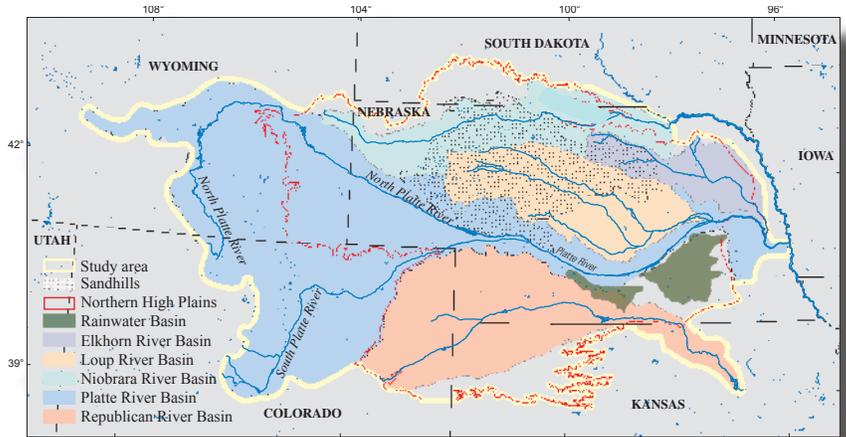


# Greater Platte River Basins—Science to Sustain Ecosystems and Communities

The Greater Platte River Basins (GPRB), located in the heartland of the United States, provides a collaborative opportunity for the U.S. Geological Survey (USGS) and its partners to understand the sustainability of natural and managed ecosystems under changing climate and resource requirements. The Greater Platte River Basins, an area of about 140,000 square miles, sustains thousands of acres of lakes and wetlands, which provide a staging and resting area for the North American Central Flyway. Part of the GPRB is within the U.S. Corn Belt, one of the most productive agricultural ecosystems on Earth. Changes in water and land use, changing patterns of snowmelt in the Rocky Mountains, drought, and increasing demands for irrigation have reduced flows in the Platte River. These changes raise questions about the sustainability of the region for both wildlife and agriculture. The USGS and partners are developing a science strategy that will help natural-resource managers address and balance the needs of this region.



The Greater Platte River Basins (within the yellow line), the Northern High Plains aquifer (within the red line), and the area occupied by the annual migration of the sandhill crane population (dotted area). The Greater Platte River Basins consist of the following watersheds: the Platte River Basin, the Rainwater Basin, the Elkhorn River Basin, the Loup River Basin, the Niobrara River Basin, and the Republican River Basin.

## USGS Science Activities



### Platte River Ecosystem Study

Since 1997, the Platte River Priority Ecosystem Study has been investigating the linkages of landscape and hydrology to the roosting and foraging habitats of migratory birds. Research on the interactions among climate, hydrology, riparian vegetation, and channel stability is improving the prediction of potential channel changes that could result from altered climate, streamflow management, and manipulation of vegetation on islands and banks. Additionally, agricultural changes can affect the nutrition of migratory birds in the Platte River and, thus, the reproductive success of the birds.

<http://ne.water.usgs.gov/platte/> Robert Swanson, 402-328-4110



### National Water-Quality Assessment Program (NAWQA)

The USGS has been monitoring GPRB streams and groundwater since 1992, tracking changes in water chemistry, stream habitat, fish and algal communities, aquatic insects, and the occurrence and distribution of contaminants in tissue and sediment. Long-term monitoring of water quality is essential to understand the effects of changes in climate, urbanization, and agricultural practices on ecosystem health and the availability of water that meets human and environmental needs.

<http://water.usgs.gov/nawqa/> Gary Rowe, 303-236-1461



### Crescent Lake Wildlife Refuge

In August 2008 the USGS conducted Time Domain Electromagnetic (TDEM) soundings around the refuge for an assessment of the hydrological framework. The following year a helicopter-mounted sensor system collected data for an electromagnetic survey of Crescent Lakes. Preliminary interpretations are encouraging for exploring the possible connection between the spread of saline water and climate change at Crescent Lake, and the potential affect on the ecosystem.

Jared D. Abraham, 303-236-1318



### High Plains Groundwater Availability Study

Water availability is a function of many factors, including the quantity and quality of water and the laws, regulations, economics, and environmental factors that control its use. Over-allocation of scarce water supplies in combination with population growth increases societal vulnerability to climate change. This USGS study, initiated in 2009, will provide tools for determining the sensitivity of the GPRB ecosystems to future human and environmental changes.

<http://txpub.usgs.gov/HPWA/index.html> Scott Christenson, 505-830-7963



### Recharge Estimation Across the Central Platte River Basin

The USGS is addressing questions about recharge, chemical transport, and chemical reservoirs in the unsaturated zone across the central Platte River Basin of the High Plains aquifer. An instrumented network of eight locations with a cluster of shallow, medium-depth, and deep wells; an instrumented borehole; and a weather station will help scientists and resource managers better understand water and chemical responses in the unsaturated zone to natural climate variability, climate change, and human activities.

<http://co.water.usgs.gov/projects/hpuzrn/> Greg Steele, 402-328-4129



### Microbial Water-Quality Effects from Lower Flows and Increased Migratory Bird Densities

Recent lower flows and decreased habitat have caused the density of migratory waterfowl to increase in roosting areas in the Platte River. To determine whether the increased waterfowl densities are affecting the microbial water quality of the Platte River, the USGS began collecting samples in 2009 from three sites on the Platte River in central Nebraska during the spring migration period. This study will inform regulators, agricultural producers, natural resource managers, and scientists about potential effects on wildlife health, human health, and the economy of the region. Study partners are the Platte River Whooping Crane Maintenance Trust and the U.S. Environmental Protection Agency.

Jason Vogel, 402-328-4130



### Effects of Water and Channel Management on Stream Ecology of the Lower Platte River, 1934–2006

In cooperation with the Lower Platte South Natural Resources District, the USGS compiled and analyzed hydraulic habitat information from field measurements collected during streamflow measurements, mostly near bridges. Of particular interest were the changes in the habitat used by pallid and shovelnose sturgeon. A secondary objective of this study was to identify the effect of bridge proximity on the distributions of streamflow depth, velocity, and microhabitats.

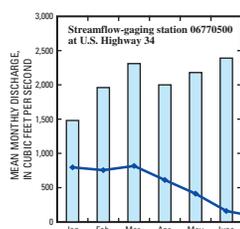
<http://www.nrdmapmaker.org/lowerplattecis/> <http://pubs.usgs.gov/sir/2008/5054/> Ron Zelt, 402-328-4140



### Magnetic Resonance Sounding (MRS) Data of the Central Platte River

The USGS is developing state-of-the-art technologies, similar to medical Magnetic Resonance Imaging (MRI), to directly measure aquifer properties without invasive drilling. The MRS measurements, in conjunction with the collection of ground-truth information, will provide improved hydrogeologic parameter estimates for use in a sub-regional groundwater flow model of Dawson County by the Central Platte Natural Resources District.

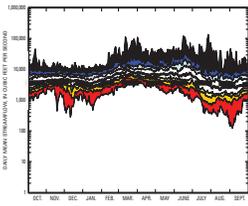
<http://pubs.usgs.gov/sir/2009/5033/> Jared D. Abraham, 303-236-1318 and James C. Cannia, 402-416-5321



### Streamflow and Topographic Characteristics of the Platte River, 1938–2007

Analyses of aerial photography, channel surveys, Light Detection and Ranging (LIDAR) data, discharge measurements, and historical land surveys were used to understand the past and present dynamics of the four channels of the Platte River near Grand Island and to detect changes with time. Findings are being used by nearby municipalities.

<http://pubs.usgs.gov/sir/2008/5106/> [http://wwwbrr.cr.usgs.gov/projects/SW\\_Env\\_Fluid/platte.html](http://wwwbrr.cr.usgs.gov/projects/SW_Env_Fluid/platte.html)  
Paul Kinzel, 303-279-4165



**Trends in Streamflow Characteristics of Selected Sites in the Elkhorn River, Salt Creek, and Lower Platte River Basins, Eastern Nebraska, 1928–2004, and Evaluation of Streamflows in Relation to Instream-Flow Criteria, 1953–2004**

Historical Platte River streamflow records were used to test for statistical trends in streamflow in the Elkhorn River, Salt Creek, and Platte River Basins and to determine whether historic flows satisfied requirements for instream-flow appropriations, which are intended to maintain fish communities, whooping crane roost habitat, and wet meadows used by several wild bird species.

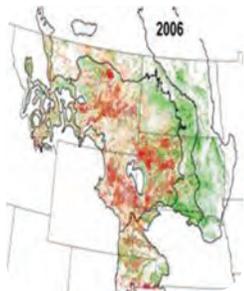
<http://pubs.usgs.gov/sir/2009/5011/> Benjamin Dietsch, 402-328-4122



**Sand Dunes in the Greater Platte River Basin**

Stabilized dune sand covers a large portion of the Great Plains region, including significant areas of the GPRB. Although this dune sand is mostly covered with vegetation at present and sand is not actively being transported, during the past 10,000 years these dunes were active several times. In addition, during the 1930's drought, numerous dunes were reactivated, even where overgrazing was not a factor. Future droughts could reactivate the now-stabilized dunes and significantly affects grazing land, croplands, wildlife habitat, and infrastructure. The USGS is studying the climatic limits of dune sand activity and comparing these findings with forecasts for future climatic conditions on the Great Plains.

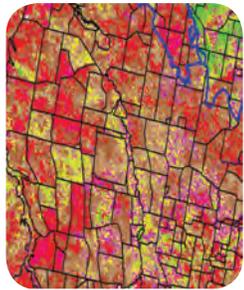
<http://esp.cr.usgs.gov/info/eolian/> Dan Muhs, 303-236-7919



**Carbon Sequestration in the Greater Platte River Basin**

Grasslands are extensive in the western GPRB, with interannual weather patterns affecting vegetation productivity and carbon sequestration. Drought years cause these grasslands to switch from a weak carbon sink to a carbon source. Grassland carbon fluxes are modeled using multiple flux towers, satellite greenness data, weather, and other spatial inputs. Grassland carbon fluxes for the GPRB for 2000–2009 will be mapped at a resolution of 250 meters.

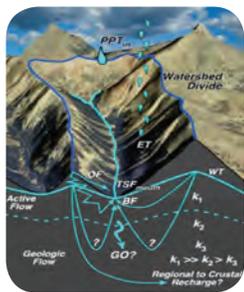
<http://lca.usgs.gov/lca/cflux/index.php> Bruce Wylie, 605-594-6078



**Land Performance/Productivity Anomalies Mapped with Satellite Imagery**

The GPRB is subject to interannual variations in weather that affect vegetation and ecosystem services, such as carbon sequestration, wildlife, and water quality. A satellite-based approach for de-trending interannual weather variations reveals areas that are more or less productive than expected. Persistence of lower productivity over multiple years may indicate a degraded or poorly managed area. Performance anomalies have been correlated to grazing pressure, percent bare ground, insect infestation, and fires.

<http://lca.usgs.gov/lca/projects.php?id=2> Bruce Wylie, 605-594-6078



**Headwaters Research and Monitoring of the Hydrologic Cycle**

Headwaters are sensitive to climate change and for some communities, are the primary source of surface and groundwater on which ecosystems, human populations, agriculture, and industry depend. Monitoring of hydrologic-cycle components along the Continental Divide in Handcart Gulch and Loch Vale, Colorado provides data from meteorological stations, stream gages, groundwater monitoring wells, water-quality samples, ecosystem inventories, glacier footprints, and numerous types of maps. Computer modeling is used to integrate the data and to document and understand the processes associated with climate change, water resources, ecosystems, mineral deposits, and other environmental contaminants.

[http://crustal.usgs.gov/projects/Handcart\\_Gulch/index.html](http://crustal.usgs.gov/projects/Handcart_Gulch/index.html) Jonathan Caine, 303-236-1822

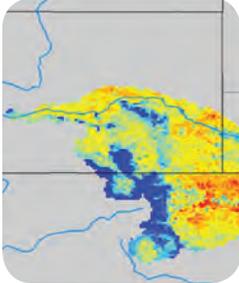


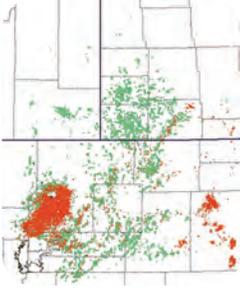
**Loch Vale Watershed**

Loch Vale is an alpine/subalpine catchment in the headwaters of the South Platte River Basin where USGS has conducted detailed hydrological, ecological, and biogeochemical research since the early 1980s. Monitoring provides high-quality, long-term data that are used to analyze trends in climate, water availability, and fluxes of carbon and nutrients. The insights gained through monitoring and research are used to develop and refine models to predict hydrologic, ecological, or biogeochemical responses to stressors such as climate change, atmospheric deposition of pollutants, or disturbance.

<http://co.water.usgs.gov/lochvale/> David Clow, 303-236-4882 x294

<http://www.nrel.colostate.edu/projects/lvws/pages/homepage.htm> Jill Baron, 970-491-1968

	<p><b>Central Colorado Assessment Project</b></p> <p>A component of the Central Colorado Assessment Project, a 5-year effort to characterize the bedrock and surficial deposits of the Colorado Front Range region, involved mapping and compiling detailed 1:100,000-scale geologic maps of quadrangles which cover large parts of the headwater regions of the South Platte River. Denver West and Estes Park quadrangles have been published, and the Fort Collins and Bailey quadrangles are in progress.</p> <p><a href="http://pubs.usgs.gov/sim/3000/">http://pubs.usgs.gov/sim/3000/</a> <a href="http://pubs.usgs.gov/sim/3039/">http://pubs.usgs.gov/sim/3039/</a> Karl Kellogg, 303-236-1305</p>
	<p><b>Surficial Geologic Mapping and Hydrogeologic Framework Studies</b></p> <p>Surficial geologic mapping and hydrogeologic framework studies of the GPRB, begun in 2009, will provide fundamental geospatial datasets on physical properties, geochemistry, genesis, age, stratigraphic relations, and areal distribution of geologic mapping units. The work will lead to a better understanding of past climates recorded in the geologic record and geomorphic processes that have produced major environmental changes in the past; information is needed by land-use decision-makers.</p> <p>Margaret E. Berry, 303-236-1240</p>
	<p><b>North American Soil Geochemical Landscapes Project</b></p> <p>Understanding of the geochemical variability of soils for the North American continent is limited. The USGS, the Geological Survey of Canada, and the Mexican Geological Survey are conducting a soil geochemical survey of the continent to establish a database that will facilitate the identification of regional geochemical patterns that affect the health of humans and ecosystems. Sampling is conducted at a density of approximately 1 site per 1,600 square kilometers (617 square miles). About 140 sites were sampled in the GPRB during 2007 and 2008.</p> <p><a href="http://pubs.usgs.gov/fs/2006/3115/">http://pubs.usgs.gov/fs/2006/3115/</a> <a href="http://minerals.cr.usgs.gov/projects/geochemical_landscapes/">http://minerals.cr.usgs.gov/projects/geochemical_landscapes/</a> David B. Smith, 303-236-1849</p>
	<p><b>National Geochemical Database (NGDB)</b></p> <p>The NGDB consists of data from the analyses of geologic materials by the USGS since the 1960's. Of the more than 2 million samples in the NGDB, more than 11,000 rock, 17,000 sediment, and 4,000 soil samples have been collected and analyzed from the GPRB. Although analytical methods, sampling methods, and sample density vary geographically, these data are useful for project planning, environmental baselines, ecosystem assessments, studies of health issues, and mineral exploration.</p> <p><a href="http://minerals.cr.usgs.gov/projects/nat_geochem_db_II/">http://minerals.cr.usgs.gov/projects/nat_geochem_db_II/</a> Steven M. Smith, 303-236-1192</p>
	<p><b>Land Cover Trends</b></p> <p>The Land Cover Trends project is monitoring and analyzing the rates, causes, and consequences of land-use and land-cover change in the conterminous United States ecoregions for 1972 to the present (2009) using Landsat satellite imagery and a statistical sampling strategy. Analysis of the ecoregions that include the GPRB indicates a spatial and temporal variability of land-cover change that depends on complex interactions among the underlying biophysical and socioeconomic factors. These results are providing a better understanding of the linkages between land change, climate variability, and land management challenges.</p> <p><a href="http://landcover Trends.usgs.gov/">http://landcover Trends.usgs.gov/</a> Mark Drummond, 970-226-9374</p>
	<p><b>Hydrologic Flux Dynamics and Trends</b></p> <p>Archived historical satellite data, climate and hydrological observations, and process-based models are used to characterize hydrologic fluxes across the basin and describe their spatial and temporal dynamics. A suite of models and methods are applied to distinguish the climate signal from the effects of resource management practices (for example, irrigation) by analyzing the relation among hydrologic fluxes within "natural" and "disturbed" subwatersheds. The approach quantifies evapotranspiration and snowmelt and balances the water budget along with precipitation and discharge measurements, complementing a landscape-based approach for validation and parameterization of hydrologic models.</p> <p><a href="http://earlywarning.usgs.gov/usewem/swi.php">http://earlywarning.usgs.gov/usewem/swi.php</a> Gabriel Senay, 605-594-2758</p>

	<p><b>Decline of Paper Birch Populations</b></p> <p>The Niobrara River Valley in north-central Nebraska supports scattered stands of paper birch, a species more typical of boreal forests. These birch stands are considered to be relict populations of the prehistoric past that now occur at only a few sites. Widespread dieback of existing mature birch has been observed in recent years. A USGS study used microclimate dataloggers in birch stands and historic weather data to explore microclimate associations with birch dieback. Current analysis indicates that the future persistence of birch in the Niobrara River Valley is uncertain.</p> <p><a href="http://pubs.usgs.gov/of/2009/1221/">http://pubs.usgs.gov/of/2009/1221/</a> Esther Stroh, 573-441-2944</p>
	<p><b>Oil and Gas Production</b></p> <p>Petroleum provinces that include the Denver, northern Park, northern Forest City, and Salina Basins are located within the GPRB. Approximately 90 percent of the oil and gas production in the GPRB is from the Denver Basin of eastern Colorado, southeastern Wyoming, and southwestern Nebraska. More than 1.05 billion barrels of oil and 3.67 trillion cubic feet of gas (TCFG) have been produced from the Denver Basin. Mean undiscovered oil and gas resources for the Denver Basin were assessed in 2002 at 104.23 million barrels of oil, 2.52 TCFG, and 51.8 million barrels of natural gas liquids and were assessed for the other provinces in 1995.</p> <p><a href="http://energy.cr.usgs.gov/oilgas/noga/">http://energy.cr.usgs.gov/oilgas/noga/</a>  <a href="http://energy.cr.usgs.gov/oilgas/noga/1995.html">http://energy.cr.usgs.gov/oilgas/noga/1995.html</a> Debra Higley, 303-236-5791</p>
	<p><b>Carbon Dioxide and Evapotranspiration in the South Platte Watershed</b></p> <p>Ecosystem-atmosphere exchanges of carbon dioxide and evapotranspiration have been measured from two strongly contrasting ecosystems in the same region during the past several years. Forest-atmosphere exchanges have been measured continuously using eddy covariance and advection flux towers near Niwot Ridge. Urban ecosystem exchanges have been measured with a combination of a tall flux tower and surface-based chambers that include methane and nitrous oxide flux measurements. Research in these contrasting ecosystems will improve quantification of carbon sequestration and emissions and our understanding of the biophysical controls regulating both carbon fluxes and evapotranspiration.</p> <p><a href="http://geochange.er.usgs.gov/carbon/ghg/">http://geochange.er.usgs.gov/carbon/ghg/</a>  <a href="http://www.fluxnet.ornl.gov/fluxnet/FluxLetter_Vol_1_No_4.pdf">http://www.fluxnet.ornl.gov/fluxnet/FluxLetter_Vol_1_No_4.pdf</a> Dean Anderson, 303-236-5691</p>
	<p><b>North Park – Medicine Bow Mountains Geology</b></p> <p>The USGS is leading an integrated, multidisciplinary investigation of the geologic history and framework of the western margin of the Front Range and Medicine Bow Mountains in northern Colorado and southern Wyoming. This area includes the headwaters of the North Platte River drainage, and particularly the glaciated headwaters of the North Platte, Illinois, Michigan, Canadian, and Laramie Rivers, and the Arapaho National Wildlife Refuge south of Walden, Colorado. The study will investigate the evolution of drainage systems in response to tectonic deformation, volcanic activity, and climate and will develop linkages among aquifer systems, sediment source areas, and water storage in the headwaters basins.</p> <p><a href="http://pubs.usgs.gov/of/2008/1360/">http://pubs.usgs.gov/of/2008/1360/</a> Jim Cole, 303-236-1417</p>
	<p><b>Hydrogeologic Framework for Selected Areas of the Upper Loup River Basins</b></p> <p>The Sand Hills is the largest sand sea in the Western Hemisphere and covers an aquifer that has the largest amount of groundwater in the High Plains. However, the hydrogeologic framework is poorly understood; such understanding is needed to evaluate the effects of management and climate change on the system. Small changes in groundwater levels can have significant impacts on the ecosystems of the area. Geophysical techniques are being used together with traditional drilling techniques and modeling to improve the hydrogeologic framework.</p> <p><a href="http://pubs.usgs.gov/sir/2009/5171">http://pubs.usgs.gov/sir/2009/5171</a>  Jared D. Abraham, 303-236-1318 and James C. Cannia, 402-416-5321</p>

	<p><b>Evapotranspiration Rates of Riparian Forests</b></p> <p>A study of water and energy balances at two sites in central Nebraska near Odessa and Gothenburg has improved the understanding of water-use rates by forests on the Platte River. Since 2002, evapotranspiration measurements have been derived from sensors installed on towers above the forest canopy. The study found that cottonwoods in forested areas of the Central Platte in Nebraska use less water than indicated by previous research.</p> <p><a href="http://pubs.usgs.gov/sir/2008/5228/">http://pubs.usgs.gov/sir/2008/5228/</a> Matthew Landon, 619-225-6109</p>
	<p><b>Resistivity Survey of Selected Irrigation Canals within the North Platte Valley</b></p> <p>The USGS and local partners are using surface geophysical methods, surface-water measurements, heatflow measurements, borehole logs and Light Detection and Ranging (LiDAR) surveys to map the near surface (depth about 10 meters) sediments and estimate leakage rates of irrigation canals. Information on where this water is preferentially leaking will improve recharge estimates for groundwater-flow models and provide critical insight into the relations between groundwater and surface water.</p> <p><a href="http://pubs.usgs.gov/sir/2006/5032/">http://pubs.usgs.gov/sir/2006/5032/</a> <a href="http://pubs.usgs.gov/ds/381/">http://pubs.usgs.gov/ds/381/</a>  <a href="http://pubs.usgs.gov/sir/2009/5194/">http://pubs.usgs.gov/sir/2009/5194/</a> Bethany L. Burton, 303-236-1327 and James C. Cannia, 402-416-5321</p>
	<p><b>Heliborne Electromagnetic Surveys for Hydrologic Studies</b></p> <p>The USGS is applying innovative approaches to data collection for development of hydrogeologic frameworks for groundwater models. The geologic framework in western Nebraska consists mostly of unconsolidated alluvial sediments lying unconformably on siltstone bedrock that crops out throughout the area; Chimney Rock historical monument (pictured) is an example. Airborne geophysics and surface geophysical methods are used to map and image the subsurface resistivity of sediments and relate them to aquifers within selected sections of the North Platte River Valley and Lodgepole Creek Valley of Nebraska.</p> <p><a href="http://pubs.usgs.gov/of/2009/1110/">http://pubs.usgs.gov/of/2009/1110/</a>  Jared D. Abraham, 303-236-1318 and James C. Cannia, 402-416-5321</p>
	<p><b>Heliborne Geophysical Mapping of the Glaciated Areas of Eastern Nebraska</b></p> <p>Approximately 70 percent of Nebraska's population lives within the glaciated areas of eastern Nebraska. The source of municipal water supplies for most of this population is the Platte River. This study will enhance the understanding of the surface and groundwater relations in the glaciated regions of Nebraska to assist in the Eastern Nebraska Water Resource Assessment. The USGS and partners are using airborne geophysics, surface geophysics, borehole geophysics, lithologic sampling, and well monitors to map the sediments and estimate the hydrogeologic parameters of the aquifers.</p> <p><a href="http://pubs.usgs.gov/of/2008/1018/">http://pubs.usgs.gov/of/2008/1018/</a> Jared D. Abraham, 303-236-1318 and James C. Cannia, 402-416-5321</p>

—June M. Thormodsgard

<b>For additional information please contact:</b>
<p>Regional Science Office  USGS Central Region  Denver Federal Center  Building 53, MS 406  Denver, CO 80225  <a href="http://www.cr.usgs.gov/rso/">http://www.cr.usgs.gov/rso/</a>  303-236-1450 (telephone)  303-236-1451 (fax)</p>