

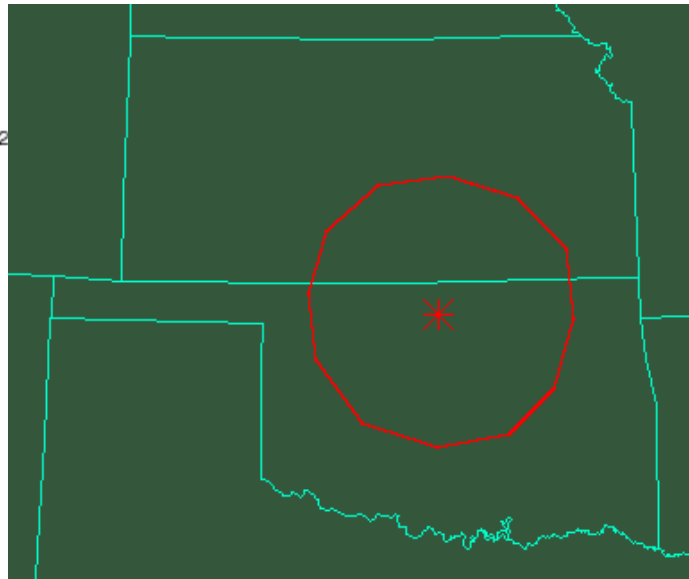
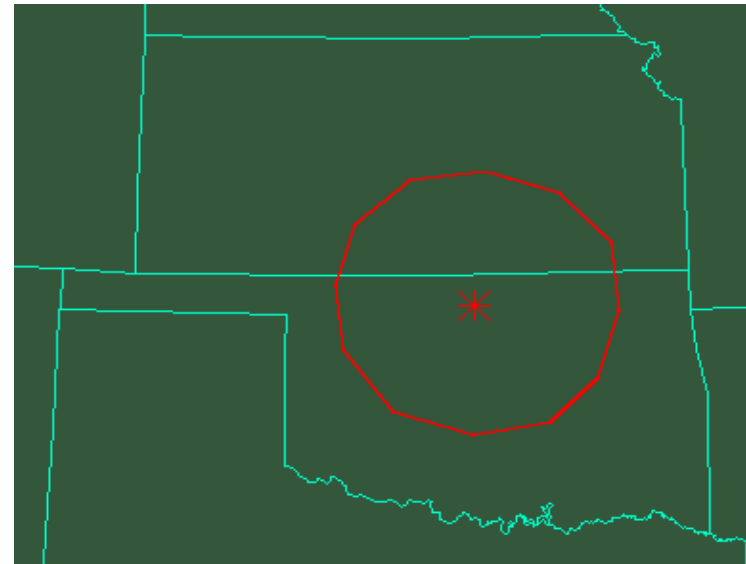
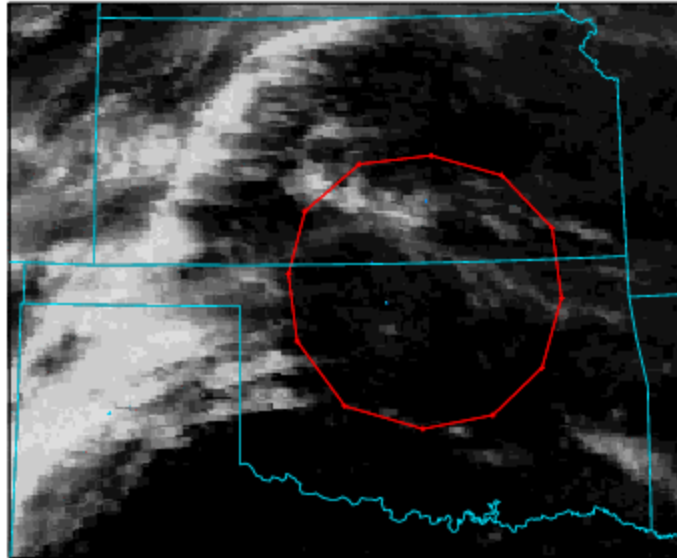
# 1. Update on the FASTER Testbed

- High resolution cloud modeling
- NWP Testbed
- SCM Testbed

# 2. Establishment of Cloud Regimes

*Presented by Wuyin Lin, BNL*

# High Resolution Cloud Modeling at BNL



GOES 8  
Nexrad


WRF3.1  
Nested

SCAM3  
subcols

Long term  
CRM simulation

# NWP Testbed for the FASTER Project

http://faster.arm.gov/ - NWP Testbed for the FASTER Project - Windows Internet Explorer



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## FASTER Project NWP Testbed

### *Model intercomparison for cloud fraction*

This links on this page show comparisons of the performance of various models at forecasting cloud fraction, particularly focusing on skill scores. For more detailed comparisons with the observations for individual models (e.g. mean, frequency of occurrence, amount when present and PDFs), click on the links to "individual models" below.

#### *All available models*

SGP:	<a href="#">Individual models</a>	<a href="#">2004</a>	<a href="#">2005</a>	<a href="#">2006</a>	<a href="#">2007</a>	<a href="#">2008</a>	<a href="#">2009</a>
Darwin:	<a href="#">Individual models</a>		<a href="#">2005</a>	<a href="#">2006</a>	<a href="#">2007</a>	<a href="#">2008</a>	<a href="#">2009</a>

#### *Met Office Global model with different forecast lead times*

SGP:	<a href="#">Individual models</a>	<a href="#">2004</a>	<a href="#">2005</a>	<a href="#">2006</a>		<a href="#">2009</a>
Darwin:	<a href="#">Individual models</a>		<a href="#">2005</a>	<a href="#">2006</a>		<a href="#">2009</a>

#### *NCEP Model with different forecast lead times*

SGP:	<a href="#">Individual models</a>	<a href="#">2004</a>	<a href="#">2005</a>	<a href="#">2006</a>	<a href="#">2007</a>	<a href="#">2008</a>	<a href="#">2009</a>
Darwin:	<a href="#">Individual models</a>		<a href="#">2005</a>	<a href="#">2006</a>	<a href="#">2007</a>	<a href="#">2008</a>	<a href="#">2009</a>

*These pages are maintained by [Ewan O'Connor](#).*

*Return to [Radar Group](#) | [Department of Meteorology](#) | [University of Reading](#)*

# Update of the FASTER's SCM Testbed

---

*Wuyin Lin<sup>1</sup>, Yangang Liu<sup>1</sup>, Yanluan Lin<sup>2</sup>, Audrey Wolf<sup>3</sup>, Roel Neggers<sup>4</sup>*

*1. Brookhaven National Laboratory, 2. GFDL, 3. GISS, 4. KNMI*

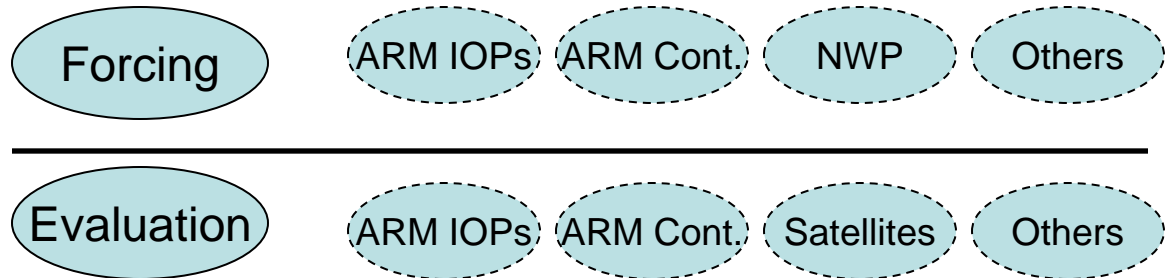
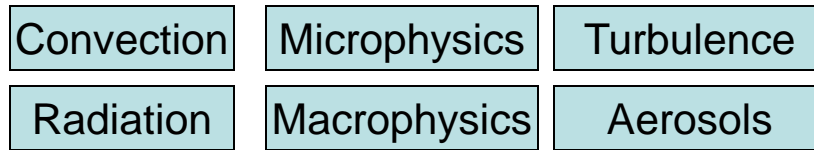
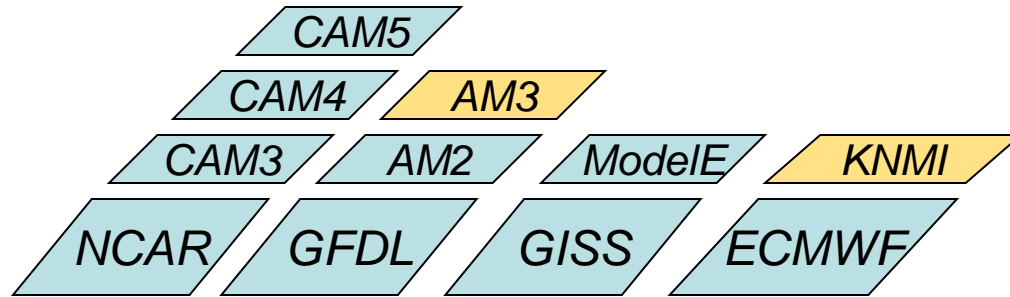
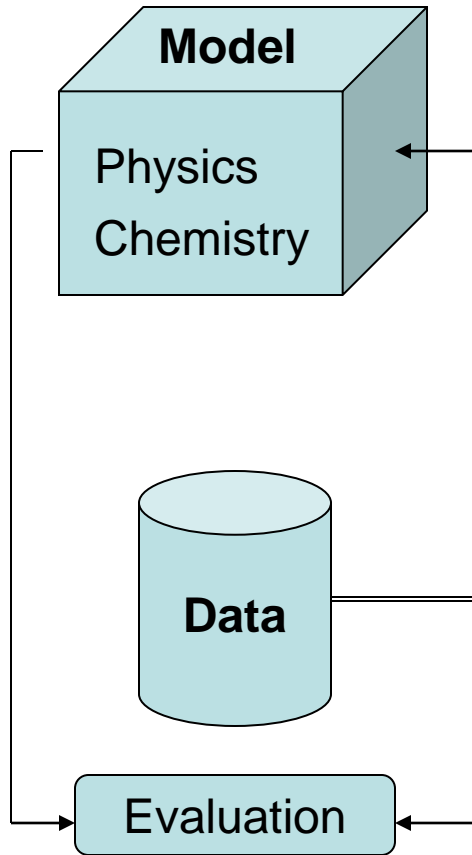
## Outline

- Overview of the design
- Recent Updates
- Demo

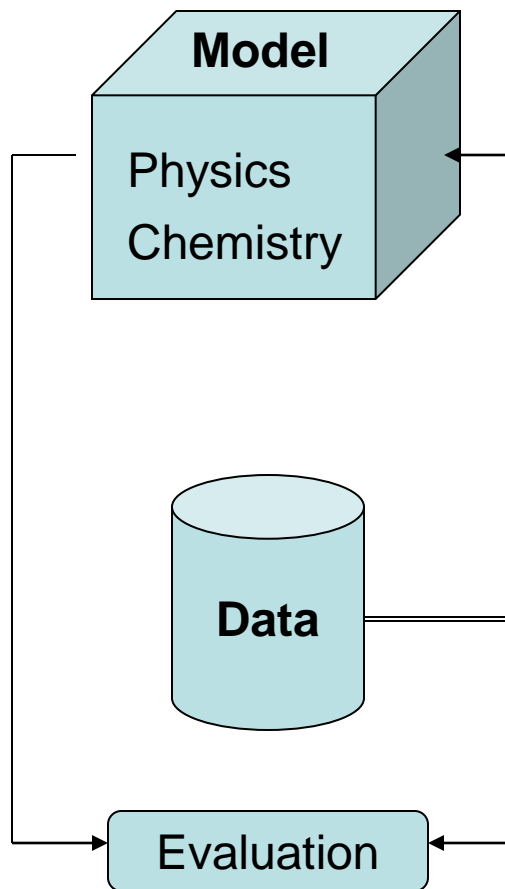
*Special thanks to Shaocheng Xie for providing many valuable inputs and customizing the forcing data for the testbed!*

# FASTER Testbed

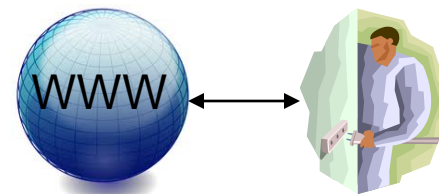
## The Testbed's Essential Components



## FASTER's SCM Testbed



Two modes to interact with the Testbed  
*pull and push*



What, Which, Where, When, and How

Multitasking supported via a  
builtin workflow management

# Fast Physics Testbed for the FASTER Project

Web-based SCM-Testbed, <http://www.bnl.gov/esm>

Select a model [Documentation](#) | [Code Browser](#) | [Specifics](#)

New parameterizations

CAM5/BAM  CAM5/MAM3  CESM/CAM4  CAM4  CAM3.1  GFDL  GISS  CAM Dev

+ Select physics schemes User modules for CAM Dev:

+ More model options

Regime-based simulations

New analysis products

- Select forcing data

IOP  Continuous Forcing  Ensemble Forcing  Regime  User data

Select an IOP

Select the starting time

Select the ending time

ARM SGP Mar. 1999	▲
ARM SGP Jul. 1999	
ARM SGP Mar. 2000	■
ARM SGP Sep. 2000	☰
ARM SGP Nov. 2000	
ARM SGP Nov. 2002	▼

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2000-03-01 19:40:00	▼

+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings


Interactive simulation and evaluation/visualization

# FAST PHYSICS PROJECT

Brookhaven Climate Consortium

Select a **NEW!** Documentation | Code Browser **NEW!** specifics

CAM5/BAM  CAM5/MAM3  CESM/CAM4  CAM4  CAM3.1  GFDL  GISS  CAM Dev







+ Select physics schemes User modules for CAM Dev: C:\Documents and S   

+ More model options







- Select forcing data **NEW!**

IOP  Continuous Forcing  Ensemble Forcing  Regime  User data **NEW!** C:\Documents and Setti

Select the starting time

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2009-06-01 00:40:00   
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2009-06-01 00:00:00   
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2009-06-01 00:40:00   
2009-06-01 01:00:00   
2009-06-01 01:20:00   
2009-06-01 01:40:00 

**NEW!**  
+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings





Fast Physics Project, Brookhaven National Laboratory, BNL - Windows Internet Explorer

**FAST PHYSICS PROJECT**  
Brookhaven Climate Consortium

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### FASTER (FAST-PHYSICS SYSTEM TESTBED AND RESEARCH) Project Brookhaven Climate Consortium

The **FASTER** project arises from the proposal “Continuous Evaluation of Fast Processes in Climate Models Using ARM Measurements” funded by the Department of Energy’s Earth System Modeling (ESM) program. The overarching goal of this project is to narrow uncertainty and biases in GCMs by utilizing continuous ARM measurements to enhance and accelerate evaluation and improvement of parameterizations of fast processes in GCMs involving clouds, precipitation, and aerosols, with six primary objectives:

1. **Construction of a Fast-Physics Testbed** to rapidly evaluate fast physics in GCMs by comparing model results against continuous long-term cloud observations made by the ARM program.
2. **Execution of a suite of CRM simulations** for selected periods/cases to augment the Fast-Physics Testbed. We will run WRFs with different parameterizations as CRMs, CRMs with bin-microphysics, and multi-scale modeling framework.
3. **Continuous evaluation of model performance** to identify and determine model errors by comparing the NWP and SCM results against continuous ARM observations, and to each other. The long-time data record at the ARM sites (e.g., SGP) permits evaluation of various statistical properties (e.g., PDFs) and recurring cloud regimes.
4. **Examination and improvement of parameterizations** of key cloud processes/properties (e.g., convection, microphysics and aerosol-cloud interactions), thus narrowing the range of treatments of fast processes that exert strong influences on model sensitivity so as to better constrain climate sensitivity.

# Fast Physics Testbed for the FASTER Project

Web-based SCM-Testbed, <http://www.bnl.gov/esm>

Select a model [Documentation](#) | [Code Browser](#) | [Specifics](#)

New parameterizations

CAM5/BAM  CAM5/MAM3  CESM/CAM4  CAM4  CAM3.1  GFDL  GISS  CAM Dev

+ Select physics schemes User modules for CAM Dev:

+ More model options

- Select forcing data

Regime-based simulations

New analysis products

IOP  Continuous Forcing  Ensemble Forcing  Regime  User data

Select an IOP

Select the starting time

Select the ending time

ARM SGP Mar. 1999	▲
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2000-03-01 19:40:00	▼

+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings

Interactive simulation and evaluation/visualization

# Establishment of Cloud Regimes for Systematic Cloud Modeling & Evaluation

---

*Wuyin Lin<sup>1</sup>, Yangang Liu<sup>1</sup>, Andy Vogelmann<sup>1</sup>, Hua Song<sup>1</sup>, Dan Lubin<sup>2</sup>*

*1. Brookhaven National Laboratory, 2. Scripps Institution of Oceanography*

## Objectives

- Establish cloud regimes to facilitate regime-based evaluation of model fast physics.
- Achieve a continuous cloud classification in temporal space using a multi-step procedure.
- Explore new use of vast amount of night-time cloud measurements that are underutilized in previous cloud classification study.
- Enrich cloud regimes with cloud system life cycle information.

# The Concept of Cloud Regimes

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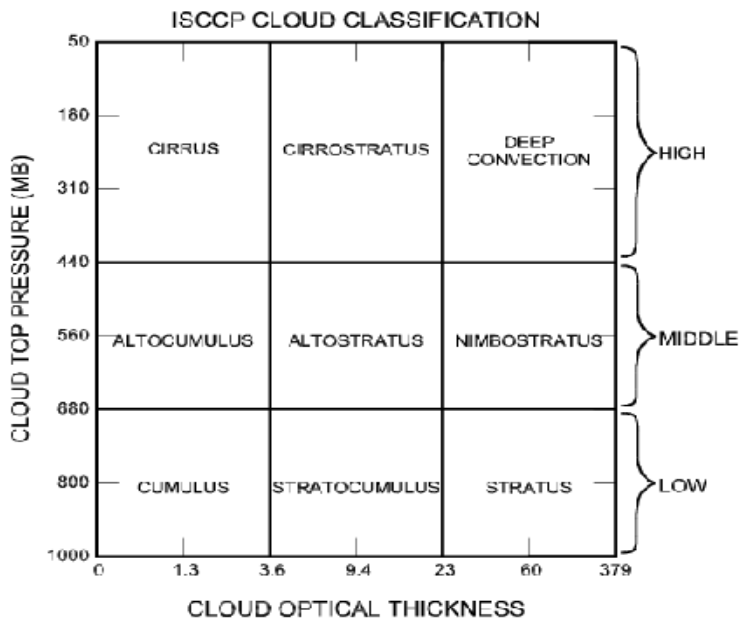
- Clouds of similar microphysical properties, vertical structures mesoscale organizations (hence large scale radiative properties),
- Recurrence in space and time
- Representation of broader (up to global) scales,
- Association with certain meteorological conditions
- In the context of “large scale”. (*with prospect that “large scale” becoming smaller*)

# Methodology and Data

---

- Multi-step classification approach, begin with K-mean clustering technique, to establish cloud regimes and the associated meteorological conditions  
*(esp. large scale forcings, RH and vertical motions).*
- Cloud regimes and meteorological conditions overall have close association.  
*(but may not be one to one correspondence)*  
Top-down classification with clouds or bottom-up with meteorological conditions?
- ISCCP D1 cloud histogram, 3-hourly, 42-cloud typings, (daytime only used here)  
ARM ARSCL cloud frequency profiles  
ARM continuous forcing data (1999-2001) *(coincident IOPs as well)*  
*(esp., large scale forcing, vertical velocity, saturation deficit, stability)*  
ABRFC (Arkansas-Red Basin River Forecast Center) Precipitation (hourly, 4 km x 4km)  
NCEP Reanalysis II Product (spatial meteorological data)

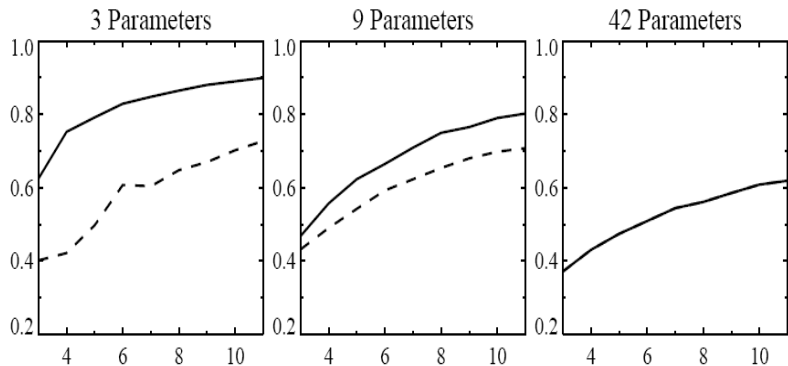
# ISCCP D1 based classification and selection



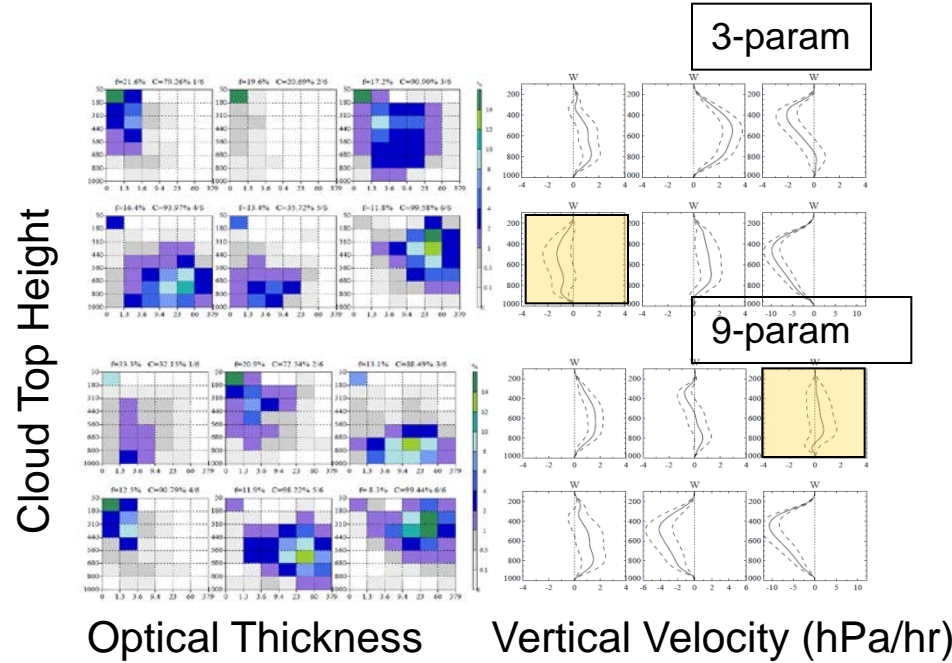
## Classification

Three approaches using cloud properties/statistics derived from daytime ISCCP D1 are explored.

- 42 parameters (full D1 histogram, as in Jakob and Tselioudis 2003)
- 3 parameters (cloud amount, cloud top, reflectivity, as in Gordon et al. 2005)
- 9 parameters (classical cloud types, this study)



Variance explained by number of clusters. Dashed line for classification data. Solid for full D1.



# Extension to ARSCL, cloud regime statistics

## Procedure

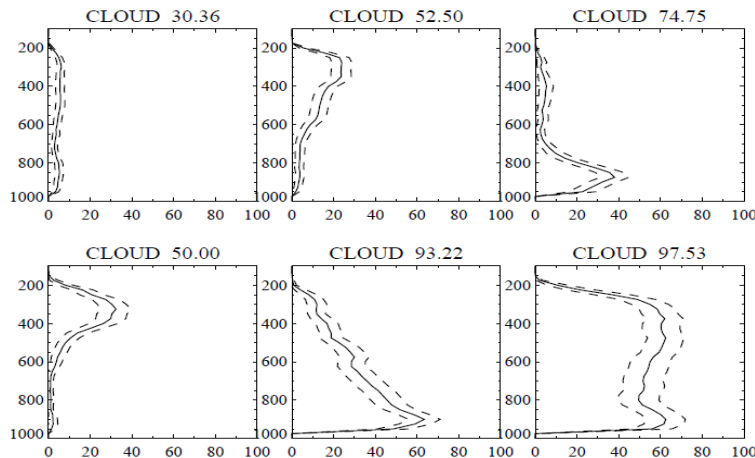
Derive mean ARSCL profiles associated with D1 classes

Continuous classification: map all ARSCL profiles to the mean profiles

Inclusion of 1<sup>st</sup> 3 moments of ABRFC precipitation improve frontal patterns

Inclusion of omega pattern correlation improves St/Sc pattern

Final 42-param pattern correlation: 0.964, 0.985, 0.910, 0.952, 0.945, 0.956



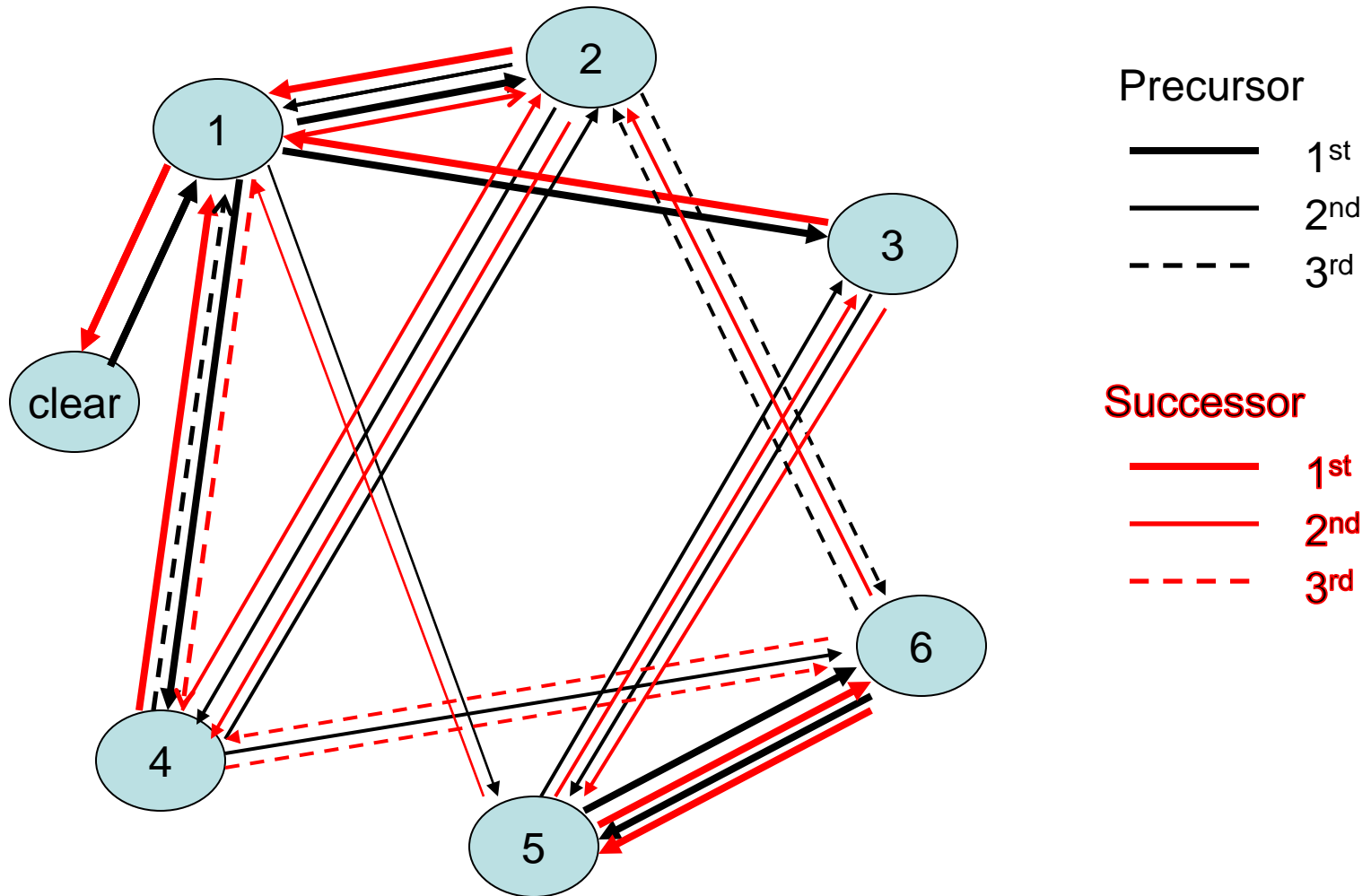
Class	1	2	3	4	5	6
Samples	2763	594	850	1388	806	1012
durations	2.6 /22	1.6/12	3.2/26	3.8/35	2.9/28	4/32

Stat: Sample size, mean and max durations (h) for three cold seasons

ARSCL Profiles corresponding to each cloud regime

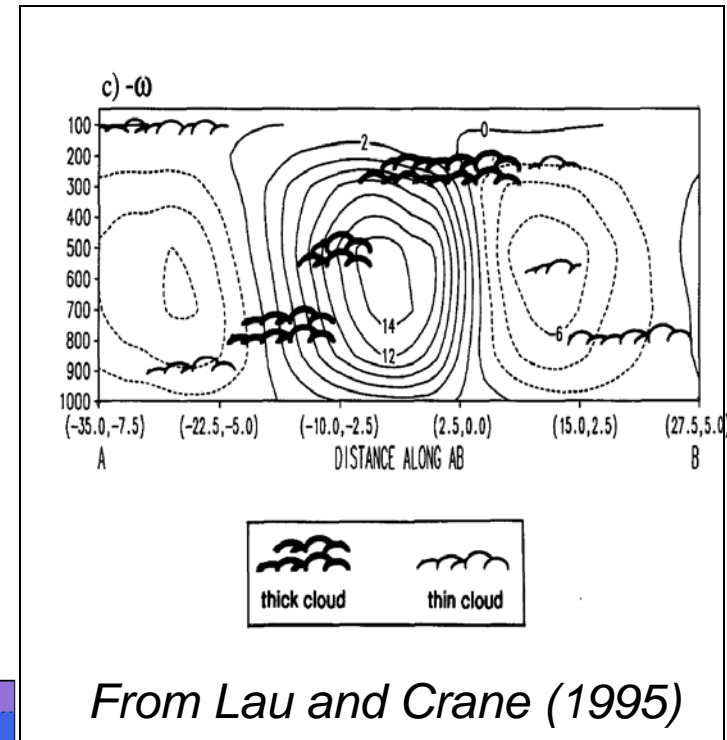
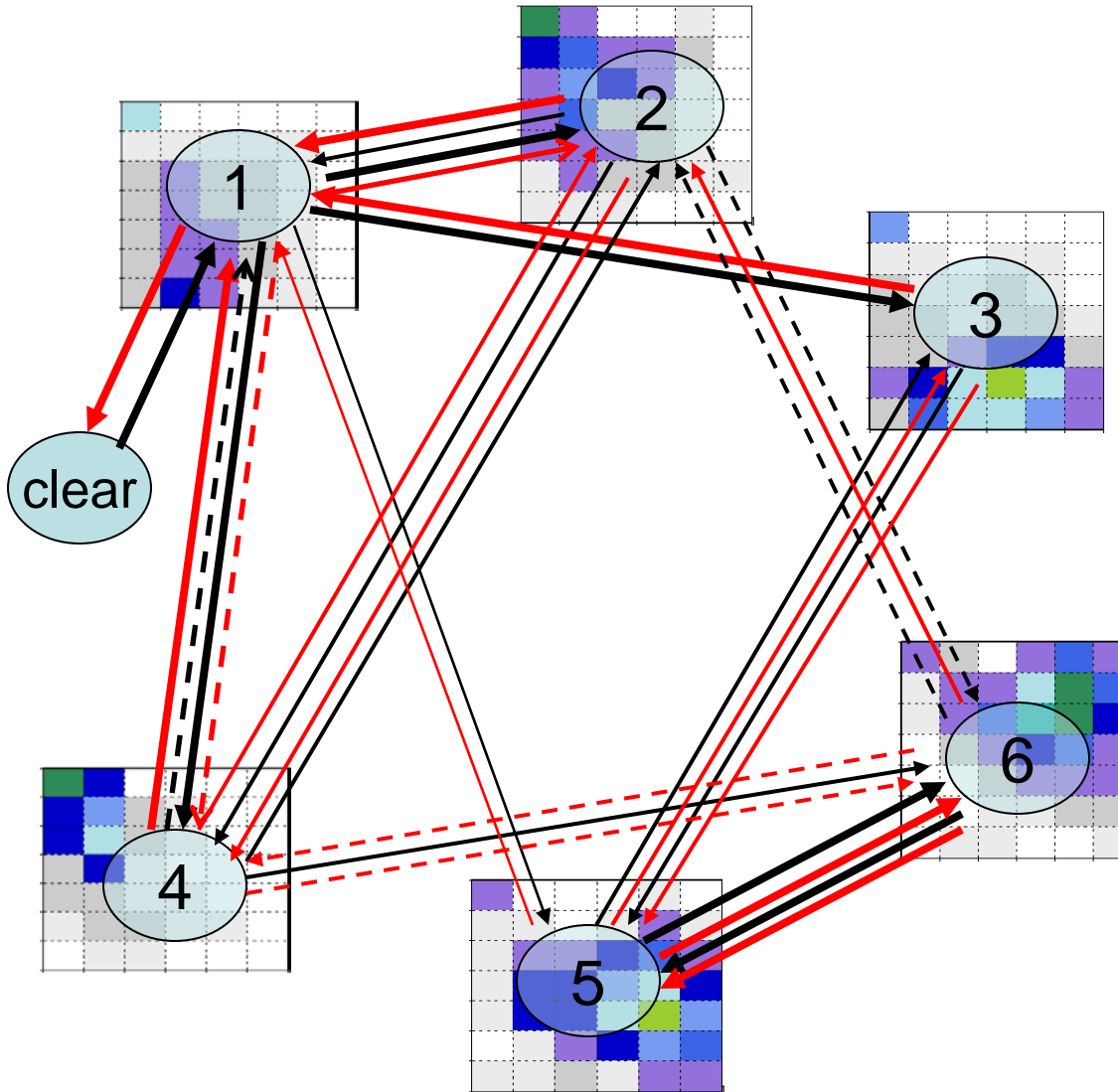


# Cloud Regime Transition Paths

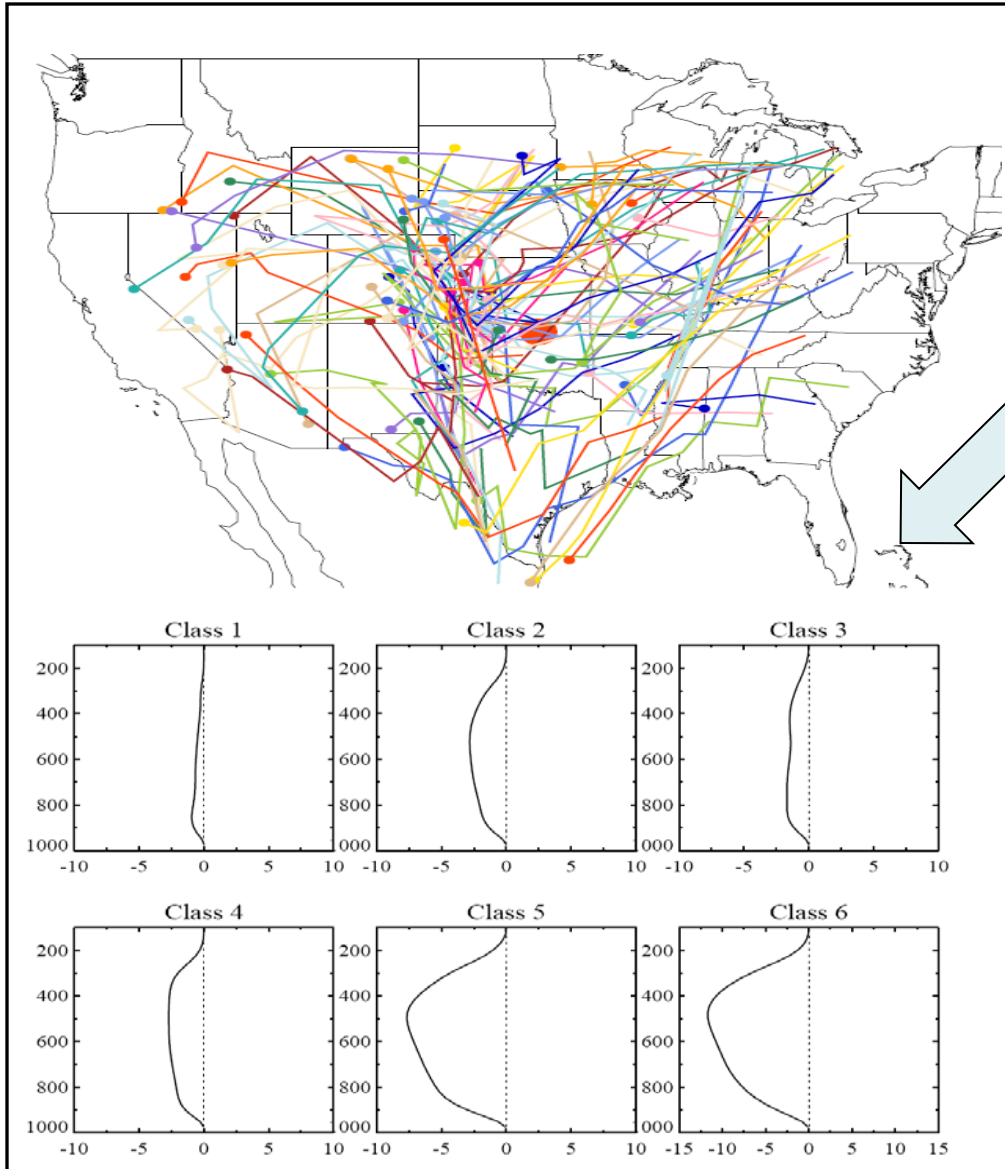




# Cloud Regime Transition Paths and Frontal Cloud Organization

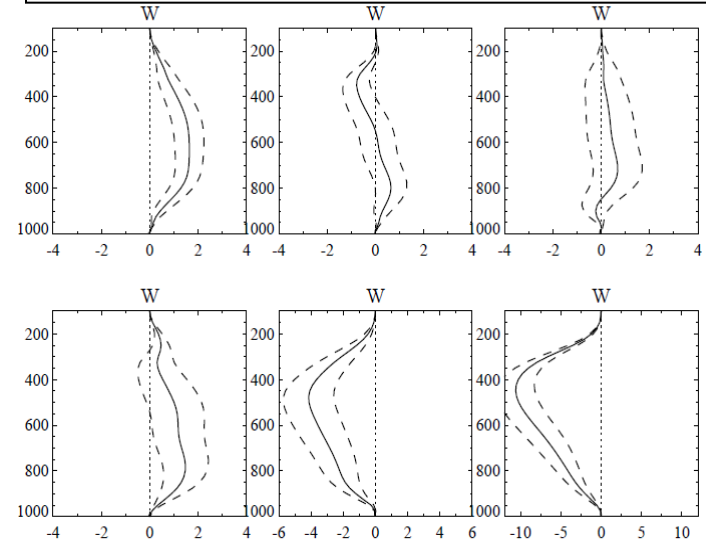


# Cloud regimes under storm influences



Storm tracks (top, use GISS's MCMS) and the vertical velocity associated with each regime (bottom) under storm influence. Storm influence is defined as storm track comes within 1000 km from SGP CF (the big red dot). The small dot shows the starting position of the storms. Note that a significant number of storms initiated within the ARM SGP domain.

Overall mean Vertical velocity for the regimes



# Summary

---

1. Achieve a continuous cloud classification using a multi-step procedure.
2. Establish cloud regimes to facilitate modeling study of clouds of various characteristics

lasting vs. short-lived for each regime,  
various regime transition paths,  
equivalent classical frontal cloud organization,  
with or without influence of organized storms,  
rapidly vs. slowly evolving stormy clouds.

3. Identify storms initiated within SGP, compared to those passing from outside SGP for

modeling & evaluation of cyclogenesis,  
study of relative importance of hydrometeors advection and IC.

Thank you!

*Screenshots for Testbed Demo to Follow*

# FAST PHYSICS PROJECT


Brookhaven Climate Consortium

Screen snapshots for Demo

Select a model [Documentation](#) | [Code Browser](#) | [Specifics](#)

Upload new physics packages

CAM5/BAM  CAM5/MAM3  CESM/CAM4  CAM4  CAM3.1  GFDL  GISS  CAM Dev




+ Select physics schemes User modules for CAM Dev:    

+ More model options




- Select forcing data

IOP  Continuous Forcing  Ensemble Forcing  Regime  User data

Select the starting time

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2009-06-01 01:40:00 

+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings


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## Upload & Build status

CAM5/BAM  CAM5/MAM3  CESM/CAM4  CAM4  CAM3.1  GFDL  GISS  CAM Dev

+ Select physics schemes User modules for CAM Dev: C:\Documents and S   

+ More model options

+ Select forcing data

## Upload new data

IOP  Continuous Forcing  Ensemble Forcing  Regime  User data C:\Documents and Settj

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2009-06-01 01:20:00  
2009-06-01 01:40:00 ▼

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# FAST PHYSICS PROJECT

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Select a model [Documentation](#) | [Code Browser](#) | [Specifics](#)

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Select the ending time

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2009-06-01 00:40:00  
2009-06-01 01:00:00  
2009-06-01 01:20:00  
2009-06-01 01:40:00 ▼

+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings

Simulation and evaluation with new physics/data

**00:00:19**



2009-06-02 09:00:00 ....




# FAST PHYSICS PROJECT

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Select a model [Documentation](#) | [Code Browser](#) | [Specifics](#)

CAM5/BAM  CAM5/MAM3  CESM/CAM4  CAM4  CAM3.1  GFDL  GISS  CAM Dev




+ Select physics schemes User modules for CAM Dev:    

+ More model options




- Select forcing data

IOP  Continuous Forcing  Ensemble Forcing  Regime  User data

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2009-06-01 01:20:00  
2009-06-01 01:40:00 

+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings

Simulation succeeded with new physics/data

00:01:40



[View/download the results.](#)

[Quicklook plots.](#) ....