WRF Enhancements for Operational Simulations

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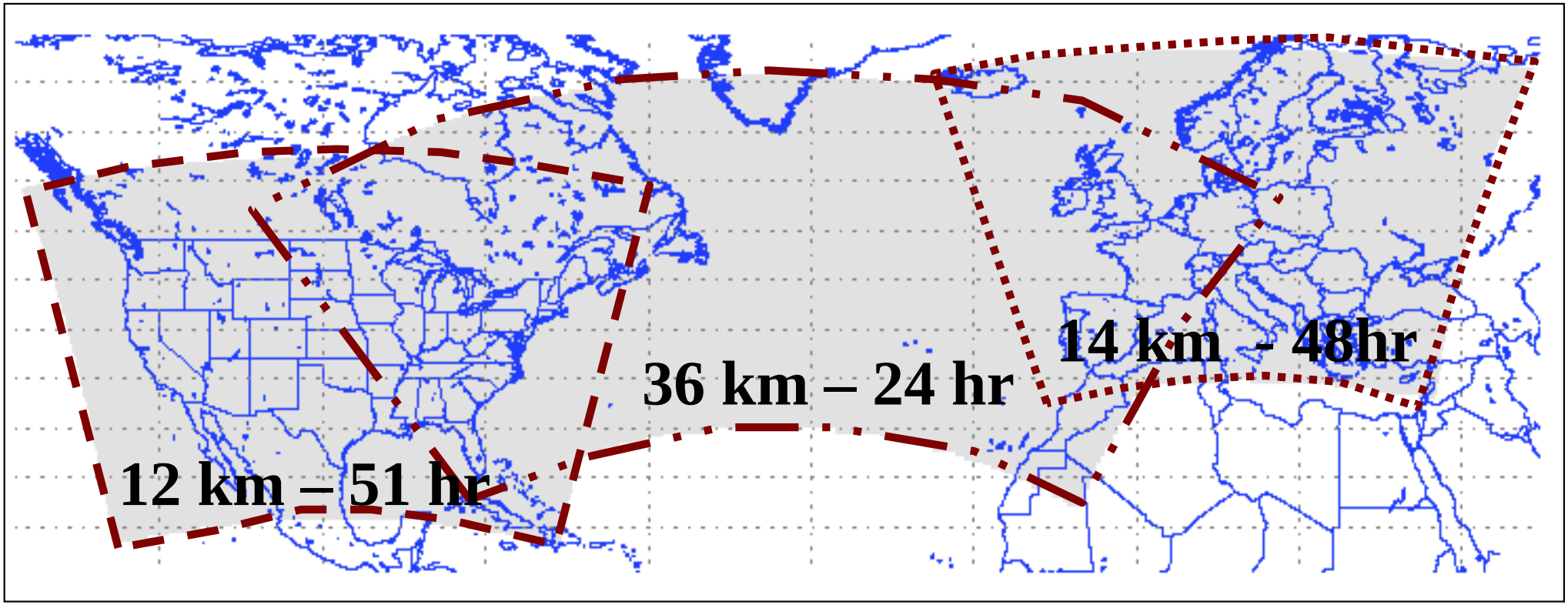
Operational Domains



CONUS – Run every 3 hours

Atlantic and Europe – Run every 6 hours

Operational Uses

- Aviation Forecasters
- Energy Forecasters
- Media Clients, packaged as WSI's *Rapid Precision Mesoscale (RPM)* model

WRF Enhancements

- Gridded Binary (GRIB) version 1 and 2 input/output (A WMO sanctioned format)
- Parallel pre-processing
- Verification

GRIB1 Output Module

- Included with official 2.0.3 WRF release.
  - Raw wrf.exe data output in GRIB format (no vertical interpolation)
- Why use GRIB 1?
  - Smaller output file sizes
  - Faster output
  - Interfaces with other graphics display systems
  - Interfaces with existing WSI systems

GRIB1 Output Module Details

- To use, simply set io_form_history to 5
- gribmap.txt (copied into “run”), provides:
  - mapping between WRF variables and GRIB parameter identifiers
  - precision for each output variable
- In WRF 2.0.3, GRIB1 output only supported for wrf.exe

GRIB1 Development Continues

- Currently adding:
  - support for GRIB1 output from wrfsi, real.exe and ideal.exe.
  - GRIB1 input for real.exe, ideal.exe and wrf.exe
- Benefits:
  - All wrf modules output in same format
  - Faster run-time
- Expected to be released later this summer
- This continued development is supported by AFWA/NCAR

GRIB 1 Results

- 3 hr forecast, 3 hr BC's, 10 minute output, 360x485 grid points, 2 processors for quilting
- File Sizes (MB):

Format	vinterp	real	wrf	**Total**
netcdf	358	442	368	**1168**
grib v1	82	157	109	**348**

- Run times (s):

Format	vinterp	real	wrf	**Total**
netcdf	224	202	719	**1145**
grib v1	147	174	519	**840**

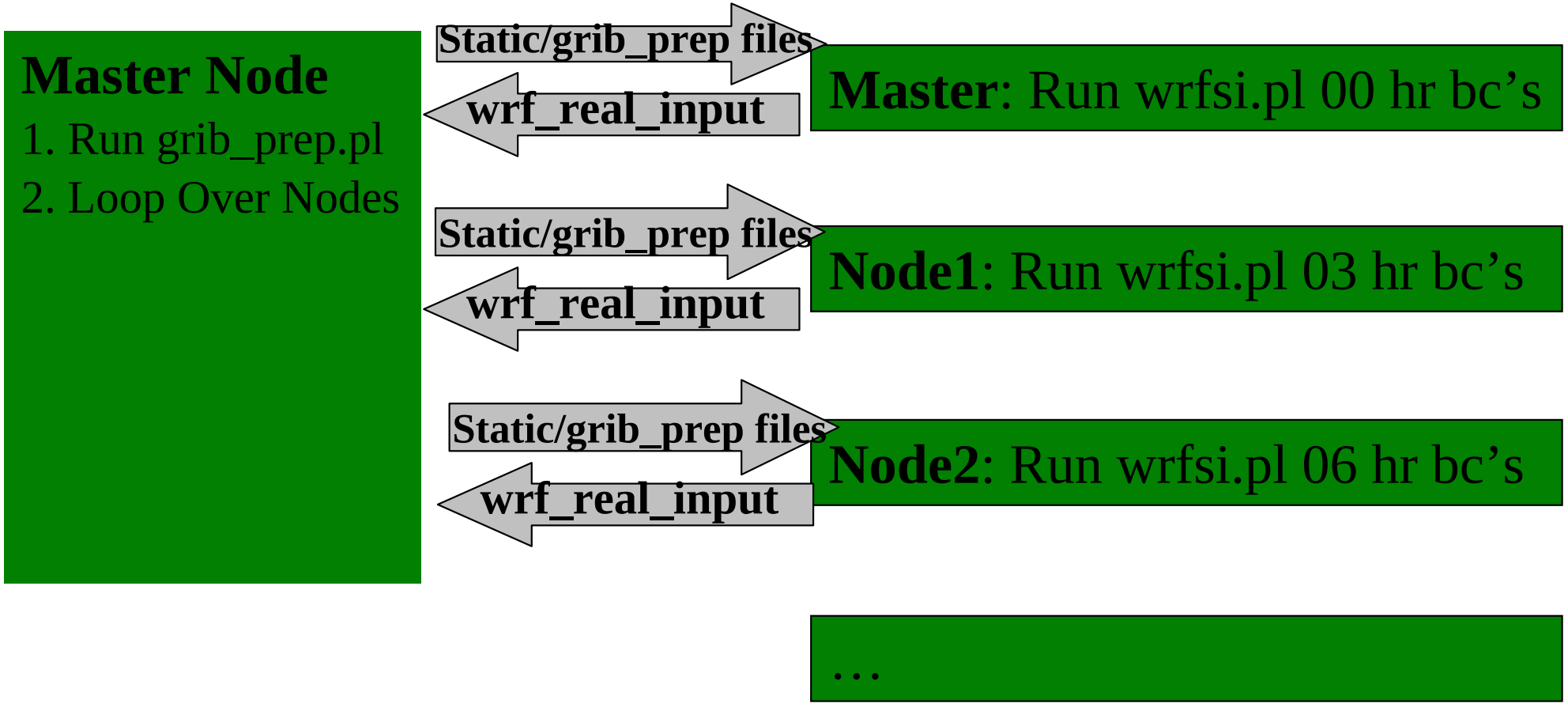
GRIB 2 Input/Output Module

- Under development; To be released later this summer
  - Expect output size to be 1/3 that of GRIB 1 and 1/10 that of netCDF.
- Conversion routines between GRIB1 and GRIB2 format will be included
- Supported by AFWA/NCAR

Parallel Pre-processing

Parallel Pre-Processing

linux cluster (i.e., distributed memory)



Parallel Preprocessing

- For our 51 hour CONUS runs:
  - Standard Preprocessing: 26 minutes
  - Parallel Preprocessing: 13 minutes
- WRFSI Modifications
  - Very minor modifications to wrfsi.pl to allow processing of single bc time.

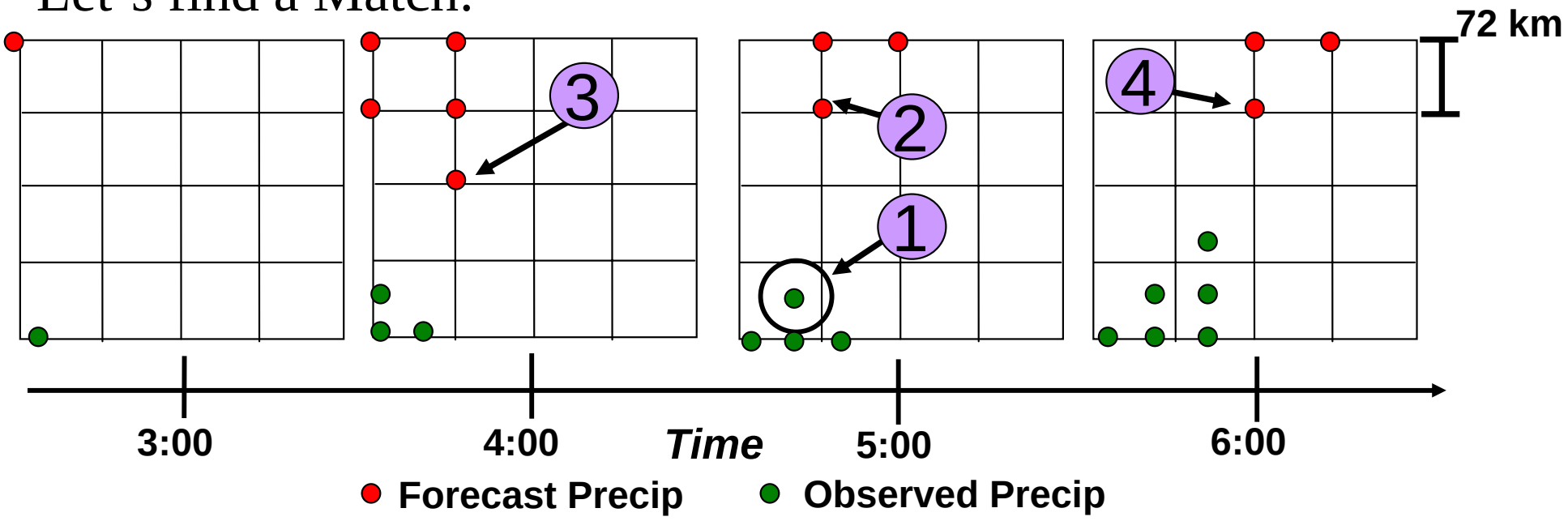
Verification

Acuity-Fidelity Verification

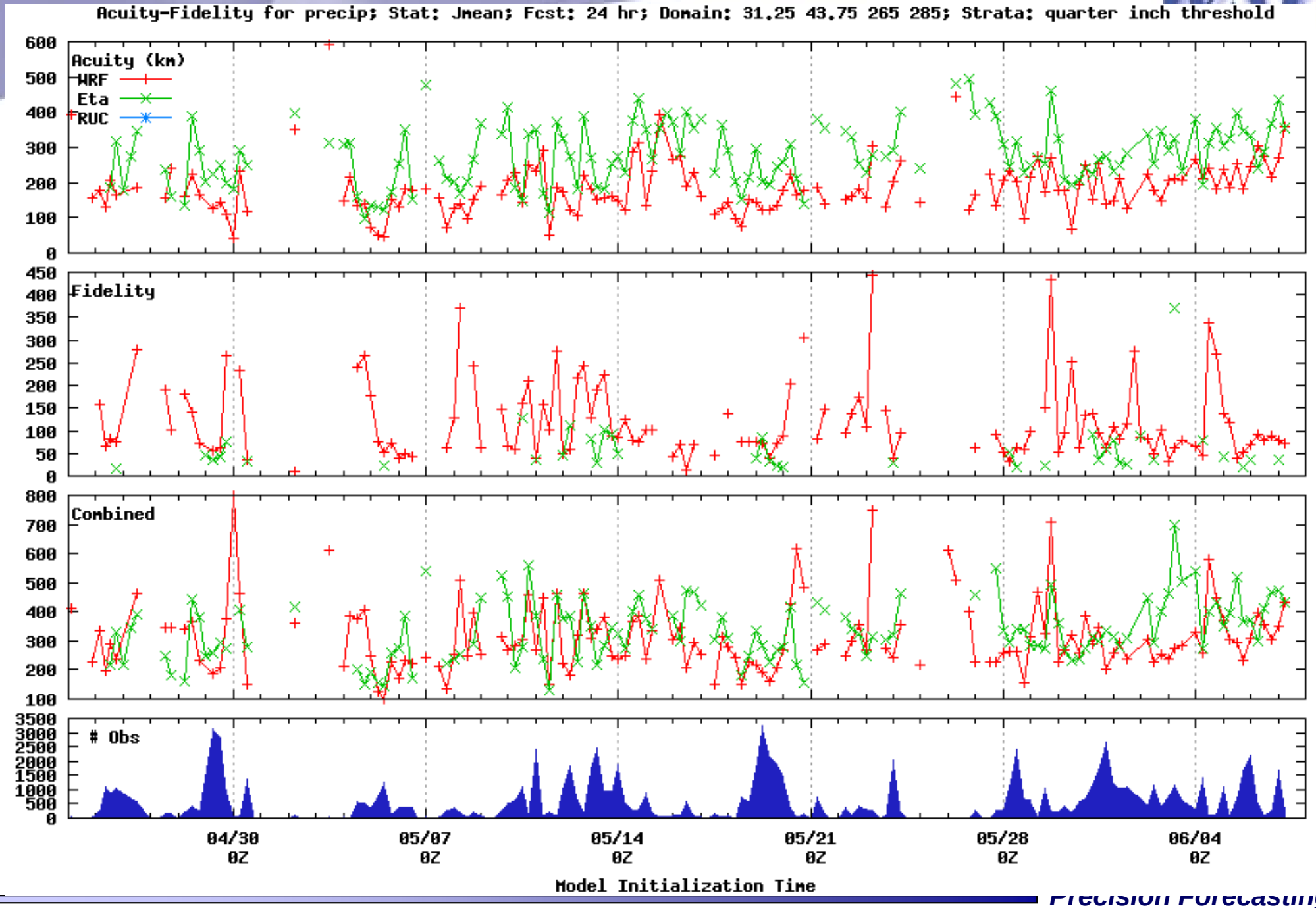
- Minimize a cost function calculated between forecast and observation
- Acuity = Detection skill
  - For each observation, find best matching forecast
  - "If it was observed, how well was it forecast?"
- Fidelity = Faithfulness of forecast to obs
  - For each forecast, find best matching observation
  - "If event was forecast, do the obs support it?"
- Units: kilometers

Acuity Example

Let's find a Match:

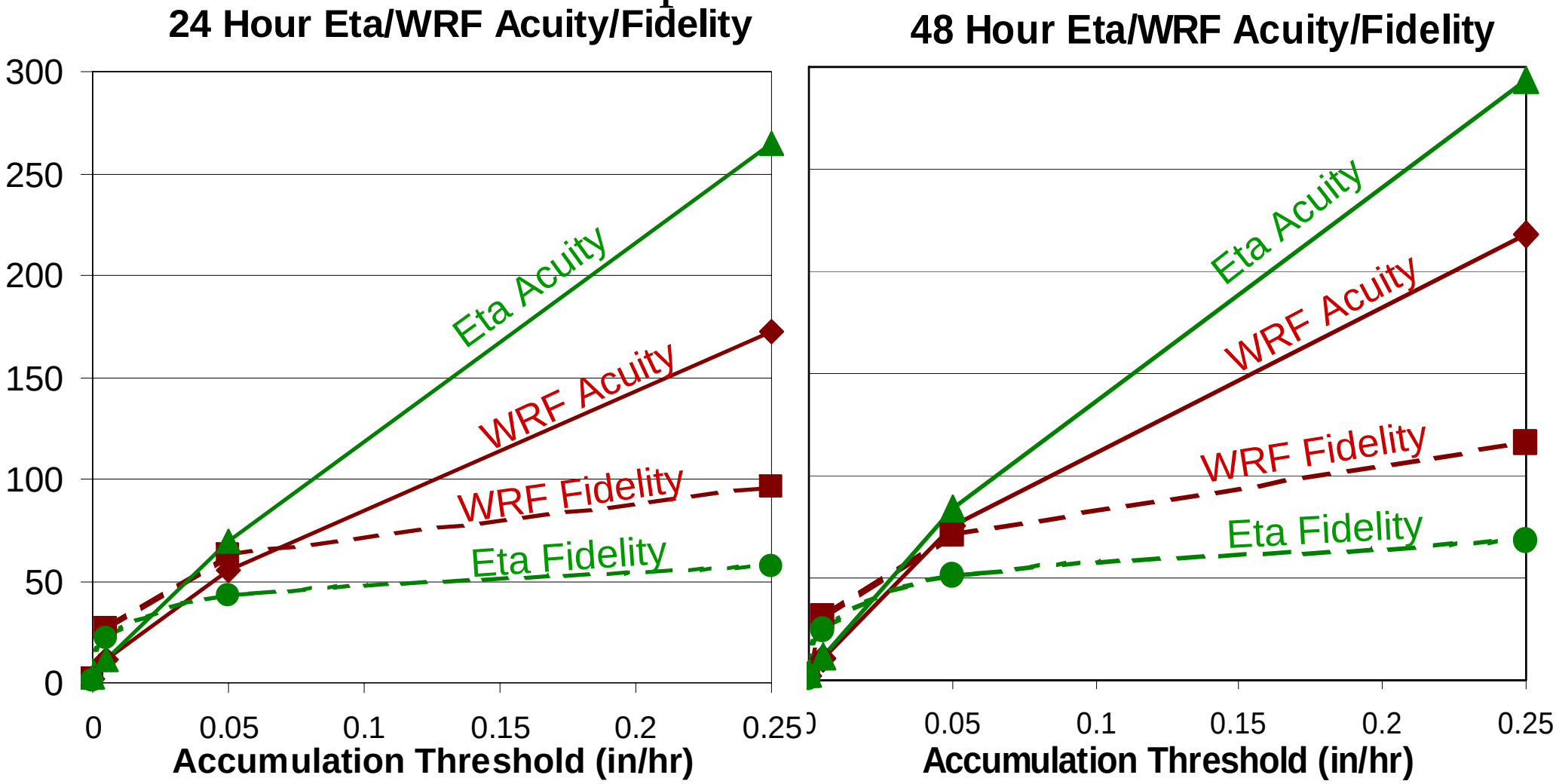


	Description	J_e +	J_s +	J_t +	J_i +	J (km)
1	Complete miss	1000	0	0	0	1000
2	Same Time	0	169	0	0	169
3	Early Forecast	0	99	1hr*x*10m/s = 36 km	0	135
4	Late Forecast	0	193	1hr*x*10m/s = 36 km	0	229


Acuity-Fidelity for precip; Stat: Jmean; Fcst: 24 hr; Domain: 31.25 43.75 265 285; Strata: quarter inch threshold
Acuity (km)
WRF
Eta
RUC
Fidelity
Combined
Obs
04/30 0Z
05/07 0Z
05/14 0Z
05/21 0Z
05/28 0Z
06/04 0Z
Model Initialization Time

Acuity-Fidelity Results

23 Apr – 8 June 2005



Summary

- WRF Enhancements:
  - addition of a grib I/O module
  - Method for parallel pre-processing
- Verification
  - WRF has proven to be more accurate at predicting heavy precipitation, however, it's false alarm rate is high