

# The Weather Company's Global Radar Mosaic Process

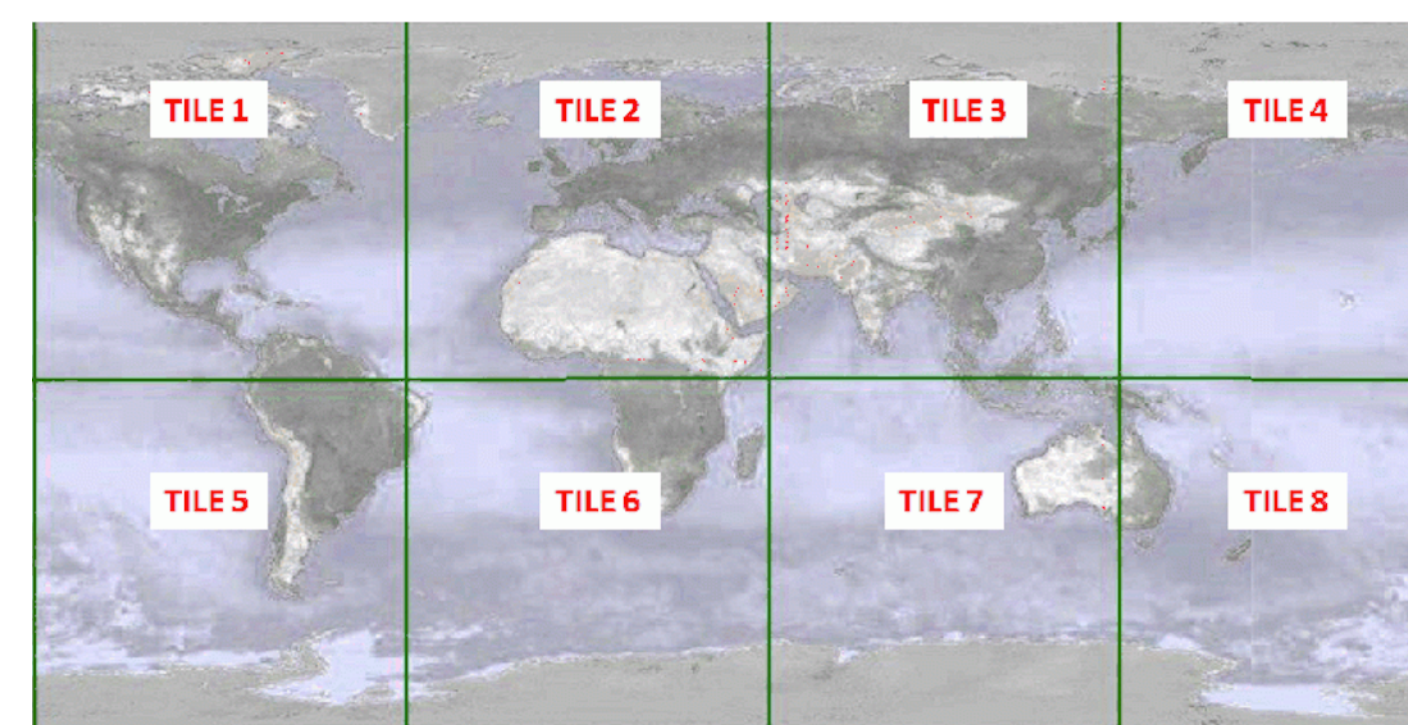
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The Weather Company (TWC), an IBM Business, produces radar mosaic imagery (NOWrad), that provides global, high resolution analyses of precipitation occurring at or near the Earth's surface. The NOWrad product is a vital piece in many of TWC's B2B and B2C product suites including current conditions and precipitation alerting. Recently additional radar datasets have been incorporated into the NOWrad product, including single site radar data from Germany, Netherlands and France. In order to meet the processing and business needs of supporting a global radar mosaic, TWC migrated from physical hardware to a cloud-based solution. In addition to expanding resources, the migration from on-prem systems to a cloud system provided TWC with a complete development stack, including a full end-to-end software QA environment. These new capabilities have provided for a quicker time to market on new radar mosaic products and features in 2019. Alongside the process of migrating NOWrad to the cloud, TWC's Human Over The Loop (HOTL) system provided the capability to manually quality control on a global scale. HOTL, based on TWC's TruVu Max platform, provides in-house meteorologists a capability to remove non-precipitating echoes from NOWrad by comparing radar echoes with other datasets such as high-resolution satellite and lightning.

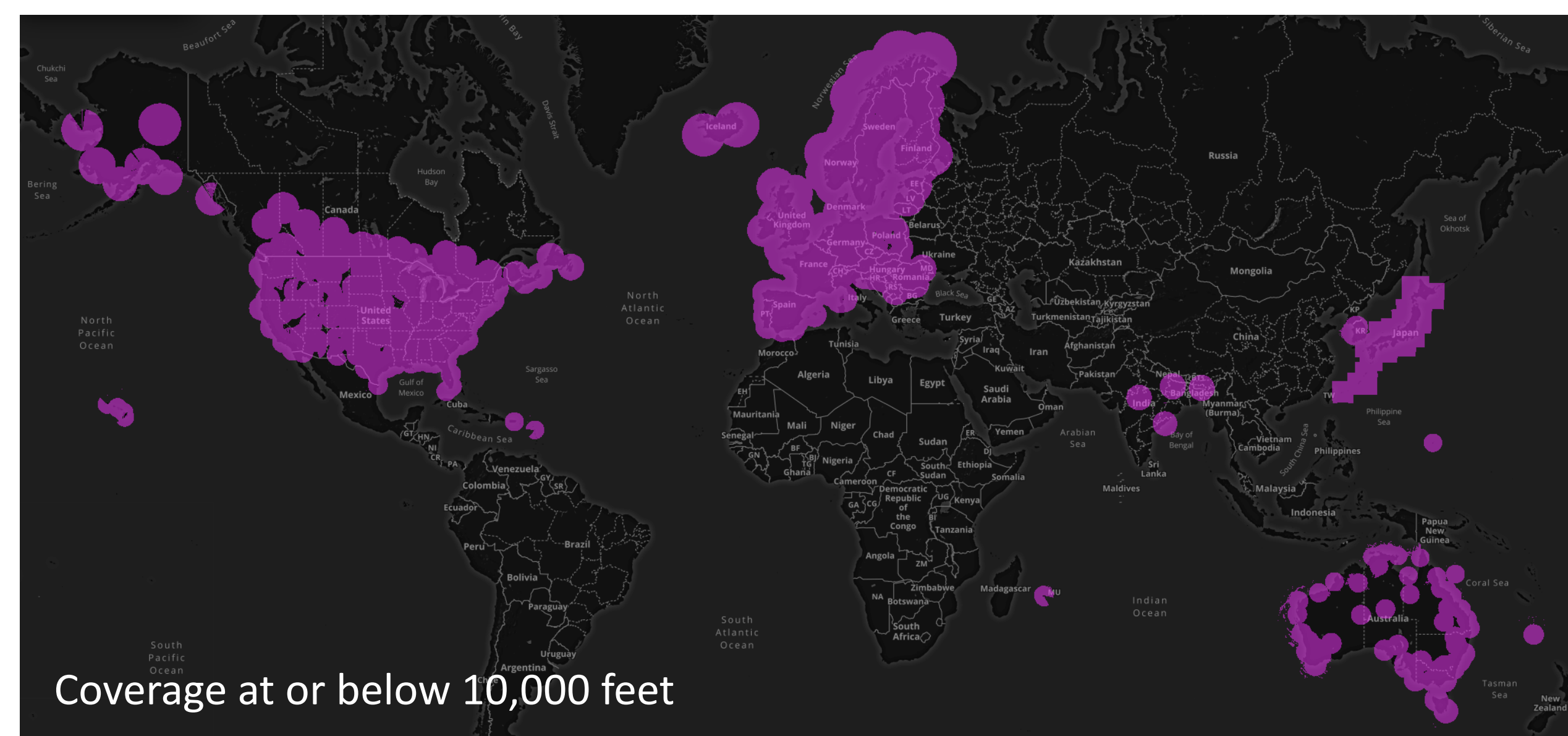
## Domain Details

The Weather Company's NOWrad radar mosaic product consists of eight tiles spanning the globe. These tiles are 1km resolution following the Tile Map Service definition from OSGeo (TMS Zoom Level 6).



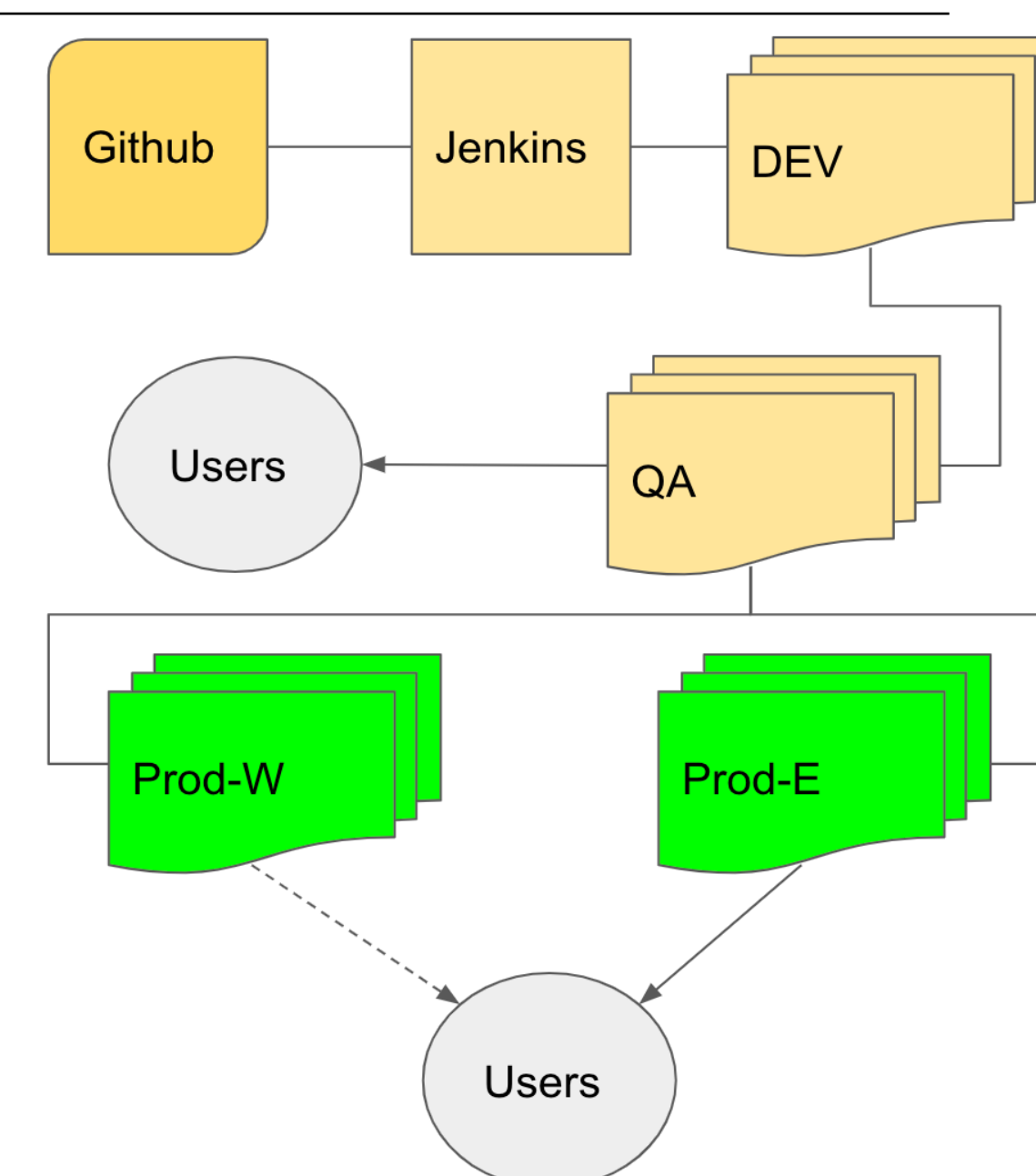
## Input Datasets

The Weather Company uses both single site and regional mosaic datasets to compose the global NOWrad product. Currently, the global NOWrad product uses single site data from NEXRAD (US, Korea, Guam, Puerto Rico), Canada, France, Germany, Australia, Netherlands, and India. In addition to the single site sources, The Weather Company includes regional mosaics from Japan, UK, and OPERA (covering Europe).



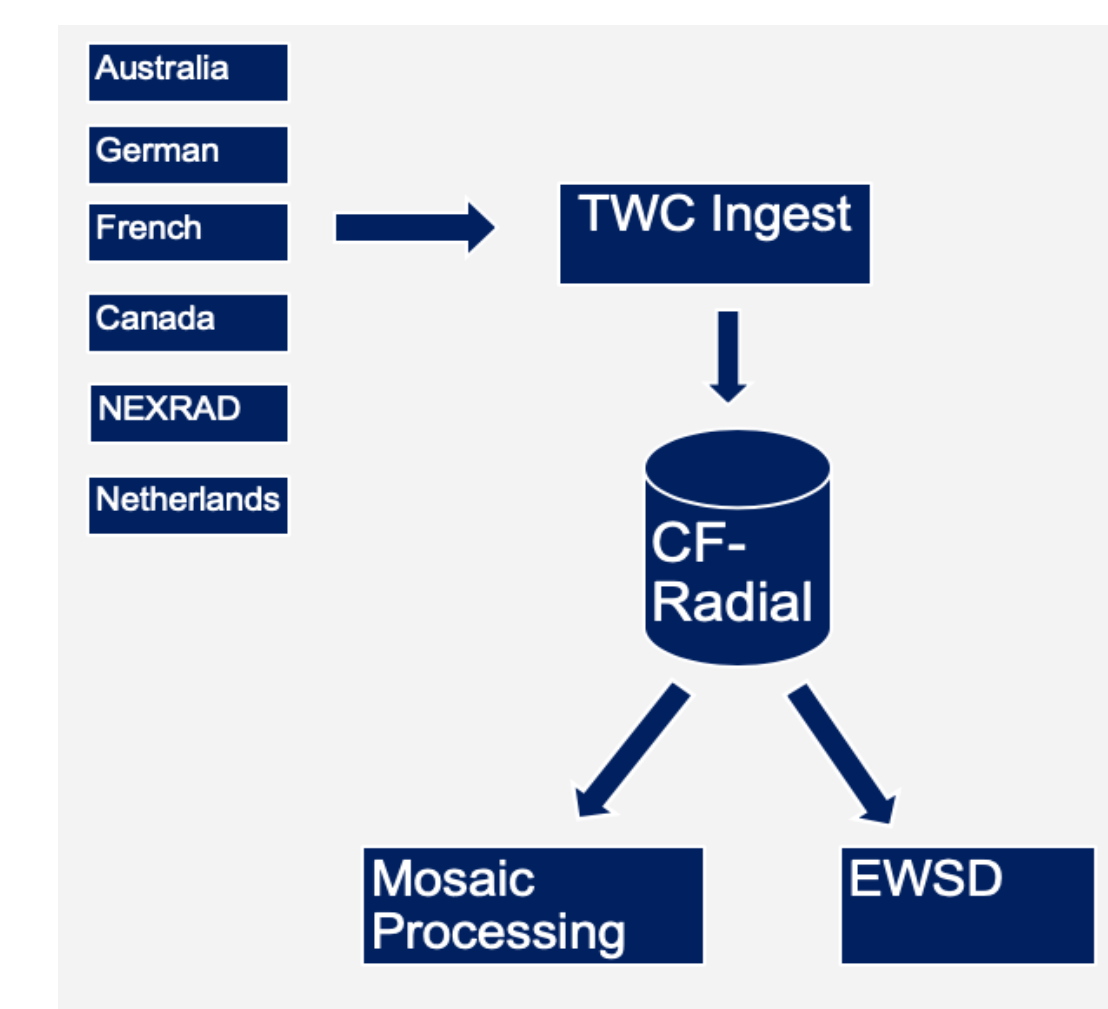
## Infrastructure

- Radar codebase in The Weather Company GitHub
- Full 14 system clusters in each environment
- Code submitted and tested in DEV environment using Jenkins for automatic code build status checks
- Full QA stack and test path to end users
- Production environment in multiple regions for operational redundancy
- Production environment in Active/Standby allowing for seamless product upgrades
- Production clusters quickly swapped via The Weather Company Meteorological Operations group

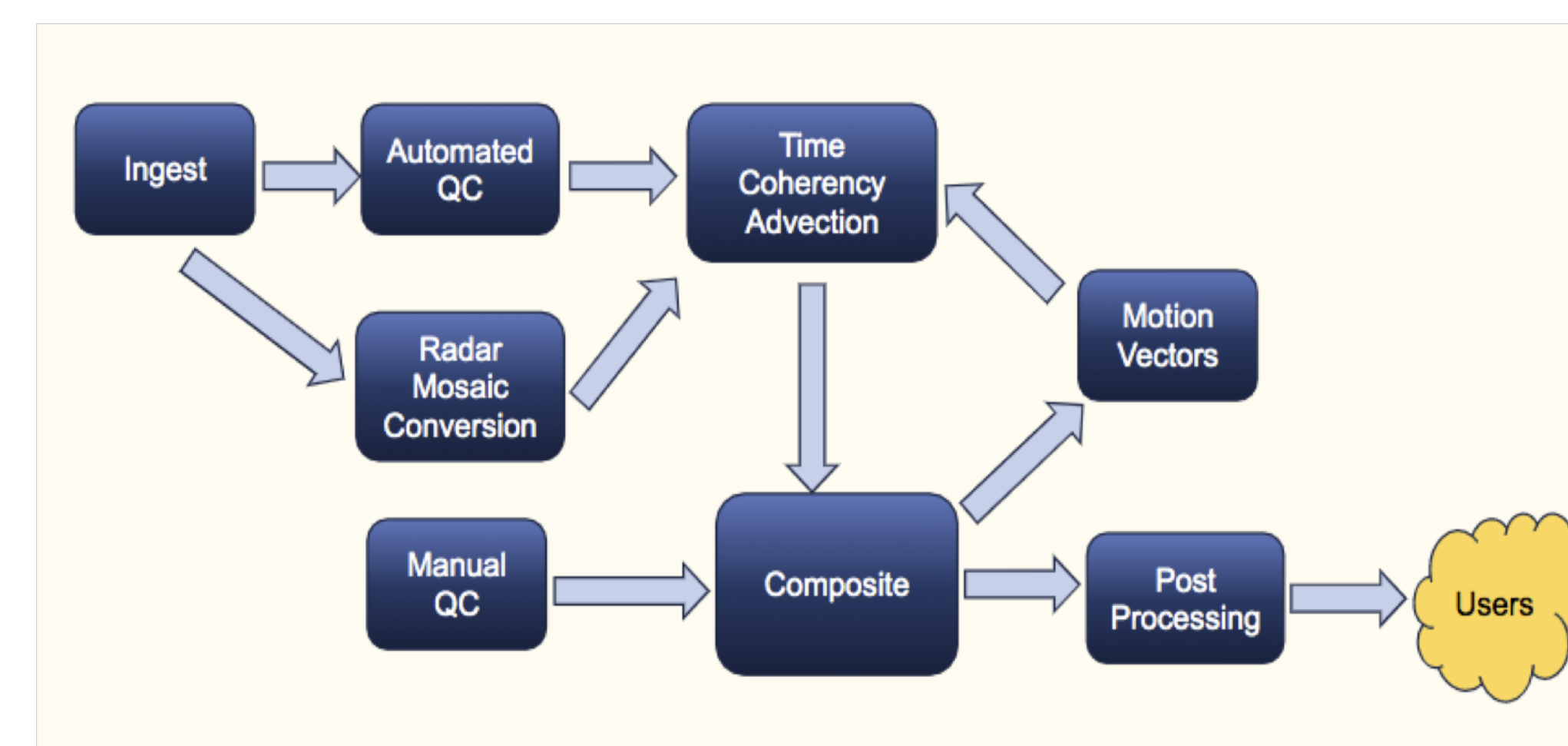


## Single Site Process

- Input Single Site Radial Data
  - NEXRAD (Level II)
  - NEXRAD (Level III)
  - Canadian (Convolf)
  - Canadian Sigmet-IRIS (volumetric)
  - German "DX" (single "best" tilt)
  - Australia (alphanumeric)
  - Netherlands (HDF5)
  - French Radar (bufr)
- Output Format
  - CF-Radial Format (netcdf)
  - Developed by NCAR/UCAR for radial data
  - Understood by radx (C++), wradlib (python), pyart (python)
  - One format for all downstream processing



## Mosaic Creation Process

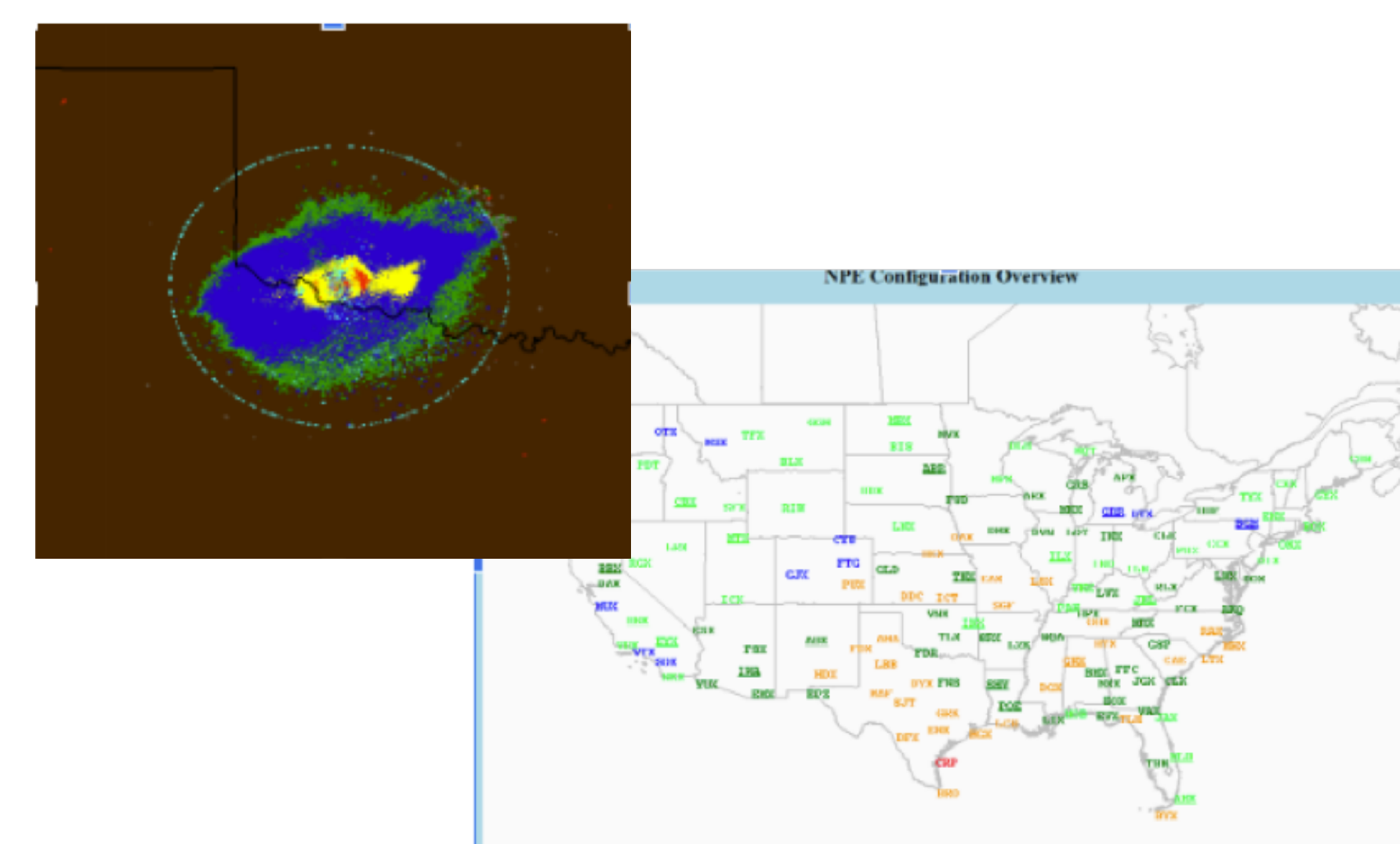


Single site CFRadial files pass through The Weather Company's Non-Precipitating Echoes (NPE) automatic quality control processing. Each single site and regional mosaic is time advected to sync the radar time to the output time of the global mosaic. This is done using NOWrad derived motion vectors. After all the input radar data is time synchronized, it is then composited together taking the lowest to the ground value where there are overlapping radar sites. This processing also considers areas where individual radar sites are blocked due to mountains or other interference using neighboring radar sites to populate the mosaic. Once the mosaic is composited together it is then post-processed for use within The Weather Company product suite.

## Quality Control Mechanisms

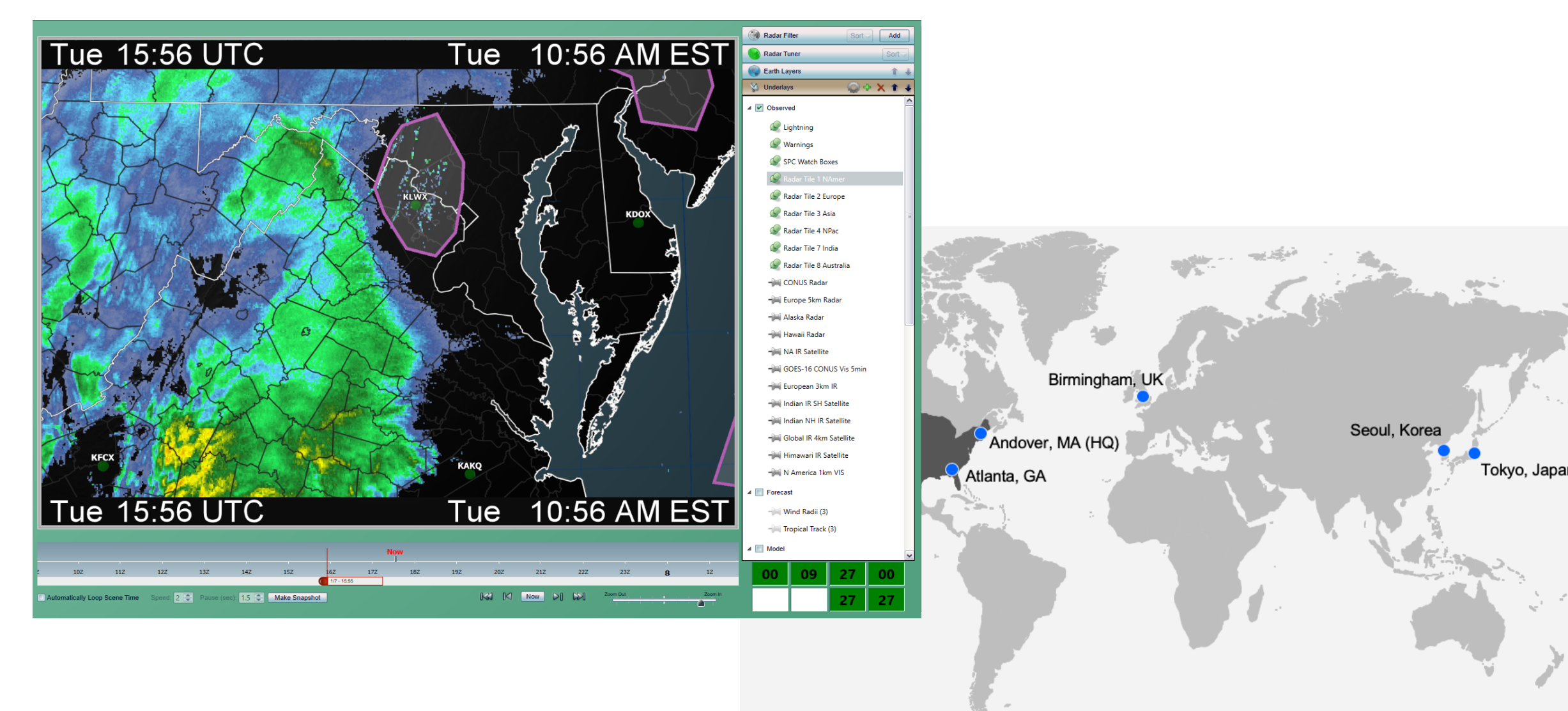
### Non-Precipitating Echoes (NPE) Algorithm

- Input Data
  - Single Site data
  - GOES Derived Cloud Temperature
  - Model Data (850 mb temperature, LI, K index, RH)
  - Precipitation probability (derived from METARs)



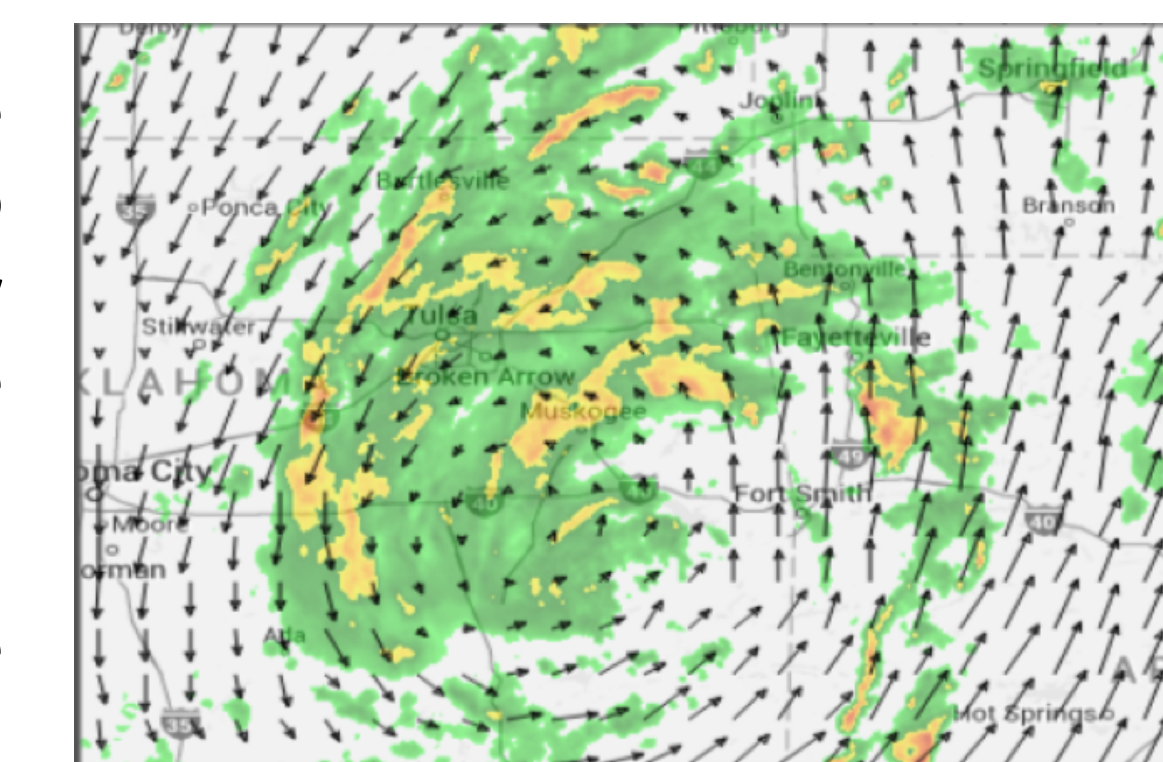
### RadarPlus

- HOTL Platform (Human Over the Loop)
  - Utilizes TruVu MAX datasets
  - Single Cloud Server
  - Five Global Offices (24/7/365)
  - Polygon edits remove false echoes



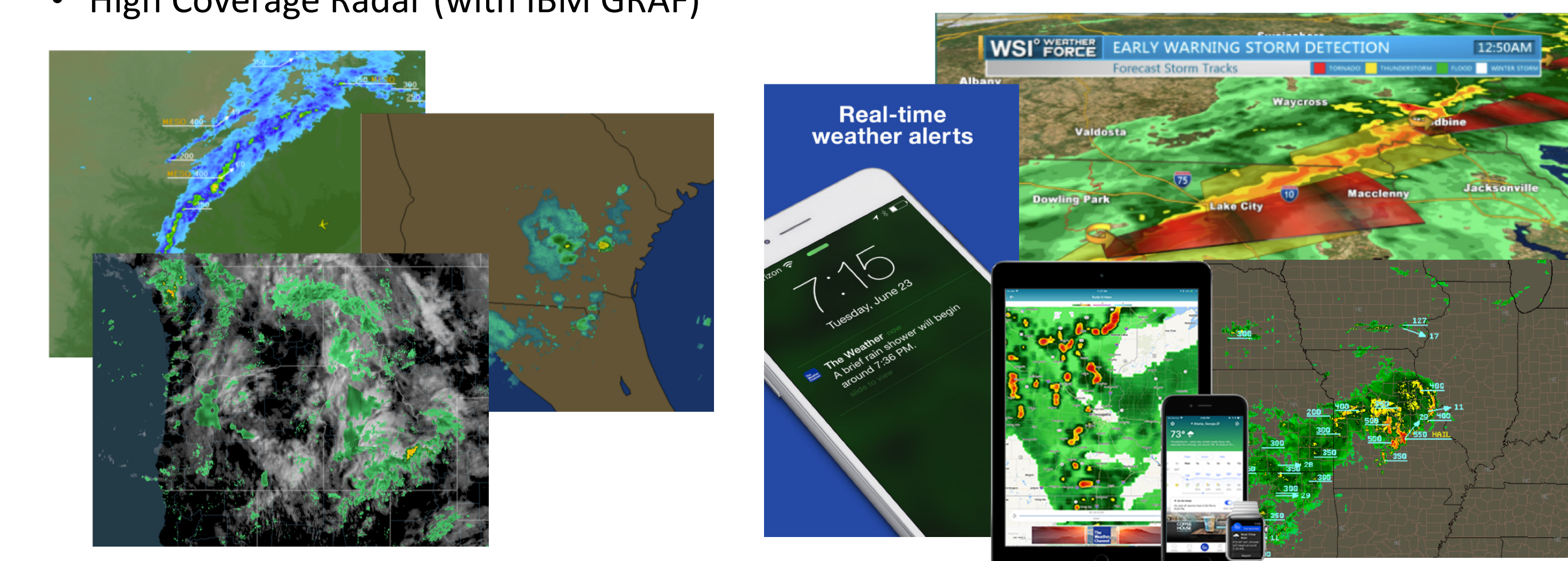
## Motion Vector Generation

In support of The Weather Company's short-term precipitation products, radar-based motion vectors are created from the global NOWrad product suite. Two versions of motion vectors are created, first a set of raw motion vectors based on two NOWrad images are generated. From these raw motion vectors a Cressman smoothing scheme is applied. These smoothed motion vectors are then used as a method to time synchronize the various single site and regional mosaic datasets. In addition to the NOWrad product, these motion vectors are used with other short-term radar derived products.



## Additional TWC Radar Products

- Echo Tops
- Vertically Integrated Liquid (VIL)
- Radar Summary/Storm Motion
- High Coverage Radar (with IBM GRAF)
- Early Warning Storm Detection (EWSD)
- Real Time Precipitation Alerts
- Composite Reflectivity



## Short Term Forecast Process (0-6 hour)

- Radar Advection (0-7 hr Forecast)
- IBM GRAF
- The Weather Company Forecaster Edits
- B2B and B2C applications
- NWS/Government Severe Watches/Warnings

