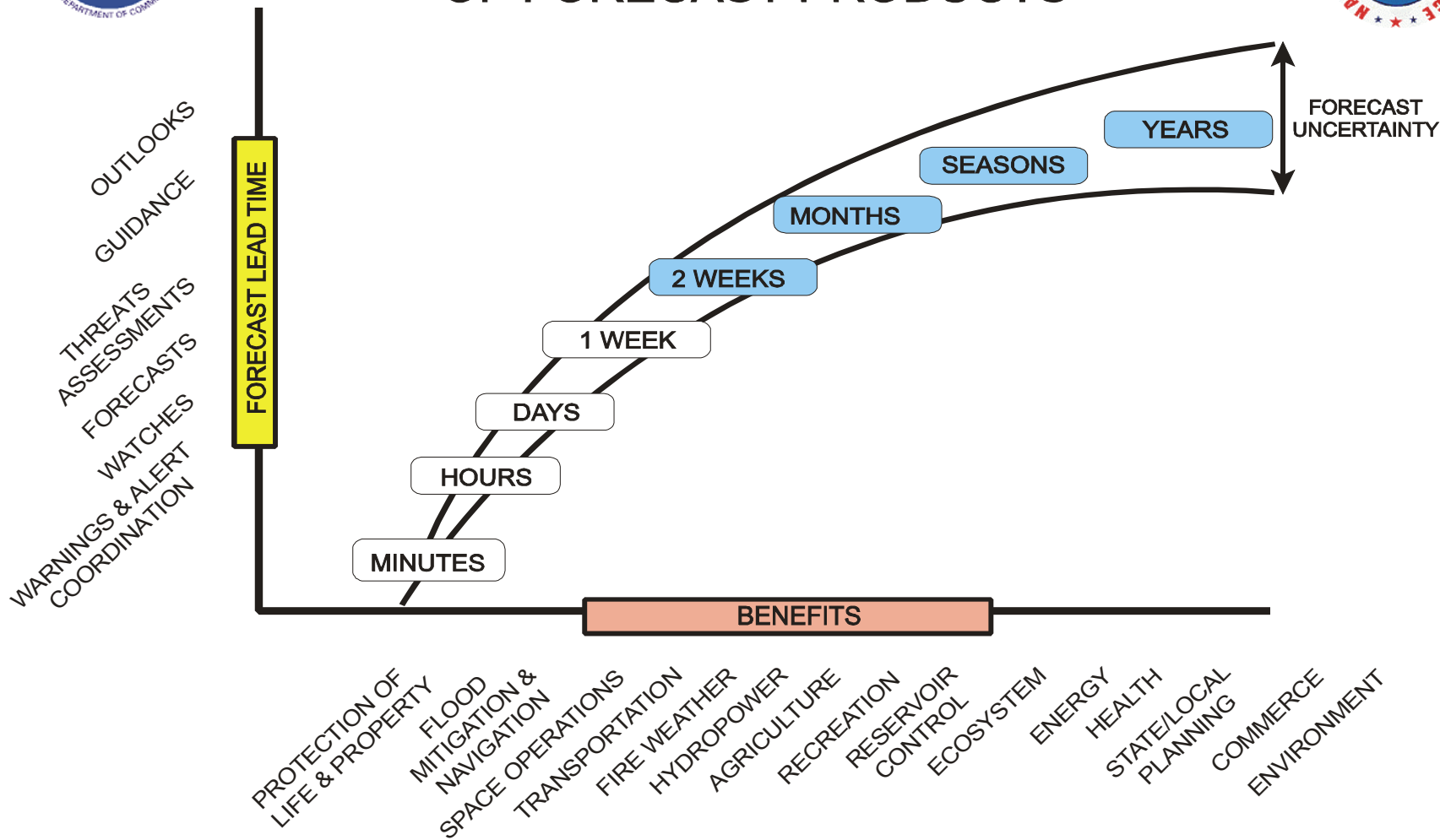# HYCOM in NCEP's Modeling Plans

D.B. Rao
Environmental Modeling Center
NCEP/NOAA
Washington, D.C.
Desiraju.b.rao@noaa.gov
November 7, 2006
HYCOM Annual Meeting

# NWS SEAMLESS SUITE
# OF FORECAST PRODUCTS

**FORECAST LEAD TIME**

OUTLOOKS
GUIDANCE
THREATS
ASSESSMENTS
FORECASTS
WATCHES
WARNINGS & ALERT
COORDINATION

FORECAST UNCERTAINTY

YEARS
SEASONS
MONTHS
2 WEEKS
1 WEEK
DAYS
HOURS
MINUTES

**BENEFITS**

PROTECTION OF LIFE & PROPERTY
FLOOD MITIGATION & NAVIGATION
SPACE OPERATIONS
TRANSPORTATION
FIRE WEATHER
HYDROPOWER
AGRICULTURE
RECREATION
RESERVOIR CONTROL
ECOSYSTEM
ENERGY
HEALTH
STATE/LOCAL PLANNING
COMMERCE
ENVIRONMENT

# Ocean Forecast Systems: Immediate Objectives

- Routine estimation of the ocean state [T,S,u,w,ssh].
  - Daily 0-4 week forecast
  - Every 5 years, re-analysis
- Help to improve the estimation of the atmosphere state
  - In short term global forecast
  - In short term regional forecast
    - Hurricane
    - US regional
- Help to improve the estimation of chemical components (water quality) and organisms distributions in the water(ecosystems).

# Ocean Forecast Systems: Domains

- Global Oceans

- Basins
  - Atlantic
  - Pacific
    - West Coast and Alaska(separately or together?)
    - Hawaiian Islands

- Regional
  - Application driven domains
  - Lakes

# Ocean Forecast Systems: some requirements

- Models:
  - Unified software systems suitable for efficient algorithm development (HOME) and coupling (ESMF)
  - Dynamical engines
    - . hydrostatic
      - Non-hydrostatic
      - Vertical coordinates
  - Non explicit physics
    - Sub grid scale parameterizations
      - Air-sea,Land-sea,ice-sea fluxes
      - Waves: gravity, internal
      - Turbulence in a variety of regimes
    - Multi-scales

# Ocean Forecast Systems: some requirements

- Data Assimilation
  - Unified software system for ocean data assimilation
  - Unified data gathering, quality control and data flows
  - Improvements in assimilation algorithms

# Ocean Forecast Systems: general configurations

- Ocean standalone Global Basin(*) and sub-basin systems for the Atlantic and Pacific(**)(0-1 week)
- Coupled Global atmosphere-ocean (***) (0-4 weeks)
- Event driven coupled regional  atmosphere-ocean (0-1 week) Tropical and extra-tropical storms
- Event driven coupled ocean physical-bio-geochemical (0-4 weeks).
- Event driven coupled ocean physical-physical (0-1 week).

*Eddy permitting to eddy resolving,

**Eddy resolving,

***Replacing standalone.

# Schedules

| | |
|---|---|
| RT-OFS Atlantic with SST assimilation | December 2005 |
| RT-OFS Atlantic with SST, CTD, SSH assimilation | FY2007 |
| Hurricane WRF-HYCOM | FY2006-2007 |
| Hurricane –HYCOM storm surge model | FY2006-2007 |

# GFS-1D ocean

- GFS sub-systems presently include one dimensional ice and land models.

- Currently a time persisted SST (from analyses) defines the boundary condition at the air-sea interface.

- 1D ocean: Bulk mixed layer model (Gaspar) with cold skin temperature parametrization.

# WRF-HYCOM Coupling Strategy

Atmosphere:

- WRF coarse domain one way nested to GFS.
- WRF fine Hurricane tracking domain two way nested to WRF coarse.
- WRF coarse domain configuration is changed every forecast cycle: 'jumping grid'.

Ocean:

- HYCOM regional one way nested to RTOFS.
- HYCOM regional domain configuration is changed every forecast cycle: 'jumping grid'.

Ocean-Atmosphere:

- Two way information exchange in over-lapping region.

# Schedules (near future; thus almost predictable)

| | |
|---|---|
| GFS-1D ocean | FY2007-2008 |
| NAM-1D Lakes | FY2008-2009 |
| Hurricane-NWW3-HYCOM storm surge | FY 2008 |
| Above coupled to NOS coastal storm surge models | FY2008-? |
| Initial RT-OFS Global HYCOM model | FY2007-2008 |
| RT-OFS HYCOM Pacific (West Coast, Alaska) | FY2008-2009 |
| RT0FS HYCOM Pacific (Hawaii Domain) | FY2009-2010 |

# Schedules (into the future)

| | |
|---|---|
| Dispersion of toxic chemicals and HAB's | FY2008 |
| GFS-HYCOM(*) coupling and improvements | FY2011-2015 |
| Global HYCOM ocean re-analyses (*) | FY 2010 and 2015 |
| Improvements in RT-OFS HYCOM Global and regional models | 2010-2015 |
| BGC-HYCOM ocean model (**) | 2011-2015 |
| •*In coordination with GFS activities | ** In coordination with NOS and Fisheries interests |

# Hurricane-Wave-Ocean-Surge-Inundation Coupled Models
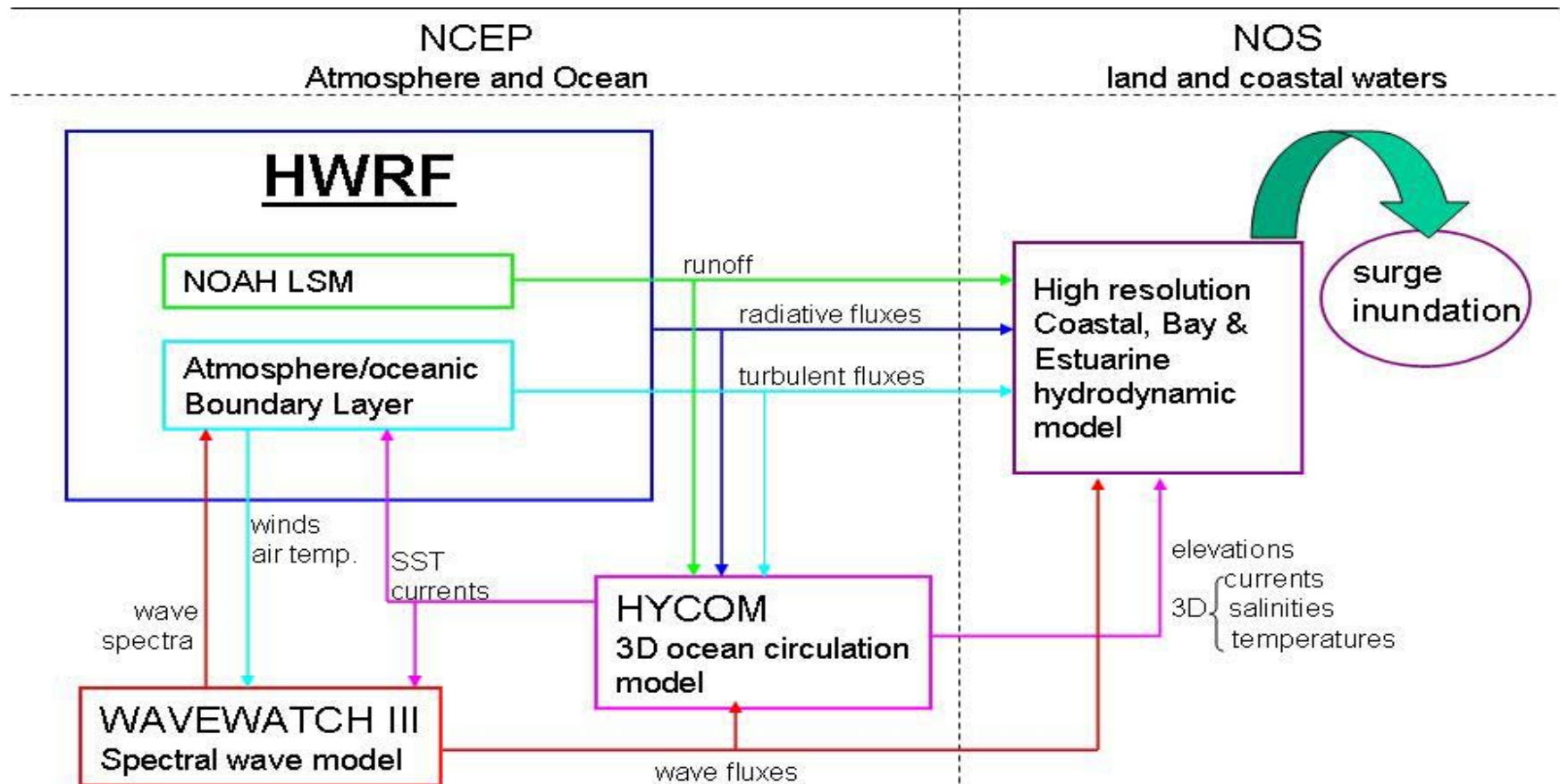
# Coupled Systems

- Coupled systems (water-sea-ice-chemicals-organims) require understanding of multi-scale multi-component non-linear interactions.

- New demands for models
  - New requirements to the physical ocean models (e.g. w for biology )
  - Integrated software and efficient coupling
  - Integrated diagnostic tools.