INTERCOMPARISON OF PHYSICS SCHEMES IN COAMPS® AND WRF

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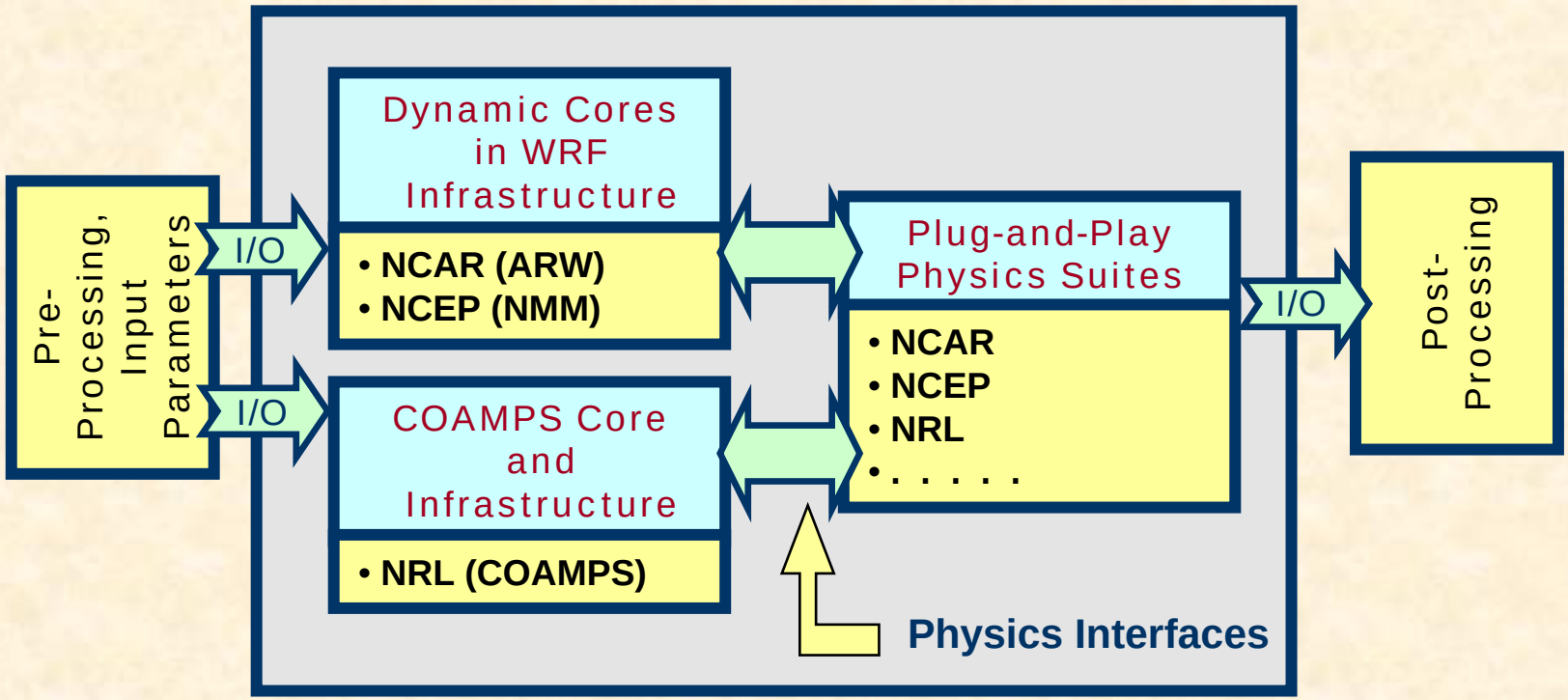
Objectives

- Create interoperable I/O capabilities for COAMPS and WRF
- Develop plug-and-play physics capability in COAMPS
- Integrate COAMPS physics suite into WRF
- Understand differences between different physics suites and individual parameterizations
- Use multiple physics suites for mesoscale ensemble forecasting

COAMPS-WRF Integration Strategy



I/O Integration

- Input:
  - COAMPS can read GFS initial fields.
  - COAMPS can read WRF-ARW initial fields.
  - COAMPS can read WRF-NMM initial fields. (On-going)
  - COAMPS can read WRF SI initial fields. (On-going)
- Output:
  - COAMPS can output in grib2 format.
  - COAMPS can output in NetCDF format.
  - COAMPS validation software can be used for COAMPS and WRF.

COAMPS can use other model's fields for initial and lateral boundary conditions. This allows NRL MRY and their collaborators to study analysis and lateral boundary condition sensitivity.

Physics Integration

- **Modular physical parameterizations for COAMPS:**
  - Radiation (short and long wave)
  - Surface slab, surface flux
  - Planetary boundary layer
  - Microphysics
- **COAMPS physics schemes restructured to accommodate differences between WRF and COAMPS:**
  - Vertical coordinates
  - Array indices
  - Update sequence of prognostic variables
  - Unit conversion
- **WRF modified to facilitate COAMPS physics integration (in collaboration with John Michalakes):**
  - Hydrometeor arrays changed from 4-d to 3-d
  - Optional arguments used in physics drivers

Physics Suites

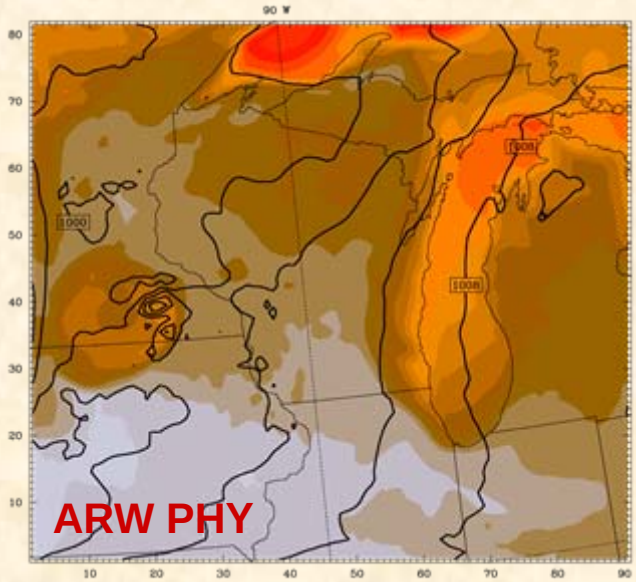
Physics Options	MP	CUPARA	PBL	RAD	SFC LAYER	LAND SFC
ARW	Lin et al	ETA KF	YSU	RRTM Dudhia	Monin-Obukov	NOAH
NMM	ETA NEW	BMJ	MYJ	GFDL	Monin-Obukov-Janjic	NOAH
COAMPS	MP COAMPS*	KF (1990)	Mellor & Yamada (1982)	Harshvardhan et al. (1987)	Louis (1979) Wang et al. (2005)	Deardorff (1978)

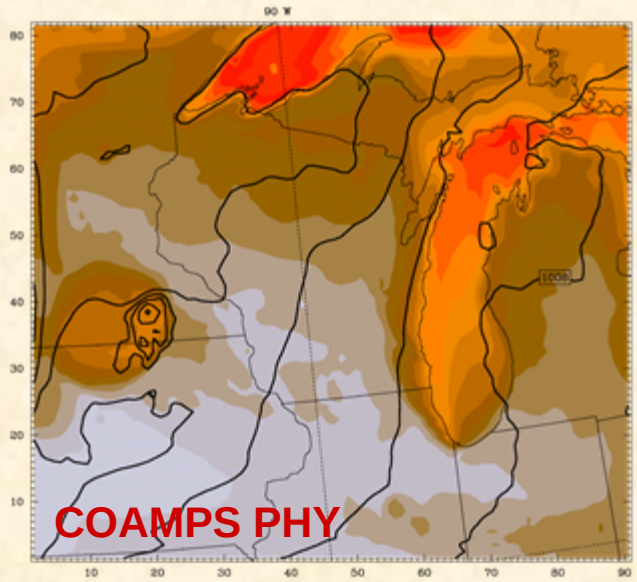
*MP COMAPS is developed based on Rutledge and Hobbs 1983 & 1984, Meyers et al 1992 and 1997, Cotton and Anthes 1989, Reisner et al. 1998, Gaudet and Schmidt 2005 & 2006; drizzle - Khairoutdinov and Kogan 2000.
http://www.nrlmry.navy.mil/projects/coamps/frame_doc.htm

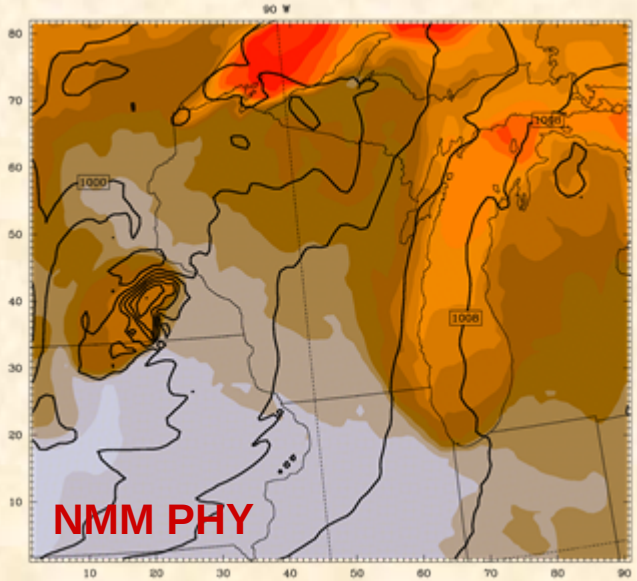
Test Case

- **ARW core**
  - WRFV2.1 as the base version updated with bug fixes from WRFV2.1.2 in surface and pbl routines.
  - 24-h simulation initialized at 1200 UTC 11 June 2001 at 10-km resolution
  - Three suites of physics (ARW, NMM, COAMPS®)

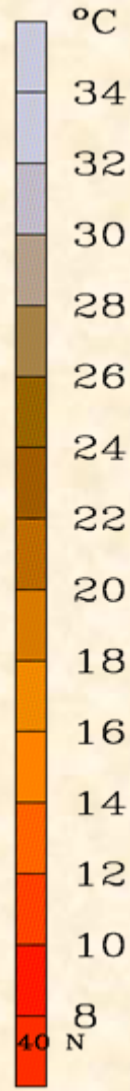
ARW Core June 2001 Case







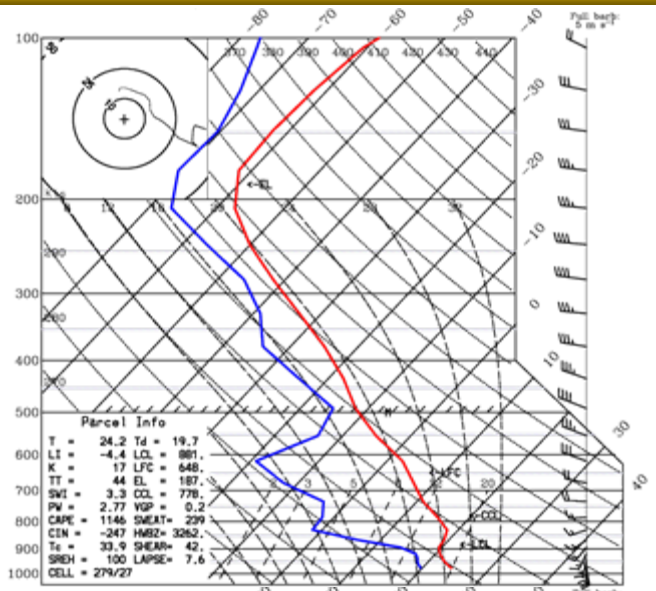
Lowest Model level air temperature (shaded, deg C) and sea-level pressure (contours, hPa)



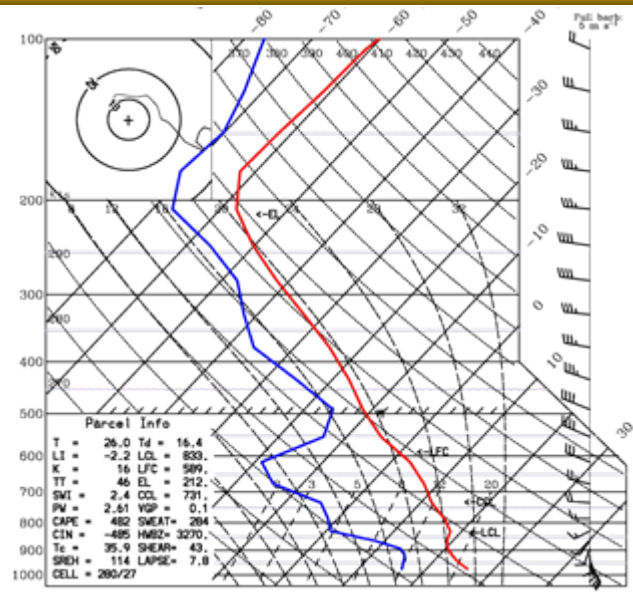
ARW Core June 2001 Case

Soundings at Green Bay, WI at 0000 UTC 12 June

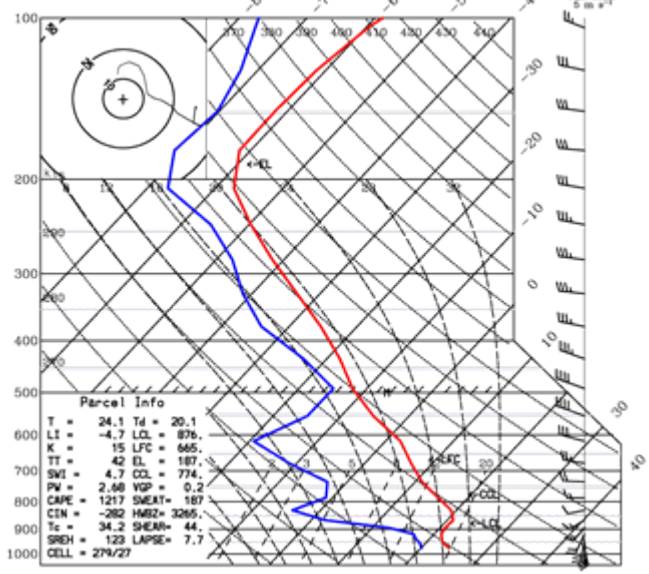
ARW GRB 12h



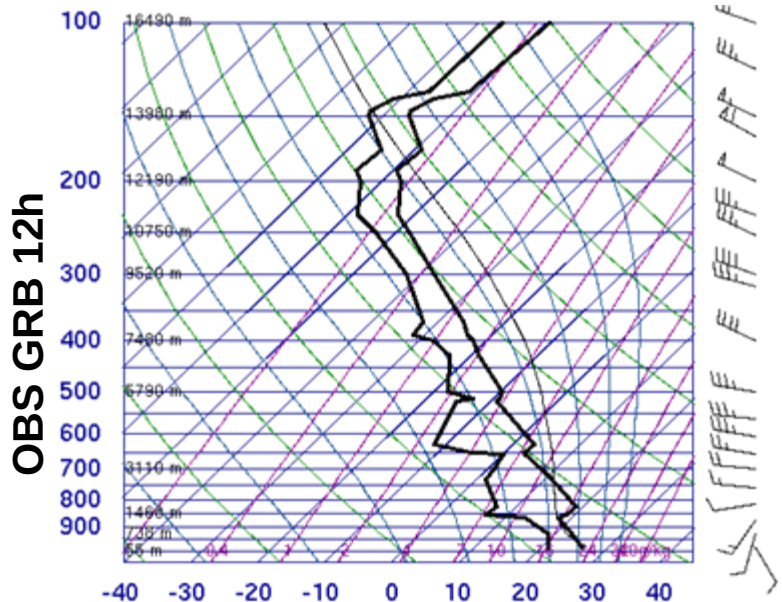
COAMPS GRB 12h



NMM GRB 12h

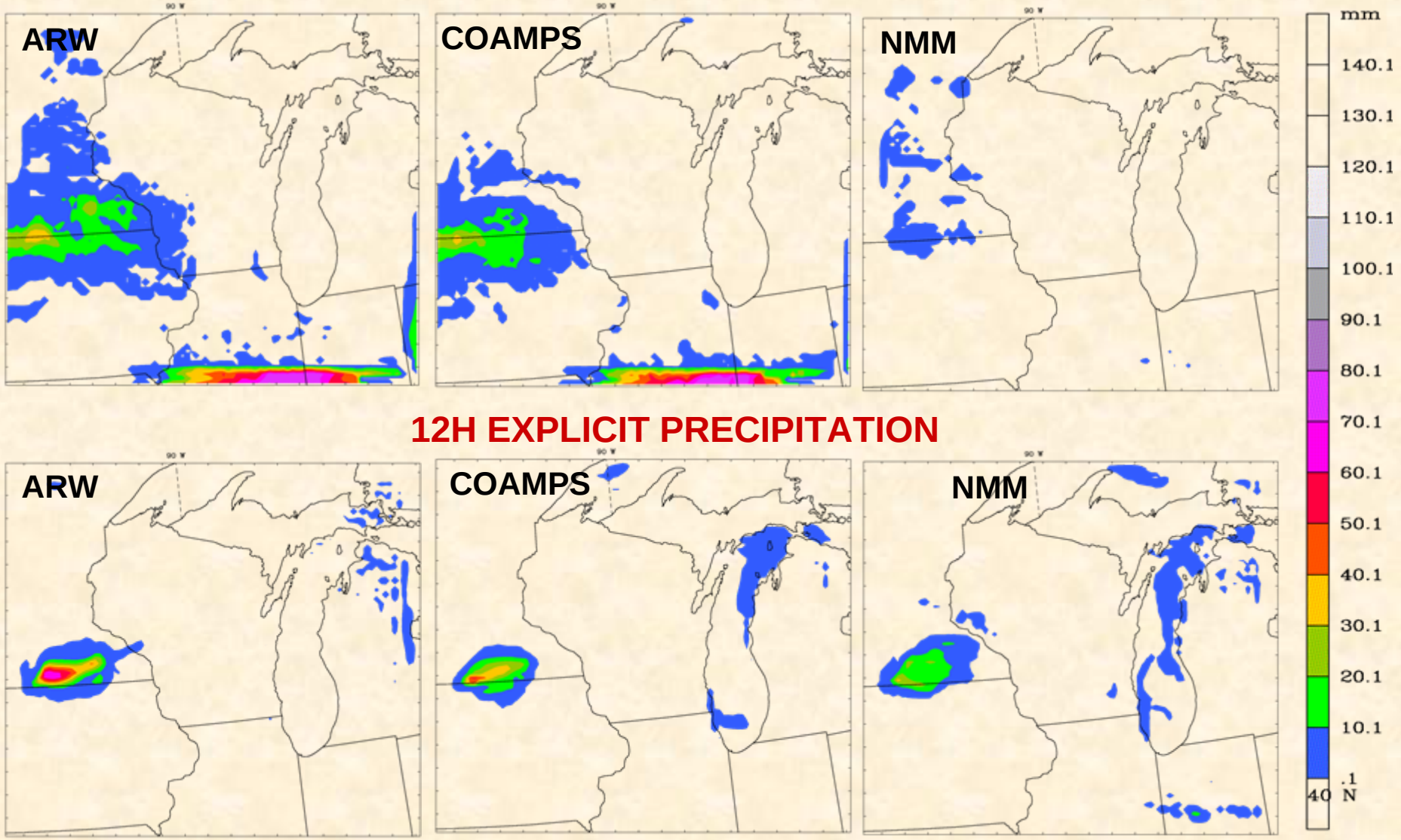


OBS GRB 12h



ARW Core June 2001 Case

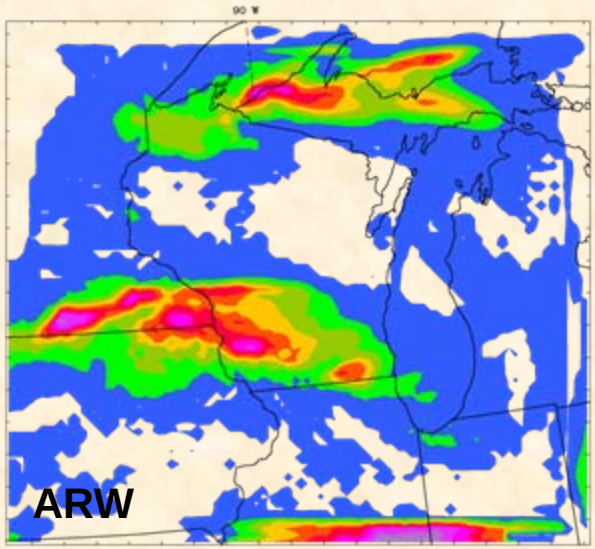
12H CONVECTIVE PRECIPITATION

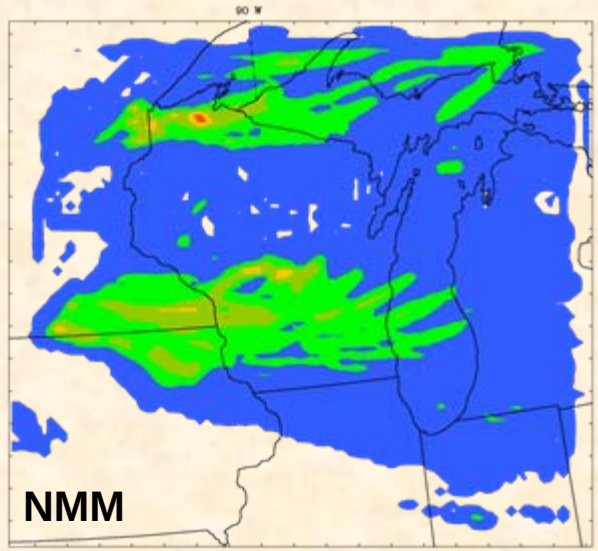


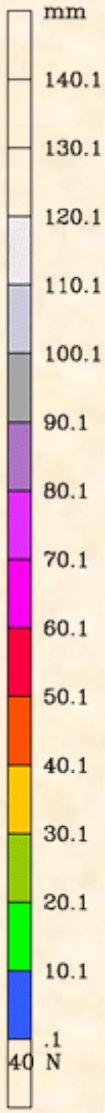
12H EXPLICIT PRECIPITATION

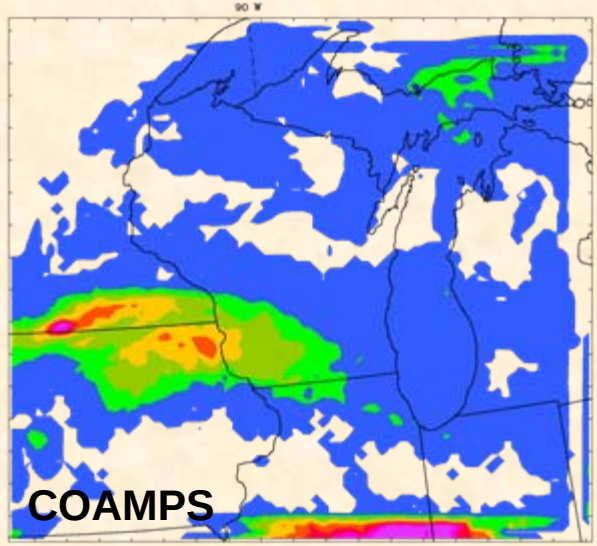
ARW Core June 2001 Case

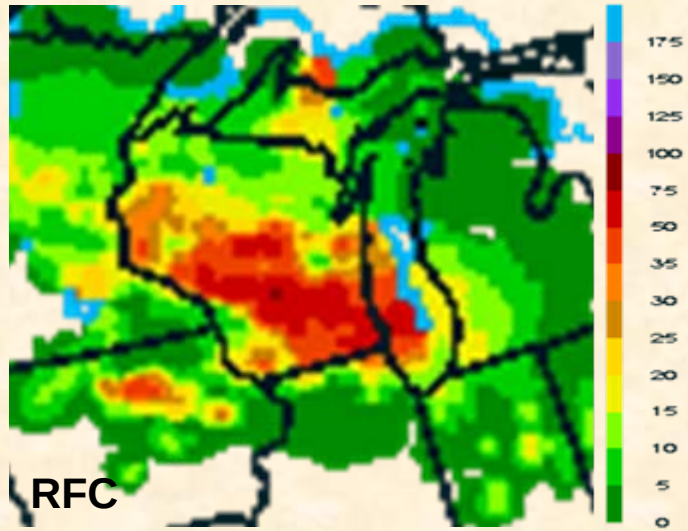
24H ACCUMULATED TOTAL PRECIPITATION





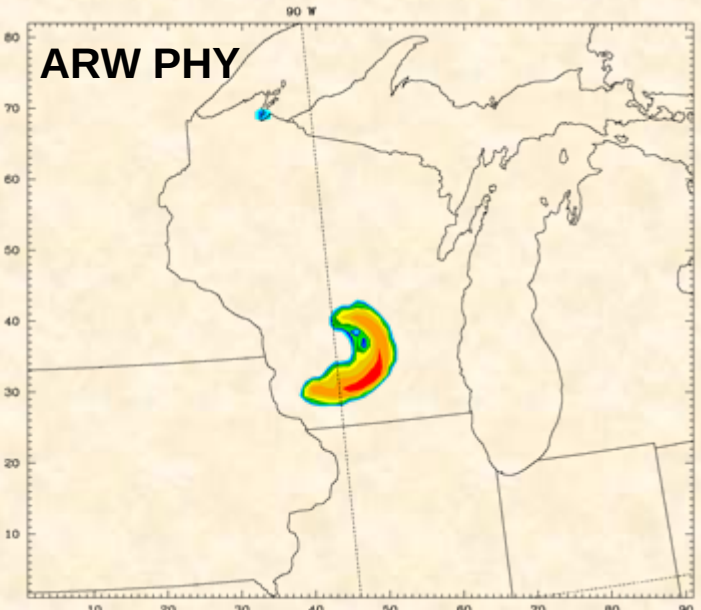


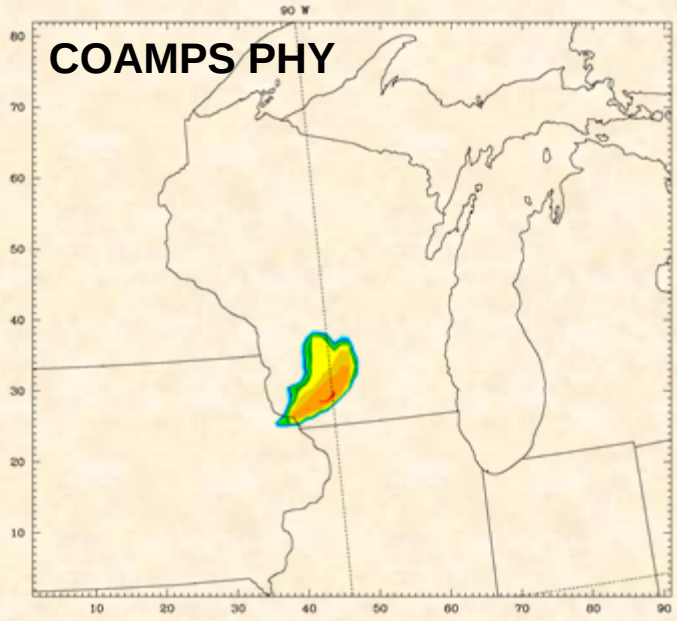


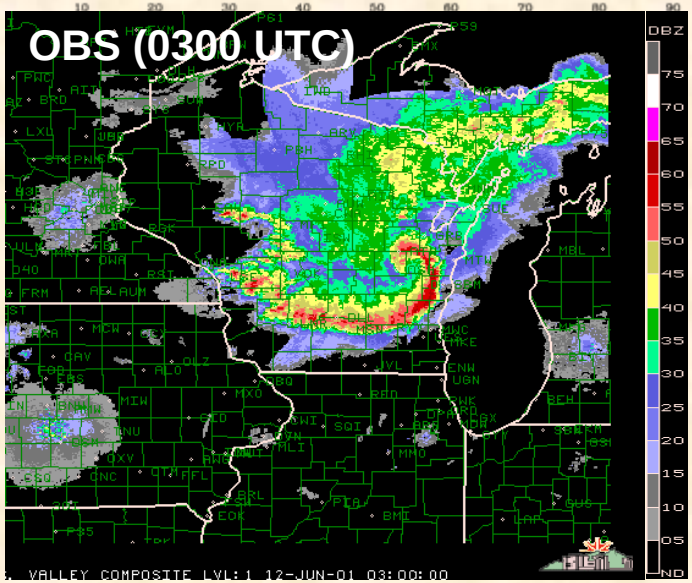


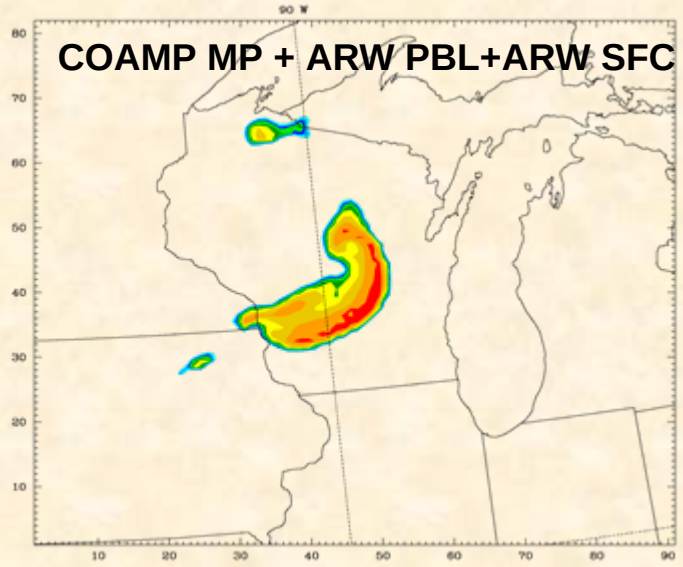
ARW Core June 2001 Case

15H FCST RADAR REFLECTIVITY (0300 UTC)



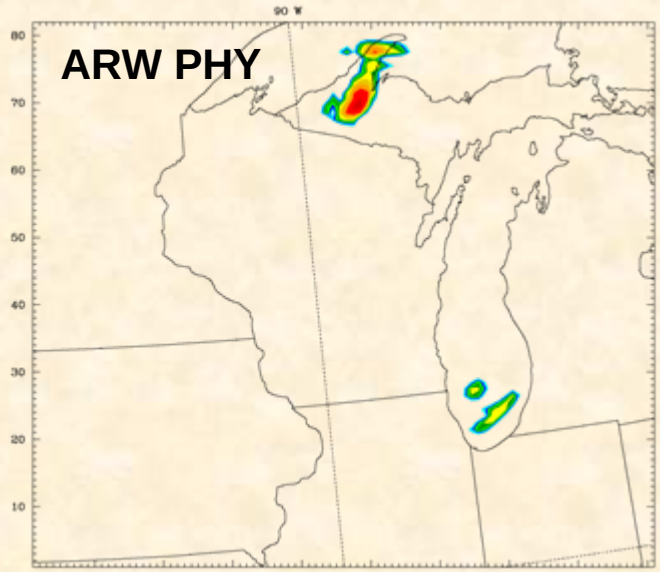


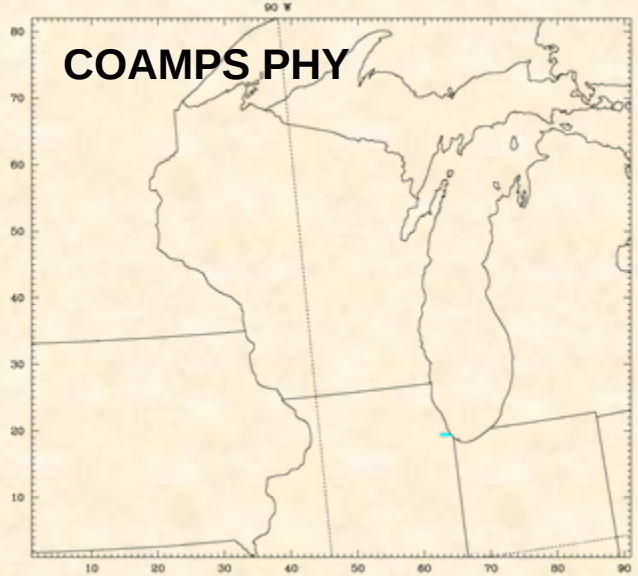


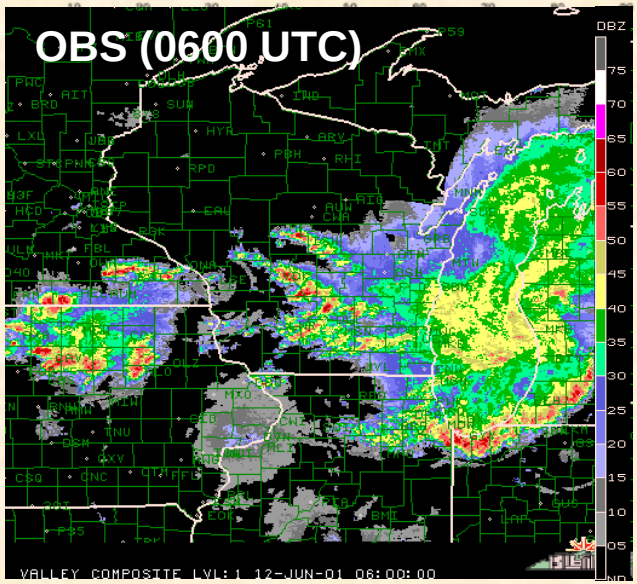


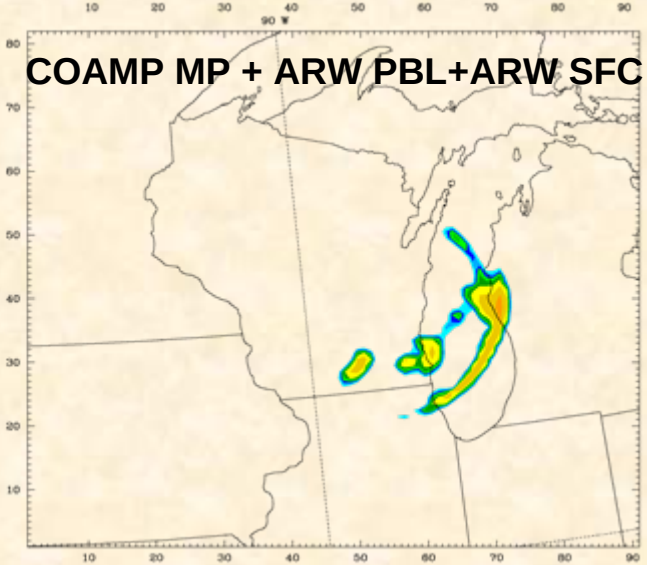
ARW Core June 2001 Case

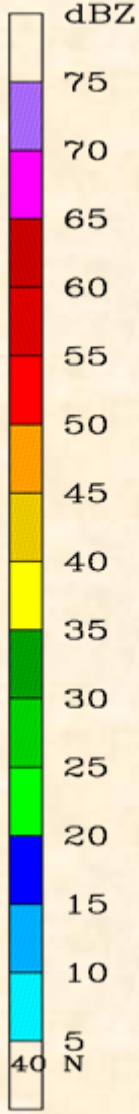
18H FCST RADAR REFLECTIVITY (0600 UTC)





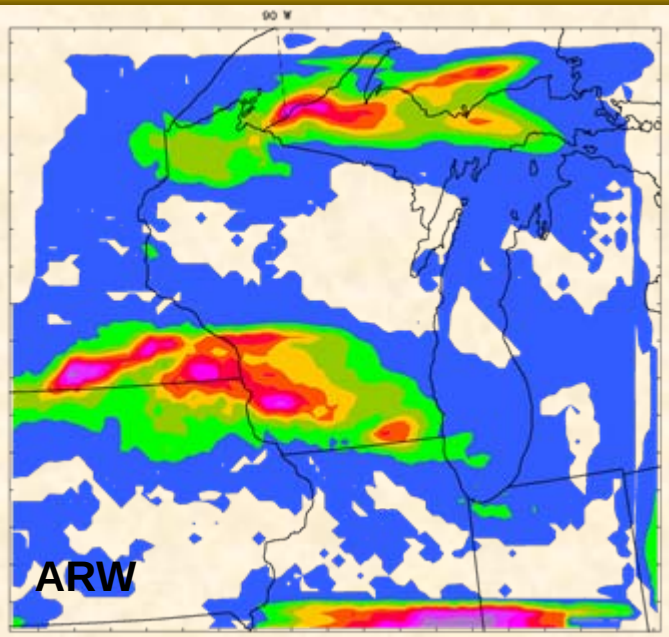


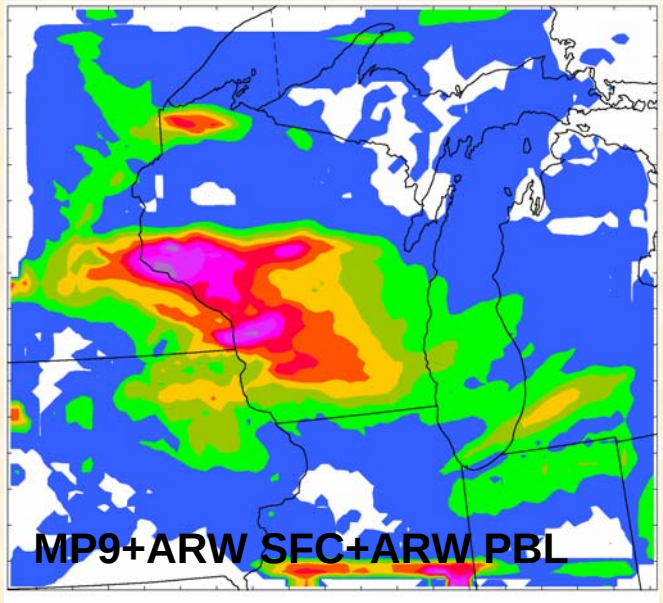


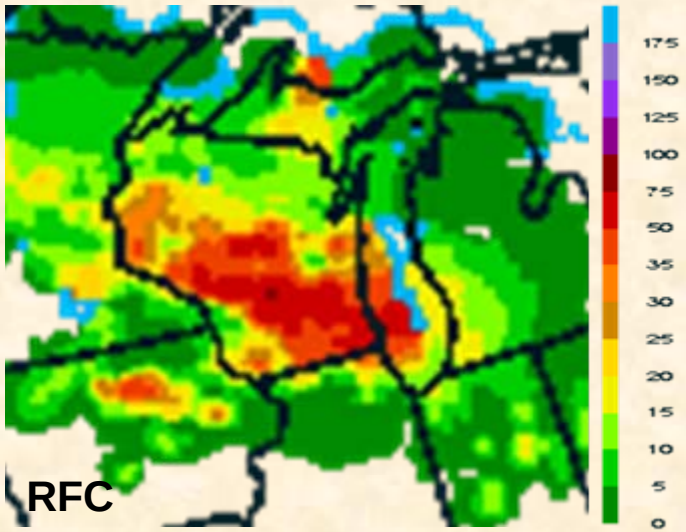


ARW Core June 2001 Case

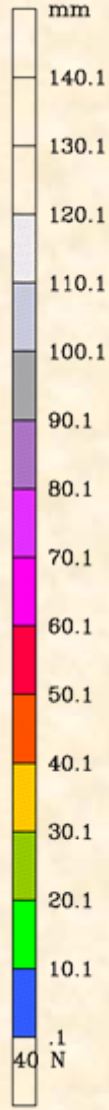
24H ACCUMULATED TOTAL PRECIPITATION







24-h total precipitation.



Summary

ACCOMPLISHMENTS

- COAMPS® can read/write WRF model input/output.
- WRF can read/write COAMPS model input/output.
- COAMPS physics suite is in WRF.
- ARW and NMM physics suites are in COAMPS.
- Plug-and-play physics provide opportunities to compare different physics suites and individual parameterizations.
- WRF plug-and-play physics results in ~35% computational overhead in COAMPS core.

FUTURE PLANS

- Complete physics integration and testing
- Improve efficiency