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Considering Climate Change in the CMAQ Simulation System

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Developments for Climate Change

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Preparing the capability to examine the response of deposition and water quantity to climate change

Want the system to be fully coupled

Meteorology driving CMAQ also coupled to hydrology (connect the Hydrosphere)

Use dynamical downscaled region climate model based on WRF model (our standard met driver)

(not statistical downscaling

Developing for GOM hypoxia study

Capability in FY15/FY16

Coupled WRF-VIC System
Connect the Hydrosphere
(at 12 km)

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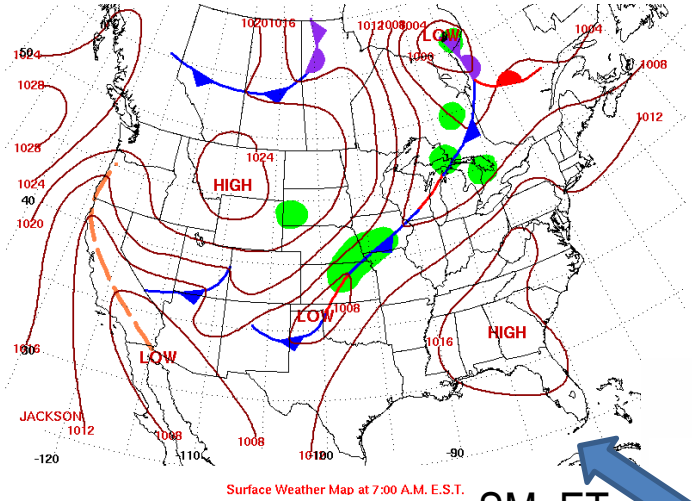
WRF

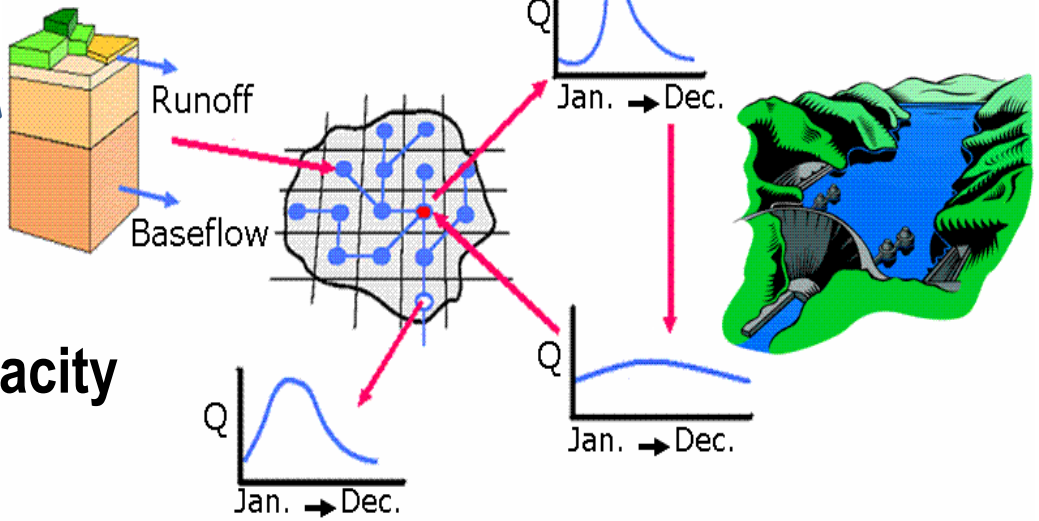


SM, ET

CESM P, T

Coupler

VIC



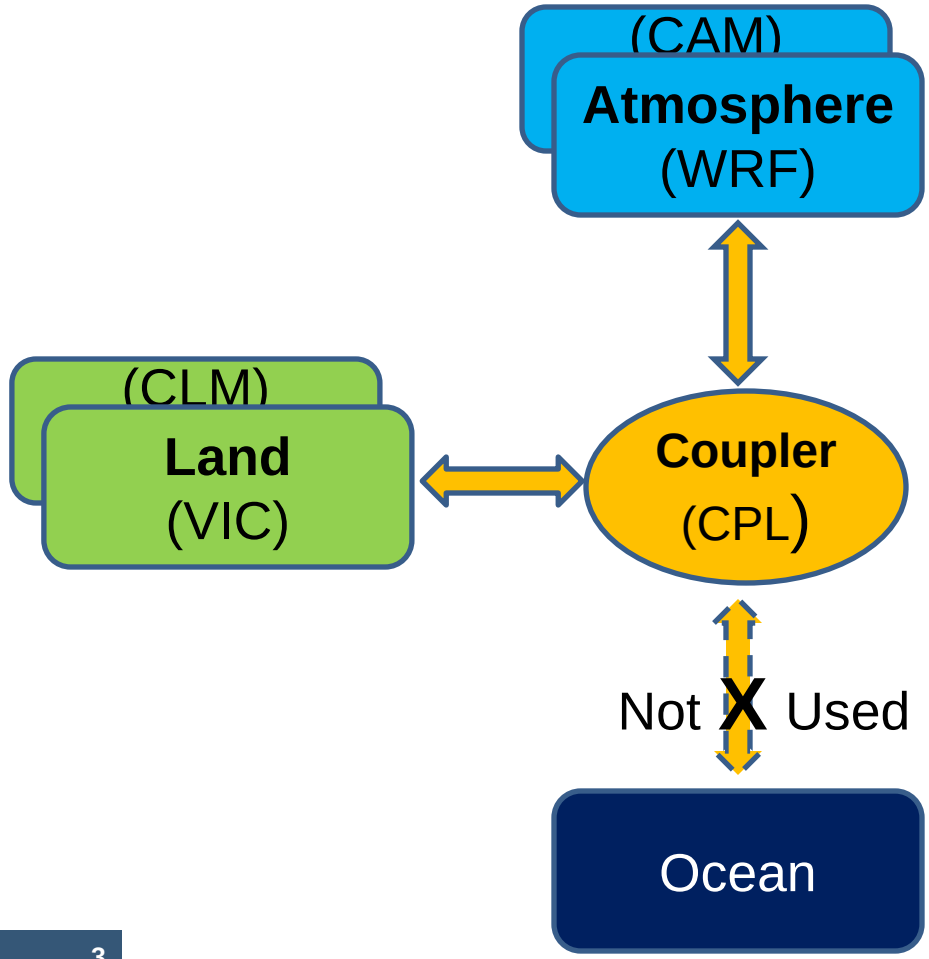
VIC Model Features:

- Multiple vegetation classes in each cell; fraction of the cell
- Sub-grid elevation band
- Sub-grid runoff variability
- Typically 3 soil layers used
- Non-linear soil moisture dependence of baseflow generation

VIC: Variable Infiltration Capacity Hydrologic Model

Developed at the University of Washington

Community Earth System Model (CESM) Coupling



Atmosphere --> Coupler

- Bottom level temperature, pressure, wind ..
- Downward shortwave (vis, nir)
- Precipitation

Coupler --> Atmosphere

(merged from land, ice, ocean)

- Latent, sensible heat fluxes
- Surface stresses
- Upward long wave
- Evaporative water flux
- Surface albedo

Dynamical Downscaling with WRF

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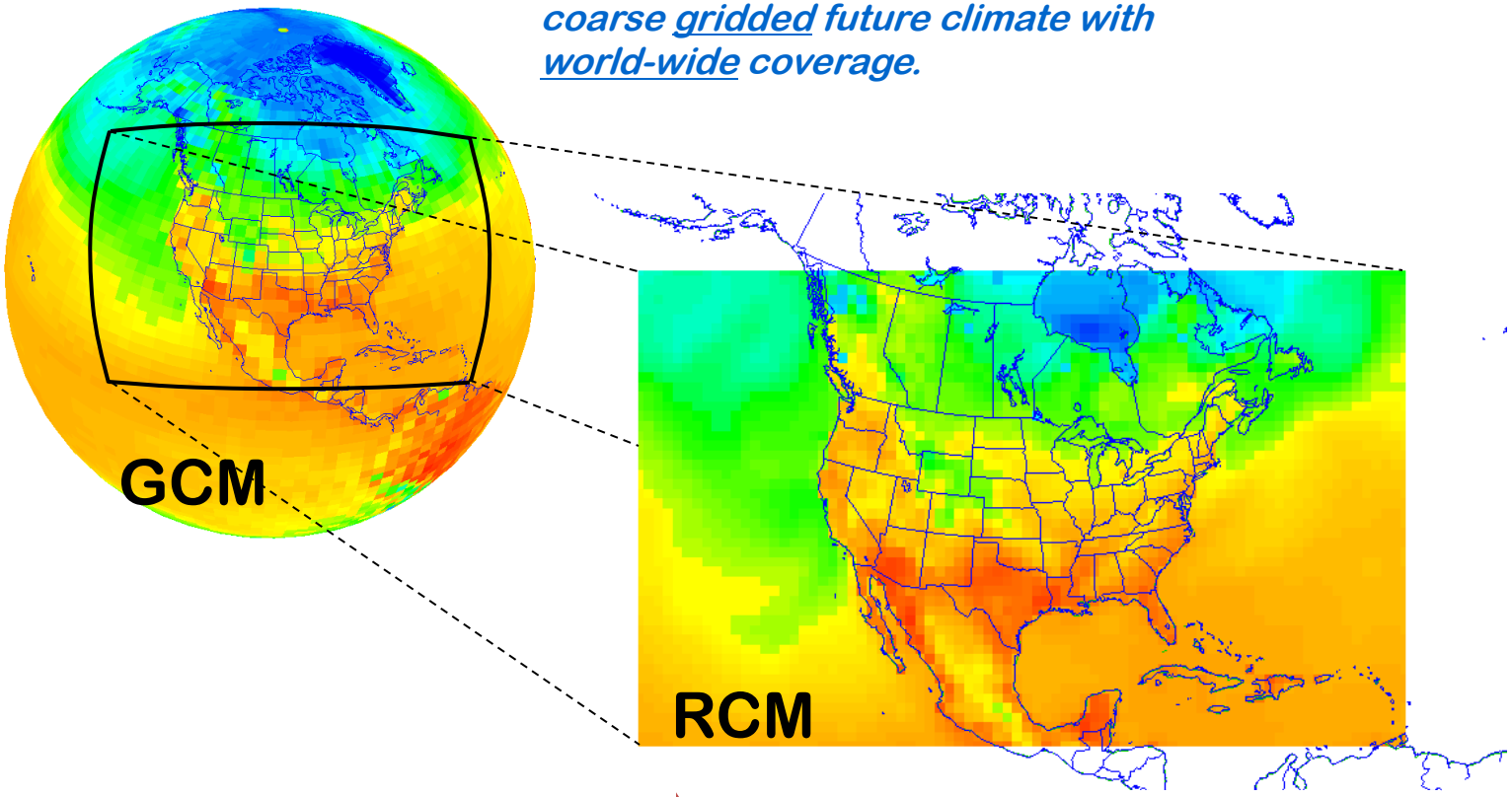
Global climate model (GCM) creates coarse gridded future climate with world-wide coverage.



Regional climate model (RCM) generates gridded higher-resolution climate predictions over focal area.

More detail in local effects from:
- *scale-appropriate physics*
- *topography & land/water interfaces*
- *urban areas (population centers)*
- *precipitation patterns*

Link to Ecosystem Models

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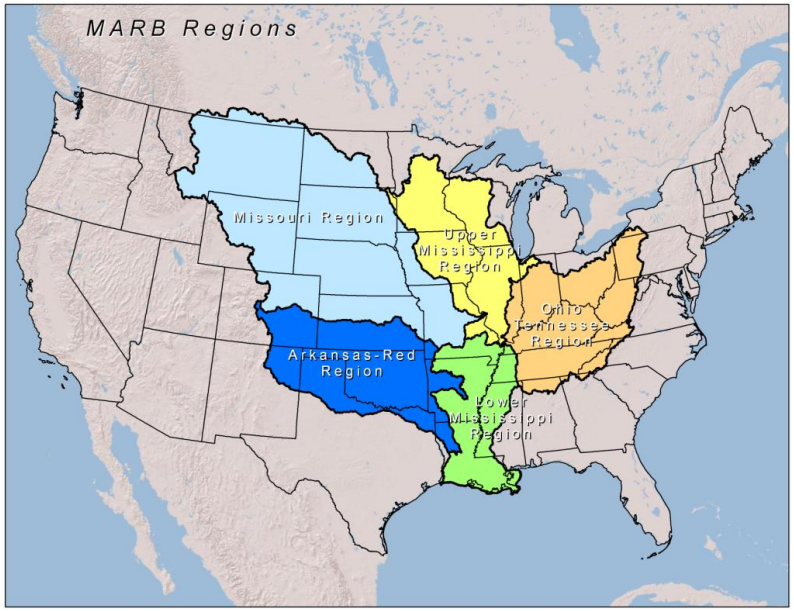
GOM Hypoxia



Agriculture Management
EPIC

NH_3

N,P Load

N_2O

Combustion
SMOKE
MARKAL

NO_X
VOC

Air Quality
CMAQ

N Deposition

Water Quality
NEWS
SWAT

N,P Load

Hypoxia
GoMDOM
GEM

Climate
EPA/AMAD
WRF
Downscaling

Meteorology
WRF

Hydrology
VIC

N Deposition

Hydrodynamics
Navy

ACE

SHC

SSWR

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Thanks

Questions?