Orbita’s Hyperspectral Satellite data User Manual

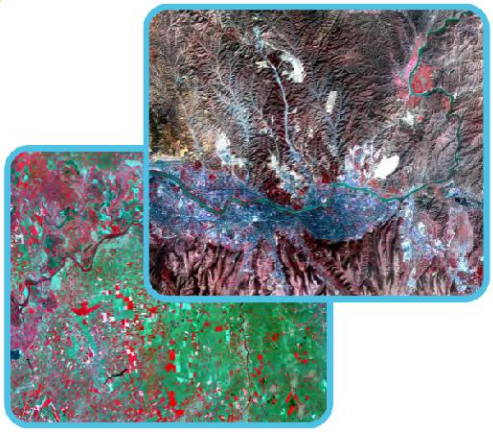
Document No.： ORBITA/BD-HSD-UMM-01

1. “ZHUHAI NO.1” hyperspectral satellite specification

Orbita Hyperspectral Satellite Specifications

OHS: OHS-01, OHS-02, OHS-03 & OHS-04

Orbit altitude :	500km @ SSO
Mass :	67 kg
Coverage(Image scan mode):	150km×2500km
Spatial Resolution :	10m
Spectrum range :	400nm - 1000nm
Spectrum resolution :	2.5nm
Selective spectrums :	32
SNR :	≥300
Data transmission rate:	300 Mbps



Zhuhai NO.1 Hyperspectral Data central wavelength							
Bands	wavelengths	Bands	wavelengths	Bands	wavelengths	Bands	wavelengths
1	466nm	9	596nm	17	716nm	25	836nm
2	480nm	10	610nm	18	730nm	26	850nm
3	500nm	11	626nm	19	746nm	27	866nm
4	520nm	12	640nm	20	760nm	28	880nm
5	536nm	13	656nm	21	776nm	29	896nm

6	550nm	14	670nm	22	790nm	30	910nm
7	566nm	15	686nm	23	806nm	31	926nm
8	580nm	16	700nm	24	820nm	32	940nm

2. “ZHUHAI NO.1” Hyperspectral data package

This chapter is mainly used to explain in detail: files and their naming methods contained in "Zhuhai No. 1" hyperspectral data package

Naming methods：

E.g..：HCM1_20180822220436_0008_L1B_MSS _CCD2

HC—— Hyperspectral satellite of “Zhuhai No.1” OHS-2C

M1——Ground station code，”Mohe”

20180822——Date of data

220436——Hour/minutes/seconds

0008——The eighth scene of the track data

L1B——Product level

MSS——Multispectral

CCD2——2nd CMOS of satellite

The files contains:

- The data of 32 bands(.tif);
- The Rpc of 32 bands(.txt);
- The xml of 15th bands (.xml)，Store remote sensor parameters and shooting parameters。

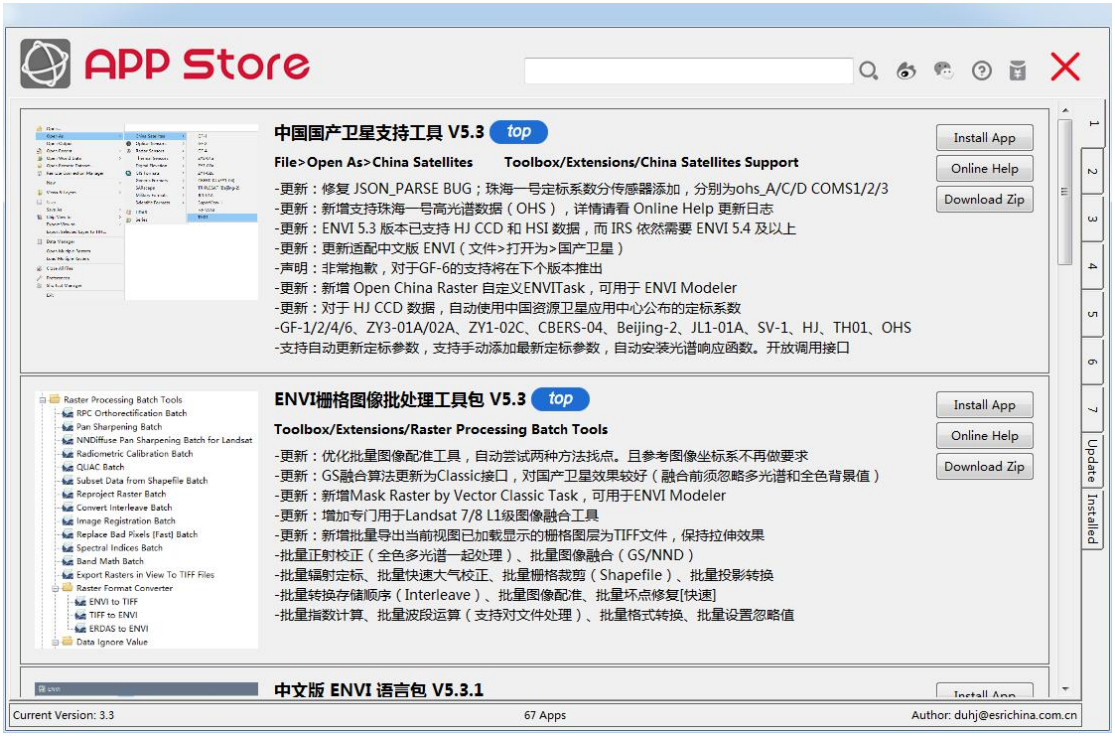
3."Zhuhai No. 1" hyperspectral satellite data processing method

Orbita's hyperspectral data can be read by using ENVI 5.3, ENVI 5.3 SP1 and ENVI 5.4, and also can do header file generation, band combination, radiometric calibration and atmospheric correction.

3.1 Software

ENVI5.3 and above provides the Orbita's hyperspectral image support tool. It is recommended to use the ENVI App Store to download and manage the ENVI extension tool, so that you can view and update the tool at any time. For other methods, please refer to www.enviidl.com

Open ENVI5.3 –> Help –> App Store，Choose"中国国产卫星支持工具 V5.3", (or search "China")Install App. After the installation is complete, please restart ENVI5.3.



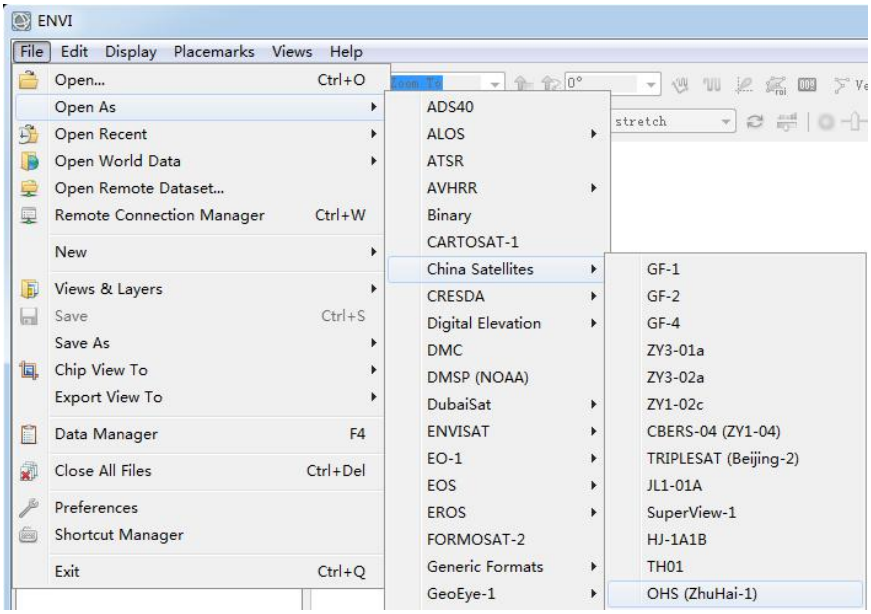
ENVI5.3 App Store

3.2 Image reading

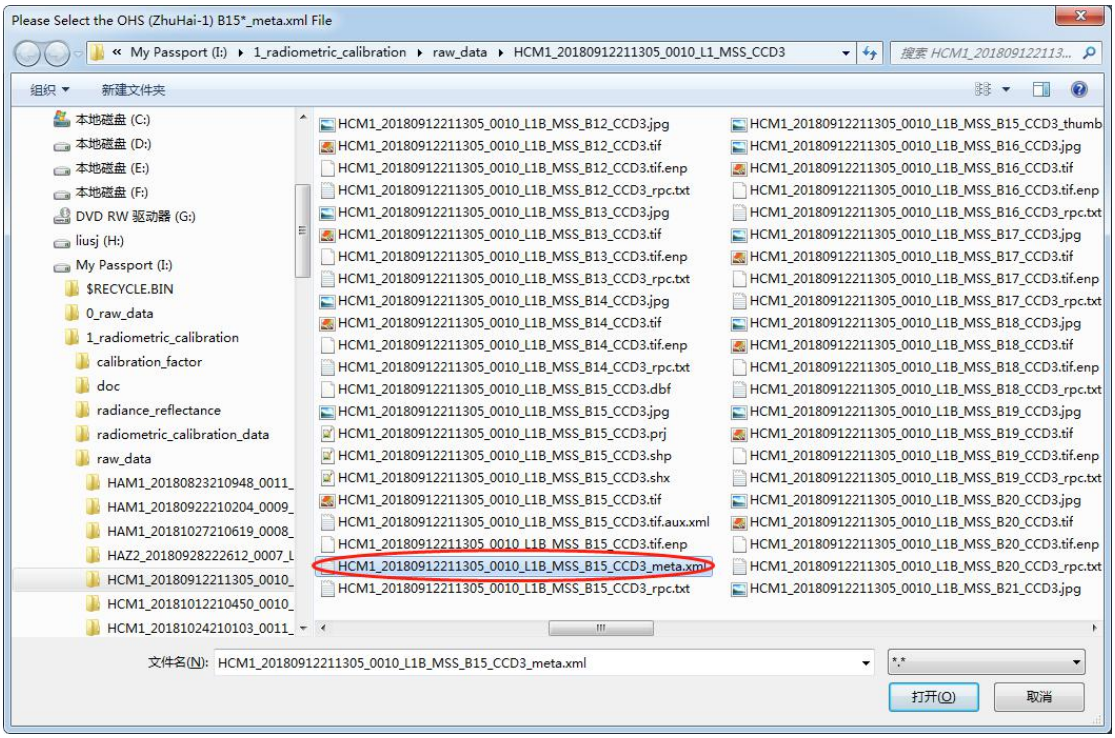
The updated ENVI 5.3 can directly read the Orbita's hyperspectral image, add field information such as center wavelength, half-height width, and calibration coefficient to identify RPC information.Open the *_B15_*meta.xml file, automatically combine the 32 tiff file bands. When opened, the *.meta and *.hdr files are automatically generated in the same directory. The file format is ENVI index file. The next time you open this data, you can use ENVI to open the meta file directly, without Open As.

Examples as follows (Each Band contains :one tif, rpc.txt.). Specific steps are as follows:

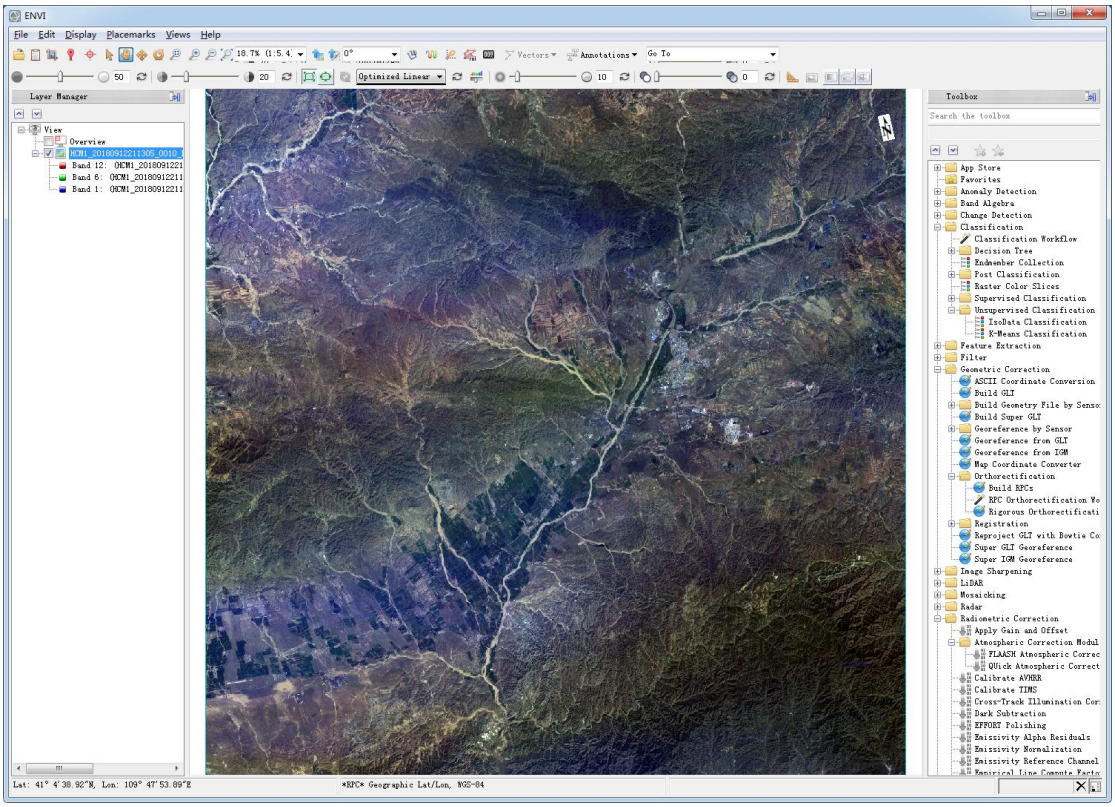
(1) Open ENVI5.3 –> File –> Open As –> China Satellites –> OHS(ZhuHai-1)

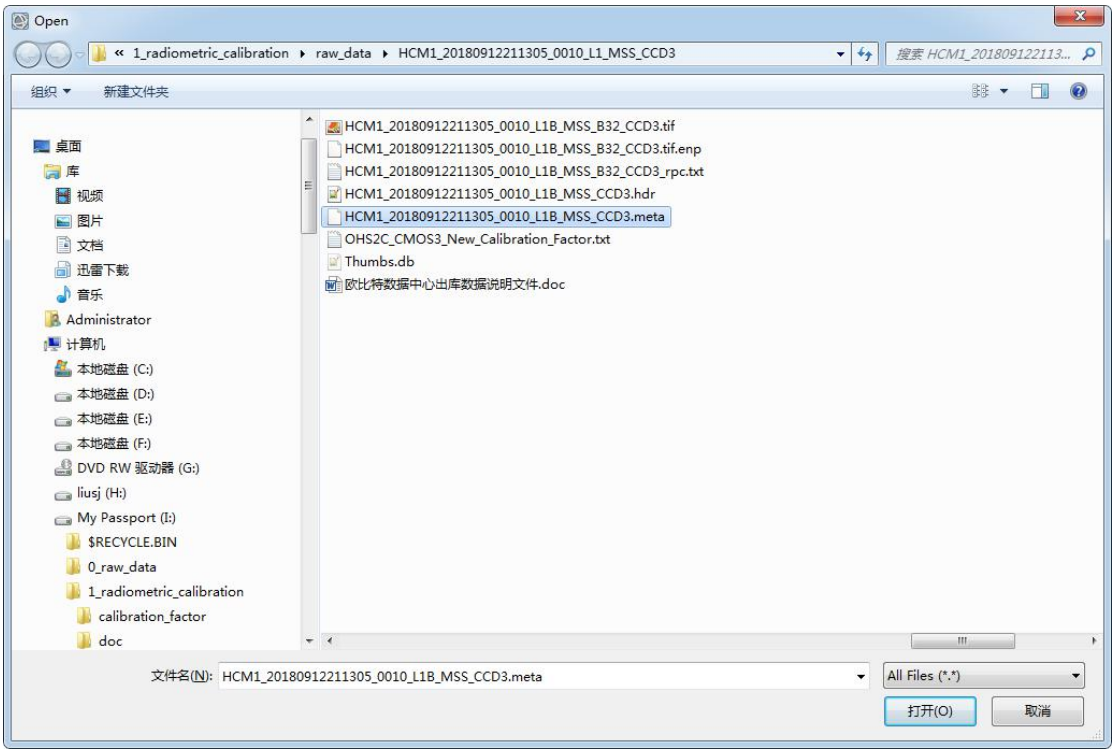


(2) Please Select the OHS(ZhuHai-1) B15*_meta.xml File→*_B15_*meta.xml



(3) When opened, the *.meta and *.hdr files are automatically generated in the same directory. The file format is ENVI index file. The next time you open this data, you can use ENVI to open the meta file directly, without Open As.


ENVI
File Edit Display Placemarks Views Help
Layer Manager
Toolbox
Search the toolbox
App Store
Favorites
Anomaly Detection
Band Algebra
Change Detection
Classification
Decision Tree
Endmember Collection
Post Classification
Raster Color Slices
Supervised Classification
Unsupervised Classification
IsoData Classification
K-Means Classification
Feature Extraction
Filter
Geometric Correction
Image Sharpening
LiDAR
Mosaicking
Radar
Radiometric Correction

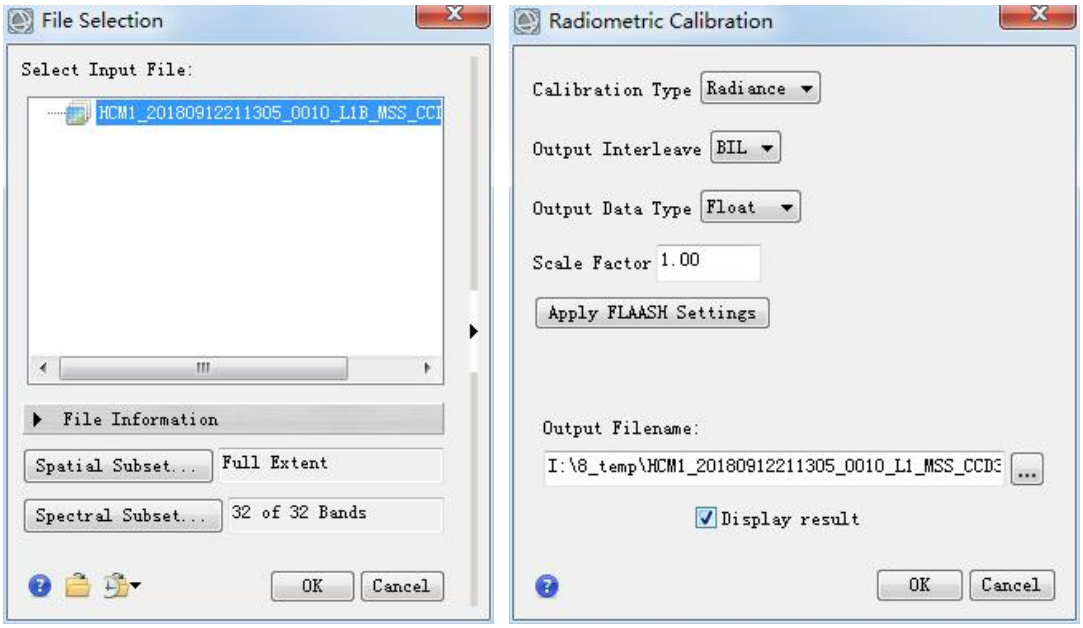

Open
1_radiometric_calibration ▸ raw_data ▸ HCM1_20180912211305_0010_L1_MSS_CCD3
组织
新建文件夹
桌面
库
视频
图片
文档
迅雷下载
音乐
Administrator
计算机
本地磁盘 (C:)
本地磁盘 (D:)
本地磁盘 (E:)
本地磁盘 (F:)
DVD RW 驱动器 (G:)
liusj (H:)
My Passport (I:)
$RECYCLE.BIN
0_raw_data
1_radiometric_calibration
calibration_factor
doc
HCM1_20180912211305_0010_L1B_MSS_B32_CCD3.tif
HCM1_20180912211305_0010_L1B_MSS_B32_CCD3.tif.enp
HCM1_20180912211305_0010_L1B_MSS_B32_CCD3_rpc.txt
HCM1_20180912211305_0010_L1B_MSS_CCD3.hdr
HCM1_20180912211305_0010_L1B_MSS_CCD3.meta
OHS2C_CMOS3_New_Calibration_Factor.txt
Thumbs.db
欧比特数据中心出库数据说明文件.doc
文件名(N): HCM1_20180912211305_0010_L1B_MSS_CCD3.meta
All Files (*.*)
打开(O)
取消

3.3 Radiation calibration

The main purpose of radiometric calibration of the "Zhuhai No.1" hyperspectral satellite image data is to convert the digital quantized value (DN) of the remote sensing image into a physical quantity such as the apparent radiance value of the atmosphere.

(1) Launch Radiometric Calibration tool, Toolbox/Radiometric Correction/Radiometric Calibration, Select input file

(2) Radiometric Calibration→Output Interleave→BIL, Scale Factor set as1.0, The units of radiance obtained are$W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$, The other parameters and path settings shown in the below figure



(3) It takes a long time to convert Orbita's hyperspectral radiometric calibration into BIL format. Please wait patiently.

3.4 Atmospheric correction

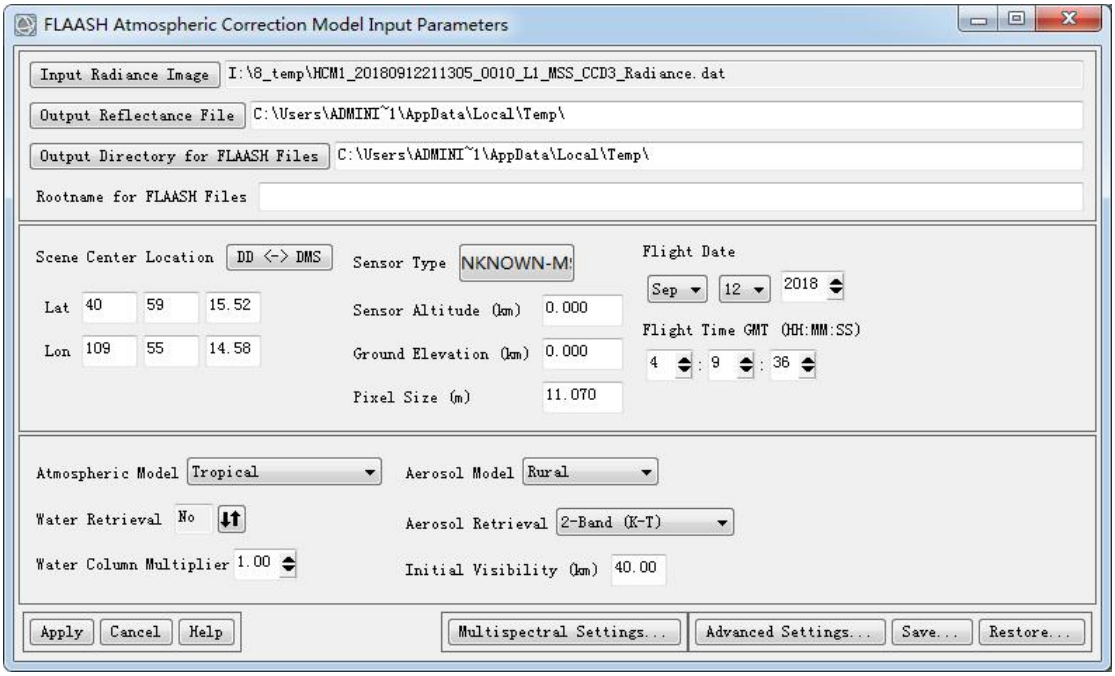
The total radiance of the ground target measured by the sensor is not a reflection of the true reflectivity of the surface. It includes the amount of radiation caused by

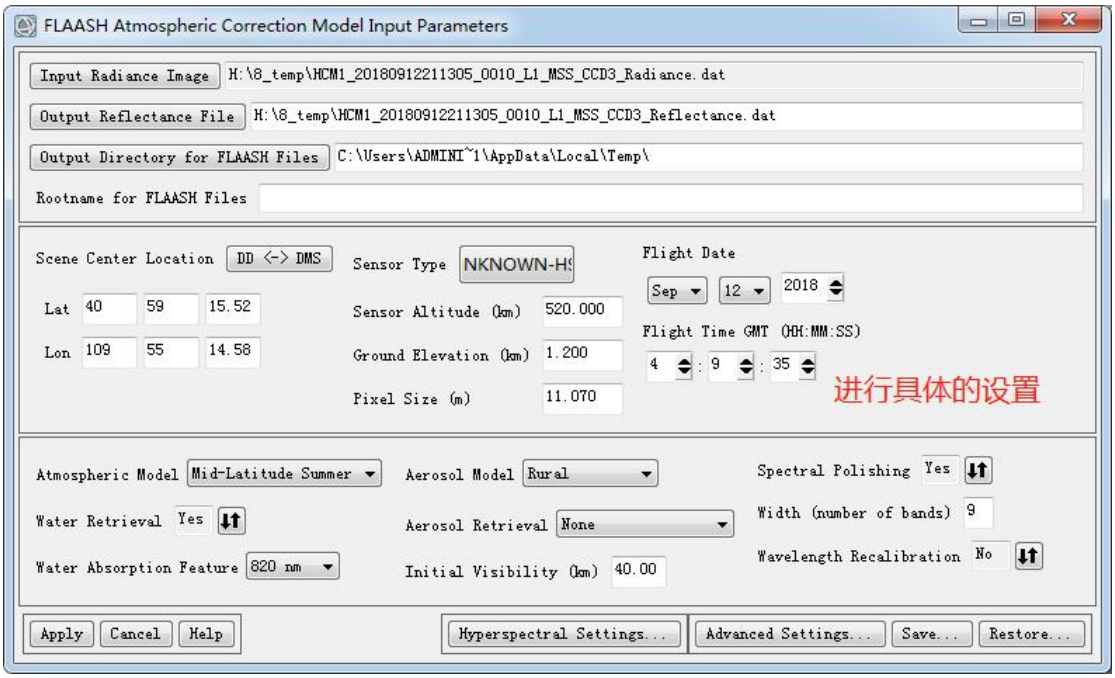
atmospheric absorption, especially scattering. The main purpose of atmospheric correction of the "Zhuhai No. 1" hyperspectral satellite image data is to eliminate these radiation errors caused by atmospheric influences, thereby inverting the true surface reflectivity of the ground objects.

FLAASH is based on the MODTRAN5 radiation transmission model, which was jointly developed by Spectral Spectral Sciences, Inc., a leader in atmospheric correction algorithm research, and the Air Force Research Laboratory. Exelis VIS is responsible for integration and GUI design. The main tools used for atmospheric calibration are the Toolbox /Radiometric Correction/Atmospheric Correction/FLAASH Atmospheric Correction. The FLAASH atmospheric model of ENVI software is based on physical model inversion and has many parameter inputs. To obtain a more accurate surface reflectance, it is recommended to refer to ENVI's FLAASH documentation.

Step 1：Atmospheric correction model selection

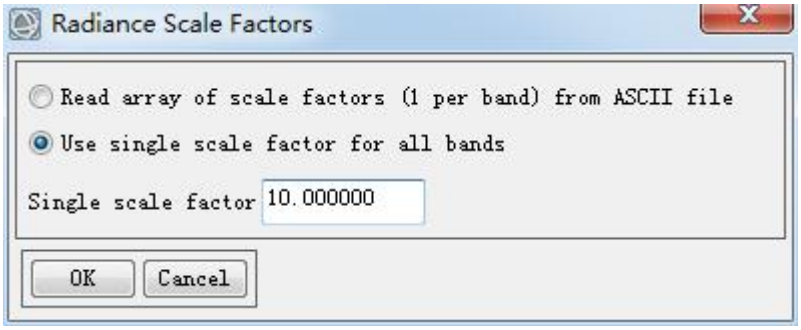
(1) Toolbox→FLAASH：/Radiometric Correction/Atmospheric Correction Module/FLAASH Atmospheric Correction，Lanuch FLAASH Atmospheric Correction Module Input Parameters as follows:





(3) FLAASH Atmospheric Correction Module Input Parameters 中，Click Select or Settin”Input Radiance Image and Output Reflectance File”. When you select a file, you need to convert the units of input radiance data from W m-2 ·sr-1 ·μ m-1 to μ W

cm- 2 ·sr-1 nm-1, so u need to in Radiance Scale Factors setting"Output Reflectance File": Set output path and file name; Output Directory for FLAASH Files: Set up additional File output Directory.



Radiance Scale Factors

Step 2: parameter settings

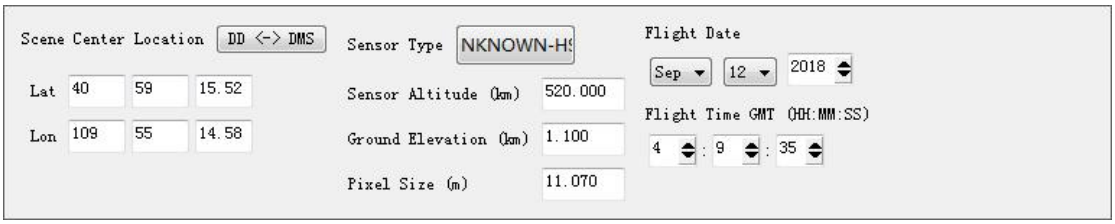
(1) Sensor basic parameter setting:

(a) Scene Center Location: it can be acquired automatically.;

(b) Select Sensor Type: Select UNKNOWN-HIS, the corresponding sensor height is 520.000, and the resolution of the image data is automatically read;

(c)Set the average ground elevation of the image area. Using Google Earth to estimate, or use the elevation data to calculate accurately. This image is about 1.100 (km).

(d) Imaging time (Greenwich time): it is generally automatic to read the amount, and you can also query the field information in the xml file in the original data < CenterTime > 2018-9-12T4:9:36.056722 < / CenterTime >, knowing that the imaging time is 05:02:11 on August 22, 2018



(2)Atmospheric Model: Mid-Latitude Summer (according to the imaging time and

latitude information according to the following Table)

Atmospheric model corresponding to data latitude and longitude and acquisition time

Latitude(°N)	Jan.	March	May	July	Sept.	Nov.
80	SAW	SAW	SAW	MLW	MLW	SAW
70	SAW	SAW	MLW	MLW	MLW	SAW
60	MLW	MLW	MLW	SAS	SAS	MLW
50	MLW	MLW	SAS	SAS	SAS	SAS
40	SAS	SAS	SAS	MLS	MLS	SAS
30	MLS	MLS	MLS	T	T	MLS
20	T	T	T	T	T	T
10	T	T	T	T	T	T
0	T	T	T	T	T	T
-10	T	T	T	T	T	T
-20	T	T	T	MLS	MLS	T
-30	MLS	MLS	MLS	MLS	MLS	MLS
-40	SAS	SAS	SAS	SAS	SAS	SAS
-50	SAS	SAS	SAS	MLW	MLW	SAS
-60	MLW	MLW	MLW	MLW	MLW	MLW
-70	MLW	MLW	MLW	MLW	MLW	MLW
-80	MLW	MLW	MLW	SAW	MLW	MLW

Note: SAW : Sub-Arctic Winter, MLW : Mid-Latitude Winter, SAS : Sub-Arctic Summer, MLS : Mid-Latitude Summer, T : Tropical.

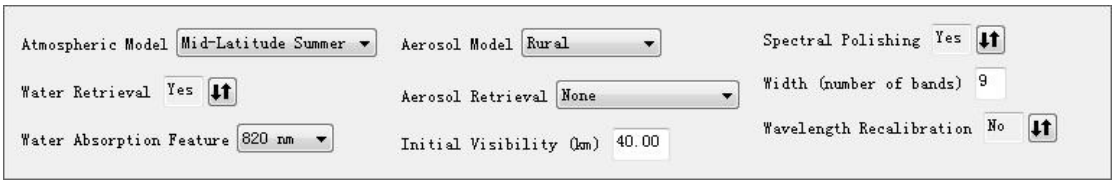
(3)Aerosol Model: Rural

(4) Aerosol Retrieval: None(Unable to use 2-band (K), upper channel not found)

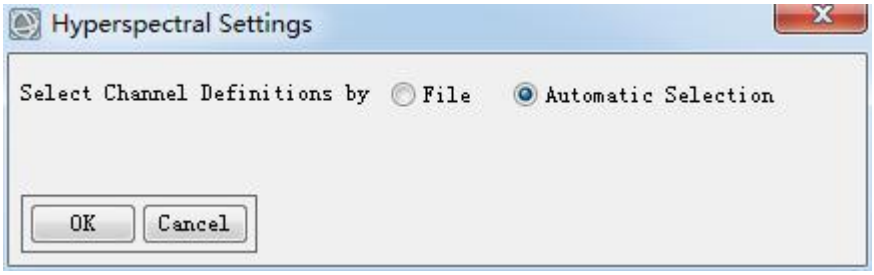
(5) Water Retrieval : Yes

(6) Water Absorption Feature : 820nm

(7) Other parameters can be set by default.



(6) Hyperspectral Settings set by default



(7) Advanced Settings:

(a) Aerosol Scale Height: General value:1~2km, Default:1.5km。

(b) CO2 Mixing Ratio: Default:390ppm

(c) Use Square Slit Function: No

(d) Use Adjacency Correction: Yes or No。

(e) Reuse MODTRAN Calculations:

No: Recalculate the MODRTRAN radiative transfer model。

Yes: Execute the MODRTRAN radiation transfer model obtained by the last FLAASH operation. After running FLAASH, an acc_modroot.fla will be generated in the root directory and temporary folder.

(f) Modtran Resolution of the MODTRAN model: The lower the resolution, the faster the speed and the lower the accuracy, the main affected area is around 2000 nm. Hyperspectral data defaults to 5 cm-1, and multispectral data defaults to 15 cm-1.

(g) Modtran Multiscatter Model: Corrects the effects of atmospheric scattering on

imaging, providing three models for selecting ISAACS,DISORT and Scaled DISORT. The default is 8 for Scaled DISORT and streams.

The Isaacs model is fast and with normal quality.

The DISORT model has higher accuracy for shortwaves (less than 1000 nm), but the speed is very slow. Since the scattering has a large influence on short waves (such as visible light), the long wave (above infrared) has less influence, so when the mist is large and shortwave images You can choose this method;

Scaled DISORT provides similar accuracy to DISORT in the atmospheric window, similar to Isaacs in speed, which is the recommended model. When selecting DISORT or Scaled DISORT, you need to select streams: 2, 4, 8, and 16. This value is used to estimate the direction of the scattering. The larger the streams, the slower the speed.

(8) observed parameter

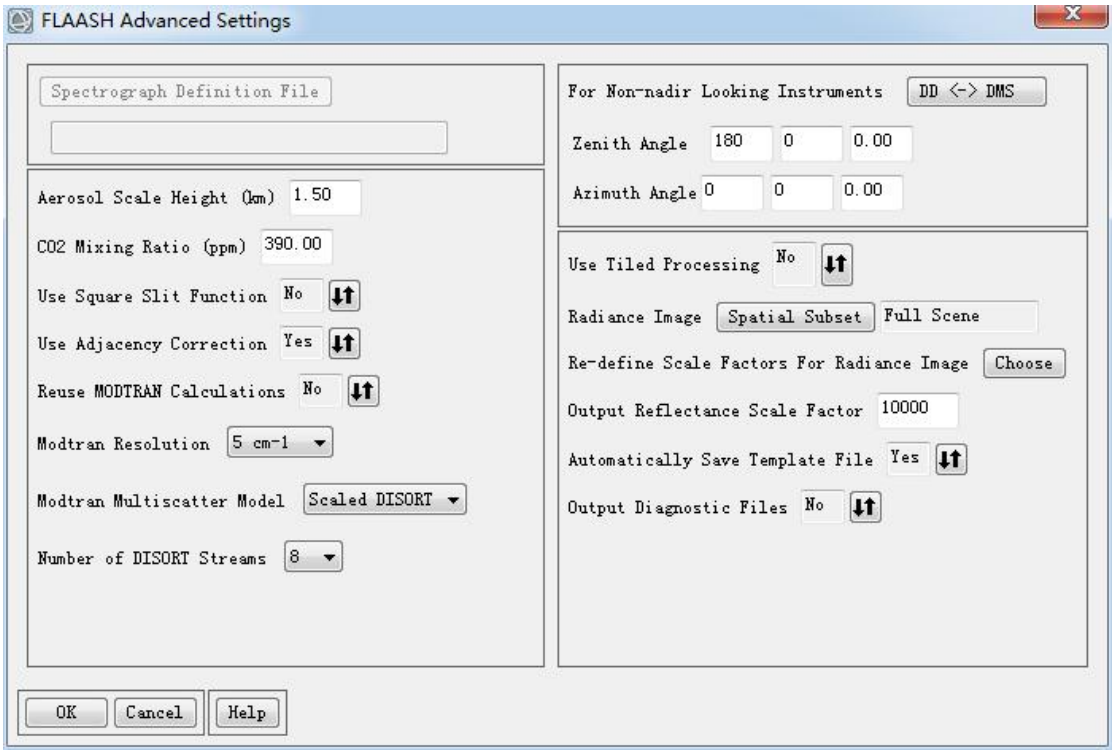
(a) Zenith Angle：range :90~180

(b) Azimuth Angle：range-180~180

(9) Image setting

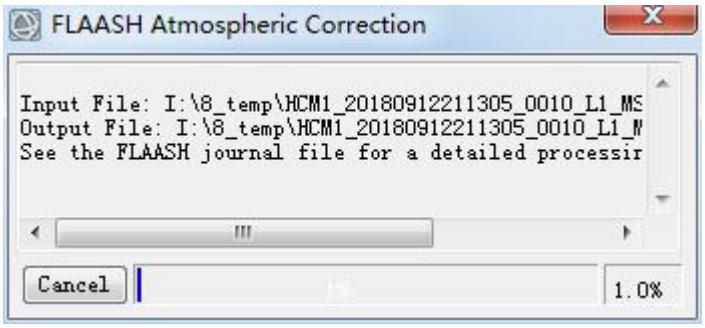
(a) Use Tiled Processing: No，

(b) Other parameters are available by default



Step 3： atmospheric correction

(1) FLAASH Atmospheric Correction Module Input Parameters→Set parameters correctly→Apply



3.5 Orthorectification

For orthorectification, the "Zhuhai No. 1" hyperspectral data package provides an orthorectification file (_rpc.txt) that can be operated with ENVI 5.3 or higher. The

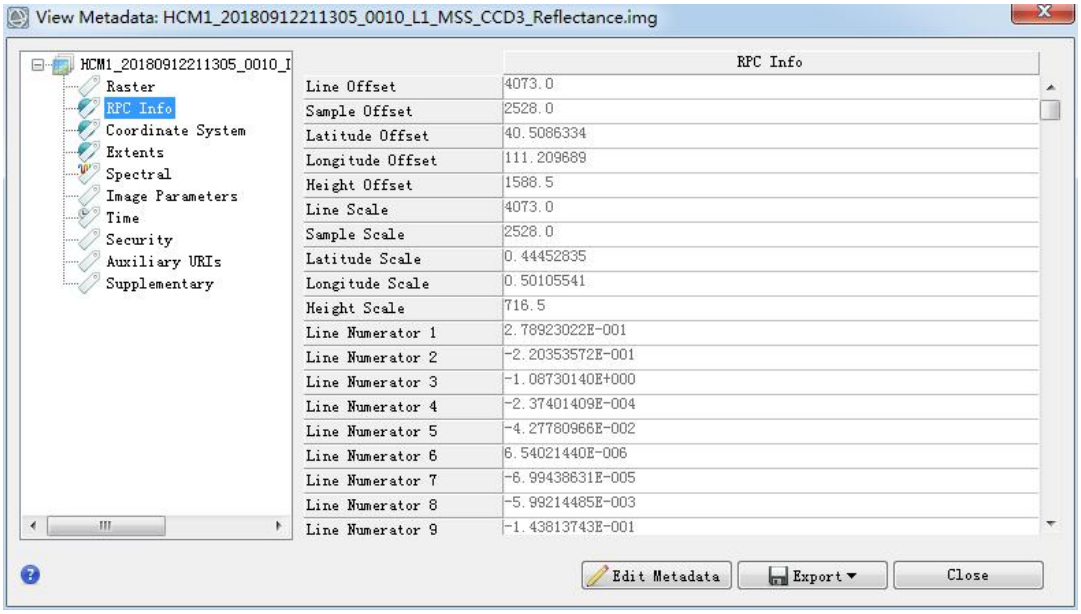
main tool used is the process tool:

Toolbox/Geometric Correction/Orthorectification/RPC Orthorectification Workflow。

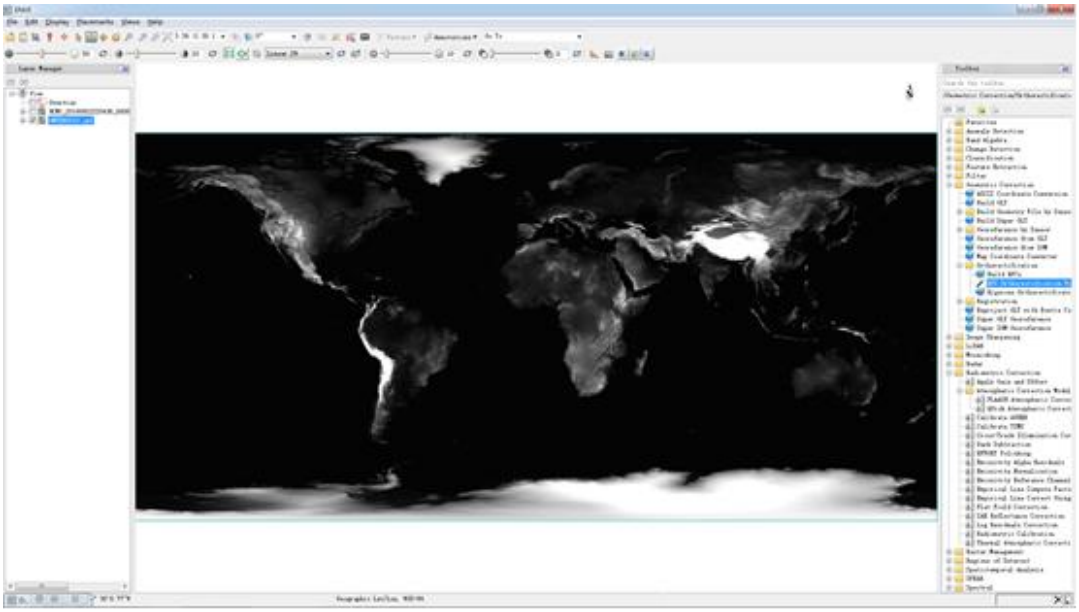
Step 1： open image

(1) File>Open， Select Open File in the pop-up dialog box"...\...\ HCM1_20180912211305_0010_L1_MSS_CCD3_Reflectance.img "。

(2) Open Data Manager，Right-click hyperspectral data，click View Metadata,You can see that ENVI automatically identifies the RPC information of OHS data.

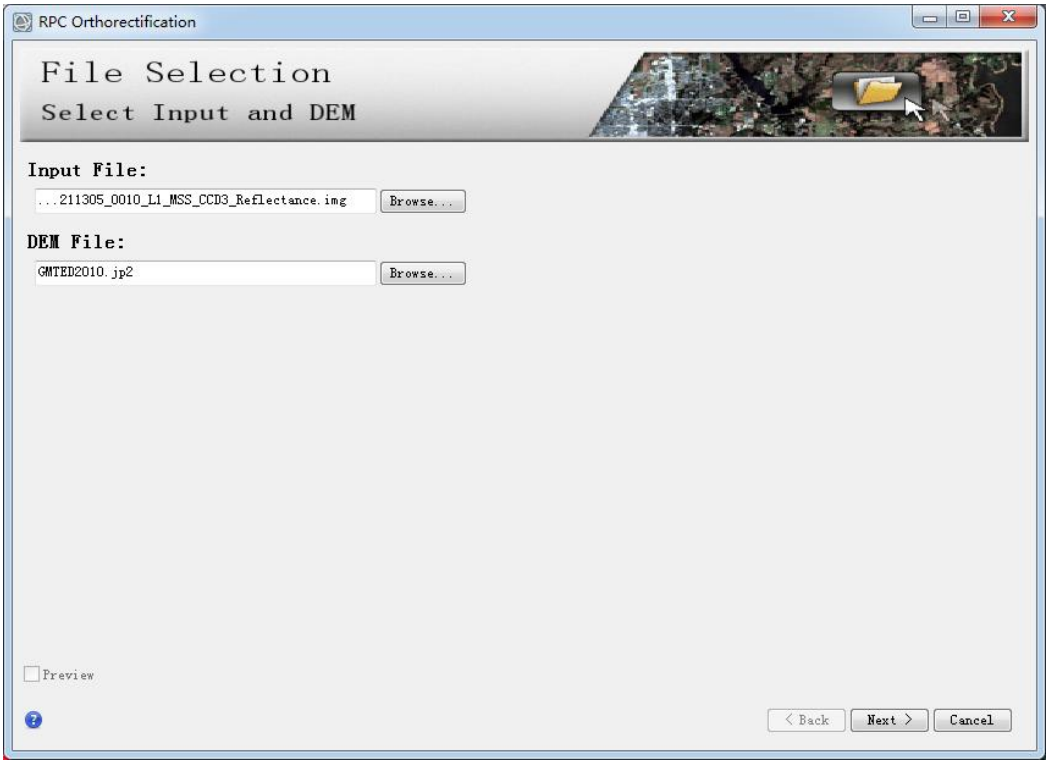


(3) open DEM: File > Open World Data > Elevation(GMTED2010)，



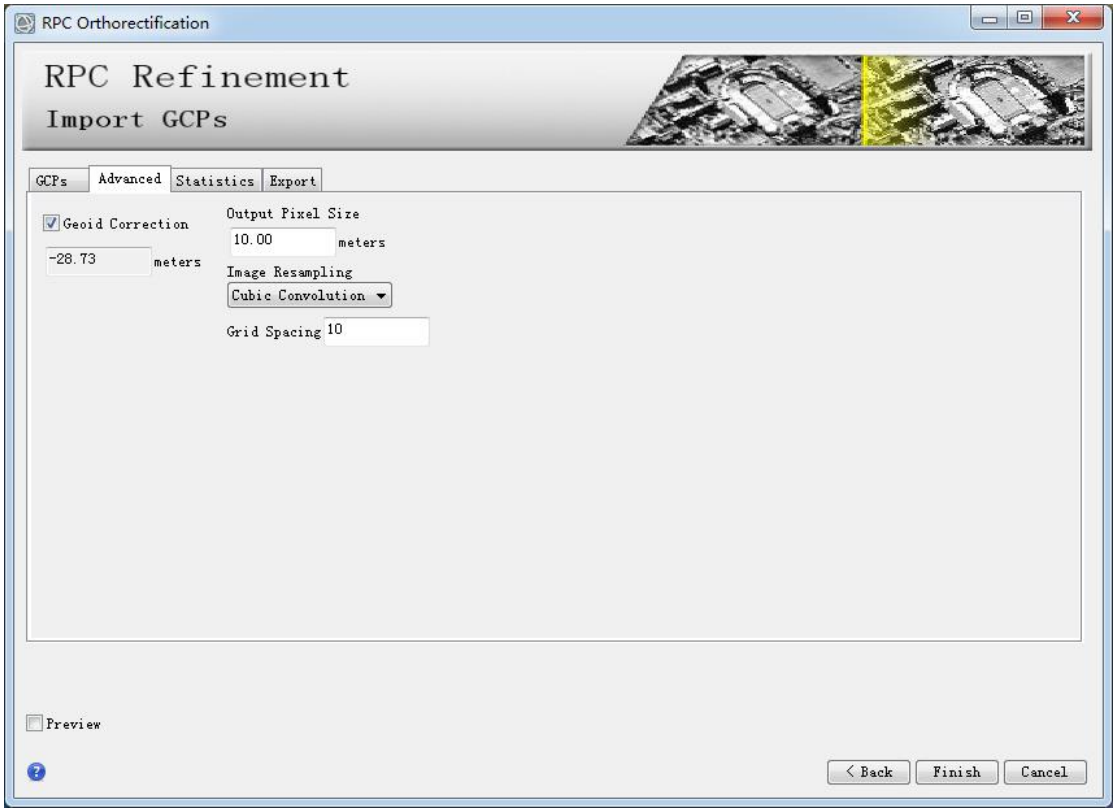
(4) Toolbox→/Geometric Correction/Orthorectification/RPC Orthorectification Workflow。

(5) File Selection→Input File， DEM File→DEM，

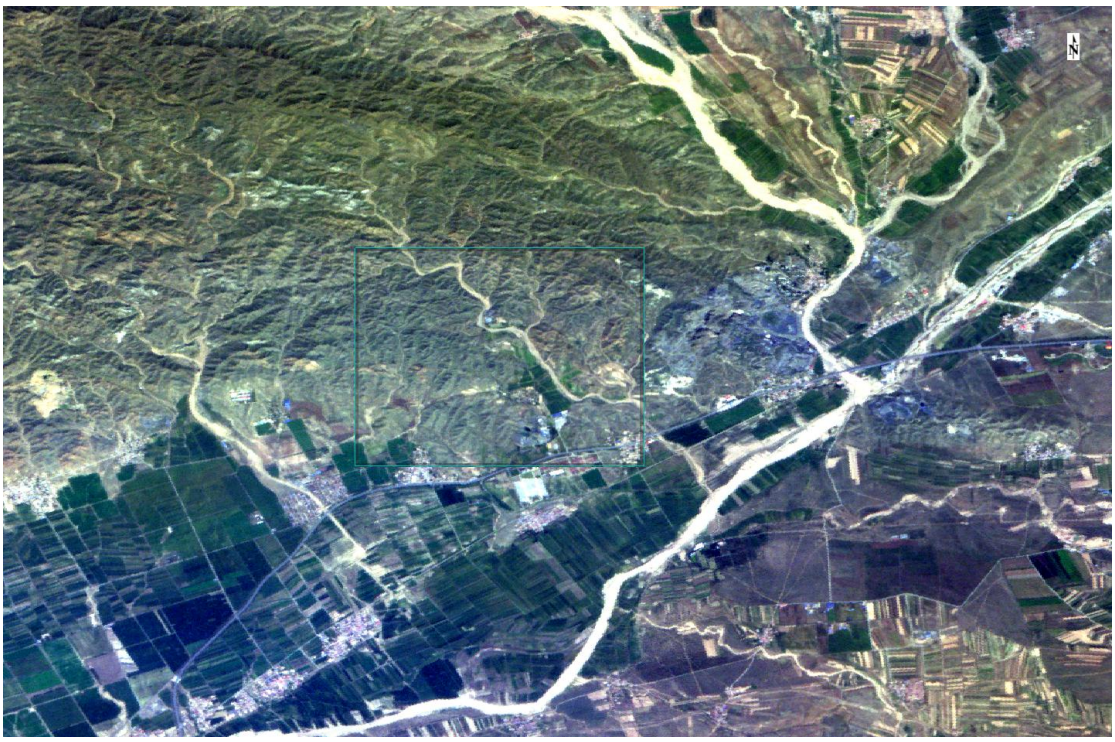


Step 2： Setting parameters

(1) Since the input of GCPs is not performed in this operation, you can directly select the Advanced tab and set parameters such as output pixel size and resampling method, as shown in Figure It is recommended to enable the Geoid Correction setting item to greatly improve RPC. The horizontal and vertical accuracy of the model. The PRC orthorectification process tool uses the Earth Gravitational Model (EGM) 1996 for geoid calibration to automatically determine the offset.



(2) When parameters and control point settings are complete, click "Preview" in the lower-left corner of the process tool to preview the results, as shown in figure.



(3) Finally switch to the Export tab, set the output file path, click Finish.