

Management and Impacts of Climate Change Programme GICC CRP 2000

6/00 - Carbon and water balance in South-West France: Recent history, present state and scenarios for the future – Comparing climatic and anthropic pressures

Summary Report

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The objectives of the project are the development and evaluation of a set of generic-type tools and methods designed for estimating and simulating fluxes and stocks of carbon and water on the scale of a pilot area of approximately 50 km x 50 km located in the Midi-Pyrénées region of France and comprising various types of ecosystem (crops, forests and abandoned land). The developed approaches aim to assess current balances on the regional scale and to simulate scenarios of these balance trends in response to climatic or anthropic factors.

The project is part of a long-term programme aiming to understand the functioning of land surfaces on the scales of the landscape and region, and to develop an integrated model of this functioning for scientific as well as management, scenario simulation and decision-making purposes.

The final report presents the methodologies developed and the results obtained in the course of this GICC-supported project. Complementary but unsynchronized funding was obtained for similar activities from the Ministry of Scientific Research (*Reseau Terre et Espace*), the Midi-Pyrénées Regional Council and CNES.

Methodologies and results are presented under three major headings: land use, water, and carbon. This partitioning reflects the main elements we need to develop in order to reach our objectives, i.e. the understanding and integrated modelling of surface functioning.

The main outputs may be classified into five broad categories:

- Information system: Data produced *via* the project or collected from various other sources (IGN, BRGM, etc.) are integrated into a geographical information system and its associated databases. These data include topographic and thematic maps, satellite and meteorological data, and readings from experimental set-ups (in collaboration with CNRM and INRA-Toulouse).
- Methodologies: methods using remote sensing to map land use (in collaboration with INRA-Toulouse) and assess water balance and gross primary productivity (in collaboration with CNRM and LSCE) were designed, and implemented on the entire pilot area. For the first time, the benefit of accessing remote sensing data series with a high space and time resolution was assessed, in particular for the evaluation of the impact of the 2003 drought.
- Processes and *in situ* measurements: A large number of soil samples were collected and analysed to study soil carbon stocks in a cultivated watershed in relation with past land use trends (in collaboration with INRA-Orléans). A special device to measure water and carbon dioxide fluxes

using the eddy covariance method was set up on two cultivated sites (in collaboration with INRA-Bordeaux).

- Thematic:

- The distribution in time and space of the water requirements of crops, whether irrigated or not, and of several other terms of the water balance (actual evapotranspiration, soil humidity) were assessed over the entire pilot area. The impact of the 2003 meteorological conditions was also assessed.

- The impact of land use changes having occurred between 1991 and 2002 on carbon stocks were assessed for part of the Haute Garonne and Gers départements.

- The impact of land use changes on the hydrology of a watershed was studied through modelling. The findings suggest that a 30 % increase of the surface area covered by forests and grasslands on a catchment could have a significant impact on water discharge (in collaboration with the Agence Régionale pour l'Environnement and the Chambre Départementale d'Agriculture de la Haute Garonne).

- Dissemination and optimization of results: The land use map of the year 2002 was distributed to a number of research teams for their own research requirements. Results concerning the estimation of water requirements for crops and the hydrological modelling were presented to several actors involved in local land development (local authorities, Agence de l'Eau, DIREN, Chambre d'Agriculture).