WRF Community Model Development: Lessons Learned

A personal perspective

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WRF User Participation

	7/15/05 Registered Users	June 2005 Workshop Participants
Principal Partners		
NCAR	90	38
NCEP	22	4
FSL	24	10
AFWA	18	4
Navy	15	4
U.S. Universities	607	59
U.S. Government Labs	245	25
Private Sector	337	22
Foreign	1648	53
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Total	3006	219
Institutions represented		117
Foreign countries represented	65	18

1365 active subscribers to wrf-news@ucar.edu

Plans for Operational WRF Implementations

Agency	Application	Date	
NOAA/NCEP	High Res Windows	Oct	2004
AFWA	Worldwide Theatres	Aug	2005
NOAA/NCEP	Short range ensemble	Sep	2005
NOAA/NCEP	N. American Meso.	Mar	2006
NOAA/FSL	Rapid Refresh (RUC)		2006
NOAA/NCEP	Hurricane forecasting		2007
Navy	Regional Domains		???
WSI	CONUS, European domains	Aug	2004
KMA Korea	Korea regional forecasting	Dec	2005
IMD India	Monsoon forecasting		2007
IAF Israel	Regional air-weather		2007
CWB Taiwan	Taiwan regional forecasting		2008

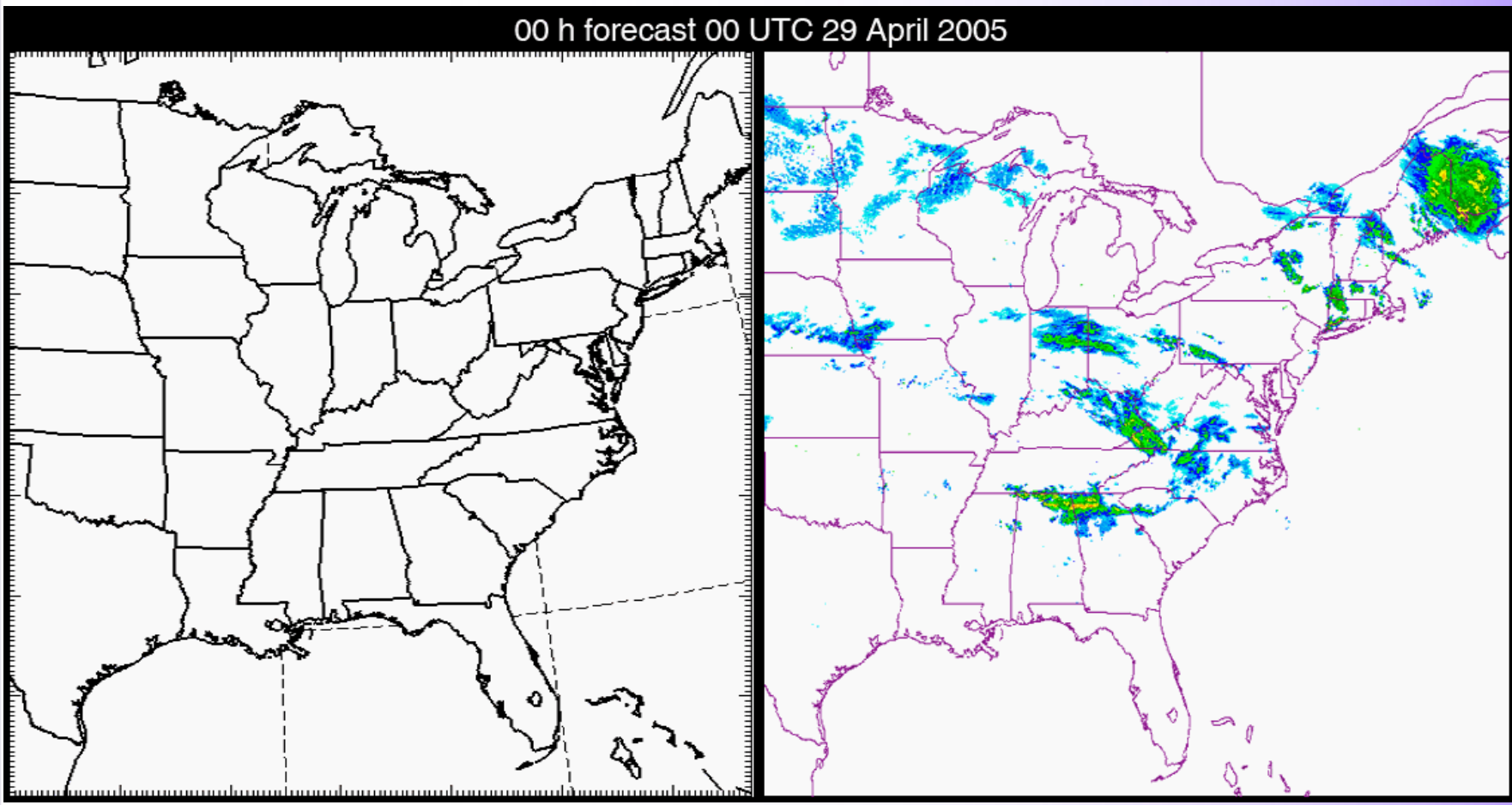
Under Consideration:

BMB	China
MetService	New Zealand
INPE	Brazil

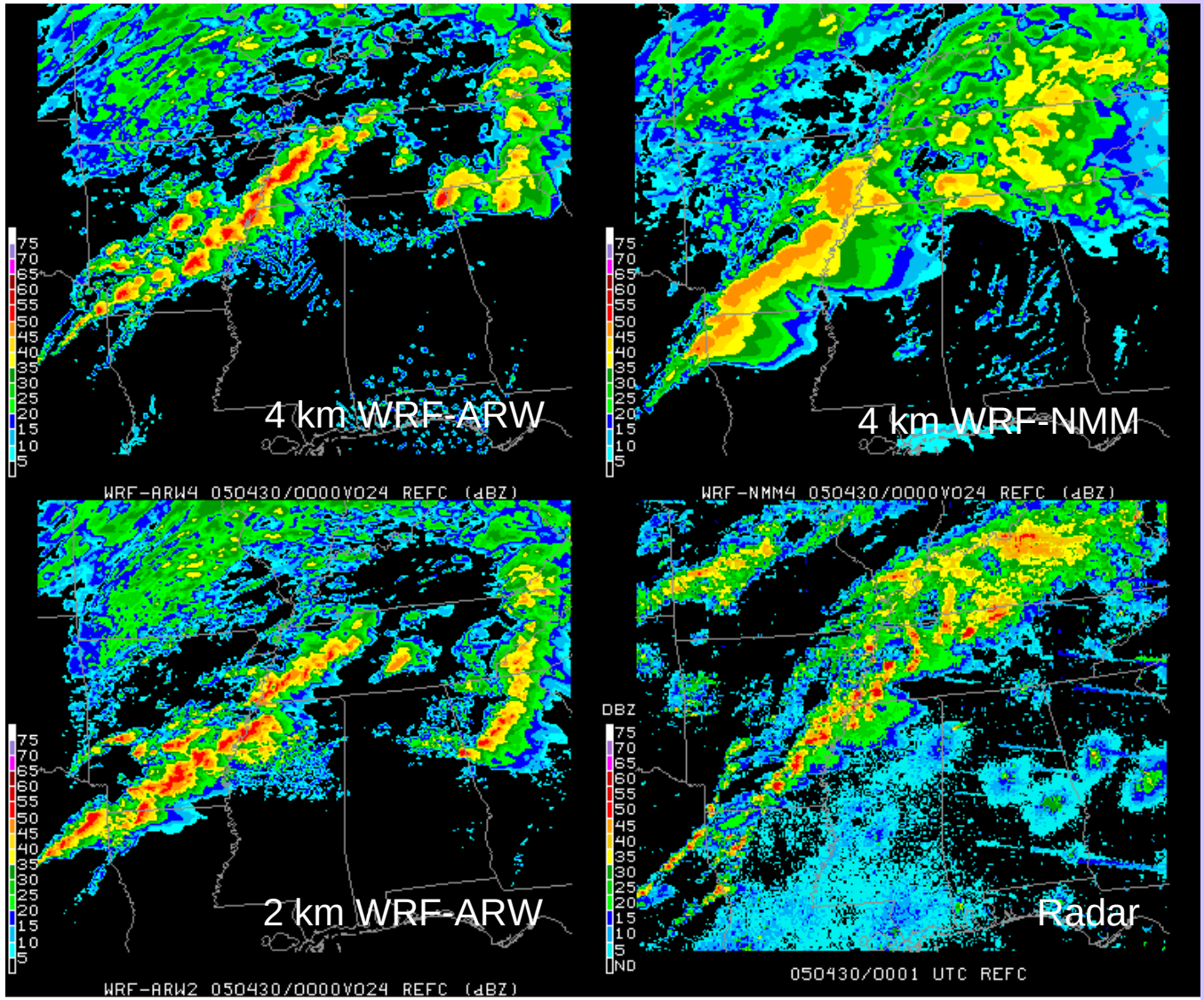
Real-time WRF 4 km Spring 2005 Forecast

Initialized 00 UTC 29 April 05

Reflectivity forecast **Composite NEXRAD Radar**



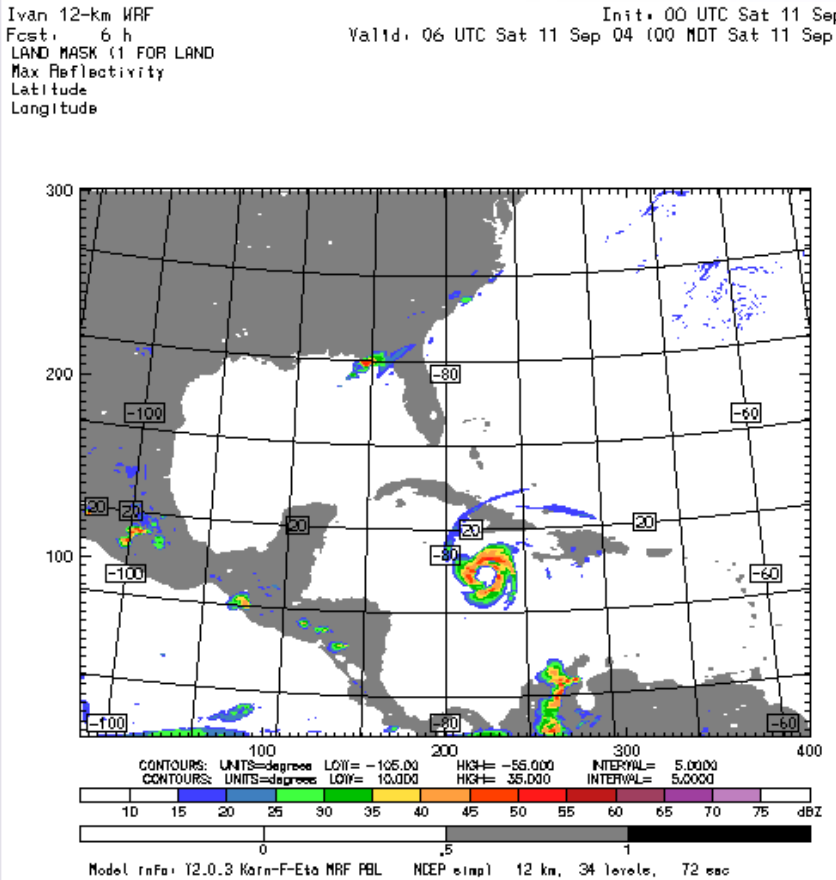
24 h Reflectivity Forecast valid 4-30-05 00Z



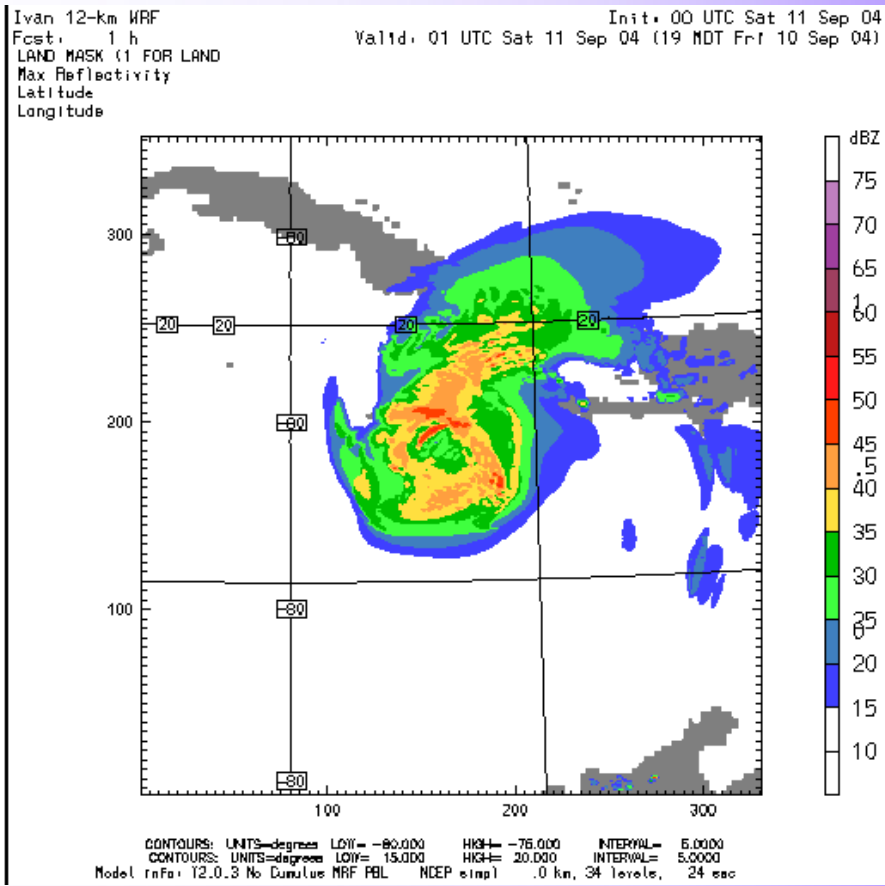
Hurricane Ivan WRF 5 Day Forecast

Initialized 00 UTC11 Sep 2004

12 km grid outer domain



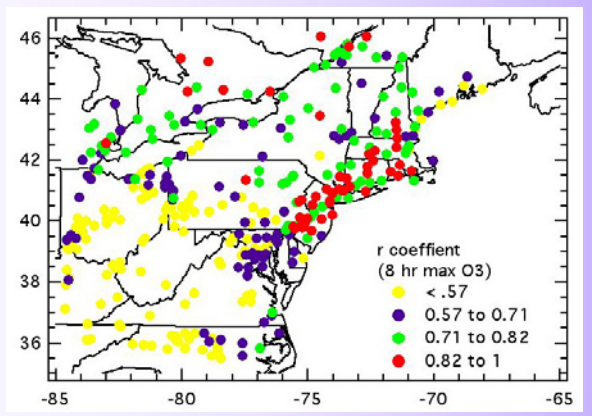
2-way interacting 4 km moving nest



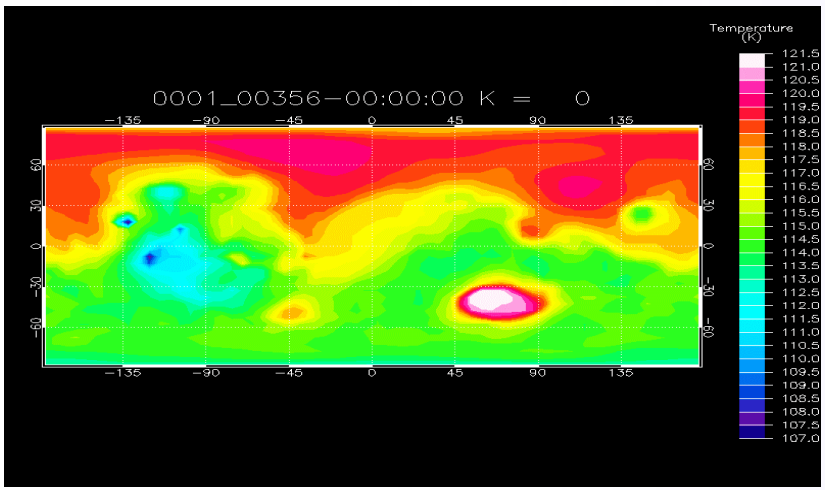
(John Michalakes)

Highlights from 2005 Users Workshop

- Expanded capabilities for air-quality and chemistry applications in WRF-Chem (Grell, FSL)
- WRF regional climate applications (Leung et al., PNNL)
- Global and plantetary version of WRF (Richardson et al., Cal Tech)



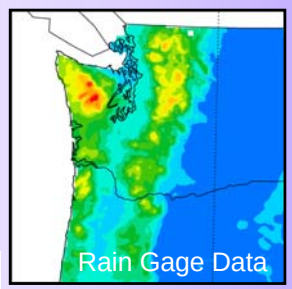
Comparison of 36 h WRF-Chem 27 km forecasts with AIRNOW daily 8-h max O_3

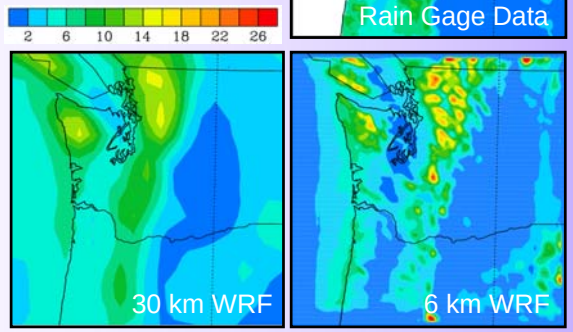


Mars - surface temperature

Regional Climate

Daily mean precip 10/1/90-3/31/91





Benefits of WRF Development Partnership

- More visibility, increased resources
- Much greater dialog between research and operational communities
- Highly flexible, modular software infrastructure capable of exploiting the range of available high-performance computing systems
- Collaborative development of certain major system components
- Unified NOAH LSM (consolidating NCEP, AWFA, & OSU versions)
- More extensive analysis and improvement of dynamic cores
- Larger suite of physics packages
- Developmental Testbed Center running the same codes used in both research and operations
- Improved capabilities to transition research advances into operations
- Better awareness of practices, priorities, and requirements across research and operational communities

WRF Research and Operational Perspectives

Research	Operations
Wide range of modeling applications	Focus on regional NWP
Maximum flexibility & options	Streamline for specific applications
Risk tolerant	Risk averse
Consequences of failure not large	Major consequences for failure
Comfortable with community software, use of external packages	Formal code configuration management, restrictions on external packages
Expertise in selected portions of code	Local expertise for all aspects of operational model code
Run time not critical	Run time a strong constraint

Challenges in Community WRF Model Development

- Under representation of research community at decision-making levels in WRF.
- Lack of resources for research community participation.
- Reconciling flexibility and options needed for research with focus and control desired in operations to derive maximum benefit from community approach to modeling system development.
  - DTC assistance in narrowing options for operational consideration
  - Acceptance of community software infrastructure
- Multiple core and DA systems cause duplication of effort and create impediments to collaboration, leveraging resources, and transfer of research advances into operations
- Need mechanism to coordinate high international user base (research and operational).

Some Recommendations

- Add NSF membership on WEOB, consider research community representatives as well.
- Enhance funding for increased research community involvement in WRF. .
- Build upon strengths of current WRF software infrastructure in developing strategy for interoperability with ESMF.
- Collaboratively examine the technical issues that underlie the differences in the existing WRF cores to identify, if possible, a single core formulation that would satisfy the needs of both research and operations.
- Work to restore WRF variational DA collaboration in building a unified 4D-Var system that upgrades existing operational 3D-Var systems leveraging advanced community DA capabilities (e.g. WRF ARW adjoint and tangent-linear codes).