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June 18, 2010

California Energy Commission
Attn Docket No. 09-AFC-8
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512

Re: Genesis Solar Energy Project; 09-AFC-8

Dear Docket Clerk:

Enclosed are an original and one copy of **TESTIMONY OF GREG OKIN ON BEHALF OF THE CALIFORNIA UNIONS FOR RELIABLE ENERGY ON SOIL AND WATER RESOURCES AND BIOLOGICAL RESOURCES FOR THE GENESIS SOLAR ENERGY PROJECT**. Please docket the original, conform the copy and return the copy in the envelope provided.

Thank you for your assistance.

Sincerely,

/s/

Rachael E. Koss

REK:bh
Enclosures

2364-071a

STATE OF CALIFORNIA

Energy Resources Conservation and Development Commission

In the Matter of: The Application for Certification for the GENESIS SOLAR ENERGY PROJECT	Docket No. 09-AFC-8

TESTIMONY OF GREG OKIN ON BEHALF OF THE CALIFORNIA UNIONS FOR RELIABLE ENERGY ON SOIL AND WATER RESOURCES AND BIOLOGICAL RESOURCES FOR THE GENESIS SOLAR ENERGY PROJECT

June 18, 2010

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Attorneys for the CALIFORNIA UNIONS FOR RELIABLE ENERGY

1. Introduction

I have reviewed those documents that address evidence of offsite ecological impacts of the project known as the Genesis Solar Energy Project ("Project") in eastern Riverside County. It is my opinion that the aforementioned documents have inadequately portrayed the potential for there to be offsite impacts from the western portion of the installation (i.e. from the eastern side of the Project's western solar array to the western boundary of the Project).

I am an Associate Professor of Geography at the University of California, Los Angeles, having received my Ph.D. from the California Institute of Technology in 2001. I maintain an active research program as a member of the Faculty at UCLA, with particular emphasis on deserts. My dissertation research was conducted not far from the Project site, between Baker and Barstow in San Bernardino County. I have written and taught extensively on the topic of soils and ecology of deserts. My *curriculum vitae* is attached as Attachment 1.

My critique centers on three primary areas of concern. (1) The potential hydrological effects of the western portion of the installation on vegetation downstream (south) of the Project; (2) the potential effects of the western portion of the installation on erosion and soil mobilization from the Project; and (3) the potential for stabilization of disturbed areas within the western portion of the installation. The western portion of the installation lies primarily on an alluvial surface mapped as Qal and Qoaf (Worley Parsons, 2010). I do not dispute this mapping, but do dispute claims made in both the Geological Report (GR; Worley Parsons, 2010) and the Revised Staff Assessment (RSA) on the ecological and geomorphic functioning of these units. It is my opinion that the Project would significantly impact these geomorphic surfaces and that dismissal of impacts on these surfaces, as well as the offsite areas downwind and downstream, as insignificant is not appropriate.

2. Hydrological impacts on vegetation south of the Project

The Applicant plans on implementing a Drainage Plan (Appendix E, Fig 19 of RSA) that involves channelization of flow from ephemeral streams to divert around the solar arrays, with spreading of the redirected flow downstream of the Project. This type of water control has been used throughout the Mojave Desert, as acknowledged by the RSA, and nearby along the I-10 corridor. Based on a site visit, the RSA suggests that this drainage plan will have little to no effect on local geomorphology and desert vegetation.

A significant amount of research has been conducted along the western flank of the nearby Coxcomb Mountains on the geomorphic and ecological impact of water diversions which were constructed to protect the Colorado River aqueduct. Schlesinger and Jones (1984) showed that the diversions caused significant decreases in plant density and overall biomass for two key Sonoran creosote bush scrub species (*Larrea tridentata* and *Ambrosia dumosa*) as well as an increase in mortality of larger specimens of *L. tridentata.* This research and that of Schlesinger et al. (1989) shows that overland flow from upstream on alluvial desert piedmonts ("bajadas") is key to the maintenance of biological productivity. Sonoran creosote bush scrub communities aren't simply reliant upon direct precipitation for their water. Water is concentrated and stored in soils during rain that produces overland flow, and this water contributes to the survival and reproduction of shrub species that serve as habitat for much of the fauna of the region.

There will be significant areas of the bajada south (downstream) of the western solar array that will be blocked from overland flow. Though the redistribution channels on the south side of the solar array will reduce these impacts, and will also reduce the potential for increased fluvial erosion due to concentrated water flow, there will also be considerable areas that will be completely blocked from overland flow (Appendix E, Fig 19, RSA). These areas can be expected to experience reduced growth and shrub mortality of the type documented by Schlesinger and Jones (1984).

Thus, it is my opinion that the Project's diversion of flow from small ephemeral channels would result in significant offsite impacts to vegetation that have not been adequately addressed by the RSA.

3. The potential effects of the western portion of the installation on erosion and soil mobilization from the Project

It is my opinion that the mapping of the geomorphic units in the western portion of the Project is correct. However, I believe that the interpretation of the meaning of these geomorphic units is outdated and their potential response to disturbance is inadequately addressed by the RSA.

The Qal and Qoaf surfaces are discussed in both the GR and the RSA as comprised of a lag gravel atop finer-grained sediments. They take the presence of this so-called lag gravel, desert varnish and rubification of surface clasts, and the presence of subsurface soil horizons as evidence that these surfaces have been "stable for 1000s of years", implying that "sand deposition is not taking place" (Appendix E, p. 9, RSA). The RSA concludes that "from a geomorphic perspective, construction of the project on the Qal should have relatively little off-site impact because there is little sediment transport occurring on this surface, construction of the proposed project does not appear likely to disrupt the movement of sediment to habitat areas" (Appendix E, p. 19, RSA). My experience and the scientific literature disputes this conclusion.

Both the GR and the RSA are incorrect in classifying the clasts on the surface of the Qal unit as a lag deposit. The GR and RSA's approach to pavement formation holds that large clasts are concentrated at the surface by the continual erosion (by wind or water) of fine particles. I know of no evidence for deflationary pavement on an alluvial fan within the Mojave Desert.

Rather, a series of papers in the scientific literature (e.g., McFadden et al., 1987; Wells et al, 1995; Anderson et al, 2002) studied the development of desert pavements in the Mojave Desert (along Kelbaker Road between Kelso and Baker, San Bernardino County in the Cima volcanic field). Through a series of geomorphic, geochemical, and micromorphometric techniques, these studies show that desert pavements arise when large surface clasts rise vertically on an accreting aeolian mantle. In essence, pavements arise when wind-blown material is deposited on the top of large clasts and is washed underneath them by subsequent rains. Depending on the age of the surface, meters of material can accumulate in this way, and geochemical evidence suggests that the clasts on the surface have, since their original deposition, remained at the soil surface.

Given the amount of aeolian activity that occurs naturally in the area near the Project, evidenced by clear sand transport corridors both east and south of the Project as well as the prevalence of dust storms in the basin, the pavements observed on the Qal surface (incorrectly called 'gravel lag deposits') are almost certainly accretionary pavements. In the field, these accreting mantles can be identified clearly by the presence of a so-called Av horizon, or vesicular A horizon, in the fine-grained sediments just below the large surface clasts. Photographs and descriptions of the soils in the western portion of the Project (e.g. Plates 11B, 12B, and 24B) indicate the presence of this Av horizon, thus strengthening the case that this is an accretionary surface.

The RSA is correct to conclude, nonetheless, that the Qal surface has been stable for thousands of years. The continual presence of the clasts atop the surface have allowed for slow processes (such as the formation of varnished surfaces and the formation of subsurface soil horizons) to take place even while there was a slow accumulation of material within the accretionary mantle.

Removal or disturbance of the pavement clasts that protect the surface can be expected to have major impacts on the availability and transport of wind-borne material. A study by Belnap et al. (2007) found that even minor disturbances, such as that caused by a single vehicle pass, leads to significant decreases of the threshold wind speed (the wind speed at which particle movement is initiated) and increases in the total amount of aeolian flux observed. Several other studies have also determined the impact of the disturbance of desert soils on threshold wind speed and sediment flux (e.g., Gillette, 1980; Field et al. 2010), all concluding that even modest disturbance can lead to significantly increased aeolian activity.

This is particularly the case with accretionary desert pavements. The aeolian materials that have been protected for millennia beneath the surface clasts are highly erodible due to their original aeolian origin. Studies from the Cima volcanic fields (Anderson et al., 2002) show that the accretionary mantle is largely made of fine sands and silt-sized particles which are easily moved by the wind once exposed at the surface.

Also within the western portion of the Project is the Qsr geomorphic unit comprised of relict sand sheets displaying a low degree of aeolian activity under current conditions.

This surface, too, can be expected to be largely remobilized once surface disturbances associated with the Project are initiated.

Thus, the large-scale disturbance that is to occur on the Qal and Qsr geomorphic surfaces in the western portion of the Project will lead to extensive new aeolian activity. Given the predominant southwestern wind direction, this will mean that a plume of sand, eroded from the disturbed area, will begin to extend from the southern edge of the Project.

In my own research, I have investigated the impacts of this sort of sand plume originating from disturbed soils, on nearby vegetation communities that were not directly disturbed. The relevant publications are Okin et al. (2001a, 2001b, 2006, and 2009). What occurs during this enhanced aeolian activity is that sand, blown from the area of the disturbance, is deposited on the downwind area, potentially burying plants. While it is moving, the sand can abrade, damage, and/or kill offsite vegetation, and the removal of fine-particles during transport (i.e. "winnowing") leaves the deposited soil with lower water-holding capacity, cation-exchange capacity, and lower levels of critical nutrient elements such as C, N, and P. The result is a downwind area with reduced vegetation cover, reduced soil fertility, shifting sands, and lower probability of establishment of new vegetation.

Of course, any disturbance of the soil surface that encourages increased aeolian activity in a soil with dust-sized (< 50 um) particles, will also lead to the production of dust. The potential for the Project to increase dust emission from the site has been evaluated in the RSA, though the emphasis appears to have been on dust emissions from vehicles, and mitigation techniques for vehicular fugitive dust emissions differ from those that would be required on large areas of land disturbed land. The potential for mitigation of both the sand and dust impacts of disturbances associated with the project will be addressed in the next section.

Thus, in my opinion the Qal and Qsr surfaces, while stable in the absence of a disturbance, have the potential to become significant sources of offsite impacts in terms of both biological resources (e.g., vegetation and fauna in the downwind area) and air resources (e.g., dust). The potential for these surfaces to yield significant offsite impacts appears to have been inadequately evaluated in the RSA. Though the staff identified the potential of the Project to increase dust emissions, the potential for the wind-driven impact on the area immediately downwind of the Project was not considered by the Staff.

4. The potential for stabilization of disturbed areas within the western portion of the Project

As mentioned above, the RSA did evaluate the potential of the Project to increase fugitive dust emissions in the basin and in the absence of effective mitigation, determined that the Project would likely have significant impacts on air quality. In light of this, the RSA has required a set of fugitive dust mitigation measures (RSA C1.-44 to 45). All but one of these focus on roads and vehicular traffic as sources of fugitive dust emissions. The only item to discuss the potential of surface disturbance to cause fugitive dust emissions reads:

> n. Wind-erosion control techniques (such as windbreaks, water, chemical dust suppressants, and/or vegetation) shall be used on all areas that may be disturbed. Any windbreaks installed to comply with this condition shall remain in place until the soil is stabilized or permanently covered by vegetation.

With the exception of chemical dust suppressants, which probably do not significantly reduce the movement of sand grains, the wind erosion control techniques might also be suggested to be useful in the mitigation of wind erosion (sand transport) from disturbed areas. Dust emission and wind erosion are tightly linked: saltation of sand-sized particles is initiated when the wind speed exceeds the wind speed required for transport. At this threshold windspeed, the finer particles that comprise the "dust" fraction are still held to the surface by interparticle forces. However, upon the initiation of saltation, moving particles impart sufficient energy to the surface when they strike it to liberate the dust-sized particles from the surface. These particles then become suspended in the air flow and leave the area as "fugitive dust".

However, it is my opinion that the measures required by the RSA to mitigate fugitive dust emissions from disturbed areas (i.e. not roads and not including dust emission from vehicular traffic) are insufficient to mitigate significant impacts from wind erosion, including offsite effects discussed above. Because wind erosion and dust emission are so tightly linked in disturbed areas, I also do not think that the required mitigation measures will significantly impact fugitive dust emissions from disturbed areas.

By far the most important factor controlling the erodibility of the surface by wind is the threshold wind velocity at which particle transport is initiated. A surface with a sufficiently high threshold wind velocity is not wind erodible even in the absence of vegetation or other objects such as windbreaks. If, on the other hand, the threshold wind velocity is sufficiently low so as to make the soil erodible under natural wind conditions, windbreaks and vegetation have limited ability to reduce the amount of aeolian activity that the surface will experience.

As discussed above, even light disturbance can reduce the threshold wind velocity sufficiently to make soils highly erodible. Disturbance at the level envisioned in this Project (grading) is sure to make the soils extremely wind erodible. There is very little that the wind-erosion control techniques suggested by the RSA can do to significantly reduce the erodibility of the surface once it has been disturbed.

As evidence of this, I point to my own research in the Manix Basin of the Mojave Desert between Barstow and Baker along I-15 (Okin et al. 2001b). In this area, soils were disturbed for agricultural purposes, though many of the fields were later abandoned. For the purposes here, the most notable aspect about the trajectory that this area took after the abandonment of agriculture is that, on some of the fields, vegetation grew back to covers several times that found in the pre-disturbance vegetation (e.g., 30% cover vs. 5 - 10% cover). Despite this, the fields with significant vegetation cover remained the source for blowing sand plumes downwind of the abandoned fields. This illustrates that, even if permanent vegetation recovers on disturbed areas, it is highly unlikely that wind erosion will be reduced in the decades following the establishment of the Project.

To make matters worse, vegetation recovery in the Mojave Desert is famously slow. A review by Lovich and Bainbridge (1999) suggested that vegetation recovery in the deserts of California takes between 50 - 300 years, with full recovery taking up to 3000 years. Recovery interventions are expensive and have low probability of success.

Thus, it is clear that natural recovery processes cannot be counted upon to limit wind erosion, and potentially dust emission, from disturbed areas. Even if vegetation recovers quickly through natural means or human intervention, my research shows that once the soil surface has been disturbed there is little that can be done to limit wind erosion and dust emission.

Windbreaks can hardly be expected to be more effective at erosion control than vegetation. The efficacy of windbreaks or chemical dust suppressants in limiting wind erosion and dust emission must be made based on the specifics of the system to be used, but there are good reasons to believe that these will not be completely effective in limiting wind erosion and dust emission. Windbreaks, for example, like plants, do not completely eliminate wind in their lee. They function to reduce the wind speed in their lee, but this effect decreases as the distance from the windbreak increases (Bradley and Mulhearn, 1983) becoming minimal at a distance of about 5 times the height of the windbreak. To be effective in limiting wind erosion (rather than dust emission) a chemical dust suppressant must be able to bind all of the most wind-erodible particles (~70 um) on the surface. However, it is my understanding that chemical dust suppressants act to aggregate dust-sized particles limiting their ability to become suspended.

In sum, the measures required by the RSA for mitigating fugitive dust emissions from disturbed areas are insufficient to mitigate significant impacts from wind erosion, including the offsite effects discussed above.

5. Cited References

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Okin, G. S., J. E. Herrick, and D. A. Gillette (2006), Multiscale controls on and consequences of aeolian processes in landscape change in arid and semiarid environments, Journal of Arid Environments, 65, 253-275.

Okin, G. S., A. J. Parsons, J. Wainwright, J. E. Herrick, B. T. Bestelmeyer, D. P. C. Peters, and E. L. Fredrickson (2009), Do changes in connectivity explain desertification?, Bioscience, 59(3), 237-244.

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Worley Thomas (2010) Aeolian Transport Evaluation and Ancient Shoreline Delineation Report.

DECLARATION

I, Greg Okin, declare as follows:

I have reviewed the above testimony regarding the Genesis Solar Energy Project. To the best of my knowledge, all of the facts in my testimony are true and correct. To the extent that this testimony contains opinion, such opinion is my own.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and belief. This declaration is signed at Athens, Greece.

Dated: June 16, 2010 Signed:

ATTACHMENT 1

GREGORY STEWART OKIN

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EDUCATION

Postdoctoral Research:	Department of Geography, University of California, Santa Barbara, Mentor: Oliver A. Chadwick	2001-2002
Ph.D.	Geochemistry, California Institute of Technology Wind-Driven Desertification: Process Modeling, Remote Monitoring, and Forecasting. Thesis Advisors: Bruce Murray, William H. Schlesinger.	2001
M.S.	Geology, California Institute of Technology	1997
B.A.	Chemistry & Philosophy (Double Major), Middlebury College	1995

APPOINTMENTS AND POSITIONS

Editor, *Reviews of Geophysics*	2010 – Present
University of California, Los Angeles, Dept. of Geography, Associate Professor	2008 – Present
New Mexico State University, Dept. of Plant and Environmental Science, Adjunct	2007 – Present
University of California, Los Angeles, Dept. of Geography, Assistant Professor	2006 – 2008
University of Virginia, Dept. of Environmental Sciences, Assistant Professor	2002 – 2006
University of California, Santa Barbara, Dept. of Geography, Postdoctoral Researcher	2001 – 2002
California Institute of Technology, Div. of Geol. and Plan. Sci., Graduate Student	1995 – 2001
Middlebury College, Undergraduate Student Researcher	1994 – 1995
University of Denver, Dept. of Chemistry, Undergraduate Researcher	1994 – 1995

GRANTS AND CONTRACTS

University of California, Los Angeles (2006-present)

Jornada Basin LTER V: Landscape Linkages in Arid and Semiarid Ecosystems. (NSF-LTER). Current NSF Long Term Ecological Research grant to study desertification and remediation processes in the Chihuahuan Desert. Co-Investigator. PI: Peters. Total Grant: $4.92M.

The Effect of Sandblasting on Desert Plant Physiology. (Sol Leshin Program for Collaboration between UCLA and BGU in Plant Sciences & Social Sciences & Humanities) Grant with Haim Tsoar of Ben Gurion University to conduct experiments on sandblasting of US and Israeli plant species. PI: Okin. Total Grant: $25,000.

Determining rates of dust emission and wind erosion on US Rangelands: A National Assessment. (National Resource Conservation Service) Grant to conduct field measurements for calibration of a wind erosion model. PI: Okin. Total Grant: $150,000.

Distribution and Dynamics of Belowground Carbon in Savannas. (NSF-DEB). Grant to study belowground carbon in the Kalahari Desert of Botswana. PI: Okin. Total Grant: $700,000. Additional REU and RET supplement in 2008. Additional REU supplement in 2008-2010.

Quantifying feedbacks between groundwater decline, wind erosion, and ecological change in desert vegetation. (NSF-EAR). Grant to study vegetation change and wind erosion associated with groundwater decline in the Owens Valley of California. PI: Elmore. Total Grant ~$450,000.

Field spectroscopy in support of aeolian geomorphology, snow hydrology, and teaching at UCLA. (NSF-EAR). Grant to acquire an ASD FieldSpec portable spectroradiometer and accessories. PI: Okin. Total Grant: $89,000.

Dust Hotspots: An advanced method for characterizing desert dust sources. (UCLA FRG). Grant to use LIDAR to detect patterns of dust emission in the Chihuahuan Desert. PI: Okin. Total Grant: $10,000.

University of Virginia (2002 – 2006)

Remote Spectral Identification of Human Activities. (DOD) Grant to study the spectral signature of human activities in arid and semiarid environments with the purpose of improving remote intelligence. Grant supports UVA Ph.D. student and UCLA visiting student Cheney Shreve. PI: Okin (2005-2006), Fuentes (2006-2008). Total Grant to date: $70,000. 2006-2008

The Role of Wind Erosion in Ecosystem Change in Desert Grasslands. (NSF-DEB Ecosystem Studies) Grant to measure and model the effects of wind on nutrient loss and vegetation change in grasslands of the Southwest. PI: Okin. Total Grant: $500, 000. Includes REU Supplemental Grant in 2006. 2003-2006

Hydrological and nutrient controls on the structure and function of southern African savannas: A multi-scale approach. (NASA-IDS) Grant to assess the feedback and stability of interactions in the savanna ecosystems of southern Africa. Co-Investigator. PI: Shugart. Total Grant: $900,000 2004-2007

Feedbacks between vegetation change and dust emission in deserts: a novel observational approach. (UVA Fund for Excellence in Science and Technology) Grant to assess the use of LIDAR for landscape-scale analysis of wind erosion and dust emission. PI: Okin. Total Grant: $50,000 2005-2006

Planning Visit: Nutrient, hydrologic, and physiological controls on belowground productivity and carbon sequestration in Kalahari savanna ecosystems. Funds for visit to Botswana for planning of savanna carbon sequestration proposal. PI: Okin. Total funds: $22,000. 2005-2006

California Institute of Technology, Graduate Student (1995 – 2001)

Supercomputing Visualization Workbench. (Caltech President's Fund) Grant to develop high-performance imaging spectrometer data analysis tools. Principal grant author and research leader. PI: Murray. 1998-1999

Time Critical Observations for Arid Region Greening. (NASA-OES) Grant to collect and analyze AVIRIS data and field spectra. Principal grant author and research leader. PI: Murray. 1997-1998

FELLOWSHIPS AND AWARDS

Editors' Citation for Excellence in Refereeing for JGR-Atmospheres 2008
UCLA Academic Advancement Program Faculty Appreciation Award 2008

NASA Earth Sciences Enterprise Fellowship 1998-2000
Koons Fellowship in Geological and Planetary Sciences 1998
Conoco Fellowship in Geological and Planetary Science 1995-1996
Valedictorian, Middlebury College Class of 1995 1995
Junior Phi Beta Kappa 1994
NSF REU Fellowship, University of Denver 1994

OTHER RESEARCH EXPERIENCE

Middlebury College, Undergraduate Student (1991 – 1995)

Variable-Field Variable-Temperature Magnetic Circular Dichroism of Co(II) Monomers and Dimers. Undergraduate Chemistry Thesis. PI: Larrabee. 1994-1995

University of Denver, Undergraduate Researcher (1994 – 1995)

Laser-induced emission from NFCl radicals isolated in low-temperature argon matrices. Summer Research. Mentor: Gilbert. 1994-1995

PUBLICATIONS

Journal Articles Submitted or In Preparation

Katjiua, Mutjinde, L. Wang, P. D'Odorico, G. S. Okin, Submitted, Nutrient and water limitations in savanna vegetation along the Kalahari rainfall gradient, *Journal of Arid Environments*

Ballantine, J.A., N.M. Mahowald, G.S. Okin, T. Dunne, Submitted, Temporal and spatial influences of precipitation and landforms on low visibility in North Africa. *Journal of Geophysical Research.*

Ravi, S., P. D'Odorico, D.D. Breshears, J.P. Field, A.S. Goudie, T.E. Huxman, G.S. Okin, R.J. Swap, A.D. Thomas, S. van Pelt, J.J. Whicker, T.M. Zobeck, submitted, Aeolian processes and the biosphere: Interactions and feedback loops, *Reviews of Geophysics.*

Okin, G.S., P. D'Odorico, In Preparation, Counterintuitive effect of climate fluctuations on grass invasions in fireproof desert shrublands, *New Phytologist*

Stewart, J., A.J. Parsons, J. Wainwright, G.S. Okin, B.T. Bestelmeyer, E.L. Fredrickson, W.H. Schlesinger, In Preparation, Modelling emergent patterns of dynamic desert ecosystems as a function of changing landscape connectivity, *Ecological Modelling.*

Alvarez, L.J., H.E. Epstein, J. Li, G.S. Okin, submitted, The effects of grass reduction and increased wind erosion on photosynthesis rates of desert grassland plants. *Oecologia.*

Shreve, C.M., G.S. Okin, T.H. Painter, In Preparation, Spatial and temporal trends in fractional snow covered area and daytime land surface temperature in the Tibetan Plateau 2000-2007 using MODIS data. *Environmental Science Letters.*

Alvarez, L.J., G.S. Okin, H.E. Epstein, in preparation, Evaluation of current shear stress partitioning models in a sparsely vegetated ecosystem, *Journal of Geophysical Research-Earth Surfaces.*

Alvarez, L.J., G.S. Okin, H.E. Epstein, J. Li, in preparation, Spatial distribution of vegetation in a desert environment.

Alvarez, L.J., G.S. Okin, H.E. Epstein, J. Li, in preparation, Community responses to wind erosion.

Peer-Reviewed Journal Articles and Articles in Press

Okin, G.S., 2010. The contribution of brown vegetation to vegetation dynamics, *Ecology*, v. 91, pp. 743-755.

Estes, L.D., P.R. Reillo, A.G. Mwangi, G.S. Okin, H.H. Shugart, 2010 Remote sensing of forest structural complexity indices or habitat and species distribution modeling, *Remote Sensing of Environment,* 14, p. 792-804.

Field, J.P., J. Belnap, D.D. Breshears, J.C. Neff, G.S. Okin, J.J. Whicker, T.H Painter, S. Ravi, M.C. Reheis,

R.L. Reynolds, In Press, The ecology of dust: local- to global-scale terrestrial perspectives, *Frontiers in Ecology and the Environment.*

Myint, S.W., A. Brazel, G.S. Okin, A. Buyantuyev, In Press. Combined effects of impervious surface and vegetation cover on the urban heat island effect in a rapidly expanding desert city, *IEEE Journal of Selected Topics in Earth Observations and Remote Sensing.*

Li, J., G.S. Okin, H.E. Epstein, 2009, Effects of enhanced wind erosion on surface soil texture and characteristics of windblown sediments, *Journal of Geophysical Research-Biogeosciences, 114*.

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Okin, G.S., New Perspectives on Desertification, August 31, 2009, Univ. Eduardo Mondlane, Dept. of Forestry Engineering.

Okin, G.S., Connectivity and Ecohydrological Feedbacks in Desertification, AGU Chapman Conference on Examining Ecohydrological Feedbacks of Landscape Change along Elevation Gradients in Semiarid Regions, Sun Valley, Idaho, October 5 – 9, 2009.

Okin, G.S. Aeolian Geomorphology: a lesson in scaling, Civil and Environmental Engineering, UCLA, January 20, 2009.

Okin, G.S. Wind as a geomorphic agent: "Connecting" aeolian studies with hillslope hydrology, January 16, 2009, Smith Lecture Series in the Department of Geological Sciences, University of Michigan, Ann Arbor, MI.

Wang, L. and G.S. Okin, Earth system understanding through the use of satellite products, April 8-10, 2007, Isoscapes 2008, Santa Barbara, CA.

Okin, G.S. Deserts as exemplars of the importance of connectivity in geomorphology, February 4, 2008, UCLA Earth and Space Sciences.

Okin, G.S. Wind erosion in the presence of nonerodible elements, April 12, 2007, Division of Geological and Planetary Sciences, California Institute of Technology.

Okin, G.S., Transport in a "dead world?" The importance of aeolian processes in desertification, March 9, 2007, Geography Department Seminar, Indiana University, Bloomington, IN.

Okin, G.S., Wind erosion in the presence of vegetation, February 9, 2007, Geology Department seminar, University of Texas, El Paso, TX.

Okin, G.S., Wind erosion feedbacks to desertification, February 8, 2007, Earth System seminar, University of Texas, El Paso, TX.

Okin, G.S. Aeolian processes in deserts, UCLA Eos Seminar, November 13, 2007, Los Angeles, CA.

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OTHER PROFESSIONAL PRESENTATIONS (Incomplete List)

Ribeiro, N., G.S. Okin, H.H. Shugart, R.J. Swap, the influence of rainfall, vegetation, elephants and people on fire frequency of miombo woodlands, northern Mozambique, IGARSS 2009, July 13-17, 2009, Cape Town, South Africa

Ravi S., P. D'Odorico, S.L. Collins, C. White, G.S. Okin, S. Macko, and L. Wang, Aeolian processes at the plant-interspace scale: Implications for patch dynamics, Ecological Society of America Annual Meeting, Milwaukee, WI, August 3 – 8, 2008.

Hewins, D.B., H.L. Throop, S.R. Archer, G.S. Okin, Soil-litter mixing enhances decomposition rates in a Chihuahuan Desert grassland Ecological Society of America Annual Meeting, Milwaukee, WI, August 3 – 8, 2008.

Herrick, J.E., D.P.C. Peters, N.K. Hansen, J.C. Ritchie, H.C. Monger and G.S. Okin, 2008, Application of soil physical models to predict soil deposition effects on plant establishment, Ecological Society of America Annual Meeting, Milwaukee, WI, August 3 – 8, 2008.

Wainwright, J. A.J. Parsons, J. Stewart, G.S. Okin, L. Turnbull, R.E. Brazier, Ecogeomorphology and Scale: Desertification due to Woody Shrub Encroachment in the US Southwest, 7th International Conference on Geomorphology (IAG), Melbourne, Australia, July 6 – 11, 2009.

Ravi, S., P. D'Odorico, L. Wang, S.L. Collins, C.S. White, G.S. Okin, 2008, Resource homogenization in degraded arid landscapes induced by fire-erosion interactions, American Geophysical Union, Fall Meeting.

Vest, K.R., A.J. Elmore, G.S. Okin, 2008, Wind erosion and vegetation structure in groundwater affected plant communities, American Geophysical Union, Fall Meeting.

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Shreve, C.M., G.S. Okin, 2008, Spatiotemporal dynamics of snow cover in the western Tibetan Plateau using a MODIS derived fractional snow cover index, American Geophysical Union, Fall Meeting.

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D'Odorico, P., G.S. Okin, Ecohydrological feedbacks and ecosystem stability at the desert margins, International workshop on environmental changes and sustainable development in arid and semiarid regions, Alashan Left Banner (Bayinhaote) Inner Mongolia, China, September 10-17, 2007.

Okin, G.S., The key role of landscape connectivity in desertification, International workshop on environmental changes and sustainable development in arid and semiarid regions, Alashan Left Banner (Bayinhaote) Inner Mongolia, China, September 10-17, 2007.

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Okin, G.S., 1998, A nascent model of desertification in the hyperarid Mojave: Impact of aeolian sand mobilization and crust destruction, Jornada LTER Research Symposium, New Mexico State University, Las Cruces, New Mexico.

Okin, G.S., W.J. Okin, D.A. Roberts, and B.C. Murray, 1998, Multiple endmember spectral mixture analysis: application to an arid/semi-arid landscape, *in* Green, R.O., ed., 7th JPL Airborne Earth Science Workshop: AVIRIS, Volume 1: Jet Propulsion Laboratory, Pasadena, CA, Jet Propulsion Laboratory, Pasadena, CA, p. 291-300.

Okin, G.S., M.M. Tice, S.H. Bauknight, T.W. Ray, B. Murray, 1997, Arid Land Degradation Processes and Monitoring in the Mojave: A Progress Report, Desert Research Symposium, San Bernardino County Museum, San Bernardino, California.

Okin, G.S., 1997, Towards Sustainable Land Use: Leading Desertification Indicators, Western Geography Graduate Student Conference, Tucson, Arizona.

TEACHING EXPERIENCE

University of California, Los Angeles

- Earth's Physical Environment (GEOG 1) — Fall, 2006-8
- Soils and Environment (GEOG/EEB/ENVIRO 127) — Winter, 2007-9
- Modeling the Environment (GEOG 166) — Spring, 2008-9
- Remote Sensing of Environment (GEOG 269) — Winter, 2008

University of Virginia

- Physical Geology — Spring, 2003 & 2004
- Introduction to Remote Sensing — Fall, 2003 & 2004
- Advanced Remote Sensing — Spring, 2004 & 2005
- Remote Sensing — January, 2005
  - Two-week short course on the physics and techniques of remote sensing
- Soils and Geomorphology — Spring, 2005

California Institute of Technology

Teaching Assistant (Earth as a Planet, Mineral Spectroscopy, Global Biogeochemical Cycles, Radioisotope Geochemistry, Terrestrial Surface Systems)

STUDENTS

Committee Chair: Kebonyethata Dintwe (M.A., in progress), Marie Javdani (Ph.D., in progress), Patrick Kahn (Ph.D., in progress), Junran Li (Ph.D., 2008), Ian McGlynn (M.S., 2006), Cheney Shreve (UVA, Ph.D., i2009), David Rachal (NMSU Plant and Environmental Sciences, Ph.D., in progress)

Committee Member: Anne Priest (UVA M.S., 2005), James Eaton (UVA M.S., 2004), Lucy Diekmann (UVA M.S., 2003), Sujith Ravi (UVA M.S., 2004; Ph.D. 2008), Natasha Ribeiro (UVA Ph.D., 2007), Mike O'Connell (UVA Ph.D., 2009), Lyndon Estes (UVA Ph.D, 2008), Lorelei Alvarez (UVA Ph.D., in progress), Will Hobbs (UCLA Geography Ph.D. 2009), Jelena Tomic (UCLA ESS, Ph.D. in progress), Travis Brooks (UCLA EEB, Ph.D. in progress), Paul Levine (UCLA Geography, Ph.D. in progress), Vena Chu (UCLA Geography, M.S., 2009), Dayna Quick (UCSB, Geography, Ph.D., in progress), Keith Gaddis (UCLA EEB, Ph.D., In Progress)

Undergraduate Thesis Students: Allen Smith (UVA 2003-4), David Cassel (UVA 2005-6)

SERVICE ACTIVITIES

University of California, Los Angeles

Geography Department

Graduate Affairs Committee 2006-present

University Service

Reviewer, ISR Summer Fellowships

Member, Faculty advisory committee, Stunt Ranch Santa Monica Reserve 2007-present

Member, Environmental Science Major Oversight Committee 2008-present

Member, Faculty advisory committee, ISR 2009-present

Member, Center for Tropical Research 2008-present

Panelist, "Negotiation skills for academic careers", UCLA Career Center, March 17 2007

Panelist, "Mastering the academic interview", UCLA Career Center, October 26 2006

University of Virginia, Department of Environmental Sciences

Departmental Committees

Graduate admissions 2002-2005

Distinguished Majors Program 2002-2004

Undergraduate academic requirements committee (UGARC) 2002-2005

Computing 2003-2005

Graduate academic requirements committee (GARC) 2004-2005

University Service

Undergraduate Academic Advisor 2002-2004

Faculty Associate, Center for South Asian Studies 2002-2005

Faculty Associate, Center for East Asian Studies 2002-2005

Member, Friends of the LGBT Resource Center Board 2005-2006

Member, LGBT Resource Center Advisory Board 2005-2006

Service to the Profession

Member, UN/GESAMP Working Group (38) on The Atmospheric Input of Chemicals to the Ocean 2008-present

Co-convener special session on "Dynamics and interactions of belowground carbon pools in dryland ecosystems", AGU Joint Assembly, Acapulco, Mexico 2007

Co-convener special session on "Soil-Water-Nutrient Interactions With Savanna Vegetation", AGU Fall Meeting 2005

Co-convener special session on "Intracontinental Mass and Energy Transport Between Alpine and Desert Ecosystems", AGU Fall Meeting 2005

Co-convener special session on "Ecosystem Effects of Dust Deposition", AGU Fall Meeting 2003
Task force on wind erosion, International Geographic Union, Commission on Land Degradation 1997-2004
Member, Geological Society of America 2001-present
Member, American Geophysical Union 1997-present
Member, American Association of Geographers 2005-present
Member, Soil Science Society of America 2006-present

SYNERGISTIC ACTIVITIES

Development of the UCLA IMAGE laboratory 2009-present
An innovative multidisciplinary laboratory for research and teaching
UCLA Environmental Science Major Oversight Committee 2008-present
Participate in curricular decisions for this new multi-displinary major at UCLA
Faculty advisory committee, Stunt Ranch Santa Monica Reserve 2007-present
Participate in research, training, and educational decisionmaking for this UC Reserve
Development of Relative Spectral Mixture Analysis 2007-present
A new MODIS-based phenological remote sensing technique
Panelist, UCLA Career Center 2006-2007
"Negotiation skills for academic careers", "Mastering the academic interview"

Declaration of Service

I, Bonnie Heeley, declare that on June 18, 2010, I served and filed copies of the attached **Testimony of Greg Okin on Behalf of the California Unions for Reliable Energy on Soil and Water Resources and biological Resources for the Genesis solar Energy Project**, dated June 18, 2010. The original document, filed with the Docket Office, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: http://www.energy.ca.gov/sitingcases/genesis_solar.

The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Office via email and U.S. mail.

I declare under penalty of perjury that the foregoing is true and correct. Executed at South San Francisco, California, on June 18, 2010.

/s/
Bonnie Heeley

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Kerry Hattevik, Director West Region Regulatory Affairs 829 Arlington Boulevard El Cerrito, CA 94530 Kerry.hattevik@nexteraenergy.com	Scott Galati Galati & Blek, LLP 455 Capitol Mall, Suite 350 Sacramento, CA 95814 sgalati@gb-llp.com	California ISO e-recipient@caiso.com VIA EMAIL ONLY

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