LROSE – LIDAR RADAR OPEN SOFTWARE ENVIRONMENT

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What problem are we trying to solve?

We support users in the scientific community, but we are finding it increasingly difficult to provide good quality support for aging legacy applications.

The scientific community has needs that are not supported by our current software.

We have a large code base of software, of varying ages and maintainability.

We have inherited data formats that are not optimal for scientific data exchange.

Collaboration

LROSE is an Open Source project. Cost reduction and efficiency will be achieved through collaboration with other organizations.

UNIDATA | NCAR/RAL | Universities | CSWR | NOAA/NSSL | NWS/ROC | NASA | DOE/ARM | International: e.g. BALTRAD Europe BOM Australia

CSWR DOW3 ROTATE-2004, Harper, Kansas, May 2004

What is LROSE?

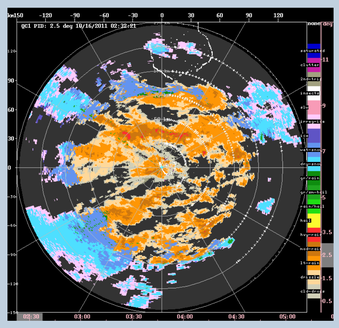
LROSE is an NSF-backed project to develop common software for the LIDAR, RADAR and PROFILER community.

It is based on **collaborative, open source** development. The code would be freely available on the web.

The core: developed by NCAR/EOL, largely based on existing code.

Algorithms and analysis tools: developed and supported by the community.

Data would be stored **in portable data formats**, based on UNIDATA NetCDF, following the Climate and Forecasting (CF) conventions to facilitate data assimilation by models.

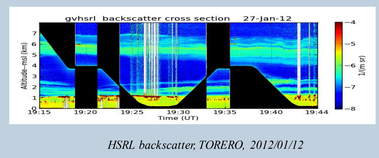


SPOL Particle ID algorithm DYNAMO 2011/10/16

LROSE would support many of the LAOF instruments

Spol-Ka | CSU/CHILL | DOWs | Eldora | HCR | Wyoming cloud radar | HSRL | DIAL | Wyoming cloud LIDAR | 915 MHz profilers | 449 MHz profilers

HSRL in GV, TORERO, 2012

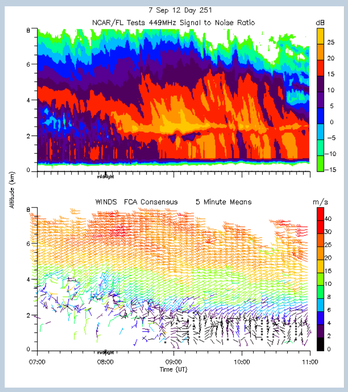


HSRL backscatter, TORERO, 2012/01/12

HCR on the NCAR GV

LROSE Components

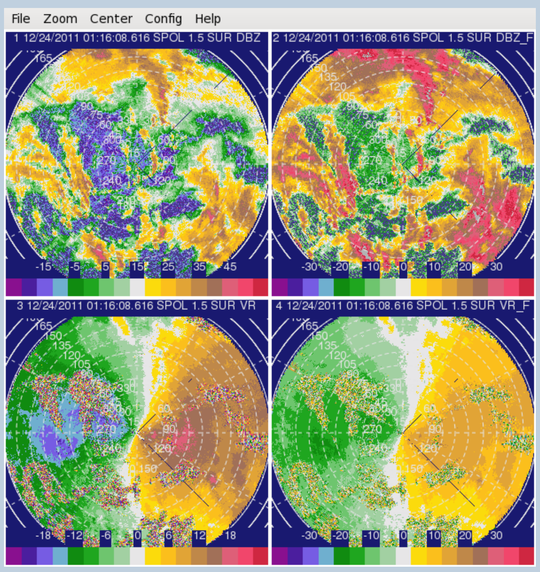
Support for profilers



XPROF profiler display, Boulder Foothills lab 2012/09/07

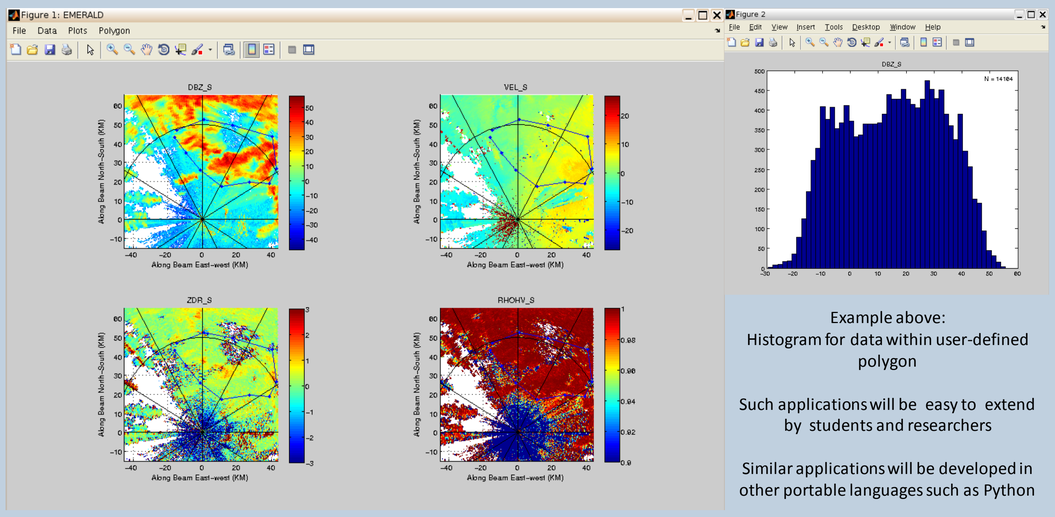
Supporting legacy applications: solo3

Native 64-bit compatible
Upgraded to latest GTK widgets
Will read/write CfRadial natively



Support for high-level languages

Example: EMERALD – a solo-like application implemented in MatLab



Example above:
Histogram for data within user-defined polygon

Such applications will be easy to extend by students and researchers

Similar applications will be developed in other portable languages such as Python

NCAR profilers
Foreground: new 7-panel modular 449 MHz profiler
Background: mobile 915 MHz profiler

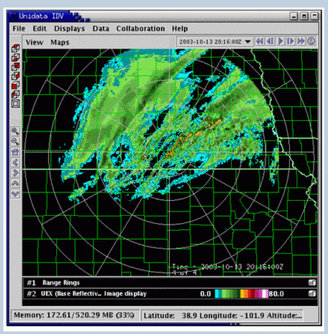
Leveraging existing displays through collaboration - IDV

The UNIDATA Integrated Data Viewer is a sophisticated 3-D –capable display.

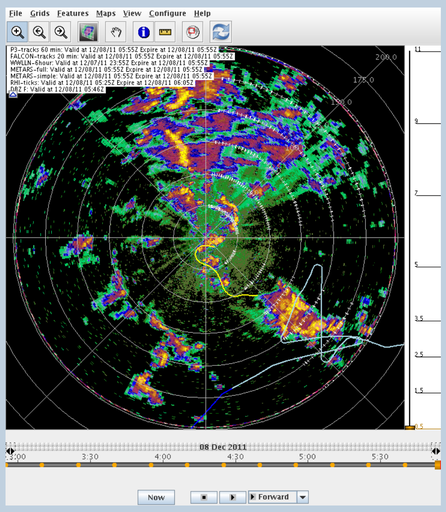
Many person-years of effort have been spent on developing IDV.

By carefully selecting data formats that are widely accepted by the community, it is possible to make use of IDV almost 'out of the box'.

This saves the large cost associated with developing capable displays that will be widely used by the community.



IDV showing data from a NEXRAD WSR88D



Web-enabled portable integrating displays - Jazz

Jazz is a Java-based web-start display that will replace the legacy CIDD data integration display (see below).

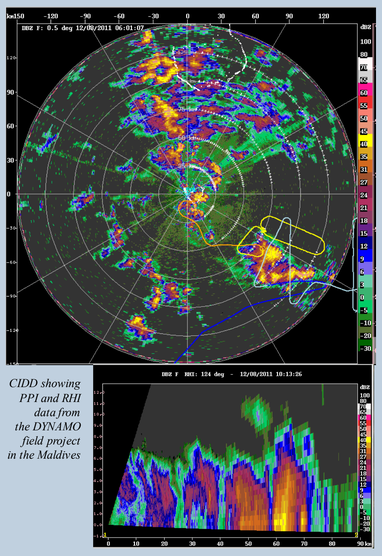
Java has the advantage of portability, with support on all major operating systems and display platforms.

Data sets will be stored on servers at central sites. Users will run Jazz on their platform of choice – there will be no need to copy the data to the user's machine. Data server applications will serve the data from the central site to Jazz in an efficient manner.

Jazz is about 80% complete. Much of the Jazz development work was carried out using non-NSF funds at NCAR's Research Applications Laboratory (RAL). This collaborative effort is continuing.

Core suite displays

Name	Description	Work to be performed	Estimated percent complete
Solo3	Viewer and editor for radial data	Upgrade to C++. Bug fixes. Handle CfRadial. Improve maintainability.	75
Jazz	Java-based web-enabled viewer for integrating radar and other data sets into a single display	Major enhancements	80
CIDD	Legacy C++ version of Jazz	Bug fixes	100
VCHILL	Java-based viewer for radial data	Provide support for VCHILL by developing a server for CfRadial data	25
IDV	UNIDATA Integrated Data Viewer	Provide support for CfRadial and profiler obs in IDV	80
ProfilerDisplay	Wind profiler spectra and correlation display	Extend interoperability	80
Xprof	IDL wind profiler plotting package	Upgrade and improve maintainability	50
Emerald	Radial data viewer in MatLab	Design and development	30
Pyview	Radial data viewer in Python	Design and development	0



CIDD showing PPI and RHI data from the DYNAMO field project in the Maldives

Prototyping using legacy displays - CIDD

CIDD (Cartesian Integrated Data Display) has been the primary integrating display at EOL over the past 6 years.

CIDD is a C++ application and only runs on 32-bit LINUX platforms. Hence the need to replace it.

Much of the prototyping work for Jazz (see above) was accomplished through CIDD development and testing.

Support for CIDD will continue until Jazz development and testing is complete and Jazz is fully deployed.

Spol-Ka at DYNAMO Maldive Islands

Core suite algorithms

Algorithm	Estimated percent complete
NIMA wind profiler moment and winds estimation	100
ICRA intermittent clutter removal	80
Boundary layer depth profiler reflectivity tracing	25
Profiler winds bird filtering	25
Profiler spaced-antenna full correlation analysis	60
Weber-Wuertz profiler Doppler spectra processing	25
Profiler precipitation / clear air identification	25
Wavelet profiler IQ time series processing	25
Gridding / interpolation from radial to Cartesian coordinates	90
Merging multiple radars into single Cartesian grid	90
Clutter detection (NP, AP) in time series	100
Clutter filtering (NP,AP) in time series	100
Moments computations from time series (single polarization and dual polarization, staggered PRT)	100
AP detection and removal using moments data	100
Multiple-radar Doppler analysis (e.g. dual-Doppler synthesis)	75
Storm tracking – convective (TITAN)	100
Storm analysis and climatology – convective (TITAN)	100
Echo tracking from correlation (ctrec)	100
Echo tracking using optical flow	50
VIL – vertically integrated liquid	100
PID – particle identification from dual polarization variables	100
VAD – velocity azimuth display (enhanced, includes an estimate of divergence)	100
Refractivity (estimation of RH field from clutter)	80
Precipitation rate from dual polarization variables	100
Precipitation accumulation over time	100
Velocity de-aliasing (James and Houze algorithm)	100
Bright band detection and mitigation in Cartesian data	100
Azimuthal and radial shear from radial velocity	100
VDRAS (Variational Doppler Radar Assimilation System)	100
Convective / stratiform partitioning	100
Power and reflectivity calibration	100
ZDR calibration from vertical pointing scanning	100
ZDR calibration from cross-polar power, using clutter echoes	90
Sun-based calibration	90