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Breakout on Land-Atmosphere-Cloud Interactions

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Breakout Session Agenda

Welcome/Overview	5 min.
Role of land-atmosphere-cloud interactions in ASR	20 min.
Review of existing science projects—where are we now?	15 min.
Impact of ARM's reorganization—setting new priorities and feedback to the program	20 min.
Measurements needs/IOPS	20 min.
Wrap-up and action items	10 min.

Goals of the breakout:

- Alignment of land-atmosphere research with ASR Program—identify areas of collaboration
- Identify measurement/instrument needs
- Organization of the group

The Role of Land-Atmosphere-Cloud Interactions in ASR Research

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ASR Mission and Objectives:

- Use these data, together with models, to understand and parameterize the processes that govern the atmospheric components and their interactions over all pertinent scales.
- Develop integrated, scale-bridging testbeds for model parameterizations that incorporate this process level understanding of the life cycles of aerosols, clouds, and precipitation in numerical models.

ASR Atmospheric System Research

- Research into land-atmosphere-cloud interactions will help us to better understand and parameterize the fate of water vapor, precursor gases, aerosol, and the initiation of clouds

The Role of Land-Atmosphere-Cloud Interactions in ASR Research

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- ASR spans a wide range of atmospheric processes

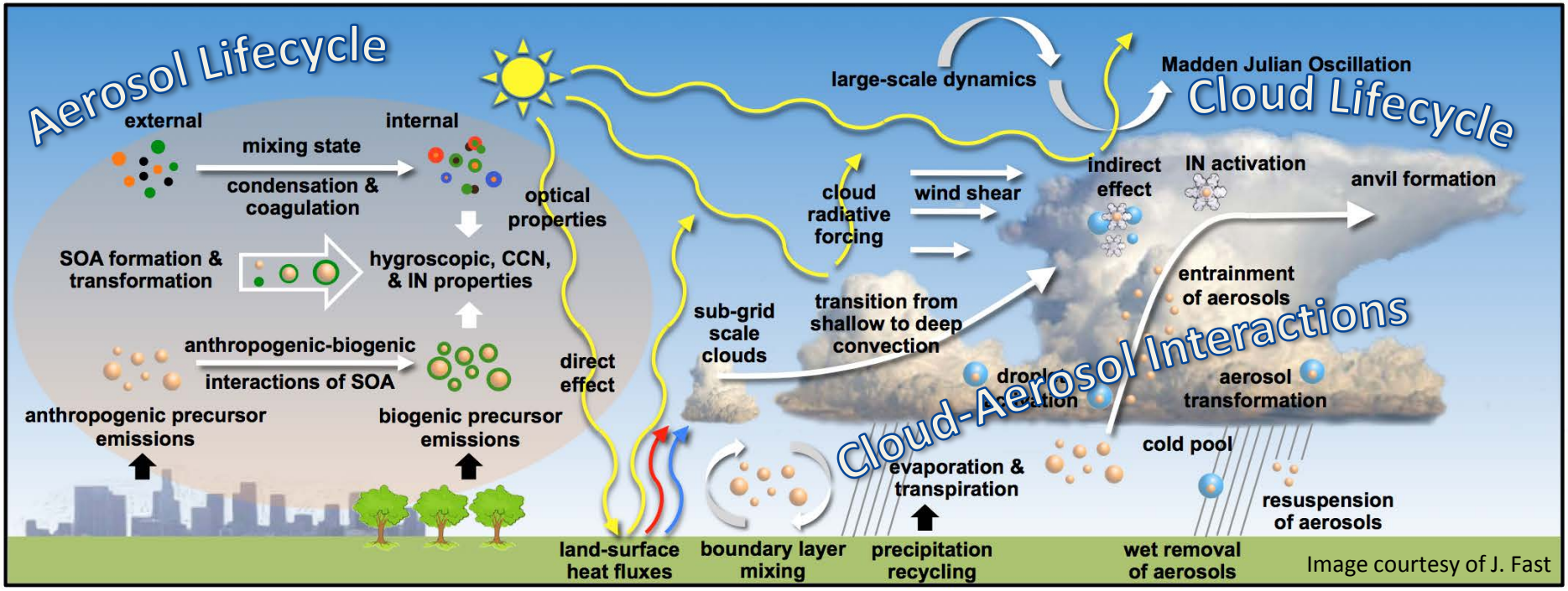

Image courtesy of J. Fast

Science Questions Relevant to ASR

Land-Atmosphere-Cloud Interactions: Where do we fit?

- Which feedbacks are important on the regional and climate scale?
  - Links between soil moisture, evapotranspiration, temperature, clouds, precipitation, aerosol, and radiation
  - Coupling analysis—Diagnosing land-atmosphere interactions at the processes level
- What level of detail/accuracy is needed for climate studies?
  - How good are the data we have now?
  - What time scales?
- Can we accurately represent the PDF of sub-grid scale variables?
  - moisture, turbulence, clouds, and light
    - Precursors for SOA
  - Anthropogenic factors
    - Irrigation, urban expansion, fire emissions
  - Are feedbacks in nature and CLM the same?
    - Some evidence suggests that they are not

Science Questions Relevant to ASR, cont.

- Relevant spatial and temporal scales—including issues related to soil wetting
- Distance and coupling between land and clouds for locations around the world, including the SGP and NSA
- Development/testing of the Community Land Model (CLM)
  - Treatment of biogenic emissions—e.g. sensitivity to temperature, moisture, turbulence, clouds, and light
    - Precursors for SOA
  - Anthropogenic factors
    - Irrigation, urban expansion, fire emissions
  - Are feedbacks in nature and CLM the same?
    - Some evidence suggests that they are not

Collaborative Project

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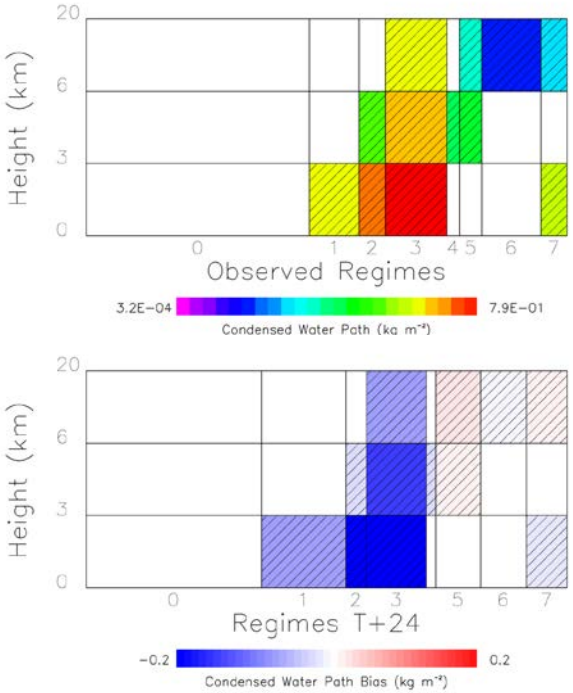
CAUSES: Clouds Above the United States and Errors at the Surface

- Aimed at improving our understanding and correcting the warm temperature bias over the US in the summer
- Effort led by:
  - Cyril Morcrette, Jon Petch (Met Office)
  - Hsi-Yen Ma, Steve Klein, and Shaocheng Xie (LLNL)
- Compare a NASA-GISS, CAM, Met Office and WRF with observations from the SGP, including data collected during MC3E



Met Office Global T+24 to T+48 dx~30km. First month of MC3E

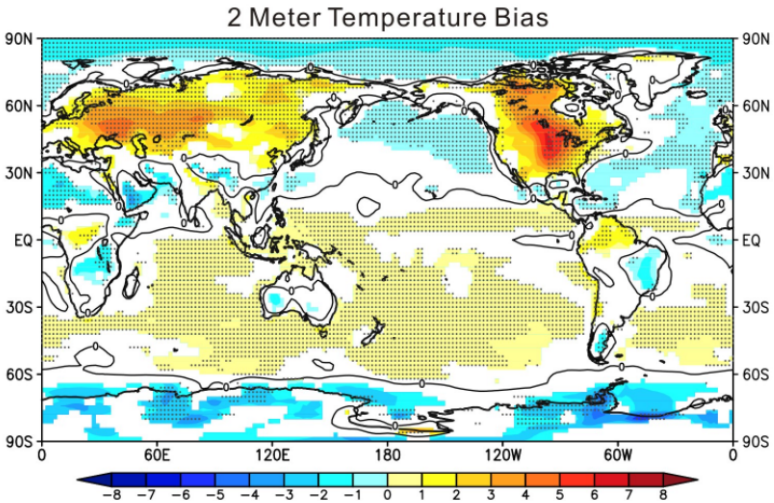
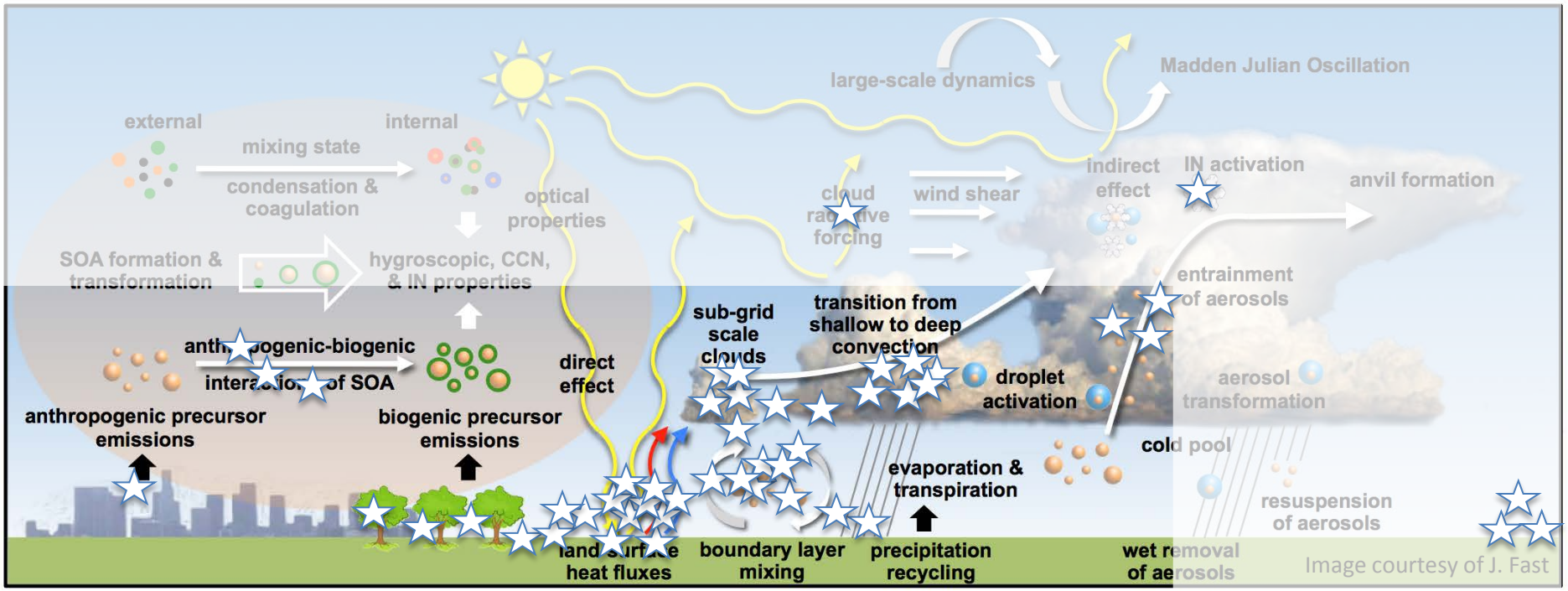


Figure 1. June-August CMIP5/AMIP multi-model mean 2 metre temperature bias (K, colour shades). Only regions where ensemble mean biases are statistically significant at the 95% confidence level are colour shaded. The stippled regions are where four or more of the five transpose-AMIP II models have the same sign of bias (Figure taken from Ma et al. 2013).

Where Are We Now?

- Where do we (existing projects) fit?
- Where can collaborations be developed?



Available Data for L-A Interaction Studies

Shaocheng Xie (LLNL)

(with help from C. Sivaraman, L. Riihimaki, M. Jensen, S. Giangrande, M. Huang, R. McCoy, Y. Zhang)

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Dataset	Variable	Resolution	Period	Notes
ARMBELAND	Soil temp, moisture, and heat flux	SGP CF, 1hr	1997-2012	Released (LLNL)
ARMBECLD	Cloud and rad.	SGP CF, 1hr	1997-2012	Released (LLNL)
ARMBEATM	LH, SH, Surface Met. data	SGP CF, 1hr	1997-2012	Released (LLNL)
ARMBEGRID	Surface and land properties	SGP 0.25^0 x 0.25^0 over 4^0 x 4^0 domain centered at CF, 1hr.	1997-2013	Being developed (LLNL)
ARM Cont. Forcing	Area mean values	SGP 300km 1hr	1999-2010	Released (LLNL)
ARMBE-CSSEF	ARMBEATM variables with UQ information	SGP all extended facilities, 1 hr	2011, other years being processed	Contact Laura Riihimaki of PNNL
ARMBE-FASTER	Same as ARMBECLD/ATM with higher res.	SGP CF, 1 hr and 5 min.	March 2000 May 2003	Contact Mike Jensen of BNL
NEXRAD Pr -CSSEF	Precipitation	1 km, 0.1^0 and 1^0 over North America		Contact Scott Giangrande (BNL)
PNNL Land Properties	Soil Temp, moisture, and turbulence fluxes	~120 stations from over SGP (OKM, ARM) ~7 stations (ARM)	1999-2012 2000-2012	Contact Moyi Huang of PNNL

Data to Be Developed for 2014 GoAmazon - Initial plan

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Dataset	Variable	Resolution	Period	Notes
AIP	Aerosol properties			
AERINOISEFILTER	Aerosol properties			
AOSCCNAVG	Aerosol properties			
MFRSRLANGLEY	Aerosol properties			
MFRSRAOD	Aerosol optical depth			
SASHELANGLEY	Aerosol optical depth			
SASHEAOD	Aerosol optical depth			
QCRAD	Surface radiation			
MPLCMASK	MPL cloud mask			
PBLHTSONDE	PBL Height			
INTERPSONDE	Merged sonde?			
MWRRET	LWP/TWP			
WACRARSCL	Cloud boundaries			
MFRCLDOD	Cloud optical depth			

Impact of ARM Reconfiguration

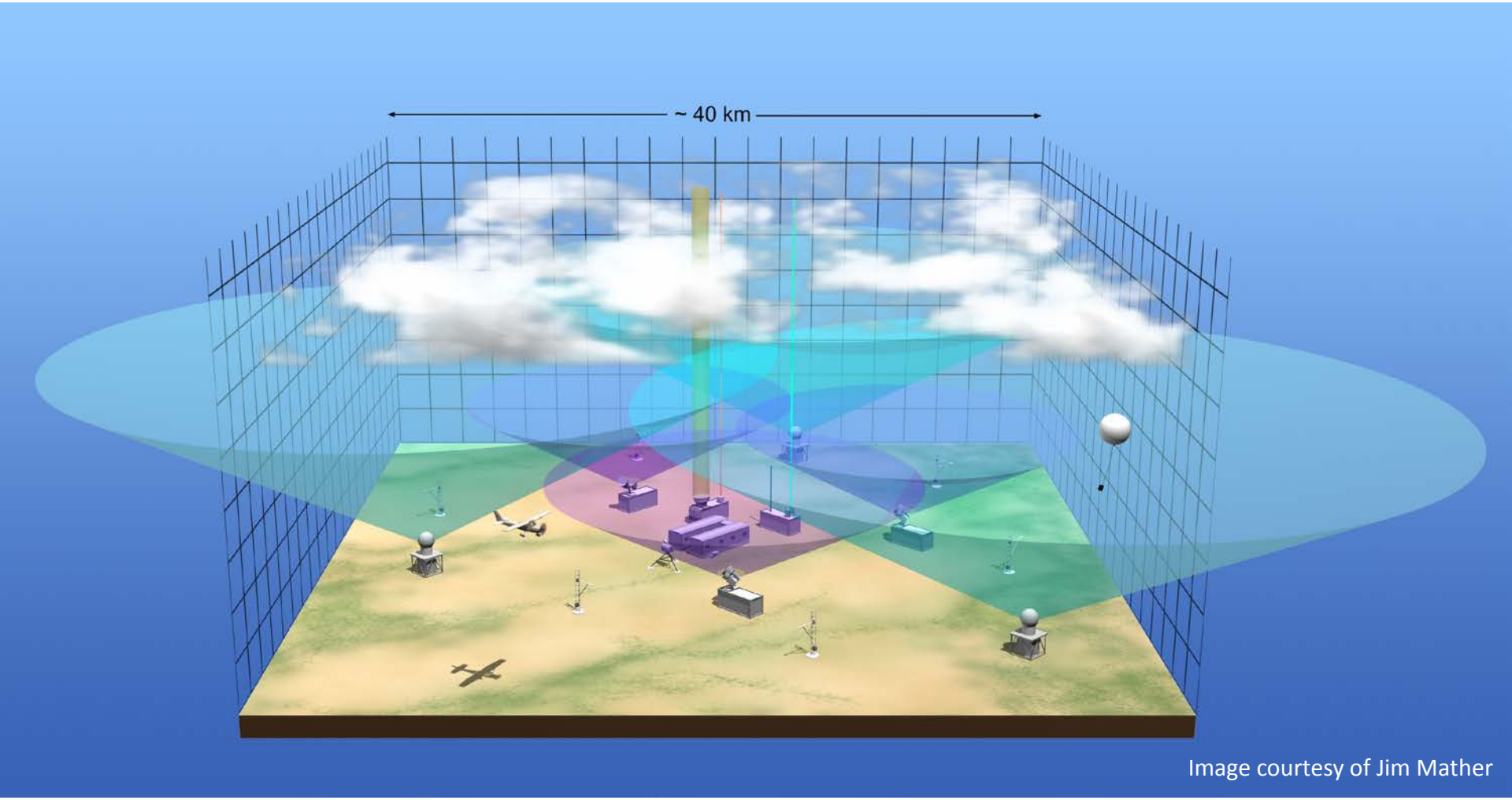

Image courtesy of Jim Mather

Impact of ARM Reconfiguration

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- What new science questions could be addressed with the new ARM paradigm?
  - Better understanding of the sub-grid PDFs.
  - How does this understanding lead to improved parameterizations?
  - ARM sites are more mobile—different sites could be selected.
- Observations
  - How many surface flux and soil moisture measurements are needed for the new ARM supersite?
  - Do we need to make some measurements of biogenic fluxes?
  - What is the role of large-scale advective processes
- Modeling
  - Should the LES model be driven with observed surface fluxes or from those generated using a land-surface model (like CLM)?
    - Could this be better done off-line?
  - Do we need a model with chemistry?

Impact of ARM Reconfiguration

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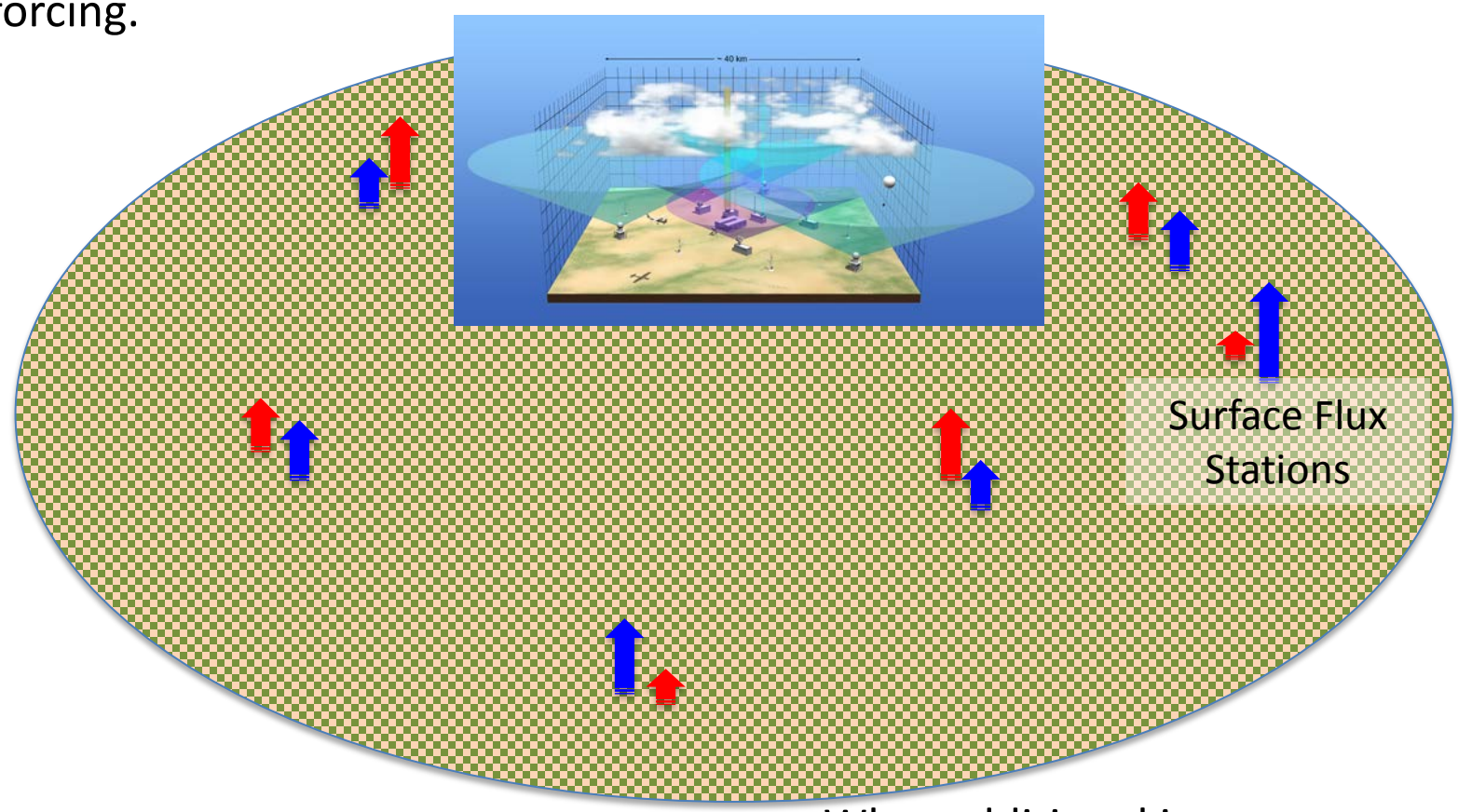
Disperse network to help match flux footprint of the interior box, and to help define the large scale forcing.



What additional instruments are needed inside the outside the supesite?

Measurement Needs/IOPs

Fixed ARM Sites

- What new measurements are required?
- Data products, new VAPS?

Other field studies

- GoAmazon
- Year of the Maritime Continent (YMC)
- What other IOPs are being developed that could be useful to the community?

Wrap-Up and Action Items

- How to proceed:
  - **Focus group:** To provide a means for organizing, coordinating, and supporting scientific efforts that are of high importance to ASR yet are substantially larger than any individual PI effort. Typically these groups will focus on a specific process that is not well understood and modeled. The results, products, and/or output from these groups will comprise some of the important deliverables that help to define ASR and its progress.
  - **Interest group:** Somewhat less formal than Focus group, no specific organization.
  - Something different?
- What specific actions will individuals take?

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