Transition from Research to Operations*: Lessons from NOAA's TAO Array

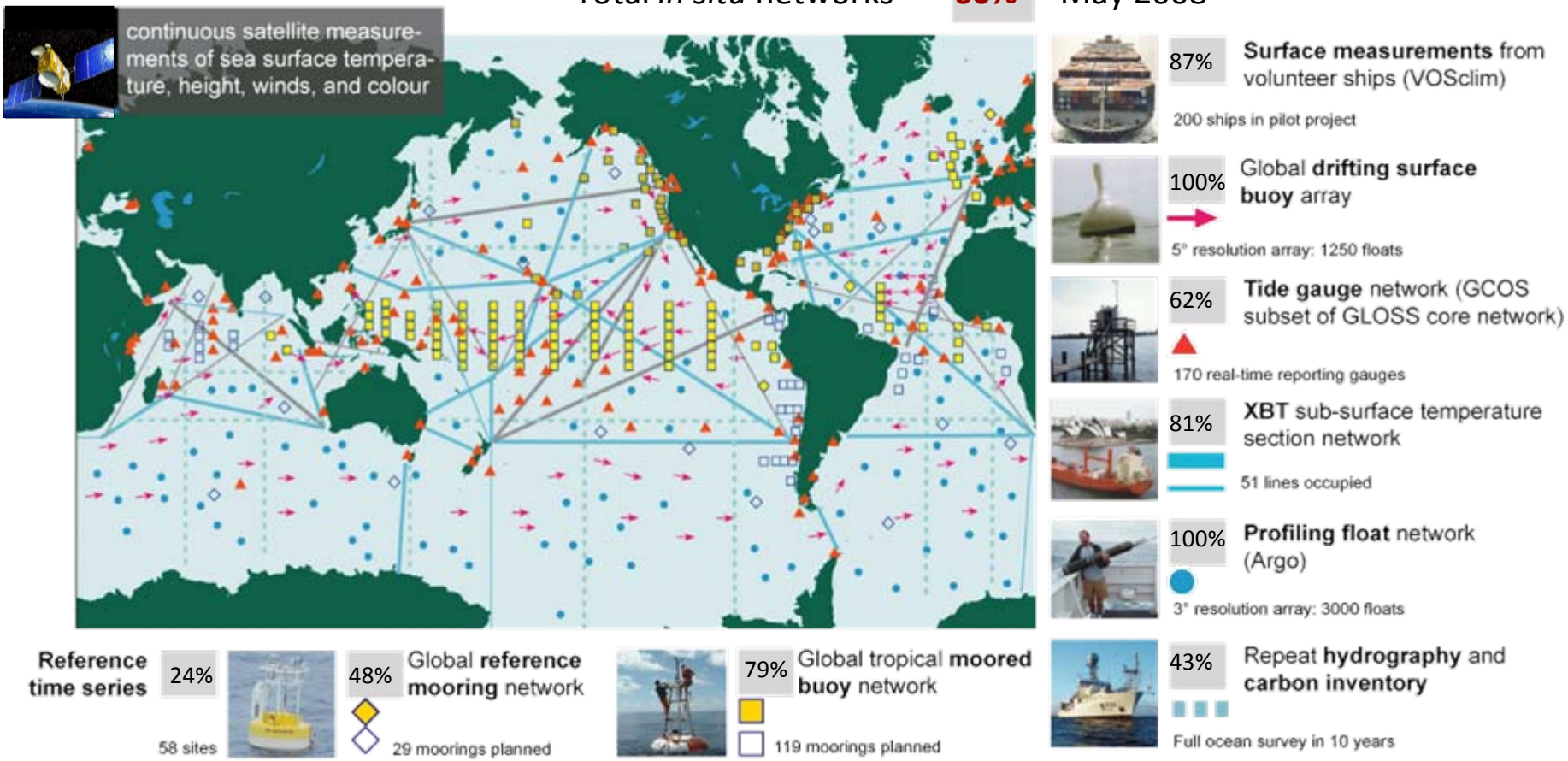
Thanks to Mike McPhaden, NOAA/PMEL

- ✓ *TAO*
- ✓ *Transition*
- ✓ *Lessons*

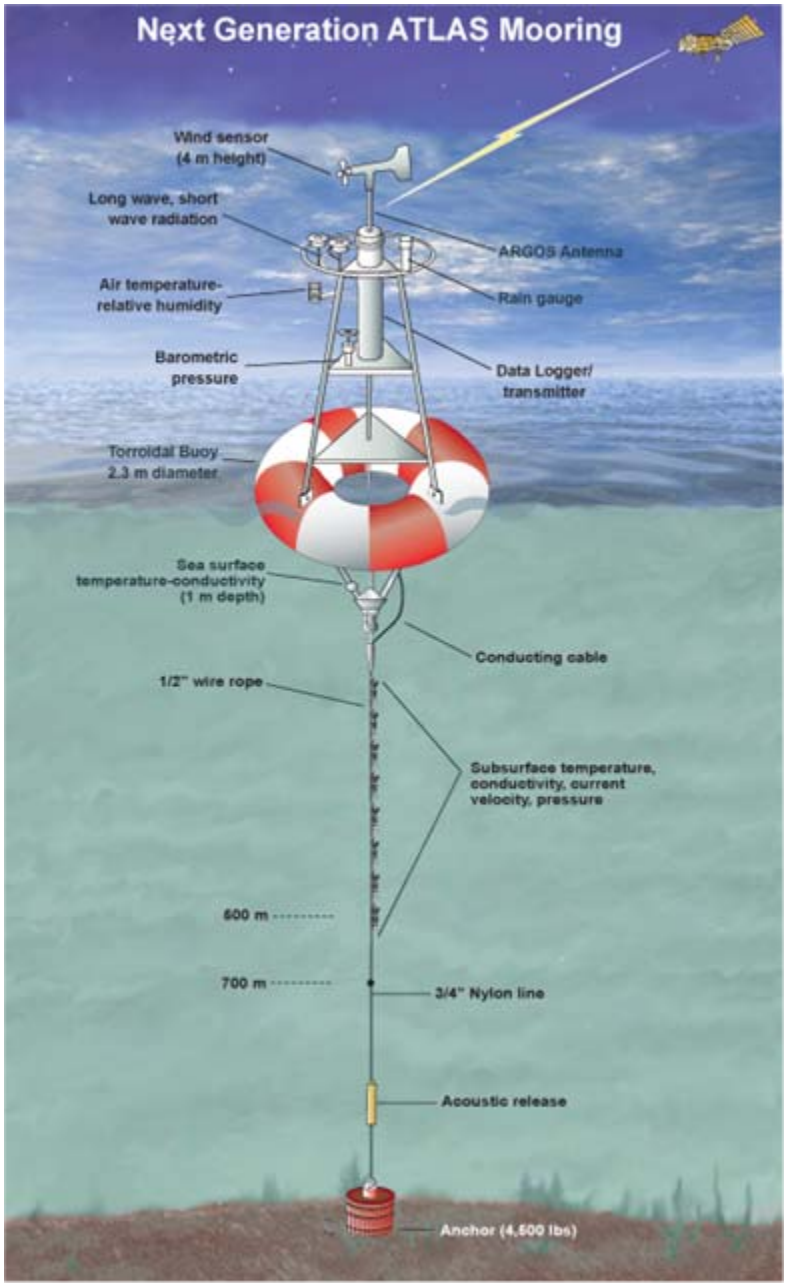
**Operations: Sustained, systematic, reliable, and robust mission activities with an institutional commitment to deliver specified products and services.*

Initial Global Ocean Observing System for Climate

Total *in situ* networks **60%** May 2008

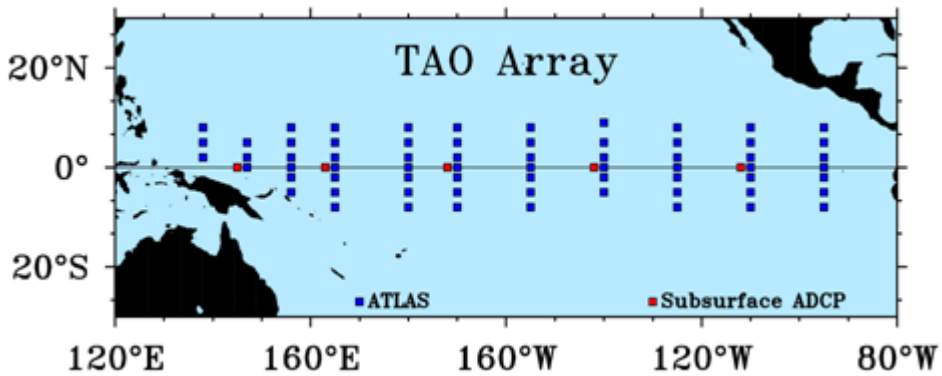


GOOS



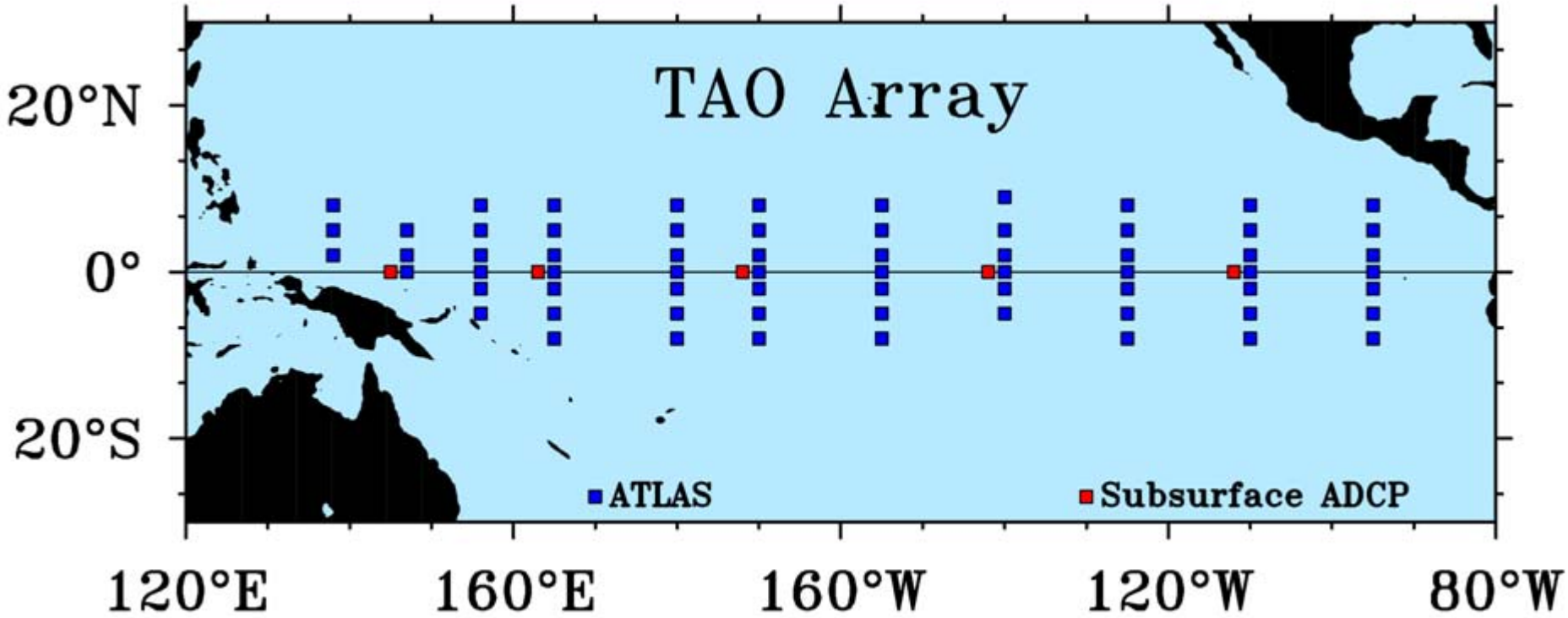
ATLAS Mooring

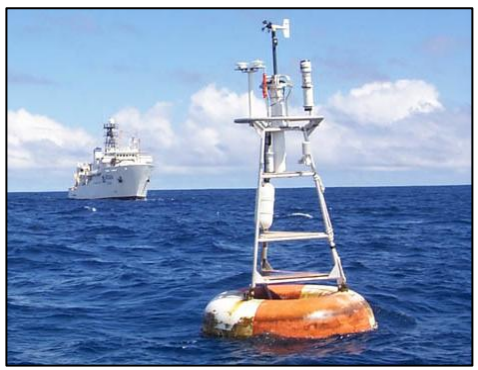
- ✓ **Ocean and atmosphere**
- ✓ **Rapid sampling in time**
- ✓ **Low cost**
- ✓ **Real-time data**



TAO array built up during the 10 yr Tropical Ocean Global Atmosphere (TOGA) program (1985-94)

Tropical Atmosphere Ocean (TAO) Array

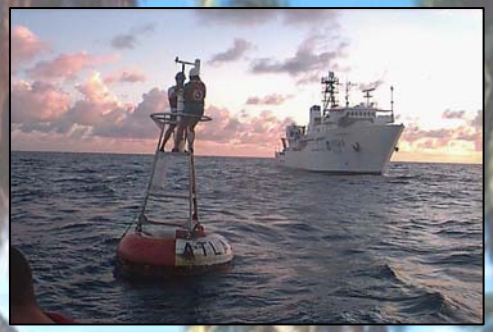


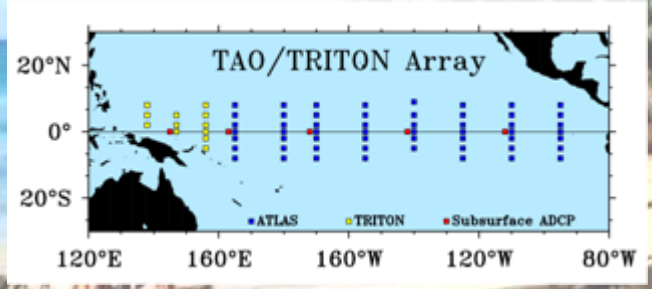


Program objective: Provide real-time data from the tropical Pacific for improved detection, understanding and prediction of El Niño and the Southern Oscillation

Milestones: 1994-2001

- Dec 1994: TAO completed; TOGA ends
- Aug 1996: NOAA Ship Ka'imimoana commissioned (dedicated to TAO)
- Nov 1997: US Congress provides $2.6M for TAO (permanent support)
- Jan 2000: TAO becomes TAO/ TRITON (JAMSTEC resources & commitment)
- Sept 2001: CLIVAR/GOOS review of TAO/TRITON:





TAO Transition (1)

- June 2002: VADM Lautenbacher, NOAA Administrator, orders transfer of TAO management to National Data Buoy Center (NDBC), which is part of the National Weather Service

- Rationale:
  - TAO effectively operational and so should be managed by operational branch of NOAA
  - NDBC responsible for NOAA operational coastal weather buoy program
  - Consolidating TAO with NDBC programs => cost efficiency, long term continuity of data, and institutional support for program stability

TAO Transition (2)

- Jan 2003-Aug 2004: TAO transition plan developed, with mandated requirements of:
  - Maintaining data quality & continuity
  - Making transition transparent to users
  - Duration of 3 yrs (2005-2007)
  - Minimal cost

Key issues:

1) Requirements were incompatible

2) Time line not realistic: PMEL homegrown ATLAS technology not suitable for transfer; no equivalent system with all Commercial Off The Shelf (COTS) components available

TAO Transition (3)

- 2005: NDBC assumes budget responsibility for TAO
- 2006: NDBC assume responsibility for TAO Data Center
- 2007: NDBC assumes responsibility for TAO field operations
- 2007-08 Initial tests of NDBC prototype ATLAS/COTS mooring system; PMEL continues to provide legacy ATLAS electronics

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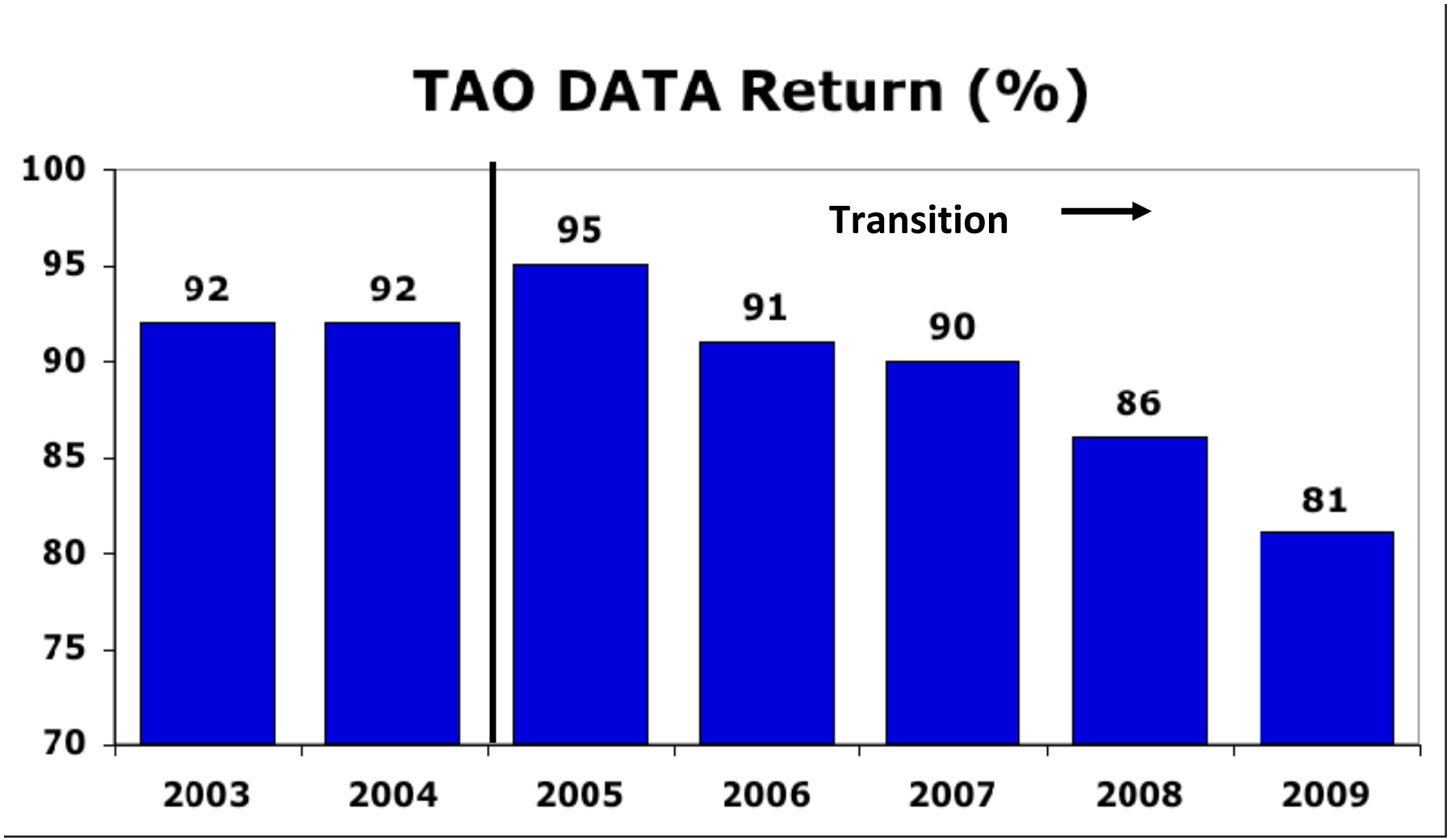
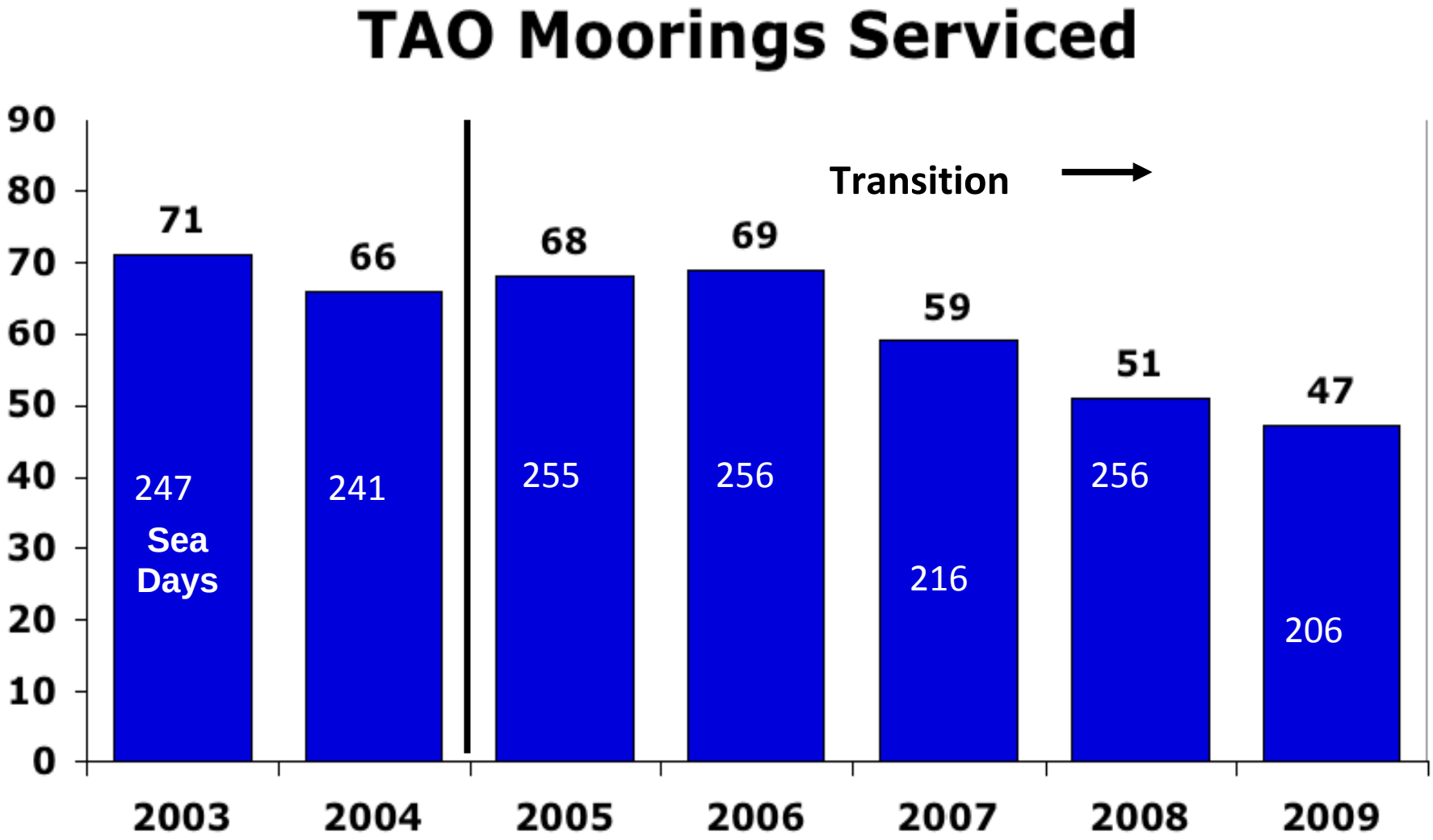
- 2009-- : NDBC tests of ATLAS/COTS prototypes continue Evaluation side by side with PMEL ATLAS for 1yr (principle of interchangeability for climate record) Revise design as necessary Iterate evaluation Capitalize ~90 ATLAS/COTS systems
- 2015: NWS estimate of when transition will be complete

Three year transition will take 11 years

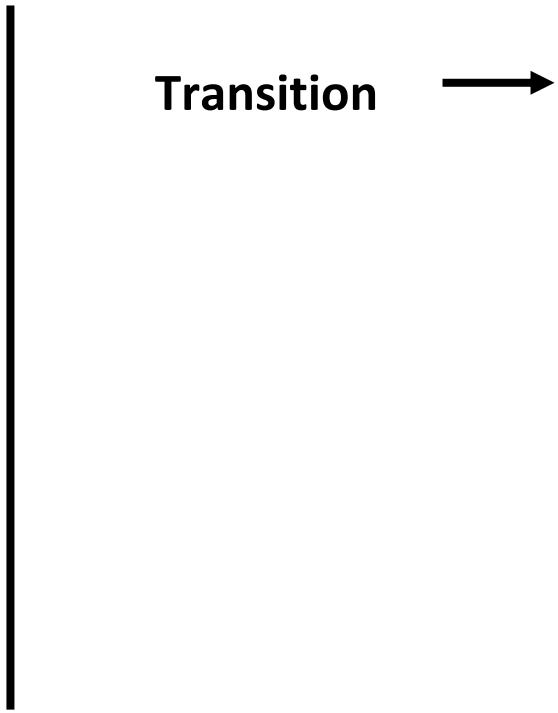
Has Transition Ensured Data Continuity?



Has Transition Led to a More Stable Program?



Has Transition Led to Cost Efficiencies?



“Most unsuccessful programs fail at the beginning”

Steven R. Meier in *Best Project Management and Systems Engineering Practices,* Project Management Journal, Wiley Interscience, 2008

Institutional Profiles, 2002

	Stations	Staff (FTEs)	Budget
NDBC	126*	176	~$16M
PMEL	69	21	~$3.2M

**Coastal weather buoy (69) and land stations (57)*

Lessons

1. **Define sound strategic principles for transition from research to operations.**
2. **Develop a realistic transition plan with a realistic time line (don't expect to do it "fast, cheap, AND well").**
3. **Provide adequate resources for transition.**
4. **Ensure technology is mature before program is transitioned.**
5. **Listen to stakeholders (Top-down, command and control decision making works well only in the military).**

More Lessons

1. "Transfer" is only one kind of "transition." "Transition in place" may be preferable to "transfer" for those climate observing systems that require ongoing research as a fundamental component of the observing system. For TAO, the benefits/costs of transition in place were not compared to the benefits/costs of transfer.

2. A transfer should be perceived as ready and mutually beneficial to both groups. The TAO transfer was not perceived as mutually beneficial.

3. For observing systems that are used by many groups outside of NOAA, like TAO is, any transition or transfer needs to be well vetted with the outside user community before any action is taken. The TAO transfer was not vetted with the user community. The project was reviewed by the COSC, which represented the user community, but the decision to transfer had already been made before the COSC was consulted. All that the COSC could do at that point was to point out the pitfalls.

4. A transfer/transition must have one person responsible for making it happen. The TAO transfer never had a person in charge. NWS and OAR were directed to work it out together. But it was never clear who was in charge.

And More Lessons

5. Transitions cost money. Transition funding needs to be estimated, identified, and allocated before transition is undertaken.

6. The receiving organization must estimate the new cost of operating the system after transition, and that cost estimate needs to be a factor in deciding whether or not to proceed. There was never a cost estimate made for operating TAO in the NDBC mode of operation as compared to the cost of the PMEL mode of operation.

7. One of the implied reasons for transferring TAO was that NDBC would be able to achieve cost efficiencies by operating both TAO buoys and the weather buoys with the same resources. Significant efficiencies did not materialize. TAO added to the NDBC workload on top of the weather buoys. At the same time, PMEL maintained its operational force to build PIRATA and RAMA. So NOAA ended up supporting two work forces to operate the Tropical Moored Buoy Network rather than one.

8. TAO and the weather buoys have different missions, so it is difficult for managers to evaluate observing system trade-offs and plan for better efficiencies and science needs. The climate networks should be managed together so that they can be constructively/efficiently assembled into a climate observation "system." E.g., moored buoys, drifting buoys, profiling floats, and ship-based systems all have their

Some Good News

1. There is a growing realization that there is a problem.
2. A new end-to-end NOAA Climate Service could oversee
   a) Observations
   b) Modeling & Forecasting
   c) Products & Services