The scale-aware and effective computational convection scheme RCP used in FGOALS-f3
- mitigates the double ITCZ problem
- improves simulation of MJO
- maintains a competitive simulation of TC and extreme precipitation
CMIP6 Evaluation with the ESMValTool
L. Bock, V. Eyring, A. Lauer, M. Righi, B. Andela, L. deMora, B. Little, V. Pedroi, J. Vegas-Regidor, B. Brötz, B. Hassler, M. Schlund and the ESMValTool Development Team

- Community diagnostics and performance metrics tool for the evaluation of Earth System
- Standardized model evaluation can be performed against observations, against other models or to compare different versions of the same model
- Many diagnostics and performance metrics covering different aspects of the Earth System (dynamics, radiation, clouds, carbon cycle, chemistry, aerosol, sea-ice, etc.) and their interactions
- Well-established analysis based on peer-reviewed literature
- Currently ≈ 110 scientist from >30 institutions part of the development team on GitHub

ESMValTool Result Browser at DKRZ
http://cmip-esmvaltool.dkrz.de

Namelist for IPCC AR5 Chapter 9

Variable: tas
Ensemble of 32 members of *historical* simulations with IPSL-CM6A-LR
Some warm too little, some warm ok, some warm too much....
Yet model ECS is 4.7 K for a doubling and aerosol forcing is smallish

Why is so? Can we learn from the members that fit the obs best? Can we learn from the members that reproduce the observed internal variability best? Can this constrain TCR in some way? Should we forget about our archaic (non) way of initialising historical simulations?
The Community Earth System Model version 2 (CESM)
Gokhan Danabasoglu, Jean-Francois Lamarque, and CESM Collaborators
National Center for Atmospheric Research, Boulder, CO USA

Short-Wave Cloud Forcing

Global-Mean Surface Temperature

Equilibrium Climate Sensitivity (ECS) = 5.3°C
The global annual mean TAS shows a warm bias for all ensemble members, that can be explained largely by the typical southern ocean warm bias. The ensemble shows substantial natural variability that includes members with and without “early warming” episodes. e20c = ERA20C reanalysis. Six ensemble members t6xx, started from initial states from the PI control run with 40 years interval.

The model spread is rather large for a 6-member ensemble, compared to few CMIP5 ensembles. It is unclear though if CMIP5 ensembles were representative due to the small number of models. Our variability in global mean temperature is often reflected by AMOC variability, which in turn is linked to interaction with Arctic sea ice cover, most of all in the Labrador See. This behaviour is mirroring features of a 600 y PI control run (not shown here).

The EC-Earth 3 model for CMIP6 has been developed and tuned in several Earth System Model configurations, with the Global Climate Model (GCM) and an interactive dynamic vegetation module LPJ-GUESS (= EC-Earth3-veg), as core physical configurations, supplemented by configurations with/without atmospheric composition, ocean biogeochemistry and Greenland glacier. We document the first ensemble of CMIP6 transient simulations with EC-Earth3-veg.
Indian Ocean Dipole and its linkage to South Asian Monsoon in IITM-ESM
Prajeeesh A G, Swapna P, Krishnan R
CCCR, IITM, India

• The fidelity in reproducing tropical Indian Ocean (IO) variability and its linkages to South Asian Monsoon Rainfall (SAMR) is investigated in the historical simulations of the IITM Earth System Model (IITM-ESM)

• Realistic representation of Indian Ocean Mean state and seasonal cycle. SST are 1K cooler than observed. Thermocline is deeper than observed.

• Leading modes of variabilities of Indian ocean (IOBM, IOD) are well represented in the model. Realisitic Wind-SST-Thermocline coupling.

• IITM-ESM simulates a realistic IOD-SAMR relationship.
The COordinated Regional Downscaling Experiment (CORDEX):
- WCRP project to improve downscaling techniques and usage
- Diagnostic model intercomparison project (MIP) in CMIP6
- Coordinates with ScenarioMIP, HighResMIP, VIACS

Coordinated Output for Regional Evaluations (CORDEX CORE):
- Provide a core set projections across CORDEX domains
- Support IPCC AR6 assessments
- Include CMIP6 GCM driving

Extratropical Cyclone Density

SON Precipitation Interpolated to Three Different Grids

Potential Diagnoses (CMIP5-based examples)
The MRI Earth System Model ver. 2.0 (MRI-ESM2.0): Basic evaluation of the physical component

Meteorological Research Institute, Tsukuba, Japan

✓ AGCM vertical resolution enhanced from 48 (MRI-CGCM3) to 80 (MRI-ESM2).
✓ Physics updated: cloud process, GWD, subgrid-scale ocean physics, etc.

MRI-CGCM3
Bias: 1.95 RMSE: 16.84

MRI-ESM2
Bias: +0.21 RMSE: 9.85

TOA SW bias

Global-mean SAT
-- HISTORICAL --

Meridional heat transports

Global-average Annual-mean Surface Air Temperature

Global-mean SAT
-- SSP --
GFDL’s contributions to CMIP6 – highlights from GFDL CM4 and ESM4
Jasmin John and GFDL’s Model Development Teams

Origins of GFDL CM4/ESM4 for CMIP6

- FLOR
- HiFLOR
- CM2.5
- CM2.6
- CM3
- ESM2M
- ESM2G

High Resolution
Light Chemistry/BGC

Atmos Chem. Aerosol Indirect Effect

OBGC
Ocean vertical coord.

Improved climatology compared to previous GFDL models

Poster: P09
Additional GFDL posters: 1_P15 (Krasting), 2_P08 (Ginoux), 7_P08 (Malyshev)
The UK Earth system model contribution to CMIP6: 1st results

• UKESM1 uses HadGEM3-GC31 as its physical core +
• interactive carbon cycle
• intermediate complexity ocean biogeochemistry
• dynamic vegetation, terrestrial N-limitation scheme
• stratosphere-troposphere chemistry and aerosols

Historical ensemble

Global mean surface temperature

Diagnosed fossil fuel emissions (GtC/yr)

The poster also includes

• 1st Tier 1 scenarioMIP results
• UKESM1 Equilibrium Climate Sensitivity
• UKESM1 Transient Climate Response
Overview of US DOE’s efforts on Model Diagnostics and Metrics for Understanding and Quantifying Model Biases

Water Cycle and Climate Extremes Modeling (WACCEM)
• MIPs: MPAS-CAM participation in HiResMIP
• Finite Amplitude Wave Activity (FAWA) metrics; FLEXTRKR for tracking MCSs

Calibrated and Systematic Characterization, Attribution, and Detection of Extremes (CASCADE)
• MIPs: HiResMIP analysis; RFMIP
• Tools: climextRemes, fastKDE, TECA

Reducing Uncertainty in Biogeochemical Interactions Through Synthesis and Computation (RUBISCO)
• MIPs: C4MIP SSC; LUMIP; LS3MIP
• Benchmark development: ILAMB & IOMB

High-Latitude Application and Testing (HiLAT)
• MIPs: ISMIP6; Polar Cordex; Collaboration on analysis of PAMIP; high-lat metrics

Program for Climate Model Diagnosis & Intercomparison – Cloud Process Research (PCMDI-CPR)
• MIPs: CFMIP; DAMIP; Metrics panel leadership; input4MIPs; OMIP (data sets)
• Metrics: PMP; ARM diagnostics

Cooperative Agreement To Analyze variability, change and predictability in the earth SysTem (CATALYST)
• MIPs: Conduct CFMIP; DAMIP; DCPP; RFMIP; simulations with CESM for CMIP6; analysis for FAMIP & ScenarioMIP
• Metrics: Precipitation benchmarking with PCMDI

An Integrated Evaluation of the Simulated Hydroclimate System of the Continental US
• MIPs: Conduct CFMIP; DAMIP; DCPP; RFMIP; simulations with CESM for CMIP6; analysis for FAMIP & ScenarioMIP
• Metrics: Precipitation benchmarking with PCMDI

Hierarchical Evaluation Framework for Assessing Climate Simulations Relevant to Energy-Water-Land Nexus
• CORDEX contributions; hierarchical metric framework

Renu.Joseph@science.doe.gov
The role of the IPCC Data Distribution Centre in supporting assessments of climate change

Martin Juckes, Martina Stockhause, Bob Chen, Charlotte Pascoe, Sarah Callaghan, Rorie Edmunds

www.ipcc-data.org

- Curation: of key datasets;
- Collaboration: with other data centres;
- Support: for IPCC authors;

NEW in AR6:
Access to multi-petabyte UK and German climate data archives for IPCC authors via cloud services.
PMIP4-CMIP6 simulations of the Last Glacial Maximum climate: first results

Johann Jungclaus’s poster on Thursday:
Transient simulations of the common era

Pascale Braconnot’s poster on Thursday:
Mid-Holocene and Last Interglacial results

Chris Brierley’s poster on Thursday:
changes in variability in PMIP4-CMIP6

Sandy Harrison’s poster on Thursday:
evaluating PMIP4-CMIP6 simulations

New Compared to previous PMIP phases, uncertainties related to boundary conditions will be investigated
PMIP4-CMIP6 simulations of the Last Glacial Maximum climate: first results

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evaluating PMIP4-CMIP6 simulations

Compared to previous PMIP phases, uncertainties related to boundary conditions will be investigated

LGM poster: today !!
CMIP5/AR5 results + very preliminary PMIP4-CMIP6 results:

New

dust

Ice sheets

Kageyama et al, GMD, 2018
Diagnosis of model bias improvement of KIOST Earth System Model
YoungHo Kim*, Yign Noh, Myong-In Lee, Ho Jin Lee, Daehyun Kim
*yhkim@kiost.ac.kr

South. Ocn. Warm Bias

KIOST_ESM1 JFM SST bias KIOST_ESM1 JAS SST bias
CM2.5 JFM SST bias CM2.5 JAS SST bias

EN4 JFM SST (1982-2010) EN4 JAS SST (1982-2010)

JFM SST JAS SST

CM2.5(REF)-EN4

ENS0

Regression map to ENSO indices

NINO3.4
KIOST_ESM
NINO3

EN4
KIOST_ESM
HadISST (Obs.)
CM2.5(REF)

MJO Wavenum-freq-spectrum

KIOST_ESM Observation CM2.5(Ref.)

OLR U-wind

Summer

OLR U-wind

OLR U-wind

OLR U-wind

Power spectrum

KIOST_ESM HadISST (Obs.) CM2.5(REF)
Phase 2 (2018-2021) will focus on additional diagnostics and will leverage the CMIP6 ensemble of simulations.

Open-source, proposal-driven effort to develop process-oriented diagnostics that will inform model development and help reduce systematic biases.

New diagnostic showing the relationship between record-breaking global annual mean temperature events and the occurrence of El Niño.

(Chia-Wei Hsu and Jianjun Yin – U. Arizona; Stephen Griffies – NOAA-GFDL.)
Advancing our understanding of the impacts of historic and projected land use: The Land Use Model Intercomparison Project (LUMIP)
Co-chairs: David Lawrence and George Hurtt

Main Questions
• What are effects LULCC and land management on climate, water cycling, and biogeochemical cycling?
• Are there regional land-management strategies with promise to help mitigate against climate change?

Additional focal topics
• Coupled vs uncoupled responses
• Biogeochemical vs. biogeophysical impact
• Land cover vs. land use change
• Modulation of LULCC impacts by land-atmosphere coupling strength
• Modulation of CO₂ fertilization by LULCCC

> 12 registered plans for manuscripts
• Aspen Global Change Institute meeting in September (?)
The Energy Exascale Earth System Model (E3SM) v1: Evaluation and Analysis of Climate Sensitivity
Chris Golaz, Peter Caldwell, Luke Van Roekel, L. Ruby Leung, and many others

- **E3SMv1** is the first major release of DOE’s Energy Exascale Earth System Model.
- E3SMv0 started as a fork of CESM1.
- New components include MPAS-Ocean, MPAS-Seaice, and MOSART (river).
- Standard resolution: 1 deg atm, 72 levels (top ~0.1 hPa); 60 to 30 km ocean, 60 levels.

Comparison of RMSE with CMIP5 (1981-2005)

- **Surface air temperature**
  - Excessive warming trend
  - Lack of warming

![](chart.png)
Brazilian Earth System Model – BESM-OA2.9
Developments Towards CMIP6

National Institute for Space Research – INPE, Brazil

How does the Earth system respond to forcing scenarios?

**BESM2.9 Coupled Suite for CMIP6**

- Coupled SpinUp
- Prescribed Land Use/CO2 Scenarios
- BAML AGCM
- MOMS OGCM
- BAML AGCM
- MOMS OGCM
- IC
- Land SMBIPs
- models
- SIS Marine ice
- hourly coupling
- GFED3

**Model Characteristics**

- Enhanced grid resolution
- Improved atmospheric physics
- Included dynamical vegetation
- Upgraded ocean model

**Model Skills**

- Global Ave SAT
- Atlantic ITCZ Index

**BESM2.5 → BESM2.9**

- Model Grids: **Atmos**: T062L28 & T126L42;
- **Ocean**: 50 zlevs Lon: 1° Lat: 0.25° Trop. 2° Poles

Acknowledgements: This work was supported by the National Institute of Science and Technology for Climate Change Phase 2 under CNPq Grant 465501/2014-1, FAPESP Grant 2014/50848-9 and the National Coordination for High Level Education and Training (CAPES) Grant 16/2014.

CMIP6 Model Analysis Workshop, 25-28 March 2019, Barcelona (Spain)
Comparison of Earth System Models through Effective Documentation of Models and Insight about the Implementation of Forcings

Presented by Charlotte Pascoe [charlotte_pascoe@ncas.ac.uk]

One of the beneficial outcomes of the formal documentation of CMIP6 within ES-DOC has been a clearer understanding of the dependencies of MIPs on each other and of experiments on shared forcing constraints.

Atmosphere
Atmospheric Chemistry
Land
Land Ice
Sea Ice
Ocean
Ocean Bio-Geochemistry

The sharing of experiments between the CMIP6 MIPs.

The ES-DOC Realms for CMIP6

Top Level
Atmosphere
Atmospheric Chemistry
Land
Land Ice
Sea Ice
Ocean
Ocean Bio-Geochemistry

Further information can be found by visiting https://es-doc.org and in Pascoe et. al. Designing and Documenting Experiments in CMIP6 (in preparation for GMD)
Objective Performance Summaries across CMIP generations

Peter Gleckler, Charles Doutriaux, Jiwoo Lee, Paul Durack, Yuying Zhang, and many others
Lawrence Livermore National Laboratory, California, USA

**AS MODELERS FOCUS ON TARGETED IMPROVEMENTS, ARE ALL CHARACTERISTICS IMPROVING OR ARE SOME NOT CHANGING OR EVEN DETERIORATING IN THEIR AGREEMENT WITH OBSERVATIONS?**

**WE USE THE PCMDI METRICS PACKAGE (PMP) TO PRODUCE A DIVERSE SUITE OF ROBUST HIGH-LEVEL SUMMARY STATISTICS COMPARING MODELS AND OBSERVATIONS ACROSS REALMS, SPACE AND TIME SCALES.**

**OUR SIMULATION SUMMARIES ARE BASED ON PCMDI RESEARCH AND COLLABORATIONS WITH EXPERT TEAMS SUCH AS CLIVAR ENSO GROUP AND WGNE MJO TASK FORCE**

![Graphs and charts illustrating model performance metrics.](image)
The importance of data references in CMIP6 data usage and IPCC climate assessments

CMIP6 Model Analysis Workshop,
25-28 March 2019, Barcelona

M. Stockhause, M. Lautenschlager
German Climate Computing Center (DKRZ)
Why cite data?

- Give credit to data providers
- Improve traceability of research findings
Three Steps for Data Citation

I. Find CMIP6 Data References

input4MIPs example:

- ESGF CoG portal
  https://esgf-node.llnl.gov/search/input4mips/

- Google Dataset Search
  https://toolbox.google.com/datasetsearch/

- NetCDF file → ES-DOC → DOI landing page
Three Steps for Data Citation

I. Find CMIP6 Data References

II. Cite Data

Include data references in reference lists of articles, e.g. https://doi.org/10.1029/2018EO101751 (according to the recommendation of the “Enabling FAIR Data Project”)
Three Steps for Data Citation

I. Find CMIP6 Data References

II. Cite Data

III. Credit and Reuse

- Impact of CMIP6 data reaches the data providers via services of the publishers (e.g. WoS) or via Scholix and data publisher services

- Article readers can reuse the data by resolving the DataCite DOI (part of the data reference), e.g. [https://doi.org/10.22033/ESGF/input4MIPs.2204](https://doi.org/10.22033/ESGF/input4MIPs.2204)
Diagnosing climate sensitivity and radiative feedback in idealized experiments of K-ACE

Minah Sun1*, Hyun Min Sung1, Byeonghyeon Kim1, Jisun Kim1, Johan Lee2, Jinwon Kim1, Sungbo Shim1, Yoon-jin Lim1, and Young-Hwa Byun1

1Climate Research Division, 2Earth System Research Division, NIMS/KMA, Jeju, Korea (E-mail: masun@korea.kr)

- The K-ACE (KMA's Advanced Climate Earth System model) has been developed by NIMS/KMA (Lee et al., 2019) to contribute to the CMIP6 experiments
- The objective of this study is to analyze the climate sensitivity and its feedback to CO2 changes in idealized experiment of K-ACE

Climate sensitivity

- ECS: 5.44 K [CMIP5: 2.1~4.7 (3.37 ± 0.29) K]
- TCR: 3.05 K [CMIP5: 1.1~2.6 (1.8 ± 0.6) K]

Climate feedback

- High Thin ↓ across maritime continent
- High Sub-visual ↓ across low latitude → negative LW CRE
- Low Thick ↓ → positive SW CRE

Radiative feedback parameter
Input Datasets for Model Intercomparison Projects

Paul J. Durack, Karl E. Taylor, Sasha K. Ames, and Jiwoo Lee

- **Purpose**: to collect and curate CMIP6 forcing datasets
- **Status**: All DECK/historical and ScenarioMIP datasets in place
  - 14 other MIPs served
- **Datasets accessible at**: [https://esgf-node.llnl.gov/projects/input4mips/](https://esgf-node.llnl.gov/projects/input4mips/)
- **Data description and history**: [http://goo.gl/r8up31](http://goo.gl/r8up31)
- **Established elements**:
  - Full version control implemented
  - Helpful metadata follows CMIP6 standards
  - ES-DOC errata service in place
  - Slack collaboration site enabled
An Overview of the First Results from ScenarioMIP Experiments
Claudia Tebaldi & co.

CNRM, IPSL, INM, MRI and UKESM

6 models

4 scenarios from Tier 1: SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5

TAS and PR results as global time series and normalized patterns of change

Focus on ensemble averages and comparison with CMIP5 for the 3 ‘common scenarios’:

SSP1-2.6 <-> RCP2.6
SSP2-4.5 <-> RCP4.5
SSP5-8.5 <-> RCP8.5
Building Bridges between Modeling and Applications Communities

The Vulnerability, Impacts, Adaptation and Climate Services (VIACS) Advisory Board for CMIP6

**Phase I (2016-2018)**
*Establishing the VIACS Advisory Board and informing the design of CMIP6 simulations*

**Phase II (2019-2021)**
*Initial evaluation of CMIP6 models using DECK experiment outputs and the application of broader CMIP6 outputs*

**Key challenges for VIACS/ESM connection**
- Improved VIACS models and analyses to make use of improved outputs
- Practical use of huge variety of models, ensemble members, and MIP experiments
- Incorporation of offline VIA results and VIA-oriented diagnostics for ESM development
- ESM expert guidance and technical facilitation for VIACS translation and application

**Practical ideas to enhance communication:**
- Create working groups on selected topics, (e.g., guidance on model output usage and model performance, FAQ, etc.)
- One VIACS/ESM contact person per participating modelling-group
- “Consumer reports” for ESMs listing known, VIACS-relevant biases
- Demonstration papers for CMIP6 MIPs: VIACS leader and MIP leader model application
- VIACS participation in major CMIP (and related) workshops and conferences

VIACS AB Mailinglist:
Science Question:
The Atmospheric Infrared Sounder (AIRS) Obs4MIPs (Observations for Model Intercomparison Projects) V1 data set was published in 2011 and is one of the most frequently downloaded Obs4MIPs data sets for climate model evaluation. However, it has three limitations: 1) A short period (September 2002 to May 2011); 2) Based on an older version of AIRS data; 3) No relative humidity.

Data & Results:
The AIRS Obs4MIPs V2 data set, a new data set containing the latest version of AIRS observations, aiming to remove the limitations of the AIRS Obs4MIPs V1 data set, and designed for climate model evaluation, has been published. This data set includes monthly mean gridded tropospheric air temperature, specific humidity and relative humidity for each calendar month from September 2002 to September 2016 on eight vertical pressure levels from 1000 to 300 hPa. The standard error and number of observations, for an estimate of data uncertainty, along with three technical notes are also provided.

Significance:
The AIRS Obs4MIPs V2 data set adds new monthly mean tropospheric relative humidity data to Obs4MIPs, and updates and extends the monthly mean tropospheric air temperature and specific humidity data in the AIRS Obs4MIPs V1 data set.


This work was supported by an award to Baijun Tian under the NASA Data for Operation and Assessment program administered by Dr. Tsengdar Lee.
The nature of 60-year oscillations of Arctic climate according to data of INM RAS climate model. P27

Volodin E. Institute of Numerical Mathematics RAS, Moscow.

1. 60 year climate oscillations in climate model INM-CM5-0 is studied on the basis of preindustrial run (1200 years).
2. Arctic surface temperature show spectral peaks at periods of 60 and 10-15 years.
3. Composite analysis of oscillation with a period of 60 years show enhanced Atlantic water inflow to Arctic ocean 15 years before Arctic warming and during warming itself, and decreased Atlantic water inflow 15 years after warming.
4. Special technique was developed and applied to estimate the contribution of each term in the equations for T and S in generation and phase evolution of 60 year oscillation.
CDO can be linked with CMOR which creates CMIP compliant output. Users can combine other operators with cdo cmor.

**cdo cmor** operator

cdo cmor,MIP-Table, \n   info=config.txt, \n   mapping_table=mt.txt \n   infile
   "File stored in: $DRS/outfile"

**cdo expr** operator

cdo mulc,9.81 in out

cdo expr,"ov=iv*9.81" in out

**Pipe cdo expr and cdo cmor**

cdo cmor,Amon,mt=mt.txt \n  -expr,"ov=iv*9.81" in out

**cdo climate extremes indices**
**Objectives**

1. Improving understanding of cloud-radiative feedback mechanisms in a changing climate.
2. Better evaluation of clouds and cloud feedbacks in GCMs.
3. Understanding of other aspects of climate response related to clouds, such as changes in circulation and precipitation, and link these knowledge to assess climate sensitivity.

**Timeline for data availability of CFMIP3 experiments**

Tier 1 data will be available by the middle of 2019, followed by Tier 2 data by the end of 2019.
Main Progress of the Beijing Climate Center Climate System Model (BCC-CSM) from CMIP5 to CMIP6
Tongwen Wu, Yixiong Lu, Fang Yongjie, and et al.

Abstract Main progresses of Beijing Climate Center (BCC) climate system model from the phase five of the Coupled Model Intercomparison Project (CMIP5) to its phase six (CMIP6) are presented, in terms of physical parameterizations and model’s performance. BCC-CSM1.1 and BCC-CSM1.1m are the two models involved in CMIP5. BCC-CSM2-MR, BCC-CSM2-HR, and BCC-ESM1.0 are the three models configured for CMIP6. Historical simulations from 1851 to 2014 from BCC-CSM2-MR (CMIP6) and from 1851 to 2005 from BCC-CSM1.1m (CMIP5) are used for models assessment. Compared to BCC-CSM1.1m, BCC-CSM2-MR shows significant improvements in many aspects including: tropospheric air temperature and circulation at global and regional scale in East Asia, climate variability at different time scales such as QBO, MJO, diurnal cycle of precipitation, and long-term trend of surface air temperature.

Fig.1 Time series of anomalies in the global (60° S to 60° N) mean surface air temperature from 1850 to 2014. The numbers in the bracket denote the correlation coefficient of 11-year smoothed BCC model data with the HadCRUT4.6.0.0

Fig. 2 Tropical zonal winds (m·s-1) between 5° S and 5° N in the lower stratosphere from 1980 to 2005

Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-254
Revised manuscript under review for journal Geosci. Model Dev.
Overview of the Global Monsoons Model Intercomparison Project (GMMIP) for CMIP6

Tianjun Zhou 1, Andrew Turner 2, James Kinter III 3

1 Institute of Atmospheric Physics, Chinese Academy of Sciences, China, 2 NCAS-Climate and Department of Meteorology, University of Reading, UK, 3 COLA & Dept. of Atmospheric, Oceanic & Earth Sciences, George Mason University, USA.

E-mail: zhoutj@lasg.iap.ac.cn

Objectives

• Contributions of internal processes & external forcings to monsoon evolution
• Effects of Eurasian orography on regional/ global monsoons
• Ocean-atmosphere interaction affects monsoon interannual variability & predictability
• Benefits of developing high-resolution models & improving model dynamics and physics

Background

Coherent variation

Orography regions specified for Tier-3

GMMIP Experiments & other related MIPs

Drivers of GM Changes

Conclusions

✓ Quantifying the role of the internal (IPO, AMO) variability and the external forcing (GHG, aerosol) to GM changes relies on climate modeling.
✓ GMMIP will focus on the dynamical & physical processes that dominate the GM changes.
✓ We hope that GMMIP will provide a useful platform for the climate modeling community in the collaboration of monsoon studies.

CMIP6 Model Analysis Workshop, 25-28 March 2019, Barcelona (Spain)