The impact of sea level rise on salt water intrusion into coastal aquifers

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According to the IPCC (2007) sea level rise is one of the more certain consequences of climate change. Salt water intrusion into coastal aquifers is an important impact of sea level rise, which has received some attention among the coastal scientific community in recent years (e.g. [1]).

Several studies have produced global scale salt water intrusion maps, buth these maps are at a coarse spatial resolution, which limits their use. We contend that there remains a need to investigate how future changes in climate will affect freshwater-seawater interactions in coastal aquifers both in terms of seawater intrusion as well as groundwater discharge.

We present a first order, global model intended to predict change in the salt water intrusion length into coastal aquifers under different sea level rise scenarios. Forecasts are made up to a pixel resolution of 30 arc-seconds. This model is based on existing sea level rise scenarios, the Bruun Rule and assumptions concerning the relation between surface topology and the hydraulic head which is expected to be a function of aquifer recharge and public consumption. Saltwater intrusion lengths in water stressed areas are likely to increase with sea level rise but that the effect of changing consumption rates due to population change is often greater than the effect of sea level rise alone.

Several limitations remain regarding the utility of the analysis based on data quality; however the model remains a useful first step towards understading future salt water intrusion at a global level.

[1] Döll, P. (2009) Vulnerability to the impact of climate change on renewable groundwater resources: a global-scale assessment. *Environmental Research Letters* **4**(3), 12pp.

Exploring geoengineering using climate and detailed modelling strategies

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Geoengineering (the deliberate perturbation of the planet to counteract some of the effects of increasing CO_2 concentrations) has received increasing attention in scientific and policy communities due to concern about the difficulty of transforming the planet's energy infrastructure and the scientific consensus that reductions in emissions must take place soon to avoid the risk of undesirable impacts and dangerous climate change. Due to the difficulty of energy transformation, societies have been slow to respond, in spite of the risks.

As a stopgap measure, a number of geoengineering strategies have been suggested that introduce aerosols into the atmosphere to increase the planetary albedo, or to reduce the opacity of the atmosphere to longwave energy to cool the planet. The conflation of aerosols, energy, and climate make these strategies a natural topic for this Goldschmidt session. I will describe some modeling studies that explore three geoengineering strategies: 1) introducing sources of stratospheric aerosols; 2) introducing sea salt aerosols to brighten marine stratocumulus clouds; 3) introducing aerosols that act as ice nuclei to reduce the opacity of cirrus clouds.

Geoengineering is complex, and it is important to consider a variety of issues in considering this topic:

1. What are the consequences of particular geoengineering strategies to climate, ecosystems, and society?
2. How do these geoengineering strategies compare to each other?
3. How well do we understand the fundamental physics and chemistry of the processes employed by each strategy? Are climate models providing an adequate representation of these processes so that they may be used for studying geoengineering consequences?

Climate models can be used to explore the planetary response to geoengineering. Process models can be used to better understand the fundamental physics and chemistry that the strategies depend upon. I will describe a number of studies performed by our group using both types of models and identify some of the remaining challenges.