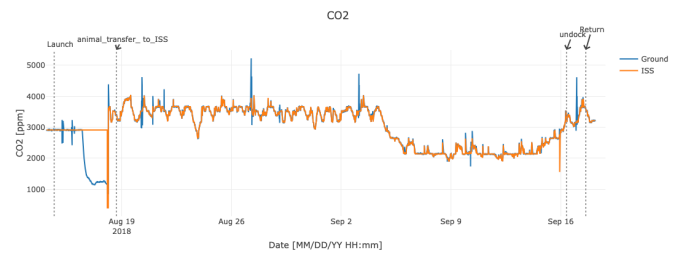
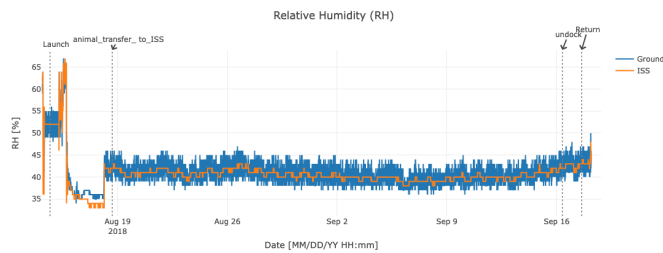
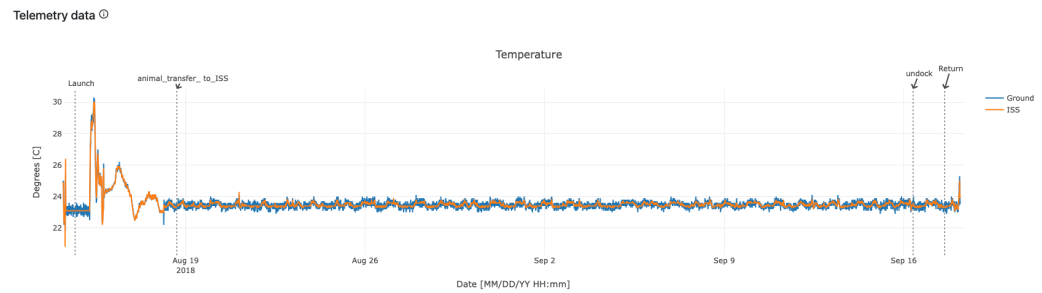
The spaceflight environment is known to result in significant physiological changes on many aspects of the body during long-duration mission in low Earth orbit, posing hazards to the astronauts. This mission's primary objective is to use mice to better understand the visual impairment and joint tissue degradation that are affecting astronauts living in space for long periods of time, and to examine possible ways to counteract those health problems. NASA is also working to maximize science return from this mission by sharing tissues from the animals with as many NASA investigators as possible. For this release, the ground dates have been matched to the flight dates.

Mission Milestone Dates

Display Mission milestones

Launch: 2018-08-14 16:33
 animal transfer to ISS: 2018-08-18 15:43
 undock: 2018-09-16 08:43
 Return: 2018-09-17 14:13

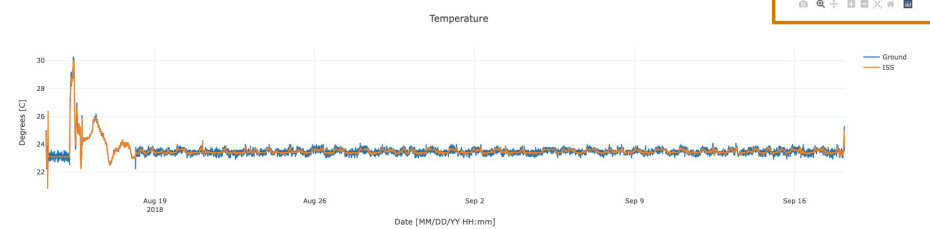
Mission milestone dates



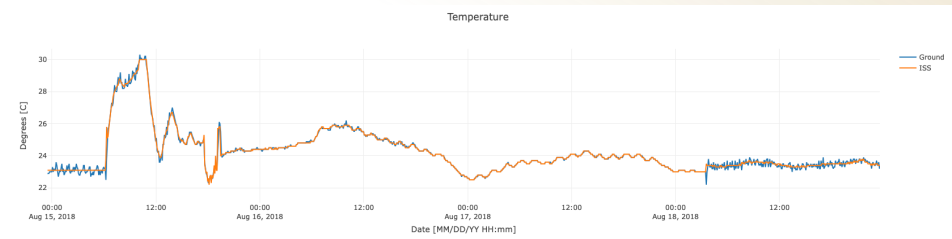
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Interactive Plots

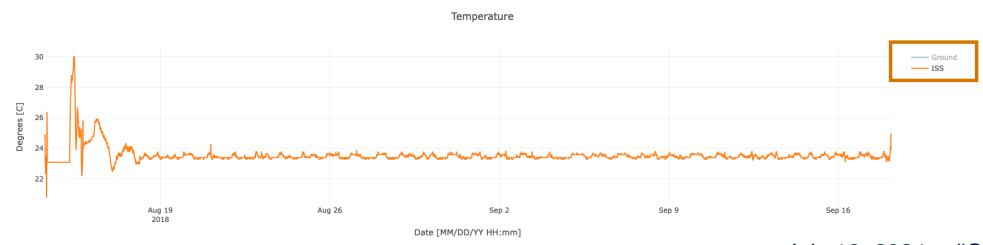
Export, Pan, Autoscale



Zoom

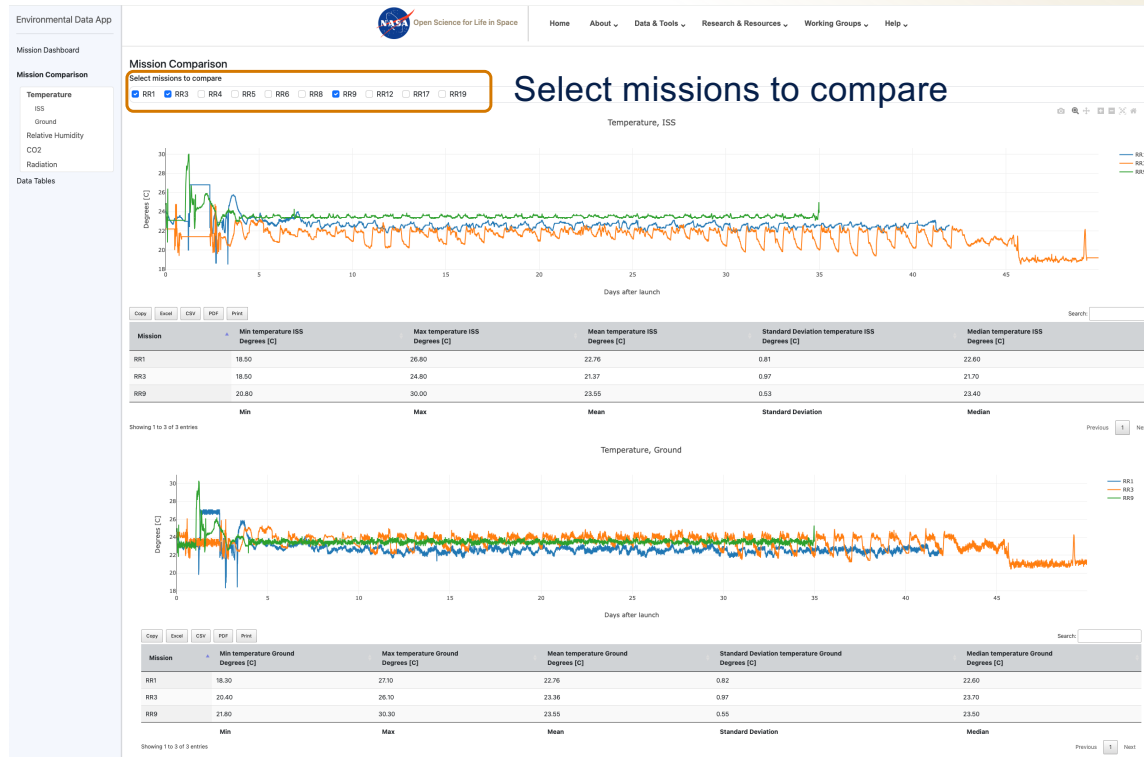


Hide/Show traces



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Mission Comparisons



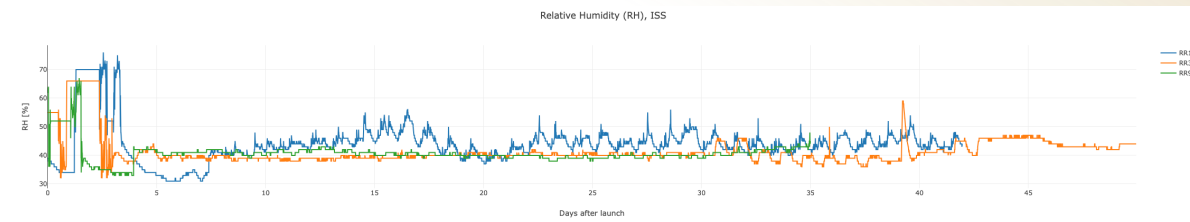
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Mission Comparisons



Telemetry plots are divided by ISS and Ground data

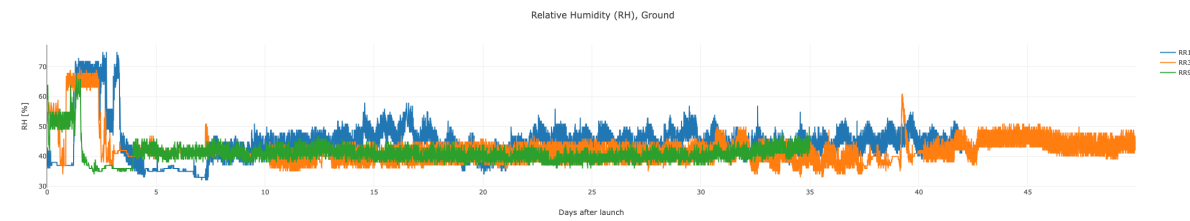
Mission Comparisons



Mission	Min RH ISS [%]	Max RH ISS [%]	Mean RH ISS [%]	Standard Deviation RH ISS [%]	Median RH ISS [%]
RR1	31.00	76.00	43.98	6.78	43.00
RR3	32.00	66.00	41.53	5.23	40.00
RR9	33.00	67.00	40.77	3.53	40.00
	Min	Max	Mean	Standard Deviation	Median

Showing 1 to 3 of 3 entries

Previous Next



Mission	Min RH Ground [%]	Max RH Ground [%]	Mean RH Ground [%]	Standard Deviation RH Ground [%]	Median RH Ground [%]
RR1	32.00	75.00	44.12	6.64	43.00
RR3	33.00	70.00	41.86	5.43	41.00
RR9	34.00	67.00	40.88	3.64	40.00
	Min	Max	Mean	Standard Deviation	Median

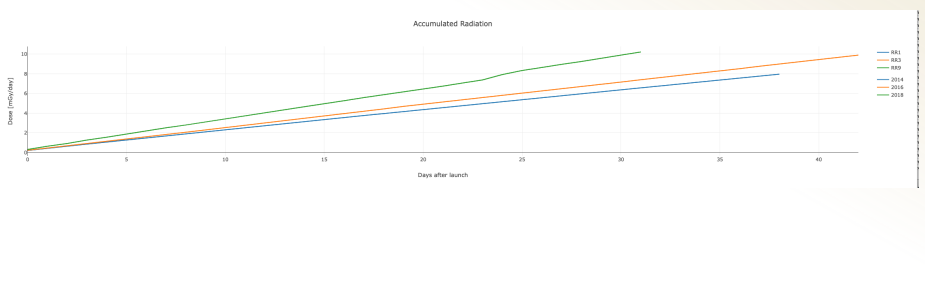
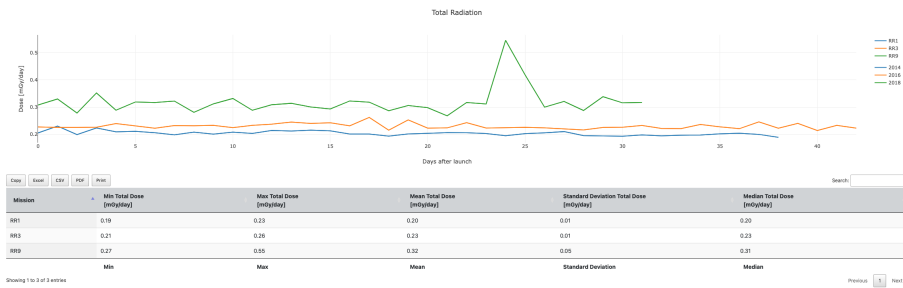
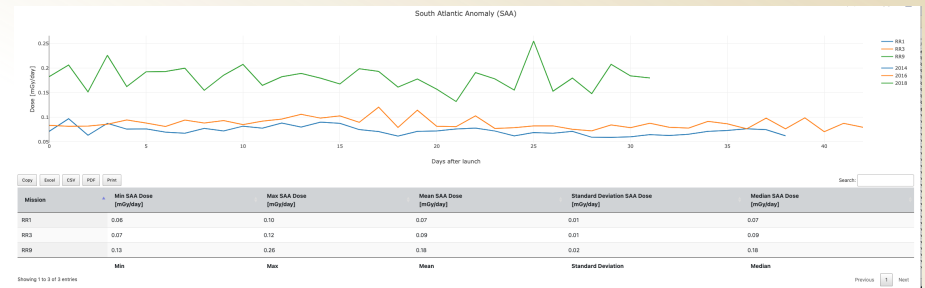
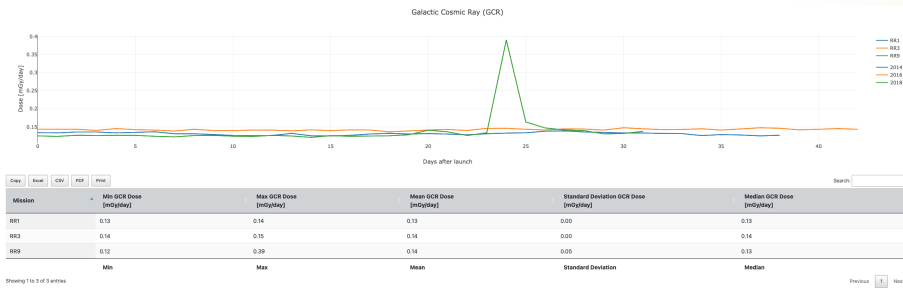
Showing 1 to 3 of 3 entries

Previous Next

Summary tables include Min, Max, Standard Deviation and Median

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Mission Comparisons



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Data Tables

Export Telemetry, Radiation or Summary Data Tables

Summary table includes Max, Min, Mean, Standard Deviation and Median for all measurements

The screenshot displays the 'Environmental Data App' interface. On the left is a sidebar with 'Mission Dashboard', 'Mission Comparison', and 'Data Tables' (selected). The main content area shows three data tables, each with a red box highlighting its export options: 'Copy', 'CSV', 'Excel', 'PDF', and 'Print'.

RR-9 Summary Table

	Max	Min	Mean	Standard Deviation	Median
CO2 Ground (PPM)	5228.00	837.00	2960.48	688.43	3206.00
CO2 ISS (PPM)	4051.00	400.00	3022.42	591.30	3203.00
Radiation Accumulated (mGy/day)	10.22	0.31	5.18	2.99	5.11
Radiation GCR (mGy/day)	0.39	0.12	0.14	0.05	0.13
Radiation SAA (mGy/day)	0.26	0.13	0.18	0.02	0.18
Radiation Total (mGy/day)	0.55	0.37	0.32	0.05	0.31
Relative Humidity Ground (%)	67.00	34.00	40.88	3.64	40.00
Relative Humidity ISS (%)	67.00	33.00	40.77	3.53	40.00
Temperature Ground [C]	30.30	21.80	23.55	0.55	23.50
Temperature ISS [C]	30.00	20.80	23.55	0.53	23.40

RR-9 Telemetry data

Controller_Time_GMT	Temp_degC_Ground	Temp_degC_ISS	RH_percent_Ground	RH_percent_ISS	CO2_ppm_Ground	CO2_ppm_ISS
2018-08-14 04:53	24.70	24.70	61.00	63.00	2920.00	2915.00
2018-08-14 04:58	24.80	24.80	60.00	63.00	2922.00	2915.00
2018-08-14 05:03	24.90	24.90	61.00	63.00	2912.00	2915.00
2018-08-14 05:08	25.00	24.80	60.00	62.00	2898.00	2915.00
2018-08-14 05:13	24.80	24.80	59.00	62.00	2918.00	2915.00
2018-08-14 05:18	24.90	24.70	63.00	62.00	2910.00	2915.00
2018-08-14 05:23	24.80	24.80	61.00	63.00	2888.00	2915.00
2018-08-14 05:28	24.60	24.80	60.00	63.00	2932.00	2915.00
2018-08-14 05:33	24.80	24.80	64.00	64.00	2914.00	2915.00
2018-08-14 05:38	24.90	24.90	63.00	64.00	2908.00	2915.00

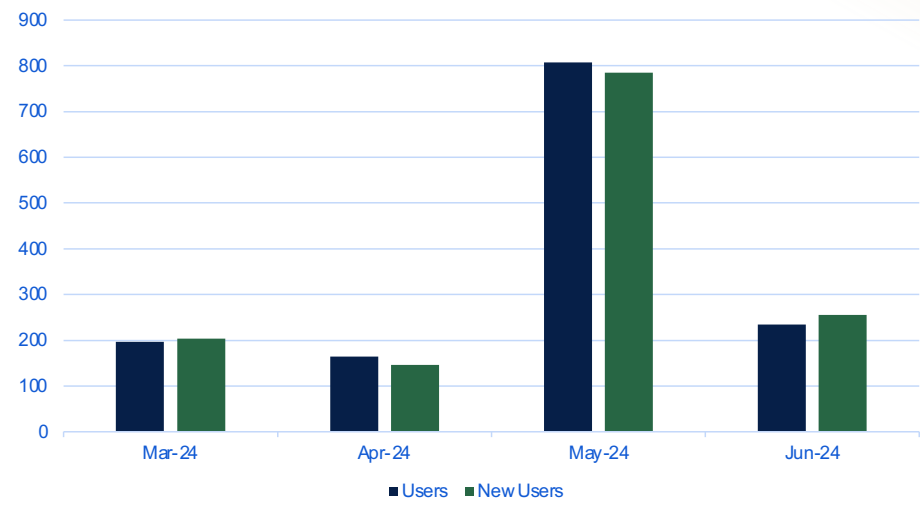
RR-9 Radiation data

Date	GCR_Dose_mGy_d	SAA_Dose_mGy_d	Total_Dose_mGy_d	Accumulated_Dose_mGy_d
2017-08-18	0.13	0.18	0.31	0.31
2017-08-19	0.12	0.21	0.33	0.64
2017-08-20	0.13	0.15	0.28	0.92
2017-08-21	0.13	0.23	0.35	1.27
2017-08-22	0.13	0.16	0.29	1.56
2017-08-23	0.13	0.19	0.32	1.88
2017-08-24	0.12	0.19	0.32	2.19
2017-08-25	0.12	0.20	0.32	2.52
2017-08-26	0.13	0.15	0.28	2.80
2017-08-27	0.13	0.19	0.31	3.11

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Users (March 2024-June 2024)

Monthly Users and New Users for EDA



COUNTRY	USERS
United States	564
Mexico	351
France	78
Canada	28
Brazil	21
Argentina	20
Italy	20

First Citation of Tool in Peer Reviewed Science Publication!
Coming Soon!



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NASA Open Science Data Repository



Stakeholders-Management

NASA Space Biology Program
NASA Biological & Physical Sciences Division
NASA Science Mission Directorate
NASA Human Research Program

Collaborators

OSDR Analysis Working Group Members
RadLab Working Group

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Wednesday, 7/17, 11-11:20a
F2.3 – Room EC1-213

RadLab: A Comprehensive Database and Graphical and Programming Interfaces for Biologically Relevant Space Radiation Data

Jack Miller



Kirill Grigorev



Wednesday, 7/17, 11:40-12p
F2.2 – Room EC1-212

Biomedical Knowledge Graph Capability for Space Biology Knowledge Gain

Sylvain Costes



Thursday, 7/18, 3:45-5p
POIS.1 – Room CON-108

Biological Research and Space Health Enabled by Machine Learning to Support Deep Space Missions

Ryan Scott



Tuesday-Thursday, 5-6:30p
Poster – EC1-Hall1, ID TWT-325

NASA Open Science Data Repository for Space Biology Data Access

Ryan Scott

