Los Angeles' Urban Heat Islands: Land Use, Pacific and Climate Change Influences

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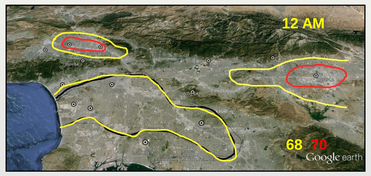
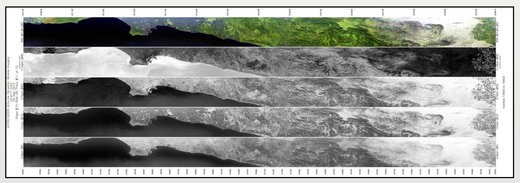
Introduction

Urban Heat Islands (UHI) are described as a urban center that is warmer than surrounding rural areas due to anthropological influences and lack of green spaces. However, the UHI is much more complex, varying spatially and temporally (diurnal, seasonal, annual scales). For this ongoing study, we are investigating Los Angeles Basin's thermal field for diurnal and seasonal changes as well as it's evolution from 1946-2012. We have found significant Pacific Ocean influences on Los Angeles' surface temperatures, especially due to Pacific Decadal Oscillation (PDO), coastal sea surface temperatures (SSTs) and coastal upwelling. An overflight by a NASA's ER-2 aircraft utilizing the Airborne Visible/Infrared Imaging Spectrometer (AVRIS) and the MODIS/ASTER Airborne Simulator (MASTER) on Sept. 24, 2013 supplies a snapshot of the UHI from above. This surface heat data gathered will be compared with ground based observations.



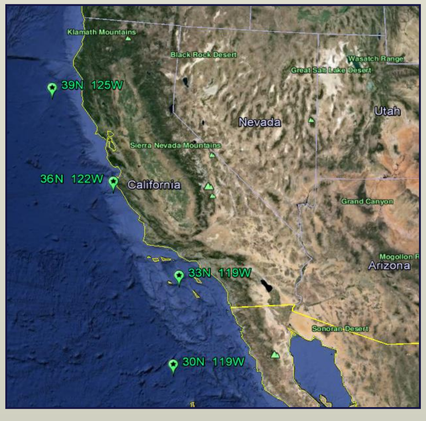


Study Area

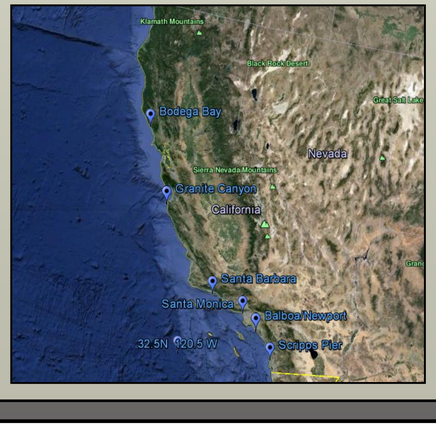
NOAA Pacific Fisheries Environmental Laboratory Upwelling Locations

1946-2012 (monthly)
- Seasonal (Spring & Summer)
- Annual

	Correlation Result **Spring/Summer** Average			
Upwelling	PDO	SOI	NOI	ONI
30N	-0.094	**0.650**	**0.330**	**-0.300**
33N	-0.079	**0.341**	**0.358**	-0.211
36N	-0.171	**0.282**	**0.455**	**-0.336**
39N	-0.132	0.176	**0.362**	**-0.396**

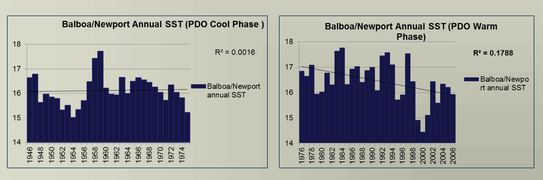


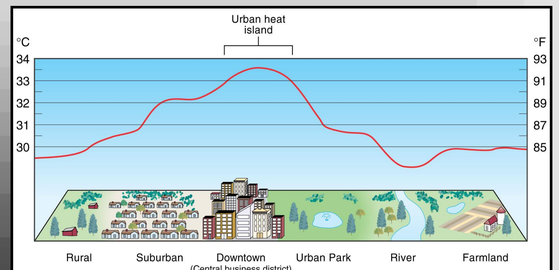
Sea Surface Temperature Locations



Preliminary Results and Urban Heat Island Influences

Los Angeles Coastal Sea Surface Temperature Trends and PDO Phases



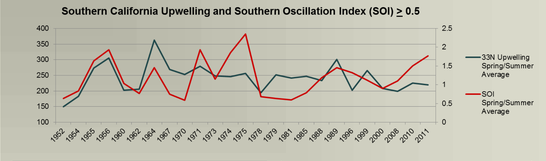


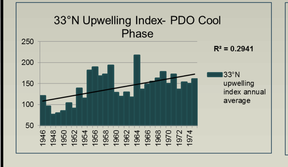
All Hydrological Years		PDO Phases		
	All Years	to 1976	1977-1998	1999-2012
	PDO All Years	**PDO Cool Phase**	**PDO Warm Phase**	**PDO Current Phase**
Los Angeles Surface Air Temperature	**0.636**	**0.467**	0.380	0.094
	Upwelling Index	Upwelling Index	Upwelling Index	Upwelling Index
Los Angeles Surface Air Temperature	**0.280**	**0.633**	0.035	0.011
	LAX Wind 4pm	LAX Wind 4pm	LAX Wind 4pm	LAX Wind 4pm
Los Angeles Surface Air Temperature	**0.440**	**0.554**	-0.004	-0.459
	MEI	MEI	MEI	MEI
Los Angeles Surface Air Temperature	**0.400**	0.316	-0.052	0.247

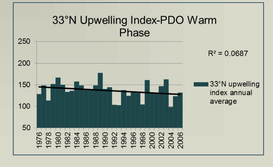
Bold values are statistically sig. at 95%

All Calendar Years				
	Balboa/Newport SST	Santa Monica SST	LA Max Wind Speed	LA Aerosol
Los Angeles Surface Air Temperature	**0.668**	**0.306**	**0.297**	-0.147

Los Angeles Coastal Upwelling Trends, ENSO and PDO Phases

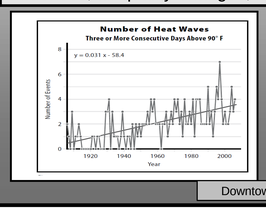


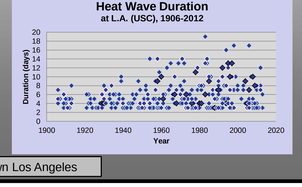


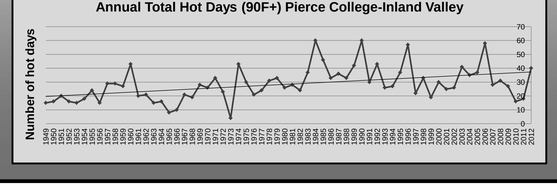


Preliminary Conclusions and Ongoing Research

The results show UHI warming rates increasing faster than regional global warming indicating that the PDO exerts significant influences on Los Angeles' UHI during cool phases, especially between 1946-1976. Whereas warm PDO phases have exerted little influence on Los Angeles surface air temperatures, upwelling, winds or ENSO phases. To further our understanding of the surface thermal gradient we will continue our analysis of Los Angeles' heating trends, including average and extreme temperature patterns, as well as coastal sea breeze influences, air quality changes, land use, and inland temperature trends and influences on the Los Angeles UHI.



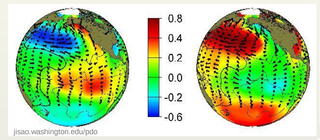




Downtown Los Angeles

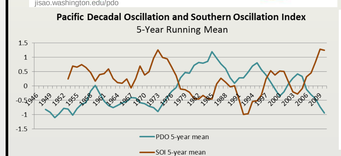
1946-2012 Los Angeles Climate Coastal Influences and Trends

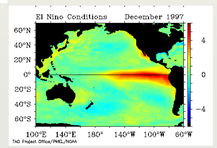
El Niño - Southern Oscillation
And Pacific Decadal Oscillation



Annual Average Correlations with SOI

PDO	**-0.60**
Cool phase	**-0.57**
Warm phase	-0.29
98-2012	**-0.76**

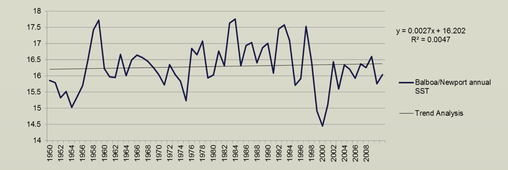




1945-2012 Los Angeles Sea Surface Temperature and Upwelling Trends

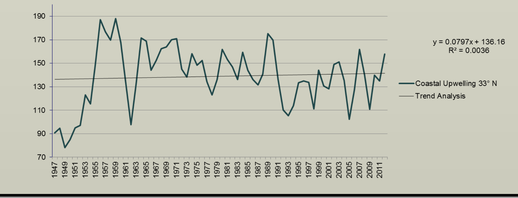
Los Angeles Coastal Sea Surface Temperature Trends

Balboa/Newport Annual Sea Surface Temperatures



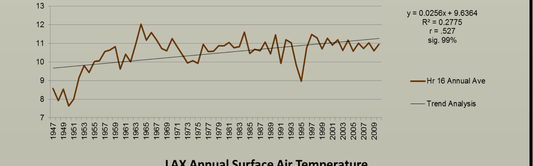
Los Angeles Coastal Upwelling Trends

Coastal Upwelling 33° N



1945-2012 Los Angeles Wind and Surface Temperatures

LAX 4 pm Annual Average Wind Speed



LAX Annual Surface Air Temperature