A REVIEW OF HF RADAR MEASUREMENTS IN EQUATORIAL WEST AFRICA

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The purpose of this paper is to review the results given by two measurement campaigns of HF radar, performed in West Africa (Ivory Coast) in 1993 and in 1994. The HF radar works between 2 and 30 MHz, its time and space resolution are 70 ms and 1.5 km. It uses two spiral antennas (100 m diameter) for ionograms, echo maps and Doppler and a 7 loop antennas for echolocation. Four radar frequencies can be used simultaneously. The originality of the radar is its large field of view associated with its wide possibilities of measurements. As data are obtained in the different ionospheric layers simultaneously from oblique and vertical directions, results concern a large set of equatorial geophysical studies. The paper will emphasize the following results : Electrojet irregularities and electric field measurements Ionospheric irregularities (type I and type II associated with two stream and cross field processes) were obtained in the electrojet region near 105 km altitude. Their horizontal motion is driven by the electrojet. The horizontal velocity determined from oblique measurements is used to retrieve the electrojet electric field. F region day time irregularities Irregularities have been observed in the electrojet but also at higher altitude. These irregularities were never been observed previously. Their structure varies with the observation altitude. Their time and space scales increase with the altitude. They are field aligned and can be used to measure the horizontal velocity of the F region plasma flow. They disappear in counter electrojet conditions. Dynamic of the F region The F region vertical motions can be measured in the different ionospheric layers. The upper F region is submitted near the local noon to large plasma flows, upward in the morning and downward in the afternoon related to the equatorial fountain process. The large and rapid F region height increase in the evening suggests prereversal enhancement of the electric field before sunset. Spread F Large plasma plumes were observed during night time. Oscillations of the reflection height, lasting several hours, are produced by large plasma depletions or bubbles moving above the radar site. Different kind of spread F were also observed.
Ionization related to upward discharges and sprites During thunderstorms, localized ionization has been observed obliquely in the upper atmosphere
following intense lightning electromagnetic emissions. Data are consistent with specular reflections

from columns of ionization, at altitudes of 55 to 65 km, produced by run away breakdown mechanism at
the origin of sprites.