# Tracking Storms in Python with *tobac* to Evaluate HRRR Weather Model Performance

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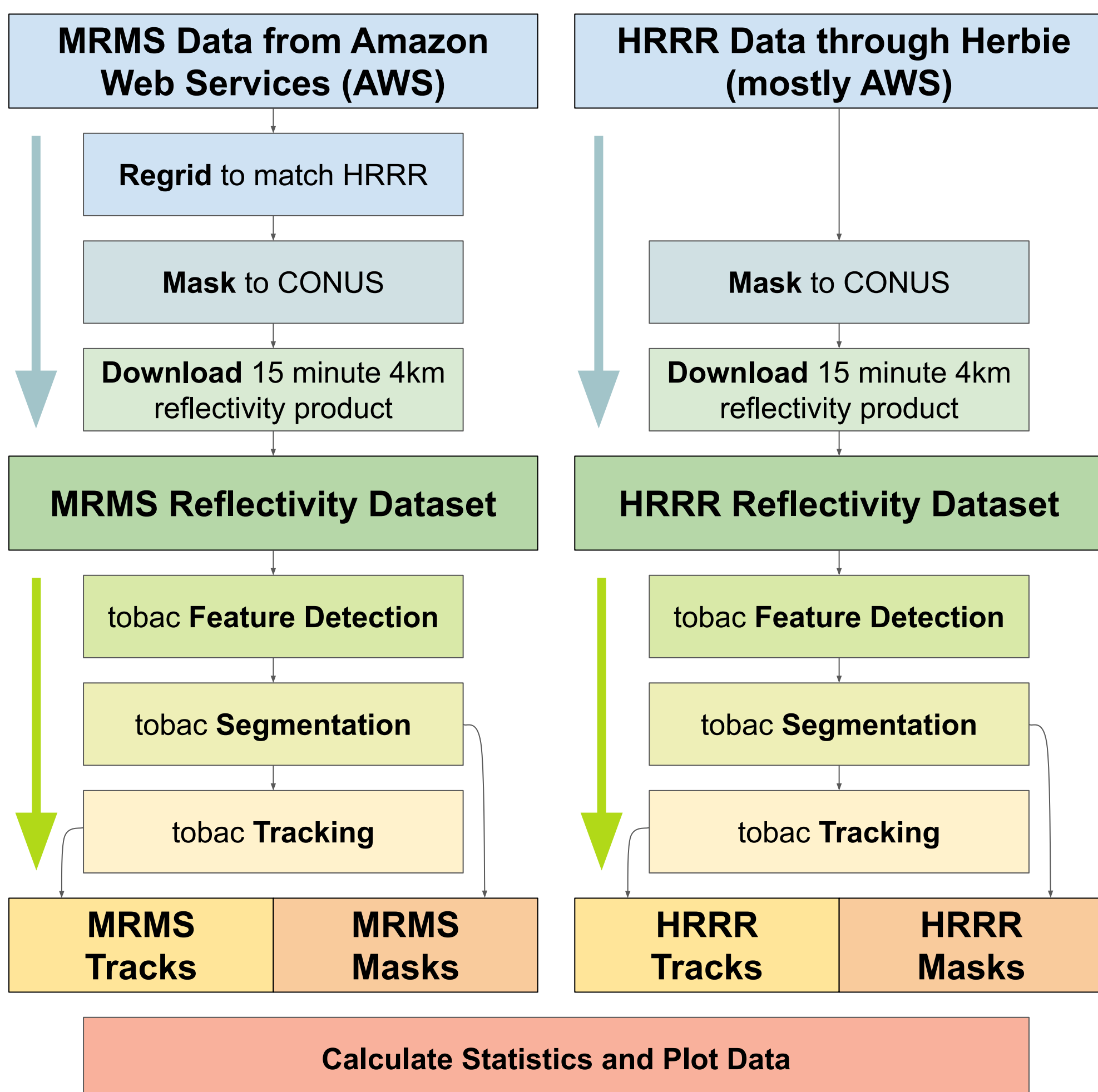
Introduction

Weather models are crucial for effective forecasting, especially for applications in severe weather prediction. The **High Resolution Rapid Refresh (HRRR)** weather model provides data used by forecasters for events within 36 hours.

HRRR 4km Reflectivity 06/02/23 18Z Run — Valid 06/02/23 23:00Z
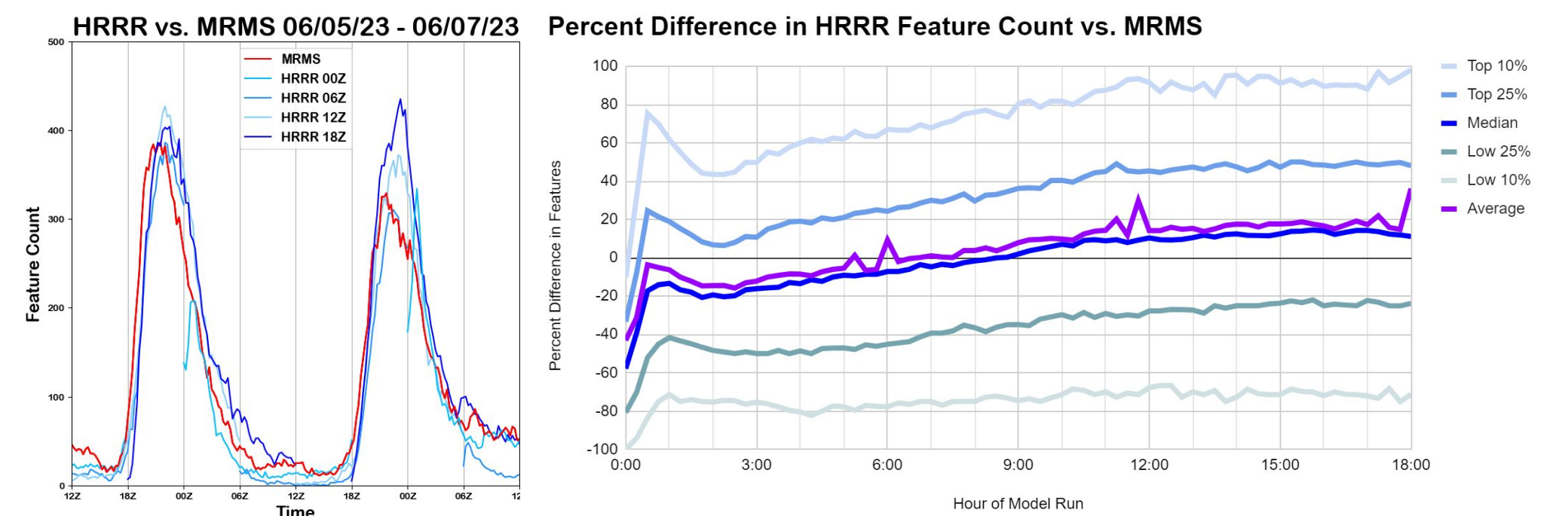
HRRR: North AL with tobac Features
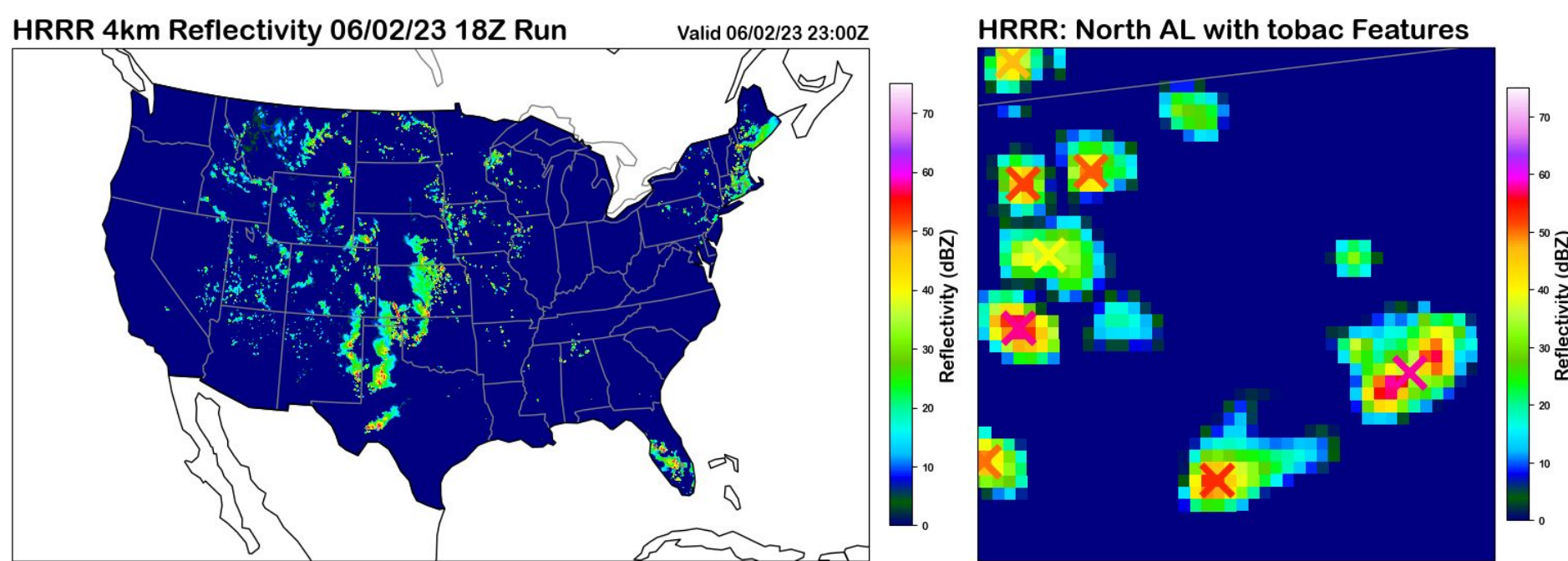
Using **Tracking and Object-Based Analysis of Clouds (tobac)**, 15 minute HRRR 4km reflectivity data for the contiguous United States (CONUS) for the entire year of 2023 was compared with corresponding actual 4km radar data from the **Multi-Radar/Multi-Sensor System (MRMS).**

Methods

MRMS Data from Amazon Web Services (AWS)
- **Regrid** to match HRRR
- **Mask** to CONUS
- **Download** 15 minute 4km reflectivity product
- **MRMS Reflectivity Dataset**
- tobac **Feature Detection**
- tobac **Segmentation**
- tobac **Tracking**
- **MRMS Tracks** | **MRMS Masks**

HRRR Data through Herbie (mostly AWS)
- **Mask** to CONUS
- **Download** 15 minute 4km reflectivity product
- **HRRR Reflectivity Dataset**
- tobac **Feature Detection**
- tobac **Segmentation**
- tobac **Tracking**
- **HRRR Tracks** | **HRRR Masks**

Calculate Statistics and Plot Data

Results

HRRR vs. MRMS 06/05/23 - 06/07/23

Percent Difference in HRRR Feature Count vs. MRMS

- The HRRR generally **overproduced cell count**, ending runs at around 11.4% higher than MRMS over the entire study dataset.
  - As seen above, the HRRR **overproduced maximums** and **underproduced minimums** on diurnally driven days.
- The HRRR tended to **underproduce cell area** during June 2023.
- From "fingerprint" analysis, the HRRR **underproduced storms in the NW CONUS.**

Implications

- **"Fingerprints"** (see QR code) provide snapshot overviews of a weather model's performance
- This **methodology** can be used to analyze other weather prediction models in the future

MRMS Tracks 06/01/23 06Z Run (Red) — HRRR Tracks 06/01/23 06Z Run (Blue)
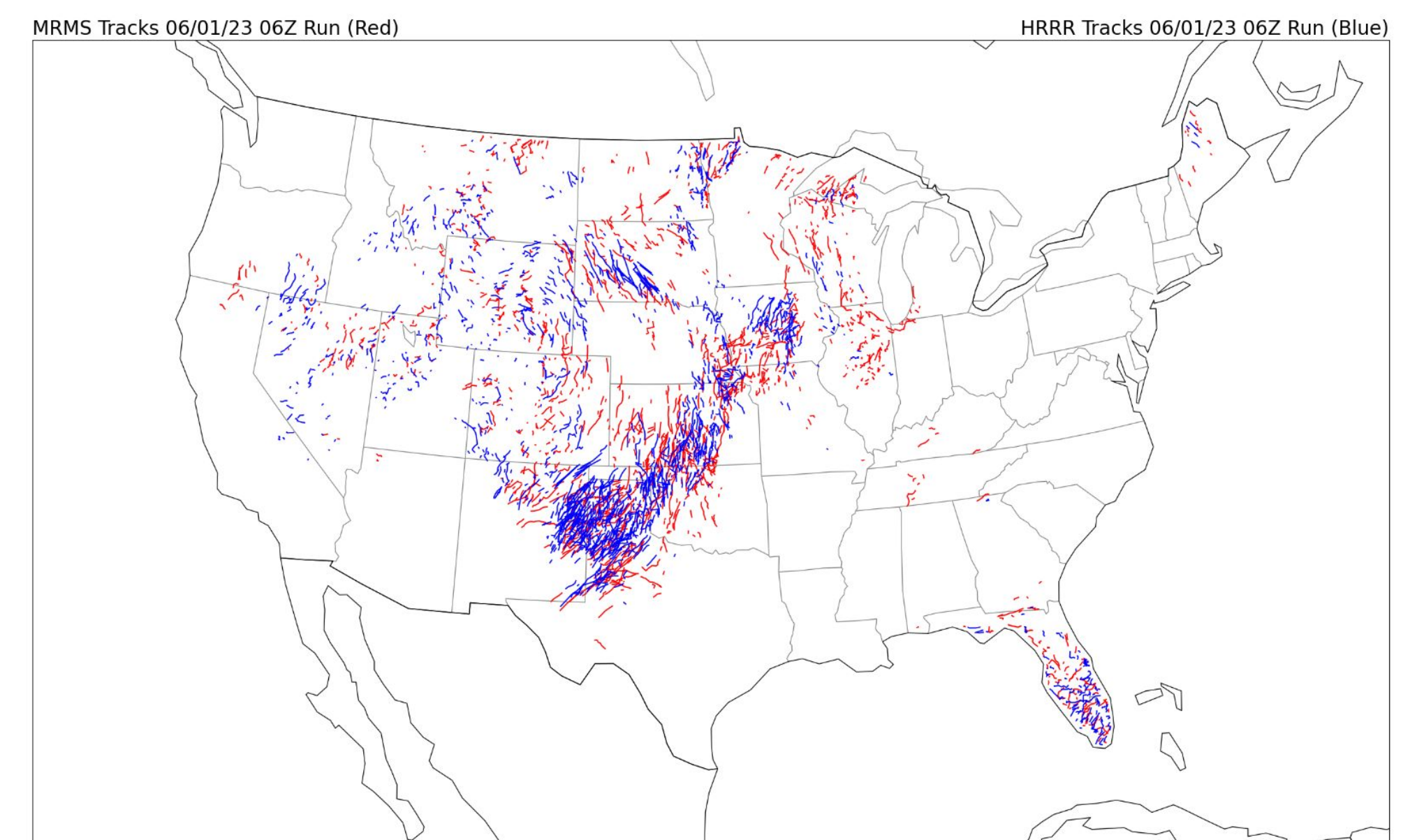
Sources:
1. tobac - Tracking and Object-Based Analysis of Clouds
2. MRMS data from Amazon Web Services, provided by National Oceanic and Atmospheric Administration
3. HRRR data downloaded using Herbie

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