Report to Aerosol Lifecycle Working Group

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OACOMP VAP

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NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*
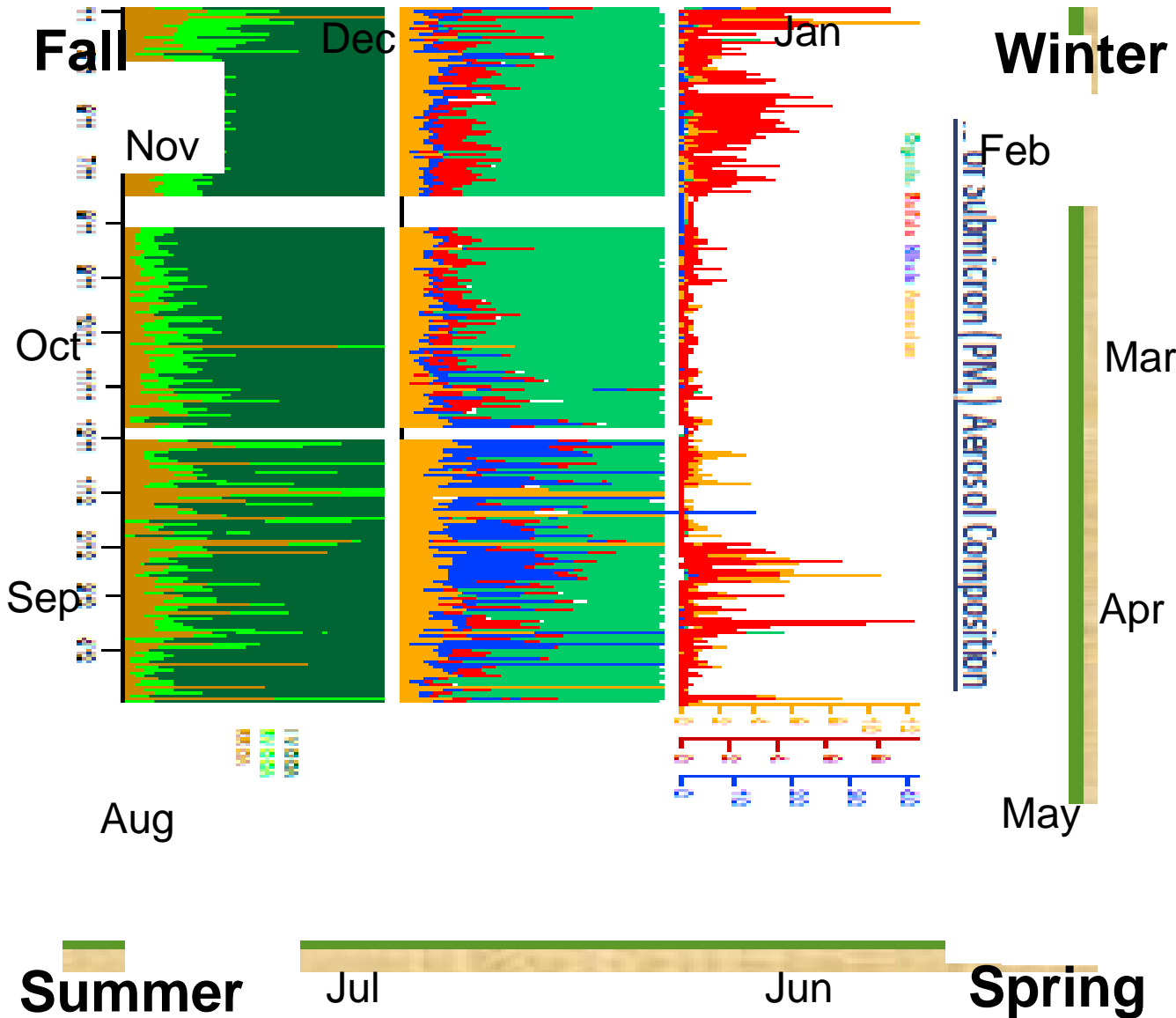
Organic Aerosol COMPonent (OACOMP)

► ACSM measures submicron OA, SO_4, NO_3, NH_4, Cl at ~30 min intervals

► Use mass spectra data to derive organic aerosol components

■ More oxidized OA (MOAA)

■ Less oxidized OA (LOOA)

■ Biomass burning OA (BBOA)
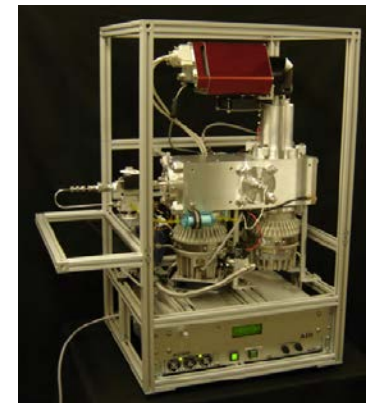
Status

► Development of scripts and code in DMF complete (ported from IGOR)

■ Pretreatment routines & multivariate analysis

■ Rolling window calculations ➡ time series of MOOA, LOOA, BBOA, and mass spectra information provided to users

► Testing of code continues – a few tweaks remain

► Evaluation product for SGP site will be made available on-line soon (few weeks)

■ Looking for volunteers to provide feedback

► Then, implement operationally

Fall

Dec

Nov

Jan

Winter

Oct

Feb

Sep

Mar

Aug

Apr

May

Summer
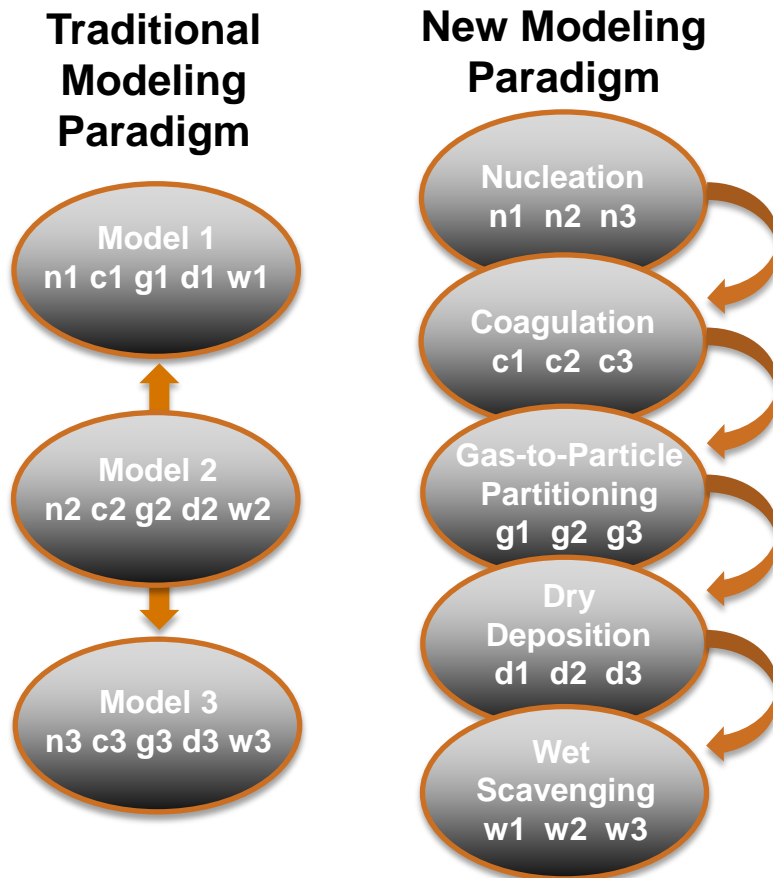
Jul

Jun

Spring

LV-OOA
SV-OOA
BBOA

For the first time, we can obtain climatology of aerosol composition and OA components at ARM sites

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Moving Towards A New Modeling Paradigm

Create a computational framework, an **Aerosol Modeling Testbed (AMT),** that streamlines the process of testing and evaluating aerosol and clouds process modules over a range of spatial / temporal scales

Traditional Modeling Paradigm

Model 1
n1 c1 g1 d1 w1

Model 2
n2 c2 g2 d2 w2

Model 3
n3 c3 g3 d3 w3

New Modeling Paradigm

Nucleation
n1 n2 n3

Coagulation
c1 c2 c3

Gas-to-Particle Partitioning
g1 g2 g3

Dry Deposition
d1 d2 d3

Wet Scavenging
w1 w2 w3

▶ **Systematically and objectively** evaluate aerosol process modules using extensive field campaign and operational data

▶ Better quantify uncertainties by **targeting specific processes**

▶ **Provide tools** that facilitate science by minimizing redundant tasks

▶ **Document performance** and computational expense

▶ Build a capability that **fosters international collaboration** – like AeroCOM but at regional scales

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Evaluation of CAM5 Physics at Higher Spatial Resolution
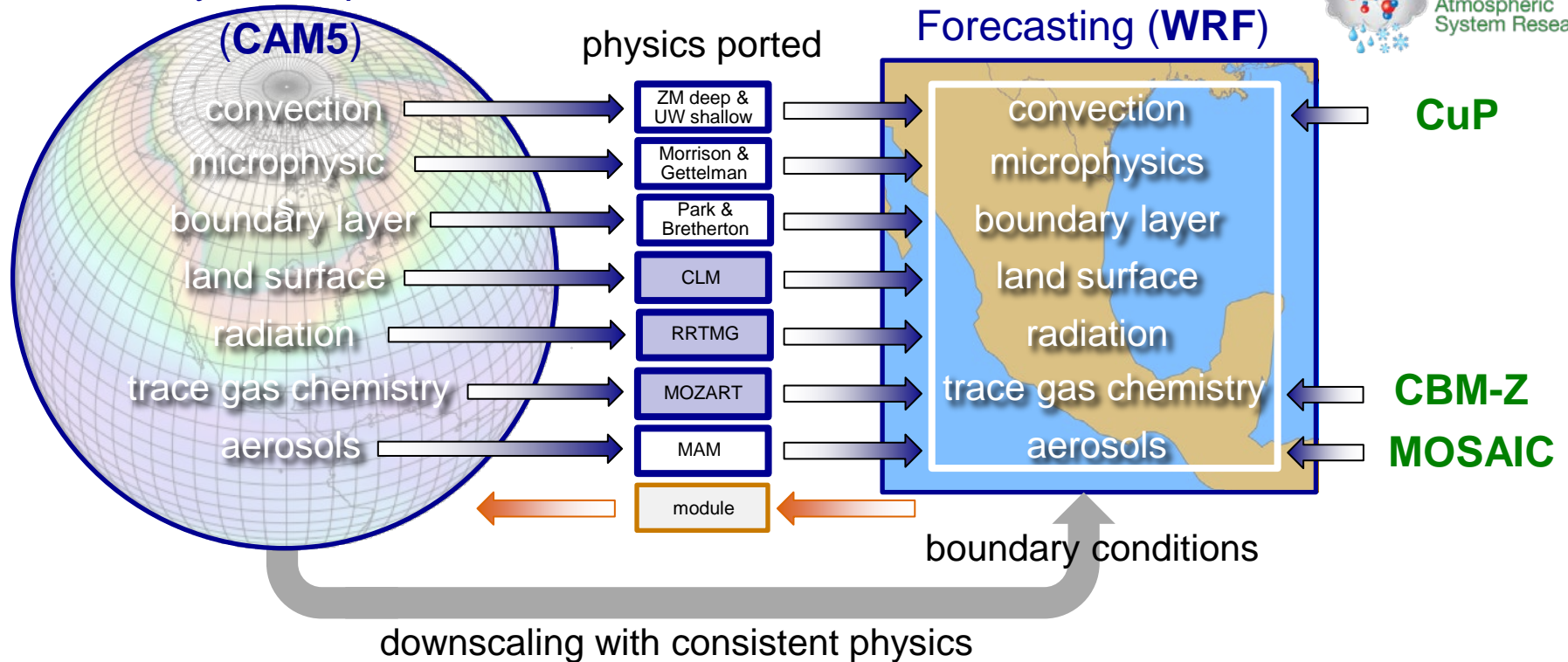
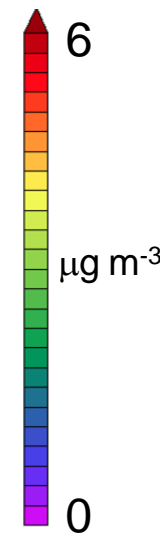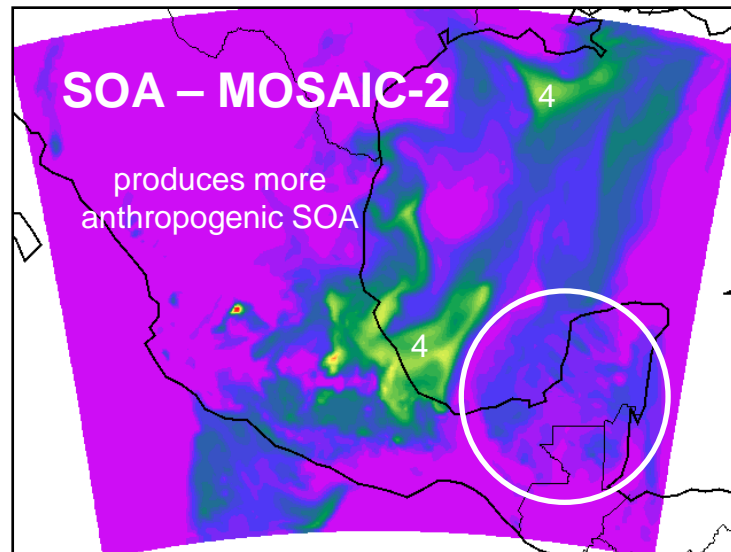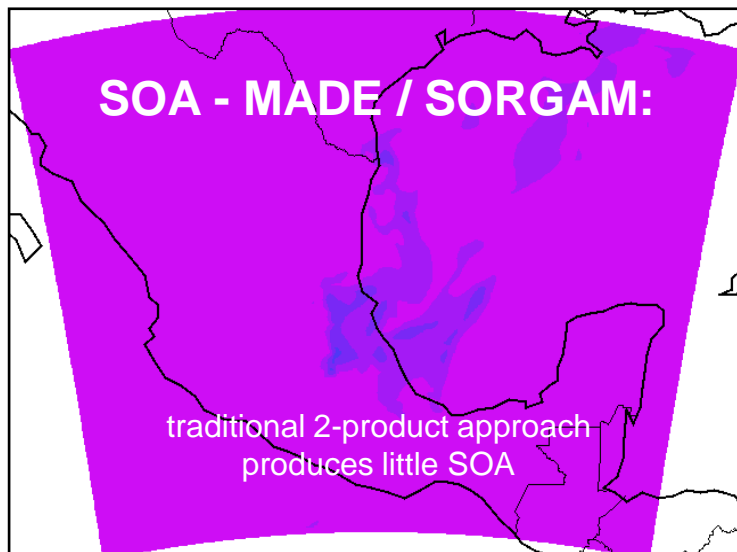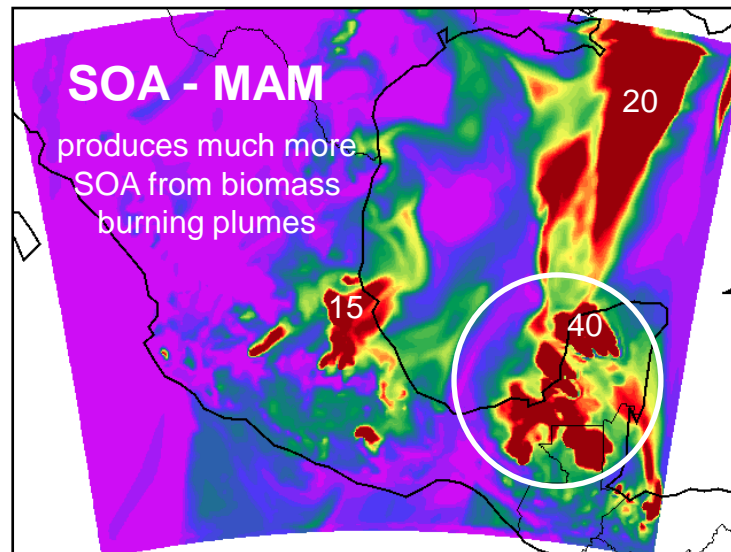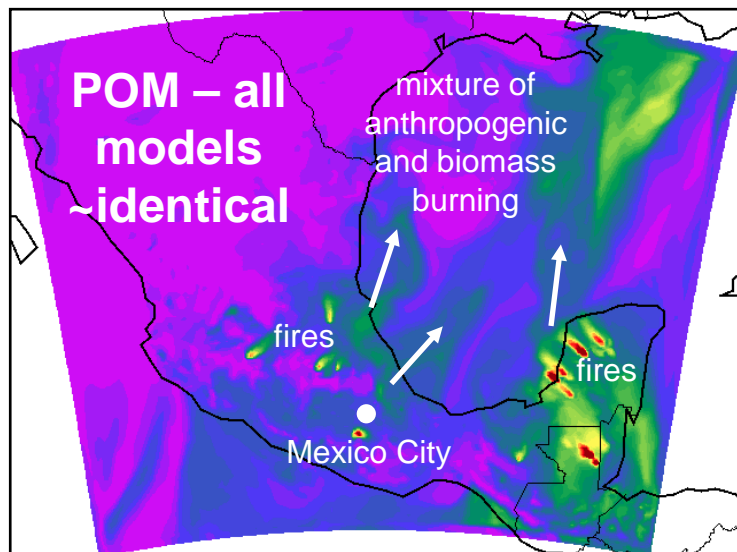**Aerosol Models in WRF: GOCART, MAM, MADE/SORGAM, MOSAIC**
Others ported (not public version): **APM** (GEOS-Chem), **MADRID** (CMAQ)

~1.4 km AGL, 21 UTC March 10, 2006

POM – all models ~identical

mixture of anthropogenic and biomass burning

fires

fires

Mexico City

SOA - MAM

produces much more SOA from biomass burning plumes

20

15

40

SOA - MADE / SORGAM:

traditional 2-product approach produces little SOA

SOA – MOSAIC-2

produces more anthropogenic SOA

4

4

µg m⁻³

6

0

also differences in NO₃, aerosol water, NH₄

BC, SO₄ ~identical

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21 UTC March 10, 2006
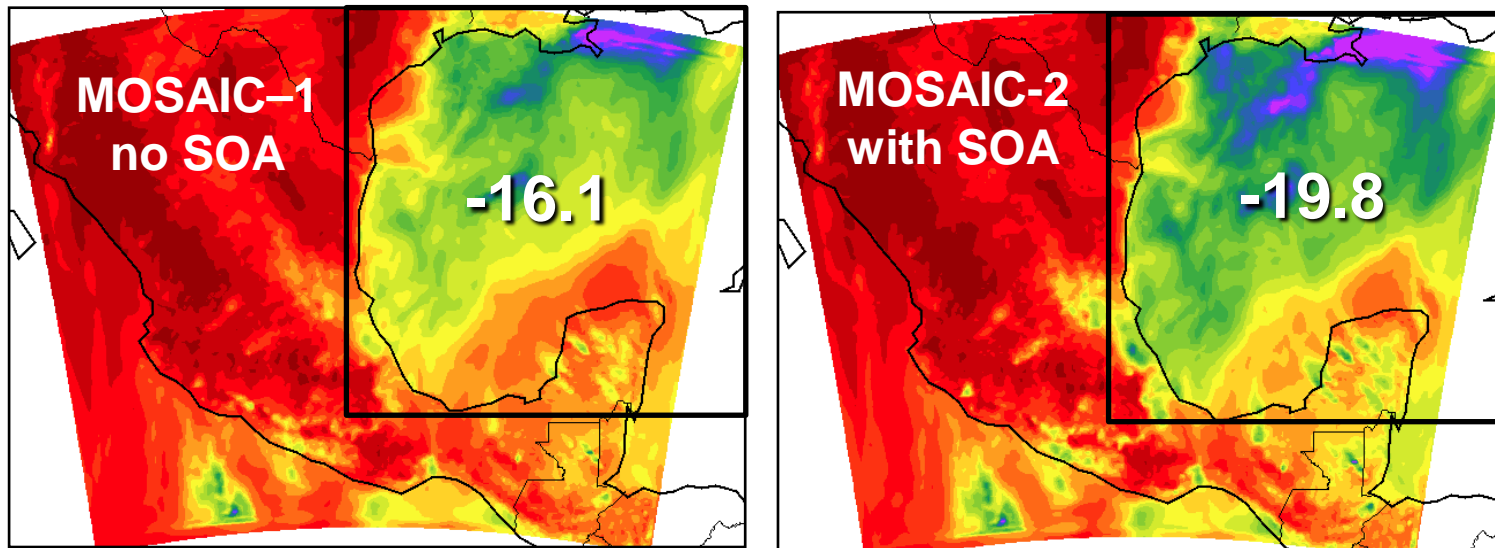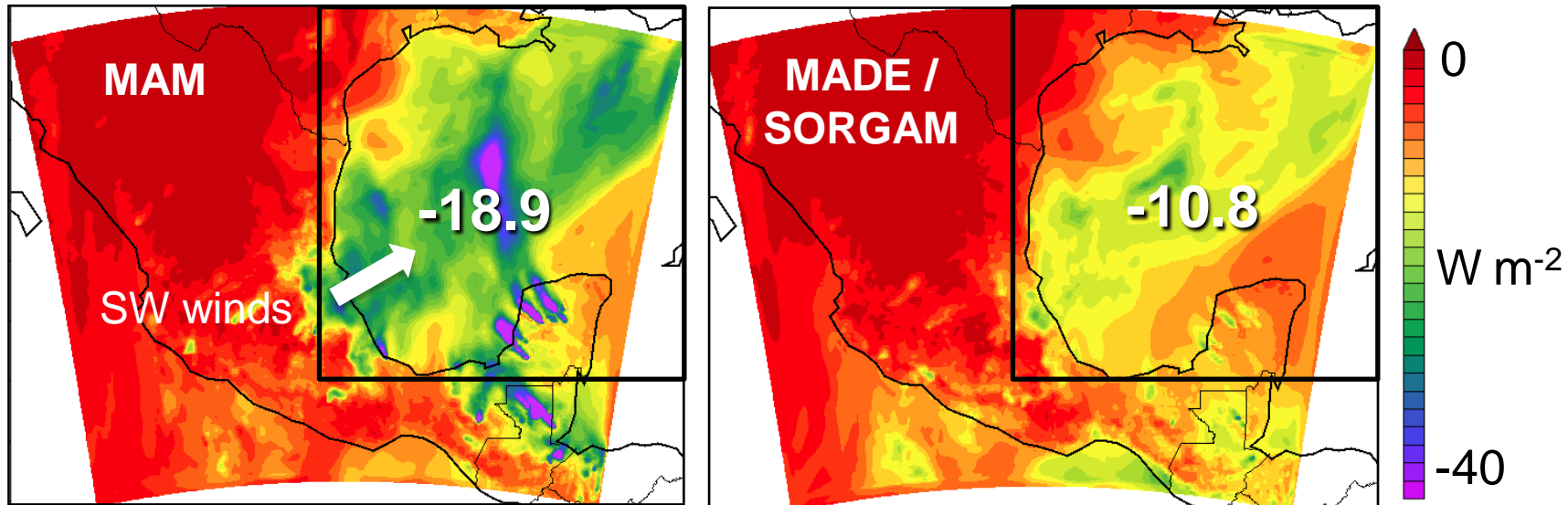
AMT: Community Tools

▶ Testbed cases employ **common a directory structure**

- Each field campaign has data in its own format (a time sink for modelers)
- Common directory structure simplifies analyses of model results

CARES / CalNex Example

CARES (red)
CalNex (blue)
both (green)
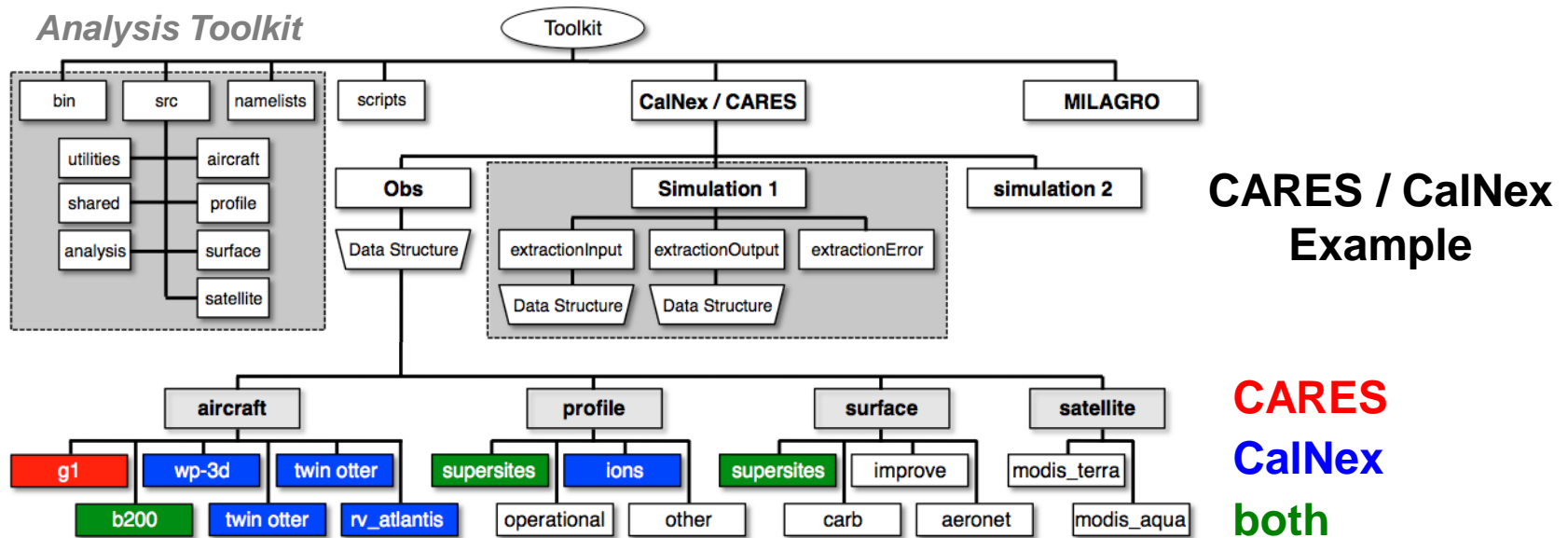
▶ 'Analysis Toolkit' and Testbed Cases available on DOE's ARM website: **http://www.arm.gov/data/eval/59**

▶ Users have adapted Analysis toolkit for **other models** (CMAQ)
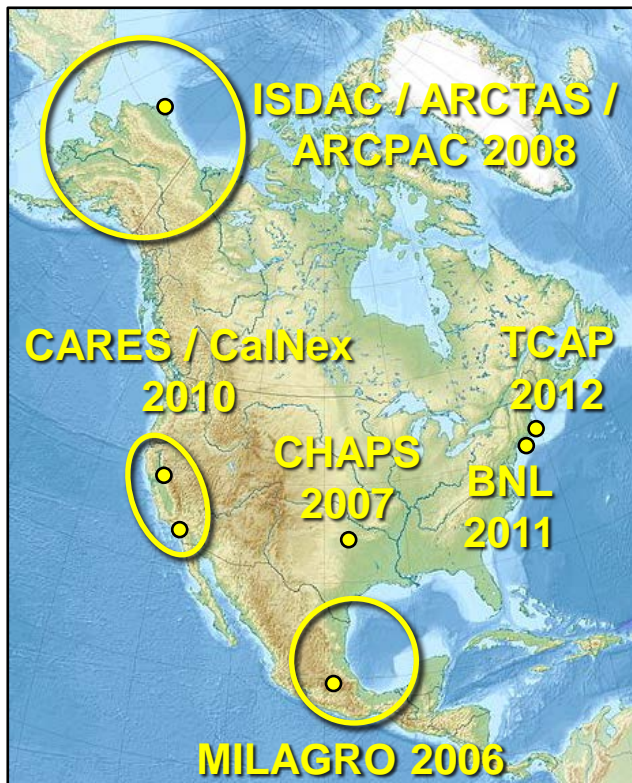
Characterization of aerosol microphysics, optical, and cloud nucleating properties at the surface and aloft using advanced instrumentation, e.g.

Aerosol Mass Spectrometer (AMS)
Single particle soot photometer (SP2)
Single particle instruments (SPLAT, ATOFAMS, PALMS)
Photoacoustic soot photometer
Cavity ring-down spectroscopy
High Spectral Resolution Lidar

(Map labels: ISDAC / ARCTAS / ARCPAC 2008; CARES / CalNex 2010; TCAP 2012; CHAPS 2007; BNL 2011; MILAGRO 2006; GOAMAZON 2012; VOCALS 2008)

Important to evaluate aerosol process modules for varying meteorology and emissions

▶ Nearly complete cases; **MILAGRO, CARES/CalNex**

▶ Several planned cases: **BNL, TCAP, GOAMAZON**

→ *aerosol aging, SOA, optical properties*

▶ Partially complete cases: **CHAPS, ISDAC, VOCALS**

→ *cloud-aerosol interactions*

▶ Users developing other cases: **POLARCAT**, **ACCESS, …**

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Plans

Near-Term:

► Expanded CARES / CalNex case and MILAGRO cases on ARM archive

► Complete BNL IOP case

► Start on TCAP case for "finalized" data

► Update to "Analysis Toolkit" software

Long-Term:

► Complete CHAPS, ISDAC, VOCALS cases

► Other cases?

► Modifying the Analysis Toolkit for use with CAM5 output when run in "numerical forecast mode"

► Modifying Analysis Toolkit files for newer generation disk storage to reduce computational expense

Aerosol Lifecycle Modeling Activities in ASR
Not Including Aerosol-Cloud Interaction Studies

Investigator	Topic – "sound-bites"
Catherine Chuang	detailed aerosol chemistry, global studies in CAM5
Neil Donahue	Formation and growth of ultrafine particles and impact on CCN, global studies in GISS
Jerome Fast	transport and mixing processes, regional-scale studies (CARES/CalNex, TCAP)
Yan Feng / Rao Kotamarthi	regional-scale studies, aerosol radiative effects (GVAX)
Alma Hodzic	SOA process development, regional-scale studies (Beachon, CARES/CalNex, MILAGRO)
Sasha Madronich / Julia Lee-Taylor	explicit chemistry associated with SOA (MILAGRO)
Nicole Riemer / Matthew West	explicit particulate modeling of aerosol mixing state
John Seinfeld	SOA process development, global studies

Aerosol Lifecycle Modeling Activities in ASR
Not Including Aerosol-Cloud Interaction Studies

Investigator	Topic – "sound-bites"
Manish Shrivastava	SOA process development, anthropogenic-biogenic interactions, regional-scale studies (lab data, CARES, MILAGRO)
Tony Wexler	Surface aerosol properties - thermodynamic model development
Rahul Zaveri	SOA process development, explicit modeling of aerosol mixing state (lab data, CARES)

Ideas

Currently, ASR is developing and/or adapting parameterizations that could be used in global climate models, but would an operational aerorol model be a useful means to demonstrate performance of ASR modules?

► NASA has GEOS-Chem, EPA has CMAQ, European consortium has MACC

► CAM5 in operational forecast mode, WRF with CAM5 and/or ASR physics, or some new modeling framework?

► Operational support for field campaigns

Should we organize / propose an intercomparison study to identify strengths and weaknesses of proposed modeling approaches for specific aerosol processes?

► We seem to have a critical mass in SOA

► Entrain modelers external to ASR?