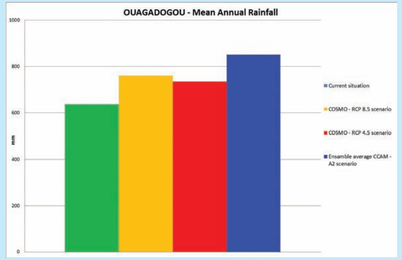
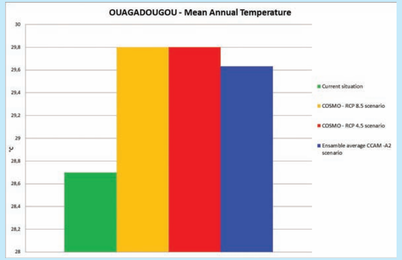
OUAGADOUGOU

Burkina Faso

CLIMATE CHARACTERISTICS

The Ouagadougou region has a pronounced rainfall maximum during the boreal summer (June to August), and experiences very dry winters (December to February). The summer rainfall maximum occurs in relation to the West African monsoon. The city has a tropical climate with average monthly temperatures ranging between 20 and 30 °C.
The results of climate simulations for the period 2010-2050 suggest that:
– mean annual rainfall could increase by 20%-25% with respect to the current situation;
– an increase of at least 1 °C in mean annual temperature is expected.





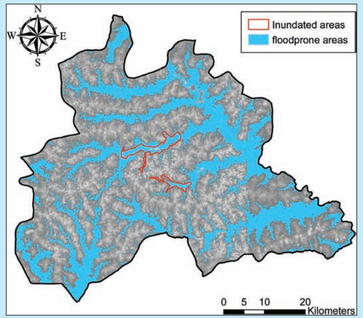
CLIMATE RELATED HAZARDS

Floods

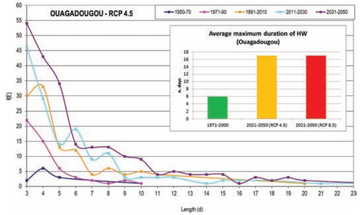
The analysis of Extreme Rainfall Events, based on climate projections data until 2050, suggests that the intensity of these events is expected to decrease, although an increase of the frequency of the Extreme Rainfall Events is envisioned. However, the extension of flood prone areas in Ouagadougou is very large due to its flat topography.
On September 1, 2009 Ouagadougou experienced the worst flooding event in the last 50 years. An estimated 109.000 people were left homeless.
The map of flood prone areas for Ouagadougou has been calibrated based on the actual flood extent as a result of the 2009 flooding event.

Drought

The analysis of the monthly average rainfall clearly shows that the current condition is extremely dry. Analysis based on climate projections reveals that this condition is expected to continue in the next 40 years with an increase of the duration of dry periods.



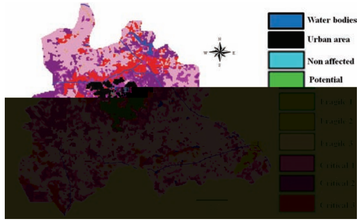
Map of Topographic Wetness Index for Ouagadougou (most susceptible areas to flooding phenomena based on a geomorphological criterion).



Average maximum duration of Heat Wave phenomena and frequency distribution plot of hot days duration for four separate bi-decadal periods.

Heat waves

Analysis of climate projections for Ouagadougou reveals a strict correlation between heat wave duration and hot days number. The length of heat wave episodes shows a mean value increasing from 6 to 17 (RCP4.5 and RCP8.5) days. The frequency distribution plot of hot days duration for four separate bi-decadal periods (see figure) shows the temporal change of heat wave characteristics. This distribution has become longer tailed with time. For example the number of events with maximum length lasting 5 days could increase from 3 to 34 (37 for RCP8.5) over 100 years (from 1950-70 to 2030-2050).
The expected persistence of long-lived heat waves lasting approximately 1.5-2 weeks is clearly longer with respect to the climatological period (1961-1990). During 100 years, short lived but more intense waves are more than doubled in duration. It is evident the needs for the national health services to develop strategies for the mitigation of the heat wave effects, to enhance the resilience of the population, particularly the elder people.



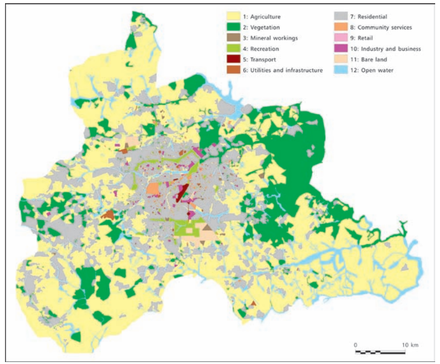
ESAI Map for Ouagadougou.

Desertification

The map representing the spatial distribution of the Index of Environmentally Sensitive Areas (ESAI) suggests that the most sensitive areas to desertification in Ouagadougou are represented by the peri-urban zones, poorly vegetated and affected by an increasing demographic pressure as the result of immigration from surrounding rural areas.

URBAN CHARACTERIZATION AND GREEN STRUCTURE MAPPING

The Greater Ouagadougou administrative zone is still largely *agricultural*. Large tracts are also associated with other areas of *vegetation*. For example, the *Mixed forest areas* are associated with recreation and conservation functions and therefore provide a valuable resource.
The periphery of the main urban core is surrounded by areas informally developed, comprising mainly adobe constructions with no formal infrastructure. Formally planned areas have full infrastructure and are mainly located between the airport and a large park area to the south of the centre. The large area of housing construction to the south of the park area is associated with further 'high class' housing and a number of administrative and commercial functions. Some of the park areas towards the north of the urban core are associated with mineral extraction, such as sand quarrying. This activity can be expected to be exerting some pressure on green structures in these areas.
Notable to the north east of the city centre is the large community woodland area (Bangr'weogo urban park) bordering the central *reservoirs*. This area connects to *riverine* vegetation zones which lead out of the city. These linear channels may sometimes act as a means of bringing cool/clean air into the northern part of the urban core.



Urban Morphology Types in the Grater Admnistrative Zone of Ouagadougou ("La grand Ouaga").

FINDINGS ON SOCIAL VULNERABILITY ASSESSMENT

Findings on social vulnerability for the communities of Sector 1, 2 and 3 for Ouagadougou have been grouped according to four main vulnerability dimensions:

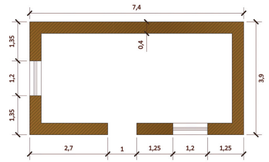
Asset vulnerability
Most households have education level not exceeding primary education, no tertiary level settlers
Main economic activities not established
Income levels between 31,000 CFA Franc (~US $60) to 350,000 CFA Franc (~US $700) per month
Health issues not established
Mixed ethnic background with Mossi being dominant
Physical Vulnerability
Some of the households (40%) have no latrines
Haphazard disposal of solid wastes
Institutional vulnerability
The National Council for Emergency and Rehabilitation (CONASUR), the Regional Council for Emergency Relief and Rehabilitation (CORESUR), the Provincial Council for Emergency and Rehabilitation (CORPOSUR), the District Council for Emergency Relief and Rehabilitation (CODESUR) and the Village Council for Emergency Relief and Rehabilitation (COVISUR) are involved in issues related to disaster management at National, Regional, Provincial and District and village levels respectively.
Attitudinal vulnerability
In flood prone area the people's decisions on urban development seem to be conditioned by poverty and not by their level on risk knowledge

SPECIFIC RECOMMENDATIONS

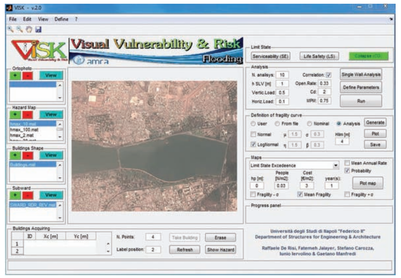
Recommendations to decrease structural vulnerability in Ouagadougou

Structural Material: Adobe; Self weight (γ): 18 KN/m3; Elastic modulus (E): 151 MPa; Compression strength (f_c): 0.89 MPa; Shear strength (f_s): 0.03 MPa; Flexural strength (f): 0.2 to 1.5 MPa;
Loading: Hydrodynamic, hydrostatic and debris impact;
Restraint: The wall panel is assumed to be fixed at the base and hinged at the two vertical sides;
As-is (default) configuration: Vulnerability of the structure to collapse is represented below by the fragility curves (probability of collapse vs. flood height). The structure has been considered to have doors and windows that are not sufficiently water- proof (case 0, black). Another as-is version can have sealed doors and windows (case 4, purple). It is assumed that the section area is being eroded due to contact with water.
Effective mitigation strategies: Three possible low-cost mitigation strategies are considered:
1. Adding water-proof protection (protecting the walls from direct contact with water, case 1, red);
2. Adding a raised platform (case 2, blue);
3. Strengthening the connection between the walls (case 3, green);

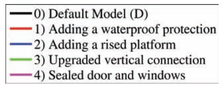
An improve in the flood-resistant performance of the structure can be appreciated as a shift to the right in the fragility curve; that is, the structure is going to collapse due to higher flood height values. It can be observed that all the three mitigation strategies considered (slightly) improve the performance of the structure. As it can be expected, building a raised platform seems to lead to the largest improvement.

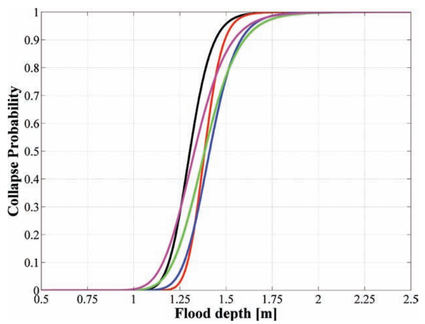


Ougadougou, flood on September 1, 2009 (photo: Prof. Hamidou Touré, UO).



The fragility curve can be read as: *the building is going to collapse with 50% probability due to a flood height of around 1.23m and it is going to collapse with 100% probability* due to a flood height of around 1.65m.*
* The 100% probability is based on the working assumptions made.





Recommendations on desertification prevention

Desertification maps are a valuable tool to promote a more efficient management of the affected areas and to address effective policies of desertification prevention, mitigation and adaptation. At the same time, these maps represents also the basis for future studies, considering the dynamic character of some of the considered environmental factors (e.g., vegetation cover).
Research needs in this area include:
a) a well-structured information about desertification in relation to other environmental issues (biodiversity, climate change, rural development planning…) at various levels (scientists, farmers, policy makers,…);
b) implementation and application of existing tools and knowledge;
c) monitoring and evaluation of sustainable land management.

GENERAL PRESENTATION

Ouagadougou is the capital of the Republic of Burkina Faso. It extends on 520 km² of which 217.5 km² are urbanized. 70% of the industrial activities of the country are concentrated in the capital which hosts a population of 1.5 million inhabitants. In 2020 the capital is expected to reach 3.4 million inhabitants, making it one of the most rapid growing cities in the region. Ouagadougou faces several urban challenges; among them is poverty. 50% of the population live in poor conditions. Women are particularly exposed, with less access to education, employment and land.
Ouagadougou counts five districts, 30 sectors and 17 villages. A council of 90 members is elected for a five years mandate since 1995. The Mayor of the city is the executive leader of the municipal authorities.

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