IMAPP Direct Broadcast CIMSS Regional Assimilation System (DBCRAS)

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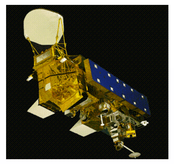
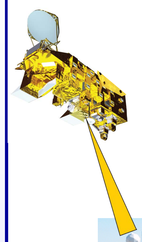


CONCEPT

Construct a re-locatable, easy to implement, numerical weather prediction package capable of generating reliable weather forecasts in real-time, initialized with locally generated IMAPP parameters.



A version of the CIMSS Regional Assimilation System (CRAS) was configured to assimilate total precipitable water and cloud parameters retrieved from the Moderate Resolution Imaging Spectroradiometer (MODIS) using IMAPP software.

Since 1996 CRAS development has been guided by validating forecasts using information from the GOES imager and sounder, making it "satellite friendly".

Design Requirements for Direct Broadcast CRAS

- Free distribution with the IMAPP Package
- Execution via simple shell scripts on Linux 32 or 64 bit platforms
- Medium bandwidth internet connection
- One time install; User specified lat/lon center of grid (near antenna)
- Automated identification and download of ancillary input data
- Backup server provided by SSEC for ancillary input data
- 72 hour forecasts of standard meteorological fields, grib2 format
- Simulated forecast satellite imagery
- Option to generate graphics using McIdas-V

Note: DBCRAS requires 200Mb of forecast grids for boundary conditions. 12 hours of MODIS passes generates ~ 2Gb of retrievals. With limited bandwidth it makes sense to……

Implement forecast model on site at local ground station.

DBCRAS Specification – Version 1.0

Grids:	48km outer grid, 16km re-locatable nest (optional), Arakawa C
Map:	Polar stereographic
Grid size:	220x150
Levels:	38 sigma levels, floating top
Time step:	240 sec
BCs:	½ degree GFS, 6-hourly to 72 hours
Initial:	12-hr spin-up using 5-7 Aqua/Terra passes SSTs and snow cover from NESDIS analysis
Dynamics:	Semi-implicit time scheme, 3rd order Advective form - Leslie, et.al.,1985 Pseudo-non-hydrostatic, Raymond and Aune, 1998 3rd order Time filter - Raymond, 1991 6th order tangent - Raymond, 1988
Physics:	Radiation – Ackerman and Stephens, 1987 Turbulence – Raymond, 1999 Precip/Clouds – modified Kessler, 1974, Tiedke, 1993 Convection – Raymond and Aune, 2002
Platform:	Dual-quad core Intel Xeon , 4Gb memory

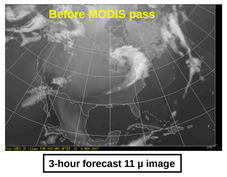
DEPLOYMENT

Since October, 2007 DBCRAS forecasts have been generated in real-time for North America using total precipitable water and cloud-top pressure retrievals generated locally by IMAPP.

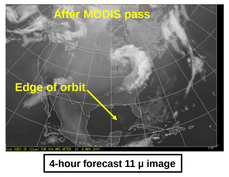
Cloud-top pressure and effective cloud amount are used to adjust cloud water mixing ratio. Cloud checks are performed for low, high, and multi-layer clouds.

Background	MODIS	Operation
Clear	Clear	Do nothing (check RH)
Cloudy	Cloudy	Adjust cloud, RH, match top (up to two layers)
Cloudy	Clear	Clear cloud, adjust RH
Clear	Cloudy	Build new cloud, adjust RH

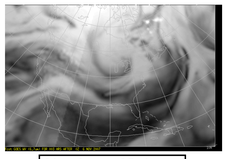
Water Vapor Adjustments using total precipitable water retrievals are performed at clear fields-of-view.
1) Mean background mixing ratio profile is computed.
2) Perturbations are removed'
3) Mean profile is adjusted to match MODIS Total PW using 1D var (strong constraint).
4) Perturbations are added to adjusted profile.
5) RH profile checked for "clearness".



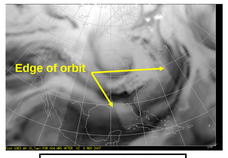
3-hour forecast 11 μ image



4-hour forecast 11 μ image



3-hour forecast 6.7 μ image



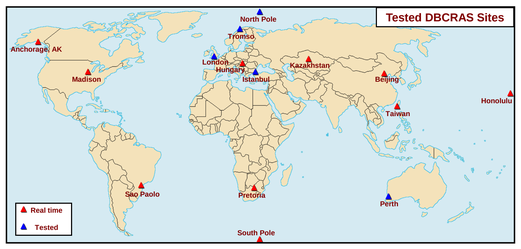
3-hour forecast 6.7 μ image

Here is an example of changes to the DBCRAS cloud and water vapor fields resulting from a single MODIS pass. Changes are monitored using forecast 11μ and 6.7μ images generated during the DBCRAS spin-up forecast.

Aqua orbital tracks at Wisconsin

View Wisconsin DBCRAS at http://www.ssec.wisc.edu/~kathys/dbcras/

A few sites implementing Version 1.0 of the CIMSS Regional Assimilation System from the IMAPP Direct Broadcast Package (DBCRAS)



DBCRAS domains used by the Department of Meteorology, Eötvös Loránd University, using MODIS retrievals provided by the Space Research Group's receiving station, Budapest, Hungary.

48km Outer Grid

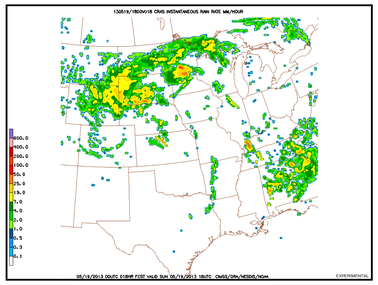
16km Nest Grid

NEXT GENERATION DBCRAS

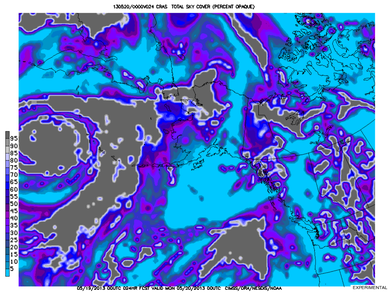
A new release of DBCRAS is nearly complete. The release is in response to feedback obtained from DBCRAS users around the globe. The release is expected to occur late in FY2013.

Scheduled Changes to DBCRAS – Version 2.0

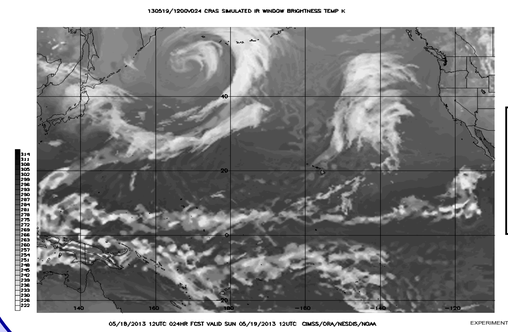
Grids:	40km outer grid, 13km nest, Arakawa C
Maps:	Polar stereo, Lambert Conical, Mercator
Grid size:	250x180
Levels:	38 sigma levels, floating top
Time step:	180 sec
BCs:	½ degree GFS, 6-hourly to 72 hours
Initial:	12-hr spin-up using additional parameters from IMAPP Improved surface climatologies
Dynamics:	Added gravity wave drag
Physics:	Improved cloud physics
Numerics:	Optimized for improved performance
Platform:	Newer multi-core Intel Xeon , 8Gb memory



Above is an 18-hour forecast rain rate (pseudo radar) from a DBCRAS 15km nest on a Lambert conical grid covering the Midwest United States. Instantaneous rain rate is output directly from the forecast model and displayed radar-like color scale.



Shown above is a 24-hour DBCRAS forecast sky cover from a polar stereo grid covering Alaska. Sky cover is computed using predicted cloud mixing ratio to estimate cloud coverage on the celestial dome centered on each model grid point.



At left is a 24-hour DBCRAS forecast 11*u* image demonstrating the advantage of using a Mercator projection in low latitudes. The 11*u* DBCRAS images are estimated using predicted water vapor and cloud mixing ratios , cloud-top temperature and surface skin temperature.

Additional DBCRAS forecasts are available at: http://cimss.ssec.wisc.edu/cras

POSSIBLE ADDITIONS

- **A self-cycling option is being considered to allow DBCRAS forecasts to continue when boundary condition grids are unavailable due to internet outages. DBCRAS would continue to cycle for two - three days using satellite data to update model grids from previous DBCRAS forecasts.**

- **Include routines to assimilate parameters from additional satellites processed by IMAPP.**

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