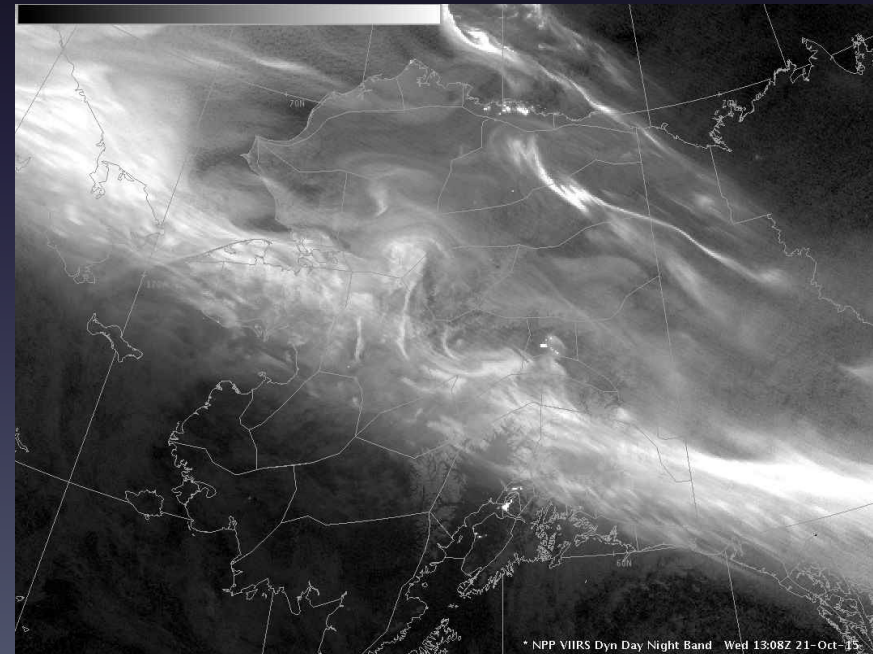# Community Satellite Processing Package (CSPP) Polar-Orbiting Satellite Software and Products

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What is CSPP?

CSPP (Community Satellite Processing Package) is a collection of software systems for processing data from meteorological satellites.

The primary goal of CSPP is to support users who

- Receive satellite data via direct broadcast;

- Create Level 1B and higher level products and images in real time.

Funding is supplied by NOAA/JPSS.

NOAA/NESDIS has contributed a number of operational algorithms for CSPP distribution.

CSPP Recent Activity

There have been several new software releases since ITSC-19 supporting multiple satellites and sensors.

- Sounder products from CrIS, ATMS, IASI, AMSU, MHS, HIRS: Profiles, precipitation, and surface properties from MIRS; Profiles and trace gases from NUCAPS; Profiles and clouds from HSRTV; Profiles from IAPP; Quicklook images from Sounder QL.

- Imager products from VIIRS, MODIS, AVHRR: Clouds from CLAVR-x; SST from ACSPO; Mapped images from Polar2Grid.

CSPP Software (Oct 2015)

CSPP Software	Product Description
1. SDR v2.1.1	VIIRS, CrIS, and ATMS geolocated and calibrated earth observations.
2. VIIRS EDR v2.0	VIIRS imager cloud mask, active fires, surface reflectance, vegetation indices, sea surface temperature, land surface temperature, and aerosol optical depth.
3. HSRTV v1.3	Hyperspectral infrared sounder retrievals of temperature and moisture profiles, cloud properties, total ozone, and surface properties.
4. Polar2grid v2.0	Reprojected imagery (single and multi-band) in GeoTIFF and AWIPS formats.
5. Hydra2 v1.0	Interactive visualization and interrogation of multispectral imagery and hyper spectral soundings.
6. MIRS v2.0	Microwave sounder retrievals of temperature and moisture profiles; surface properties; snow and ice cover; rain rate; and cloud/rain water paths.
7. CLAVR-x v1.0	Multispectral imager retrievals of cloud properties; aerosol optical depth; surface properties; ocean properties.
8. NUCAPS v1.0	Combined hyperspectral infrared sounder and microwave sounder retrievals of temperature and moisture profiles, cloud cleared radiances, and trace
9. IAPP v1.0	Combined infrared sounder and microwave sounder retrievals of temperature and moisture profiles, water vapor, total ozone, and cloud
10. ACSPO v1.0	Multispectral imager retrievals of sea surface temperature.
11. Sounder Quicklook v1.0	Creates mapped images and Skew-T plots of sounding products from HSRTV, NUCAPS, MIRS, and IAPP.

CSPP by the numbers

Satellites supported: 9

Software packages: 11

Sensors supported: 25

Releases and updates: 33

Registered users: > 1000

Individual downloads: > 5000

Releases since ITSC-19 (15)

October 12, 2015	Polar2Grid Reprojection Software Version 2.0
October 9, 2015	Microwave Integrated Retrieval System (MIRS) Software Version 2.0
September 29, 2015	CrIS, VIIRS and ATMS SDR Software Version 2.1.1 Patch
July 16, 2015	Sounder Quicklook Software Version 1.0
April 9, 2015	Advanced Clear-Sky Processor for Oceans (ACSPO) Software Version 1.0
April 3, 2015	International ATOVS Processing Package (IAPP) Software Version 1.0
February 24, 2015	NUCAPS CrIS/ATMS EDR Retrieval Software Version 1.0
February 2, 2015	CrIS, VIIRS and ATMS SDR Software Version 2.1
October 20, 2014	Patch for SDR Version 2.0
September 3, 2014	VIIRS SDR GeoTIFF and AWIPS Reprojection Software Version 1.2
August 4, 2014	CrIS, VIIRS and ATMS SDR Software Version 2.0
August 4, 2014	VIIRS EDR Software Version 2.0
August 4, 2014	VIIRS Imagery EDR Software Version 2.0
May 16, 2014	CLAVRx VIIRS, MODIS and AVHRR Cloud Retrieval Software Version 1.0
April 29, 2014	CrIS, AIRS and IASI Dual Regression Retrieval Software Version 1.3

CSPP Satellite/Sensor/Product Matrix

Satellite	Multispectral Imager	Infrared Sounder	Microwave Sounder
Suomi NPP	**VIIRS** *SDRs (Level 1B), Images, Visualization, Clouds, Aerosols, Land, Ocean*	**CrIS** *SDRs (Level 1B) Atmospheric Profiles, Clouds, Visualization*	**ATMS** *SDRs (Level 1B), Atmospheric Profiles, Precipitation, Visualization*
Metop-A/B	**AVHRR** *Clouds, Aerosols, Land Surface, SST, Visualization*	**IASI, HIRS** *Atmospheric Profiles, Clouds, Visualization*	**AMSU, MHS** *Atmospheric Profiles, Precipitation*
NOAA-18/19	**AVHRR** *Clouds, Aerosols, Land Surface, SST, Visualization*	**HIRS** *Atmospheric Profiles*	**AMSU, MHS** *Atmospheric Profiles, Precipitation*
Terra	**MODIS** *Images, Visualization*	*N/A*	*N/A*
Aqua	**MODIS** *Images, Visualization*	**AIRS** *Atmospheric Profiles, Clouds, Visualization*	**AMSU** *Atmospheric Profiles, Precipitation, Visualization*
FY-3B/C	**VIRR, MERSI** *Images*		

MIRS

MIRS (<u>M</u>icrowave <u>I</u>ntegrated <u>R</u>etrieval <u>S</u>ystem) retrieves atmospheric temperature and moisture profiles, precipitation, and surface products from microwave sounder data.

Heritage	Developed at NOAA/NESDIS by Sid Boukabara, Chris Grassotti, et al.
Satellites/Sensors	Suomi NPP ATMS; Metop-A/B AMSU, MHS; NOAA-18/19 AMSU, MHS.
Products	Temperature and moisture profiles, total precipitable water, surface skin temperature and emissivity, rain rate, cloud liquid water, rain water path, ice water path, liquid water path, sea ice concentration, snow water equivalent, and snow cover.
Features	• Multi-sensor common algorithm. • Physics-based retrieval. • Retrieves land and ocean products in all sky conditions. • Extensively validated and documented.

MIRS Examples

Metop-B 2015/03/30 02:01 UTC
SNPP 2015/03/18 11:03 UTC

Metop-B AMSU/MHS 840 hPa
temperature and water vapor
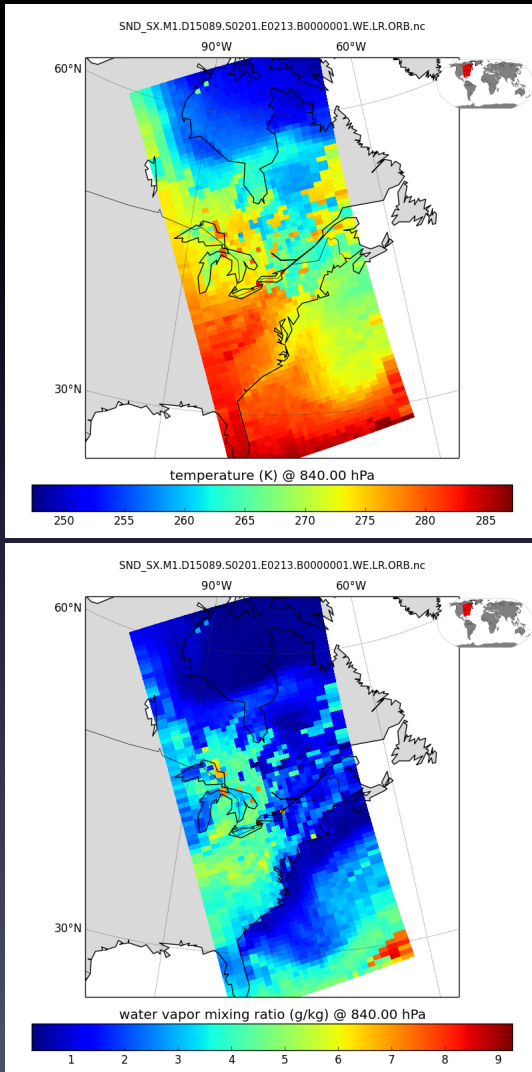
SNPP ATMS Surface Skin Temperature with Rain Rate
contours and isosurface of Rain Mass Profile
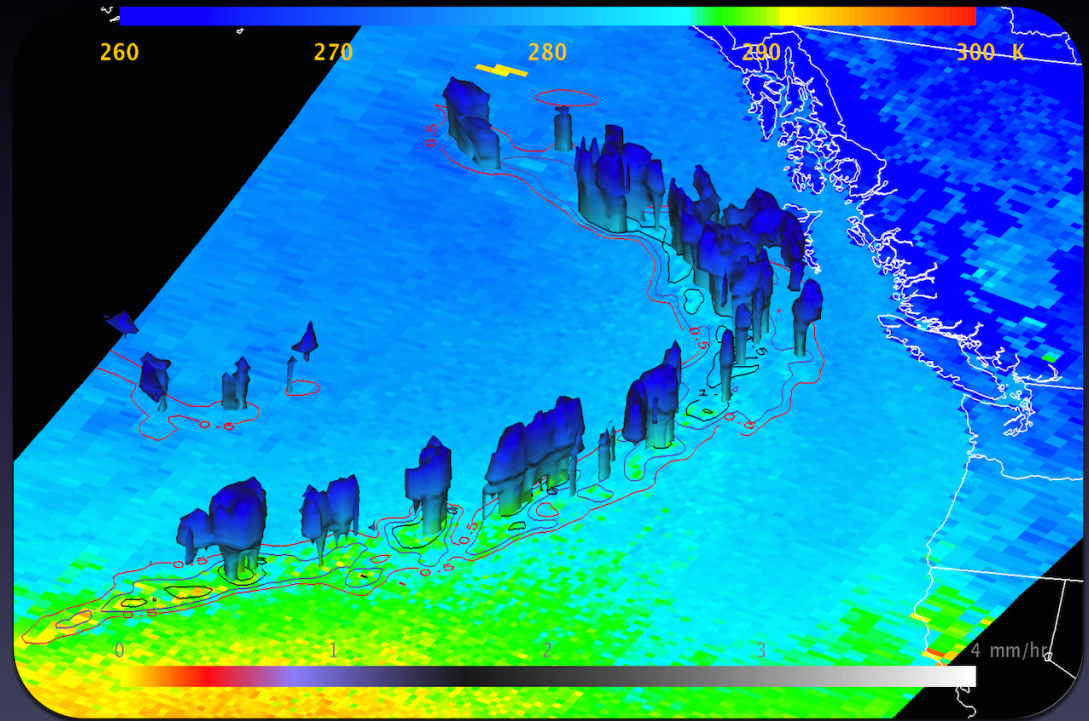
CLAVR-x

CLAVR-x (<u>Cl</u>ouds from <u>AV</u>HRR <u>Ex</u>tended) retrieves cloud, aerosol, and surface products from imager data.

Heritage	Developed at NOAA/NESDIS/STAR and CIMSS/SSEC by Andy Heidinger, Andi Walther, Denis Botambekov, et al.
Satellites/Sensors	Suomi NPP VIIRS; Terra/Aqua MODIS; Metop-A/B AVHRR; NOAA-18/19 AVHRR.
Products	Cloud mask, type, fraction, and phase; cloud top height, pressure, temperature, and emissivity; cloud optical depth and effective radius; aerosol optical thickness; normalized difference vegetation index; sea surface temperature; all in HDF4 format.
Features	• Multi-sensor common algorithm. • Product files include cloud and surface products, calibrated observations, and many ancillary data fields (user controlled). • CLAVR-x is the official NOAA cloud product for JPSS.

CLAVR-x Examples

SNPP 2015/10/26 17:58 UTC
Terra 2015/10/26 16:10 UTC

SSEC
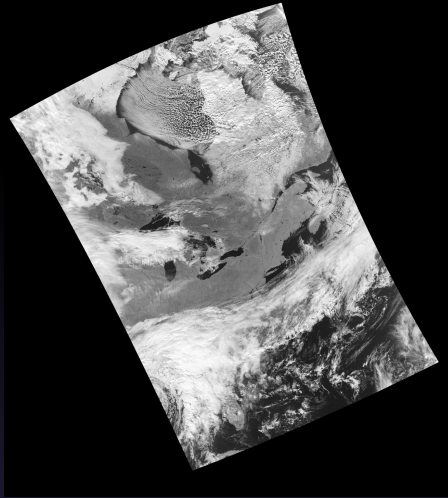
VIIRS 0.87 micron
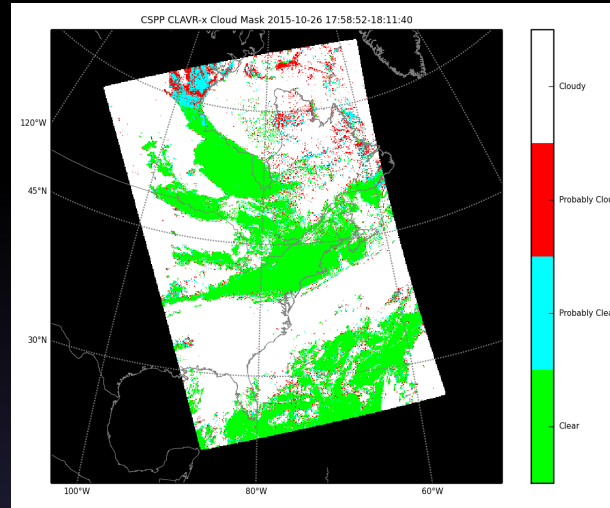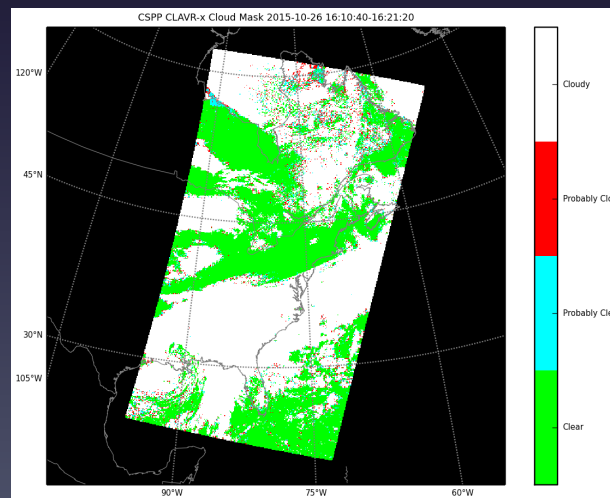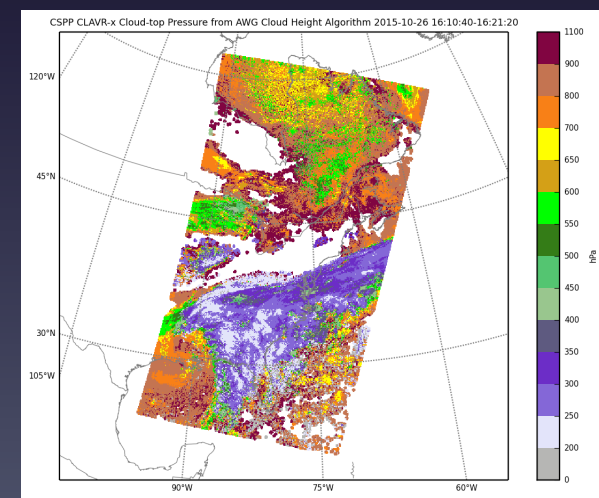

Cloud Mask
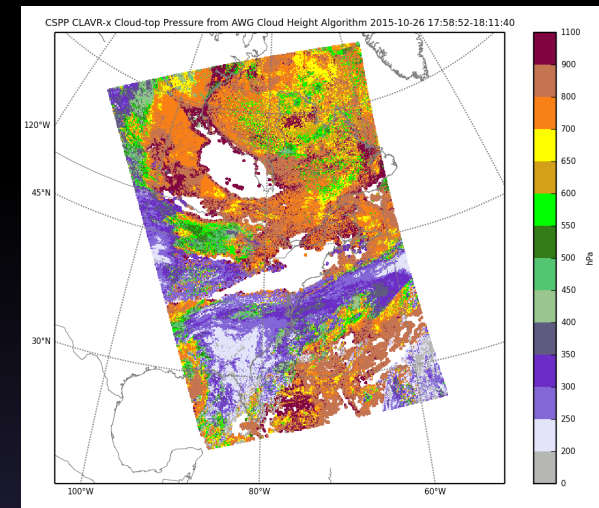
Cloud Top Pressure

MODIS 0.87 micron

Cloud Mask

Cloud Top Pressure

11
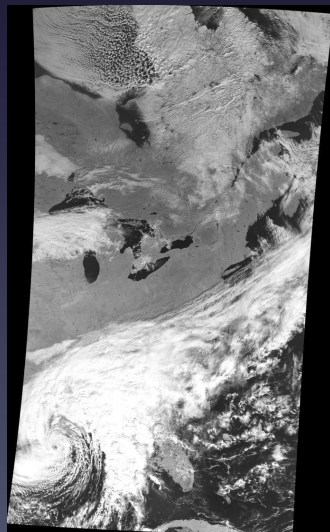
NUCAPS

NUCAPS (NOAA Unique CrIS/ATMS Processing System) retrieves atmospheric temperature, moisture, and trace gases from combined infrared and microwave observations.

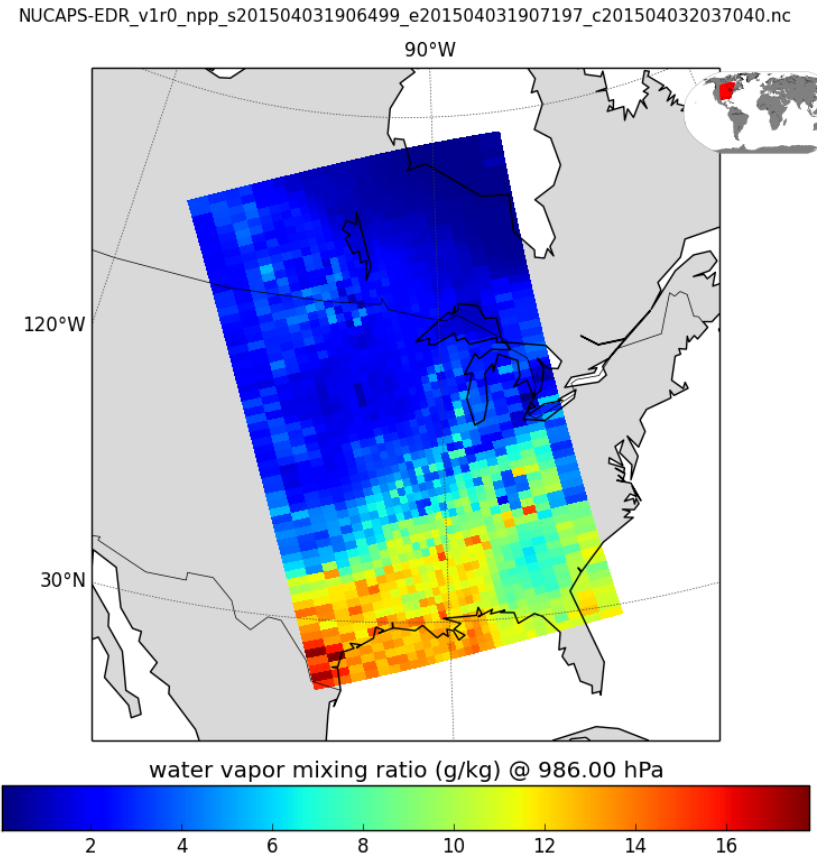| Heritage	Developed at NOAA/NESDIS/STAR by Chris Barnet, Antonia Gambacorta, Walter Wolf, Mark Liu et al.
Satellites/Sensors	Suomi NPP CrIS/ATMS
Products	Temperature, water vapor, and ozone profiles; trace gas profiles including ozone, carbon monoxide, methane, carbon dioxide, nitrous oxide, sulphur dioxide; infrared and microwave surface emissivity; cloud cleared radiances.
Features	• Multi-sensor common physical retrieval algorithm. • Future versions will support Metop-A/B IASI/AMSU/MHS and Aqua AIRS/AMSU. • NUCAPS is the official NOAA sounding product for JPSS.

NUCAPS Examples
SNPP 2015/04/03 19:07 UTC

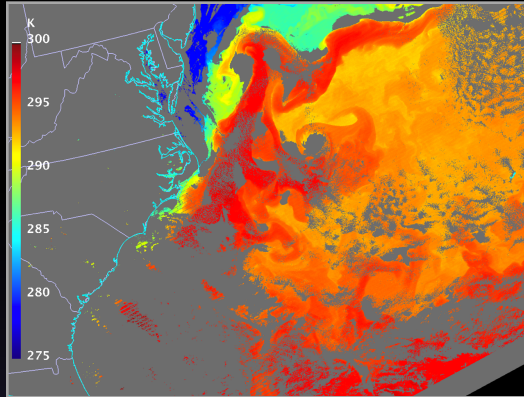

Temperature
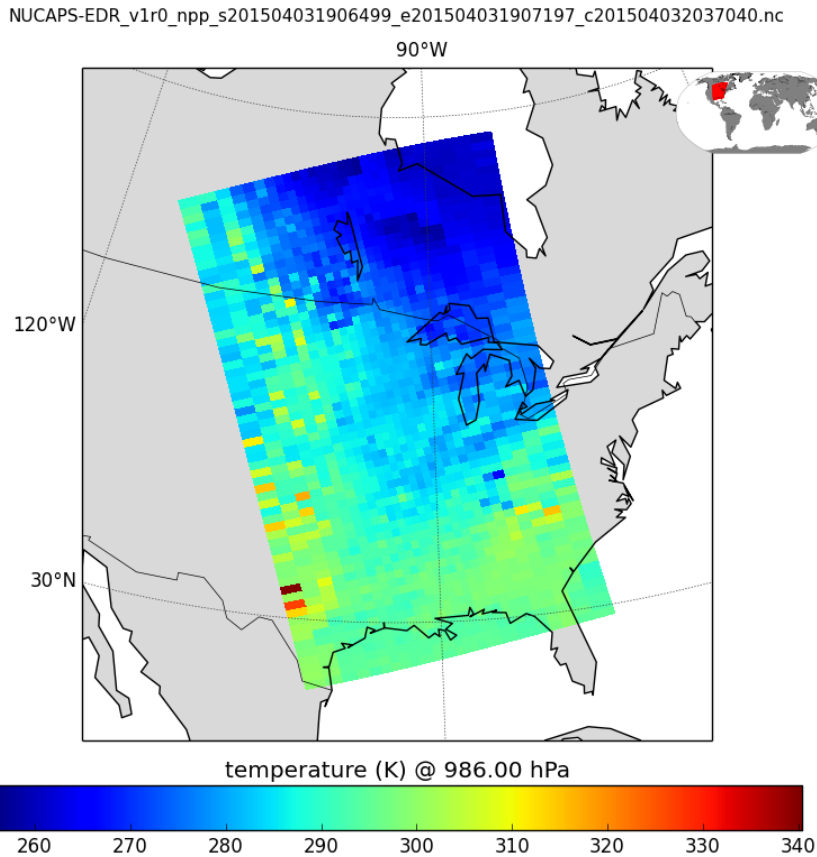
Water Vapor Mixing Ratio

ACSPO

ACSPO (Advanced Clear-Sky Processor for Oceans) retrieves sea surface temperature from multispectral imager observations.

Heritage	Developed at NOAA/NESDIS/STAR by Alex Ignatov, John Sapper, John Stroup, and Yury Kihai.
Satellites/Sensors	Suomi NPP VIIRS; NOAA-18/19 AVHRR; Metop-A/B AVHRR; Terra/ Aqua MODIS.
Products	Sea surface temperature, aerosol optical thickness; and clear-sky radiances.
Features	• Multi-sensor common algorithm. • ACSPO is the official JPSS algorithm for SST.

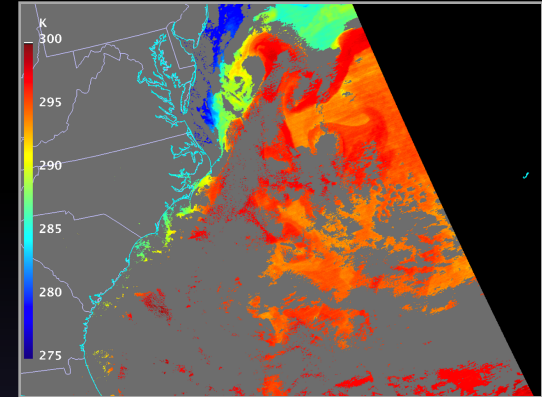# ACSPO Examples

2015/04/02

VIIRS SST 17:44 UTC
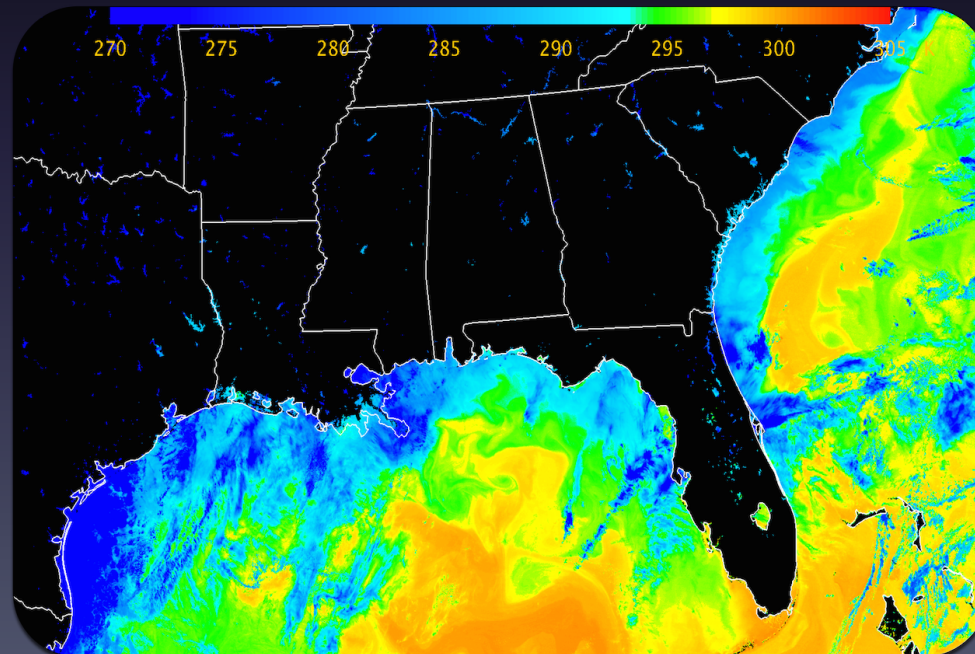
AVHRR SST 18:31 UTC
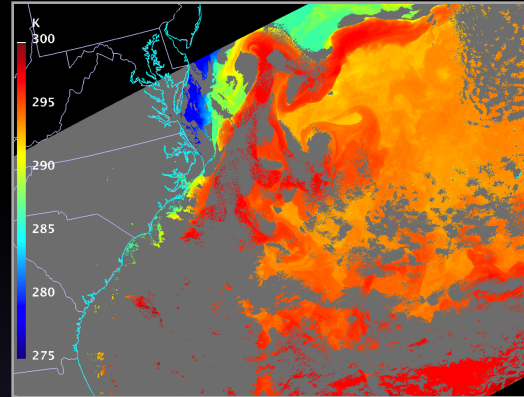
MODIS SST 18:35 UTC

VIIRS SST 2015/03/18 07:40 UTC

IAPP

IAPP (<u>I</u>nternational <u>A</u>TOVS <u>P</u>rocessing <u>P</u>ackage) retrieves atmospheric temperature and moisture, total ozone, and cloud top properties from ATOVS sounder data.

| Heritage	Developed at CIMSS/SSEC by Hal Woolf, Jun Li, Chia Moeller, Tom Achtor et al.
Satellites/Sensors	NOAA-18/19 HIRS/AMSU/MHS; Metop-A/B HIRS/AMSU/MHS.
Products	Temperature and water vapor profiles; total column water vapor and ozone; cloud fraction; cloud top pressure and temperature; surface skin temperature and microwave emissivity.
Features	• Fast regression first guess; iterative nonlinear physical retrieval. • Also supports NOAA-15/16 (non operational).

IAPP Examples

Metop-B 2015/04/02 16:35 UTC
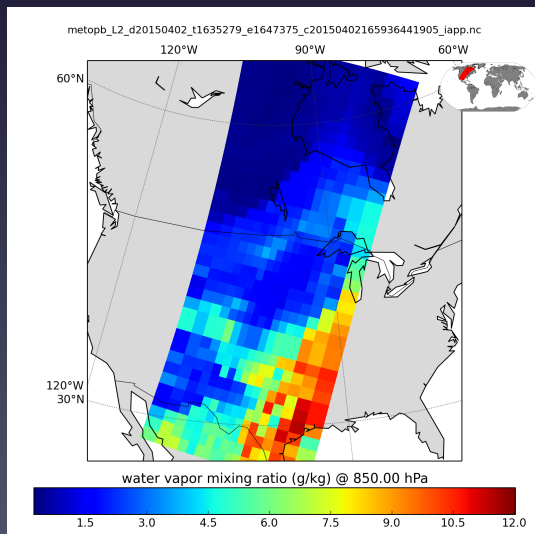NOAA-18 2015/04/02 23:08 UTC

SSEC

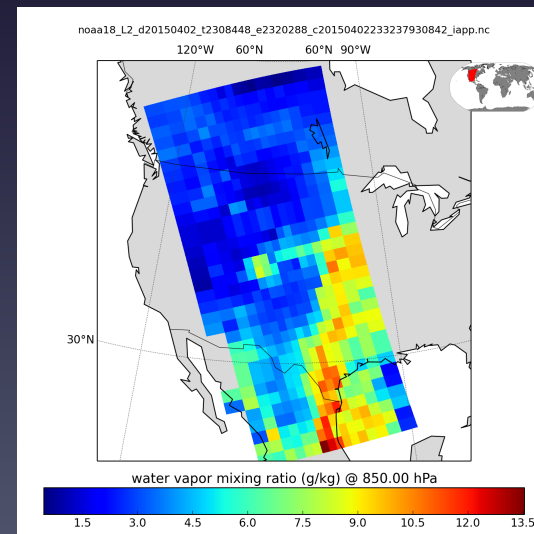Metop-B Temperature at 850 hPa
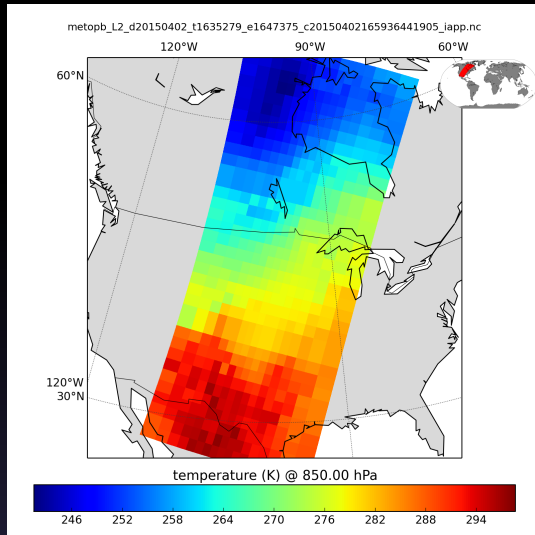
NOAA-18 Temperature at 850 hPa
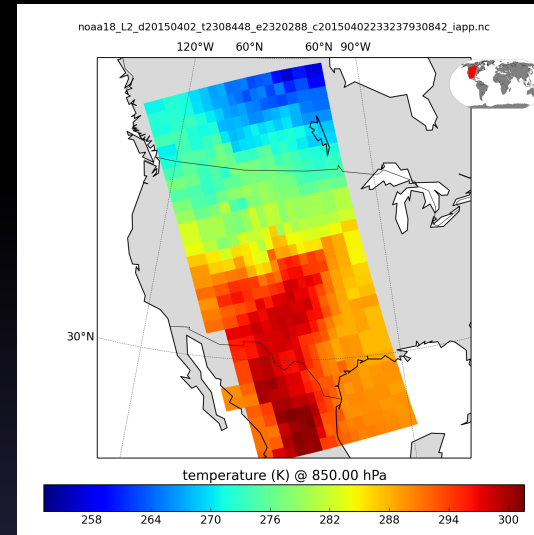
Metop-B Water Vapor at 850 hPa

NOAA-18 Water Vapor at 850 hPa
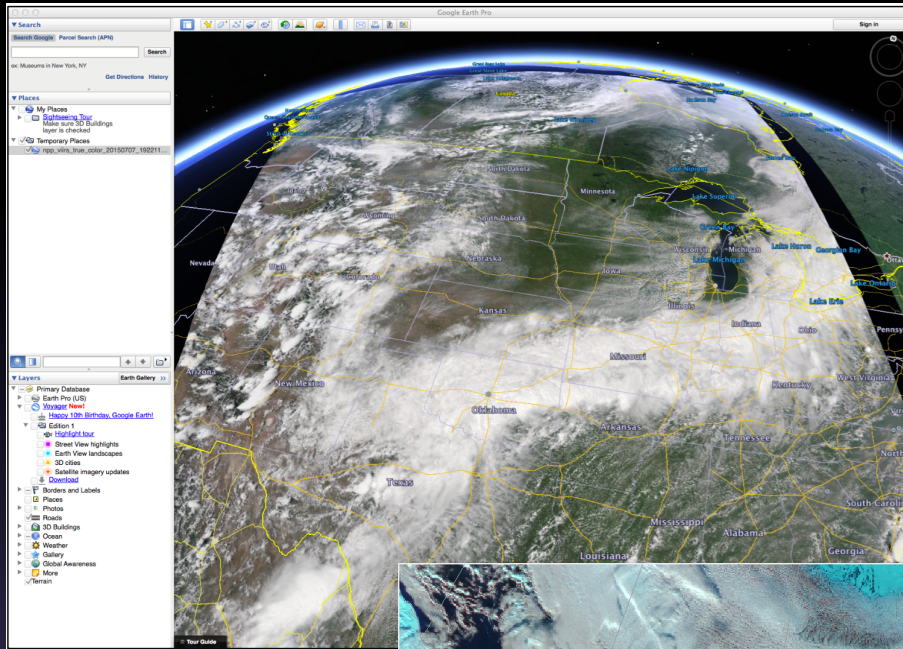
Polar2grid

Polar2grid creates reprojected imagery for single bands (grayscale) and band composites (RGB) from imager data.

Heritage	Developed at CIMSS/SSEC by Dave Hoese.
Satellites/Sensors	Suomi NPP VIIRS; Terra/Aqua MODIS, NOAA/Metop AVHRR, FY-3 VIRR.
Products	Single band and multi-band images in GeoTIFF, netCDF/AWIPS, KMZ, HDF5, and binary output.
Features	• Atmospherically corrected VIIRS and MODIS true color images. • Can read user-defined binary input data in swath format. • User defined 24-bit false color images and projection grids. • Creates composites from multiple orbit swaths.

Polar2Grid Examples
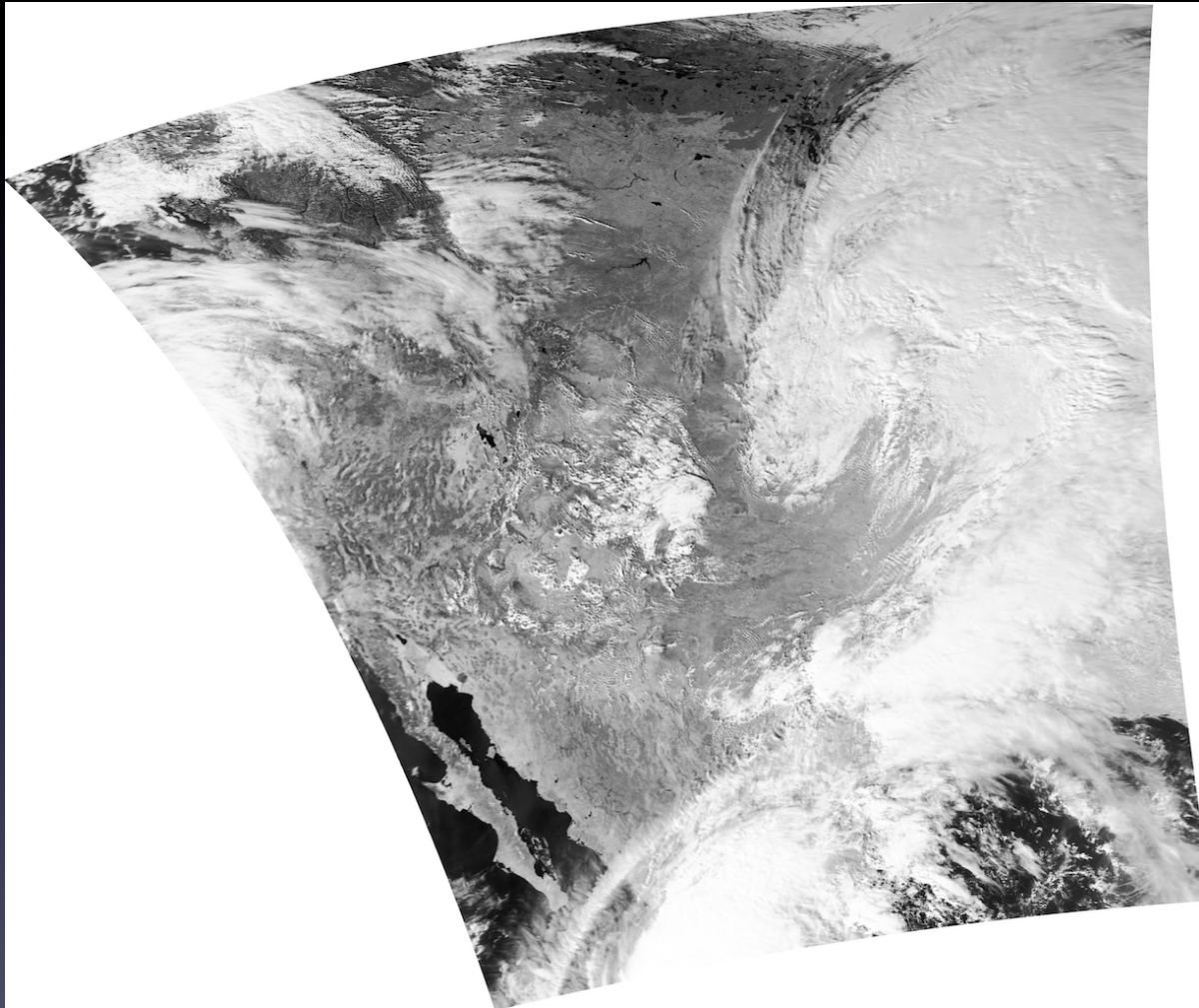
SNPP VIIRS True Color KMZ in Google Earth

Metop-B AVHRR netCDF in AWIPS2
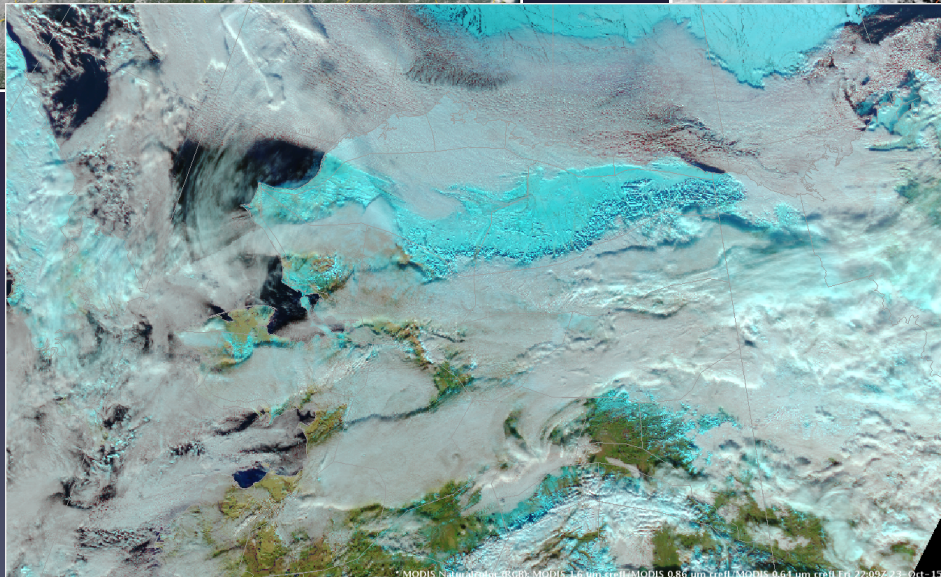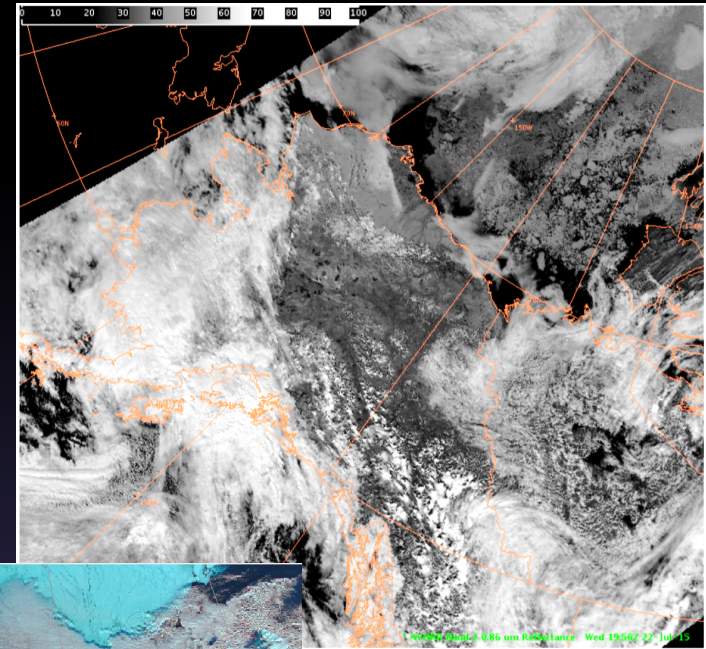
Terra MODIS false color netCDF in AWIPS2

Polar2Grid Examples (FY-3B)

FY-3B VIRR 0.87 micron GeoTIFF in Plate Carree projection

JSON file describing binary image, latitude, longitude data

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{
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        "instrument": "virr",
        "satellite": "fy3b",
        "data_kind": "reflectance",
        "begin_time": "2015-10-23T20:47:16.990000",
        "end_time": "2015-10-23T20:57:13.820000",
        "fill_value": 65535,
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        "swath_rows": 3582,
        "rows_per_scan": 3582,
        "swath_data": "vis_image_enhanced_f32.gray",
        "data_type": "real4",
        "swath_definition": {
            "swath_name": "nav",
            "latitude": "lat.dat",
            "longitude": "lon.dat",
            "data_type": "real4",
            "fill_value": NaN,
            "rows_per_scan": 3582,
            "swath_columns": 2048,
            "swath_rows": 3582
        },
        "description": "",
        "units": ""
    }
}
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CSPP Summary

- CSPP continues to support the polar orbiting satellite DB community with a wide range of software and products supporting Suomi NPP, Metop, NOAA, EOS, and FY-3 satellites.

- CSPP GEO now supports geostationary satellites (see poster 3p.08 by Graeme Martin).

- We look forward to JPSS-1 in early 2017.

http://cimss.ssec.wisc.edu/cspp/