

# drms: A Python package for accessing HMI and AIA data

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## Software

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## Summary

The NASA Solar Dynamics Observatory (SDO; Pesnell, Thompson, & Chamberlin, 2012) spacecraft has continuously observed the Sun since 2010. It takes about 1.5 terabytes of data per day, in the form of images or spectral data and associated metadata. The data from two of its instruments, Helioseismic and Magnetic Imager (HMI; Schou et al., 2012) and Atmospheric Imaging Assembly (AIA; Lemen et al., 2012), are stored and distributed by the Joint Science Operations Center (JSOC) at Stanford University. Specifically, the metadata and pointers to the image data are stored in a PostgreSQL database and managed by the Data Record Management System (DRMS). The data and metadata can be accessed using the [JSOC website](#).

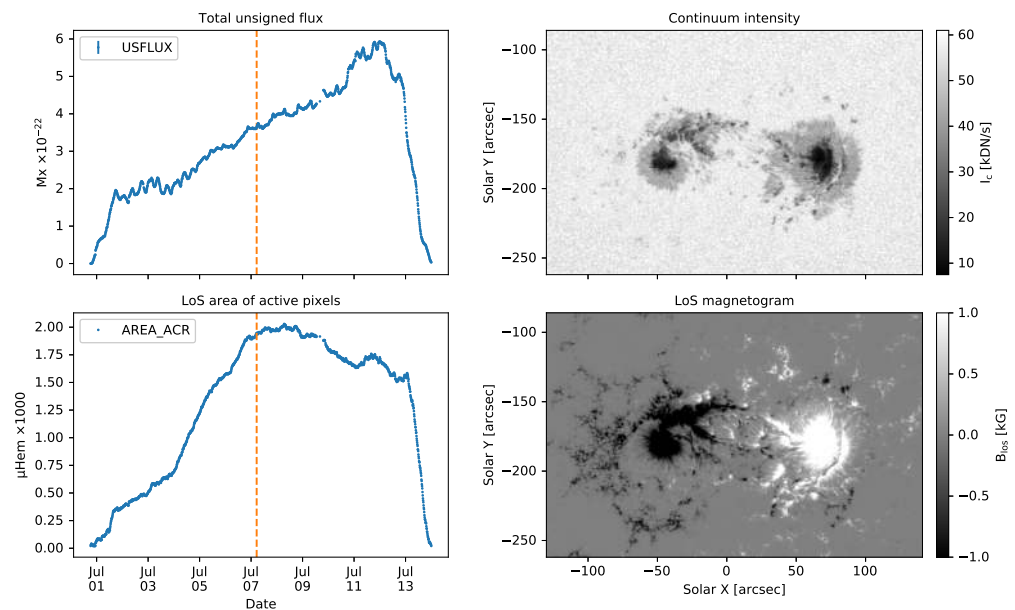
`drms` is a SunPy-affiliated (SunPy Community et al., 2015) Python package for accessing data hosted by JSOC. A vast majority of these data come from the HMI and AIA instruments, but JSOC also hosts data from the Michelson Doppler Imager (MDI; Scherrer et al., 1995) aboard the Solar and Heliospheric Observatory (SOHO) spacecraft and data from the Interface Region Imaging Spectrometer (IRIS; De Pontieu et al., 2014). The `drms` package allows users to execute complex queries across any number of metadata keywords and export tailored datasets in a variety of formats (including FITS files, movies, and images).

The `drms` package is used as backend for SunPy's JSOC client, but it can also be installed independently from [PyPI](#) using `pip` or from [conda-forge](#) using the `conda` package manager. Source code and documentation are available on [GitHub](#) and the [SunPy website](#) respectively. The `drms` client communicates with DRMS servers using an HTTP/JSON interface. By default the `drms` client connects to the JSOC DRMS, but it can also be configured to access local DRMS installations at other sites, provided the site runs a webserver hosting the required Common Gateway Interface (CGI) programs.

One advantage of the DRMS is that it decouples metadata from image data. This means that a user can access and export metadata without downloading any image data. Users can also construct queries across any number of metadata keywords, to only download images of interest.

Each data collection in JSOC (for example, AIA images of the solar corona in 171 Å or HMI maps of the photospheric magnetic field in 6173 Å) is associated with its own database table and it is called a *data series*. An example of a data series with rich, valuable metadata is called `hmi.sharp_720s` and contains Space-weather HMI Active Region Patches (Bobra et al., 2014), or SHARPs.

The left two panels of Figure 1 show a small selection of the available metadata which characterize a particular solar active region. From the steep gradient in the total unsigned



**Figure 1:** Left: Total unsigned flux and mean current helicity of HMI Active Region Patch (HARP) Number 4315 during its disk passage; the dashed orange line marks the central meridian crossing of the active region. Right: Continuum intensity map and magnetic field map at the time of the central meridian crossing.

magnetic flux and the increasing area of active pixels, it is directly evident, without inspecting any image data, that this is a strong emerging active region. The right two panels show a selection of image data corresponding to the time indicated by the dashed orange line in the left two panels. Figure 1 was created from metadata and image data obtained from the JSOC DRMS server using the `drms` package. A Python [script](#) that creates this figure is available in the [examples](#) directory of the `drms` source code.

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