PART III

Web-Based Resources
This section provides information to help locate key resources on tools and methods being developed by international, national, and civil society agencies that work on different aspects of land and natural resource management.

**GLOBAL FIELD AND MARKET INTELLIGENCE ON CEREAL AND OILSEEDS**

The U.S. Department of Agriculture (USDA) and Foreign Agricultural Service (FAS) have a site where users can access near real-time data and growing conditions for major cereal, fiber (such as cotton), and oilseed crops in most countries (figure 6.1).

To use the USDA-FAS Crop Explorer, go to http://www.pecad.fas.usda.gov/cropexplorer/.

**REMOTE-SENSING TOOL FOR WATER RESOURCES MANAGEMENT**

The USDA and FAS, in cooperation with the National Aeronautics and Space Administration (NASA) and the University of Maryland, are routinely monitoring lake and reservoir height variations for approximately 100 lakes located around the world. The Global Reservoir and Lake Monitor project (figure 6.2) is the first of its kind to use near real-time radar altimeter data over inland water bodies in an operational manner.

Surface elevation products are produced by a semiautomated process and placed at this Web site for USDA and public viewing. Monitoring heights for approximately 100 reservoirs and lakes around the world will greatly assist the Production Estimates and Crop Assessment Division of the FAS in locating regional droughts quickly, as well as improve crop production estimates for irrigated regions located downstream from lakes and reservoirs. All targeted lakes and reservoirs are located within major agricultural regions around the world. Reservoir and lake height variations may be viewed by placing the cursor on and clicking the continent of interest.

The link to Global Reservoir and Lake Monitor project is http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/.

**HYDROLOGICAL DATA AND DIGITAL WATERSHED MAPS**

The Conservation Science Program of the World Wildlife Fund (WWF) is currently developing a new and innovative global hydrological database, called HydroSHEDS. HydroSHEDS stands for Hydrological data and maps based on SHuttle Elevation Derivatives at Multiple Scales (figure 6.3). For many parts of the world, these data and the tools built to use them open a range of previously inaccessible analyses and applications related to freshwater conservation and environmental planning. HydroSHEDS is based on
high-resolution elevation data obtained during a Space Shuttle flight for NASA’s Shuttle Radar Topography Mission.

At the most basic level, HydroSHEDS allows scientists to create digital river and watershed maps. These maps can then be coupled with a variety of other geospatial data sets or applied in computer simulations, such as hydrologic models, to estimate flow regimes. HydroSHEDS allows scientists and managers to perform analyses that range from basic watershed delineation to sophisticated flow modeling.

HydroSHEDS can be used for a wide range of applications. WWF has already applied the data to create aquatic habitat classification maps for remote and poorly mapped
regions, such as the Amazon headwaters and the Guiana Shield. Ultimately, taxonomists will be able to link their field-site locations directly to digital river maps. WWF researchers hope to use HydroSHEDS in the future to assess the possible impacts of climate change on freshwater ecosystems.

HydroSHEDS has been developed by the Conservation Science Program of WWF, in partnership with the U.S. Geological Survey, the International Centre for Tropical Agriculture, the Nature Conservancy, and the Center for Environmental Systems Research at the University of Kassel in Germany. Major funding for this project was provided to WWF by JohnsonDiversey Inc.

Data for Asia, Central America, and South America are now available. Other continents are scheduled for completion by 2009. HydroSHEDS data are freely available for non-commercial use.

For more information and data, visit http://hydrosheds.cr.usgs.gov.

BASIN AND WATERSHED SCALE HYDROLOGICAL MODELING

The hydrology of a regional-scale river system can be modeled as a geospatially explicit water mass balance for each grid cell within the basin contributing to stream flow and downstream routing. As such, a model can be divided into two major components: (a) a vertical component that calculates the water balance at each individual grid cell and (b) a horizontal component that routes the runoff generated by each grid cell to the ocean. This split into two separate components has a number of advantages. It separates indirect water routing from direct water diversions. The former includes impacts of land-use change and climate change and is expressed mainly through the vertical model—that is, the water balance at the grid cell level. The latter includes increased withdrawals and diversions for agricultural, industrial, and domestic use and affects mainly the horizontal model, which represents the flow routing. The separation into the grid cell and channel components creates an easy interface to treat non-point-source and in-channel chemical processes separately.

To learn more about the variable infiltration capacity (VIC) macroscale hydrologic model, visit http://www.hydro.washington.edu/Lettenmaier/Models/VIC/VICchome.html.

The Distributed Hydrology Soil Vegetation Model (DHSVM) is a distributed hydrologic model that explicitly represents the effects of topography and vegetation on water fluxes through the landscape. It is typically applied at high spatial resolutions on the order of 100 meters for watersheds of up to 104 square kilometers and at subdaily time scales for multiyear simulations (figure 6.4).

To learn more about DHSVM, visit http://www.hydro.washington.edu/Lettenmaier/Models/DHSVM/index.shtml.

RIVER BASIN DEVELOPMENT AND MANAGEMENT

The International Water Management Institute is documenting the historical development of nine river basins from dif-
ferent parts of the world to derive generic understanding about how societies manage water resources under growing population and basin closure, which problems are faced, and which range of solutions (technical and institutional) are available for a given physical and societal context (see figure 6.5). The studies first address the past transformations of each basin, periodize changes, and draw lessons on how population growth and water resource development relate to food production and environmental degradation and preservation. Second, they investigate in more detail the present situation and define the scope for improvement in management, allocation, environmental services, and income generation. A third part deals with projections and scenarios, with the aim of informing current or future stakeholders’ dialogues and providing decision makers with a state-of-the-art analysis and understanding of the basin challenges and opportunities.

To learn more about the conceptual framework, basin studies, and tools, visit http://www.iwmi.cgiar.org/assessment/Research_Projects/River_Basin_Development_and_Management/.

**TRACKING FLOODS GLOBALLY: THE DARTMOUTH FLOOD OBSERVATORY**

The Dartmouth Flood Observatory detects, maps, and measures major flood events worldwide using satellite remote sensing. The record of such events is preserved as a “World Atlas of Flooded Lands.”

An “Active Archive of Large Floods, 1985 to present,” describes these events individually. Maps and images accompany many of the floods described and can be accessed by links in the yearly catalogs (see, for example, figure 6.6). As the archive of reliable data grows, the possibility increases of predicting where and when major flooding will occur and of analyzing trends over time.

Surface Water Watch is a satellite-based surface-water monitoring system. Orbital AMSR-E (Advanced Microwave Scanning Radiometer for the Earth Observing System) microwave measurements over selected river reaches and wetlands are used to measure discharge and watershed runoff. The system can be used to determine where flooding is under way today, to predict inundation extents, and to assess the current runoff status of watersheds. For rivers in cold regions, river ice status is also being monitored.

To access the Dartmouth Flood Observatory and its products, visit http://www.dartmouth.edu/~floods/.

**THE CARNEGIE LANDSAT ANALYSIS SYSTEM**

![Figure 6.4 The Distributed Hydrology Soil Vegetation Model](source: Lettenmaier, University of Washington, Seattle.)

---

(c) The International Bank for Reconstruction and Development / The World Bank
Figure 6.5  River Basin Development and Management Comparative Study


Figure 6.6  Dartmouth Flood Observatory Map

Source: http://www.dartmouth.edu/~floods/.
Problems in detecting selective logging with remote sensing are complicated by the fact that tree species diversity in some tropical rainforests (for example, the Brazilian Amazon or the Congo) is very high, and most species are locally rare. Logging is highly selective because markets accept only a few species for timber use. This situation contrasts with logging practices in other parts of the world where clear-cutting or nearly complete harvests predominate. These large differences in logging intensity result in variation of forest disturbance and collateral damages caused by harvesting activities.

The Carnegie Landsat Analysis System (CLAS) uses high spatial resolution satellite data for regional and global studies of forest disturbance. CLAS is an automated processing system that includes (a) atmospheric correction of satellite data; (b) deconvolution of spectral signatures into subpixel fractional cover of live forest canopy, forest debris, and bare substrates; (c) cloud, water, and deforestation masking; and (d) pattern recognition algorithms for forest disturbance mapping.

Figure 6.7 compares an example of the CLAS high-resolution detection of selective logging in the eastern Amazon during 2001 to 2002 from the CLAS processing (right), with deforestation mapping provided by standard Landsat processing (Program for the Estimation of Deforestation in the Brazilian Amazon, or PRODES).

For more information on CLAS and associated publications, visit http://asnerlab.stanford.edu/.

PLANT BIODIVERSITY: RAPID SURVEY, CLASSIFICATION, AND MAPPING

The Center for Biodiversity Management (CBM) provides users worldwide with free access to state-of-the-art biodiversity assessment methodology and related software. The software highlighted here, VegClass 2.0 and DOMAIN, are available free at http://www.cbmglobe.org/softwaredev.htm.

VegClass 2.0: Field Tool for Vegetation Data Entry and Classification

Figure 6.7  Comparison of CLAS High-Resolution Processing with Standard Landsat Processing

Source: Asner and others 2005.
Note: The image on the left shows deforestation mapping under standard Landsat processing for PRODES. The image on the right shows deforestation mapping using CLAS high-resolution processing.
VegClass 2.0 is a computer-assisted data-entry and analytical package for general vegetation classification and analysis. It is built around a novel system of classifying vegetation according to morphological adaptations to environment as well as species, vegetation structure, and additional recording-site physical features. The software allows the user to choose from a range of variables to suit a particular purpose and scale. References to the theory and practice underlying this software are available in scientific literature, as well as on the Internet. The software runs on personal computers with Microsoft Windows® software. The instructions are in simple English. With minimal training, users of VegClass will find it a powerful tool for both entering and compiling field data. VegClass uses a formal protocol that allows transfer of data summaries into a wide range of industrial computerized spreadsheet and relational database formats, such as Microsoft Excel® and Access®.

Apart from being useful in the field, VegClass is an excellent tool for training purposes and has been successfully used in a number of developing countries in tropical West Africa (Cameroon) and the sub-Sahel (Mali); southern Africa (Mozambique); Indomalesia (India, Indonesia, the Philippines, Thailand, and Vietnam); and Latin America (Brazil, Costa Rica, and Peru). Because it provides a ready means of producing standardized data sets, VegClass is rapidly becoming popular in vegetation surveys in different countries. It provides a unique, generic means of recording and comparing data within and between regions, and it is a unique tool for global and local comparative purposes. VegClass has been supported by the Center for International Forestry Research as well as by CBM.

**DOMAIN: Habitat Mapping Package**

DOMAIN is a user-friendly software program that makes possible the exploration of potential habitats for plant and animal species. Unlike many other potential mapping programs, DOMAIN allows the use of relatively few spatially referenced data points, such as known species locations. When these data points are overlaid on known environmental variables, such as soil type, elevation, and certain climate variables, the program constructs an environmental DOMAIN map showing different levels of similarity. The program is now widely used in more than 80 countries.

**AGRICULTURAL PRODUCTION REGIONS AND MODIS: NASA’S MODERATE RESOLUTION IMAGING SPECTRORADIOMETER**

Mosaic images were created by the NASA MODIS (Moderate-Resolution Imaging Spectroradiometer) Rapid Response System team to overlap the agricultural regions shown by the rectangles in panel a of figure 6.8. New MODIS mosaics are produced daily for each agricultural region in false color and true color from the Terra and Aqua satellites at 1-kilometer, 500-meter, and 250-meter resolution. These near real-time images can be viewed and downloaded after clicking on a region (panel b of figure 6.8).

To access daily images, go to http://www.pecad.fas.usda.gov/cropexplorer/modis_summary.

**INTEGRATED GLOBAL OBSERVATIONS FOR LAND**

Since its creation in 1998, the Integrated Global Observing Strategy (IGOS) has sought to provide a comprehensive framework to harmonize the common interests of the major space-based and in situ systems for global observation of the Earth.

Integrated Global Observations for Land (IGOL) is the land theme of IGOS and has the responsibility of designing a cohesive program of activities that will provide a comprehensive picture of the present state of terrestrial ecosystems and build capacity for long-term monitoring of those ecosystems. Global Observation of Forest and Land Cover Dynamics is strongly involved in developing the IGOL theme. The current IGOL aims at an integrated and operational land observation system that focuses on the following areas (figure 6.9):

- Land cover, land-cover change, and fire
- Land use and land-use change
- Agricultural production, food security, sustainable agriculture, and forestry
- Land degradation and soils
- Ecosystems and ecosystem goods and services
- Biodiversity and conservation
- Human health and effects of land properties on vectors
- Water resource management, water use for agriculture, and human use of water
- Disaster early warning systems (for fires, floods, and droughts)
- Climate change impacts on land properties
- Energy (biomass and fuelwood)
- Urbanization and infrastructure

Figure 6.8 MODIS Image Gallery

a. MODIS world map

b. MODIS mosaic image