Partners Project Title Page
Proposal for a Partners Project

Title: Empirical Probability of Precipitation (PoP) in Weakly Forced Environments

Date: 12/18/19

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SUMMARY OF BUDGET REQUEST:

COMET FUNDS: Year 1 $14,978

NWS FUNDS: FY 1________ FY 2________

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SUMMARY OF BUDGET REQUEST:

COMET FUNDS: Year 1 $14,978

NWS FUNDS: FY 1 $0 FY 2 $0

Empirical Probability of Precipitation (PoP) in Weakly Forced Environments

LSU Principal Investigator: Dr. Paul Miller[1]

NWS Principal Investigators: Chis Bannan[2]
Kevin Gilmore[2]

[1]Louisiana State University, Department of Oceanography and Coastal Sciences
[2]National Weather Service, Slidell, LA

Project budget: $14,978 **Project period:** 3/1/2020 – 2/28/2021

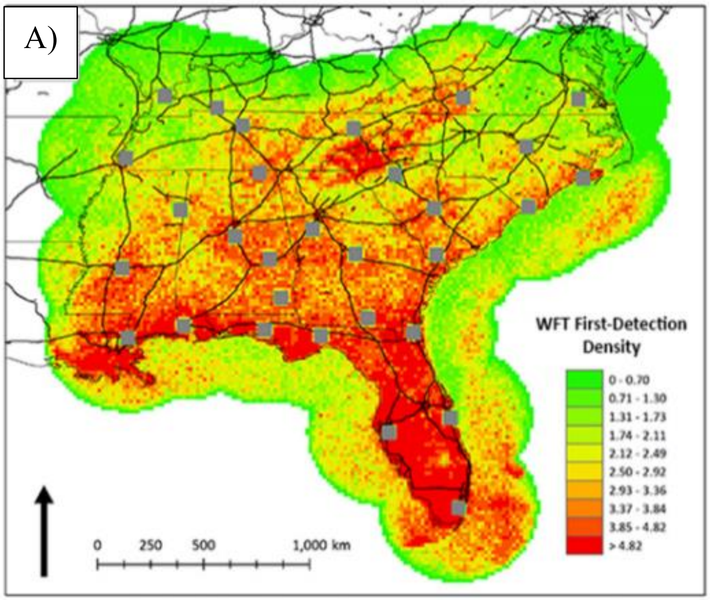
[1] Project Summary

Weakly forced thunderstorms (WFTs) are difficult-to-forecast events due to their short lifespans, small spatial footprints, and challenges monitoring and modeling the concurrent large- and small-scale environmental conditions in which they form. Fueled by the diurnal instability, short-lived, isolated convection generally forms during the afternoon in hot, humid, summertime air masses. Typically lasting between 30 minutes and one hour, each cell consists of a three-stage life cycle (i.e., the cumulus, mature, and dissipating stages) first described by Byers and Braham (1949) during the Thunderstorm Project. These storms are a staple feature of the summer climate across the central and eastern United States.

In weak-shear regimes, mesoscale features such as cold pools and sea-breeze fronts are primary sources for mechanical forcing to the level of free convection (LFC). However, because these mechanisms often form on scales finer than the current observational network, they are difficult to detect and assimilate into numerical weather prediction (NWP) models to produce accurate near-term forecasts. Further, WFTs routinely grow upscale on weakly sheared days increasing the probability of precipitation (PoP) over the forecast area, contrary to the oft-repeated idea that convection occurs as isolated cells in weakly sheared environments. Meanwhile, PoPs are the primary means of communicating the likelihood of precipitation to the public (Stewart et al. 2016) by both broadcast and operational meteorologists. However, in weakly forced environments with poorly resolved convection, the forecasts become especially challenging. Not only is the timing of convection initiation difficult to predict, but the propagation, translation, and formation of secondary convective cells can all serve to "bust" the PoP forecast on synoptically weakly forced days.

Though National Weather Service (NWS) Forecasting Offices (NWSFOs) all over the Southeast U.S. face troublesome weakly forced environments for much of the warm season, this challenge is especially relevant for sea-breeze influenced coastal regions such as the Slidell, Louisiana (LIX), NWSFO county warning area (CWA). These difficult forecasting environments and the WFTs they host are already common in the summertime Southeast. U.S. (Fig. 1a), and they are projected to expand spatially and seasonally (Fig. 1b) affecting larger areas for longer, even with modest warming. Thus, it is critical to improve our ability to accurately forecast them. Though impovements to the current observational network and NWP models will certainly prove helpful, this project aims to improve the quality of PoP forecasts using a historical assessment of precipitation coverage in synoptically weakly forced environments over the LIX CWA, though the methods emplyoed are extensible to any other CWA in the Southeast U.S. The project will also leverage first-hand 2020 warm season forecasting experiences from LIX meteorologists to identify the circumstances during which PoP forecasts poorly verify.

This project will integrate an existing 15-yr WSR-88D-based WFT dataset to determine empirical thunderstorm probabilities in weakly forced warm season regimes. Next, hourly Stage IV precipitation estimates during these same weakly forced thunderstorm days will be masked into precipitation and non-precipitation areas to similarly build an emiprical climatological PoP map. Lastly, the Partners Project will engage the local forecasting experiences of LIX meteorologists to develop cataloge of PoP "busts" as the 2020 warm season progresses. LSU partners will then employ the random forests machine learning technique to identify the convective environmental parameters and their values that characterize PoP forecast busts in the LIX CWA,. Thus, this collaborative effort will provide LIX forecasters with a new suite of climatological PoP forecasting aids, as well as a knowledge of when PoP forecasts tend to be the most unreliable.



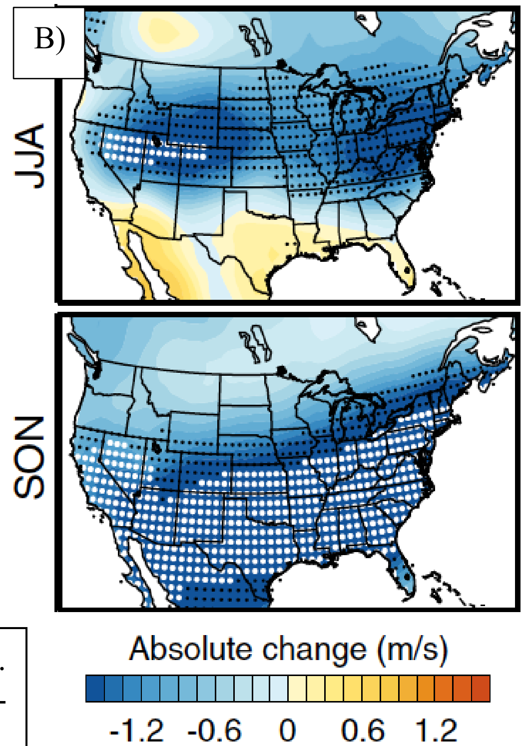


Figure 1. A) WFT climatology for Southeast U.S. (Miller and Mote 2017); B) Projected changes in 0-6-km wind shear from Diffenbaugh et al. (2013).

[2] Statement of Objectives

Given the weak synoptic forcing, disorganized convection is more sensitive to small-scale factors that may otherwise play a secondary role in convection initiation and maintenance (Miller and Mote 2017a). Though they may be synoptically "simple" environments, the difficulty in observing and modeling small, short-lived processes, such as outflow boundaries (e.g., Byers and Braham 1949; Haerter et al. 2019), urban interactions (e.g., Mote et al. 2007; Bentley et al. 2010), subtle topographic circulations (e.g., Bentley and Stallins 2005; Kirshbaum et al. 2015), etc, that prompt WFT activity continues to handicap forecast accuracy in these setting (e.g., Vaughan et al. 2017; Keil et al. 2019). Though forecasting textbooks emphasize the role of climatology in formulating a weather forecast (e.g., Lackmann 2011, p. 311), such a tool is unavailable for this already difficult-to-forecast thunderstorm type. Thus, the purpose of this project is to develop a PoP climatology forecasting to for LIX forecasters to employ in developing precipitation forecasts during warm season, weakly forced regimes.

This project will address three primary research questions: **[1]** What is the areal coverage of WFT activity within weakly sheared convective environments over the LIX CWA? **[2]** What is the climatological probability of precipitation within weakly sheared convective days over the LIX CWA? **[3]** What are the distinguishing environmental characteristics of PoP forecast busts during the 2020 warm season?

Beyond providing valuable local forecasting knowledge for operational meteorologists at the LIX NWSFO, this study can serve as a prototype that can be replicated a numerous other NWSFOs that also face routine weakly forced conditions. Further, the project will be truly collaborative by *(1)* allowing student workers at LSU to participate in regularly scheduled meetings with LIX forecasters both at the LSU campus and the LIX NWSFO in Slidell, LA; *(2)* investigating a local forecasting problem that was identified by LIX forecasters prior to their interactions with LSU faculty; and *(3)* directly engaging NWSFO forecaster participation during the 2020 warm season. This project represents an important first step in collaboration between the LIX NWSFO, responsible for the LSU campus in Baton Rouge, LA, and the newly formed LSU Coastal Meteorology program. A successful COMET Partners Project between the two groups will set an important tone of collaboration and cooperation as the LSU Coastal Meteorology program continues to grow.

[3] Research Objectives and Methods

Research Objective 1: Determine the areal coverage of WFT activity within weakly sheared convective environments over the LIX CWA

Objective 1 Background: Figure 1a depicts the 15-yr convection initiation pattern for WFTs in the Southeast U.S. between 2001–2015 (Miller and Mote 2017b). Though this map includes WFT initiations over coastal Louisiana, the analysis was not conducted with enough fidelity to serve as an effective local forecasting tool. Figure 2 shows a higher-resolution graphic generated using the same source data for the LIX CWA, which the depicts the spatial nuances of the convection initiation over the study area. For decades, numerical modeling experiments (e.g., Weisman and Klemp 1982; Rotunno et al. 1988) as well as educational texts (e.g., Markowski and Richardson 2010) suggest that thunderstorms in weakly sheared environments remain small, short-lived, and isolated. However, as argued by Miller and Mote (2017a), upscale convective growth routinely occurs even in weakly sheared environments, and this reality should not be dismissed in the PoP forecasting process. Figure 2 does not account for thunderstorm propagation, translation, or secondary initiation, thus under-representing WFT coverage for operational PoP forecasting purposes. The purpose of Objective [1] is to establish a climatological likelihood of WFT areal frequency.

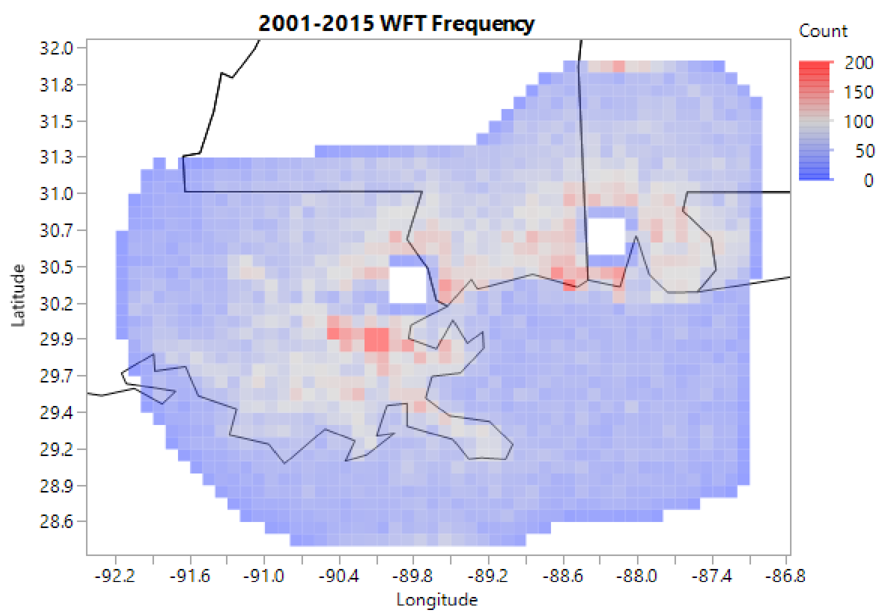


Figure 2. WFT initiation frequency over the LIX CWA during 2001–2015 from the MM17 dataset.

Objective 1 Methods:

Step [1] Thunderstorm morphology identification

A large, unique database of weakly forced convection created by Miller and Mote (2017b; hereafter MM17) will be utilized to determine the occurrence and associated morphology of thunderstorms between 2001–2015. The original MM17 WFT dataset incorporates Weather Surveillance Radar - 1988 Doppler (WSR-88D) data from 30 sites in the Southeast U.S. from May-September 2001–2015. This project restricts its study to WFTs, thunderstorms forming in the absence of synoptic-scale dynamical support, over coastal Louisiana and Mississippi (Fig. 2). MM17 identify thunderstorms as areas of spatially and temporally contiguous composite

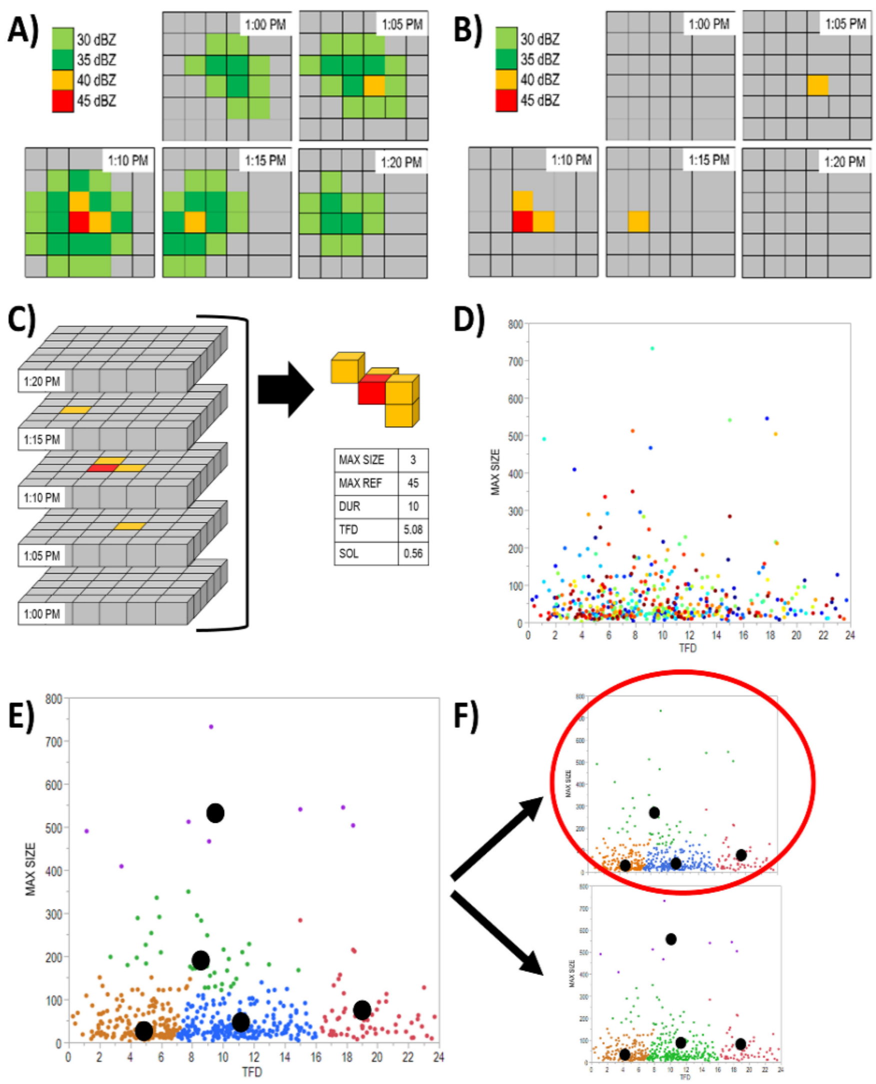


Figure 3. Weakly forced thunderstorm identification workflow. Panes (a)-(c) depict the extraction of contiguous convective reflectivities, and (d)-(f) illustrate the statistical discrimination of weakly forced from strongly forced convection using morphological and environmental traits.

reflectivities (≥40 dBZ) with WFTs designated as those that also formed within high-instability, weakly sheared environments (Figure 3). The entire 15-yr database contains 885,496 WFTs with 95,033 such events occurring over the study area shown in Fig. 2.

Beyond simply the binary occurrence WFTs, the MM17 dataset includes the geographical coordinates and timestamps of all composite reflectivity pixels associated with each storm throughout its lifetime. It also includes several morphological metrics, such as the initiation location and time, duration, maximum size, maximum intensity (dBZ), total constituent reflectivities, and a measure of spatiotemporal uniformity. Collectively, these variables were employed by MM17 in conjunction with convective environmental parameters (i.e., bulk wind shear, mean-layer CAPE) to designate WFTs (Fig. 3).

Step [2] Determine spatially referenced WFT probability

The Spatial Synoptic Classification (SSC) database developed by Sheridan (2002) is a publicly available air mass categorization system (http://sheridan.geog.kent.edu/ssc.html). SSC classifications are frequently employed in climatological convection studies to isolate days characterized by stagnant, moist, and often weakly sheared air masses (Mote et al. 2007; Bentley et al. 2010), labeled as "moist tropical" in the SSC system. Because the WFTs were identified by MM17 based partially on near-storm convective environmental conditions, WFT activity should largely occur on SSC moist tropical days anyway. However, the SSC dataset is employed here to maintain consistency with Objective [2], when explicit WFT categorizations are not available.

WFTs in the MM17 dataset occurring on moist tropical days at LIX will be extracted and mapped according to the storm's total lifetime areal footprint. The WFT footprints will be merged on a daily scale to create a binary storm-no storm map of the LIX CWA for each moist tropical day. The maps will then be regridded to a common ~5-km cartesian grid over the CWA, and the probability of WFT occurrence will be determined for each cell in the grid. For instance, if the 5-km grid cell containing the New Orleans airport experienced a WFT on 342 of 978 moist tropical days (values are fabricated for the sake of argument) for which the MM17 dataset was available (May–September 2001–2015), then that grid cell would be assigned a climatological WFT probability of 34.9%. This procedure would be repeated for each cell in the domain, yielding a map of the 15-yr WFT probability for the LIX CWA.

Objective [1] expected outcome: WFT probabilities within the CWA will be higher than typically assumed because the probability map generated by Objective [1] will incorporate the effects of storm movement and upscale growth. *Deliverables*: A WFT probability map for LIX CWA.

Research Objective 2: Determine the areal coverage of precipitation within weakly sheared convective environments

Objective 2 Background: Whereas Objective [1] investigates the coverage of deep moist convection over the CWA, Objective [2] will focus specifically on PoPs in these environments. Currently, the best available climatological PoP forecasting tools are similar to those shown in Figure 4 (Jorgensen 1967; Changnon 2001). However, these tools, designed to complement more advanced NWP guidance, are woefully obsolete, and share common deficiencies: (1) They are much coarser than the resolution of PoP forecasts being issued by NWSFOs; They were created using interpolated station data, not radar or satellite observations; and (3) They are not regime-specific, meaning they include precipitation produced in both organized and disorganized convective environments. Objective [2] will improve upon these products by using high-resolution spatially referenced precipitation products, rather than interpolated station data. This technique provides a climatological, operational complement to NWP guidance that informs forecasters about the spatial distribution of PoPs in weakly forced environments. In this sense, the Objective [2] even improves upon model output statistics (MOS), which only produce location-specific PoPs for a few sites within the CWA. Further, Objective [2] will be stratified across the diurnal cycle to inform the daily, spatialized cycle of PoPs across the LIX CWA as well.

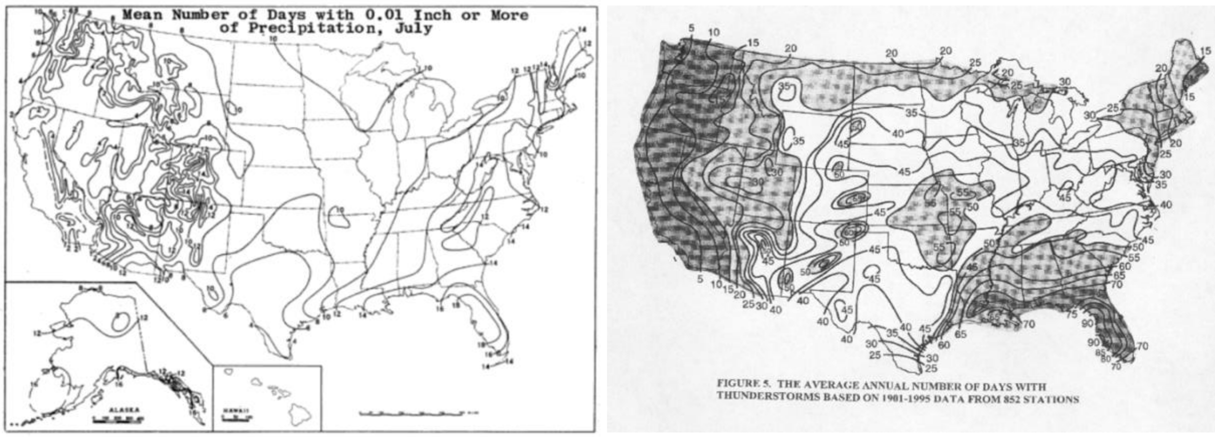


Figure 4. Mean number of thunderstorm days according to Jorgensen (1967) (left) and Changnon (2001) (right).

Objective 2 Methods:

Step [1] Characterizing precipitation frequency

Objective [2] will be completed using hourly multi-sensor precipitation estimates (MPE) from the NCEP Stage IV dataset (Lin 2011). Stage IV precipitation analysis is a gauge-calibrated radar-based precipitation product available hourly over the continental U.S. from 2002 to present at 4-km resolution. The Stage IV gridded precipitation fields will be filtered to only include only those analyses occurring on SSC moist tropical days as in Objective [1].

For each precipitation field, cells with <0.25 mm of rain (equivalent to 0.01”) will be set equal to 0 and cells with ≥0.25 mm will be set equal to 1. Figure 5 shows an example of an hourly Stage IV analysis field over coastal Louisiana from 1900 UTC 27 July 2019 as well as the regions that would have been set equal to 1 as measurable precipitation. All precipitation fields occurring at the same UTC hour on moist tropical days during the study period will then be summed and divided by the number of fields contributing to the Stage IV arrays. This procedure will produce 24 PoP maps depicting the evolution of PoP in weakly forced summer environments over the CWA.

Next, the same analysis will be repeated; however, instead of a fine, 1-hr PoP analysis, the hourly precipitation arrays will be summed to produce a 12-hour total, and the 0.25-mm mask will be applied to the 12-hour accumulations. The purpose of this second procedure is to produce spatialized PoP tools for disorganized summer environments that match the typical 12-hr forecast

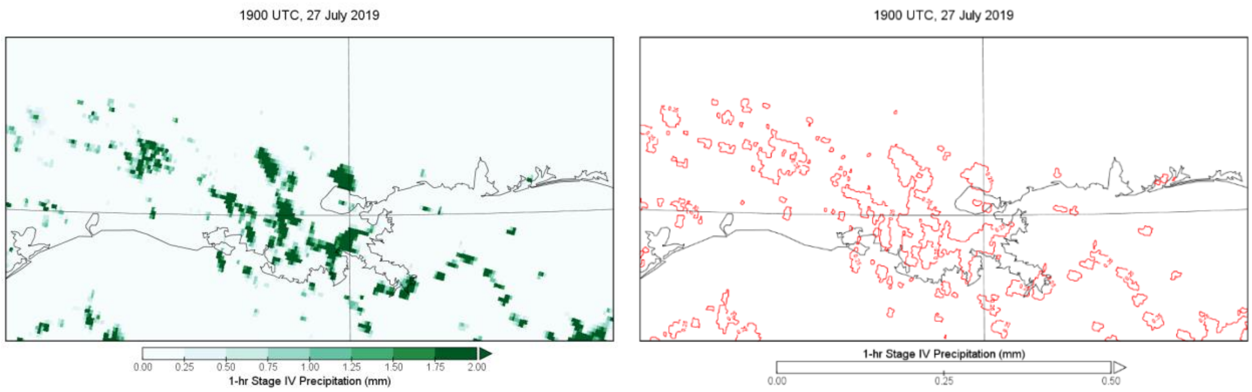


Figure 5. Example of NCEP Stage IV precipitation analysis. Left pane shows a single 1-hr precipitation total from 1900 UTC on 27 July 2019, whereas the right pane shows the same image with a red contour line denoting all regions with ≥0.25 mm.

period used by the NWS. This analysis will yield a climatological PoP map that can be used by LIX forecasters to issue 12-hr PoP forecasts like the one pictured in Figure 6. Meanwhile, the hourly PoP analysis and the WFT probabilities in Objective [1] can be used to better precipitation and thunder meteogram forecasts such as that shown in the right pane of Fig. 6.

Objective [2] expected outcome: Weakly forced PoPs will peak during the diurnal cycle with coastal locations peaking earlier in the day than points further inland. *Deliverables*: (1) A 24-hr diurnally evolving climatological PoP forecasting tool for weakly forced environments across the LIX CWA; (2) Two aggregated 12-hr climatological PoP maps for the LIX CWA

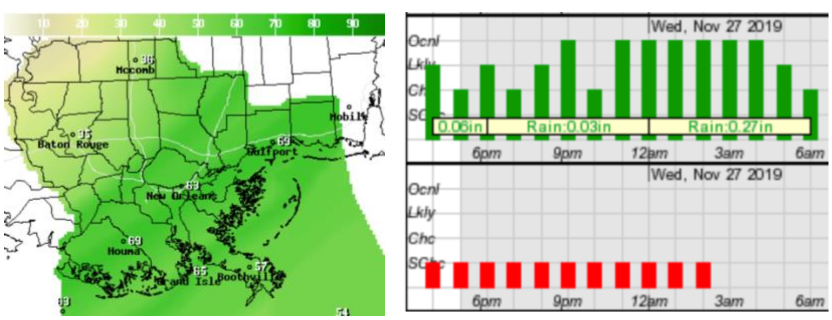


Figure 6. Example of LIX PoP forecast taken from the LIX homepage on 27 November 2019 (left). Example of LIX. meteogram for same period (right).

Research Objective 3: Identify the common factors of PoP busts during the 2020 warm season

Objective 3 Background: Whereas Objectives [1] and [2] will provide forecasters with climatologically based forecasting tools, Objective [3] will engage forecaster experience to understand the circumstances in which these tools are less reliable. Although PoPs ultimately communicate forecast uncertainty (Murphy 1998), PoP forecasts containing exceptionally high or low PoPs may be interpreted deterministically by the public. Thus, PoP forecasts including high or low probabilities that verify poorly may be interpreted by the public as false alarms (Barnes et al. 2007) and influence how future forecasts are interpreted. If the common threads to these PoP forecast "busts" can be identified, then forecasters can adjust the forecast text or mention that the PoPs are somewhat uncertain in the area forecast discussion.

Objective 3 Methods:

Step [1] Identifying PoP forecast busts

During the 2020 warm season, the LIX operational staff will identify instances of large PoP forecast errors as they occur. Prior to the onset of the 2020 warm season, the NWS PI will brief the LIX forecast staff about the proposed project and its aforementioned local forecasting goals. At that time, he/she will also instruct the LIX staff about the local PoP bust collection efforts, as well as the criteria for PoP forecasts "busts". These guidelines will be firmly established during a Spring 2020 meeting between the LSU and NWS PIs, but will likely include a mix of subjective and objective criteria. Whenever a PoP bust is identified during Summer 2020, local forecasters will complete a Google form (or some similar process) circulated by the NWS PI and archive the NWS gridded PoP forecast for that day.

Step [2] Determining common traits of PoP busts

At the conclusion of the 2020 warm season, the NWS PI will assemble the dates and associated PoP grids that verified poorly. For all days (both busts and non-busts) between May and September 2020, a series of convective parameters will be computed from 0000 and 12000 UTC KLIX radiosonde launches using the SharpPy Python module. The LIX NWSFO is advantageously positioned to leverage the radiosonde data because the balloons are launch by the LIX staff at their office in the center of the CWA, a relatively unique capability for research purposes. Common convective forecasting values such as mean-layer convective available potential energy (MLCAPE), precipitable water (PW), convective inhibition (CINH), total totals (TT), etc., will be among those derived from the soundings. The convective forecasting parameters for both the bust and non-bust days will be integrated into a single dataset, and a random forest machine learning algorithm will be applied.

In short, a random forest is an ensemble of individual decision trees with each tree trained on a subset of the available variables and forecast days. The forest will be grown with the 1200 UTC convective environmental parameters and trained to predict the bust versus no-bust outcome. The random forest will be using two-thirds of the available days and then validated on the remaining third. Multiple forest structures will be tested to identify the most appropriate configuration using setting such as the number of forecast days required to split a branch, the maximum number of splits allowed, the number of trees in the forest, and the number of input variables sampled for each tree. Tree splits are determined by optimizing the LogWorth statistic, which is a transformation of the chi-square p-value (Sall 2002). The LogWorth increases as the split variable and its split value lead to more dramatic segregations bust versus no-bust days. The forests will then be analyzed to understand the relative importance of the convective environmental parameters in influencing the PoP forecast accuracy outcome as inferred through their total sum of squares (SS) statistic. The percentage of the cumulative SS in the random forest contributed by each convective forecasting variable will inform the conclusion of which parameters might indicate the PoP forecast is prone to error.

Previous random forest applications in atmospheric science include near-term predictions of mesoscale convective system formation (Ahijevych et al. 2016), storm mode classification (Gagne et al. 2009), and quantitative precipitation forecasts (Gagne et al. 2014). Specifically, a recent effort by the LSU PI applied random forests to differentiate severe and non-severe WFTs using a combination of radar and convective environmental information (Miller and Mote 2018b).

Objective [3] expected outcome: The PoP forecast will be most prone to error when moisture-related variables such as PW are large and precipitation is widespread without strong wind shear to aid cold pool-shear interactions. *Deliverables*: (1) A diagnosis of the most important forecasting parameters for anticipating potential PoP busts; (2) A peer-reviewed journal article synthesizing the results from Objectives [1] – [3]; (3) A training session for LIX staff where the results of the Partners Project will be communicated and LSU student workers will be present.

[4] General implementation plan

4.1 LSU versus NWS responsibilities

Paul Miller (LSU PI) is an Assistant Professor in the Department of Oceanography and Coastal Science at Louisiana State University. He has extensive experience with disorganized convective processes (e.g., Miller et al. 2015c, 2015a, 2015b; Miller and Mote 2017a), and his research primarily pulls upon the observation techniques employed here (Miller and Mote 2018a, 2018b). Miller will serve at the primary project administrator, and ensuring the completion of deliverables by the deadlines specified below, the quality of all deliverables, and timely project progress reports. Miller will supervise the student worker at LSU in completing Objectives [1] and [2]. Miller and his student will also complete the random forest component of Objective [3].

Chris Bannan and Kevin Gilmore (NWS PIs) Bannan serves as the Lead Forecaster at LIX and Gilmore is a Meteorologist/Forecaster. The NWS PIs will conduct the LIX staff orientation prior to the 2020 warm season, and coordinate the PoP forecast collection efforts at LIX. They will also coordinate a second staff seminar at the conclusion of the project where the results of the Partners Project will be presented to the LIX operational forecasting staff.

4.2 Timeline of milestone completion

A table summarizing the timeline project milestones is shown below. The project will begin on 1 March 2020 and conclude 28 February 2020. Spring, Summer, and Fall in the table below correspond to March-May 2020, June-September 2020, and October 2020-February 2021, respectively.

#	Milestone	Objective	Period		
			Spr	**Sum**	**Fall**
1	Pair MM17 WFTs with SSC moist tropical days	1			
2	Map WFT footprints over LIX CWA and compute probabilities over gridded domain	1			
3	Access and download all Stage IV data	2			
4	Compute >0.01" diurnal probabilities over gridded domain for moist tropical days	2			
5	Aggregate Stage IV PoP analysis to 12-hr periods	2			
6	Conduct Partner Proposal training for LIX staff	3			
7	Collect PoP forecast busts at LIX	3			

8	Derive convective environmental parameters for 1200 UTC warm season radiosondes	3			
9	Perform random forest analysis to identify commonalities of PoP bust days	3			
10	Present findings to LIX staff	--			

4.3 Team communication

The LSU and NWS team members, including the student worker(s), will participate in monthly conference calls to discuss project updates. These meetings will allow the project collaborators to gage progress and discuss the technical issues related to the project implementation. File sharing services on DropBox will allow the team members to quickly build upon the results being produced by other team members. Monthly conference calls will be supplemented with in-person meetings organized around during the three periods indicated in Section 4.2.

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Paul W. Miller
Department of Oceanography and Coastal Sciences
Louisiana State University
2231 Energy, Coast, and Environment Building
Baton Rouge, LA 70803

a. Professional preparation

Institution	*Major*	*Pursuit*	*Year*
Virginia Tech	Geography	B.A.	2012
Virginia Tech	Meteorology	B.S.	2012
Virginia Tech	Geography	M.S.	2014
University of Georgia	Geography	Ph.D.	2017
University of Georgia	--	Post-doc.	2018

b. Appointments

2019-present Assistant Professor, Department of Oceanography and Coastal Science, Louisiana State University

c. Five Key Relevant Products (20 total)

1. **Miller, P. W.**, and T. L. Mote, 2018: A climatology of weakly forced and pulse thunderstorms in the Southeast United States. *Journal of Applied Meteorology and Climatology*, 56, 3017–3033.
2. **Miller, P. W**., A. Kumar, F. D. S. Moraes, T. L. Mote, and D. R. Mishra, 2019: Persistent hydrological consequences of Hurricane Maria in Puerto Rico. *Geophysical Research Letters*, 46, 1413–1422.
3. **Miller, P. W.**, and T. L. Mote, 2017: Standardizing the definition of a "pulse" thunderstorm. Bulletin of the American Meteorological Society, 98, 905–913.
4. **Miller, P. W.**, A. W. Ellis, and S. Keighton, 2015: A preliminary assessment of using spatiotemporal lightning patterns for a binary classification of thunderstorm mode. *Weather and Forecasting*, 30, 38–56.
5. **Miller, P. W.**, and T. L. Mote, 2018: The algorithmic detection of pulse thunderstorms within a large, mostly nonsevere sample. *Meteorological Applications*, 24, 629–641.

d. Selected Synergistic Activities

1. Editorial Board member for *Atmosphere*, 2019–present.
2. Honors Director for Climate Specialty Group of the American Association of Geographers, 2019–present.
3. Louisiana Sea Grant fellow for discovery, application, and integration leadership (LaDIA Fellows program), 2019–2020.
4. Science advisor for NASA DEVELOP student team. *Assessing Changes in Cloud Dynamics in a Tropical Montane Cloud Forest Using Remotely Sensed and In-Situ Observations Following Catastrophic Defoliation from Hurricane Maria.* 2018.
5. Guest scientist lecturer at UGA Marine Extension youth summer camps. 2018.

Chris Bannan

23400 Airport Rd
Slidell, LA 70460
christopher.bannan@noaa.gov
(985) 649-0429

Work Experience

National Weather Service, New Orleans, LA – Lead Forecaster
March 2009 – current
National Weather Service, Jackson, MS – General Forecaster
June 2004 – February 2009
National Weather Service, North Platte, NE
August 2003 – June 2004, General Forecaster
February 2003 – August 2003, Meteorologist Intern
United States Marine Corp Reserves, Bossier City, LA
May 1997 – May 2003

Education

University of Louisiana - Monroe, Monroe, LA – Bachelor of Science in Atmospheric Science

Kevin Gilmore

23400 Airport Rd
Slidell, LA 70460
kevin.gilmore@noaa.gov
(205) 478-6754

Work Experience

National Weather Service, New Orleans, LA – Meteorologist/Forecaster
May 2018 – current
National Weather Service, Great Falls, MT – Meteorologist Intern
April 2017– May 2018
AccuWeather, State College, PA – Operational Meteorologist I
March 2016– February 2017
University of South Alabama Meteorology Department, Mobile, AL – Student Assistant
January 2013 – May 2014
CHILI (Center for Hurricane Intensity and Landfall Investigation) – Instrument Technician
May 2013 – December 2013

Education

University of South Alabama, Mobile AL – Bachelor of Science in Meteorology, Minor in Mathematics
January 2012 – May 2014
Jefferson State Community College, Birmingham AL
January 2007 – December 2011

Proposal Budget

[1] Budget Narrative

Louisiana State University

Personnel: One hourly summer student worker for 320 hours (20 hr/week x 16 weeks) at a rate of $25/hour. This student will work under the supervision of Miller performing the PoP analysis.

Travel: Funds for two participants to travel the 2021 American Meteorological Society meeting in New Orleans, LA, for PI Miller and the student worker at roughly $1000 each ($750 lodging + $250 food = $1000) are requested.

Supplies: Funds are requested for a cloud data storage service for the project period at $120.

Indirect costs: Indirect costs are calculated at LSU's federally negotiated rate of 48% MTDC for on campus research.

[2] Project budget

	COMET Funds	NWS Contributions
University Senior Personnel		
1. Paul Miller	**$0**	**NA**
2.		**NA**
Other University Personnel		
1. Student worker	**$8000**	**NA**
2.		**NA**
Fringe Benefits on University Personnel	**$0**	**NA**
Total Salaries + Fringe Benefits	**$0**	**NA**
NWS Personnel		
1.	**NA**	**208**
2.	**NA**	**208**
Travel		
1. Research Trips	**$0**	
2. Conference Trips	**$2000**	
3. Other	**$0**	
Total Travel	**$2000**	
Other Direct Costs		
1. Materials & Supplies	**$0**	**NA**
2. Publication Costs (put in the NWS column if a co-author will be an NWS employee)		
3. Other Data	**$0**	
4. NWS Computers & Related Hardware	**NA**	
5. Other (cloud data storage)	**$120**	
Total Other Direct Costs		
Indirect Costs		**NA**
1. Indirect Cost Rate	**48%**	
2. Applied to which items?	**Wages, travel, supplies**	
Total Indirect Costs	**$4,858**	**NA**
Total Costs (Direct + Indirect)	**$14,978**	

DEPARTMENT OF HEALTH & HUMAN SERVICES

Program Support Center
Financial Management Portfolio
Cost Allocation Services

1301 Young Street, Room 732
Dallas, TX 75202
PHONE: (214) 767-3261
FAX: (214) 767-3264
EMAIL: CAS-Dallas@psc.hhs.gov

June 3, 2019

Ms. Elahe N. Russell
Director, Financial Accounting & Reporting
Louisiana State University and A&M College
Office of Financial Accounting & Reporting
204 Thomas Boyd Hall
Baton Rouge, LA 70803

Dear Ms. Russell:

A copy of the indirect cost Rate Agreement is being sent to you for signature. This Agreement reflects an understanding reached between your organization and a member of my staff concerning the rate(s) that may be used to support your claim for F&A and fringe benefit costs on grants and contracts with the Federal Government.

Please have the Agreement signed by an authorized representative of your organization, email to me, retaining a copy for your files. Our email address is cas-dallas@psc.hhs.gov. We will reproduce and distribute the Agreement to the appropriate awarding organizations of the Federal Government for their use.

Requirements for adjustments to cost claimed under Federal Grants and Contracts resulting from this negotiation are dependent upon the type of rate contained in the negotiation agreement. Information relating to these requirements is enclosed.

In addition, both parties agree to the following over (+) / under (-) recoveries:

	2017/2019	2018/2020
Main Campus	($4,675,936)	($3,974,762)
Federal Employees	($424,509)	($96,115)
Non Federal Employees	($3,734,210)	($6,783,959)
Graduate Assistants – Tuition Remission	($5,980,058)	($10,996,572)
Post Docs		-0-

These amounts are included in your fixed fringe benefit rates for the fiscal years ending 6/30/2019 and 6/30/2020 which are listed in the attached Rate Agreement. The grantee added a post doc fringe rate effective 7/1/2019. The fixed rate(s) for fiscal year ended 6/30/2017 and 6/30/2018 are considered final.

A Fringe Benefit cost proposal, together with supporting information and the certified audit financial statement, is required each year. Thus, your next Fringe Benefit cost proposal based on actual costs for the fiscal year ending June 30, 2019 is due in our office by December 31, 2019.

An F&A cost proposal, together with supporting information, are required to substantiate your claim for F&A costs under grants and contracts awarded by the Federal Government. Your next F&A cost proposal for fiscal year ending June 30, 2020 is due in our office by December 31, 2020.

Please submit your proposals electronically to the following email address: CAS-Dallas@psc.hhs.gov.

Since this is an integral part of the Negotiation Agreement, please note your acceptance by signing in the space provided below.

Thank you for your cooperation.

Sincerely,

Arif M. Karim -S
Digitally signed by Arif M. Karim -S
DN: c=US, o=U.S. Government, ou=HHS, ou=PSC, ou=People, cn=Arif M. Karim -S, 0.9.2342.19200300.100.1.1=2000212895
Date: 2019.06.10 09:02:10 -05'00'

Arif Karim
Director
Cost Allocation Services

Enclosures

ACCEPTANCE:

Louisiana State University and A&M College
(Institution)

(Signature)

Daniel T. Layzell
(Name)

Executive Vice President for Finance + Admin./CFO
(Title)

6/14/19
(Date)

COLLEGES AND UNIVERSITIES RATE AGREEMENT

EIN: 1726000848A1

DATE:06/03/2019

ORGANIZATION:

Louisiana State University
330 Thomas Boyd Hall
Baton Rouge, LA 70803-2701

FILING REF.: The preceding agreement was dated 06/22/2018

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section III.

SECTION I: INDIRECT COST RATES

RATE TYPES: FIXED FINAL PROV. (PROVISIONAL) PRED. (PREDETERMINED)

TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
	EFFECTIVE PERIOD				
PRED.	07/01/2017	06/30/2021	48.00	On Campus	Organized Research (1)
PRED.	07/01/2017	06/30/2021	49.00	On Campus	Instruction
PRED.	07/01/2017	06/30/2021	35.00	On Campus	Other Spon. Act.
PRED.	07/01/2017	06/30/2021	40.00	On Campus	Agri. Center
PRED.	07/01/2017	06/30/2021	26.00	Off Campus	All Programs
PROV.	07/01/2021	Until Amended			Use same rates and conditions as those cited for fiscal year ending June 30, 2021.

*BASE

Modified total direct costs, consisting of all salaries and wages, fringe benefits, materials, supplies, services, travel and subgrants and subcontracts up to the first $25,000 of each subgrant or subcontract (regardless of the period covered by the subgrant or subcontract). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, participant support, student tuition remission, rental costs of off-site facilities, scholarships, and fellowships as well as the portion of each subgrant and subcontract in excess of $25,000.

(1) Includes all Pennington Biomedical Research Center Projects.

SECTION I: FRINGE BENEFIT RATES**

TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
FIXED	7/1/2018	6/30/2019	44.00	Main Campus	Main Campus Employee
FIXED	7/1/2018	6/30/2019	33.00	AG Center	Federal Employees
FIXED	7/1/2018	6/30/2019	49.00	AG Center	Non Federal Employees
FIXED	7/1/2018	6/30/2019	35.00	All	Graduate Assistants Tuition Remission
FIXED	7/1/2019	6/30/2020	44.00	Main Campus	Main Campus Employees
FIXED	7/1/2019	6/30/2020	33.00	AG Center	Federal Employees
FIXED	7/1/2019	6/30/2020	51.00	AG Center	Non Federal Employees
FIXED	7/1/2019	6/30/2020	36.00	All	Graduate Assistants Tuition Remission
FIXED	7/1/2019	6/30/2020	22.00	All	Post-Doctoral Researchers
PROV.	7/1/2020	6/30/2023			Use same rates and conditions as those cited for fiscal year ending June 30, 2020.

** DESCRIPTION OF FRINGE BENEFITS RATE BASE:

Salaries and wages.

SECTION II: SPECIAL REMARKS

TREATMENT OF FRINGE BENEFITS:

The fringe benefits are charged using the rate(s) listed in the Fringe Benefits Section of this Agreement. The fringe benefits included in the rate(s) are listed below.

TREATMENT OF PAID ABSENCES

Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages and are claimed on grants, contracts and other agreements as part of the normal cost for salaries and wages. Separate claims are not made for the cost of these paid absences.

OFF-CAMPUS DEFINITION: For all activities performed in facilities not owned by the institution and to which rent is directly allocated to the project(s) the off-campus rate will apply. Grants or contracts will not be subject to more than one F&A cost rate. If more than 50% of a project is performed off-campus, the off-campus rate will apply to the entire project.

FRINGE BENEFITS:

Main Campus-
Group Medical & Life Insurance
Medicare Contribution, Social Security
La. State Retirement System, TIAA-CREF Matching Retirement
Teachers' Retirement System
Unemployment Compensation, Workers' Compensation
Termination Pay, Sabbatical Leave
Optional Retirement Plan
Employee Tuition Exemption Program
LA Deferred Comp.457 Plan
LA School Employees Retirement System
Graduate Assistant Tuition Exemption Program

Agriculture Centers-
Group Medical & Life Insurance
Medicare Contribution
Unemployment Compensation, Workers' Compensation
Social Security
Termination Pay, Sabbatical Leave
Graduate Assistant Tuition Exemption Program

Non-Federal employees:
LA State Retirement System
TIAA-CREF Matching Retirement
Teachers' Retirement, Optional Retirement Plan

Federal Employees:
Federal Civil Service Retirement

Per 2 CFR 200.414(g) - A rate extension has been granted.

*This rate agreement reflects the new fringe benefit rates only. *

Next Proposal Due:

The next F&A cost proposal based on actual costs for the fiscal year ending 06/30/2020 is due in our office by 12/31/2020.

The next fringe benefit cost proposal based on actual costs for the fiscal year ending 06/30/2019 is due in our office by 12/31/2019.

Equipment means tangible personal property (including information technology systems) having a useful life of more than one year and a per-unit acquisition cost which equals or exceeds the lesser of the capitalization level established by the non-Federal entity for financial statement purposes, or $5,000.

SECTION III: GENERAL

A. LIMITATIONS:

The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its facilities and administrative cost pools as finally accepted: such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as facilities and administrative costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. ACCOUNTING CHANGES:

This Agreement is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from facilities and administrative to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES:

If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES:

The rates in this Agreement were approved in accordance with the authority in Title 2 of the Code of Federal Regulations, Part 200 (2 CFR 200), and should be applied to grants, contracts and other agreements covered by 2 CFR 200, subject to any limitations in A above. The organization may provide copies of the Agreement to other Federal Agencies to give them early notification of the Agreement.

E. OTHER:

If any Federal contract, grant or other agreement is reimbursing facilities and administrative costs by a means other than the approved rate(s) in this Agreement, the organization should (1) credit such costs to the affected programs, and (2) apply the approved rate(s) to the appropriate base to identify the proper amount of facilities and administrative costs allocable to these programs.

BY THE INSTITUTION:

Louisiana State University

(INSTITUTION)

(SIGNATURE)

Daniel T. Layzell

(NAME)

Executive Vice President for Finance & Admin. / CFO

(TITLE)

6/14/19

(DATE)

ON BEHALF OF THE FEDERAL GOVERNMENT:

DEPARTMENT OF HEALTH AND HUMAN SERVICES

(AGENCY)

Arif M. Karim -S Digitally signed by Arif M. Karim -S DN: c=US, o=U.S. Government, ou=HHS, ou=PSC, ou=People, cn=Arif M. Karim -S, 0.9.2342.19200300.100.1.1=2000212895 Date: 2019.06.10 09:03:11 -05'00'

(SIGNATURE)

Arif Karim

(NAME)

Director, Cost Allocation Services

(TITLE)

6/3/2019

(DATE) 4114

HHS REPRESENTATIVE: Tyra Tallie

Telephone: (214) 767-3261

NWS Checklist for Submitting a COMET Outreach Proposal

Actions Before Proposal is Submitted to COMET	**YES**	**NO**	**DATE**
1. Did NWS office staff and university staff meet to discuss and form outline and scope of project?	X		6/6/19
2. Did NWS office consult Scientific Services Division (SSD) staff?	X		12/11/19
3. Was Statement of Work and budget formulated as a team effort between university and NWS staffs?	X		12/1/19
4. Was proposal submitted to SSD for review?	X		12/18/19
5. Did SSD forward copies of proposals dealing with WSR-88D data to Radar Operations Center (ROC), Applications Branch Chief for review?	N/A		
6. Did SSD forward copies of proposals dealing with hydrometeorology to the Senior Scientist of OHD for review?	N/A		
7. Did SSD review the data request for project to ensure its scope and criticality for proposal?	X		1/10/20
8. Is all data for the project being ordered by NWS offices through the National Climatic Data Center's (NCDC) Research Customer Service Group free of charge?	X		N/A
9. Does budget include publication charges and travel costs for NWS employees to present results at scientific conferences?		X	N/A
10.Does budget separate NWS costs into fiscal year costs and university costs into calendar year costs?	X		N/A
11.Does proposal include a separate justification for university hardware purchases which are usually not funded by the COMET Outreach Program?	N/A		
12. Have the following people signed off on the proposal cover sheet: - MIC/HIC? - SSD Chief? - Regional Director?	X		1/10/20
13. Is a letter of endorsement signed by regional director attached?	X		1/28/20

NWS Checklist for Submitting a COMET Outreach Proposal

Actions after Endorsement by NWS	**YES**	**NO**	**DATE**
1. University submits proposal to the COMET Program.			
2. Proposal acknowledgment letter sent by the COMET Program to submitting university with copies to SSDs and NWS office.			
3. COMET review of proposal (internal review for Partners Project proposals and formal review for Cooperative Project proposals).			
4. The COMET Program sends acceptance, rejection, or modification letters to university with copies to SSD, NWS office, and OST12.			
5. The COMET Program allocates funds for university.			
6. OST12 obligates funds for NWS offices.			
7. SSD/NWS office orders data from NCDC.			
8. NWS office or SSD calls OST12 for accounting code for expenses.			
9. NWS office sends copies of all travel vouchers and expense records to OST12.			
10. NWS office or SSD sends copies of publication page charge forms to OST12.			
11. NWS office keeps SSD informed of progress on the project and any results or benefits derived from the project.			

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE SOUTHERN REGION
819 Taylor Street, Room 10E09
Fort Worth, TX 76102

Ms. Lorrie Alberta
COMET Outreach Program Administrator
University Corporation for Atmospheric Research
P.O. Box 3000
Boulder, CO 80307-3000

Dear Ms. Alberta,

We have reviewed the COMET Partners Project proposal between Louisiana State University and the National Weather Service (NWS) Office in Slidell (New Orleans), Louisiana, entitled "Empirical Probability of Precipitation (PoP) in Weakly Forced Events." This proposal is being submitted in response to the 2019 COMET Outreach Program Partners Project announcement. The proposal intends to build upon prior research and incorporate new techniques to improve the probability of precipitation forecasts within weakly forced events. These events are most common in the warm season when localized heavy rain and isolated severe storms result in impacts to local communities. Thus, improving the prediction and characterization of these events is highly valuable for much of the gulf coast region. In addition, the project methodologies can be used as a template for other weather service offices even if they not frequently impacted by weakly forced convective events.

WFO Slidell is located a relatively short drive from Louisiana State University and there are ample opportunities for collaborative growth between the two entities. Thus, Southern Region Headquarters fully supports this partner project proposal and hopes the COMET Outreach Program strongly considers this proposal for funding.

Sincerely,

Steven G. Cooper 1/28/2020

Steven G. Cooper
Director, Southern Region HQ