





RACC Integrated Assessment Model (IAM) Scenario Development Workshop

Davis Center
University of Vermont
October 26, 2015

Our goals for the workshop

- To garner stakeholder input into the design and execution of the RACC IAM
- To assess, as a group, the state of modeling and data collection for the management of water quality (and more specifically nutrient loading) for the LCB
- To generate a set of scenarios to run as simulations in the RACC IAM
- To set the stage for our final Delphi forum and workshop in the spring of 2016 in which scenarios results will be shared)

Agenda

Morning:

 Presentations and discussions about modeling and data collection work completed by RACC to date

Afternoon:

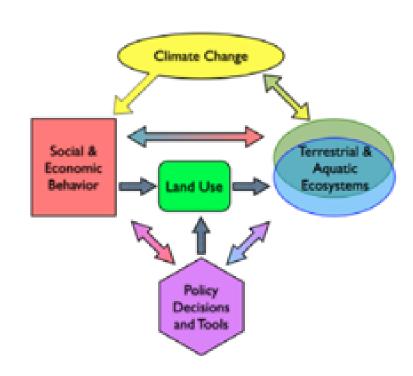
- Presentations and discussions about other modeling and data management efforts being conducted to manage water quality in the LCB
- Scenario Development Exercise to Guide Simulations for RACC IAM



http://www.uvm.edu/~epscor/new02/?q=node/30

In the face of uncertainties about climate change, land use and lake response scenarios, how can adaptive management interventions (e.g. regulation, incentives, treaties) be designed, valued and implemented in the multi-jurisdictional Lake Champlain



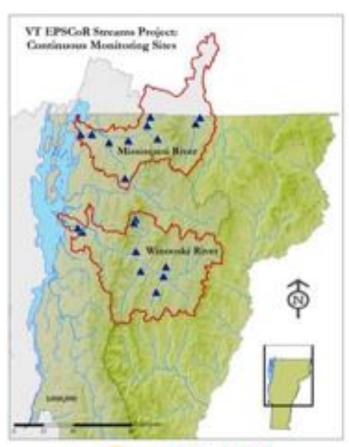


Experimental Program to Stimulate Competitive Research (EPSCOR)



Project components:

- Regional Climate Downscaling
- Q1: In lake processes
- Q2: To lake processes
- Q3: Land use, <u>policy &</u> governance decision making
- Integrated Assessment Modeling (IAM)





Adaptive management is a systematic process for improving management policies and practices by <u>learning from the</u> <u>outcomes of management strategies</u> that have already been implemented. Adaptive water management aims to increase the adaptive capacity of the water system by putting in place both learning processes and the conditions needed for learning processes to take place (Geldof 1995, Pahl-Wostl 2004, 2007).

RACC was, in part, conceived to better understand the UNCERTAINTY, CONFLICTING VALUES AND MULTIPLE SCALES/COMPLEXITY of the nonpoint source pollution problems facing the Lake Champlain Basin.

		Degree of Consensus among Stakeholders		
		Low	High	
Degree of	Low	Status Quo Typical result: Confrontational debate and no improvement	Mediated Discussion Typical result: Consensus on goals or problems but no help on how to achieve the goals or sold the problems	
Understanding of the System Dynamics	High	Expert Modeling Typical result: Specialized model whose recommendations never get implemented because they lack stakeholder support	Mediated Modeling Typical result: Consensus on both problems/goals and process leading to effective and implementable policies	

Source: Van den Belt, 2004, p.18

RACC Stakeholder Engagement Activities

- Climate Change Impact Assessment Workshop: March 2012
- Water Quality Climate Change Adaptive Intervention Online Delphi and Workshop: March to May 2014
- RACC IAM Scenario Development Workshop: October 2016
- RACC IAM Scenario Valuation and Analysis Online Delphi and Workshop: Spring 2016

Adaptive management

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(Geldof 1995, Pahl-Wostl 2004, 2007)

#1: Climate Change Impact Assessment, November 2012

SELECTED CLIMATE CHANGE SCENARIOS AND ADAPTATION STRATEGIES SOIL DYNAMICS RIVER AND STREAM **LAKE HYDROLOGY SCENARIOS SCENARIOS SCENARIOS** Third Order First Order Second Order First Order Second Order Third Order First Order Second Order Third Order Adaptation Strategies **Adaptation Strategies** Adaptation Strategies Impacts Impacts Impacts Impacts Impacts Impacts Impacts Increase in property damage Increase in Change in rease in hum Increase in assimilative Increase in Decrease in wetlands risk: injury and loss of life stressed capacity flooding rism/recreation egetation: leaves Increase in icrease in sept Increase in sediment and Increase in flooding nutrient loading Increase in irrigation vulnerabilities blowdowns health impacts Increase in increase in lake Decrease in hange in infrastructure Changes in root crosion armoring crease in sugarir soil moisture structure design requirements Change in Lake Change in ncrease in need for soi Change in planning Champlain recreational conducator tal Change in Increase in negative (anagement: soil health activities Basin elevation mpacts on farming stream and fertility (building in general Hydrology dynamics Increase in Decrease in Change in Change in planning Change in anima effluent pecies range and composition and infrastructure design and zoning concentration viability distribution requirements Increase in rease in floodin Change in infiltration impacts Change in aquati Increased emergency nfrastructure design and riparian plan Maintain forest cover. quality composition and requirements planning maximize ground becrease in cost of distribution infrastructure infiltration to maximize Increased emergency maintenance Harmful Aleae ground storage and Maintain forest cover, Change in planning maintain springs maximize ground temperatures infiltration to Uncertainty in surface and maximize ground Decrease in ground water storage and maintain Change in costs income from availability to recreation tourism Increase in Change in vulnerability of hydropower seasonal Change in habitat Environment storage and pools/wetlands **Environment** Environment potential Agriculture Agriculture Agriculture Change in Social/Recreation feasibility Infrastructure Infrastructure. Infrastructure

Change in water quality

DRIVERS

increased rate of regeneration Shortening biological carbon cycle: Slove aprese of classes

Change in focust dynamics

Decrease in **#**ood impacts

Decreased seament transport Decreased national loading

Decreased operand runoff

Decreased agriculture runoff

Damagedbree roots increased posts Extreme red season Increased municipal cost burden

Decreased infigstructure costs Higher Mosdo offect (regional)

Demage to housing increased demand for tire response

Increase in climate regionalism Increase in conteminated wells, ased tost heaves. Change introgetation Decreased fost heeses

Change in goothermal effect

Degraded weter supply Decreased exterPot stream habital

Increased thought and increased temperatures Increased demar@ for infrastructure

Change ingrop yields Warning oblive ground Increased runker of wetlands.

Extended low flows from lacked snowpack and agring rains Change in spines composition Decrease in aesther; and visual quality

More political conflict Decreased transportation network

Increased depited by west construction increased depited by model to increased within

Despote front.

Loss of dissolved oxygen from decomposition increase in digal blooms

Increased Accordings

Decrease instal strength Loss of show and ice cover increased providence recharge

Increase of Sentisc signs Loss of belief wrafty

Infrastructure ner Oak Calmysetment Decrease in quality

increased demand to deersify tourism industry. Stranded capital assets (e.g. in ski industry)

Mussel, fish Heat disconnect.

Increased of Aractic costs
(costs and of Africa contamination
(Negative impact of show dependent industry (e.g. 60 areas)

Increased introducture damage Higher races Cocreased interest capacity Change in production capability, location

Loss of small coldwater community type Decreased coldwater species range

served options from

wildlife (Qitte loss

Incressed pestode use Increased waterporre pests

Increased population movement increased fire fine Change in special range and visit increased population movement forming events increased with date of the change in change in change in change in change in change in change

Change to species ings and visbility

Increase in Mornelessress No heating/water

Emergencyloritical respondent unable to read and

| Transactive Change | Change

Increased hydroxianing rather

Increase in summe peak electric load Increased colors Change in empt concentration of country to purpose the colors of the

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Change in quality of the Increased seguined for ponds Change in tous smiteroreation

Proressed wate President costs Decreese in vater availability

Transportation television consent to function Increased opp deseases ased suggety of medicine ecreased elipply of fuel

Increased development pressure Change in chickednesse infections

Increase in impervious surfaces Change in growthen development Decreased deterior development

Change in a quatic species Increased unemployment increased and discoveraged land Decreased logging or harvest use

Loss of terrance Change in plaining outdoor events cosed cost for supplies

Delayed and Deplace Essential Supplies
Increased demand for logar food
Lost tath inapproximated
increased.

Decreased demand for water stronge | Decreased to hearth | Decreas

More digeo wells.

Change in functionality of drainage infrastructure Incressed mod prioss Increased transportation of food Loss of jobs, Scorrel/wages Increased Pro-Change in lakeshore eroslog Increased) hunger

Increased range for existing invasive species

Increased risk to dam structures

Emergency harvest of acriculture

Sporter (New Season) Change in seasonal precipitation. So the Date Loss of Greater's Processor South Date Increases in regions/cytical impacts Increase in new invasite species (plants/pests) Decreased profit for farmers increased cossof pest control

Decrease in the control of the contr

Decreased land available for production

Change in lakewhole flooding Decreeded propyleids Inghes applied of synthetic flections increased in property in the control of synthetic flections increased in property in the control of synthetic flections increased in property increased in the control of synthetic flections increased in the control of synthetic flections increased in the control of synthetic flections Decrease number of farms Increased field work (Democrat winter ecosion Increased Water Changes to size and lookion of riperan welfends

Change of crop & victied added products Change in waste supply for agr.

increased fight expenses increased rainfor prowerest Uncertainty lewater supply increased area of indeveloped land

Change in ground water table elevation

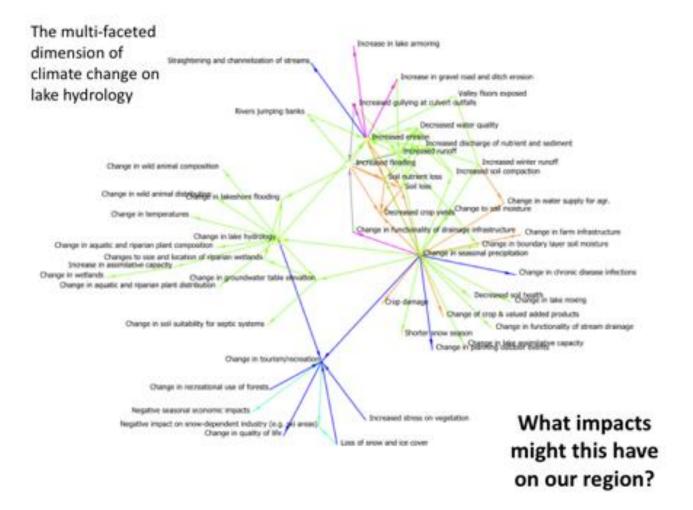
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Increased its tallition of tile drains. Drilling regre wells

Change in letage quality
Change in soil suitability for sectic systems
Change in policinari loading

increase in assignitative capacity

Change lewetlands





css2cc.org

2 Water Quality Climate Change Adaptation Online Delphi Forum and Workshop: March to May, 2014

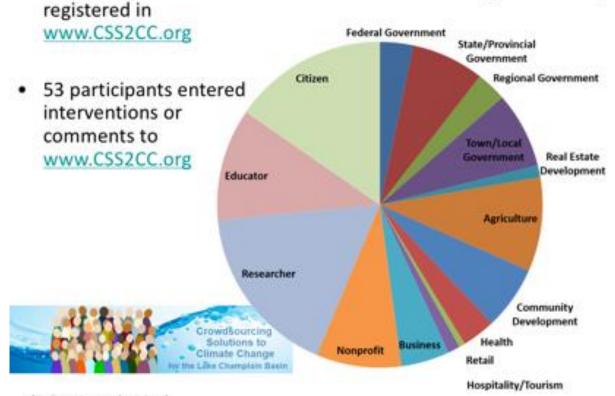
Goals

- To deepen our capacity as a region to adapt to human-induced climate change, and in particular to secure our region's water quality for the long term.
- To envision a wide array of intervention strategies for ensuring water quality for the Lake Champlain Basin
- To develop adaptation scenarios for stakeholder groups using a variety of simulation tools.

Stakeholders Identified 104 Adaptive Actions to Build Resilience in Lake Champlain in the Face of Climate Change



• 204 participants Professions of CSS2CC.org
Registered Participants



(Coleman et al., 2014)

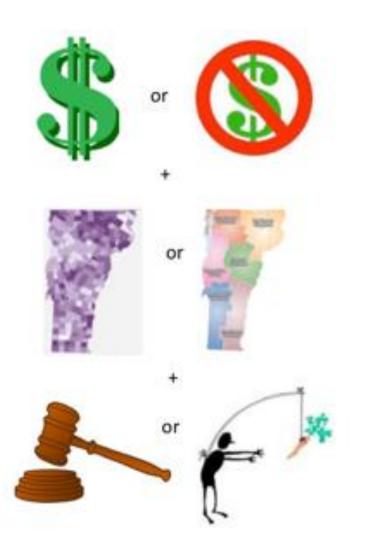
104 discrete interventions were identified

Popular Discussions

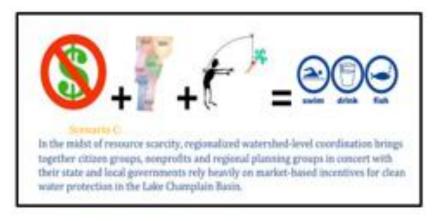


Newest Discussions





Policy, resource and governance scenario testing



RACC Workshop #2:
May 12, 2014 Generated
Scenarios Based on Resource
Availably, Governance
Config. & Policy Preferences

Final List of Adaptive Interventions Surfaced During Crowdsourcing Solutions to Climate Change Forum and Workshop Spring 2014

Highlighted interventions = Can be simulated in current iteration of RACC IAM

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	Ecological Design / Technological Interventions
1.	Bioremediation, phytoremediation, brownfields clean-up to reduce pollution and improve quality of existing developed areas
2.	Change fuel pump designs and gas station runoff management to reduce flow of oil/gas into water bodies
3.	Edible forest gardens as a way to increase forest cover
4.	Employ erosion control measures on targeted streambanks
5.	Employ smart growth principles and low-impact development practices in planning and
	design of development and transportation
6.	Encourage/allow separation of grey water from sewage and reuse of grey water in appropriate settings
7.	Improve function of and harvest/remove phosphorus from on-site septic systems
8.	Increase energy efficiency in buildings, infrastructure, and transportation systems
9.	Increase soil organic matter on farms to improve water storage and soil fertility
10.	Manage barriers to water flow (causeways) in Lake Champlain to mitigate sediment and nutrient accumulation
11.	Manage floodplains to give rivers room to move
12.	Plant vegetated buffers in riparian zones and along lakeshores
13.	Retrofit existing commercial and industrial sites with green stormwater infrastructure
1/1	Size culverts with un-to-date precipitation data to prevent washouts

We will draw on 16 of the strategies identified during the Delphi process this afternoon...

- Crop and land management BMPs (crop rotation; cover cropping; reduced tillage; riparian buffers)
- Taxing fertilizers and animal feed
- Transitioning dairy to pasture
- Steer development patterns (Smart growth; Act 250; flood plain development; wetland preservation; easements)