



A Global Context and Shared Implications

Social

- Change
- Uncertainty
- Ambiguity
- Technical Challenge
- Expansion
- Constraint
- Knowledge
- Rapid Pace

Technical



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'All the instances of scientific development and practice . . . are as much embedded in politics and cultures as they are creations of the researchers, practitioners, and industries.'



(Paraphrased from Heymann, 2010; Dulay, unpublished image)

Common Pool Resources Come into Conflict



Texas Fires Shot in Water War
— ABQ Journal, 01/09/13

Chilean senate blocks El Tatio geothermal exploration



EL TATIO
ES UNA FUENTE DE VIDA
DONDE NACEN NUESTRAS
AGUAS
¡GENTEMOS UNA SOLA VOZ
UN SOLO CAMINO POR EL
DERECHO Y RESPETO A SEGUIR
EXISTIENDO.



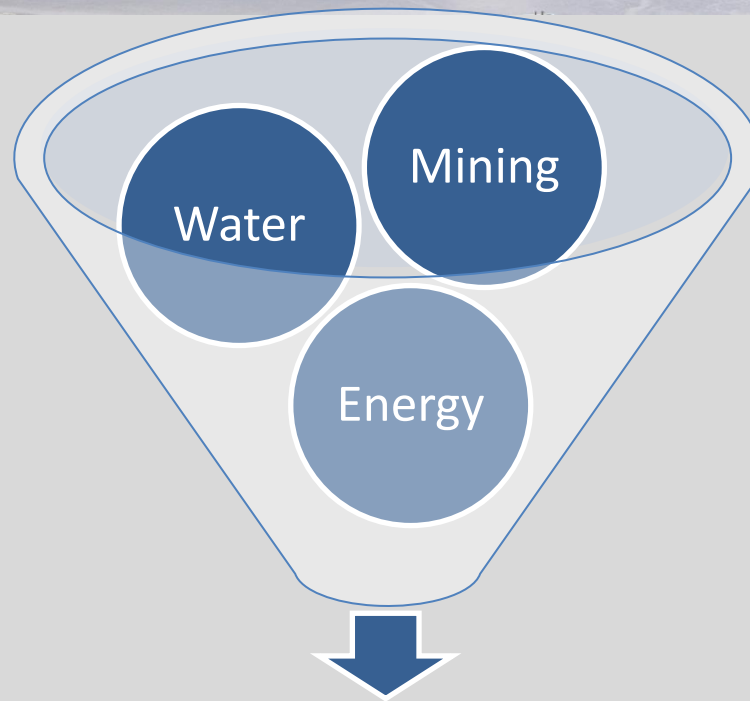
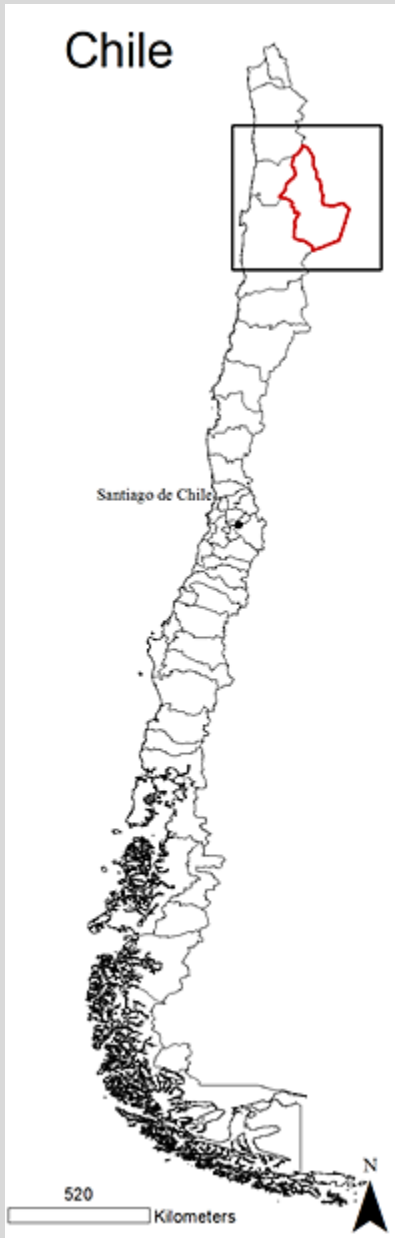
Integrated Water Resources Management



Collaborative processes meld the use of scientific information with citizen participation and technical decision support systems

Finding rigorous and effective approaches to science-based resource management and dialogue.

IWRM Case Study – Northern Chile



Multi-Scale Complexity



Global demand for Copper drives localized use of energy and water resources



Energy and Water



Primary Resource Candidates

Geothermal: Estimated 3,300 and 16,000 MW potential estimated by the Energy Ministry. Key sites throughout country with highest potential sites currently at Puchuldiza, Tatio, and Tolhuaca.

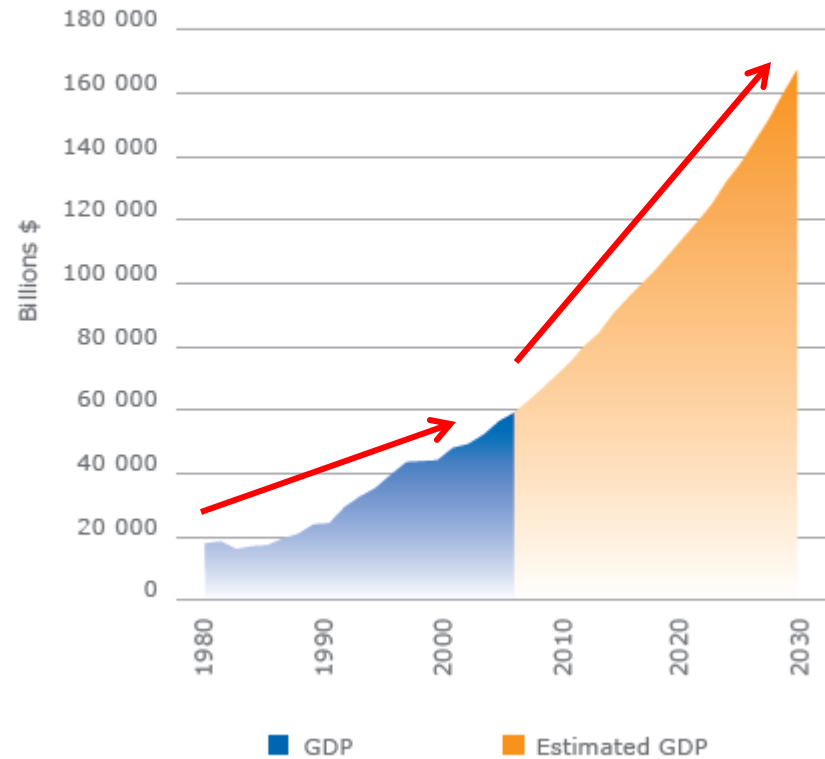
Playa lake: an arid zone feature that is transitional between a playa, which is completely dry most of the year, and a lake (Briere, 2000).

In this study, a **salar** is an internally drained evaporative basin with surface water occurring mostly from spring discharge.



GDP Projection ; 2007-2030

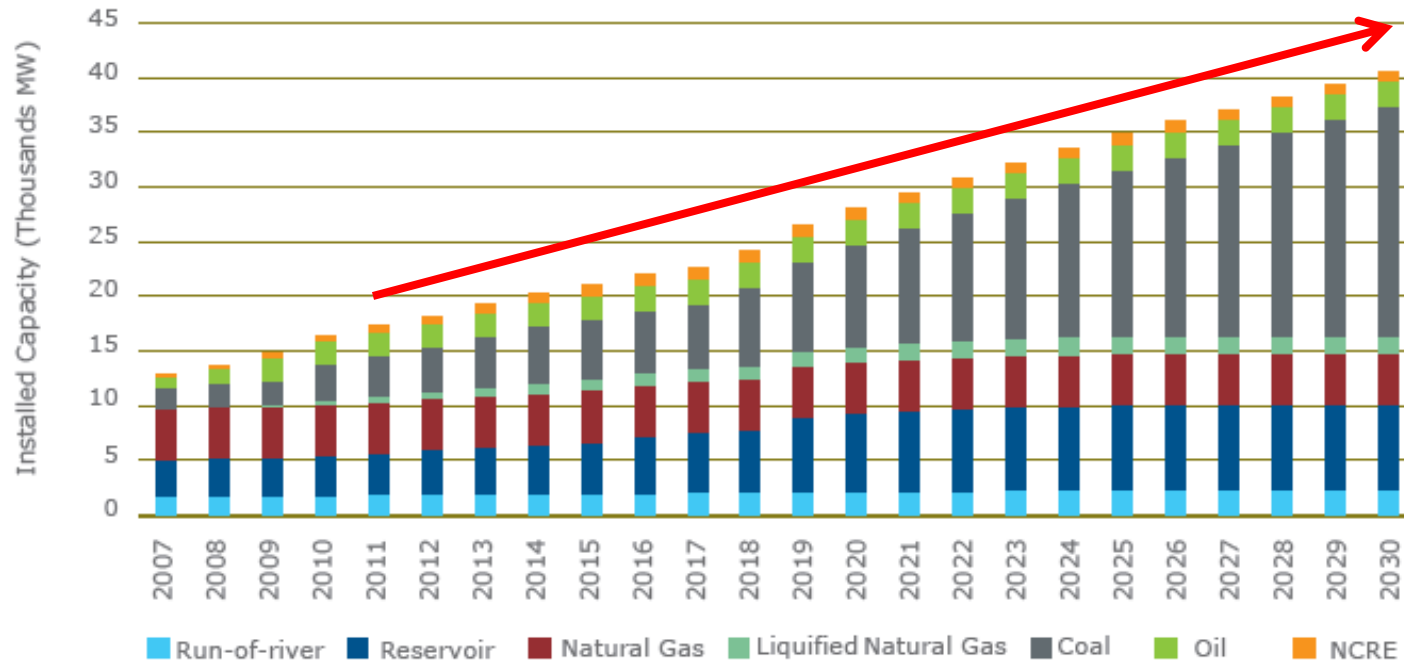
(Billions \$)



Source: PROGEA (2009)

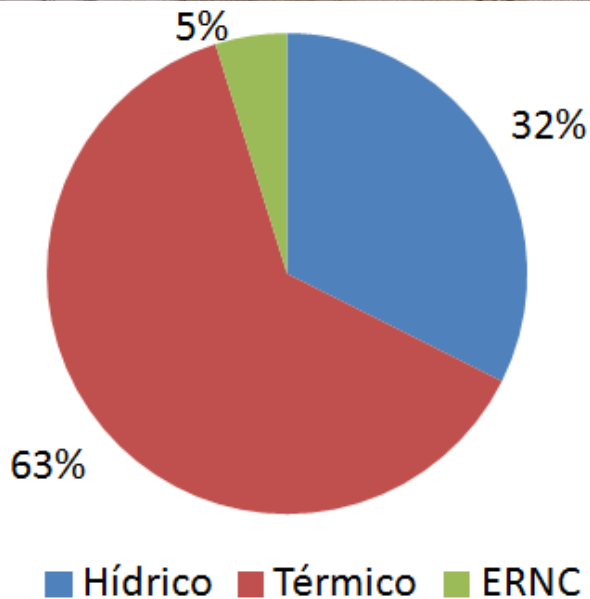


Projected Installed Power Capacity 2007 – 2030 (Thousands MW)

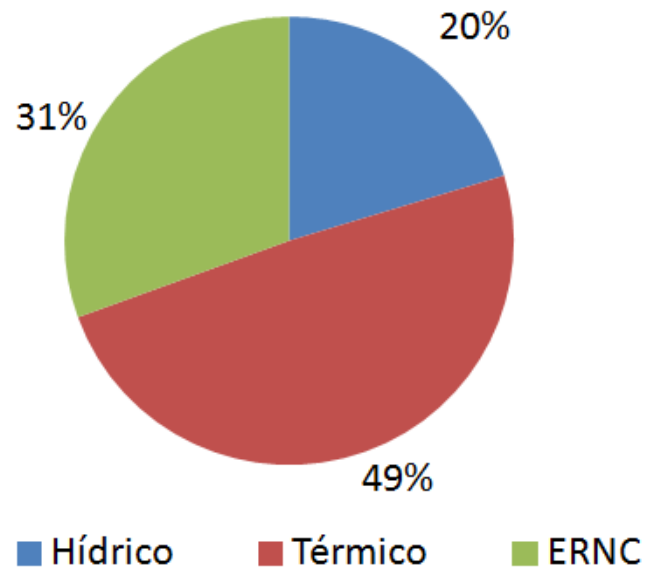


Source: PROGEA (2009)

Energy Context



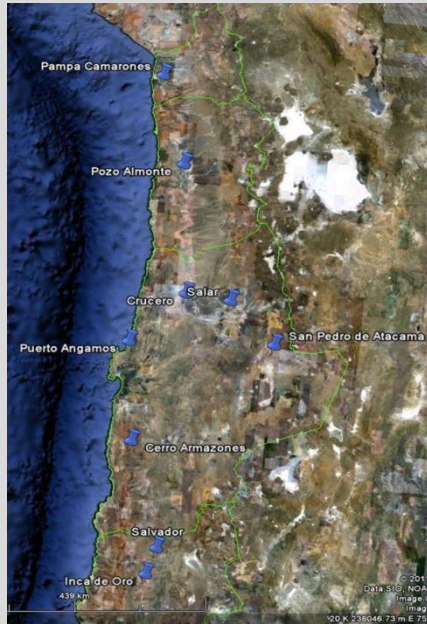
Installed Capacity: 15.420 MW



NextGen: 33.024 MW

Renewables

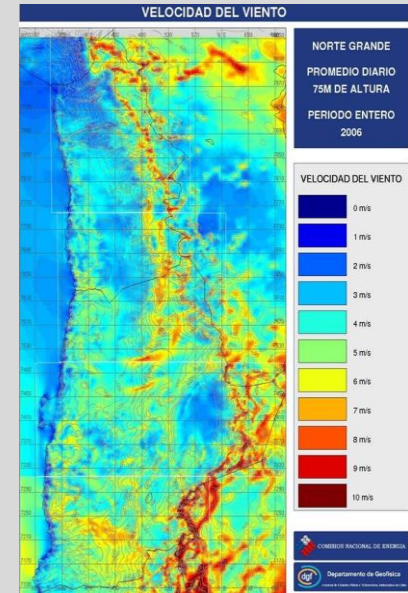
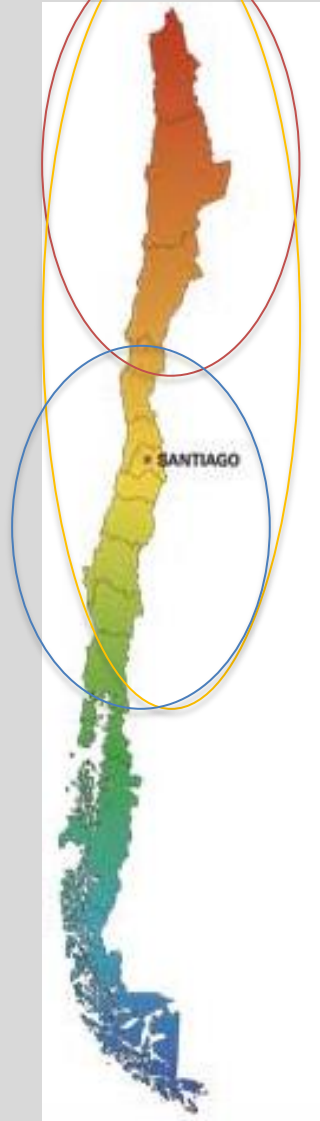
Recurso Solar



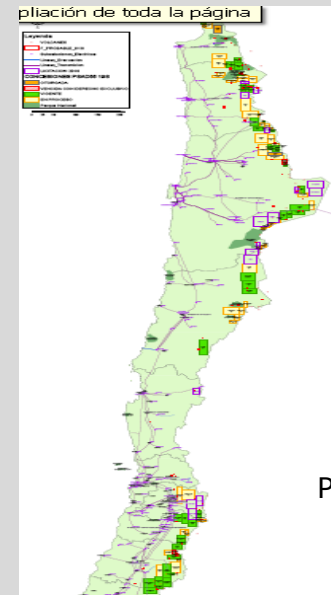
Recurso Hidrológico (En desarrollo)



Recurso Eólico



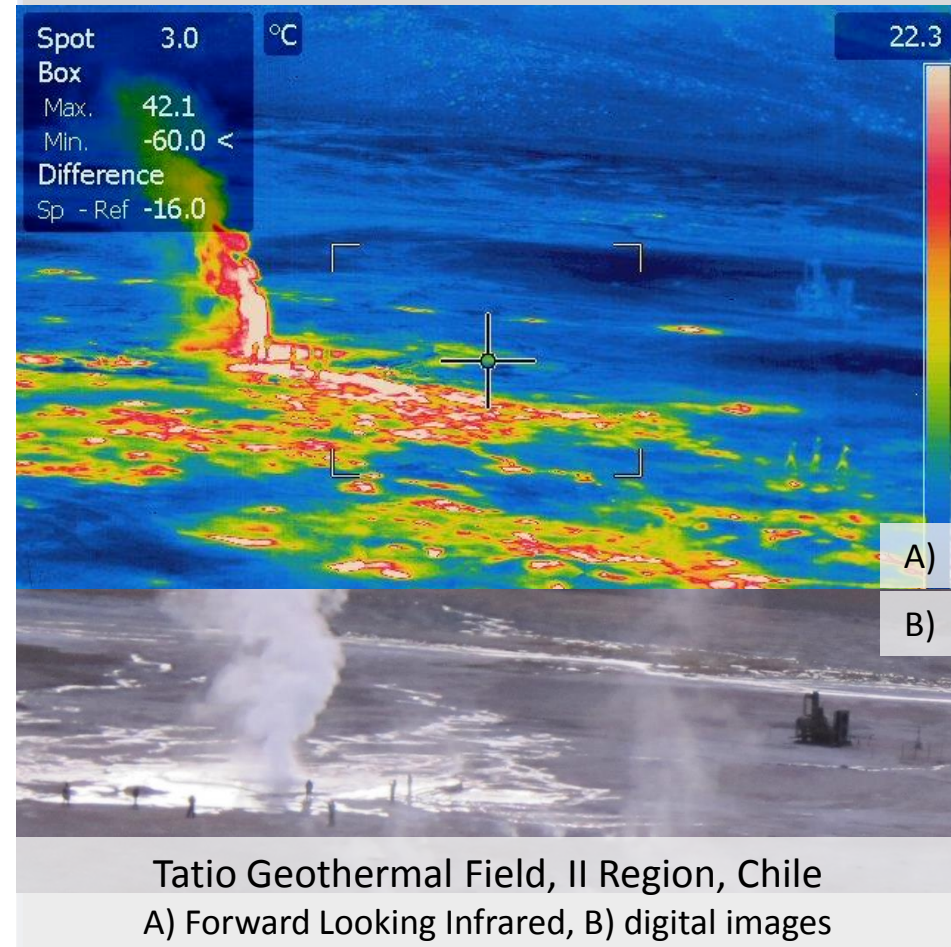
Recurso Geotérmico (Concesiones)



Per Ministerio de En
Perez-Arce, May

Geothermal Energy Resource Development

- Chile has about 3000 volcanoes along the Andes, and ~150 are active.
- Chile's geothermal potential is estimated at 16,000 MW, 1.2 times the energy capacity currently installed in the country.

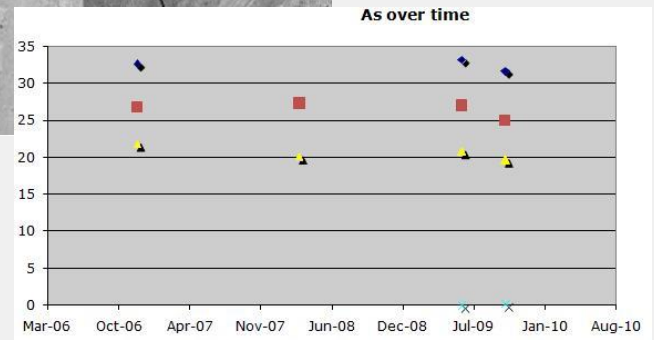
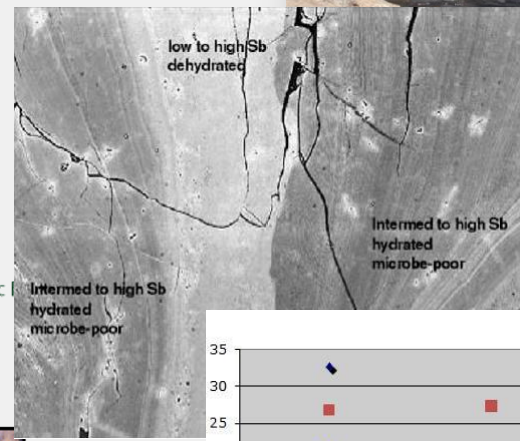
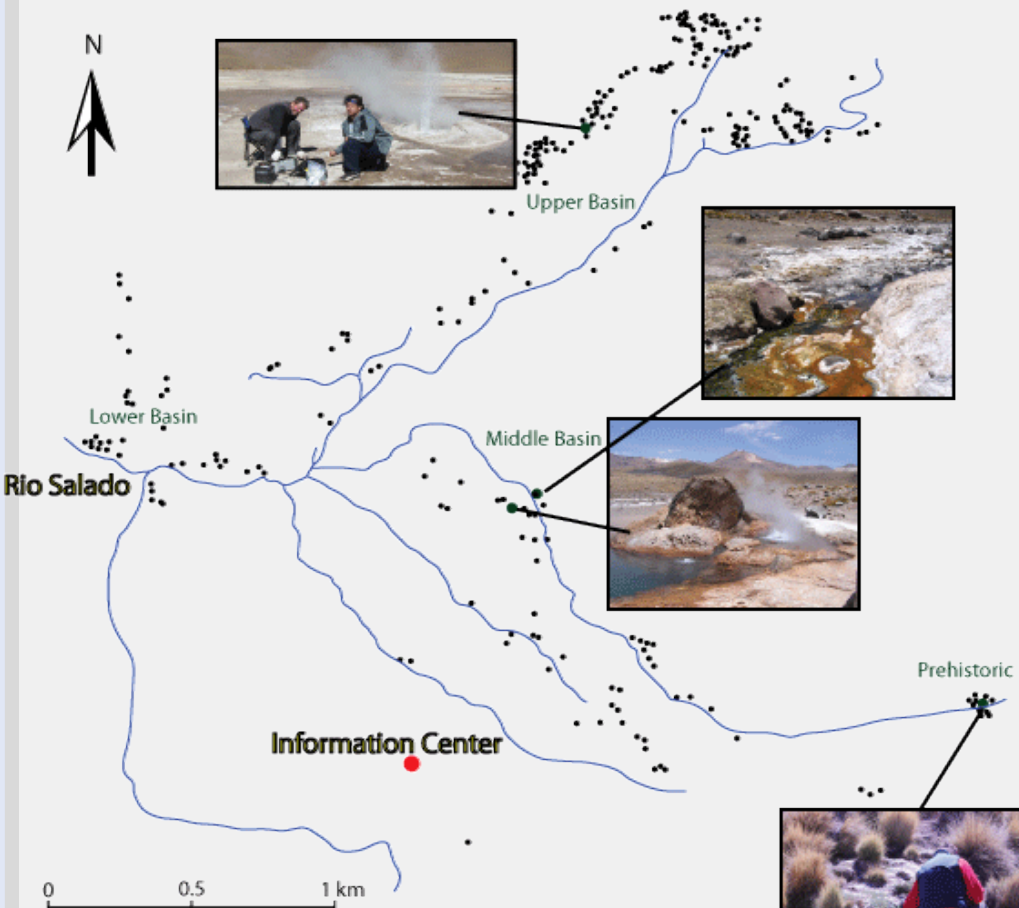


E^NCOMPASS Pilot Case



- Geothermal Resource in Chile
- Precipitating Event – Natural laboratory
- Important economic resource
- A center point for regional heritage

El Tatio Natural Laboratory

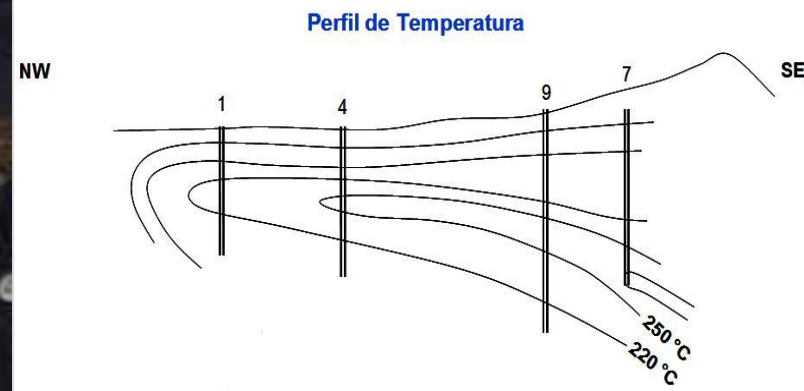
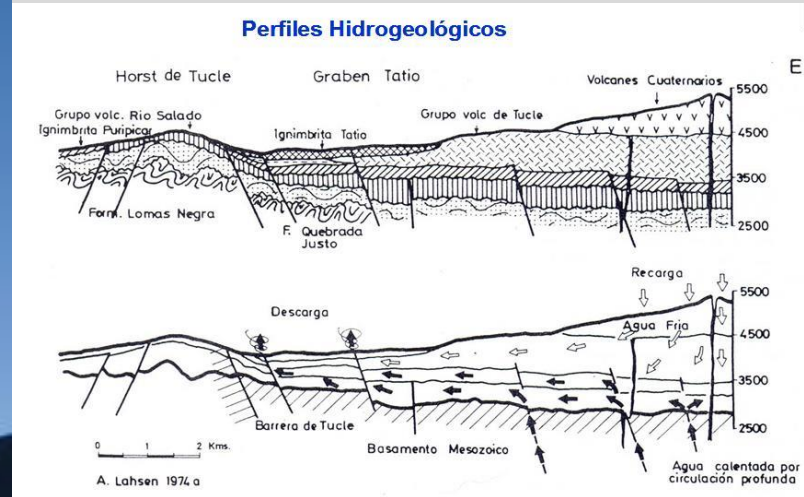


- Legend**
- geothermal features
 - geothermal features used in this study
 - hydrothermal run-off and meteoric streams

El Tatio Geothermal Event

Sept - Oct 2009

Pressure testing
for geothermal
energy
exploration
resulted in a well
blow-out.



Reaction was Intense



Information to Knowledge



Chilean senate blocks El Tatio geothermal exploration

Photograph: NOORTJE BRANTEGEM

Problem Recognition

Commitment to Action / Decision

Socio-technical Systems are the People and Technology Dyad

Common Pool Resources Understanding Stakeholders First

Require spanning information and knowledge needs



High
Performance
Computing



Subject
Matter
Experts



Formal
Education



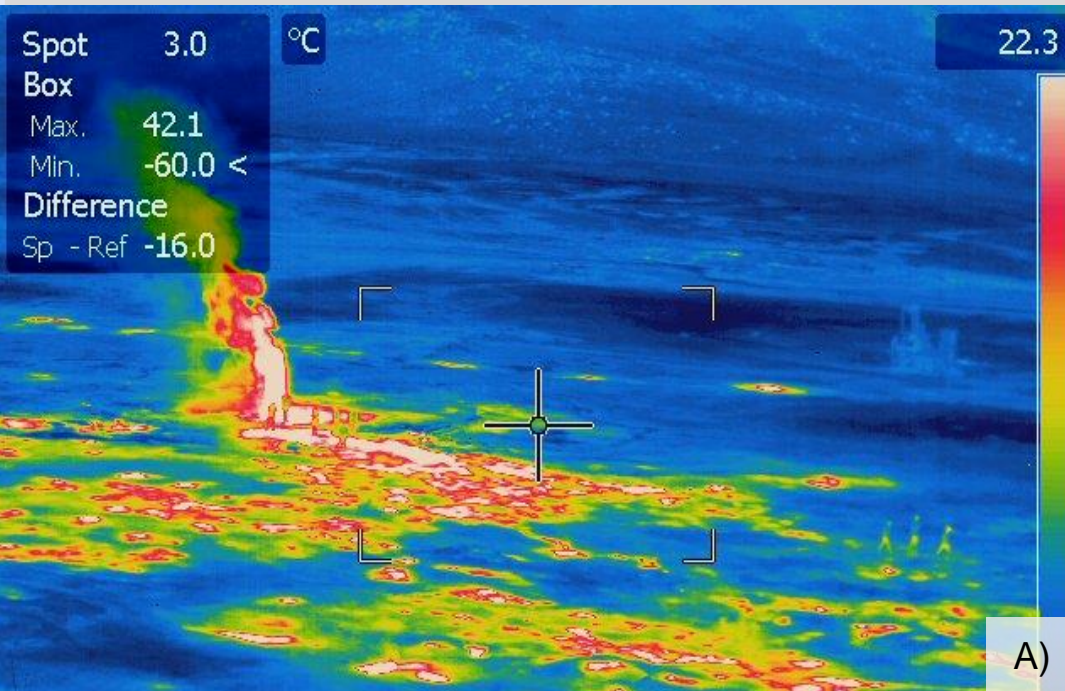
Communities



Informal
Education

Broad Spectrum of Users/Contributors

Mixed Methods Approach



Biophysical

- Field observations of geyser basin temp, geochemical/microbial sampling
- Satellite data

Social Science

- Phenomenographic interviews
- Science-ethnic workshop

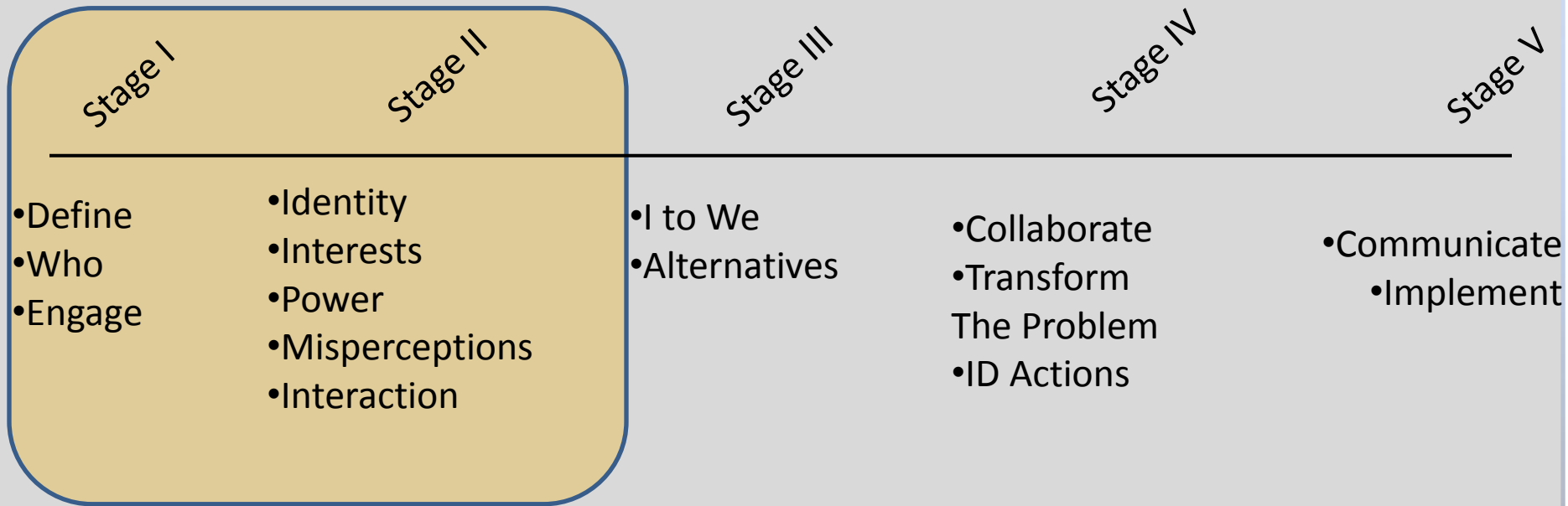
Tatio Geothermal Field, II Region, Chile
A) Forward Looking Infrared, B) digital images

Early Results - Phenomenography

- **Indigenous** population is enacting resistance and rejecting hierarchy
- **Government** operating in a planned change model
- **Industry**
 - Energy – concern regarding resistance, inevitable
 - Tourism - sees other sectors as an identity threat
 - Mineral Mining – sees the issues for Tatio, but don't connect relationship to their sector



Sustained Dialogue



Social Equilibrium Shift
Opportunity for Science-Dialogue
Intervention

(Stewart and Saunders, 2009)

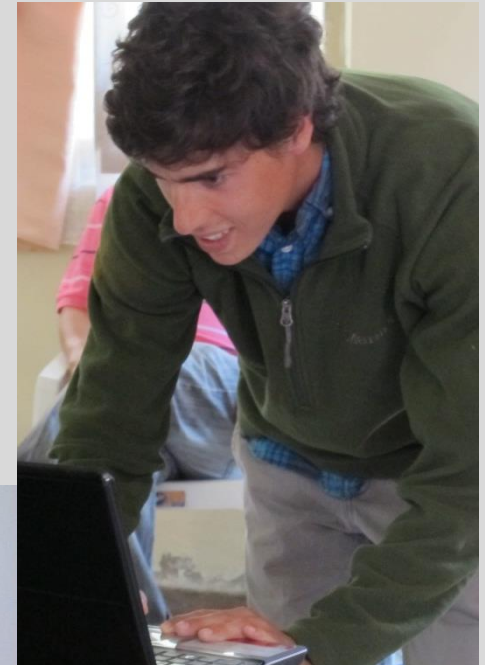
Education and Engagement

Group learning is one of the most powerful mechanisms humans use to make sense of complexity around us.






Seminario Etnico Cientifico, January 28, 2012

Dialog & Deliberation



regional groundwater system?

NDWI	Unsupervised Classification	Supervised Classification
		
$NDWI = \frac{Green - NIR}{Green + NIR}$ <ul style="list-style-type: none">Xu, 2006Overestimates	<ul style="list-style-type: none">Casteñeda et al., 2005Depth/salinity	<ul style="list-style-type: none">A priori knowledgePossible Volume

Seminario Etnico Cientifico, 28 de Enero 2012

Social Learning to Increase Relevance

- Sustained Dialogue workshops
- Capacity building for citizen science
- Vision and Priority identification



Creating Tools
to deliver
scientific
information
to people

What is the most important thing you can do with a stakeholder group?

Context & Communication

A newspaper is better than a magazine. A seashore is a better place than the street. At first it is better to run than to walk. You may have to try several times.

It takes some skill, but it is easy to learn. Even young children can enjoy it. Once successful, complications are minimal. Birds seldom get too close. Rain, however, soaks in very fast.

Too many people doing the same thing can also cause problems. One needs lots of room. A rock will serve as an anchor. If things break loose from it, however, you will not get a second chance."

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KITE

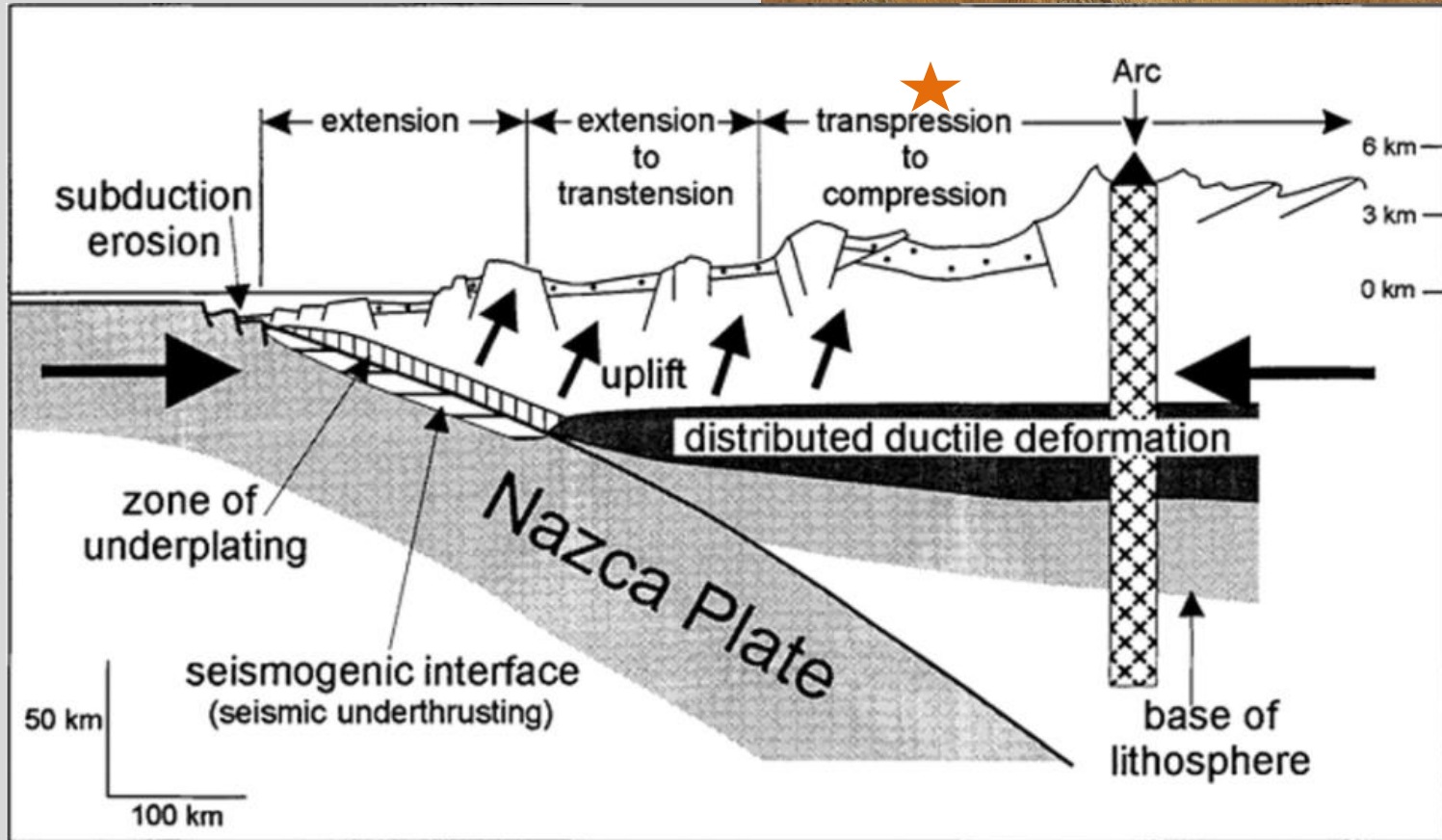
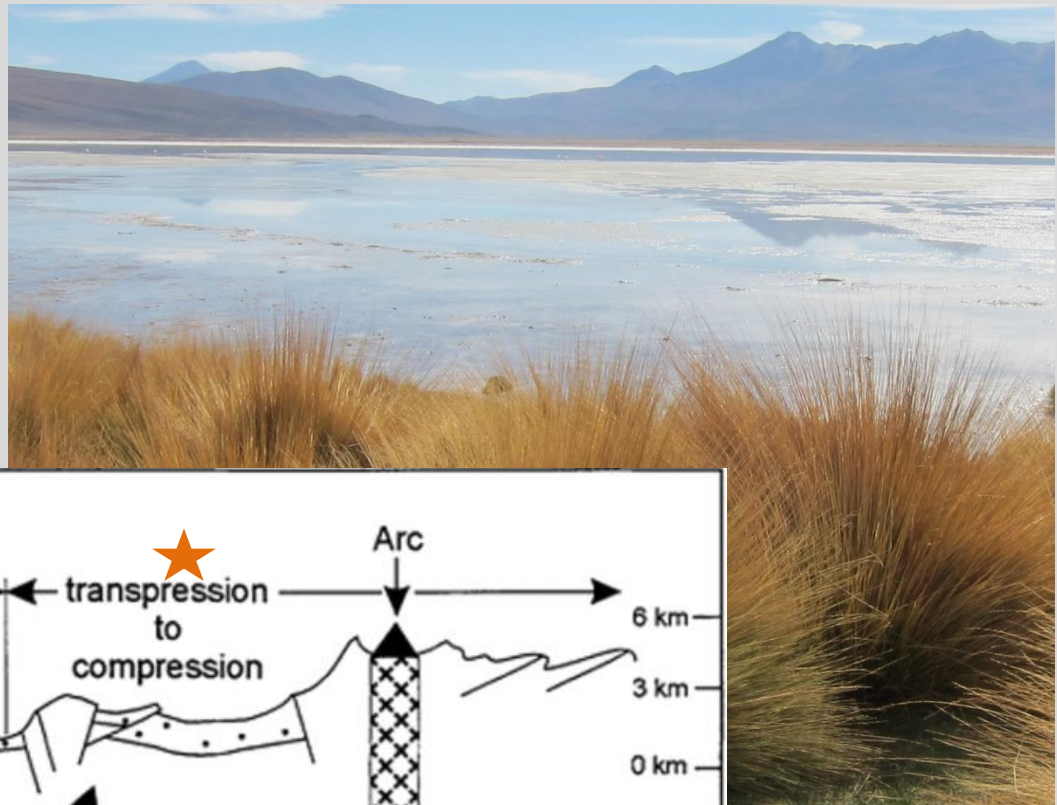
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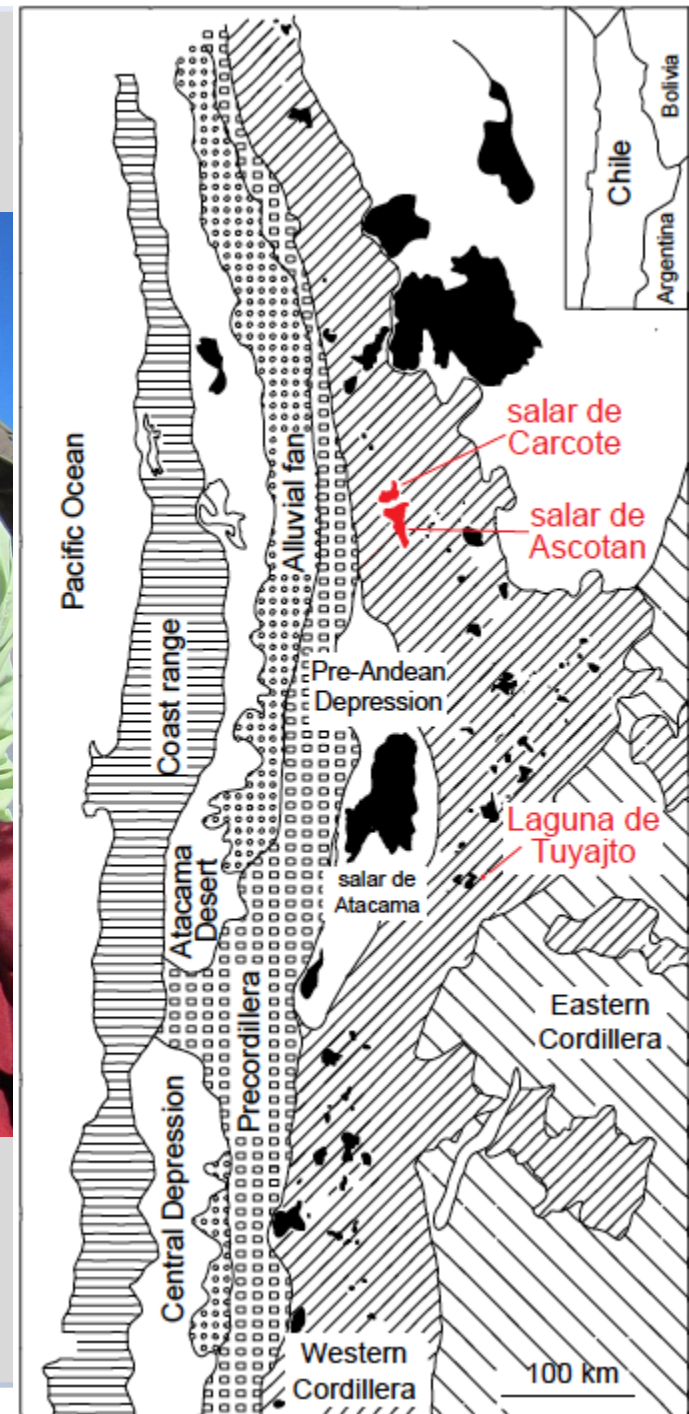
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How can we deliver integrated models
and science to stakeholders
in context?

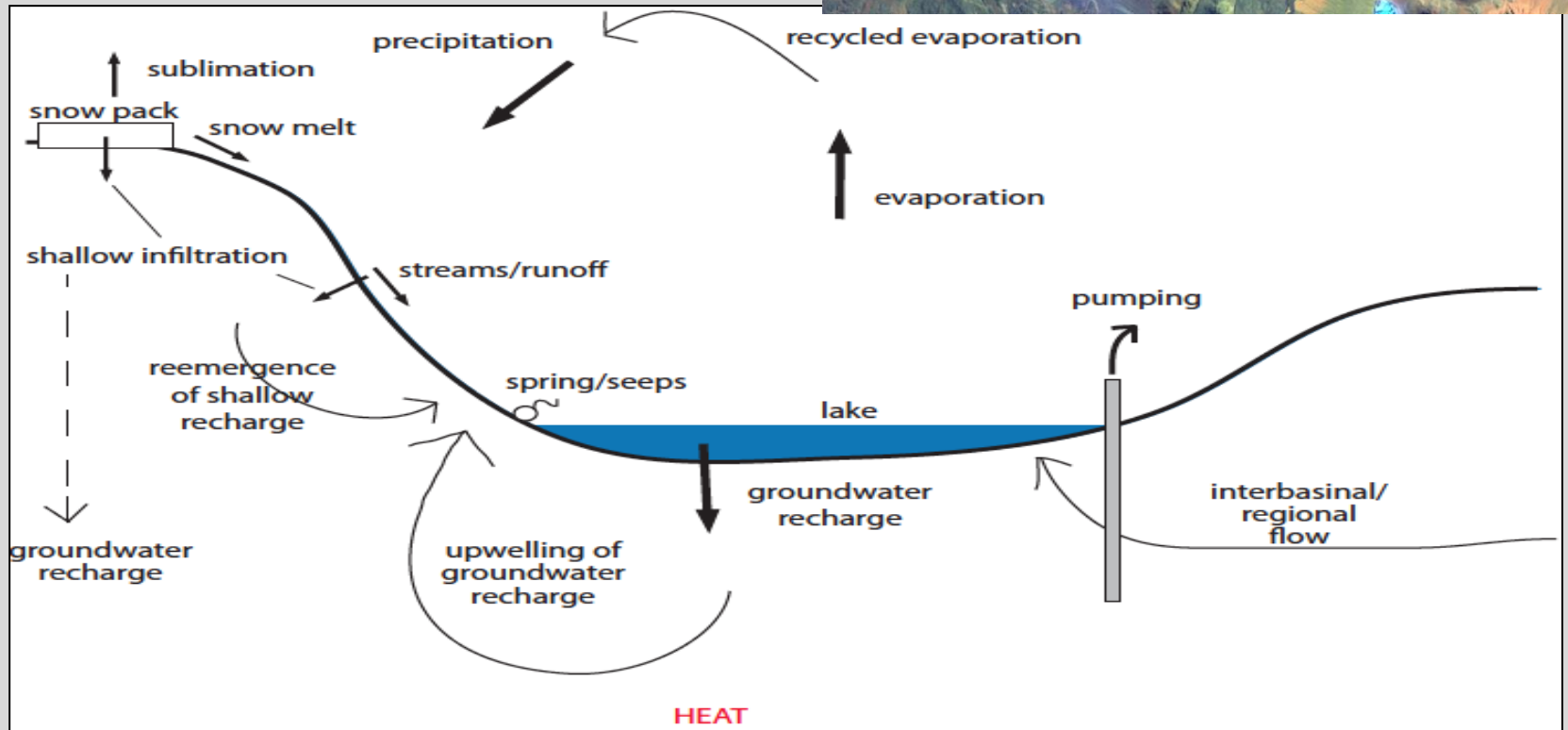
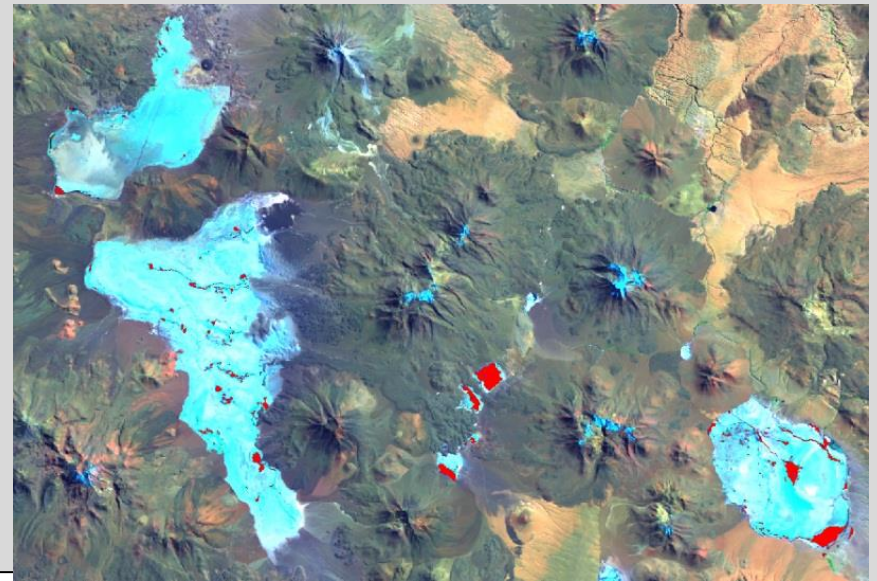
Environment



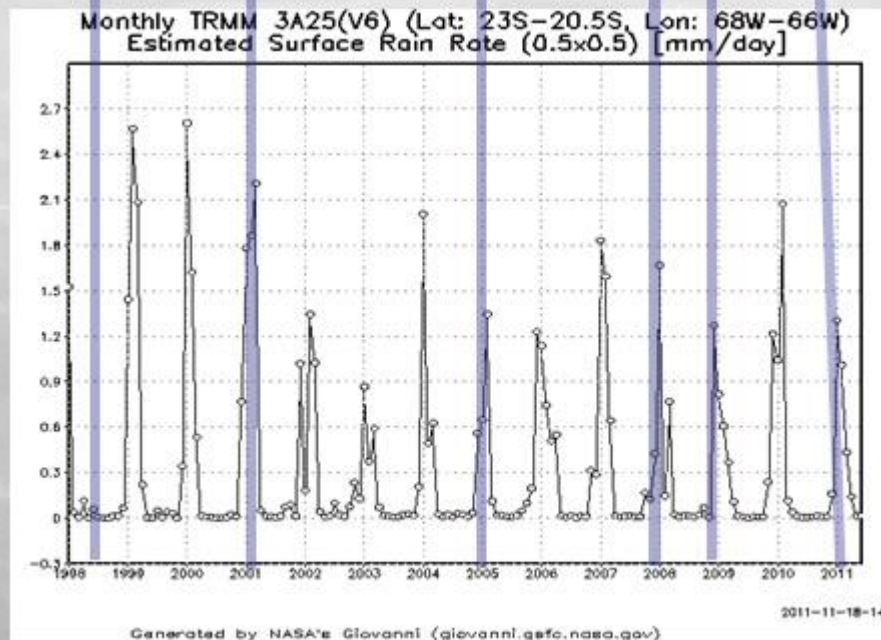
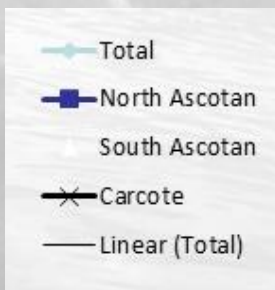
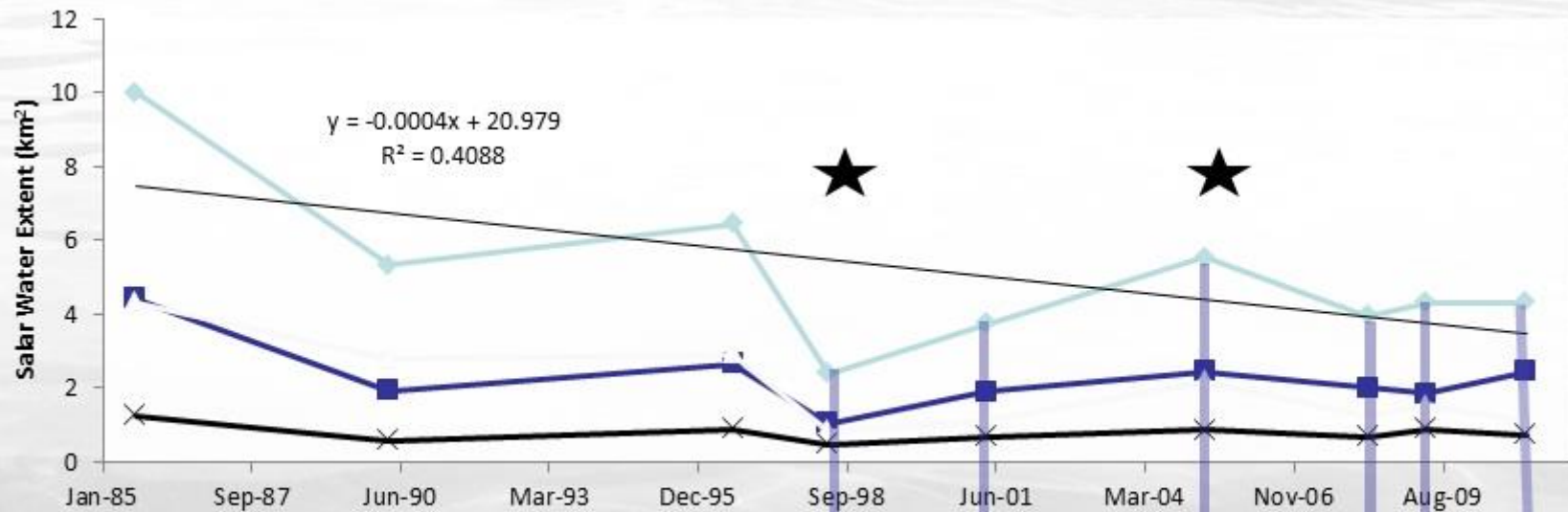
Field Sites



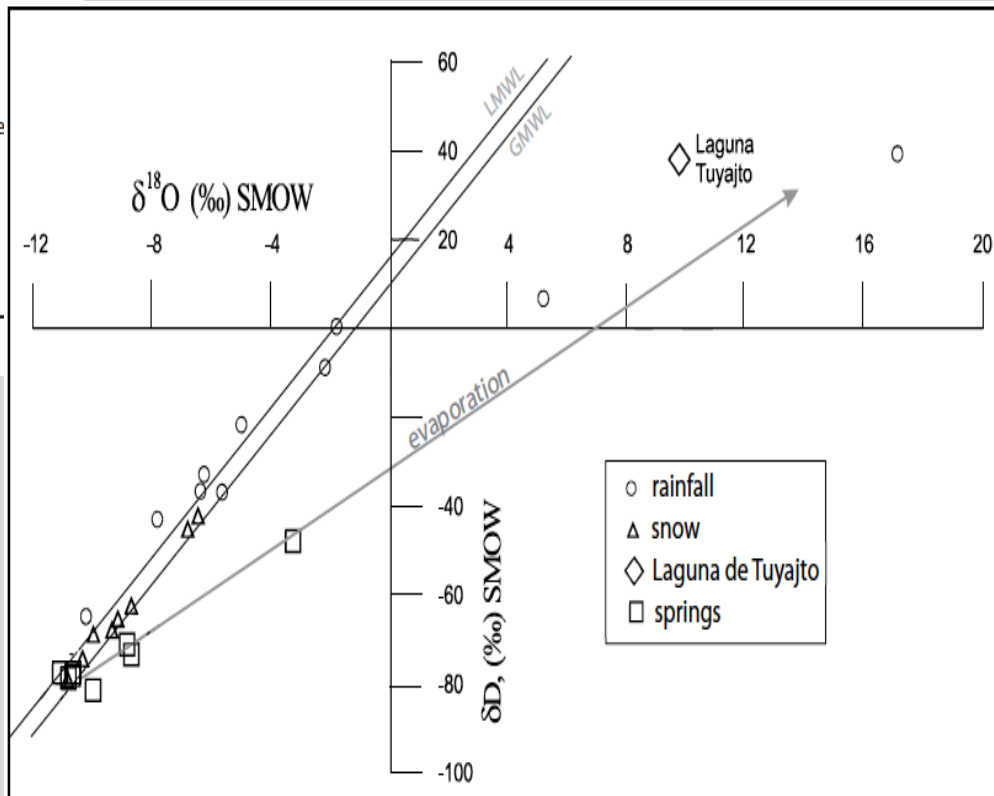
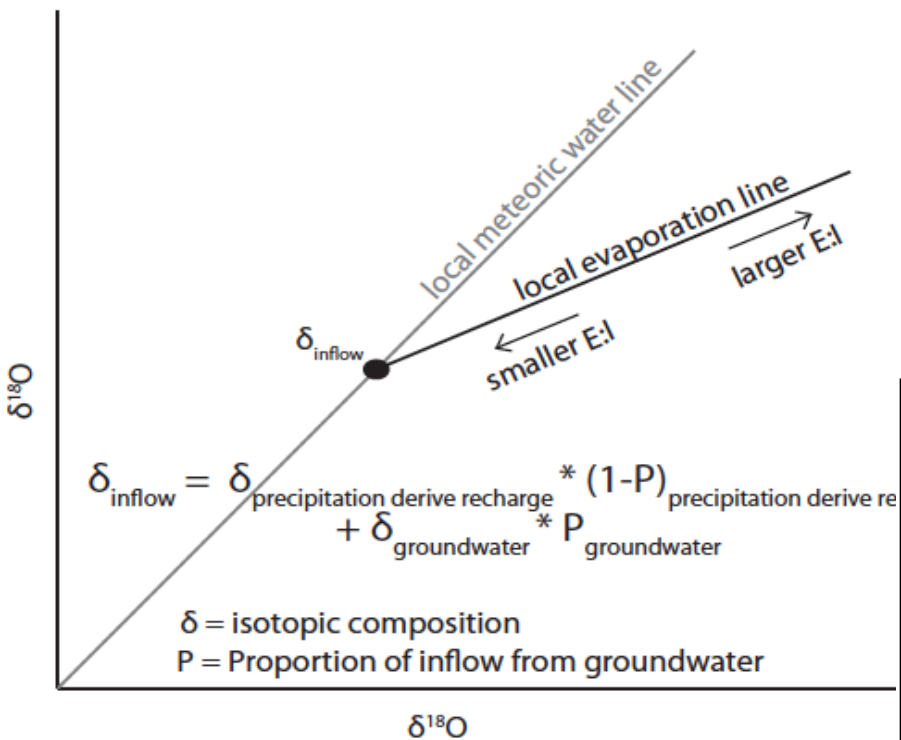
Conceptual model



Field Observations with Satellite Data



Isotopic Field Observations



Technology

Enables participation and dialogue

How off-camera events change the world



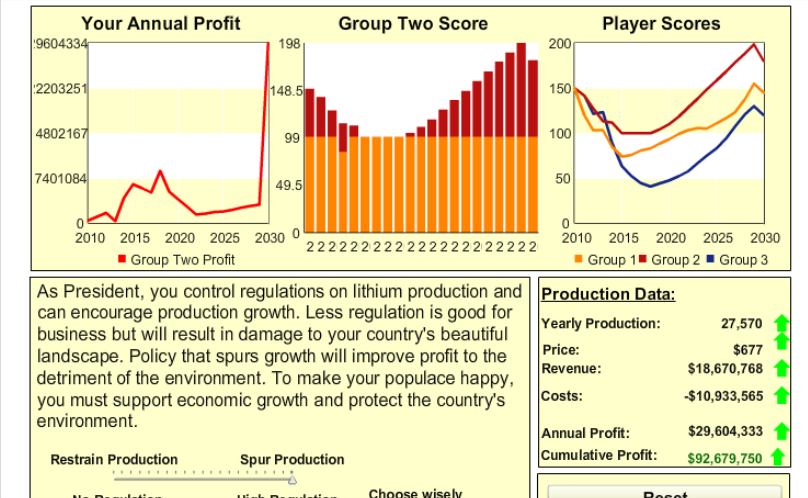
TEAM HEATSEEKERS

The University of Texas at Austin

Interactive Interfaces and Visual Analytics



Serious Gaming



Thoughts on current state ...

Complexity – accessibility and generalizable patterns

- Platforms that enable data access provide accessibility and interactivity to data sets and algorithms to seek patterns and complete analyses for increased insight

Relevance – framing to overcome science illiteracy and uncertainty

- New modalities for addressing data needs of subject matter experts and educational tools to support social learning processes

Common Pool – Consensus Yield - information delivery modalities

- Technology is enabling improved forms of engagement paired with a relationship lens transformative social process can be achieved



Acknowledgement

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Thank You!



