

Community SWIRLS Nowcasting System (Com-SWIRLS)



Nowcasting Systems

Library	Language	Website	Availability
com-SWIRLS	Python	https://com-swirls.org	free license
IMPROVER	Python, Shell	https://improver.readthedocs.io	open source
INCA	C, Fortran, Shell	https://www.zamg.ac.at	free license
pysteps	Python	https://pysteps.github.io	open source
rainymotion	Python	https://github.com/hydrogo/rainymotion	open source
STEPS	C, C++	https://www.bom.gov.au (Alan Seed)	free license



Com-SWIRLS

- A Service of RSMC for Nowcasting (Hong Kong)
- To facilitate knowledge exchange and collaboration
- Freely shared with all National Meteorological & Hydrological Services (NMHS)
- Source codes included
- Codename: SwirlsPy



https://com-swirls.org/



Features of Com-SWIRLS 2.0

- Continuously Maintained and Updated
- Installable by Conda, Single Command
- Documentation Website with User Examples
- Readable Codes, Reusable Modules
- Version Control with GitLab
- Technical Support & Discussions by GitLab Issues
- Support Various Radar Data Formats
- Various QPE Interpolation Methods
- Numerous Motion Field and Forecast Algorithms
- Verification Metrics

	Com-SWIRLS 1.x	Com-SWIRLS 2.0	
Installation	VM	Conda *	
Programming Language	Assorted	Primarily Python, plus C++	
Libraries	NCL, ImageMagick etc.	Open-source Python lib.	
Grid Size	480x480 Only	Rectangular grid of any size	
Supported Radar Data	1	8	
Motion Field Algorithms	1	5	
Forecast Algorithms	1	5	
QPE Methods	1	14, plus multi-sensor QPE	
Verification Metrics	No	14	
Documentation	Limited	Full Documentations	
Version Control	No	Yes, using GitLab-CE	
Software Testing	At initial development only	Upon any changes	

* VM and Docker available on request



Use of Open-Source Libraries

- wradlib, Metpy etc.
- Py-ART by ARM of DoE(USA)
- Cartopy by UKMO
- pySTEPS





Maintained and Updated Codebase

Updated every One or Two Months

- For
 - Bug Fix
 - New Features
 - Documentation Update
- Releases:

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- 2.0.8: 2019-09-26
- 2.0.7: 2019-07-09
- •
- 2.0.0: 2018-12-19

Change Log





Distribution and Installation

- Distributed as Conda packages
- Can be Installed with Single Command:

conda create -n swirlspy
 -c https://2018:314159@conda.com-swirls.org
 -c defaults -c conda-forge swirlspy

 Virtual Machine (VM) and Docker Images available upon request



Documentation with Examples

SwirlsPy
Docs » Welcome to SwirlsPy's documentation!

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View page source

Note

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Welcome to SwirlsPy's document ×

The documentation on this page refers to a DEVELOPMENT VERSION. For the latest release, go to https://docs.com-swirls.org/latest/

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Welcome to SwirlsPy's documentation!

SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems) is the operational rainstorm nowcasting system of Hong Kong Observatory (HKO). State-of-the-art techniques are implemented in SWIRLS for analysis and prediction of precipitation and convective weather phenomena in the next few hours. SWIRLS has been in operation in HKO since 1999. SWIRLS was also implemented in various meteorological services or participated in international forecasting projects to support the research and development of rainstorm nowcasting techniques.

The community version of SWIRLS, or com-SWIRLS, is developed to facilitate knowledge exchange and cooperation on development of rainfall nowcasting technique. Com-SWIRLS can be available from this website for use by the National Meteorological and Hydrological Services (NHMSs) upon request. To request or for any enquiry, please send an e-mail to swirls@hko.gov.hk

- Sign In or Register
- RSMC for Nowcasting
- SWIRLS Nowcast System

Documentation Website <u>https://docs.com-swirls.org/</u>



Example User Codes



Readable Codes, Reusable Modules

What's up with "Python"?

***Readable Syntax**

Python	Other language
if a is not 5 :	if (a!= 5) {
if a is 5 :	if (a == 5) {
while (<i>a</i> is True and <i>b</i> is False) : python code	while (a == true && b == false) { other code }
while (a is True or B is False):	while (a == true b == false) {
print "hi there"	console.log("hi there")
not penjee.isWater(ahead)	! penjee.isWater(ahead)

- Adopted Python, a highly readable programming language
- Supplemented with C++ for performance-critical components

Use of **xarray**, a labelled multi-dimensional array data structure, as the common data model between modules





Version Control with GitLab

- HKO running GitLab-CE, an open-source software development platform
- Version Control, enabling simultaneous developments by staff & contributors
- Continuous Integration (CI) for automated tests
- Continuous Deployment (CD) for automated packaging and documentation generation

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	conda.recipe	fix ci/generate_meta.py	3 months ago		
m	Contrib	Update contrib/@leungyupo/runner	2 months ago		
~	docs	fix document and example	6 days ago		
σο	Dublic	remove public/html and create mar	7 months ago		
#	rover	Update: bin file	4 months ago		
	🖿 sla	Update: bin file	4 months ago		
	b swirlspy Fix: import method 6 days ago				
	🖹 .gitignore	add .yarnrc	2 months ago		
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### **GitLab's Issues**



- Facilitates Technical Support and Idea Exchange
- Any user can create an issue, HKO's team will respond asap
- Also useful for recording Merge Requests
- Past issues are searchable, thus becoming a *Knowledge Base* in the long run



### **Various Radar Data Format**

#### Supported Formats

- ASCII (ESRI's)
- CINRAD (China)
- IRIS
  - Raw
  - Reflectivity
- HDF5
- NetCDF
  - A variant for Philippines
  - Two variants for Vietnam
- UF





# **Various QPE Algorithms**



**Multi-Sensor Precipitation Estimator** 

# Spatial Interpolation Methods:

- Linear
- Nearest
- Cubic
- RBF
  - multiquadric
  - inverse
  - gaussian
  - linear
  - cubic
  - quaintic
  - Thin_plate
- Natural Neighbour
- Barnes
- Cressman
- Ordinary Kriging



## **Various QPF Algorithms**

#### **Motion Field Generation**

- Persistence
- ROVER
- Constant
- DARTS
- Dense Lucas-Kanade
- VET

#### **Forecast Algorithm**

- Simple Advection
- Semi-Lagrangian Advection
- SPROG
- SSEPS
- STEPS



QPF by STEPS



### **Various Verification Metrics**

#### Traditional

- POD
- FAR
- CSI
- Accuracy
- Frequency Bias
- ETS
- HSS
- POFD

#### Advanced

- FSS
- Brier Skill Score
- F1 Score
- Precision Recall
- Reliability
- ROC

# From In-House Development To Collaborative Development

Community SWIRLS





### **Future Plan**

- More Radar Data Format, e.g. Rainbow
- More QPF Algorithms
- Nowcast with Satellite Data
- Integrated Precipitation Estimator for QPE
- Lightning Potential Nowcast
- Blending with NWP outputs



### **Support Services for Users**

- Online Technical Support:
  - Email (swirls@hko.gov.hk)
  - GitLab Issues
- Cusomitzation:
  - Modules
  - Examples
- Training Workshop
  - Hosted by HKO
  - Served as Expert Lecturer
- Training Attachment
  - 2 weeks 2 months



### **Register Now**

#### <u>https://com-swirls.org/</u>

#### GitLab Community Edition

#### Open source software to collaborate on code

Manage Git repositories with fine-grained access controls that keep your code secure. Perform code reviews and enhance collaboration with merge requests. Each project can also have an issue tracker and a wiki.

Sign in	Register
Full name	
	1
Username	
	1
Email	
	12
Email confirmation	
	1
Password	
	1
Minimum length is 8 characters	
Regist	er