P1.2

Numerical and Observational Study of the Great Salt Lake Breeze

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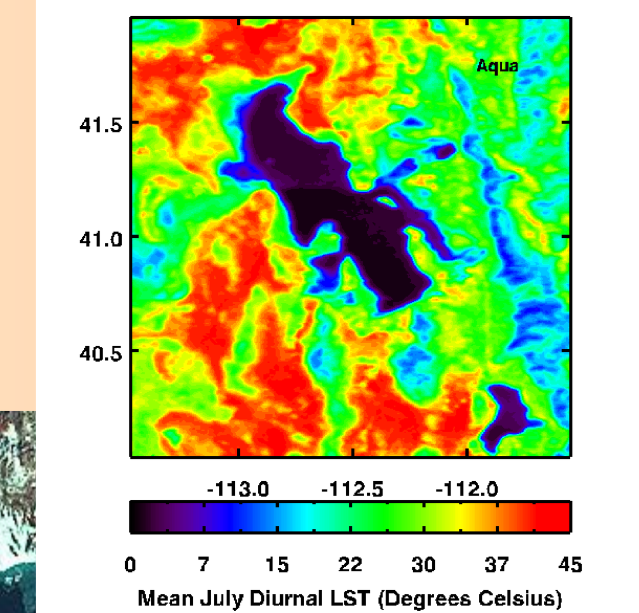
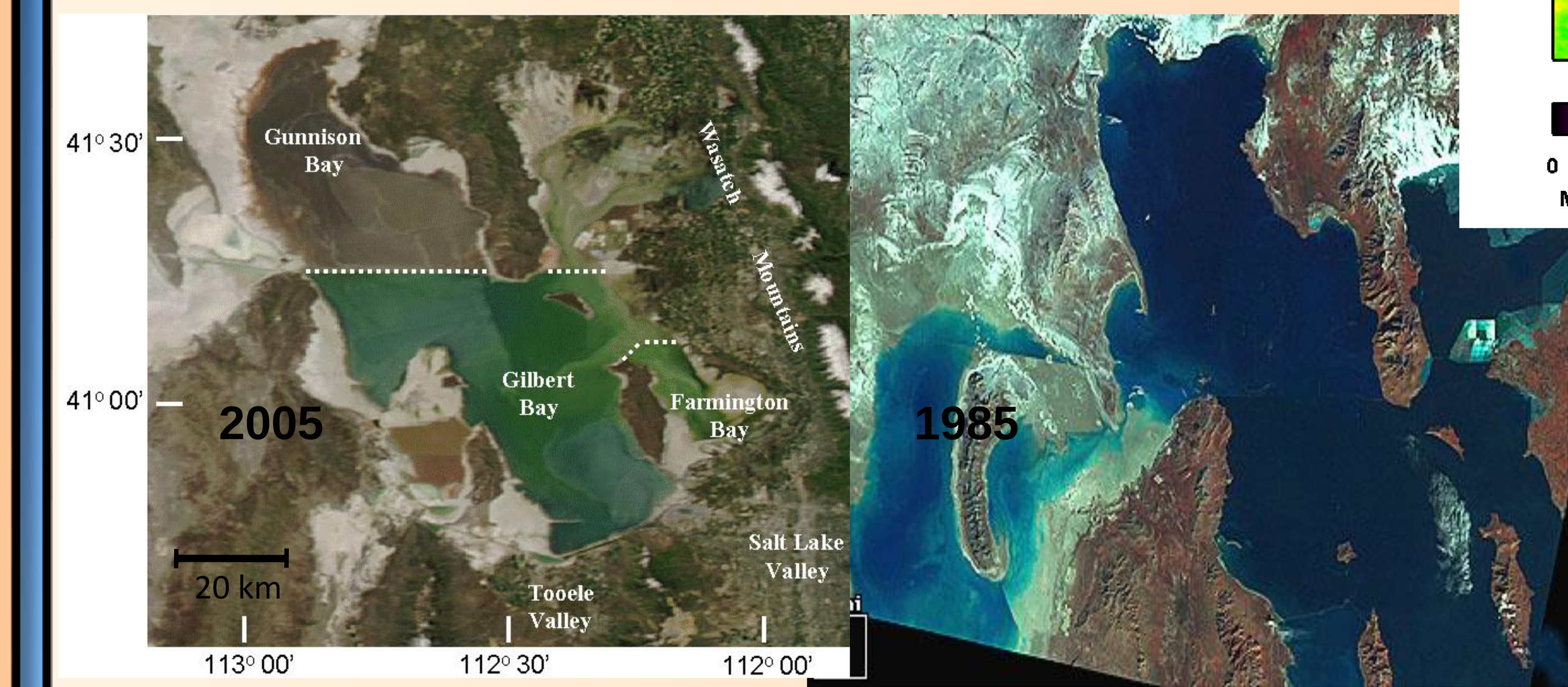
1. Introduction

- Lake breezes have been studied less than sea breezes.
- Most previous modeling studies have relied on 2-D models with parameterized boundary layers.
- Computational capabilities now allow for 3-D domains and to explicitly resolve boundary layer turbulence.
- Large variations in lake, land and atmospheric state make the Great Salt Lake an ideal natural laboratory for validating model simulations.

2. Research Question

- How do variations in lake size, surface heat flux, atmospheric stability and background wind influence the lake breeze?

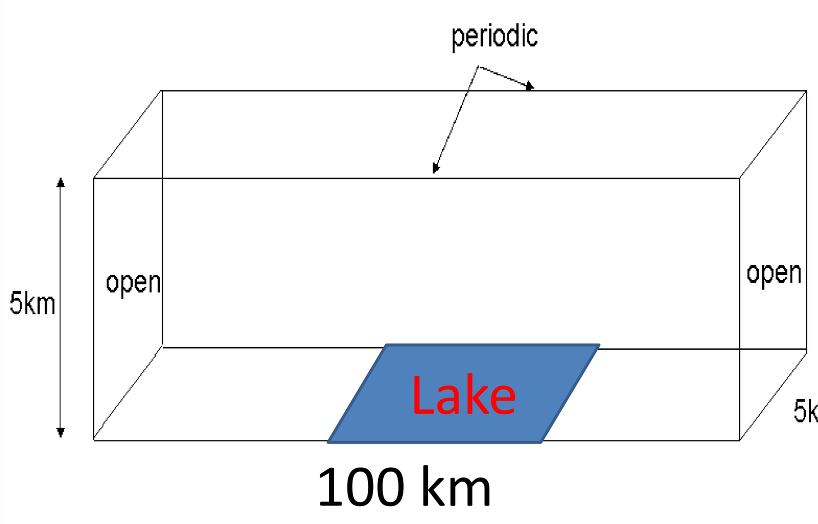




MODIS diurnal land surface temperature range (°C) for July (above) and MODIS true color bands 1-3-4 for 24 May 2005 (far left). NASA Photo of the lake at high water during the 1980's (near left).

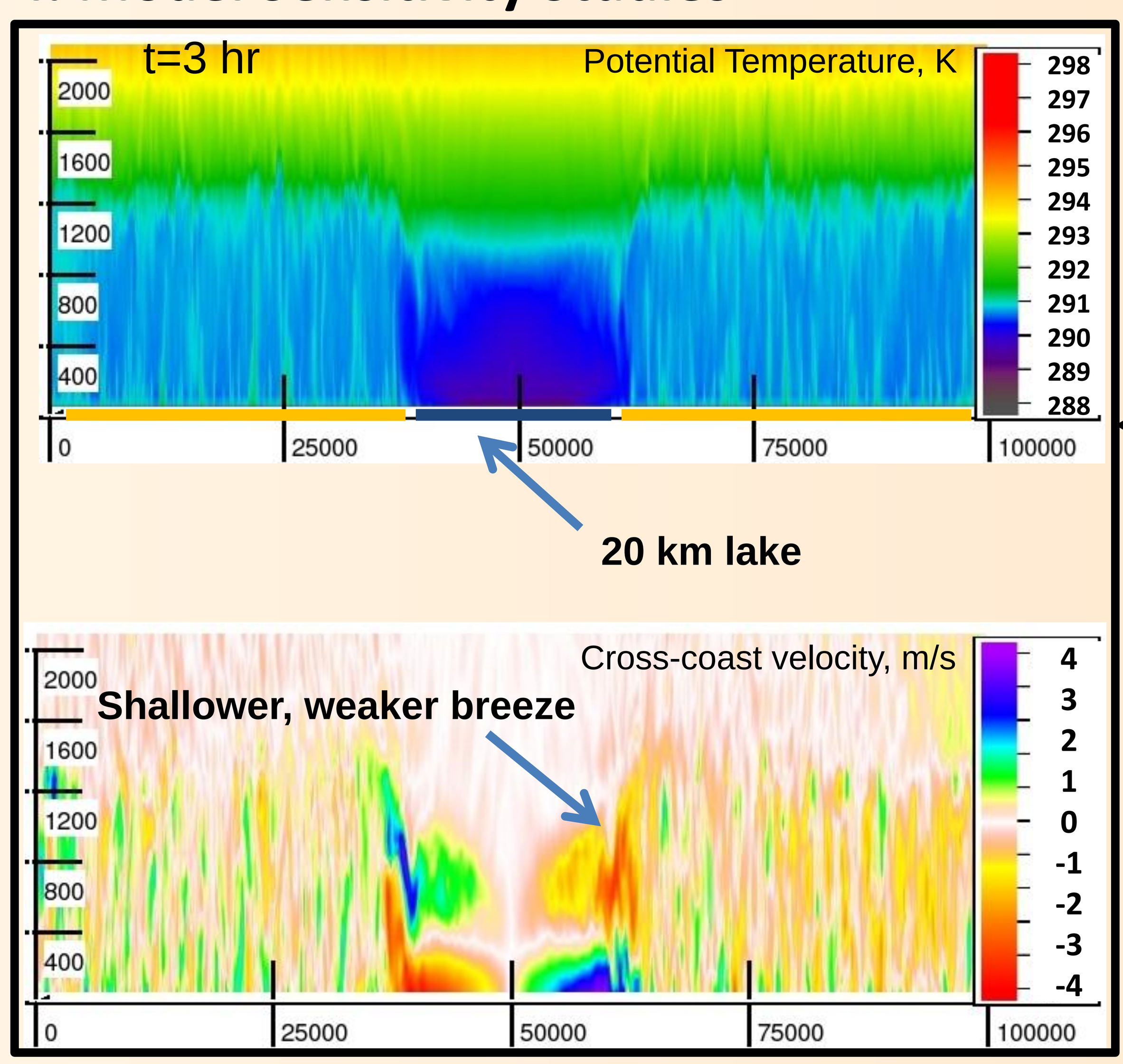
3. Model Setup

- Weather Research and Forecasting (WRF) model.
- Nonhydrostatic, terrain-following hydrostatic-pressure coordinate, third-order Runge-Kutta time-integration scheme and fifth-order advection scheme.
- Prognostic equation for subgrid-scale turbulent kinetic energy (TKE).



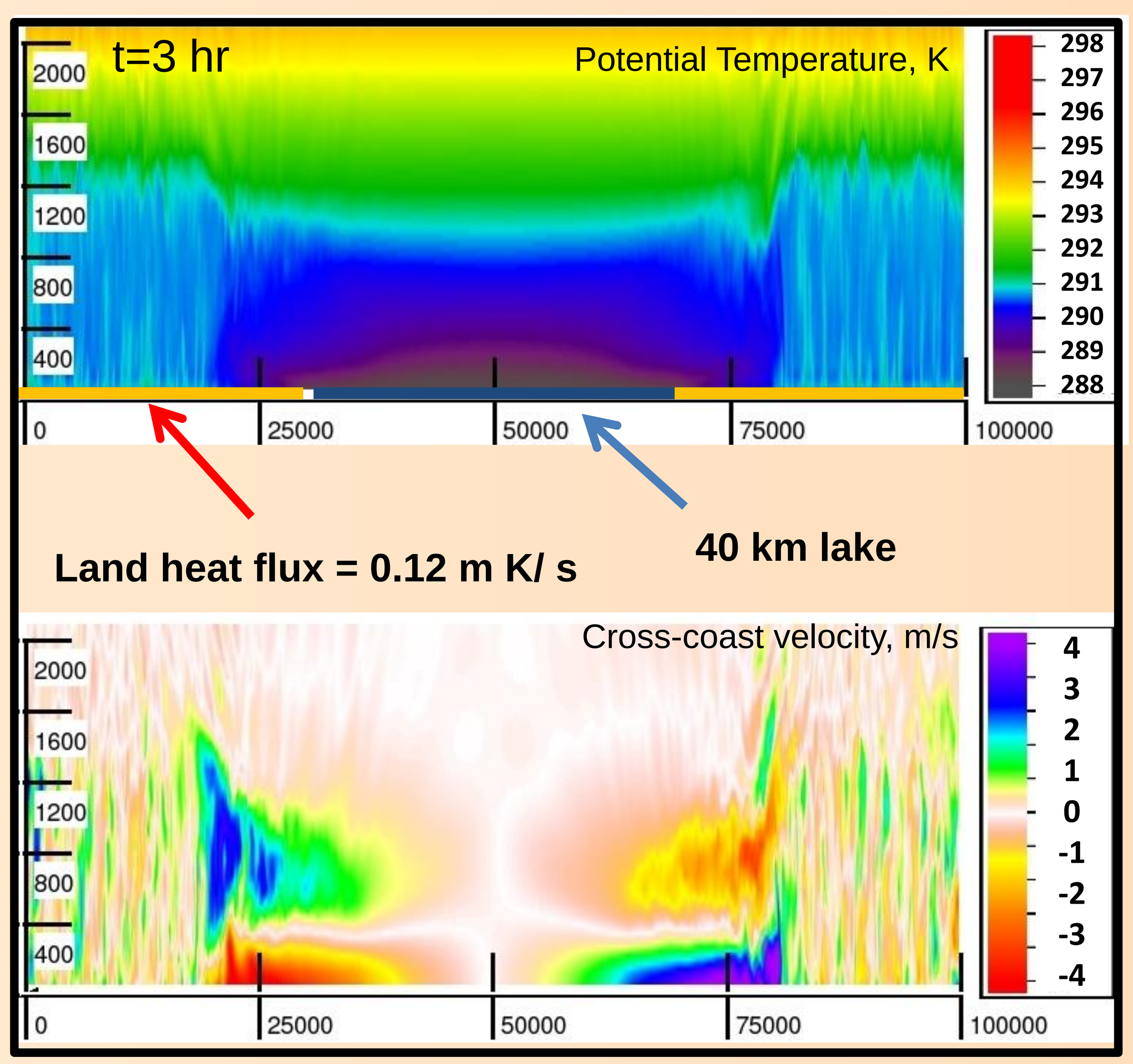
- No radiation, surface layer, or physics param-eterizations (dry).
- Surface layer fluxes and drag specified.
- Time step 1 s.
- dx, dy, dz = 100 m.

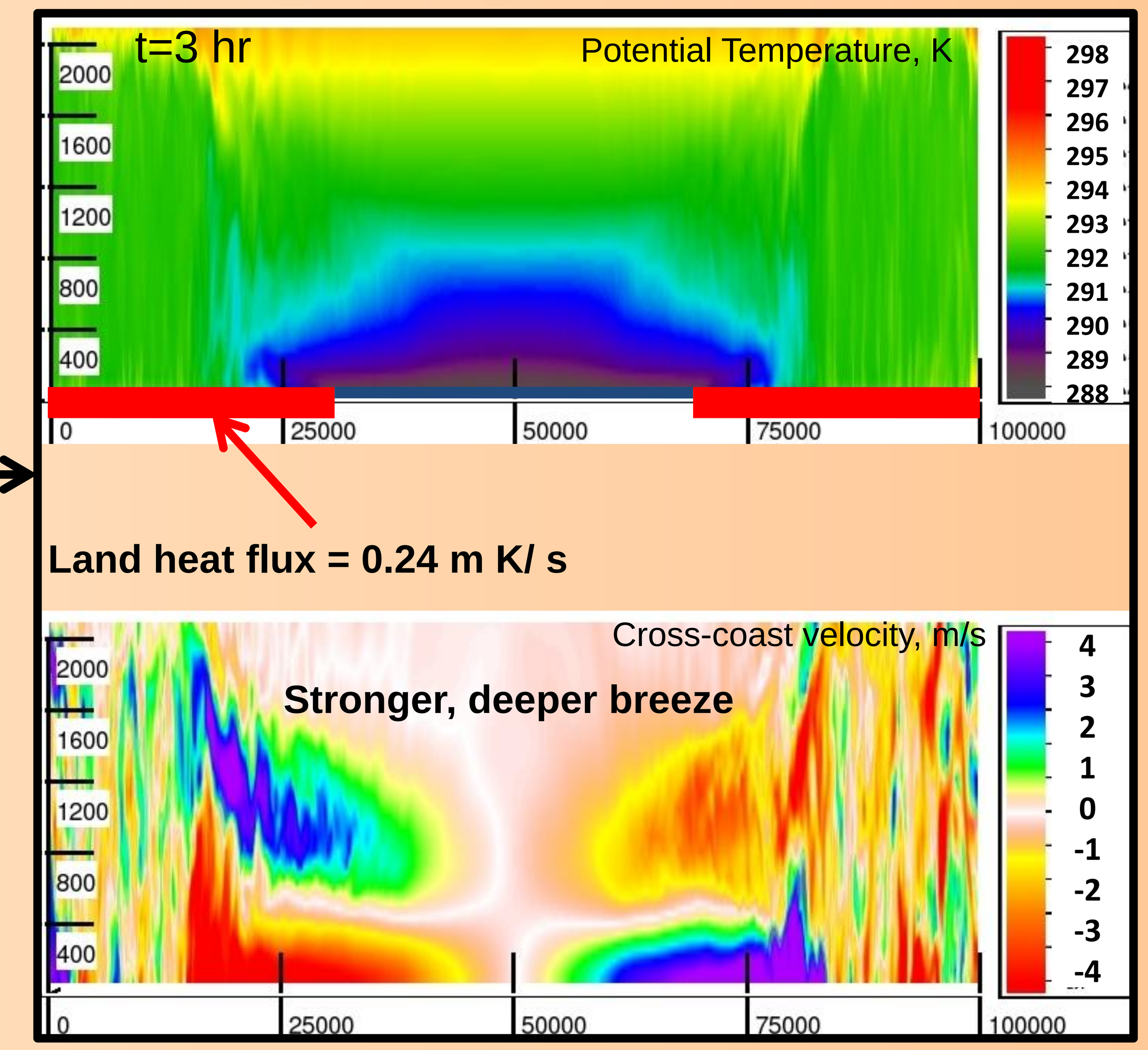
4. Model Sensitivity Studies

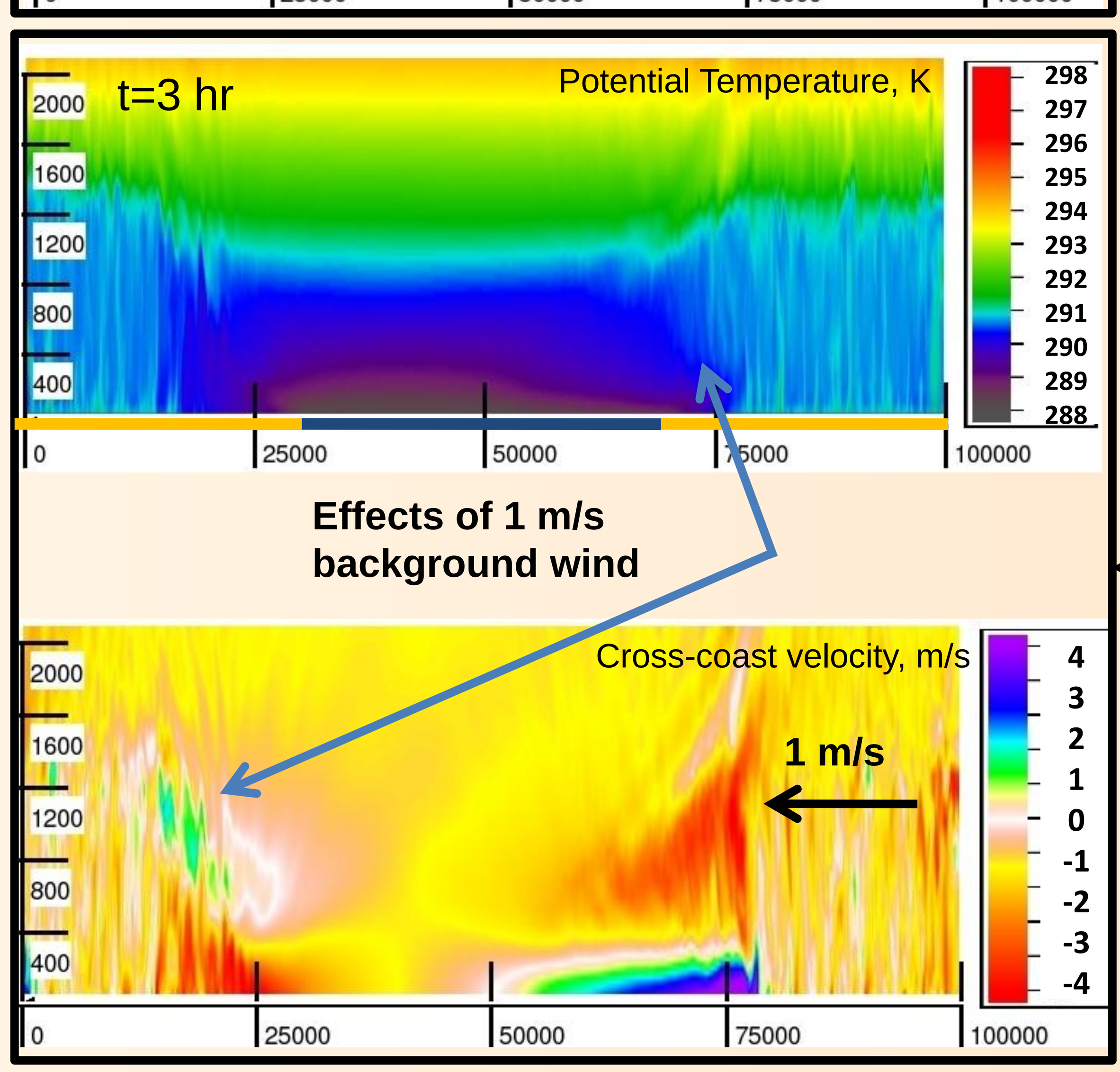


Sensitivity to Lake Size
A **smaller** lake has a **weakened** lake breeze circulation and **decreased** onshore penetration.

Sensitivity to Heat Flux
A **higher** heat flux **strengthens** the lake breeze circulation and **increases** onshore penetration.

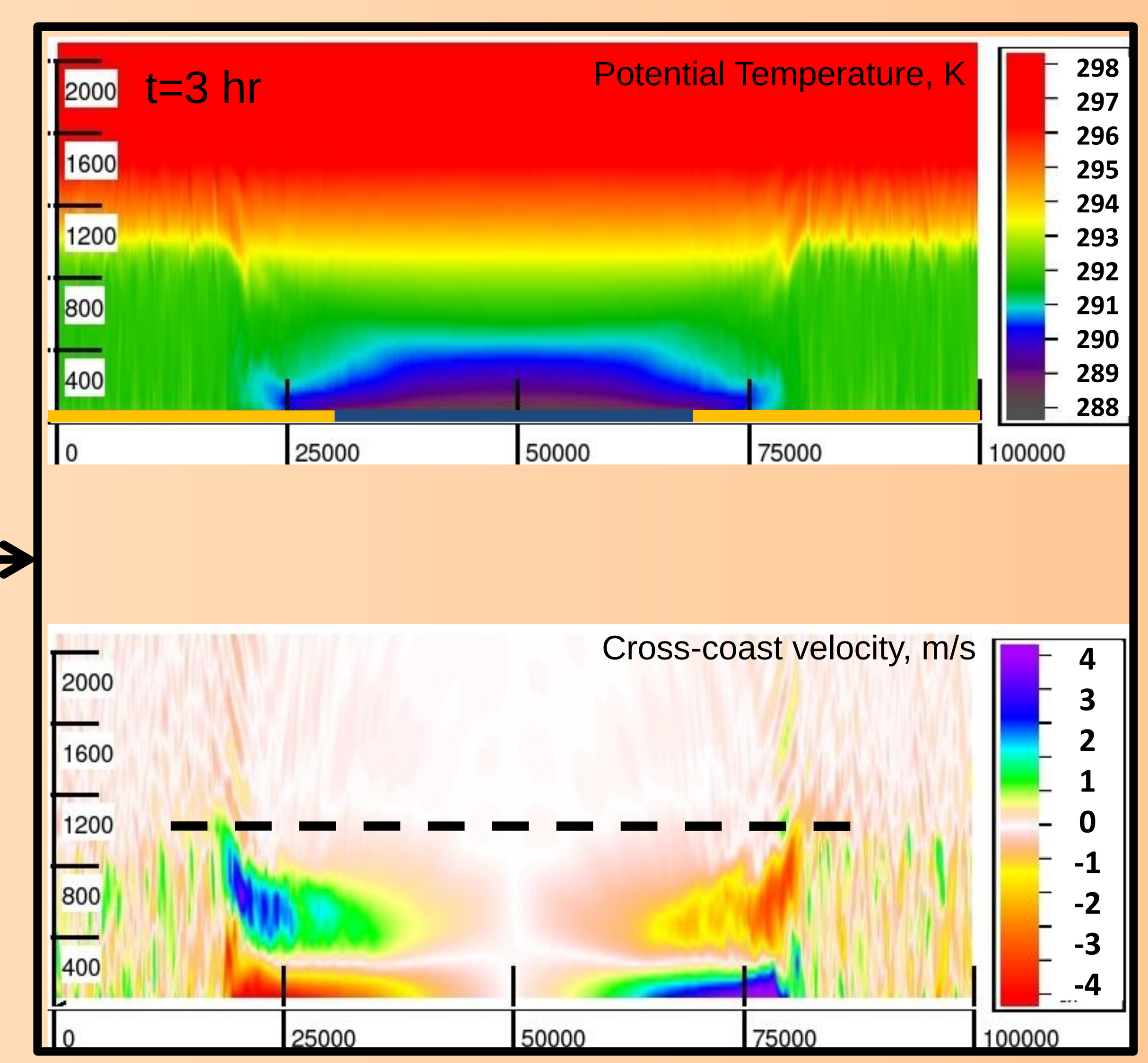






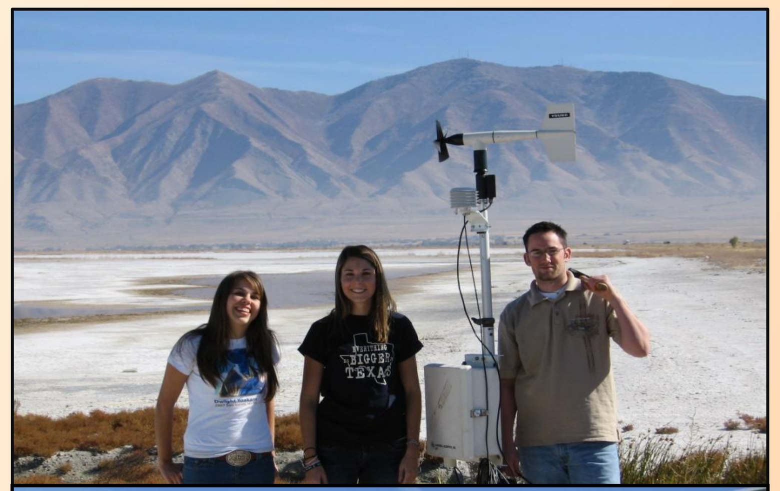
Sensitivity to Background Wind
Opposing flow influences the **movement** and **intensity** of the lake breeze.

Sensitivity to Stability
Increasing atmospheric stability **increases** onshore penetration and confines vertically the lake breeze circulation.



5. Future Work

- Add spatial and temporal variations in surface heat flux and terrain.
- Dimensional analysis.
- Real case studies.
- Ongoing validation **field study** with undergraduate students supported by NSF.



Undergraduate students setting up a weather station (top) and launching a weather balloon (bottom) on the southern shore of the Great Salt Lake on 27 October 2008.

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