

## Note on GOES 13-15 Solar Protons and Yaw Flips

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The GOES-13, -14 and -15 satellites are capable of a yaw flip, in which the satellite rotates about the axis pointed toward the center of the earth. The yaw flip is performed for the benefit of the GOES Imager and Sounder (see *GOES N Series Data Book*, Revision D, February 2010, p. 3-6 and p. 4-6). The consequence of a yaw flip for the solar proton measurements by the GOES Energetic Proton, Electron and Alpha Detector (EPEAD) is that the detector formerly looking east (west) now looks west (east). In general, the GOES westward observations of solar protons most closely approximate the conditions in the interplanetary medium near Earth because the geomagnetic cutoffs are much lower for the westward direction than for the eastward direction. As a result, the westward-observed fluxes commonly are an order of magnitude greater than the eastward-observed fluxes (Rodriguez et al., 2010, 2014; Rodriguez, 2012; Kress et al., 2013). Therefore, users of the archive data need to know which data channels represent westward- and eastward-observed fluxes.

In the NGDC archive data files, one encounters variable names such as "P2E\_COR\_FLUX" AND "P2W\_COR\_FLUX". It is *not correct* to assume that the 'E' and 'W' in these names refer unvaryingly to eastward and westward look directions. As described in Section 2.5 of GOESN-ENG-048 Rev D (available at <http://www.ngdc.noaa.gov/stp/satellite/goes/documentation.html>):

The EPEAD telemetry channels labeled 'E' look westward when the spacecraft is upright (yaw flip flag = 0) and eastward when the spacecraft is inverted (yaw flip flag = 1). These are labeled 'B' on the summary and quality control (QC) plots.

The EPEAD telemetry channels labeled 'W' look eastward when the spacecraft is upright (yaw flip flag = 0) and westward when the spacecraft is inverted (yaw flip flag = 1). These are labeled 'A' on the summary and quality control (QC) plots.

The orientation notes on the monthly QC and summary plots (e.g., 'B=East') refer to the state at the beginning of the month.

NGDC has plans to produce an orientation flag that will enable users of the data to determine the look direction of the EPEAD units. In the meantime, the following historical summary, which is updated periodically, may be helpful in interpreting the data. It covers times for which EPEAD data are available at NGDC.

### GOES-13

May 2010 to date: Upright for the entire period

### GOES-14

GOES-14 was operated during the autumn 2012 eclipse season, 15 August-5 Nov 2012. It was in the inverted state throughout this period, including during the SEP event in early September 2012.

### GOES-15

September 2011 to date:

GOES-15 undergoes a yaw flip twice a year, at the equinoxes. The maneuver lasts about half an hour; the times given below are approximate.

Yaw Flip Date	Yaw Flip UT	Resultant State	Resultant EPEAD Orientation
September 22, 2011	c. 1800	0 (upright)	'E' / 'B' = westward 'W' / 'A' = eastward
March 20, 2012	c. 2100	1 (inverted)	'E' / 'B' = eastward 'W' / 'A' = westward
September 20, 2012	c. 2100	0 (upright)	'E' / 'B' = westward 'W' / 'A' = eastward
March 20, 2013	c. 2100	1 (inverted)	'E' / 'B' = eastward 'W' / 'A' = westward
September 23, 2013	c. 2100	0 (upright)	'E' / 'B' = westward 'W' / 'A' = eastward
March 20, 2014	c. 2100	1 (inverted)	'E' / 'B' = eastward 'W' / 'A' = westward

### References

Kress, B. T., J.V. Rodriguez, J.E. Mazur, M. Engel, Modeling solar proton access to geostationary spacecraft with geomagnetic cutoffs, *Advances in Space Research*, Volume 52, Issue 11, 1 December 2013, 1939-1948, <http://dx.doi.org/10.1016/j.asr.2013.08.019>

Rodriguez, J. V. (2012), Undulations in MeV solar energetic particle fluxes in Earth's magnetosphere associated with substorm magnetic field reconfigurations, *J. Geophys. Res.*, 117, A06229, doi:[10.1029/2012JA017618](https://doi.org/10.1029/2012JA017618)

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Rodriguez, J. V., J. C. Krosschell, and J. C. Green (2014), Intercalibration of GOES 8–15 solar proton detectors, *Space Weather*, 12, 92–109, doi:10.1002/2013SW000996