

Towards community-based analysis of the CMIP DECK experiments

Peter J. Gleckler

Crescendo-Primavera kick-off meeting

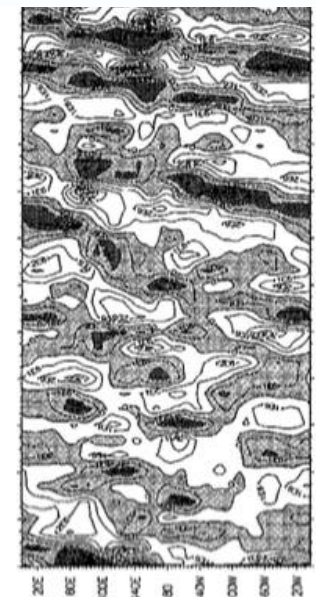
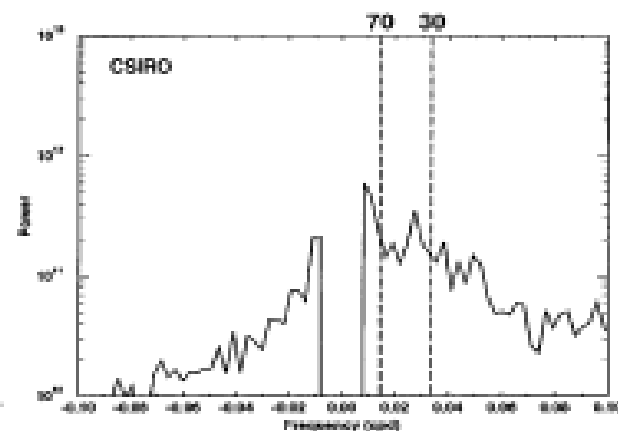
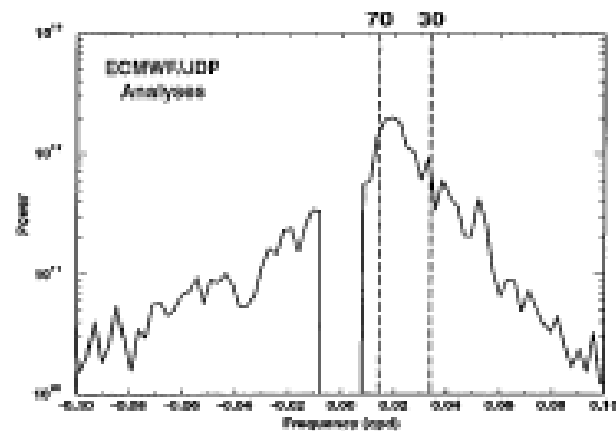
Exeter, November 24-25, 2015

Program for Climate Model Diagnosis and Intercomparison, LLNL



Intraseasonal oscillations in 15 atmospheric general circulation models: results from an AMIP diagnostic subproject

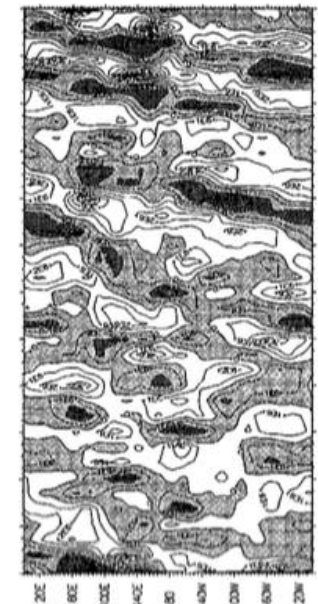
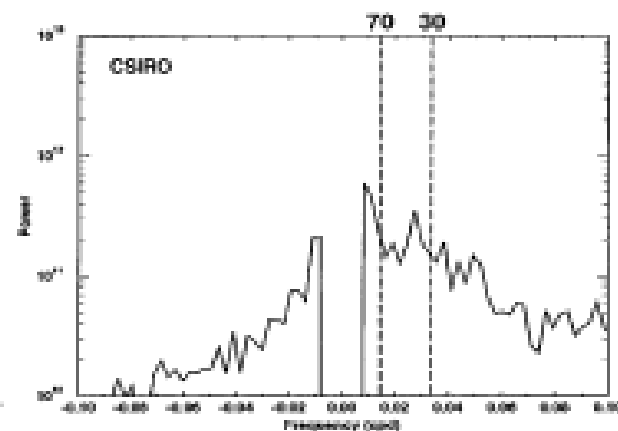
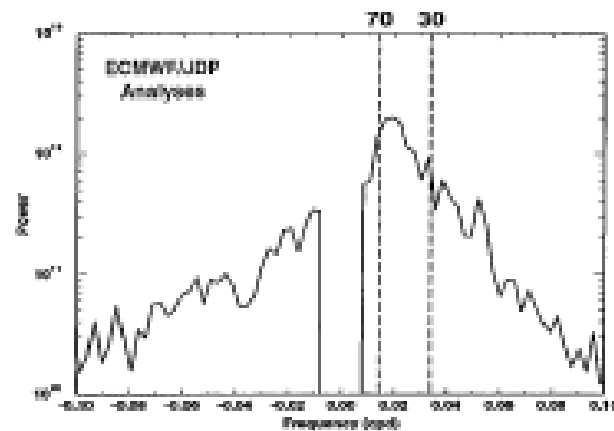
Upper Level Velocity Potential (10°N - 10°S average) Wave # 1 Power Spectra (June-May)



Intraseasonal oscillations in 15 atmospheric general circulation models: results from an AMIP diagnostic subproject

J. M. Slingo¹, K. R. Sperber², J. S. Boyle², J.-P. Ceron³, M. Dix⁴, B. Dugas⁵, W. Ebisuzaki⁶, J. Fyfe⁷, D. Gregory⁸, J.-F. Gueremy³, J. Hack⁹, A. Harzallah¹⁰, P. Inness⁸, A. Kitoh¹¹, W. K.-M. Lau¹², B. McAvaney¹³, R. Madden⁹, A. Matthews¹, T. N. Palmer¹⁴, C.-K. Park¹⁵, D. Randall¹⁶, N. Renno¹⁷

Upper Level Velocity Potential (10°N-10°S average) Wave # 1 Power Spectra (June-May)



Talk outline

- **Intro and motivation**
 - **Obs4MIPs and related efforts**
 - **Toward community-based analysis of the CMIP DECK**
 - **Some perspective on how we might get there**
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CMIP Infrastructure

“Nuts and bolts”

- Experiment protocols and standard output descriptions
- Climate Forecast (CF) convention (as applied in CMIP)
- Software to ensure data complies to CMIP structure: CMOR; CF-checker
- Distribution: ESGF targets the CMIP application of CF
- Coordinating projects: Earth System CoG interfaced to ESGF



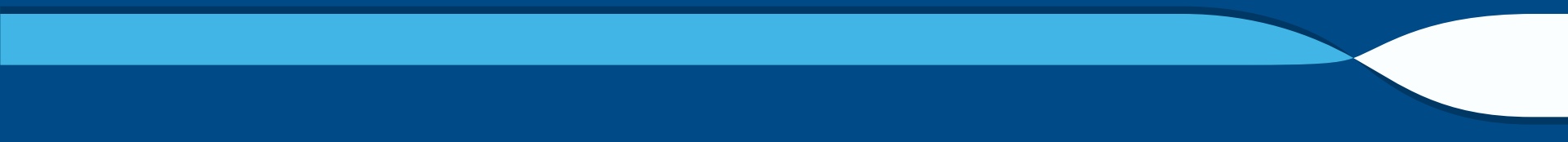
CMIP Infrastructure

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 - Distribution: ESGF targets the CMIP application of CF
 - Coordinating projects: Earth System CoG interfaced to ESGF
- Little in the way of coordinating:
 - Routinely used observations
 - Community-based analysis well-suited for repeat use

Obs4MIPs

**Objective: To make observational data more accessible
for evaluation of CMIP class simulations**

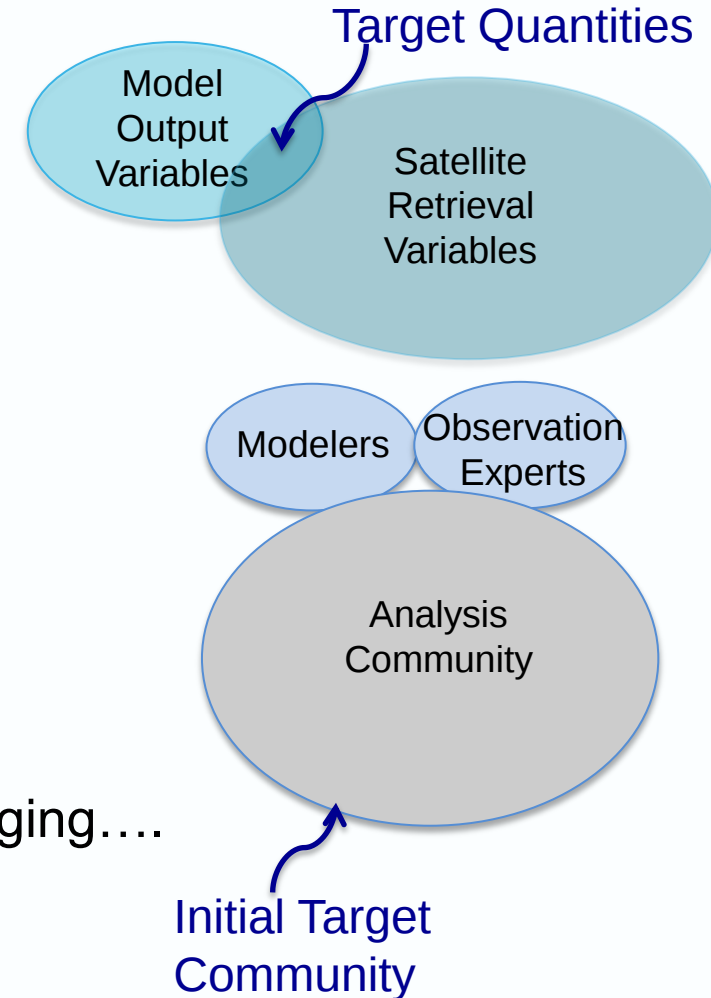
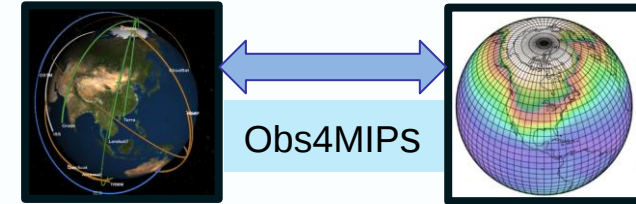


obs4MIPs: the 4 commandments

Is now a WCRP project with oversight provided by a WDAC task team

1. Use the CMIP standard model output as guideline for selecting observations
2. Observations structured similar to CMIP model output
3. Hosted on the ESGF with CMIP output
4. Include a technical note for each dataset

Has been limited to satellite data but that is changing....



obs4MIPs: Current set of satellite observations

Sorted by CF Variable *Long Name*

Air Temperature	Near-Surface Wind Speed
Ambient Aerosol Optical Thickness at 550 nm	PARASOL Reflectance
CALIPSO 3D Clear fraction	Precipitation*
CALIPSO 3D Undefined fraction	Sea Surface Height Above Geoid
CALIPSO Clear Cloud Fraction	Sea Surface Temperature
CALIPSO Cloud Fraction	Specific Humidity
CALIPSO High Level Cloud Fraction	Surface Downwelling Clear-Sky LW
CALIPSO Low Level Cloud Fraction	Surface Downwelling Clear-Sky SW
CALIPSO Mid Level Cloud Fraction	Surface Downwelling LW
CALIPSO Scattering Ratio	Surface Downwelling SW
CALIPSO Total Cloud Fraction	Surface Upwelling Clear-Sky SW
Cloud Fraction retrieved by MISR	Surface Upwelling LW
CloudSat 94GHz radar Total Cloud Fraction	Surface Upwelling SW
CloudSat Radar Reflectivity CFAD	TOA Incident SW
Fraction of Absorbed Photosynthetically Active Radiation	TOA Outgoing Clear-Sky LW
ISCCP Cloud Area Fraction (Joint histogram of opt thickness and CTP)	TOA Outgoing Clear-Sky SW
ISCCP Mean Cloud Albedo (Cloud-fraction weighted & daytime)	TOA Outgoing LW
ISCCP Mean Cloud Top Pressure (Cloud-fraction weighted & daytime)	TOA Outgoing SW
ISCCP Mean Cloud Top Temperature (Cloud-fraction weighted & daytime)	Total Cloud Fraction
ISCCP Total Cloud Fraction (daytime only)	Water Vapor Path
Leaf Area Index	
Mole Fraction of O3	

* 3 hourly data

A number of new datasets in the queue

A high bar: completeness criteria for documenting obs4MIPs satellite datasets provided by agencies or data experts (current status)

Meets data technical requirements

Can be related to CMIP standard output

Includes obs4MIPs technical note

Demonstrated use for evaluating climate models

DOI issued for data

DOI issued for technical note

Maturity Matrix of data processing/documentation

Maturity Matrix of data quality

Required for inclusion in obs4MIPs

Strongly encouraged

Additionally desired criterion



obs4MIPs planning for CMIP6 – future needs

Workshop at NASA HQ (May 2014)

Consensus recommendations:

- Expand the inventory, and include higher frequency satellite data
- Push for reliable and defensible error characterization/estimation
- Include datasets in support of off-line simulators
- Collocated observations, including in-situ datasets, particularly valuable for diagnosing critical processes

Ferraro et al., 2015: Evolving Obs4MIPs to Support CMIP6. *BAMS*, **96**, ES131–ES133.



Current status

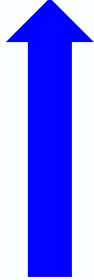
- Available through CoG-ESGF; peer-projects ana4MIPs, CREATE-IP
 - Commitments to contribute datasets: ESA CCI, EUMETSAT, NASA, NOAA
 - WCRP/WDAC recommendation for activity to extend beyond satellite data
 - PCMDI preparing CMOR3 for CMIP6 *and* to accommodate observational data, via an “EZ-CMOR” package to facilitate new obs4MIPs categories
- Work needed to define metadata templates for different classes of data (e.g., describing uncertainty estimates, in-situ); keeping aligned to CMIP
- Task team streamlining process of accepting/implementing datasets
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Targeting the CMIP6 DECK + HISTORICAL

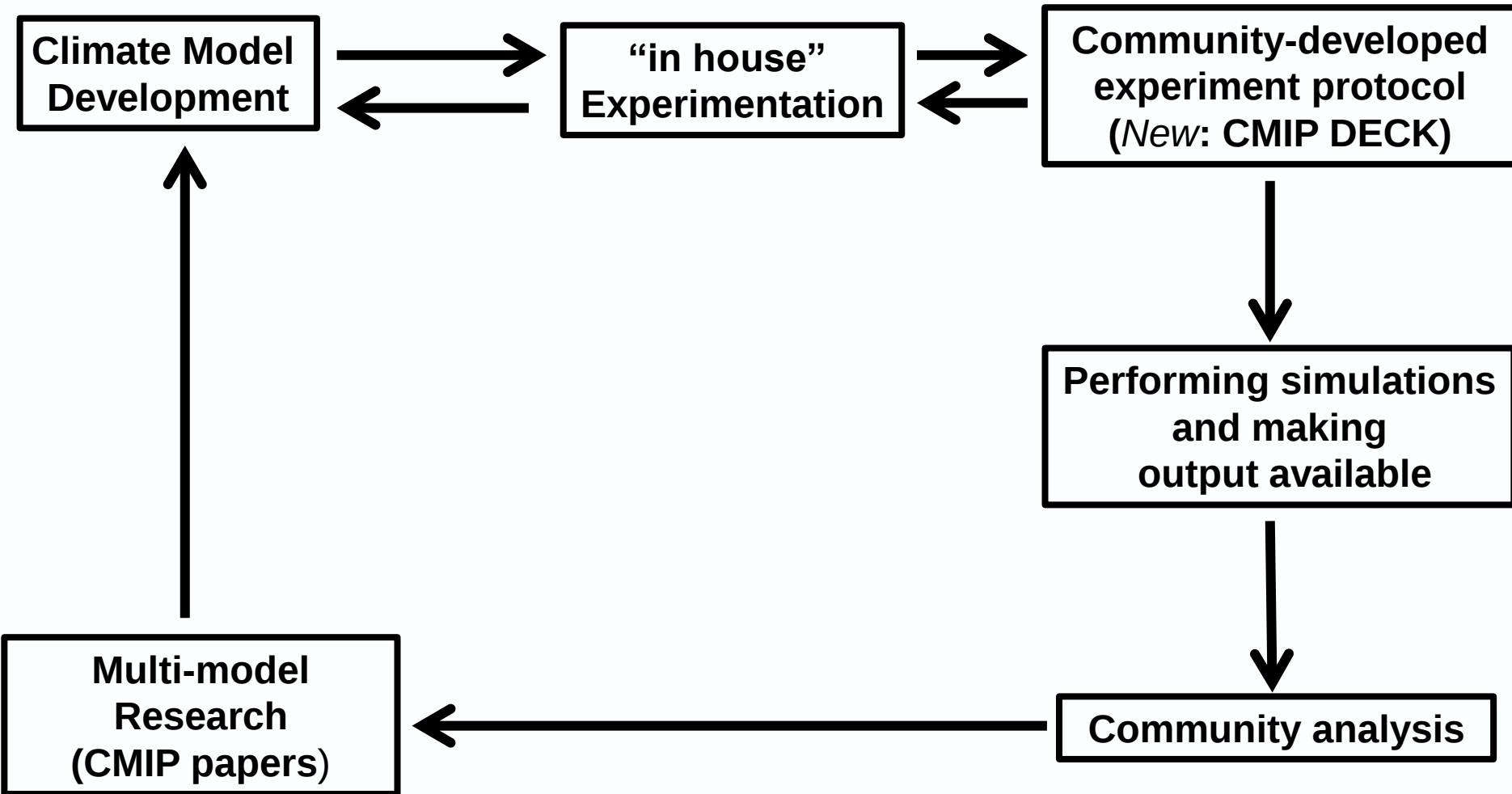


Documenting model behaviour

Differentiating between benchmarking and research

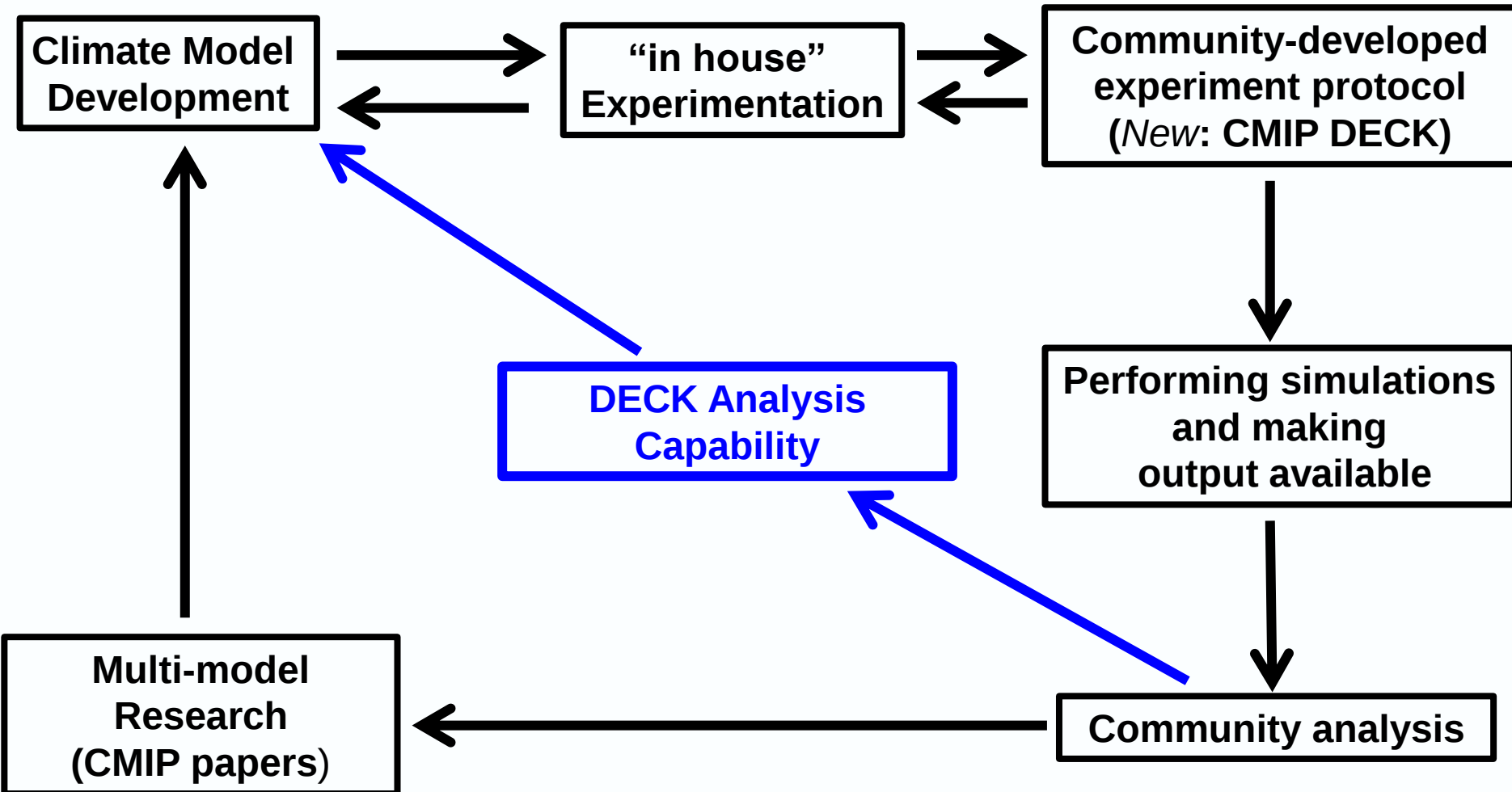
- Slowly evolving CMIP DECK is ideally suited for repeat application or “benchmarking” with well-established evaluation capabilities
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- Research driven; new methods
 - Targeted experimentation (individual group experimentation, TAMIP, CFMIP, new CMIP6 MIPs, ...)

How can CMIP more directly assist model development?



How can CMIP more directly assist model development?

Enable modelers to leverage diverse analysis community expertise



CMIP evaluation tools to produce well-established analyses as soon as model output becomes available
e.g., Community-developed ESM Evaluation Tool and PCMDI metrics package



AR5 CHAPTER 9



LINK TO PROJECTION



Opportunities

Benchmarking the Diagnosis, Evaluation & Characterization of Klima

- A wealth of rapidly produced results documenting model behaviour, and useful for research
- Compliment and enhance traditional MIP research:
 - Reduce “reinventing the wheel”
 - “Raise the bar”
- Better positioned to address external needs/pressures:
 - Providing material for climate assessments
 - Demonstrate to funders the value of community collaboration

Challenges

Benchmarking the Diagnosis, Evaluation & Characterization of Klima

- Coordinating a potential flood of rapid DECK results in CMIP6
 - A WGNE/WGCM panel is tasked to do this
- Developing a flexible path that enables use of multiple tools
- Distinguishing between well-established analysis and research
- How do we document these results?
 - Traceable code and data needed (workflow)
 - What level of granularity? (A DOI for each plot!?)

How do we get there?

CMIP DECK as a target for community based evaluation

- Community working effectively in a distributed environment
 - Improved sharing of model output despite increasing data volumes
 - Observations used repeatedly are readily accessible and traceable
- Effective code sharing -> CMIP analysts contributing diagnostics:
 - Well suited for repeat use evaluation/characterization of DECK runs
 - Easy for modeling groups to implement and facilitate model development

Summary

- Documenting model behavior via the DECK is going to be an important and valuable compliment to exploratory CMIP research
- Crescendo and Primavera ideally positioned to play a leading role:
 - Developing tools well-suited for further development
 - Research leading to new contributions
 - Coordinating with others will further strengthen possibilities