



# Model Developer's View of R202R20...

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# NOAA Affiliated Research Centers



## Federally Funded Research and Development Centers (FFRDCs)



**NCAR (UCAR)**



JPL (Caltech)



**NSO (Association of Universities for Research in Astronomy)**



Pacific Northwest National Laboratory (Batelle)



## NOAA Research Laboratories



Atlantic Oceanographic and **Meteorological** Laboratory (AOML)



**Air** Resources Laboratory (ARL)



**Earth System** Research Laboratory (ESRL)



**Geophysical Fluid Dynamics** Laboratory (GFDL)



Great Lakes Environmental Research Laboratory (GLERL)



National **Severe Storms** Laboratory (NSSL)



Pacific Marine Environmental Laboratory (PMEL)



## NOAA Cooperative Institutes (incomplete list)



Cooperative Institute for Marine and **Atmospheric** Studies (U. Miami)



Cooperative Institute for **Mesoscale Meteorological** Studies (U. Oklahoma)



Cooperative Institute for Marine Ecosystems and **Climate** (UCSD)



Joint Institute for Marine and **Atmospheric** Research (U. Hawai'i)



Joint Institute for the Study of the **Atmosphere** and Ocean (U. Washington)



Cooperative Institute for Research in **Environmental** Sciences (CU)



Cooperative Institute for Research in **the Atmosphere** (Colorado State U.)



Cooperative Institute for **Meteorological Satellite** Studies (U. Wisconsin)



Cooperative Institute for **Climate** and Satellites (U. Maryland)



Cooperative Institute for **Climate** Science (Princeton U.)

**No Space Weather Research Lab**

**No Cooperative Institute  
for Space Weather**

# Community Models

- Leading weather models – all government based/funded
  - European Centre for Medium-Range Weather Forecasts (**ECMWF**) is an independent intergovernmental organization supported by most of the nations of Europe and is based at Shinfield Park, Reading, UK.
  - UK Met Office Unified Model (**UKMET-UM**) is a numerical model of the atmosphere used for both weather and climate applications.
  - NOAA NCEP's Global Forecast System (**GFS**) is the cornerstone of NCEP's operational production suite of numerical guidance.
  - NCAR's Weather Research and Forecasting (**WRF**) Model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs.
  - The German Meteorological Office runs a global hydrostatic model (**GME**). They also run a non-hydrostatic Lokal-Modell for Europe (**LME**).
- Leading global space weather models – all university/SB based
  - MAS: Global coronal model developed by SAIC and maintained by PSI
  - ENLIL: Global heliosphere model developed at CIRES and maintained at Catholic University
  - OpenGGCM: Global magnetosphere model developed at UCLA and maintained at UNH
  - LFM: Global magnetosphere model developed at NRL and maintained at Dartmouth and NCAR
  - GAIM: Data assimilative ionosphere-thermosphere model developed at Utah State University
  - SWMF: Sun-to-Ionosphere model developed at the University of Michigan

# It Takes a Village: SWMF Development

Software Design (framework, best software practices for high-end computing)	Computational Scientists (develop new methods and algorithms for high-end scientific computing)	Physics Modelers (develop new equations, and/or implement them in high-performance codes)	Application Scientists (implement boundary conditions, source terms and visualization)	End Users (apply existing codes to specific events and cases)
	Toth			
		Sokolov		
		van der Holst		
		Tenishev		
			Ridley	
			De Zeeuw	
		Gombosi		
			Manchester	
			Welling	
			Hansen	
			Huang	
			Jia	
				Liemohn
				Ilie
				Ganushkina
				CCMC
				SWPC
SWMF Development and Application Team				

- 4 T&TT faculty
- 11 Res. Faculty
- Integrated design, development, beta testing and applications team
- Strong R2O focus (CCMC, SWPC)
- 20 years, ~150 PersonYear investment (~\$50M)
- Unique circumstances, non-reproducible
- Many funding sources (various NSF, NASA, DoD, DoE programs)

# Why, or Why Not Universities?

## Advantages

-  Innovation
-  Little bureaucracy, lots of freedom
-  Flexibility
-  Student involvement

## Disadvantages

-  Soft money uncertainty
  - M** When the money goes away, the effort dies
-  Usually lives and dies with a lead faculty
-  No government ownership (nobody cares if the group goes away)

# Bayh–Dole Act (1980)

- The Bayh-Dole Act permits a university, small business, or non-profit institution using federal funds for research to produce an invention to retain the title on any patent issued for such inventions.
- Specifically the Bayh-Dole Act allows universities, small businesses and other non-profit organizations to elect to retain any “subject invention” made with federal funds.
- The institution retaining the title must commit to the commercialization of that invention.
- The university is also required to share a portion of the royalties from the invention with the inventors and must use a portion of the royalties for laboratory purposes.
- The government does reserve certain rights to protect the public interest.
  - It retains a “nonexclusive, nontransferable, irrevocable, paid-up license to practice on behalf of the United States any subject invention.”
  - The government also has the right to require the contractor who owns either the title or an exclusive license to the invention to grant a nonexclusive, partially exclusive, or exclusive license in any field of use to a responsible applicant.

# Intellectual Property Rights of SWMF

- The Regents of the University of Michigan hold the copyright to SWMF
  - SWMF is the most open of all global space weather models
    - **M** Source code is freely downloadable....
    - **M** ...but source code cannot be changed without UM permission
- NOAA can use SWMF for operational purposes. However,
  - NOAA cannot use SWMF for research without involving the University of Michigan
    - **M** ...but operational run library can be made available for scientific use
  - NOAA cannot disseminate SWMF to third parties
  - SWMF cannot be renamed or changed without specific permission from the University of Michigan
  - In documents NOAA should refer to the model as “SWMF developed at the University of Michigan”
- Since the SWMF team at the University of Michigan is largely funded by soft money, we need to coordinate any research use:
  - Outside users of SWMF should contact the developers before using it in any other field
  - Outside users of SWMF should invite as a co-author at least one SWMF development team member who worked on code features central to the research
  - Outside users of SWMF should coordinate all research proposals using SWMF or its components with an appropriate development team member
  - Outside users of SWMF should consider the funding of development/maintenance of SWMF a group and community priority and should include appropriately funded Michigan Co-I(s) in any proposal
  - Outside users of SWMF should consider continued communication and coordination of the utmost importance and should speak with, send email or make phone calls to the SWMF development team frequently to avoid misunderstandings and unnecessary competition

# Recommendations

- NOAA needs a Space Weather Research Laboratory
  - ...but not at an FFRDC and not in Colorado...
- NOAA needs a couple of Space Weather focused Cooperative Institutes
  - Rename/refocus CIRES at CU?
  - Add more or refocus others?
- Community models and operational models should be separate but coordinated
  - Operational model results should be available for scientific analysis
  - Operational models should not be run in science mode
- Intellectual property issues should be solved in a mutually acceptable way.
  - Template need to be developed
  - Universities, FFRDCs, Cooperative Institutes need different templates.
- Long-term funding solutions to be found for university developed operational models