DOCKET
09-IEP-1P
DATE June 08 2009
RECD. June 04 2009

UC SANTA CRUZ

Effect of Climate Change on Renewables in California: Wind and PV's

Lisa C. Sloan, Mark A. Snyder, and Travis O'Brien
Climate Change and Impacts Laboratory
Dept. of Earth and Planetary Sciences
University of California, Santa Cruz

Climate Change and Energy Workshop | June 8, 2009

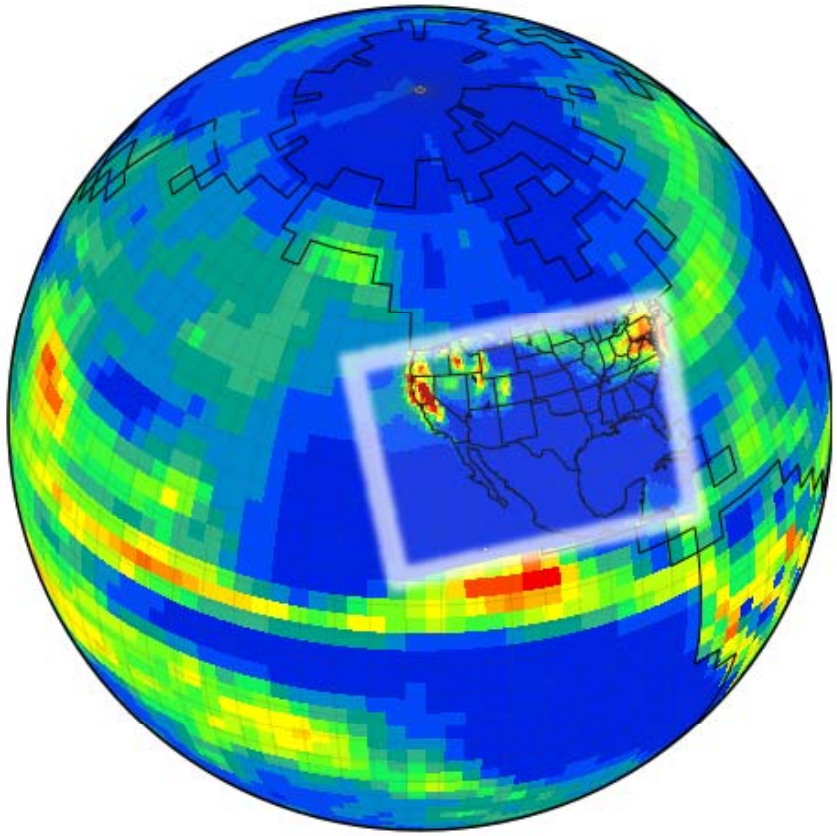
Renewable Energy: Wind and PVs

- Wind power currently provides 3.6 % of California's energy.
- Solar power (includes photovoltaic (PVs)) currently provides 0.6 % of California's energy.
- State goal of 33% of total energy production from renewables by 2020.
- California ideal for increased production

Research Tools

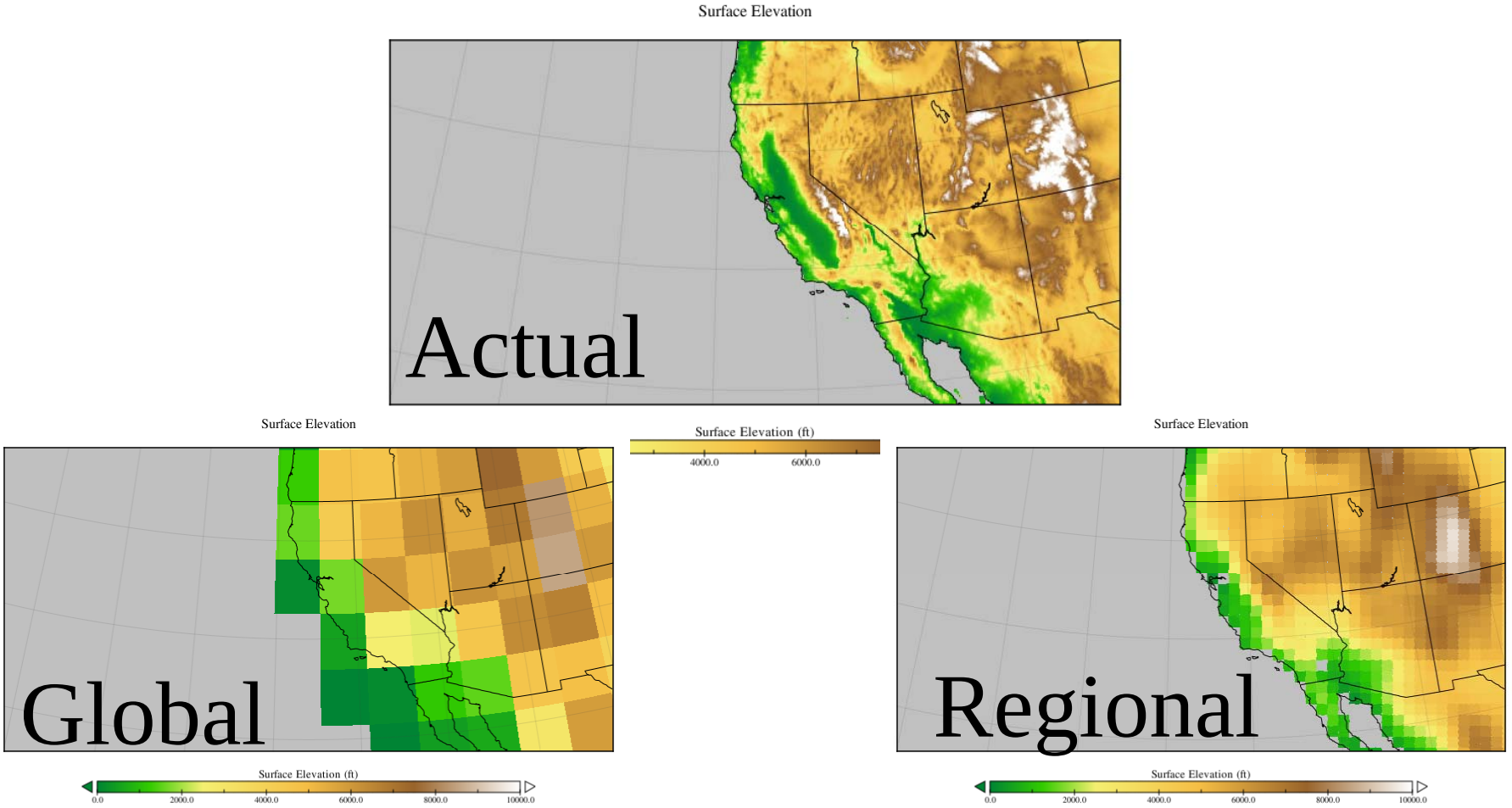
- Global and regional scale (GCM and RCM) climate models provide the best available information on future wind and solar conditions.
- Horizontal resolution of GCM is an issue (100-300 km grid cell)
- RCM horizontal resolution of 10 km – 30 km is better for examining climate in CA

Global Climate Models



- Climate models divide earth into grid-boxes and approximate climate in each box
- Global climate models (GCMs) work over the whole globe
- Same type of model used in IPCC reports

Global vs Regional Climate Models (**RCMs**)



Surface Elevation

GCM Advantages and Questions

- Many models, producing many future scenarios.
- Research Questions:
  - Is current horizontal resolution adequate?
  - Can statistical downscaling techniques be successfully applied to GCM data?

RCM Advantages and Questions

- Higher horizontal resolution, critical for topographic complexity of California.
- Model physics better suited to fine scale simulation than GCM
- Research Questions:
  - What is optimum horizontal resolution?
  - What is optimum balance of computational resources vs. number of simulations?
  - Can cloud representations/models be improved?

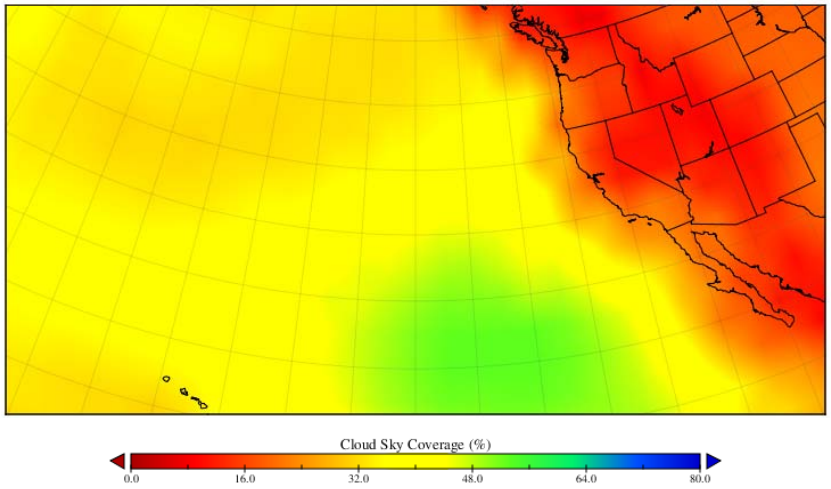
General Research Directions

- Further research needed on cloud models and parameterizations (e.g. marine stratocumulus) in GCMs and RCMs

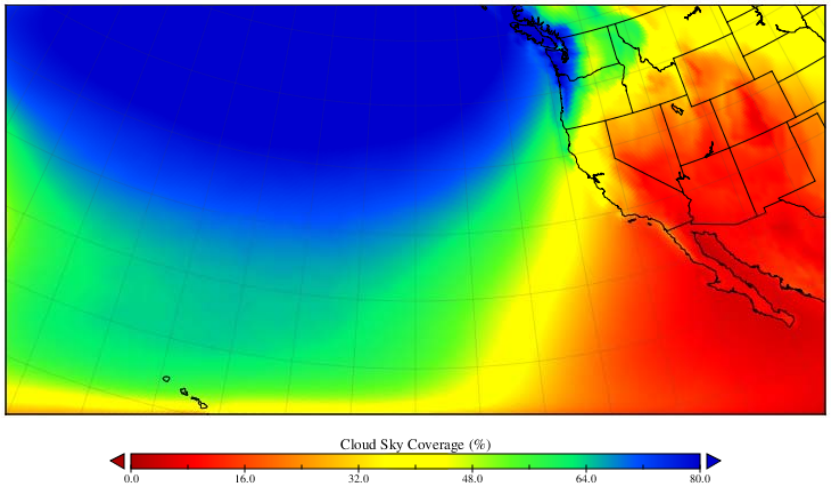
- Investigate effects of renewable energy infrastructure on climate

Improve cloud modeling in RCMs

Observations

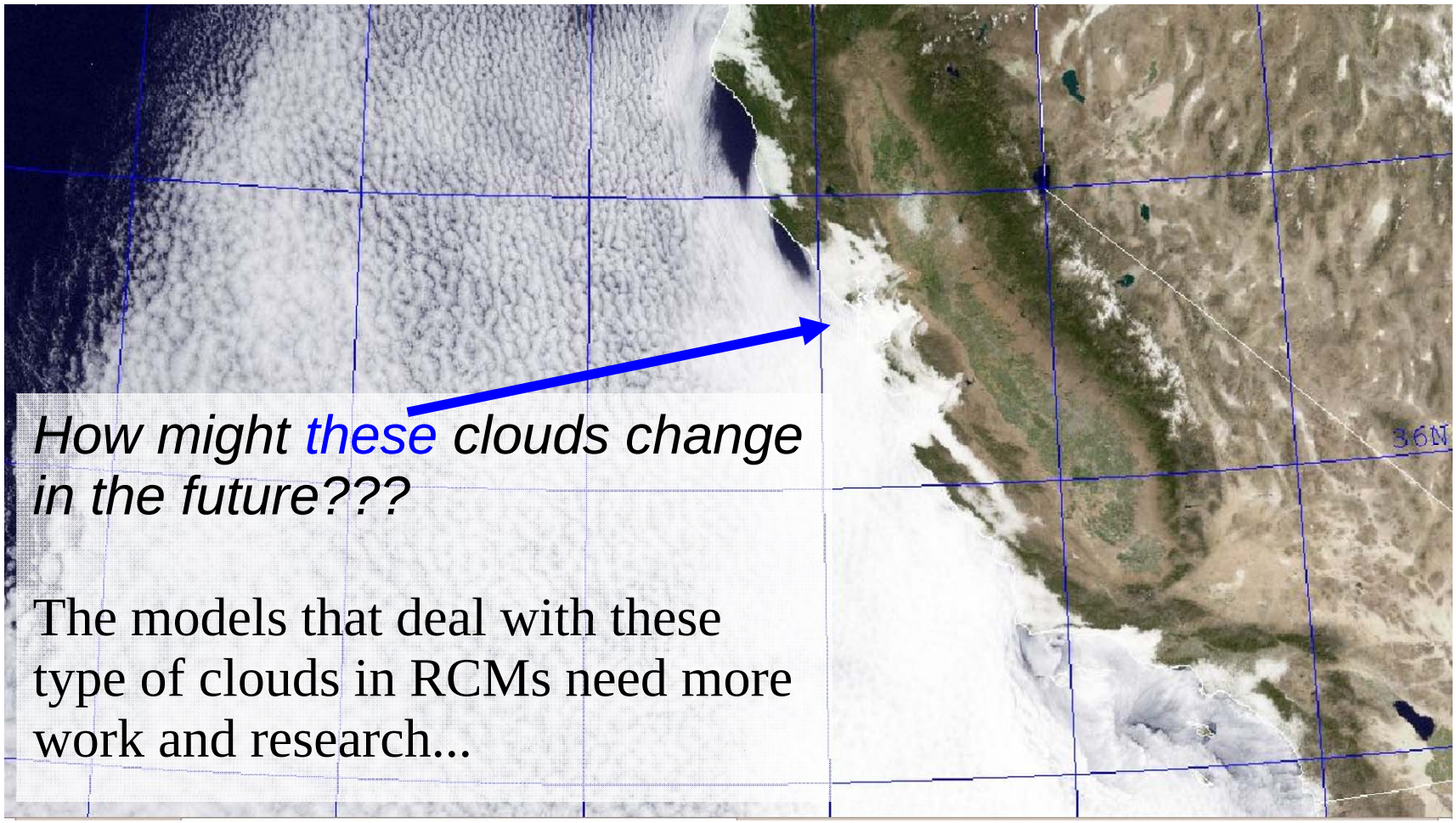


RCM



Cloudiness (low clouds)

Marine Stratocumulus



How might these clouds change in the future???

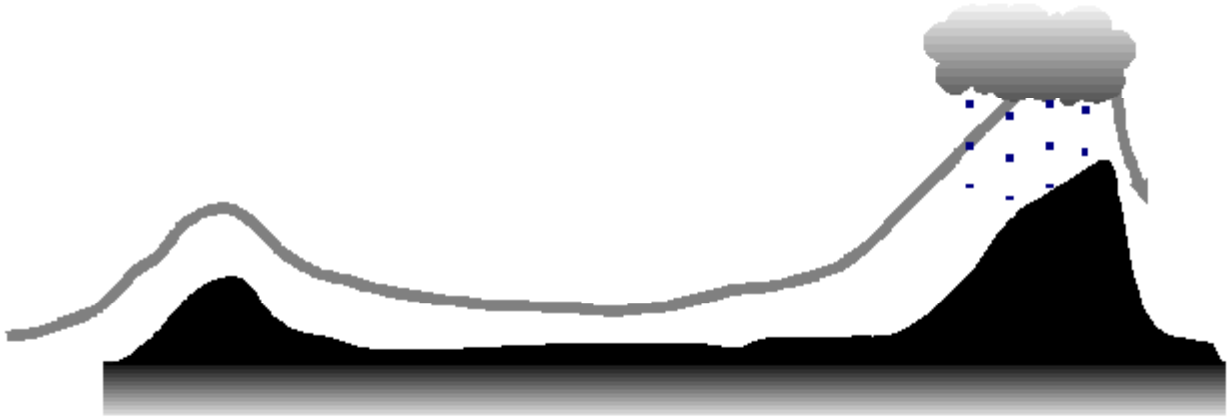
The models that deal with these type of clouds in RCMs need more work and research...

General Research Directions

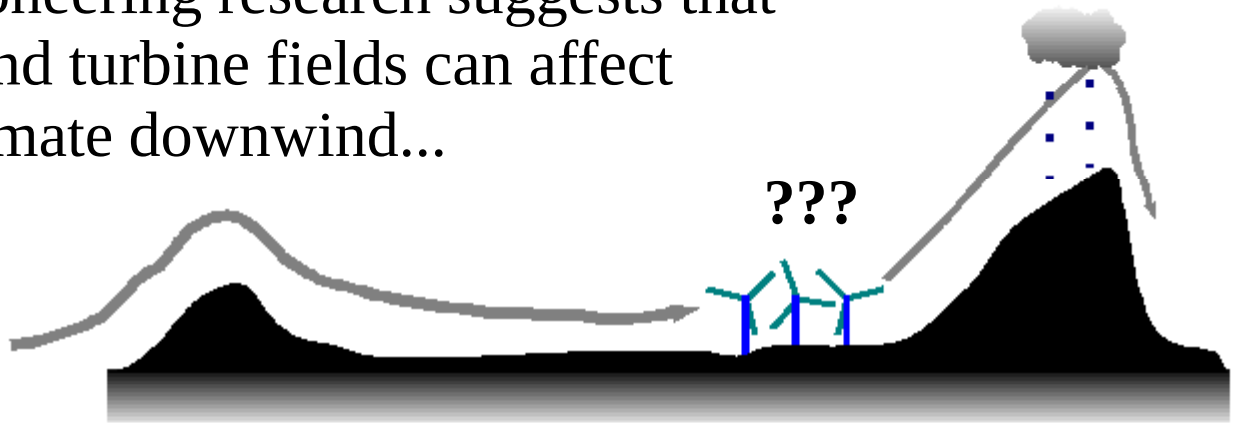
- Further research needed on cloud models and parameterizations (e.g. marine stratocumulus) in GCMs and RCMs

- Investigate effects of renewable energy infrastructure on climate

Wind power climate impact



Pioneering research suggests that wind turbine fields can affect climate downwind...



Photovoltaic climate impact

- Replacing lighter surfaces with darker surfaces increases radiation absorption (e.g. desert to solar panel)
- One study suggests that benefits of photovoltaics in reducing GHG impacts outweigh negatives of increased radiation absorption
- Further California specific studies needed

Summary

- GCMs and RCMs are important tools for research into the impacts of climate change on wind and solar power.
- As California adds renewable energy infrastructure, we need to investigate possible unintended effects on climate, making the use of GCMs and RCMs more important in the future.

Acknowledgements

Funding: The California Energy Commission