The Multi-Year Reanalysis of Remotely Sensed Storms (MYRORSS)

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Why MYRORSS?

Provide a consistent radar data set across the CONUS

Support research in the development of probabilistic information for warnings

Support implementation of MRMS to operations
Multi-Radar Multi-Sensor System

MRMS

MRMS Merged Reflectivity QC 02:00 [2012/07/18 20:02:00 UTC]

MRMS Maximum Hail Size

MRMS MESH 01:00 [2012/07/18 20:02:00 UTC]

KBOX KOKX

MRMS Maximum Hail Size

+ other neighboring radars

vLAB Forum: MYRORSS
MYRORSS Domain

5-minute, 0.01x0.01 degree resolution, 35 vertical levels
# of Volumes Collected by WSR-88Ds By VCP

Σ ~ 105 million volume scans
MYRORSS Processing

Data Store

Server #1 → Server #2 → Server #3

Raw radar data and processed model grids

Processed single radar data

Merged data

Further post-processing and science

Data Store

Server #1 → Server #2 → Server #3 → Server #4
MYRORSS post processing

Merged 3D reflectivity

Severe Wx Products

Aviation Products

Hydro Products
1. Conversion into netCDF

2. Radar QC
   a) QCNN – Lakshmanan et al. 2007 & 2010
   b) Further bloom QC for biological scatterers—Tang et al. 2011

3. Dealiasing
   a) 2D dealiasing—Jing & Weiner 1993

4. Azimuthal Shear Calculations
   a) LLSD—Smith and Elmore 2004
   b) Range correction—Newman et al. 2013
   c) Composite layers (0-3 km AGL and 3-6 km AGL)
MYRORSS QC
Erroneous MESH detections—large areas and large values—due to radar ducting and coastline interactions. The most common QC problem.
Using the Data: Radar-based Climatologies

Individual timesteps are cleaned up using a threshold, minimum size of clusters and temporally using a multiple-hypothesis tracking method. MHT accumulations are then run through a series of smoothers to further clean up the field and make the size of the fields appropriate for climatology generation.
Using the Data: Radar-based Climatologies

Yearly Accumulation (MHT)—2000

Yearly Accumulation (MHT & Smoothed)—2000
Future Fixes

Make timing of products smooth (right now ~5 minutes, need exactly 5 minutes)

Fix LLSD corrected shear calculations

Produce un-QC’d composite

Identify and correct reflectivity issues affecting QPE estimates
What’s Next?
Forecasting a Continuum of Environmental Threats

Follows the flow of “The Warning Process”
Multi-scale storm “cluster” identification
Multi-scale storm "cluster" identification

200 km$^2$
Multi-scale storm “cluster” identification

2000 km²
Multi-scale storm “cluster” identification
Storm classification inputs from **MYRORSS / MRMS**

<table>
<thead>
<tr>
<th>Storm Attribute</th>
<th>Max 30 Minute MESH</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20 C Merged Reflectivity</td>
<td>Most Unstable CAPE</td>
</tr>
<tr>
<td>0 C Merged Reflectivity</td>
<td>Most Unstable LCL Height</td>
</tr>
<tr>
<td>Aspect Ratio</td>
<td>Probability of Severe Hail (POSH)</td>
</tr>
<tr>
<td>0-2 km Merged Azimuthal Shear</td>
<td>Quality Controled Merged Reflectivity Composite</td>
</tr>
<tr>
<td>3-6 km Merged Azimuthal Shear</td>
<td>Severe Hail Index (SHI)</td>
</tr>
<tr>
<td>0-6 km Shear Magnitude</td>
<td>Storm Size</td>
</tr>
<tr>
<td>0-1 km Storm Relative Helicity</td>
<td>Surface CAPE</td>
</tr>
<tr>
<td>0-3 km Storm Relative Helicity</td>
<td>Surface Dewpoint</td>
</tr>
<tr>
<td>Longevity</td>
<td>Surface Temperature</td>
</tr>
<tr>
<td>Maximum Expected Size of Hail (MESH)</td>
<td>Vertically Integrated Liquid (VIL)</td>
</tr>
</tbody>
</table>
Storm classification

Disorganized
- Discrete
  - In Cluster
  - In Line

QLCS
- Bow Echo

Supercell Right Mover
- Discrete
  - In Cluster
  - In Line

Supercell Left Mover
- Discrete
  - In Cluster
  - In Line

Based on:
Storm classification: Example Decision Tree
Generate probability (P) of:

\[\text{[tornado/wind/hail/heavy precip/lightning/mesocyclone/etc.]}\]

For each storm cluster.

- \(P(\text{event is ongoing})\)
- \(P(\text{event will occur in X minutes})\)

Probabilistic 0-60 minute Nowcast
Informed Probabilistic Hazard Information (PHI)
• Blending with 0-2 hour storm-scale ensembles

• Validation of storm mode in convection-allow models

• Baseline for evaluation of Warn-on-Forecast: beating climatology
High resolution verification & Synthetic verification

e.g. Severe Hazards Analysis and Verification Experiment; mPING; radar proxies for severe wx...

Days of operation: 554
Total data points: 63353
Hail data points: 45406
Wind data points: 6456
Flood data points: 9313
Winter data points: 2178
Questionable time: 33371
'No wind' reports: 4117
'No flood' reports: 6821
'No hail' reports: 20226
Non-svr hail reports: 15196
Svr hail reports: 8848
Sig hail reports: 1021
Measured hail reports: 380
Measure avg reports: 89
Relational database: storm type / severity by environment

Supplement to Smith et al. 2012, including weak severe, non-severe, and synthetic verification measures.
Quantitative Precipitation Estimation

Key MRMS *QPE* Products

- Surface Precip Type
- Surface Precip Rate
- Radar QPE (1, 6, 24, 48, 72h, 10day acc)
- Gauge QPE
- Local gauge bias corrected radar QPE
- Gauge + orographic pcp climatology QPE
- Radar QPE Quality Index (RQI)
- Gauge Influence Index (GII)

The radar QPE quality is better in warm season than in cool season, and is better in the east than in the west.
Other Opportunities & Plans

- Fix issues, re-run! (and again, and again…)
- Near real time addition of new data
- Web front end for data mining / case studies by collaborators
- Aviation
- Insurance / Reinsurance
- Climate
- Agriculture
- And more!
MYRORSS processing is ongoing
Many QC issues identified
Next: post processing
QPE radar retrospective is another talk
Many science opportunities at many time/space scales

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