

REMOTE SENSING STUDY OF THE URBAN DYNAMICS OF THE CITY OF NIAMEY (NIGER) AND CONCOMITANT RAINFALL VARIATIONS FROM 1985 TO 2016

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ABSTRACT

In recent decades, the city of Niamey has experienced an exponential demographic growth. This phenomenon has led to a strong urban dynamic characterized by the increase and densification of urbanized areas (buildings plus infrastructure) that cause the occupation of natural areas. In a few decades, Niamey has become a large city thanks to its political, administrative and commercial functions. Its population growth has resulted in a rapid expansion of the city: the number of neighborhoods was in less than a century multiplied by 16; 5 neighborhoods during the installation of the city on the plateau in 1937, and 89 today. The location of the study area is presented in **Figure 1**. This study aims to highlight the urban evolution of the city of Niamey by remote sensing from 1985 to 2016 and evaluate its relationship with the evolution of rainfall through the Standardized Precipitation Index (SPI). To do this, several data were used including, among others, the Landsat sensor images (TM, ETM + and OLI), the Chirps precipitation data, **Table 1**.

The methodological approach adopted is to map the evolution of the city of Niamey by processing Landsat images at four different dates (1985, 1994, 2003, 2016) through a classification supervised by the maximum likelihood algorithm. Before processing these Landsat images, we applied pre-treatments on the images to better extract the desired information. This is the radiometric correction (Conversion of Digital Number in reflectance value) and the geometric correction (fusion of Landsat ETM + images, OLI to obtain resolutions of 15 m, then we resampled the pixels of the Landsat TM images from 30 m to 15 m to make it uniform to those of ETM + and OLI).

For the SPI assessment, the 34-year (1981-2014) CHIRPS precipitation data were used to calculate this meteorological drought indicator using the formula given by Mckee *et al.* (1993). **Table 2**, presents the classification of drought according to SPI values.

Plates 1, 2, 3 and 4 present the land occupation maps of the city of Niamey during the dates mentioned above. The result show an extension of the built-up area mainly in the North-West and West-East direction of the city of Niamey, **Plate 5**. The use of the matrix of change made it possible to determine the classes of land occupations that were converted into urbanized space from 1985 to 2016, **plate 6**. Thanks to the results of the SPI we were able to highlight the dry periods and wet periods recorded since 1981 in the city of Niamey. The annual evolution of the SPI values is given in **Tables 3, 4 and 5**. Overall, the annual average values of the standardized precipitation index (SPI) are positive over 18 years, corresponding to wet years (52.94%) with extreme humidity in 1994 and 1999, and negative over 16 years (dry years, 47.06%) with cases of extreme drought in 1984 and moderate drought in 1987, **plate 7**.

KEYWORDS

Landsat, Urbanization, Niamey, Niger, Drought, Remote sensing.

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