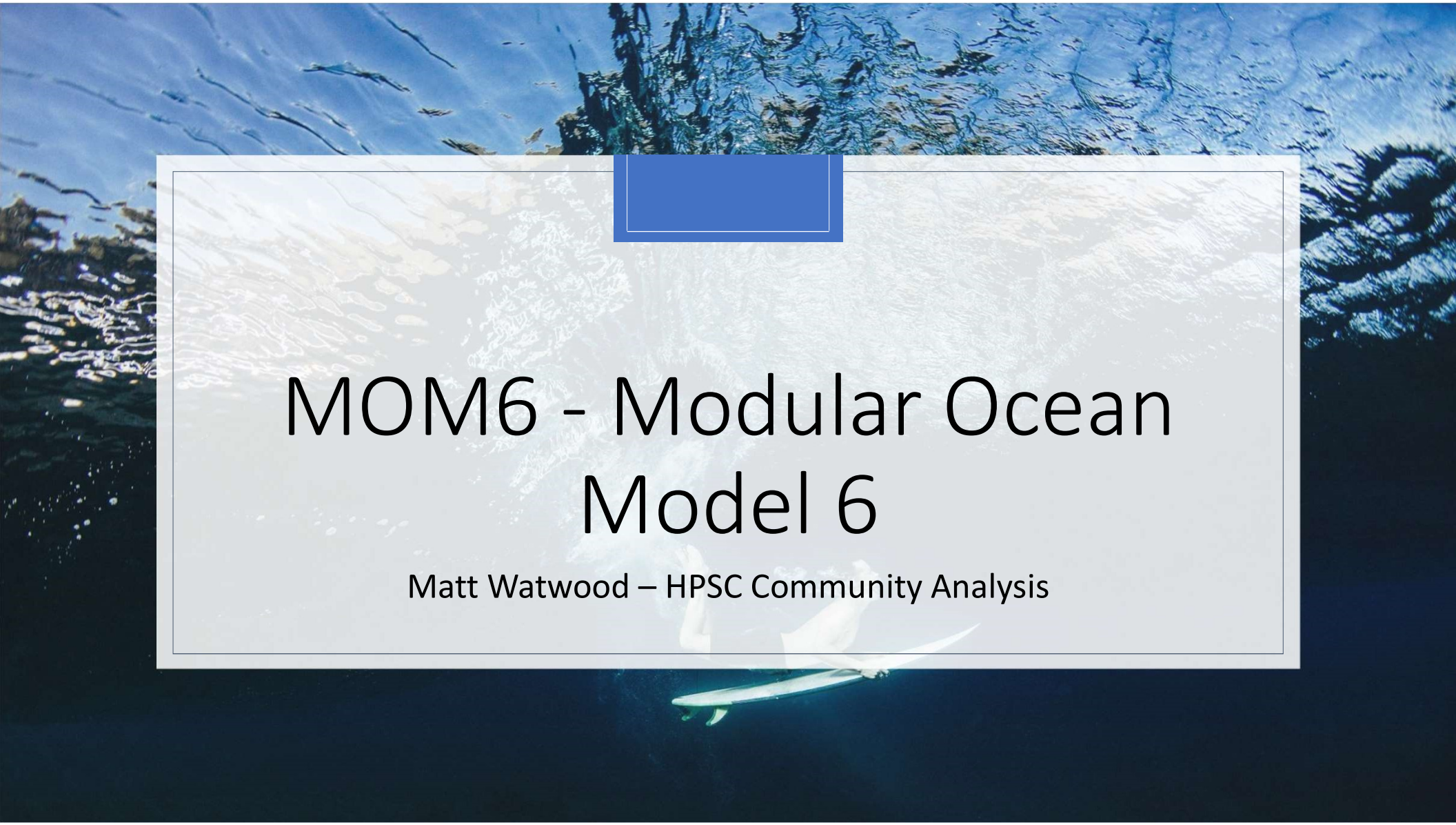
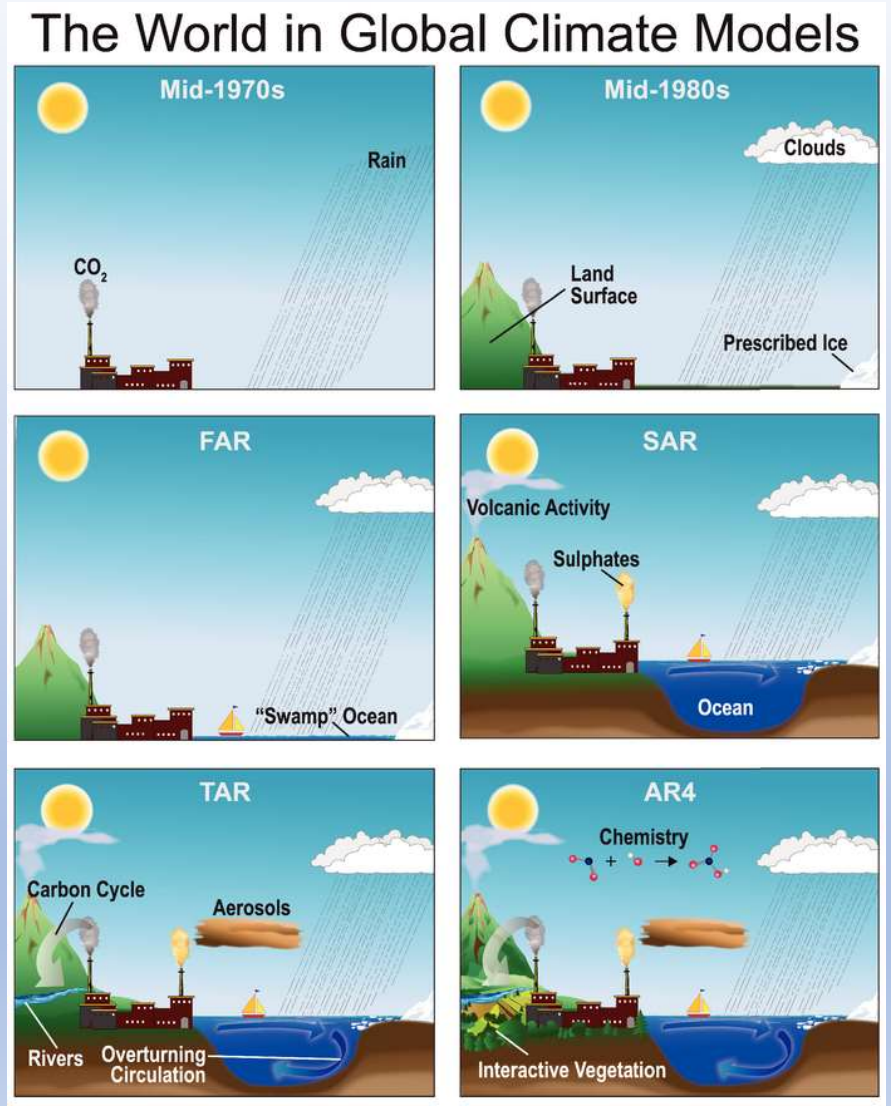


MOM6 - Modular Ocean Model 6

Matt Watwood – HPSC Community Analysis

Global Coupled Climate Models

- What are they?
  - Independent physical models of ocean, atmosphere, land, and sea ice components
  - Coupled to each other and run over a variety of time scales
- Distinct software development effort to create the coupling effects and components
- Modular design allows expertise in each component and the coupling effects

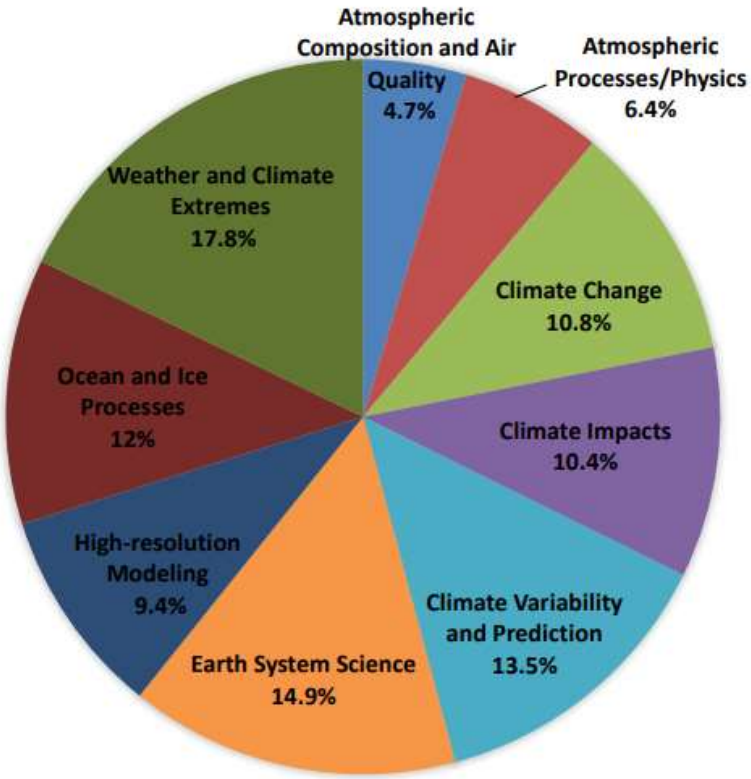

The World in Global Climate Models
Mid-1970s
Rain
CO_2
Mid-1980s
Clouds
Land Surface
Prescribed Ice
FAR
"Swamp" Ocean
SAR
Volcanic Activity
Sulphates
Ocean
TAR
Carbon Cycle
Aerosols
Rivers
Overturning Circulation
AR4
Chemistry
Interactive Vegetation

Primary Development – NOAA GFDL

- The National Oceanographic and Atmospheric Administration (NOAA) Geophysical Fluid Dynamics Lab (GFDL)
- Based out of New Jersey and dating back to 1955 founding of GFDL
- MOM1 Released in 1991.
- 2018 Operating Budget of ~$54 million

Budget

Geophysical Fluid Dynamics Laboratory
FY18 Funding of Research Areas



Research Area	TOTAL ($K)
Atmospheric Composition and Air Quality	$2,527
Atmospheric Processes/Physics	$3,484
Climate Change	$5,818
Climate Impacts	$5,638
Climate Variability and Prediction	$7,319
Earth System Science	$8,068
High-resolution Modeling	$5,084
Ocean and Ice Processes	$6,493
Weather and Climate Extremes	$9,644
TOTAL	**$54,074**

Communication

- Excellent Github documentation for contributions!
- GFDL claims to be the first ocean model to move to open source.[1]
- Extensive documentation available and in active development
- Stats:
  - GFDL MOM6 Contributors – 40 total with 26 > 10 commits
  - Project start ~February 2013

1 A Historical Introduction to MOM. 2015 Griffies et al. https://www.gfdl.noaa.gov/wp-content/uploads/2019/04/mom_history_2017.09.19.pdf

Stakeholders and Involved Communities

- GFDL – Coupled Model (CM) and Earth System Model (ESM)
  - NOAA's Global Coupled Models
- NCEP – National Center for Environmental Prediction
  - 9 Centers within this, notably the Ocean Prediction Center
- NCAR - National Center for Atmospheric Research
  - Community Earth System Model (CESM)
- Rutgers University
- Florida State University
- Australian National University

NCAR Specific

- NCAR Total Budget ~$95 million
- CESM3
  - Integrating MOM6 into the next iteration
- Two full time software developers to work on this integration

Current HPSC Related Projects

- Output and Visualization using HTML and Jupyter
- OpenMP/MPI Optimizations and Balancing
- Parallel I/O

Videos!

- https://www.gfdl.noaa.gov/visualizations-aerosols-and-clouds/