CA LCC Fog Project FY 2012 Summary
Torregrosa, Alicia (U.S. Geological Survey)

Outcomes include: 1) creation of a science team to satisfy the fog data needs of natural resource managers, 2) synthesis of existing knowledge about coastal fog among the core group of 30 - 40 scientists from diverse disciplines 3) compilation of existing fog-related datasets and exchange of research-grade fog data products among the fog team members, 4) presentations at 3 national scientific meetings on the project team's research activities and planned products, and 5) deployment of fog sensors as a pilot study to better correlate liquid water content associated with the fog events observed by satellite sensors.

1) The Science Team

The team of 15 scientists from 9 disciplines that initially came together to provide fog datasets for resource management needs has grown to a core group of 42 scientists with an additional 40 members who participate occasionally. Of the core group, 22 will be presenting research results at the first "Coastal Fog Session" of the American Geophysical Union (AGU) during the annual fall meeting, Dec 3- 7, 2012, San Francisco. The group has been coordinated by Alicia Torregrosa who leads the weekly team meetings and also organized and hosted a 4-day working session, April 3 – 6, at the U.S. Geological Survey, Menlo Park, CA. See appended list for fog team participants.

2) Synthesis of existing knowledge

The core team began the process of synthesizing and integrating existing "fog knowledge" by each presenting research in webinar format to the rest of the team during hour long weekly team meetings. The webinars were highly interactive and were recorded and archived. They have been especially useful for new members to get up to speed quickly with the team's common knowledge base and also for review by team members from other disciplines. The main areas of synthesis are relationships between satellite-derived measures of coastal fog and those factors that drive its formation, distribution, and duration that can be quantified through meteorological or oceanographic observations. The 4-day working session was an opportunity for in-depth discussion that led to a comprehensive set of research goals. See appended workshop agenda. A workshop summary is being prepared.

3) Compilation of existing datasets

Four satellite-derived fog cover datasets are forming the core of the space-based observations of fog: GOES, AVHRR, MODIS, and Landsat. The project was extremely fortunate that Cindy Combs (Cooperative Institute for Research in the Atmosphere, Colorado State University) had already spent nearly 4 years processing the GOES weather satellite data archive into a coastal fog cover dataset for 1999 – 2009. Data retrieval earlier in the archive will require additional quality control to address severe problems with geolocational accuracy. The dataset is in an atmospheric research file format (McIdas area files) with coverage extending from Eureka to Monterey on a 4 km grid at an hourly basis. Significant filtering based on reflectance thresholds has resulted in a very high quality product. Conversion into a GIS ingestible format will occur after decisions have been finalized regarding the most scientifically defensible indices to use. Issues the team is addressing are the cyclical nature of fog events and the correlation with known oceanic patterns such as El Niño Southern Oscillation and Pacific Decadal Oscillation. Also fortunate for the project was the cloud cover dataset that Eric Waller (UC Berkeley) has recently completed from the 1 km MODIS archive of 2000 – 2010. Although the spatial extent of Waller's dataset is centered on the Central Valley, it does extend to the coast with daily cloud cover estimates. The Landsat archive is the least frequent (once every 16 years) but has remarkable signal coherence on an annual basis with airport visibility data provided by Jim Johnstone (Univ Washington). Torregrosa is developing a fourier-transform-based statistical method to assess the correspondence between these different frequencies (e.g. hourly, daily, biweekly). Ocean and meteorology datasets are routinely collected and made available in relatively accessible form by NOAA and are being collected from NOAA websites as the statistical and research need arises.

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4) Presentations at national scientific meetings
October 6 – 11, 2012, National Weather Association, 37th Annual Meeting, Madison WI. Poster, Ellrod, Torregrosa, Combs
December 3 – 7, 2012, American Geophyscial Union, 45th Annual Meeting, San Francisco, CA. Coastal Fog Oral and Poster Session. Conveners: Torregrosa, O'Brien, Faloona, Still
January 6 – 10, 2012, American Meteorological Society, 93rd Annual Meeting, Austin, TX. Poster, Ellrod, Torregrosa, Combs

5) Fog sensor pilot study
During the April workshop, ground-based measurements of fog along an elevational gradient was identified as a major research need to enable an analysis into the relationship between the satellite signal of fog and the meteorological and oceangraphic events best correlated to the fog events picked up by the satellite. To address this need a pilot field-based fog monitoring pilot was instituted under the leadership of Ismail Gultepe, a cloud physicist based with Environment Canada. Environment Canada generously loaned two fog sensors capable of measuring particle density giving estimates of liquid water content of localized fog. After consideration of several sites the team decided on 1) Bodega Marine Laboratory (BML) as the ocean site so as to co-locate the sensor with the large array of other sensors managed by UC Davis and NOAA and 2) Pepperwood Preserve as the inland site 50 km from the Pacific Ocean and ~ 350 m higher. The two sensors were deployed by Torregrosa, Marcel Losekoot (technical spcialist, BML), Dave Anderson (technical specialist, Pepperwood), Rob Reed (technical specialist, Environment Canada), Paulo Paes (student, UC Davis). Others on the research team include Professor Ian Faloona (UC Davis atmospheric scientist focusing on boundary layer dynamics), and his two UC Davis students who have been investigating synoptic weather and ocean conditions, vertical atmospheric profiles, and fog model forecast. In July the project was also joined by Dr. Peter Weiss of UC Santa Cruz who recently published a landmark article on mercury concentrations in fog. As our fog monitoring continues we will be making collected fog drip samples available to Dr. Weiss for analysis. Lessons learned from the pilot will be applied to an expanded fog monitoring network to be proposed for summer 2013.