Inspecting multi-spectral and hyper-spectral data using HYDRA

Paul Menzel
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What is HYDRA?
What can it do?
Some examples
How to get it?
HYperspectral viewer for Development of Research Applications - HYDRA

MODIS, AIRS, IASI, AMSU, CALIPSO

Developed at CIMSS by
Tom Rink
Tom Whittaker
Kevin Baggett

With guidance from
Paolo Antonelli
Liam Gumley
Paul Menzel
Allen Huang

Freely available software
For researchers and educators
Computer platform independent
Extendable to more sensors and applications
Based in VisAD
(Visualization for Algorithm Development)
Uses Jython (Java implementation of Python)
runs on most machines
512MB main memory & 32MB graphics card suggested
on-going development effort

Rink et al, BAMS 2007

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http://www.ssec.wisc.edu/hydra/
For hydra
http://www.ssec.wisc.edu/hydra/

For MODIS data and quick browse images
http://rapidfire.sci.gsfc.nasa/realtime

For MODIS data orders
http://ladsweb.nascom.nasa.gov/

For AIRS data orders
http://daac.gsfc.nasa.gov/
The HYDRA Window
Loading a Granule

HYDRA IR window with 29 May 2001 MODIS L1B 1KM granule
Select region for full resolution display
Select color and Zoom to see single pixel resolution
**Multichannel Viewer**

**Under Tools**

**Linear Combinations** opens Channel Combination Tool display where you can specify linear combinations of spectral bands a, b, c and d (\(a + x / b\) +\(x / (c + x / d)\)).

**RGB** allows you to select a spectral channel for each color in the RGB display.

**Transect** allows you to create a line on the image and see the temperatures or radiances along the transect marked by shift plus right click and drag.

**Capture Display** allows you to save the image as a jpeg.

**Statistics** displays the min and max values in the image.

**Reference Spectrum** allows you to compare spectral measurements from two selected pixels (controlled by the arrows in the bottom toolbar).
Pseudo RGB Composite Image

Red – ch 1
0.65 μm
Green – ch 4
0.55 μm
Blue – ch 3
0.47 μm
Transect
Linear Combination BT4 – BT11
Linear Combination BT4 – BT11
BT4 > BT11 in low clouds along coastline
Comparing IR to NIR Cloud Detection

Thin cirrus show up in BT8.6-BT11 (left) as well as r1.38 (right)
Setting up for scatter plot of BT11 vs r0.66
Scatter Plot of $r_{vis}$ vs $BT_{11}$ with colors highlighting locations of pixels in plot on images
Linear Combinations Pseudo Image of Normalized Vegetation Index \( \frac{(r_2 - r_1)}{(r_2 + r_1)} \)
MODIS level 2 cloud mask display

clear = green
probably clear (95% certain) = turquoise
uncertain = red
cloudy = white
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AIRS data

over

Black & Caspian Seas

28 August 2005
BT1384.5 minus BT1387.2

BT differences of more than 40 K are seen in clear regions and less than 1 K in opaque high cloudy regions.
Cld and clr spectra in CO2 absorption separate when weighting functions sink to cloud level
Cld and clr soundings indicate cloud is at 250 HPa
AIRS (right) and MODIS (left) co-located display of spectra
Investigating AIRS Retrievals

On-line off-line BT difference is greater in western (blue x) than eastern (red dot) location of Black Sea; x has more low level moisture than dot.

This is confirmed by moisture profiles (upper left); 900 hPa retrieved moisture image (lower left) shows moisture gradients.
Transect in Black Sea comparing where MODIS IRW does not see low level water vapor hence BTs are closest to Off-H2O-line AIRS BTs.
Transect in Black Sea comparing where MODIS DIRW does see low level water vapor but BTs are still close to Off-H2O-line AIRS BTs
IASI data over Mediterranean 8 March 2008
IASI (right) and AMSU-A (left) display of BT transect for 23GHz and 940 cm$^{-1}$
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Colocating CALIOP within MODIS
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HYperspectral-viewer for Development of Research Applications

If you would like to send comments and be notified of updates, please join the HYDRA email list, by sending a note to: hydra-subscribe@ssec.wisc.edu. You will receive a confirmation email that you will also need to respond to in order to verify your email address.
Updated 3 March 2005

Downloading and Installing HYDRA

For Windows Users

Important note: before installing this version, be sure to uninstall the previous one! using Start->Control Panel->Add/Remove Programs.

Download the installer file from this location to a temporary directory. When the transfer is complete, just run this file and follow the instructions. We recommend just using the default options presented.

For Linux Users

Download the tar-gz file from this location. When the transfer is complete, then 'cd' to the parent directory and unpack the archive. This will create its own hydra subdirectory as a child.

For Mac OS-X Users

Download the tar-gz file from this location. When the transfer is complete, then 'cd' to the parent directory and unpack the archive. This will create its own hydra subdirectory as a child. You must have Java and Java3D installed in order to use HYDRA.

Running the HYDRA application

To startup the Hydra application, either click on the menu item (Windows) or type the command runhydra.bat. On Linux, you will likely just type in the command runhydra. Please see the on-line tutorial for more details.
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Hydra has been part of environmental remote sensing training, education, and outreach

Bologna, Italy (Sep 01), Rome, Italy (Jun 02), Maratea, Italy (May 03), Bertinoro, Italy (Jul 04), Cape Town, South Africa (Apr 06), Krakow, Poland (May 06), Ostuni, Italy (Jun 06) Benevento, Italy (Jun 07)