

2. Overview of WRF Program Status

WRF Executive Oversight Board

Meeting 3

13 April 2005

WRF Three-Phase Program

- Phase 1 Status -



Phase 1 Strategy and Goals

Strategy: “Develop and **implement** WRF as the next-generation mesoscale NWP modeling system, infrastructure and process.”

Goals:

1. *Establish* common modeling **(a) software and (b) organizational infrastructures** that facilitate inter-organizational collaboration for the development and transfer of new science into a common WRF mesoscale modeling system for research and operations.
2. *Release and support* WRF as the next-generation mesoscale NWP modeling system supported to the **research community**.
3. *Implement* WRF model and infrastructure as the next-generation mesoscale NWP system used **in operations**.
4. *Create* a **sustainable repeatable process** that facilitates inter-organizational collaboration to develop and transfer new science into the common mesoscale NWP modeling infrastructure.
5. *Develop* a plan for **Phases 2 and 3**.

Quick Overview of Phase 1 Status: April '05

| Goal | Threshold Activities: (Boxes indicate no.of metrics) | | | | | | Objective Activities: (Boxes indicate no. metrics) | | | |
|------|---|------|------|------|------|------|---|------|-----|--|
| 1a | Done | FY05 | FY06 | FY06 | TBD | | | | | |
| 1b | Done | Done | FY05 | TBD | Done | Done | TBD | TBD | | |
| 2 | Done | | Done | | FY05 | | FY05 | FY05 | TBD | |
| 3 | Done | Done | Done | FY05 | TBD | | TBD | | | |
| 4 | Done | Done | Done | Done | FY05 | FY05 | TBD | | | |
| 5 | Done | FY05 | FY05 | FY05 | FY05 | TBD | TBD | | | |

Color key for capability metrics:

15 Goals achieved

14 Goals on track

10 Delayed, pending or need revision

0 Critical at-risk areas

Status of Desired Outcomes – Phase 1, Goal 1a

“A common WRF modeling infrastructure established that provides interoperability to the WRF system at level of...”

- “Software Infrastructure, allowing...
 - Input/output-field exchange *(Threshold, T)*
 - Physics exchange *(Threshold, T)*
 - Dynamic-core exchange *(Objective, O)*
- ...among WRF users.”

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|---|----------------|------------------|
| - 2 WRF cores established at NCAR, FSL, NCEP, AFWA & Univs (T) | Done | Sept '03 |
| - 2 WRF cores <i>released</i> for community as single Reference code, with physics interoperability * (T) | On Track | May '05 |
| - <i>I/O interoperability</i> between COAMPS and WRF Reference code (T) | On Track | FY06 |
| - <i>Physics interoperability</i> between COAMPS and WRF (T) | On Track | FY06 |
| - <i>Core interoperability</i> : 3 WRF cores released to community as single Reference code (O) | Under Revision | TBD |

Status of Desired Outcomes – Phase 1, Goal 1b

“A common WRF modeling infrastructure established that provides interoperability to the WRF system at level of...”

- “Organizational Infrastructure that...
 - Defines institutional roles of DTC and OTCs (*Threshold*)
 - Establishes common DTC (*Objective*)
 - Establish OTCs (NCEP + shared DoD).” (*Objective*)

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|---|---------------|------------------|
| - DoD OTC proposal submitted and approved (T) | Done | Apr '03 |
| - DTC (Boulder) proposal approved (T) | Done | Mar '04 |
| - DTC functional (O) | Done | Mar '04 |
| - Distributed-DTC TOR written and signed (T) | ExOB Approval | Jul '05 |
| - Distributed DTC functional (O) | Pending | TBD |
| - OTC functional at DoD (AFWA/FNMOC) (O) | | |
| - AFWA | Done | Jul '04 |
| - FNMOC | Done | Sep '04 |
| - NCEP OTC proposal written and approved (T) | Written | TBD |
| - OTC functional at NCEP (O) | Pending | TBD |

Status of Desired Outcomes – Phase 1, Goal 2

“WRF modeling system **released and supported to the research community** at a level that defines and supports...”

- “Reference code for **one core** to the research community (*Threshold*)
- Reference code for **three cores** to the research community.” (*Objective*)

| <u>Capability Metrics</u> | <u>Status</u> | <u>Susp.Date</u> |
|---|----------------|------------------|
| - Eulerian mass core (WRFv1.0) in code repository (Reference code) and supported to community (tutorial) (T) | Done | Jun '03 |
| - WRF-ARWv2.0 Advanced Research WRF Reference code with two-way grid nesting supported to community (T) | Done | May '04 |
| - One core supported with grid nudging (T) | On track | Sept '05 |
| - WRFv2.0 Reference code with two cores supported to community (O) (with documentation + tutorial) | On track | Aug '05 |
| - WRF with grid nesting for two cores supported to community (O) | On track | Sep '05 |
| - WRF with three cores supported to community (O) (documentation + tutorial) | Under Revision | TBD |

Status of Desired Outcomes – Phase 1, Goal 3

“WRF model and infrastructure **implemented** as the next-generation mesoscale NWP system used **in operations ...**”

- “... At 2 operational NWP centers *(Threshold)*
- At all three operational NWP centers.” *(Objective)*

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|---|-----------------------|------------------|
| - <i>End-to-end real time WRF experimental systems running daily at NCEP and AFWA (T)</i> | <i>Done</i> | <i>Oct '03</i> |
| - <i>DTC retrospective testing of WRF completed and statistics available (as per WRF Test Plan) (T)</i> | <i>Done</i> | <i>Jun '04</i> |
| - <i>WRF (two cores) implemented operationally at NCEP in Hi-Res Window domains (T)</i> | <i>Done</i> | <i>Sep '04</i> |
| - <i>WRF (one core) implemented operationally at AFWA in classified domains (T)</i> | <i>On Track</i> | <i>July '05</i> |
| - <i>WRF-based COAMPS experimental system running daily at FNMOC (O)</i> | <i>Under Revision</i> | <i>TBD</i> |
| - <i>WRF-COAMPS implemented operationally at FNMOC (O)</i> | <i>Under Revis'n</i> | <i>TBD</i> |

Status of Desired Outcomes – Phase 1, Goal 4

“**Sustainable repeatable process created** that facilitates inter-organizational collaboration to develop and transition new science into the common mesoscale NWP modeling infrastructure, including...”

- “WRF organization and roles defined *(Threshold)*
- WRF annual operating plan developed *(Threshold)*
- WRF 5-Year plan developed *(Threshold)*
- WRF resource plan defined.” *(Objective)*

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|--|-----------------|------------------|
| - <i>DTC and NCEP-OTC organization and roles proposed (T)</i> | <i>Done</i> | <i>Dec '03</i> |
| - <i>WRF program Management Plan approved by ExOB (T)</i> | <i>Done</i> | <i>Dec '03</i> |
| - <i>WRF Management charters (roles) & appointments approved (T)</i> | <i>Done</i> | <i>Aug '04</i> |
| - <i>DTC FY05 annual operating plan developed & approved (T)</i> | <i>Done</i> | <i>Feb '05</i> |
| - <i>Preliminary WRF 5-Year Plan developed and submitted (T)</i> | <i>On Track</i> | <i>Jun '05</i> |
| - <i>Comprehensive WRF 5-Year Plan developed and submitted (T)</i> | <i>On Track</i> | <i>Nov '05</i> |
| - <i>WRF interagency resource plan defined (O)</i> | <i>Pending</i> | <i>TBD</i> |

Status of Desired Outcomes – Phase 1, Goal 5

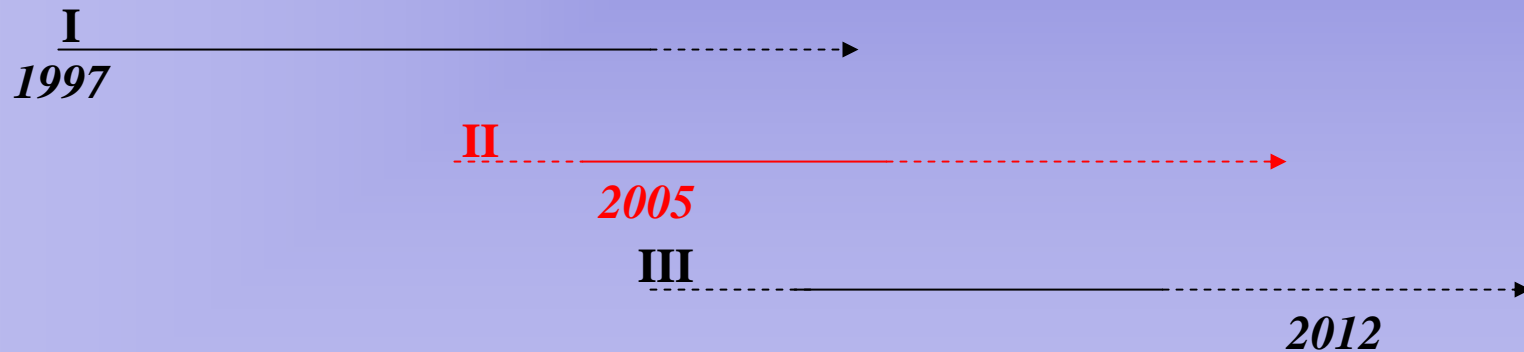
“Plan for Phases 2 and 3 developed, including...

- **Significant deficiencies identified** and prioritized in Phase 1 WRF modeling system, common modeling infrastructure (CMI) and process (threshold)
- Strategy, roadmap and resource plans developed for each (threshold)
- At least one cycle of improvement executed to demonstrate repeatability
 - for one of three areas (**CMI**) (threshold)
 - for all three areas (objective)
- Funding strategy identified to entrain university community
 - strategy developed (threshold)
 - strategy implemented (objective)

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|--|---------------|------------------|
| - Critical deficiency identified in WRF infrastructure (T) | Done | Jul '03 |
| - Strategy, roadmap and resource plan developed for infrastructure documentation, training and code streamlining (T) | Done | Sep '03 |
| - Infrastructure training held for WRF signatories (T) | Done | Jan '04 |
| - Infrastructure documentation draft complete (T) | Done | Dec '04 |
| - Infrastructure documentation finished & released (T) | Done | Jan '05 |
| - Infrastructure streamlining strategy developed (T) | On track | Oct '05 |
| - Infrastructure streamlining completed (T) | Pending | TBD |
| - Infrastructure “understudy” position fully functional (T) | On track | May '05 |
| - Funding strategy developed to entrain universities (T) | Done | Jul '04 |

WRF Three-Phase Program

- Phase 2 Status -



Phase 2: Strategy

“Use the WRF process and infrastructure to **infuse and sustain** the flow of new science and technology into the WRF mesoscale NWP modeling system to improve operations and to open new research opportunities:”

- *Identify* significant deficiencies in Phase 1 WRF:
 - modeling system
 - **common modeling infrastructure**
 - process
- *Develop* strategy, roadmap and resource plan for each
- *Execute* at least one cycle of improvement in all three areas to demonstrate repeatability

Phase 2: Critical Deficiency Identified

- “The **WRF Software Infrastructure** is complex, difficult for new users to understand, lacks in-depth documentation, and is fully known to only one person (single point of failure)”

ExOB Mtg., 1 Dec 2003

- “The **WRF Software Infrastructure** is inadequately supported for the user community.”

EMC, March 2005

Goals for Alleviating WRF Infrastructure Deficiency

1 Dec 2003

1. **Modify existing WRF Software Infrastructure** to enhance its functionality, usability and extensibility in sync with an ESMF end state
2. **Provide second full-depth expert** for WRF infrastructure support to alleviate “single point of failure”
3. **Publish developer-level documentation** that enables experienced programmers to implement & extend WRF codes for research and operations.
4. **Upgrade user support services** through WRF infrastructure problem-logging and “help-desk”
5. **Establish infrastructure training** for new and advanced users

Quick Overview of Phase 2

Infrastructure Deficiency Status: April '05

| Goal | Threshold Activities: (Boxes indicate no.of metrics) | | | Objective Activities: (Boxes indicate no. metrics) | |
|------|---|-----|------|---|-----|
| 1 | TBD | TBD | TBD | TBD | TBD |
| 2 | Done | | FY05 | TBD | TBD |
| 3 | Done | | | TBD | |
| 4 | Done | | | Done | |
| 5 | Done | | | TBD | |

*Color key for
capability
metrics:*

4 Goals achieved

1 Goals on track

9 Delayed, pending or need revision

0 Critical at-risk areas

Status of Desired Outcomes for Phase 2: Alleviating Infrastructure Deficiency – Goal 1

- “WRF **Software Infrastructure is modified** to provide different levels of complexity necessary to satisfy different functions, such that...
 - Current infrastructure is **optimized for run-time efficiency** (*Threshold*) for two cores, maintaining flexibility for research users
 - Infrastructure is **streamlined/rewritten** to enhance usability (*Threshold*) for advanced users, with efficiency & threshold functionality
 - Infrastructure is **extended** to establish compatibility with (*Objective*) ESMF standards and linkage to global capability”

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|--|----------------|------------------|
| <i>- Two WRF cores in current infrastructure optimized for run time efficiency (T)</i> | <i>On hold</i> | <i>TBD</i> |
| <i>- Plan developed to rewrite a streamlined WRF infrastructure that maintains efficiency & threshold functionality (T)</i> | <i>Pending</i> | <i>Sep '05</i> |
| <i>- Efficient, more understandable, streamlined infrastructure completed (T)</i> | <i>Pending</i> | <i>TBD</i> |
| <i>- Plan developed to extend WRF infrastructure to establish compatibility with ESMF standards and linkage to global capability (O)</i> | <i>Pending</i> | <i>TBD</i> |
| <i>- WRF infrastructure extended to be ESMF compliant and supporting global capability (O)</i> | <i>Pending</i> | <i>TBD</i> |

Status of Desired Outcomes for Phase 2: Alleviating Infrastructure Deficiency – Goal 2

“**Second full-depth expert provided** for WRF infrastructure support to alleviate single point of failure by...

- Hiring infrastructure understudy at DTC *(Threshold)*
- Having infrastructure understudy fully trained and able to provide range of user support *(Threshold)*
- Having infrastructure understudy train others at OPCs and partner research labs to establish local full-depth infrastructure expertise” *(Objective)*

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|--|-----------------|------------------|
| <i>- Infrastructure understudy hired and on site at NCAR/MMM (T)</i> | <i>Done</i> | <i>Sep. '04</i> |
| <i>- Infrastructure understudy fully trained and able to provide range of user support (T)</i> | <i>On track</i> | <i>May '05</i> |
| <i>- Full-depth infrastructure expertise established at two OPCs and two partner research labs (O)</i> | <i>Pending</i> | <i>TBD</i> |
| <i>- Full-depth infrastructure expertise established at three OPCs and all signatory research labs (O)</i> | <i>Pending</i> | <i>TBD</i> |

Status of Desired Outcomes for Phase 2: Alleviating Infrastructure Deficiency – Goal 3

“**Developer-level documentation published** that enables experienced programmers to implement & extend WRF codes for research and operations, by...

- Completing draft version of WRF Infrastructure developer-level documentation *(Threshold)*
- Completing final version of WRF infrastructure developer-level documentation reviewed and published” *(Objective)*

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|--|---------------|------------------|
| <i>- Draft version of WRF infrastructure developer-level documentation completed (T)</i> | <i>Done</i> | <i>Sep. '04</i> |
| <i>- Final version of WRF infrastructure developer-level documentation completed, reviewed and published (O)</i> | <i>Done</i> | <i>Dec. '04</i> |

Status of Desired Outcomes for Phase 2: Alleviating Infrastructure Deficiency – Goal 4

“WRF **problem-logging and ‘help-desk’** support services upgraded for users,
by...

- Establishing routine call-in support for users of the WRF infrastructure via “understudy” *(Threshold)*
- Establishing enhanced on-line web site for logging user problems & coordinating assistance on infrastructure issues” *(Objective)*

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|---|---------------|------------------|
| <i>- Routine call-in support established for users of the WRF infrastructure (T)</i> | <i>Done</i> | <i>Sep '04</i> |
| <i>- On-line web site enhanced for logging user problems and coordinating assistance on infrastructure issues (O)</i> | <i>Done</i> | <i>Jan '05</i> |

Status of Desired Outcomes for Phase 2: Alleviating Infrastructure Deficiency – Goal 5

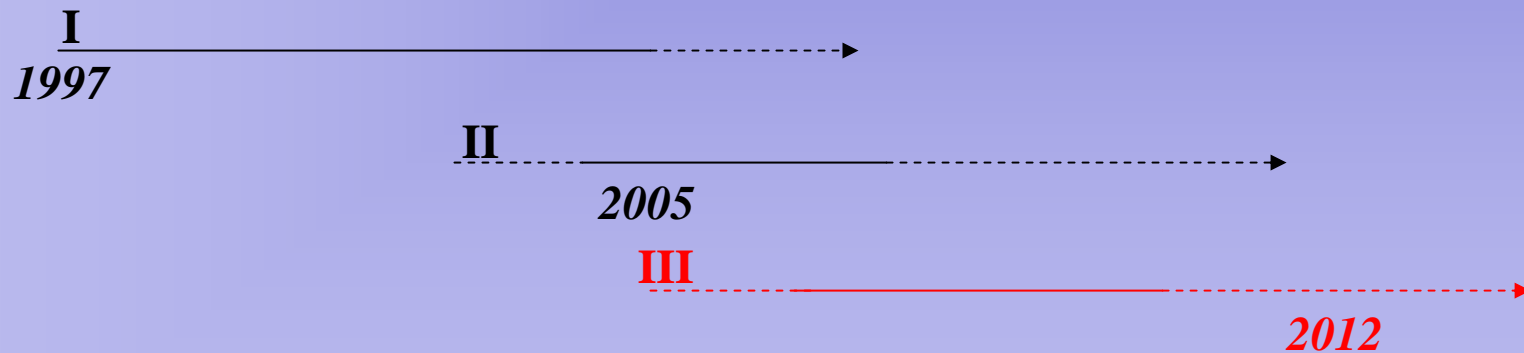
“**Infrastructure training established** for new and advanced WRF users,
by...

- Completing a special WRF infrastructure training workshop for at least one group of users *(Threshold)*
- Establishing routinely scheduled tutorial classes for training in the WRF infrastructure” *(Objective)*

| <i>Capability Metrics</i> | <i>Status</i> | <i>Susp.Date</i> |
|--|----------------|------------------|
| <i>- Special training workshop on the WRF infrastructure completed for one group of users (T)</i> | <i>Done</i> | <i>Jan '04</i> |
| <i>- Routinely scheduled tutorial classes established for training in the WRF infrastructure (O)</i> | <i>Pending</i> | <i>TBD</i> |

WRF Three-Phase Program

- Phase 3 Status -



Phase 3 Strategy and Goals

Strategy: **“Extend WRF collaboration into other modeling areas of mutual interest—e.g., Ocean modeling, Global modeling, Climate modeling, Diagnostic and Statistical post-processing”**

Goals:

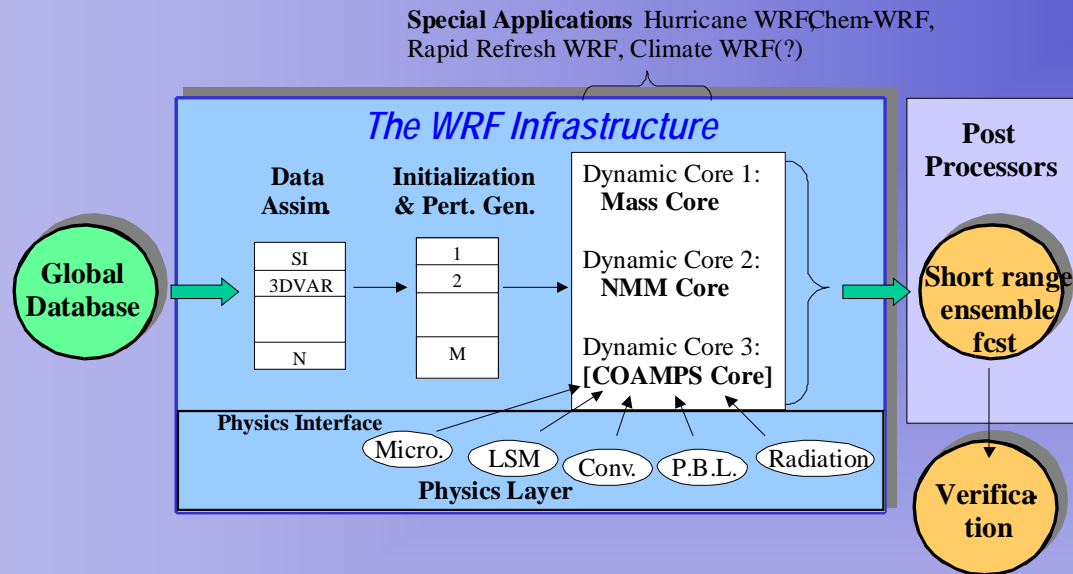
- 1. Identify additional areas of desired collaboration
e.g. - Unified Global-Regional WRF system (proposed by COPC)**
- 2. Develop strategy, roadmap and resource plan for each**

Initiation of Phase 3 requires development of Vision statement, Focused goals, Executive-level roadmap and Resource plan, as per Phase 1, Goal 5.

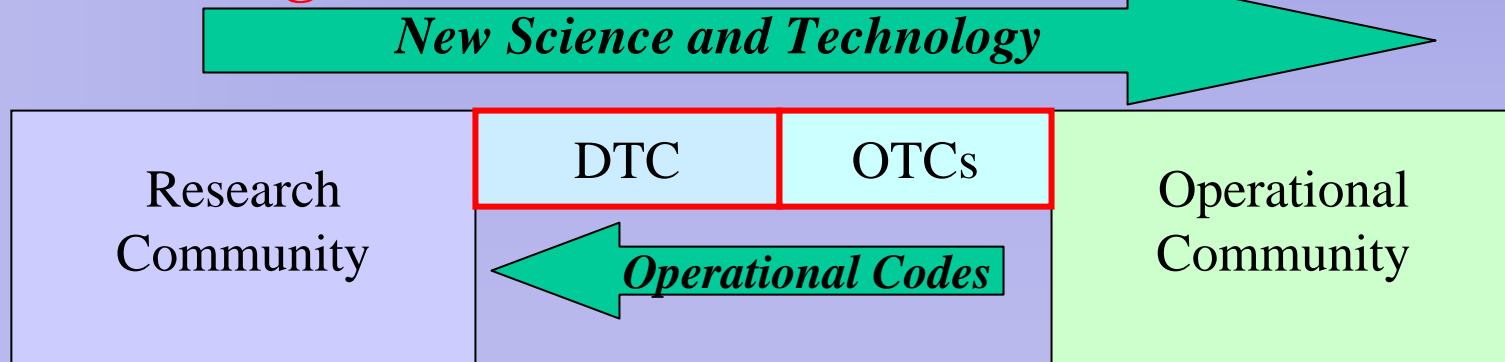
Backup Slides

The WRF Modeling Infrastructure is two-fold

1a. WRF Software Infrastructure :



1b. Organizational Infrastructure:



Phase 2:

Identification of Significant WRF Deficiencies

- a. *Modeling System:* “Original WRF **Standard Initialization** was constructed rapidly from available components to meet immediate needs, but suffers from incoherent design and insufficient reliability and maintainability.” *WRF PC and WG2, July 2004*
- b. *Process:* “Most of the various **WRF distributed DTC and OTC units** are fragmented in concept, lack an integrated plan for bridging the ‘Valley of Death’ and are under-resourced for efficient transition of new science and technologies to operations and for support of research and operational software to the broader research community.” *WRF PC, DTC Dir. and EMC Director, March 2005*