

20th Annual CESM Workshop
Societal Dimensions Working Group Meeting

18 June 2015

The Village – Breckenridge, Colorado

Ten Mile Room

Abstracts

SESSION ON CLIMATE IMPACTS AND INFORMATION FOR SOCIETY

Caspar Ammann – Efficient user access to appropriate CESM data and efforts toward new collections

Caspar Ammann, NCAR; Lorna Kaatz, Denver Water

Randy Bullock – Advantages of using MODE – Time – Domain applied to climate problems

Randy Bullock, NCAR

MODE Time Domain (MTD) was originally developed as a forecast verification tool, but has recently found use in the climate sciences. MTD works with regions of interest (sometimes called objects) in both space and time. These spacetime objects are compared, and a fuzzy logic engine is used to pair up forecast and observed objects. Various types of forecast errors can be inferred and quantified, such as location, extent, shape and intensity errors, as well as velocity and timing errors. Verification statistics can then be stratified on these classes of error. Examples will be given from traditional model forecast data, as well as a climatological drought data set.

Claudia Tebaldi – Benefits of mitigation for future heat extremes

Claudia Tebaldi, NCAR; Michael Wehner, LBNL

As part of the BRACE project, using large initial condition ensembles from CESM under RCP4.5 and RCP8.5, we investigate changes in statistics of extreme daily temperature. The ensembles provide large samples for a robust application of extreme value theory. We estimate return values and return periods for annual maxima of the daily high and low temperatures as well as the three-day averages of the same variables in current and future climate. Results indicate significant increases in extreme temperatures over large fractions of the land areas even as soon as 2025 under both higher and lower emission scenarios. Significant differences between them, and therefore significant benefits from mitigation, start to appear over large regions by 2050 and become pervasive by 2075.

Brian O’Neill – Global population exposure to extreme heat events projected with CESM

Bryan Jones, City University of New York; Brian O’Neill, NCAR; Keith Oleson, NCAR

Climate change risks are a function of both the nature of physical hazards related to climate and the vulnerability and exposure of society and ecosystems to those hazards. While the association between climate change, extreme heat events, and adverse health outcomes is well established in the literature, there have been few attempts to quantify potential changes in future human vulnerability and exposure to extreme heat. Furthermore, little is known about the relative contributions of changes in physical hazards, exposure and vulnerability to overall risks under alternative future scenarios. We focus on the exposure of future populations to extreme heat events. The degree of exposure of the population to heat extremes depends on future changes in the nature and spatial pattern of climate change as well as the spatial distribution of the population. In this study we compare exposure outcomes that result from two different climate projections and two different population projections in order to estimate possible changes in exposure of populations to extreme heat relative to current exposure, to estimate the difference that reducing climate change would have on exposure, and to characterize the relative contributions of future population and climate outcomes to uncertainty in exposure. Projections of urban and rural heat extremes are from the Representative Concentration Pathway (RCP) 8.5 and RCP 4.5 projections from the Community Earth System Model (CESM), while projections of population distribution are from the Shared Socioeconomic Pathways (SSPs) 3 and 5, produced with the NCAR spatial population downscaling model. These two SSPs assume divergent population outcomes, with SSP3 (the Regional Rivalry pathway) assuming high population growth and low urbanization and SSP5 (the Fossil Fueled Development pathway) assuming low population growth and high urbanization. Our primary comparison in exposure outcomes is across RCPs, paying particular attention to how this variation depends on the choice of SSP. We also assess how exposure changes based on the choice of SSP for a given climate outcome (RCP), and whether population change or climate change is a more important determinant of the outcome. Assessment of results is carried out at the global, regional, and grid-cell scale.

Andrew Gettelman – Simulating tropical cyclone damages

Andrew Gettelman, NCAR

Most studies of climate change and tropical cyclones have focused on simulations with physical models of the climate system. Here we use the outcomes of such studies to assess the possible economic impact of tropical cyclones on physical assets in coastal areas. We draw on tropical cyclone simulations carried out with the NCAR Community Atmosphere Model (CAM) reported in Bacmeister et al. in this special issue and use them as input to the tropical cyclone damage model CLIMADA from Swiss Re. CLIMADA relates geographically explicit maps of physical asset values to downscaled impacts of cyclone wind exposure to estimate a ‘fractional loss’ of assets in percentage or monetary terms. We use existing spatially explicit data for current socio-economic assets and projections of future assets from Swiss Re that are consistent with the country-specific assumptions about future growth in Gross Domestic Product.

Peter Lawrence – Understanding the role of land management for carbon and climate mitigation under RCP4.5 and RCP8.5 using CESM

Peter Lawrence, NCAR

As part of the Coupled Model Intercomparison Project Phase 5 (CMIP5), land cover change and wood harvest were prescribed as major climate forcings for historical and future Representative Concentration Pathway (RCP) projections. Lawrence et al. (2012) described how land cover change was prescribed in all of these simulations and how the climate system and carbon cycle responded to the land cover change in concert to other transient forcing in the Community Earth System Model (CESM). The attribution of carbon cycle and climate changes directly due to land cover change, however, were not possible due to the design of the CMIP5 experiments. Through a series of new CESM simulations, we have attributed the land cover change impacts for the historical time series as well as RCP 4.5 and RCP 8.5 with and without land cover change. These simulations show that the direct land cover change fluxes to the atmosphere found in the CMIP5 simulations did not account for the lost uptake of carbon that would have been possible in the absence of land cover change and wood harvest. Once these losses are taken into account, the historical losses of terrestrial carbon increased from 61.2 PgC to 129.6 PgC, the RCP 4.5 uptake of 62.8 PgC changed to a loss of 5.8 PgC, and the RCP 8.5 loss of 49.0 PgC increased to 168.8 PgC. In order to assess the potential of land management to mitigate carbon and climate consequences, we are currently simulating RCP 4.5 and RCP 8.5 with large scale global afforestation scenarios compared to maximum biofuel production through increased crop lands. In this talk we present the differences in all of these experiments for both ecosystem carbon and climate.

SESSION ON NEW SCENARIO FRAMEWORK

Brian O’Neill – The role of scenarios in CMIP6

Brian O’Neill, NCAR; Claudia Tebaldi, NCAR; Detlef van Vuuren, PBL Netherlands

Future scenarios of greenhouse gas emissions, concentrations, and land use based on the Shared Socioeconomic Pathways (SSPs) will provide the basis for a number of experiments within the Coupled Model Intercomparison Projection Phase 6 (CMIP6). Most of these experiments will be carried out as part of the Scenario Model Intercomparison Project (ScenarioMIP), an activity whose primary goal is to simulate future climate outcomes based on alternative plausible future scenarios. A number of other MIPs will use simulations in ScenarioMIP as a basis for further experiments to explore particular aspects of these scenarios. In particular, experiments focused on land use (within LUMIP) and aerosols and atmospheric chemistry (within AerChemMIP) will be performed in connection with ScenarioMIP scenarios. We present the goals and purposes of ScenarioMIP, describe its experimental design, and outline links to other components of CMIP6, in particular LUMIP and AerChemMIP.

Kate Calvin – Scenarios of energy, emissions, and land use based on the Shared Socioeconomic Pathways

Kate Calvin, Joint Global Change Research Institute

The Scenario Model Intercomparison Project (ScenarioMIP), a CMIP6-endorsed MIP, has identified a set of future scenarios to analyze in the upcoming CMIP process. These future scenarios were selected from a larger set of scenarios developed by the Integrated Assessment Modeling (IAM) community as part of the quantification of the Shared Socioeconomic Pathways (SSPs). In this presentation, we describe the ScenarioMIP-identified future scenarios, focusing on climate-relevant aspects of these scenarios. In particular, we examine changes in emissions, concentration, forcing, land use and land cover in the six ScenarioMIP scenarios.