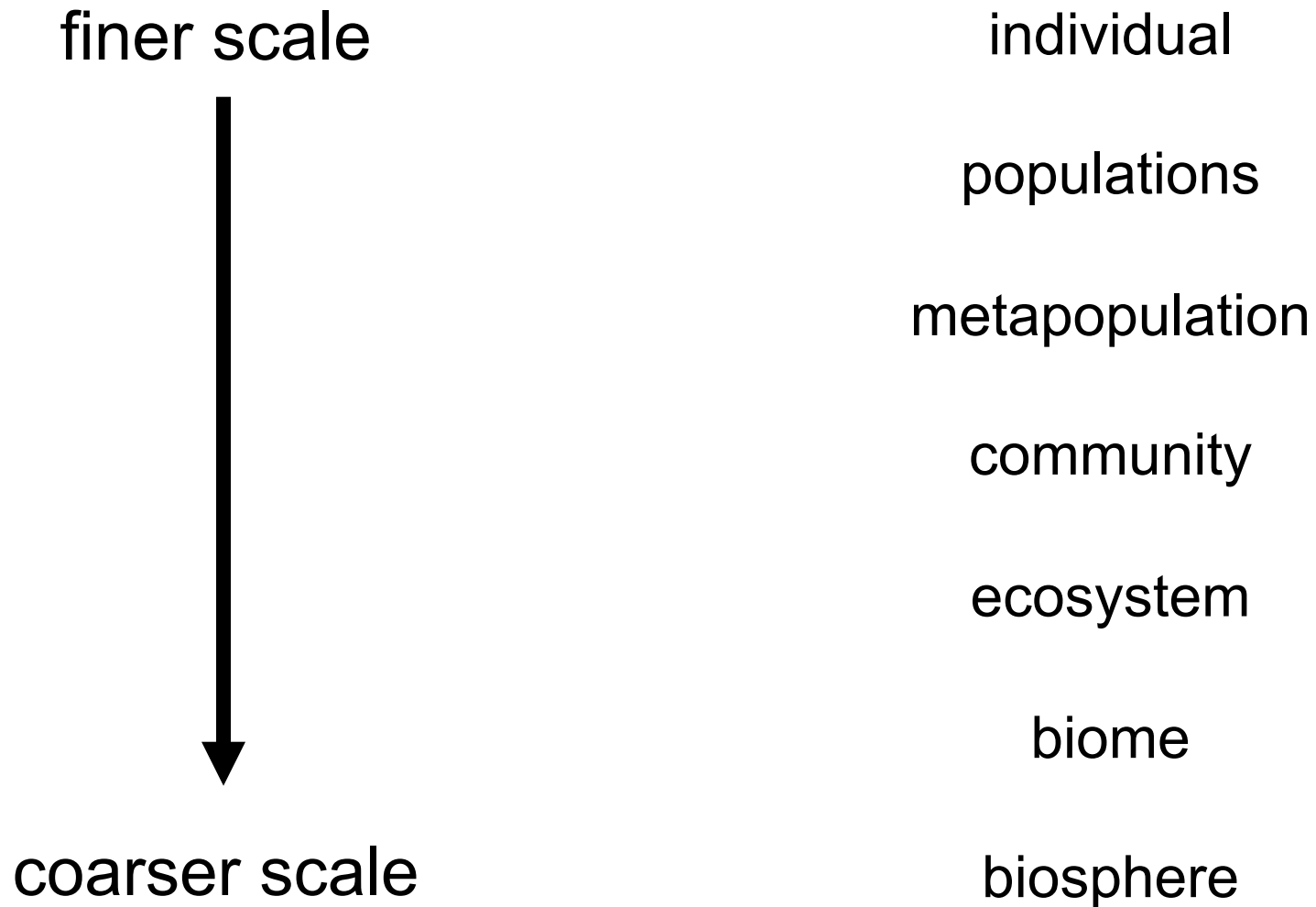


Biology and the hierarchies of life



Communities: “all species that live together in one place”

Eucalypt woodland in Australia



www.environment.act.gov.au/nativeplantsandanimals

Alpine meadows in Canada



www.alpine-club.mb.ca

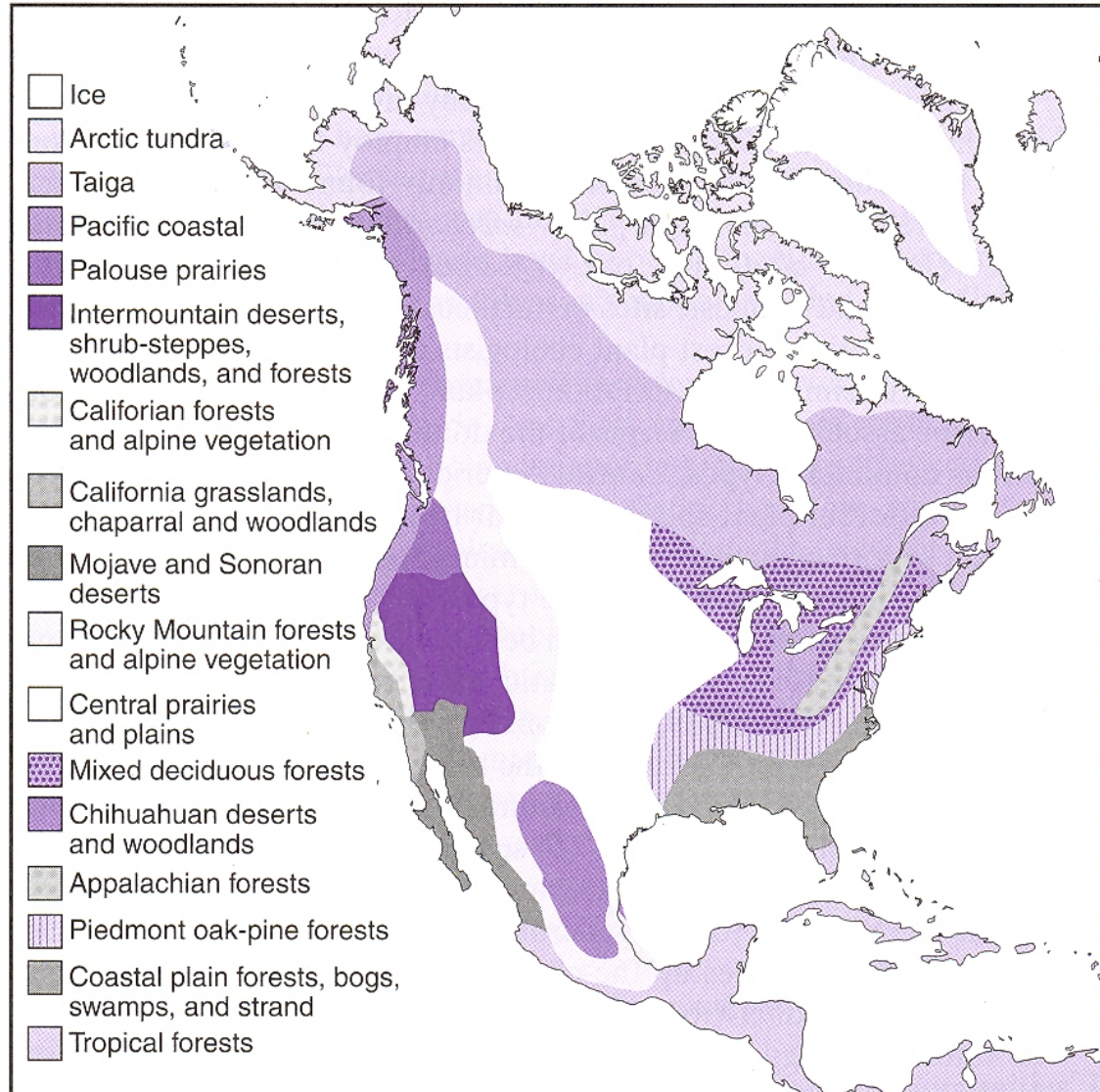


FIGURE 6.1 The major vegetation communities (formations) of North America (after Babour and Billings, 2000).

Classifications using Vegetation Structure

Based on:

1. plant physiognomy (trees vs. no trees)
2. degree of canopy closure
3. may include number of vegetation strata

Example of six types of vegetation:

Forest: Sites dominated by trees and a generally continuous canopy

Woodland: Sites typified by widely spaced trees allowing for substantial areas dominated by shrubs, grasses, or herbs

Shrubland: Sites dominated by a relatively continuous canopy of shrubs

Grassland: Sites dominated by grasses and herbs

Scrub: Sites dominated by widely spaced shrubs

Desert: Sites dominated by sparse xerophytic plant cover with mostly bare ground

Brown and Lomolino, 1998

What' s a forest?

FAO:

Land with tree crown cover (or equivalent stocking level) of more than 10% and area of more than 0.5 ha.

Trees should be able to reach a minimum height of 5 m at maturity in situ.

May consist of closed forest formations where trees of various storeys and undergrowth cover a high proportion of ground or open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10%.

Merriam life zone classifications

1-mile upward in elevation =
800-mile northward in latitude

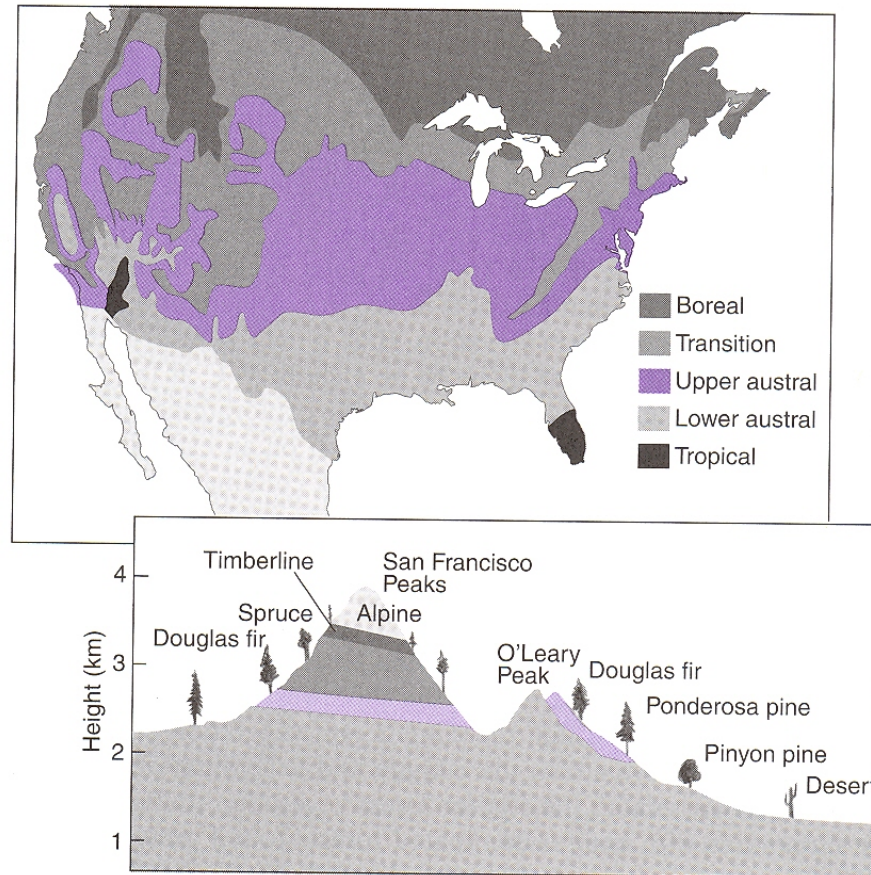


FIGURE 6.4 Merriam's life zones for the classification of North American vegetation based on similarities in structure and climate (based upon Merriam, 1890, 1894; Bailey, 1996; Brown and Lomolino, 1998).

Map of biomes and relationships to climate

Advantages:

- based on widely available climate variables
- simple
- objective

Disadvantages:

- no seasonality of climate
- *remember water deficit?*
- potential, not actual, vegetation

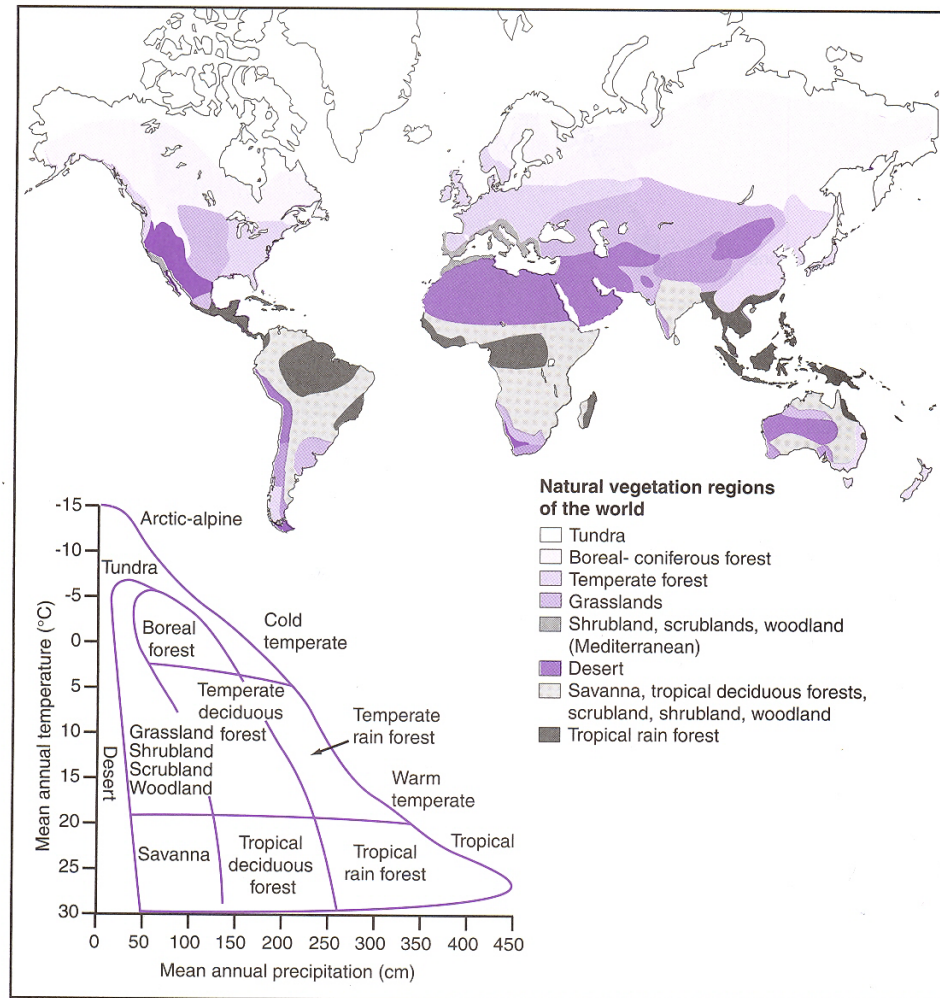
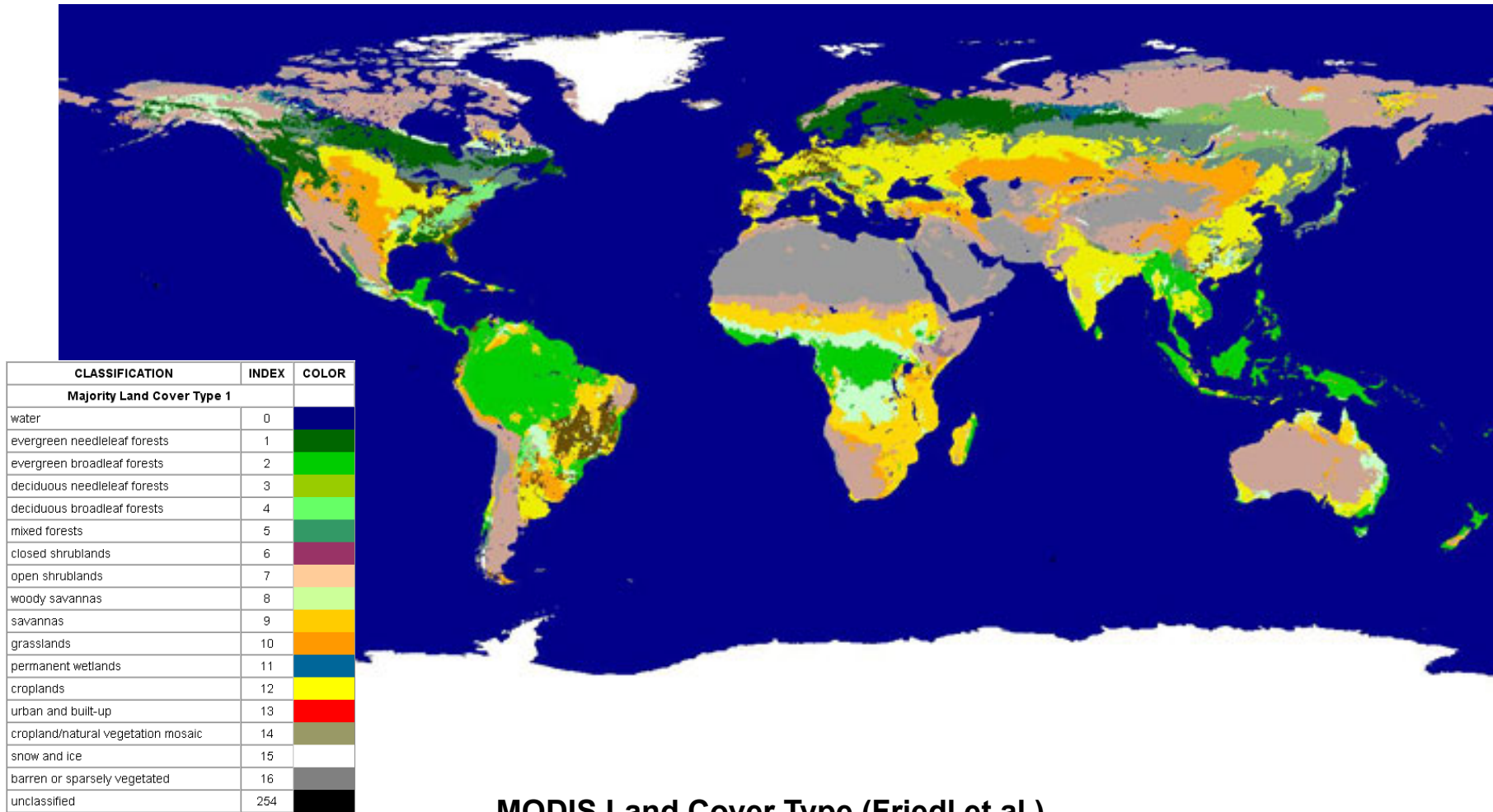


FIGURE 6.6 The relationship between the biomes and climate according to Whittaker's system and a general map of the world's biomes (after Whittaker, 1975 and a variety, of sources).

Satellite Land Cover Products

Based on satellite observations and sometimes ancillary data (e.g., topography, ecoregions, temperature)



MODIS Land Cover Type (Friedl et al.)

Satellite Land Cover Products

Table 1. IGBP Land Cover Units	
<i>Natural Vegetation</i>	
Evergreen Needleleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Almost all trees remain green all year. Canopy is never without green foliage.
Evergreen Broadleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Almost all trees and shrubs remain green year round. Canopy is never without green foliage.
Deciduous Needleleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Consists of seasonal needleleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
Deciduous Broadleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Consists of broadleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
Mixed Forests	Lands dominated by trees with a percent cover >60% and height exceeding 2 meters. Consists of tree communities with interspersed mixtures or mosaics of the other four forest types. None of the forest types exceeds 60% of landscape.
Closed Shrublands	Lands with woody vegetation less than 2 meters tall and with shrub canopy cover >60%. The shrub foliage can be either evergreen or deciduous.
Open Shrublands	Lands with woody vegetation less than 2 meters tall and with shrub canopy cover between 10-60%. The shrub foliage can be either evergreen or deciduous.
Woody Savannas	Lands with herbaceous and other understory systems, and with forest canopy cover between 30-60%. The forest cover height exceeds 2 meters.
Savannas	Lands with herbaceous and other understory systems, and with forest canopy cover between 10-30%. The forest cover height exceeds 2 meters.
Grasslands	Lands with herbaceous types of cover. Tree and shrub cover is less than 10%.
Permanent Wetlands	Lands with a permanent mixture of water and herbaceous or woody vegetation. The vegetation can be present in either salt, brackish, or fresh water.
<i>Developed and Mosaic Lands</i>	
Croplands	Lands covered with temporary crops followed by harvest and a bare soil period (e.g., single and multiple cropping systems). Note that perennial woody crops will be classified as the appropriate forest or shrub land cover type.
Urban and Built-Up Lands	Land covered by buildings and other man-made structures.
Cropland/Natural Vegetation Mosaics	Lands with a mosaic of croplands, forests, shrubland, and grasslands in which no one component comprises more than 60% of the landscape.
<i>Non-Vegetated Lands</i>	
Snow and Ice	Lands under snow/ice cover throughout the year.
Barren	Lands with exposed soil, sand, rocks, or snow and never has more than 10% vegetated cover during any time of the year.
Water Bodies	Oceans, seas, lakes, reservoirs, and rivers. Can be either fresh or salt-water bodies.

MODIS satellite-derived land cover classification

Land cover classes used

Classes define:

1. annual vs. perennial
2. leaf longevity
3. leaf type

Advantages

- actual vegetation
- high spatial resolution

Disadvantages

- coarse thematic resolution
- accuracy?

modis.gsfc.nasa.gov/data/atbd/atbd_mod12.pdf

NCAR Community Land Model

Plant Functional Types

Climate Rules

<u>Remote Sensing Data Products</u>	→	<u>Plant Functional Types</u>
Needleleaf evergreen tree		temperate boreal
Needleleaf deciduous tree		boreal
Broadleaf evergreen tree		tropical temperate
Broadleaf deciduous tree		tropical temperate boreal
Shrub		broadleaf evergreen temperate broadleaf deciduous temperate broadleaf deciduous boreal
Grass		C3 C3 arctic C4
Crop		Crop 1 (e.g., corn) Crop 2 (e.g., wheat)

Trees

1-km U. Maryland tree cover

- needleleaf, broadleaf
- evergreen, deciduous

Others

1-km IGBP DISCover

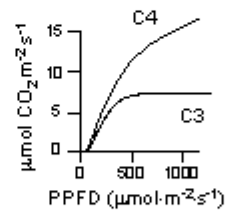
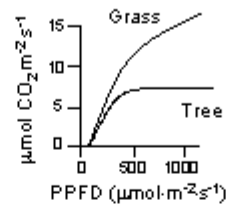
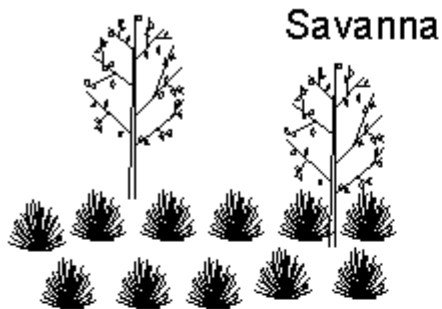
- shrub, grass, crop

Monthly Leaf Area

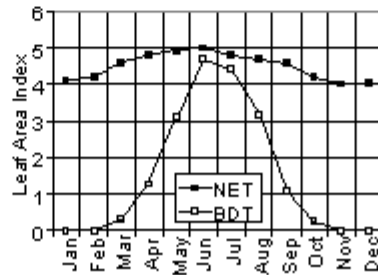
- 1-km AVHRR red and near infrared reflectance
- April 1992 to March 1993
- 'Pure PFT' NDVI for 200 km × 200 km grid
- Average NDVI for each 1-km pixel with PFT > 60%

NCAR Community Land Model

Mixed Life-Form Biomes



Mixed Forest



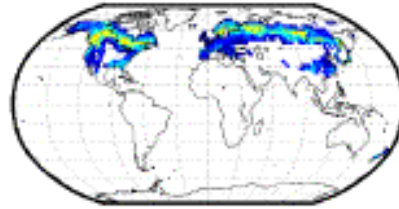
within model, PFTs define:

- leaf physiology
 - leaf morphology and radiative characteristics
 - phenology
 - whole-plant carbon allocation
 - root distribution
-
- can allow for simulation of biomes through competition

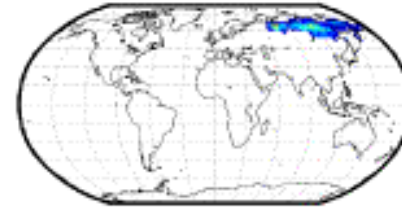
Plant Functional Type Geography

NCAR
Community
Land Model

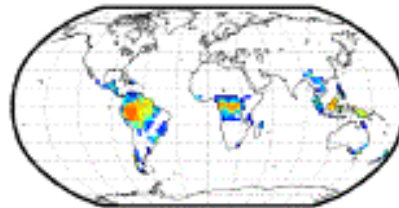
(A) NEEDLELEAF EVERGREEN TREES



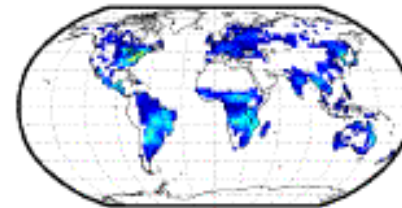
(B) NEEDLELEAF DECIDUOUS TREES



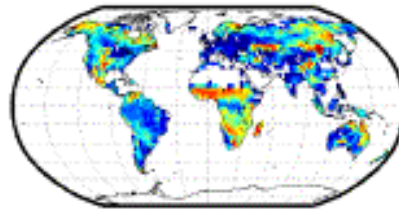
(C) BROADLEAF EVERGREEN TREES



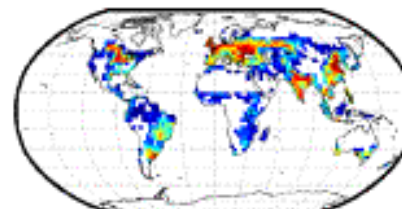
(D) BROADLEAF DECIDUOUS TREES



(E) GRASSES

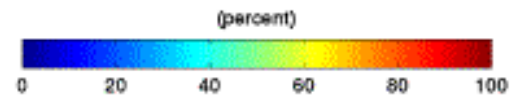


(F) CROPS



www.cgd.ucar.edu/tss/clm/pfts/pft-geography.gif

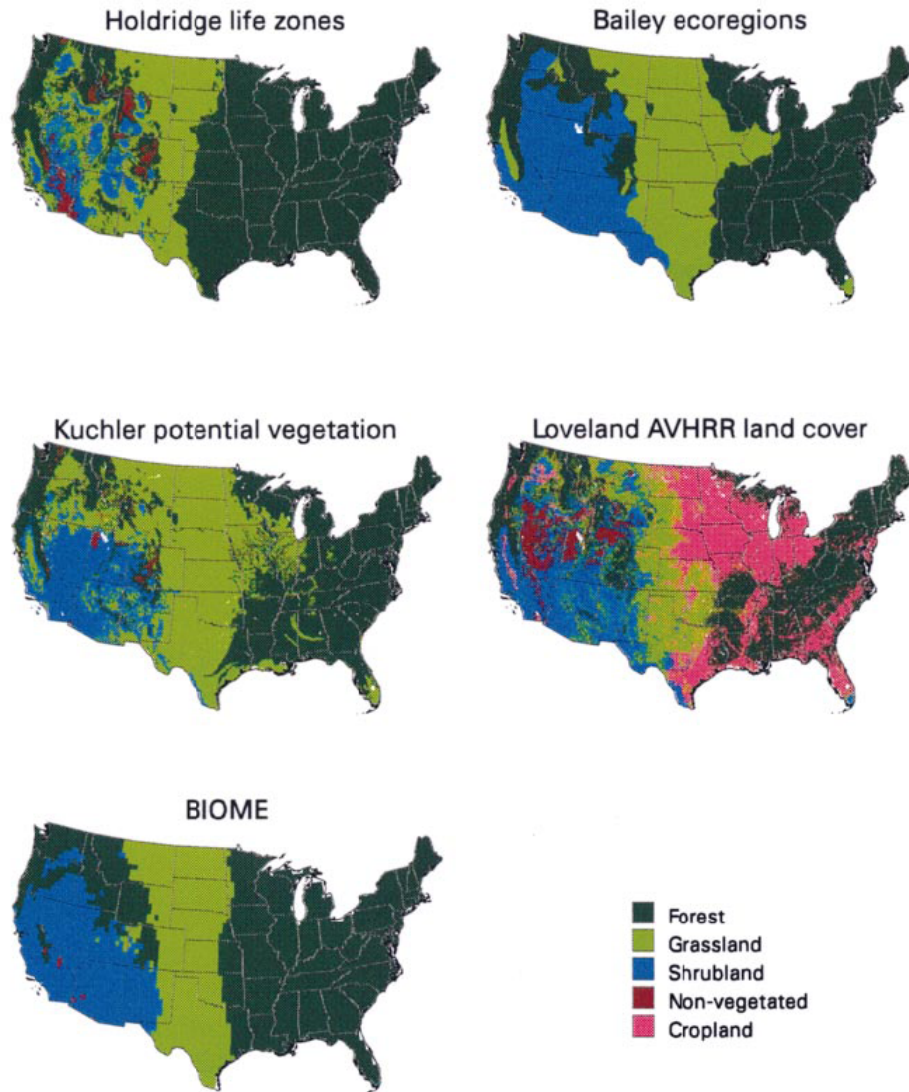
Biogeography



($\frac{1}{2}^{\circ}$ grid)

cke

Comparisons among maps: good or bad?



Comparison among mapping results

Holdridge = climate

Bailey = ecosystem properties

Kuchler = potential veg from local knowledge and temperature

Satellite-derived (actual) land cover

BIOME = modeled seasonal climate and soils (potential vegetation)