1. Update on the FASTER Testbed

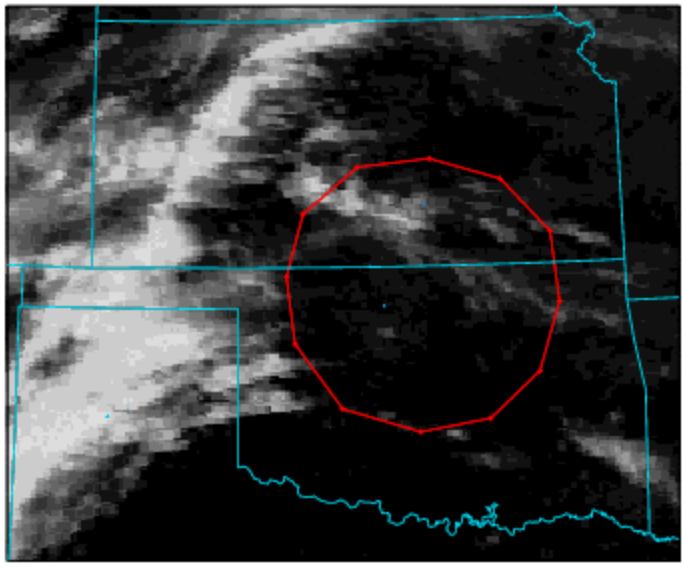
- ❑ High resolution cloud modeling
- ❑ NWP Testbed
- ❑ SCM Testbed

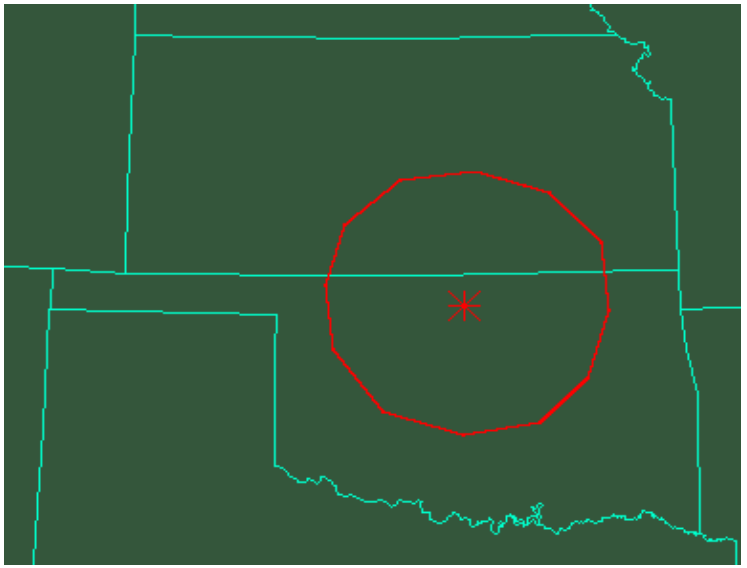
2. Establishment of Cloud Regimes

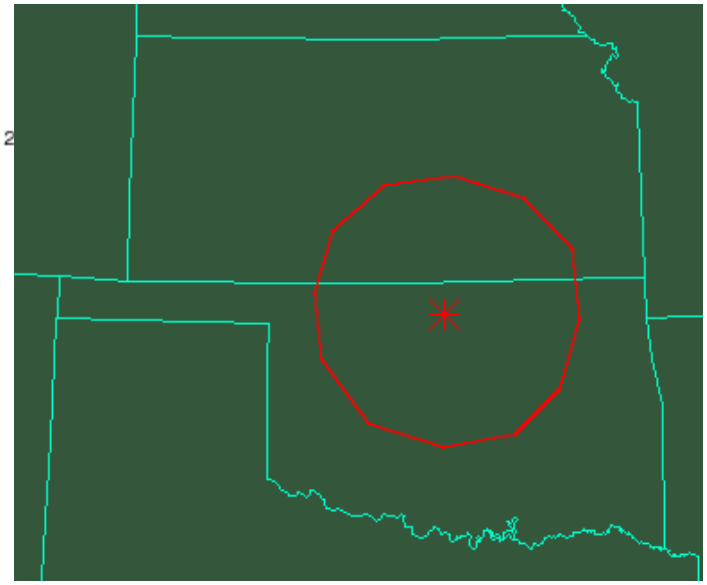
Presented by Wuyin Lin, BNL

ASR Science Team Meeting, Mar. 28, 2011

High Resolution Cloud Modeling at BNL

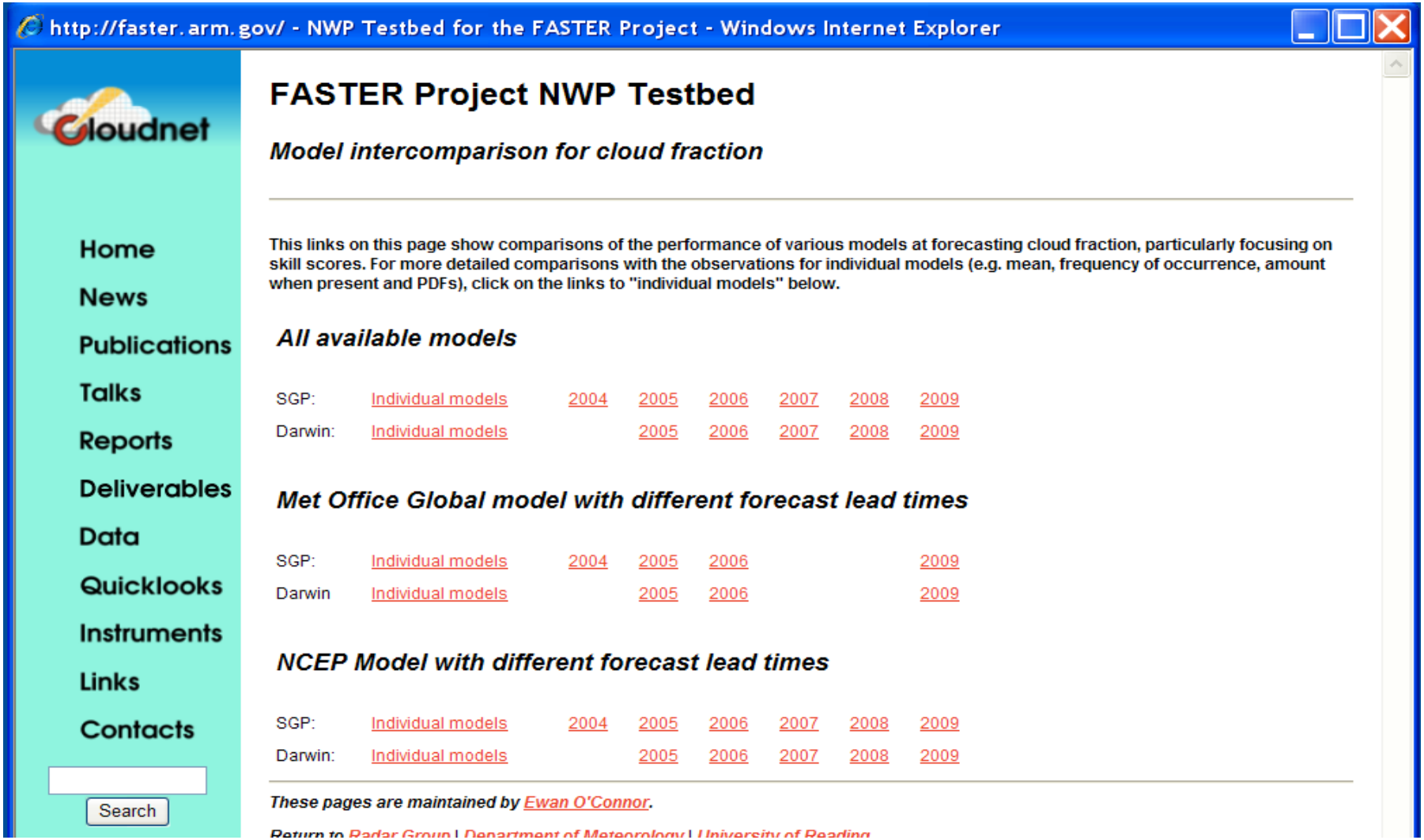






GOES 8 Nexrad	WRF3.1 Nested
SCAM3 subcols	Long term CRM simulation

NWP Testbed for the FASTER Project



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Update of the FASTER's SCM Testbed

Wuyin Lin[1], Yangang Liu[1], Yanluan Lin[2], Audrey Wolf[3], Roel Neggers[4]

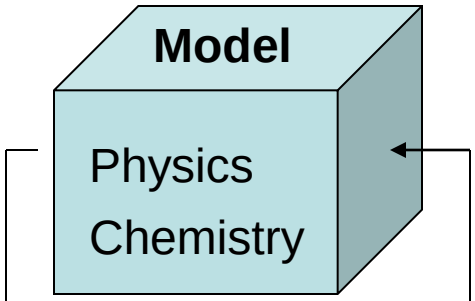
1. Brookhaven National Laboratory, 2. GFDL, 3. GISS, 4. KNMI

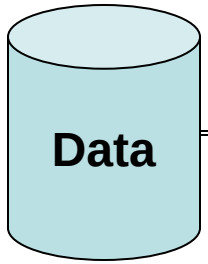
Outline

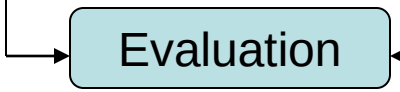
- Overview of the design
- Recent Updates
- Demo

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

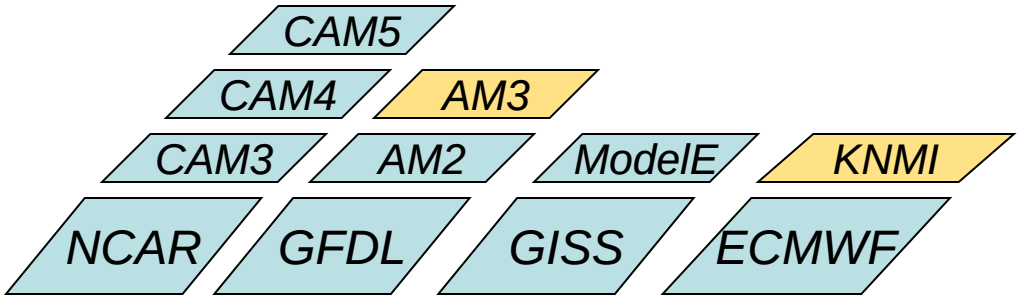
FASTER Testbed

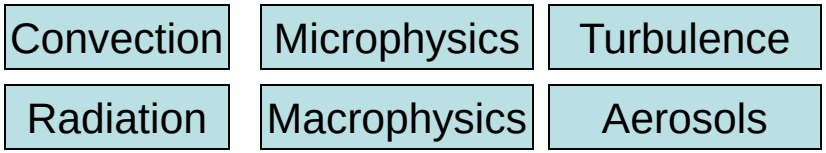


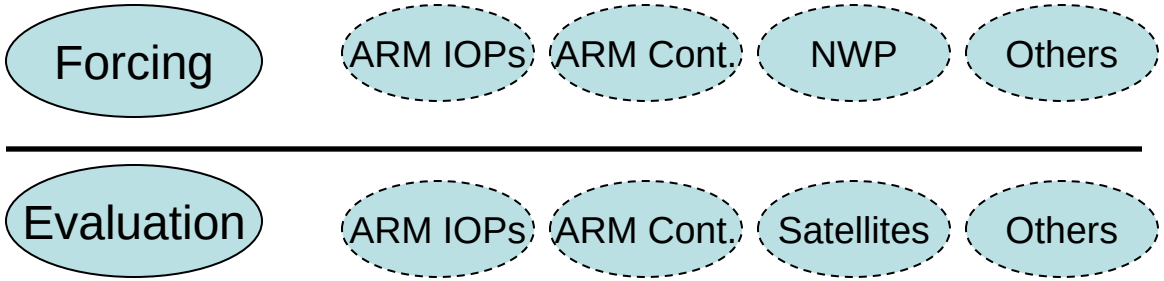




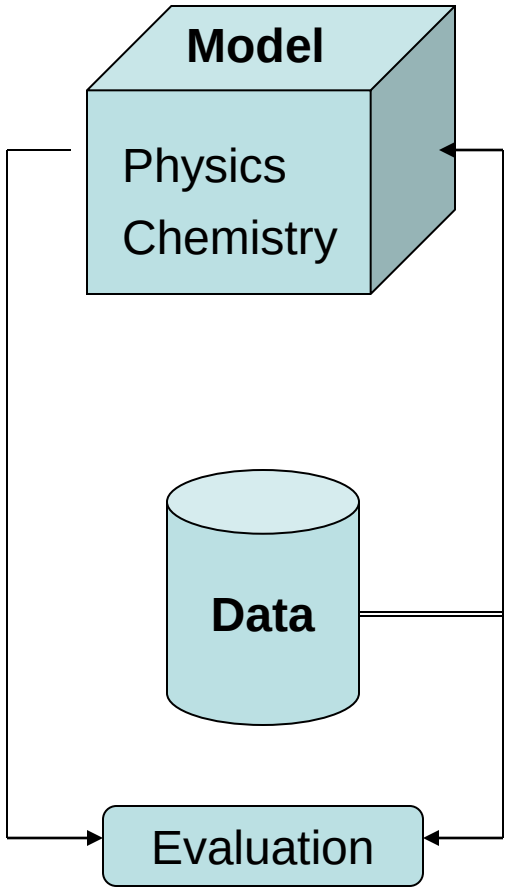
The Testbed's Essential Components



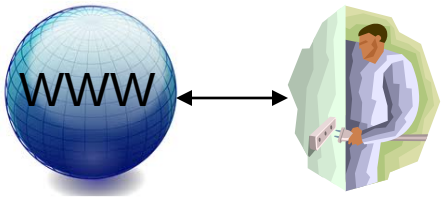




FASTER's SCM Testbed



Two modes to interact with the Testbed
pull and push

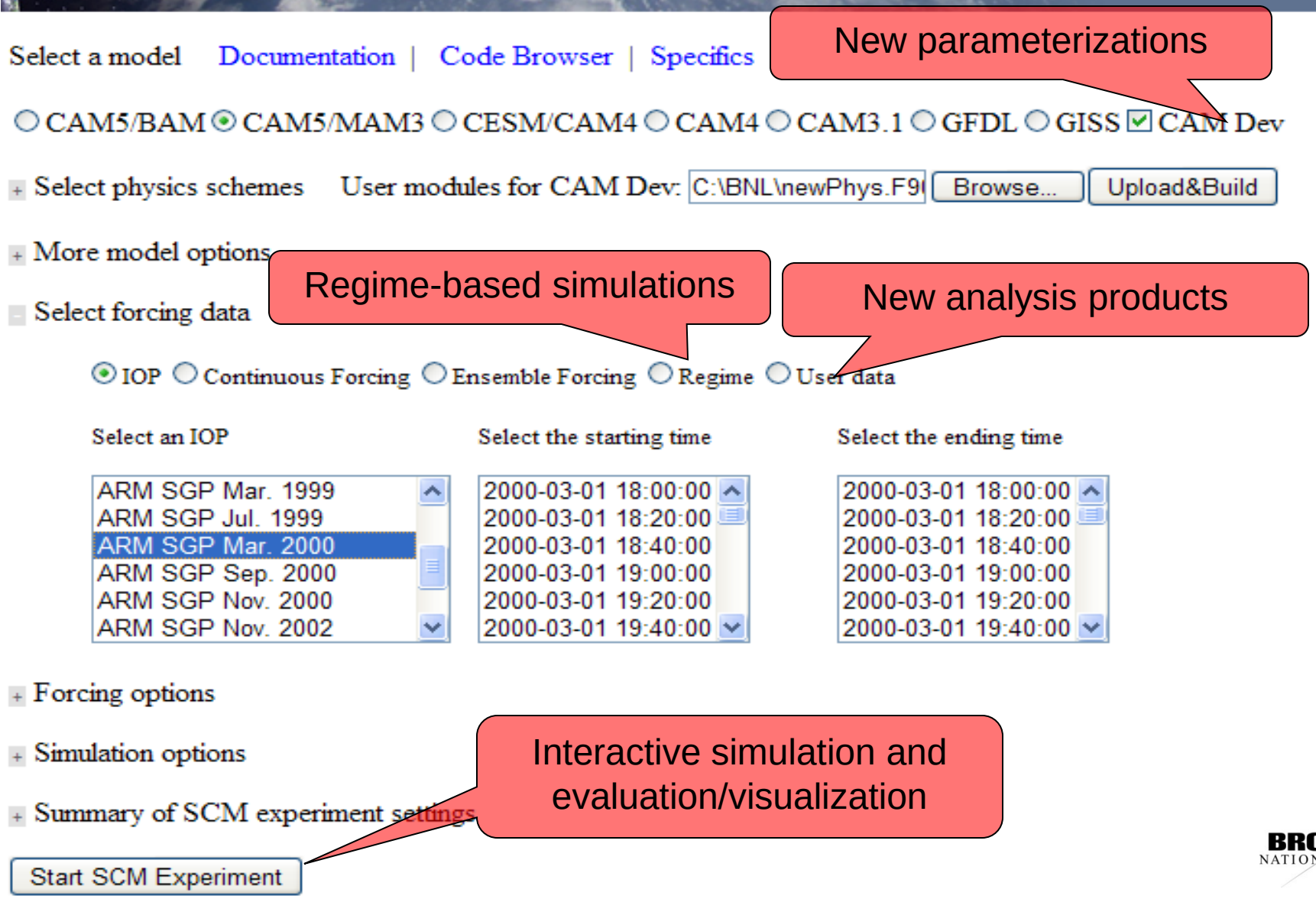


What, Which, Where, When, and How

Multitasking supported via a builtin workflow management

Fast Physics Testbed for the FASTER Project

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



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FAST PHYSICS PROJECT

Brookhaven Climate Consortium

Select a... | Documentation | Code Brows... | ...ecifics

NEW! NEW! NEW! NEW! NEW!

○ 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 Browse... Upload&Build

+ More model options

− Select forcing da...

NEW! NEW!

○ IOP ○ Continuous Forcing ○ Ensemble Forcing ○ Regime ◉ User data C:\Documents and Setti Browse... Upload

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

NEW!

+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings

Start SCM Experiment

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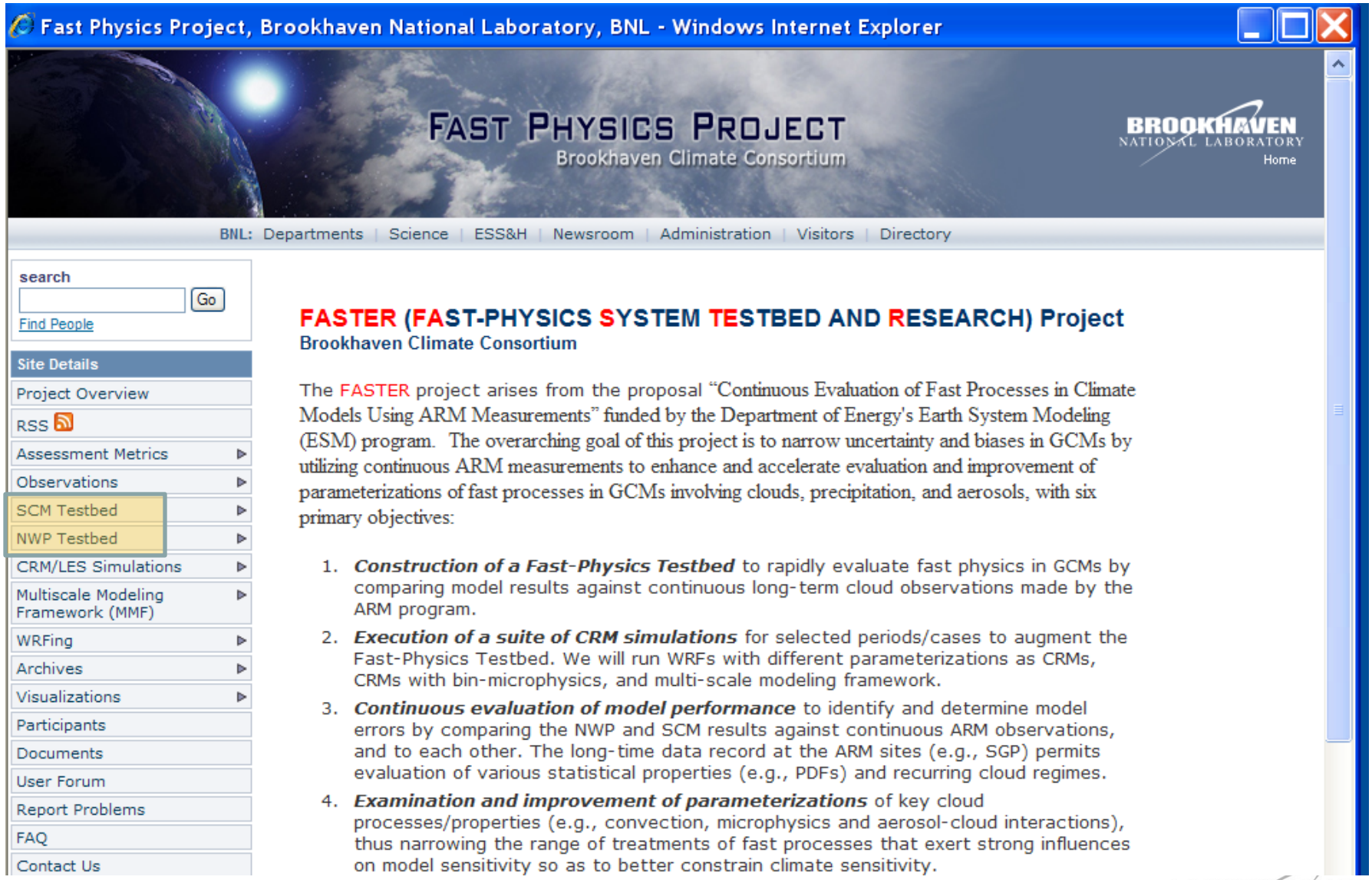
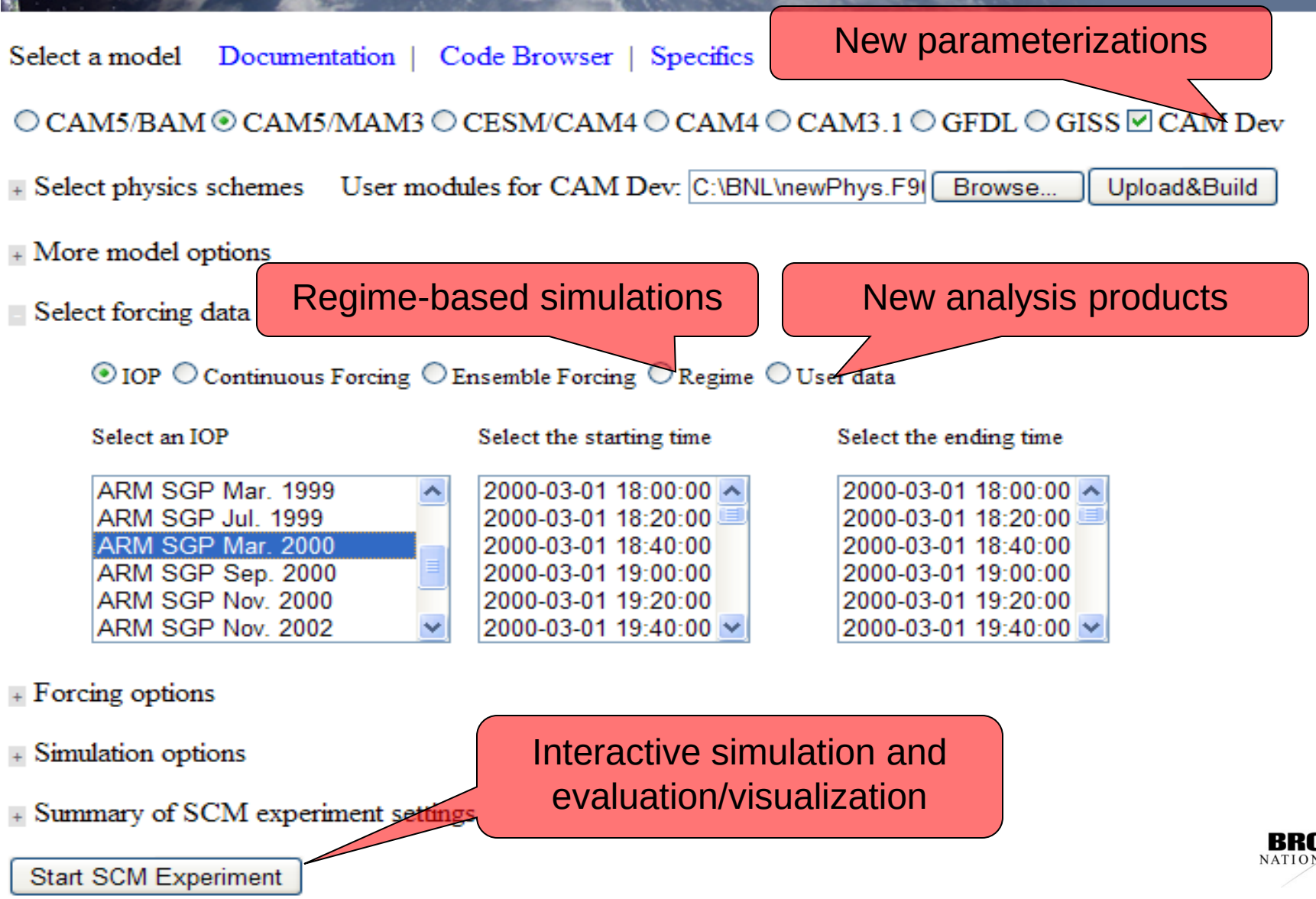
http://www.bnl.gov/esm, login: ASR11, password: SATX



Fast Physics Testbed for the FASTER Project

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



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Establishment of Cloud Regimes for Systematic Cloud Modeling & Evaluation

Wuyin Lin[1], Yangang Liu[1], Andy Vogelmann[1], Hua Song[1], Dan Lubin[2]

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

- 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

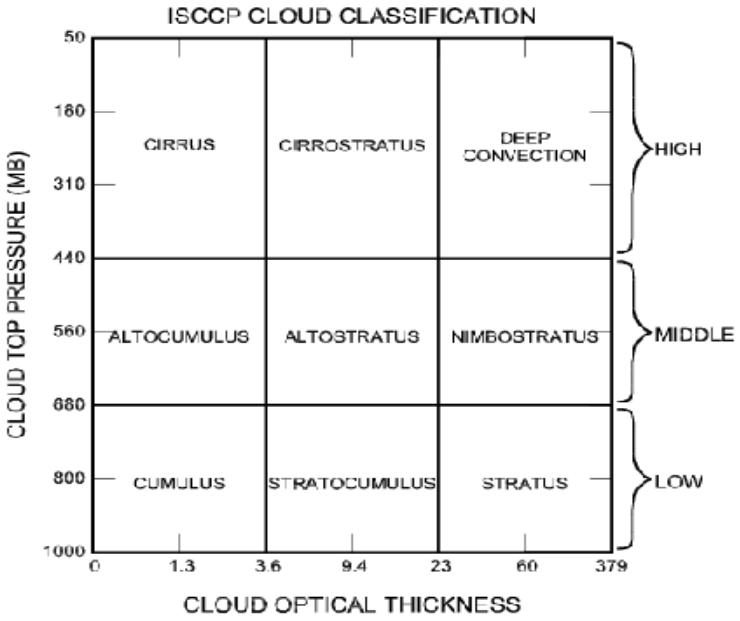
  ARM continuous forcing data (1999-2001) *(coincident IOPs as well)*

  (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)

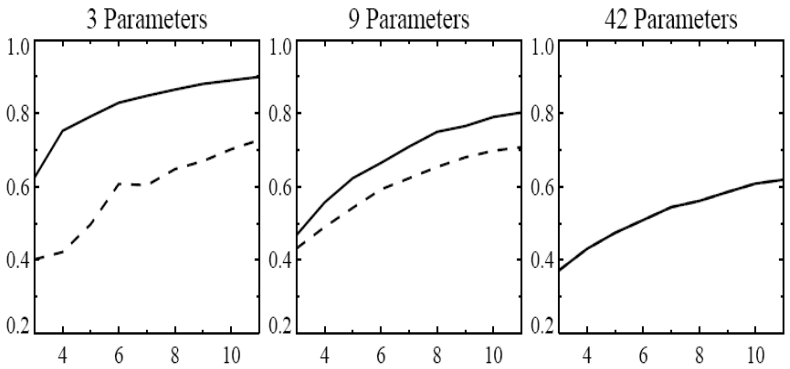
ISCCP D1 based classification and selection



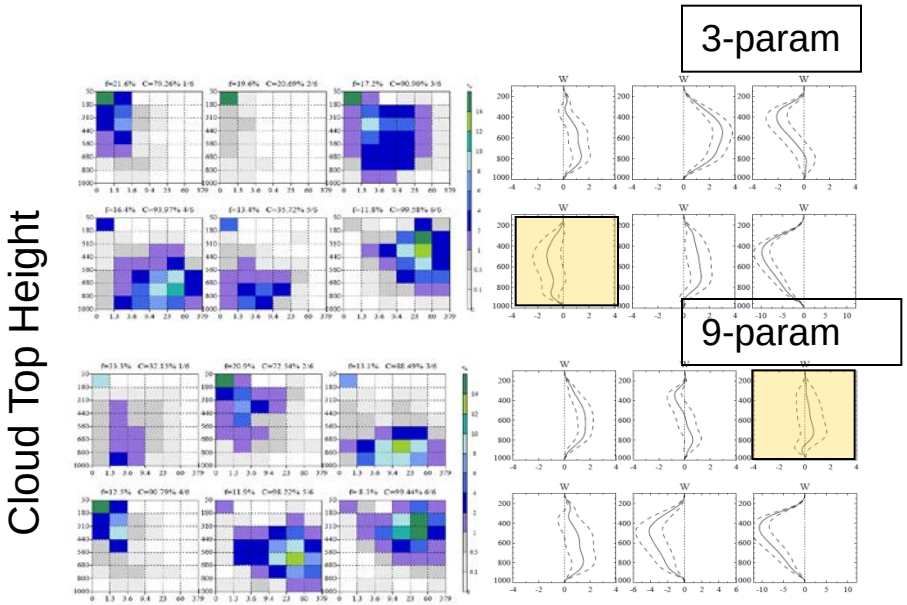
Classification

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.



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Extension to ARSCL, cloud regime statistics

Procedure

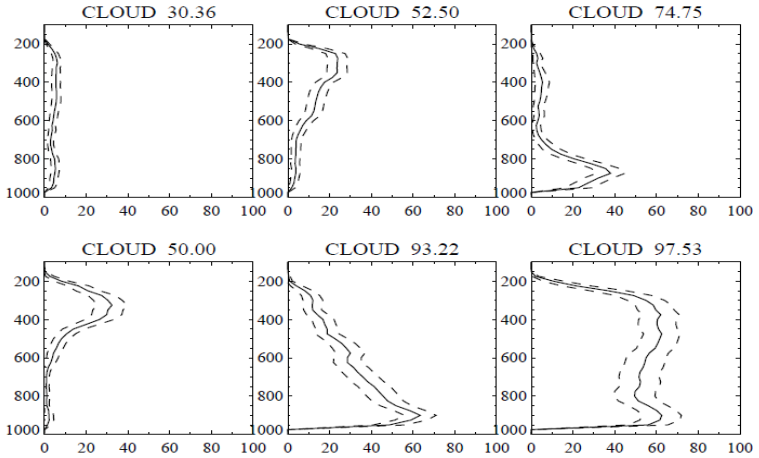
Derive mean ARSCL profiles associated with D1 classes

Continuous classification: map all ARSCL profiles to the mean profiles

Inclusion of 1st 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

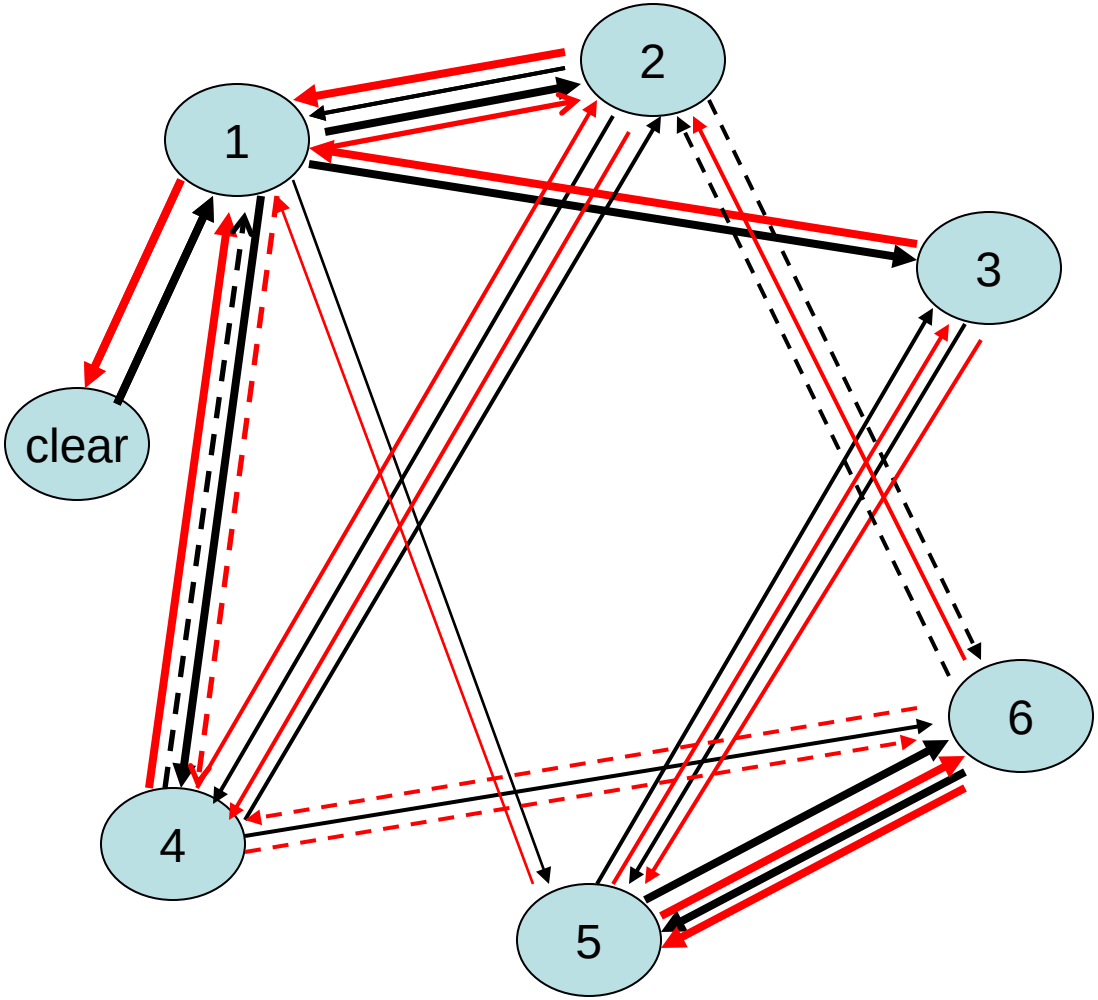


ARSCL Profiles corresponding to each cloud regime

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

Cloud Regime Transition Paths



Precursor

1st

2nd

3rd

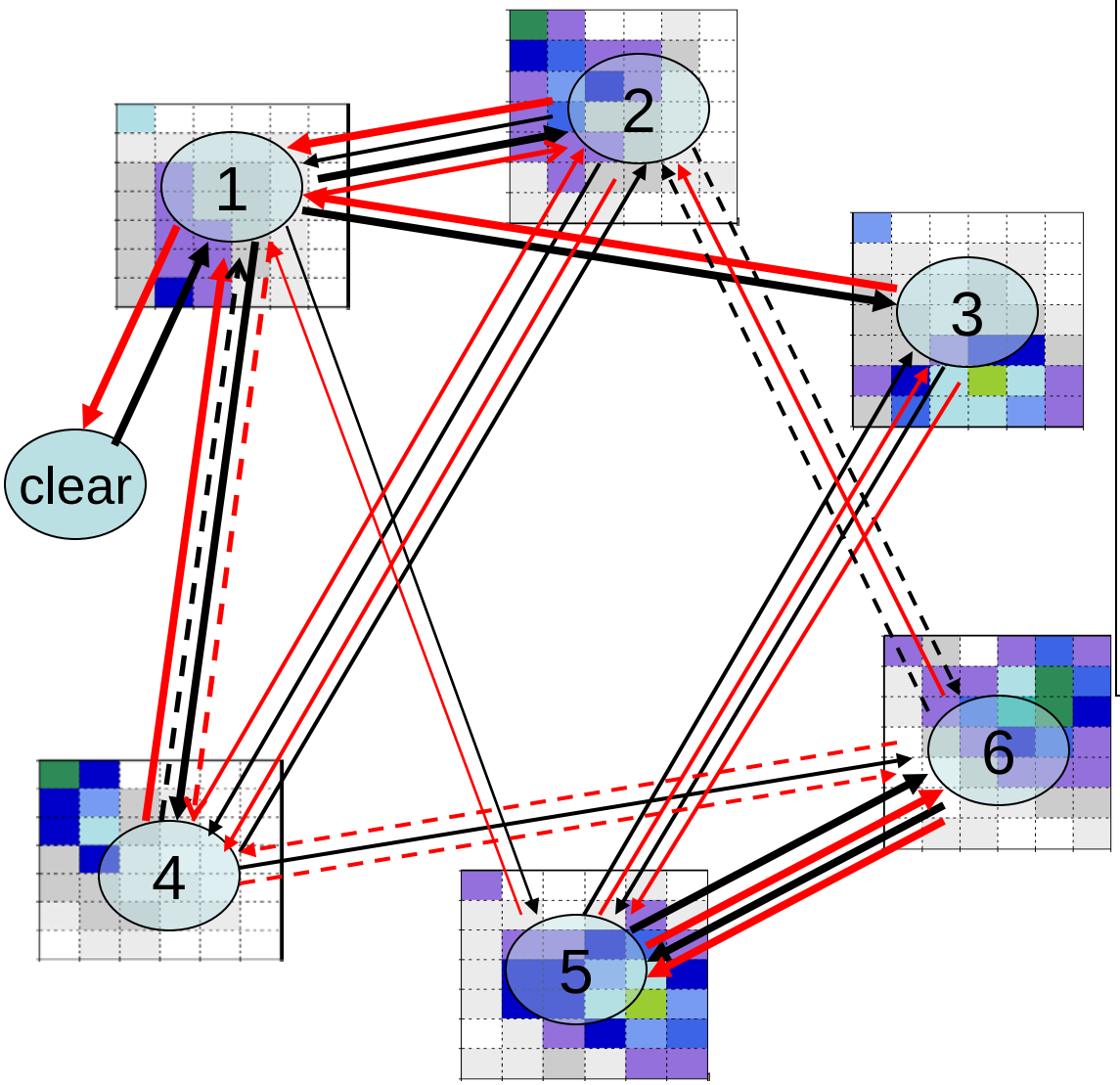
Successor

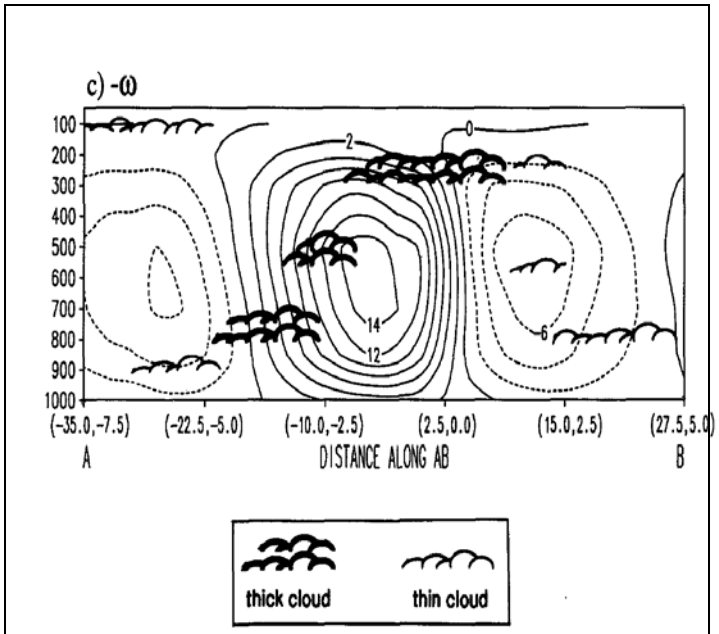
1st

2nd

3rd

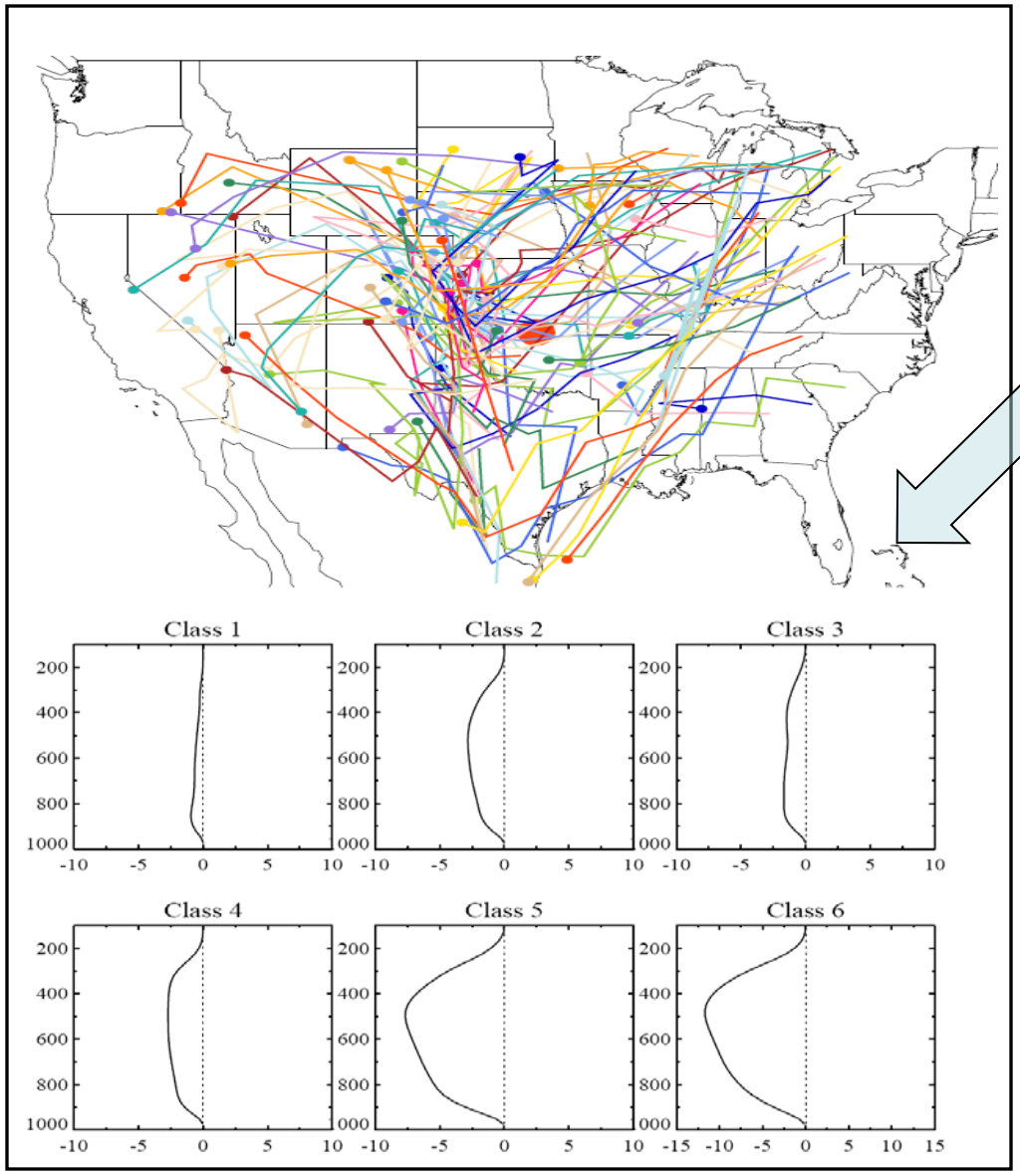
Cloud Regime Transition Paths and Frontal Cloud Organization





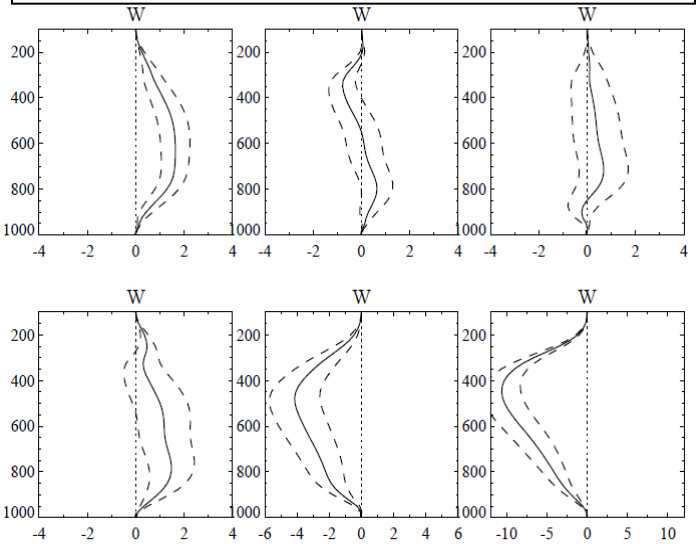
From Lau and Crane (1995)

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



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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.

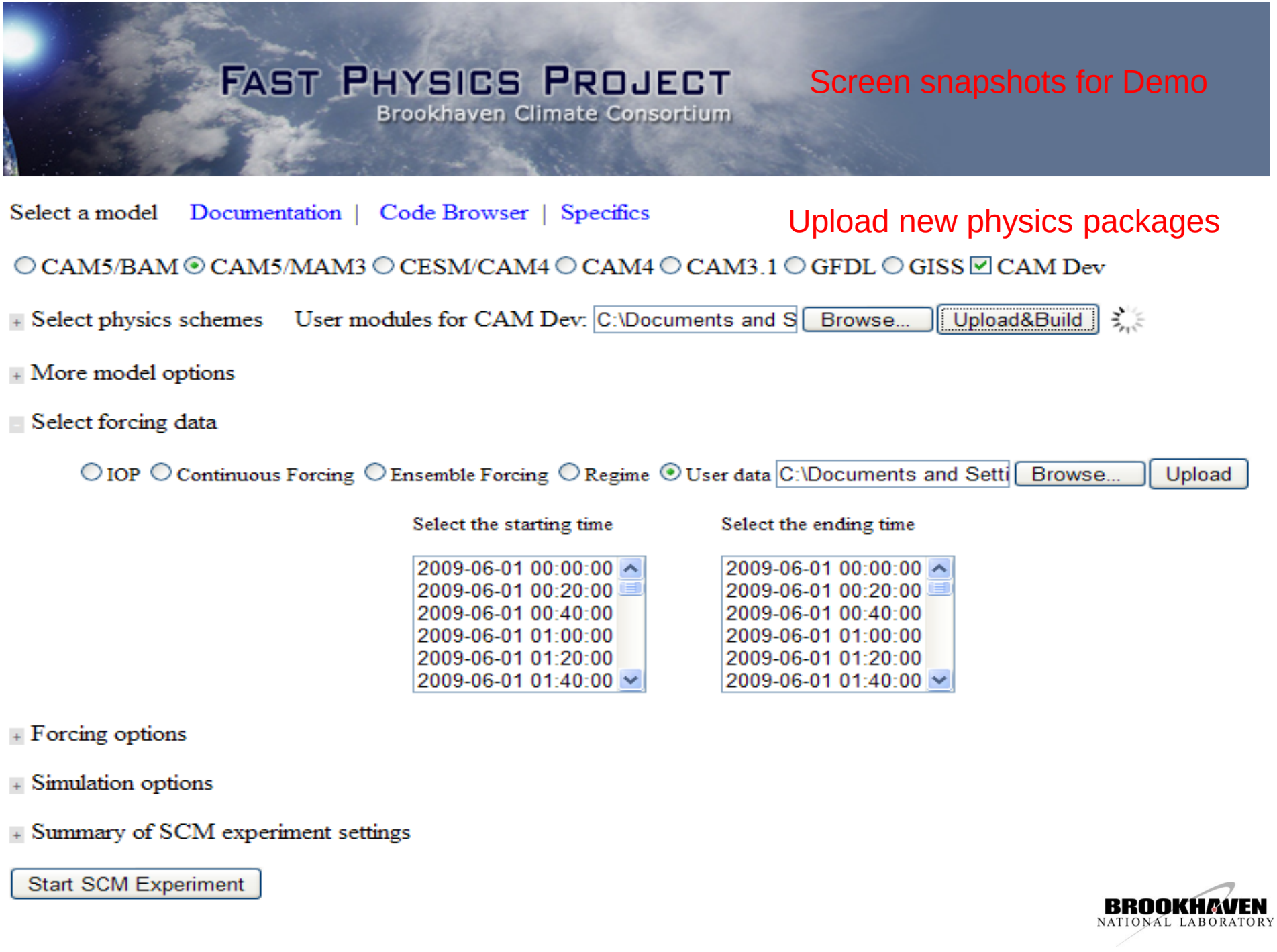
3. Identify storms initiated within SGP, compared to those passing from outside SGP for

   modeling & evaluation of cyclogenesis,

   study of relative importance of hydrometeors advection and IC.

Thank you!

Screenshots for Testbed Demo to Follow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Brookhaven Climate Consortium
Screen snapshots for Demo
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Forcing options
Simulation options
Summary of SCM experiment settings
Start SCM Experiment
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Select a model Documentation | Code Browser | Specifics

Upload & Build status

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More model options

Select forcing data

Upload new data

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+ More model options

− Select forcing data

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+ Forcing options

+ Simulation options

+ Summary of SCM experiment settings

Simulation and evaluation with new physics/data

Start SCM Experiment 00:00:19 2009-06-02 09:00:00 ....

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

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More model options

Select forcing data

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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 succeeded with new physics/data

Start SCM Experiment 00:01:40 View/download the results. Quicklook plots. ....

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