Fostering links to the Vulnerability, Impacts, Adaptation, and Climate Services (VIACS) communities

Co-Chairs: Claas Teichmann[1] and Alex Ruane[23]
and the VIACS Advisory Board

[1]Climate Service Center Germany (GERICS), HZG, Hamburg
[2]NASA Goddard Institute for Space Studies, New York City
[3]Columbia University Center for Climate Systems Research

Pan-WCRP modelling meeting
9-12.10.2017

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

VIACS Advisory Board - Overview

Designed to help form more coherent and productive link between the climate modeling community and users of CMIP6 outputs from the applications community.

- **Facilitates two-way communication around science and application goals:**
  - construction of model scenarios and simulations
  - informed use of model outputs
  - design of online diagnostics, metrics, and visualizations of relevance to society.

Vulnerability, Impacts, Adaptation

Charged with understanding how climate changes affect natural and human systems

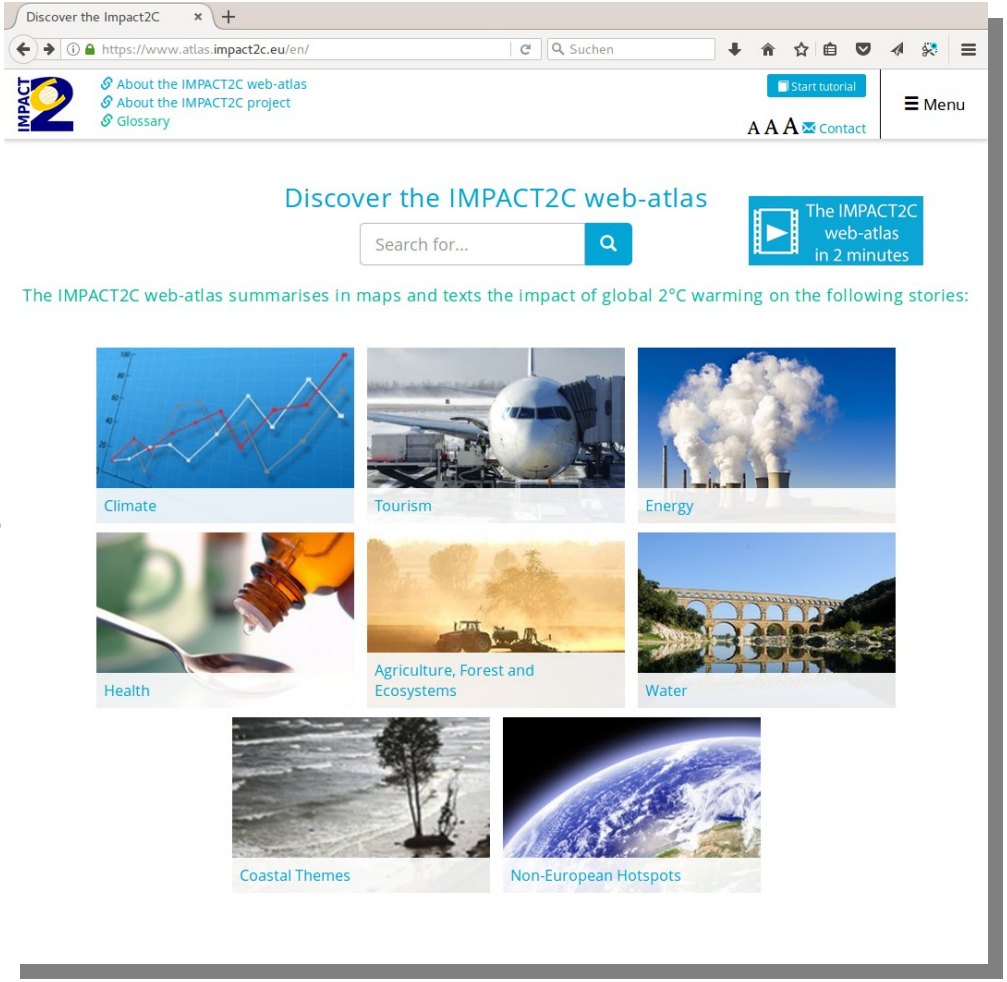
- **VIA Sectors:**
  - Agriculture
  - Forestry
  - Energy
  - Water Resources and Hydrology
  - Oceans/Fisheries
  - Coastal
  - Biomes/Ecology
  - Urban
  - Health
  - Infrastructure/Transportation
- **Projects and Programs:**
  - TGICA, CORDEX, ICONICS
  - WCRP Working Group on Regional Climate
  - ISI-MIP, AgMIP, WaterMIP
  - Others…

Climate Services

Operationalizes climate and VIA information as user-oriented products and tools.

- **Climate Service Organizations:**
  - Public Agencies
  - Private Organizations
  - Academic Institutions

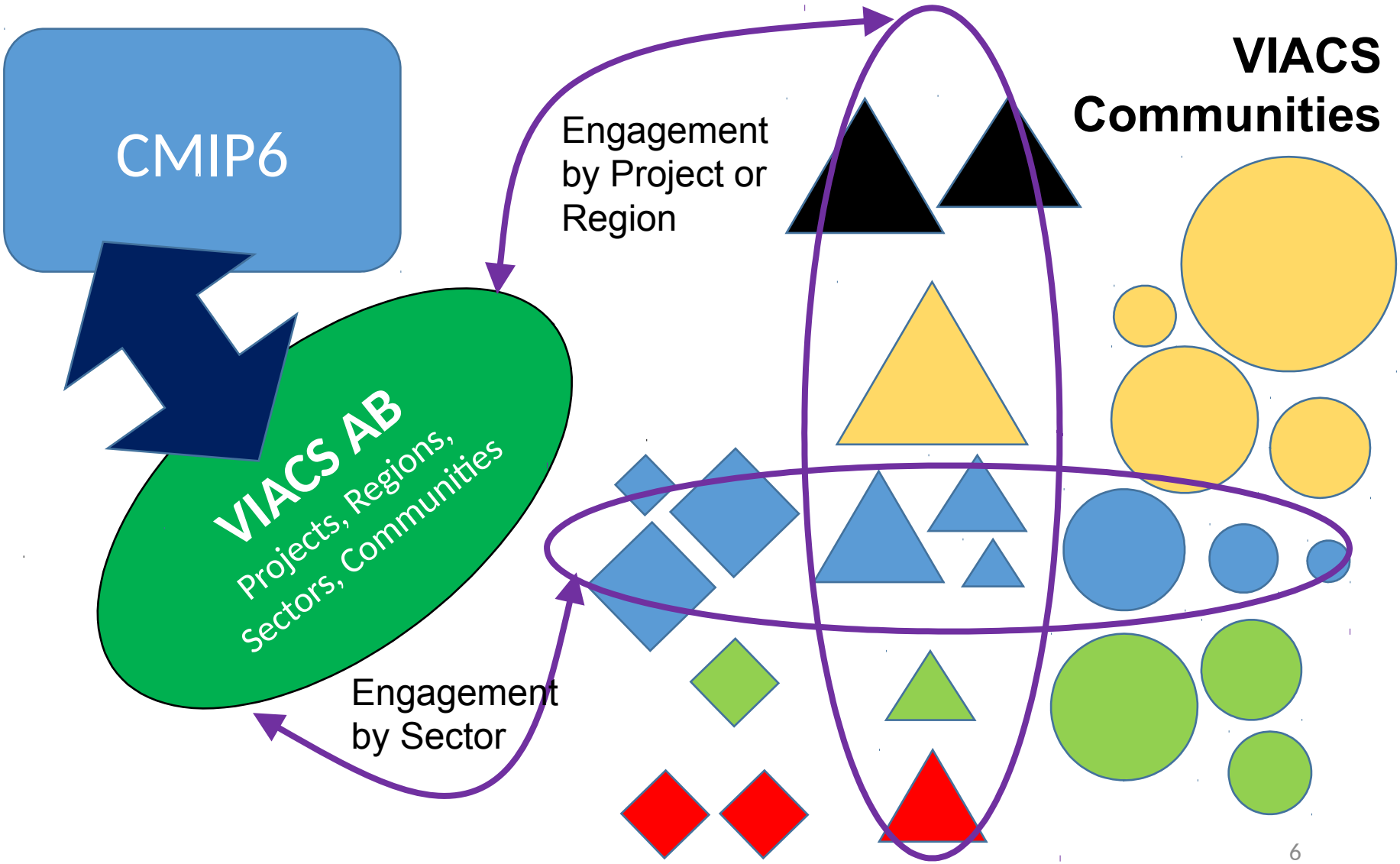
- **Projects and Programs:**
  - Climate Services Partnership
  - Global Framework for Climate Services
  - Climate Change Copernicus Service
  - Others…



VIACS Advisory Board

Name	Community	Institution
Alex Ruane (co-chair)	*Agriculture/AgMIP*	NASA Goddard Institute for Space Studies, USA
Claas Teichmann (co-chair)	*Climate Services*	Climate Service Center, Hamburg, Germany
Nigell Arnell	*WaterMIP*	University of Reading, UK
Tim Carter	*TGICA*	Finnish Environment Institute (SYKE), Finland
Kristie Ebi	*ICONICS/Health*	University of Washington, USA
Katja Frieler	*ISI-MIP*	Potsdam Institute for Climate Impacts Research, Germany
Clare Goodess	*WGRC*	University of East Anglia, UK
Bruce Hewitson	*CORDEX*	University of Cape Town, South Africa
Radley Horton	*Urban/Coastal*	Columbia University, USA
Sari Kovats	*Health*	London School of Hygiene and Tropical Medicine, UK
Heike Lotze	*Oceans/Fisheries*	Dalhousie University, Canada
Linda Mearns	*ICONICS*	National Center for Atmospheric Research, USA
Antonio Navarra	*Climate Services*	Istituto Nazionale di Geofisica e Vulcanologia, Italy
Dennis Ojima	*Land Ecosystems*	Colorado State University, USA
Keywan Riahi	*Energy/IAMs*	International Institute for Applied Systems Analysis, Austria
Cynthia Rosenzweig	*PROVIA/AgMIP*	NASA Goddard Institute for Space Studies, USA
Matthias Themessl	*Climate Services*	Climate Change Centre Austria, Austria
Katharine Vincent	*Climate Services*	Kulima Integrated Development Solutions, South Africa

VIACS Advisory Board – Allows for additional coordinated interaction between CMIP6 and VIACS Communities



VIACS Advisory Board Engagement with CMIP6 Variable Design

900+ CMIP5 Variables assessed for VIACS applications

- Necessary variables for most applications already exist
- Determined priorities – strong desire for more validation studies

60+ new variables requested

- Requirement of different time periods or heights
- Need for low-frequency reports of high-frequency statistics (e.g., monthly output file showing number of days where precipitation exceeded a given heavy rain threshold)

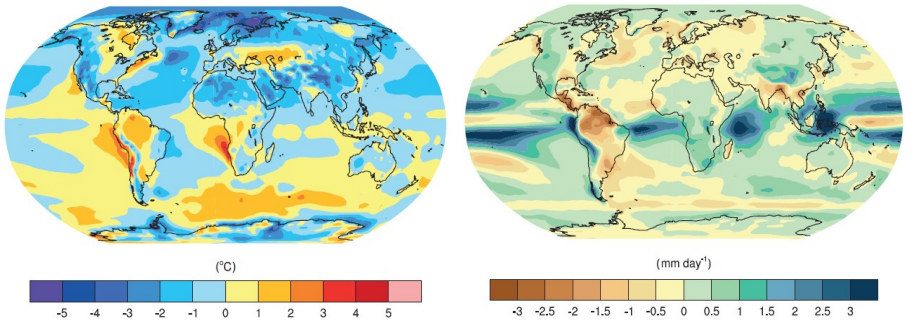
188 MIP Experiments assessed for VIACS applications

- Determined priorities
- Identified specific experiments within MIPs that VIACS community is interesting in exploring for broader implications
- Historical and ScenarioMIP experiments most widely sought, followed by Decadal Climate Prediction Project (DCPP)

Raw ESM output rarely used directly for VIACS analysis due to resolution, biases, sampling of internal variability, and efficiency

ESM outputs are often evaluated through the following lenses:

- Further downscaling
  (dynamical or empirical)
- Bias-adjustment / scenario generation
  (depends heavily on change statistics and target observational dataset)
- Weather generators
  (produce synthetic climate series based on core statistics to examine extremes)
- ESM subsets
  (to eliminate heavily biased models and/or focus resources)
- Climate emulators (e.g., MAGICC, HECTOR)
  (reduced form representation of models for integrated assessment models)



Multi-model mean annual biases for Temperature (left) & Precipitation (right) (Flato et al., 2013)

Key challenges for ESM-VIACS Connections

Improved VIACS models and analyses to make use of improved outputs

Incorporate offline VIA results for ESM development

- Benchmarking of global crop models and vegetation models' croplands (Müller et al., 2017)
- Review of agricultural land representation in ESMs (McDermid et al., in press)

ESM expert guidance and VIACS translation needed:

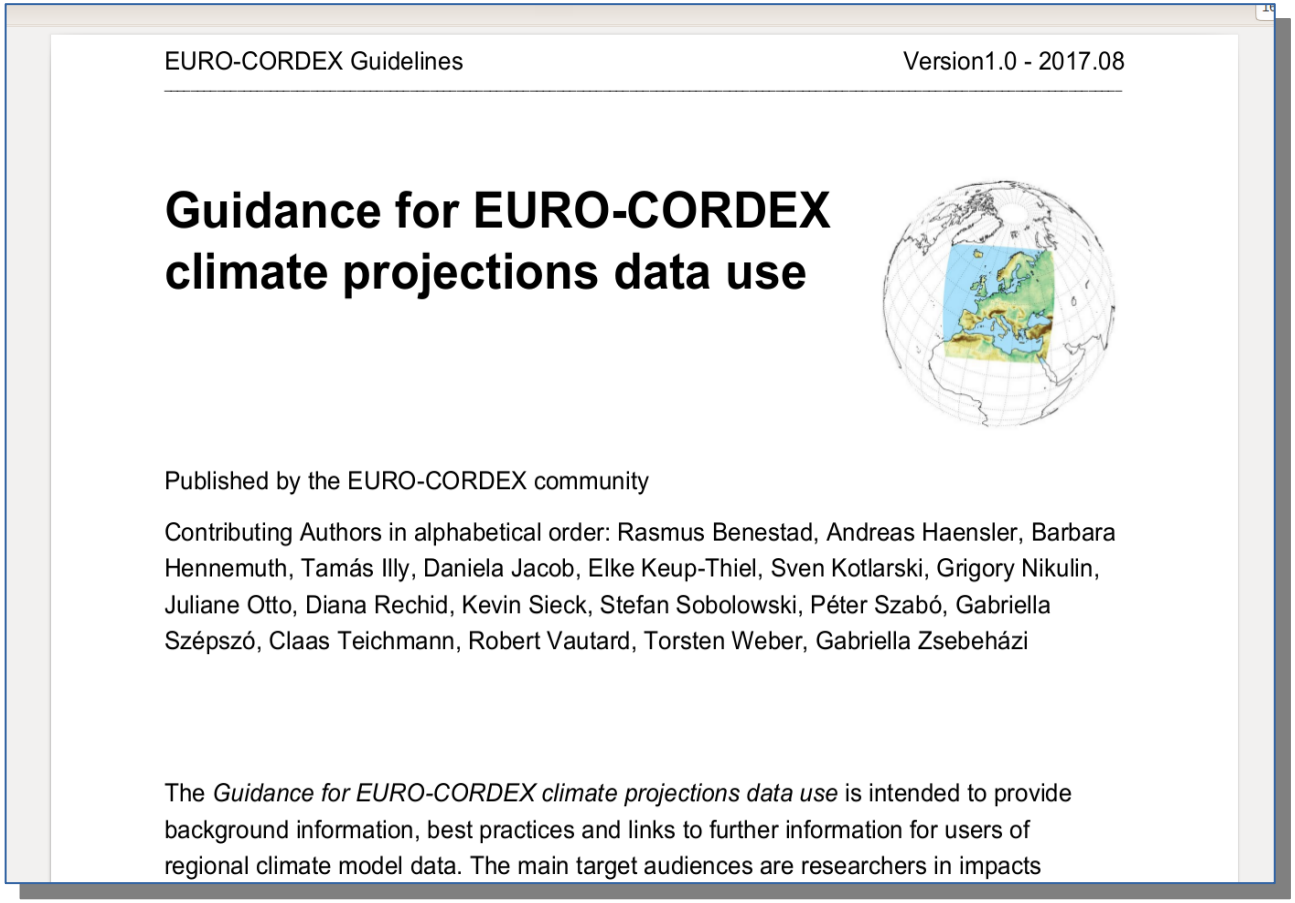
- Do we eliminate models for any purposes?
- How to handle requests that require output variables we do not trust? (e.g., sea-level rise in AR5 without ice sheet dynamics; solar radiation changes; localized extreme events)

Technical facilitation:

- Output access and processing for those with limited resources
- Interactive exploration of potentially huge number of tailored metrics that will be requested

Example for guidelines

EURO-CORDEX guidelines released and distributed to many networks



EURO-CORDEX Guidelines Version1.0 - 2017.08

Guidance for EURO-CORDEX climate projections data use

Published by the EURO-CORDEX community

Contributing Authors in alphabetical order: Rasmus Benestad, Andreas Haensler, Barbara Hennemuth, Tamás Illy, Daniela Jacob, Elke Keup-Thiel, Sven Kotlarski, Grigory Nikulin, Juliane Otto, Diana Rechid, Kevin Sieck, Stefan Sobolowski, Péter Szabó, Gabriella Szépszó, Claas Teichmann, Robert Vautard, Torsten Weber, Gabriella Zsebeházi

The *Guidance for EURO-CORDEX climate projections data use* is intended to provide background information, best practices and links to further information for users of regional climate model data. The main target audiences are researchers in impacts

guidelines.euro-cordex.net

Suggestions to Better Serve VIACS Applications and Downstream Stakeholders

- Produce low-frequency outputs of high-frequency statistical quantities
  - Facilitates large initial condition ensembles to explore internal variability
  - Daily histogram values for temperature and precipitation *(and perhaps RHmin)*
  - Hourly values for extreme thresholds (hot, cold, and wet)
  - Likely more efficient to count in model rather than post-process due to huge amount of output that would be required

- Online data holdings and workflows to facilitate access where computational resources are limited (ESMValTool, PMP, FACE-IT)
  - Common post-processing (e.g., regridding)
  - Ideally could allow customizable metrics (e.g., growing degree days with specified base temperature; number of extreme heat events in specified growing season; percentage of total precipitation falling in heaviest 5% of events)

- General interest in post-processing for applications
  - Summary variables
  - Accessibility (not just huge NetCDFs)
  - Presentation and description

Fostering interaction

Common VIACS-ESM mailinglist:

- Please subscribe for interaction with VIACS AB
  - https://www.listserv.dfn.de/sympa/subscribe/viacsab

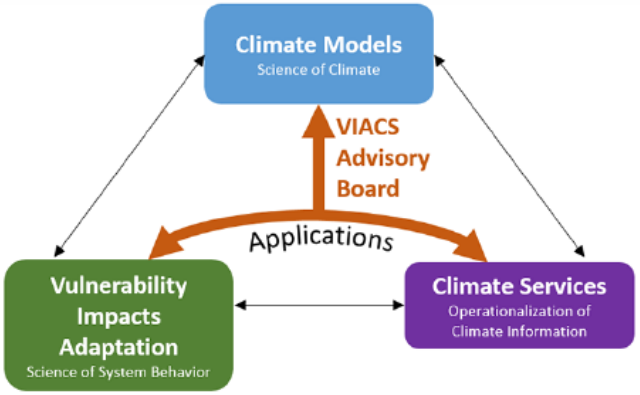
In case of doubt, get in touch with Alex and Claas:

- alexander.c.ruane@nasa.gov, claas.teichmann@hzg.de

Further ideas to enhance communication:

- Create working groups on selected topics, e.g., guidance on model output usage and model performance, FAQ, etc.
- One 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

Continuing Work / Further Ideas



- Stronger link between climate modellers and VIACS AB needed
- Expect new energy for VIACS as CMIP outputs become increasingly available
- Need to ensure that climate models produce outputs that are accessible and of interest to climate application community
- Currently working to construct and process VIACS-relevant metrics for ESM evaluation (e.g., precipitation distributions, 100 meter winds, and 2D surface fields) – *Aspen Global Change Institute Workshop on ESM Evaluation*
- Interest in MIP/VIACS leaders co-authoring papers demonstrating robust applications
- Proposed Obs4VIACS to provide observations for more robust and standardized calibration and validation of impacts models and applications

Thank you for your attention!

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VIACS Advisory Board

Geosci. Model Dev., 9, 3493–3515, 2016
www.geosci-model-dev.net/9/3493/2016/
doi:10.5194/gmd-9-3493-2016

Geoscientific Model Development
Open Access
EGU

The Vulnerability, Impacts, Adaptation and Climate Services Advisory Board (VIACS AB v1.0) contribution to CMIP6

Alex C. Ruane[1], Claas Teichmann[2], Nigel W. Arnell[3], Timothy R. Carter[4], Kristie L. Ebi[5], Katja Frieler[6], Clare M. Goodess[7], Bruce Hewitson[8], Radley Horton[9], R. Sari Kovats[10], Heike K. Lotze[11], Linda O. Mearns[12], Antonio Navarra[13], Dennis S. Ojima[14], Keywan Riahi[15], Cynthia Rosenzweig[1], Matthias Themessl[16], and Katharine Vincent[17]

- **Motivation, initial activities, and plans for VIACS Advisory Board**

VIACS Advisory Board Engagement with CMIP6 Variable Design

900+ CMIP5 Variables assessed for VIACS applications

- Necessary variables for most applications already exist
- Determined priorities – strong desire for more validation studies
- Identified complete sets needed to allow particular applications (e.g., ocean ecosystems requires many unique variable sets)
- Variables may now be downloaded from the CMIP6 Data Request according to community (e.g., several AgMIP packages)

				Variable Set Requests/Categorization			
				AgMIP	CSP	Arctic	FISH-MIP
Variable Category	Time Resolution	Long Name	Units				FISH-MIP
2(e) Monthly land biogeochemistry, soil and land cover data							
CMOR Table Lmon: Monthly Mean Land Fields, Including							
Physical, Vegetation, Soil, and Biogeochemical Variables							
@Lmon	monthly mean	Moisture in Upper Portion of Soil Column	kg m-2	2	2	0	0
	monthly mean	Total Soil Moisture Content	kg m-2	1	1	0	0
	monthly mean	Soil Frozen Water Content	kg m-2	2	2	0	0
	monthly mean	Surface Runoff	kg m-2 s-1	2	2	0	0
	monthly mean	Total Runoff	kg m-2 s-1	2	2	0	2
	monthly mean	Precipitation onto Canopy	kg m-2 s-1	3	3	0	0
	monthly mean	Evaporation from Canopy	kg m-2 s-1	3	3	0	0
	monthly mean	Water Evaporation from Soil	kg m-2 s-1	3	3	0	0
	monthly mean	Transpiration	kg m-2 s-1	3	3	0	0
	monthly mean	Water Content of Soil Layer	kg m-2	1	1	0	0
	monthly mean	Temperature of Soil	K	3	3	1	0
	monthly mean	Tree Cover Fraction	%	4	4	0	0
	monthly mean	Natural Grass Fraction	%	4	4	0	0

VIACS Advisory Board Engagement with CMIP6 Variable Design

60+ new variables requested (and more continuously coming in)

- Requirement of different time periods or heights
- Need for low-frequency reports of high-frequency statistics, e.g.:
  - monthly output file showing number of hours where precipitation exceeded a given heavy rain threshold
  - separation of variables by wet and dry days
- Interest in tile information, if simulated (e.g., agricultural tile of broader grid box)

Photo: constructionweekonline.com

Time resolution	Name (plus description as needed)	Units	Additional notes
New variables requested by the agricultural sector (for Historical, DECK, and ScenarioMIP experiments, as well as requests for experiments within AerChemMIP, C^{4}MIP, DAMIP, DCPP, GeoMIP, LUMIP, and VolMIP).			
Monthly	Surface concentration of ozone	ppm	Also for use ecosystem and health sectors
Daily, monthly	Cropland tile maximum temperatures	K	Tile contains information from agricultural
Daily, monthly	Cropland tile minimum temperatures	K	fraction of land in a given GCM
Daily, monthly	Cropland tile precipitation	kg m^{-2} s^{-1}	grid box.
Daily, monthly	Cropland tile minimum relative humidity	%	
Daily, monthly	Cropland tile wind speed	m s^{-1}	
Monthly	Number of precipitation days where accumulation was above 1 kg m^{-2}	No.	These two variables combine to describe the intensity of rainfall when it does occur.
Monthly	Average precipitation accumulation on days where accumulation was above 1 kg m^{-2}	kg m^{-2}	

VIACS Advisory Board Engagement with CMIP6 MIP Application

188 MIP Experiments assessed for VIACS applications

- Determined priorities for various application packages
- Identified specific experiments within MIPs that VIACS community is interesting in exploring for broader implications

- Historical and ScenarioMIP experiments most widely sought, followed by Decadal Climate Prediction Project (DCPP)
- Nearly all MIPs had at least one experiment that generated VIACS interest

CMIP6 MIP Experiments that you plan on exploring (see full names of MIPs in next tab):

Experiment group	Experiment short name	Experiment Description / Design			AgMIP
@EXPT			188		
Diagnostics, Evaluation, and Characterization of Klima (DECK)-1	AMIP	observed SSTs and sea ice prescribed	24	0	1,2,3
DECK-2	control	coupled atmosphere/ocean pre-industrial control run	26		1,2,3
DECK-3	1pctCO2	impose 1%/yr increase in CO2 to quadrupling*	25		1
DECK-4	abrupt4xCO2	Abruptly quadruple CO2, then hold fixed**	24		1
DECK-5	historical	emission- or concentration-driven simulation of the recent past (~165 years)	26		1,2,3,4,5
AerChemMIP-1	RFDOC-01	Perturbation from 1850 control using PD aerosol and ozone precursor emissions (all aerosols interact with radiation)	23		1, 5
AerChemMIP-1	RFDOC-02	Perturbation from 1850 control using PD aerosol and ozone precursor emissions (only BC aerosols interact with radiation)	21		0