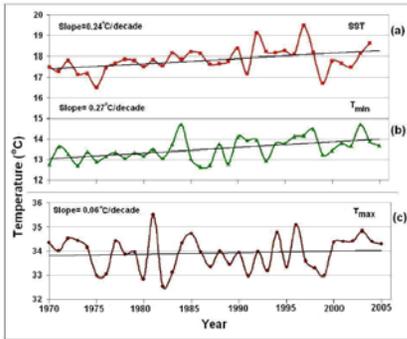


INTRODUCTION

The need for comprehensive studies of the relationships between past and projected changes of regional climate and human activity in complex urban environments has been well established. The HypsIRI preparatory airborne activities in California, associated science and applications research, and eventually HypsIRI itself provide an unprecedented opportunity for development and implementation of an integrated data and modeling analysis system focused on coastal urban environments. We will utilize HypsIRI preparatory data collections in developing new remote sensing-based tools for investigating the integrated urban environment, emphasizing weather, climate, and energy demands in complex coastal cities.

PREVIOUS WORKS

Our team has reported the important finding of 2-m (herein referred to as “surface”) asymmetric summer cooling- and heating-trends over the last 40 years in two California coastal basin areas. These studies showed:
 (a) Increased max and min temperatures statewide (with the Tmin increasing more than Tmax).
 (b) Increased max temperatures in the Central Valley and other inland areas.
 (c) Decreased max temperatures in the low-elevation coastal areas of the South Coast (SoCAB) and San Francisco Bay Area (SFBA) air basins.

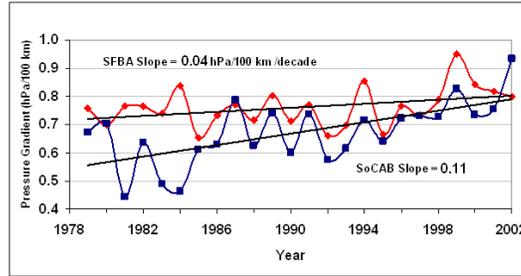


California summertime trends (°C decade⁻¹) of: (a) SST, (b) 2-m land min-temperature, and (c) 2-m land maximum-temperature.

This asymmetric warming is accompanied by concurrent increases in sea surface temperatures (SSTs) along the coastal areas of CA and may be a manifestation of global warming.

HYPOTHESIS

We hypothesize that this asymmetric thermal state is caused by increases in sea breeze activity driven by increased coast-to-inland temperature and pressure gradients, with resulting cooling of inland areas from increased sea breeze penetration. Areas blocked by complex regional topography are exceptions to these cooling observations. The ultimate origins of the cooling/warming trends are not completely understood and are difficult to apportion between global warming and/or changes in regional land use. These trends could have significant impacts on air quality and energy demands, particularly during summer peak periods. Regionally, summer daily average and peak per capita energy-use trends should decrease near the coast and increase inland.



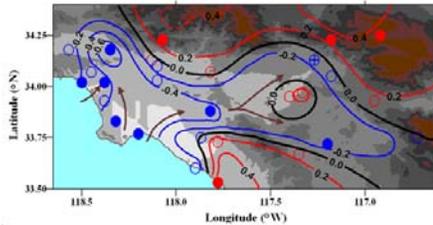
Trend summer coastal sea-level pressure gradient (hPa 100-km-1 decade-1) at 1800 UTC for SFBA (red) and SoCAB (blue)

VALIDATION

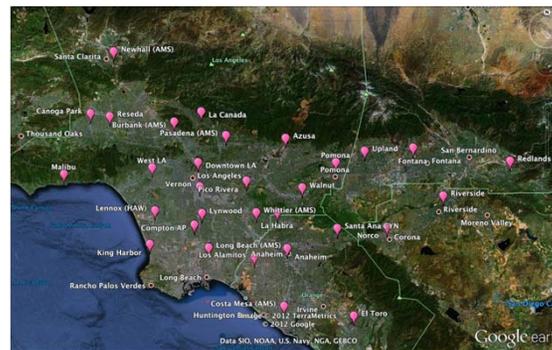
We plan the validation of the Summer Coastal Cooling hypothesis using flightovers in the LA area combined with ground temperature and wind data



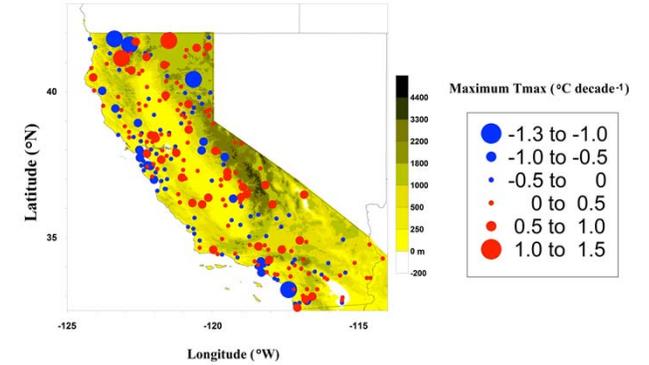
AVIRIS Flightover Santa Monica Mountains 8/8/2008



SoCAB 2-m summertime maximum-temperature trends (°C decade-1)



31 Wind surface stations managed by the South Coast Air Quality Management District in the SoCAB region



Summer Maximum Temperature trends for California 1970-2010

PRODUCTS

We plan for a detailed investigation of the seasonal surface thermal gradient and associated impacts to average- and peak-energy demands on California coastal areas. We will use these local studies to develop a methodology and analysis construct applicable to coastal urban environments in preparation for HypsIRI. Our approach is to investigate diurnal, seasonal and intra-seasonal changes in

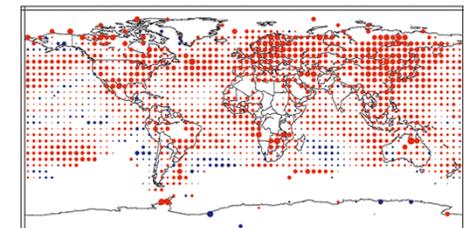
- (a) Sea breeze patterns.
- (b) Urban climate.
- (c) Energy response under normal and extreme (heat waves) conditions.
- (d) Parametrization of a high resolution weather forecasting model that incorporates energy modelin.

METHODOLOGY

We will focus on California coastal areas, with emphasis on SoCAB, as well as their neighboring inland areas taking advantage past Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) and proposed NASA plans to fly same sensors the and the MODIS/ASTER Airborne Simulator (MASTER).

EXTENSION TO THE REST OF THE GLOBE

Once validated and developed the methodology in the LA area, we plan to scale this research for other coastal cities and urban environments using HypsIRI to detect regions with intense sea breeze activity and temperature or pressure gradient and use this data for climate and energy modeling.



Other coastal regions in the world have been reported with cooling trends, in particular, Peru and Chile