

# Climate Adaptation Risk Visualization System (CARViS)

Applying Science for Climate Adaptation and Resilience



## ERM's Climate Adaptation Risk Visualization System (CARViS) uses scientific data to optimize project investment, preserve net present value and manage current and future climate impact risks by improving resilience.

Identifying and mitigating risks is a common and essential practice for resource development companies. However, climate change is a potential high-risk area that can be challenging to address. Gradual changes in climate, accompanied by regional increases in storm frequency and intensity, have resulted in operating conditions that are outside of the commonly-accepted norm. In 2013, losses attributed to climate events were \$125 billion (USD) worldwide. In the World Economic Forum, Global Risks 2014, climate change is among the five most impactful risks, with extreme weather events listed as the second most likely to occur. Water crises and biodiversity loss also appear high on the list.

The 2013 Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report stated that the projected impacts due to climate change will be “widespread and consequential” and “nobody will be untouched”. The 2013 report includes four chapters on climate adaptation and,



Dr. Chris Field (IPCC working group co-chair) states that “the challenge is one of managing risks.”

Climate fluctuations outside of the historically measured ranges are impacting environmental systems, including changes in vegetation, and hydrology. Increases in storm frequency and severity, and extreme temperature fluctuations are impacting existing structures – structures that were built to withstand normal climatic stressors, such as historical levels of wind, flooding, or erosion. However, as climate extremes continue to escalate, these structures are becoming vulnerable to climate risk. Historically extreme events are now becoming the norm.

A reliable climate risk and impact analysis system must be able to incorporate a variety of uncertainties, such as predicted climate scenarios and limited data availability, to develop risk hazards for a variety of assets (e.g., pipeline, infrastructure), each with their own vulnerabilities. Furthermore, different hazards have different parameters (e.g. temperature, rainfall, wind, vegetation) that impact risk. For example, the parameters affecting wildfire would be different than those affecting waves and coastal erosion.

### ERM's CARViS Approach

CARViS combines process-based models (i.e., models that represent the physical and biological processes) to estimate the impacts of a changing and unpredictable climate on the environment. Impacts are not predicted using historical conditions (e.g., indices), therefore predictions are responsive to the unique and yet unseen future conditions of a changing climate. Leading science-based models that have been successfully applied on every continent and used by the IPCC are applied to make relevant predictions of climate risks and associated impacts, answering the question: “What does climate change mean to me?”

*Best available science is integrated to make relevant predictions of climate impacts.*

## The CARViS Structure

CARViS has an interactive model structure that allows for the inclusion of modules, such as climate (past and future), site (e.g., slope, elevation), and biophysical attributes (e.g., soils, vegetation, water movement). It combines these modules with applicable process models (e.g., vegetation, hydrology, wave and marine) to develop a customized model structure that addresses the parameters of interest necessary to produce a meaningful risk matrix. The interactive model structure optimizes flexibility and outputs for both current and future use. The interactive feedback loops provide a system that easily responds to changes to both spatial and temporal scales. For example, 60 cm (24 in) of rain averaged monthly will have a much different impact than if that same rainfall occurred over 24 hours. Also, a 50 X 50 km scale may be appropriate for estimating the risks associated with sea level rise, but a much smaller scale is



needed for risks associated with coastal erosion a specific site. Risk level, project stage, and parameter of interest can help to determine the appropriate assessment level.

CARViS incorporates the company's asset and business plan to develop risk matrices as a function of hazard type and asset vulnerabilities. It is effective for comparing current risks with projected future risks, and also for determining tipping points – the threshold at which currently acceptable risks become unacceptable risks. CARViS is valuable for sensitivity and scenario analyses, and for comparing the potential impacts and costs/benefits of mitigation strategies.



## Application Examples

- Predict impacts and risks on receiving environment.
- Evaluate changes in ecosystem integrity and resilience.
- Predict socioeconomic effects of climate change.
- Predict vegetation shifts that affect wildlife, thereby impacting subsistence use.
- Predict impacts on supply chain.
- Predict physical risks from climate change to operations.
- Predict impact of climate change on a number of climate and weather related risks.
- Risk assessment on available resources, e.g., water.
- Risk assessment for existing infrastructure.
- Risk assessment for new development.
- Incorporate climate change in Environmental Impact Assessment (EIS), National Environmental Policy Act (NEPA) process and Environmental, Socioeconomic Health Impact Assessments (ESHIA).

## Value Proposition

Benefits of CARViS include:

- Financial optimization
- Preservation of net present value
- Scientific foundation
- Risk management

CARViS was developed to address climate risk adaptation and support resource development, permitting, restoration, rehabilitation, and reclamation applications to mitigate the effects of climate change. CARViS supports decision-making throughout all phases of resource development including environmental, socioeconomic and health impact assessments, EISs, wildlife (terrestrial, marine and aquatic) impacts, evaluating available resources (e.g. water), stakeholder involvement, aging infrastructure and site closure.

*CARViS develops robust risk assessments from solid, defensible and repeatable science -- assessments that can be used to evaluate management options and minimize the environmental, social, and business risks associated with resource development due to climate change.*

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