Ten Years at the Calif. Energy Commission & White Roofs to Cool your Building, your City and (this is new !) Cool the World

UC Sustainability Committee
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California Energy Commission.

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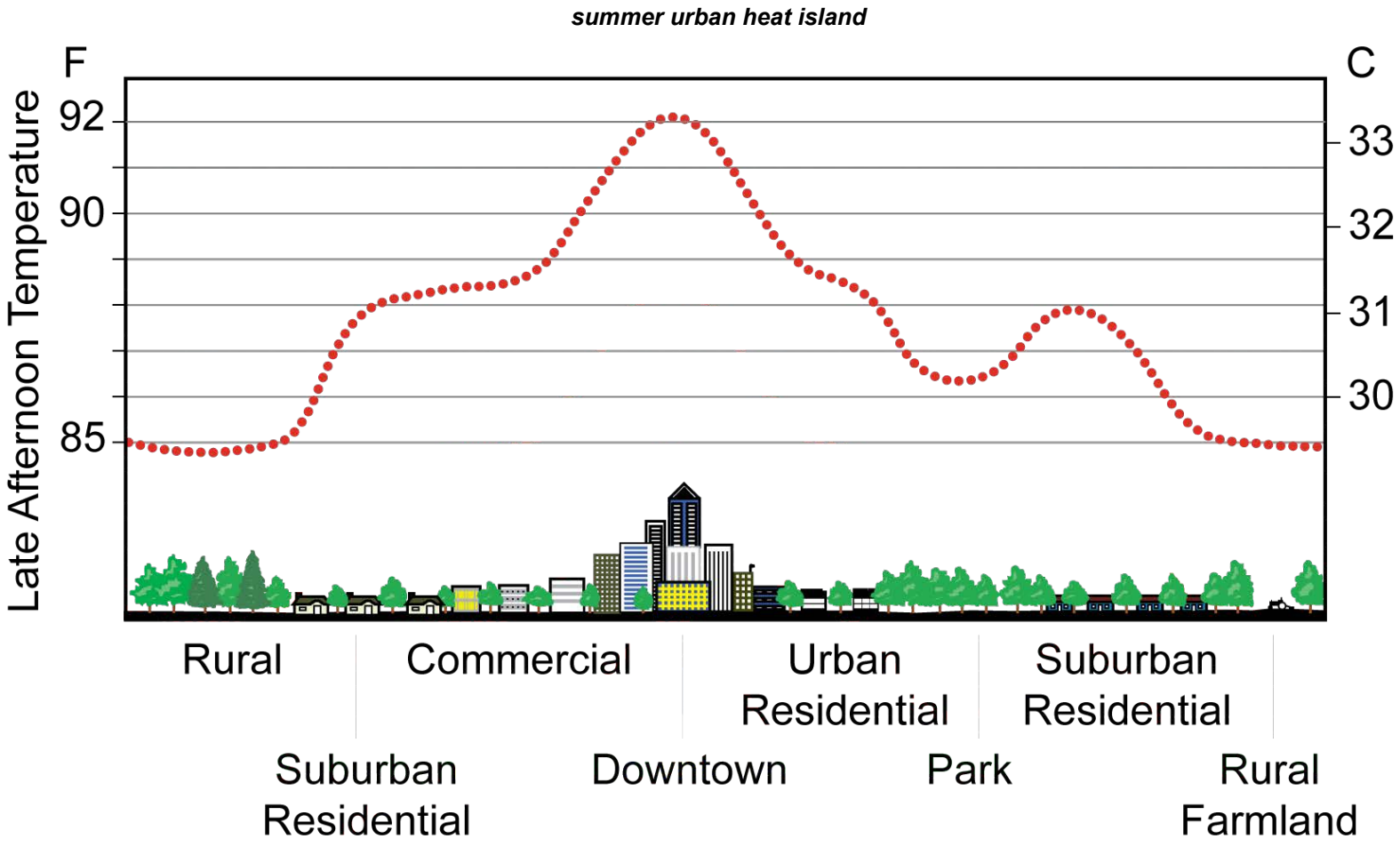
Presentation available at www.ArtRosenfeld.org

Filename UC Sustainability fm IEA Annex 53 LBNL fm Carnegie DC fm Russian Talk 6-5-11 + DR from EE Summit Sacto. Path DinnerTalk Life at CEC. ARPA-E

Summer in the city



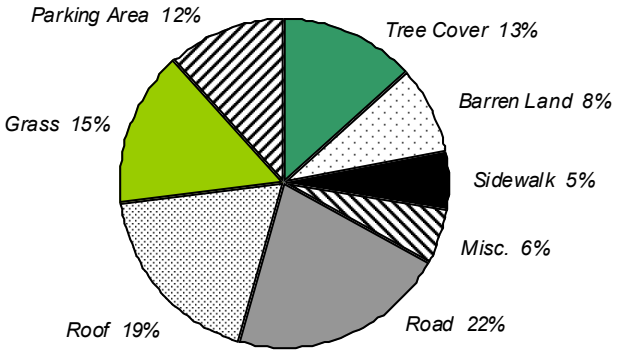
Bird's eye view of urban land use

3

~ 1 km^2

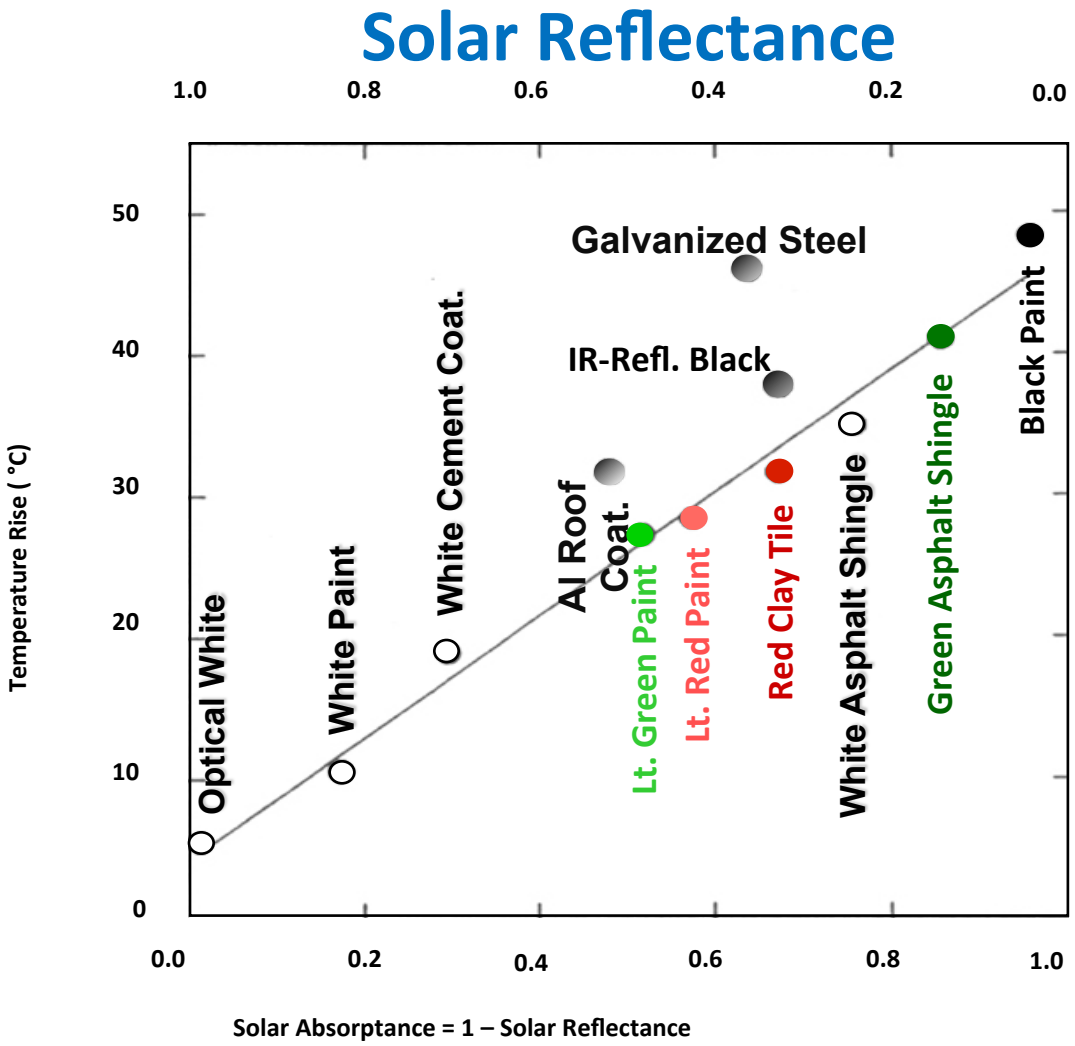
The surface of Sacramento, CA is about

- **20% roofs**
- **30% vegetation**
- **40% pavement**



Area by Land-Cover Category Above the Canopy

Reflective roofs stay cooler in the sun



White roofs, cool-colored roofs save money

OLD

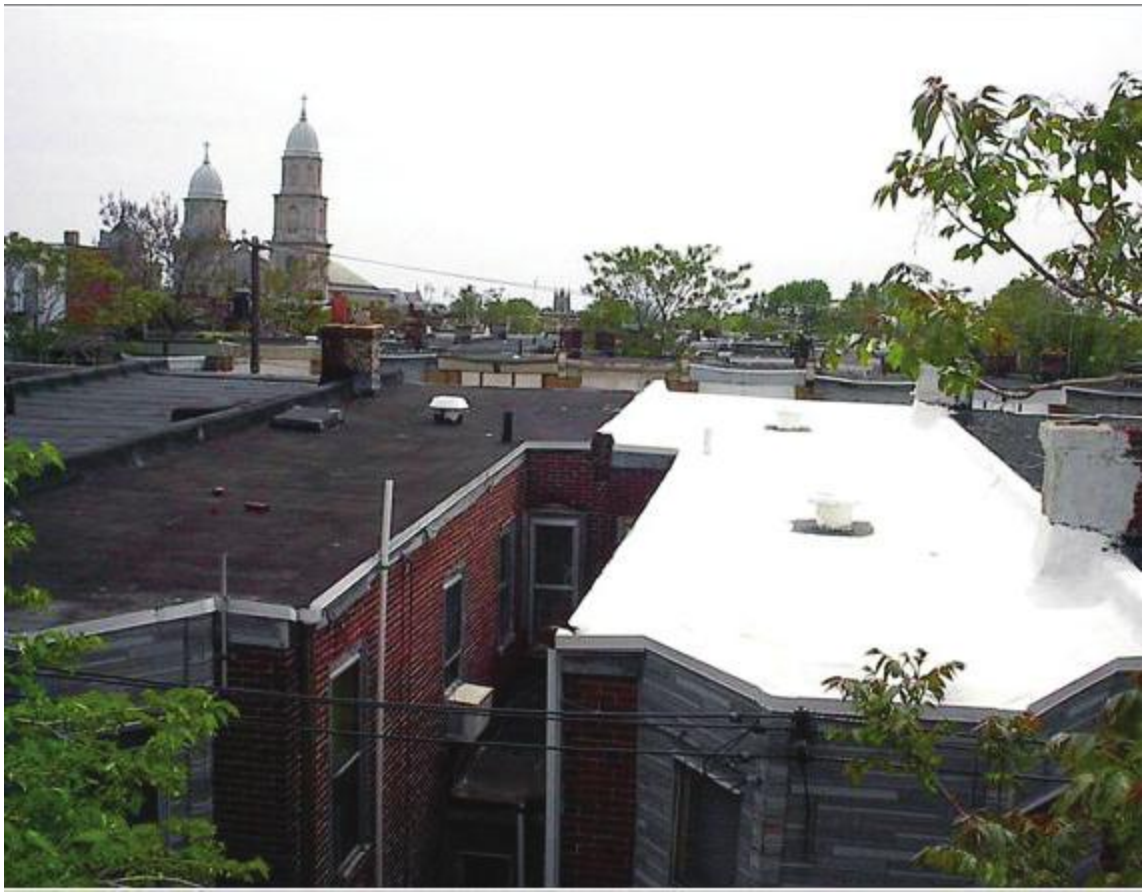
flat, white

pitched, white

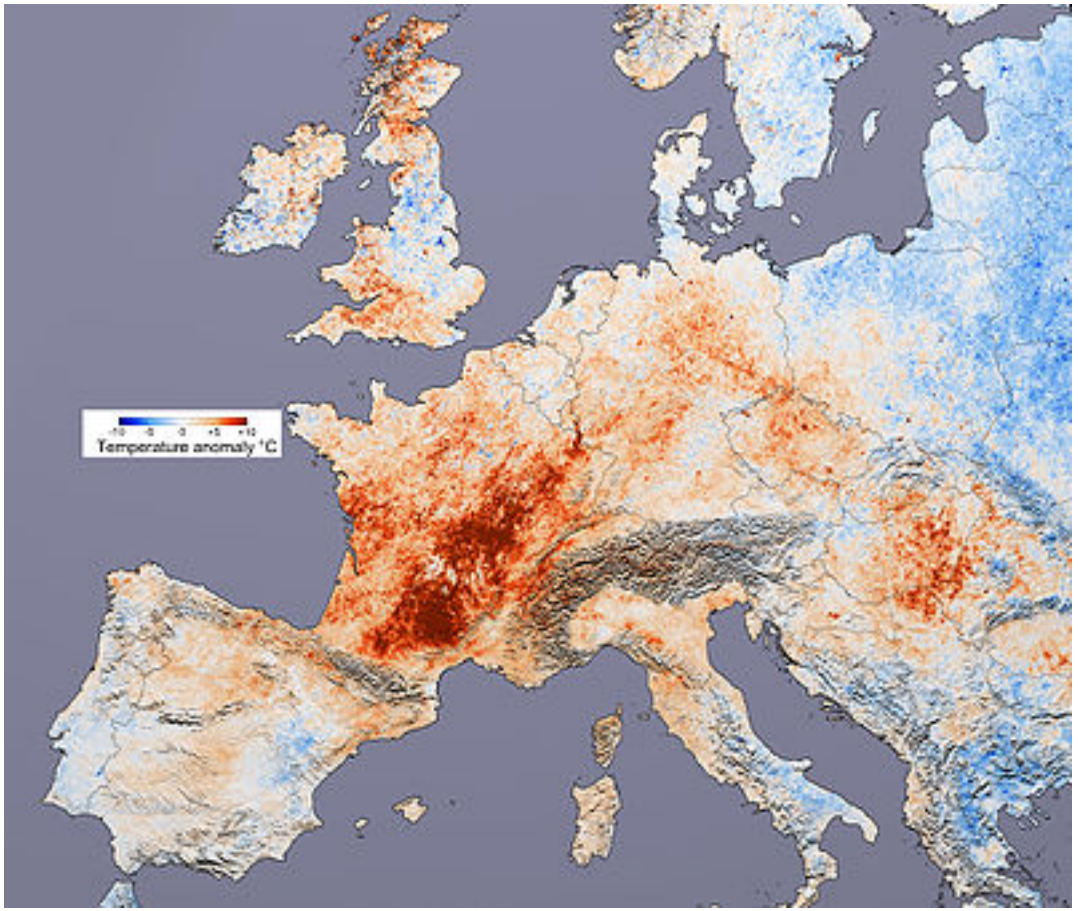
NEW

pitched, cool & colored

Chicago Heat Wave 1995, 739 Deaths
The most lethal floor was the top floor of a building with a black roof



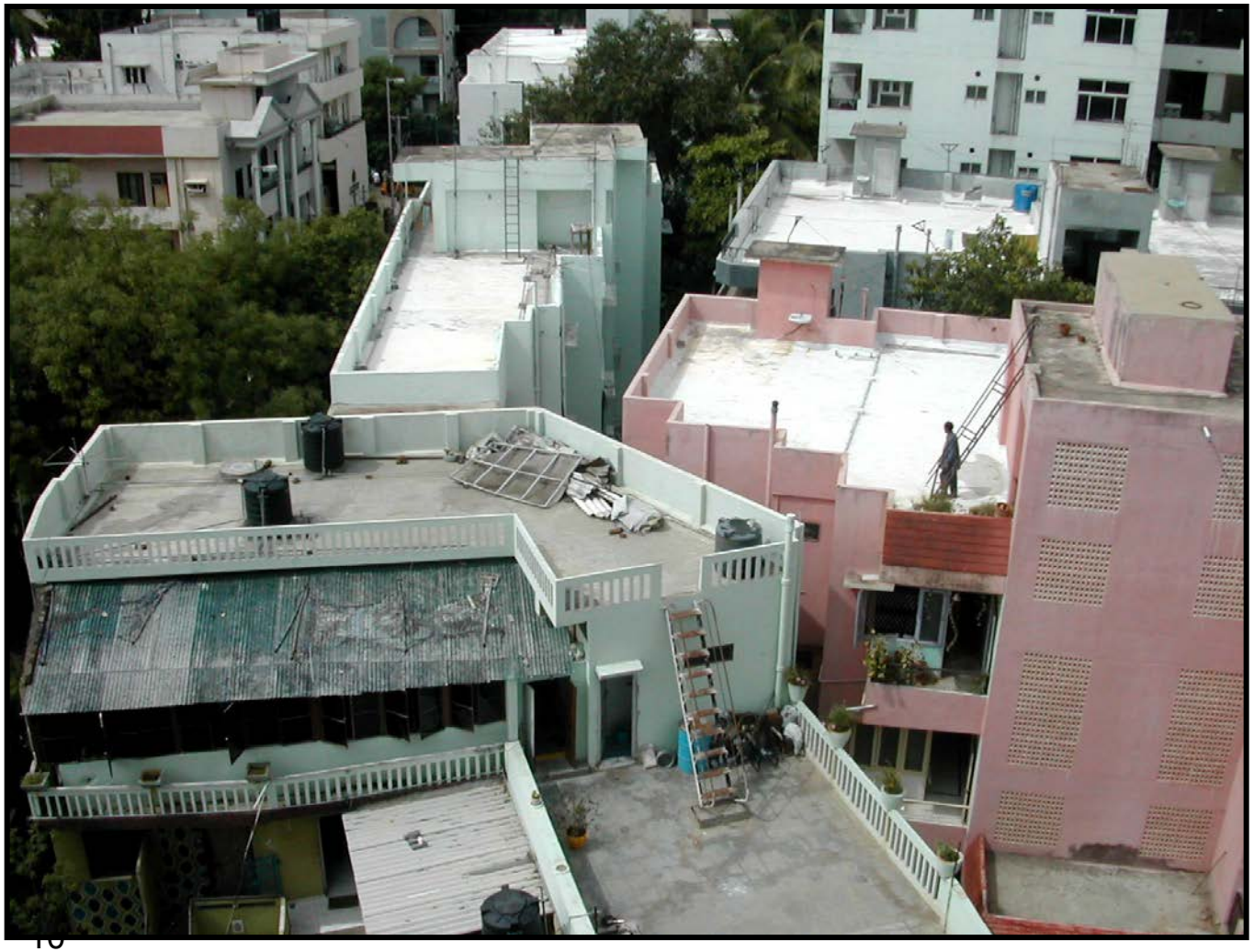
European Heat Wave 2003, 30,000 Deaths
Moscow-Centered Heat Wave 2010,~10,000 Deaths



White roofs around the world

…in Santorini, Greece

…in Hyderabad, India

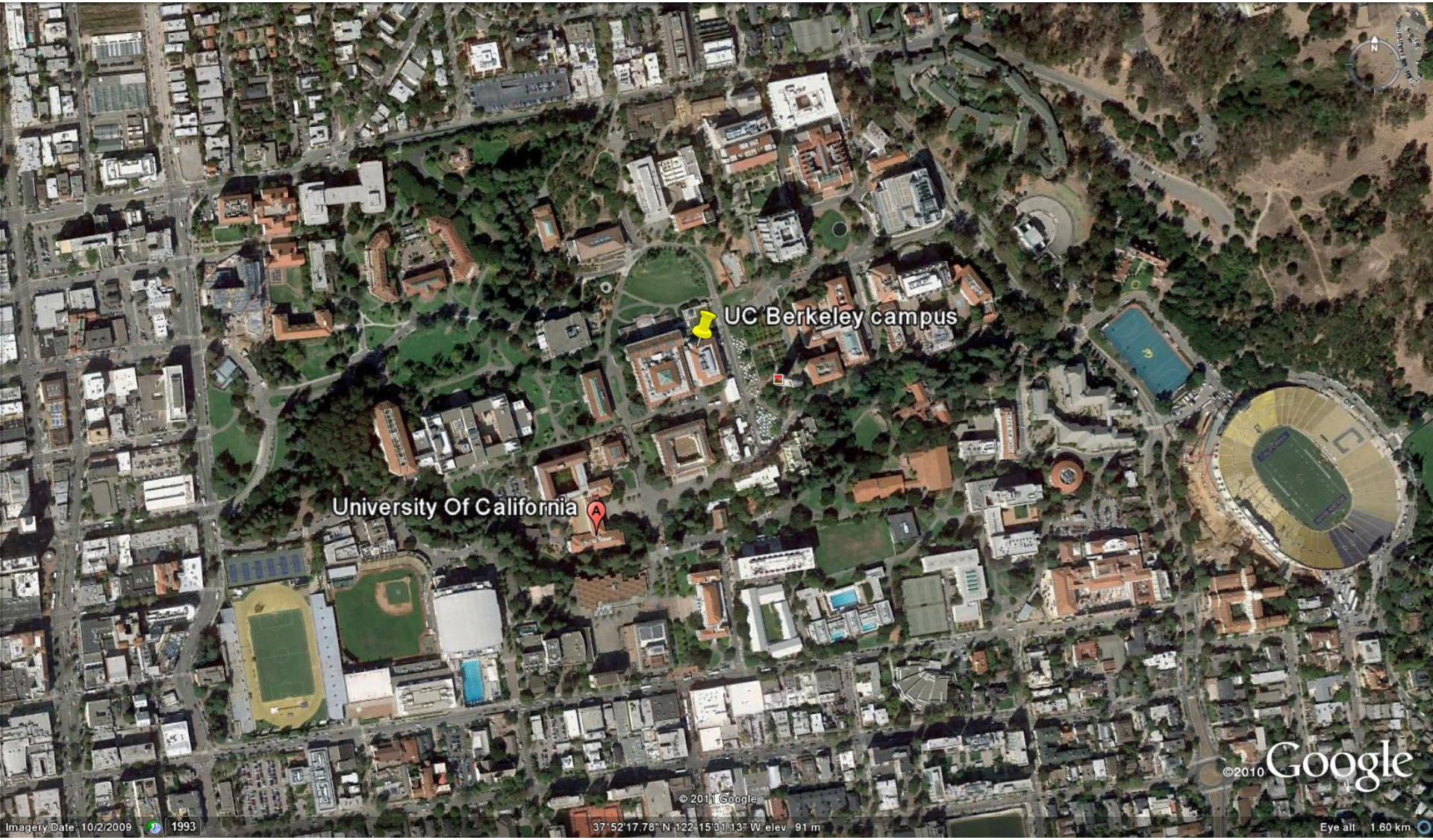


…and widely in the state of Gujarat, India.

Walmart store in northern California

University of California
9 campuses viewed by
Google Earth

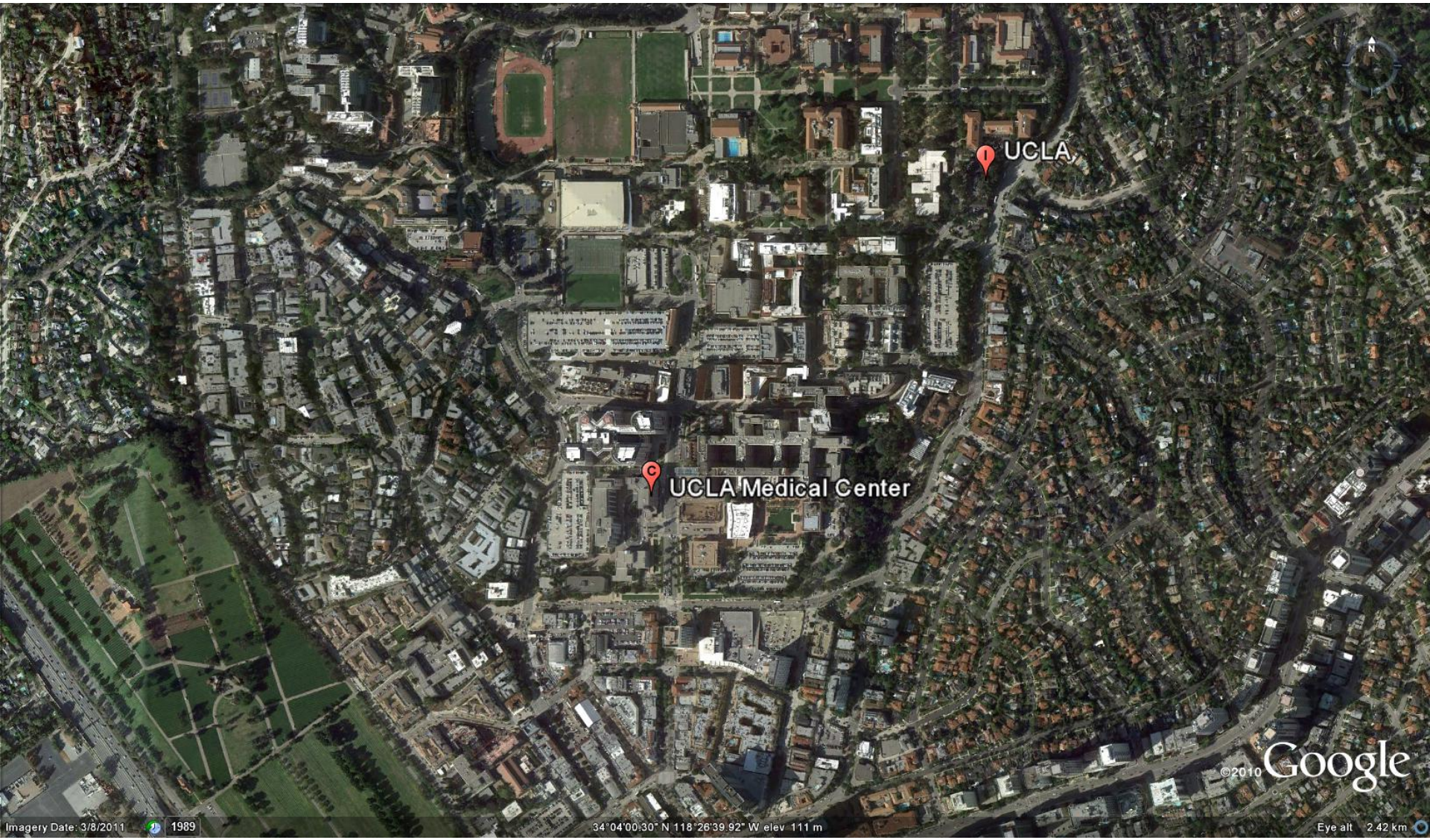
University of CA at Berkeley



University of CA at Davis

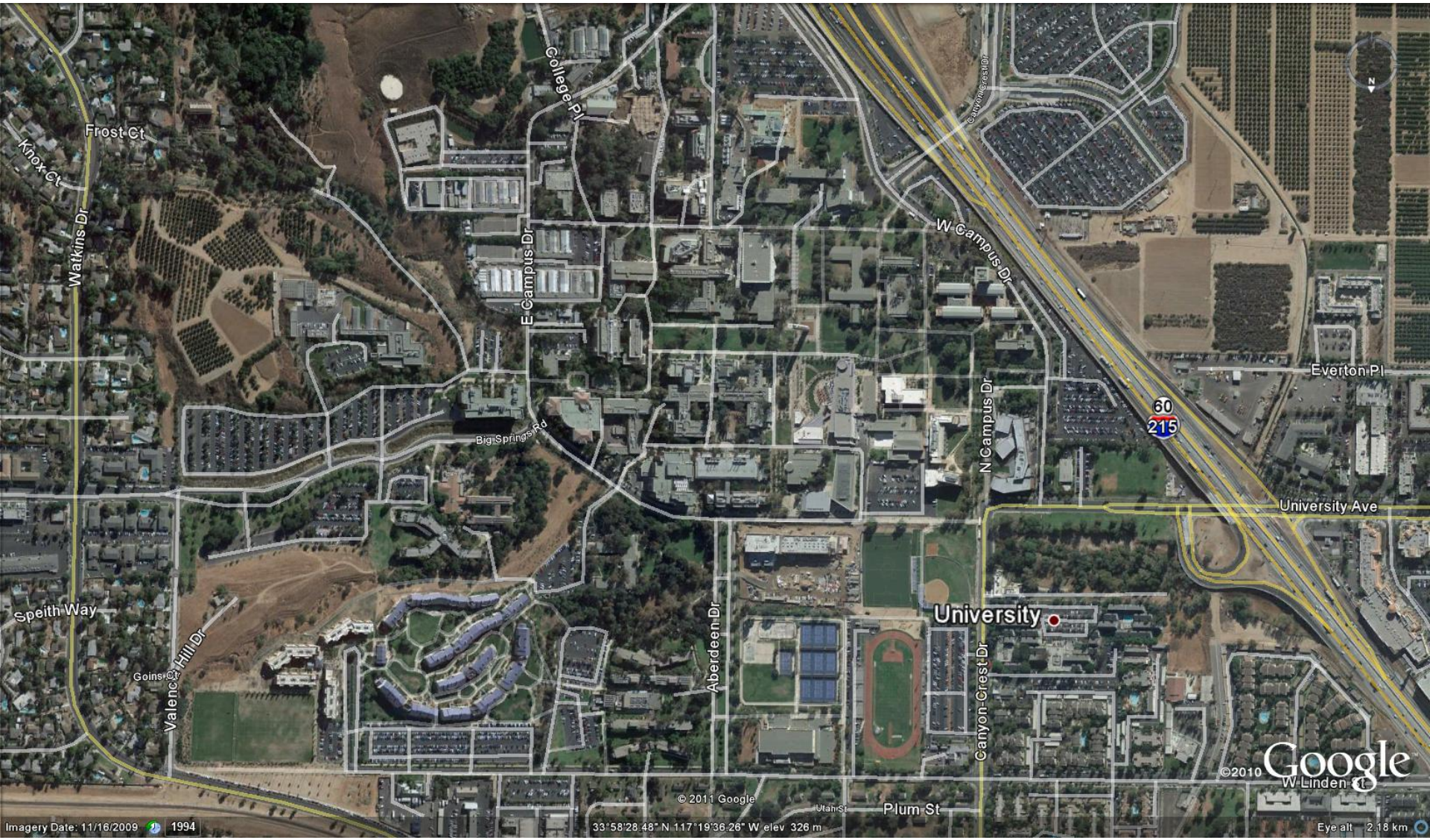
University of CA at Irvine

University of CA at Los Angeles

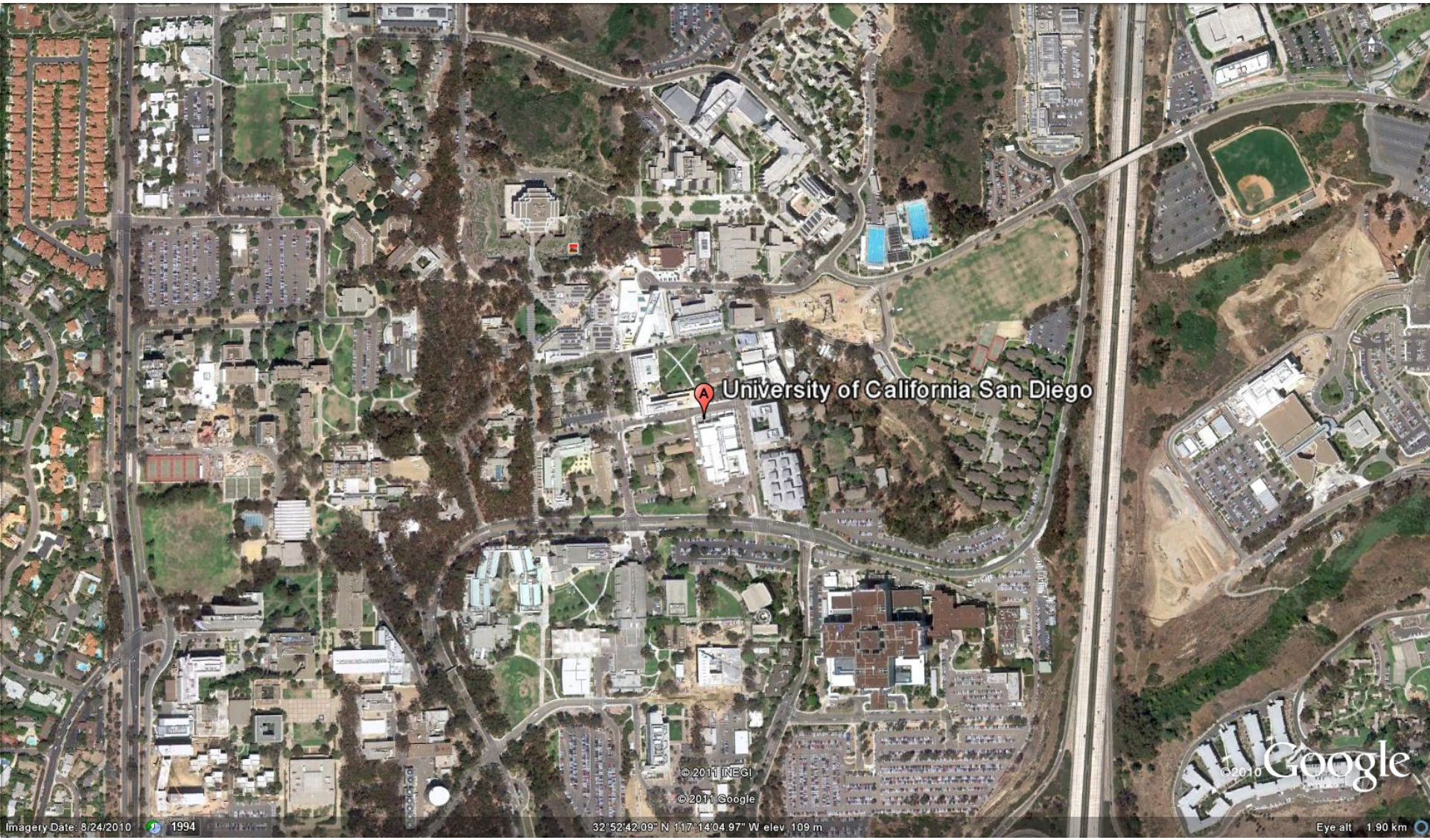


University of CA at Merced

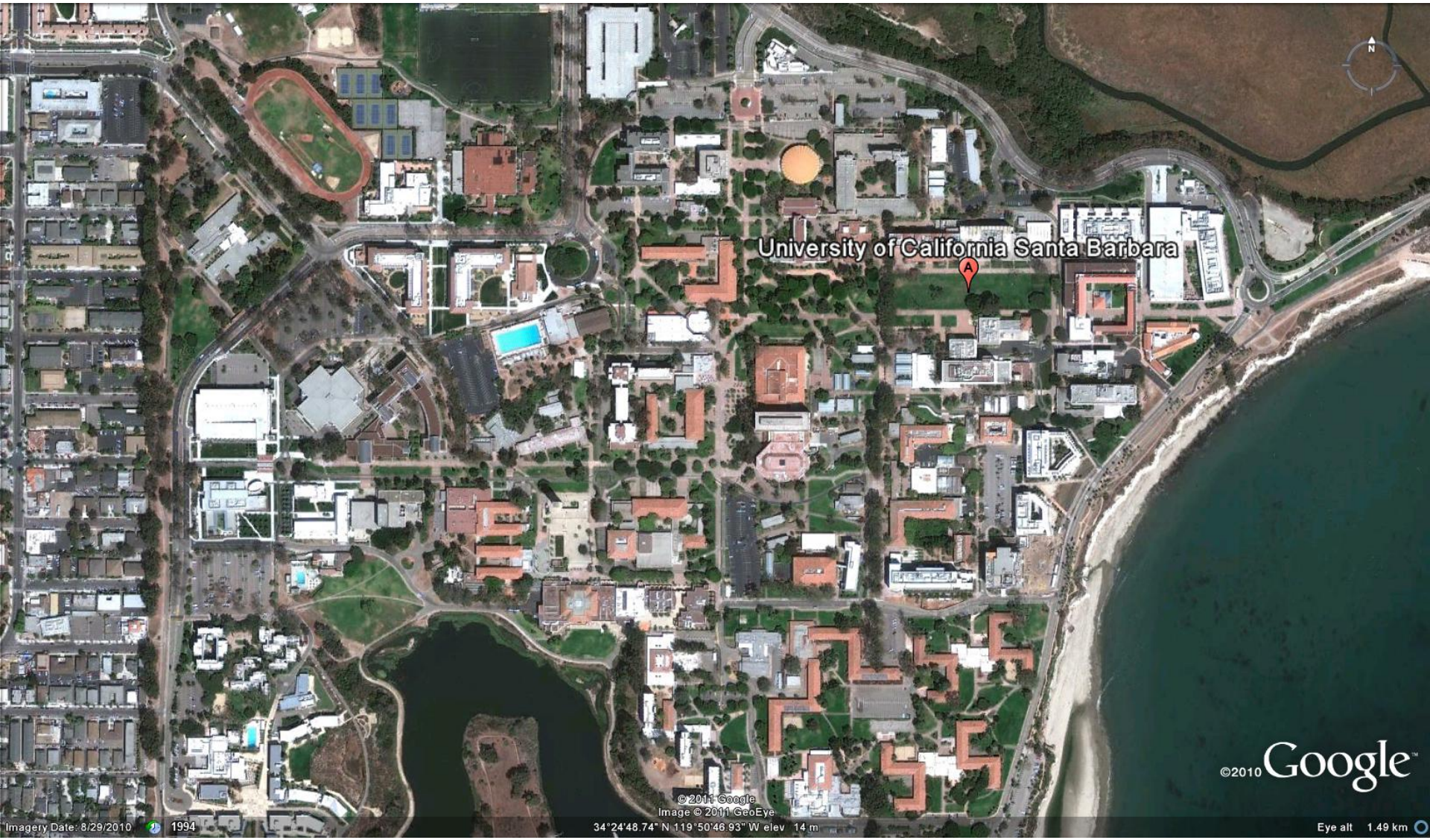
University of CA at Riverside



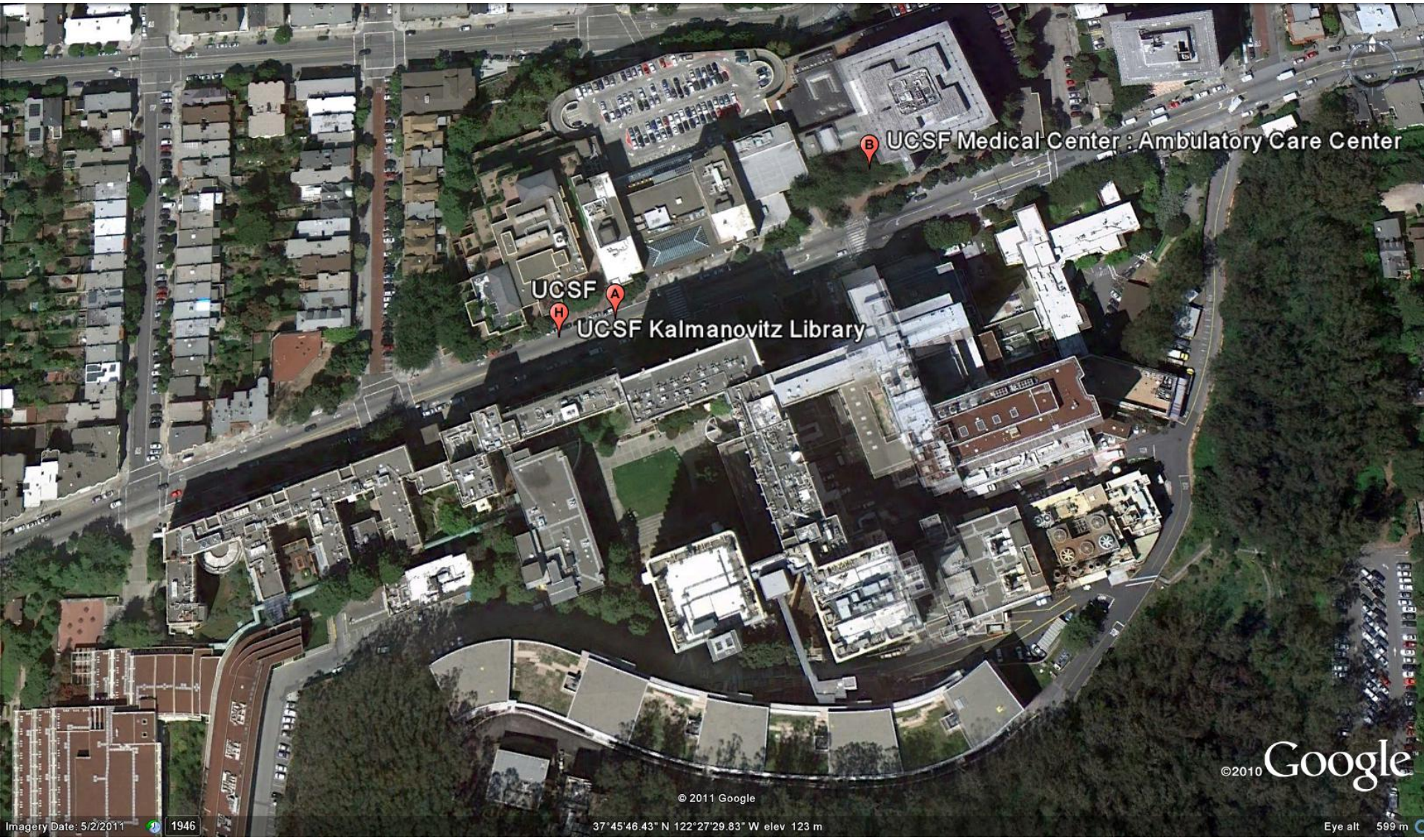
University of CA at San Diego



University of CA at Santa Barbara

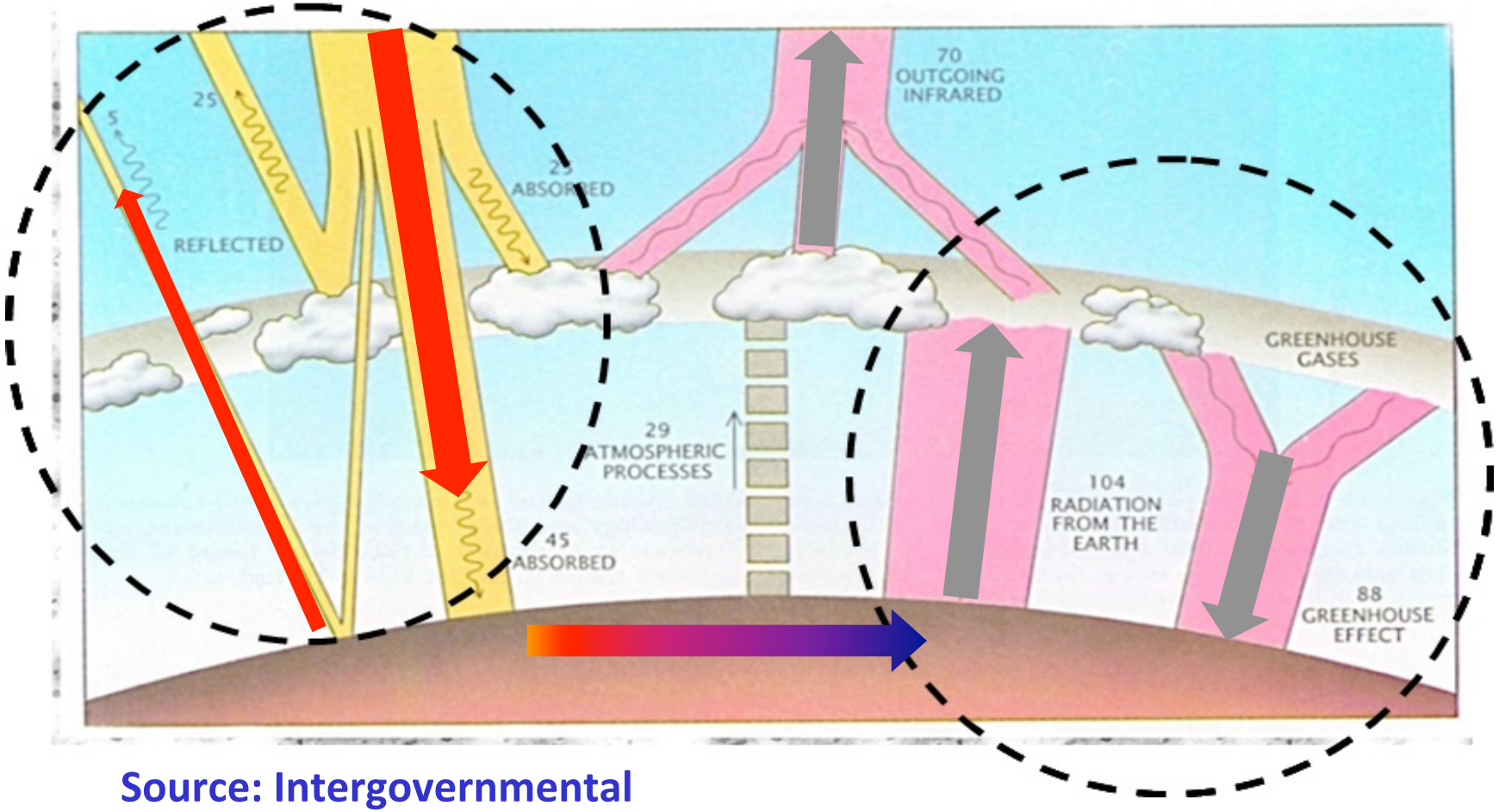


UCSF Parnassus Campus



Cooling our planet

Solar-reflective surfaces cool the globe via “negative radiative forcing”



Source: Intergovernmental Panel on Climate Change (IPCC)

23

GLOBAL COOLING: making 100 m^2 (1000 ft^2) of gray roofing white offsets the **emission** of 10 t of CO_2

24

How much CO_2 equivalent is offset if we whiten all eligible urban flat roofs world-wide? (i/ii)

- Answer: **24 Gigatonnes (Gt)**
  - 2/3 of a year's worldwide emission
  - Gigatonne = billion metric tons

- If implemented over 20 years (the life of a roof or a program) this is ≈ 1.2 Gt/year.

How much CO_2 equivalent is offset if we whiten all eligible urban flat roofs world-wide? (ii/ii)

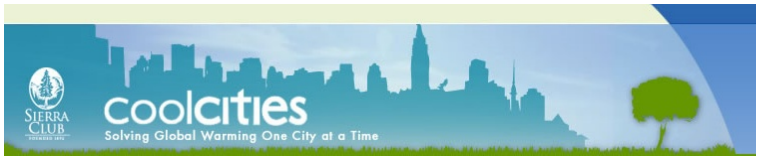
- Offset is equivalent to **taking 300 million cars off the road for 20 years**.
  - There are about 600 million passenger cars world wide, and they each emit ≈ 4 t CO_2/ year.

In terms of avoided power plants

Full white roof potential can ***offset*** **the emissions from 500 medium-sized coal fired power plants or 1,000 medium-sized gas fired power plants**.

That is just the albedo effect – if the building is air conditioned, it will avoid comparable *real* CO_2 back at the power plant.

Global Cool Cities Alliance could unite many initiatives and trade associations



American Council for an Energy-Efficient Economy

THE CLIMATE GROUP

A UC White Roof Information Exchange

- For facilities staff to exchange experience between campuses, with the Heat Island Group at LBNL, and with Global Cool Cities Alliance
- Sample topics for “flat” (low-slope) roofs:
  - Initial cost premium for choosing white?
  - Does white have a longer service life than dark?
  - Annual maintenance?
  - Annual A/C savings (as a fraction of cooling load of space under roof)?
  - Complaints about glare?
  - Cost-effectiveness of cisterns to hold and use storm water?

Cool UC Information Exchange

- Sample topics for pavements:
  - Why give repaved asphalt a superblack coating?
    - Does anybody know how to overcome this practice?
  - Consideration of light-colored aggregate for “asphalt” roads?

- If you have experience and/or ideas with cool roofs or pavements, please contact Benjamin Mandel with thoughts on these issues:
  - BHMandel@LBL.gov
  - (516) 672-2680

Resources on the web

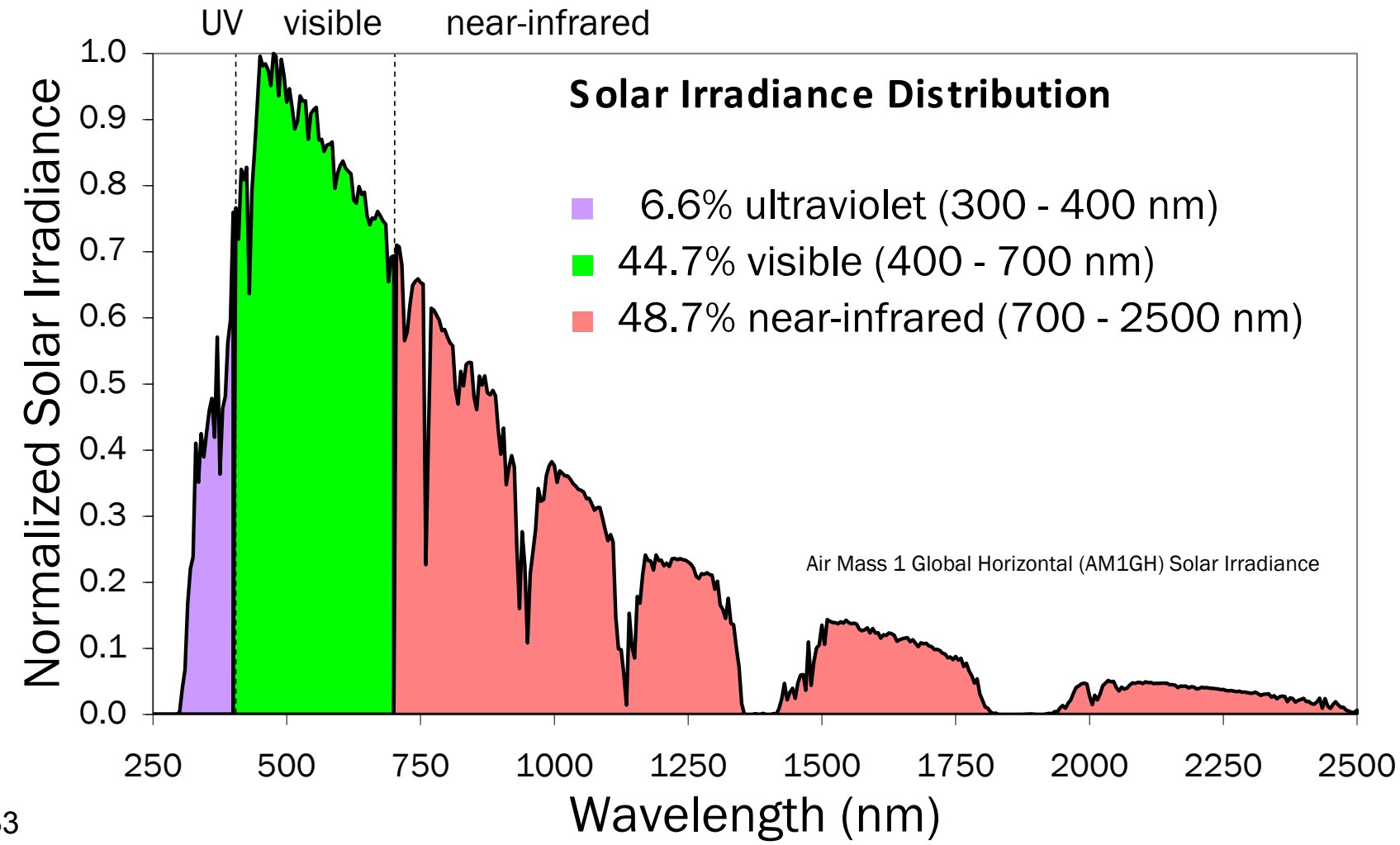
- **Art Rosenfeld's website**
  - ArtRosenfeld.org
- **Cool Colors Project**
  - CoolColors.LBL.gov
- **Heat Island Group**
  - HeatIsland.LBL.gov
- **Cool Communities Project**
  - CoolCommunities.LBL.gov
- **Roof Savings Calculator**
  - RoofCalc.com
- **Global Cool Cities Alliance**
  - GlobalCoolCities.org
- **Cool Roof Rating Council**
  - CoolRoofs.org
- **Cool California**
  - CoolCalifornia.org
- **EPA Heat Islands**
  - epa.gov/heatisland
- **Energy Star Cool Roofs**
  - EnergyStar.gov

LAWRENCE BERKELEY NATIONAL LABORATORY PRESENTS:
SCIENCE AT THE THEATER

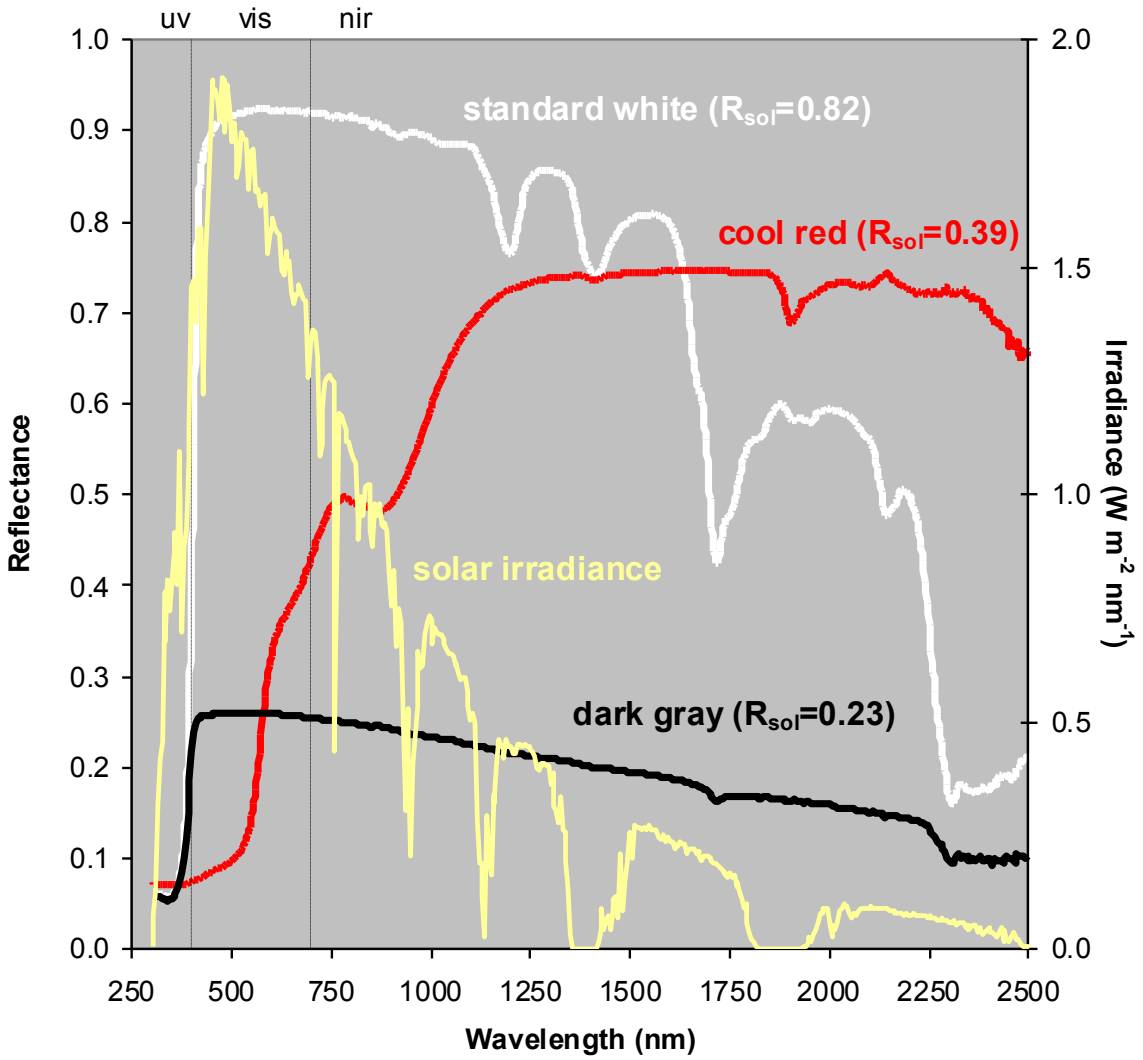
COOL CITIES, COOL PLANET

Cool Colors

Sunlight — more than meets the eye



White, cool color, warm color



white roof

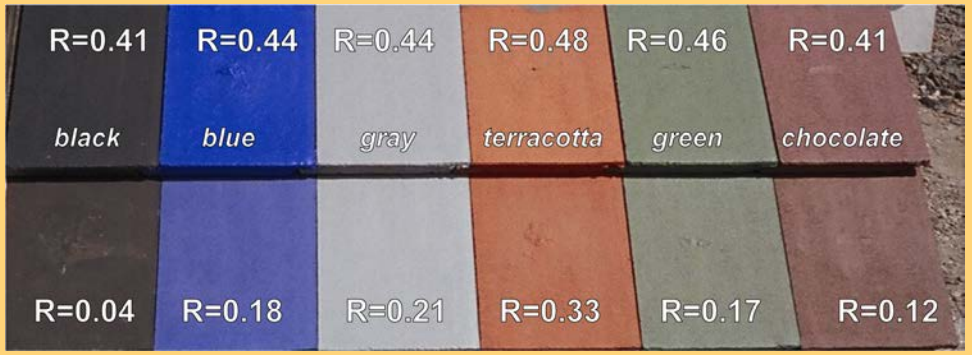
cool red roof

gray roof

Cool colored roofs available today

cool concrete tile
R ≥0.40

standard concrete tile
(same color)

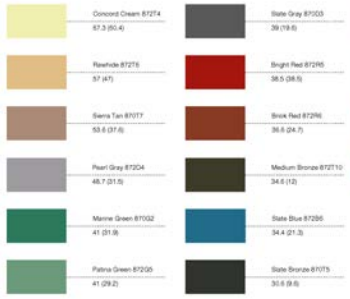


solar reflectance gain = **+0.37** **+0.26** **+0.23** **+0.15** **+0.29** **+0.29**

Courtesy American Rooftile Coatings

cool clay tile
R ≥0.40

Courtesy MCA Clay Tile



cool metal
R ≥0.30

Courtesy BASF Industrial Coatings

cool fiberglass asphalt shingle
R ≥0.25
Courtesy Elk Corporation

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