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Onset of the rainy season and crop yield in West Africa

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Especially in semi-arid or arid regions, where rainfall is limited to only few months per year, rainfall is the most important factor affecting crop growth and yield. Every year, farmers are faced with the crucial question when to start planting. Do the first rainfalls after the dry season resemble the Onset of the Rainy Season (ORS) or not? The farmers' seeds and effort will be lost if no major rainfall follows within the following weeks. It is apparent, that the choice of the planting date is crucial for crop yield.

A fuzzy logic algorithm for estimating the onset of the rainy season and the optimal planting date is developed. It is based on rainfall data and accounts for agriculturally meaningful aspects, expressed in terms of the following definition constraints: i) rainfall amounts, ii) number of rainy days, and iii) the occurrence of dry spells at the beginning of the growing season. The ORS algorithm, which is calculating the planting date for each year, is coupled to the physically based crop model CropSyst.

A Monte Carlo approach is applied to generate annual planting dates (1979-2003). Therefore, the definition constraints, which are allowed to vary within reasonable parameter ranges, are generated randomly. The averaged crop yield is serving as performance measure for each realization. The parameter range of the best realizations is retained. Various iterations are necessary to obtain a robust set of definition parameters.

The coupled ORS definition-crop modelling system is applied for different crop species and observation sites across Cameroon for the period 1979-2003. It is shown that the derived optimal planting dates would allow significantly increased crop yields compared to the existing planting rules. Finally, based on the robust definition parameterizations, expected future crop yield is estimated by statistical downscaling of different global climate scenarios (ECHAM5).

Keywords: Crop Modelling, Monte Carlo, Onset of the Rainy Season, Planting date