

AVIDOS

A programm package for European accredited aviation dosimetry

EURADOS Annual Meeting, January 2009, Braunschweig

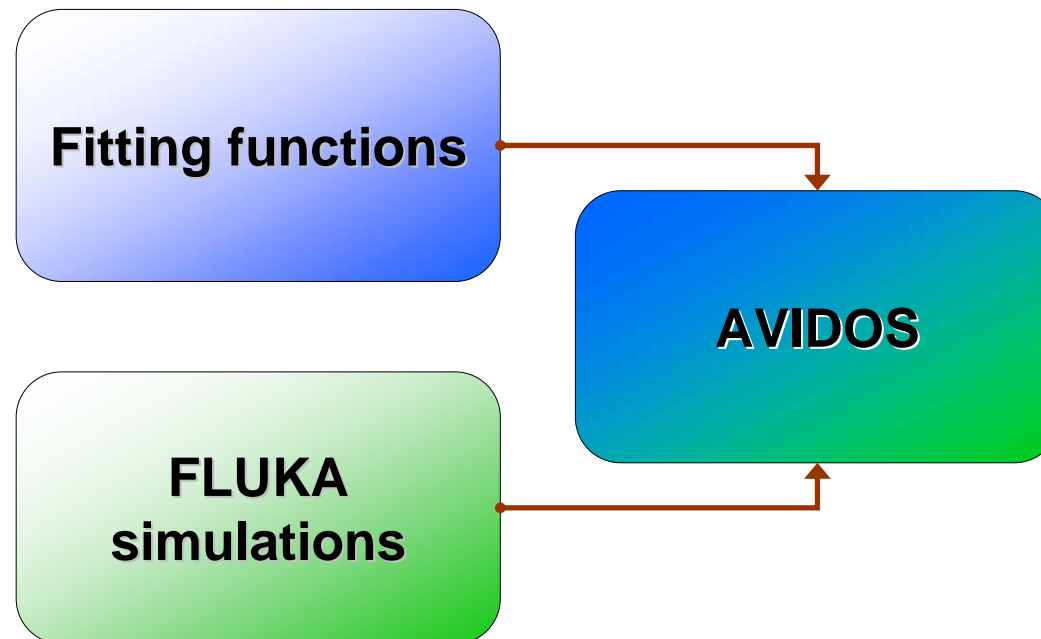
P. Beck, M. Latocha, S. Rollet, all from ARC / HNA / Radiation Research

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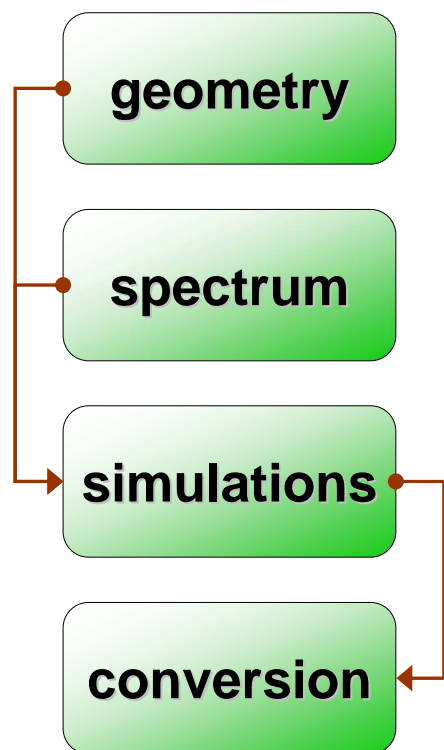
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Introduction

- AVIDOS is a computer code allowing calculations of dose assessment of aircraft crew exposure due to cosmic radiation.



FLUKA simulations



- 3D spherical Earth
- Height-density profile of the atmosphere

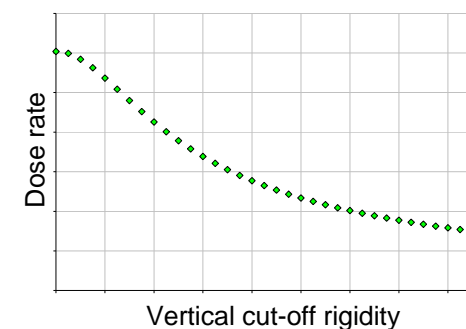
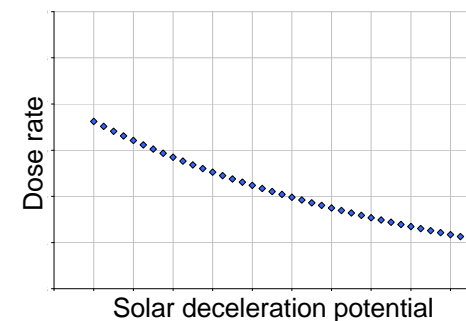
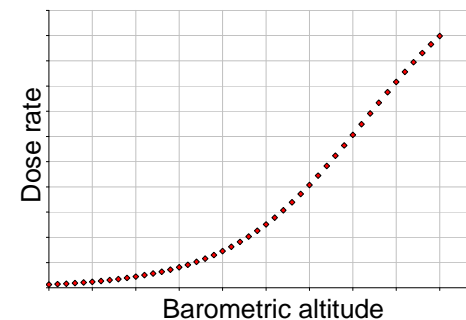
- Updated proton input primary spectrum
- Modulation due to solar activity

- FLUKA version 2005

- Fluence energy spectra
- Fluence-to-dose conversion coefficients
- Results in terms of $dH^*(10)/dt$, dE/dt



Fitting functions

- Based on FLUKA simulations
- Parameters
 - Barometric altitude, h
 - Solar deceleration potential, Φ
 - Vertical cut-off rigidity, r_c
- Set of fitting functions for selected parameters range



Accredited work procedure

- Accredited by Austrian office for accreditation
- Input data
 - Altitude (FL)
 - Longitude (decimal degree)
 - Latitude (decimal degree)
 - UTC (dd/MM/yyyy hh:mm)
- Results
 - Date/Time (dd/MM/yyyy hh:mm)
 - Flight duration (minutes)
 - Ambient dose equivalent, (μSv)
 - Effective dose, (μSv)

Sicherheit und Risiko

GSR-FB-0100 AVIDOS v1.0

Route dose assessment:

durchgeföhrt von: Latocha Datum 27/01/2009

Flight	ARC-10				
	Waypoint	Altitude (FL)	Longitude (dec deg)	Latitude (dec deg)	Date/Time (dd/MM/yyyy hh:mm)
DEPARTURE	0	-70.84	42.66	31/10/1997 05:29	0.12
waypoint 1	330	-70.32	42.87	31/10/1997 05:32	5.07
waypoint 2	330	-68.81	43.72	31/10/1997 05:41	5.11
waypoint 3	330	-67.26	44.65	31/10/1997 05:51	5.15
waypoint 4	330	-65.67	46.35	31/10/1997 06:00	5.18
waypoint 5	330	-64.26	46.28	31/10/1997 06:09	5.22
waypoint 6	330	-62.87	47.26	31/10/1997 06:19	5.26
waypoint 7	330	-61.41	48.24	31/10/1997 06:28	5.30
waypoint 8	330	-59.87	49.21	31/10/1997 06:38	5.34
waypoint 9	330	-58.28	50.16	31/10/1997 06:47	5.37
waypoint 10	330	-56.46	50.95	31/10/1997 06:56	5.38
waypoint 11	330	-54.61	51.62	31/10/1997 07:06	5.38
waypoint 12	330	-52.49	52.26	31/10/1997 07:15	5.38
waypoint 13	330	-50.42	52.86	31/10/1997 07:25	5.40
waypoint 14	330	-48.40	53.55	31/10/1997 07:34	5.40
waypoint 15	330	-46.36	54.22	31/10/1997 07:43	5.41
waypoint 16	330	-44.26	54.85	31/10/1997 07:53	5.42
waypoint 17	330	-42.06	55.45	31/10/1997 08:02	5.43
waypoint 18	330	-39.80	56.02	31/10/1997 08:12	5.43
waypoint 19	330	-37.44	56.58	31/10/1997 08:21	5.43
waypoint 20	330	-34.91	57.11	31/10/1997 08:30	5.43
waypoint 21	330	-32.29	57.59	31/10/1997 08:40	5.43
waypoint 22	330	-29.62	57.97	31/10/1997 08:49	5.42
waypoint 23	330	-26.88	58.04	31/10/1997 08:59	5.41
waypoint 24	330	-24.16	58.06	31/10/1997 09:08	5.39
waypoint 25	330	-21.46	58.01	31/10/1997 09:17	5.36
waypoint 26	330	-18.79	58.01	31/10/1997 09:27	5.34
waypoint 27	330	-16.13	58.05	31/10/1997 09:36	5.32
waypoint 28	330	-13.48	58.05	31/10/1997 09:46	5.30
waypoint 29	330	-10.83	57.99	31/10/1997 09:55	5.27
waypoint 30	330	-8.38	57.57	31/10/1997 10:04	5.22
DESTINATION	0	-5.06	57.01	31/10/1997 10:14	0.12

Calculate

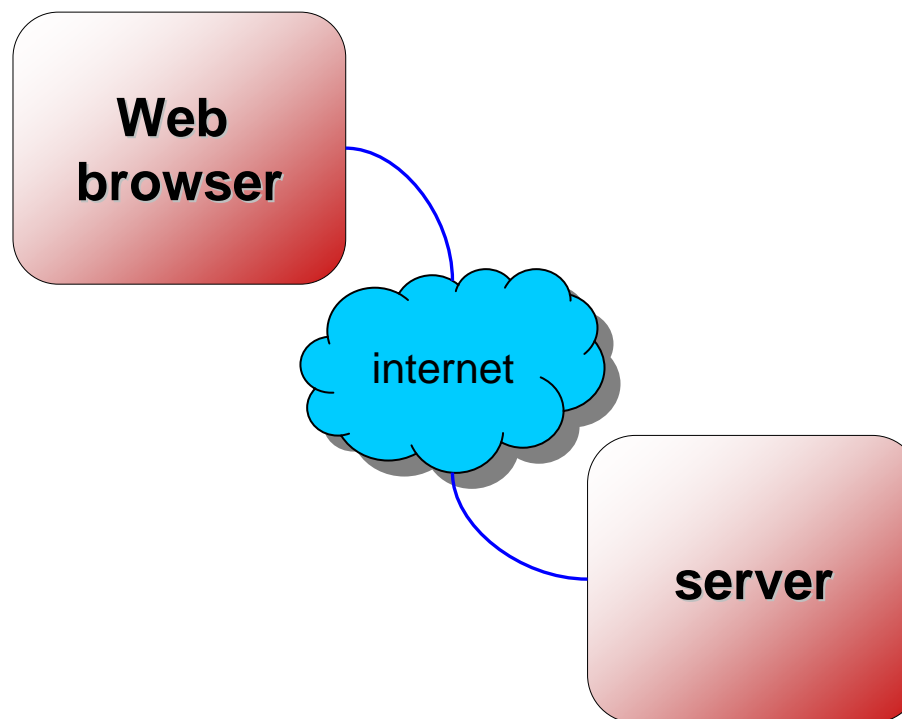
Flight	ARC-10
Date/Time	31/10/1997 05:29
Duration (minutes)	04:45
Ambient dose equivalent (μSv)	24.8 \pm 7.4
Effective dose (μSv)	30.5 \pm 9.2

Änderungen in den Versionen:

Name:	Datum:	Unterschrift:
Erstellt / geändert von: DI Marcin Latocha, RAS	05/02/2007	
Gepföhrt von: Dr. Peter Beck, Leitung RAS	05/02/2007	
Freigegeben von: Dr. Martina Schwaiger, Leitung GSR	05/02/2007	

AVIDOS on the internet web site

- Free access for public <http://avidos.healthphysics.at>
- Simplified version
 - Great Circle route
 - Constant altitude
 - Estimated flight time
- Java web application





AVIDOS - Aviation Dosimetry



AVIDOS - Aviation Dosimetry



Flags: USA, UK, Germany, Austria, France, Italy, Poland, Czech Republic, Russia, etc.

AVIDOS ver.1.0

1. Select date
Fri, 04 Jul 2008 [Calendar]

2. Select locations
Select departure or click on the map
[Dropdown]
Select destination or click on the map
[Dropdown]

3. Enter altitude or use default
350 [Dropdown] FL [Dropdown] Default

4. Enter total flight time or estimate automatically
01 [Dropdown] : 00 [Dropdown] hh:mm Estimate

[Submit]

Results

Parameter	Value
Departure date	
Destination date	
Altitude (FL)	
Total flight time (hh:mm)	
Effective dose (μ Sv)	

<- Previous Next ->

AVIDOS - Aviation Dosimetry

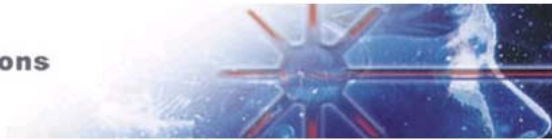
The screenshot displays the AVIDOS software interface. At the top, there is a world map. A 'Calendar' window is open, showing the month of May 2008. Below the map, there are several flags representing different countries. The main interface is divided into four numbered steps for data entry:

- 1. Select date:** Shows 'Fri, 04 Jul 2008' and a 'Calendar' button.
- 2. Select locations:** Includes two dropdown menus for 'Select departure or click on the map' and 'Select destination or click on the map'.
- 3. Enter altitude or use default value:** Shows a dropdown for '350', a dropdown for 'FL', and a checked 'Default' checkbox.
- 4. Enter total flight time or estimate automatically:** Shows a time input '01:00' in 'hh:mm' format and a checked 'Estimate' checkbox.

At the bottom, there are 'Submit', '<- Previous', and 'Next ->' buttons. On the right side, there is a 'Results' section with a table:

Parameter	Value
Departure	
Destination	
Date	
Altitude (FL)	
Total flight time (hh:mm)	
Effective dose (μSv)	

The text 'AVIDOS ver.1.0' is visible in the bottom right corner of the interface.



AVIDOS - Aviation Dosimetry



Courtesy NASA map



AVIDOS ver.1.0

1. Select date
Tue, 27 Jan 2009

2. Select locations
Select departure or click on the map
HOUSTON, TX, USA
Select destination or click on the map
HANNOVER, GERMANY

3. Enter altitude or use default value
350 FL Default

4. Enter total flight time or estimate automatically
01:00 hh:mm Estimate

Results

Parameter	Value
Departure	
Destination	
Date	
Altitude (FL)	
Total flight time (hh:mm)	
Effective dose (µSv)	

<http://www.healthphysics.at/avidos>

AVIDOS - Aviation Dosimetry



Flags: USA, UK, Germany, Austria, France, Italy, Poland, Russia, etc.

AVIDOS ver. 1.0

1. Select date
Tue, 27 Jan 2009 [Calendar]

2. Select locations
Select departure or click on the map
HOUSTON, TX, USA
Select destination or click on the map
HANNOVER, GERMANY

3. Enter altitude or use default value
350 FL [Default]

4. Enter total flight time or estimate automatically
01:00 hh:mm [Estimate]

Submit <- Previous Next ->

Parameter	Value
Departure	HOUSTON, TX, USA
Destination	HANNOVER, GERMANY
Date	Tue, 27 Jan 2009
Altitude (FL)	350
Total flight time (hh:mm)	10:57
Effective dose (µSv)	75

Summary

- AVIDOS is based on FLUKA simulations
- The work procedure with AVIDOS is accredited by the Austrian office for accreditation
- Web site version is open for public usage
- AVIDOS calculations were compared with other codes within EURADOS WG5

References

- The European Radiation Dosimetry Group (EURADOS). *Cosmic radiation exposure of aircraft crew*. EU Commission Radiation Protection Issue No. 140, ISBN 92-894-8448-9 (2004).
- Ferrari, A., Sala, P.R., Fasso, A., and Ranft, J. *FLUKA: A Multi Particle Transport Code*. pp-386. (2005). Geneva, Switzerland, CERN, INFN, SLAC.
- Gaisser, T. K., et al. *Primary Spectrum to 1 TeV and Beyond*. Proceedings of the 27th International Cosmic Ray Conference (ICRC 2001), Hamburg, Germany, 643–646, 7–15 August 2001.
- Pelliccioni, M. *Overview of fluence-to-effective dose and fluence-to-ambient dose equivalent conversion coefficients for high energy radiation calculated using FLUKA code*. Radiat. Prot. Dosim. 88(4), 279–297 (2000).
- Smart, D.F., Shea, M.A. *World grid of cosmic ray vertical cut-off rigidities for Epoch 1990*. Proceedings of the 25th International Cosmic Ray Conference, Durban, South Africa, 1997, pp. 401-404.
- Badhwar, G. D. *The radiation environment in low-Earth orbit*. Radiat. Res. 148, 3–10, (1997).
- Beck, P., Latocha, M., Rollet, S., Dormann, L., and Pelliccioni, M. *Measurements and simulation of the radiation exposure to aircraft crew workplaces due to cosmic radiation in the atmosphere*, Radiat. Prot. Dosim. 126(1-4) 564-567 (2007).

Thank you!

