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# **MIPP and SMHI/DMI Common Processing Environment**

*Release v1.0.0*

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This is a presentation of:



## python-mipp an introduction

mipp is a Meteorological Ingest-Processing Package (<http://github.com/loerum/mipp>).

It's a Python library and it's main task is to convert low level satellite data into a format understood by mpop (<http://github.com/mraspaud/mpop>). The primary purpose is to support Geostationary satellite data (level 1.5) but there is also support for the reading of some polar orbiting SAR data (see below).

A more sophisticated interface to satellite data objects is supported by mpop.

Currently it handles data from all current Meteosat Second Generation (MSG) satellites, Meteosat 7, GOES 11-15, MTSAT's, and GOMS, all as retrieved via EUMETCast:

```
L-000-MTP___-MET7_____ -00_7_057E-PRO_____ -201002261600-__
L-000-MTP___-MET7_____ -00_7_057E-000001_____ -201002261600-C_
L-000-MTP___-MET7_____ -00_7_057E-000002_____ -201002261600-C_
L-000-MTP___-MET7_____ -00_7_057E-000003_____ -201002261600-C_
...
...
L-000-MSG2___-GOES11_____ -00_7_135W-PRO_____ -201002261600-__
L-000-MSG2___-GOES11_____ -00_7_135W-000001_____ -201002261600-C_
L-000-MSG2___-GOES11_____ -00_7_135W-000002_____ -201002261600-C_
L-000-MSG2___-GOES11_____ -00_7_135W-000003_____ -201002261600-C_
...
...
```

In addition mipp handles Synthetic Aperture Radar (SAR) data from Terrscan-X, Cosmo-Sky Med, and Radarsat 2.

mipp will:

- Decompress XRIT files (if Eumetsat's `xRITDecompress` is available). Software to uncompress HRIT/XRIT can be obtained from EUMETSAT (register and download the [Public Wavelet Transform Decompression Library Software](#)). Please be sure to set the environment variable `XRIT_DECOMPRESS_PATH` to point to the full path to the decompression software, e.g. `/usr/bin/xRITDecompress`. Also you can specify where the decompressed files should be stored after decompression, using the environment variable `XRIT_DECOMPRESS_OUTDIR`. If this variable is not set the decompressed files will be found in the same directory as the compressed ones.
- Decode/strip-off (according to [\[CGMS\]](#), [\[MTP\]](#), [\[SGS\]](#)) XRIT headers and collect meta-data.
- Catenate image data into a numpy-array.
  - if needed, convert 10 bit data to 16 bit

- if a region is defined (by a slice or center, size), only read what is specified.

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**Note:**

- MET7: not calibrated.
  - GOES, METSAT: calibration constants to Kelvin or Radiance (not Reflectance).
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## Code Layout

### **xrit.py**

It knows about the generic HRIT/XRIT format

- `headers = read_headers(file_handle)`

### **MTP.py**

It knows about the specific format OpenMTP for MET7

- `mda = read_metadata(prologue, image_file)`

### **SGS.py**

It knows about the specific format Support Ground Segments for GOES and MTSAT

- `mda = read_metadata(prologue, image_files)`

### **sat.py**

It knows about satellites base on configurations files. It returns a slice-able object (see below).

- `image = load('met7', time_stamp, channel, mask=False, calibrated=True)`
- `image = load_files(prologue, image_files, **kwarg)`

### **slicer.py**

It knows how to slice satellite images (return from `load(...)`). It returns meta-data and a numpy array.

- `mda, image_data = image[1300:1800, 220:520]`
- `mda, image_data = image(center, size)`

### Utilities

#### **cfg.py**

It knows how to read configuration files, describing satellites (see below).

#### **convert.py**

10 to 16 byte converter (uses a C extension)

#### **bin\_reader.py**

It reads binary data (network byte order)

- `read_uint1(buf)`
- `read_uint2(buf)`
- `read_float4(buf)`
- ...

#### **mda.py**

A simple (anonymous) metadata reader and writer

#### **geosnav.py**

It will convert from/to pixel coordinates to/from geographical longitude, latitude coordinates.



## Example definition of a satellite

```
# An item like:
#   name = value
# is read in python like:
#   try:
#       name = eval(value)
#   except:
#       name = str(value)
#

[satellite]
satname = 'meteosat'
number = '07'
instruments = ('mviri',)
projection = 'geos(57.0)'

[mviri-level2]
format = 'mipp'

[mviri-level1]
format = 'xrit/MTP'
dir = '/data/eumetcast/in'
filename = 'L-000-MTP____-MET7_____-%(channel)s_057E-%(segment)s-%Y%m%d%H%M-__'

[mviri-1]
name = '00_7'
frequency = (0.5, 0.7, 0.9)
resolution = 2248.49
size = (5000, 5000)

[mviri-2]
name = '06_4'
frequency = (5.7, 6.4, 7.1)
resolution = 4496.98
size = (2500, 2500)

[mviri-3]
name = '11_5'
frequency = (10.5, 11.5, 12.5)
resolution = 4496.98
size = (2500, 2500)
```

## Usage

```
import xrit

image = xrit.sat.load('meteosat07', datetime(2010, 2, 1, 10, 0), '00_7', mask=True)
mda, image_data = image(center=(50., 10.), size=(600, 500))
print mda
fname = './' + mda.product_name + '.dat'
print >>sys.stderr, 'Writing', fname
fp = open(fname, "wb")
image_data.tofile(fp)
fp.close()
```

## Examples of the usage of some lower level tools

Here an example how to get the observation times (embedded in the ‘Image Segment Line Quality’ record) of each scanline in a segment:

```
import mipp.xrit.MSG

segfile = "/local_disk/data/MSG/HRIT/H-000-MSG3__-MSG3_____-WV_062____-000002____-
↪201311211300-__"
lineq = mipp.xrit.MSG.get_scanline_quality(segfile)
print lineq[0]

(465, datetime.datetime(2013, 11, 21, 13, 1, 48, 924000), 1, 1, 0)
```

## A script, process\_fsd

The script is intended for work on other geostationary data than the MSG (Meteosat) data, the so-called Foreign Satellite Data (FSD). That is e.g. GOES, MTSAT and COMS.

```
process_fsd --check-satellite <prologue-file>
    check if we handle this satellite

process_fsd --check [-l] <prologue-file>
    check if number of image segments are as planned
    -l, list corresponding image segment files

process_fsd --decompress [-o<output-dir>] <file> ... <file>
    decompress files to output-dir (default is working directory)
    -l, list decompressed files

process_fsd --metadata <prologue-file> <image-segment> ... <image-segment>
    print meta-data

process_fsd [-o<output-dir>] <prologue-file> <image-segment> ... <image-segment>
    it will binary dump image-data and ascii dump of meta-data)
```

## MSG series

The calibration of the meteosat second generation satellites is done according to the Eumetsat documents [\[refl\]](#), [\[bt\]](#).

## Reflectances

The visible and near infrared channels are calibrated according to the following formula:

$$r = R / I$$

where

- $r$  is the bidirectional reflectance factor
- $R$  is the measured radiance
- $I$  is the solar irradiance

$R$  is derived from the xRIT data, and  $I$  is given in [\[refl\]](#).

In [\[refl\]](#) the additional following corrections are applied:

- sun-earth distance correction
- cosine of the solar zenith angle.



### MIPP

```
exception mipp.CalibrationError
exception mipp.ConfigReaderError
exception mipp.DecodeError
exception mipp.MippError
exception mipp.NavigationError
exception mipp.NoFiles
exception mipp.ReaderError
exception mipp.UnknownSatellite

mipp.strptime()
    string, format -> new datetime parsed from a string (like time.strptime()).
```

### Metadata

```
class mipp.mda.Metadata

    dont_eval = ('satnumber',)
    ignore_attributes = ()
    read(file_name)
        Read until empty line, 'EOH' or 'EOF'.
    save(file_name)
    token = ':'

mipp.mda.mslice(mda)
```

## Configuration

```
mipp.cfg.read_config(satname, instrument='')
```

## Logging

```
class mipp.log.NullHandler
```

Empty handler.

```
    emit(record)
```

Record a message.

```
mipp.log.debug_on()
```

Turn debugging logging on.

```
mipp.log.get_logger(name)
```

Return logger with null handle

```
mipp.log.logging_off()
```

Turn logging off.

```
mipp.log.logging_on(level=None)
```

Turn logging on.

## XRIT input layer

### MSG

This module will read MSG level1.5 files, format documented in: ‘MSG Level 1.5 Image Data Format Description’, EUM/MSG/ICD/105, v5A, 22 August 2007

```
mipp.xrit.MSG.read_metadata(prologue, image_files, epilogue)
```

Selected items from the MSG prologue file.

### GOMS

Read Electro L N1 HRIT files.

```
mipp.xrit.GOMS.read_epiheader(fp)
```

```
mipp.xrit.GOMS.read_metadata(prologue, image_files, epilogue)
```

Selected items from the Electro L N1 prolog file.

```
mipp.xrit.GOMS.read_proheader(fp)
```

### MTP

This module will read satellit data files in OpenMTP format (eg. Meteosat-7 prolog file). Format described in: ‘The Meteosat Archive; Format Guide No. 1; Basic Imagery: OpenMTP Format’; EUM FG 1; Rev 2.1; April 2000

```
mipp.xrit.MTP.read_metadata(prologue, image_files)
```

Selected items from the Meteosat-7 prolog file.

## SGS

This module will read satellit data files in SGS (Support Ground Segments) format (eg. GOES, MTSAT). Format described in: ‘MSG Ground Segment LRIT/HRIT Mission Specific Implementation’; EUM/MSG/SPE/057; Issue 6; 21 June 2006

`mipp.xrit.SGS.read_metadata` (*prologue, image\_files*)

Selected items from the GOES image data files (not much information in prologue).

## xrit

This module will read LRIT/HRIT headers. Format described in: “LRIT/HRIT Global Specification”; CGMS 03; Issue 2.6; 12 August 1999 “MSG Ground Segment LRIT/HRIT Mission Specific Implementation”; EUM/MSG/SPE/057; Issue 6; 21 June 2006

`mipp.xrit._xrit.read_prologue` (*file\_name*)

`mipp.xrit._xrit.read_epilogue` (*file\_name*)

`mipp.xrit._xrit.read_imagedata` (*file\_name*)

`mipp.xrit._xrit.read_gts_message` (*file\_name*)

`mipp.xrit._xrit.read_mpef` (*file\_name*)

`mipp.xrit._xrit.read_mpef_clm` (*file\_name*)

`mipp.xrit._xrit.decompress` (*infile, outdir='.'*)

Will decompress an XRIT data file and return the path to the decompressed file. It expect to find Eumetsat’s xRITDecompress through the environment variable XRIT\_DECOMPRESS\_PATH

`mipp.xrit._xrit.list` (*file\_name, dump\_data=False*)

## bin\_reader

`mipp.xrit.bin_reader.read_cds_expanded_time` (*buf*)

`mipp.xrit.bin_reader.read_cds_time` (*buf*)

`mipp.xrit.bin_reader.read_cuc_time` (*buf, coarse, fine*)

`mipp.xrit.bin_reader.read_float4` (*buf*)

`mipp.xrit.bin_reader.read_float8` (*buf*)

`mipp.xrit.bin_reader.read_int2` (*buf*)

`mipp.xrit.bin_reader.read_int4` (*buf*)

`mipp.xrit.bin_reader.read_uint1` (*buf*)

`mipp.xrit.bin_reader.read_uint2` (*buf*)

`mipp.xrit.bin_reader.read_uint4` (*buf*)

`mipp.xrit.bin_reader.read_uint8` (*buf*)

## loader

`class mipp.xrit.loader.ImageLoader` (*mda, image\_files, mask=False, calibrate=False*)

`raw_slicing` (*item*)

Raw slicing, no rotation of image.

## convert

```
mipp.xrit.convert.dec10216 (in_buffer)  
mipp.xrit.convert.hrpt_dec10216 (in_buffer)
```

## sat

```
mipp.xrit.sat.load_meteosat07 (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_meteosat09 (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_goes11 (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_goes12 (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_goes13 (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_mtsat1r (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_mtsat2 (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_electrol (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_himawari8 (time_stamp, channel, **kwarg)  
mipp.xrit.sat.load (satname, time_stamp, channel, **kwarg)  
mipp.xrit.sat.load_files (prologue, image_files, epilogue=None, **kwarg)
```

## Metadata

```
class mipp.xrit.mda.Metadata  
  
    ignore_attributes = ('line_offset', 'first_pixel', 'coff', 'loff', 'image_data', 'boundaries')  
    token = ':'
```

## XSAR input layer

### Cosmo Sky-med

### Radarsat-2

### Terra-SAR X

## sat

```
mipp.xsar.sat.load (satname, time_stamp, channel, **kwarg)
```

## Metadata

```
class mipp.xsar.mda.Metadata  
  
    ignore_attributes = ('data', 'calibrate', 'tiepoints')  
    token = ':'
```



## CHAPTER 4

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### Indices and tables

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## Bibliography

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