

# Global Gridded Land-use Forcing Datasets

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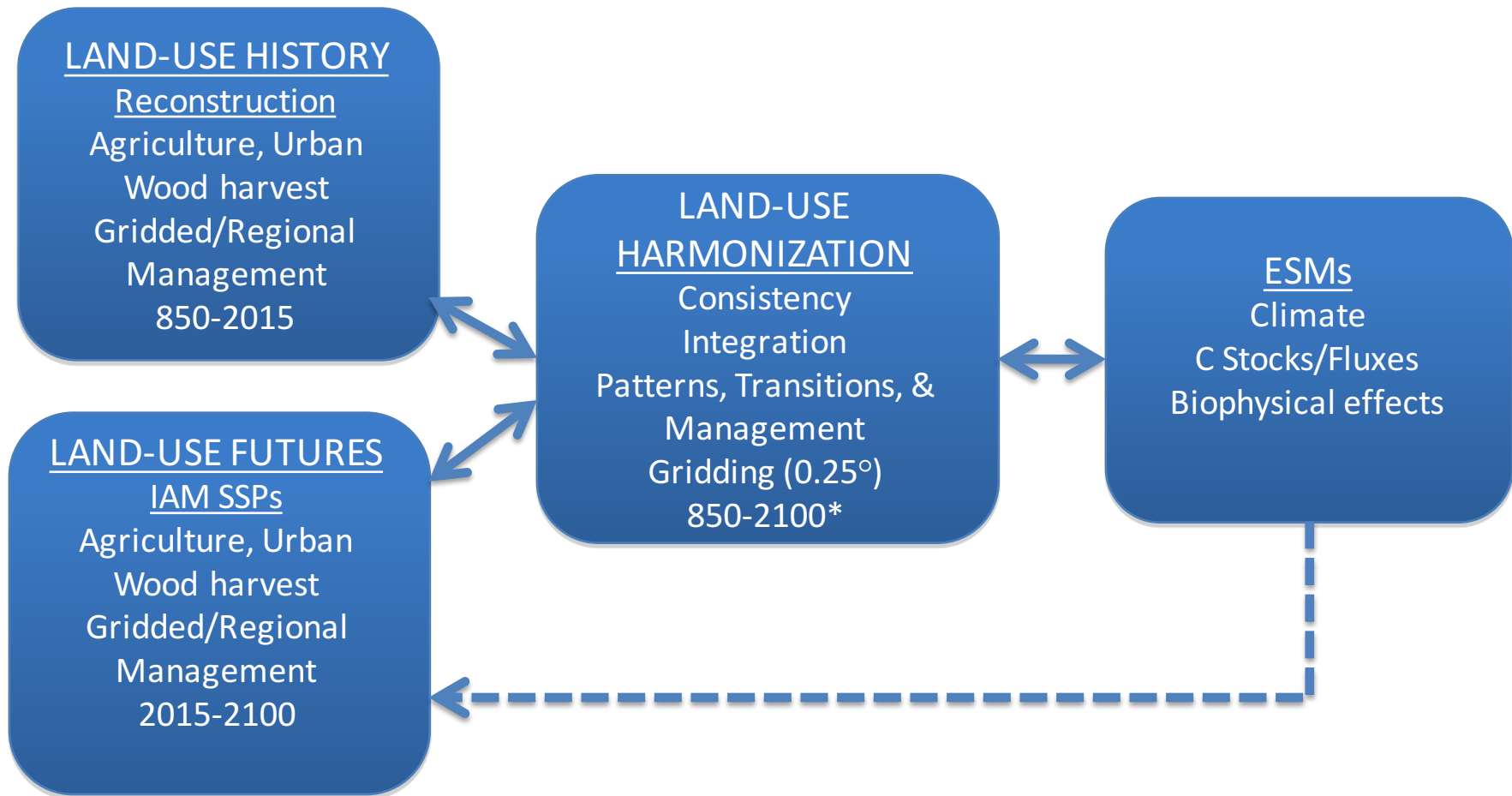
# Acknowledgements

**DOE-SciDAC:** Louise Chini (UMD), Steve Frolking (UNH), Ritvik Sahajpal (UMD), Matt Hansen (UMD), Dave Lawrence (NCAR), Peter Lawrence (NCAR), Peter Thronton (DOE), Bill Collins (LBL), Andy Jones (LBL), Jay Edmonds (JGCRI), Kate Calvin (JGCRI), Kees Klein Goldewijk (PBL)

**LUMIP-SSG:** Dave Lawrence (NCAR), Almut Arneth (KIT), Victor Brovkin (MPI), Kate Calvin (JGCRI), Andy Jones (LBL), Chris Jones (UKMO), Peter Lawrence (NCAR), Nathalie de Noblet-Ducoudré (IPSL), Julia Pongratz (MPI), Sonia Seneviratne (ETH), Elena Shevliakova (GFDL)

**Other:** Ole Mertz (KU), Andreas Christensen (KU), Andreas Heinemann (UBE), Johann Jungclaus (MPI), Jed Kaplan (EPFL), Fernando Sedano (UMD)

# Land-Use Scheme (CMIP6)



\* Upto 2300 for extensions

*After Hurtt et al (2009, 2011)*

# Land-Use Datasets (CMIP6)

## New History

- Hyde 3.2 based
- Landsat F/NF
- Multiple crop types (5)
- Multiple pasture types (2)
- Updated Forest Cover/B
- Updated Wood harvest
- Updated Shifting Cultivation
- Extended time domain (850-2015)

## New Mgt. Layers

### Agriculture

- Fraction of cropland irrigated
- Fraction of cropland flooded
- Fraction of cropland fertilized
- Fertilizer application rates
- Fraction of cropland tilled
- Fraction of cropland for biofuels

### Crop rotations

### Wood Harvest

- Fraction used for industrial products
- Fraction used for commercial biofuels
- Fraction used for fuelwood

## New Future Scenarios

Six futures, SSP-based

## New Resolution

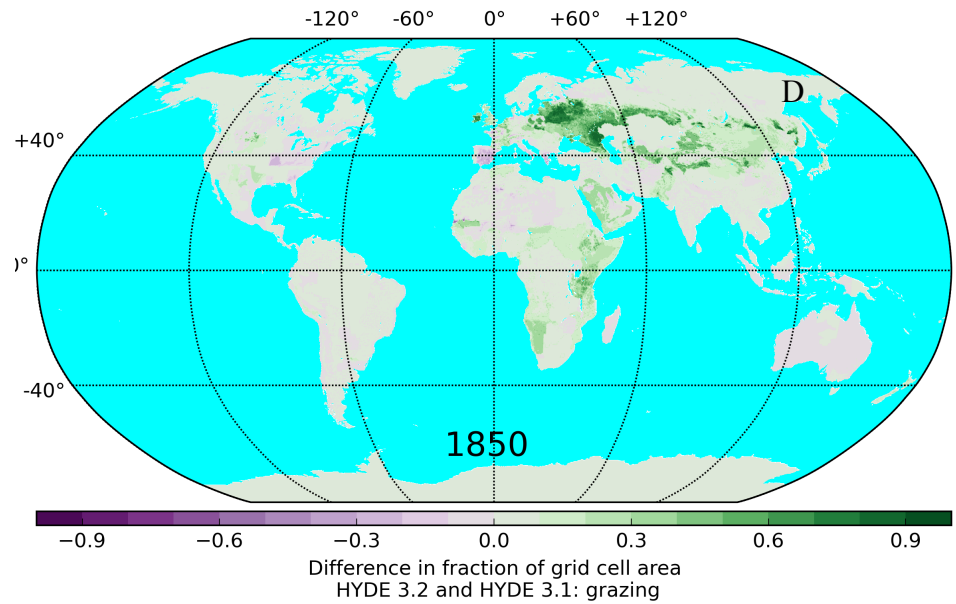
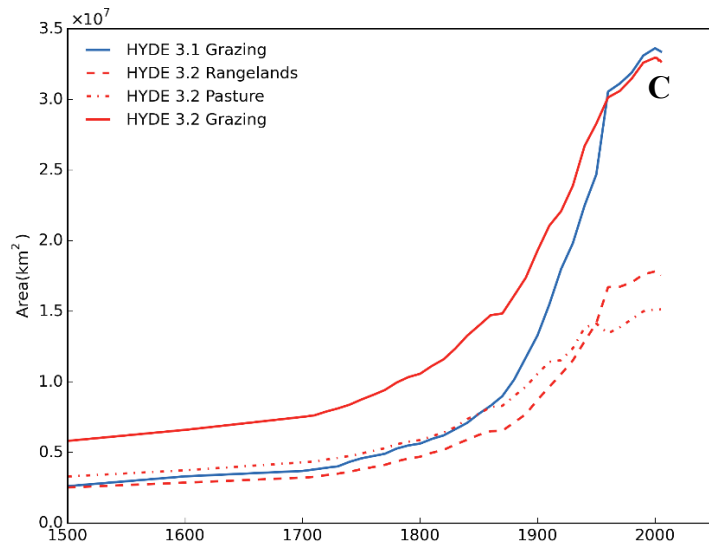
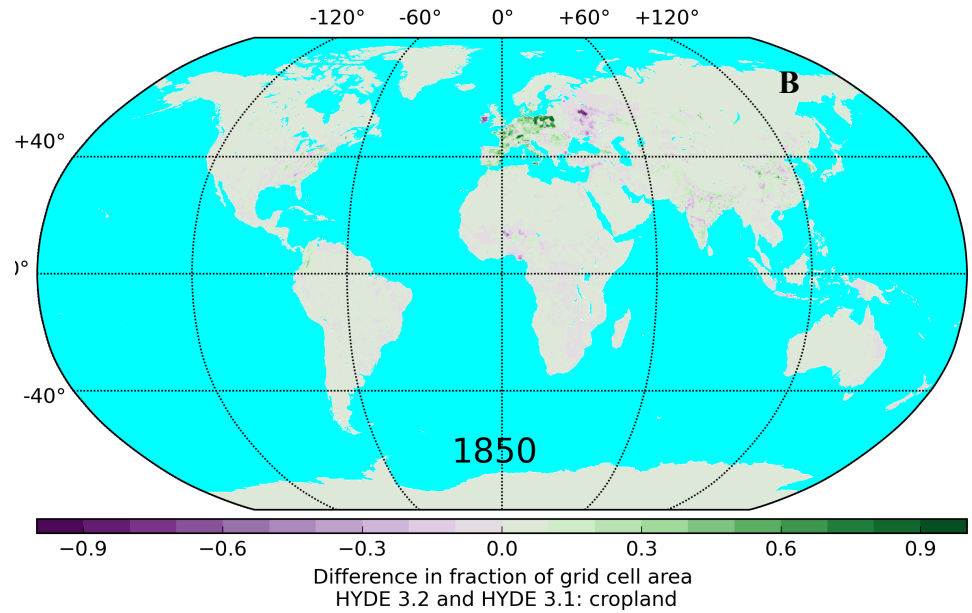
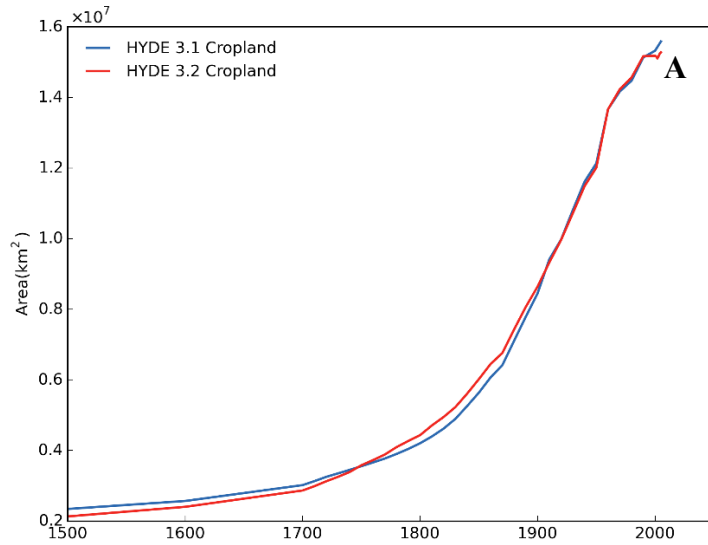
0.25°

## New Transition Matrix

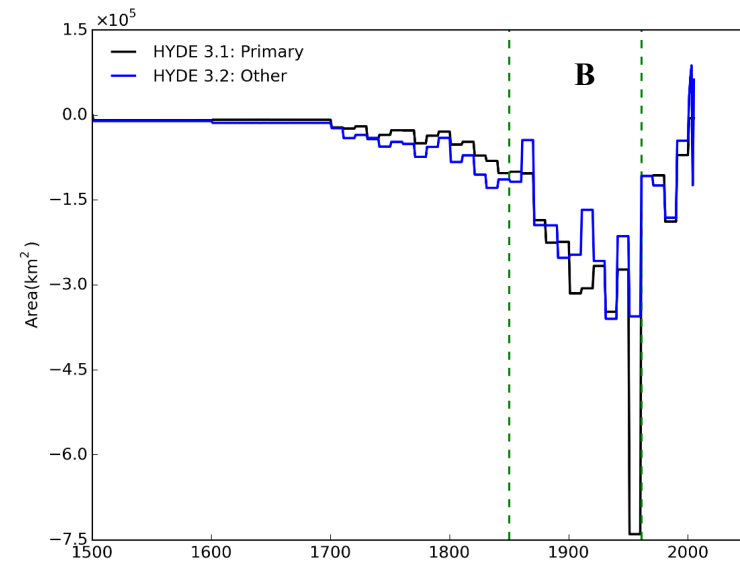
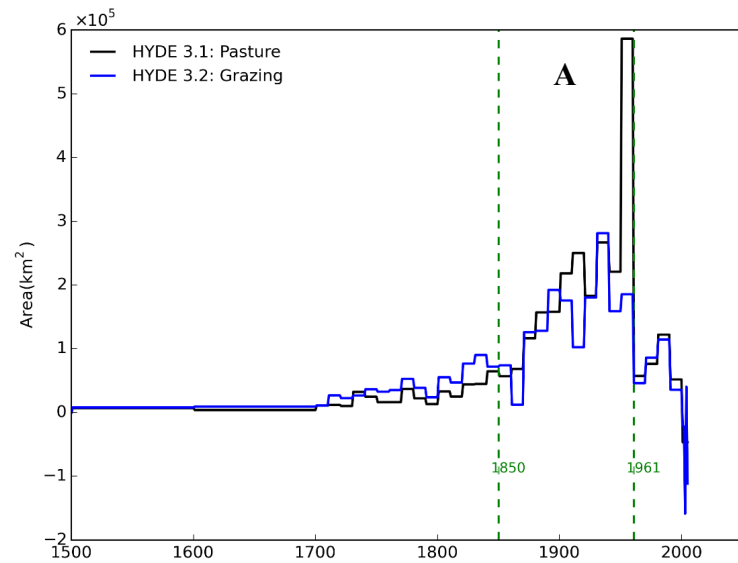
	Pri F	Pri NF	Sec F	Sec NF	C3 Ann	C4 Ann	C3 per	C4 per	C3 N-Fix	Pasture	Rangeland	Urban
Pri F	■	■		■								
Pri NF	■	■	■									
Sec F	■	■	■	■								
Sec NF	■	■	■	■								
C3 Ann	■	■			■							
C4 Ann	■	■				■						
C3 Per	■	■					■					
C4 Per	■	■						■				
C3 N-Fix	■	■							■			
Pasture	■	■								■	■	
Rangeland	■	■								■	■	
Urban	■	■										■

~ 50x information content of CMIP5!

# Global Agricultural Area: HYDE 3.2\* and HYDE 3.1



## Annual Changes in Global Agricultural Area: HYDE 3.2\* and HYDE 3.1



Forcing category	Type of Scenario	Forcing in 2100 <sup>1</sup> (W/m2)	SSP	Short name	Use by other MIPs <sup>2</sup>
<b>Tier 1<sup>3</sup></b>					
High	SSP-based RCP	8.5	5	SSP5-8.5	C <sup>4</sup> MIP, GeoMIP, ISMIP6, RFMIP
Medium-high	Gap: Baseline	7.0	3	SSP3-7	AerChemMIP, LUMIP
Medium	SSP-based RCP	4.5	2	SSP2-4.5	VIAAB, CORDEX, GeoMIP, DAMIP, DCPD
Low	SSP-based RCP	2.6	1	SSP1-2.6	LUMIP
<b>Tier 2</b>					
<i>Additional 21st century scenarios</i>					
Medium <sup>4</sup>	SSP-based RCP	6.0	1	SSP1-6.0	GeoMIP
Low	Gap: Mitigation	3.7	4	SSP4-3.7	
<i>Overshoot scenario</i>					
Overshoot <sup>5</sup>	Gap: Mitigation	2.6	X	SSPx-2.6 over	
<i>Ensembles<sup>6</sup></i>					
SSP3-7.0, 9-member ensemble	Gap: Baseline	7.0	3	SSP3-7.0	AerChemMIP, LUMIP
<i>Extensions</i>					
SSP5-8.5, long-term extension	SSP-based RCP	8.5	5	SSP5-8.5 ext	C <sup>4</sup> MIP, ISMIP6, GeoMIP
SSP5-8.5, long-term – overshoot	SSP-based RCP	8.5	5	SSP5-8.5 ext-over	C <sup>4</sup> MIP, ISMIP6, GeoMIP
SSP1-2.6, long-term extension	SSP-based RCP	2.6	1	SSP1-2.6 ext	
<b>Tier 3</b>					
<i>Additional 21st century scenarios</i>					
Low <sup>7</sup>	Gap: Mitigation	<2.6	X	SSPX-Y	

Notes

1 Forcing levels are nominal identifiers. Actual forcing levels of the SSPs depend, for non-climate policy scenarios, on socio-economic developments while for scenarios that include climate policy, the objective was to replicate forcing in the RCPs run as part of CMIP5. These values differed somewhat from the nominal levels.

2 Current plans by other MIPs to use ScenarioMIP scenarios either directly or as a basis for a variant to be run as part of their own design are indicated here.

## IAM Marker

ReMIND-MAgPIE (PIK, Germany)\*

AIM (NIES, Japan)

MESSAGE-GLOBIOM (IIASA, Austria)\*

IMAGE (PBL, Netherlands)

IMAGE (PBL, Netherlands)

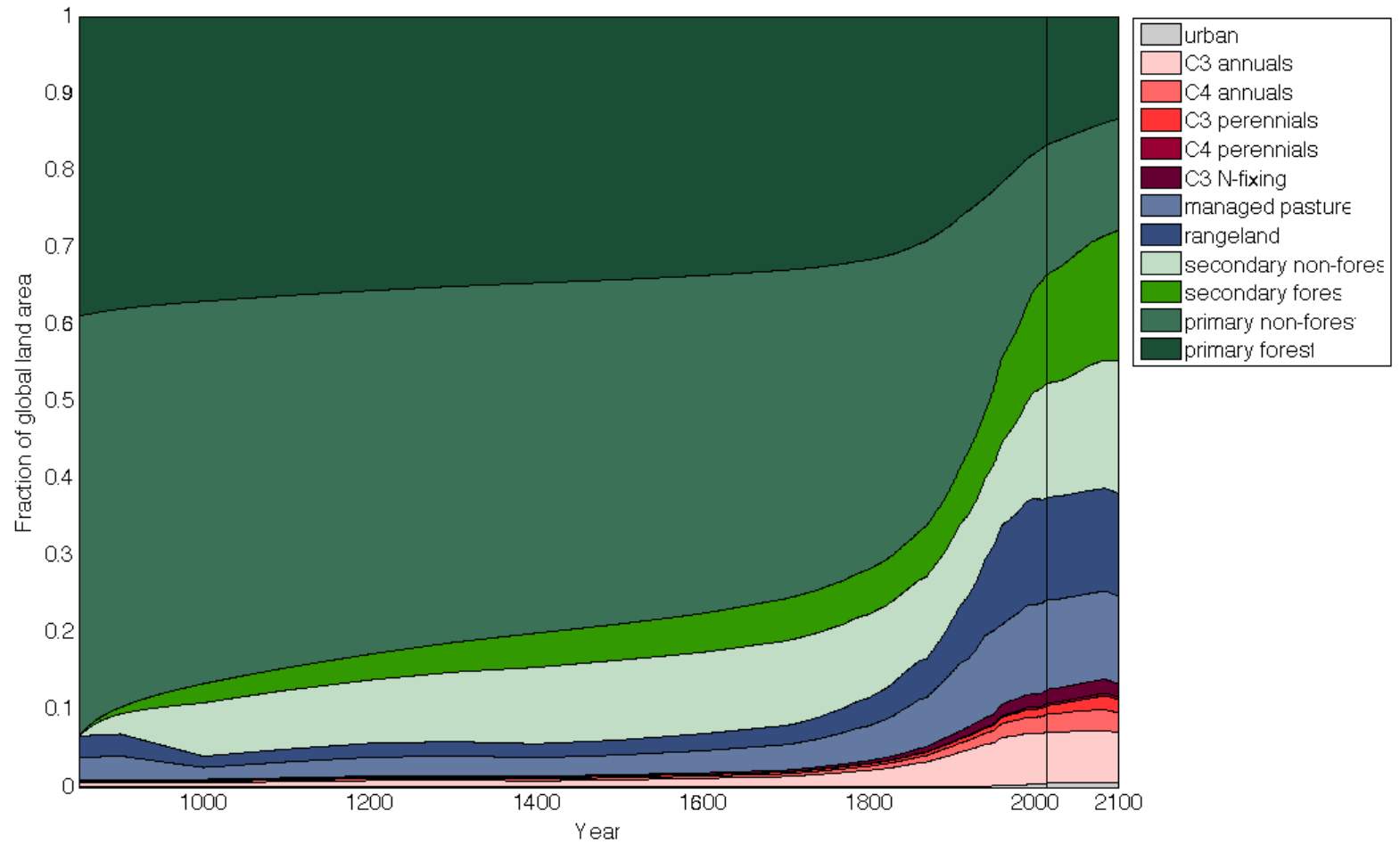
GCAM (PNNL, USA)\*

\*Received draft data

DRAFT

DRAFT

Fraction of global land area for all land-use classes  
(LUH2-v0.3, partial harmonization only)



DRAFT

DRAFT



# LUMIP/LU Forcing Timeline

- 2013 Summer: Concept
- 2013 Fall: CMIP Proposal, WGCM Briefing
- 2014 Spring: GLP Meeting, Workshop 1
- 2014 July 18-19: GEWEX – Biogeophysics
- 2014 July 22-23: Hamburg – Biogeochemistry
- 2014 August 5-9: AGCI Aspen Joint-MIP Workshop
- 2014 September 15: LUMIP proposal due
- 2015 January: Prototype Land-use dataset released (v0.1)
- 2015 July: CMIP6 Endorsement
- 2015 September: Prototype Land-use dataset released (v0.2)
- 2015 October: Prototype Land-use dataset released (v0.3)
- 2015 October: WGCM/CMIP6/LandMIP workshops
- 2015 ... <additional prototype release(s)>
- 2016 January: Final Land-use dataset released (v1.0)
- 2016 March: GMD papers due
- 2016-2019: Model experiments, results and synthesis
- 2020: WG1 AR6 Report published

LUMIP | Land Use Model Intercomparison Project

LUMIP

Home

LUMIP HOME

LUMIP | LAND USE MODEL INTERCOMPARISON PROJECT

- LUMIP Proposal to CMIP Panel - Updated June 10, 2015
- Proposed LUMIP Experiments List for CMIP6 - see **Experiments** tab and look for LUMIP
- LUMIP New Variables List for CMIP6 - see **New variables** tab
- Land Use Harmonization (LUH2 v0.2) README - September 9, 2015
- Land Use Harmonization (LUH2 v0.1) README - January, 2015

LUMIP GOOGLE GROUP

We will update the LUMIP community on simulations and datasets and make plans for analysis through this google group. To sign up, click [here](#)

OVERVIEW

Human land-use activities have resulted in large changes to the biogeochemical and biophysical properties of the Earth surface, with resulting implications for climate. In the future, land-use activities are likely to expand and/or intensify further to meet growing demands for food, fiber, and energy. CMIP5 achieved a qualitative scientific advance in studying the effects of land-use on climate, for the first time explicitly accounting for the effects of global gridded land-use changes (past-future) in coupled carbon-climate model projections. Enabling this advance, the first consistent gridded land-use dataset (past-future) was developed, linking historical land-use data, to future projections from Integrated Assessment Models, in a standard format required by climate models. Results indicate that the effects of land-use on climate, while uncertain, are sufficiently large and complex to warrant an expanded activity focused on land-use for CMIP6.

PRIMARY CONTACTS

- George Hurtt ([gchurtt@umd.edu](mailto:gchurtt@umd.edu), U. Maryland)
- Dave Lawrence ([dlawren@ucar.edu](mailto:dlawren@ucar.edu), NCAR)

SCIENTIFIC STEERING COMMITTEE

Almut Arneth (KIT), Victor Brovkin (Max Planck), Kate Calvin (PNNL), Andrew Jones (LBNL), Chris Jones (Hadley Centre), Peter Lawrence (NCAR), Nathalie de Noblet Ducoudré (IPSL), Julia Pongratz (Max Planck), Sonia Seneviratne (ETH-Zurich), Elena Shevliakova (GFDL)

PRIMARY SCIENCE QUESTIONS

The primary science questions of LUMIP are:

- What are the effects of land use and land-use change on climate and biogeochemical cycling (past-future)?
- Are there regional land management strategies with promise to help mitigate and/or adapt to climate change?
- What are the effects of climate change on land-use and land-use change?

LUMIP

- [LUMIP Home](#)
- [Experimental Protocols](#)
- [Timeline & Meetings](#)

<https://cmip.ucar.edu/lumip>

# Challenges

- Scientific advances: Extended history, increased data density, new quantities, additional future scenarios...  
More work = more science (Fun!)
- Data usage: Make greatest use of features in dataset, and standardize use of data across models
- Timeline: Tight, and has models freezing code prior to final datasets

RECC: Recommend models use of data prototypes now for I/O and testing, contribute to ongoing development of data use protocols, have potential workshop this spring on std data/usage/project integration, participation in LUMIP