DAI: Achievements, Plans and Concerns

Report to DAI Scientific Review Panel
24 September, 2004

Selected Achievements: FY03-04

1. Successful releases of DART; incorporation of wide range of models
2. Ability to ingest real observational data into all DART models
3. Development of complex forward operators for radar, GPS
4. Development of self-calibrating general filter algorithms
5. Development of efficient scaling filtering algorithms
6. Hosted NCAR's 2003 ASP summer colloquium (DART for exercises)
7. Explored observing system design, value of surface obs.
8. Collaborating: NCAR's ACD, ASP, CGD, HAO, MMM, RAP, SCD
9. Initiated several collaborations with UCAR universities
10. Collaboration with NOAA/NCEP&CDC on ensemble filters for GFS

Short Term Plans, FY05

1. GSP/DAI/SAMSI workshop on ensemble data assimilation (special DART session)
2. A major DART release including comprehensive documentation and examples
3. Prototype global/regional (CAM/WRF) ensemble assimilation system
4. Improved systematic error detection and quality control of observations
5. Using ensemble assimilations to adjust gravity wave drag coefficients in CAM
6. Ensemble assimilations to aid in the design and tuning of convective parameterizations
7. Information content of GPS observations, efficiency of forward observation operators
8. Operational parallel tests of the NCEP GFS filter
9. Postdoc jointly with SAMSI to explore observing system design
10. The DAI seminar series will continue
11. Possibility of extending the CAM filtering system to WACCM will be investigated
12. Studies of observations of the upper atmosphere with ROSE
13. CAM3 assimilations to explore the impact of ARM observations with PCMDI

Long term science focuses: FY05-07

I. Ensemble filtering theory and implementation

Performance vs. ensemble size
Theory and improved implementation for dealing with systematic errors
Use of difficult non-linear observations (radar, satellite radiances...)
Assimilating 'discrete' structures (thunderstorms, ocean eddies...)
Ensemble methods for tracer assimilation; source sink identification

II. Using assimilation to address model deficiencies

Assimilating model parameters
Evaluating relative error characteristics of different parameterizations

III. Design and evaluation of observing systems

Measuring information content of an observation
Cost function constrained observation system design

IV. Towards an earth system assimilation capability

Add additional model components
Coupled model assimilation

Long term DART development plans: FY05-07

1. Enhance performance and generality of parallel filter implementations
2. Improve ability to add new observation types
3. Greatly enhanced observation space diagnostics
4. Add a more general quality control facility including ensemble Q.C.
5. Improved documentation and educational examples
6. Enhanced software support for users (no staff to do this)

Key challenges

1. Supporting the DART facility / software engineering support
   - Mostly done by Hoar and Anderson
   - Neither is software engineer
   - Amount of code and number of users growing rapidly
   - Should we sacrifice science for software support?

2. Transitioning activities to divisional support
   - Plan was for interaction between divisions and initiative
   - DAI would provide assimilation expertise
   - Division staff would help with implementation
   - At present, DAI staff are doing lots of implementation
   - How to transition mature collaborations so DAI can move on?

Key Challenges (cont.)

3. Variational assimilation and NCAR's variational activities?
   - Many NCAR assim. activities independent of DAI (and older)
   - Most obvious example is WRF 3D- and 4D-var
   - Also efforts in ACD, HAO, RAP, CGD
   - We can't possibly support variational for a range of models
   - How should we coordinate with, for instance, WRF variational?

4. Developing and supporting an educational component?
   - DART already being used for limited educational use
   - Lots of demand for software for (under)graduate courses
   - How should we publicize this?
   - How much software / user support will it take?

Key Challenges (cont.)

5. Controlling number of collaborations

Probably have too many for current staff already

DAI core staff isn't really core

For instance, Raeder is tied to CAM, Caya tied to WRF

How many external collaborations should we have?

6. Growth (with a shrinking budget?)

How should we prioritize our activities?

What can we drop?

NOTE: Original ambitious plans based on continued growth

Key Challenges (cont.)

7. How do we fit in with IMAGe?
   - Interaction with GSP already exists
   - Is there a way to interact with Geophysical Turbulence?
   - Should we increase our interaction with SCD (algorithms?)

8. Others?

Summary

Initial progress has been very good, due to excellent core staff

Strategy for focusing the effort (DART) has been key to progress

Initial growing pains (budget, hiring, identifying key collaborators)

DART and available models give unprecedented capabilities

Progress with GFS assimilation should increase our credibility

Primary fear: initial successes will lead to expanding too rapidly;

Must avoid letting our success kill us.

Possible directions for the panel:

1. What are the most notable strengths of DAI?
2. What are the most notable deficiencies?
3. Is DAI fulfilling its function as a cross-cutting initiative at NCAR?
4. Does the panel have any insights on the 7 challenges list in the conclusion?

What would DAI like from the panel?

1. A verbal critique later this afternoon.
2. A TERSE written report in the next few weeks summarizing your main conclusions.