FY 2013/2014 Implementation of the U.S. Integrated Ocean Observing System (IOOS)
Southern California Coastal Ocean Observing System (SCCOOS)
National Oceanographic Partnership Program Report:
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1) PROJECT SUMMARY

The Southern California Coastal Ocean Observing System (SCCOOS) is one of eleven regions that contribute to the national U.S. Integrated Ocean Observing System (IOOS®). The regional observing systems work to collect, integrate, and deliver coastal and ocean observations in order to improve safety, enhance the economy, and protect the environment. The primary goal of SCCOOS is to provide the scientific data and information needed to inform decision-making and better understand the changing conditions of the coastal ocean in Southern California. SCCOOS has aligned its priorities and objectives with the focus areas designated by U.S. Integrated Ocean Observing System (IOOS®), as identified by users and stakeholders throughout the nation.

- **Ecosystems and Climate:** to monitor ocean climate trends and environmental changes in the Southern California Bight by collecting physical, chemical, and biological variables.
- **Water Quality:** to provide monitoring, tracking, and prediction tools for harmful algal blooms, outfall and storm water plumes, and surf zone contaminants.
- **Marine Operations:** to advance integrated, customized products that are critical for safe and efficient navigation, search and rescue, and oil spill response.
- **Coastal Hazards:** to provide accurate, validated inundation models and information with the long-term goal of improving coastal safety.
- **Science Education and Communication:** to provide a way for the public to learn, educate, and promote scientific research using data obtained from SCCOOS.

2) PROGRESS AND ACCOMPLISHMENTS

SCCOOS continues to have the ability to achieve its milestones by providing access to high-quality integrated data and support regional user needs while complying with the standards and protocols for sharing and archiving data that are developed nationally. SCCOOS actively participates in IOOS Data Management efforts such as the Thematic Real-Time Environmental Distributed Data Services (THREDDS). By leveraging the Coastal Data Information Program (CDIP) and the HF Radar National Network programs, SCCOOS will target THREDDS distribution for both wave and surface current data. SCCOOS participants also contribute to ongoing efforts to develop quality control standards for waves and HF radar-derived surface currents. Wave and current data have associated XML and FDGC compliant metadata.

The following goals/milestones have been met.

Ecosystems and Climate:

- Underwater glider surveys collect offshore measurements of temperature, salinity, chlorophyll, and current velocity. http://sccoos.org/data/spray/
- Add sensors for dissolved oxygen to gliders to monitor hypoxia and ocean acidification.
- As part of CalCOFI-LTER program, measure variables in nearshore region including temperature, salinity, zooplankton, phytoplankton, fish eggs and invertebrate larvae. http://sccoos.org/data/calcofi/
- Conduct shipboard observations three times yearly to count seabirds in conjunction with CalCOFI-LTER surveys. http://sccoos.org/data/seabirds/
- Meteorological stations provide wind speed and direction, air temperature, sea surface temperature, barometric pressure, humidity, and rainfall levels. http://sccoos.org/data/mets/

Water Quality:

- Monitor Harmful Algal Blooms (HABs) at five pier stations by collecting weekly measurements of temperature, salinity, chlorophyll, nutrients, and toxic species; distribute data and expand HABs website to include Central and Northern California. http://sccoos.org/data/habs/fullscreen.php
- Implement the 3-km California statewide ROMS ocean forecasting system for real-time operations and conduct a systematic validation of the model. http://sccoos.org/data/roms-3km/
- Provide HF radar-based trajectory tracking tool for Tijuana River Plume http://sccoos.org/data/tracking/IB/

Marine Operations:

- The live feed of HF radar data is maintained through the national HFR network for oil and hazardous spill response in the multiple applications such as the Environmental Response Management Application® (ERMA) map viewer for the southwest region; the General NOAA Operational Modeling Environment (GNOME) for oil spill trajectory analysis; and the National Preparedness for Response Exercise Program (NPREP) drill scenarios led by the U.S. Coast Guard in San Diego, Los Angeles, and Ventura.

- Customized and expanded interactive map displays of wind, wave, and surface currents with multi-layered views of observations, nowcasts, and forecasts are maintained for Naval Air Systems Command (NAVAIR), Point Mugu. http://sccoos.org/projects/navair/
- The customized, interactive map display of ocean conditions and forecasts for the Port of San Diego, Los Angeles and Long Beach Harbor is used to improve navigation, safety, and efficiency for commercial vessels, harbor pilots, and port operations. http://sccoos.org/data/harbors/
- NOAA CO-OPS integrated High Frequency Radar surface currents into their Tides & Currents Product http://tidesandcurrents.noaa.gov/hfradar/

Coastal Hazards:

- Validate and refine inundation models based on surveys of beach sand and water levels http://sccoos.ucsd.edu/projects/2010CardiffErosion/.
- EPA Region 9 is automating NetCDF conversion into ArcGIS for developing applications related to the Coast of California.

Science Education and Communication

- SCCOOS science education and communication were uploaded to the IOOS Cloud entitled 2012-2014 Inventory: Education, Outreach, and Training Resources https://docs.google.com/spreadsheets/d/1xsgY6Qz1ldwsotma1nmRLWVsJne5BWnt0J6qQZi9_Xk/edit#gid=16

U.S. IOOS regional awards were finalized by the National Oceanic and Atmospheric Administration (NOAA) in late August 2011, so work on this award is still ongoing.

Ecosystems and Climate

- Long-term time series of physical, biological, and chemical ocean data are critical in monitoring climate trends and determining ecosystem health. Physical and ecological ocean patterns and processes constitute valuable information for Coastal and Marine Spatial Planning and marine protected areas monitoring. Under the auspices of SCCOOS, the California Current Ecosystem Long Term Ecological Research (CCE_LTER) program, and in conjunction with the California Cooperative Ocean Fisheries Investigation (CalCOFI), the distribution and abundance of seabirds during 3 seasonal surveys were studied. http://sccoos.org/data/seabirds/
- Publish survey reports and maps of species' distribution and abundance on SCCOOS web site with links to individual hydrographic data reports. http://sccoos.org/data/calcofi/
- Operate, support, and maintain network of three glider lines to collect measurements of temperature, salinity, chlorophyll, current velocity, and acoustic backscatter; deliver data to SCCOOS website and push to modeling centers. http://sccoos.org/data/spray/
- The integration of dissolved oxygen sensors on the gliders is proceeding for the purpose of monitoring hypoxia in coastal waters. The dissolved oxygen (DO) data also allow an estimate of parameters relevant to ocean acidification through proxy relationships. Using relationships developed by scientists at Scripps Institution of Oceanography, NOAA Pacific Marine Environmental Laboratory, Universidad Autonoma de Baja California, and University of Washington, the glider data have been used to estimate pH and aragonite saturation. Aragonite is important to organisms that form shells, as saturation levels below one may lead to dissolution of the shells. Due to SeaBird changing its DO sensor that was developed for our Spray glider the DO plots will be absent from SCCOOS data. Currently Dan Rudnick's group is developing new protocols and tests to ensure that the new DO sensor design will work with current set up.
- The automated shore stations program has been able to operate all 4 stations (Scripps Pier, Newport Pier, Santa Monica Pier and Santa Barbara Pier) over the last year and provide real-time continuous data at 1-4 minute intervals with limited interruptions. Real-time coastal measurements of temperature, salinity and fluorescence. The automated shore station data are one of the most requested data sets provided through SCCOOS. These data are used by the public and local state and research agencies to

assess local conditions related to water quality, nearshore processes, population dynamics of coastal species and harmful algal blooms. Data collected at these stations includes temperature, salinity, fluorescence, and pressure. Calibration samples have been collected during cleaning and service dives, however incorporation of these data quality checks is not feasible at the current funding level. http://sccoos.org/data/autoshorestations/autoshorestations.php

- Collaboration with the Orange County Sanitation District (OCSD) to improve data quality at Newport Beach Pier Automated Shore Station. Real-time measurements of temperature, salinity and fluorescence provide current resources for evaluating coastal conditions of water quality and potential harmful algal blooms. Over the last year, data quality has improved by funding additional service dives to clean sensors and the purchase of new fluorimeters. http://sccoos.ucsd.edu/data/autoshorestations/?project=Shore%20Stations&study=Newport%20Pier
- SCCOOS is working closely with staff from the California Ocean Science Trust's Marine Protected Area Monitoring Enterprise on the development and successful execution of a monitoring program for Southern California's newly established network of marine protected areas.

Water Quality

- Accurate forecasts, measurements, and reports of water quality, for coastal pollutants and harmful algal blooms, inform beach closures and warnings which can affect tourism revenue and the local economy.
- Tracking impacted or polluted sources such as rivers and sewage outfalls can influence public health and ecosystem health (Areas of Special Biological Significance and marine protected areas). http://sccoos.org/data/asbs/?p=20
- SCCOOS continues to provide HF radar-based trajectory tracking tool for Tijuana River Plume which is accessed on a daily basis by users such as lifeguards, Department of Environmental Health, and local surfers/beach goers. http://sccoos.org/data/tracking/IB/
- Conduct a systematic validation of the 3-km California statewide ROMS ocean forecasting system for real-time operations. A manuscript describing the 3-kn CA ROMS validation is in progress.
- The SCCOOS HAB program contributes to the statewide HAB Monitoring and Alert Program (HABMAP - http://www.habmap.info/) initiated by NOAA, the California Ocean Science Trust, and the Southern California Coastal Water Research Project (SCCWRP). The HAB program generates a baseline time-series of ocean properties to monitor ocean conditions and harmful algal blooms in the very near shore zone of the Southern California Bight. These measurements are used to inform the public and statewide agencies of current harmful algal blooms (HABs) that can impact human health, marine life, and recreational beach use. Furthermore, regional observations increase our knowledge of the sign, frequency, and magnitude of variation of temperature, salinity, density, nutrients, and harmful algal blooms.
- Weekly reports of HAB species and related water quality measurements and are provided to the California Department of Public Health; http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/Shellfish.aspx and the HAB Monitoring and Alert Program Group.
- Boat sampling *Pseudo-nitzscha* blooms that produce domoic acid are being monitored. The Caron lab is responsible for the analysis of domoic acid from the 5 SCCOOS HAB monitoring sites.
- Primary inorganic nutrients samples will be analyzed by Brzezinski's group at the Analytical Laboratory at the Marine Science Institute at the University of California, Santa Barbara for the 5 SCCOOS HAB monitoring sites.
- At UCLA analyses are ongoing for the nested fine-scale simulations with ROMS for waste-water effluent dispersal and dilution during Fall 2006 and for more general material dispersal throughout the Southern California Bight shelves during 2007-2008 (in collaboration with UCSB). The former study includes both the Hyperion Treatment Plant outfall in Santa Monica Bay and the Orange County Sanitation District outfall in San Pedro Bay, and it also includes alternative near-shore outfalls used when repairs are necessary (as happened in Fall, 2012, in Orange County and will happen soon for Santa Monica Bay). The dominant transport and mixing rates are controlled by mesoscale and submesoscale eddies. In all these effluent situations, the material stays mainly on the continental shelf and slope

beneath the surface, and for the near-shore outfall the material stays at the surface and close to the coast. Validation analyses are underway with USC glider measurements. Manuscripts have been submitted for publication (Uchiyama et al., 2013; Romero et al., 2013). A new study is being made of the space-time structure of shelf currents in the Bight in these simulations.

Marine Operations

- Ocean observing data can be used to inform and validate ocean models used by the military and federal agencies.
- SCCOOS continues to operate and maintain the network of short, medium, and long range HF radar systems and deliver data streams to the National HFR Network http://www.sccoos.org/data/hfrnet/.
    - Cal Poly HFR Operations and Maintenance update: Replaced housing enclosures at AGL1 and ARG1. Installed new TX and RX antenna along with cables at PTC1. Installed updated RX antenna and TX/RX cables at DCLR. Installed mac minis at all sites along with Ethernet power controller's to allow for remote restarts to decrease site downtime and travel time. Replaced all GPS antenna's at 9 Cal Poly sites. General maintenance of sites has been kept up.
- Customized, interactive map displays of ocean conditions with multilayer views of observations, nowcasts, and forecasts can improve navigation and safety for military regions and testing ranges.
- Customized, interactive map displays of ocean conditions can improve navigation, safety, and efficiency for commercial vessels, harbor pilots, and port operations.
- Implementation of ocean conditions, surface currents measured by the national HF radar network, and surface wind analyses can be used to aid in spill response operations and are also accessible by U.S. Coast Guard for search and rescue (SAR) applications using their Environmental Data Server.
- Glider data are provided to the Naval Oceanographic Office (NAVO) for assimilation into operational models.

Coastal Hazards

- Expand development and integration of inundation web site.
- Develop Shoreline inundation forecast, validation, and dissemination of warnings.
- Develop and distribute information about wave and tide-induced coastal inundation and erosion in southern California.
- Use surveys of sand levels on beaches and monitor storm inundations at selected locations to validate and refine coastal data and forecast models of erosion, flooding, and inundation levels can be used to protect and improve beaches, real estate, and highways.

3) SCOPE OF WORK

SCCOOS operates as a system of partnerships and projects that are facilitated by technical and programmatic staff. Organized by the four focus areas, the SCCOOS scientific and technical approach is based on a system of core ocean observing technologies and the delivery of useful data products and tools. System components include sub-surface ocean observations from underwater gliders, nearshore and coastal measurements, wave measurements and models, pier-based monitoring, satellite imagery, high frequency (HF) radar surface current mapping, and data assimilative ocean modeling. The projects described in this report represent the multi-disciplinary and collaborative efforts of the research teams that contribute data and information to SCCOOS.

4) PERSONNEL AND ORGANIZATION STRUCTURE

- SCCOOS has hired a new Public and Government Relations Coordinator, Jen McWhorter. She replaced Chris Cohen.

5) BUDGET ANALYSIS

In FY14/15, SCCOOS will continue its core observations and expand data products when possible within budget constraints. SCCOOS is also committed to contributing to larger ocean observing efforts regionally, nationally, and internationally.

Expenditures are progressing as expected, with no major discrepancies between actuals and budgeted on both the main award and the subawards.

6) ANNUAL SUPPLEMENTALS

Regional Ocean Governance Organization Activities

- SCCOOS participates in the Southern California Coastal Water Research Project Bight Regional Monitoring. The working groups that participate in for the Bight '13 Monitoring are:
  - Marine Protected Areas
  - Nutrients
- SCCOOS participates in the San Diego Harbor Safety Meetings for the ports of San Diego, Long Beach and Los Angeles throughout the year.
- SCOOS participates in the Southern California Beach Water Quality Workgroup meetings throughout the year.
- Throughout the year SCCOOS participates in the Tijuana River Valley Recovery Team meetings, the U.S. International Boundary Water Commission citizen's forum meetings, the West Coast National Marine Sanctuary Education and Outreach meetings, Marine Protected Areas Collaborative Meetings, and Maritime Alliance networking/informational meetings.
- Over the past year SCCOOS has participated in many discussions regarding supplementing research with ocean observations to save time, money, and to streamline strategic efforts. Examples of working groups are NOAA fisheries, NOAA Marine Mammals, Modeling, Harmful Algal Blooms forecasting, Ecological forecasting, Aquafarm collaboration, Oil Spill meetings and Acoustic Tagging Network activities.
- SCCOOS (alongside CeNCOOS and NANOOS) is participating in webinars, conference calls, and workshops to continue participation and further collaboration with the WCGA on Ocean Acidification and Marine Debris.

Efforts to Leverage IOOS Funding

- Each fiscal year SCCOOS uses its' award to support leveraged and collaborative programs. An explanation of these programs are;
  - SCCOOS supports Dan Rudnick's glider effort out of Scripps institution of Oceanography (SIO), where he maintains three continuous glider lines off the California coast since 2008 (http://www.sccoos.org/data/spray/?r=0). Through a cooperative agreement with U.S. IOOS, SCCOOS funds one continuous transect, and the other two are funded by the NOAA Ocean Climate Observation Program through the Consortium on the Ocean's role in Climate.

    Profiling gliders are rapidly becoming essential instruments for operational observing of the nation's coastal oceans and Great Lakes. Dan's gliders have contributed 14,797 of the 25,722 glider days (2008-2012) that contribute to the U.S. IOOS sustained subsurface observations. He plays a pivotal role as a steering committee member in the U.S. IOOS National Glider Network goal to expand program-level dialog on glider deployment and operation, community standards for data access and organization, as well as what the expansion paths toward a national capacity and availability.

    This dataset lead to the development of the SCCOOS SoCal Niño index. Using glider-measured temperatures at 50m along California Cooperative Oceanic Fisheries Investigations (CalCOFI) line 90 (line 90 is off Dana Point, California). The data is compared to NOAA's sea surface temperatures in their El Niño 3.4 region (http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/). The climate

prediction Center and the National Centers for Environmental Prediction (NCEP) prepares and updates regarding the El Niño Southern Oscillation (ENSO) Cycle. The two indices are remarkably correlated.

- SCCOOS funds 9 nearshore sampling stations (http://sccoos.ucsd.edu/data/cast/calcofi/) of California Cooperative Oceanic Fisheries Investigations (CalCOFI) 66 sampling stations. The focus of this study is the management of the marine environment off the coast of California, and its living resources monitoring the indicators of El Nino and climate change. Quarterly cruises are conducted off southern & central California, collecting a suite of hydrographic and biological data on station and underway.

  CalCOFI research is supported by contributions from the participating agencies: The California State Department of Fish and Game, NOAA, National Marine Fisheries Service, Southwest Fisheries Science Center, and the University of California, Integrative Oceanography Division at the Scripps Institution of Oceanography, UCSD.

- SCCOOS Leverages both CalCOFI and Seabird Surveys as sentinels of marine climate change via the Farallon Institute. Due to their existence at the boundary layers of the atmosphere and the ocean, seabirds are the most conspicuous of all marine organisms which rely on surface and near-surface ocean habitats. Seabirds also are less exploited than other upper level predators such as fish and mammals. Owing to these and other characteristics, seabirds have been put forth as reliable ecological indicators of coupled physical-ecological change. In this project we are investigating changes in the abundance, distribution, and spatial organization of seabirds in the California Current. In this study FI biologists make counts of seabirds from fisheries research vessels.

  The seabird data is valuable for several reasons:

  1. Information on seabird/mammal distribution and abundance provides an upper trophic level perspective which complements the hydrographic and lower trophic-level (plankton) data collected by others.
  2. Estimates of seabird/mammal distribution and abundance contributes to understanding the spatial ecology of these regions.
  3. By extending our existing records (May 1987-present off southern CA; May 1996-present off central-northern CA), these data contribute to understanding the effects of natural and anthropogenic climate variability on the southern and central sectors of the California Current ecosystem.

- SCCOOS leverages the national HF radar network (HFRNet) that provide surface currents in near real-time (http://www.sccoos.org/data/hfrnet/). This network is made up of more than 150 radars from 31 different institutions. They contribute their data to the HFRNet data management system, which is funded by U.S. IOOS and managed by CODRC (Eric Terrill's Lab) at Scripps institution of Oceanography (SIO) with aggregation nodes at SIO, the National Data Buoy Center (NDBC) and Rutgers University.

  The National HF Radar Network supports a number of applications such as coastal search and

rescue, oil spill response, water quality monitoring, and safe and efficient marine navigation. The data is used in operational applications within organizations such as the U.S. Coast Guard, NOAA Office of Restoration and Response, and CA Office of Spill Prevention and Response.

- SCCOOS leverages the California Data and Information program (CDIP) mission is to monitor and predict nearshore waves and shoreline change (http://www.sccoos.org/data/waves/?r=0). The program has deployed over 130 wave stations, has archived over 100GB of wave data, and disseminates these data in near real time via the CDIP website, National Data Buoy Center, and the National Weather Service radio broadcasts.

  CDIP is primarily funded by the U.S. Army Corps of Engineers in support of planning and design of structures and beach nourishment projects and considers this funding their main contribution to the U.S. IOOS. This resource is accessed by over 6,000 sites daily by the Navy, Marines, Coast Guard, coastal planners and managers, maritime pilots, commercial fisherman, recreational boaters, and beach-goers.

- SCCOOS leverages the Marine Mammal Center by displaying their marine mammal health map on the SCCOOS site (http://sccoos.org/projects/mmhealth/). The goal of this project is to develop a national marine mammal health tracking program that is web-based and readily accessible to scientists, managers and the general public. This will allow detection of spatial and temporal changes in marine mammal health that will enable early prioritization of management and conservation efforts to mitigate mortality and identify potential public health risks. In addition, this project will potentially contribute to the detection of climate change impacts on marine mammal health.

- SCCOOS visualizes AIS ship tracking by leveraging the Southern California Marine Exchange and NOAA Office of Coast Survey.

- SCCOOS visualizes meteorological observations by leveraging National Oceanic and Atmospheric Administration (NOAA) Research (Oceanic and Atmospheric Research) Earth System Research Laboratory (ESRL) Global Systems Division (GSD) developed the Meteorological Assimilation Data Ingest System (MADIS) to collect, integrate, quality control (QC), and distribute observations from NOAA and non-NOAA organizations.

- SCCOOS visualizes satellite ocean data by leveraging NASA jet propulsion laboratory.

- SCCOOS visualizes modelled wind and rain nowcasts and forecasts by leveraging The COAMPS® model is a product of NRL: The Naval Research Laboratory's Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS®). COAMPS® is produced by NRL Monterey and accessed through the US Global Ocean Data Assimilation Experiment (USGODAE).

- SCCOOS visualizes west coast Ocean Acidification by leveraging the west coast shellfish industry, AOOS, NANOOS and CeNCOOS.

- SCCOOS facilitated the NE Pacific Anomalies Science and Technology Workshop on May 5 & 6, 2015 by leveraged support from NOAA/IOOS, NOAA Ocean Climate Observation Program, SeaGrant California, Scripps Institution of Oceanography, The California-Nevada Application

Program, a NOAA Regional Integrated Sciences and Assessments (RISA) program and The Southwest Climate Science Center.

- SCCOOS and CeNCOOS leveraged their assets with oil spill prevention and response office efforts to create a webpage that integrated all assets, notifications and updates related to the Refugio Oil Spill that began on May 19 and continues to in the clean up process.

Updates to RA Governance Board Membership

Region	Type of Governance	Distribution of Governance Board Membership								Total Number of Governance Committee Members
		Government				Non-Government			Foreign (all sectors)	
		State	Local	Tribal	Federal	Research Institute	Industry	NGO		
SCCOOS	MOU	8	9	0	12	11	1	1	1	43

- Mas Dojiri, the manager of the City of Los Angeles Sanitation District's Environmental Monitoring Division joined the SCCOOS Board of Governors.
- Bruce Cornuelle, a research oceanographer head with oceans, atmosphere section at Scripps Institution of Oceanography joined the SCCOOS Board of Governors.
- Captain Kip Louttit, the executive director of the Southern California Marine Exchange joined the SCCOOS Board of Governors.
- Cisco Werner, the director of research at NOAA's Southwest Science Fisheries Center joined the SCCOOS Board of Governors.
- Michael Jones, the director of the Maritime Institute joined the SCCOOS BoG.
- Clare Waldmann, from the California Ocean Protection Council, was removed from the SCCOOS/CeNCOOS Joint Strategic Advisory Committee (JSAC).
- Brian Aldrich, with the U.S. Coast Guard has retired and was removed from the SCCOOS/CeNCOOS Joint Strategic Advisory Committee (JSAC). Once is replacement is announced we will solicit his successor to consider joining our JSAC.
- John Orcutt, a distinguished professor of geophysics and the San Diego Supercomputer has been removed from SCCOOS's Board of Governors and the Board executive Committee.

Governance Activities and Accomplishments

- SCCOOS has facilitated and participated many governance meetings over the last 6 months;
  - SCCOOS program meeting in preparation for our next 5 year proposal – January 20 & 21, 2015
  - CeNCOOS/SCCOOS data management meeting – February 3, 2015
  - IOOS Spring Meeting – March 2-6, 2015
  - Scripps Institution of Oceanography Shore Station meeting – March 19, 2015
  - CeNCOOS/SCCOOS Modeling meeting – March 23, 2015
  - Board Executive Committee Meeting – April 21, 2015
  - IOOS DMAC meeting May 26-29, 2015
  - IOOS Glider DAC review – May 27, 2015
  - Executive Steering Team meeting – June 3, 2015

Education and Outreach Activities

- SCCOOS participates in education and outreach activities throughout the year. The list of activities for FY 14/15 are at, https://docs.google.com/a/noaa.gov/spreadsheet/ccc?key=0Ar1oUzIQ8DBVdHFQTXk2RThlWFVsdkVIYW5qWUUwNkE&usp=sharing