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Twelfth
Neutron Users Club
Thursday 7 October 2004

Recent Developments Investigating Radiation Doses to Aircraft Crew

Estimating Heliocentric Potentials: The Solar Activity Index

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UCL MSSL

Contents of Presentation

- What is Heliocentric Potential?
- What is it used for?
- How is it derived?
- How it relates to ground-level monitor data
- Using that relationship to generate values over shorter timescales
- The effect of these values on comparisons with TEPC measurements

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The Heliocentric Potential (HP)

- What is HP?
  - HP is an index of Solar Activity
  - Active Sun → High HP → Reduced CR Dose Rates
  - Quiet Sun → Low HP → Increased CR Dose Rates
  - Used by CARI to adjust calculated route doses
- How is HP Derived?
  - "…based on ground level neutron measurements provided by… the Apatity Cosmic Ray Station…, Russia" [CARI Web-page]
  - That's all we know!

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From the CARI Web-page

Heliocentric Potentials for Recent Dates

Flights in the Month of	Heliocentric potential in megavolts
September 2003 (09/2003)	826
October 2003 (10/2003)	887
November 2003 (11/2003)	1135
December 2003 (12/2003)	883
For the year of 2003 (00/2003)	888
January 2004 (01/2004)	894
February 2004 (02/2004)	755
March 2004 (03/2004)	654
April 2004 (04/2004)	617
May 2004 (05/2004)	585
June 2004 (06/2004)	592
July 2004 (07/2004)	651
August 2004 (08/2004)	617
September 2004 (09/2004)	588

Heliocentric potentials for recent months are preliminary.

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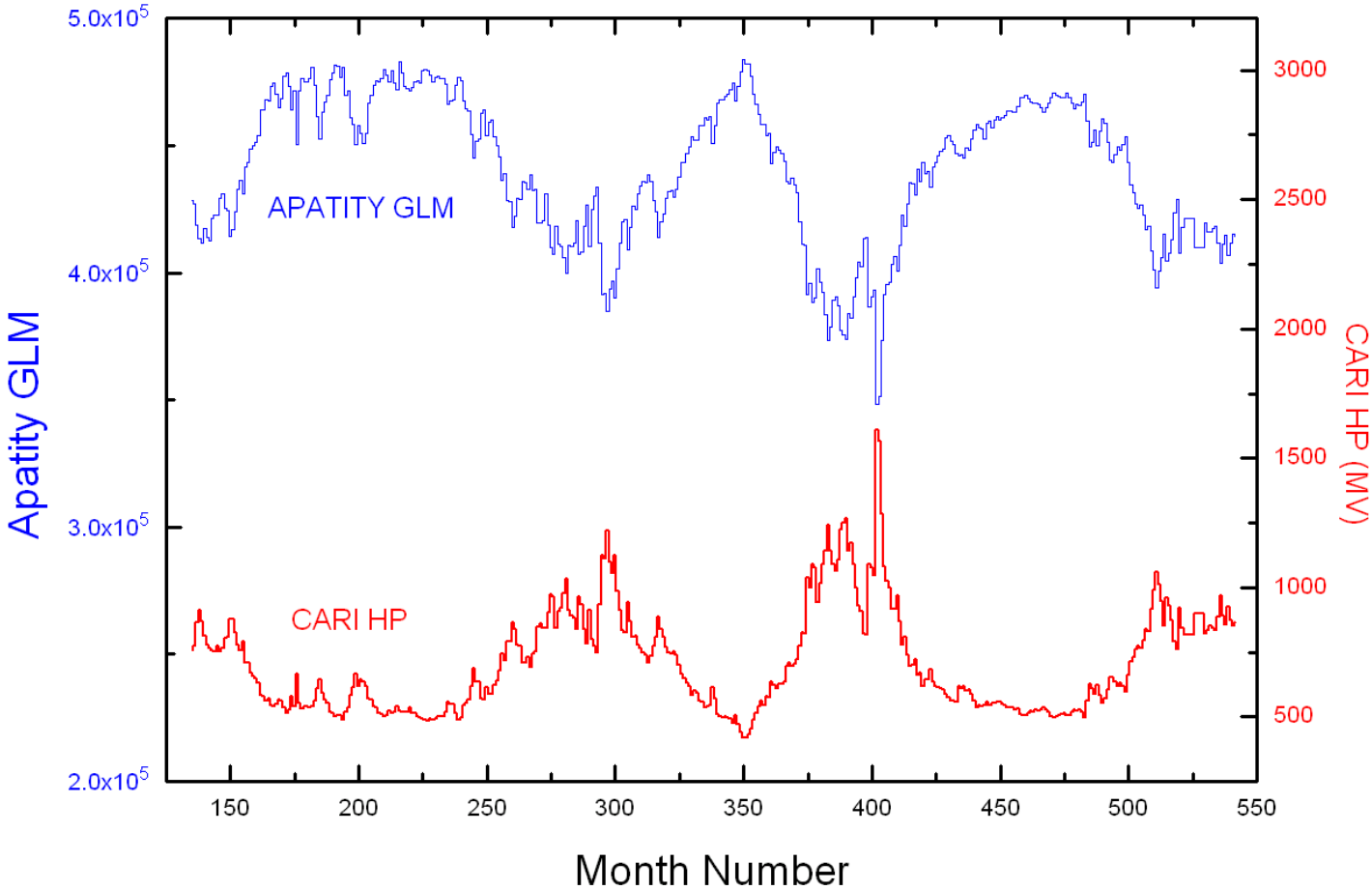
CARI HP values compared with Apatity GLM count rate



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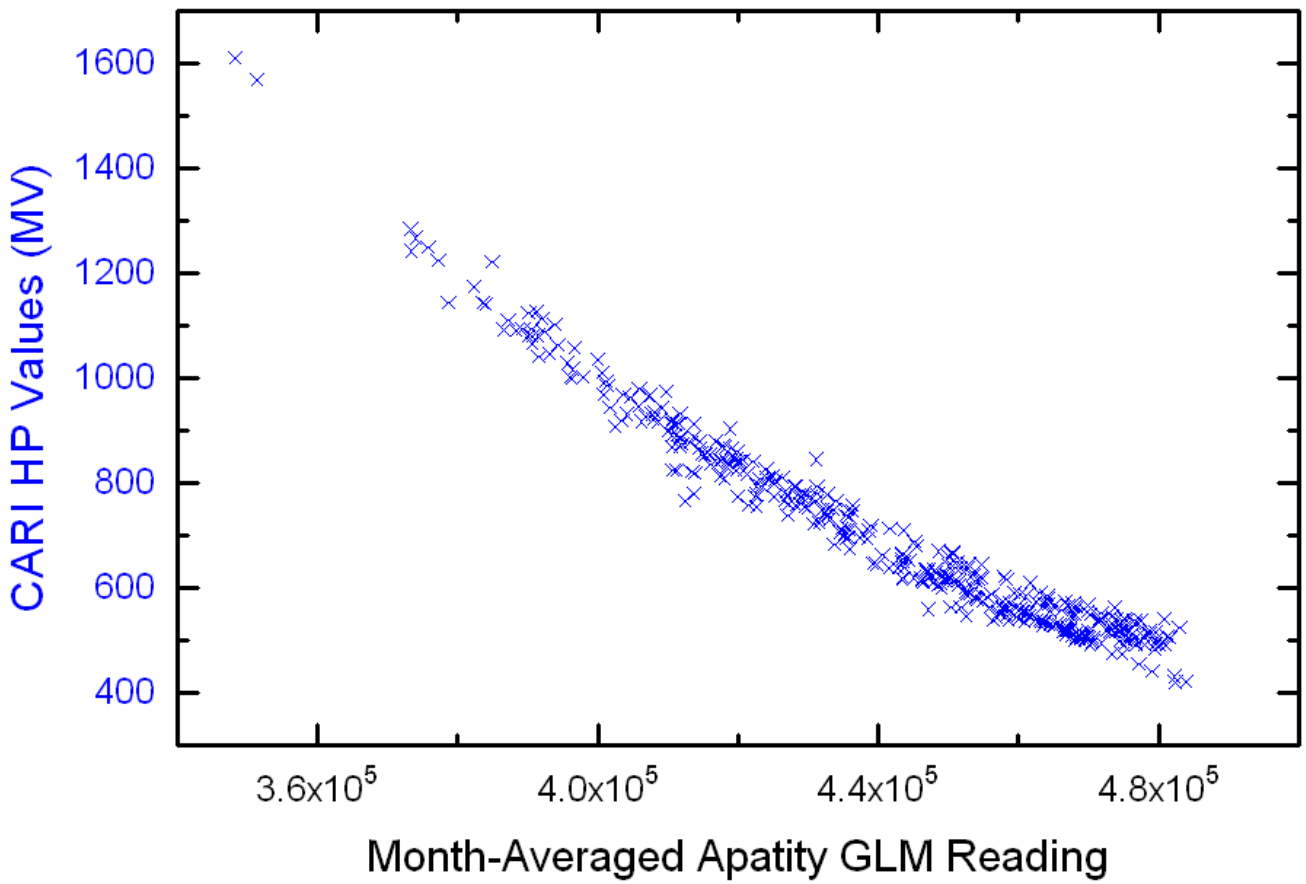
CARI HP values as a function of Apatity GLM count rate



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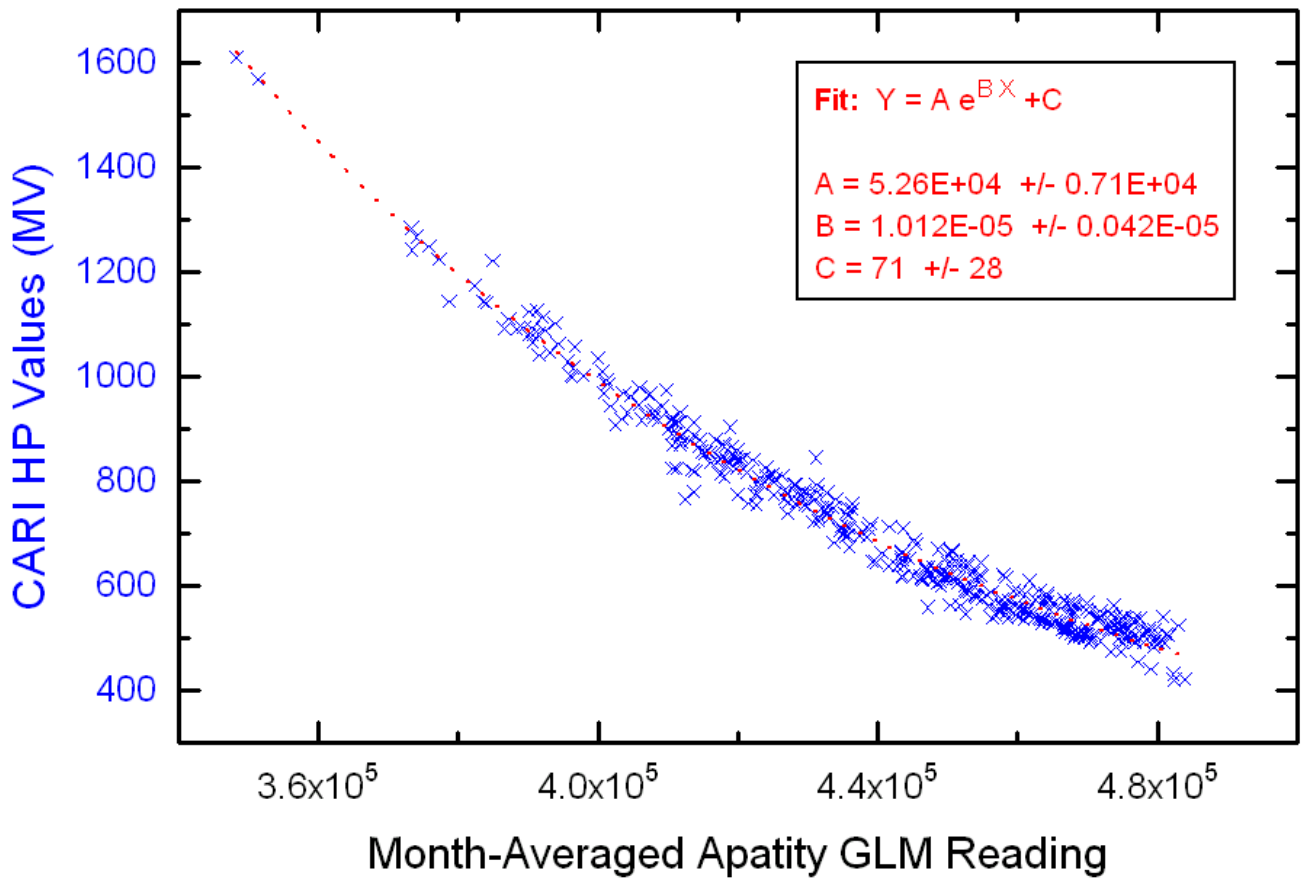
CARI HP values as a function of Apatity GLM count rate



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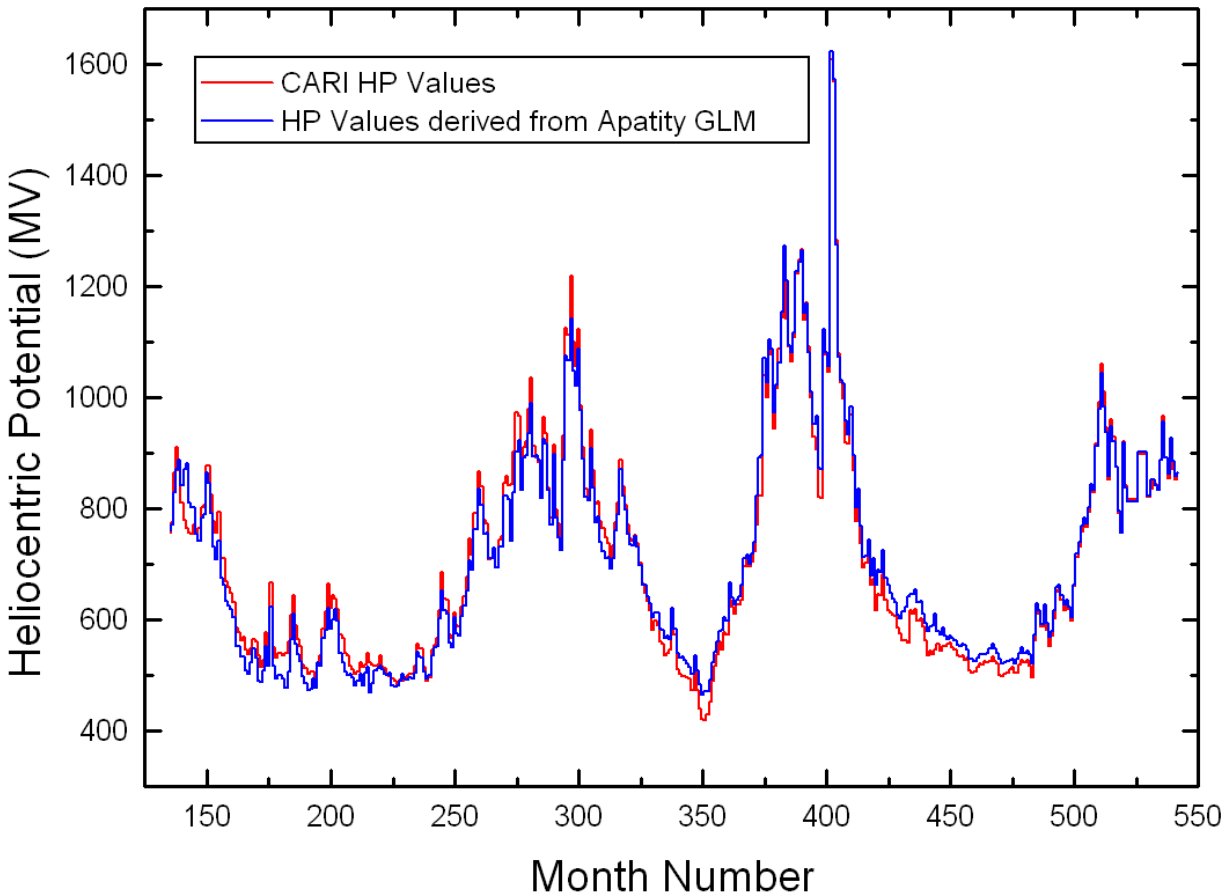
CARI HP values compared with Apatity - derived HP values



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Apatity-Based HP Estimation …Why?

- Why develop method for estimating HP values?
  - CARI Team only publish monthly values
  - Use HP estimation method to derive daily HP values
    - Use to derive flight-by-flight values
  - Allows better comparison with measurements

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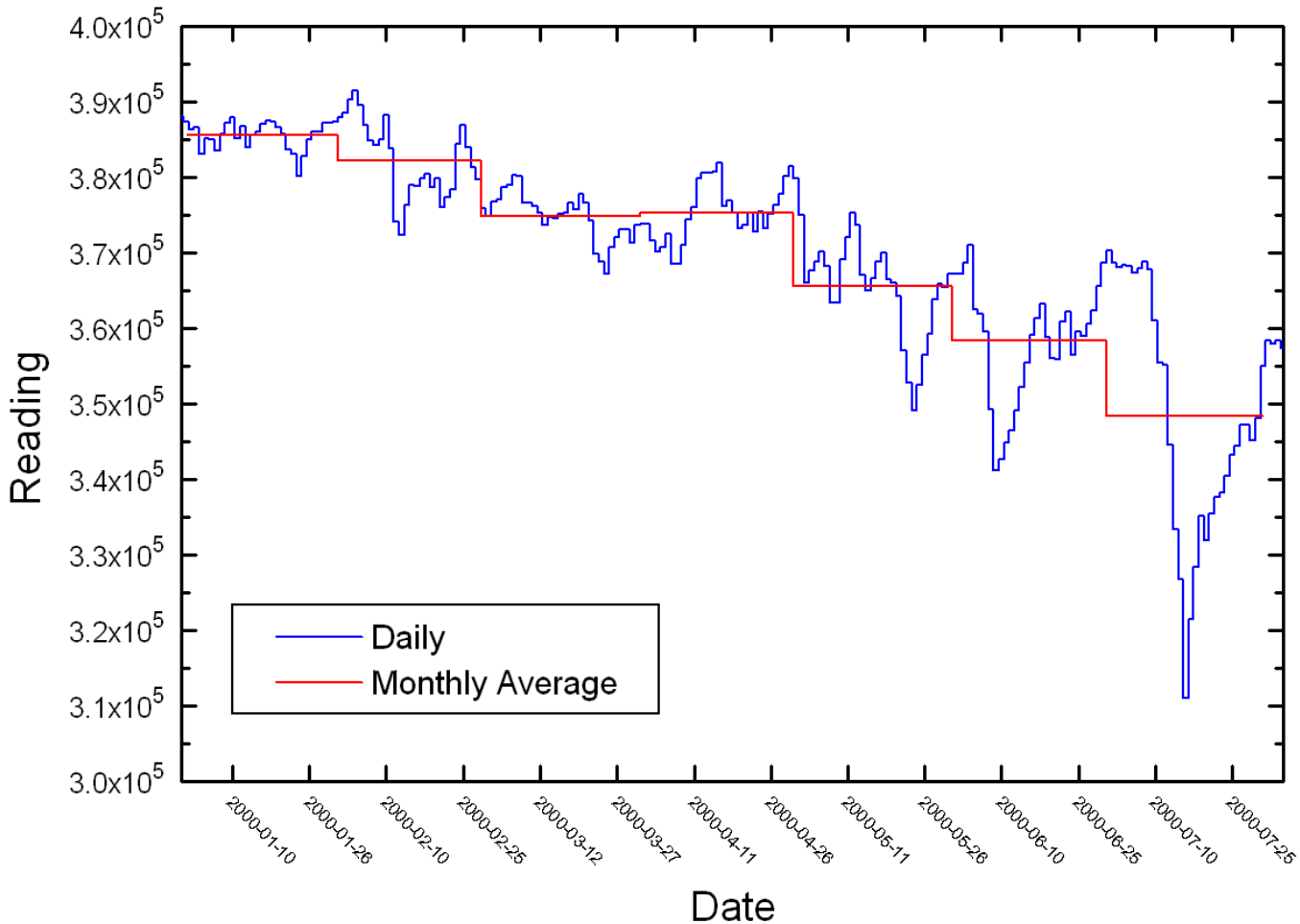
Daily vs Monthly Variation in Apatity GLM Readings Jan – July 2000



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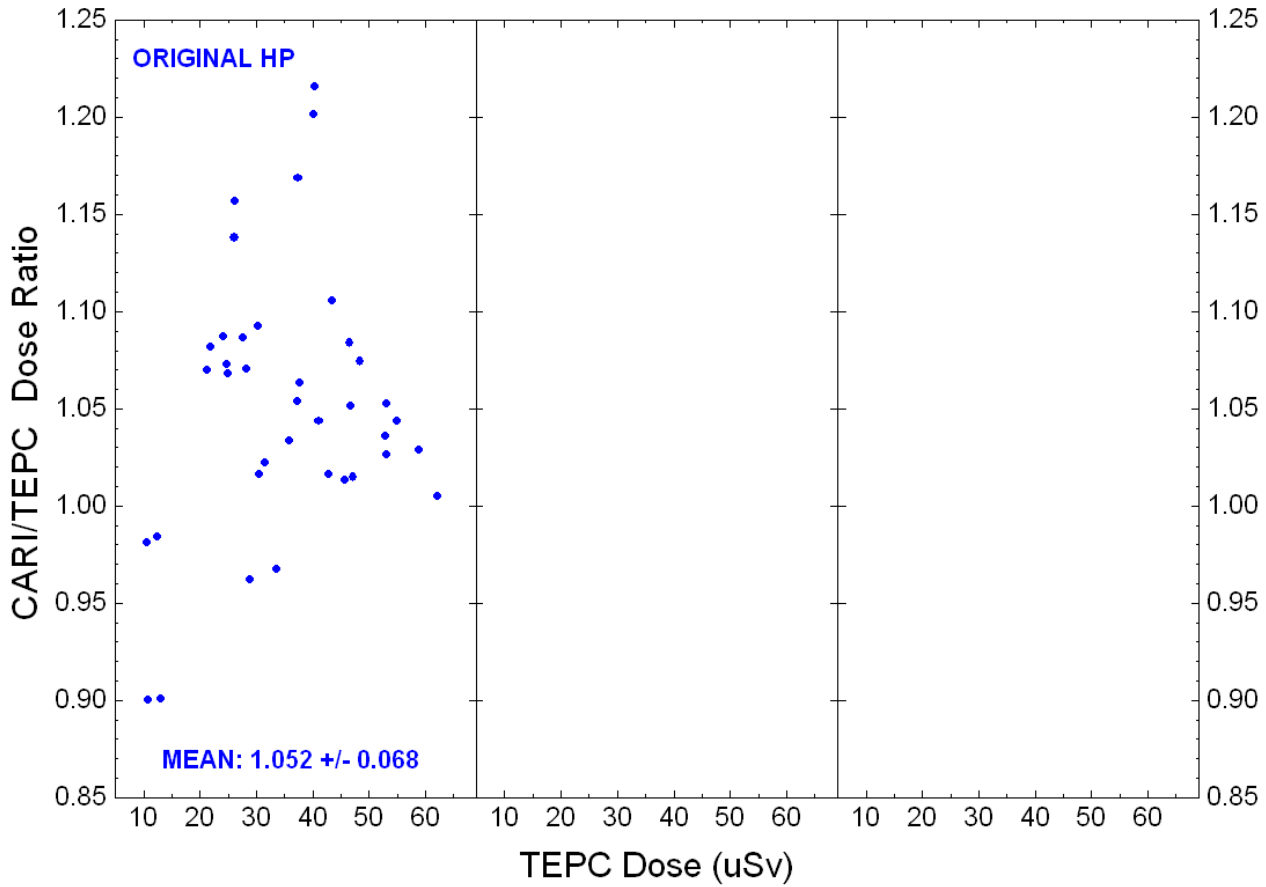
Dose Ratios (CARI/TEPC) for Different HP Estimates



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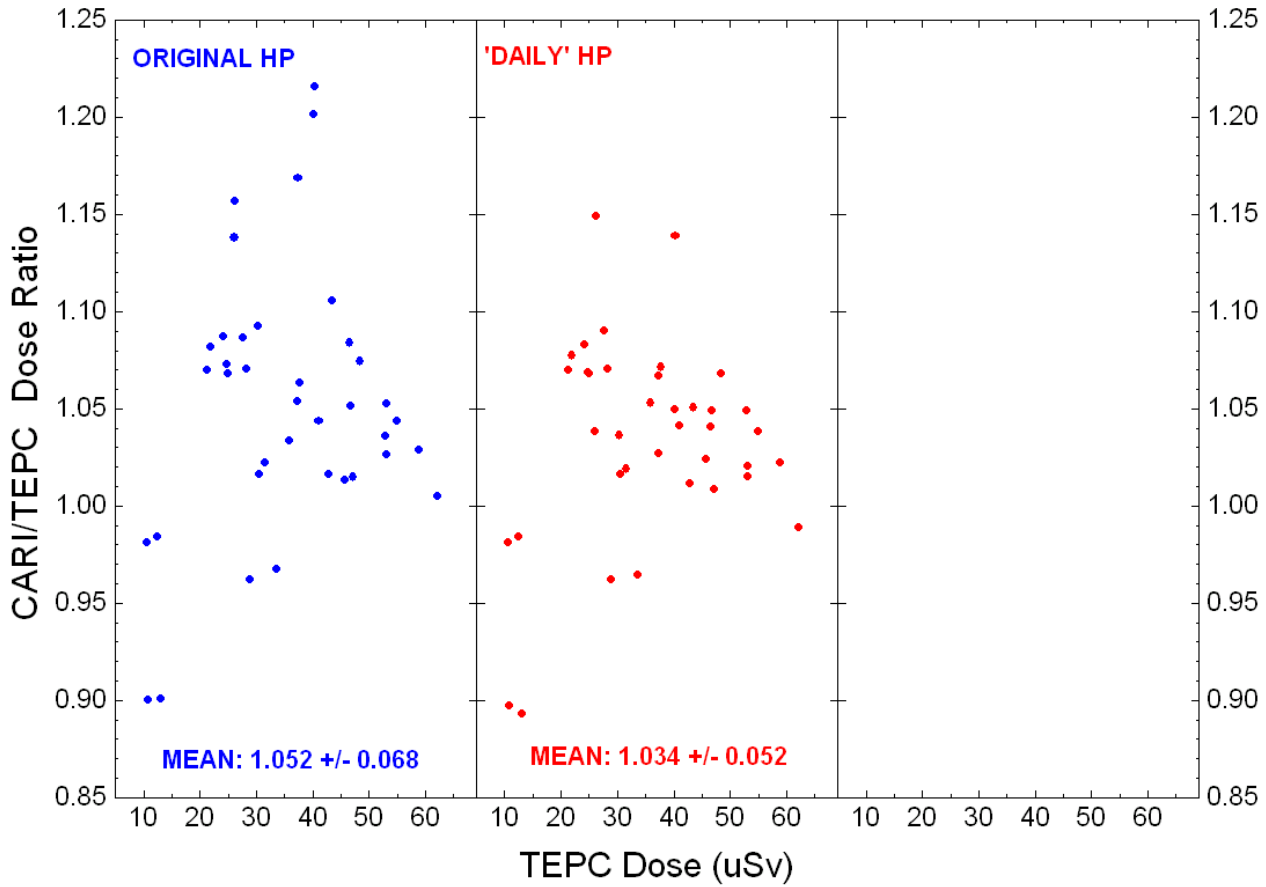

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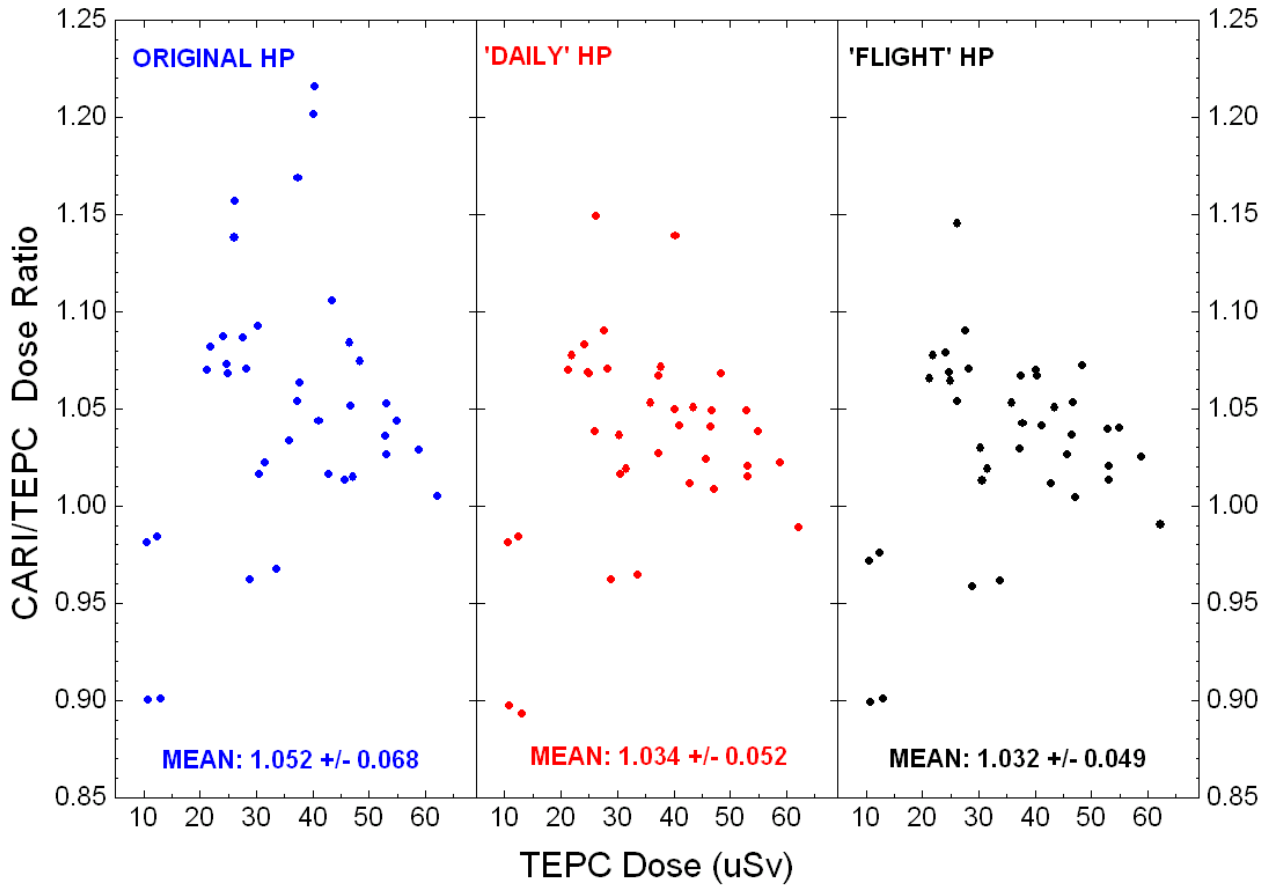

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Dose Ratios (CARI/TEPC) for Different Routes to/from LHR

		Original
Jo'burg	Mean	0.9207
	SD	0.0236
LA	Mean	0.9142
	SD	0.0560
Tokyo	Mean	0.9590
	SD	0.0366
New York	Mean	0.9803
	SD	0.0581
Hong Kong	Mean	0.9308
	SD	0.0627
Athens	Mean	1.0642
	SD	0.0536
Shanghai	Mean	0.9725
	SD	0.0205

<2%
<4%
<6%
<8%
>8%

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Dose Ratios (CARI/TEPC) for Different Routes to/from LHR

		Original	Daily
Jo'burg	Mean	0.9207	0.9224
	SD	0.0236	0.0221
LA	Mean	0.9142	0.9520
	SD	0.0560	0.0157
Tokyo	Mean	0.9590	0.9799
	SD	0.0366	0.0215
New York	Mean	0.9803	0.9924
	SD	0.0581	0.0376
Hong Kong	Mean	0.9308	0.9474
	SD	0.0627	0.0437
Athens	Mean	1.0642	1.0674
	SD	0.0536	0.0574
Shanghai	Mean	0.9725	0.9684
	SD	0.0205	0.0115

<2%
<4%
<6%
<8%
>8%

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Dose Ratios (CARI/TEPC) for Different Routes to/from LHR

		Original	Daily	Flight
Jo'burg	Mean	0.9207	0.9224	0.9242
	SD	0.0236	0.0221	0.0218
LA	Mean	0.9142	0.9520	0.9493
	SD	0.0560	0.0157	0.0185
Tokyo	Mean	0.9590	0.9799	0.9807
	SD	0.0366	0.0215	0.0211
New York	Mean	0.9803	0.9924	0.9918
	SD	0.0581	0.0376	0.0417
Hong Kong	Mean	0.9308	0.9474	0.9636
	SD	0.0627	0.0437	0.0187
Athens	Mean	1.0642	1.0674	1.0690
	SD	0.0536	0.0574	0.0487
Shanghai	Mean	0.9725	0.9684	0.9673
	SD	0.0205	0.0115	0.0100

<2%
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<6%
<8%
>8%

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Summary and Conclusions

- Heliocentric Potential is a measure of Solar Activity
- Used by CARI to adjust calculated route doses
- Derivation of CARI HP data from Apatity GLM not public
- Simple relationship exists between monthly HP values and monthly-averaged Apatity GLM values
- Derived formula allows estimates of HP values on finer timescale: daily, or even flight-by-flight
- Finer time resolution leads to better agreement between TEPC measurements and dose predictions from CARI especially during periods of variable solar activity

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