# Modeling the Earth System

Overview

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Geophysical Fluid Dynamics Laboratory Review
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### We're on a Mission

**NOAA's Mission:** Science, Service and Stewardship

- 1. To understand and predict changes in climate, weather, oceans and coasts;
- 2. To share that knowledge and information with others; and
- 3. To conserve and manage coastal and marine ecosystems and resources.

The GFDL mission is to be a world leader in the development of comprehensive, integrated and unified models of the Earth system comprising the atmosphere, oceans, land, biosphere, cryosphere, and ecosystems; and application of these models for the seamless understanding, predictions and projections of the Earth system, from hours to decades and from global-to-regional spatial scales, accounting for natural variations and forced changes.

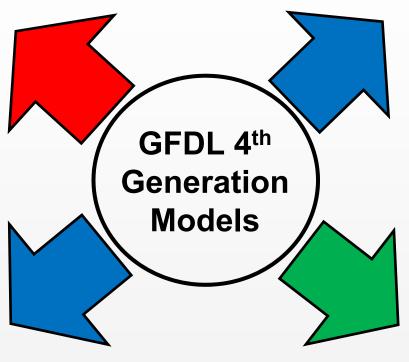


## **Broadening GFDL Model Customer Base**

Climate Projections and Assessments

(CMIP6, ...)

**Experimental Climate Prediction (NCEP NMME)** 

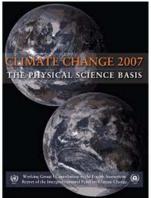


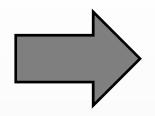
US Weather Prediction (NOAA NGGPS)

Community Support (NCAR, NASA, ...)

## **Some History: Divergence to Convergence**







2013: CM3, ESM2



High atmos. res. CMs for seasonal

HiRAM

High res. AM for

sub-seasonal to

seasonal forecasting

forecasting FLOR HiFLOR

CM2.5 CM2.6 High ocean res. CMs

( CM3

ESM2M ESM2G

CM with Atmos. chem. Aerosol indirect effect

Carbon cycle; ocean vertical coordinate

The 2011 GFDL Strategic Science Plan outlined a unification of this model suite





### **Our Fourth Generation Model Configurations**

#### SHIELD

Weather; Subseasonal to Seasonal (S2S)

#### FV3

Weather Scale Physics

Atmos. DA

Global uniform/Nested/Stretched Grids 3-25 km horizontal resolutions 63-91 vertical levels

> Mixed-Layer Ocean

NOAH Land model

#### SPEAR

Seasonal to Decadal (S2D)

#### FV3

AM4.0

Climate Scale Physics

Simplified Aerosol Chemistry

100/50/25 km horizontal resolutions 33-63 vertical levels

#### MOM6

SIS2

Ocean DA (ECDA)

1 degree horizontal resolution 75 vertical layers

LM4.0

#### CM4

Decades to Centuries Climate processes

#### FV3

AM4.0

OM<sub>4</sub>

Climate Scale Physics

Simplified Aerosol Chemistry

100/50/25 km horizontal resolutions 33 vertical levels

### MOM6

SIS2

1/4 degree horizontal resolution 75 vertical layers

LM4.0

#### ESM4

Decades to Centuries Climate composition

#### FV3

AM4.1

Climate Scale Physics

Fully Interactive Atmos. Chemistry

> 100km horizontal resolutions 49 vertical levels

#### MOM6

SIS2

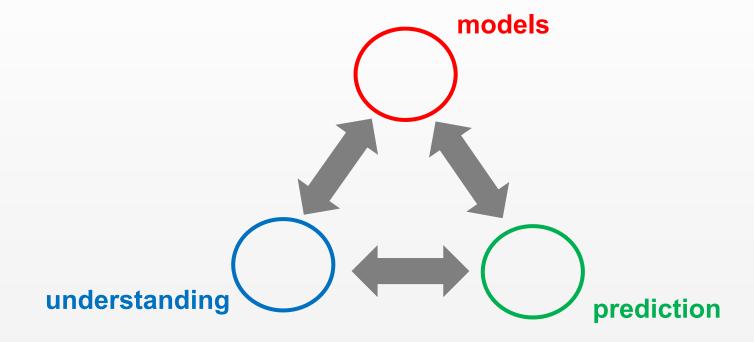
COBALT

1/2 degree horizontal resolution 75 vertical layers

LM4 1

### **Session Connections**

The 2019 GFDL Strategic Science Plan outlines the use of our new model suite for understanding, predictions, and projections





## **Coming Up**

- 9:35 FV3 at GFDL and beyond Lucas Harris
- 9:55 MOM6, SIS2 and OM4 Alistair Adcroft
- 10:15 New generation atmospheric model AM4 and Cloud-Climate Initiative Ming Zhao
- 10:35 **Break**
- 10:55 Land-climate interactions and GFDL's new land model LM4 Elena Shevliakova
- 11:15 Atmospheric chemistry-composition in GFDL Models Vaishali Naik
- 11:35 GFDL's fourth generation CM4 and ESM4 John Dunne
- 12:05 Discussion (Leaders: Isaac Held and Mike Winton)

