The SAC-C Project

Project Description

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The SAC Program

ARGENTINA - USA

Cooperative Program

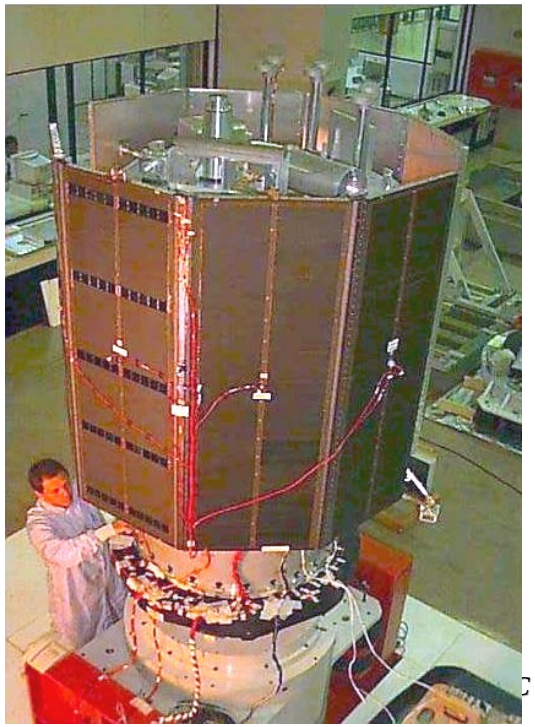
Small Low-Cost Scientific Missions of mutual interest

- More than 10 years of cooperative agreement.
- Three satellite missions and more.

The SAC Program

International Cooperation Program

- **CONAE** Providing Bus and Scientific Instrumentation.
- **NASA** Providing Launch and Scientific Instrumentation.



SAC-A Launch: **Dec/1998**

SAC-C Launch: **Nov/2000**

The SAC Program

Small Low-Cost Scientific Missions of mutual interest

- In the SAC Program 3 satellite mission have been launched

SAC-B

Launched in Nov. 1996

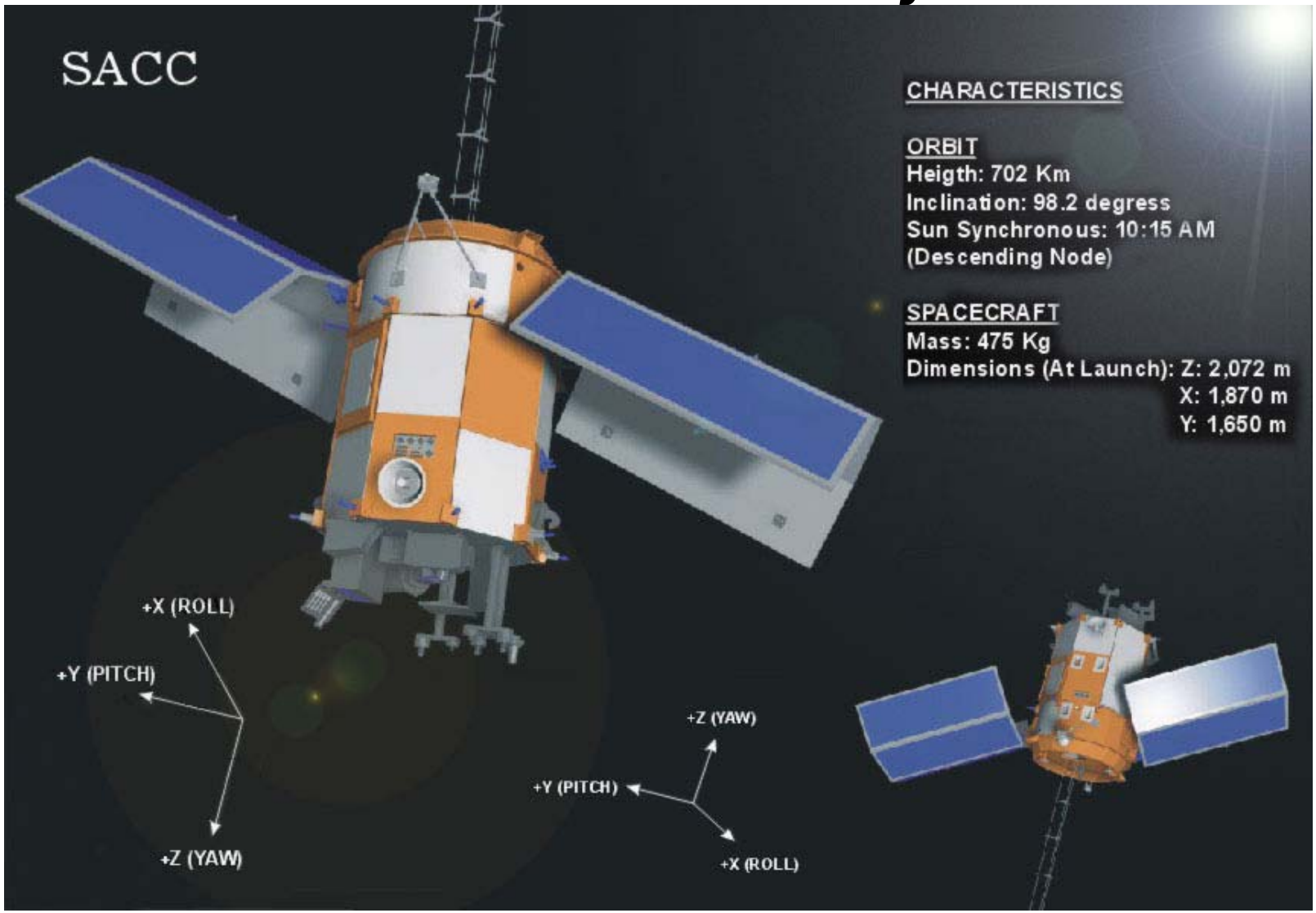
SAC-A

Launched in Dec. 1998

SAC-C

Launched in Nov. 2000

The SAC-C Project



SAC-C Mission Objectives

- Study the ground and sea ecosystems to monitor the atmospheric temperature and water vapor content to determine the variability in the atmospheric structure.
- Provide space observatory quality measurement of the geomagnetic field.
- Measure the long wavelength component of the gravity field, valuable to many studies including the determination of polar cap mass and ocean circulation.
- Measure of space radiation in the environment and component testing.

Other SAC-C Partners

- *Italy*

  provide the Solar Panels, a GPS for orbit and attitude determination and a Star Tracker.

- *Denmark*

  provide the MMP payload.

- *France*

  provide Radiation Monitor.

- *Brazil*

  provide its testing facilities for system level testing.

SAC-C Science Payloads *(1/3)*

MULTISPECTRAL MEDIUM RESOLUTION SCANNER (MMRS)

The spectral bands were selected so as to afford studies of both terrestrial and coastal marine ecosystems. Real time and stored images at resolutions of 175 and 350 meters are available, the image swath width will be 360km.

The bands will be:

- ◊ 480 - 550 nm
- ◊ 540 - 560 nm
- ◊ 630 - 690 nm
- ◊ 772 - 815 nm
- ◊ 1.55 - 1.70 μm

The operational modes include a low resolution image broadcast through an S band transmitter for low cost ground segment.

HIGH RESOLUTION TECHNOLOGICAL CAMERA (HRTC)

Spectral band	Ground resolution	Mass memory capability
450 to 750Nm	35 meter	96 Mbytes

Objective: it is used for MMRS image sharpening.

SAC-C Science Payloads *(2/3)*

- ***HIGH SENSITIVITY TECHNOLOGICAL CAMERA (HRTC)***

  - Spectral band 450 to 750Nm.
  - Ground resolution 200m, Swath width: 900 km.
  - Mass memory capability : 96 Mbytes.

Objective: to monitor atmospheric phenomena, ice and snow evolution, fire detection and monitoring.

- ***DATA COLLECTION SYSTEM / WHALES TRACKER***

Data collection from on ground platforms. DCS will permits to study the "FRANCA" whale migration activities.

- ***ICARE***

Space Radiation Environment Monitoring and Advance Electronics components Testing Instrument.

SAC-C Science Payloads *(3/3)*

- ***MAGNETIC MAPPING PAYLOAD (MMP)***

Includes two instruments:

- Scalar helium magnetometer for scalar magnetic field measurement. Absolute measurement error less than 1NTesla.
- Compact spherical coil tri-axial magnetometer for measuring field vectors. Angular resolution 20 arc sec. Absolute measurement error less than 3-5NTesla.

- ***GEODETIC GPS (Global Positioning System) RECEIVER.***

- To carry out atmospheric profiling of stratospheric temperature with an expected accuracy of one degree or less.

- ***Attitude and Orbit Determination Experiment.***

- It includes a GPS/GLONASS and a Star Tracker from the Italian Space Agency.

Objective: To Perform Fully Autonomous Attitude and Orbit Determination.

SAC-C Mission Summary (1/2)

LIFETIME

4 YEARS

ORBIT

Height : ***707 Km.***

Ground Track Error : ***± 10 Km. (EOL)***

Type : ***Circular Sun-Synchronous, 10:20 AM***

Inclination : ***98.2 deg.***

Revisit Time : ***16 days***

Satellite Mass & Envelope

475 kg

1.87 x 1.65 x 2.07 mts. (L. conf)

CONAE

SAC-C Mission Summary (2/2)

Spacecraft Power	**Bus Voltage** ***21 - 35 Volts*** **Solar Array Generated Power** ***456 Watts EOL (6 sqm)***
Spacecraft Attitude Control	**Accuracy & Stability** ***0,2 deg; 0,003 deg/sec*** **Knowledge** ***70 acrcsec***

Sensors: 2 horizon sensors, 2 TAM, 1 star tracker, 2 GPS, 8 coarse sun sensors.

Actuators:2 momentum wheels, 3 torque rods, 8 thrusters.

CONAE

The SAC-C Project

- November 21st 2000

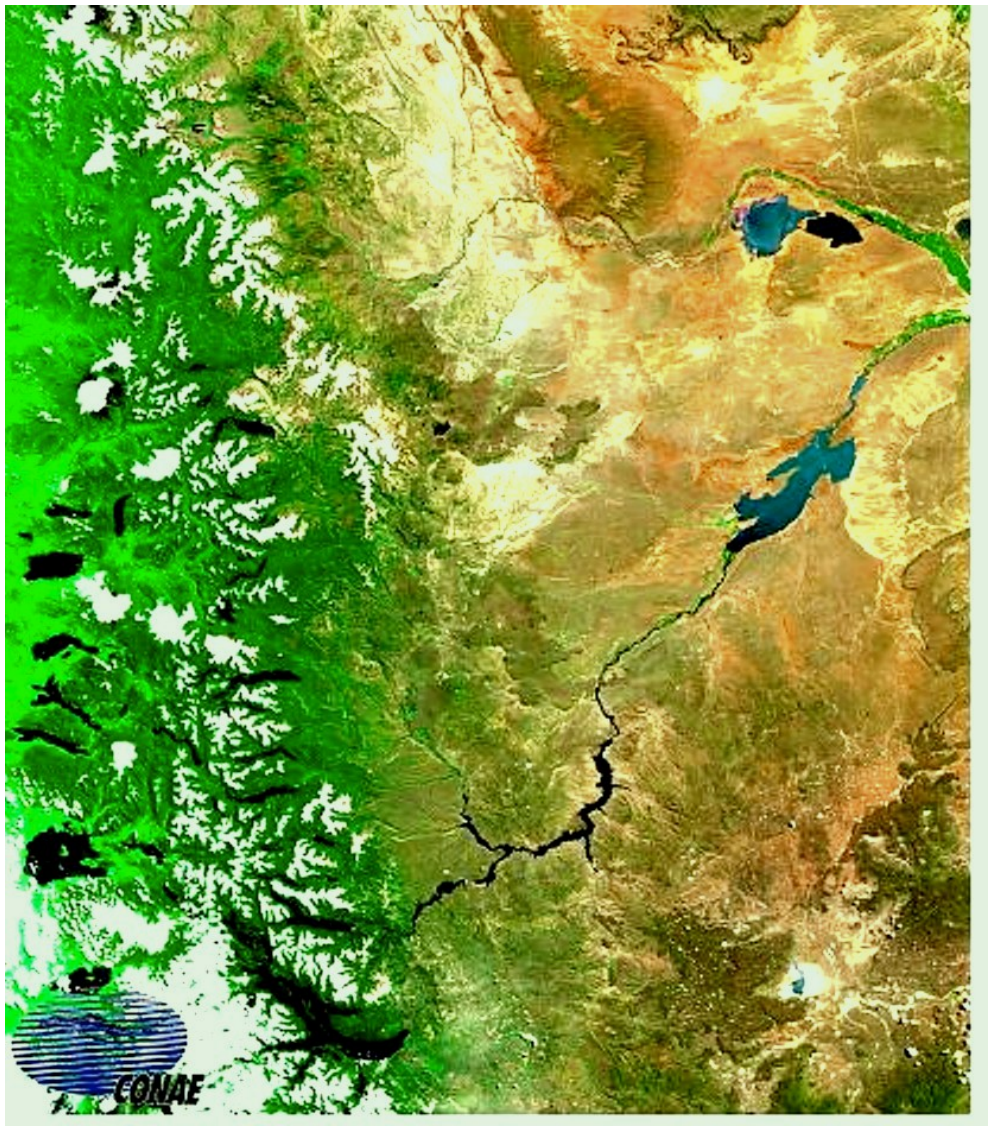
SAC-C is launched on a Delta 7320-10 in a dual launch configuration with the EO-1 satellite.

EO-1/SAC-C

DELTA II

Delta Launch Vehicle Programs

SAC-C First Image

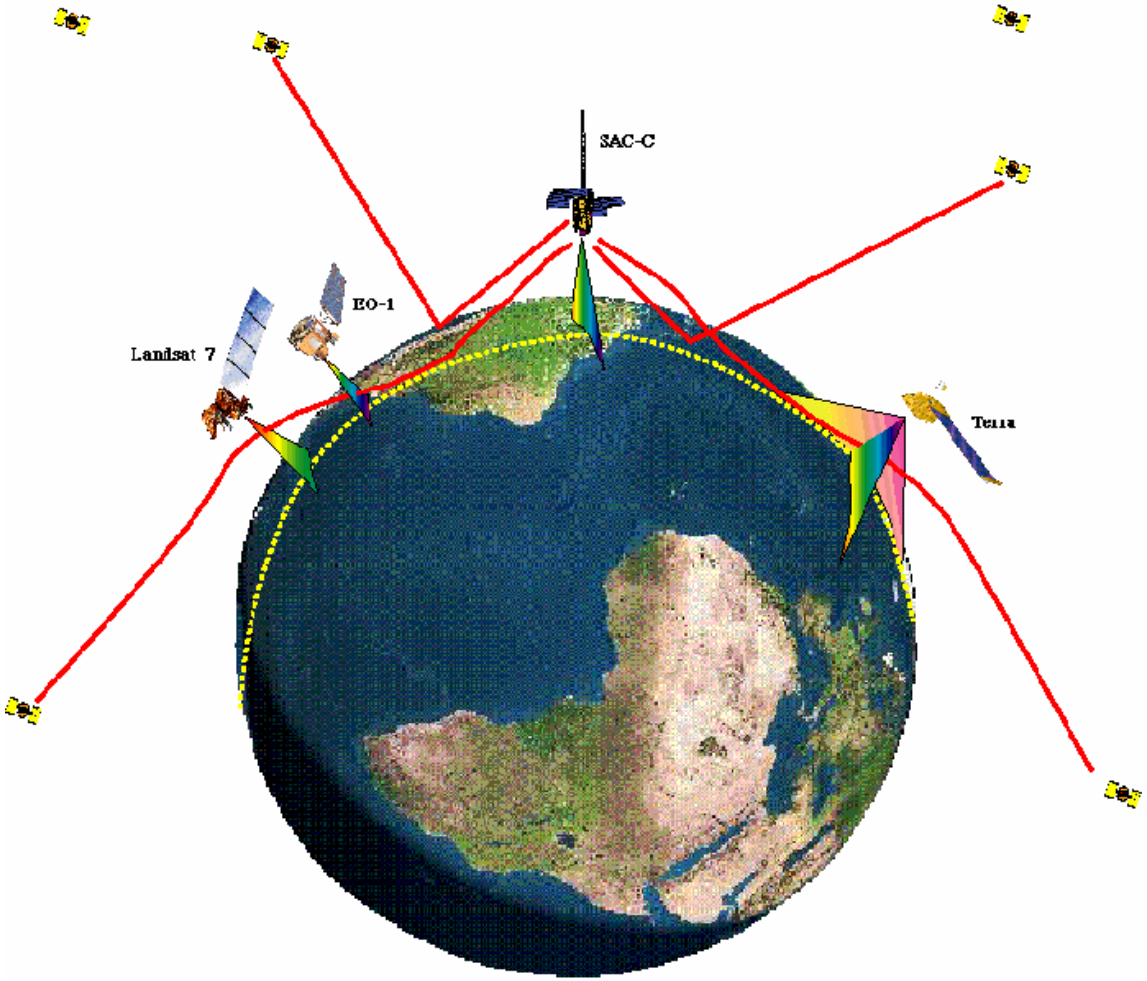


SAC-C Project - PMSEP September 10TH - 13TH 2002

- November 21st 2000

SAC-C MMRS camera was commanded to acquire the first image from Argentina in the Andes region.

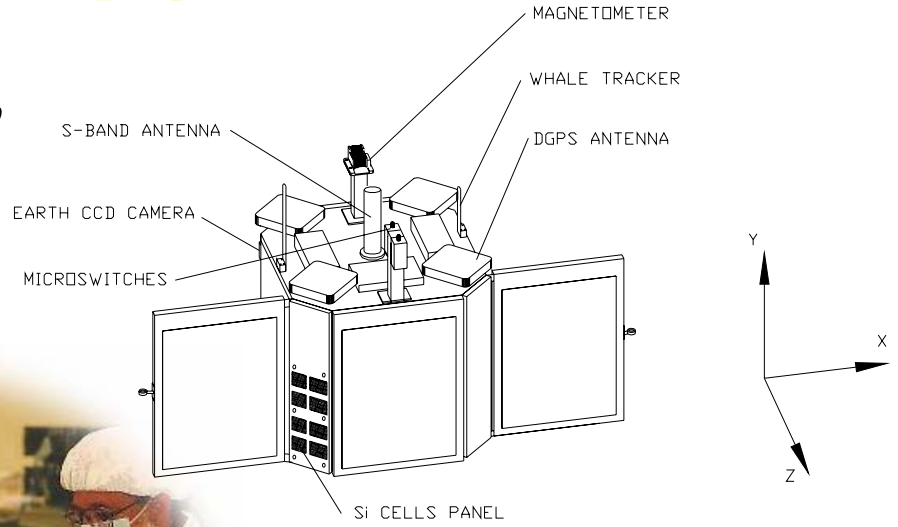
The AM Constellation



The main purpose of the AM Constellation is to enhance the science benefits from sensors of individual Missions.

The SAC-A Mission

SAC-C Technological Demonstration Mission



Main Objectives

- GSP applications
- Solar Cells and Panels test
- Momentum wheel test
- Mission Operation experience

Project Management

MAIN TOPICS IN SAC-C PROJECT MANAGEMENT

- Project Chronology.
- Project Organization.
- International Projects Environment
- Relationship with NASA.
- Relationship with other foreign partners.
- Key elements & Conclusions.

Project Management

SAC-C PROJECT CHRONOLOGY

- Mission definition started in 1993. Three partners and 3 instruments. Satellite mass 247 kg.
- End 2004 Contractual arrangements.
- Mid 1995 developments started.
- July 1996 PDR.
- November 1996 SAC-A development started as a SAC-C technological mission.
- During 1996 others partners were added to the mission.
- October 1997 SAC-C CDR and SAC-C PSR.
- December 1998 SAC-A launch.
- July 1999 SAC-C Pre-Shipment Review (PSR).
- October 1999 SAC-A reentered.
- Nov. 2000 SAC-C launch. Six partners and 9 instruments. Satellite mass 475 kg.

CONAE

Project Organization

ARGENTINEAN INDUSTRIES AND INSTITUTIONS

- For SAC-C development INVAP S.E., a company located at Bariloche, Argentina was selected.
- INVAP has been the Prime Contractor for the three missions developed jointly between NASA and CONAE.
- Several others companies have been working as INVAP subcontractors.
- Science and Technology Institutes were also involve in several developments.
  - CITEFA: Communication Subsystem antennae.
  - INIFTA: Batteries Test support.
  - La Plata University: Data Collection System receiver development.
  - CNEA: Solar Panels design review and tests support.

Project Organization

INVAP / CONAE INTEGRATED TEAMS MODALITY

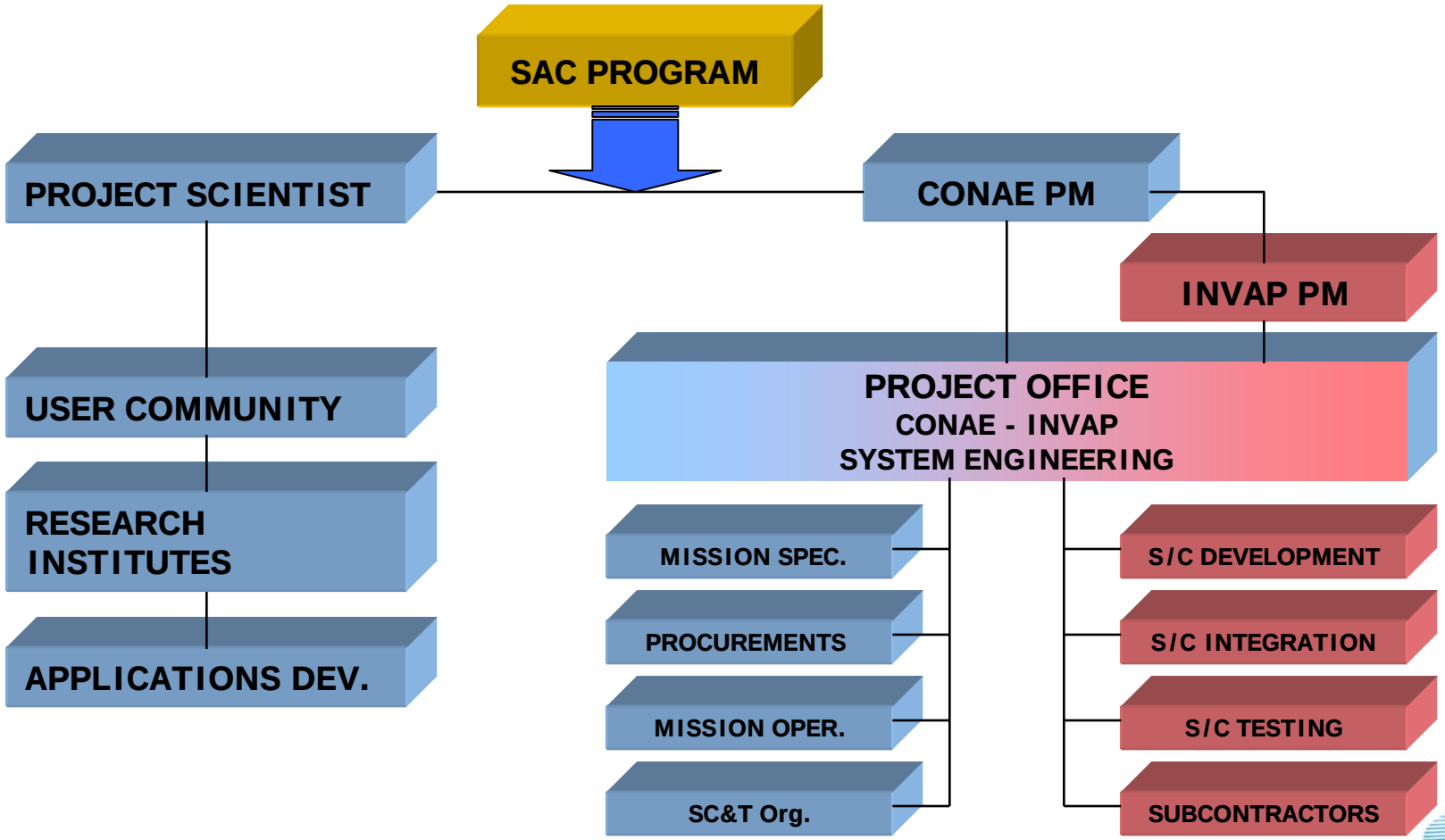
- Integrated CONAE/INVAP Teams, under CONAE's responsibility for Mission Requirements definition.
- Integrated INVAP/CONAE Teams, under INVAP's responsibility for design, development and testing activities.

PRIME CONTRACTOR RESPONSIBILITIES

- Design & Development, Manufacturing, Assembly, Integration and Testing of SAC-C Bus, GSE and instruments.
- Mission Operation Control support.

Project Organization

INTEGRATED TEAM ORGANIZATION CHART



Project Organization

INTEGRATED TEAM ORGANIZATION

Contractual Arrangement

- Contracts are specially tailored for projects that include advance technological developments.
- Contracts are based on a reference price established on very preliminary specifications.
- Fix price is agreed with the contractor every three month for those task planned for that period.
- In case of deviation from the referenced price up to that moment, a CONAE top management formal review is required.
- Costs and Schedule are reviewed every month.

Project Organization

INTERNATIONAL PROJECTS ENVIRONMENT

Topics to have in mind.

- Idiosyncrasy is a central aspect.
- Different languages, different way to express the same (frequent misunderstanding).
- Different way to do things, to develop communications, different organizations.
- Different industrial realities.
- Different cultures.

It is necessary: flexibility, good communications, consider everybody as part of the same enterprise.

Project Organization

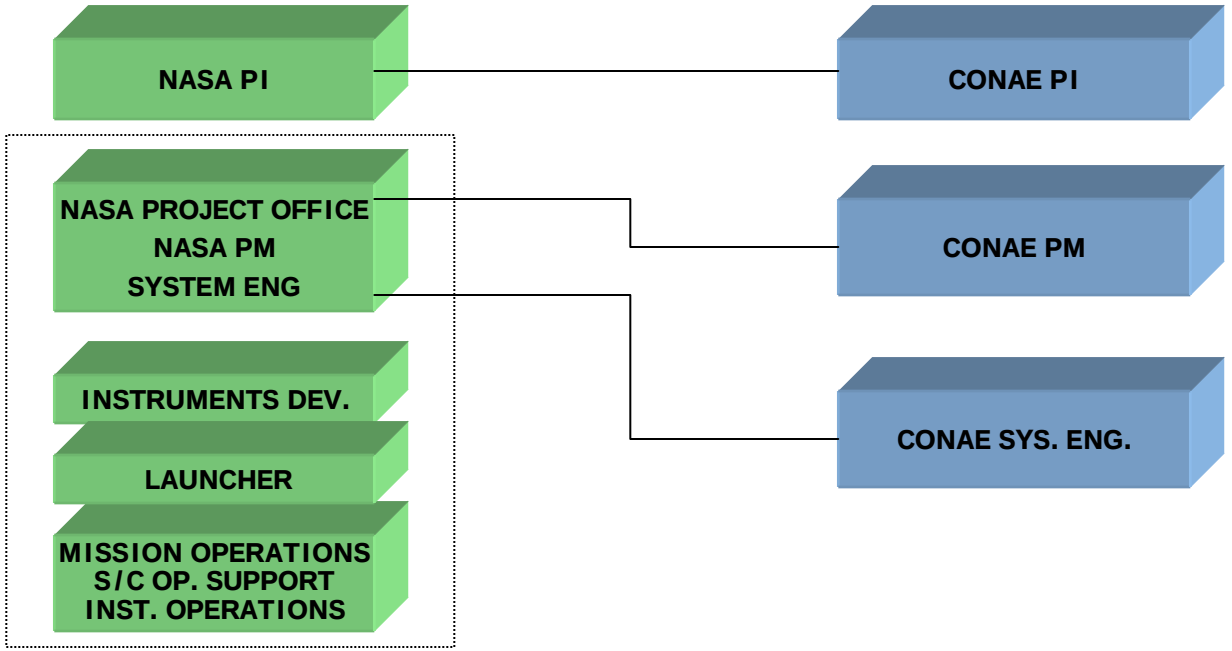
SAC-C: ***A GOOD EXAMPLE OF AN INTERNATIONAL PROJECT***

- SAC-C was developed with the participation of 6 countries.
- There were 9 instruments to integrate, 5 of them from foreign partners.
- System Level Tests were performed at INPE facilities in Brazil.
- Acoustic and vibration test on structural model and solar panels T/V and electrical test performed at GSFC.
- Parts and components suppliers from Europe and US.

Considerable coordination effort has been necessary to be able to complete such a type of development, successfully.

Project Organization

RELATIONSHIP WITH NASA



- The interfaces are at the level of CONAE and NASA Project Managers and System Engineers.
- System Level Activities including the Interface Control Documents were under CONAE responsibility.

Project Organization

RELATIONSHIP WITH NASA

- System design, integration and verification, including the Interface Control Documents are under CONAE responsibility.
- Launch services activities coordination and Safety. Package definition are responsibility of NASA.
- Mission Operations definition and implementation are responsibility of CONAE.
- Nasa coordinates for Ground Network support definition, pre-launch tests and Mission Operations Support Plan.
- NASA and CONAE support each other to resolve difficulties arisen during the Project development.

Project Organization

RELATIONSHIP WITH FOREIGN PARTNES

- Agreements are based on the concept of mission of mutual interest.
- The interfaces are at the level of CONAE and NASA Project Managers and System Engineers.
- Interface Control Documents for foreign partners instruments are Managed by CONAE.
- CONAE is responsible for defining requirements for design and testing of all components / instruments to be part of the mission.

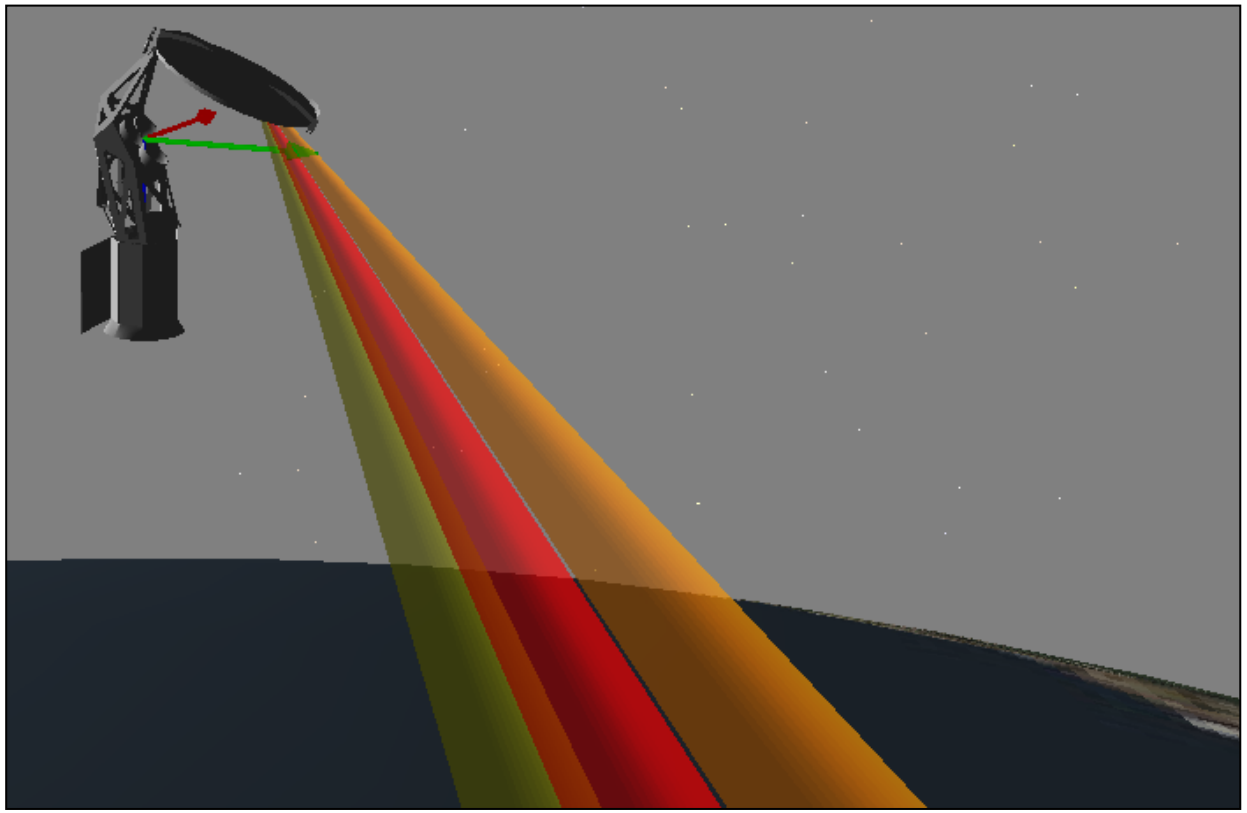
Project Organization

KEY ELEMENTS AND CONCLUSIONS

- The principal element to undertake successfully SAC-C Project development was the team.
- Small team, few paperwork, fluid communications and highly motivated and skilled people.
- Institutional and industrial commitment.
- NASA GSFC and JPL support and commitment.
- CONAE commitment all the time.

Have a good team, institutions supporting the project and a good amount of commitment and everything is possible...

Working on the next step



SAC-D_Aquarius Project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