

# Report on IMAGE retreat August 28, 2006

The Institute of Mathematics Applied to Geosciences (IMAGE) held a retreat for NCAR scientists and staff on August 28, 2006 at the Community House in Chautauqua, Boulder, CO. The retreat had several goals:

- Bring forward ideas for Theme-of-the-Year topics and process, and for the expansion of IMAGE to better represent applied mathematics.
- Provide a forum for IMAGE and NCAR researchers to outline goals for IMAGE and also to voice concerns.
- Allow the participants to become better acquainted with all the groups in the Institute.

There were approximately 50 participants comprising the staff in IMAGE, members of the CISL/SCD computational sciences section and a wide sampling of NCAR staff that have connections to applied mathematics and/or the science programs pursued by IMAGE. The timing of this retreat was chosen to provide an internal, NCAR perspective on IMAGE that would be useful for the IMAGE advisory board visit on October 3-4, 2006.

## An overview of the retreat discussion

*IMAGE identity* The participants raised issues of the identity of IMAGE in several modes. Emerging from the reports was the description of IMAGE as engaged in *transformative mathematics*—mathematical methods and models that can advance or shape a scientific field in new ways. There was wide recognition, however, that while its multi-disciplinarity was a great strength, IMAGE lacked sufficient specific representation in applied mathematics. A strong sentiment was that the mathematical scientists in other groups in CISL should be transferred and made part of IMAGE. Also, IMAGE should build on its ability to engage in high-performance computing. Finally, although IMAGE staff identified strongly with their home sections, identifying as a member of the Institute as a whole was not widespread. It was felt IMAGE needs to acquire new Scientist-I positions, but organizationally would benefit from consolidation and interlinking of its groups before seeking to expand.

*IMAGE collaboration and outreach* The retreat generated several topics for the Theme-of-the-Year that resonate with the NCAR science plan. These are:

- Stochastic dynamics and modeling
- Capability computing

- Seamless prediction of geophysical processes across scales.
- Mathematics of closure-scheme formulation and evaluation
- Nested regional-climate modeling
- Astrophysical and planetary dynamos
- Transitions between 2D and 3D turbulence
- Solution of nonlinear partial differential equations

In general the participants felt that mathematics has an important role in supporting the NCAR science program. There was some diversity of opinion, however, in how to pursue effective collaborations across the institution and the balance of IMAGE efforts among research, outreach and thematic activities and service. Besides developing and becoming part of a network of mathematics groups with a geoscience focus the participants also suggested the value of consolidating and reinforcing activities among the Front Range university mathematics departments.

*Feedback to NCAR leadership* The retreat was very successful in bringing together a diverse group of NCAR staff and much of the discussion also served to make the participants aware of the scope of IMAGE activity. The retreat was attended by the NCAR Deputy Director (Larry Winter), Director of CISL (Al Kellie), Deputy Director of ESSL (Annick Pouquet) and SCD Deputy Director (Rich Loft) and was very helpful in informing the NCAR leadership how IMAGE is viewed by its members and other NCAR staff.

## Retreat format

The agenda was divided into three parts: 1) a series of short presentations by Nychka on IMAGE and Anderson, Sain and Pouquet on the activities of each section, 2) a plenary discussion to refine topics for breakout groups and 3) breakout-group discussions followed by plenary reporting. There were two sessions for the breakout-group activity. The first breakout groups considered the topics listed below. and the second breakout session refined the discussion on these topics based on the first session reporting. The retreat format was a balance between initial discussion on several prescribed topics and more wide-ranging topics that were generated by the participants. A transcript of rough notes written up for plenary viewing during the breakout group reports is attached as an appendix to this report.

Breakout group topics:

**IMAGE 360:** What are the current strengths and weaknesses of IMAGE? Where should IMAGE be going? How should we get there? What challenges and opportunities does the current budget outlook present?

**IMAGE growth – the new box:** Currently the composition of IMAGE may not sufficiently represent a large part of applied mathematics: e.g., applied probability, PDEs, dynamical systems, numerical methods. If IMAGE were to grow, what are fruitful areas that would improve IMAGE’s role within NCAR and also with the external math and geoscience communities?

**IMAGE organization and management:** How should IMAGE get advice? How should IMAGE activities be coordinated within NCAR? How should the members be informed about and participate in IMAGE decisions?

**Theme-of-year:** What is an appropriate 2007-2008 theme in applied mathematics that has an impact on NCAR science? In general how should Themes be chosen, and how can other groups at NCAR be involved?

## Summaries of discussion

### IMAGE growth – the new box

*Plenary suggestions* Before considering growth, identify what current areas may be near to critical size, what funds may increase or decrease, and what synergies exist or have potential. Then, build on strength and consolidate what we have. Then ask: “What do we aspire to? What do we want to be known for?” Possible growth areas include: involvement of observational data specialists; and uncertainty quantification.

#### *Morning group report*

Low (moderator), Rosenberg, Cooley, Lindsay, Loft, Lee, Gilleland, Matsuo.

There are at least 2 kinds of growth to consider: a *new* section with greater applied-mathematics focus (possibly fulfilling a “glue” function for diverse research activities); vs *reinforcement* of applied mathematics in current sections. Growth should address geosciences methodology, and exploit the natural connection to NCAR supercomputing. The IMAGE mission statement needs improvement; it should focus on transformative mathematics for geosciences, i.e., mathematics that can and does transform how geosciences are conducted. The labeling of new areas shouldn’t be overly topical, and suggestions include: Multiscale & Numerical Modeling Section (MNMS); and Mathematics of Modeling Section (MoMS).

#### *Afternoon group report:*

Low (moderator), Tribbia, Hoar, Malmberg, Snyder, Jeffrey Weiss, Large, Hui Liu, St-Cyr.

There are concerns about: current sections’ near-critical size; the credibility and ambitiousness of past and potential funding proposals; and if IMAGE can be identified as

a true mathematics institute by outside observers. Partly to address these, this group recommends to merge sections rather than multiply section types. Merge GSP & DAREs because they both emanate from and connect to statistics practices. Merge TNT, CSS/CS and similar activities that include focus on computational and numerical mathematics, especially for partial differential equations governing fluid mechanics. While new expertise is also needed, e.g., in dynamical systems, first we need new synergies to inform choices to be made later.

## **IMAGe organization and management**

### *Plenary suggestions*

How can would-be collaborators short-circuit the current “3 steps up-1 across-2 down” approval-gaining protocol? Besides informing & deciding, who assimilates and advertises new ideas? In particular, how can members participate in planning allocation and pursuit of funding? Finally, what are appropriate metrics of success for such a multi-disciplinary and multi-purpose membership as is in IMAGe?

### *Morning group report*

Raeder (moderator), Alexakis, Matt P(ocernich?), Smolarkiewicz, Eva F, Hui Liu, Nancy Collins

Obstacles to joint appointments and other interactions need to be removed. The obstacles can trigger budget concerns. IMAGe management needs to advertise loudly, “We’re here to help”.

Management needs to strive to unify members’ diverse efforts to contribute to building an institutional program that would attract funding. Is there sufficient institutional support for IMAGe activities?

Coordination, collaboration and participation could perhaps be supported by: co-locating sections (but not if it would harm IMAGe-external collaborations); formalizing IMAGe-internal communications; and strengthening the formal Seminar Series, perhaps preceding some seminars with tutorials.

Success metrics include the usual metrics, plus feedback from users of IMAGe software tools, perhaps as well as some comparison to programs similar to IMAGe.

How should advice come? When is there too much advice? How should advice be consolidated? Should the External and Internal advisory boards contain a software person?

### *Afternoon group report*

Raeder (moderator), Katz, Matsuo, S Thomas, Rosenberg, Anderson. “Role of IMAGe joint appointments”

Are JAs needed? Are other collaborations too limited? Currently, there is a new limited mechanism that sometimes discourages JAs. Otherwise, JAs rely on ad-hoc memoranda of agreement that concern: evaluation, percent time across appointments, primary supervisor identification etc. From the point of view of the potential JA (especially a junior person), (s)he may fear promotion/evaluation problems would arise. Is there a guaranteed return to one's home division, including a buffer of salary funds? Is JA a dead end? Will IMAGE even be there in the long run, despite what some rumors said at the onset?

How should IMAGE create incentives for JAs? Evaluation of JAs especially needs to rely on more than publication count, and should be more the responsibility of one division than the other one(s). Should there be grants, like the Directors Initiative, targeted for JAs? But, really it's an NCAR-wide policy issue. "Moral support does not equal institutional support!" How do they do it elsewhere, like at IPAM? There are also successful JA histories between MMM & RAL and MMM & ISSE. It will take significant work to make advantages overcome disadvantages.

Is overhead the main financial issue? This should not be a problem because it's zero-sum! Perhaps off-set this by giving a bonus to participating divisions.

Administrative/computing support for JAs is non-existent.

## **Theme-of-the-Year**

The TOY can be a great benefit to IMAGE but currently is not fully funded and has the potential to be a drain on the scientists and staff. The TOY as an ongoing activity needs more structure and outline. Topics for the TOY can be selected using a request-for-proposal format, the role and length of residence for the codirector should be delineated and the themes should address both existing collaboration and initiating new research. The TOY should have some long-term (e.g., 10-year) goals:

- Are methods from the TOY being used?
- Does the TOY have volunteers for the codirector position.
- Have publications resulted from TOY collaboration.

An important elaboration of the TOY is to go beyond series of workshops and conferences and "actually do something". The afternoon breakout group outlined how a TOY could be organized around a challenge problem that would involve a multi-disciplinary team.

Some future TOY topics that are well aligned with the NCAR science plan and involve applied mathematics are:

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# List of participants

First Name	Last Name	Affiliation
Alexandros	Alexakis	IMAGe/TNT
Jeff	Anderson	IMAGe/DAReS
Grant	Branstator	CGD
Vani	Cheruvu	SCD
John	Clyne	SCD
Nancy	Collins	IMAGe/DAReS
Dan	Cooley	IMAGe/GSP
John	Dennis	SCD
Natasha	Flyer	SCD
Aime	Fournier	IMAGe/TNT
Christian	Franzke	IMAGe/GSP
Alan	Fried	EOL
Eva	Furrer	IMAGe/GSP
Eric	Gilleland	RAL
Peter	Gilman	HAO
Wojciech	Grabowski	MMM
Jonathan	Graham	IMAGe/TNT
Jack	Herring	Emeritus
Tim	Hoar	IMAGe/GSP
Rick	Katz	ISSE/IMAGe
Al	Kellie	CISL
William	Large	CGD
Ed	Lee	IMAGe/TNT
Don	Lenschow	MMM
Bo	Li	IMAGe/GSP
Keith	Lindsay	CGD
Hui	Liu	IMAGe/DAReS
Rich	Loft	SCD
BC	Low	HAO
Anders	Malmberg	IMAGe/GSP
Tomoko	Matsuo	IMAGe/GSP
Travis	Metcalfe	SCD
Mark	Miesch	HAO
Ram	Nair	SCD
Doug	Nychka	IMAGe
Matt	Pocernic	RAL
Annick	Pouquet	IMAGe/TNT
Kevin	Raeder	IMAGe/DAReS
Mark	Rast	CU/NCAR
Duane	Rosenberg	IMAGe/TNT
Stephan	Sain	IMAGe/GSP
Piotr	Smolarkiewicz	MMM
Chris	Snyder	MMM/IMAGe
Amik	St-Cyr	SCD
Bjorn	Stevens	UCLA
Peter	Sullivan	MMM
Claudia	Tebaldi	ISSE/IMAGe
Steve	Thomas	SCD
Joe	Tribbia	CGD/IMAGe
Jeff	Weiss	CU/NCAR
Larry	Winter	DIR

# Appendix: Transcript of rough notes written up for plenary viewing during reporting and discussion of breakout groups

## Appendix: Transcript of break out group oral reports.

Raw transcript of 2006/8/28 IMAGE Retreat displayed notes

Approximate

legend:"====" starts a topical group, I, II, III, IV, V;  
A, B, C, ... sheets for each topic.  
"++++" closes suggested topic modifications, starts reports.  
"'''''" starts discussion after reports.  
"~~~~" changes the participants, morning-afternoon.  
[ ] contain interpretations (mostly to be avoided).  
{ } contain rosters for groups

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I.A

{Low, Rosenberg, Cooley, Lindsay, Loft, Lee, Eric G, Tomoko}

IMAGE growth: the new box

If IMAGE were to grow what are fruitful areas that would improve IMAGE's role within NCAR and with external research communities.

I.B

- \* Consolidate what we have
  - What are sub-critical?
  - What funds will grow/shrink
- \* Aspirations ---What could we be?
- \* Potential synergies
- \* What do we want to be known for!
- \* Fields: Uncertainty quantification
  - Observationalist collaboration

+++++

I.C

4th box to contain  
Math  
Methodology [1] in Geosciences

Natural connection to supercomputing

Mission to contain  
"Transforming mathematics for geosciences"  
(i.e., mathematics that transforms)

Section name: shouldn't be too topical.  
(1) "Multiscale & Numerical Modeling Section" suggested  
(2) "Mathematics of Modeling"

e.g., numerical observations suggesting singularities implies to  
attract analysis

[1] e.g., numerical convergence was observed but enhanced after  
proofs done.

I.D

Growth, at least 2 kinds:

- 1. New section containing applied mathematics component
  - 1a. Glue function/activity for diverse research activities
- 2. More mathematics in current sections ---Reinforcement

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"How do we make a decision about the new box?"  
{Low, Tribbia, Hoar, Anders M, Chris S, Jeff W, Large, Hui Liu, St-Cyr}

I.E

Survey says: there is contradiction



Survey further

Recommend [2]: fewer (i.e., 2) boxes (different from universal model)  
GSP & DAREs to merge because share statistics ideas  
TNT, CSS [3] et al. that already contain mathematics to merge to  
Computational mathematics, Partial Differential Eqs.

Solicit ambitiously, be convincing!!

New expertise: dynamical systems  
(... can't be more specific today.  
Need synergies to inform choices later)

Need to be identified as true mathematics institute by outside

Individuals should get grants, hire students...

[2] Because of concern of sub-criticality of current groups

[3] Or at least inform w.r.t. reorganization decisions

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II.A

{Tebaldi, Cheruvu, Katz, Anderson, S Thomas, Sain,  
Anders M, Branstator, Jonathan P-G}

IMAGe 360 [Tebaldi moderated]

Current strengths and weaknesses.

Where are we going?

How to get there?

Challenges and opportunities presented by current budgets.

II.B.1

\* Promote excellence

\* Software dissemination[,] weak today.

\* Mission: appropriate? How to realize?  
= general (interface) vs specific (awards)

\* CISL support

\* Balance between direct mathematics research and support of scientific projects at NCAR

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II.B.2 [Tebaldi copy of II.B.1 ?]

\* Promote excellence

\* Software dissemination (now a weakness)

\* Mission statement: appropriate?  
                                  how to achieve it?  
Balance between broad mission (interface)  
and specific science projects  
(where \$\$ are!)

\* IMAGE and (within) CISL

\* IMAGE and NCAR (Where are we in the strategic plan?)

II.C

[Tebaldi group]

Identity crisis? Cohesion?

How to work together?

Resources and infrastructure, improvement needed.

External funding leads to over-specification

TotY under-supported

II.D

\* Research-support activity balance

\* What is added value of IMAGE vs elsewhere?

\* Tool building: requires long-term commitments.

[asks if:] appropriate?

support exists?

[asks:] How to measure success?

\* Recommendations:

+ Identify, where going, how to get there

[insert in] Mission Statement

+ Educate community

+ Tools, need to evaluate success

+ Identify and better exploit CISL/SCD interactions, synergy

+ Summer colloquia for promotion [would effect] outreach

[implies] need coordinator

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## II.E

Is information from postdoc activities communicated effectively?

Postdoc seminars

\* present to advisory panel?

\* need to be broad enough (little jargon)

## II.F

What are remedies (whence \$) to morning discussion

.....

"How should IMAGE establish a coherent identity?"

II.G

"How should IMAGE establish a coherent identity"  
[Tebaldi, Cheruvu, Cooley, Kellie, Matt P]

\* Do we want to?

\* Would aid soliciting funding because:  
get critical mass  
get visibility  
funding is a war.

[It's] all about selling (packaging)

\* Build identity from the inside  
What is the benefit of identity to individual?

OK, how?  
Strategic planning: 5-10y enterprises  
"Transformative mathematics"  
RFPs lead to collaborations and cohesion

II.H

Given identity, how to sell it outside?

\* Doug has long experience from GSP background.

\* Need brochure/newsletter

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Post-docs: Seminars, research reviews, very useful for learning  
what institute activities are.

Balance also with supercomputing advances

Metrics discussion will/must continue (A Kellie)

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III.A

IMAGe 360

[Clyne, Snyder, Miesch, Herring, St-Cyr, Nair, Franzke, Alan -, Tribbia]

[Clyne group, reported on II.C]

Strengths: interdisciplinarity

TotY

Community tools

leverage of mathematics expertise

Weaknesses: lack of mathematicians

lack of external interactions

lack of mission focus

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III.B

{Clyne, Miesch, Bo, Franzke, Alexakis, Nancy C, Loft, Alan -, Sain}

"How to pursue funding, especially for infrastructure, core staff?"

"What should we do with a windfall/flat budget scenario?"

Pursue soft \$ for development, core \$ for maintaining

Forecast future needs, leads to better internal \$ support

More S1, with better support, especially in getting grants

III.C

Proposal winning

---More partnerships

Budget scenarios, either way

Balance

Prioritization

Don't sacrifice what we have

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Brand-name recognition by NSF/DMS

Don't limit to NSF only.

Q: Front Range synergies, partnerships?

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IV.A

Theme of the Year:

{Pouquet, Winter, Hoar, J Dennis, Bo, Jeff W, Sullivan, Large}

What is an appropriate 2007-2008 theme related to applied mathematics that has an impact on NCAR science?

In general how should [TotY] be chosen, involving other groups at NCAR.

IV.B

\* How many people, doing what, what scale?!

\* Collaborative observations/data fitting

\* Memorable experiences

+++++  
IV.C

Co-Directors: How to obtain  
Advisory board should [offer] list

Topics: Novelty vs Relevance

Workshops: Need better announcing  
For whose benefit?

NCAR science should almost always present unresolved problems.

Co-Director: How interacting at NCAR, how long ... ?  
Needs improvement.

Community involvement: local vs non-local

Sharing speakers locally

\$ for TotY

.....

10-year goals: Methods in use?

Collaborations

Publications

Co-Director volunteers?

IV.D

2008 TotY [suggestions]

[a] mathematics of closure/seamless prediction

[b] capability computing

Why do we have a computing center?

Do problems heretofore impossible.

Analogy to telescopes

[pointing at same vs at different objects]

[c] stochastical dynamics including modeling

Share TotY with CU ...? => Synergy.

.....

"TotY: More than just workshops. What?"

{Pouquet, Piotr S, Eric G, Eva F, J Dennis, Lindsay, Lee,  
Sullivan, Branstator, Herring}

IV.E

\* a' la IPAM:

Solve a new problem, e.g., nested regional climate

Incentives--- build sibling-hood

Leverage--- existing staff, resources, framework

Need new resources

\* Topics

[a] nested regional climate

[b] solar dynamo  
[c] is 2D turbulence a limiting case of 3D?

\* Topic choice criteria: Math relevance, NCAR relevance, student involvement, time scale, resource requirements, existence of public or academic educational component.

#### IV.F

Could solicit external proposals (e.g., sabbatical visitors)

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Additional criteria: Broader impact  
In 2 words: "DO something"

TotY legacies: Books, persistent collaborations.

Track collaborations.

Topic [d]: Methods for nonlinear partial differential equations.

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#### V.A

{Raeder, Alexakis, Matt P, Piotr S, Eva F, Hui Liu, Nancy C}

IMAGe organization and management:  
How should IMAGe get advice?  
How to coordinate activities within NCAR?  
How should members be informed about, and participate in, decisions?

#### V.B

\* How to interact between IMAGe & greater NCAR,  
short-circuit "3 steps up-1 across-2 down" [protocol]

\* Who assimilates new ideas, advertises them?

\* Funding planning participation

\* Metrics of success



+++++

V.C

\* Joint appointments/interactions

Remove obstacles, hurdles.

\$ question!

"We're here to help" ---Advertise

\* Stronger seminar series, precede by tutorials?

\* Managed growth. Response to budget pressure?

Unification of efforts to build, what can attract funds

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\* Success metrics

Usual, plus software feedback

compare to similar programs?

V.D

How advice comes? Is there too much? How to consolidate?

External advisory board, Internal advisory board

[IAB] contains a software person?

Software user feedback. Keep them happy.

Is there institutional support for IMAGE activities.

IMAGE-internal communications. Now not formal.

Researcher collocation: facilitates internal collaboration

reduces collaboration outside IMAGE

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"Role of IMAGE joint appointments"

V.E [Raeder written sheet]

{Raeder, Katz, Tomoko, S Thomas, Rosenberg, Anderson}

Current---new limited mechanism [that] discourages JAs  
[otherwise] random memoranda  
[that concern:] \$  
evaluation  
% time  
primary supervisor

Are [JAs] needed? Other collaborations too limited?

Fear of promotion/evaluation problems  
for taking chances and cross-cutting  
junior people especially  
How to make incentives?

Overhead?

Give a bonus to participating divisions

Guaranteed return to home? No mechanism  
No \$ buffer

New policy exists, evolving  
doesn't cover promotion, return to home

Administrative/computing support for JAs non-existent

NCAR issue: not IMAGE or lab level

[Are there] university solutions? IPAM

V.F [Raeder written sheet]

Negotiating %/\$ between supervisors still an issue (even with JA mechanism)

Poor prognosis at start: "IMAGE might not last"

Evaluation: base on other than publication

Need targeted grants for JAs?

Meaningful rewards from NCAR/directorate to JAs, like Initiatives

Moral support does not equal institutional support

V.G

MoU: leaves holes

\* Are JAs needed?

\* Hurdle: evaluation equity fear!

\* Hurdle: overhead wars

Should not be a problem because it's zero-sum!

Hurdle: Can go home again?

Hurdle: administrative & computing support sufficient?

Hurdle: negotiating %

Hurdle: perceived as dead end!

Moral support does not equal institutional support

V.H

To get over hurdles:

\* How does university? IPAM?

\* How evaluate in addition to publications etc.?

\* JA targeted grants?

Will take significant work to make advantages overcome disadvantages.

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One division [should] take greater responsibility than the other.

Learn from successful JA histories (Snyder)

MMM-RAL, MMM-ISSE