

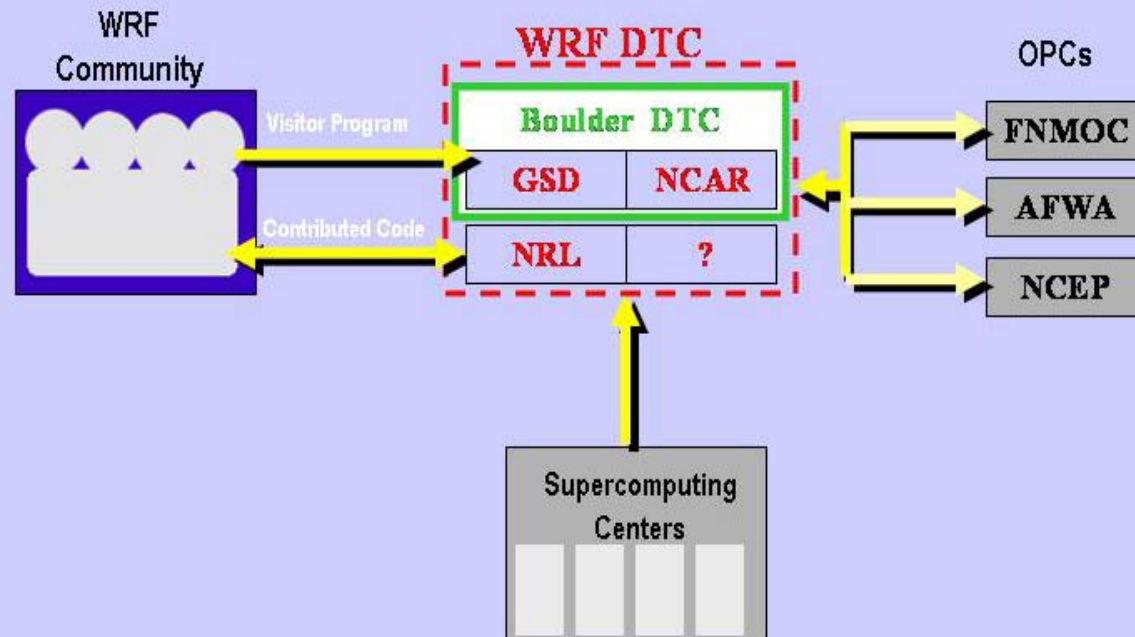
# The WRF Developmental Testbed Center: Current and Future Activities



## *What is the WRF DTC?*

*A facility where NWP research & operational communities interact to accelerate the testing & evaluation of models & other numerical techniques for research applications & operational implementation.*

## The DTC Architecture



# Boulder WRF DTC Team



## NCAR

Bob Gall (Director)  
Louisa Nance  
Meral Demirtas

## FSL

Steve Koch (Deputy Director)  
Ligia Bernardet

## **Funding:**

NOAA  
NCAR/NSF  
FAA  
AFWA

## **Collaborators:**

NCAR/MMM  
NCAR/RAL  
NOAA/GSD  
NOAA/EMC/NCEP  
NOAA/NWS  
Navy/NRL  
AFWA  
Universities



# Outline

- Testing and Evaluation
  - WRF Core Test
  - TREX
- WRF DTC Visitor Program
- Support for WRF-NMM
- WRF DTC Advisory Board

# WRF Core Test

## Goals -

- Conduct controlled experiments carefully comparing the 2 WRF dynamic cores.
- Provide datasets to support GSD's dynamic core recommendation to NCEP for WRF-RR

## Participants:

DTC (NCAR & GSD)

NOAA/ESRL/GSD

NCAR/MMM

NOAA/NCEP/EMC

NCAR/RAL – AWRP PDTs

NOAA/NWS

# WRF Core Test



NCAR

Model configuration –

ICs: RUC13

LBCs: NAM

Upper BC:

Physics frequency:

NMM – default

Radiation - 30 min

ARW – damping layer (5 km)

Other - ARW 72 s, NMM 60 s

Domain: CONUS

Grid spacing: 13 km

Time step: ARW 72 s, NMM 30 s

# of vertical levels: 50

Forecast length: 24 h

Forecast cycles: 00 & 12 Z

Dates -

Summer 15 Jul - 15 Aug 05

Fall 1 - 30 Nov 05

Winter 15 Jan - 15 Feb 06

Spring 25 Mar - 25 Apr 06

Physics

Phase 1

Phase 2

Microphysics

Ferrier

Thompson

Radiation

GFDL

GFDL

PBL

MYJ

MYJ

LSM

Noah-99

RUC

Cumulus

BMJ

Grell-Devenyi



NCAR

# Core Test Challenges

- Domain definition for cores with different map projections
- Interoperability of dynamic cores with physics packages
  - *See Poster 5.9 Smirnova et al.*
- Post-processing for multiple cores & physics options

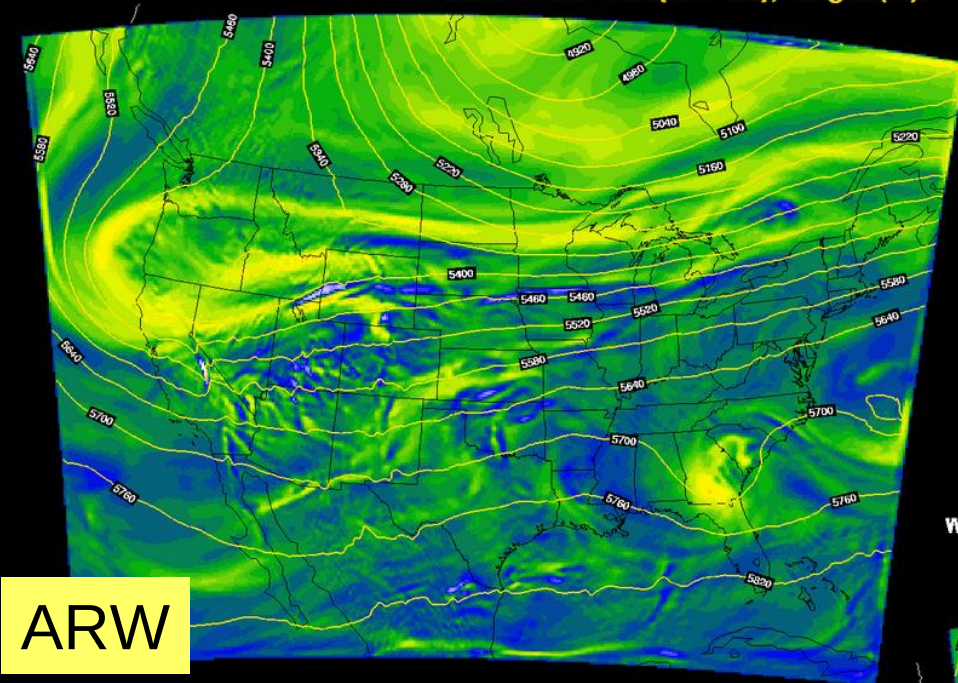
## Core Test Evaluation

- Standard verification statistics, including assessment of statistical significance
- Case Studies
- Application to aviation products by AWRP PDTs
  - *See 8.9 Benjamin et al.*

WRF-RR ARW 02/15/2006 (00:00) 9 hr fcst

Valid 02/15/2006 09:00 UTC

500mb Abs Vort ( $10E-4/s$ ), Height (m)



ARW



ARW has sharper mesobeta-scale features than NMM, both near mtns & elsewhere

Provided by:  
John Brown (NOAA/ESRL/GSD)

500mb abs vorticity  
9-h fcst  
valid 09Z 15 Feb 06

Patterns very similar at  
mesoalpha scales & larger

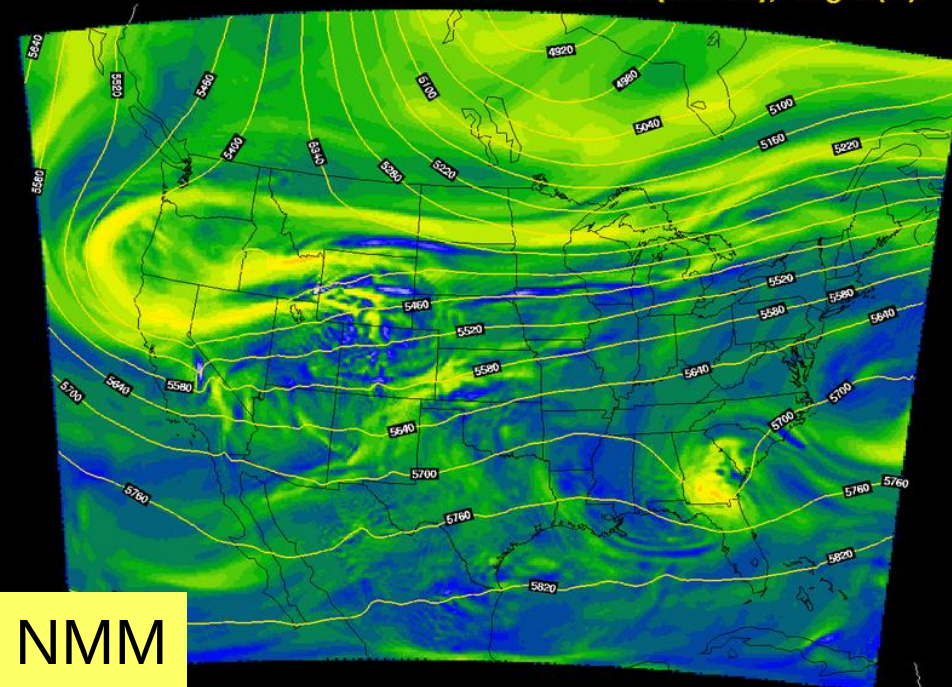


NCAR

WRF-RR NMM 02/15/2006 (00:00) 9 hr fcst

Valid 02/15/2006 09:00 UTC

500mb Abs Vort ( $10E-4/s$ ), Height (m)



NMM



# TREX

## Field phase

- Real-time forecasts for both dynamic cores
- Code: Core Test Phase 1
- Grid Spacing: 2 km
- Forecasts: 15 Mar - 30 Apr 06

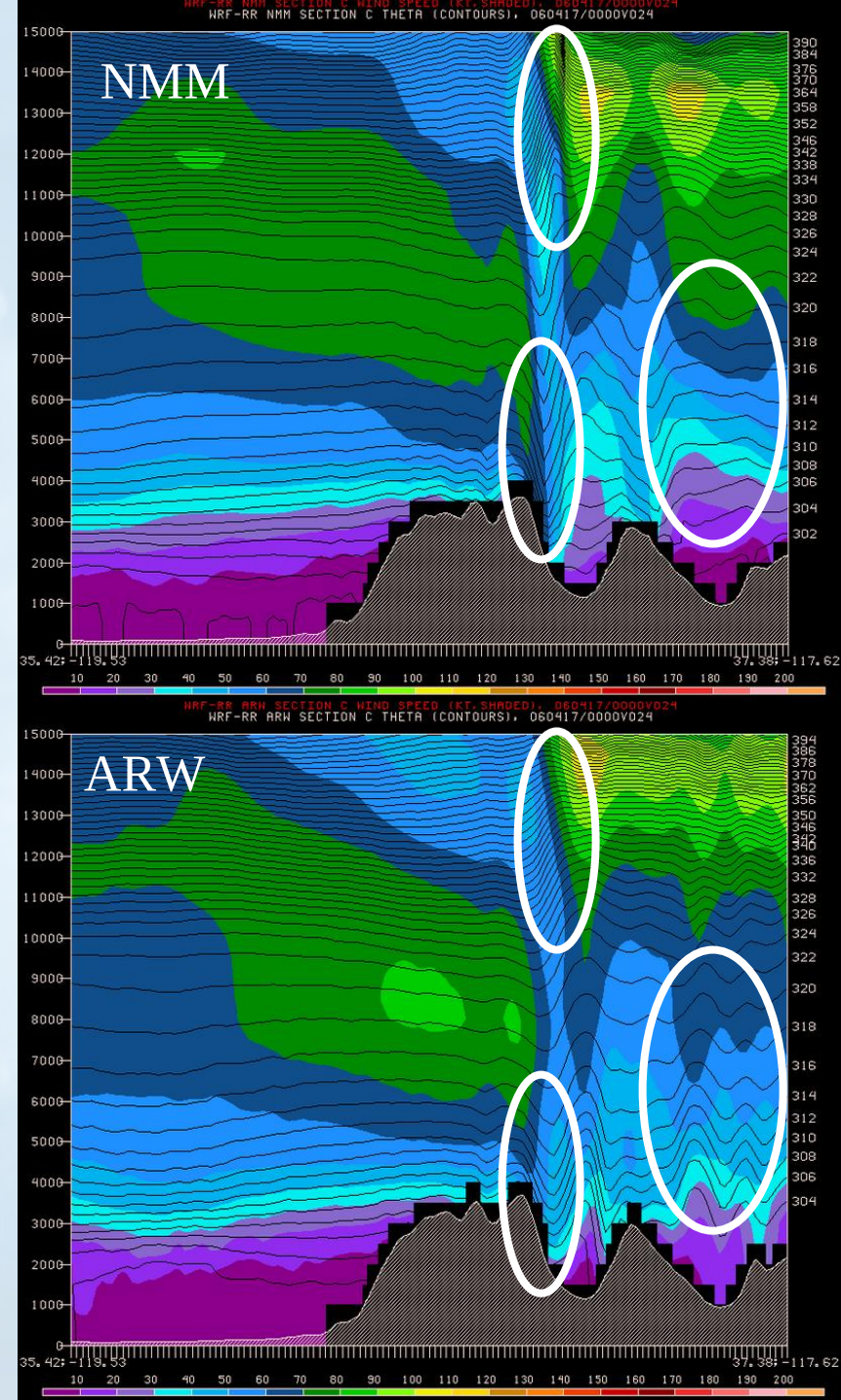
## Future work

### Sensitivity experiments

- Method used for reducing spurious gravity wave reflection off top boundary
- NMM divergence damping method
- Terrain smoothness effects on the sfc pressure gradient force

Sample:

00Z 17 April 06 / 24 h forecast



# WRF DTC Visitor Program



2005-2006

- Released 2 Announcements of Opportunity (Feb & Apr 05) – funded 8 of 32 proposals
- Review panel - NCAR, FSL, NCEP, AFWA, & NRL
- Funding for up to 1 month salary, travel, & per diem
- Access to DTC computational resources

Future activities

- Visitor Workshop in Boulder 17-18 August 2006
- New Announcement of Opportunity, when funding becomes available

# 2005-06 WRF DTC Visitor Program



NCAR

|                                             |                                                   |                                                                                                   |
|---------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Bill Gallus<br>Isidora Jankov<br>Eric Aligo | Iowa State University                             | Impacts of grid spacing and physical parameterizations for convective systems                     |
| Joe Galewsky                                | University of New Mexico                          | Resolution dependence of convective parameterizations                                             |
| Paul Roebber                                | University of Wisconsin – Milwaukee               | Event-oriented verification                                                                       |
| Mark Stoelinga                              | University of Washington                          | Verification methods for simulated reflectivity                                                   |
| Caren Marzban                               | University of Washington / University of Oklahoma | Cluster analysis for verification of WRF precipitation fields                                     |
| Hsiao-Ming Hsu                              | NCAR/RAL                                          | Multiscale Verification Method                                                                    |
| Dale Barker<br>James Drake<br>Jianjun Xue   | NCAR/MMM<br>AFWA<br>JCSDA                         | Development of tools for WRF Data Assimilation                                                    |
| Ming Xue                                    | University of Oklahoma                            | Implementation & evaluation of WSR-88D radial velocity & reflectivity data assimilation via 3DVAR |

# Resolution dependence of convective parameterizations

Joe Galewsky

University of New Mexico

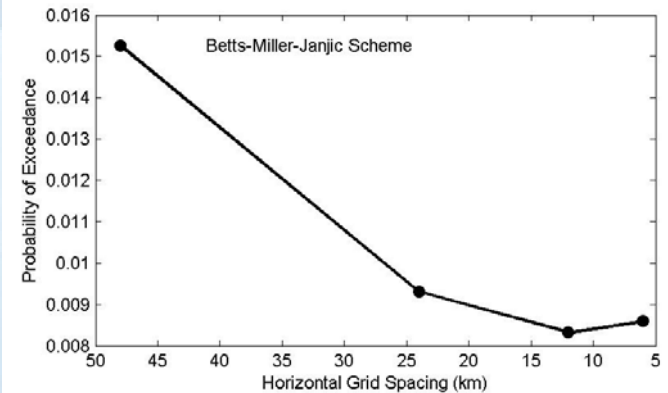
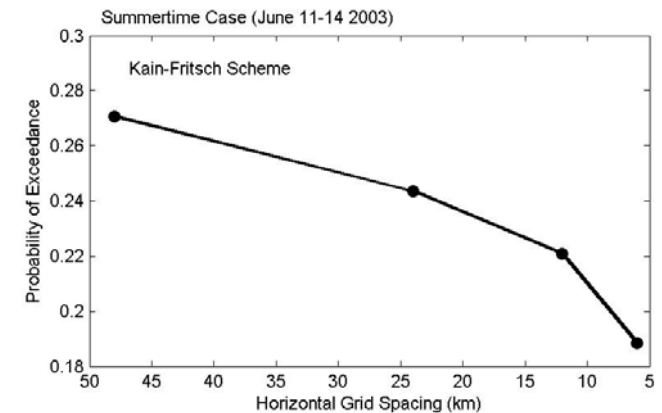


Goal: Develop diagnostic criteria for determining the activity of the convective scheme in WRF

- 3-day simulation for case over central US
- Joint probability that the convective scheme contributes > 50% of precip at a grid pt for total precip > 20 mm over 3-day period

Results -

- BMJ generally much less active than KF
- KF: convective precip contribution decreases rapidly for grid spacing < 12 km
- BMJ: convective precip contribution decreases rapidly for grid spacing transition from 48 to 24 km with little variation for grid spacing < 24 km



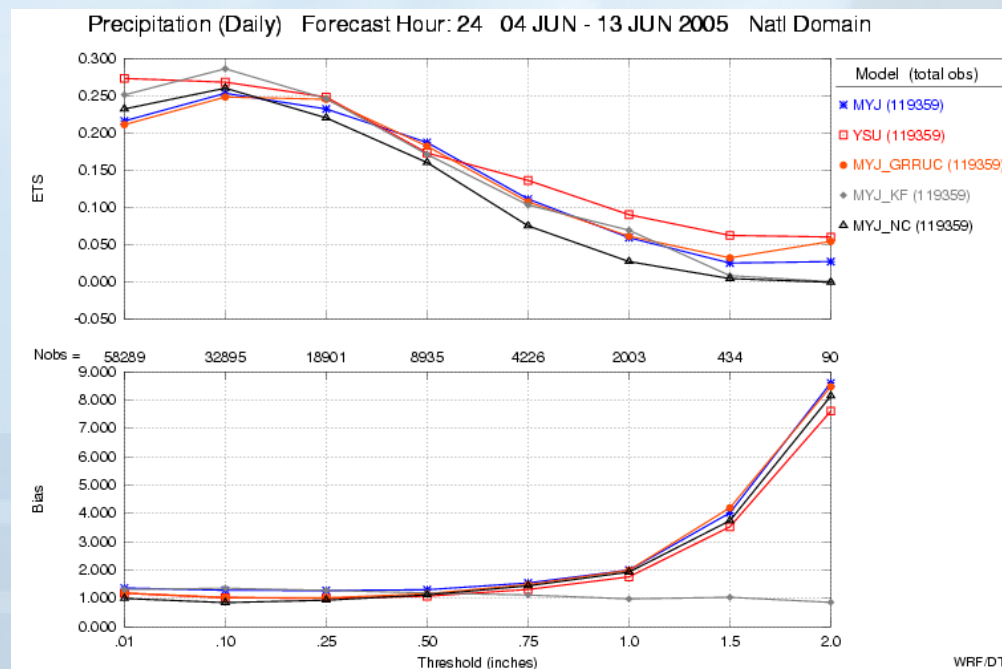
# Impacts of grid spacing & physical parameterizations for convective systems

Bill Gallus  
Iowa State University



- 5 WRF configurations / 4-13 June 05
- No particular convective scheme (or modification) consistently improves forecasts

Future work: Can modifications to Grell-Devenyi scheme improve performance?



# Cluster analysis for verification of WRF precipitation fields

Caren Marzban

University of Washington / University of Oklahoma

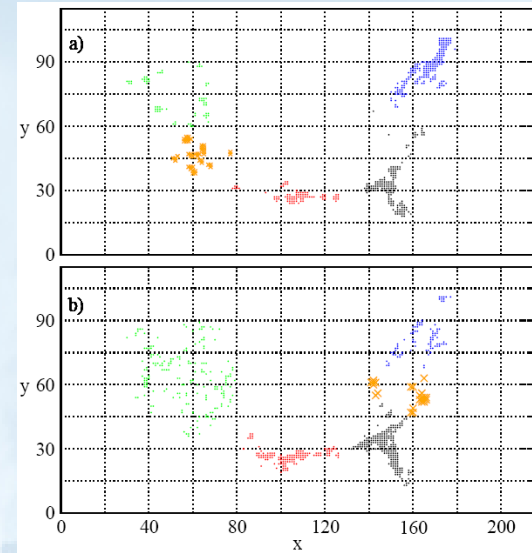


## Methodology

- Identifies clusters and matches clusters between obs & forecast fields
- Produces physically reasonable clusters & matches

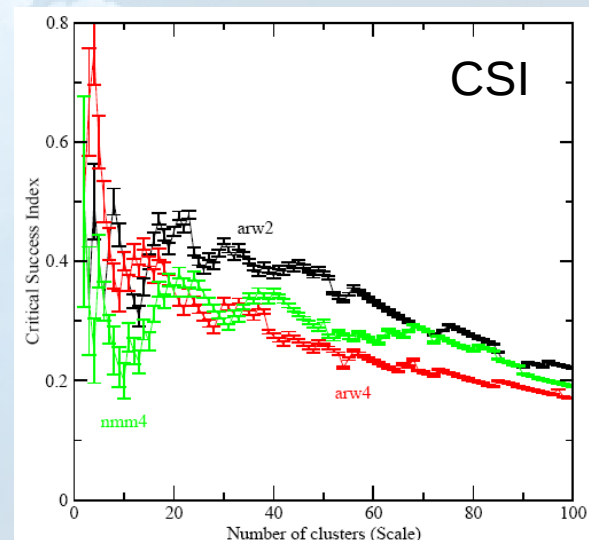
## Sample result –

- ARW2 generally better than ARW4 & NMM4
- NMM4 better than ARW4 for smaller scales (lrg # of clusters)
- ARW4 better than NMM4 on larger scales (small # of clusters)



Observed

Forecast



# Support for WRF-NMM



## Code

- Initial distribution (SI, model, & post-processor) at Sept '05 tutorial
- Code officially available from downloads page of WRF-NMM Users Page on 12/6/06
- Support for NMM portions of WRF through wrfhelp@ucar.edu

## Registered users - 6/5/06

|            |       |
|------------|-------|
| Government | 18    |
| University | 64    |
| Private    | 26    |
| Foreign    | 145   |
|            | <hr/> |
|            | 253   |

## Documentation

- User's Guide available via WRF-NMM Users Page
- Scientific documentation – work w/ NCEP to make document available to community in FY07

WRF-NMM Users Page

<http://www.dtcenter.org/wrf-nmm/users>

# WRF NMM Tutorials

- Conducted 2 tutorials  
27-29 September 2005  
7-10 February 2006
- Lecturers from NCEP, GSD, & NCAR
- Next scheduled 8-11 August 2006

|            | Sept | Feb |
|------------|------|-----|
| Government | 14   | 9   |
| University | 16   | 14  |
| Private    | 4    | 5   |
| Foreign    | 2    | 7   |
|            | 36   | 35  |



# DTC Advisory Board



- Established in June 05
- Tasked with helping DTC management shape the overall program of the WRF DTC

| Organization | Number | Members                                                                   |
|--------------|--------|---------------------------------------------------------------------------|
| NOAA/NCEP    | 2      | Geoff Dimego, Naomi Surgi                                                 |
| NOAA/OAR     | 1      | Tom Schlatter                                                             |
| NAVY/FNMOC   | 1      | Mike Sestak                                                               |
| NAVY/NRL     | 1      | Simon Chang                                                               |
| AFWA         | 2      | Jerry Weigel, Chris Finnigsmier                                           |
| FAA          | 1      | Roy Rassmussen                                                            |
| ARL          | 1      | Bob Dumais                                                                |
| NCAR         | 1      | Greg Holland                                                              |
| Academic     | 3      | Brian Colle (SUNYSB), Ming Xue (U of OK), Paul Roebber (U of W-Milwaukee) |