An Operational Configuration of the ARPS Data Analysis System to Initialize WRF in the NWS Environmental Modeling System

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Outline

- Goal: Use high-resolution ADAS analyses for initializing regional WRF forecasts
- Regional modeling “primer”
  - What’s needed to run a local model?
  - “Hot start” concept for regional modeling
- NWS Environmental Modeling System (EMS)
- ADAS to initialize WRF: Why bother?
- Benefits of ADAS in EMS
- Gory details: See me
  - Implementation of ADAS in EMS to initialize WRF

Regional Modeling "Primer"

- What is required to run a regional model like WRF?
  - Static fields
    - Terrain height, soil type, vegetation, etc.
    - These data are available with WRF
  - Initial and lateral boundary conditions
    - Usually come from an existing NWP model (e.g. NAM, GFS)
    - Advects information in at N/S/E/W edges of WRF grid
- What is optional but highly desired?
  - High-resolution initial conditions at regional model's resolution
    - ADAS, LAPS, or variational analysis scheme
  - High-resolution, accurate lower boundary data
    - Satellite-derived sea-surface temperature (e.g. MODIS)
    - Accurate land-surface data (e.g. soil temperature/moisture)

"Hot Start" Concept

- Cold start regional NWP model run
  - Running model with only required fields
  - No small-scale features present initially
  - Few hours of spin-up needed to generate precipitation & high-resolution features
  - Primary benefit is higher resolution producing local circulations
- Hot start regional NWP model run
  - Running model with high-resolution initial condition
    - Adjustments to wind, temperature, and moisture fields
    - Reflectivity and satellite IR converted to model precip & cloud fields
  - Preserves mesoscale and convective features in short-term
  - No need for "spin-up"; precipitation occurs almost right away
  - Fills gap between "nowcasting" and large-scale NWP
  - Computationally simple compared to variational data assimilation

Environmental Modeling System

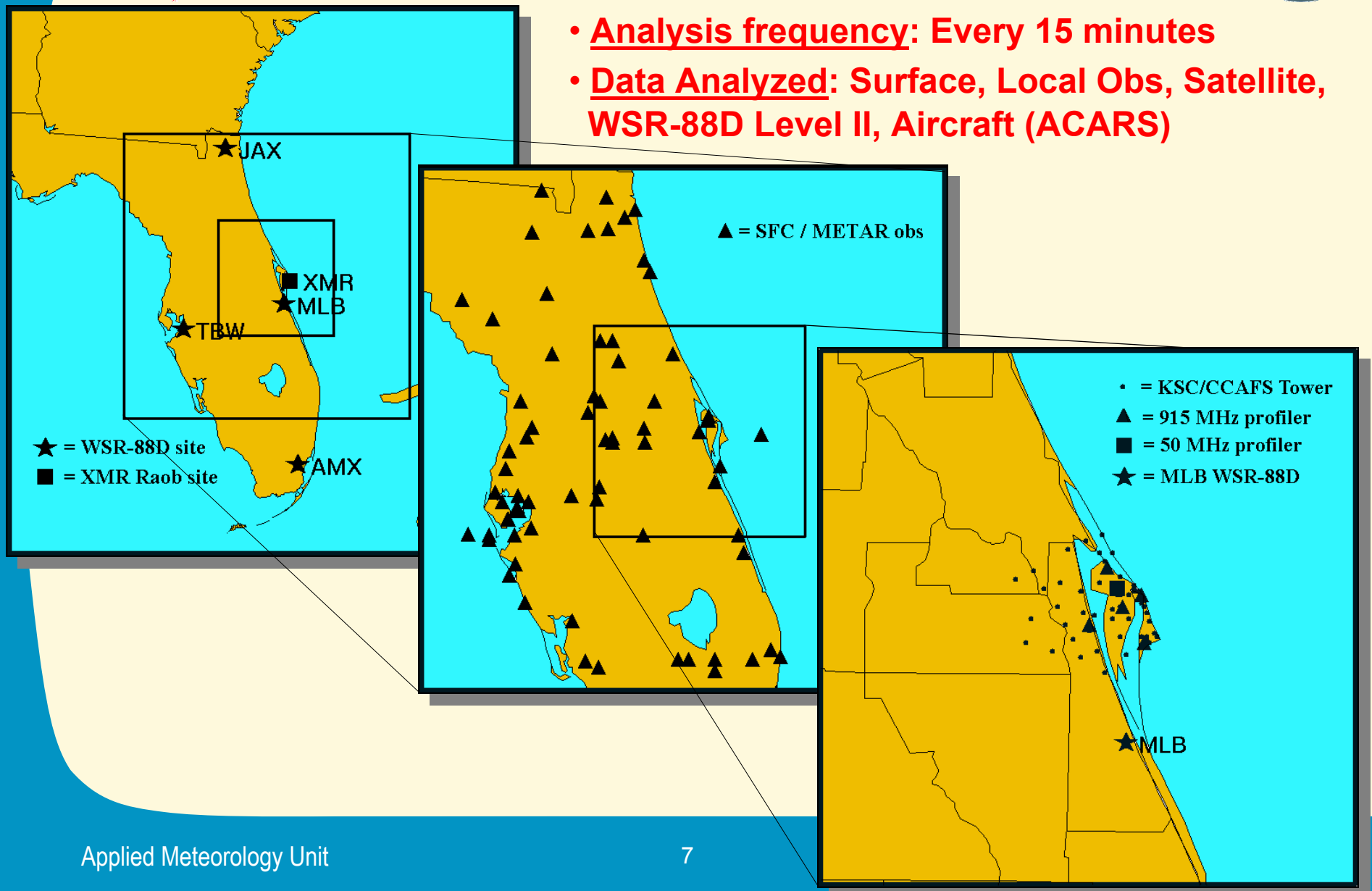
- NWS SOO Science & Training Resource Center (STRC)
  - Author: Robert Rozumalski (Fantastic job!)
- All-inclusive software for running WRF with ease
  - Pre-compiled executable programs for any linux architecture
  - Automatically fetches boundary condition data from the web
  - Can run both versions of WRF (NCAR and NCEP)
  - Post-processing utilities built-in
    - GEMPAK, GrADS, AWIPS-formatted files, BUFR
    - Can post-process data while WRF model runs!
  - Sets up capability to run real-time forecast at installation
- Available to NWS offices

ADAS initializing WRF in EMS:
Why should we care?

- Objective: Improved short-term NWP
- Added value of ADAS initial condition:
  - Assimilation of all operationally-available local/regional data
    - Surface obs, mesonets, satellite, radar, etc.
    - Provides mesoscale "snapshot" of the atmosphere for WRF
    - Already operational at NWS Melbourne, FL and SMG
  - High temporal (15 min) and spatial resolution (4 km) output
  - Visualization, Time Animation, & Prognostics not currently available with national models
- Result: Regional, high-resolution model guidance to support 0-12 hour forecast decisions

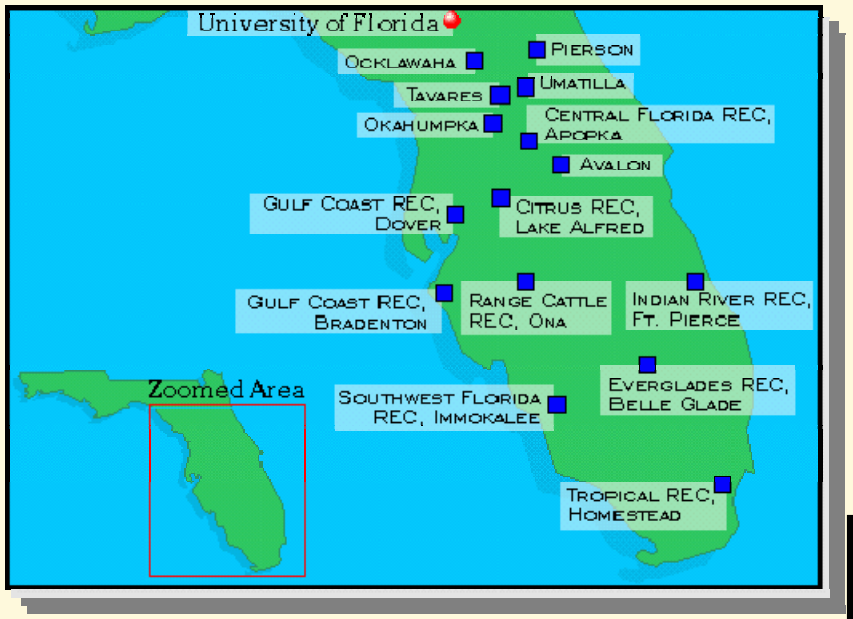
Observational Data Sets Ingested

- **Analysis frequency**: Every 15 minutes
- **Data Analyzed**: Surface, Local Obs, Satellite, WSR-88D Level II, Aircraft (ACARS)



Observational Data Sets, cont.

FAWN: fawn.ifas.ufl.edu
(**F**lorida **A**utomated **W**eather **N**etwork)



APRS: www.findu.com/aprswxnet.html
(**A**utomatic **P**osition **R**eporting **S**ystem)

- Amateur Radio Operators
  - Volunteered weather data
  - Data collected by NOAA/GSD server
  - NWS MLB obtains data from GSD
- Surface Observations
  - Temperature, dew point temperature
  - Winds and altimeter setting

ACARS: acweb.fsl.noaa.gov

- Commercial Aircraft Observations
  - Temperature and winds
  - Variable coverage and availability
  - NWS MLB obtains data from GSD

ADAS initializing WRF in EMS:
Why should you care?

- Forecasters could use additional guidance for short-term mesoscale weather prediction
  - Summertime air mass thunderstorms: Where will they initiate?
  - Terrain-induced circulations unique to specific regions
  - Localized mesoscale winter weather phenomena
- ADAS produces good representation of mesoscale atmosphere
  - ADAS is easy to configure and run
  - Applied Meteorology Unit (AMU) has detailed documentation
- Most anyone can run a regional WRF model run today
  - Computer hardware is relatively cheap
  - WRF EMS software does all the hard work for the user

Benefits of ADAS in EMS

- ADAS can initialize either version of WRF
  - Without EMS, ADAS can only initialize the NCAR WRF (ARW)
  - Within EMS, ADAS can also initialize the NCEP WRF (NMM)
  - NMM WRF → Runs 2.5 times faster than ARW
- NWS Melbourne & SMG can leverage off operational ADAS
  - Ingests all local and regional data sets
  - Already runs operationally → Simply plug in analyses into EMS
- Provides “hot start” capability to WRF
  - Full initialization of model wind, cloud, and precipitation fields
  - GSD code modifications from LAPS to be implemented in EMS

Summary

- Background on regional modeling
  - Required and desired features
- Cold start vs. hot start model runs
  - Why hot start is better
- NWS Environmental Modeling System
  - Very streamlined, easy-to-use software for running WRF
- Running ADAS to initialize WRF EMS makes sense
  - Allows users to initialize either version of WRF with ADAS
  - Plug-and-play ADAS/WRF at NWS Melbourne and SMG
- Questions?
- AMU Web page: http://science.ksc.nasa.gov/amu