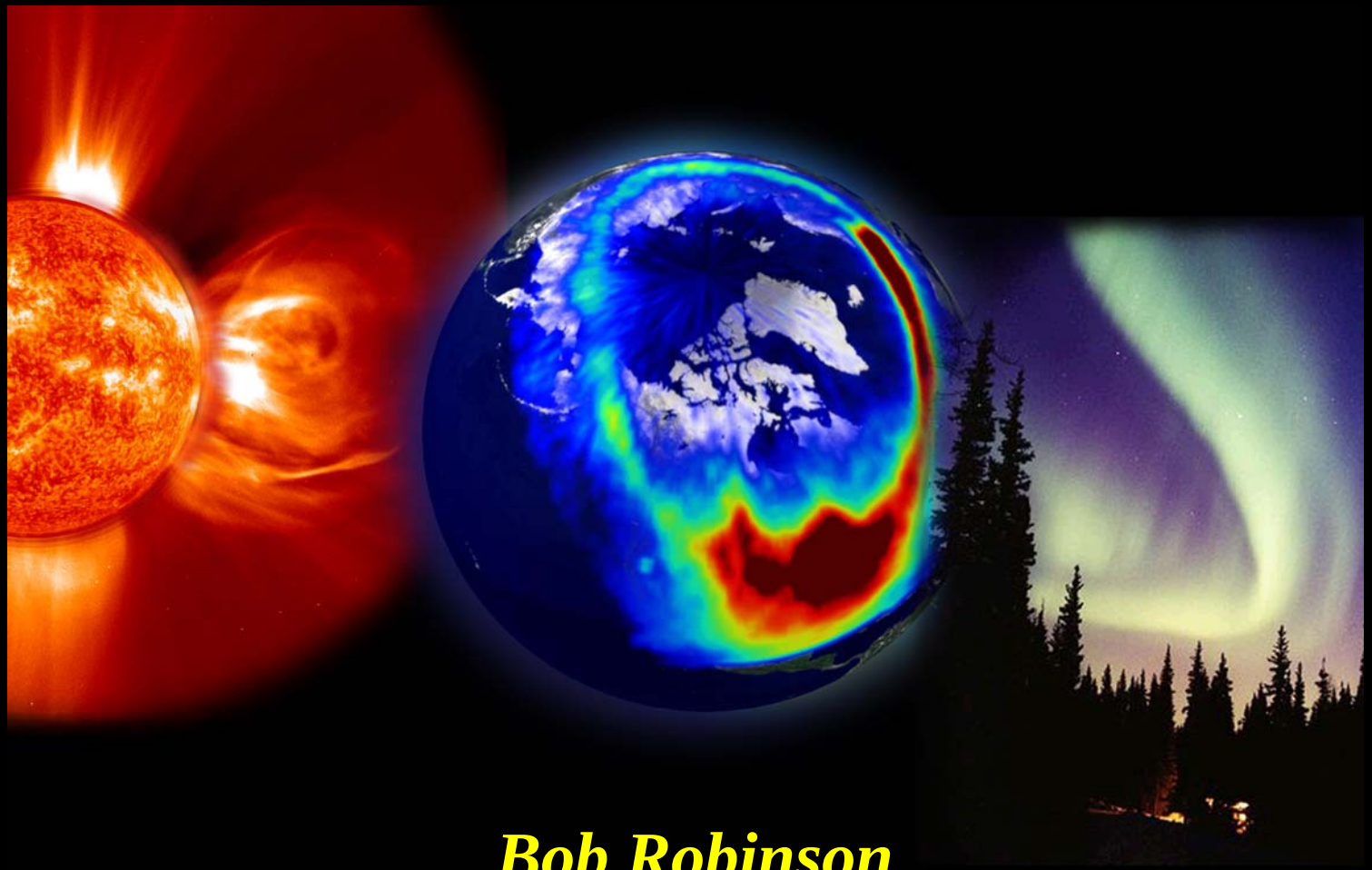
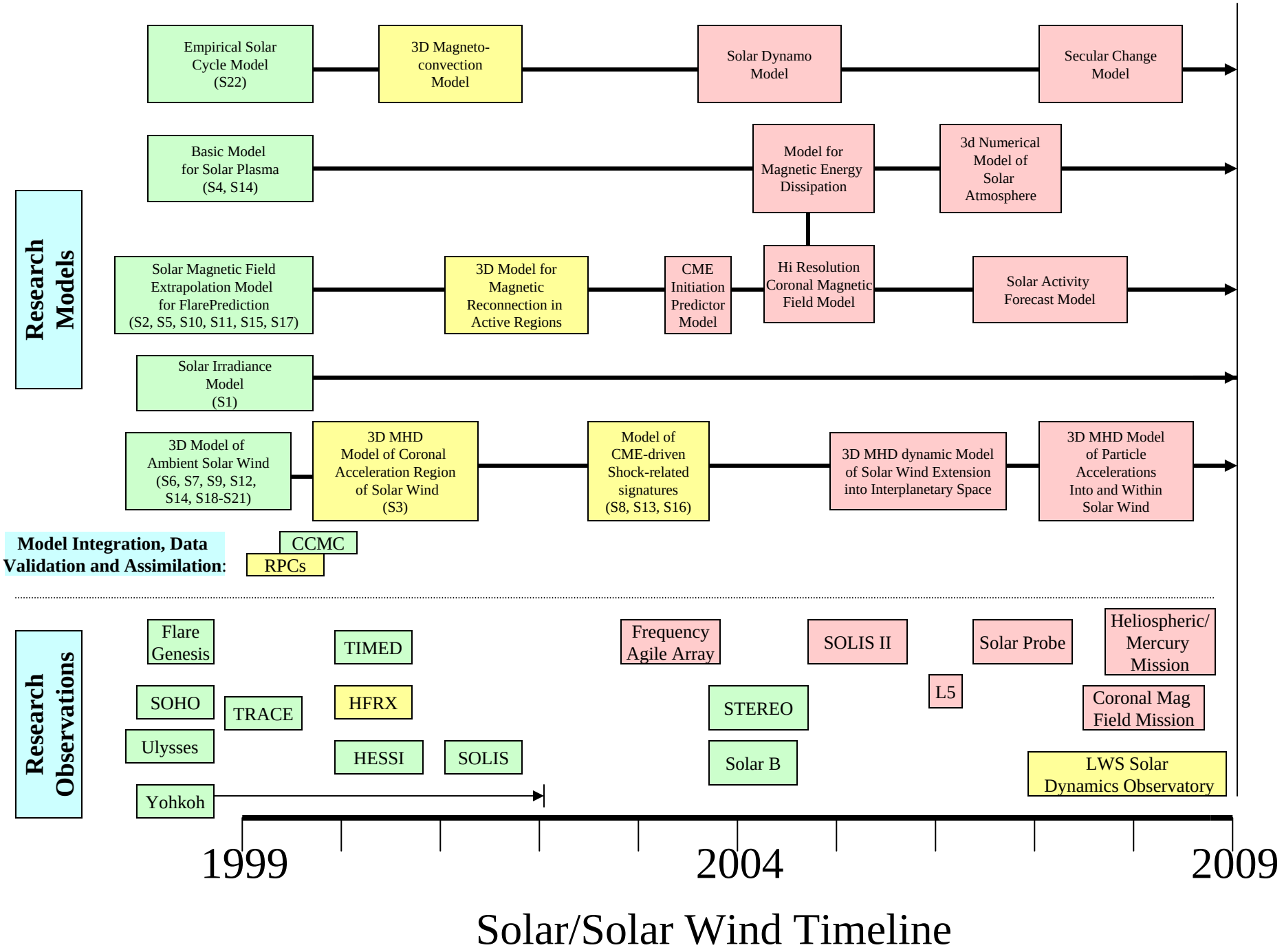
Community-based Space Weather Modeling for the Future

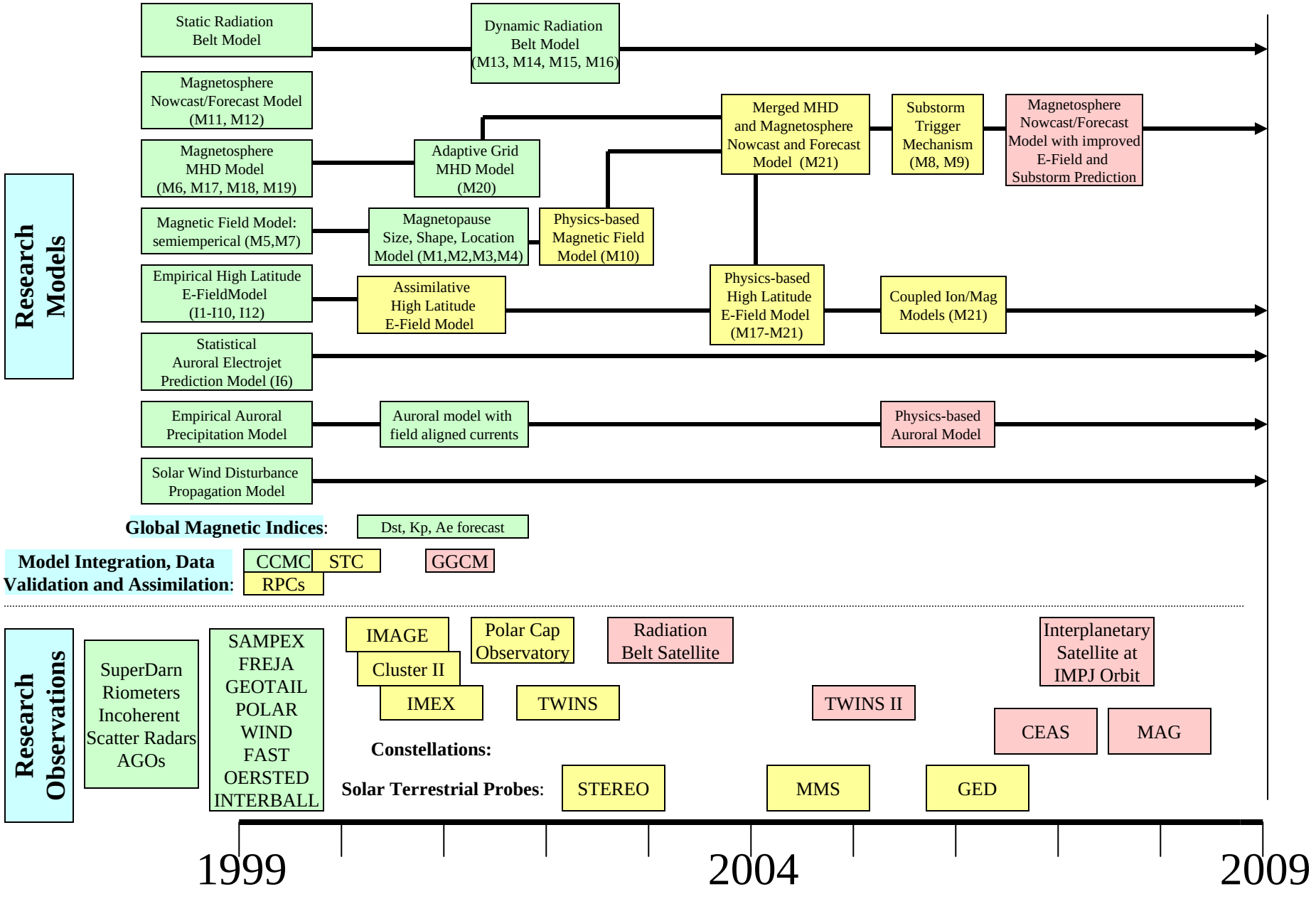


Bob Robinson

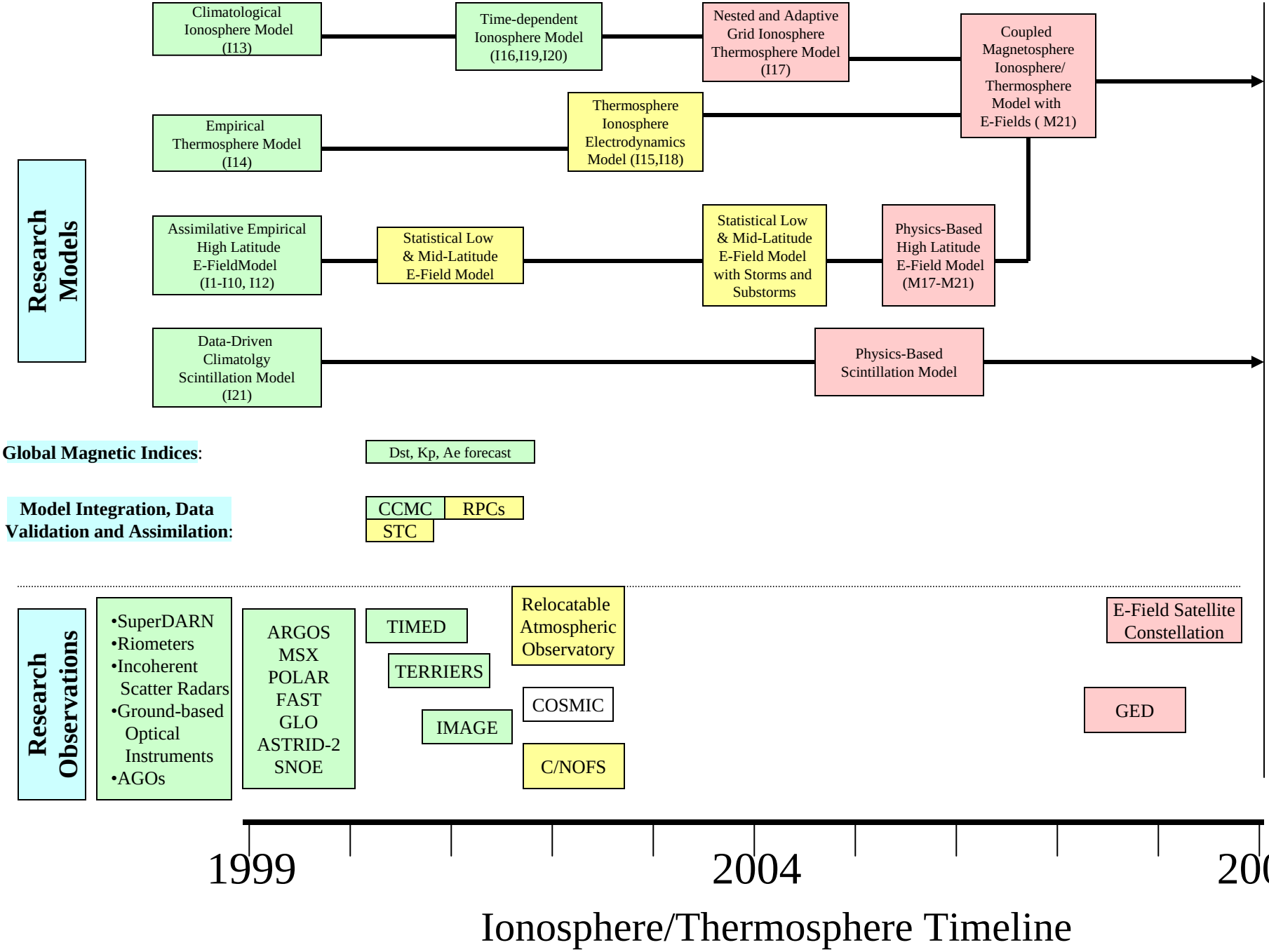
NSF



Solar/Solar Wind Timeline

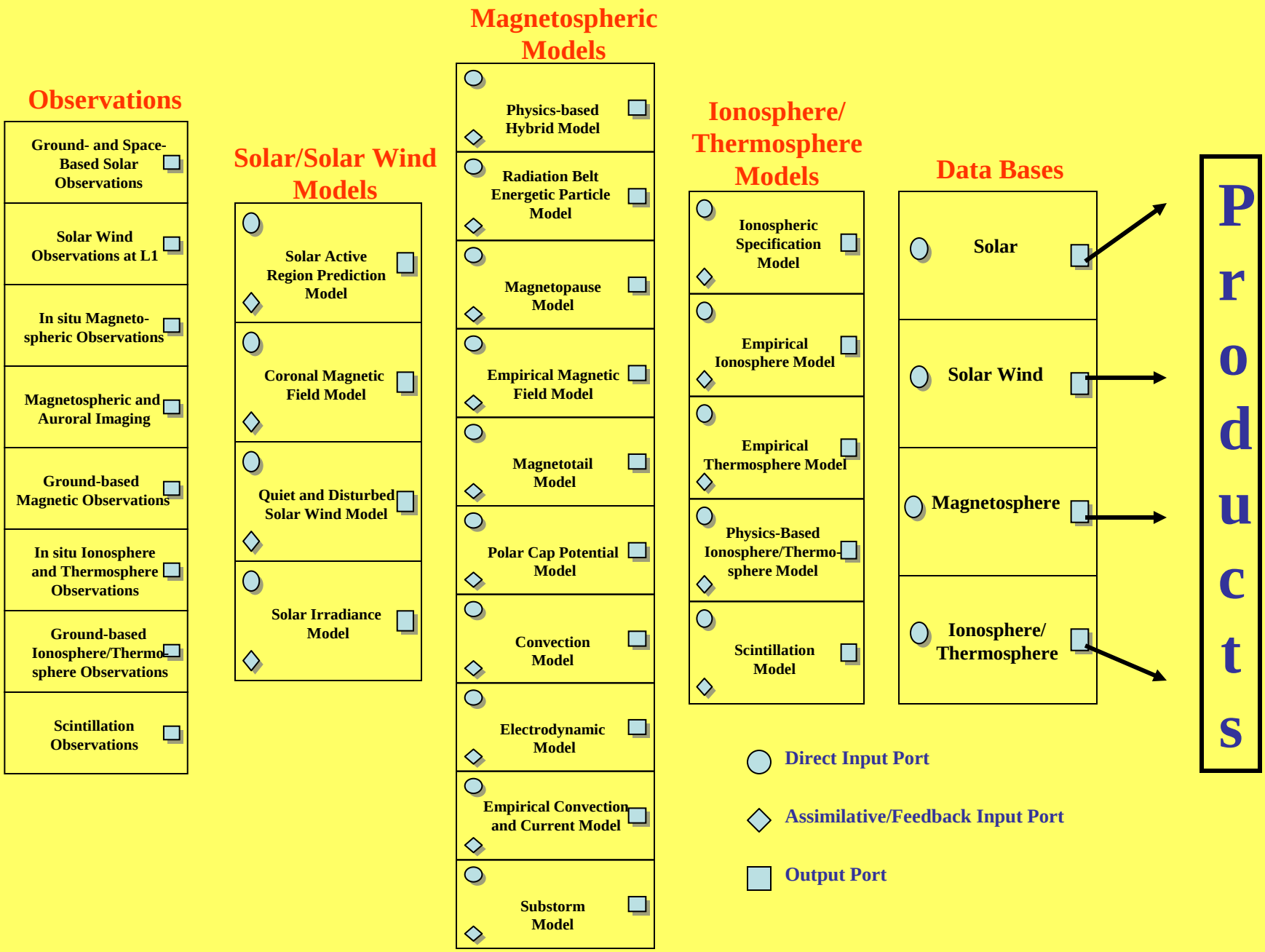


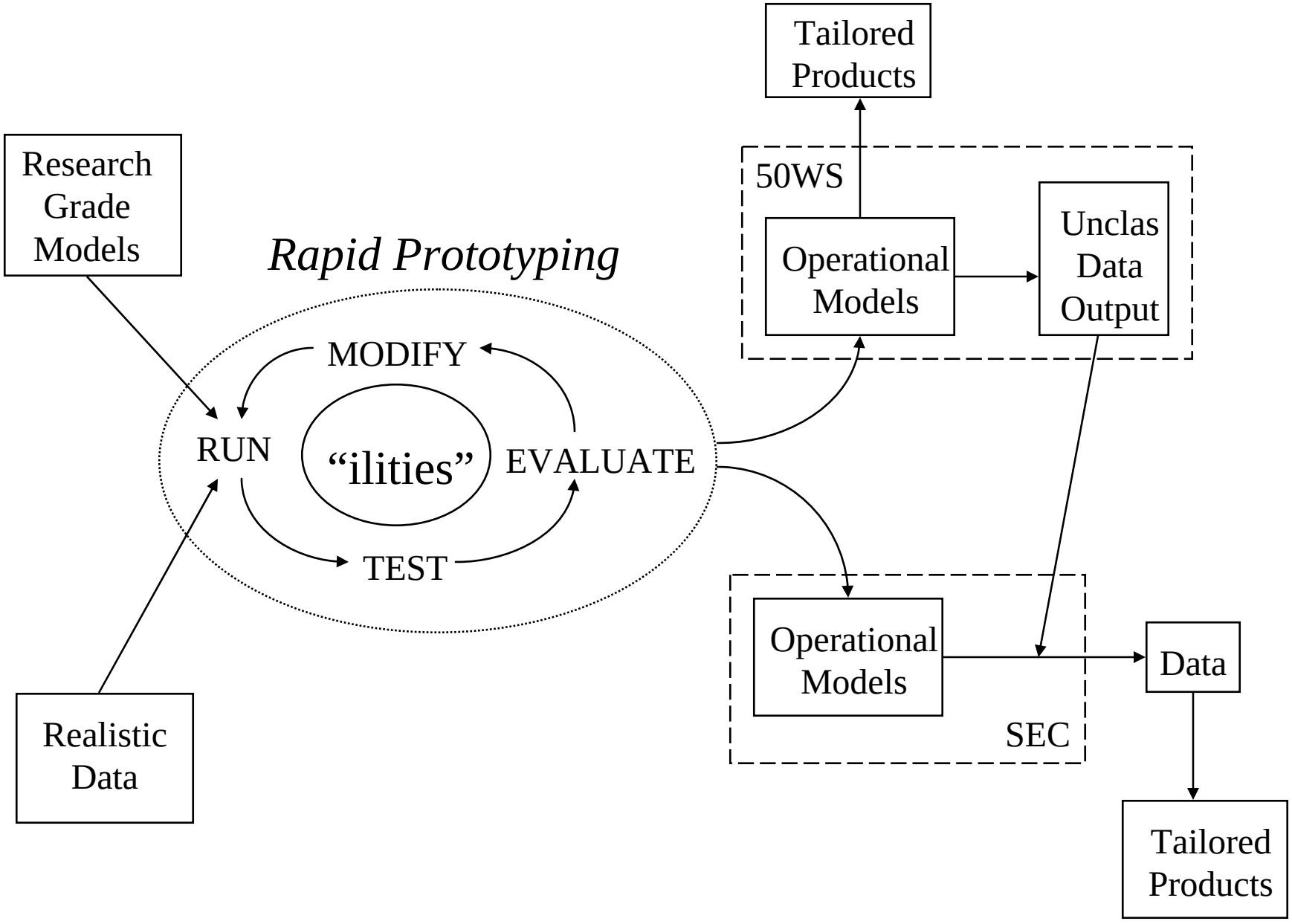
Magnetosphere Timeline



Ionosphere/Thermosphere Timeline

Patch-Panel Approach to Space Weather Modeling




Tailored Products
Research Grade Models
50WS
Rapid Prototyping
Operational Models
Unclas Data Output
MODIFY
RUN
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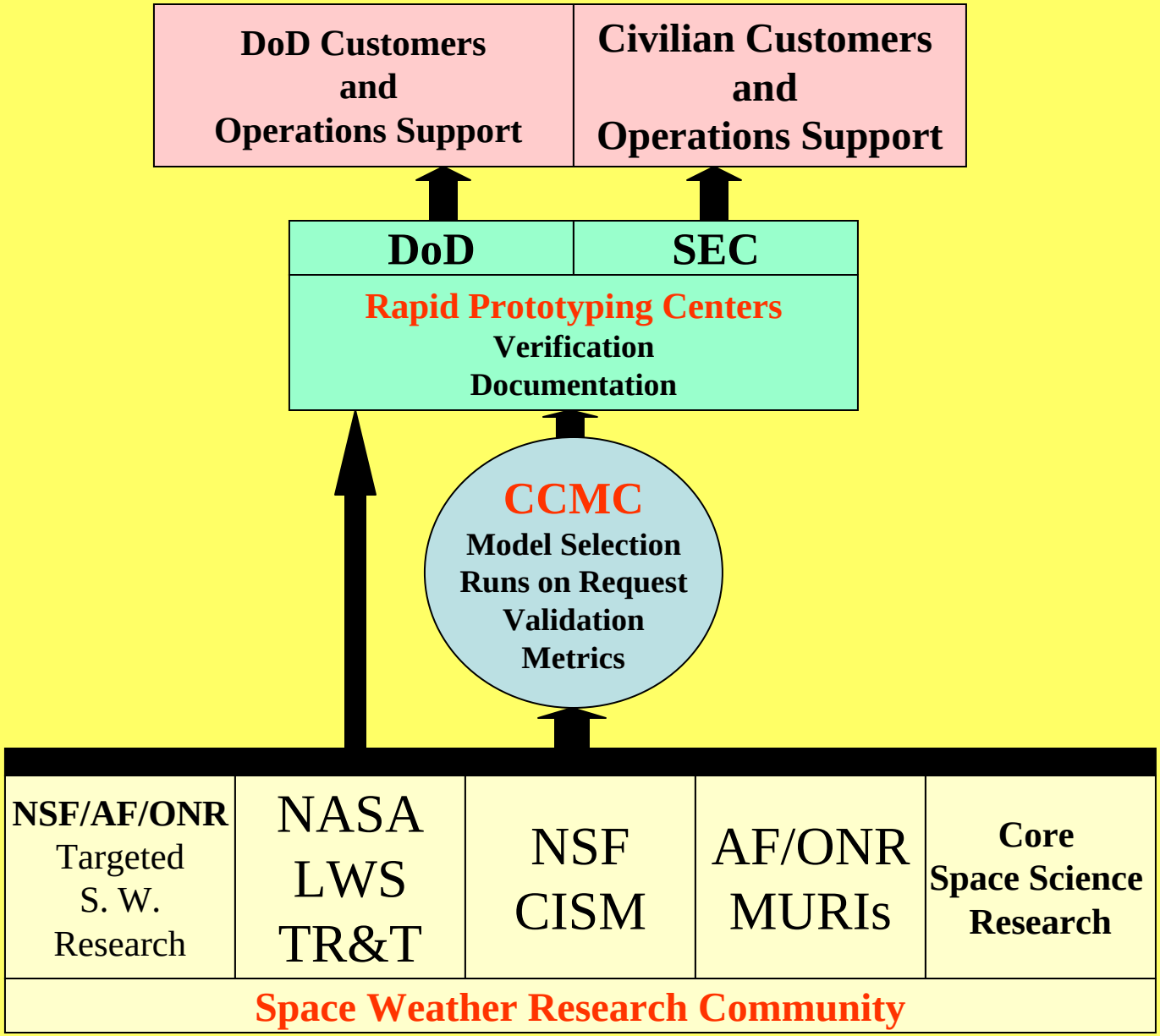
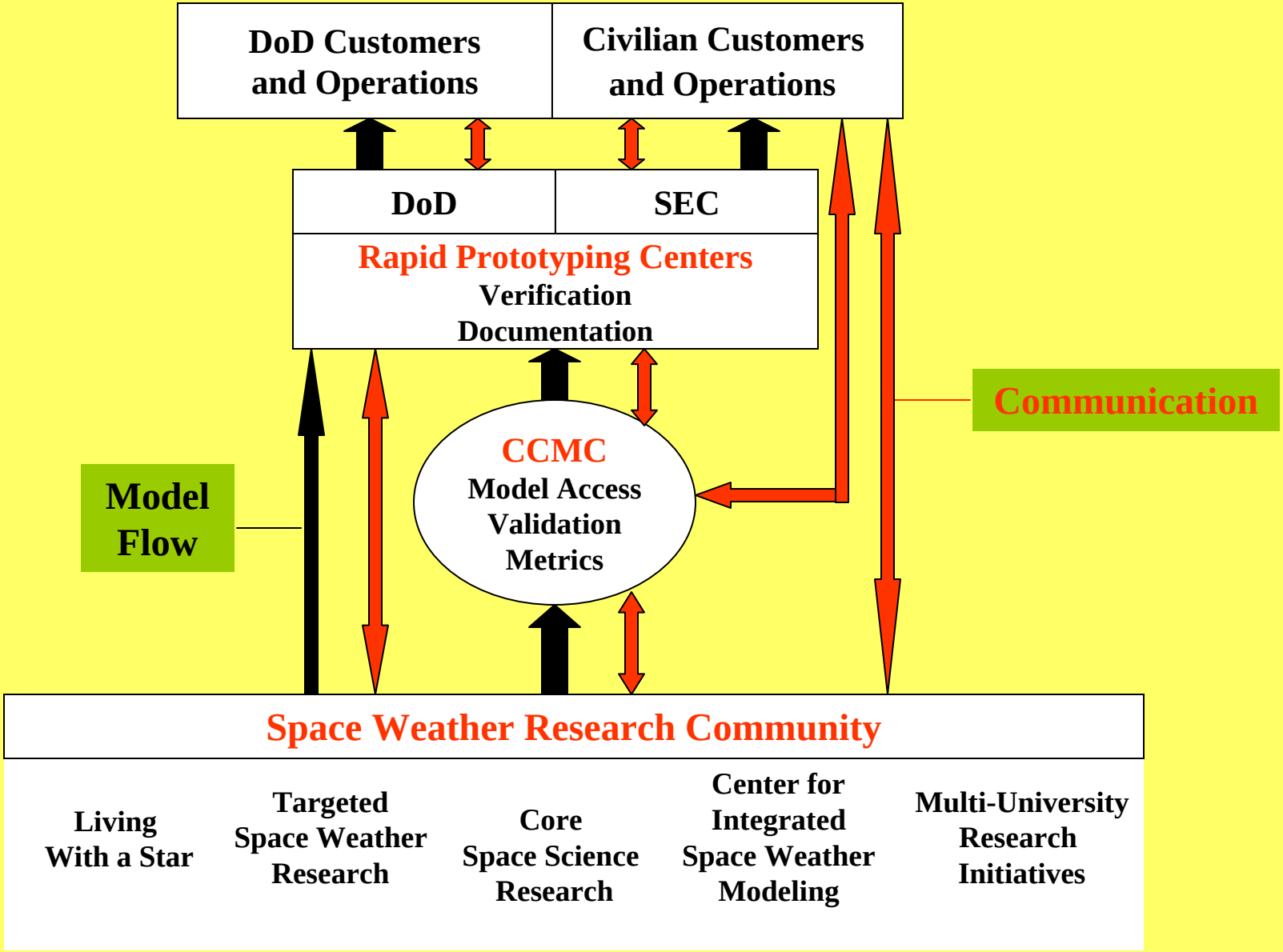
EVALUATE
TEST
Operational Models
Data
Realistic Data
SEC
Tailored Products

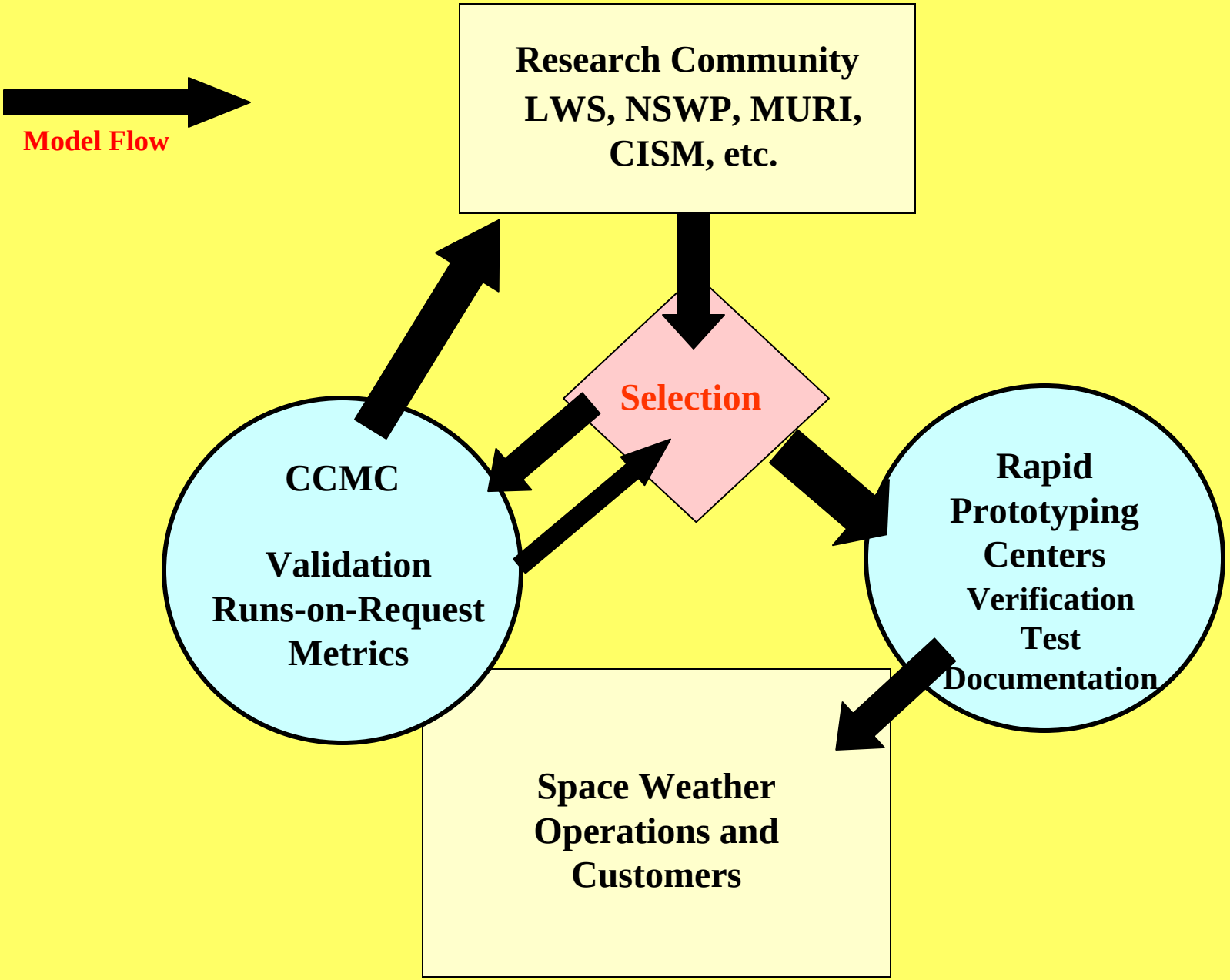
Space Weather Model Development



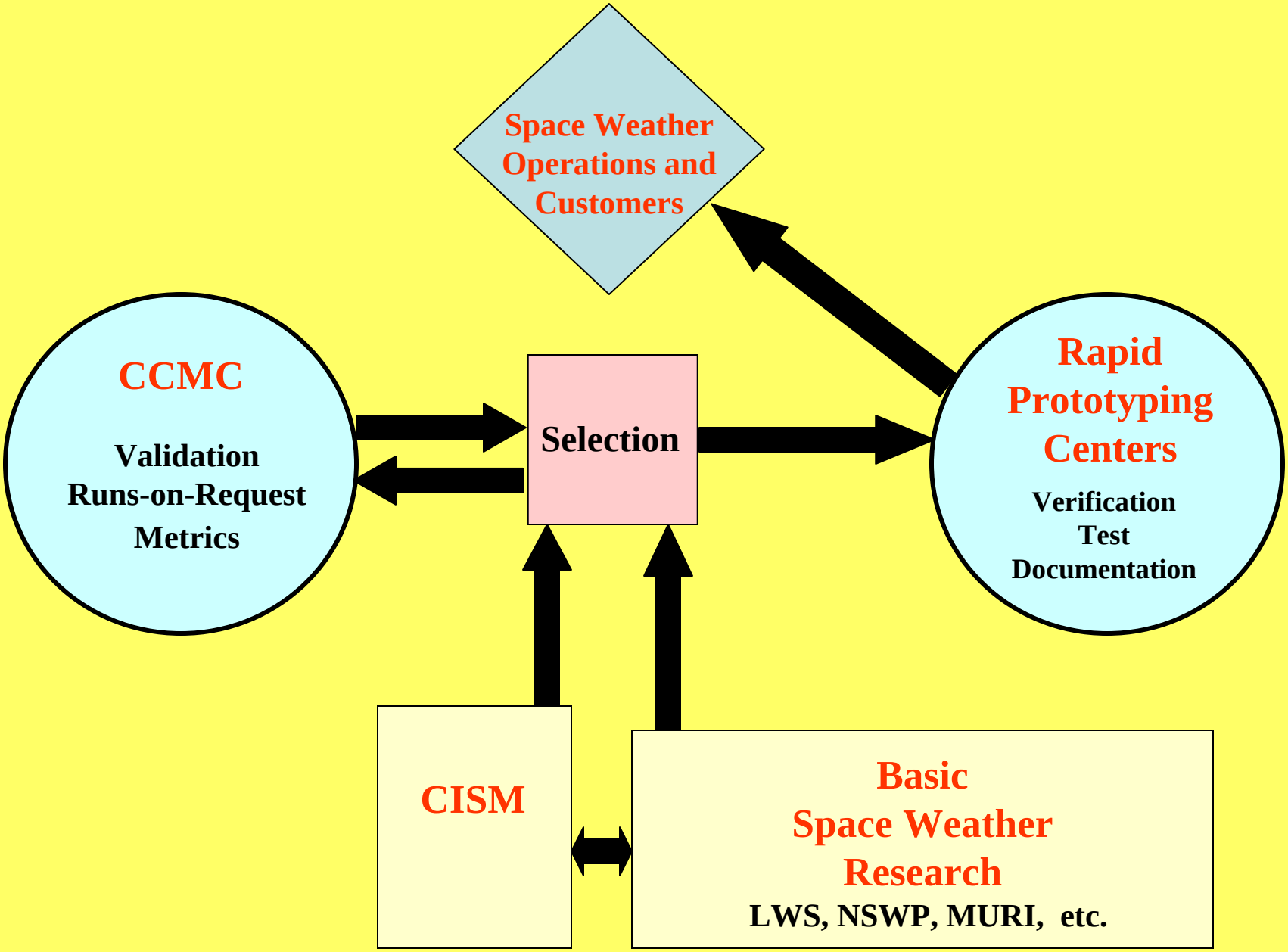
Space Weather Model Development



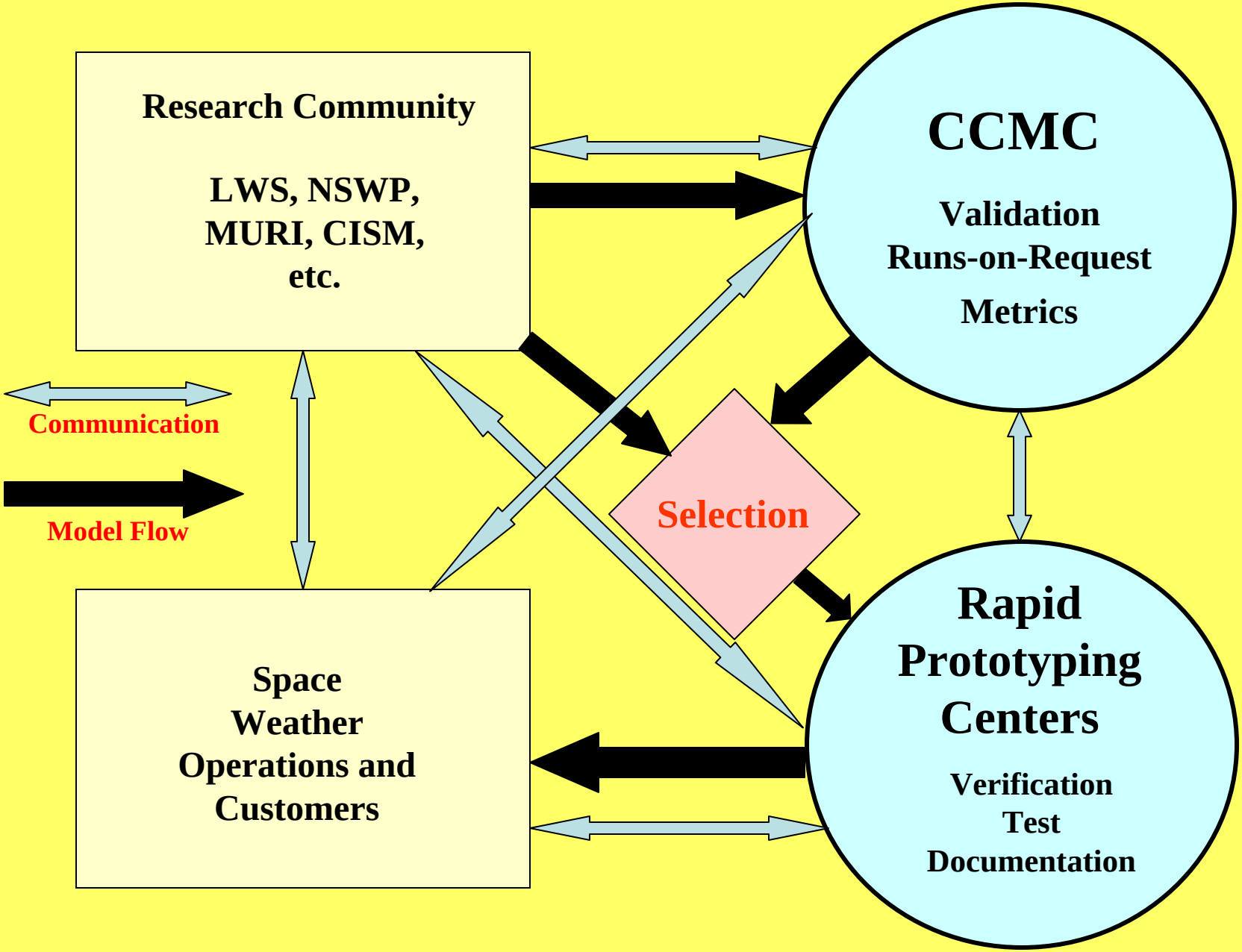
Space Weather Model Development



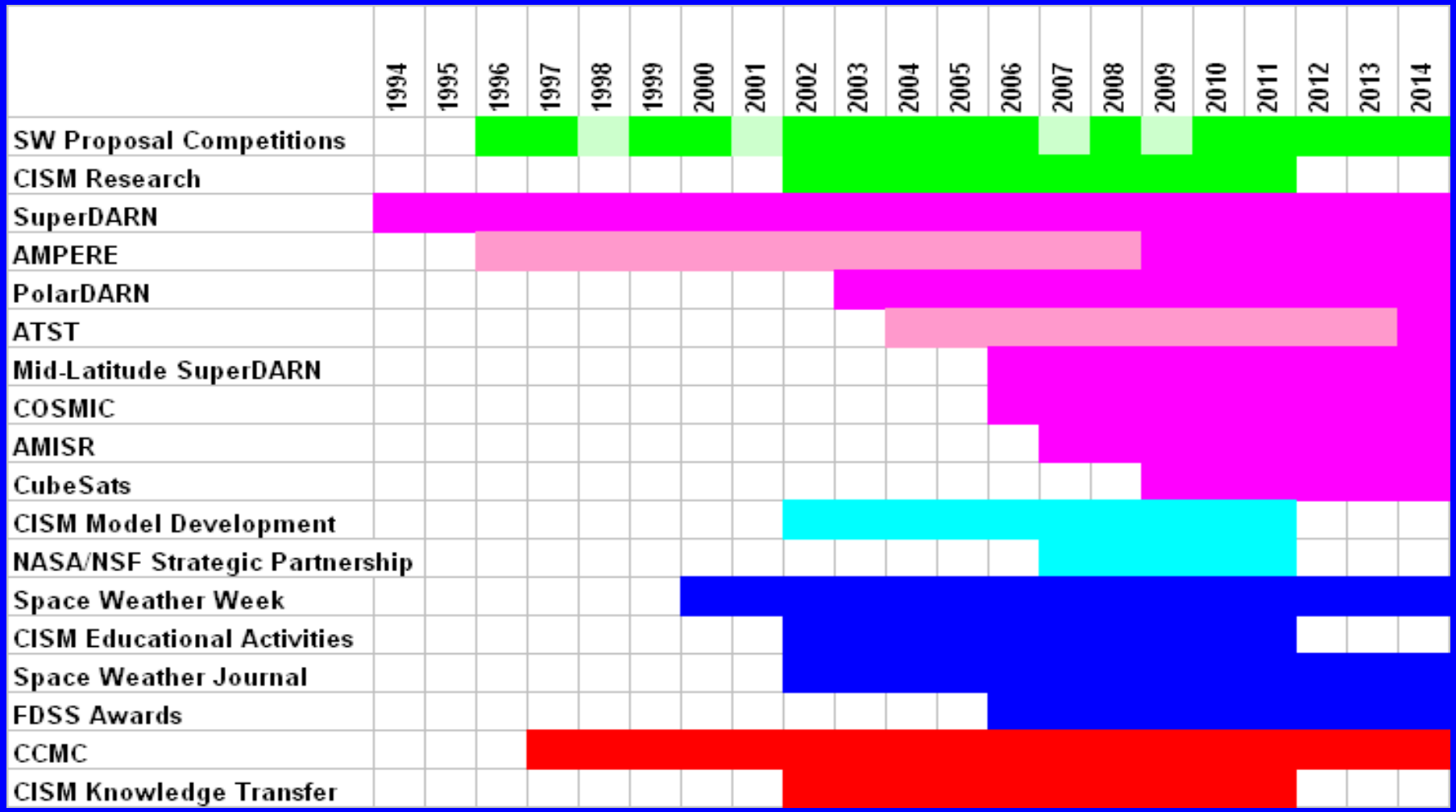
Space Weather Model Development



Space Weather Model Development



NSF Contributions to Space Weather Activities



Zermatt Discussions

- **The workshop included four panel sessions covering the following topics:**
  - **Lessons learned from existing community programs,**
  - **Lessons learned from current modeling activities,**
  - **Interest by modelers in a community program, and**
  - **Perspectives from the space weather user community.**

Zermatt Conclusions

- **Space Weather modeling is good**
- **General support for a community modeling program**
- **Disagreement about the role of a center with sustained support**
- **Where should new funding go? Targeted toward space weather modeling or enhancement of SHINE, GEM, and CEDAR**
- **Targeted SW modeling should be for model development, test, validation, and use.**
- **Need balance between individual investigator awards and center-type modeling activities.**

CISM Lessons Learned

(From Quinn and Hughes, SW 2009)

- **Coupled models capture important "system" aspects of space weather.**
- **Component model development is essential.**
- **A single Sun-to-Earth model does not meet all needs; a flexible suite of models that can be coupled and driven in different combinations is more practical and effective.**
- **For models with future application to operations, sustained interaction between forecasters and model developers is essential.**
- **"Center" synergy encourages collaborations, stimulates research, enables valuable educational and outreach opportunities.**

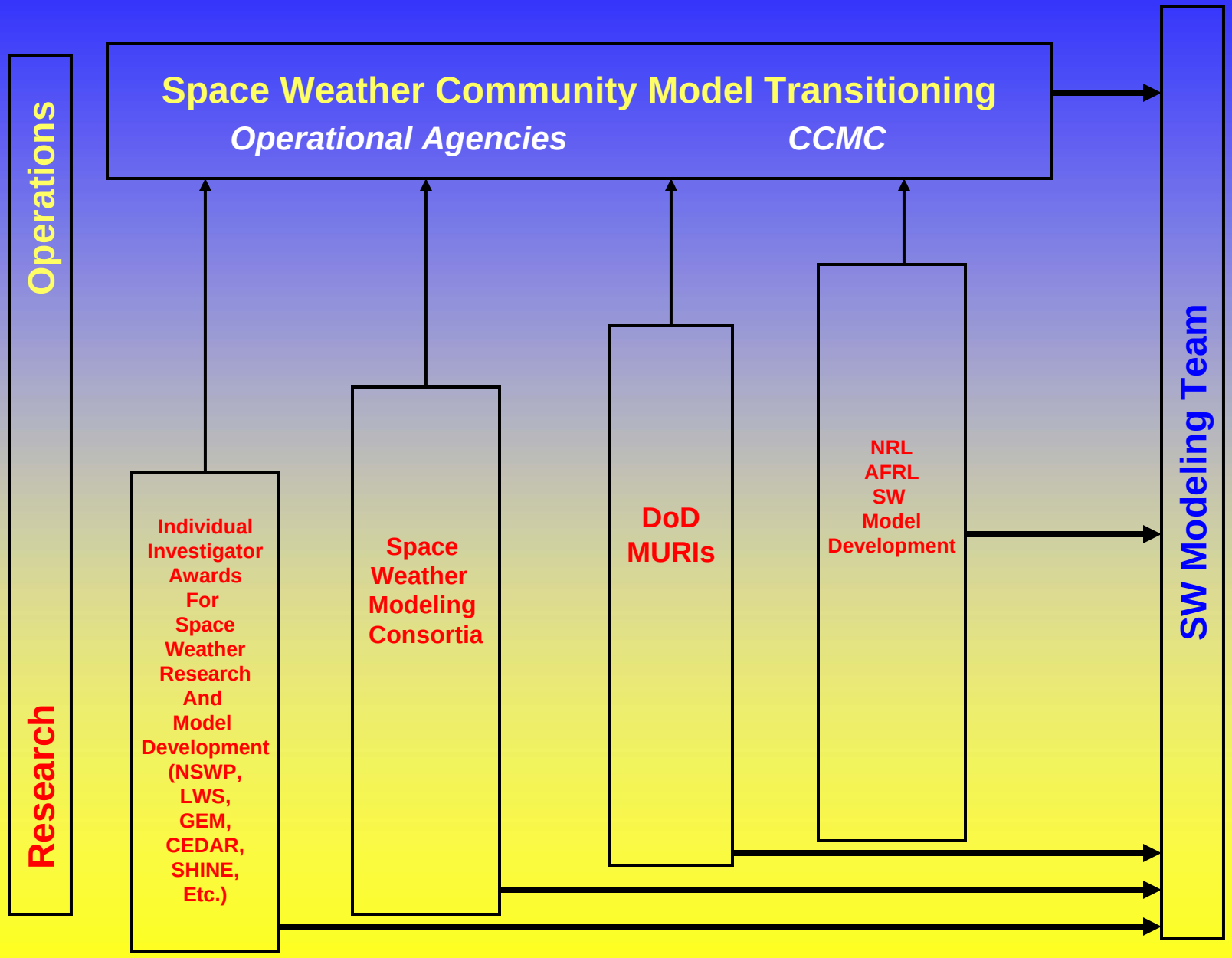
CISM suggestions on the way forward:

- **Keep the component model pipeline primed.**
- **Integrative activities (coupling models, building frameworks, implementing new software and hardware technologies) must be supported.**
- **Community-directed model development that transcends institutional and disciplinary boundaries is essential.**
- **Transitioning research to operations requires extended collaborations among all stakeholders.**
- **Systematic validation of models provides the foundation for understanding fundamental processes and model capabilities.**

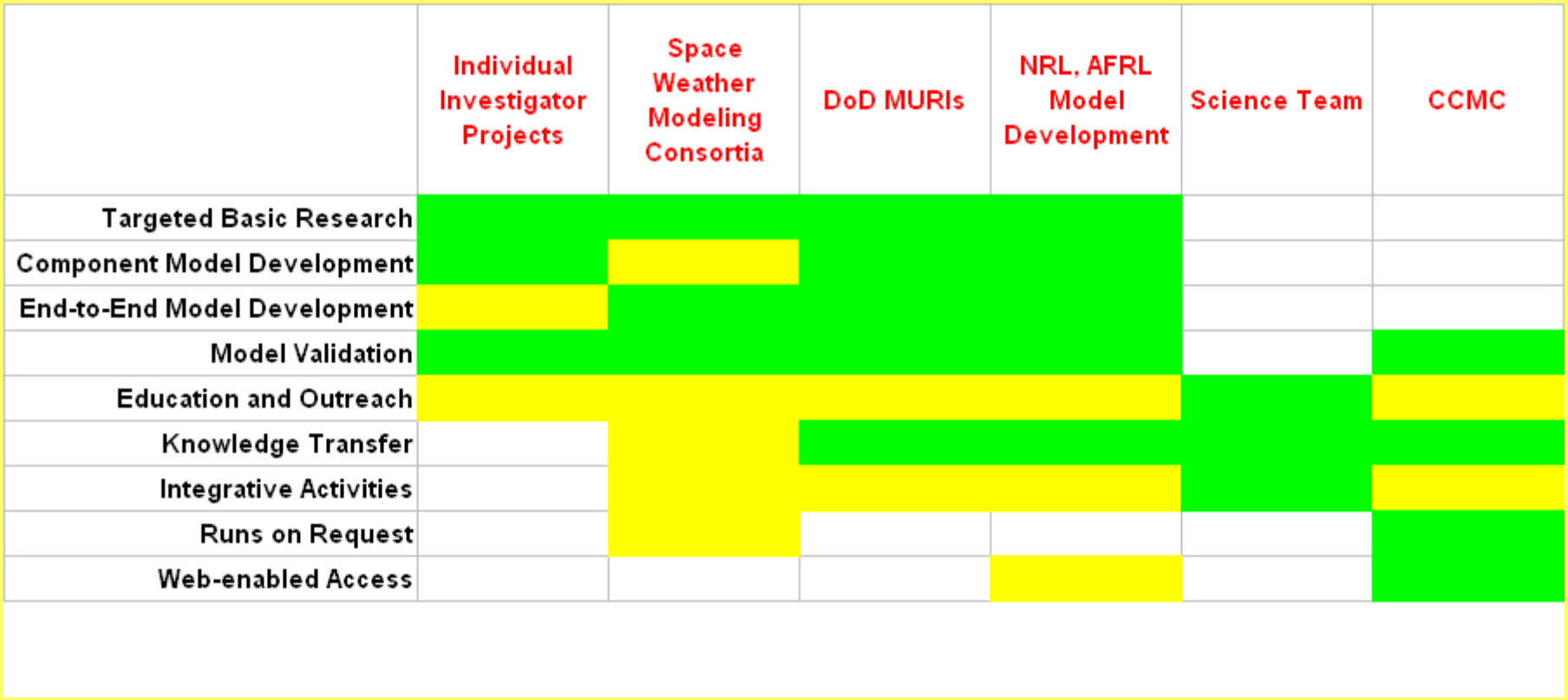
Recommendations from discussions on the Space Weather Prediction Testbed (SWPT) in January and March 2009

- **Protection of intellectual property**
- **The importance of in-house research at NOAA SWPC**
- **Participation of model developers in transitioning**
- **Competitive bidding of SWPT implementation**
- **Composition of the SWPT Executive Board**
- **Public distribution of metrics results**
- **Multiple paths from research to operations**
- **Fair and open selection process for models**
- **Strong participation from the private sector**
- **Importance of interagency participation**
- **Importance of including different types of models**
- **Accounting for the staffing and computing limitations of the operational centers**

Space Weather Community Modeling Program



Distribution of Space Weather Community Modeling Activities



Conclusion

How to Move Forward

- **Develop a plan that captures what we are already doing.**
- **Emphasize communication and coordination.**
- **Justify redundancy of effort or eliminate it.**
- **Emphasize how strongly coupled the Sun –Earth system is.**
- **Stay on the same page.**