

8 Image Processing

8.1 Introduction

8.2 Data Storage

Portable Network Graphics (PNG)—Developed in 1994, this image format is used as an alternative to the GIF. Like GIF, PNG can use indexed 8-bit color palettes with up to 256 colors. However, PNG also supports grayscale images as well as 24-bit and 48-bit RGB images.

8.3 Importing, Processing, and Exporting Images

8.4 Importing, Processing, and Exporting Landsat Images

These two sensors provide coverage of the global landmass at spatial resolutions of 30 meters (VNIR, SWIR), 100 meters (TIR), and 15 meters (panchromatic) (Ochs et al. 2009, Irons et al. 2011).

8.5 Importing and Georeferencing Terra ASTER Images

8.6 Processing and Exporting EO-1 Hyperion Images

```
wavefile = 'E01H1690582013197110KF.WVL'
```

The radiance for the shortwave infrared (SWIR) bands (i.e., Bands 71 to 242) is calculated by dividing HYP by 80. Here, we keep in mind that Python indexing starts at zero and that the index ranges are open to the right, so we use `[:, :, 0:70]` and `[:, :, 70:242]` to access the desired Bands 1 to 70 and 71 to 242, respectively (Chap. 2.3):

It is again important to remember that Python indexing begins with zero and that we must therefore use `band-1` as an index. We first obtain an overview of the range of the data using a histogram plot with 100 classes:

8.7 The Normalized Difference Vegetation Index NDVI

```
filename = '2017_0328_110031_007.RAW'
```

8.8 Image Enhancement, Correction, and Rectification

The resulting image looks quite disappointing, and we therefore use the improved `equalize_adapthist()` instead of `equalize_hist()`. The improved function uses *contrast limited adaptive histogram equalization* (CLAHE), which was created by Zuiderveld (1994).

8.9 Removing Periodic Noise from Images

8.10 Grain Size Analysis from Microscopic Images

After displaying the results from the watershed segmentation, we can determine the number of pixels for each object using the recipe described above, but index i runs from 2 to $\max(L)$ since the value of 1 denotes the background and 0 denotes the boundaries of the objects.

8.11 Quantifying Charcoal in Microscopic Images

8.12 Shape-Based Object Detection in Images

8.13 Digitizing from the Screen

The third stage uses `ginput()` to define the upper-left and lower-right corners of the image.

Recommended Reading

Irons J, Riebeek H, Loveland T (2011) Landsat Data Continuity Mission – Continuously Observing Your World. [NASA and USGS \(available online\)](#)

Lein JK (2012) Environmental Sensing–Analytical Techniques for Earth Observation. Springer, Berlin Heidelberg New York

Marwan N, Trauth MH, Vuille M, Kurths J (2003) Nonlinear time-series analysis on present-day and Pleistocene precipitation data from the NW Argentine Andes. *Climate Dynamics* 21:317–326

MathWorks (2026) Image Processing Toolbox–User's Guide. The MathWorks, Natick, MA

Ochs B., Hair D, Irons J, Loveland T (2009) Landsat Data Continuity Mission, NASA and USGS ([available online](#))

Trauth MH, Alonso RA, Haselton KR, Hermanns RL, Strecker MR (2000) Climate change and mass movements in the northwest Argentine Andes. *Earth and Planetary Science Letters* 179:243–256

Trauth MH, Strecker MR (1999) Formation of landslide-dammed lakes during a wet period between 40,000 and 25,000 yr B.P. in northwestern Argentina. *Palaeogeography Palaeoclimatology Palaeoecology* 153:277–287

Zuiderveld K (1994) Contrast Limited Adaptive **Histogram** Equalization. *Graphic Gems IV*. San Diego: Academic Press Professional, 474–485

Figure Captions