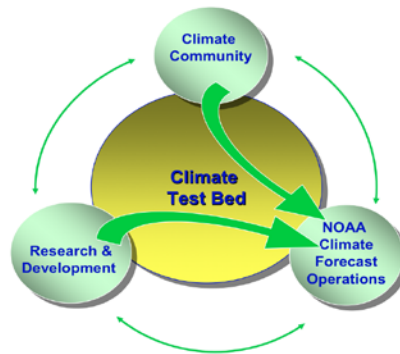# NOAA Climate Test Bed (CTB)

## a mechanism to support NCEP-CICS collaborations

### Jin Huang, CTB Director



Mission: To accelerate the transition of scientific advances from the climate research community to improved NOAA climate forecast products and services.

http://www.cpc.ncep.noaa.gov/products/ctb/

# What's CTB?  How does CTB operate?   What's new?

**Outline:**

- CTB mission, scope, priorities, structure
- Ongoing projects
- Proposal writing  and review processes
- Post-project review

# NCEP Test Beds

Service – Science Linkage with the Outside Community:
**Accelerating the R2O Transition Process**

- **EMC**   WRF Developmental Test Center (DTC)

  Joint Center for Satellite Data Assimilation

- **CPC**   **Climate Test Bed**

- NHC   Joint Hurricane Test Bed

- HPC   Hydrometeorological Test Bed

- SPC   Hazardous Weather Test Bed with NSSL

- SWPC   Space Weather Prediction Test Bed with AFWA

- AWC   Aviation Weather Test Bed

- OPC   IOOS Supported Test Bed (in discussion

      with NOS/IOOS)
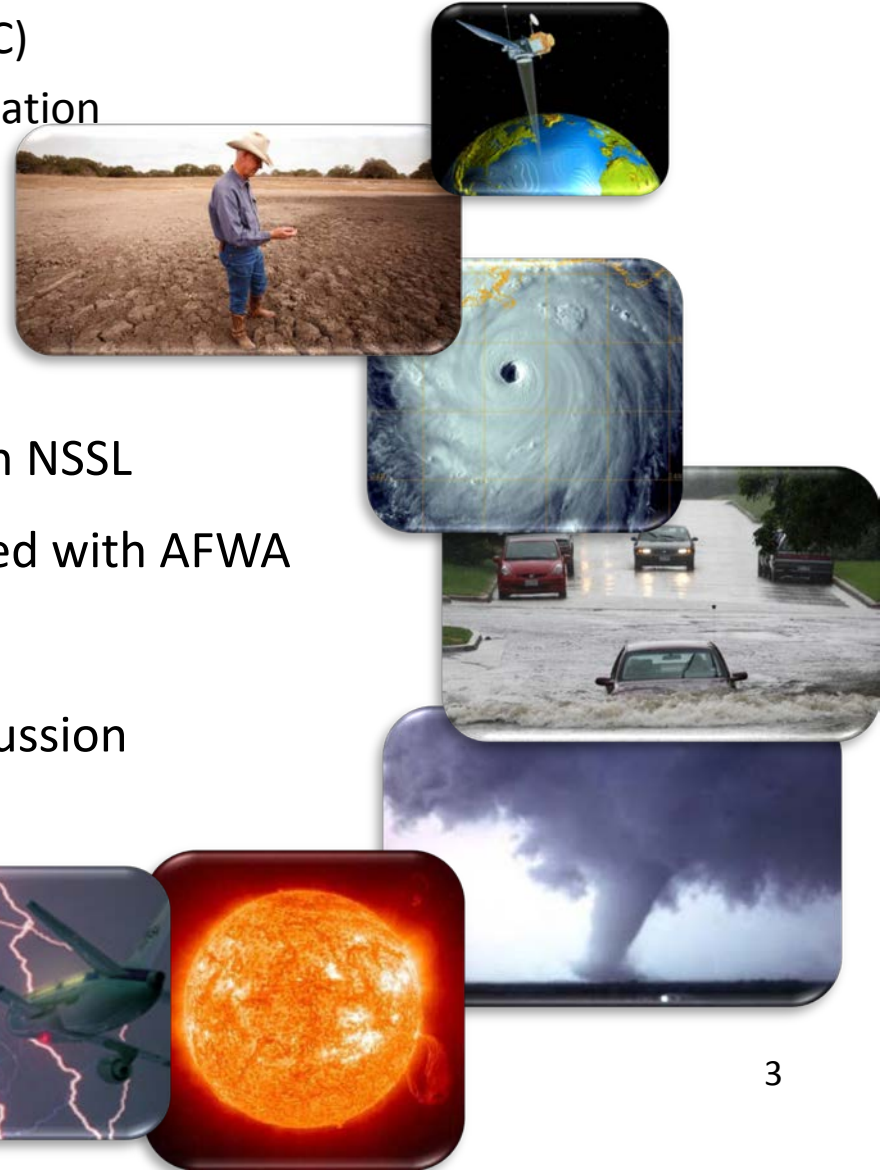
**Organization structure, scope and funding sources are different for different Test beds**

# NOAA Climate Test Bed (CTB)
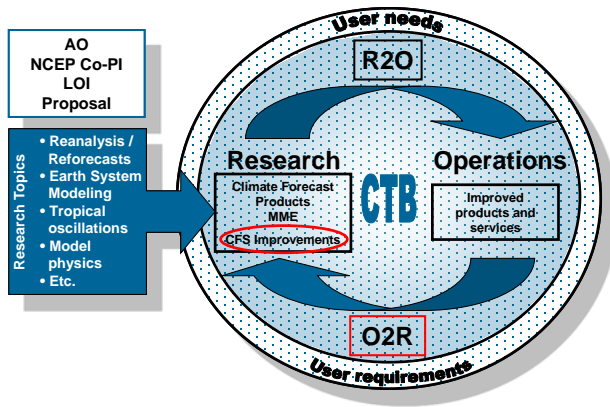
- **Joint NCEP and CPO Effort**
  - Human resources provided by NCEP
  - Grants projects sponsored by CPO MAPP program

- **CTB Science Advisor Board (SAB)**

- **Established in 2005**

**Currently MAPP-CTB calls for proposals every 2 years.**

**CTB Mission:** Advancing NOAA operational climate <u>monitoring</u>, <u>modeling</u>, and <u>prediction</u> capabilities

- Accelerate research-to-operation (**R2O**) transition to improve NCEP operational climate prediction

- Provide operation-to-research (**O2R**) support to the climate research community with access to operational models, forecast tools and datasets

**CTB priorities:**
1) *CFS improvements*
2) *Multi-model ensembles*
3) *Climate forecast products*
4) *Climate Reanalysis (new)*

# A Mission-Driven Process
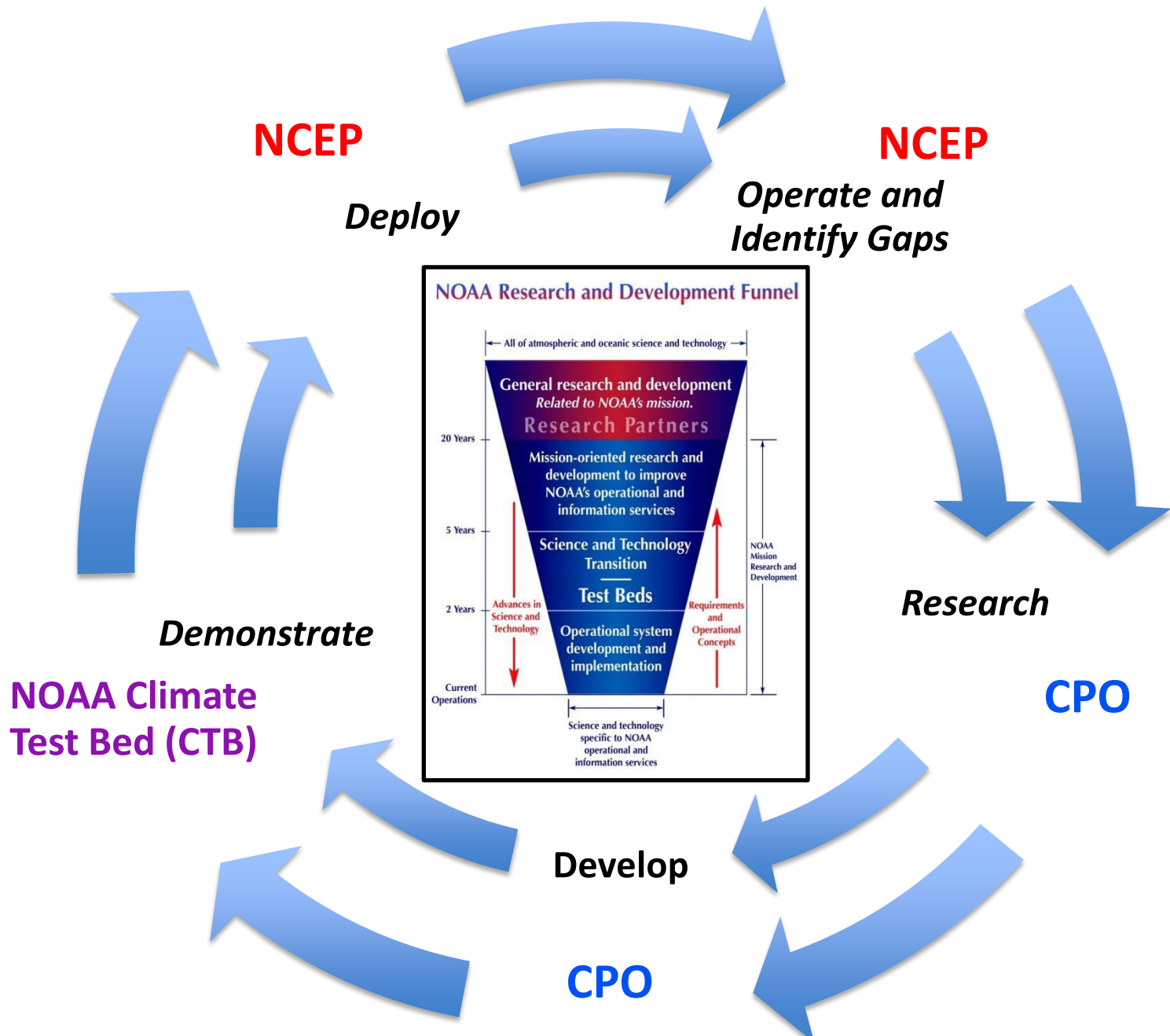
# MAPP-CTB Currently Funded Projects

**Modeling:**

1. A CPT to improve cloud and boundary layer process in GFS/CFS (**Bretherton**)
2. A CPT for improving turbulence and cloud processes in the NCEP global models (**Krueger**)
3. Improving the NCEP Climate Forecast System (CFS) through Enhancing the Representation of Soil-Hydrology-Vegetation Interactions (**Chen**)
4. Advances in Lake-Effect Process Prediction within NOAA's Climate Forecast System for North America (**Jin**)
5. Improving Cloud Microphysics and Their Interactions with Aerosols in the NCEP Global Models (**Lu**)

**Prediction:**

1. North American Multi-Model ensemble (NMME) Phase II (**Kirtman**)
2. Improved probabilistic forecast products for the NMME seasonal forecast system (**Barnston**)
3. Subseasonal NMME Forecasts:  Skill, Predictability, and Multi-model combinations (**DelSole**).
4. Assessment of CFS predictions of U.S. severe weather activity (**Tippett**)
5. Bridging the gap in NOAA's extended and long range prediction systems through the development of new forecast products for weeks 3 and 4. (**Johnson**)

# CTB Priority (1): Multi-Model Ensembles

**NMME (North American Multi-Model Ensemble)**

An unprecedented MME system to improve intra-seasonal to interannual (ISI) operational predictions based on the leading US and Canada climate models.

**NMME was funded as a CTB project in FY11 and FY12-13 and extended to FY14 by NOAA/CPO/MAPP and other US agencies.**

**What was tested:** A multi-model prediction system based on major climate models in U.S. and Canada for NCEP operational seasonal forecasts

**How it was tested:** Tests based on 30-year hindcasts and real- time forecasts since August 2011

**What was demonstrated:** Improved forecast reliability, forecast skill (anomaly correlation, rank probability score)

**Impact:** (1) Improved numerical guidance for NCEP/CPC operational seasonal forecasts; (2) the most comprehensive seasonal prediction dataset available to the public for research and applications

## Current NMME Forecast Providers

| Organizations | Models |
|---|---|
| NOAA/NCEP | CFSv2 |
| NOAA/GFD | CM2.1 |
|  | FLOR |
| NASA/GMAO | GEOS5 |
| Environment Canada | CMC1-CanCM3 |
|  | CMC2-CanCM4 |
| NCAR | CCSM3.0 |
|  | CCSM4.0 |
| NCAR | CESM1.0 |

**Next Steps:**
- Sustain the NMME seasonal forecast system
- Explore the potential for NMME sub-seasonal forecast for weeks 3-4

# CTB Priority (2): CFS Evaluation and Improvements

To accelerate evaluation of and improvements to the operational Climate Forecast System (CFS) and to enhance its use as a skillful tool in providing NCEP's climate predictions and applications

## (1) Support R2O testing/demonstration grants projects

- Test and evaluate new parameterizations, schemes, model components in NCEP operational models

- **5 ongoing modeling projects**
  **Cloud-CPT 1** PI: Krueger, EMC Co-PI: Moorthi
  **Cloud-CPT 2** PI: Bretherton, EMC Co-PIs: Jongil Han and Rui-Yu Sun
  **Lake Module** PI: Jin J, EMC Co-PIs: Ek and Wu
  **Land Module** PI: Chen, EMC Co-PIs: Ek, Yang and Meng
  **Aerosol Module** PI: Lu, EMC Co-PI: Hou YT Co-I Moorthi

## (2) Engage the external community

- Led the publication of the **Special CFSv2 Collection in Climate Dynamics** (23 articles)

- Leading **MAPP Climate Model Development Task Force** with a focus on NCEP/CFSv3 planning/development in 2014-2016

# CTB Priority (3):
# Improving Prediction Tools and Products

**Goal:** To provide reliable climate forecast products that are responsive to the needs of users and incorporate state-of-the-art science and research

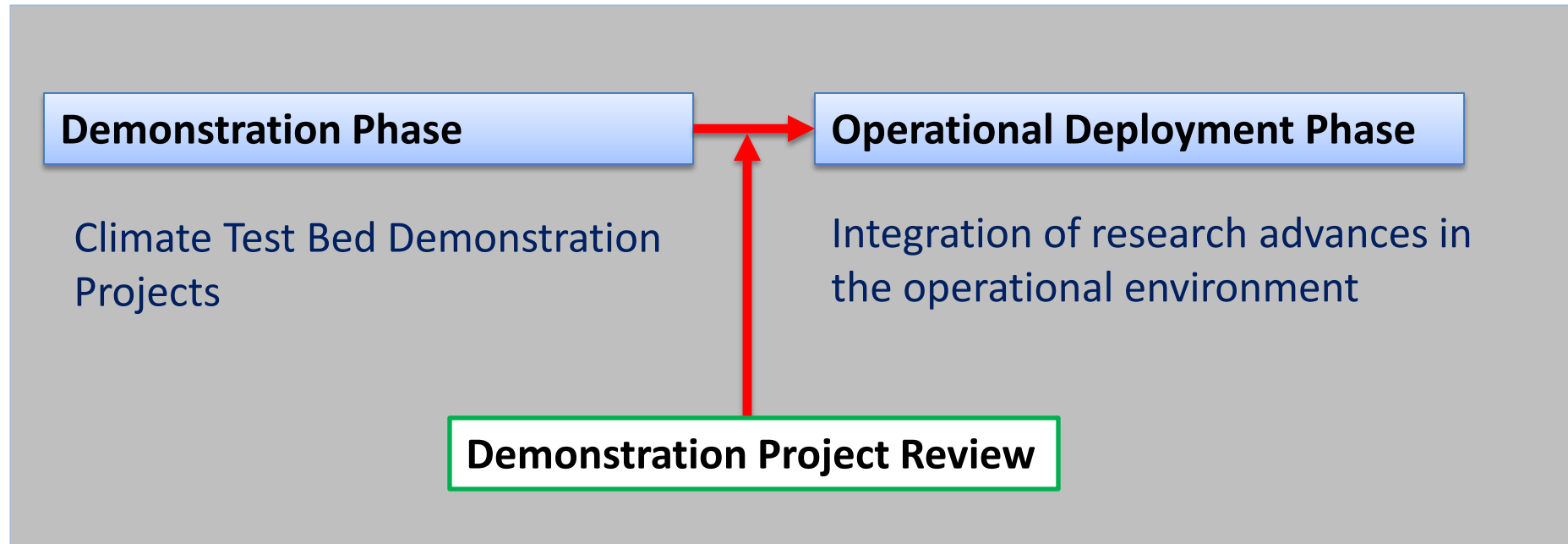## 4 ongoing Projects on Prediction Tools and Product Development

1. **Week-3 and Week-4 Forecast Tools** PI: Xie/Johnson, CPC Co-Pis: L'Heureux and Baxter
2. **Extended Range Severe Weather Forecast Tools** PI: Tippett, CPC Co-PI: Gottschalck, SPC Co-PI: Carbin
3. **NMME Prediction Post-processing Protocol** PI: Del Sole, CPC Co-PI: Kumar
4. **Probabilistic NMME Products** PI: Barnston, CPC Co-PIs: van Den Dool and Becke
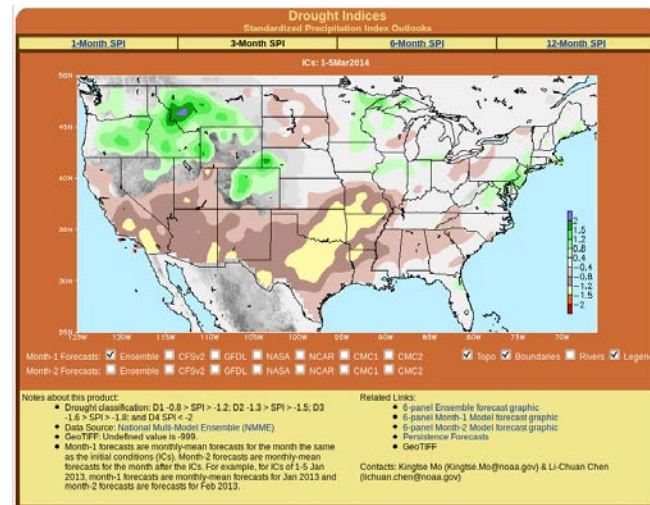


**NMME-based Seasonal Drought Outlook**

# Two Phases in CTB R2O Process

- A MAPP-CTB Execution Agreement (2012) defining basic process and roles
- Guiding Document: NOAA Administrative Order 216-105 Policy on Transition of Research and Development to Application

**Demonstration Phase**

Climate Test Bed Demonstration Projects

**Operational Deployment Phase**

Integration of research advances in the operational environment

**Demonstration Project Review**

# *Two Phases in CTB R2O Process* – Requirements

| Demonstration Phase | → | Operational Deployment Phase |
|---|---|---|

**Competitively Select Meritorious Climate Test Bed Demonstration Projects**

- Relevance to NCEP
- Involve an NCEP co-PI
- Clear testing objectives and operational outcomes
- High merit/right Technical Readiness Level (TRL)
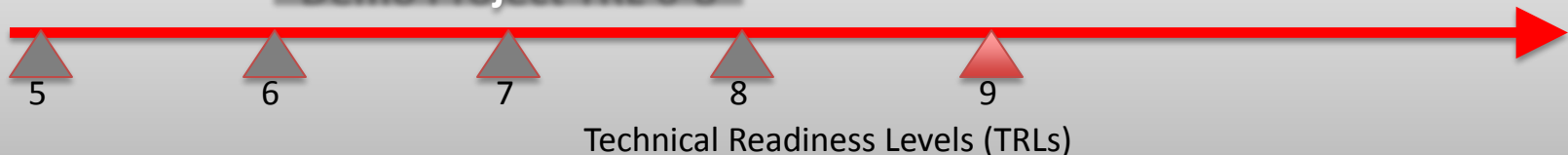- Clear metrics
- Feasibility and support from NCEP

**Operationally Deploy Successful New Methods and Models**

- Plan for deployment, both systems and resources
- Adapt experimental new methods and models to comply with the operational suite (e.g., code requirements)

## END-TO-END PLANNING

Demo Project TRL 5-7

Demo Project TRL 6-8

5        6        7        8        9

Technical Readiness Levels (TRLs)

# Specific Requirements for CTB Proposals

- CTB proposals need to include
  - NCEP Co-PIs or collaborators.
  - **A transition plan** for both demonstration phase and operational deployment phase

- NCEP will review the CTB proposals in particularly the transition plans before they are submitted to CPO for peer reviews

- NWS management needs to sign the transition plans.

# Template for MAPP-CTB Transition Plans

***Demonstration Phase:***

- *Metrics for measuring the success of the demonstration phase*

- *Tasks, timelines*

- *Targeted TRL*

***Deployment Phase:***

- *What is potentially being deployed operationally?  and where?*

- *Year of potential deployment*

- Tasks and timeline for deployment

- *Cost to NCEP for deployment (if any)*

- *HPC requirements for NCEP during deployment and operations*

# Technical Readiness Levels*

| Mission Function | TRL # | Technical Readiness Level Definition |
|---|---|---|
| Research | 1 | Basic principles observed and reported |
| | 2 | Technology concept and/or application formulated |
| Development | 3 | Analytical and experimental critical function and/or characteristic proof-of-concept |
| | 4 | Component/subsystem validation in laboratory environment |
| | 5 | System/subsystem/component validation in relevant environment |
| Demonstration | 6 | System/subsystem model or prototyping demonstration in a relevant end-to-end environment |
| | 7 | System prototyping demonstration in an operational environment |
| | 8 | Actual system completed and "mission qualified" through test and demonstration in an operational environment |
| Deployment | 9 | Actual system "mission proven" through successful mission operations |

*NAO 216-105