Ferguson 2015-16 Related Activities

1. LoCo paper in JHM

Song, H.-J., C.R. Ferguson, and J.K. Roundy (2016), Land-atmosphere coupling at the Southern Great Plains Atmospheric Radiation Measurement (ARM) field site and its role in anomalous afternoon peak precipitation, J. Hydrometeor., doi:10.1175/JHM-D-15-0045.1.

2. 2015 DOE-ARM Enhanced Soundings for Local Coupling Studies (ESLCS) Final Report

Ferguson CR, JA Santanello, and P Gentine. 2016. Enhanced Soundings for Local Coupling Studies Field Campaign Report. Ed. by Robert Stafford, DOE ARM Climate Research Facility. DOE/SC-ARM-16-023.

3. NA RHP Organizing Committee Member, Early Career Outreach Coordinator: New Video Competition

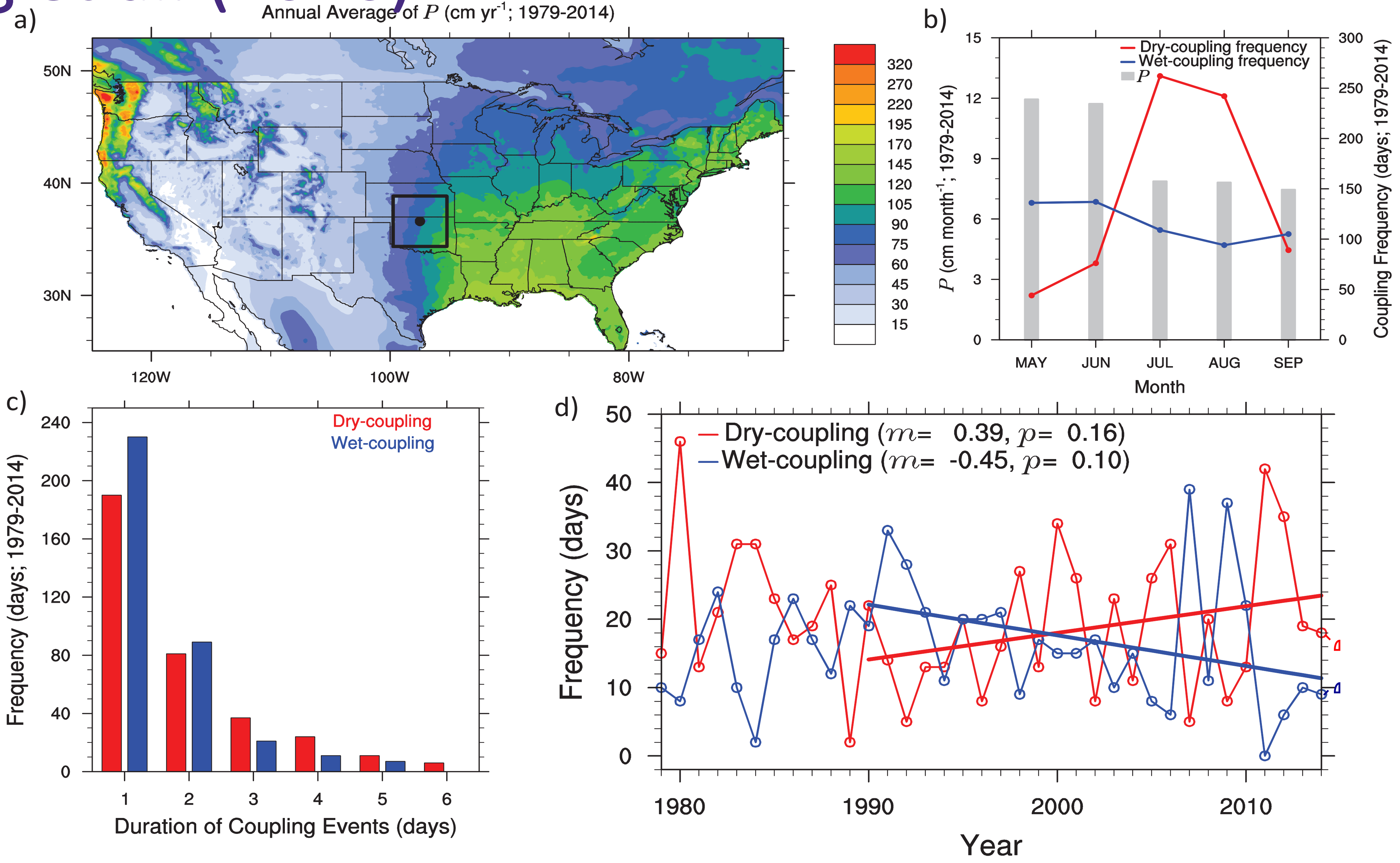
4. New York State Mesonet Soil Instruments Mentor: soil textural classification ongoing.

5. NASA SMAP proposal selected: “2016-19: The Role of Soil Moisture in Weather Predictability”

UNIVERSITY AT ALBANY
State University of New York

Craig R. Ferguson
Atmospheric Sciences Research Center, University at Albany, State University of New York, Albany, NY, USA

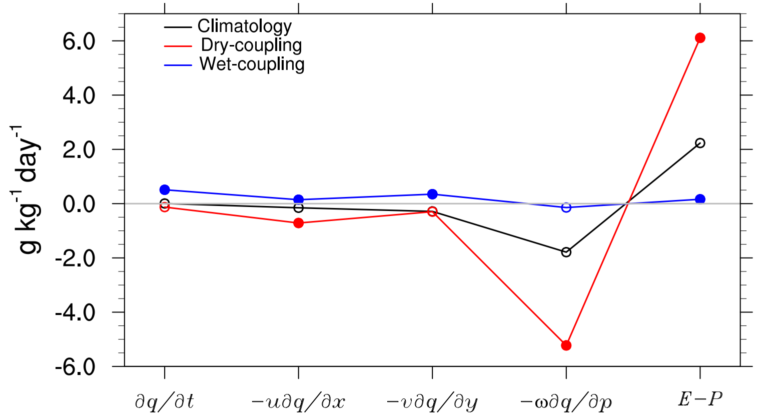
Song et al. (2016)



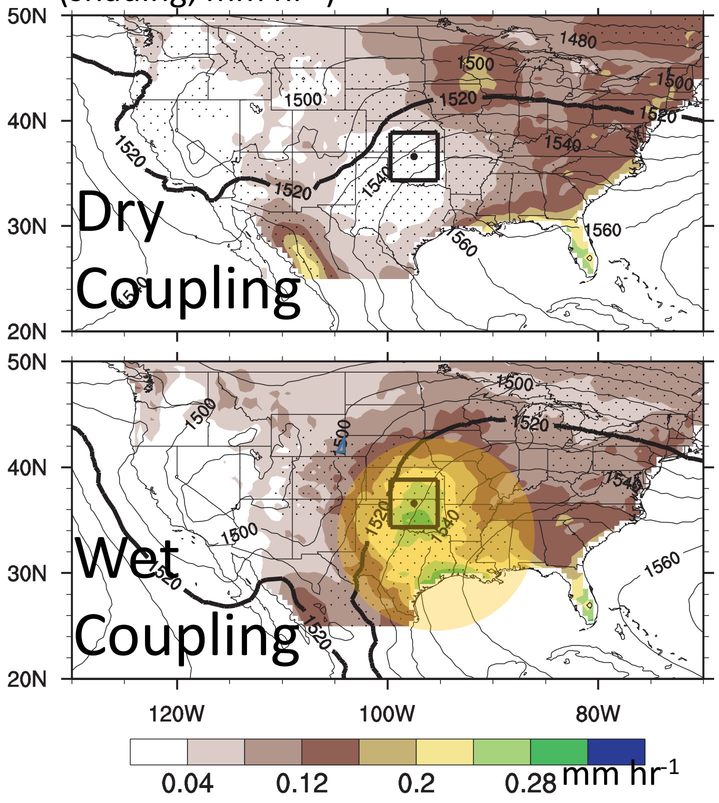
Results:
Synoptic-scale

Regime composites for the 24 h period preceding CTP-HI event classification for the SGP domain (0600 CST Day -1 to 0500 CST Day 0)

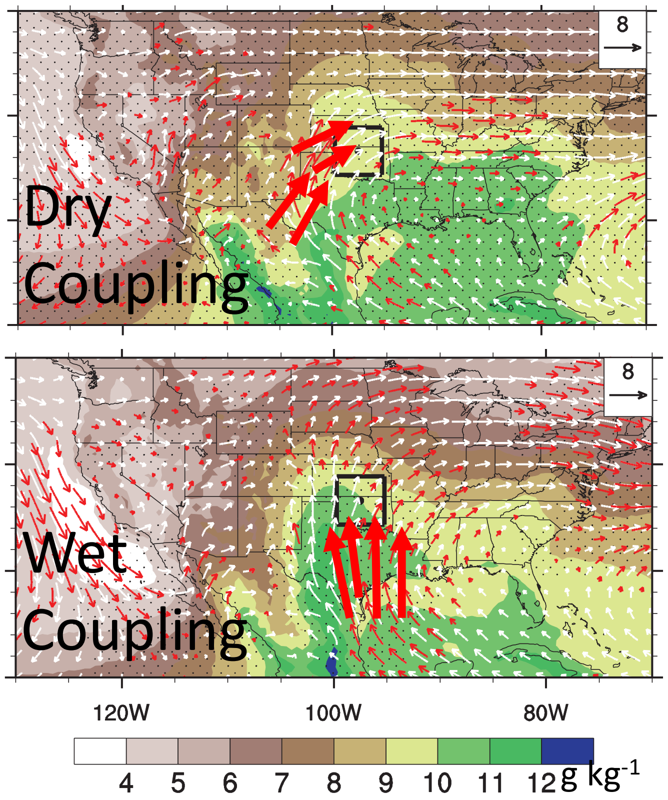
975-700 hPa 1-Day Lead Moisture Budget



1-day lead 850 hPa z (contours, m) and P (shading; mm hr^{-1})



1-day lead 850 hPa v (vectors, m s^{-1}) and q (shading; g kg^{-1})



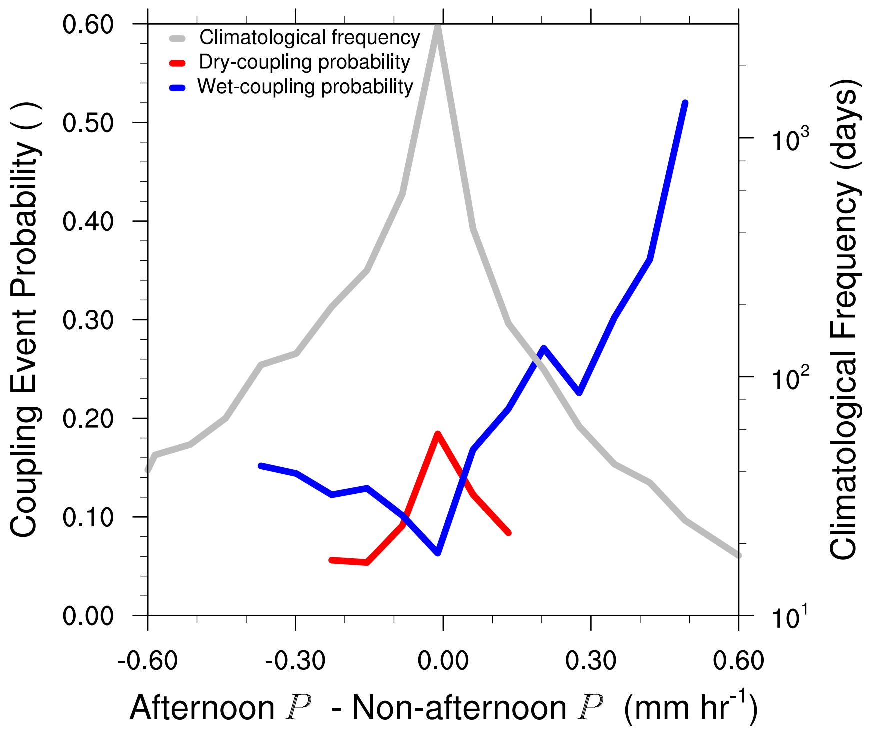
Legend

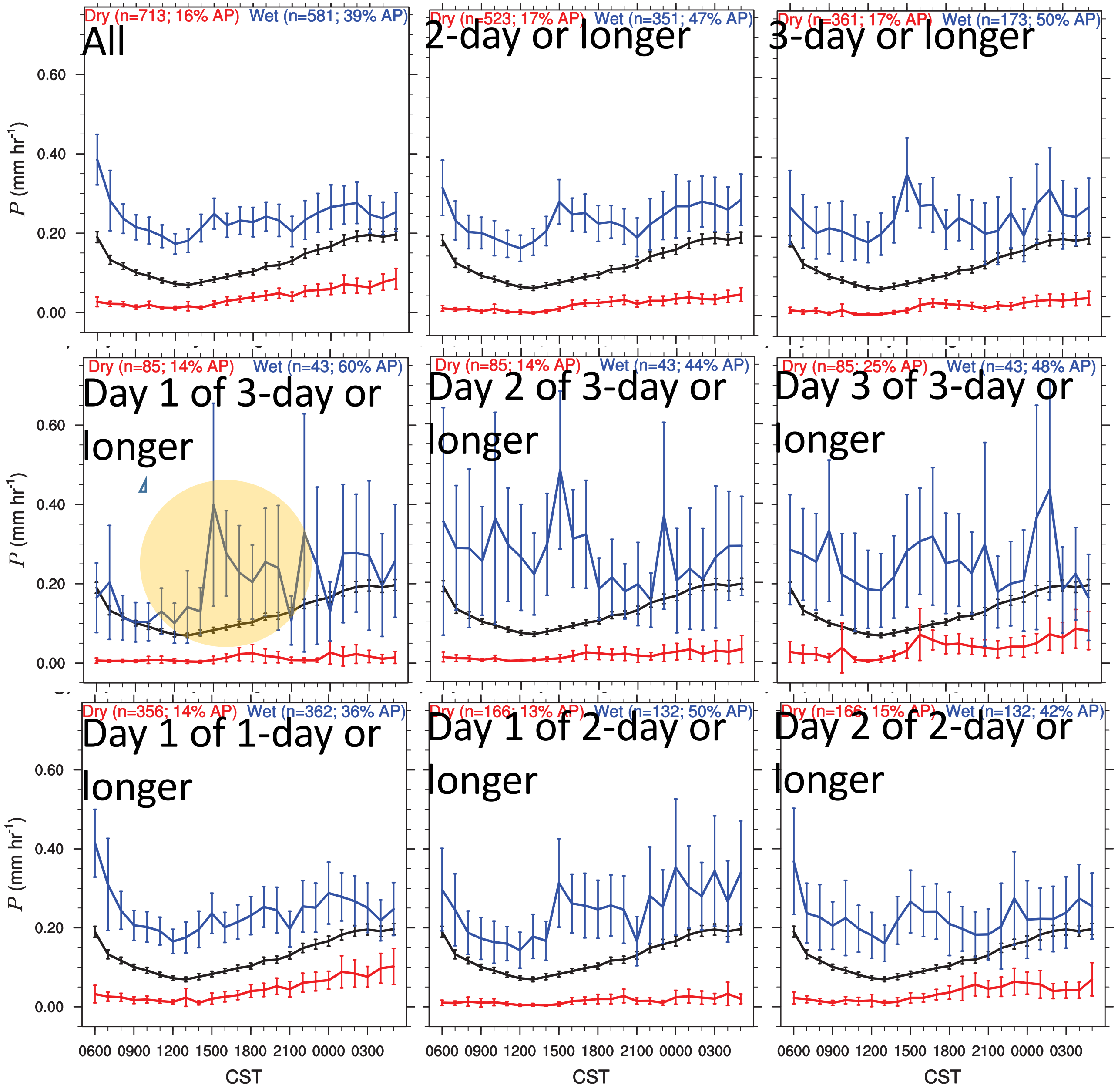
Difference from climatology is significant at 95% CI

Results: local scale

Afternoon Peak (AP) precipitation day

Afternoon P (1400-1900 CST) is greater than non-afternoon P (0600-1300 CST Day 0 and 2000 CST Day 0 to 0500 CST Day 1)





Results: local-scale

Identify explanatory variables of AP occurrence and magnitude

Total sample

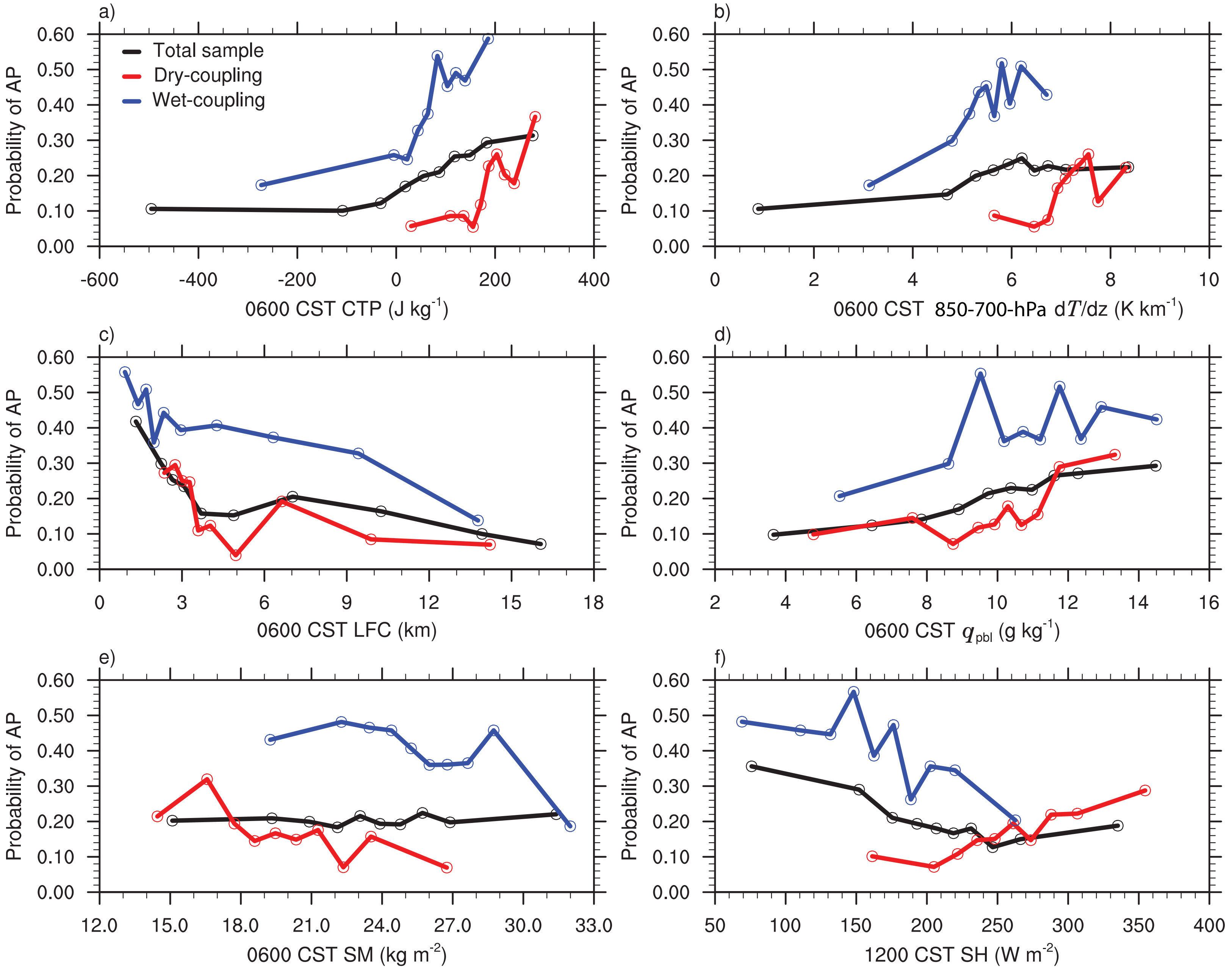
Conditional sample means

Variable (units)	Sample					
	All days (n=5424)	**All days w/AP (n=1104)**	Dry-coupling days (n=713)	**Dry-coupling days w/AP (n=118)**	Wet-coupling days (n=581)	**Wet-coupling days w/AP (n=230)**
0600 CST CAPE (J kg^{-1})	653.9	**708.0**	608.3	**713.6**	575.6	614.3
0600 CST CTP (J kg^{-1})	46.1	**93.4**	175.9	**207.7**	66.7	**88.7**
0600 CST 850-700-hPa d*T*/dz (K km^{-1})	5.9	**6.1**	7.1	**7.3**	5.5	**5.7**
0600 CST PBLH (km)	0.6	0.6	0.6	0.6	0.6	0.5
0600 CST CIN (J kg^{-1})	151.6	**116.7**	240.6	**211.3**	50.8	48.2
0600 CST LCL (km)	1.4	**1.1**	1.6	1.6	0.7	**0.6**
0600 CST LFC (km)	6.6	**4.7**	5.5	**4.3**	4.5	**3.5**
0600 CST HI_{low} (K)	15.5	**12.5**	22.7	**21.4**	6.3	6.0
0600 CST q_{PBL} (g kg^{-1})	9.6	**10.4**	9.8	**10.5**	10.8	**11.1**
0600 CST PWV (kg m^{-2})	16.8	**15.9**	17.4	17.5	16.6	15.2
1200 CST SH (W m^{-2})	211.1	**197.4** ↓	256.2	**272.7** ↑	167.5	**157.6** ↓
1200 CST LH (W m^{-2})	241.1	**235.9**	227.3	**207.9**	243.7	237.9
1200 CST EF	0.5	**0.5**	0.5	**0.4**	0.6	0.6
0600 CST SM (kg m^{-2})	23.3	23.4	20.1	**19.1**	25.6	**25.1**
1200 CST *A* (W m^{-2})	452.2	**433.2**	483.5	480.6	411.1	**395.5**
0000 CST v_{850} (m s^{-1})	3.0	**3.6**	3.0	3.6	3.7	4.2
0000 CST NLLJ index (m s^{-1})	8.3	8.4	8.4	8.8	6.8	7.0

Legend: Bold: significantly different from parent same at 95% confidence level; Orange highlight: AP-only sample mean differs significantly from parent in both dry (red) and wet coupling (blue).

Results: local-scale

AP probabilities across the distribution of identified explanatory variables



Results: 2015 DOE-ARM-SGP Enhanced Soundings for Local Coupling Studies Field Campaign

PI's: Craig Ferguson, Joseph Santanello, and Pierre Gentine
https://www.arm.gov/campaigns/sgp2015eslcs

On 12 IOP days:
daytime 1-hourly radiosondes with 10-minute 'trailer' radiosondes every 3-h

Objectives:

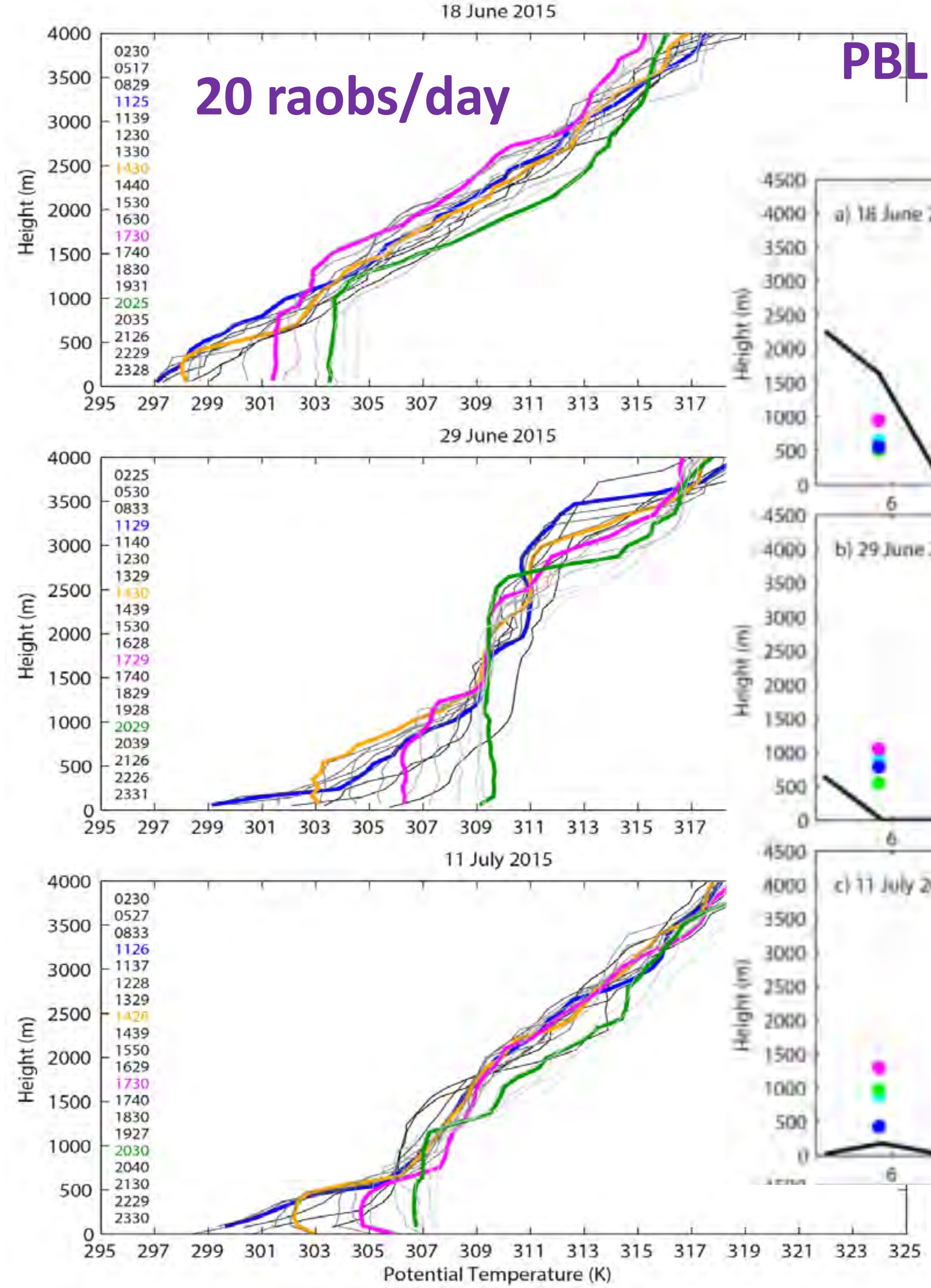
1. How well does the existing suite of instruments at ARM-SGP capture land-atmosphere interactions (in space and time)?(Gap Analysis)

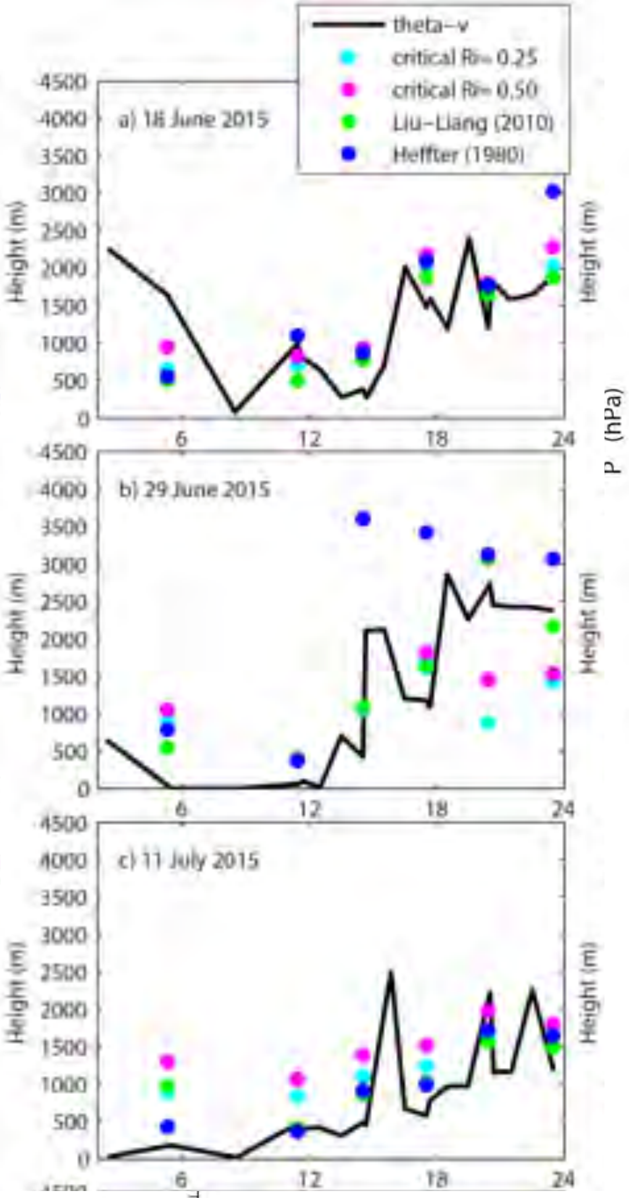
2. Could we forecast local land-induced convective triggering/ afternoon peak rainfall?

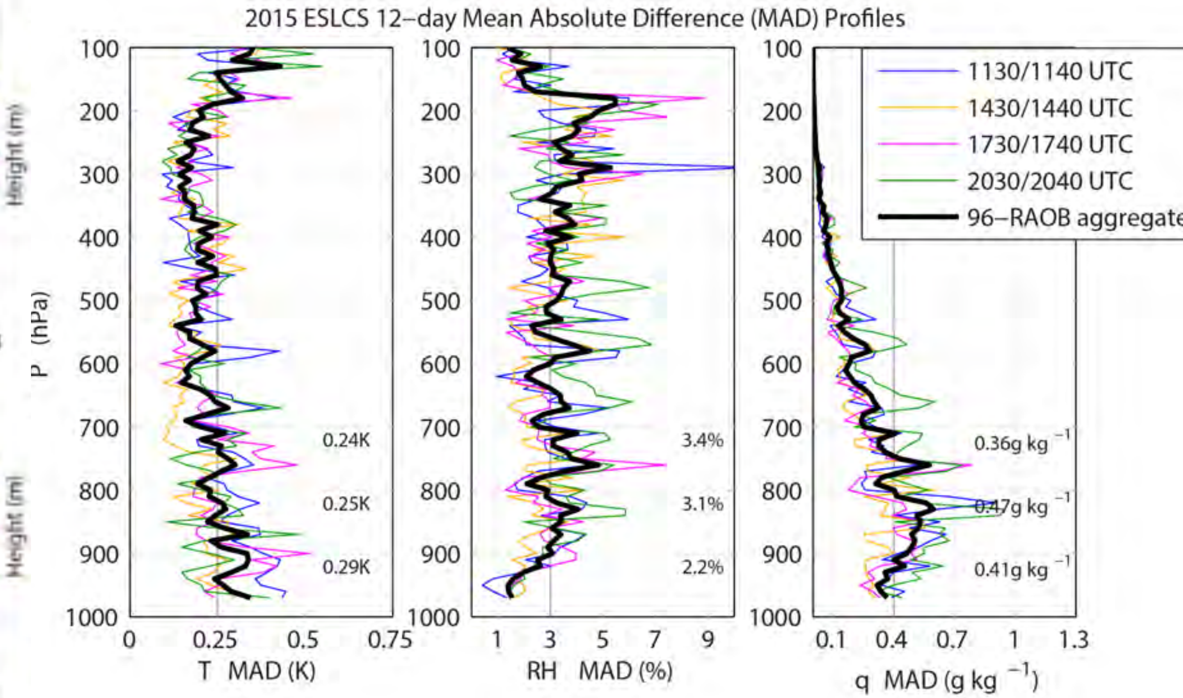
PBLh estimates

https://www.arm.gov/campaigns/sgp2015eslcs

10min measurement uncertainty







Redirecting LoCo to better serve the GEWEX Grand Challenges: a program review

Craig R. Ferguson
Atmospheric Sciences Research Center, University at Albany, State University of New York, Albany, NY, USA

Motivation

GLASS and the global modeling community are transitioning from coarse off-line and coupled ocean-atmosphere simulations to hyper resolution and fully-coupled earth system models, respectively. Never before has the need for LoCo input been more critical for the model development cycle.

Now is an opportune time for LoCo to revisit past efforts and agree on continued and new priorities that will ensure LoCo's effectiveness, scientific impact, and fit within GLASS and overarching GEWEX GC's.

Perceived LoCo roadmap

1. Propose and explore candidate L-A coupling metrics
2. Make global maps! (establish spatio-temporal relevance/context)
3. Identify the mutual and independent information content of metrics, as well as inherent (obs v. models, scale) limitations
4. Recommend a subset (hierarchy) of metrics
5. Translate metric subset to inter-disciplinary community
6. Establish corresponding (obs?) performance benchmarks
7. Facilitate automatic computation and streamline their adaption into operational model evaluation/development cycle, including CMIP6
8. Return to process-level refinement with a focus on attribution of errors (and coupling strength) through focused observational and modeling activities. Rather than a focus on proliferation of additional metrics.
9. Cycle back to #6 with data gap analysis
10. LoCo saves the world from underperforming climate models!

LoCo 2016 review

1. Propose and explore candidate L-A coupling metrics (completed)
2. Make global maps! (establish spatio-temporal relevance/context) (completed)
3. Identify the mutual and independent information content of metrics, as well as inherent (obs v. models, scale) limitations (In progress)
4. Recommend a subset (hierarchy) of metrics (In progress)
5. Translate metric subset to inter-disciplinary community (In progress)
6. Establish corresponding (obs?) performance benchmarks (poor progress)
7. Facilitate automatic computation and streamline their adaption into operational model evaluation/development cycle, including CMIP6 (In progress)
8. Return to process-level refinement with a focus on attribution of errors (and coupling strength) through focused observational and modeling activities. Rather than a focus on proliferation of additional metrics. (poor progress)
9. Cycle back to #6 with data gap analysis (poor progress)
10. LoCo saves the world from underperforming climate models! (poor progress)

LoCo 2016 review

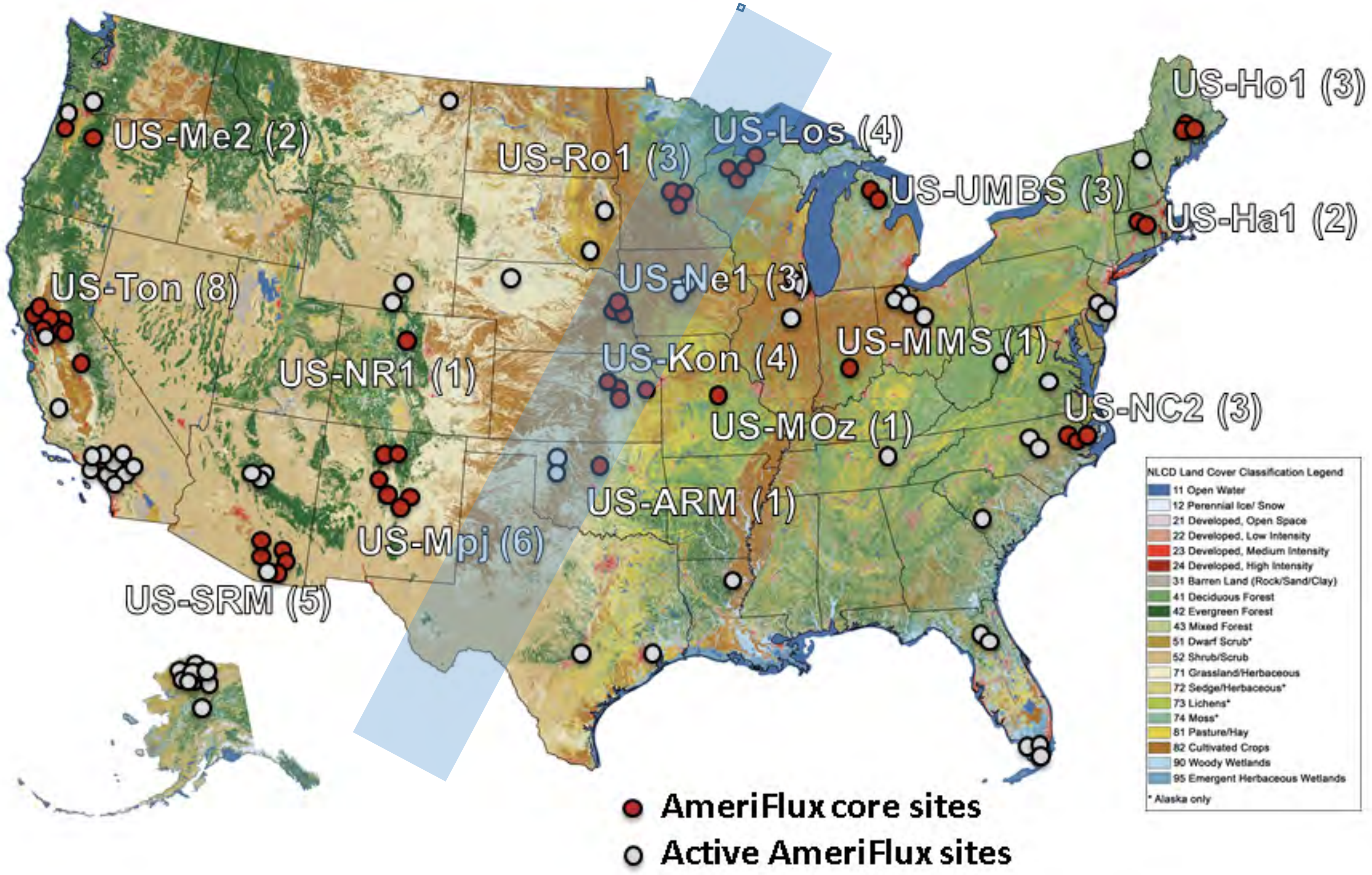
What have we learned?
Is LoCo effective?

Do we have enough metrics to capture L-A coupling information across a sufficient range of spatio-temporal scales?

Are we in a position to recommend (or agree within LoCo/GLASS?) on the required observational suite for L-A coupling verification, i.e. for U.S. RHP deployment OR establish highly instrumented datasets/testbeds (c.f. Mike Ek)?

LoCo Opportunities

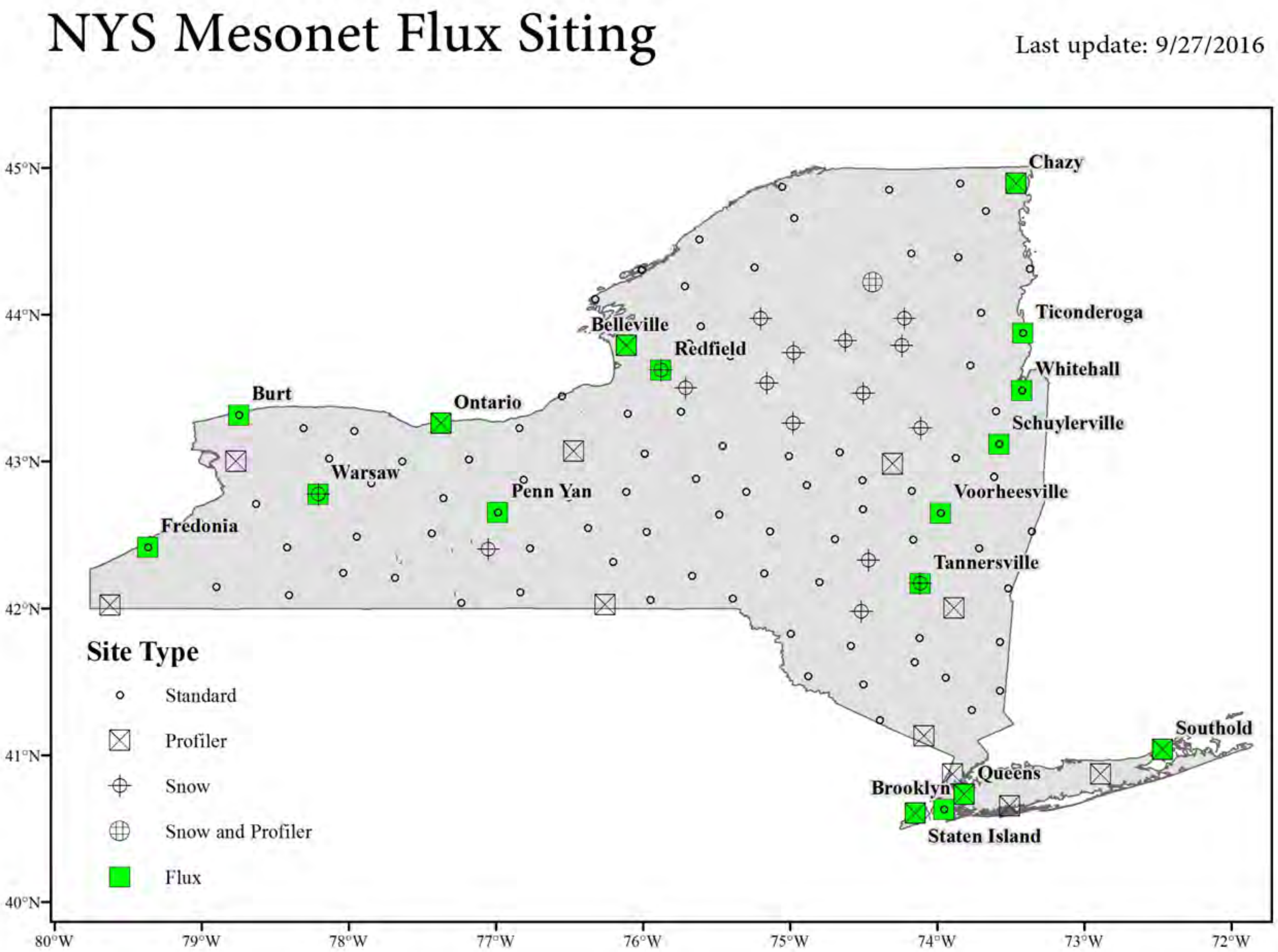
1. NA RHP multi-season LoCo monitoring (Dirmeyer, Ferguson, Basara, Barros, Tawfik)



LoCo Opportunities

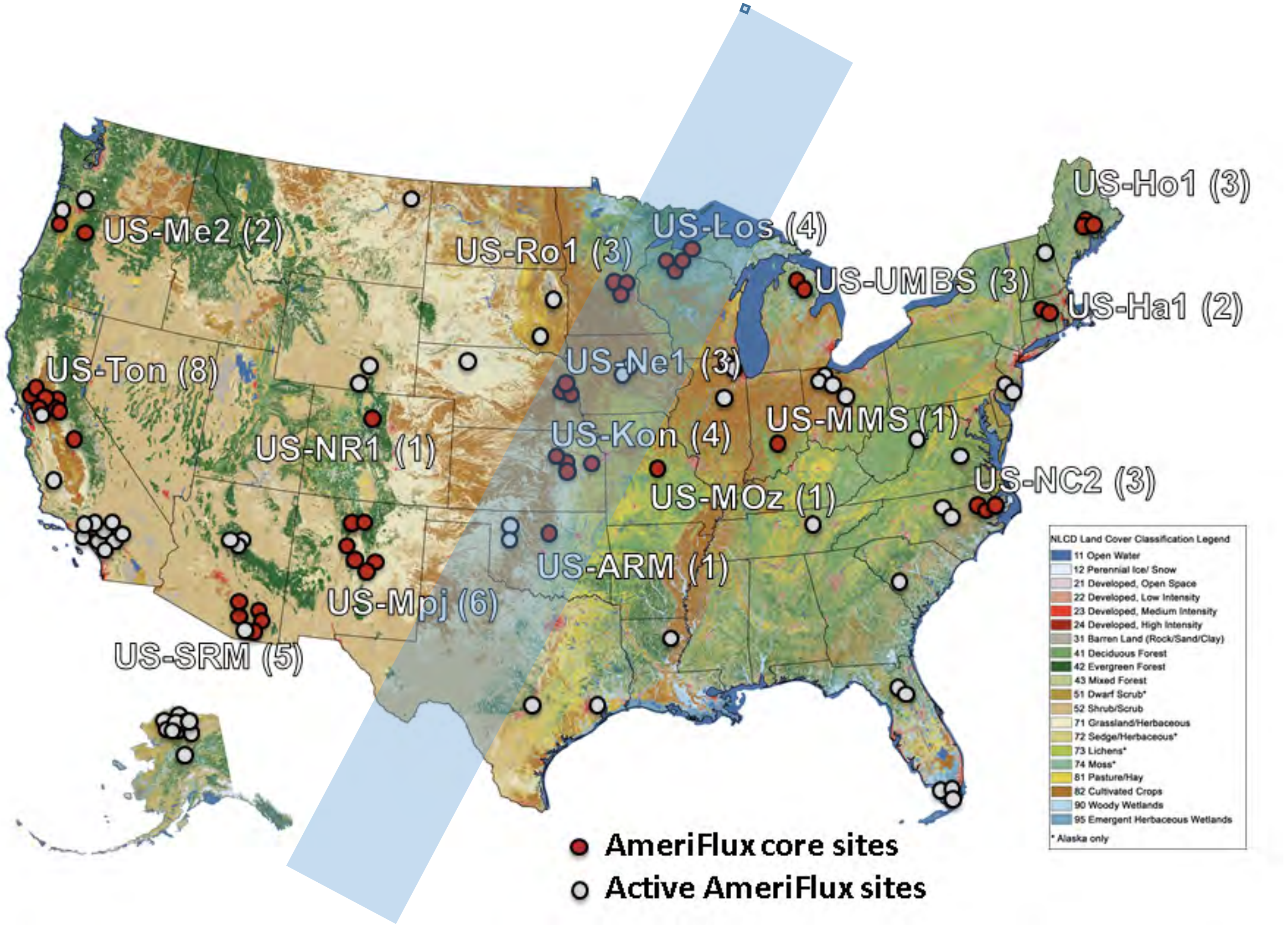
2. NYS LoCo verification of models; prototype for RHP LoCo stations?; PALS?

3. Diagnostic packages to evaluate CMIP6 (incl. LS3MIP, GSWP3)



LoCo Topical foci

- Field-scale impacts on local circulations, including mountain met.;role of natural and human (urban and ag.) land disturbances
- L-A impacts on precipitation predictability (amount, frequency, intensity, diurnal cycle)
- Coupling between local climate and large-scale circulation modes and sensitivity to climate change
- Predictability from seasonal transitions (e.g., A. Betts snow-on/snow-off)



An Integrated Water Availability (WA) Project

Western U.S. WA at intra-seasonal timescales: accounting for direct sfc/gw withdrawal and global warming indirect effects

1. To what accuracy is the current WA and regional water use known?
2. How have/may changes in LULC, including snow cover and phenology, feedback on local and remote WA?
3. What are the key processes and are their sensitivities well modeled?
4. Can we verify process sensitivities through existing observations or a new (i.e. summit to plains) campaign?

Processes:

Global circulation modes
Atmospheric blocking (Arctic warming or tropical source?)
Great Plains low-level jet (LLJ)
Convection and mesoscale convective systems (MCSs)
Mountain meteorology and hydrology
Dynamic vegetation
Land-atmosphere interactions
Water management for agriculture, energy, and tap water

Applications:

Enhanced short-range weather forecasts
Improved flood, drought and heatwave prediction
Informed water, forest, and agricultural management

Tools:

Numerical Weather Prediction models (NWP)
Short range and seasonal forecast system
Satellite retrievals in complex terrain
Integrated water+energy measurements; diurnal PBL T, q, and winds
Data assimilation
Multi-agency OSSE in a cloud?
CMIP-6 DECK and MIPs, incl. Hi-Res

Craig R. Ferguson
Atmospheric Sciences Research Center, University at Albany, State University of New York, Albany, NY, USA

GEWEX U.S. RHP Workshop
3 May 2016

An Integrated Water Availability (WA) Project

Central Valley WA at intra-seasonal timescales: accounting for direct sfc/gw withdrawal and global warming indirect effects

1. To what accuracy is the current WA and regional water use known?
2. How have/may changes in LULC, including snow cover and phenology, feedback on local and remote WA?
3. What are the key processes and are their sensitivities well modeled?
4. Can we verify process sensitivities through existing observations or a new (i.e. summit to plains) campaign?

Processes:

Global circulation modes
Atmospheric rivers
Mountain meteorology and hydrology
Dynamic vegetation
Land-atmosphere interactions
Intensive water management for agriculture, energy, and tap water
Decision making and governance

Applications:

Enhanced short-range weather forecasts
Improved flood, drought and heatwave prediction
Informed water, forest, and agricultural management
Cost/benefit of large-scale desalinization
Social "game theory" case study

Tools:

Numerical Weather Prediction models (NWP)
Short range and seasonal forecast system
Satellite retrievals in complex terrain
Integrated water+energy measurements; diurnal PBL T, q, and winds
Data assimilation
Multi-agency OSSE in a cloud?
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