THE AQUARIUS/SAC-D MISSION OVERVIEW

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1. INTRODUCTION

The Aquarius/SAC-D mission (Figure 1), scheduled for launch in late 2010, comprises one of NASA's Foundational Missions, bridging the period between the Earth Observing System (EOS) and the Decadal Survey. It will provide a spectrum of microwave passive and active measurements to derive ocean salinity, ocean rainfall, ocean winds and sea ice cover, land soil moisture, and other independent measurements [1]. This mission is primarily a partnership between the United States and Argentina, and includes participation from Italy, France, Canada and Brazil.

2. PROGRAM RELEVANCE

As a bridge mission between NASA's EOS and Decadal Survey, Aquarius/SAC-D will make fundamental new measurements of surface salinity over the open ocean and investigate the interaction between variations in ocean circulation, global water cycle and climate. Ocean salinity is a tracer for the variations in precipitation, evaporation and ice melt. The associated salinity variations alter seawater density, and thus influence the ocean currents and mixing processes that regulate the ocean's heat and freshwater transport and storage [2]. These processes are not adequately represented in the present-day climate models. Aquarius/SAC-D will measure sea surface salinity with ~150 km spatial resolution with sufficient accuracy on monthly average to advance our basic knowledge of a range of oceanic and air-sea interaction processes related to climate variability. Aquarius will also be able to obtain low resolution (150 km and 7-day) soil moisture retrievals using both passive radiometer and active radar measurements to precede the higher resolution SMAP Decadal Survey mission and Argentine SAOCOM mission. Lastly, the Aquarius/SAC-D rain measurements will contribute to the satellite constellation that comprises the current Global Precipitation Measurement (GPM) program.

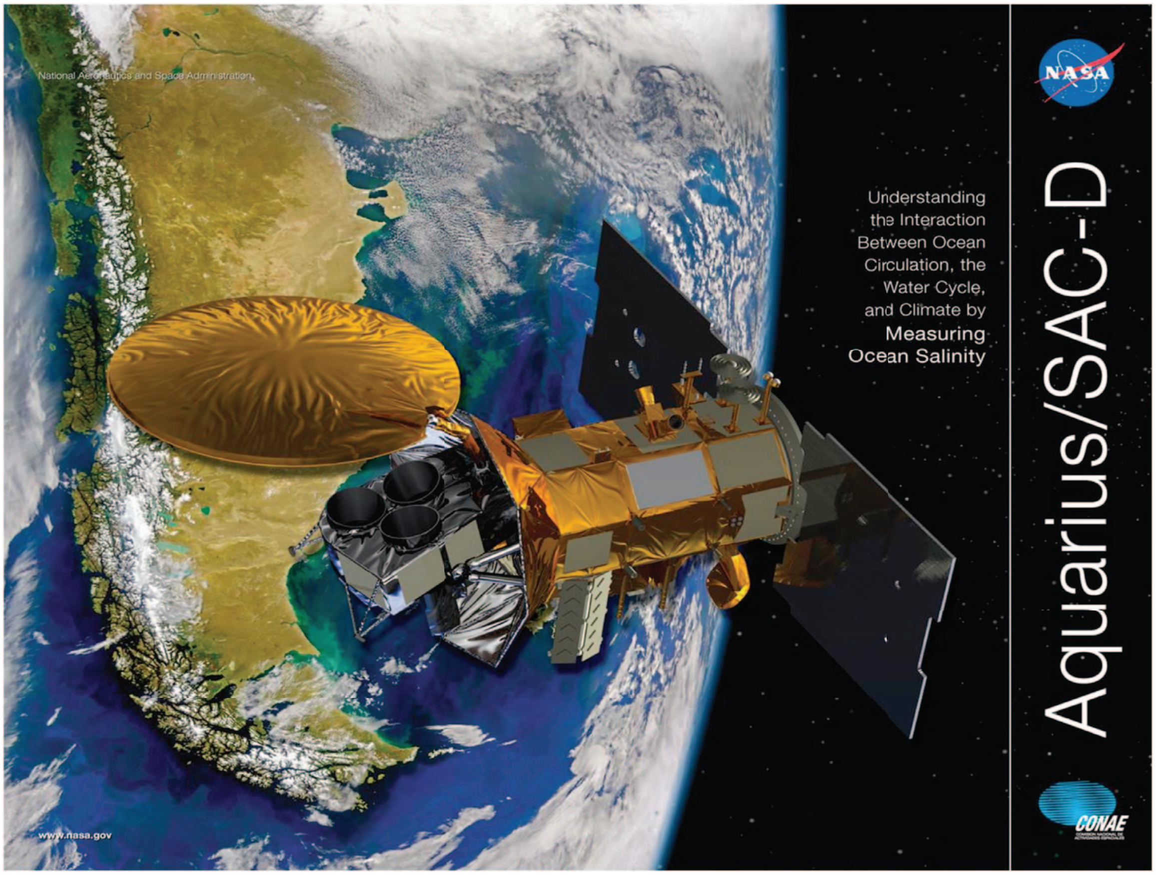

Figure 0: The Aquarius/SAC-D satellite.

3. SCIENCE INSTRUMENTS

The Aquarius L-band microwave instrument [3] will make passive polarimetric (H, V, +45, -45) measurements at 1.413 GHz and coincident radar backscatter measurements at 1.26GHz. The radiometer 1.413 GHz H and V channels are used to retrieve ocean salinity, while the +/- 45 channels will be applied to remove Faraday rotation from the ionosphere. The L-band radar channels (HH, HV, VH, VV) will provide ocean surface backscatter data to correct for the effect of ocean surface roughness due to wind and waves. The K and Ka-band Microwave Radiometer (MWR) carries a 23.8 GHz V-pol channel, and 36.5 GHz (H, V, +45, -45) polarimetric channels which are intended to provide the coincident rain rate, wind and sea ice measurements, as well as water vapor and cloud liquid water. The sensors will have overlapping 390 km wide swaths, with three fixed beams of 90 km, 120 km and 150 km widths from the Aquarius L-band sensor and eight beams of ~45 Km width on the MWR (Figure 2). The sensors will collect data over the globe (ocean, land and ice surfaces) from a 6pm/6am sun-synchronous polar orbit [1].

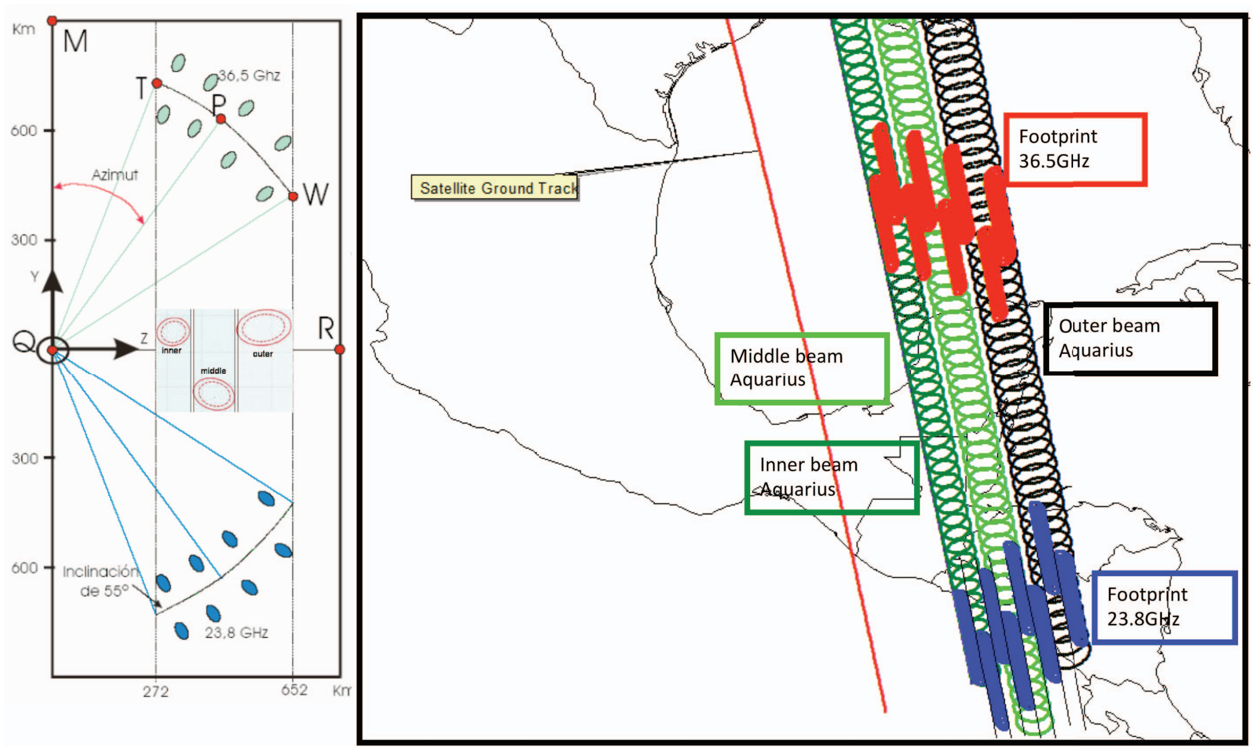

Figure 1: Left Panel shows the fixed 8-beam pushbroom patterns for the MWR 23.8 and 36.5 GHz channels, and in the center the 3-bean Aquarius footprint. Right Panel: Overlapping Aquarius and MWR ground tracks.

Other onboard instruments included in this Observatory are a) the New InfraRed Sensor Technology (NIRST) camera to observe high surface temperature events (fires, volcanoes) and to estimate sea and land surface temperature, b) the High Sensitivity Camera (HSC) for observing nighttime light sources, c) the GPS Radio Occultation for Sounding the Atmosphere (ROSA), d) the CARMEN instrument to study the influence of space radiation on advanced components and measure micrometeoroids and micro-orbital debris in space environment, e) the Data Collection System (DCS) to receive in situ data from ground platforms, and f) the Technological Demonstration Package (TDP) to measure parameters useful for determining satellite attitude (Table 1).

INSTRUMENT	OBJECTIVES	SPECIFICATIONS	RESOLUTION	AGENCY
Aquarius Radiometer & Scaterometer	Sea Surface Salinity Soil Moisture	Integrated L- Band Radiometer (1.413 Ghz) & Scatterometer (1.26 Ghz) Swath: 390 km	Three beams:76 x 94, 84 x 120, 96 x 156 km	NASA
MWR Microwave Radiometer	Precipitation, wind speed, sea ice concentration	Bands: 23.8 Ghz V Pol. and 36.5 Ghz H and V Pol. Band width: 0.5 and 1 Ghz swath: 380 km	Sixteen beams < 54 km	CONAE
NIRST New Infrared Sensor Technology	Hot spot events, sea surface temperature measurements	Bands: 4, 11 y 12 um Instantaneous swath 182 Km extended swath 1000Km Pointing: ±30°	Space resolution: 350 m in temperature: 0.5°C smallest burning detectable area 200 m²	CONAE CSA
HSC High Sensitivity Camera	Urban lights, electric storms, polar regions, snow cover, ships detection	Pancromatic: 450-600 nm Swath: 700 Km	200-300 meters	CONAE
DCS Data Collection System	Data Collection System	401.55 Mhz uplink	2 contacts per day with 200 platforms	CONAE
ROSA Radio Occultation Sounder for Atmosphere	Atmospheric properties	GPS Occultation Techniques	Horiz: 300 Km Vert: 300m	ASI
CARMEN I ICARE & SODAD	Effects of cosmic radiation in electronic devices, distribution of micro-particles and space debris	I: three Si detectors, Si/Li S: four MOS sensors	I: 256 channels spectra S: Sensitivity: 0.5 u part. at 10Km/sec	CNES
TDP Tech. Demonstration Package	Position, velocity and time inertial angular velocity determination	GPS receiver Inertial Unit Reference	Position: 20m, velocity:1m/sec Angular Random Walk: 0.008 deg/sqrt h	CONAE

Table 1: Details of the Aquarius/SAC-D science payload

11. REFERENCES

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[2] US CLIVAR Salinity Working Group. "Report of the US CLIVAR Salinity Working Group". US CLIVAR Report no. 2007-1. US CLIVAR Office, Washington, DC, 2007. (Available online at: http://www.usclivar.org/Pubs/Salinity_final_report.pdf).

[3] Le Vine, D.M., G.S.E. Lagerloef, F. R. Colomb, S. H. Yueh, F. A. Pellerano, "Aquarius: An Instrument to Monitor Sea Surface Salinity from Space", IEEE Trans. Geosci. Remote Sens., Vol. 45 (no. 7), pp. 2040-2050, July, 2007.