The Lidar-Radar Open Software Environment (LROSE) : Progress and Plans

AMS 2020 Annual Meeting

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LROSE: Lidar-Radar Open Software Environment

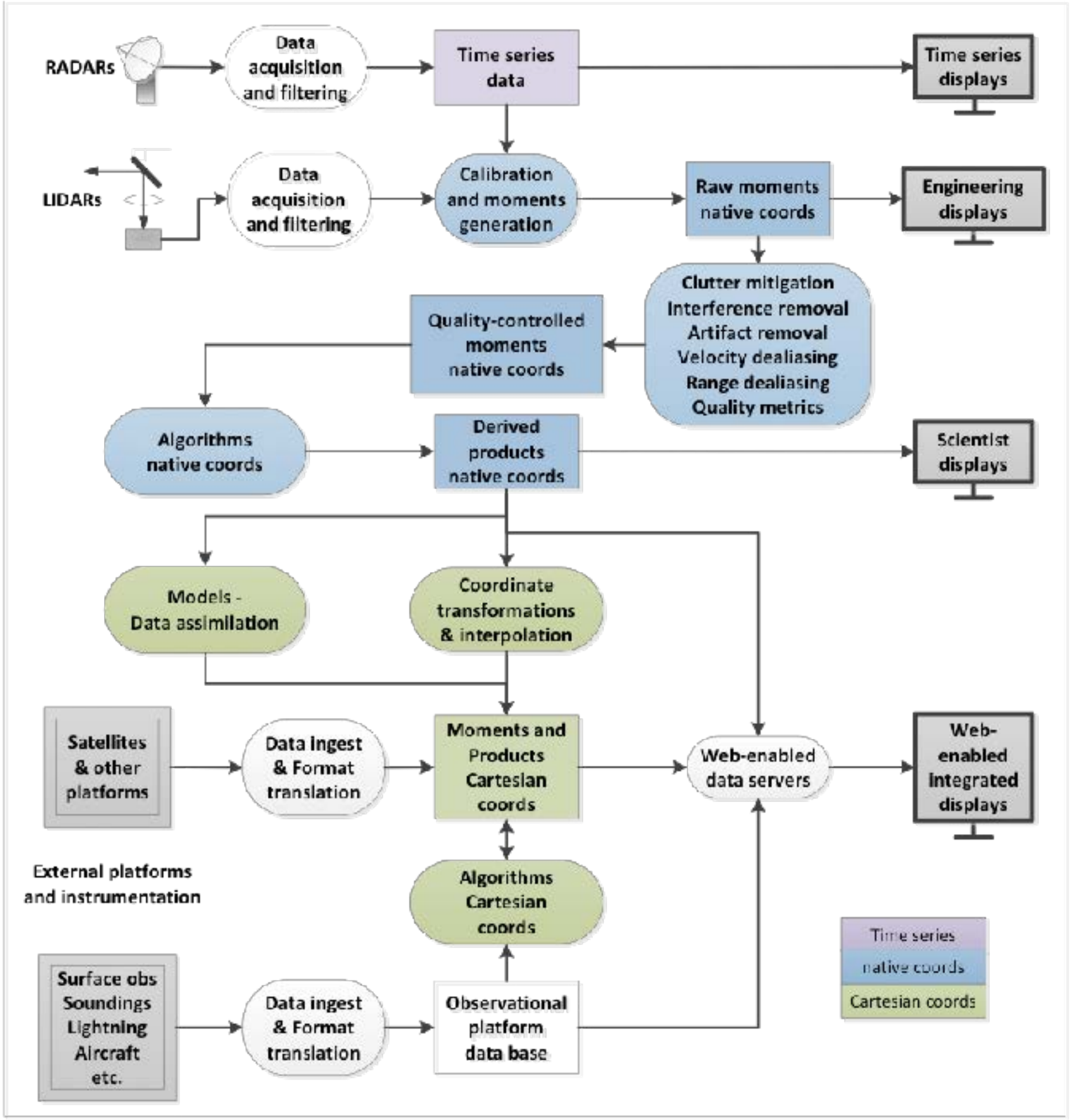
- LROSE is a project to develop common software for the LIDAR, RADAR and Profiler community

- Joint 4-year project between Colorado State University and NCAR Earth Observing Laboratory funded by NSF SI2-SSI
  - Moving into year 4, with plans for no-cost extension to year 5

- LROSE is based on collaborative, open source development, with algorithms and techniques developed and supported by the community

  - Primary focus of final years of project to build and support community

LROSE-core now has over 400 'apps' for all aspects of the lidar/radar workflow. A subset are in the formal releases and documentation. Focus on documentation moving forward



NSF Radar Workshop 2012 Survey (Bluestein et al. 2015)

Radar Software Needs	Personal Research Needs	Community Needs	Total Score
NCAR-maintained centralized repository for radar software (esp. including wind synthesis) with data sets for software testing	55	41	96
Standardized software packages and toolkits (multi-platform, modular, menu-driven, easy for community to add to, ease of conversion among new and old radar data formats)	30	53	83
Training (workshops/online tutorials)	48	15	63
Ability to integrate radar and non-radar data sets	25	32	57
Open source tools and software	30	16	46
3D/4D Visualization Software (with publication quality output)	24	21	45
Next generation wind synthesis software to replace the legacy (REORDER/CEDRIC) algorithms, while maintaining current functionality	15	27	42
Common radar data format standard and a common metadata standard (e.g. CfRadial)	19	15	34
64-bit compatible real-time display software tool	19	11	30
Improved radar data quality control (solo) (Oye et al., 1995)	12	20	32
Automated quality control software	14	13	27
Detailed documentation for data products, tools, and code	18	7	25
Improved dual-polarization processing	10	12	22
Accessible variational Doppler radar assimilation and thermodynamic retrieval	7	4	11

Still lots to do, but progress made in all key areas identified by community

LROSE staffing update

1. Bruno Melli left CSU in August 2019, Ya-Chien Feng moved to NCAR ASP in October 2019

2. Jeff Smith worked part-time on HawkEye editor from August to November

3. Brianna Lund will join LROSE team in January 2020

4. ‘lrose-help’ team:

Michael M. Bell, Jen DeHart, Ting-Yu Cha, Ali Cole, Brianna Lund
Colorado State University

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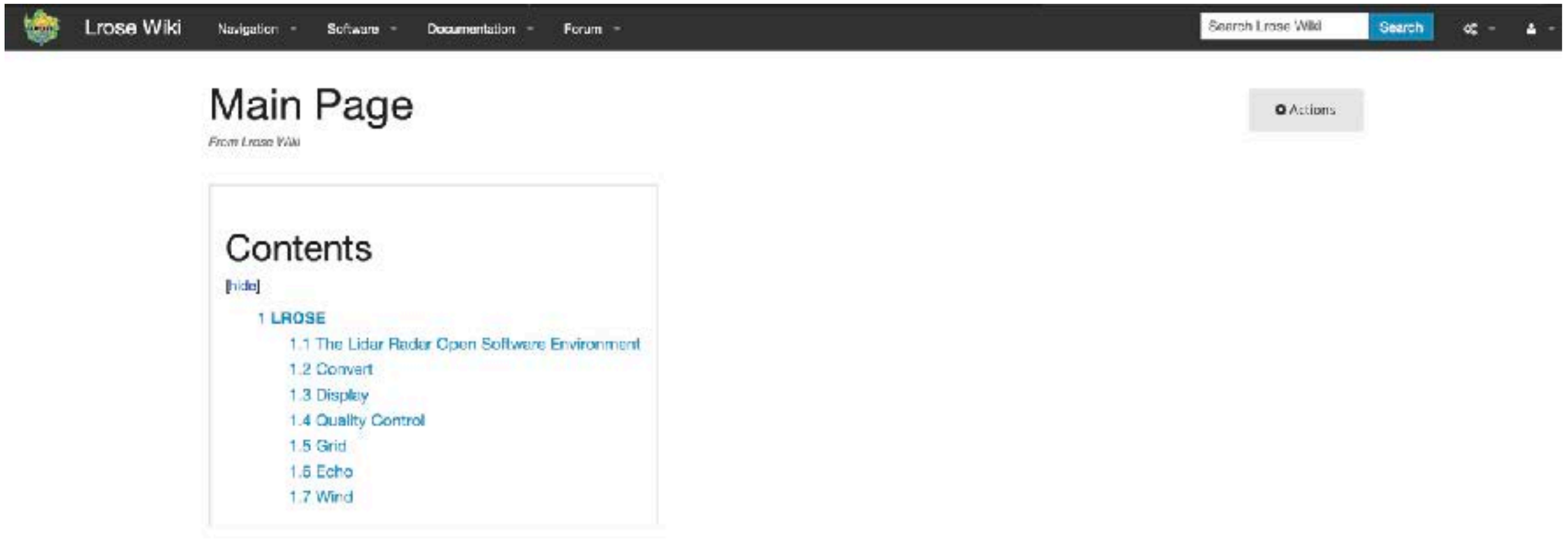
NCAR

wiki.lrose.net



LROSE

The Lidar Radar Open Software Environment

DOI

The current LROSE release is called "Cyclone" (a bright red rose) and encompasses six key toolsets that define a core lidar/radar workflow: *Convert, Display, QC, Grid, Echo, and Winds*

Cyclone can be used from a 'Virtual Toolbox' using Docker and a wrapper script, or compiled in C++ for native apps on Linux or Mac. Preliminary support is available for some tools on Windows.

Full documentation for Cyclone is available on the LROSE website.

We encourage users to register in order to receive critical software updates, and sign up for the mailing list to help build the LROSE community.

Help can be obtained by posting issues directly to the lrose-cyclone Github repository, via our help mailing list, or Discourse user forum.

LROSE is a co-operative project between:

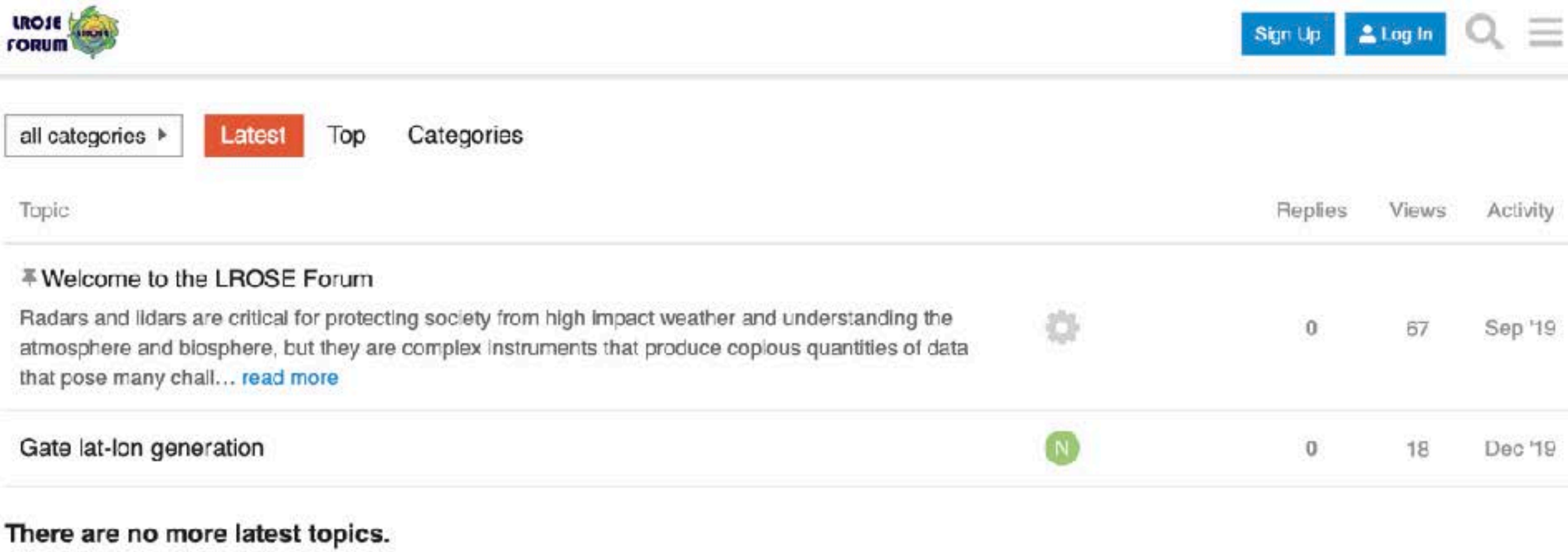
- Dept. of Atmospheric Science at Colorado State University (CSU) and the
- The Earth Observing Lab at the National Center for Atmospheric Research (NCAR).

LROSE is funded by the National Science Foundation.

Cyclone focuses on high-quality, well-tested, well-maintained and well-documented key applications as 'building blocks', allowing users to assemble trusted, reproducible workflows to accomplish more complex scientific tasks.

In the current release, the following tools are available:

forum.lrose.net



LROSE development plan and schedule

Year	Major release name	Looks like ...
2018	Blaze	
2019	Cyclone	
2020	Elle	
2021	Jade	
2022	Topaz	

Legacy (stable, citable, no new development)

Stable (bug-fixes)

Unstable (active development)

Planned under SI2 support

Community garden!

LROSE Convert

- **RadxConvert**

  - Convert to/from CfRadial netCDF format

Type	Notes	Type	Notes
CfRadial-1	Read-write		
CfRadial-2 (WMO)	Read-write (work in progress)	Leosphere (LIDAR)	Read-only
BUFR	Read-only	NEXRAD Level 2	Read-write
D3R	Read-only	NEXRAD Level 1,3	Read-only
DOE	Read-only	NOXP	Read-only
DORADE	Read-write	NSSL-MRD	Read-only
EEC-Edge	Read-only (work in progress)	ODIM-H5	Read-write (work in progress)
FORAY	Read-write	RAPIC	Read-only
Gamic	Read-only	SIGMET Raw (Vaisala)	Read-only
Gematronik Rainbow	Read-only (writeable with python script)	TDWR	Read-only
HSRL (LIDAR)	Read-only	TWOLF	Read-only
HRD (Hurricane Research Division)	Read-only	UF	Read-write

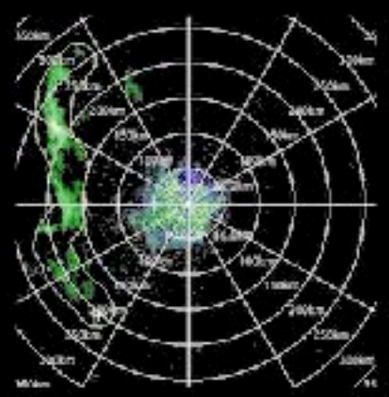
- **RadxBUFR** for GSI data assimilation

LROSE Display

1. **HawkEye**

- Engineering and real-time display suitable for both scanning and vertically pointing radars. ***Editing support will be in Elle***

Boundaries in HawkEye



HawkEye supports drawing a boundary around a region within your radar data, enabling you to exclude (delete) that portion of the data, or perhaps perform some extra processing on that region.

HawkEye is part of LRose (joint project between CSU and NCAR)

LROSE Display

1. **Jazz:** Java-based integrating display

2. **CIDD:** C++-based integrating display

3. **TITAN:** Nowcasting, storm tracking display

- Advanced display tools available now under lrose-core, will be included in Elle release

LROSE QC

1. **RadxFilter (cyclone)**: Compute QC factor for automated editing

2. **RadxMergeFields (cyclone)**: Combine fields from CfRadial files

3. **RadxPersistentClutter (cyclone)**: Persistent ground clutter identification and removal

4. **RadxDealias (elle)**: 4D velocity dealiasing (James & Houze 2011)

5. **RadxQC (elle)**: Remove AP & sea clutter, RF interference, chaff

6. **AirborneRadarQC (elle)**: Airborne navigation corrections and automated editing (Cai et al. 2017)

LROSE Grid

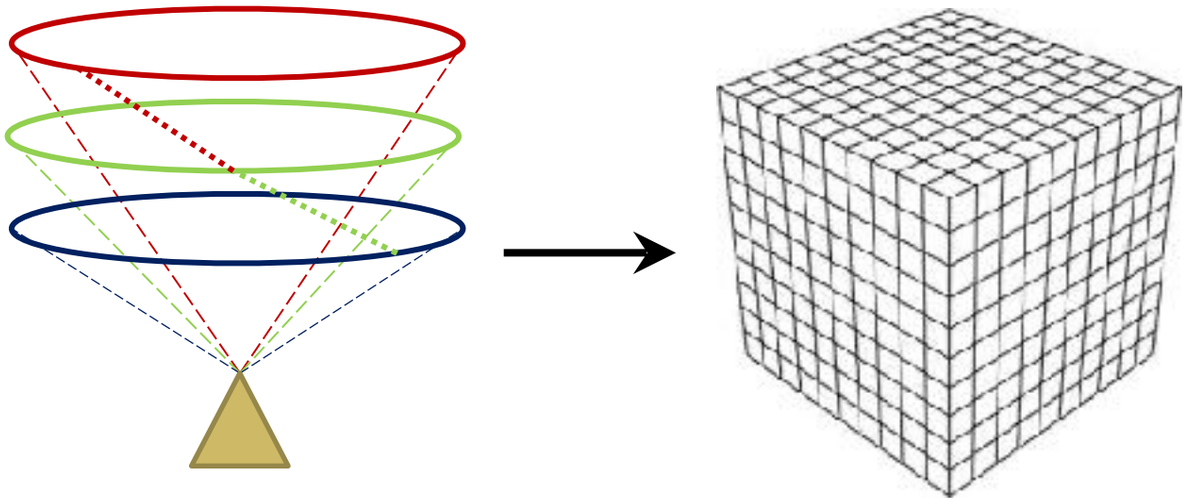
1. **Radx2Grid**

    1. 3-D Cartesian grid (x, y, z)

    2. Cartesian PPIs (x, y, elev)

    3. Regular polar grid (range, az, elev)

    - Recent development has streamlined options in the parameter file for typical use cases.



2. Reorder-style gridding for airborne radar available in FRACTL and SAMURAI

LROSE Echo

1. **RadxRate (formerly RadxPartRain)**

App	KDP	Z & ZDR Attenuation	NCAR PID	Precip Rate
RadxKdp	✓	✓	✗	✗
RadxPid	✓	✓	✓	✗
RadxRate	✓	✓	✓	✓

2. **RadxQPE:** Accumulated quantitative precipitation estimation

3. **RadxBeamBlock**: Beam blockage identification

4. **ConvStrat (elle)**: Convective-stratiform partition

5. **Refract (elle)**: Refractivity calculations

LROSE Wind

1. Multi-Doppler

1. **FRACTL**: Fast Reorder and Cedric Technique in LROSE. Highly optimized classic dual-Doppler solver
2. **SAMURAI**: Spline-based 3DVAR technique (Bell et al. 2012)

2.Single Doppler

1. **RadxEvad**: Enhanced VAD (Matejka & Srivastava 1991)
2. **VORTRAC**: GBVTD and GVTD (Jou et al. 2008)

LROSE Installation

OS-version	lrose-core	HawkEye	fractl	vortrac	samurai	Qt5 OK?
CENTOS 6	Yes	Yes	No	No	No	Yes
CENTOS 7	Yes	Yes	Yes	Yes	Yes	Yes
CENTOS 8	Yes	Yes	Yes	No	Yes	Yes
Fedora 28	Yes	No	Yes	No	No	No
Fedora 29	Yes	No	Yes	No	No	No
Fedora 30	Yes	No	Yes	No	No	No
Fedora 31	Yes	No	Yes	No	No	No
Debian 9	Yes	Yes	Yes	Yes	Yes	Yes
Debian 10	Yes	No	Yes	No	No	No
Ubuntu 16.04	Yes	Yes	Yes	Yes	Yes	Yes
Ubuntu 18.04	Yes	Yes	Yes	Yes	Yes	Yes
Ubuntu 18.10	Yes	No	Yes	No	No	No
Ubuntu 19.04	Yes	No	Yes	No	No	No
Ubuntu 19.10	Yes	No	Yes	No	No	No
Suse leap	Yes	Yes	Yes	No	Yes	Yes
Suse latest	Yes	Yes	Yes	No	Yes	Yes

LROSE Installation

Latest release

se-cyclone-20...

1ce0872

Verified

lrose-cyclone release 20200110

Edit

mike-dixon released this 2 days ago

Docker image available from docker hub

```
$ docker pull nsflrose/lrose-cyclone
```

For brew, uninstall previous versions of lrose before installing lrose-cyclone

```
$ brew uninstall lrose-core
$ brew uninstall lrose-blaze
$ brew uninstall lrose-cyclone
```

Then, install lrose-cyclone (after downloading the formula lrose-cyclone.rb)

```
$ brew install lrose-cyclone.rb
```

▼ Assets 7

HawkEye.dmg	28.8 MB
lrose-cyclone-20200110.src.mac_osx.tgz	99.7 MB
lrose-cyclone-20200110.src.tgz	99.6 MB
lrose-cyclone.rb	2.39 KB
vortrac.dmg	35.4 MB
Source code (zip)	
Source code (tar.gz)	

New release of 'Cyclone' available, with final bug fix release coming shortly

2nd LROSE Users Workshop
26 to 30 October

1. Full week workshop at NCAR for science presentations, tutorials, and discussion

2. Agenda will be based on submitted abstracts and community survey

3. Save the date and more information will be provided soon

Get involved @ lrose.net

1. LROSE focused on building radar and lidar community software tools through open source development

2. Focus has been on developing high-quality, well-tested, well-maintained and well-documented key applications as ‘building blocks’, allowing users to assemble trusted, reproducible workflows to accomplish more complex scientific tasks

3. In 2020, focus will be on improving documentation, build process, soloii replacement, building user community (wiki, forum, survey, user workshop)

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