# DEVELOPING INTERNATIONAL COLLABORATION FOR IASCLIP

A proposal submitted in response to NOAA's Climate Program Office
FY2009 Funding Opportunity
Funding Opportunity Number: OAR-CPO-2009-2001430

Specifically for the
Climate Prediction Program for the Americas (CPPA) announcement

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FUNDS REQUESTED:

Year 1: $112,320
Year 2: $ 87,075

total requested: $199,395

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**Abstract**

The Inter-Americas Study of Climate Processes (IASCLIP) is a climate research activity that has recently been endorsed as a specific subprogram of the VAMOS, a WCRP/CLIVAR program focused on the climate of the Americas. Beginning in FY2009 NOAA CPPA plans specific support for research focusing on the Inter-American Seas region in parallel with the initiation of the IASCLIP activity.

This proposal requests funds to carry out activities towards producing a comprehensive plan for IASCLIP long-term monitoring and process studies. This will require developing and expanding ties between oceanographic and meteorological institutions and universities in the more than 20 countries in the Caribbean Sea region and surrounding areas, with the goal of involving them in future IASCLIP activities. In particular, their collaboration will be sought for help with IASCLIP observations, monitoring, and research activities. The specific activities that we propose to carry out include:

1) Soliciting input from the IASCLIP science community on what observations might be needed to enhance the IASCLIP research objectives, given a suite of possible technologies and different strategies for measuring the ocean and atmosphere.

2) Travel to countries with suitable interest and infrastructure to explain the IASCLIP program and determine possibilities for collaboration. Evaluate meteorological and oceanographic observations made by these countries, both routine and for research, and consider possibilities for joint activities.

3) Based on 1) and 2) develop an IASCLIP Field Observations Implementation plan through iteration with US IASCLIP researchers that details the observations and strategies needed for both short-term process-studies and for long-term monitoring of the region's climate. The details of the entire IASCLIP observational component would be provided through the IASCLIP web site - a site that would also serve as a portal for input from the collaborating countries.

The proposed activity has a duration of two years, to ensure follow-up to the initial contacts, development of the web-based materials, and to allow for developing a consensus among U.S. IASCLIP researchers about the Implementation plan.

1. **Results from prior research**

*Measuring the evolution of tropical waves over West Africa into tropical storms over the eastern Atlantic*, March 1, 2006 – Feb 28, 2009. First year $120,000, second year $77,895 (requested), and third year $84,442 (requested), NASA. NASA supported participation in the 2006 NAMMA field program, which involved two components. The first involved strengthening the pilot balloon network over West Africa to describe African easterly waves propagating westward towards the Atlantic. The second component involved helping to design and conduct research flights with the NASA DC-8 aircraft into developing tropical storms over the eastern Atlantic. Key observations to date show that vortices exiting the African coast can be distinctly cold-core at 700 hPa, yet develop a warm core within 72 hr. The African wave structure is still ambiguous, due to lack of sufficient over-continent soundings.

*Explaining the spatial variability of the mid-summer drought over the Inter-American Seas region*. May 1, 2007 – April 30, 2010, total $280,125. NOAA-CPPA. This project, currently in its second year, aims to map the mid-summer drought with satellite imagery and diagnose the key circulation changes associated with its onset and decay from NARR and observations. GOES and MODIS imagery have been used to map the horizontal distribution and intensity of the MSD, using a simple index. According to our index the strongest MSD signal appears along the Pacific coast of Central America, over eastern El Salvador and southern Honduras.

NAME-related grants extending to 2005:

Four activities were supported as part of the NAME-2004 field program. Three that continued into 2005 are described below.

*A regional-scale atmospheric sounding network in support of the North American Monsoon Experiment*, Dec 1 2003 – Sept 30 2005, $396, 529. NOAA-PACS-GAPP. A network of 20 pilot balloon stations was established for providing a multi-month data set to show seasonal evolution of the windfield over the NAME core region. These observations have been assimilated into recent CSU analyses of the NAME data. They support a variety of NAME-related studies.

*Mesoscale circulations and moisture fluxes associated with the North American Monsoon System*, Dec 1, 2003 to Sep 30, 2006, $134,195, PACS-GAPP, NOAA. Aircraft operations by the NOAA P-3 were used to describe the horizontal and vertical structure of gulf surge events, and are being used as validation data for WRF simulations of surges during NAME. The aircraft data have also been used to study the genesis of the surges at the mouth of the Gulf of California.

*The role of sea surface temperature and vegetation characteristics in the seasonal evolution of summer rains over Northwestern Mexico*, Dec 1, 2003 to Sep 30, 2005, $172, 422. PACS-GAPP, NOAA. The role of vegetation and its green-up after the start of rains over northwestern Mexico was studied through a grant that purchased a flux tower, selected instruments, and

funded a sounding network around the central Gulf of California. Results suggest that although there is a dramatic change in vegetation during the onset of rainy season, the albedo does not change much, and the sea-land breeze windfield response is relatively small. These results however, are preliminary.

## 2. Statement of work

### 2.1 The IASCLIP Program and general science issues

The Intra-Americas Study of Climate Processes (IASCLIP) is a climate research activity that has recently been endorsed as a specific subprogram of the VAMOS, a WCRP/CLIVAR program focused on the climate of the Americas. Beginning in FY2009 NOAA CPPA plans specific support for research focusing on the Inter-American Seas region in parallel with the initiation of the IASCLIP activity. The Science and Implementation Plan (hereafter SIP) for the IASCLIP, a living document, is online at:

ftp://ftp.aoml.noaa.gov/phod/pub/enfield/Visitor_temp/IASCLIP_S&Iplan_spr08_v2.pdf

The IASCLIP science topics range widely, and involve questions on all scales of atmospheric motion. Climate variations that affect the IAS domain range from planetary scale phenomena (El Niño-Southern Oscillation (ENSO), North Atlantic Oscillation (NAO), Multi-Decadal Oscillation (MDO) to local forcings, such as that of local topography in modifying trade wind flow around islands and topographic gaps in Central America and the ubiquitous sea-land breeze circulations driven by the diurnal cycle of solar heating. In addition, the large-scale variations modify the local forcings, requiring multi-scale perspectives to explain local climate.

As the SIP notes, "only if a climate model represents well convective and boundary-layer processes over both ocean and land and reproduces well both local climate processes and global climate modal variability, can it do well in the IAS region. The IAS is, therefore, an ideal natural laboratory to test the overall fidelity of climate models." This clearly is not just an academic exercise - climate predictions need to be made on the spatial scales that are useful for users of climate forecasts.

The current IASCLIP SIP presents many questions of climate relevance. Paraphrasing some of these:

*Why do many, if not most, GCMs misrepresent the spatial distribution of precipitation in the IAS region? Is it simply limited resolution? Or are there problems with physics?*

*How reliable are current estimates of daily, monthly, and seasonal estimates of water vapor transport over the IAS domain and into the monsoonal regions and extratropics of each hemisphere?*

*What are the structure and dynamics of the low-level jets in the IAS? If the reanalyses represent these jets acceptably well, then diagnosis of reanalysis output should be revealing. But how do we know the LLJ's are accurately depicted, even in the mean?*

*What are the typical errors in global and regional models in their simulation and prediction of the MSD? But the MSD has interannual variations in intensity and is not in phase throughout the IAS domain, complicating any assessment of such a diagnosis.*

The IASCLIP SIP further recommends 1) Documenting uncertainties in global reanalysis (their discrepancies) in the IAS region and identifying possible sources for the uncertainties, and 2) Identifying the in-situ observations from the IAS region that are the most urgently needed for model validations and improvement.

Quoting the current SIP "The IAS region is a unique location in the world where so many countries are affected by the same set of climate phenomena. They share the same concerns of predicting climate variability, mitigating natural disasters and seizing opportunities resulting from climate variability. Many of the countries in the IAS region are limited in their capacity of all around climate research, yet can make unique and valuable contributions. International collaboration is pivotal to the success of any climate research program for the IAS region". *The current proposal focuses on the opportunity to strengthen the international collaboration among the countries of the IASCLIP domain, with the aim of designing an IASCLIP implementation plan for effective climate monitoring and process studies.*

## 2.2 Developing an effective Implementation plan

*Problems with the IASCLIP timeline*

The current SIP for the IASCLIP now includes a major section on Implementation of the activities. These activities include diagnosis of existing data, modeling activities, and process studies. The initial thoughts were to carry out these sequentially, with data analysis and modeling activities leading to the development of questions and hypotheses that require observations either from special process studies or monitoring activities. While this organization is logical, this does not allow much time for some aspects, such as long-term monitoring, before the program is scheduled to end in 2014. More difficult is the planning for possible process study(s) in the IASCLIP domain. The lead times required for the usual field facilities (whether from NOAA, NCAR, UNOLS (University-National Oceanographic Laboratory System), or NASA) are usually several years. Thus, a field program that might be planned for the 2011-12 time frame would require requests of major resources in 2009-2010. Since the first IASCLIP-specific funding for research will only become available in mid-2009 there is very little time for developing an observational component to IASCLIP that is based on IASCLIP-specific research.

The VAMOS program has a history of carrying out major International Field Programs to explore aspects of the climate processes of the Americas. The South American Low-Level Jet Experiment (SALLJEX), the North American Monsoon Experiment (NAME), and the VAMOS Ocean-Cloud-Atmosphere-Land Study VOCALS (currently in the field) are all examples of major field campaigns associated with the principle thrusts of VAMOS research in the past decade. All have relied extensively on the major field facilities noted above. There is a good understanding of how these facilities can be employed for certain objectives. Yet it is not clear that the IASCLIP requires these facilities, or if other measurements might be more effective for the science issues at hand. The following section discusses the reasons for our proposed effort to develop a detailed field observation implementation plan.

*Some issues related to developing an observational plan for IASCLIP*

Climate research activities are inherently international in their nature, since the applications of climate forecasting improvements have the potential to occur everywhere, and since the monitoring of global climate is by necessity global. It would be intuitive that any climate research activity involving a large geographical region would involve participants, whether individual scientists or institutions, from a number of countries. This has indeed been the case in the VAMOS research activities, such as the SALLJEX, with major participation from Brazilian and Argentinean scientists. However, other VAMOS programs, such as NAME and VOCALS, primarily have involved regions where the climate research infrastructure is weaker.

The usual procedure in preparation for VAMOS field programs has been to invite participants to a planning workshop, often coinciding with another meeting to reduce travel costs. Naturally, such meetings are dominated by climate research scientists, followed by individuals from the host country. Time is usually short, and very often, individuals with detailed knowledge of the key observing systems in a particular country are not in attendance. Discussions are compressed into several breakout sessions, and this, coupled with the long time between meetings (often 1 year), results in a relatively slow pace to the development of field program implementation plans.

Holding meetings dedicated to planning field programs are feasible, but again, funds are always insufficient to bring enough individuals from enough institutions to such a meeting, and the size of an effective working group has certain limits.

A common problem when planning international research activities is that there is often a difference between the scientific focus of US climate scientists and those in developing countries, where there may be a greater focus on local issues, and where computer facilities may not allow for extensive modeling activities. This is likely to be the case with many of the countries in the IASCLIP domain, whose research infrastructure is limited. Even in the area of field observations, most countries do not have many of the advanced measurement systems that are available to US researchers. This may result in limited interaction with host countries during the planning and research stages of the activity unless an effort is made to arrange for this early on.

There is another aspect of field program implementation at the international level that is not always recognized by the US scientific community. Collaboration clearly does exist between the US climate research community, usually residing at universities or government research laboratories, and the international scientific community. However, more often than not, foreign climate scientists are affiliated with universities, while the bulk of the infrastructure support for either short-duration process studies or long-term monitoring are associated with government institutions that may not have a strong climate research component. These institutions, often associated with a branch of the military or a National Meteorological Service, may not have a good working relationship with their own university scientists, whom may often be viewed as competitors for scarce research funds or for national prestige. In the planning for a field activity that may involve costly resources, it is important to also consider institutions that might not have active researchers in climate-related research, but whose facilities may permit effective field measurements. Thus, early interaction with these institutions is important, even if it is outside

the normal sphere of basic research. As an example, the recent NAME capitalized on the availability of two Mexican research ships that provided suitable platforms for a fraction of the cost of a comparable ship from either the NOAA or UNOLS fleet. These ships provided acceptable platforms for the measurements required.

The desire for strong international collaboration in the IASCLIP should be apparent, but the potential benefits are perhaps most tangible in activities that involve often-expensive field observations. Many field programs are dominated by the deployment of research aircraft or oceanographic ships, meteorological radars, and other specialized observing platforms or systems. Competition for resources usually limits deployments of these facilities to less than several months, limiting the focus of the field studies to phenomena that can be well-sampled in over this time frame. Unfortunately, to monitor intraseasonal or interannual variations requires longer-term measurements. The usual deployment pools fail in this regard, and such long-term measurements usually default to the operational networks of the region of interest. These are rarely stable in developing countries of the tropics, and often contain large gaps in observations, changes in observing stations, or changes in instrumentation that affect the overall quality of a long-term dataset. A conspicuous example of the unstable character of the IASCLIP domain radiosonde network was evident during 2008, when only 3 to 4 of the 15 Mexican radiosonde sites made observations on any one day and none were made in northwestern Mexico – which had the wettest summer on record. Farther south, both the Costa Rican radiosonde site at San Jose and the Colombian station at San Andres Island failed to make observations from June through September. In addition to the lack of observations from San Andres, most other Colombian sites also failed to make observations during the 2008 summer.

While the 2008 performance of the upper-air sounding network in the IASCLIP region may have been worse than normal, outages of varying duration occur each year, and the observations themselves are not free of error.

### 2.3 Specific activities to be carried out

The activities we are proposing to carry out will comprise three distinct activities. These are described below.

*Phase 1: Solicit input from IASCLIP science community on what might be needed, given a suite of possible observations and strategies.*

The first phase requires soliciting input from the IASCLIP community as to what questions require observations for confirming a hypothesis or verifying simulations. Before requesting this we will summarize the observations that routinely exist over the IASCLIP region, as well as a summary of those that have traditionally been made with available resource pools of NCAR, NOAA or NASA. Such a summary, as well as realistic estimates of the costs of such observations, are needed to provide IASCLIP researchers with the background to evaluate the feasibility of different field program strategies. The IASCLIP should evaluate new observing systems and techniques, especially if extended observations are viewed as needed. We will summarize these measurement strategies as well.

*Phase 2: Travel to countries with suitable interest and infrastructure to explain the program and suggest real collaboration. Evaluate routine observations and possible improvements.*

Once there is a reasonable consensus or perception of what observations may be desirable to support IASCLIP research activities (including extended monitoring) and with a clear science plan having already been articulated (the SIP discussed above), then it will be feasible to arrange travel to countries that are likely to have mutual interests in research topics, or be essential for establishing additional measurements (see Table 1).

Although it might appear that much of the required communications could be done via email, and while this is likely to facilitate the initial arrangements for whom to meet with and to discover key contacts in different organizations, it is rarely a substitute for meetings. Arranging a meeting and inviting interested parties was considered but has major disadvantages when compared with visits to each country. We propose individual country visits because we can reach many times more individuals in this manner – and especially many more students, who might be encouraged to work on aspects of the IASCLIP. In addition, since the communication would be in Spanish in Spanish-speaking countries many more individuals would be able to participate in discussions. Language is a significant factor in preventing attendance at international meetings, especially among operational staff. Finally, there is no substitute for seeing the infrastructure of each institution firsthand – the condition of possible ships, the availability of research facilities, and perhaps most importantly, the interest level of potential collaborators.

Compared with the SALLJEX, NAME, and VOCALS projects, the IASCLIP is more challenging in its international organization. The international coordination required for NAME (Mexico), VOCALS (Peru and Chile), and even SALLJEX (Bolivia, Peru, Brazil, Paraguay, Argentina) pales by comparison with that needed for the IASCLIP domain, where there are at least 22 countries and where there are also a large number of islands affiliated with the UK, France or the Netherlands.

As an example of the benefit that might arise from extended communication between IASCLIP experiment organizers and a collaborating institution we can consider the case of the Center for Oceanographic and Hydrographic Research (CIOH), located in Cartagena, Colombia. CIOH has a substantial research staff and two research vessels (see Fig. 1) that are potentially available – should a suitable scientific need for the platforms be identified. If the routine cruise schedules and routes of these ships could be determined – along with their daily operating costs, this would help in extended monitoring or process study design. Joint activities, where CIOH objectives are incorporated, would likely lower costs further. Based on NAME experience with contracting of foreign oceanographic vessels, the successful incorporation of a single oceanographic ship from CIOH into IASCLIP activities (assuming it was suitable for the desired observations) could save the IASCLIP research budget hundreds of thousands of dollars as well a provide greater flexibility in scheduling, as the ships are based within a day's sailing of the core IAS region.

In addition to possible involvement of oceanographic ships from the region in any IASCLIP activity, there are a number of very small and flat islands in the western Caribbean that have military garrisons to maintain sovereignty (Fig. 2). These islands offer the potential for a number of nearly-ideal measurement sites that would be much less expensive to maintain than

ships or buoys. However, making arrangements to access the islands and to arrange for measurements (either automatic or requiring personnel) will require communications with, and approval by, the respective services of Colombia, Honduras, Nicaragua and Jamaica. We do not take this challenge lightly; the current VOCALS - Rex project failed to obtain a suitable arrangement with the Chilean Navy for measurements on San Felix Island.

While we do not underestimate the challenge in developing the contacts required to allow for observations across the Caribbean islands, we have worked with the Colombian CIOH and Colombian Air Force for some years, and also have worked with the Nicaraguan Meteorological Service as part of the the PACS-SONET (Douglas and Murillo, 2008). Since the entire IASCLIP domain is interested in improved hurricane forecasting, it is likely that aspects of common interest for the IASCLIP monitoring activities can be built around this theme.

*Fig. 1 Colombian Navy Research Ship ARC Malpelo. There is also a similar ship (ARC Providencia) as well as smaller vessels.*

Some countries may be less interested in IASCLIP research than in the generation or use of operational products – or in better education for their staff; these countries may also contribute to IASCLIP with observations or infrastructure support if there is perceived benefit from their perspectives.

The tentative list of countries and institutions that will be visited is provided in Table 1. The exact travel details will depend on the responses of the various institutions to our email queries and correspondence, but we are budgeting for three separate trips.

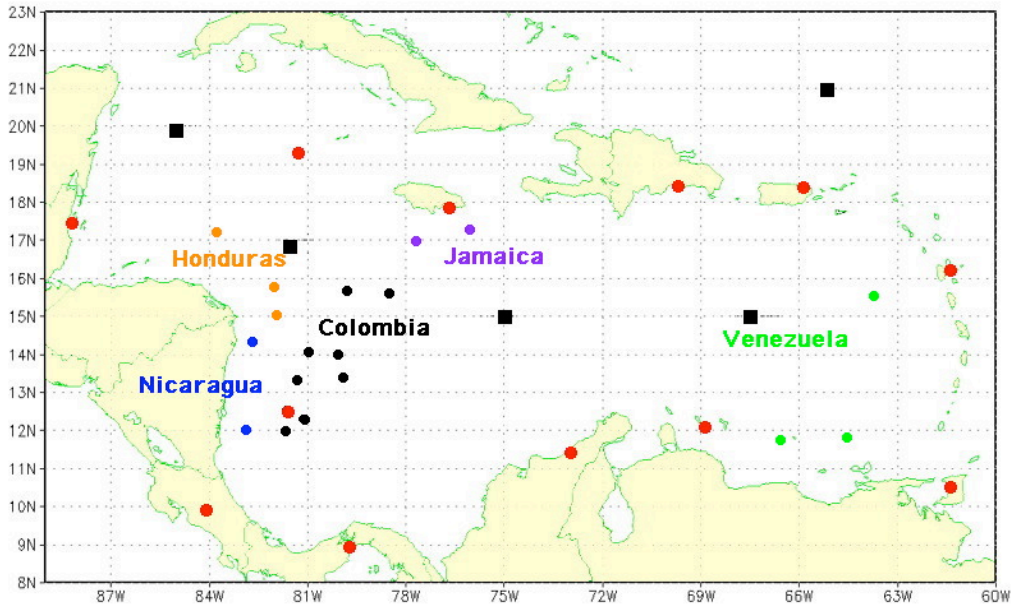


*Fig. 2. Radiosonde sites (red dots) around the Caribbean Sea and the location of very small islands (smaller dots) where observations potentially might be made. None of these sites are currently making meteorological observations. Black squares are current NOAA moored buoy locations.*

*Phase 3: Based on 1) and 2) develop options for both a) joint collaborative observing networks for longer-term monitoring for the region that provides what is needed for research and climate monitoring activities and b) strategies for more focused, short duration field programs that address unresolved IASCLIP issues that require such observations.*

A detailed summary of the findings of the international travel will be published shortly after the travel is completed, being made available on the IASCLIP website. This will provide information on the meteorological and oceanographic interests and logistical resources of institutions and individual researchers in the IASCLIP region. We will prepare various draft IASCLIP scenarios, both for extended monitoring and process studies, based on our findings. These drafts will be circulated via email and linked to the IASCLIP website for review by the ISCLIP community, with the idea being to produce an iteration that appears as a consensus of the entire IASCLIP community. This would serve as the implementation plan for IASCLIP long-term monitoring activities and process studies.

**2.4 Parallel activity in support of IASCLIP objectives**

An entirely separate proposal is being formulated to the "FY 2009 Joint Hurricane Testbed (JHT) Opportunities for Transfer of Research and Technology Into Tropical Cyclone Analysis and Forecast Operations"' that will complement certain aspects of the present proposal. The JHT proposal will request support to establish a trial adaptive observing network in the western Caribbean Sea region during the May-October period. This observing network, comprising

surface and upper air measurements, would serve to improve detection of early and late-season hurricane genesis in the western Caribbean Sea. Some aspects of the network would be adaptive, in the sense that some of the balloon soundings would be made on request from the National Hurricane Center.

| Country/likely participation | Institution | Expected IASCLIP contribution/activity |
|---|---|---|
| *Very likely* | | |
| Colombia | CIOH | Research personnel, research ship resources |
| Colombia | IDEAM | Sounding sites, research collaboration |
| Colombia | Navy | Island sites, personnel, island logistics |
| Colombia | Universities (2-3) | Joint research activities |
| Colombia | Air Force | Personnel for observations |
| Venezuela | Met Service | Personnel, education, sounding network |
| Venezuela | Navy | Possible research vessels, logistics to Aves island |
| Venezuela | Disaster prevention | Climate and weather monitoring |
| Venezuela | Universities (2-3) | Joint research, student participants |
| Barbados | Caribbean Met Institute | Educational activities, dissemination. |
| Dominican Republic | Met Service | |
| Netherland Antilles | Met Service | Observations, joint research |
| Jamaica | Met Service | Observations, logistics to Cays, joint research |
| Jamaica | universities | |
| Nicaragua | Met Service | Observations, logistics to islands |
| | universities | |
| Honduras | Met Service | Logistics to Swan Islands and other Cays |
| | universities | |
| El Salvador | Met Service | Observations, joint research |
| Costa Rica | Met Service | Observations, joint research |
| Costa Rica | Univ. Costa Rica | Joint research, logistics |
| Panama | | Observations, joint research |
| Mexico | | Observations, joint research, ship resources |
| | | |
| *possible* | | |
| Belize | | Observations, joint research |
| Cuba | | Observations, joint research |

Table 1. Probable countries and institutions that may be contacted for IASCLIP collaboration.

The objective of the proposed network would be to improve the early detection of tropical cyclogenesis in the western Caribbean Sea region through an enhanced network of 1) surface automatic weather stations on small islands and 2) a network of 11 pilot balloon and one radiosonde station that are operated both in a routine mode and on special request from the NHC. The network should allow for improved efficiencies (potential cost savings) in the use of other NHC operational resources, such as special USAF Investigative flights and G-IV DWS missions.

Novel characteristics of the proposed work would include:

1) implementation of an adaptive sounding network that will provide frequent measurements on request from NHC and lower-temporal sampling during summer season.

2) emphasizes observations from very small islands with negligible diurnal cycle or topographic effects.

2) provides parallel operational evaluation of three independent observing enhancements: automatic station data, pilot balloon observations, and radiosonde observations. All three systems are similar in cost.

3) requires active collaboration of observers from 5 countries in the region, where strong interest exists in hurricane forecasts.

The point of mentioning the JHT proposal is that it would in some sense jump-start certain IASCLIP monitoring activities and some of the travel required might be done jointly with that of the current proposal. Although the objectives are fundamentally operational, the use of small island sites would also benefit IASCLIP objectives. In addition, the experience gained arranging for the JHT measurements - and the required interaction with the operational communities of the countries involved would facilitate carrying out any IASCLIP field activities in these countries.

**Timeline for the proposed work**

We expect that, early in 2009, communication will take place among the US IASCLIP community regarding ideas for observations that might be needed to address research issues. Upon notification of approval of our proposal, communication via email would begin with foreign institutions, as would continued development of web resources. Once funding arrived, travel would commence. Late in 2009 a detailed report on options for IASCLIP measurements would be circulated for review and comment. This may be sufficiently early for guiding funding for monitoring activities starting in early 2011 and for major facilities in 2012. Some limited monitoring activities might begin as early as late 2009, depending on the success of the JHT proposal.

## References

Douglas, M.W. and J. Murillo, 2008: The Pan American Climate Studies Sounding Network, Bull. Amer. Met. Soc., in press.

## 3. Budget justification

The project requests funds for supporting John Mejia as project scientist. He is scheduled to receive his PhD in December 2008 and this would allow him to continue IASCLIP activities and to finish NAME and SALLJEX related projects that he was also involved with. He has extensive field experience from the SALLJEX, PACS-SONET, and NAME field activities, including extensive aircraft experience (SALLJEX and NAME) and ship-based activities (NAME). He also has many contacts with meteorological institutions in Colombia (he is from Medellin) and his Spanish will facilitate communications with Spanish-speaking IASCLIP participants.

This proposal requests funds for two years. While many aspects need to be carried out relatively quickly within the first year, the fine-tuning of a detailed field campaign strategy requires much iteration among interested researchers and key institutions and this invariably takes time. Such iteration can only take place after a first draft of the observational requirements has been prepared and after initial contacts have been made and travel to the region have been carried out.

The travel costs are estimates, subject to many uncertainties. We believe that the required travel can be accommodated within the requested amounts. Official per diem rates are often unrealistically high in this region and are not specified in the budget; actual travel expenses for food and lodging will be adjusted to fit within the available travel budget.

## 6. BUDGET (year 1)

**Personnel:**

| | |
|---|---|
| Project scientist (100% time, $45,000 base salary plus benefits) | $58,700 |

**Travel**

| | |
|---|---|
| Central America (Honduras, El Salvador, Nicaragua, Belize, Panama, Costa Rica) | |
| RT and per diem for 16 days for 2 individuals | $ 8,000 |
| Northern South America (Colombia, Venezuela, Netherland Antilles, Barbados) | |
| RT and per diem for 16 days for 2 individuals | $ 8,000 |
| Caribbean Sea and Atlantic islands (Dominican Republic, Jamaica, Cayman Islands, Bahamas) | |
| RT and per diem for 12 days for 2 individuals | $ 6,000 |
| National travel (1 meeting, two individuals) | $ 2,500 |
| Total | $83,200 |
| NSSL indirect costs (35%) | $29,120 |
| **total request for year 1** | **$112,320** |

**Year 2 budget**

**Personnel:**

| | |
|---|---|
| Project scientist (100% time) | $62,000 |
| **Travel** | |
| National travel (1 meeting, two individuals) | $ 2,500 |
| total | $ 64,500 |
| NSSL indirect costs (35%) | $ 22,575 |
| **total request for year 1** | **$87,075** |

**Biographical Sketch - Michael W. Douglas**

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*Education:*

Ph.D. Meteorology, Florida State University, Tallahassee, Florida, 1987. Advisor: T.N. Krishnamurti Dissertation: *Structure and dynamics of monsoon depressions.*

M.S. Atmospheric Science, University of Miami, Coral Gables, Florida, 1977. Advisor: M.A. Estoque. Thesis: *Structure and occurrence of disturbances along the ITCZ over the GATE area.*

A.B. Geophysics, University of California, Berkeley, California, 1975.

*Principal Employment Experience:*

10/92 - present Employed at National Severe Storms Laboratory, Norman, Oklahoma as Meteorologist. Work is principally related to explaining the warm-season circulations and rainfall patterns over the tropical Americas.

07/90 - 09/92 CIRES, Univ. of Colorado, Boulder, Colorado. Work was with the National Severe Storms Laboratory/NOAA and involved analysis of data from Mexico and southwestern U.S. (R. Maddox supervisor)

10/86 - 12/87 and 06/88-06/90 CIRES, Univ. of Colorado, Boulder, Colorado. Work with WPL/NOAA involved participation in field experiments to collect data in the vicinity of polar lows and developing oceanic cyclones and to subsequently analyze this data. (M. Shapiro supervisor)

*Additional experience:*

07/06 - 09/06 PI for NASA-supported measurement campaign involving pilot balloons and radiosondes in four west African countries as part of the NASA-AMMA.

04/97 - 05/06 Principal investigator for NOAA-supported pilot balloon observation network (PACS-SONET) involving ~20 stations in Latin America. Program made more than 50,000 observations since 1997 at more than 60 locations.

05/04 - 10/04 Principal investigator for 4 NOAA-supported projects associated with the North American Monsoon Experiment (NAME). Projects involved NOAA P-3 aircraft (10 flights), pilot balloon network (22 sites), vegetation monitoring and atmospheric feedbacks, and a Mexican research ship activity.

11/02 - 02/03 Principal investigator for three separate NOAA-supported projects involving a NOAA P-3 (13 flights), raingauge networks, and a 20-station pilot balloon network during the South American Low-Level Jet Experiment (SALLJEX).

06/93 - 08/93 Helped to organize the EMVER-93 observational network (9 pilot balloon and 2 special radiosonde sites) over northwestern Mexico and establish a temporary regional analysis center in Obregon, Sonora.

06/90 - 08/90 Participated in Southwest Area Monsoon Project (SWAMP). Was responsible for organizing a network of 11 pilot balloon stations in Mexico and Arizona to describe the southwest North American monsoon circulation.

02/87 - 03/89 Participated in planning and execution of four aircraft field programs using NOAA P-3 aircraft. Programs were Coordinated Eastern Arctic Research Experiment (CEAREX), Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA), Ocean Storms, and Alaska Storms Experiment.

***Formal publications in the past 3 years and other relevant publications***

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**Current and pending support for M. Douglas**

**Current:**

NOAA CPPA: Explaining the spatial variability of the mid-summer drought over the Inter-American Seas region. May 1, 2007 to April 30, 2010. Total requested $280,125 YEAR 1: $119,475, YEAR 2: $114,750, YEAR 3: $45,900

NASA: Measuring the evolution of tropical waves over West Africa into tropical storms over the eastern Atlantic. March 1, 2006 – Feb 28, 2009. First year $120,000, second year $77,895, and third year $84,442.

**Pending:**

This proposal.

Hurricane Testbed Proposal (being prepared for Oct 30, 2008 submission). Proposed start date June 1, 2009. Two years, estimated budget $225K each year.