# Land use change as a driver of local and regional climate change

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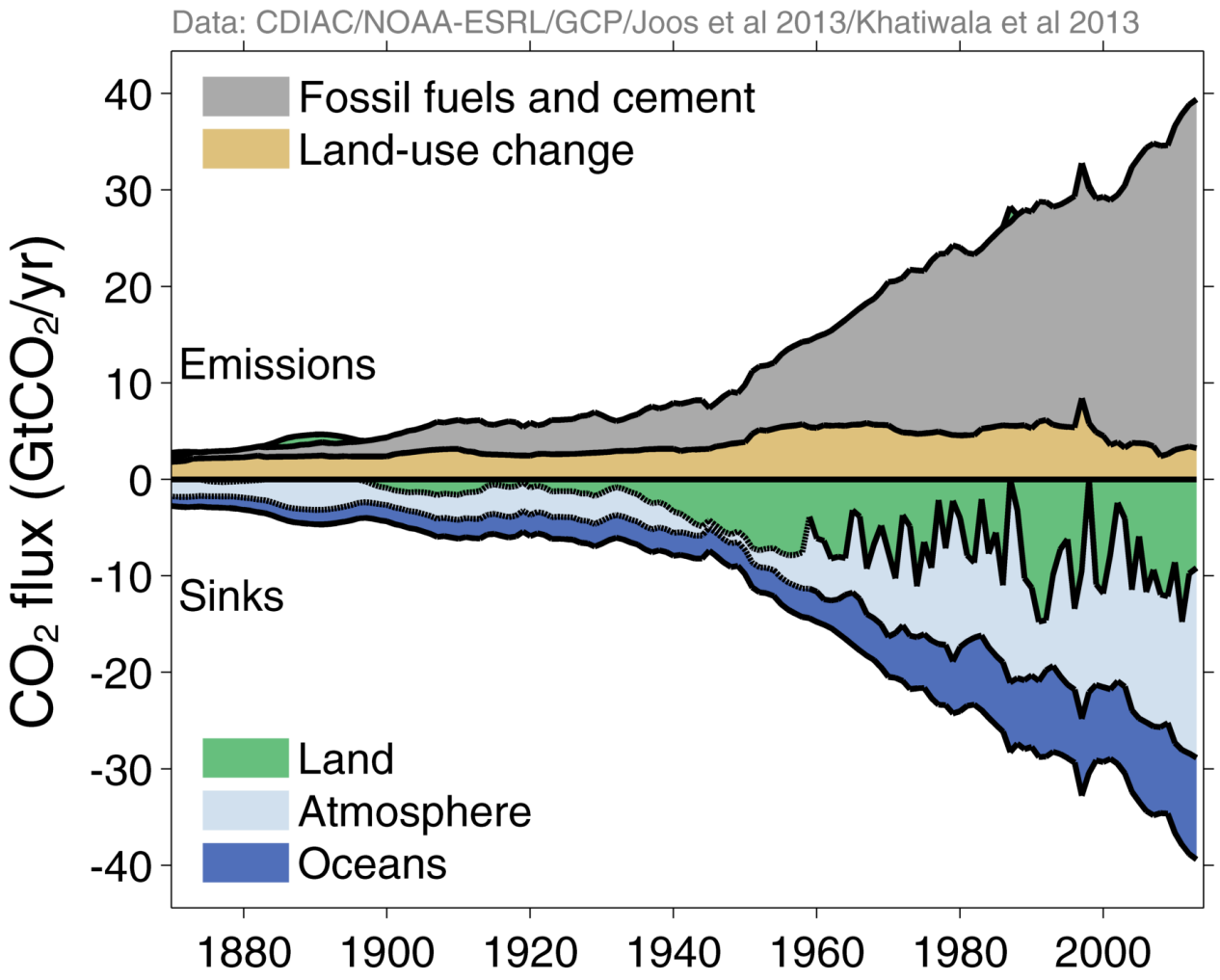
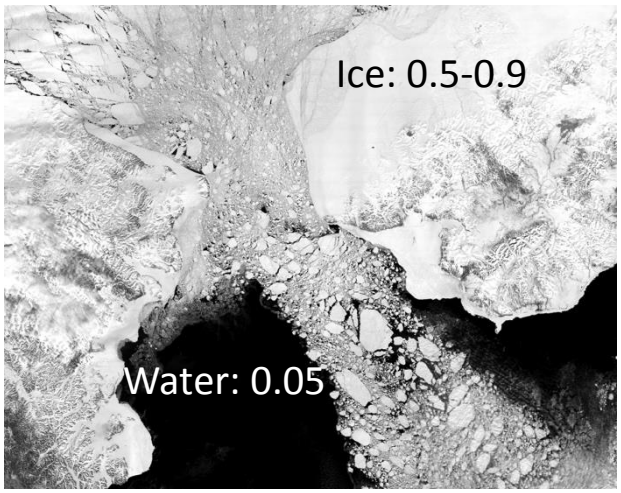
# Land-use change can produce $CO_2$ emissions and promote C sinks



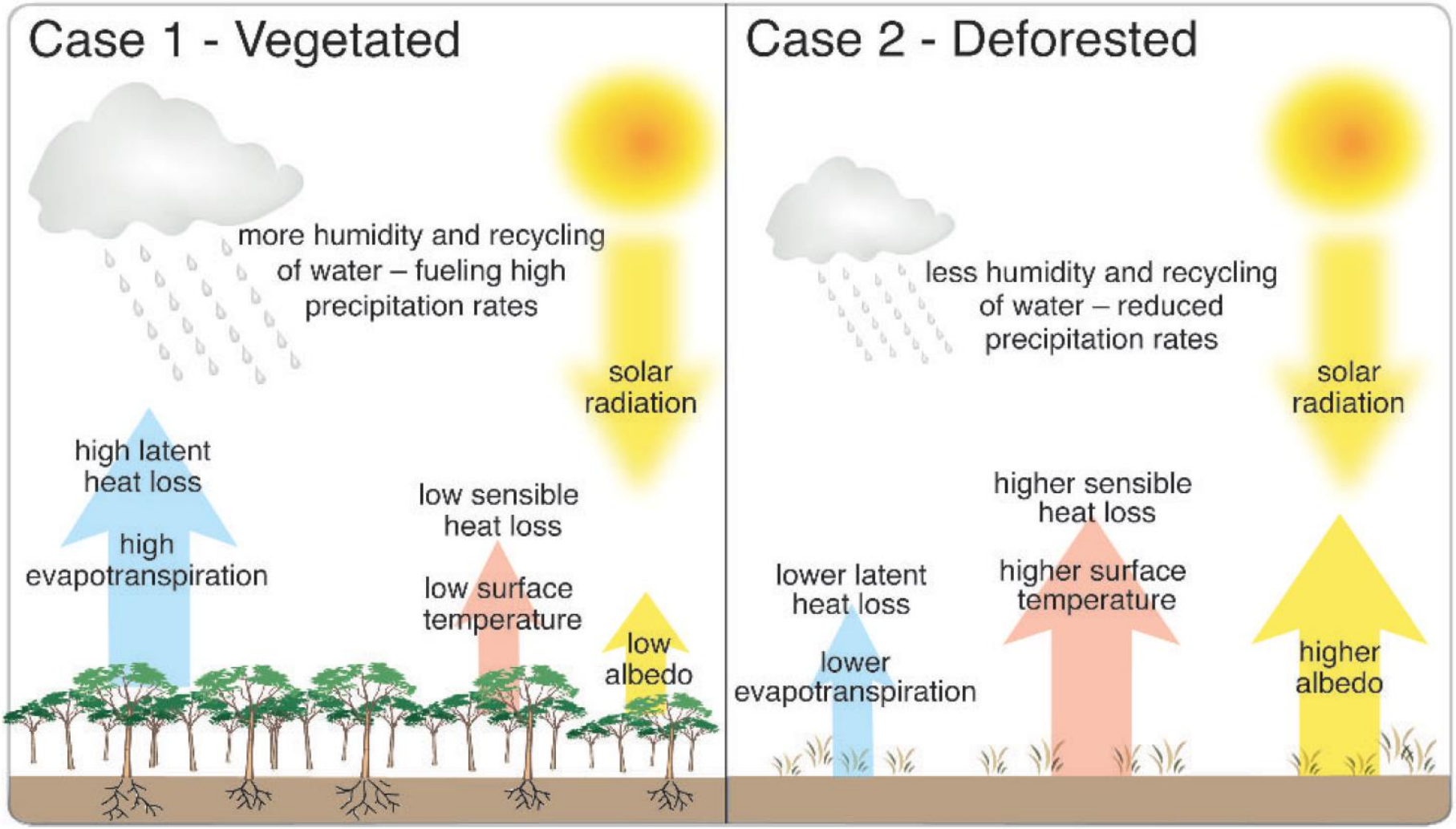

# Primary biogeophysical effects of land-use change on climate

- Amount of incoming radiation reflected (albedo)
- Partitioning of absorbed energy to evapotranspiration vs sensible heating of the lower atmosphere
- Efficiency of energy transfer to the atmosphere





# Example: tropical deforestation



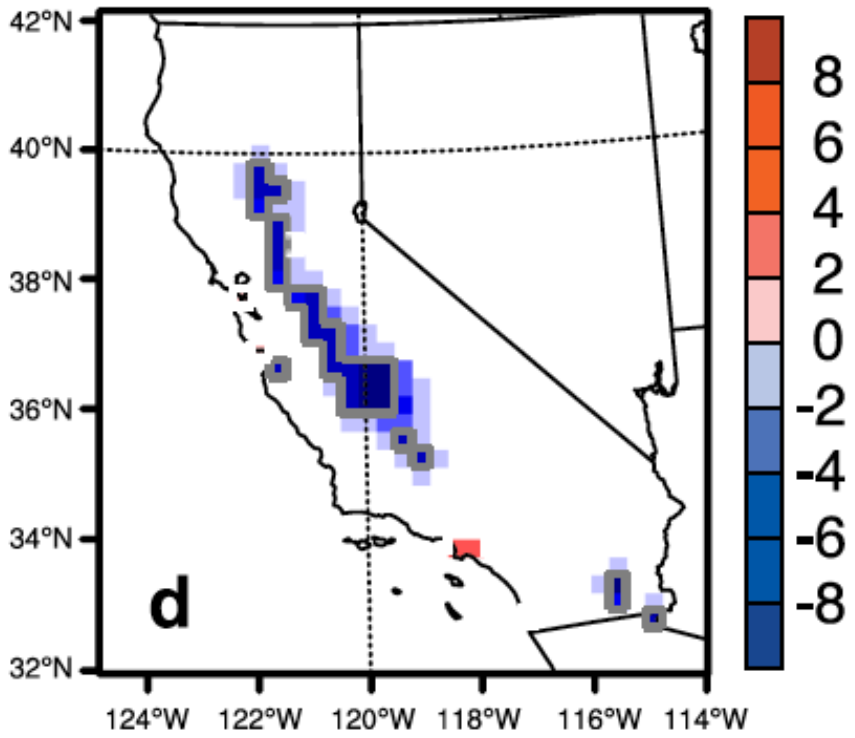

(Foley et al. 2003)

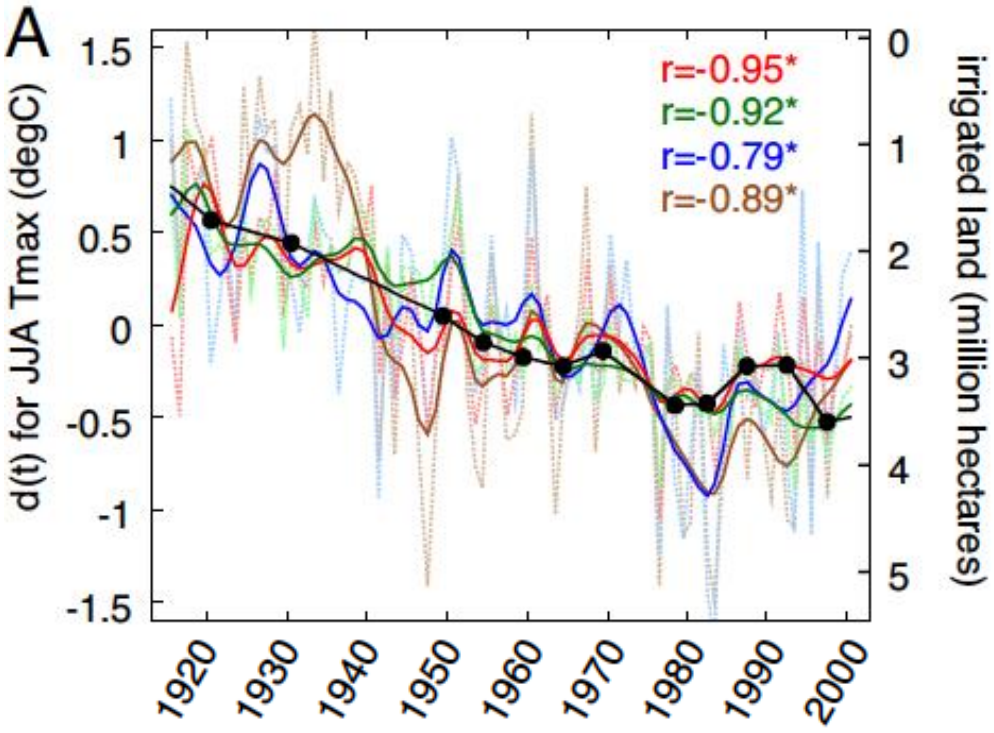
# Agricultural land-use change

- Major impact from irrigated agriculture

# Climate effects of irrigation

- Irrigation cools daytime climate by increasing evapotranspiration, reducing sensible heating
- Historical increase in irrigated area likely countered large scale warming trend

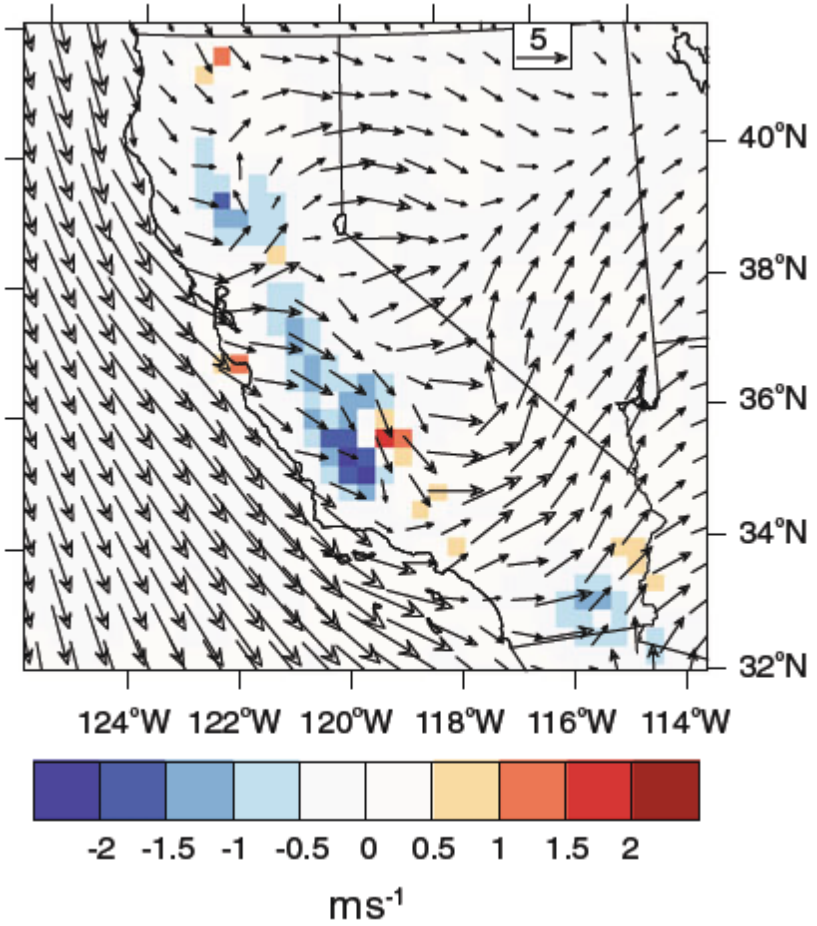


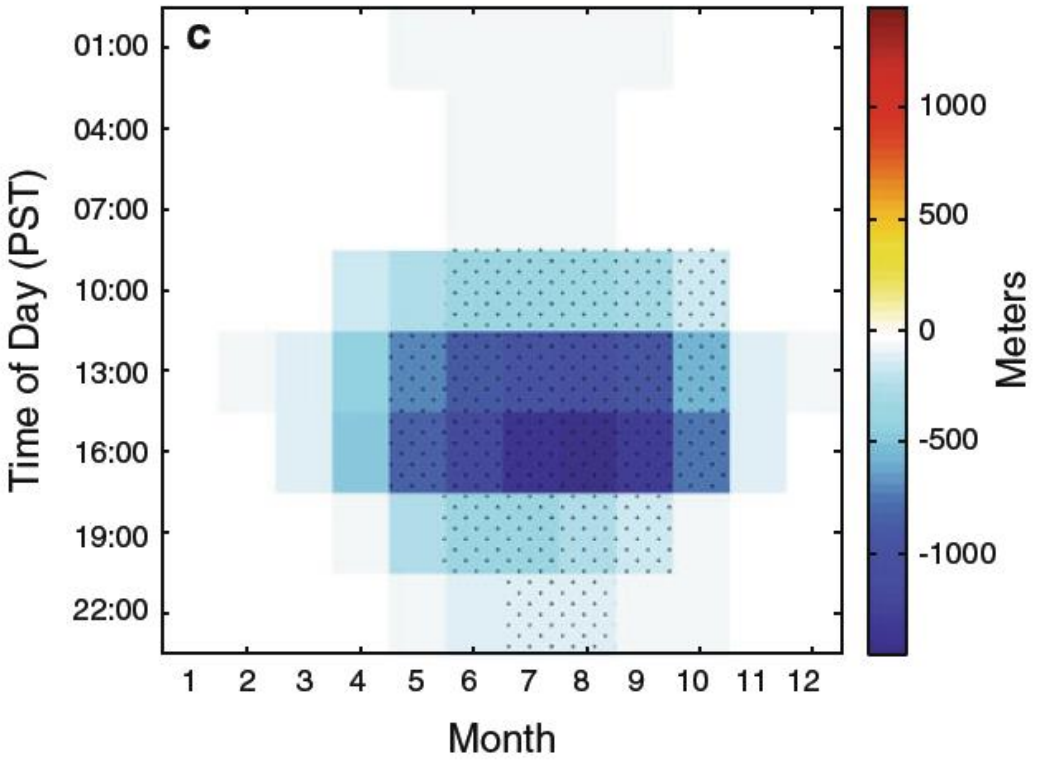




(Kueppers et al. 2007, Bonfils & Lobell 2007)

# Regional irrigation changes also can alter circulation, height of boundary layer

- Important to air pollution (as is increase in humidity)



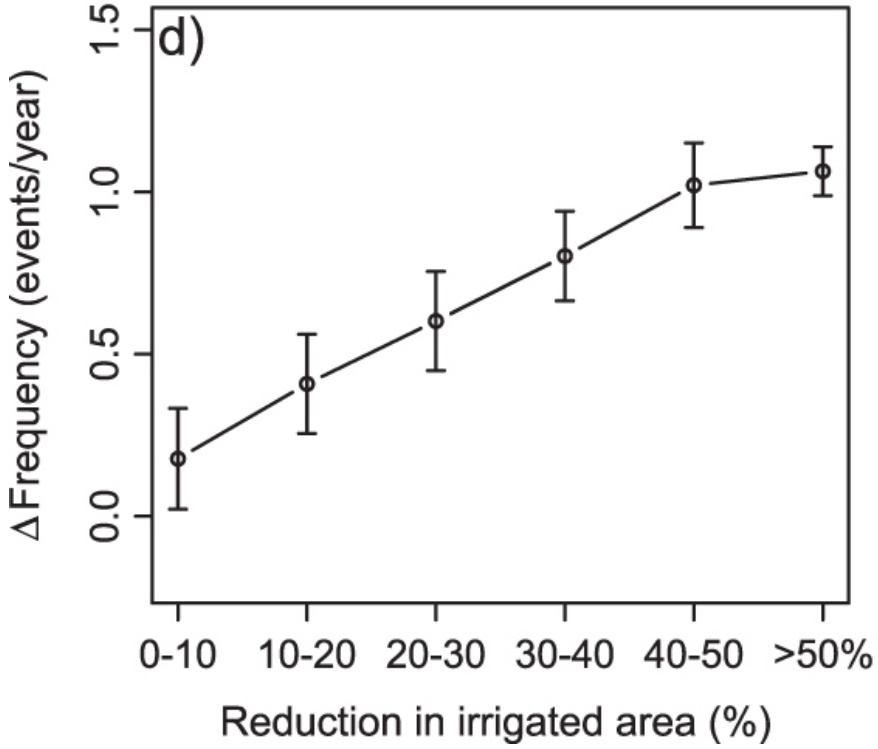




(Kueppers & Snyder 2011)

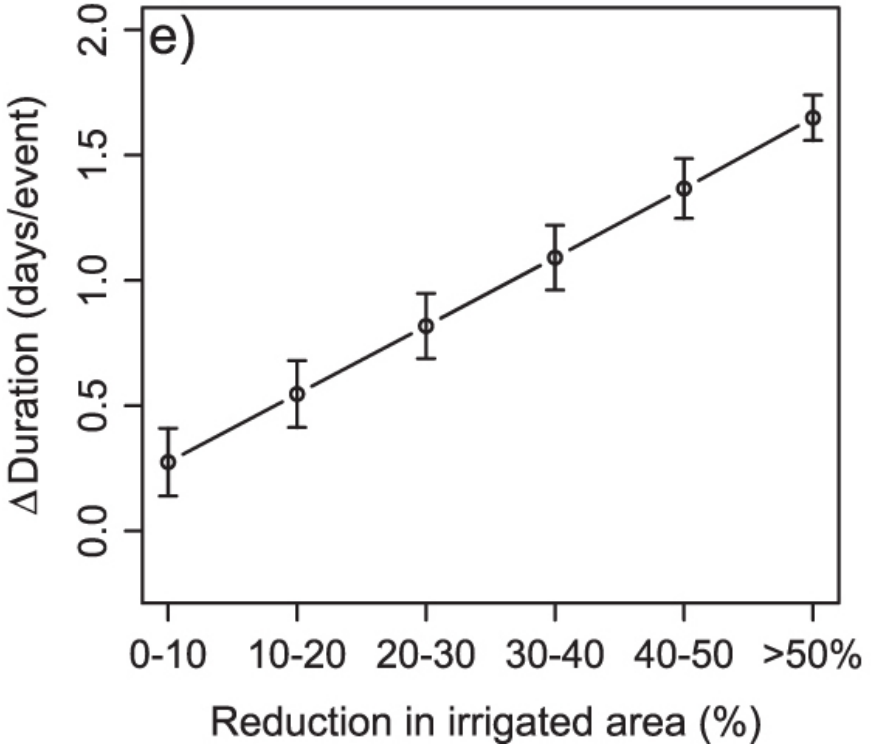
# Loss of irrigation would have the reverse effect: warming

- Hypothetical loss of irrigation in the Great Plains increases heat waves

Change in heat wave **frequency**



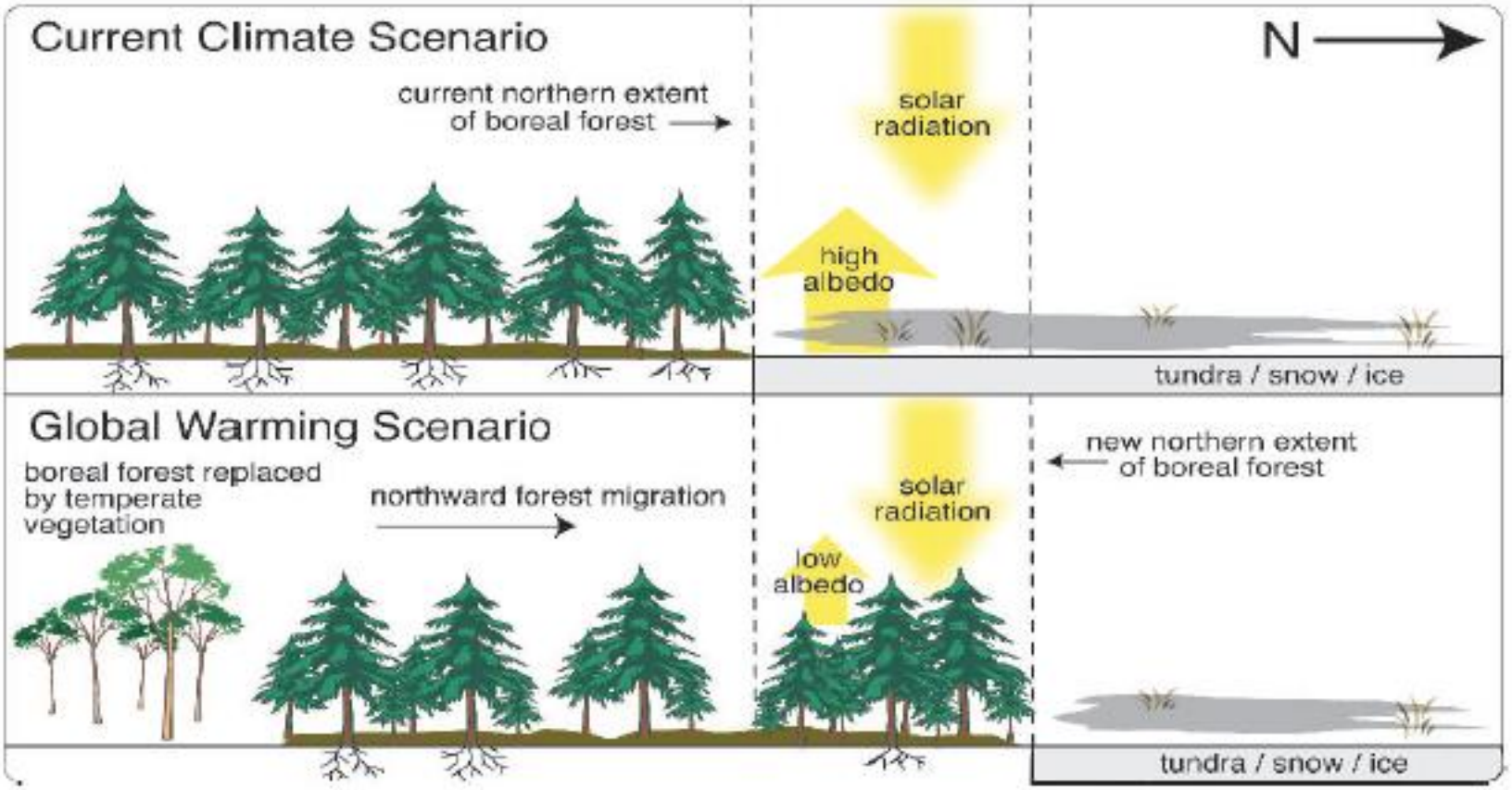

Change in heat wave **duration**




(Lu & Kueppers 2015)

How will increases in fallow land in CA affect local and regional climate?

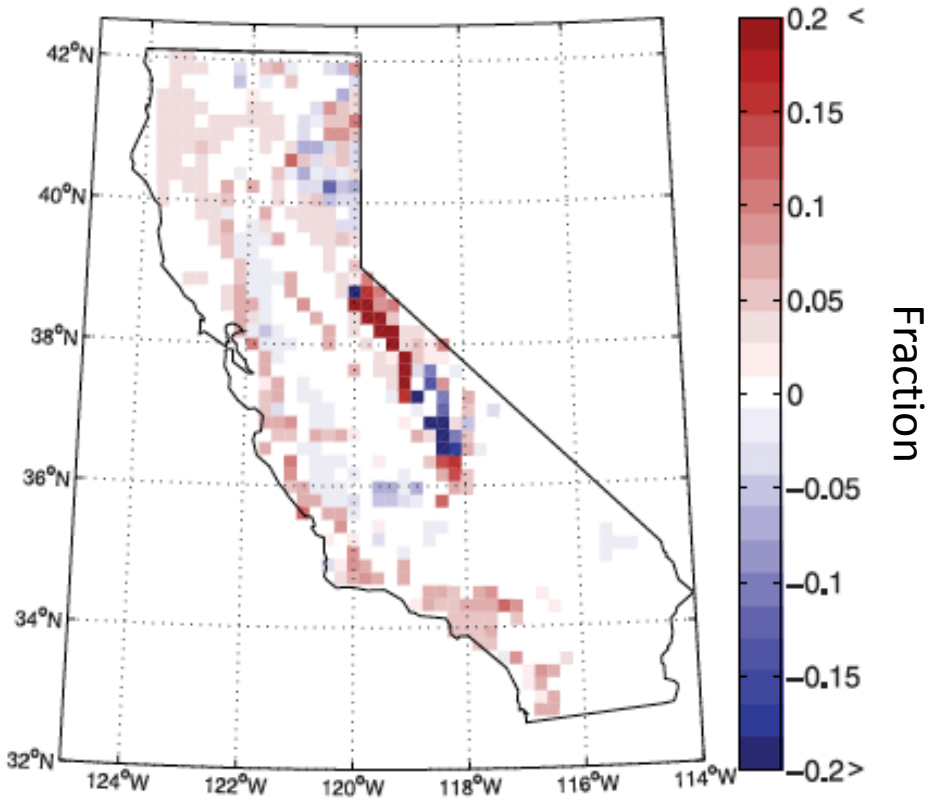
# Vegetation shifts with warming
# Example: boreal forest shift



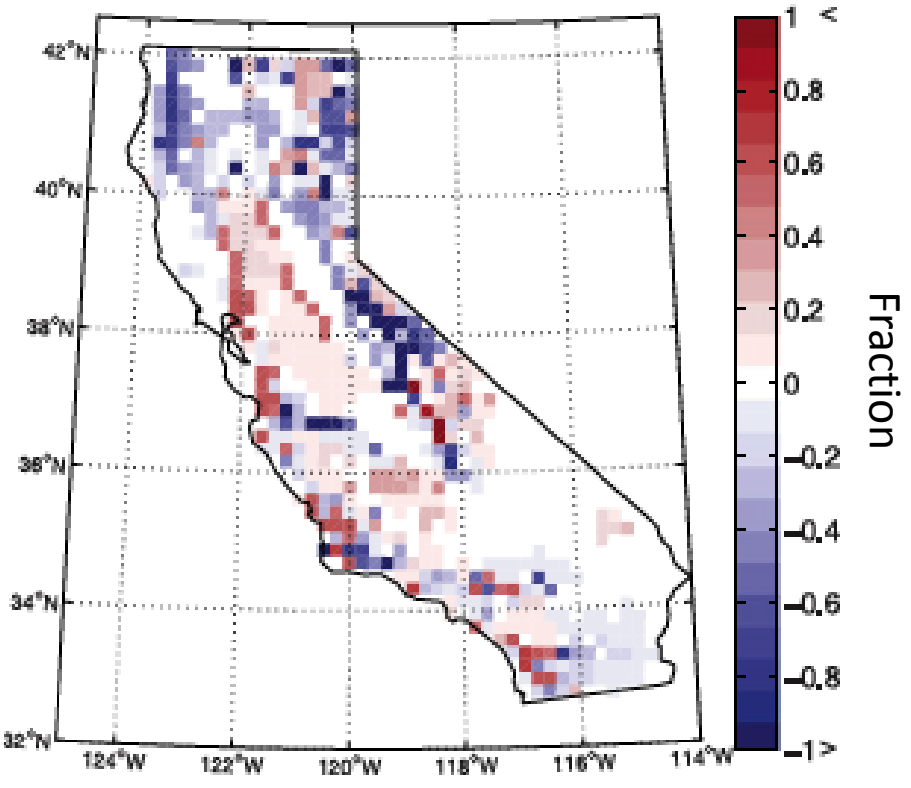

(Kueppers et al. 2007)

# Temperature change from projected vegetation shifts comparable to that from global warming

Summer afternoon albedo




Summer afternoon T feedback ratio

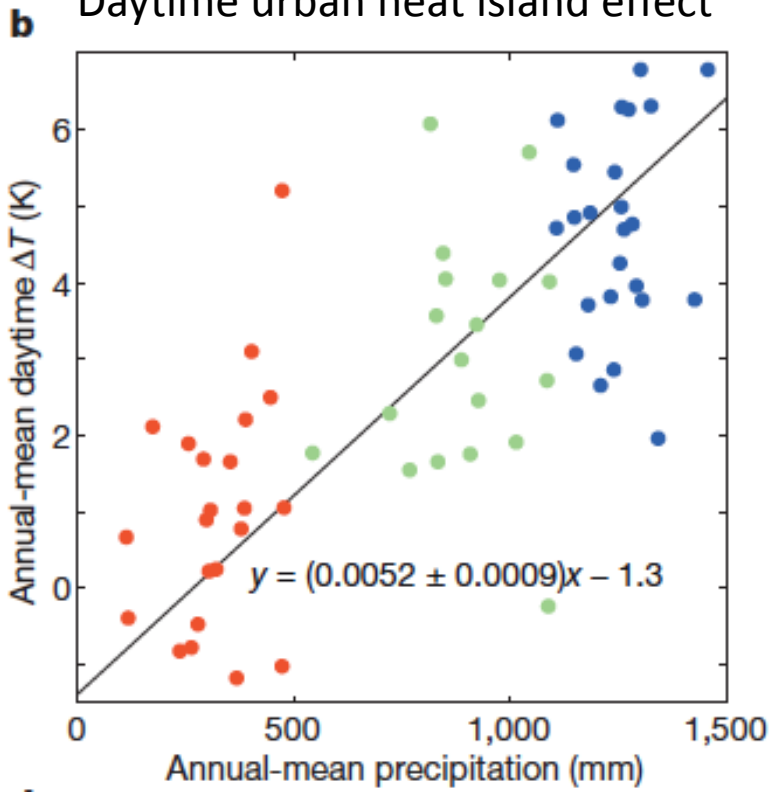



(Subin et al. 2011)



# Effect of urban land use local and context-dependent

Daytime urban heat island effect




(Zhao et al. 2014)

# Summary

- Land use change has *biogeochemical* and *biogeophysical* effects on climate

- In California, large-scale conversion to/from irrigated agriculture an important *regional* climate driver

- Conversion of forests, warming-driven shifts in vegetation, expansion of urban areas all have important local biogeophysical effects


Thank you.