APEX Open Science Data Set

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Key Facts **Issue 1.0**

Date	2011-06-26
Time	1017 UTC
Altitude	4600 m asl
Heading	56°
Dimensions	1500 x 1000 pixels
Spectral coverage	413nm - 2421nm

Pixel size	1.8 m
File size	815 MB
Units	Reflectance (HCRF)
Land covers	Forest, Urban, Freshwater, Agriculture
Geometry	RAW (Imaging Geometry)
File format	ENVI Cube

Overview

Welcome to the first issue of the APEX Open Science Data Set!

We are very pleased to make the first APEX (Airborne Prism Experiment) [1, 2] imaging spectrometer data set available to the remote sensing community. We sincerely hope that this data set will assist you in gaining insights into the huge potential of APEX and help you in assessing its applicability to your domain of spectroscopy research.

Data Acquisition

The APEX Open Science Data Set was acquired during an APEX flight campaign in June 2011. APEX was mounted on a Dornier DO-228 research aircraft operated by Flight Operation and Acquisition of DLR (German Space Agency).

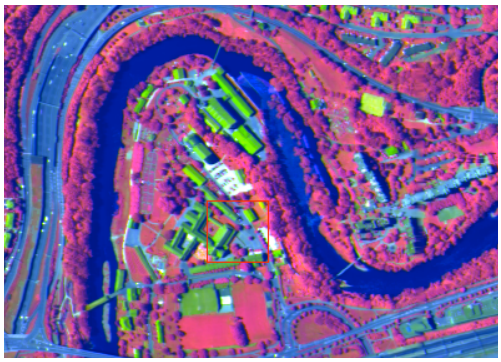
Data were acquired on a clear day from a flight altitude of 4600m above sea level with a heading of 56° in the vicinity of Baden, Switzerland.

APEX Open Science Data Set - True Colour

RAW to Level 1 Processing

Data were processed from RAW to Level1 in the dedicated APEX PAF (Processing and Archiving Facility) [3]. Level 1 processing comprised the following operations, relying on APEX calibration information generated during extensive system calibration at the CHB (Calibration Home Base) situated at DLR Oberpfaffenhofen [4]:

1. Dark current correction using linear dark current modelling per flight line
2. Radiometric calibration
3. Bad Pixel replacement by spatial linear interpolation
4. Wire pixel replacement by spatial linear interpolation
5. Negative radiances, typically appearing in water vapour absorption bands, have been set to zero
6. Spatial misregistration (Frown) correction by linear resampling to common across track angles
7. Spatial coregistration of the VNIR and SWIR detector
8. Destriping



PCA Colour Composite

Swiss Midlands during APEX Open Science dataset acquisition flight

DO 228 at Oberpfaffenhofen air field

Quality Indicator Generation

Quality indicators (QI) are generated as a standard APEX PAF output, in line with requirements defined within the HYQUAPRO FP7 project [5]. Two cubes are provided containing spatial QI and frame related QI information.

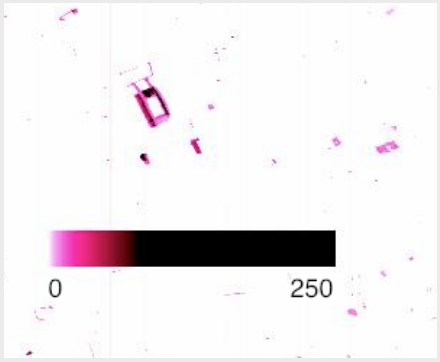
The spatial QI cube consists of a frequency map of saturated pixels, i.e. accumulated numbers of saturated pixels per spatial position, where a saturated pixel is defined as being in the upper, non-linear region of the detector. The latter criterion also applies to bad pixels, which appear in the saturation layer as stripes.

The frame QI cube holds accumulated saturated pixels per detector pixel, an overall bad pixel map, an interpolated bad pixel map, bad pixels set to NaN, across-track angular deviations from the nominal and percent change of the dark current over a given flight line.

Atmospheric Correction

Operational atmospheric processing of APEX imagery is carried out in a Modtran based software implemented within the Central Data Processing Center (CDPC) at VITO [6], converting at sensor radiances to on ground hemispherical-conical reflectance factors (HCRF).

In the case of the Open Science Data Set, atmospheric correction was based on ATCOR [7-9]. Spectral misregistrations were detected by the ATCOR smile module and corrected for, resulting in a uniform wavelength per spectral band before a final spectral polishing was applied. The atmospheric correction also includes the interpolation of known atmospheric absorption features where signal levels are too low for a reliable estimation of the surface reflectance properties. Interpolated bands are denoted with an asterisk in the header file of the APEX Open Science Data Set HCRF cube.



Zoom of an APEX spatial saturation QI layer showing saturated manmade objects

APEX true colour composite of the above saturation example

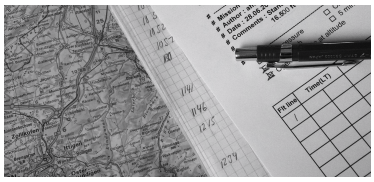
Data Usage Policy

The APEX Open Science Data Set may be freely used. Any publication utilising the APEX Open Science Data Set is to reference the following paper:

M. E. Schaepman, M. Jehle, A. Hueni, K. Meuleman, The APEX Team, and K. I. Itten, "The 4th generation imaging spectrometer APEX and its application in Earth observation," IEEE Transactions on Geoscience and Remote Sensing, 2012 (in preparation).

Known Issues

Greatest care is taken in processing APEX data sets to provide high accuracy spectroscopy data sets to the user community. However, APEX is an experimental system and some issues remain as artefacts in the data. These known issues are being addressed as part of the continuous improvement of the dedicated processing chain to provide even better data in the future. For a list of known issues please refer to the table provided below.



Residual along track striping	**APEX is a pushbroom instrument and hence technologically prone to striping artefacts. Most of the striping is removed during radiometric calibration and destriping before atmospheric correction. However, some residual striping, occasionally at lower spatial frequency may appear.**
Residual across track striping	**Some minimal across track striping may be observed in a limited number of bands.**
Interpolated wires	**Wires were placed on the entry slit to observe spatial shifts. Depending on the geometric shifts apparent on the flight level of this data cube, some remaining wire residuals may exist. Some linear artefacts due to interpolation may exist. The across track wire positions are: 334-335 and 674-675, the interpolated region currently encompasses a buffer of 1 pixel around the wire positions. Pixels in the interpolated wire region should be treated with caution. Interpolated wire pixels are also contained in the interpolated bad pixel quality layer.**
Image crispness	**Spatial misregistration correction can lead to loss of information and according visual fuzziness due to spatial resampling.**
Radiometric artefacts	**Some radiometric miscalibrations are known to exist in the spectral band region 1020nm ±2 bands and spatial sample positions 319-324 as well as in the 1030nm region for all across-track positions. Pixels contained within the above mentioned spatial-spectral regions have been corrected for these artefacts but should be treated with care in this processing version.**
Saturated pixels	**A low number of pixels is affected by saturation due to high radiance reflected from very bright or specular objects in the scene. Spectral signatures of these pixels should be treated with caution. The saturated pixels are indicated in the supplied saturation quality layer.**
Directional effects	**The data are known to exhibit spectro-directional effects which have not yet been corrected for. These natural effects are known to affect information extraction routines in shaded and sloped areas of the imaged scene.**
Low SWIR HCRF	**Targets with very low reflectance characteristics in the SWIR may appear to bright due too yet to be compensated detector non-linearities.**

References

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