ASTRO-H

INSTRUMENT CALIBRATION REPORT
RIGIDITY AND SAA
ASTH-GEN-CALDB-SAA

Version 0.1

Oct 12 2016

ISAS/ GSFC

Prepared by: Hitomi Science Data Center

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DOCUMENT TITLE : Rigidity and SAA

ISSUE	DATE	PAGES AFFECTED	DESCRIPTION
Version 0.1	March 2016	All	First Release
Version 0.2	Aug 2016	Sec 2.1 2.2	Add HXI high background regions
Version 0.3	Oct 2016	Sec 2.1 (bullet 1)	Add link to the IGRF model

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Introduction

1.1 Purpose

This document contains information of two calibration files: one with the rigidity map (COR) used by Hitomi and one with the the South Atlantic Anomaly (SAA) cornet definitions.

1.2 Scientific Impact

COR and SAA are two parameters used in the screening process. Both information are calculated and written for each observation in the .ehk file. They are derived using the values stored in CALDB.

2 Release CALDB 20160310

Filename	Valid data	Release data	CALDB Vrs	Comments
ah_gen_cor _20140101v001.fits	2014-01-01	20160310	001	First release
ah_gen_saa_20140101v002.fits	2014-01-01	20160812	004	Second release of this file

2.1 Data Description

1) The rigidity values in the "ah_gen_cor" file are calculated using the International Geomagnetic Reference Field (IGRF, https://www.ngdc.noaa.gov/IAGA/vmod/index.html) version 12 model updated in 2015. This model may be used to derive map of COR values for different year. The rigidity map used by Hitomi is calculated for the year 2016.0 using the library code in the HEASoft in the file attitude/lib/geomag/geomag.f and the output is in the file "ah_gen_cor". This file is used by the task ahmkehk that calculates the ehk file and stores the information relative to this IGRF model for the year 2016 in the column COR3.

2) The SAA information stored in CALDB determines the origin of the calculation of the satellite position with respect to the SAA, and contains the longitude and latitude of the vertices that define the SAA for each Hitomi instrument. The file contains 6 columns and 6 rows. The columns are associated with the different instruments (SXI SXS HXI1 HXI2 SGD1 SGD2) and the rows are the vertices that defined the SAA. The vertices are different for each instrument This information is stored in the 1st extension of the file "ah_gen_saa".

3) After launch the HXI determined regions of high background that are used instead of the standard SAA (described in 2) to screen the data. These new regions are written in the 2nd extension of the file "ah_gen_saa" that contains the longitude and latitude of the vertices that define the HXI high background region. These new definitions are introduced with the Hitomi CALDB ver 4.

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2.2   Data Analysis

1) Comparison between the rigidity maps derived from the IGRF version 12 model for different years and the rigidity maps used by ASCA and Suzaku are shown in Figure 1.
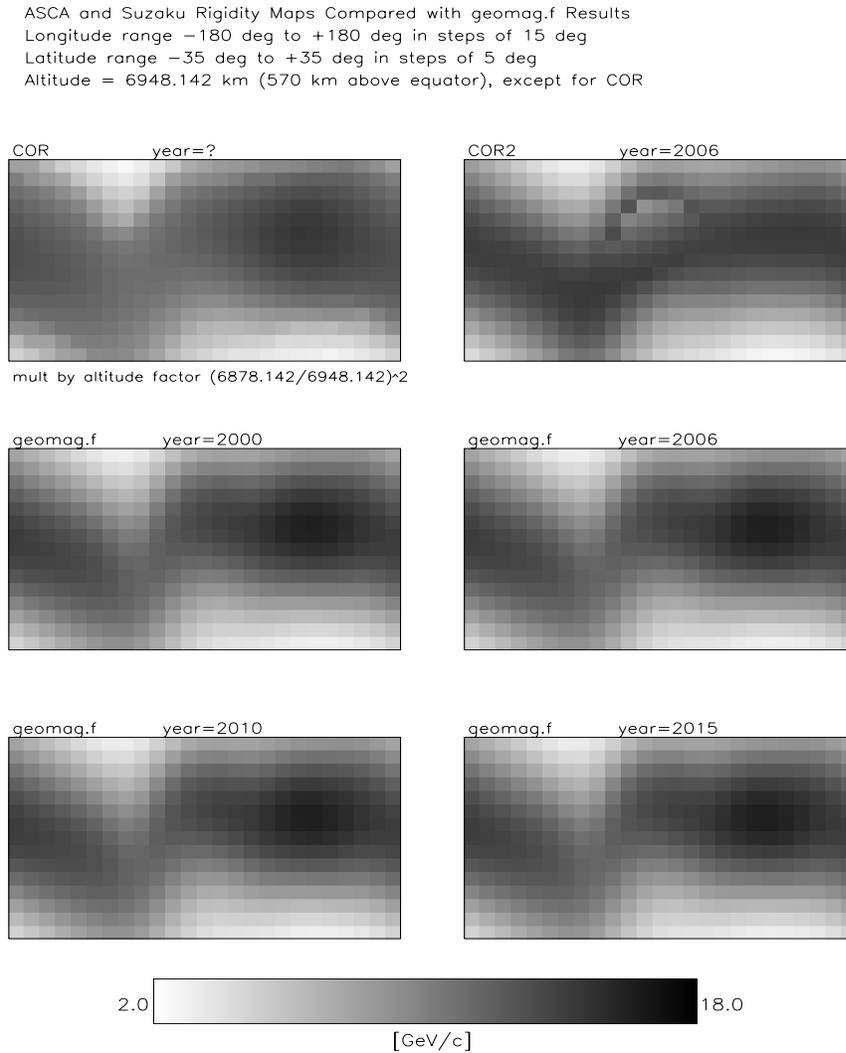

Figure 1: Grayscale renderings of rigidity maps computed with the code "geomag.f " for the epochs 2000.0, 2006.0, 2010.0, and 2015.0, as compared to the COR (ASCA- not dated) and COR2 (Suzaku) maps

It appears veryclearly (upper right corner image) that Suzaku data (column name COR2 in the ehk file , Year 2006) has a distortion at longitude around 0 and positive latitude not seen in the

other maps. Figure 2 shows a projection along longitudinal variations for different fixed values of the latitude where the distortion is more clear (upper panel green curve).
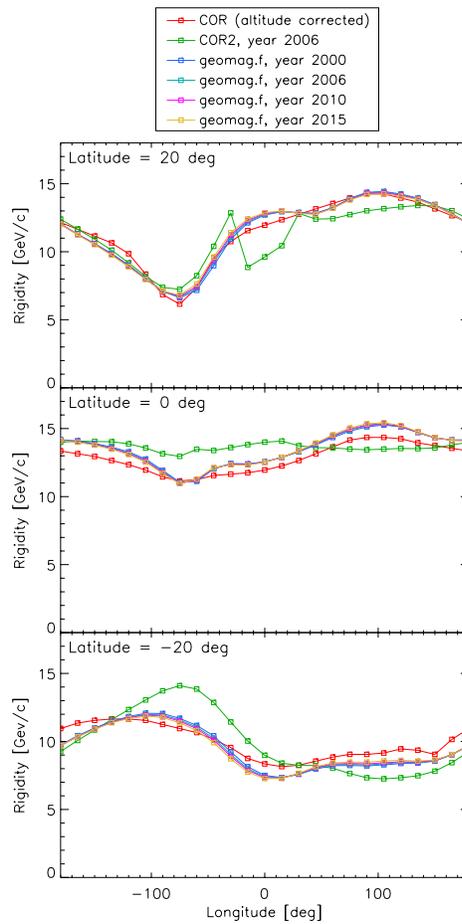
Figure 2: Cuts along latitude +20 deg, 0 deg, and -20 deg, as a function of longitude,for the same set of rigidity maps

2) Fig 3 show the SAA region used for the data screening. These regions are the same used on board and they are set the same for all instruments
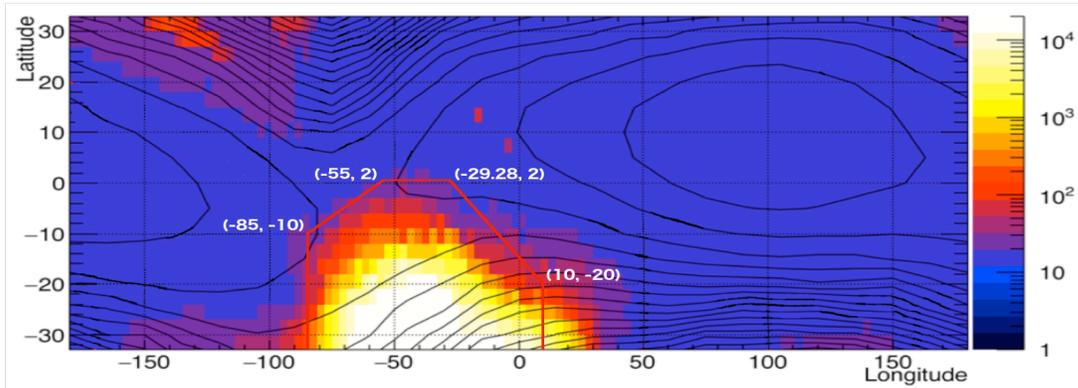
Figure 3: SAA region defined prelaunch for all instruments

3) Fig 4 show the high background region defined for the HXI, these regions are used used for the data screening instead of the SAA . These regions include the SAA as described for all other instruments but also others that affect the detector and the data screening
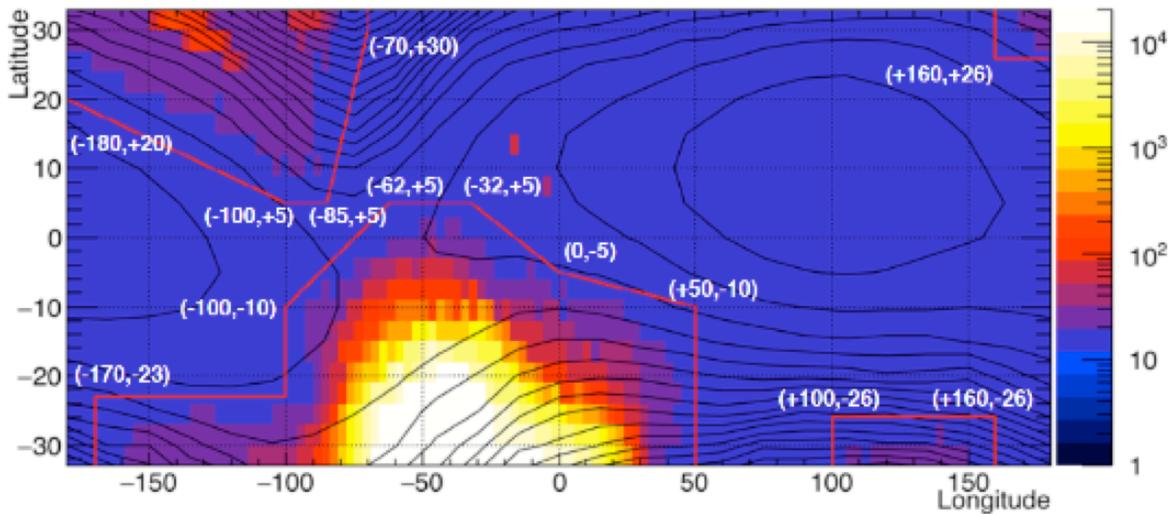

Figure 4: HXI high background region

2.3   Results

1) The rigidity map in CALDB for Hitomi contains a file based on the data derived from the code, using the 2015 IGRF model and computed for year 2106.0

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3   Previous Release CALDB 20160310

Filename	Valid data	Release data	CALDB Vrs	Comments
ah_gen_cor_20140101v001.fits	2014-01-01	20160310	001	First release
ah_gen_saa_20140101v001.fits	2014-01-01	20160310	001	First release