SwampSat II Satellite Technical Description

SwampSat II is a 3U CubeSat designed to characterize very low frequency (VLF) wave propagation in the upper ionosphere. There exists a limited number of VLF experiments to date and most measurements are 20-30 dB lower than existing models predict. The objective of this mission is to provide additional experimental measurements of narrowband VLF transmitter signals and lightning-generated VLF sferics in low Earth orbit.

The satellite will be launched as a secondary payload aboard the Cygnus NG-12, from Wallops Island, VA October 19, 2019. NG-12 will dock at the ISS and then depart ISS for higher orbit, around January 12, 2020. Some time in mid-January Swampsat II will deploy from NG-12 into a 51.6 degrees inclined circular orbit, at 500 km perigee and 500 km apogee. Transmissions will begin 30 minutes after ejection from the deployment container and cease 12 months later, or sooner if commanded. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs approximately two years after launch. See the Orbital Debris Assessment Report for details.

The spacecraft is a single 3U with an overall dimension of 10 cm x 10 cm x 34 cm. The total mass is approximately 3.7 kg and its center of mass is in close proximity to its geometric center.

The payload on SwampSat II is square loop antenna with a total length of 16 m to characterize the target VLF waves (shown in Figure 1). The satellite contains the following systems: Payload, Attitude Determination and Control (ADC), Command and Data Handling (CDH), Electrical Power System (EPS), Structures, Mechanisms, and Thermal (SMT), and Telemetry, Tracking, and Command (TTC).

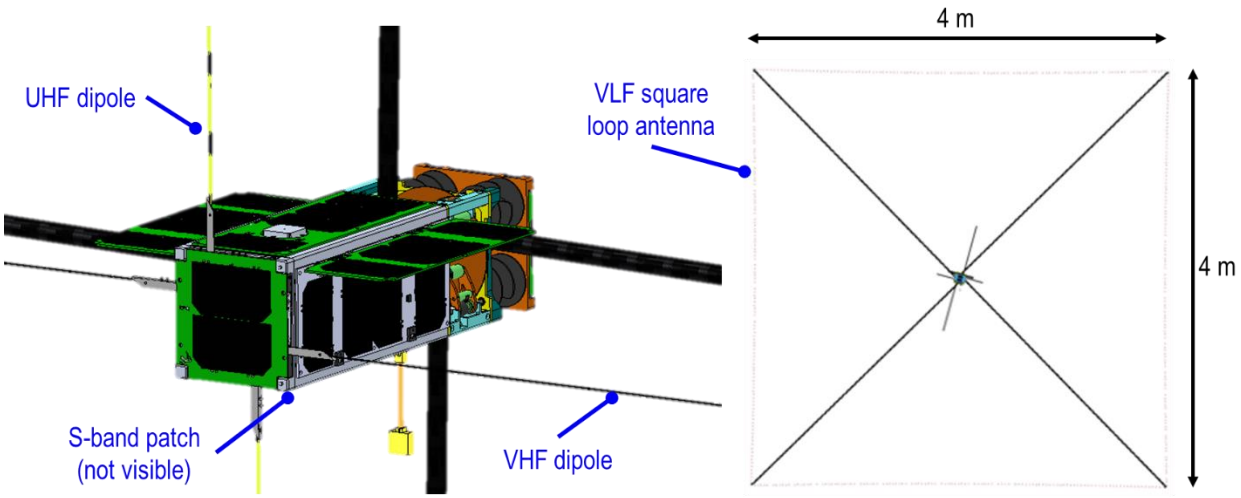

Figure 1 SwampSat II overview

Payload (PLD): The payload consists of a VLF receiver and an antenna storage and deployment system (ASDS). The ASDS includes the antenna boom system, the antenna element system, and the deployment motor. The VLF receiver, designed and developed in-house, will sample VLF waves in the 1 – 32 kHz frequency range. The antenna boom system deploys four carbon fiber reinforced polymer booms. The antenna element, a 16 m long 14 AWG flexible, stranded copper

conductor, deploys with the booms through the use of a stepper motor and a gear train. Deploy is recorded with a camera.

Attitude Determination and Control (ADC): The ADC subsystem performs two attitude control tasks: detumbling and pointing. The ADC subsystem is comprised of the CubeSpace Y-Momentum ADC package that includes attitude determination sensors (a 3-axis rate gyro, a deployable three-axis magnetometer, and multiple Sun-sensitive photodiodes) and actuators (a momentum wheel, two magnetorquers, and a magnetic coil). A piNAV-NG GPS receiver from SkyFox Labs is integrated with the ADC package but is not used for attitude determination; its primary purpose is to geo-tag the scientific data.

Command and Data Handling (CDH): The CDH subsystem consists of an on-board computer (OBC) board that includes a microprocessor, two data storages, analog-to-digital converter, communication interfaces, motor driver, camera, and temperature sensors along with the associated software. There are four main software functions: (i) health status monitoring, (ii) operational mode handling, (iii) command processing and execution, and (iv) payload data acquisition and storage. The CDH subsystem is the central interface for all other subsystems and is responsible for monitoring and maintaining the operational state of the satellite. The CDH is also responsible for controlling the payload deployment motor, controlling the camera used to verify payload deployment, and for sampling, compressing, and storing data from the VLF receiver.

Electrical Power System (EPS): The EPS has three main functions: (i) power generation, (ii) power storage, and (iii) power distribution. Power generation and storage consists of two 2U single deployable, one 2U body-mounted, and two 1U solar panels with Spectrolab XTJ solar cells that generate approximately 7 Whr to charge a 40 Whr lithium polymer battery. For power distribution, the EPS uses an array of power distribution modules and power conditioning modules to deliver power to the rest of the satellite. The solar panels, battery, and the power distribution board are all components from Clyde Space.

Structure, Mechanisms, and Thermal (SMT): The SMT subsystem encompasses the structure, mechanisms, and thermal. The structure provides the supporting framework to house the payload and the satellite bus. The structure is made of Aluminum 7075-T6 and will be hard anodized. The satellite has three deployment mechanisms: solar panel deployment mechanisms, UHF/VHF antenna deployment mechanisms, and the magnetometer deployment mechanism. All deployment mechanisms are commanded through the CDH subsystem. For thermal, only the battery has built-in heaters for active thermal control and the rest of the satellite consists of passive thermal control using thermally conductive and insulated silicone epoxies.

Telemetry, Tracking, and Command (TTC): A VHF receiver and dipole antenna on board the spacecraft, support uplink commands from the ground station at the UF campus. Bus and payload status data is downlinked via a UHF transmitter and dipole antenna to the receiver at the UF campus. An S-band transmitter and patch antenna are used to download experiment data to the UF ground station receiver.

Propulsion: No propulsion subsystem is included