

Chapter 3.1

THE ASTRONOMICAL OBSERVATORY OF HONDURAS: A PROJECT OF INTERNATIONAL COOPERATION

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Abstract The history, current situation and achievements in Astronomy and Astrophysics as academics fields of the National Autonomous University of Honduras is described. The first activity was the Project “An Astronomical Observatory for Central America: a realistic way of strengthening basic space science in developing countries”, because it is the frame incorporating all the initial work for the development of the different academic activities, on the basis of which the Central American Suyapa Astronomical Observatory was brought forward in a project of permanent international cooperation. The associated education, research and outreach activities are described to illustrate the well-organized model of this academic unit with international recognition. Finally we comment on the regional and international scope of this Central American Astronomy Project in Honduras.

Introduction

In Central America, the initiative to create the first astronomical observatory of modern times was raised in Honduras at the beginning of the last decade of the twentieth century. The project, "*An Astronomical Observatory for Central America: A realistic way of strengthening basic space science in developing countries*" (Pineda de Carias, M. C., 1993) contains the basis for the establishment of a regional astronomical centre. For the development of this regional project, a strategy based on permanent international cooperation has been organized around the following main activities:

- Central American Assembly of Astronomers;

- Central American Courses on Astronomy and Astrophysics;
- Central American Master Program in Astronomy and Astrophysics;
- Central American observational facilities; and,
- International Agreements of Cooperation.

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In July 1994, the authorities of the National Autonomous University of Honduras (UNAH) approved the establishment of the University's Astronomical Observatory (OA/UNAH) as an academic unit responsible for:

1. Carrying out observations and scientific research projects in the field of astronomy and other related areas;
2. Managing and developing instrumentation facilities for observations, reduction and analysis, and for receiving astronomical images;
3. Providing basic astronomical services to students of different levels of the National Educational System and to general public;
4. Organizing and coordinating outreach activities and Education in Astronomy Programs for the dissemination of astronomical knowledge.

In June 1997, within the frame of the 7th UN/ESA Workshop on Basic Space Science held in Tegucigalpa, Honduras, (Report on the Seventh UN/ESA Workshop, 1997) and the participation of 80 scientists from about 30 Agencies and Organizations, the Observatory OA/UNAH was renamed to the broader and international “*Central American Suyapa Astronomical Observatory (OACS)*”, opening a new Era of development and establishment of Astronomy and Astrophysics in Central America. The first act was the inauguration of the first regional observational facility, the “Rene Sagastume Castillo” Telescope, a 42 centimeters Schmidt Cassegrain optical telescope, immediately followed by the opening of the Master in Astronomy and Astrophysics program, a post-graduate program for engineers, physicists and mathematicians that, after having completed a 5 years university career, want to continue with Astronomy as a professional career in Central America.

At present, OACS/UNAH is the only astronomical observation and research centre at a Central American university. The level of organization it has achieved now it can be considered as a model for academic development for the establishment of Space Science, trough education, research, outreach and administrative affairs. The work done at OACS/UNAH is very important and highly recognized. It has contributed:

- To give presence to Honduras and Central American countries in the development of space science and technologies, including Astronomy and Astrophysics.
- To raise the Central America human resources indices for training to the highest level;
- To increase research and technical production in Central America;
- To open new fields and to create new training opportunities for new generations;
- To strengthen, in general, international cooperation links between universities, and in particular among astronomical observatories and research centers.

It still remains in agenda to insert Central America into research and space exploration projects. However, it should be recognized that some steps have already be done at the university level (OACS/UNAH), in order to continue with national science and technology policies looking to worldwide projects such as the World Space Observatory (Wamsteker et al, 2003).

1. The Astronomical Observatory of Honduras

The Central America Suyapa Astronomical Observatory of Honduras (see fig. 1-1) is located at the main campus of the National Autonomous University of Honduras (Lat: 14° 05' N; 87° 09' W; Alt: 1076 meter over sea level). The site of the observatory was chosen within the university campus in order to provide students with facilities to make their own observations and also to provide public access to the observatory so that local citizens could learn about astronomy.

The main telescope of OACS/UNAH is a Schmidt-Cassegrain LX200 with an equatorial mount (Latitude: 14 North). The size of the primary mirror is 42 centimeters and the focal ratio is f/10 or f/6. The telescope is equipped with a CCD camera and a filter wheel. Scientific journals, textbooks, astronomical catalogs and specialized software (i.e. IRAF over Linux platform) are available for data reduction and analysis of astronomical images obtained at the OACS/UNAH or in any other observational center, supported by permanent Internet connections (24 hours per day, 7 days per week).



Figure 3.1-1. Central America Suyapa Astronomical Observatory, inaugurated on 18 June 1997 at the 7th UN/ESA Workshop on Basic Space Science in Tegucigalpa, Honduras. In this picture we can see the dome housing the 42 centimeters optical telescope, the offices and lectures buildings.



Figure 3.4.1 Before (left, 1998) and after (right, 2000) views of the Location of Astronomical Observatory at National University of Asunción, Campus San Lorenzo Paraguay.

The main working activities of the OACS/UNAH are: education, research and outreach.

a) Education. In the field of education in Astronomy, OACS/UNAH offers and actively supports the following:

- *Master in Astronomy and Astrophysics.* A postgraduate regional program intended to train professionals in charge of the establishment and development of Astronomy and Astrophysics within the region, through the permanent international cooperation. Since 1998, when the program was opened, collaboration of astronomers coming from universities and astronomical observatories of Argentina, Brazil, France, Spain, United States and Mexico had been available; with some institutions having signed International Agreements of Cooperation. In visits of one or two months, these astronomers come to the OACS/UNAH as staff to teach different courses in their own field of interest, and also as thesis projects advisors. So far, three cohorts of students, MAA-98, MAA-99 and MAA-2001, every 2 years have been taken the 20 courses that comprises the whole Master Program Syllabus, and have initiated their research project, with some of them having the opportunity to travel to Argentina, from one up to six months, to the foreign institution where their advisor belongs. In 2002 the first postgraduate students finished her work, and from here on, more students are finishing their Master in Astronomy and Astrophysics career.
- *AN-111 Introduction to Astronomy (4 credits.)* A general and optional course for students of all university careers. Observations and Models, Solar System, Stars and Interstellar Medium, and Galaxies and Cosmology, are the four units of the academic program developed in this one-semester course, in theoretical classes complemented with some practical and observational activities. Yearly, 5 members of the OACS/UNAH staffs teach to about 500 university students of about 30 careers.
- *Central American Courses in Astronomy and Astrophysics (CURCAA).* These are regional courses where participants have the opportunity to discuss relevant topics on the Sun, solar system, star formation and evolution, interstellar medium, galaxies and cosmology, and observational and data reduction techniques. These courses also promote the interchange of ideas and experiences among staff and students working in Astronomy and Astrophysics. Between 1995 and 2001, six CURCAA have been developed, each one in the Central American countries of Honduras (1995), El Salvador (1996), Guatemala (1997), Panama (1998), Nicaragua (1999) and Costa Rica (2001). In a second cycle, the CURCAA returned to Honduras in 2002, to continue to El Salvador in 2003.

These CURCAA are programmed within the frame of the Central American Assembly of Astronomers (AAAC, in Spanish), a regional organism already recognized by the International Astronomical Union (IAU) to promote the development of Astronomy through the permanent international cooperation. The AAAC has its own rules and by laws, and sessions are scheduled in periodical dates, having change their Board every two years.

b) Research. As a results of the level reach at the OACS/UNAH, several research areas have been defined and began to produce some results, to a national and international scale:

- *Education in Astronomy*. Beginning with the Project "An Astronomical Observatory for Central America: a realistic way to strengthening basic space science in developing countries" (M. C. Pineda de Carias, 1993), several papers on Education in Astronomy have been published, among which special attention deserves "The Central American Master Program in Astronomy and Astrophysics" (M. C. Pineda de Carias, 2001), the first document presented at a General Assembly of the International Astronomical Union, by a Central America astronomer.
- *Astronomical Observations at OACS/UNAH (I)*. A project that studies the observational conditions of the site of the OACS, and the type of observational programs that could be performed with the telescope LX200 "René Sagastume Castillo". Following the model designed for this project, 4 avenues are explore: i) Site, in order to characterize the site where the telescope is placed at the campus of the university; ii) Telescope and its accessories, in order to determine the performance of the instruments and facilities already installed; iii) Human Resources, to find out who are the users and in which observational projects they are interested; and iv) Astronomical Observations, to develop different observational programs to find out which one fits best accordingly to the conditions of the site, the instruments already installed and the human resources involved.
- *Astronomical Observations at OACS/UNAH (II)*. This is another project looking to study those astronomical events such as eclipses, meteor showers or comets, visible from Honduras territory, before, during and after their occurrence or appearance. Some papers already published in these fields are: "About some measurements done in Honduras during the total solar eclipse of July 11, 1991" (AIP, 1993), and, "About a big fireball seen in Honduras" (Meteoroids, 1998).

- *Dynamics of Planetary Systems.* Evolution of different objects of our Solar System and of other planetary systems around other stars is studied. Currently, there are two areas under development: 1) Minor Objects (asteroids) of the Solar System, an area that after Master in Astronomy and Astrophysics thesis: "About secular perturbations in the outer zone of Saturn" have derived into the study of Instabilities of the Outer Zone of Saturn and Binary Asteroids. 2) Extra solar Planets, currently studying The Possibility of existence of terrestrial planets.
 - *Stellar Atmospheres.* The dynamical and thermodynamics structure of circumstellar material in short period binary systems is studied. After having look for a suitable binary in UV data (INES / IUE, Wamsteker et al., 2000), for the identification of specific spectral lines, the application of special methodologies, and after having complete observational campaigns, a study on the dynamic and thermodynamic the circumstellar material in interacting binaries is under development.
- c) **Outreach.** In order to contribute to divulge and to widespread astronomical knowledge, the following outreach projects are under development at OACS/UNAH:
- *Astronomical Ephemeris.* Honduras and Central American Astronomical Ephemeris of the Sun, Moon, planets and special events are prepared and divulge as a monthly publication. Special editions of these ephemeris are prepared for those events that withdraws the general public attention such as eclipses, meteor showers, Sun zenith passage, equinoxes, solstices and others.
 - *Academicals Visits to OACS/UNAH.* Under the lemma: "From Honduras, Central America: a window to the Universe", a program of educational and touristry interest is currently developed three day per week. Elementary schools, High schools and university students and teachers, participate of lectures, exhibitions, practical activities and astronomical observations. Yearly, about 4000 students of the different levels of the national educational system enjoy and become beneficiaries of this important project.
 - *Astronomical Nights.* Every Friday evening, for about two hours, children, young and grew up people visits the OACS/UNAH to listen special talks intended to popularize astronomy at all levels, and also to allow people to make astronomical observations of the moon, planets, deep sky objects and special astronomical events. Yearly OACS/UNAH receives about 5,000 all age persons, and this program is well known and highly recognized within the country.

- *Solar Activity.* A relation between the background sky intensity, coronal mass ejections and the derived geomagnetic effects is studied. Through bibliographic research about chronography, chronographic observations, coronal mass ejections and other dynamic phenomena in the solar atmosphere and geomagnetic phenomena; and through the statistical analysis that correlates dynamic solar and geomagnetic phenomena, derived from data obtained from MICA (Mirror Chronograph for Argentina); a relation between the background sky intensity as indicator of coronal mass ejections is studied.
- *Maya Archaeoastronomy.* Evidence of astronomical activity among the Mayas, through the study of dates and orientation of structures and monuments at Copan, Honduras is studied. In this project, astronomers and archaeologists are working together at OACS/UNAH, studying planes, maps, bibliographical documents of the archaeological site of Copan; after choosing the area and the astronomical object under study; the problem is stated and the research methodology; specific structures and monuments are documented, and astronomical observations are done in order to obtain results. Currently there are two areas under development: alignments and orientation of structures and monuments; and, calendar cycles.
- *Remote Sensing.* After the Hurricane Mitch damage in Honduras the need of permanent monitoring of the territory and the need of evaluation of the impact of damage using space technologies was unveiled. After that a Remote Sensing Laboratory was organized and opened at OACS/UNAH. Important part of the Remote Sensing Lab is the Geographical Information System already conformed with satellite images and aerial photographs of Honduras and Central America, for different years. A NASA/CCAD Mesoamerican Biological Corridor Project, Classification and land cover and land use projects, and the Characterization and change detection of protected areas, are some of the projects under development.

2. Some Final Remarks

As final remarks the following must be emphasized:

- With regard to doing research and the training of astronomers for Central America, these are actually the main objectives behind the establishment of the Central American Suyapa Astronomical Observatory. To train, with permanent international cooperation, cohorts of astronomers that will have the responsibility to move Central America further into relevant fields of scientific research. The acquired knowledge, use and applications of astronomical instrumentation and space technology are of particular significance in the furtherance of the general objective of the OACS, and of course, as a contribution for sustainable development of the country and the

region. Therefore, in order to strengthen this project, the international community of astronomers may help by providing visiting professors willing to come to Honduras to collaborate as they may be needed; and with funds for scholarships for graduate students to finish their degrees up to the highest level, while guaranteeing and stimulating them to remain in their own Central America countries.

- The Central America Regional Courses (CURCAA) are excellent opportunities to assemble first line worldwide astronomers with Central American university staff and students interested in the establishment of an astronomical tradition in Central America. Somehow, these events represent a regional chapter of a bigger effort performed by the UN/ESA series of Workshops on Basic Space Science. Because all the national Central American universities have agreed to organize this type of event on an annual basis, in order to continue this effort and reinforce this type of activity, special grants from interested international organizations, institutions, societies and the like could be quite useful. In this way larger numbers of participants from the different countries of Central America will be guaranteed. So far, for all CURCAA, all Central American national universities and other local organizations, the IAU and some other foreign universities and organizations have sponsor participants.
- Further, after having hosted one and participated at most of the UN/ESA Workshops on Basic Space Science, we have learned of the multiple advantages of gathering scientists from different regions of the world in order to reach accurate objectives and goals. Also, after our projects have been presented in such an international forum, our national authorities are made aware of the importance of the fields of astronomy and basic space science to the development of indigenous capabilities. This is especially true after having creating small groups in each of the Central American countries that are jointly looking for mechanisms that could allow them to establish astronomy and astrophysics as professional fields with the permanent international cooperation in their own countries.

References

- Pineda de Carias, M. C., AIP Conference Proceedings 320. American Institute of Physics. New York, U. S. A., 1993.
- Borovicka, J, Pineda de Carias, M. C., et al. Meteoritics. 1998
- Pineda de Carias, M. C., Astronomy for Developing Countries, IAU Special Session at the 24th General Assembly, 2001. Allan H. Batten, ed., ASP Conference Series SPS, pg. 69-79.
- Report on the Third UN/ESA Workshop on Basic Space Science, organized in cooperation with the Government of Nigeria and hosted by the University of Nigeria, Nsukka, and the Obafemi

Awolowo University, Ile-Ife, Lagos, Nigeria, 18-22 October 1993, United Nations General Assembly Document A/AC.105/592/Add.1, 18 January 1995.

Report on the Seventh UN/ESA Workshop on Basic Space Science: Small Astronomical Telescopes and Satellites in Education and Research, hosted by the Observatorio Astronómico de la Universidad Nacional Autónoma de Honduras, on behalf of the Government of Honduras, United Nations General Assembly Document A/AC.105/682, 20 January 1998; and *COSPAR Information Bulletin*, 141, 9-10 (1998).

M. C. Pineda de Carias. Mensaje al Futuro: 10 años de Astronomía Centroamericana en Honduras. OACS/UNAH. 2001.

World Wide Web Site available at: <http://www.astro.unah.hondunet.net>

Wamsteker, W., et al., 2000. AP&SS, 273, 155

Wamsteker, W., and Shustov B.M., 2003, this volume