

Environmental Prediction: Empowering Canadians to Manage Their Future

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PROTECT CANADIANS

Presentation Outline

“In times of change, learners inherit the Earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists”

-Eric Hoffer, American Social Philosopher

- **Background/Introduction**
- **The Nature of Environmental Prediction**
 - Definition/Examples
 - Why now?
 - Significance and Opportunity
- **Requirements for Improving Environmental Prediction**
 - Engagement and Decision-Making Framework
 - EP Creation Cycle
 - Principles for Success
- **Conclusions**

Background/Introduction

2005: Environment Canada initiates investigation into benefits of/demands for EP

2006: Decision to formulate a Departmental Strategic Approach to promote:

- Widespread appreciation of EP and its potential
- Enhanced strategic investments for policy/program development & delivery

2007: Departmental uptake:

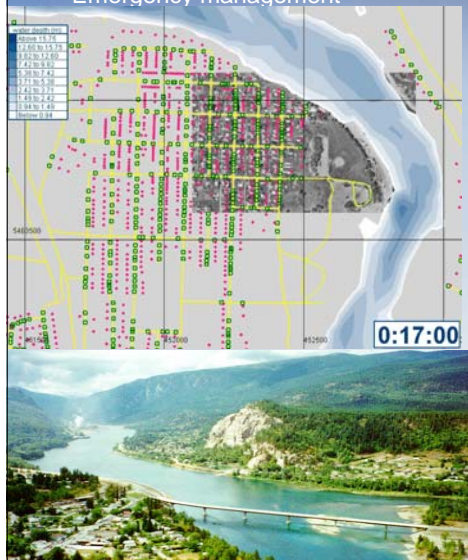
- EP Strategic Approach document drafted
- EP #1 Strategic Direction of Integrated Science Plan
- Governance changes and EP pilots in development

200?: National uptake?

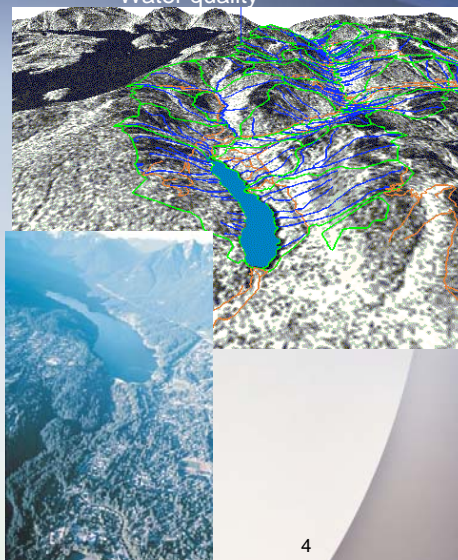


Examples of Environmental Prediction

Emergency management



Water quality



Environmental Prediction Defined

EP is a *process* of:

“...Developing and using knowledge of environmental and socioeconomic sciences to project likely or conditional states of the natural world...”

...in order to assess future risks and opportunities that support decision-making regarding human health and safety, the environment, & socio-economic well-being”

Risk = (Probability of Hazard) x (Significance of Impact*)

Opportunity = (Probability of Reward) x (Significance of Reward)

*relates to vulnerability

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Importance of EP: Real and Potential Requirements of Canadians

Industry

- **Energy:** Supply & demand forecasts for Hydro, Tidal; Solar, Wind; Facility downtime; Ocean platform hazards...
- **Insurance:** risk transfer: flooding, wind, landslides and other life/property hazards
- **Human Health:** AQ exposure mapping; Emergency case load prediction and prevention; Establishment of new pathogens vectors; Pollen & spore prediction
- **Agriculture:** Prediction of airborne plant & animal disease vectors; Growing season forecast; Last spring frost; Winter snow pack
- **Transportation:** Rail buckling prediction, Scenario modeling of auto emissions, Aircraft de-icing alert, Leaf adhesion forecasts
- **Defence:** Battlefield tactics

Strategic Issues

- **Limits to growth:** integrating economic forecasts with water cycle models to estimate potential future of water quality/availability on and by industry
- **Geo-political:** Long range transport of atmospheric pollutants/radiation, [sea-level rise](#), environmental refugees (NB: support for Foresight)
- **Environmental Assessment:** evaluating environmental impacts of potential projects on biodiversity, landscapes

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Importance of EP (con't): More Real and Potential Requirements of Canadians

Natural Capital

Water

- **Availability:** Integration of hydrology/atmosphere on a basin framework for supply/flood forecasts; Potential ecological impacts of interbasin water transfer (bulk-water export)
- **Quality:** Integration of atmospheric, hydraulic, hydrologic, and chemical/pathogen models to predict impacts of events upon drinking water quality supplies

Landscapes

- Merging biotic and abiotic models (e.g., climate change) for resource use, wildlife management, alien species control, range expansion; Air/water pollution effects on forest & plant growth; loss of permafrost

Air Quality

- Combining air emissions, air quality and energy production models to develop scenarios for emissions trading, Air Quality Health Index

“Climate change is only one way in which the environment and human activities are affecting biodiversity. Forecasts must integrate other human impacts as well, but generally they do not”

Source: BioScience, March 2007

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EP's significance to Canadian governments/industry

Government Responsibilities

Legal and Leadership :

- Sustain productive and healthy environmental systems
- Increase societal resilience to impacts from nature
- Facilitate conditions that maximize societal opportunities
- Manage international agreements & emergencies

Policy Development

- Identifies emerging policy issues
- Generates policy options
- More than a tool: a policy instrument

Industry Responsibilities

EP Enhances Return on Investment

- Responsive to changing risk drivers
- Streamlines industrial processes
- Facilitates regulatory requirements
- Caters to environmental industry
- Reduces risk of liability
- Enhances corporate image

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EP as opportunity. Now.

Rapidly Growing Need: a world of uncertainty

- Speed and magnitude of Earth systems change increasing: *imperative to adapt/mitigate*
- Greater global environmental & economic interconnectivity: *solutions beyond sole control*
- Resource limitations approaching: *increased need to manage risks and opportunities*
- Rising awareness of civil society: *increased expectations*

Rapidly Growing Capability: a world of possibilities

- Rise in computational power/data transmission speed/data assimilation techniques
- Rise in *in situ* & *ex situ* data availability
- Rise of IDR (consilience): Merging of disciplines leading to innovation
- Reduction of transaction costs via Internet 2.0: Governance via “Mass Co-production”

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Recognition of the value of EP Internationally

MSC Canada

Environmental prediction
Science and technology in the Met Office
2003-2004

Global Prediction

STRATEGIC PLAN
2003-2012
RESEARCH AND DEVELOPMENT PROGRAM

The Issue of “Useful” Predictive Knowledge

- Evaluating user needs is complex, requires significant effort
- Social sciences engaged in resolving issue around linking knowledge to action
- Move toward “co-production” of knowledge across boundaries to enhance usefulness of product and service development (requires credibility, saliency, legitimacy)

Example readings:

David W. Cash, Borck, Patt (2006) Countering the “Loading Dock” Approach to Linking Science and Decision-Making: Comparative Analysis of El Nino Southern Oscillation Forecasting Systems. *Journal of Science, Technology & Human Values*, Vol. 31, No. 4, 465-494

Take Home Messages

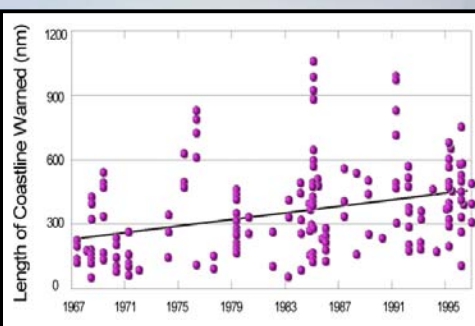
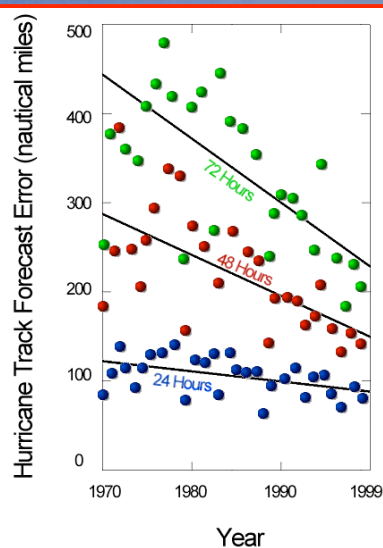
- EP ready to provide useful risk-based decision-making tools in a rapidly changing world
- Understanding risk factors (i.e., needs) of users/receptors is critical for decision-making

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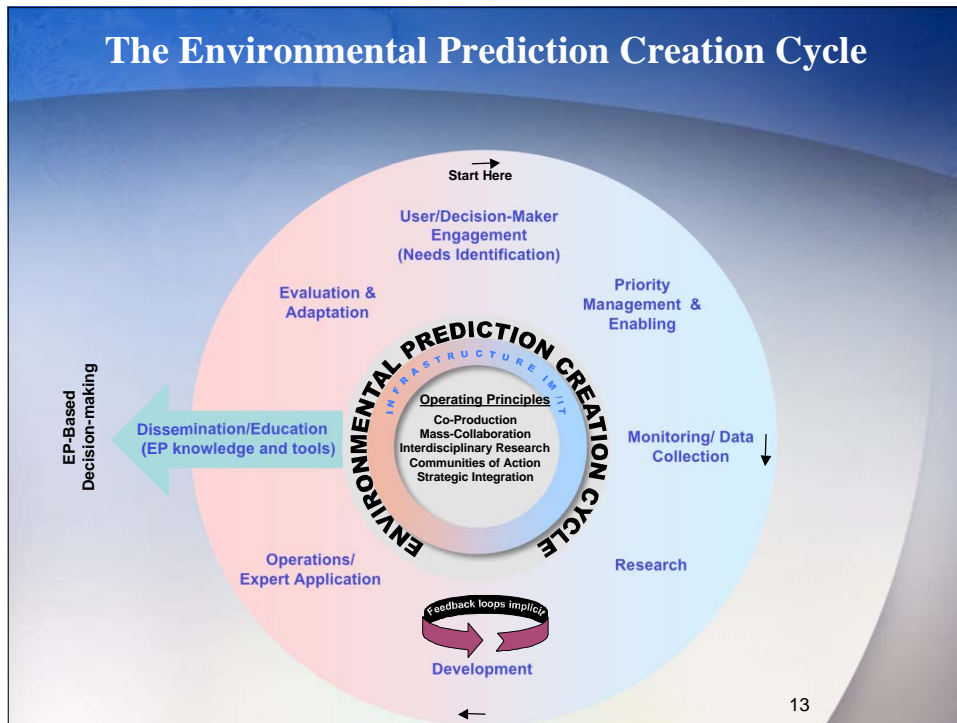
Pop Quiz: Need for a Decision-Making Framework

(slide courtesy of Roger Pielke Jr./Oxford University)

Data Source: Jarrell and Demaria 1999



The Environmental Prediction Creation Cycle



EP Creation Cycle Organising Principles

1. **Co-production:** The act of producing information or technology through the collaboration of scientists and engineers with non-scientists, which incorporate values and criteria from both communities
2. **Mass Collaboration:** Engaging many individuals on a non-organised distributed basis to contribute to the creation of new products process or services
3. **Communities of Action** - groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis
4. **Interdisciplinary Research (IDR):** a mode of research by teams or individuals a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice
5. **Integration of Management Strategies:** Managing resources within a given EP component across thematic subjects where feasible can lead to production efficiencies

Conclusions: Imperatives to Act

Opportunities

- Rising demand for EP
- Good potential for success
- Informs and is responsive to political/policy shifts
- EP is communal: must develop partnerships
- EP is a natural integrator of intra- and extra-government activities

A systemic approach to improving Environmental Prediction offers a novel means of bridging science-policy

Risks

- Foreign EP institutions may mean loss of competitive edge for Canada
- Environment may not be effectively managed
- Reduced safety and security of Canadians
- Perception of inaction



Conclusion: Key Shifts for S&T from *Status Quo*

