CONTRIBUTION OF GALACTIC COSMIC RAYS AND OF EARTH RADIATION BELT INTO THE DAILY DOSE ABOARD THE ISS DETERMINED BY THE DATA OF RMS ISS

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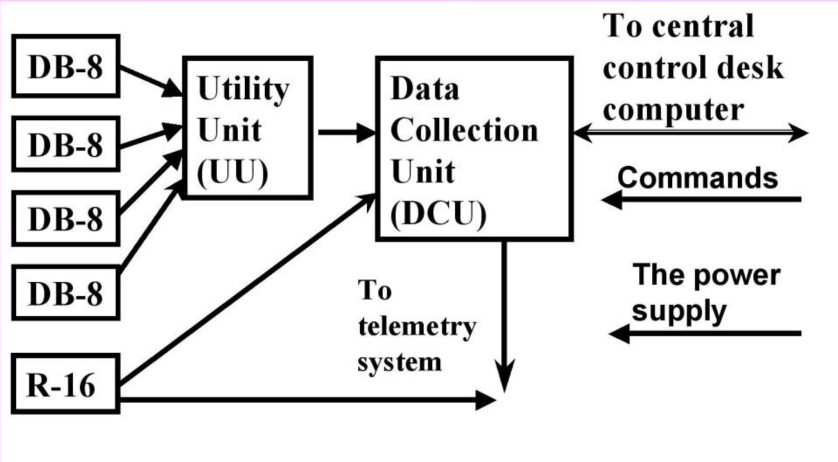
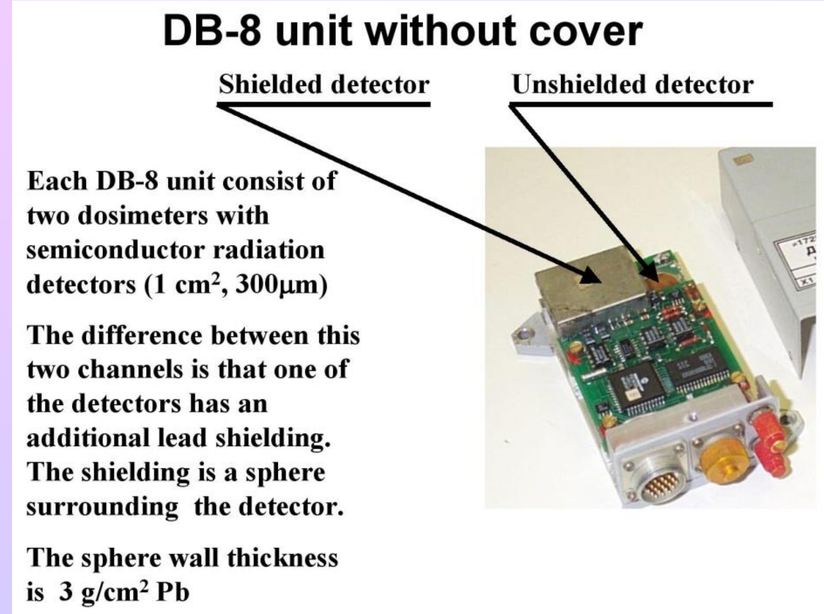
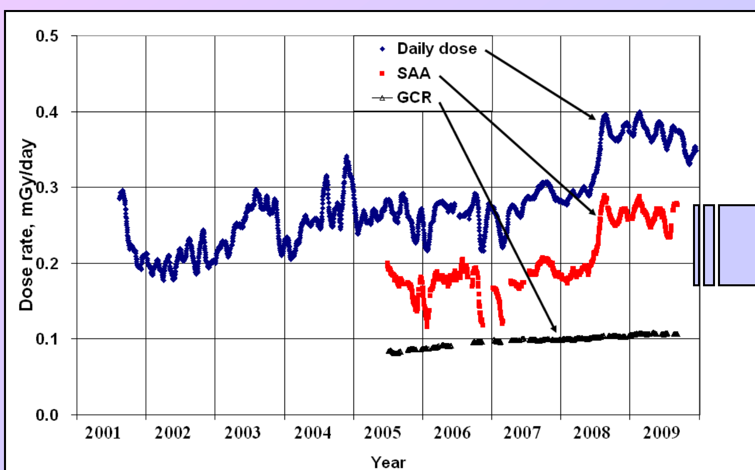
Configuration of the Radiation Monitoring System (RMS)

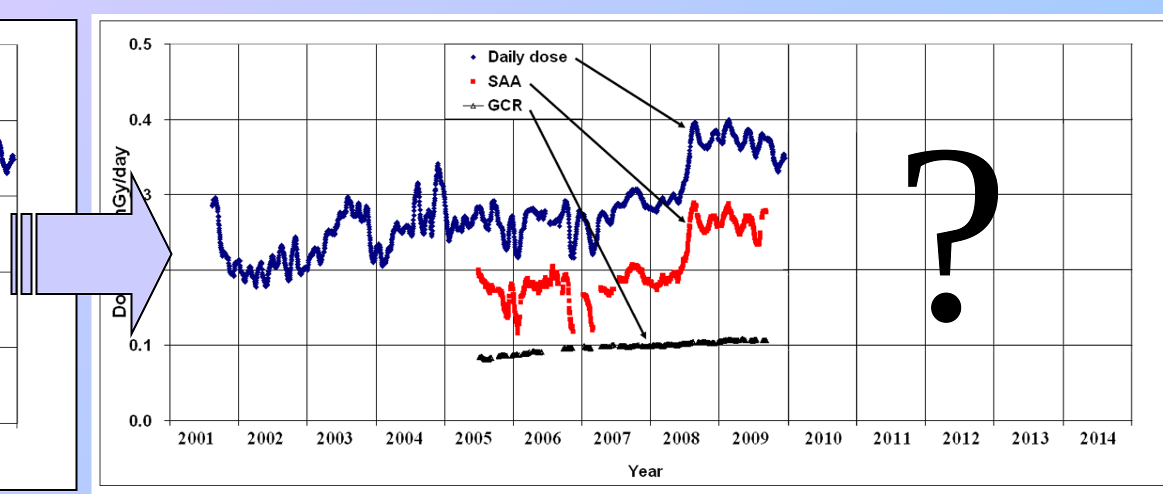




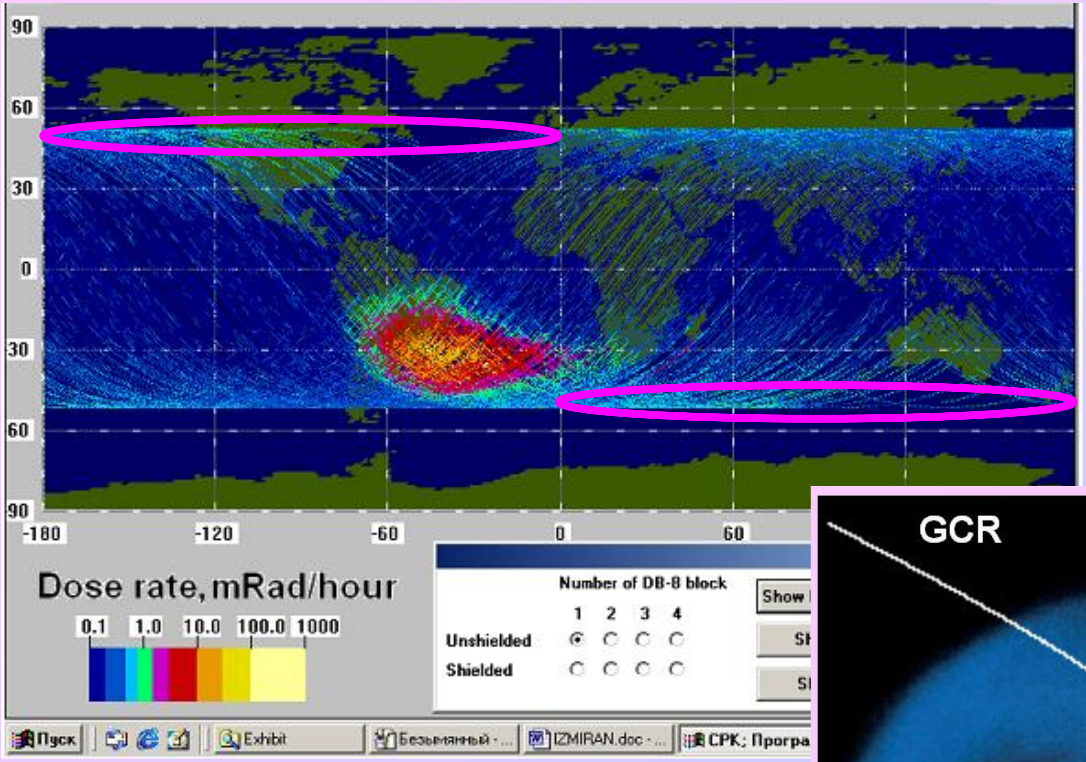
http://wrmiss.org/workshops/eighteenth/Benghin.pdf

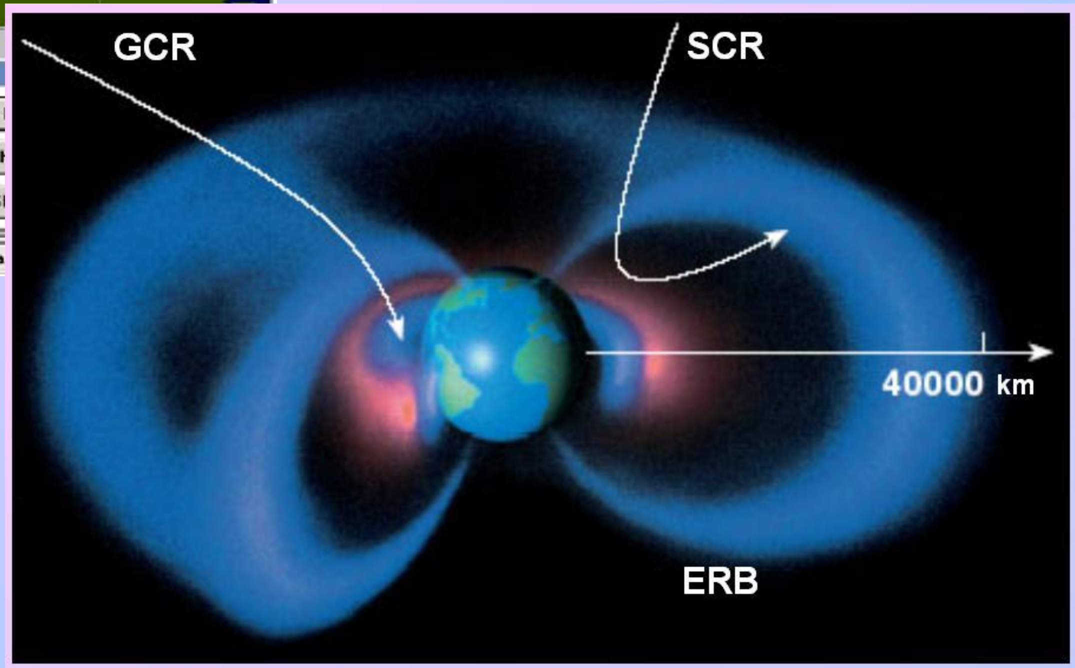
Contribution to a daily dose from galactic cosmic rays and from the inner radiation belt of the Earth





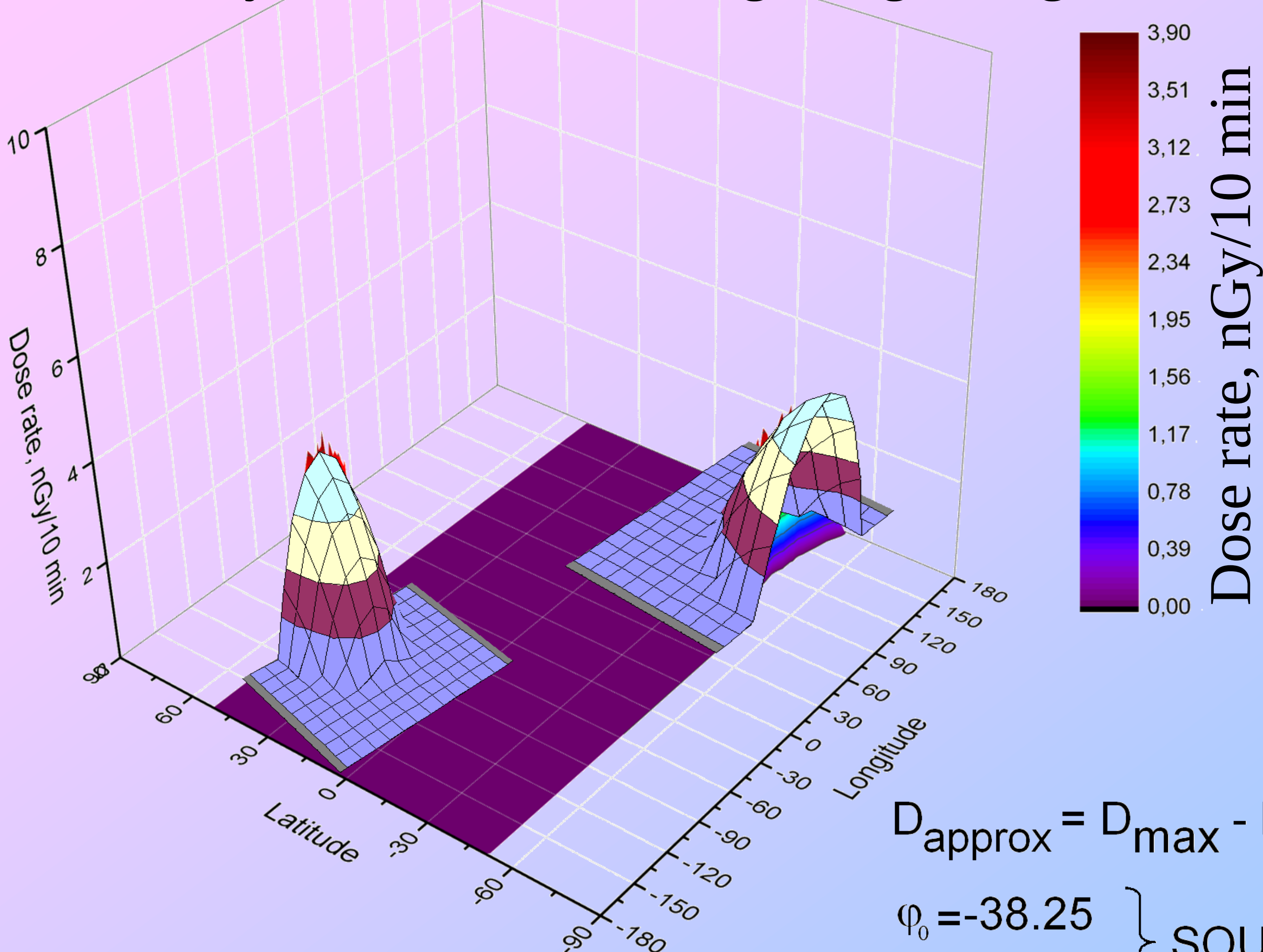
The distribution of the dose rate at the ISS flight trajectory





http://ligaspace.my1.ru/news/2010-01-01-197#ent1356

Paraboloid approximation of dose rate distribution measured in January – March 2008 at highest geomagnetic latitude regions



$$D_{approx} = D_{max} - b * (\varphi - \varphi_0)^2 - c * (\lambda - \lambda_0)^2$$

φ_0 =-38.25
λ_0= 114.64
SOUTH POLE

φ_0 = 72.94
λ_0=-86.47
NORTH POLE

Calculating estimated values of dose rates and their comparison with the experimental values

$$D_{calc} = D_{exper} * \frac{D_{ref}}{D_{approx}}$$

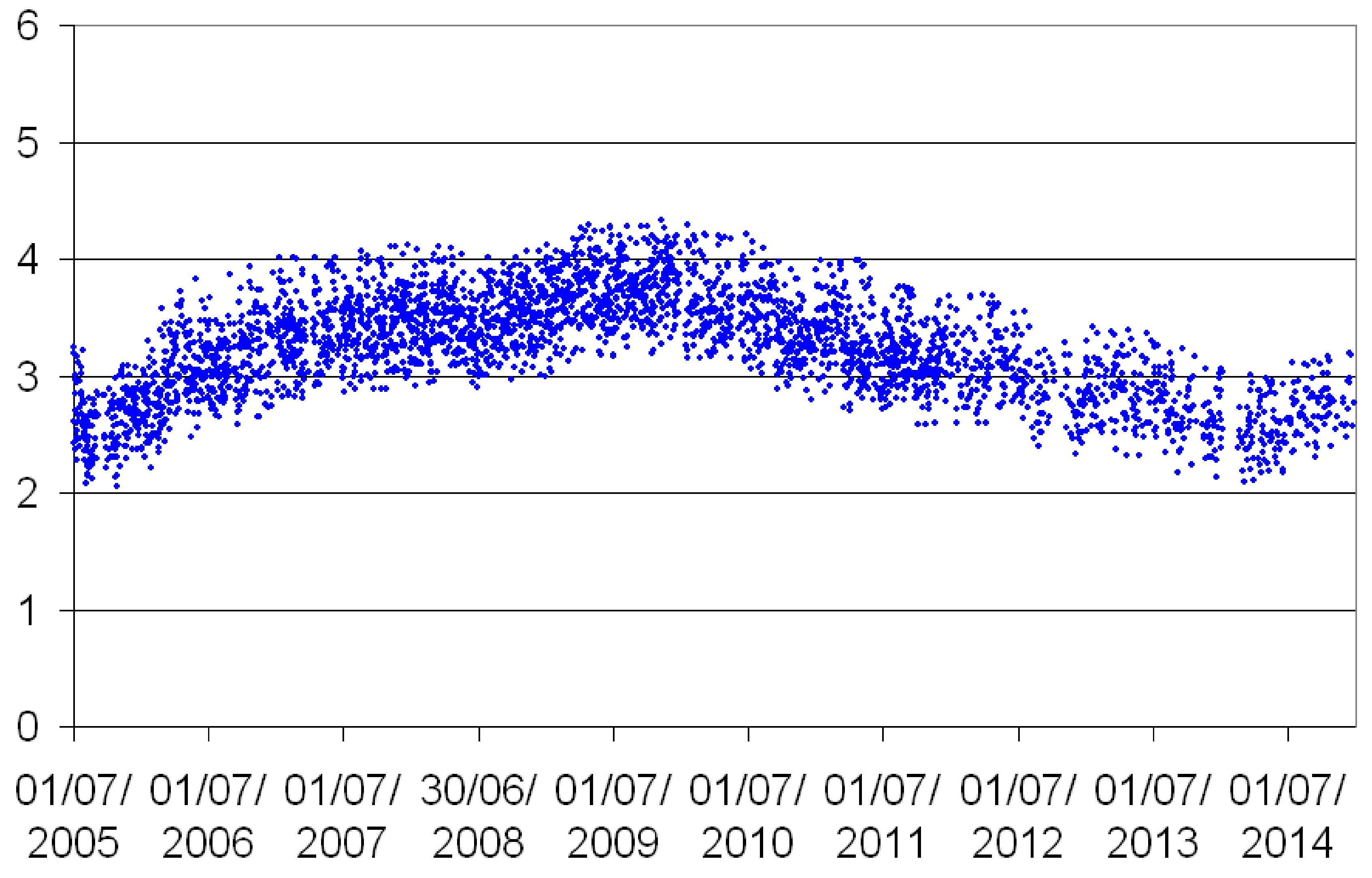
$$D_{approx} = D_{max} - b * (\varphi - \varphi_0)^2 - c * (\lambda - \lambda_0)^2$$

$$\left.\begin{array}{l} \varphi_0 = -38.25 \\ \lambda_0 = 114.64 \end{array}\right\} \text{SOUTH POLE}$$

$$\left.\begin{array}{l} \varphi_0 = 72.94 \\ \lambda_0 = -86.47 \end{array}\right\} \text{NORTH POLE}$$

$$D_{ref} = D_{approx}\Big|_{\begin{array}{ll} \varphi = -51 & \varphi_0 = -38.25 \\ \lambda = 95 & \lambda_0 = 114.64 \end{array}}$$

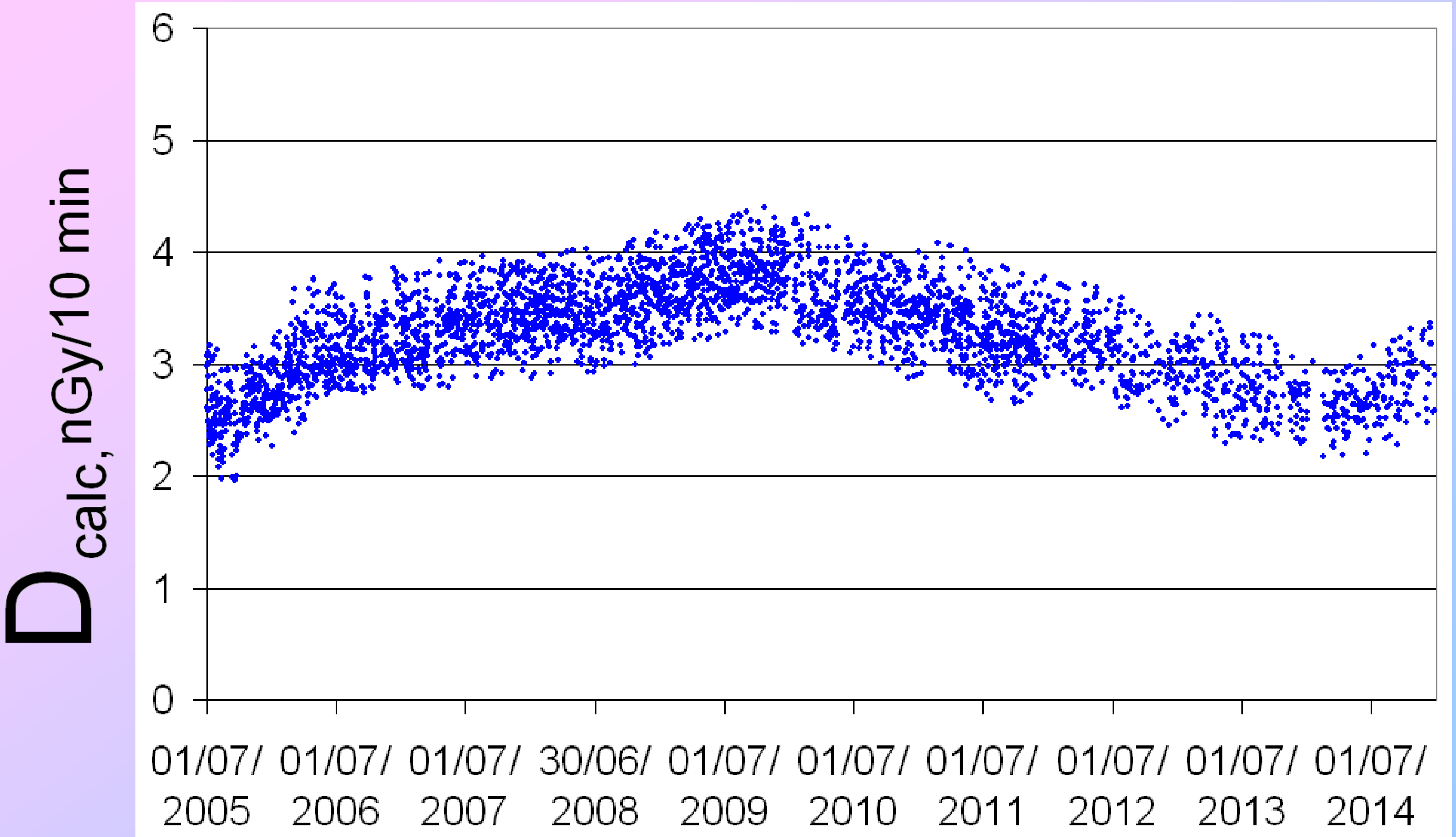
NORTH POLE, DB-8 No. 1



D_{calc}, nGy/10 min

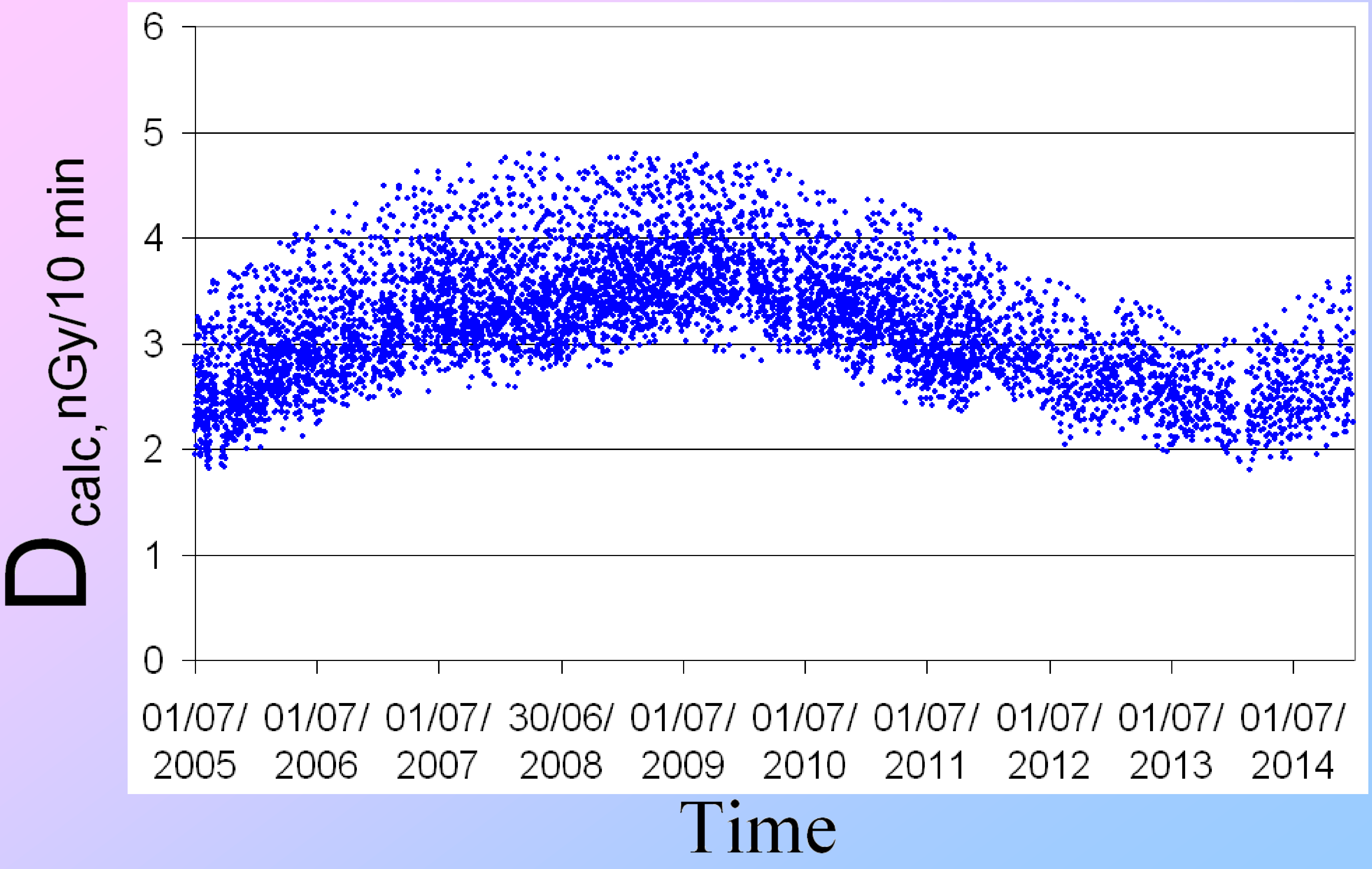
Time

NORTH POLE, DB-8 No. 4

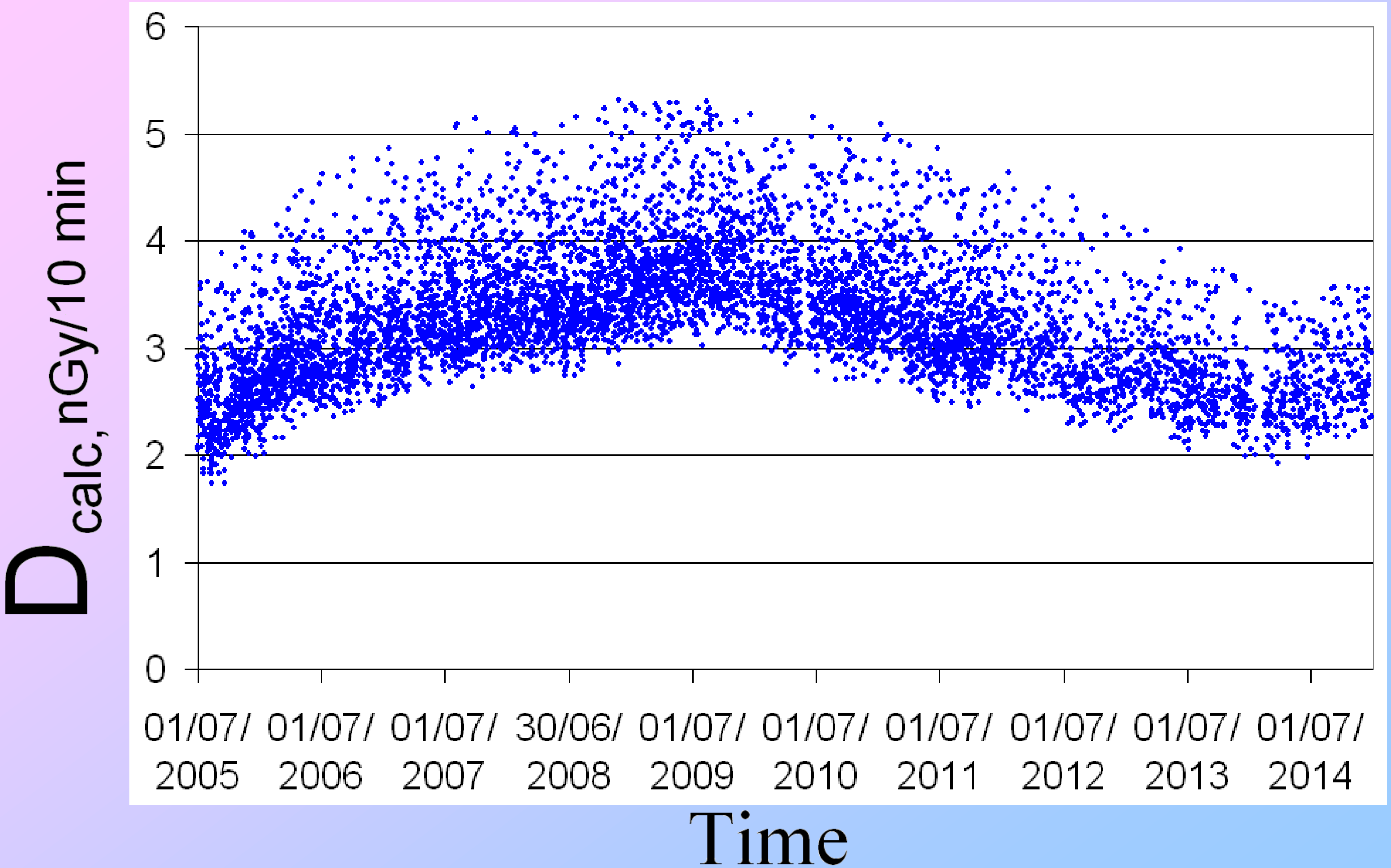


Time

SOUTH POLE, DB-8 No. 1

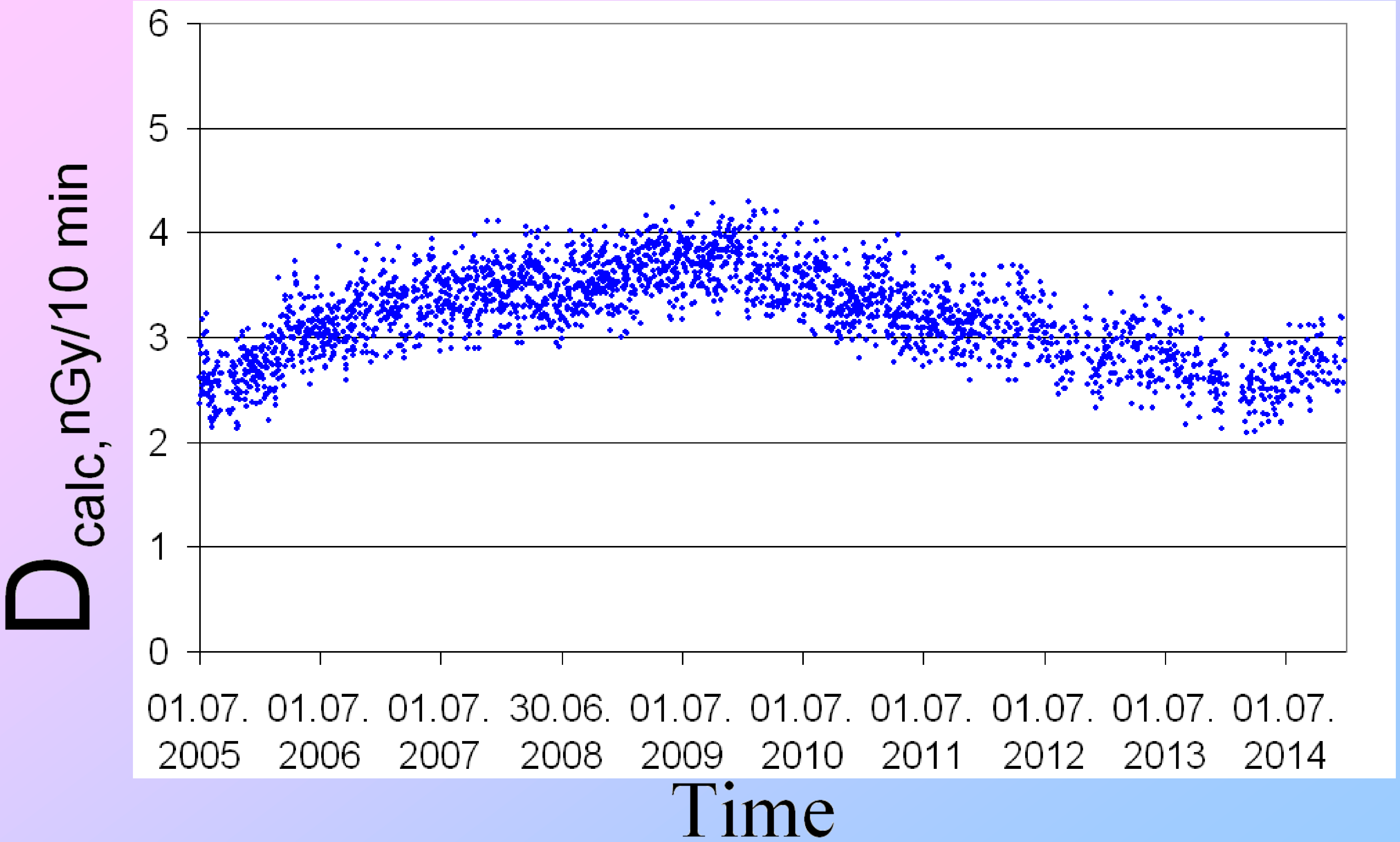


SOUTH POLE, DB-8 No. 4



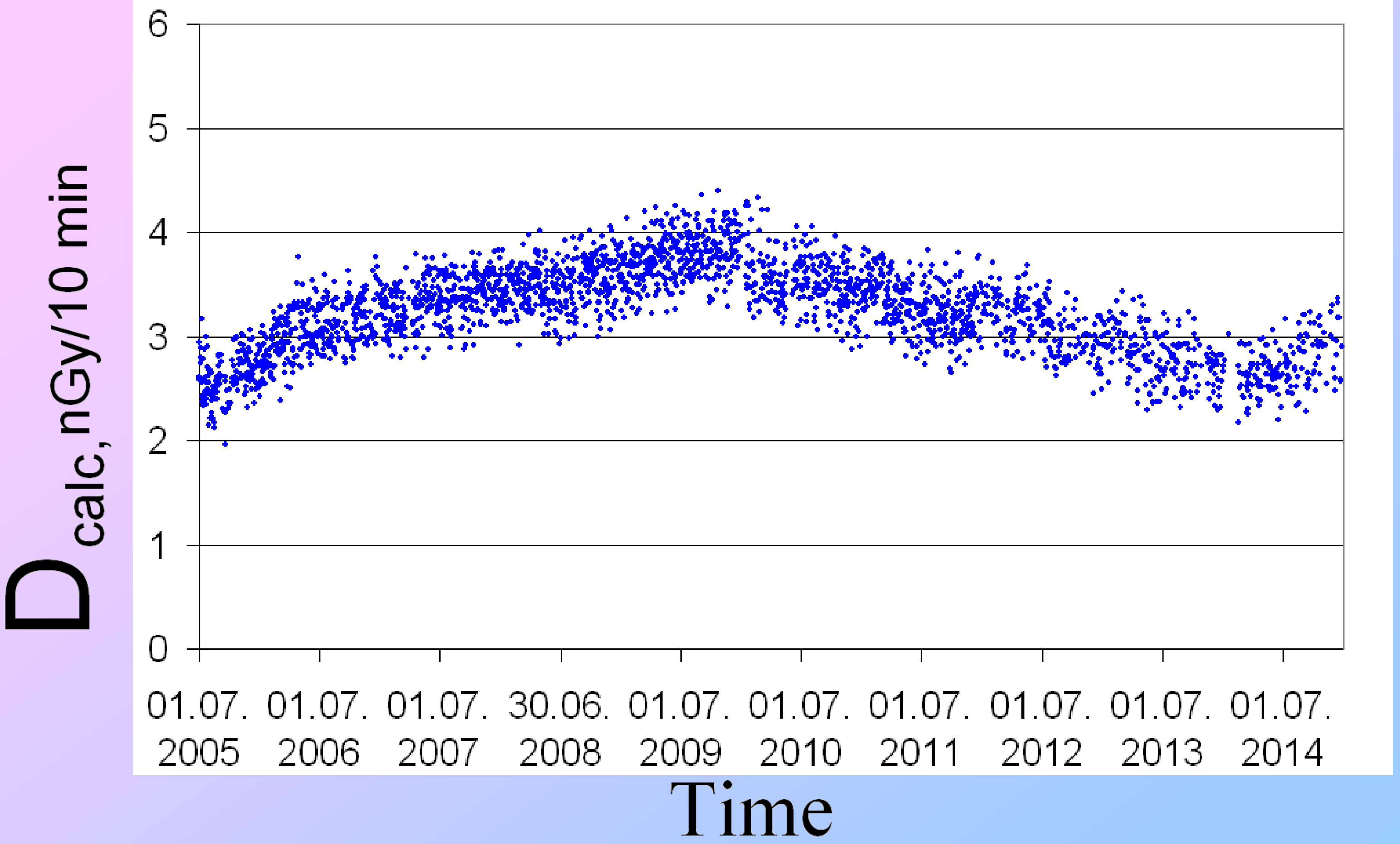
Recalculation to
DAILY average

NORTH POLE, DB-8 No. 1



Recalculation to DAILY average

NORTH POLE, DB-8 No. 4



Recalculation to DAILY average

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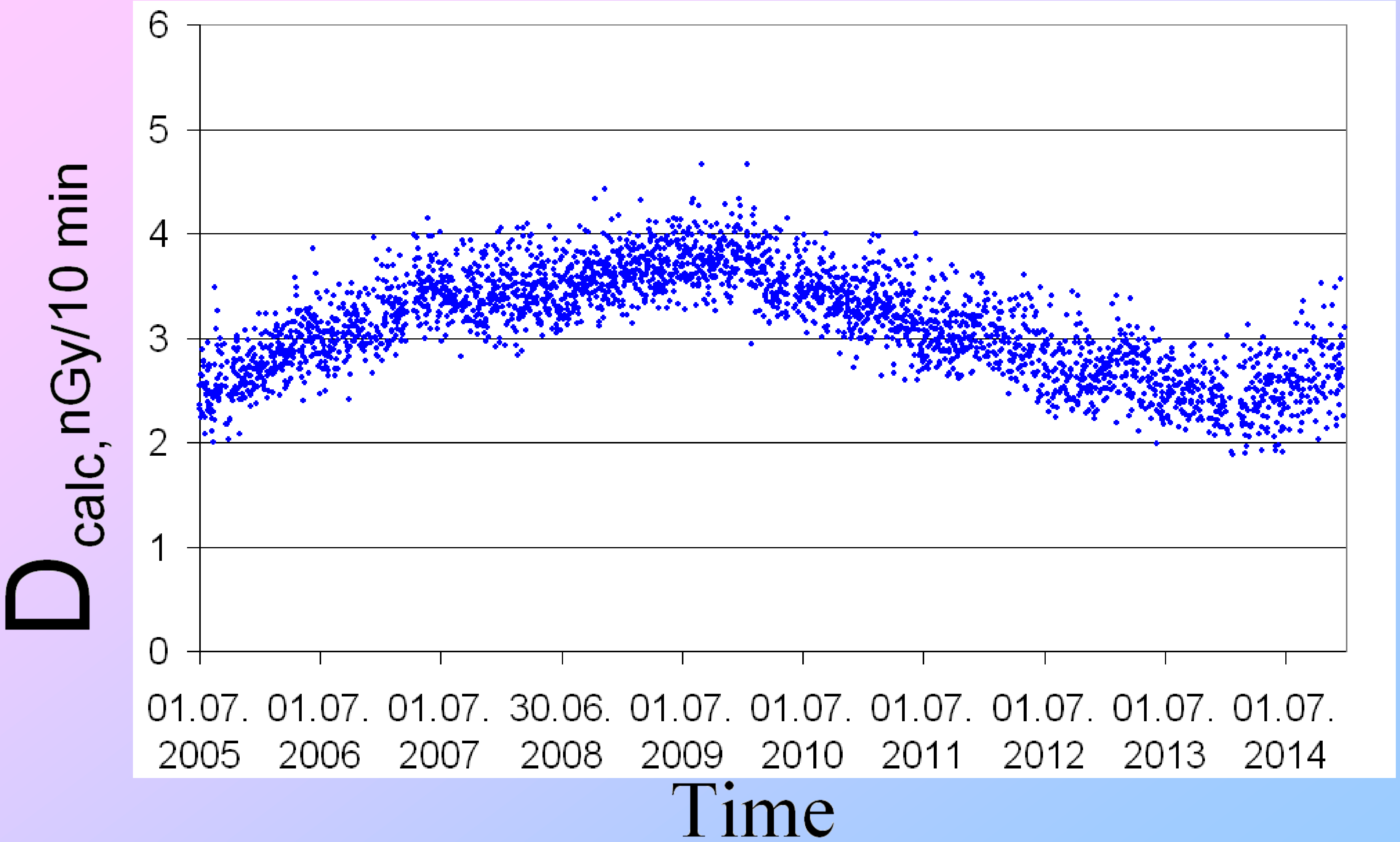
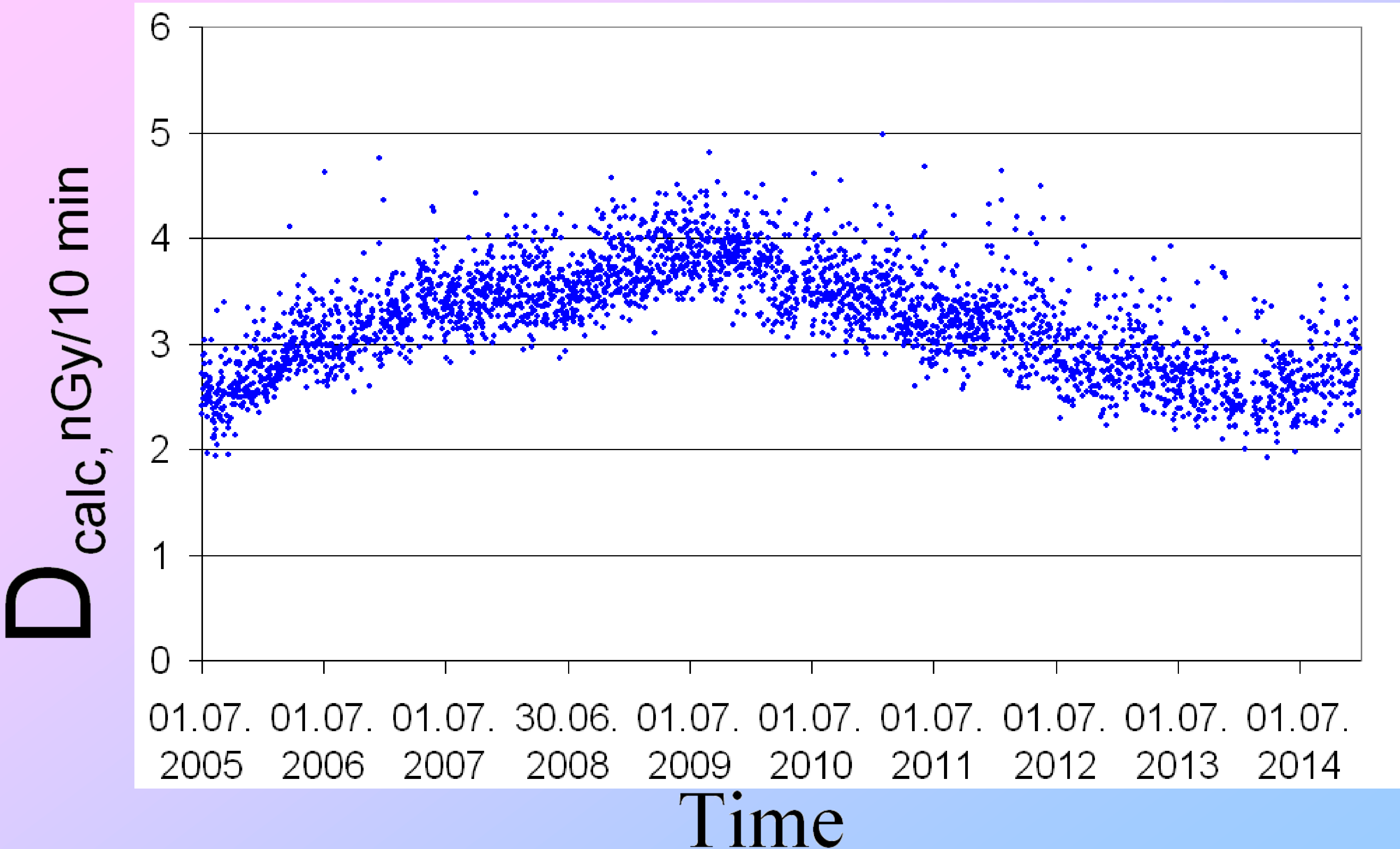


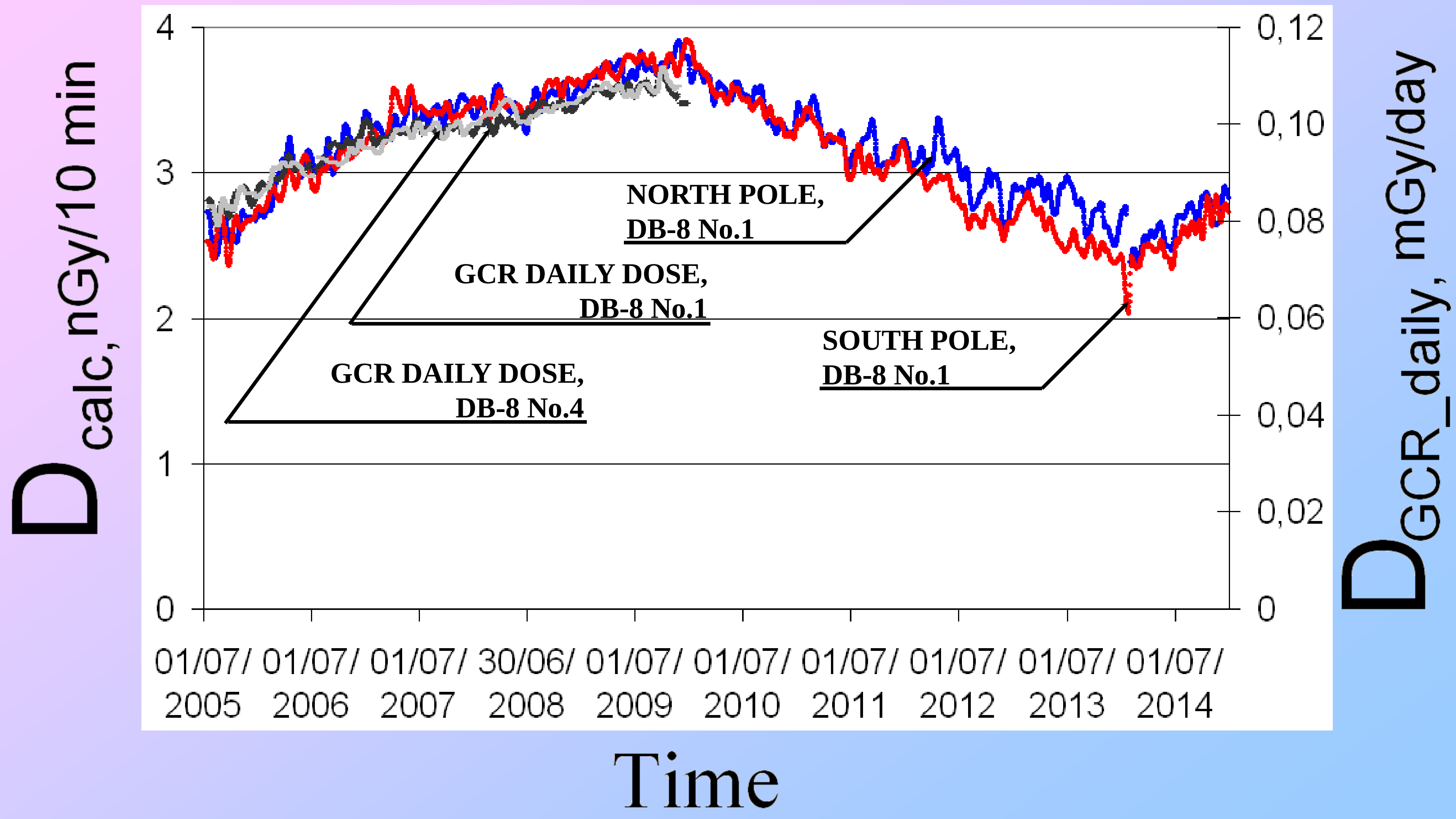
Recalculation to DAILY average

SOUTH POLE, DB-8 No. 4



NORTH and SOUTH POLE, DB-8 No. 1

Averaging and comparing resulting data on daily GCR doses from
Variations of Radiation Environment on the International Space Station in 2005–2009
A. E. Lishnevskii, M. I. Panasyuk, V. V. Benghin, V. M. Petrov, A. N. Volkov, and
O. Yu. Nechaev //Cosmic Research, 2012, Vol. 50, No. 4, pp. 319–323



NORTH and SOUTH POLE, DB-8 No. 4

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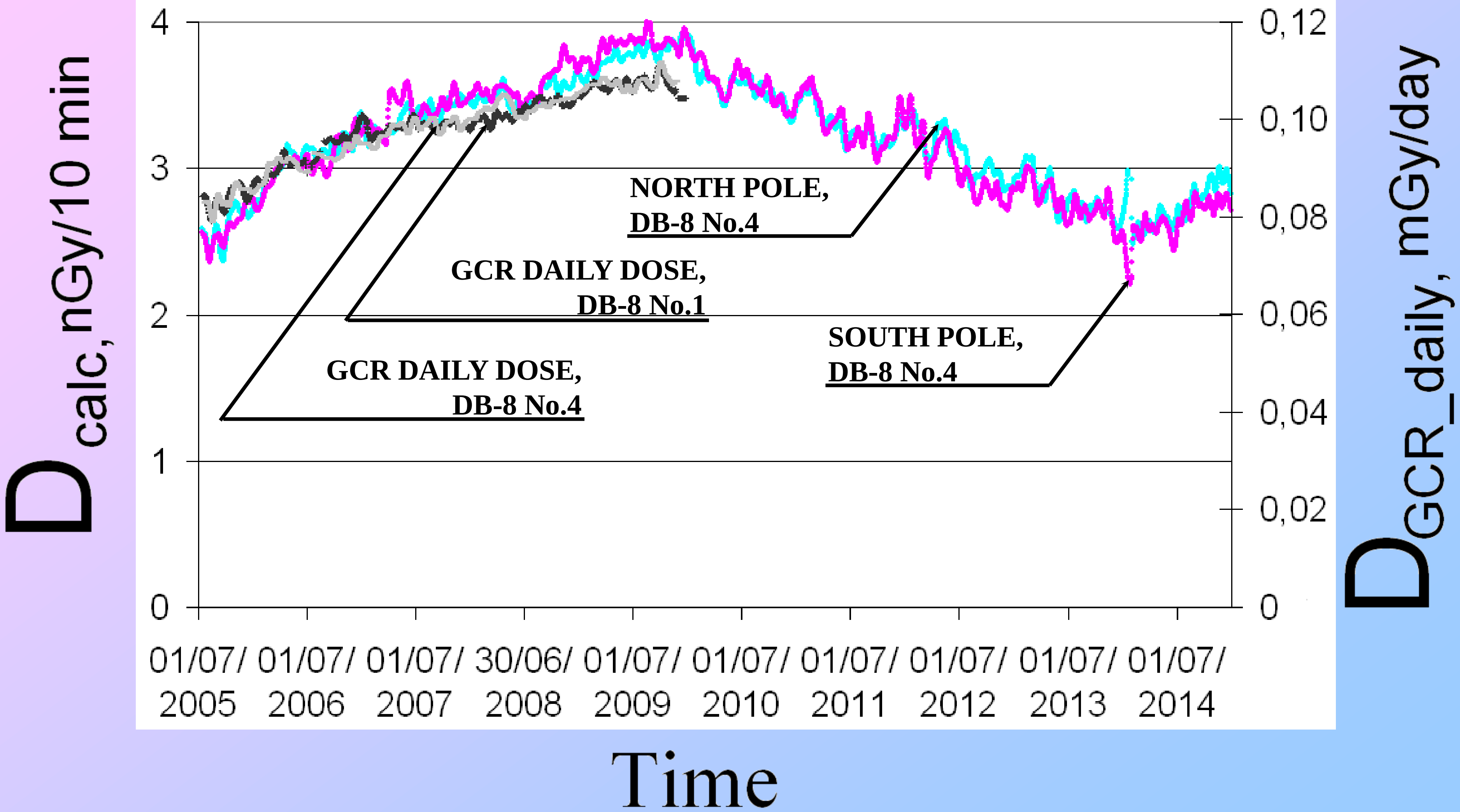
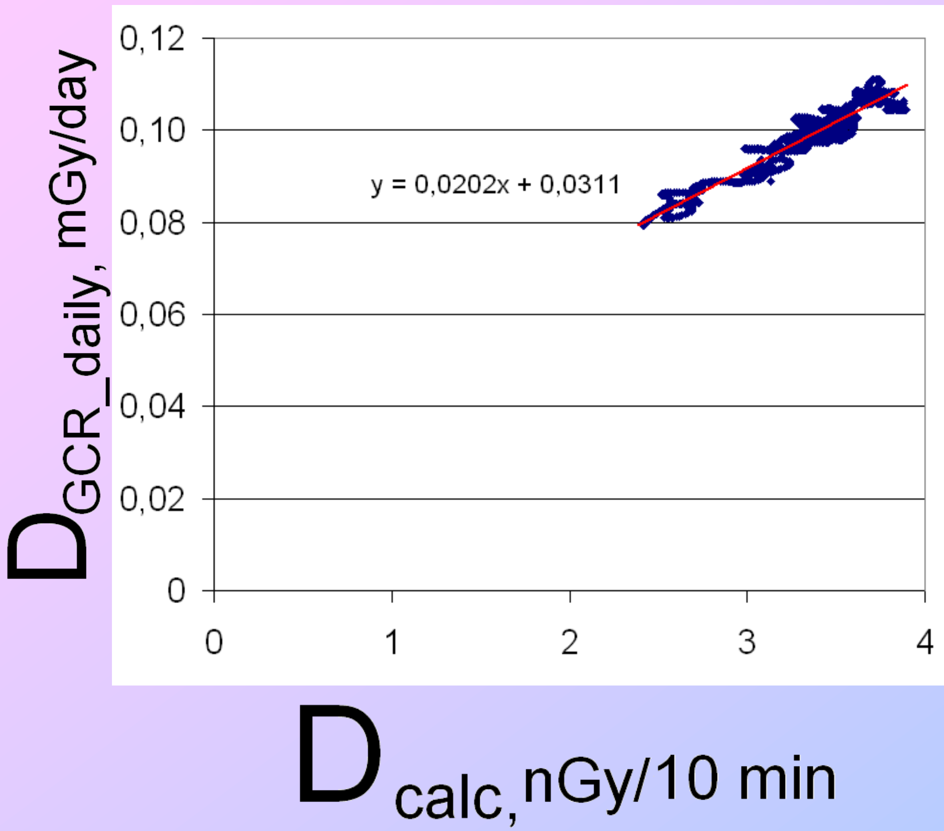
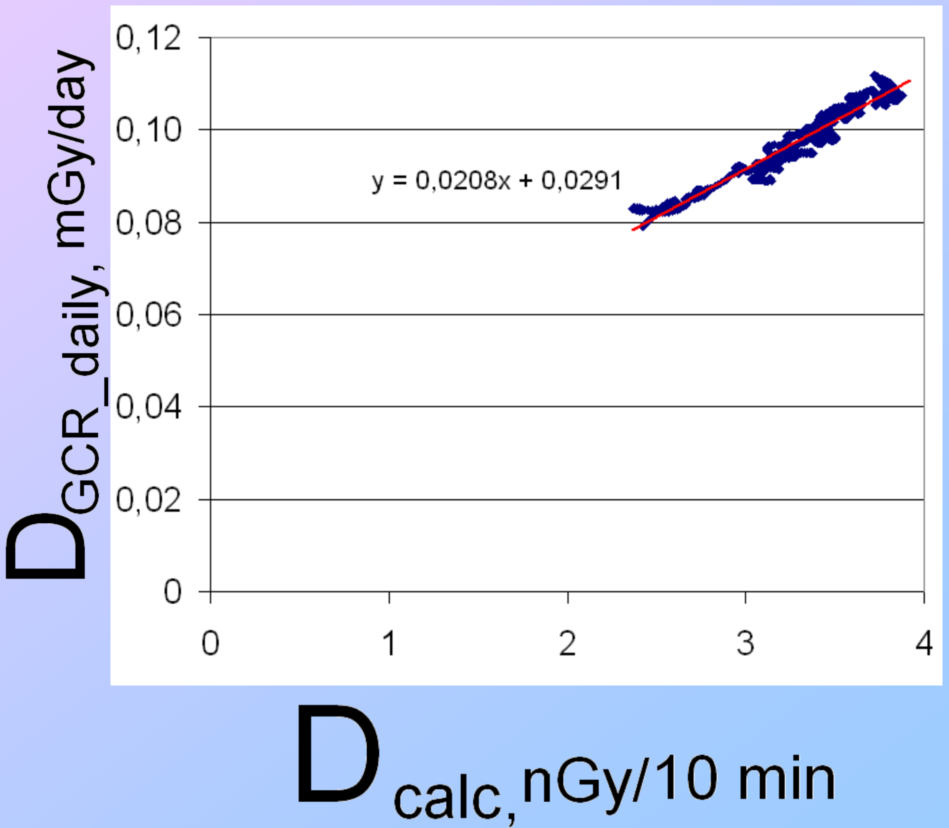


Determine the correlation ratios between averaged values of D_{calc} and daily GCR doses

NORTH POLE, DB-8 No. 1

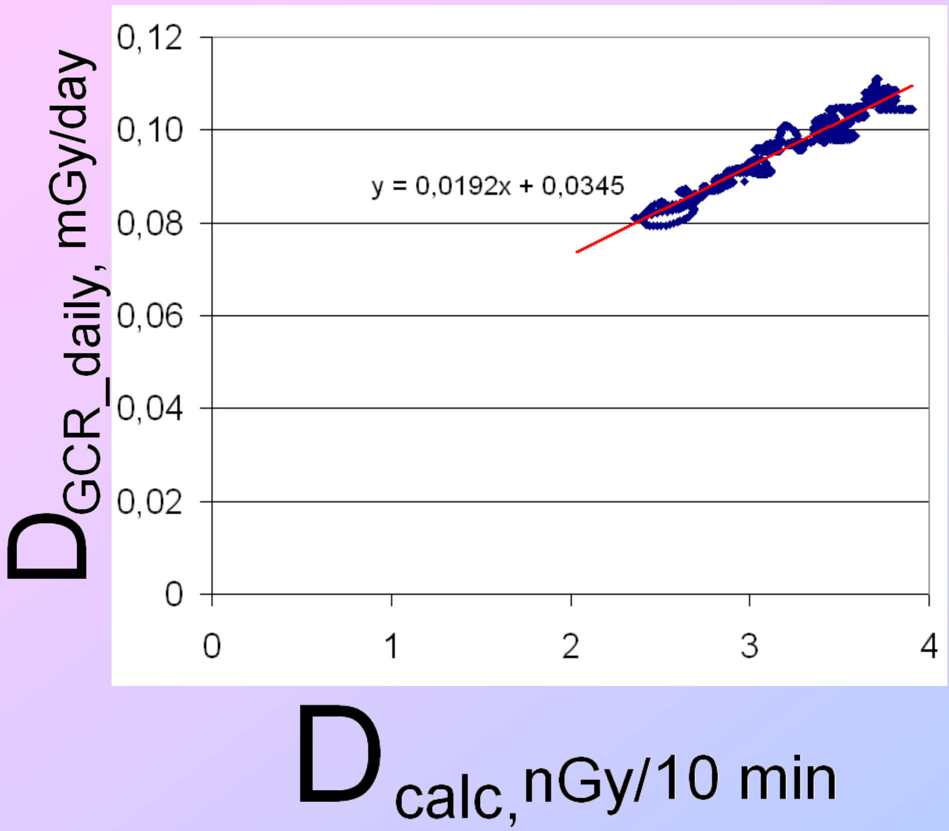


NORTH POLE, DB-8 No. 4

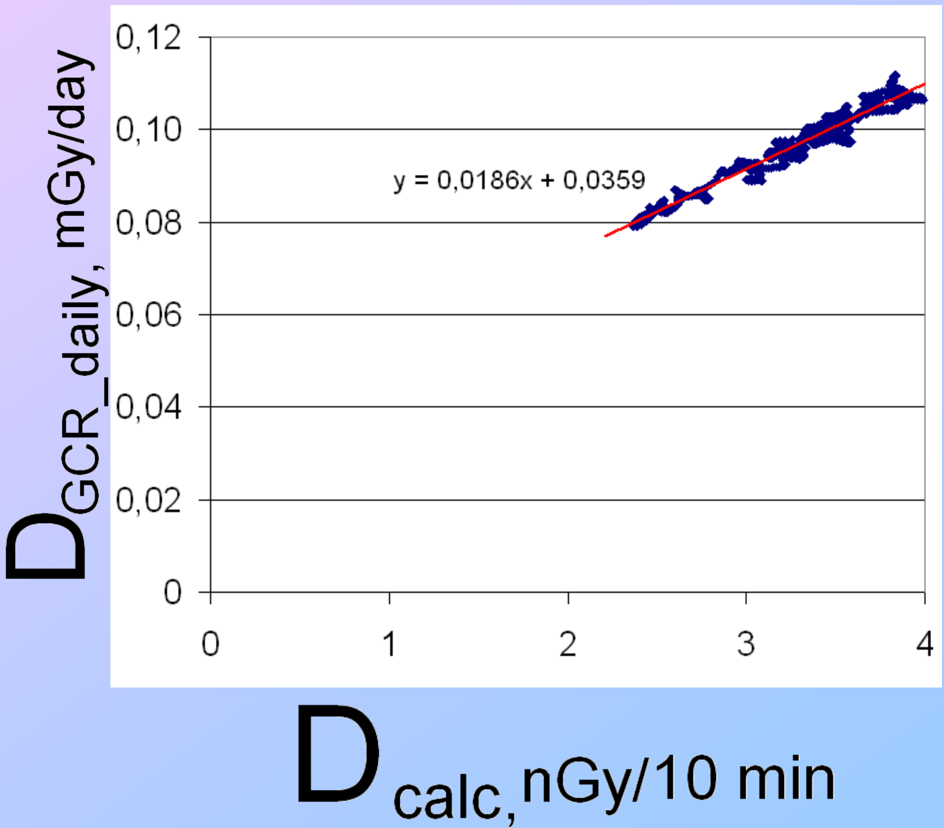


Determine the correlation ratios
between averaged values of $D_{\mathbf{calc}}$ and daily GCR doses

SOUTH POLE, DB-8 No. 1



SOUTH POLE, DB-8 No. 4



Averaging the numeric coefficients in correlation ratios

$$D_{\mathbf{GCR\_daily}} = 0.0205*D_{\mathbf{calc}} + 0.0301$$

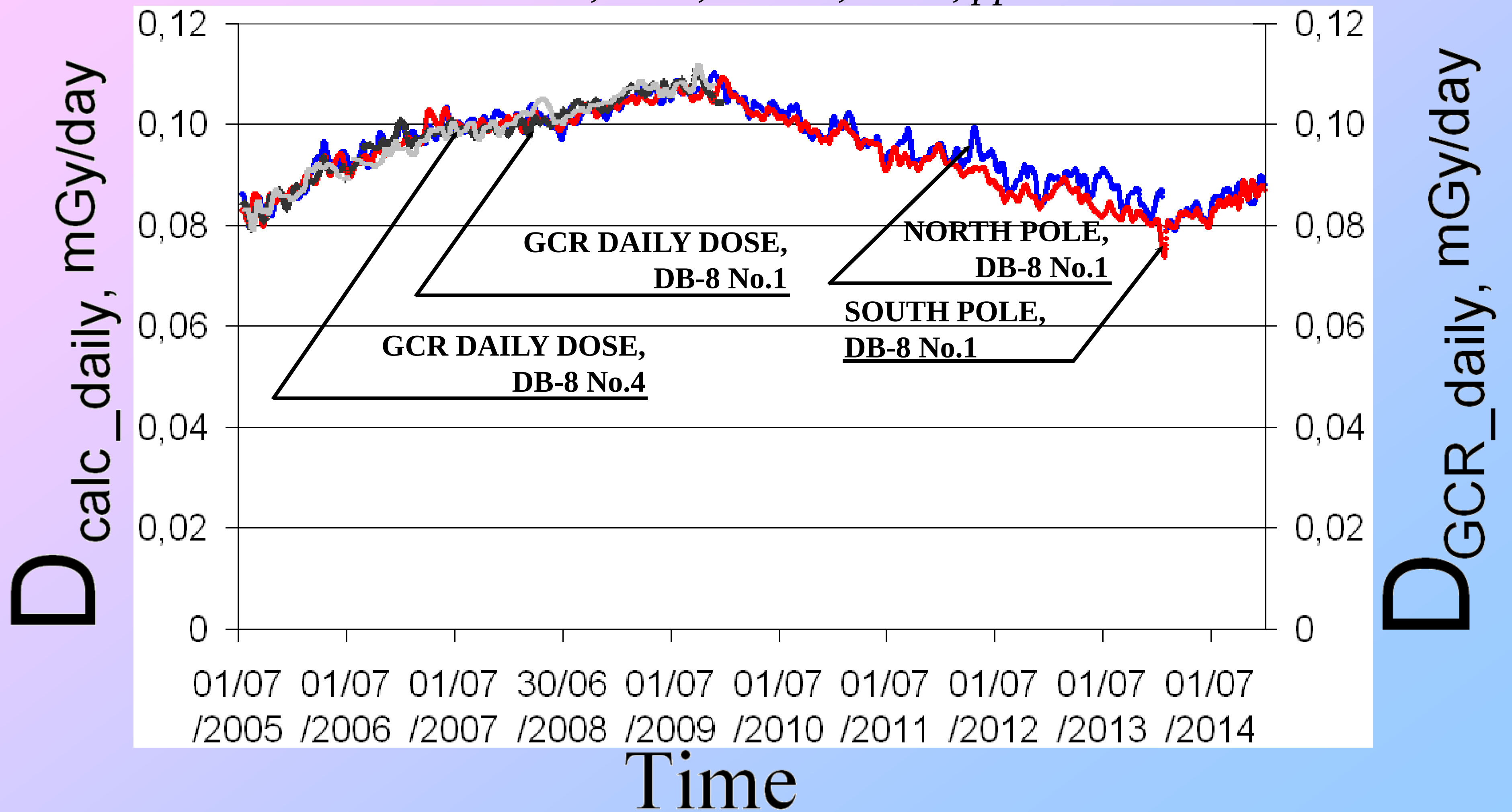
(for NORTH POLE)

$$D_{\mathbf{GCR\_daily}} = 0.0189*D_{\mathbf{calc}} + 0.0352$$

(for SOUTH POLE)

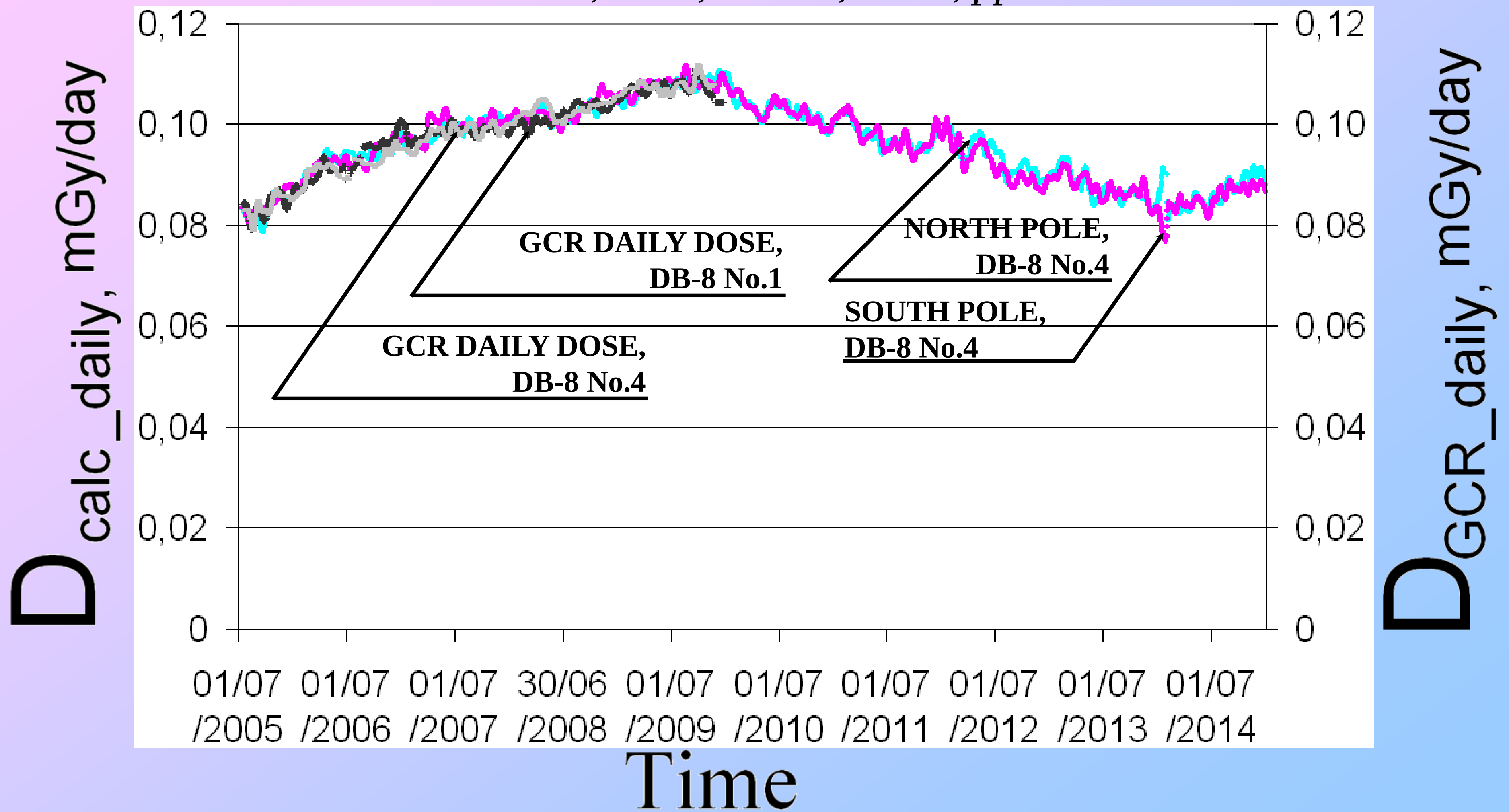
NORTH and SOUTH POLE, DB-8 No. 1

Recalculating D_{calc} values into contribution to daily dose from GCR and comparing the resulting data with the daily doses from GCR obtained in *Variations of Radiation Environment on the International Space Station in 2005–2009 A. E. Lishnevskii, M. I. Panasyuk, V. V. Benghin, V. M. Petrov, A. N. Volkov, and O. Yu. Nechaev //Cosmic Research, 2012, Vol. 50, No. 4, pp. 319–323*



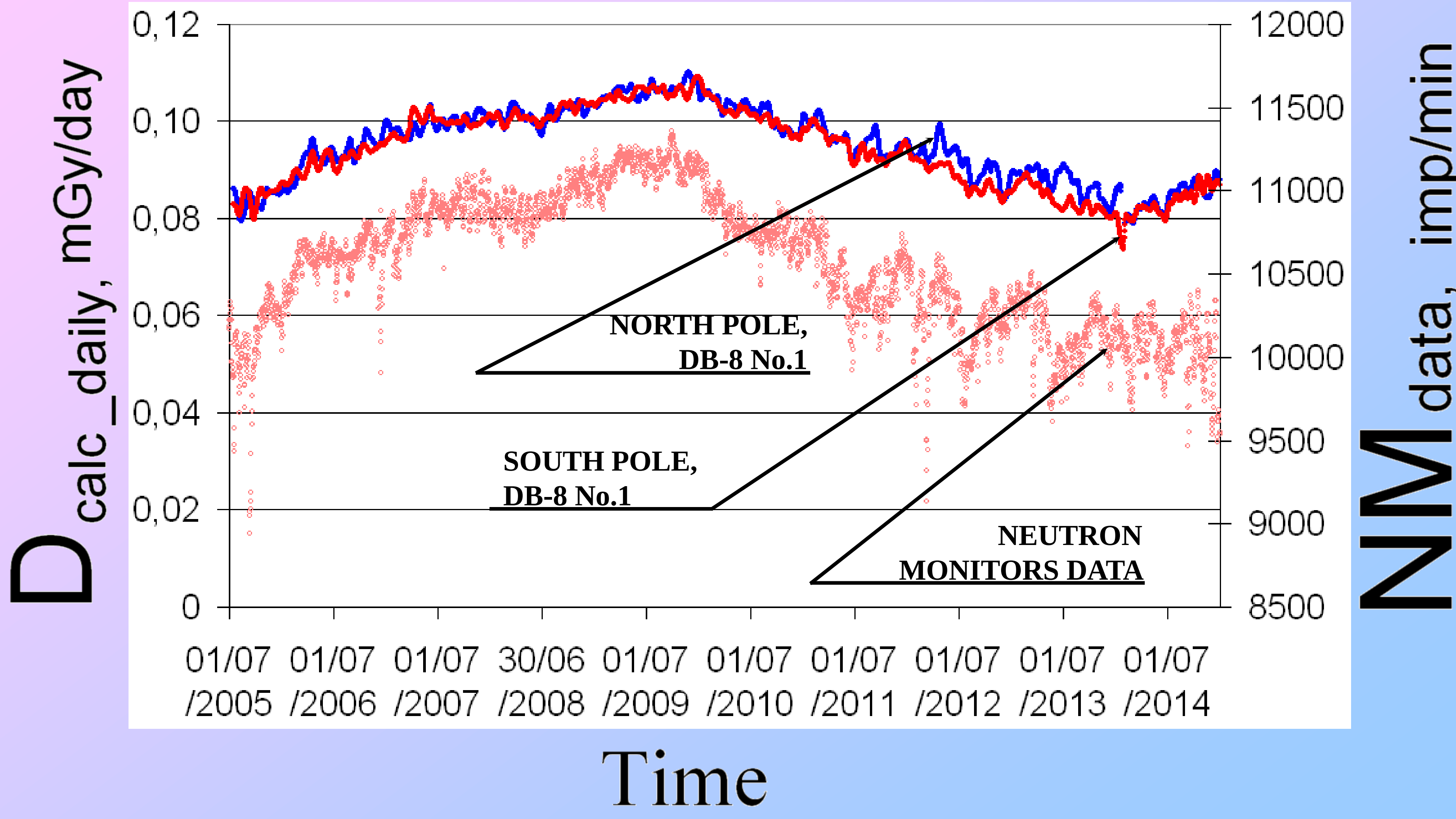
NORTH and SOUTH POLE, DB-8 No. 4

Recalculating D_{calc} values into contribution to daily dose from GCR and comparing the resulting data with the daily doses from GCR obtained in *Variations of Radiation Environment on the International Space Station in 2005–2009 A. E. Lishnevskii, M. I. Panasyuk, V. V. Benghin, V. M. Petrov, A. N. Volkov, and O. Yu. Nechaev //Cosmic Research, 2012, Vol. 50, No. 4, pp. 319–323*



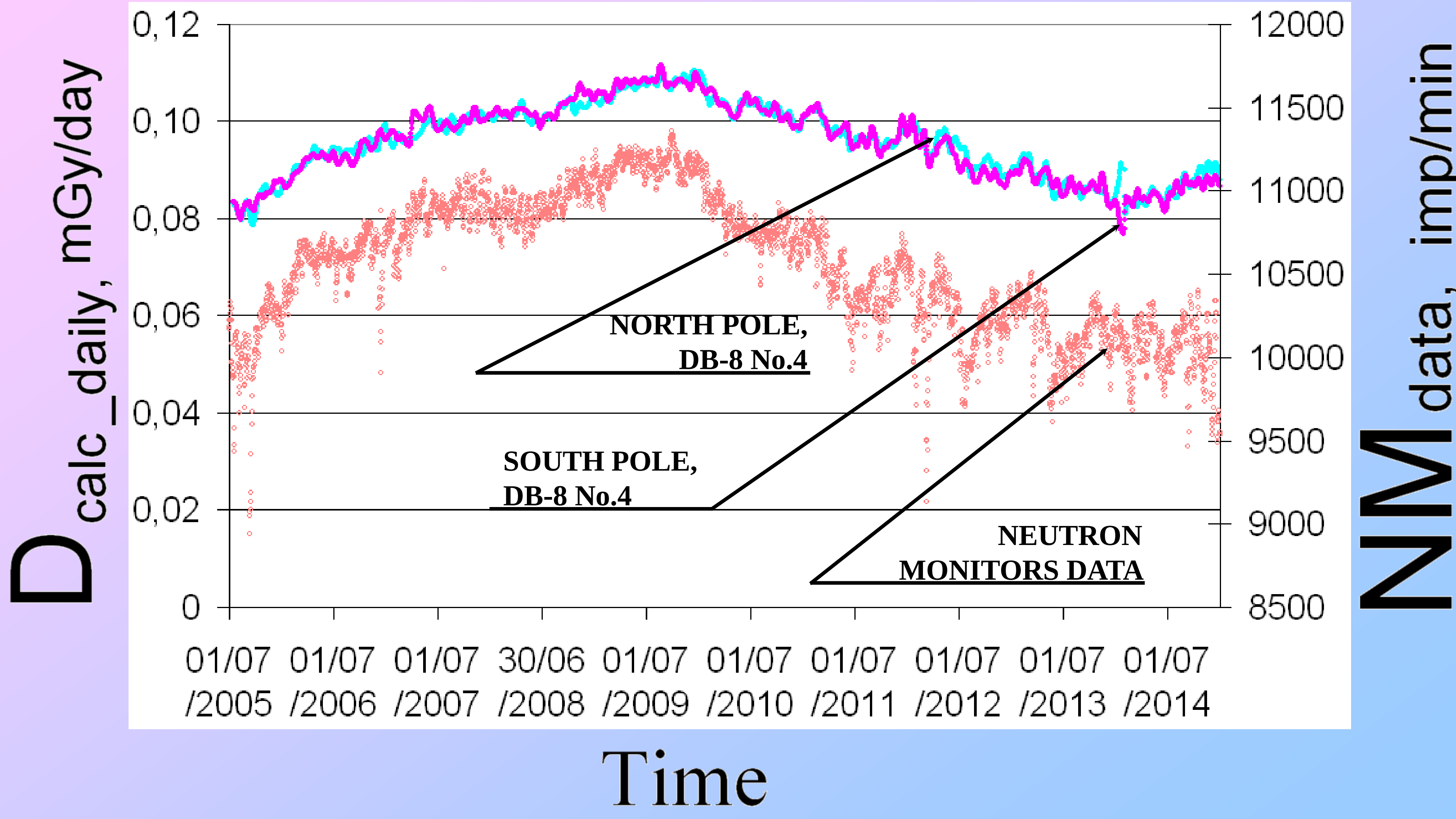
NORTH and SOUTH POLE, DB-8 No. 1

Comparing data on neutron monitors (Apatity, http://pgia.ru/data/nm/)

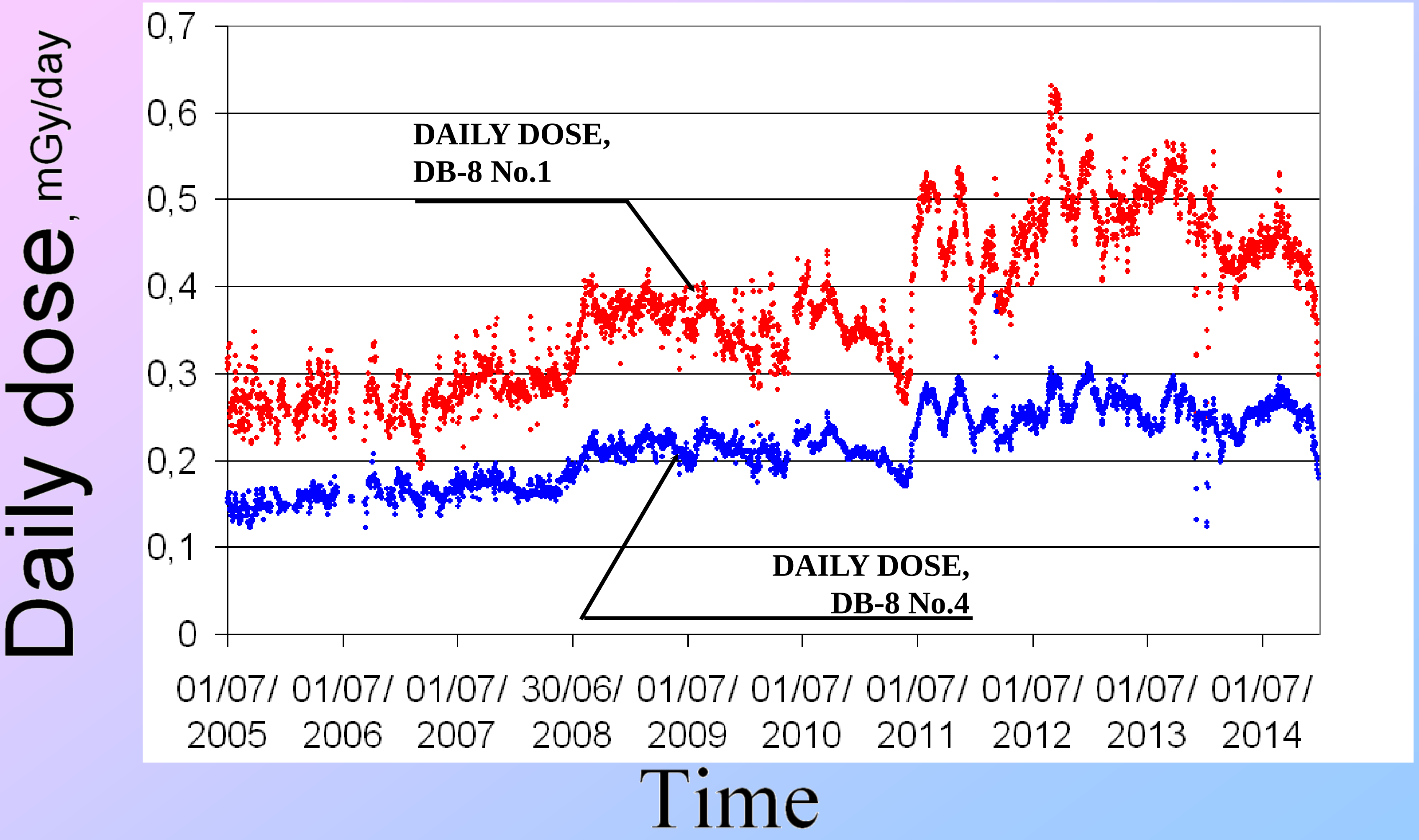


NORTH and SOUTH POLE, DB-8 No. 4

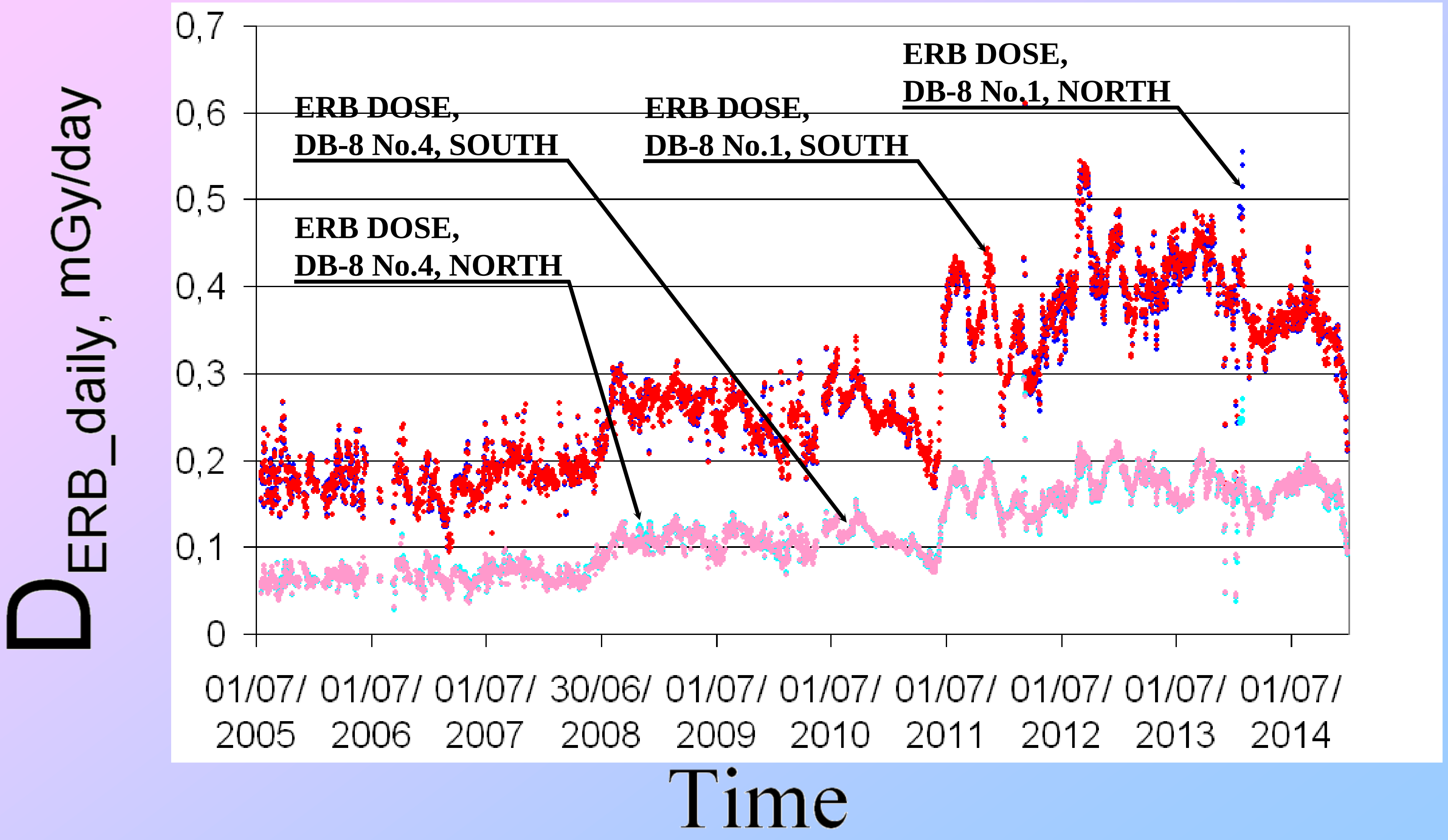
Comparing data on neutron monitors (Apatity, http://pgia.ru/data/nm/)



Daily doses on ISS, DB-8 No. 1 and No. 4

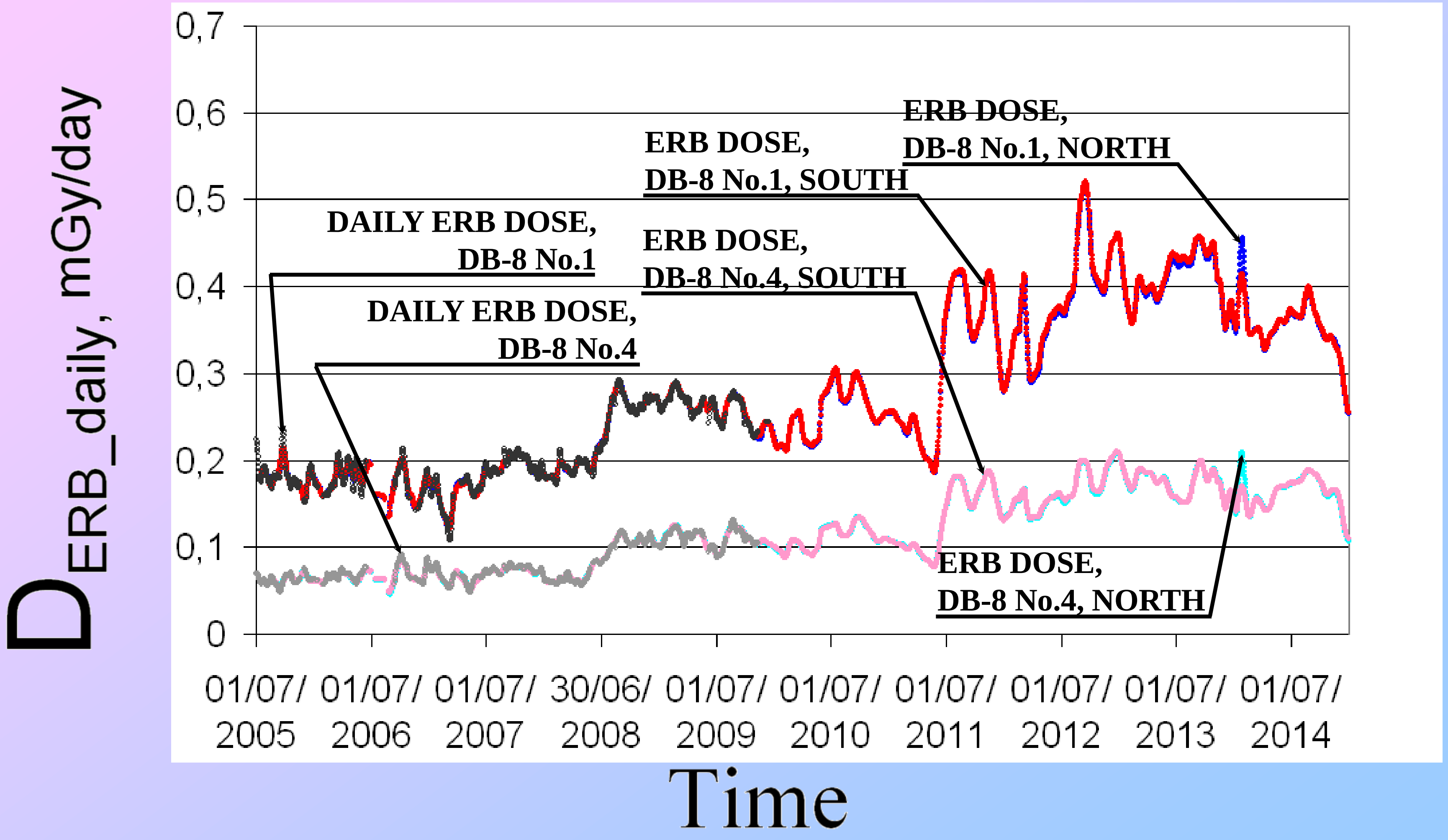


DOSE from inner ERB,
NORTH and SOUTH POLE, DB-8 No. 1 and No. 4



DOSE from inner ERB,
NORTH and SOUTH POLE, DB-8 No. 1 and No. 4

Averaging and comparing resulting data on daily ERB doses from *Variations of Radiation Environment on the International Space Station in 2005–2009 A. E. Lishnevskii, M. I. Panasyuk, V. V. Benghin, V. M. Petrov, A. N. Volkov, and O. Yu. Nechaev //Cosmic Research, 2012, Vol. 50, No. 4, pp. 319–323*



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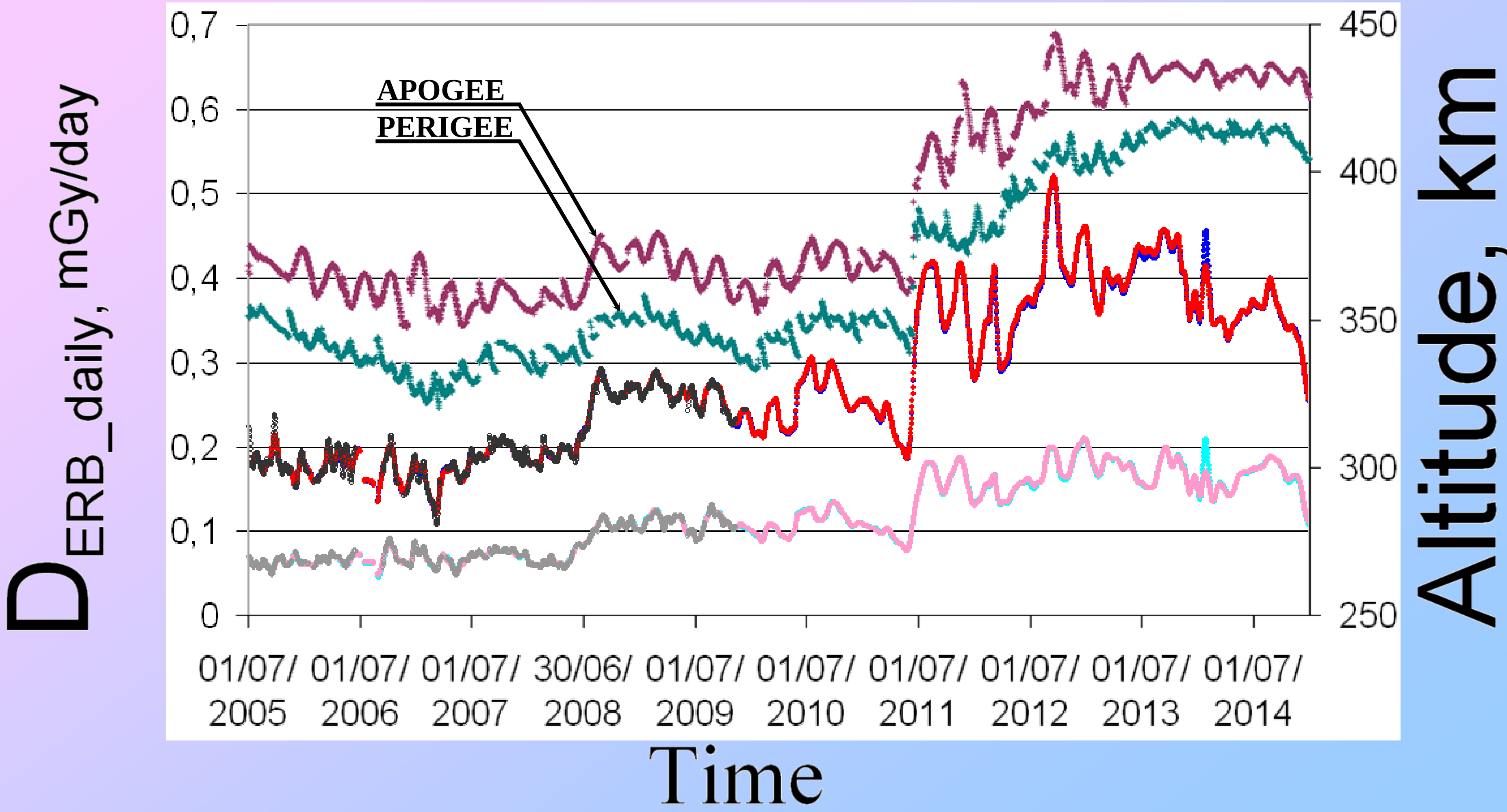

Conclusion

1. We have developed the method of RMS data analysis that permits to separate the contribution of GCR and inner ERB into the daily dose according to dosimetric data obtained during the ISS passings through the areas of highest geomagnetic latitudes.

2. As a result of RMS DB-8 detectors data analysis we obtained temporal dynamics of the contribution of GCR to daily dose for the time period from July 2005 to December 2014. This result correlates well with the data from neutron monitors (Apatity).

3. As a result of RMS DB-8 detectors data analysis we obtained temporal dynamics of the contribution of inner ERB to daily dose for the time period from July 2005 to December 2014. Dependence of the daily dose temporal dynamics in the SAA region on the altitude of the ISS orbit is confirmed.

4. The suggested methodical approach to the processing of dosimetric data is possible to use not only for the ISS but also for other similar orbital stations equipped with dosimetric instrumentation.

5. Modulation depth of readings of the daily dose from GCR (15.8%) and neutron monitors (16.1%) differs by 9.7% due to the different contribution of the low-energy part of the spectrum of the detected particles into these values. Contribution from the inner ERB for the least and the most protected DB-8 detectors increased, in comparison with the period 2005 - 2009, from 0.30 mGy/day to 0.45 mGy/day (the least protected detector) and from 0.14 mGy/day to 0.20 mGy/day (the most protected detector) due to the increasing of altitude of the Station’s orbit.

Thank you for your attention!