

# *Data Sources for Rain Fade Forecasting*

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# *Ka Mitigation Techniques*

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- Wide-area diversity
  - Both space and ground
- Power Control
  - Encoding
  - Multi-beam power sharing
  - Variable data rates
- Transmission time shifting

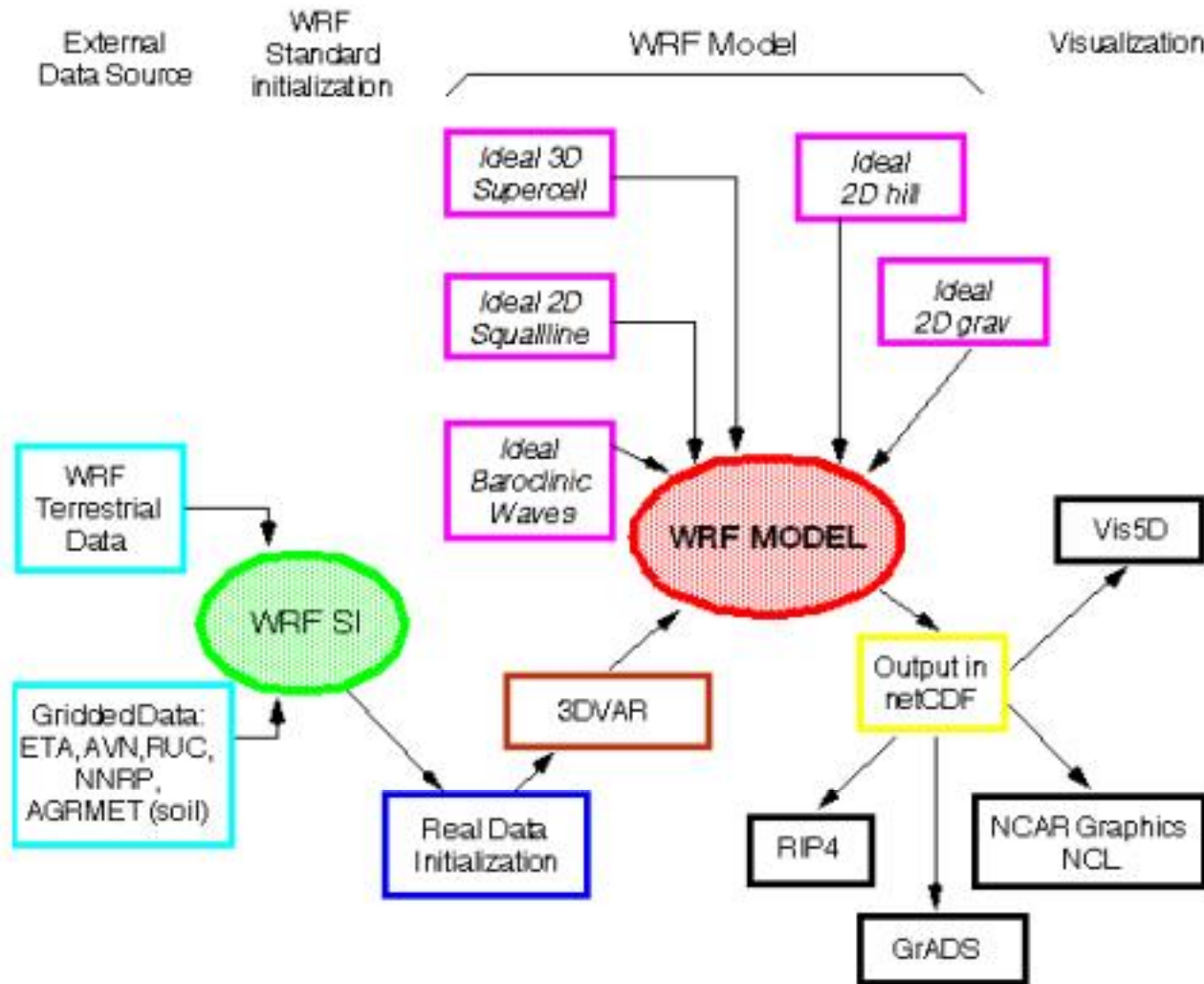
# *Fade Prediction Strategies*

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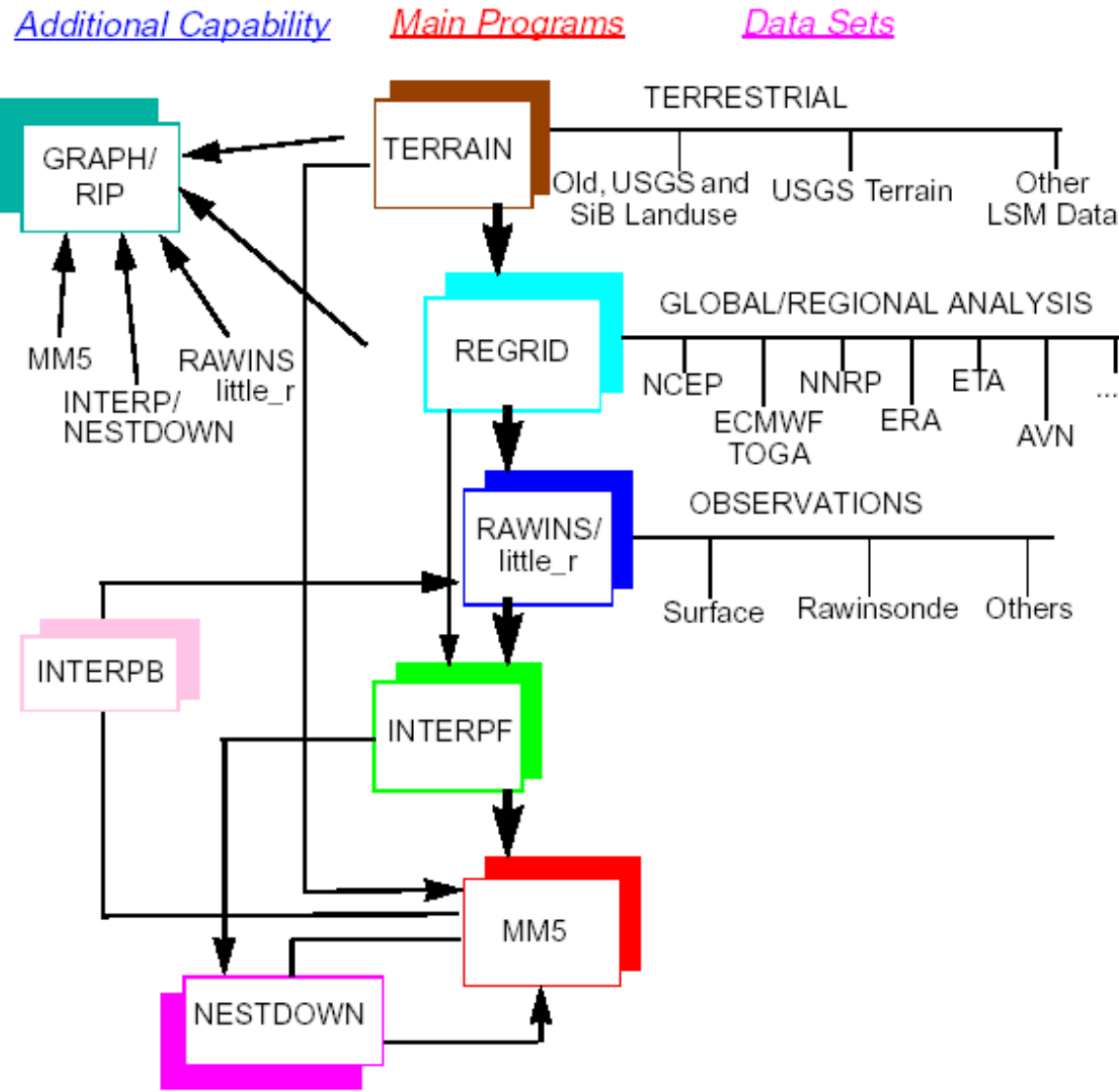


- Mission Planning
  - Long term forecast - days to weeks to years
    - Global/Regional weather models
    - Climatology data
- Near Earth Communication
  - Extreme Nowcasting
    - Forecasting < 30 minutes
    - Direct measurement using Doppler radar
- Deep Space Communication
  - Short term forecasts - minutes to hours to days
    - Mesoscale models
      - WRF & MM5

# WRF Mesoscale Model



# MM5 Mesoscale Model



# Mesoscale Model Inputs

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- Land Information
  - Land type/use
  - NDVI from USGS
  - DTED from USGS
  - Agrimet - if available
    - Soil moisture for northwest US
- Global and regional grids
  - ETA, AVN, RUC, ECMWF, etc.
- Observations
  - Surface
  - Rawinsonde
  - Doppler radar

- Deploy a mesonet for each site for direct input to model computations
  - A mesonet is a regional network of observing stations (usually surface stations) designed to diagnose mesoscale weather features and their associated processes.
- Install site specific Doppler radar located specifically to support model prediction of rain rates

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

- Environmental prediction can help in mitigating rain fade
  - Deep Space
    - Provides guidance for data rate selections for scientific payload transmissions.
    - Provides guidance for time shifting payload transmissions.
    - Allows for time scheduled bit rate changes to maximize payload data recovery
  - Near Space
    - Provides direct inputs to mission operations to select the optimum mitigation technique: Wide-area diversity, adaptive power control or time shifting data recovery
- Rain prediction improvements
  - For space communications, mesonets can be deployed at each site to improve model forecast accuracy.