IEM for Alaska and Northwest Canada • Fact Sheet Supplement

Version 2
November 2013

The Integrated Ecosystem Model (IEM) Project is designed to help resource managers understand the nature and expected rate of landscape change. Maps and other products generated by the IEM will illustrate how arctic and boreal landscapes are expected to shift due to climate-driven changes to vegetation, disturbance, hydrology, and permafrost. The products will also provide resource managers with an understanding of the uncertainty in the expected outcomes.

The tables in this document provide a more detailed description of the IEM Project's anticipated data products for 2012–2015. Data products for 2016 are largely to be determined and therefore omitted from this document. Additionally, this document includes a timeline of project deliverables and references for the IEM project fact sheet which includes more general information about the project and methods.

Project data and deliverables are broke down by Generation 1 (Gen 1) and Generation (Gen 2), which are described in the *"How are the models linked together?"* section of the fact sheet. Generations are further delineated by phases a and b. IEM Generation 1a, 1b and 2a products are driven by the ECHAM-5 and CCCMA models using the mid-range A1B emission scenario. Generation 1a uses the DOS-TEM soil module, while Generation 1b uses the DVM-DOS-TEM soil and vegetation modules. IEM Generation 2b products will be driven by the AR5 Models and RCPs.

Climate (e.g., temperature, precipitation, radiation, vapor pressure)

Dataset Name	Data Type	Description	Year Available / Location
Projected average monthly temperature, precipitation, radiation, and vapor pressure *(ECHAM5-A1B scenario)*	Spatial	Downscaled projections of monthly temperature, precipitation, radiation, and vapor pressure from the Max Planck Institute for Meteorology European Centre Hamburg Model 5 (ECHAM5).	2012 snap.uaf.edu/data
Projected average monthly temperature, precipitation, radiation, and vapor pressure *(CCCMA-A1B scenario)*	Spatial	Downscaled projections of monthly temperature, precipitation, radiation, and vapor pressure from the Canadian Centre for Climate Modeling and Analysis General Circulation Model 3.1 (t47) (CCCMA).	2012 snap.uaf.edu/data
Historical average monthly temperature, precipitation, radiation, and vapor pressure *(CRU)*	Spatial	Downscaled historical simulations of monthly temperature, precipitation, radiation, and vapor pressure, from Climatic Research Unit (CRU) at the University East Anglia time series (TS) datasets CRUTS 3.1 or CRUTS3.1.01.	2012 snap.uaf.edu/data
Projected average monthly temperature, precipitation, radiation, and vapor pressure *(AR5 models and RCPs)*	Spatial	Downscaled projections of monthly temperature, precipitation, radiation, and vapor pressure for AR5 climate models that perform well in the Arctic.	Dec. 2014

Ecosystem dynamics (e.g., carbon flux)

Dataset/ Data Collection Name	Data Type	Description	Year Available / Location
Data from wetland field component of the IEM	Site specific spatial data; Text; Tables/graphs	Observational data such as net ecosystem exchange (NEE), Ecosystem Respiration, (ER), Gross Primary Productivity (GPP), soil temperature, soil moisture, air temperature, solar radiation, CH_4 flux, and CH_4 isotopes. In later years, additional datasets, including soil carbon and nitrogen storage values, modeled rates of permafrost carbon loss, and wetland carbon accumulation will be added.	2013, 2014 www.lter.uaf.edu/data_detail.cfm?datafile_pkey=524 www.lter.uaf.edu/data_detail.cfm?datafile_pkey=520
Carbon fluxes and pools *(ECHAM5 and CCCMA-A1B scenario)* †	Spatial; Text; Tables/graphs	Model output data related to carbon fluxes (GPP, Net Primary Productivity, decomposition, carbon released by fire) and carbon pools in soil and vegetation.	June 2014 (Gen 1a) Sept. 2014 (Gen 1b) Dec. 2014 (Gen 2a)
Carbon fluxes and pools *(RCP 4.5, RCP 6.0, and RCP 8.5)* †	Spatial; Text; Tables/graphs	Model output data related to carbon fluxes (GPP, Net Primary Productivity, decomposition, carbon released by fire) and carbon pools in soil and vegetation.	June 2015 (Gen 2b)

Disturbance (e.g., area burned, burn severity, stand age, thermokarst)

Dataset/ Data Collection Name	Data Type	Description	Year Available / Location
Historical area burned	Spatial	Historical area burned	2013 snap.uaf.edu/data
Area burned and burn severity *(ECHAM5 and CCCMA -A1B scenario)*	Spatial; Tables/graphs	Maps and graphs that depict simulations of area burned and burn severity.	June 2014 (Gen 1a) Sept. 2014 (Gen 1b) Dec. 2014 (Gen 2a)
Area burned and burn severity *(AR5 models and RCPs)*	Spatial; Tables/graphs	Maps and graphs that depict simulations of area burned and burn severity.	June 2015 (Gen 2b)
Potential susceptibility to thermokarst	Spatial	Modeled data used to identify areas susceptible to thermokarst disturbance. Datasets may include contemporary fractional coverage of thermokarst/wetland landforms, distance from surface to ice rich permafrost, amount of ice in the soil column, drainage efficiency (parameter that describes the ability of the landscape to store water), and soil water content.	2013
Thermokarst disturbance	Spatial; Tables/graphs	Maps and graphs for depicting changes in (1) low-center, high-center, and transitional polygons in tundra, (2) fen and bog area in boreal forest, (3) soil moisture due to thermokarst (4) vegetation due to thermokarst and (5) proportion of shallow and deep thermokarst lakes. This dataset will also include maps identifying areas susceptible to massive subsidence caused by thermokarst.	June 2014

Soil properties (e.g., permafrost, active layer, soil temperature)

Dataset/ Data Collection Name	Data Type	Description	Year Available / Location
Permafrost distribution, active layer thickness, and mean annual ground temperature *(ECHAM5 and CCCMA-A1B scenario)*	Spatial; Text; Tables/graphs	Maps and graphs depicting modeled permafrost distribution, simulated active layer thickness (m), and simulated mean annual ground temperature (°C).	June 2014 (Gen 1a) Sept. 2014 (Gen 1b) Dec 2014 (Gen 2a)
Soil characteristics *(ECHAM5 and CCCMA-A1B scenario)* †	Spatial; Text; Tables/graphs	Modeled soil-related output data, such as soil moisture and soil temperature generated by IEM. These data will be made available by request.	June 2014 (Gen 1a) Sept. 2014 (Gen 1b) Dec 2014 (Gen 2a)
Permafrost distribution, active layer thickness, and mean annual ground temperature *(AR5 models and RCPs)*	Spatial; Text; Tables/graphs	Maps and graphs depicting modeled permafrost distribution, simulated active layer thickness (m), and simulated mean annual ground temperature (°C).	June 2015 (Gen 2b)
Soil characteristics *(AR5 models and RCPs)* †	Spatial; Text; Tables/graphs	Modeled soil-related output data, such as soil moisture and soil temperature generated by IEM. These data will be made available by request.	June 2015 (Gen 2b)

† Data available by request. Please submit requests by completing the 'Contact Us' form at www.snap.uaf.edu/people.php#contact

Landcover and landscape (e.g., vegetation type, treeline extent, topography)			
Dataset/ Data Collection Name	Data Type	Description	Year Available / Location
Model input land cover	Spatial	Model input landcover for the IEM domain. This data layer is a greatly modified product derived from the "2005 Land Cover of North America at 250 meters, Edition 1.0" dataset produced as part of the North America Land Change Monitoring System (NALCMS). This data was developed as and focused solely on model input data requirements, which is a simplification of the landscape.	2012 snap.uaf.edu/data
Elevation, aspect, and slope	Spatial	Modeled elevation (m), aspect, and slope derived from elevation data developed by the PRISM climate group and distributed by ClimateSource via www.climatesource.com or www.prism.oregonstate.edu.	2012 snap.uaf.edu/data
Growth dynamic of vegetation *(ECHAM5 and CCCMA-A1B scenario)*	Spatial; Tables/ graphs	Maps and graphs showing changes in biomass over time of different plant functional types within six vegetation types (white spruce, black spruce, deciduous forest, graminoid tundra, shrub tundra, wetland tundra).	June 2014 (Gen 1a) Sept. 2014 (Gen 1b) Dec. 2014 (Gen 2a)
Treeline extent *(ECHAM5 and CCCMA-A1B scenario)*	Spatial	Maps depicting projected treeline migration.	June 2014 (Gen 1a) Sept. 2014 (Gen 1b) Dec. 2014 (Gen 2a)
Vegetation distribution *(ECHAM5 and CCCMA-A1B scenario)*	Spatial; Tables/ graphs	Modeled distribution of six vegetation types (white spruce, black spruce, deciduous forest graminoid tundra, shrub tundra, wetland tundra). Graphs showing changes in area of vegetation types through time.	June 2014 (Gen 1a) Sept. 2014 (Gen 1b) Dec. 2014 (Gen 2a)
Growth dynamic of vegetation *(AR5 models and RCPs)*	Spatial; Tables/ graphs	Maps and graphs showing changes in biomass over time of different plant functional types within the four vegetation types.	June 2015 (Gen 2b)
Treeline extent *(AR5 models and RCPs)*	Spatial	Maps depicting projected treeline migration.	June 2015 (Gen 2b)
Vegetation distribution *(AR5 models and RCPs)*	Spatial; Tables/ graphs	Modeled distribution of six vegetation types (white spruce, black spruce, deciduous forest, graminoid tundra, shrub tundra, wetland tundra). Graphs showing changes in area of vegetation types through time.	June 2015 (Gen 2b)

Model code and documentation			
Dataset/ Data Collection Name	Data Type	Description	Year Available / Location
IEM program code	Source Code	The **IEM Generation 2** (i.e., cyclical coupling) will be made available as source code (available through the http://github.com source management tools) and also packaged in installable Linux packages. Code provided upon request.	Dec. 2014
Alaska Thermokarst Module program code	Source Code	The Alaska Thermokarst Module will have source code available via a http://github.com repository, and will also be bundled with the **IEM Generation 2** installable Linux packages.	June 2014

† Data available by request. Please submit requests by completing the 'Contact Us' form at www.snap.uaf.edu/people.php#contact

What can we expect from the IEM team in the future?

Long-term objectives for the IEM team are to develop datasets for Alaska and northwest Canada and phase in refinements to the model that are necessary to better understand the potential effects of climate change. The table below outlines the major research activities for 2013-2016.

Year	Model Coupling	Tundra Fire & Treeline Dynamics	Thermokarst Dynamics	Wetland Dynamics
2013	Full assessment IEM 2.0 over the IEM domain. Models driven by A1B emission scenario.	Development of IEM 2.1 by incorporation of tundra fire & treeline dynamics program code into IEM 2.0; proof-of-concept study.	Development of new program code; testing of landscape-scale thermokarst dynamics module.	Development of new program code for wetland dynamics.
2014	Full assessment of IEM 2.1 (IEM 2.0 with tundra fire & treeline dynamics) over the IEM domain. Transition from AR4 models A1B scenario to AR5 models and RCPs.	Assessment of IEM 2.1 across the IEM domain.	Development of IEM 2.2 by incorporation of thermokarst dynamics program code into IEM 2.1; proof-of-concept study.	Testing and evaluation of wetland dynamics module.
2015	Full assessment of IEM 2.2 (IEM 2.1 with thermokarst dynamics) over the IEM domain. Models driven by RCP4.5, RCP6.0, and RCP8.5.	Identification and development of resource impact models that can be coupled to IEM 2.1 (tundra fire & treeline dynamics), e.g., caribou energetic models.	Assessment of IEM 2.2 across the IEM domain.	Development of IEM 2.3 by incorporation of wetland dynamics program code into IEM 2.2; proof-of-concept study.
2016	Full assessment of IEM 2.3 (IEM 2.2 with wetland dynamics) over the IEM domain. Models driven by RCP4.5, RCP6.0, and RCP8.5.	Identification and development of resource impact models that can be coupled to IEM 2.2 (e.g., waterbird habitat models.	Identification and development of resource impact models that include thermokarst dynamics.	Assessment of IEM 2.3 across the IEM domain.

Citations

Commission for Environmental Cooperation (CEC). 2010. 2005 North American Land Cover at 250 m spatial resolution. Produced by Natural Resources Canada/Canadian Centre for Remote Sensing (NRCan/CCRS), United States Geological Survey (USGS); Insituto Nacional de Estadística y Geografía (INEGI), Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) and Comisión Nacional Forestal (CONAFOR).

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