Training Course on Climate, Drought, and Remote Sensing

The 2-day course is designed for the California Department of Water Resources and its federal, state, and local partners. About 40 attendees are anticipated, with backgrounds in engineering, hydrology, meteorology, and water management. The course is sponsored by National Integrated Drought Information System (NIDIS), NOAA National Weather Service Climate Services Division (NWS CSD), U.S. Geological Survey (USGS), and California Department of Water Resources.

The course goal is to elevate level of understanding of climate variability (especially drought) and change, modeling, and remote sensing with special emphasis for impacts on hydrologic variables and water resources. The course will focus in the following areas:
(1) The difference between climate and weather
(2) Remote sensing and modeling of drought-relevant variables like snow pack, soil moisture, evapotranspiration, and vegetation
(3) An overview of current and planned satellite missions, their products, and how to access them
(4) Dynamics, physical mechanisms, and impacts of climate variability phenomena including Madden Julian Oscillation (MJO), El Nino / La Nina, tropical forcing, and teleconnections
(5) Performance of the climate forecast products, limitations, and resources supplementing the forecasts
(6) The climate change modeling and downscaling tools

Expected specific outcomes

Each trainee, upon completion of the training, should be able to:

- Understand and explain the difference between climate and weather
- Understand and explain primary physical mechanisms of the following climate variability phenomena: oscillations (including El Nino /La Nina, MJO, North Atlantic Oscillation) and teleconnection indices
- Understand the basic physical principles of optical, thermal, and microwave (passive and active) satellite remote sensing
- Know the range of satellite remote sensing missions that are active or scheduled for launch in the near future
- Know how to find and access remote sensing products of interest
- Understand and explain the impacts on U.S. climate of such features as drought, ENSO, MJO, etc.
- Know where and when the climate forecast is skillful and what resources are available to supplement the climate forecast limits
- Become familiar with principles used for general circulation modeling and regional and local climate downscaling, results, and applications

Agenda for 2- Day Climate Course for CA Department of Water Resources

Remote Sensing Topics Climate Topics

Wednesday, June 17, 2009	
8:00 a.m.	**Welcome (10m)** Jeanine Jones, CA DWR
8:10 a.m.	**Introduction** Dr. Ahsha Tribble, NOAA NWS *Overview of the course purpose, scope and expected outcomes*
8:30 – 9:10	**Review of climate physics (40 m)** Mike Staudenmaier, NOAA NWS *Overview of basic physical mechanisms of climate systems, weather-climate scales, climate variability, anomalies, and teleconnections*
9:10 – 9:50	**Review of the Physics of Remote Sensing (40m)** James Verdin, NIDIS *Overview of the electromagnetic spectrum, radiation principles (sources, atmospheric interactions, earth surface interactions), satellite data acquisition, and product generation*
9:50 – 10:15	Break
10:15 -11:15	**Drought science (1h)** Kelly Redmond, WRCC *Physical Mechanism, Predictability, Predictions, Impacts*
11:15 – 12:15	**Review of Satellite Remote Sensing Missions**, James Verdin, NIDIS *Overview of Earth observation instruments in orbit and planned; the targets, frequency and resolution the observations; and the available products and how to access them.*
12:15 – 1:15	Lunch
1:15 – 2:15	**National Snow Analyses (1h)**, Don Cline, NWS/NOHRSC *Use of remote sensing in a snow data assimilation system; daily analyses of snow water equivalent, maps, and web visualization tools; overview of available products and how to access them.*
2:15	Break
2:30– 3:30	**Soil Moisture and Land Data Assimilation Systems** (1h) John D. Bolten, NASA *Why SM is important? Estimates of surface wetness and soil moisture from microwave remote sensing systems, and their limitations; assimilation of remote sensing data to model soil moisture; the upcoming NASA Soil Moisture Active and Passive (SMAP) mission. SCAN products, GRACE products*
3:30	Break
3:45 – 4:45	**Evapotranspiration Estimates Using Remotely Sensed Land Surface Temperature (1h)** Byron Clark, SEBAL North America, Davis, California *Energy balance solutions using land surface temperatures from thermal infrared imagery to estimate latent heat fluxes over crops and rangelands. Review of different techniques and scale of products at 100 m*
4:45	**1st Day summary** James Verdin
5:00	Free time

Thursday, June 18, 2009	
8:00 – 9:00	**Review of Climate Variability Phenomena (1h):** Kelly Redmond, WRCC *ENSO (ONI, SOI, MEI, etc.), PDO, NAO/AO, PNA, QBO, Physical Mechanism, Impacts, Predictability, Predictions*
9:00 – 9:15	Break
9:45 – 10:15	**Sub-seasonal Tropical-Extratropical Variability: Madden – Julian Oscillation (MJO, 1 h):** Jon Gottschalk, NOAA NWS *Physical Mechanism, Predictability, Predictions, Impacts*
10:15 – 10:30	Break
10:30 – 11:15	**Climate forecast skill, limitations (45min)** Marina Timofeyeva, NOAA NWS *Climate forecast verification 101, when and where CPC climate forecasts are useful*
11:15 – 12:00	**NWS resources to supplement the forecast information (45 min)** Kelly Redmond, WRCC *CA climate historical data products, quality, availability, resources, examples of applications*
12:00 – 1:00	Lunch
1:00 – 2:00	**Hydrology and Climate Interaction (1 h)** Kevin Werner, NOAA NWS *Water resources and Climate Variability and Change, Hydro variables trends, Sensitivity studies*
2:00 – 2:15	Break
2:15 – 3:15	**General Circulation Modeling (1h)** Phil Duffy, Climate Central, Palo Alto, CA *General principles, forcing, modeling experiments, applications, projections*
3:15 – 3:30	Break
3:30 – 4:00	**Downscaling to Local Climate (0.5 h):** Mike Dettinger, USGS *General principles, available methods, desired applications*
4:00 – 5:00	**Discussion (1h):** Ahsha Tribble, NOAA NWS *What NOAA sees as priorities for climate applications to hydrology, data acquisitions and application, direction of where we are going, interaction with audience, feeding WR information to NOAA climate activities*
5:00	Adjourn

COURSE LOCATION:
California Department of Water Resources (CA DWR) training facility
San Joaquin/Castaic room
1721 13th Street (13th and R Streets), Sacramento, CA

DWR Training Center Map

PARKING LOT INFORMATION			
1A **STATE OWNED** Hours 6:00 AM - 7:00 PM	**2A** **CITY OWNED** Open 24 Hours	**2B** **CITY OWNED** Open 24 Hours	**3** **PRIVATELY OWNED** Hours Vary

Parking at the site is unfortunately very limited. (Please do not to park in the adjacent warehouse lot, or they will be ticketed. The lot is posted no parking.) On street spaces are difficult to come by, so locations of nearest parking garages are marked as 1A.

Team of instructors:
Ahsha Tribble, NWS
Michael Staudenmaier, NWS
Byron Clark, SEBAL North America, Davis, California
Don Cline, NWS/NOHRSC
Jon Gottschalk, NWS/CPC
Mike Dettinger, CA RISA
Kelly Redmond, WRCC
Alan Haynes, NWS RFC
Kevin Werner, NWS RFC
Phil Duffy, Climate Central, Palo Alto, CA
Local NWS WFO/RFC staff
Marina Timofeyeva and Jim Verdin, course coordinators and instructors
John D. Bolten, Ph.D.; Hydrological Sciences Branch, Code 614.3; NASA