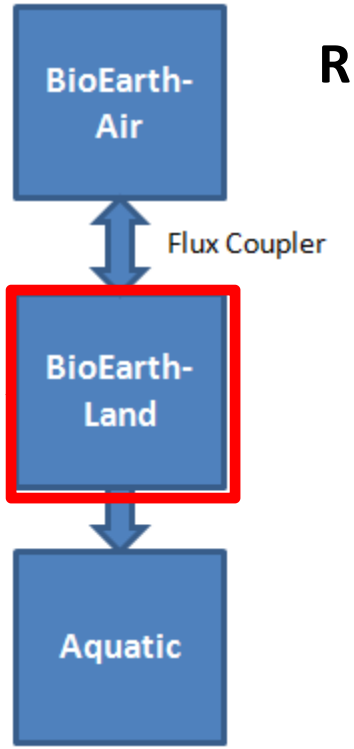
BioEarth

Biosphere-relevant earth system model

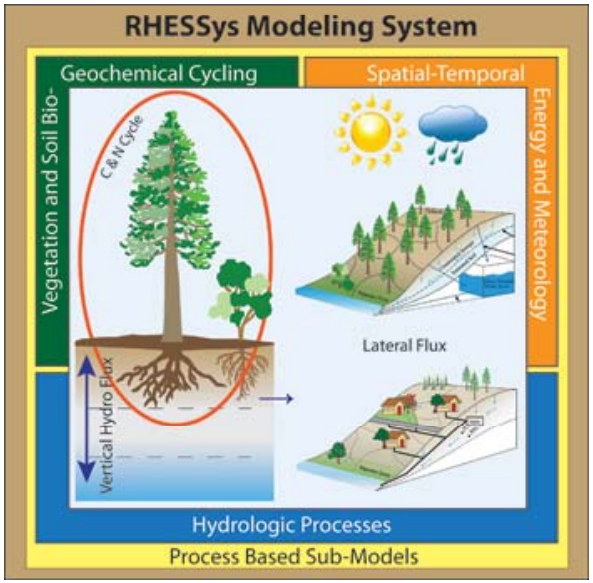
WG Ib – Terrestrial & Aquatic processes

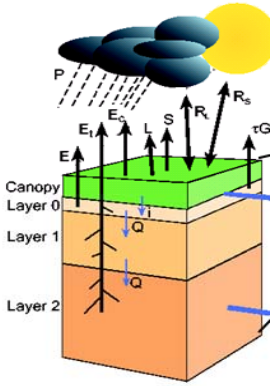
All-Hand Meeting
February, 2013

MODELS IN BIOEARTH-LAND/AQUATIC



RHESSys: ecohydrology and dynamic vegetation





VIC large-scale physical hydrology: we will utilize surface energy balance components

CropSyst: will use to incorporate crops into RHESSys

Streamflow routing, reservoirs, water management

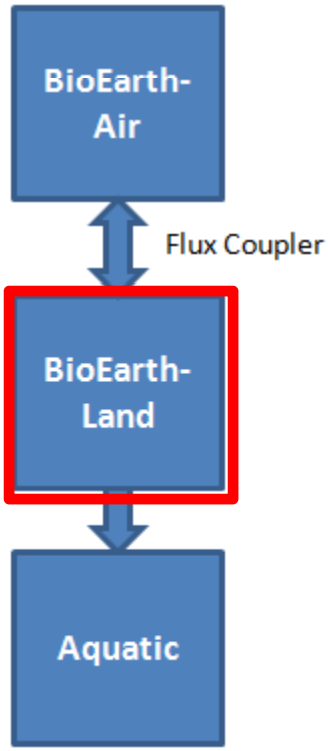
MEGAN Biogenic VOC Emission Estimates

Global NEWS
Global Nutrient Export from Water(S)heds

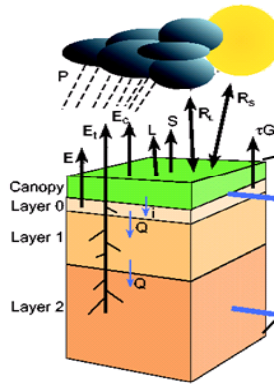
Nutrient Export

Economic Decision Making

Two BioEarth-Regional-scale Land Surface Model Options in Development



1. VIC-CropSyst (hydrology/crops)

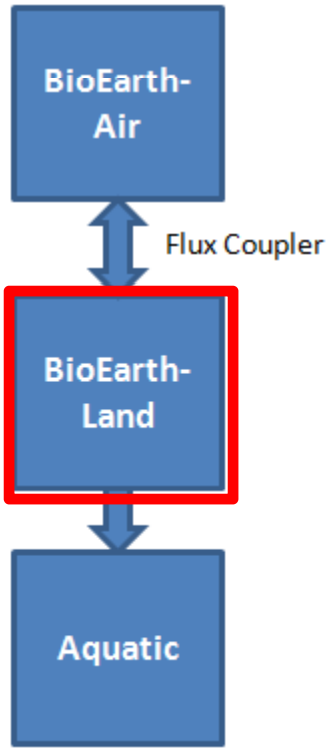


VIC: large-scale physical hydrology, including an hourly full energy balance needed for coupling to atmospheric models

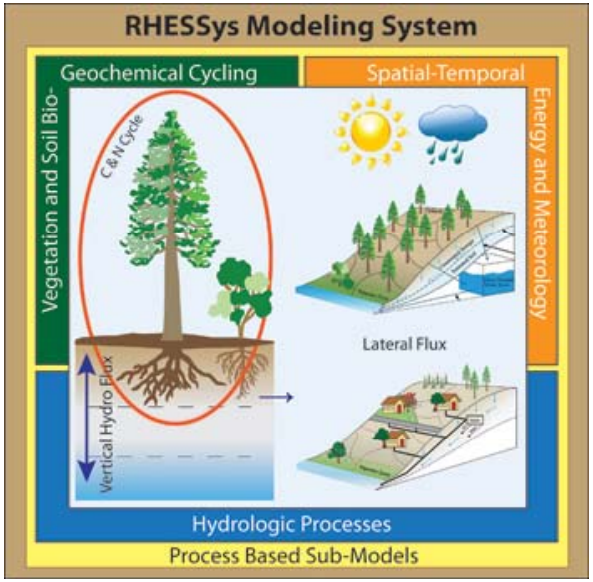
CropSyst: crop phenology and crop – plugs into VIC as a dynamic vegetation function

Crop dynamics in croplands, physical hydrology in all lands

Two BioEarth-Regional-scale Land Surface Model Options in Development



2. Upscaled RHESSys: ecohydrology and dynamic vegetation



Coupled C:N:H2O in forested and grassland ecosystems

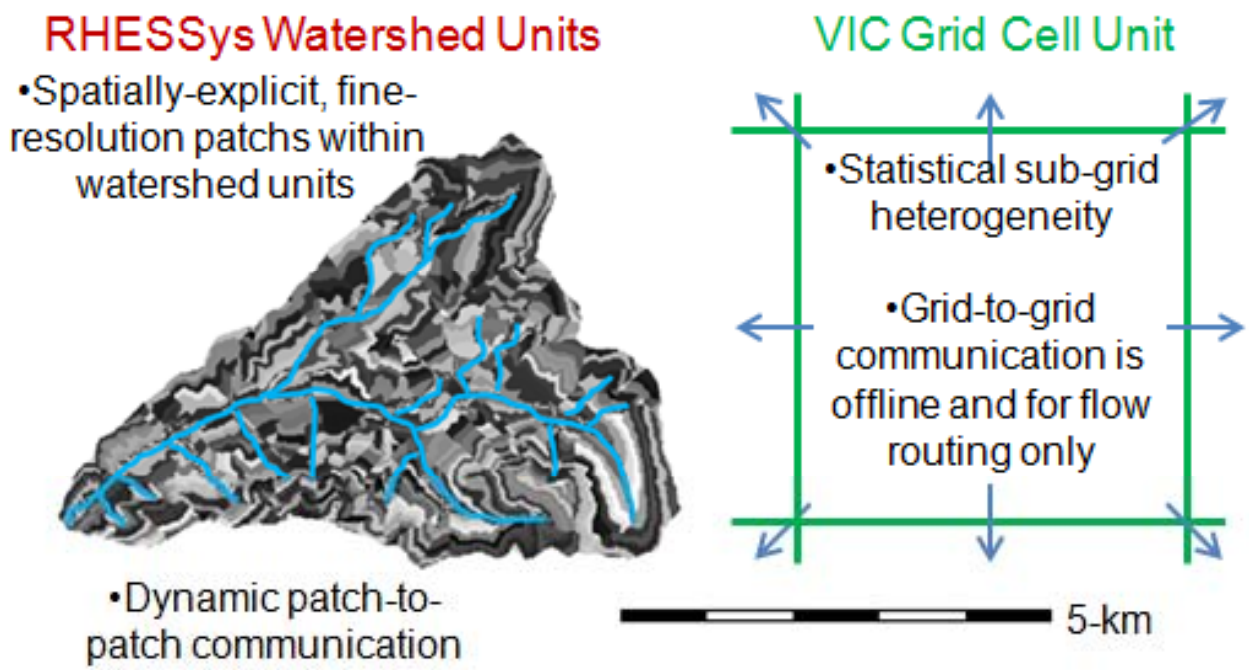
Comparison of Hydrologic Modeling Approaches at 2 Scales

Modeling Watersheds at Finer Scales, e.g., native RHESSys scale

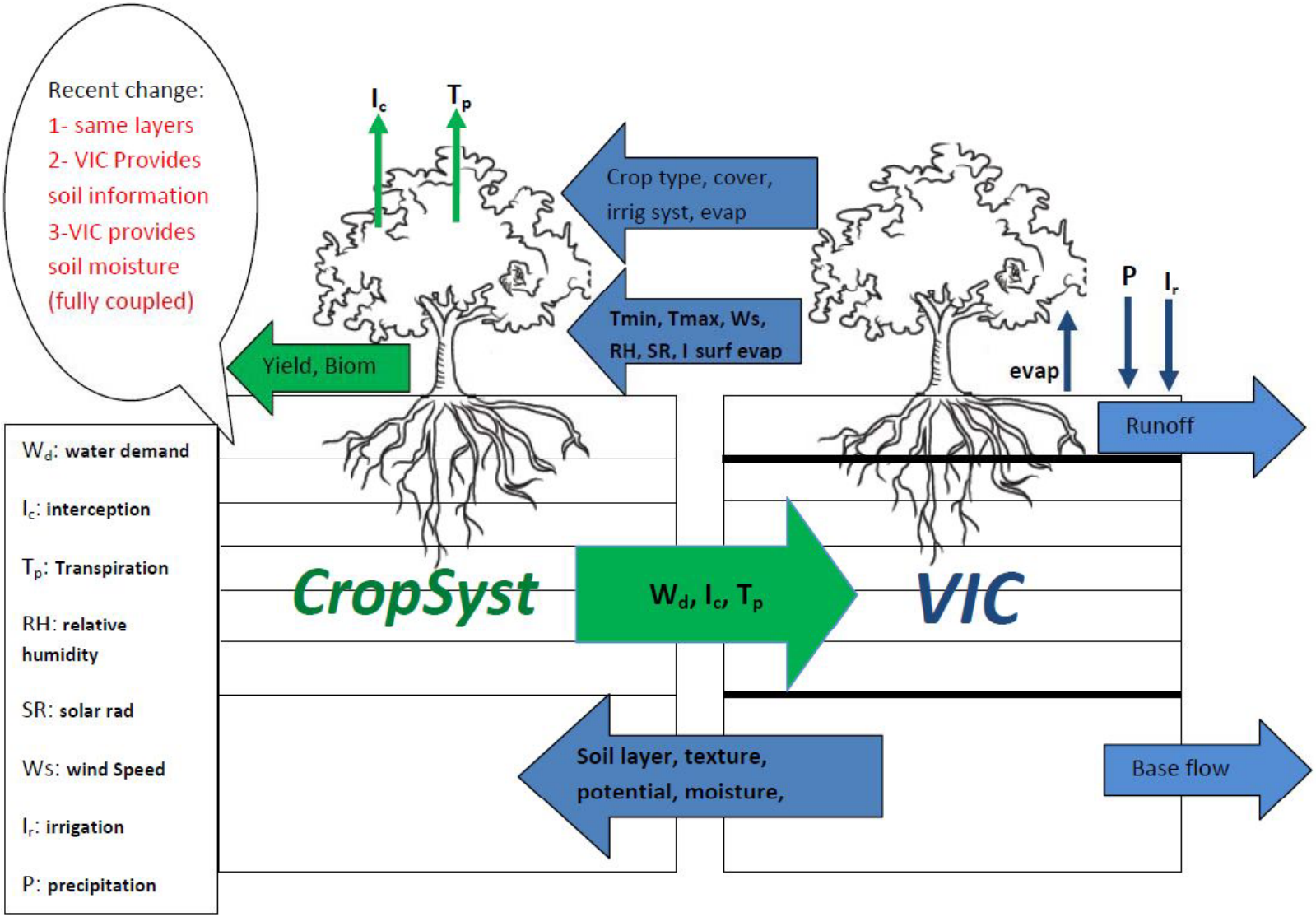
- High detail in lateral dimension, may have slightly less detail in vertical dimension and time w.r.t. VIC

Modeling the Region at Coarser Scales, e.g. VIC/VIC-CropSyst

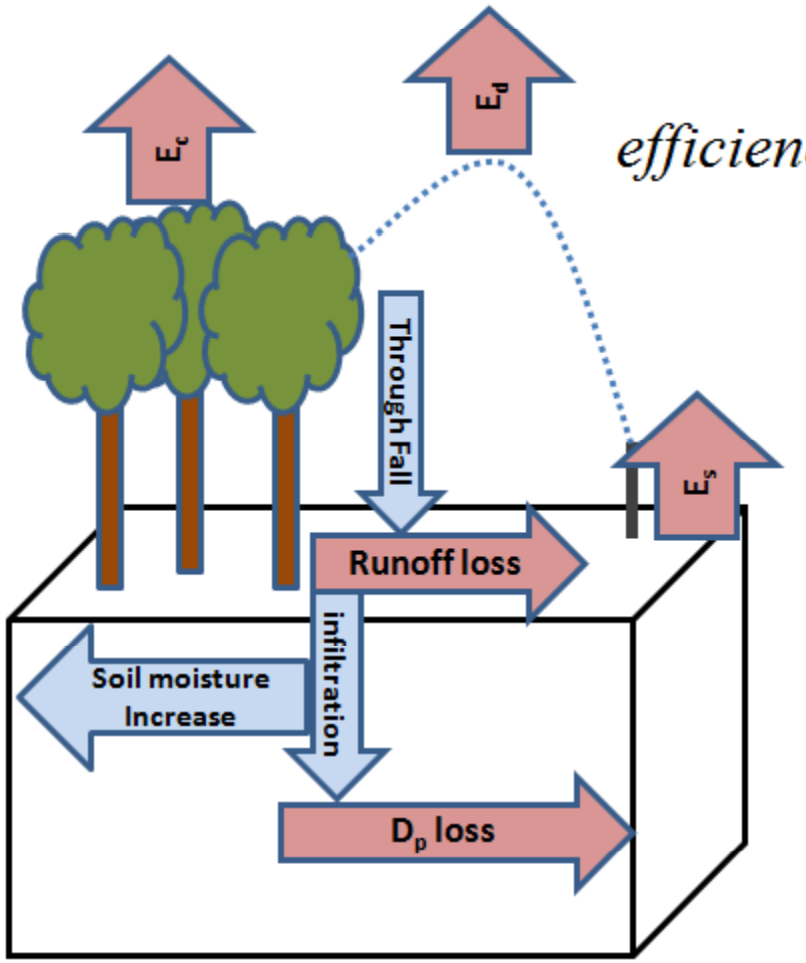
- High detail in vertical dimension and in time, coarse in lateral dimension (land/atm interactions)



Option 1: Progress Towards VIC-CropSyst Tight Coupling Between Models



Option 1: Progress Towards VIC-CropSyst Capturing ET Losses by Irrigation Technology



$$efficiency = 1 - \frac{E_d + E_s + E_c + R + D_p}{total\ applied\ water}$$

Ec: evaporation from canopy intercepted water
Es: evaporation from soil
Ed : evaporation from irrigation droplet
Dp: deep percolation loss
R : Runoff loss

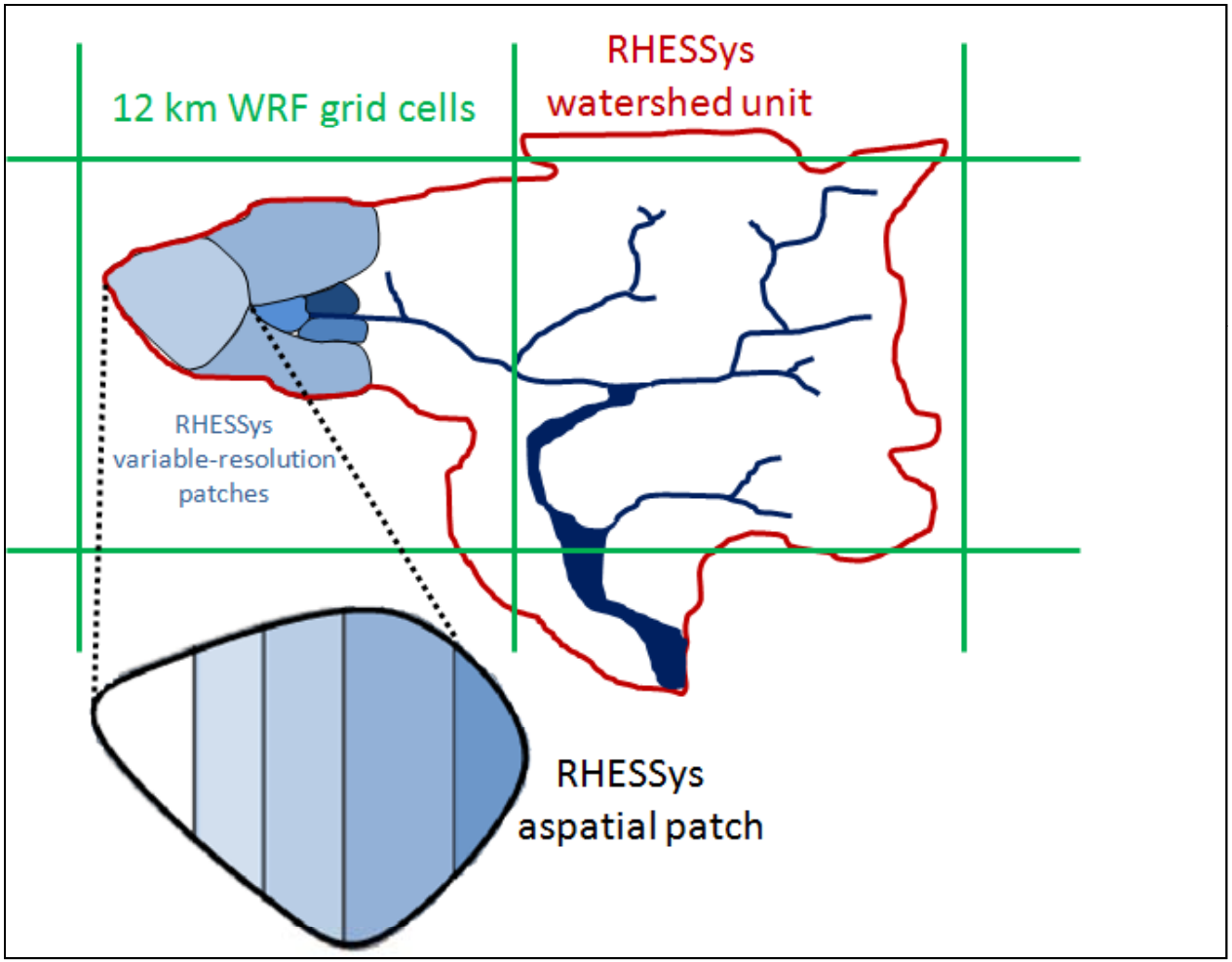
Option 2: Progress Towards RHESSys Upscaling

- 12 km grids converted from latitude/longitude boxes to watershed boundaries (see right)

- RHESSys will run at a finer resolution (for each "patch") within each watershed, handling all hydrology

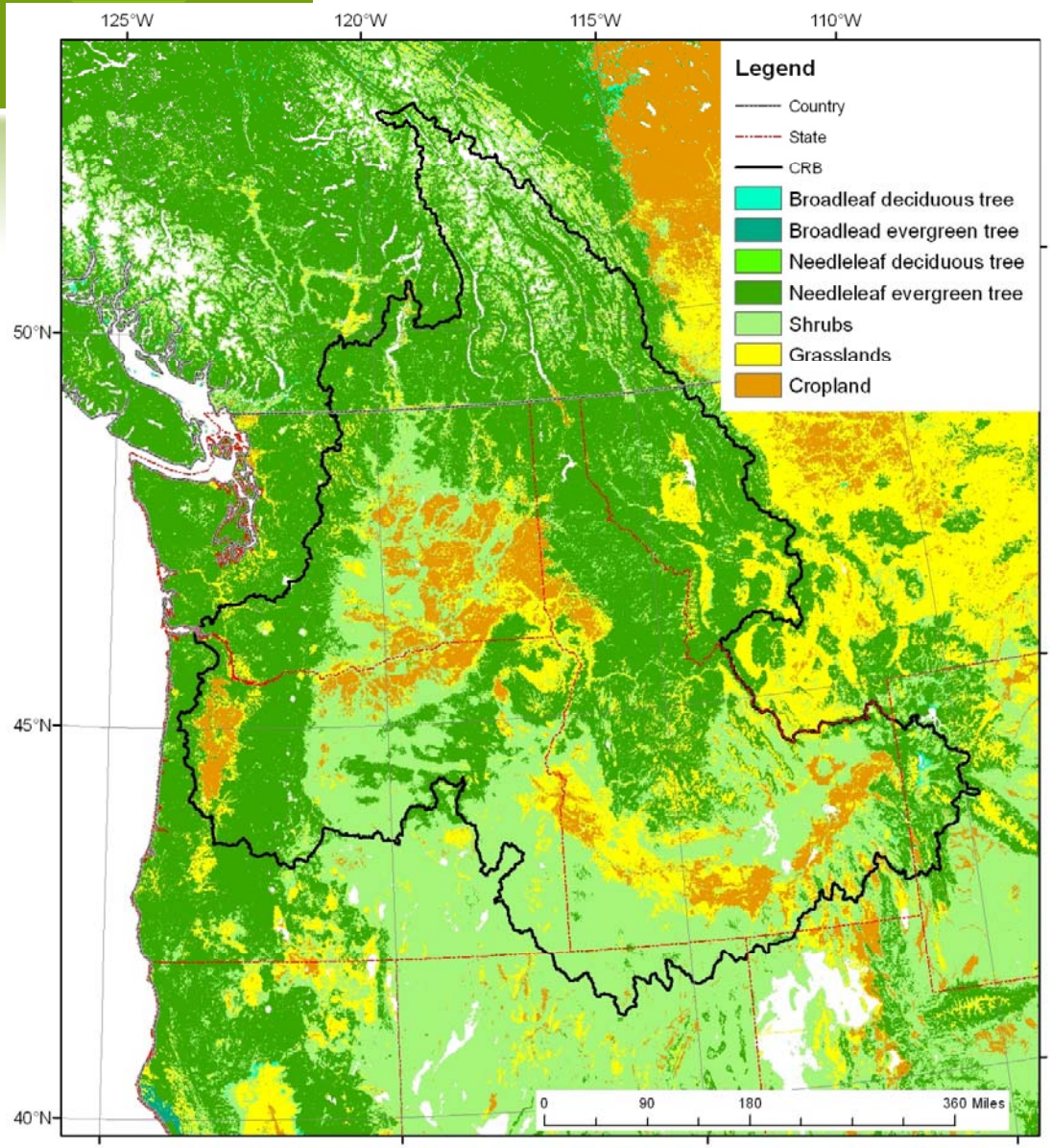
- RHESSys patches resolution will be finer within riparian areas and coarser in upland areas; these scales are one of our research questions

- Patches will be sub-divided statistically to increase computational efficiency (i.e., the patches can be bigger)



- RHESSys will route flow within the VIC grid; a separate routing algorithm will be used to route flow contributed from the VIC grids

Land Cover Consistency



Need to ensure land cover consistency between NLDAS2+crops dataset we have been working on and Alex Guenther's new vegetation dataset (left).

Near-term Future Directions for NEWS in BioEarth (1-year goals)

- Downscale, test and apply NEWS-DIN (DIN=dissolved inorganic nitrogen, NO_3 + NH_4) at the sub-basin scale for the Columbia River Basin

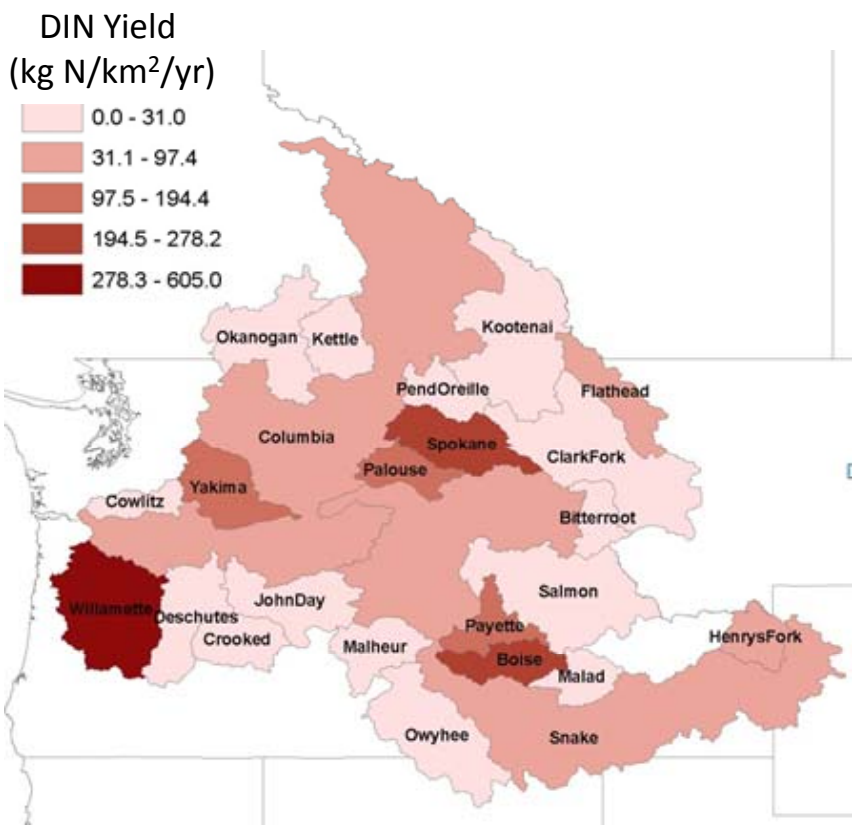
- Integrate an explicit wetland component into the sub-basin NEWS-DIN model

Longer-term Future Directions for NEWS in BioEarth

- Use sub-basin DIN model to investigate sensitivity of river DIN loading to:
  - Inter-annual climate variability
  - Historic and anticipated changes in land use
  - Historic and anticipated changes in nitrogen inputs to the landscape
  - Changes in wetland extent
  - Others?

Inputs needed by NEWS from other BioEarth models (near-term goals)

- We have or are working on developing:
  - Basin delineations for 24 sub-basins at 1 km resolution,
  - DIN yield for 24 sub-basins
  - Half degree spatially explicit inputs for all NEWS inputs



Inputs needed by NEWS from other BioEarth models (near-term goals)

- Needed:
  - Appropriately scaled spatially explicit inputs for sub-basins:
    - Hydrologic inputs: Runoff, Irrigation demand (VIC)
    - Nitrogen inputs: Deposition (CMAQ), Fertilizer application (VIC-CropSyst), Natural and Agricultural N Fixation(VIC-CropSyst/RHESSys), N Harvested (CropSyst?)