# UDAS_MATLAB manual

*for UDAS_MATLAB 1.00b*

10 May 2020

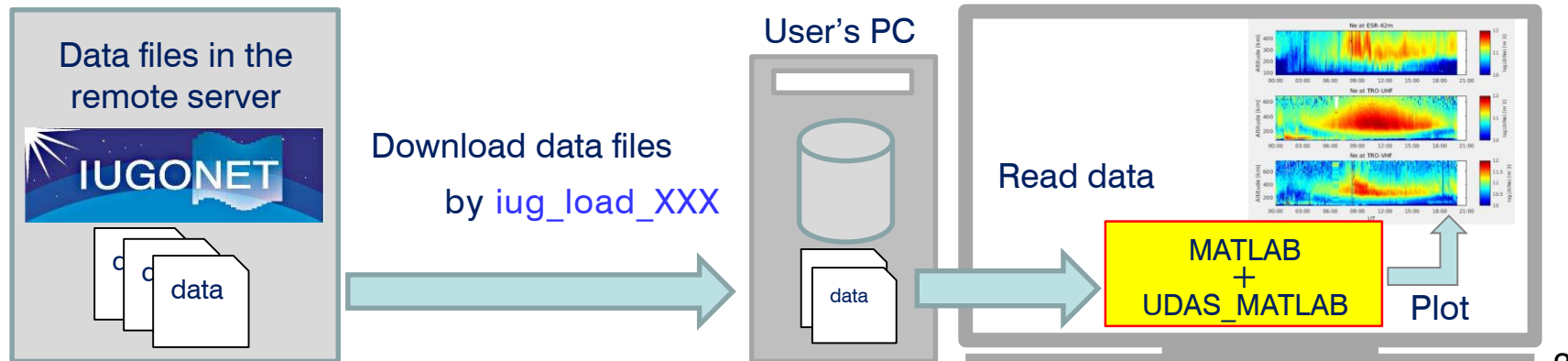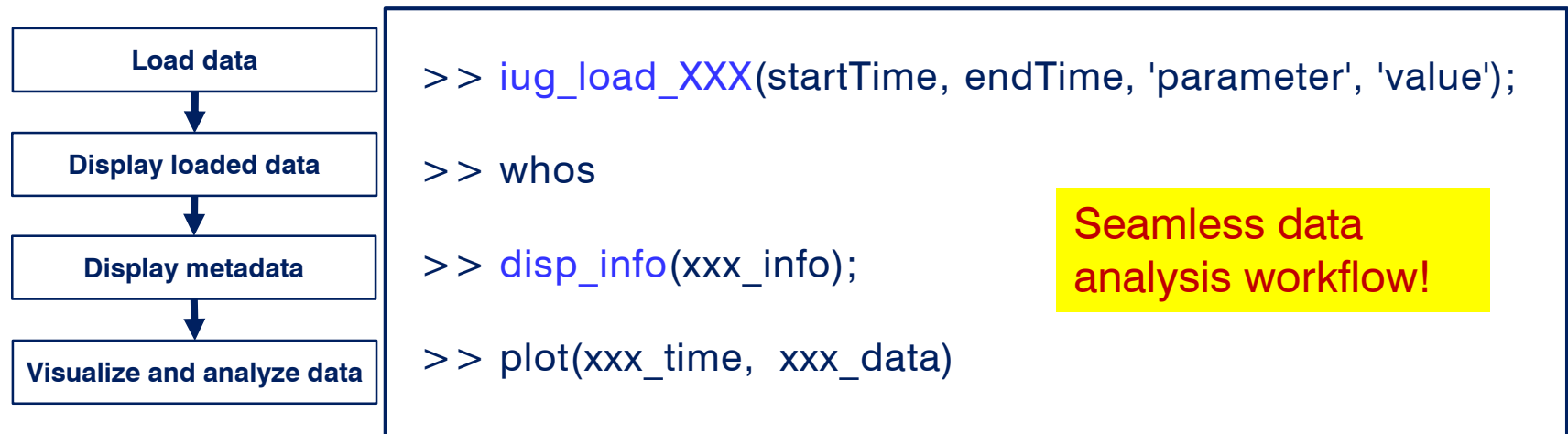IUGONET project team

1. What is UDAS_MATLAB？

2. Load functions included in this package

3. Installation

4. Basic usage of UDAS_MATLAB

5. Sample scripts

6. System requirements, notes, and contact information

UDAS_MATLAB is a MATLAB library for loading and analyzing various kinds of data released by IUGONET universities and institutes.

The load functions included in the package enable users to download and read data files for several days by a command and lead them to data visualization and analysis quickly.

| Load data |
| Display loaded data |
| Display metadata |
| Visualize and analyze data |

```
>> iug_load_XXX(startTime, endTime, 'parameter', 'value');

>> whos

>> disp_info(xxx_info);

>> plot(xxx_time,  xxx_data)
```

Seamless data analysis workflow!

Data files in the remote server

IUGONET

data

Download data files by iug_load_XXX

User's PC

data

Read data

MATLAB + UDAS_MATLAB

Plot

IUGONET

## Load functions included in this package（As of May 2020）

| No. | Data | Load functions |
|---|---|---|
| 1 | All-sky imager data from NIPR | iug_load_asi_nipr |
| 2 | All-sky keogram data from NIPR | iug_load_ask_nipr |
| 3 | Wide beam riometer data from ISEE, Nagoya Univ. | iug_load_brio_isee |
| 4 | EISCAT radar data | iug_load_eiscat |
| 5 | Fluxgate magnetometer data from ISEE, Nagoya Univ. | iug_load_gmag_isee_fluxgate |
| 6 | Induction magnetometer data from ISEE, Nagoya Univ. | iug_load_gmag_isee_induction |
| 7 | MAGDAS magnetometer network data | iug_load_gmag_magdas |
| 8 | 210° magnetic meridian magnetometer network data | iug_load_gmag_mm210 |
| 9 | Fluxgate magnetometer data from NIPR | iug_load_gmag_nipr |
| 10 | Induction magnetometer data from NIPR | iug_load_gmag_nipr_induction |
| 11 | Meteor radar data from RISH, Kyoto Univ. | iug_load_meteor_rish |
| 12 | MF radar data from RISH, Kyoto Univ. | iug_load_mf_rish |

## 【Load functions which will be released in future】

We plan to develop new load functions for CDF (Common Data Format) and NetCDF (Network Common Data Form) files released by the IUGONET universities/institutes. Then, we will develop the load functions for ASCII, FITS format files.

・Tohoku Univ.: Jupiter's/solar wide band spectral data in HF-band, Low Frequency Radio Transmitter data
・NIPR: Imaging riometer data
・ISEE, Nagoya Univ.: VLF-band electromagnetic wave data, OMTI all-sky imager data
・RISH, Kyoto Univ.: EAR radar data, MU radar data, Radiosonde data, GPS radio occultation full spectral inversion data
・SuperDARN radar data, EISCAT ion velocity and electric field vector data, ABON/VLF-B data

1.  **Download and install Udas_Matlab.**

    URL: https://github.com/iugonet/UdasMatlab

    Download the zip file from **[Clone or Download]** button and unzip it in an arbitrary directory.

2.  **Download and install the latest version of MATLAB-CDF software（V3.7.1）.**

    URL: https://spdf.gsfc.nasa.gov/pub/software/cdf/dist/cdf37_1/matlab/

    *   Windows:  matlab_cdf371_win64.exe
    *   Linux:       matlab_cdf371_lin64.tar.gz      * Please see HOWTO-install.txt for the installation.
    *   Mac OS:   matlab_cdf371_mac64.tar.gz

3.  **Set path to Udas_Matlab and CDF software.**

    GUI:

    1.  Start MATLAB and click **[Set Path]** in the **[ENVIRONMENT]** section of the **[HOME]** tab.
    2.  Click **[Add with Subfolders]** in the **[Set Path]** window and select the Udas_Matlab directory.
    3.  Similarly, Click **[Add with Subfolders]** and select the CDF software directory and subdiretories.
    4.  Click **[Save]** to save path and click **[Close]** to close the window.

    CUI:

    1.  Start MATLAB and run the commands as follows:

    >> addpath(genpath('Path to the top directory of Udas_Matlab'))
    >> addpath(genpath('Path to the top directory of CDF software'))

    * If you want to add these directories permanently to the MATLAB path, create "startup.m" in the MATLAB startup directory or any directory in the MATLAB path and add the commands above to the startup.m.

iug_load_XXX(startTime, endTime, 'option', 'value');

Loads data released by IUGONET universities and institutes.

XXX is replaced with the name of data type, instruments, or project.

(Example)
>> iug_load_gmag_magdas('2007-3-1', '2007-3-5', 'site', {'asb', 'kuj'});

>> whos

| Name | Size | Bytes | Class |
|------|------|-------|-------|
| magdas_mag_asb_1sec_all | 1x9 | 26266822 | cell |
| magdas_mag_asb_1sec_f | 345600x1 | 2764800 | double |
| magdas_mag_asb_1sec_hdz | 345600x3 | 8294400 | double |
| magdas_mag_asb_1sec_info | 1x1 | 71148 | struct |
| magdas_mag_asb_1sec_time | 345600x1 | 2764800 | double |
| magdas_mag_kuj_1sec_all | 1x9 | 26266822 | cell |

…..

The load functions download data files to the user's PC and then show the rules of the road in the console. Please read the rules of the road carefully.

The data are loaded as predefined variable names.

In this example, the variable names of the loaded data are
**"magdas_mag_sitename_temporalresolution_parameter"**.

magdas_mag_asb_1sec_all  : A cell array that includes all data.
You can get data values by magdas_mag_asb_1sec_all{index}.
magdas_mag_asb_1sec_info : A structure that includes the metadata. You can see them by the "disp_info" command.
magdas_mag_asb_1sec_time : Time variable. A serial date number (the whole and fractional number of days from a fixed, preset date (January 0, 0000).
magdas_mag_asb_1sec_hdz : Three components of the magnetic field vector.
magdas_mag_asb_1sec_f    : Absolute value of the magnetic field.

disp_info(xxx_info);

Displays the information of data (i.e., metadata) in the console.

The input argument is the loaded metadata (xxx_info).

（例）
```
>> disp_info(magdas_mag_asb_1sec_info)
1. epoch_1sec
    FIELDNAM: Epoch
    CATDESC: Time, beginning of interval
    VALIDMIN: 01-Jan-1990 00:00:00.000
    VALIDMAX: 31-Dec-2100 23:59:59.999
    SCALEMIN: 01-Jan-1990 00:00:00.000
    SCALEMAX: 31-Dec-2100 23:59:59.999
    .....

2. time_1sec
    .....

>> plot(magdas_mag_asb_1sec_time,…
        magdas_mag_asb_1sec_hdz(:,1))

>> datetick('x', 'mm/dd')
>> set(gca, 'xlim', [datenum(2007,3,1), datenum(2007,3,4)])
```

The metadata of the first data (xxx_all{1})

The metadata of the second data (xxx_all{2})

The consecutive number of the displayed metadata corresponds to the element number of the loaded cell array (magdas_mag_asb_1sec_all).

In this example, 9 metadata are displayed because the cell array has 9 elements.

Plot of the north-south component of 1sec-resolution magnetic field data at ASB.

Time is a serial date number from a fixed, preset date (January 0, 0000). The "datetick" function changes the tick labels to date-based labels. The x-axis limit is specified by using the "datenum" function.



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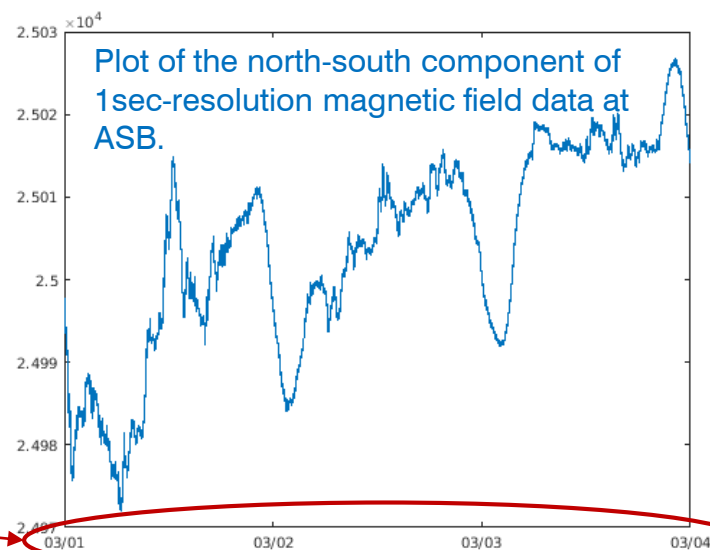
Input arguments of the load functions

**iug_load_XXX**(startTime, endTime, 'option', 'value')

**Required arguments**

| No. | Name | Data type | Format | Examples | Description |
|---|---|---|---|---|---|
| 1 | startTime | character array or datetime array or serial date number | 'yyyy-MM-dd HH:mm:ss' or datetime(Y,M,D,H,MN,S) or datenum(Y,M,D,H,MN,S) | '2000-01-02 03:04:05' datetime(2000,1,2,3,4,5) datenum(2000,1,2,3,4,5) | Start date and time. Data from startTime to endTime are connected. |
| 2 | endTime | character array or datetime array or serial date number | 'yyyy-MM-dd HH:mm:ss' or datetime(Y,M,D,H,MN,S) or datenum(Y,M,D,H,MN,S) | '2000-06-07 08:09:10' datetime(2000,6,7,8,9,10) datenum(2000,6,7,8,9,10) | End date and time. Data from startTime to endTime are connected. |

**Optional arguments**　　　　　**(\*)The existence and name of the options depend on each load function.**

| No. | Name (*) | Data type | Format | Examples | Description |
|---|---|---|---|---|---|
| 3 | site | character array or cell array | 'site1' {'site1', 'site2', 'site3'} | 'asb' {'asb', 'kag', 'kuj'} 'all' or '*' | Character array or cell array that specifies site name. Data at all sites are loaded with 'all' or '*'. |
| 4 | datatype | character array or cell array | 'type1' {'type1', 'type2', 'type3'} | '1sec' {'1sec', '1min', '1h'} 'all' or '*' | Character array or cell array that specifies data type. All types of data are loaded with 'all' or '*'. |
| 5 | parameter | character array or cell array | 'para1' {'para1', 'para2', 'para3'} | 'iono' {'iono', 'meso', 'trop'} 'all' or '*' | Character array or cell array that specifies parameter. All types of data are loaded with 'all' or '*'. |
| 6 | downloadonly | integer | 0 or 1 (The default value is 0) | 1 | 0: Load data. 1: Download data files only and does not load data. |
| 7 | no_download | integer | 0 or 1 (The default value is 0) | 1 | 0: Download data files from the remote servers. 1: Does not download data files from the remote servers and reads the local data files. |

**IUGONET**

examples/iug_crib_XXX.m is a sample script of the load function, iug_load_XXX.

(Example) iug_crib_gmag_magdas.m

```matlab
%----- Delete all variables -----%
clear all;

%----- Load 1 site data -----%
iug_load_gmag_magdas('2007-3-1', '2007-3-5', 'site', 'asb');          ←——————— Load data.

%----- Check the loaded data -----%
whos                                                                   ←——————— Display the loaded data.

%----- Display metadata -----%
disp_info(info);                                                       ←——————— Display the metadata of data.

%----- Pause -----%
input('Press any key.');

%----- Load 1 site data -----%
figure;
plot(magdas_mag_asb_1sec_time, magdas_mag_asb_1sec_hdz(:,1))          ←— Plot the loaded data.
```

**【How to use the crib sheets】**

The example crib sheet, iug_crib_XXX.m, explains how to use the load function, iug_load_XXX. The users can run the load functions by copying & pasting the commands in the crib sheets into the command line. Or alternatively, execute

\>\> iug_crib_XXX

By using the crib sheet, the users can experience to load data, display metadata, and create quick-look plot, and advance to more detailed data analysis for the user's research.

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## System requirements (As of May 2020)

| | |
|---|---|
| O S | Windows / MacOS / Linux |
| MATLAB | 8.5 or higher |
| CDF software | v3.7.1 or higher     (https://cdf.gsfc.nasa.gov/) |

## Notes

1.  When you use the UDAS_MATLAB, please refer to the rules of the road of the IUGONET project. Rules of the road:  http://www.iugonet.org/rules/
2.  Please note that we do not take any responsibility or liability for any damage or loss caused by the UDAS_MATLAB.

## Contact information

We welcome any questions and comments. Please send any feedback to
Email: iugonet-contact@iugonet.org  (Yoshimasa Tanaka)