NOAA Scientific Publications Report
July 21, 2014

Highlighted Articles

Rapid subsurface warming and circulation changes of Antarctic coastal waters by poleward shifting winds

PERSIANN-CDR: daily precipitation climate data record from multi-satellite observations for hydrological and climate studies

Additional Articles

Persistent organic pollutants in forage fish preyed upon by rhinoceros auklets breeding in Puget Sound and the northern California Current

Comparison of potential increases in juvenile salmonid rearing habitat capacity among alternative restoration scenarios, Trinity River, California

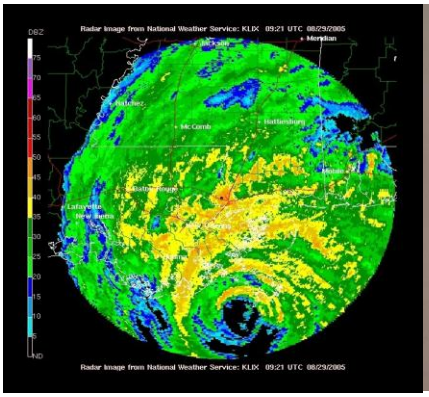
The use of satellite tags to redefine movement patterns of spiny dogfish (*Squalus acanthias*) along the U.S. east coast: implications for fisheries management

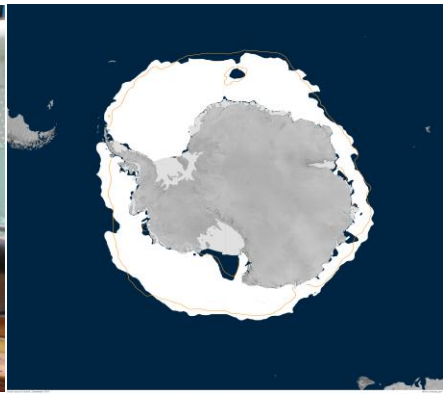
Landscape factors affect the genetic population structure of *Oncorhynchus mykiss* populations in Hood Canal, Washington

Using aerogravity to produce a refined vertical datum

Standardizing compositional data for stock assessment

Energy content of pacific salmon as prey of northern and southern resident killer whales





NOAA SCIENTIFIC PUBLICATIONS REPORT
JULY 21, 2014

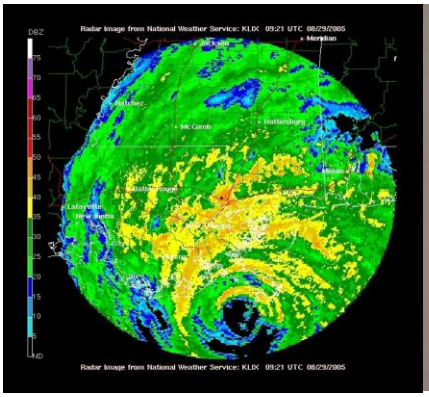
HIGHLIGHTED ARTICLES

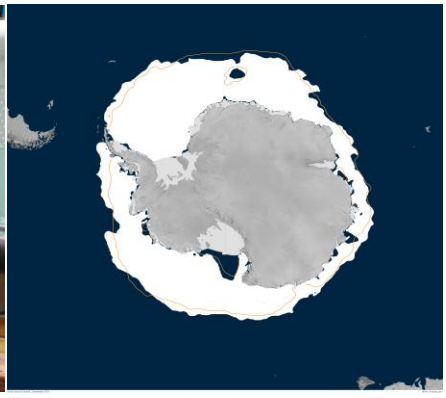
Rapid subsurface warming and circulation changes of Antarctic coastal waters by poleward shifting winds
Geophysical Research Letters
P. Spence, **S. M. Griffies (OAR/GFDL)**, M. H. England, A. M. Hogg, O. A. Saenko, and N. C. Jourdain

- Through model simulation, this study shows that anthropogenically induced wind changes can dramatically increase the temperature of ocean water at ice sheet grounding lines and at the base of floating ice shelves around Antarctica, with potentially significant ramifications for global sea level rise.
- Within a few years, warming of subsurface coastal waters could exceed 2°C at 200-700m depth.

The southern hemisphere mid-latitude westerly winds have been strengthening and shifting poleward since the 1950s, and this wind trend is projected to persist through the 21st Century under continued anthropogenic forcing. This study shows that within a few years, a poleward wind shift at the latitudes of the Antarctic Peninsula can produce an intense near-circumpolar warming of subsurface coastal waters that exceeds 2°C at 200-700m depth. The model-simulated warming is associated with weakened coastal currents. The intrusion of warm ocean water onto the Antarctic continental shelf causes increased melt rates at the base of floating ice shelves, a retreat of ice sheet grounding lines, and increased ice sheet discharge.
Expected Publication Date: August 2014

PERSIANN-CDR: daily precipitation climate data record from multi-satellite observations for hydrological and climate studies
H. Ashouri, K. Hsu, S. Sorooshian, D. K. Braithwaite, **K. R. Knapp**, **L. D. Cecil**, **B. R. Nelson**, and **O. P. Prat (NESDIS/NCDC)**





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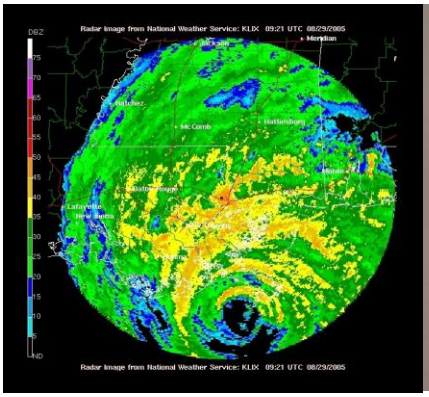
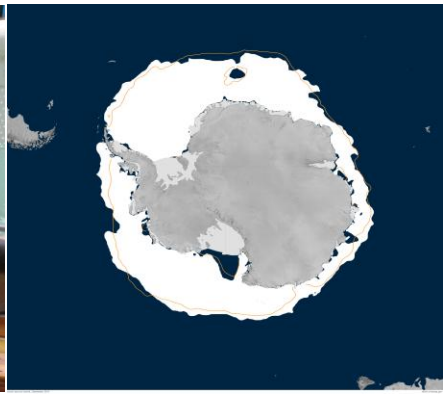
Bulletin of the American Meteorological Society

- This paper describes the development of a new near global (60°S-60°N,) long-term (1980-2013), multi-satellite, high-resolution precipitation dataset that provides rain-rate estimates at 0.25° and daily spatiotemporal resolution.
- This dataset will be valuable for precipitation climate variability studies, especially the study of extreme precipitation events that have occurred over the past three decades and regional and global long-term hydro-climate studies.
- Validation studies show good agreement with National Centers for Environmental Prediction (NCEP) Stage IV precipitation analyses, gauge observations, probability density functions extracted from the Climate Prediction Center (CPC) gauge data, and the Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA) precipitation product.

This paper presents a new retrospective satellite-based precipitation dataset developed as a climate data record for hydrological and climate studies. The Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks-Climate Data Record (PERSIANN-CDR) is a near global (60°S-60°N) long-term (1980-2013), multi-satellite, high-resolution precipitation product that provides rain-rate estimates at 0.25° and daily spatiotemporal resolution. PERSIANN-CDR is aimed at addressing the need for a consistent, long-term, high-resolution precipitation dataset for studying precipitation variability and trends, especially extreme precipitation events, over the past three decades. PERSIANN-CDR is generated from the PERSIANN algorithm using GridSat-B1 infrared data. PERSIANN-CDR is adjusted using the Global Precipitation Climatology Project (GPCP) monthly estimates to maintain consistency of two datasets at 2.5° monthly scale throughout the entire reconstruction period. PERSIANN-CDR daily precipitation data demonstrates considerable consistency with both GPCP monthly and GPCP one-degree daily (GPCP-1DD) precipitation products. Verification studies for Hurricane Katrina show that PERSIANN-CDR has a good agreement with the National Centers for Environmental Prediction (NCEP) Stage IV precipitation analysis,





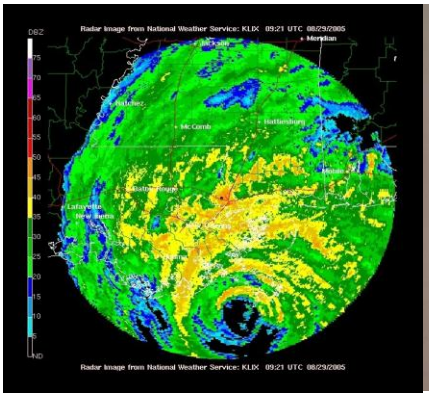
noting that PERSIANN-CDR has more complete spatial coverage than the radar data. In addition, validation of PERSIANN-CDR against gauge observation during the 1986 Sydney flood in Australia shows the capability of PERSIANN-CDR in providing rainfall estimates during the pre-1997 period. Moreover, the Probability Density Function (PDF) of the PERSIANN-CDR over the contiguous United States (CONUS) was compared with the PDFs extracted from the Climate Prediction Center (CPC) gauge data and the Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA) precipitation product. The comparison also shows good agreement of the PDF of PERSIANN-CDR with the PDFs of TMPA and CPC gauge data. The results indicate strong potential for using PERSIANN-CDR for long-term hydro-climate studies in regional and global scales.
Expected Publication Date: 2015

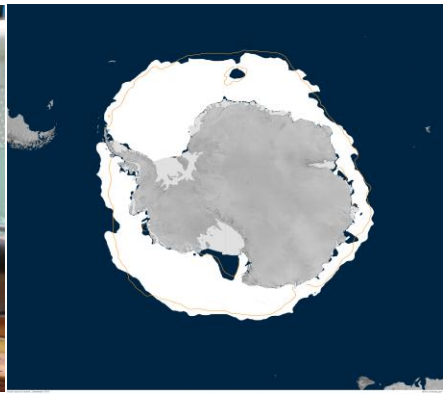
ADDITIONAL ARTICLES

Persistent organic pollutants in forage fish preyed upon by rhinoceros auklets breeding in Puget Sound and the northern California Current
Marine Pollution Bulletin
T. P. Good, S. F. Pearson, P. J. Hodum, **D. Boyd**, **B. F. Anulacion**, and **G. M. Ylitalo (NMFS/NWFSC)**

- This study demonstrates the contaminant levels in important mid-trophic level forage fish.
- This research also suggests that contaminant levels in resident breeding marine birds may be important.

Organochlorine contaminants in upper trophic-level consumers inhabiting Puget Sound are consistently higher than in those consumers inhabiting other locations on the same coast. They analyzed persistent organic pollutants (POPs) in prey obtained from rhinoceros auklets on Protection Island (Puget Sound), Tatoosh Island (WA coast), and Destruction Island (WA



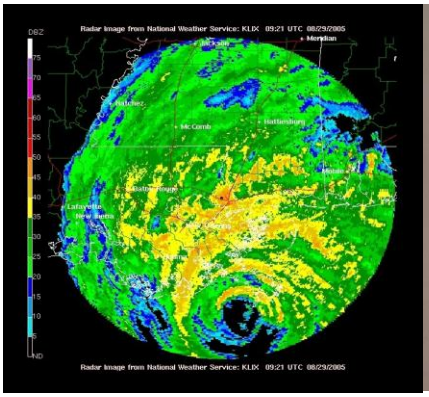


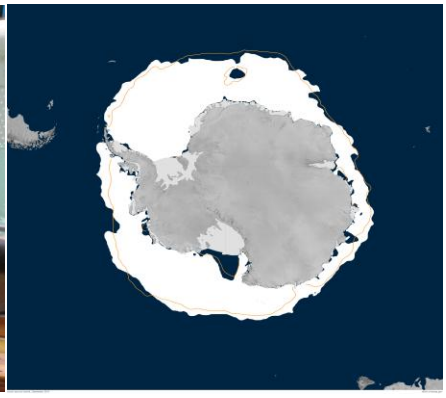
coast). They measured levels of POPs in the six most common fish prey delivered to auklet chicks. Overall, concentrations of PCBs, DDTs, and PBDEs in fish from Puget Sound were 2-4 times more contaminated and had similar contaminant profiles compared to fish from the outer coast. Elevated PCB and PBDE concentrations in Chinook salmon from the outer coast likely reflected Columbia River influences. Monitoring of breeding auklets, their prey, and other resident marine birds is needed to assess biomagnification impacts in the Puget Sound marine ecosystem.
Expected Publication Date: Fall 2014

Comparison of potential increases in juvenile salmonid rearing habitat capacity among alternative restoration scenarios, Trinity River, California
Restoration Ecology
T. J. Beechie, **G. R. Pess**, **H. Imaki**, A. Martin, J. Alvarez, and D. Goodman
(NMFS/NWFSC)

- Quantitative analyses of potential biological responses to alternative restoration scenarios can inform restoration planning and help set realistic expectations for restoration outcomes.
- Alternatives analysis can help to determine whether planned actions can achieve a desired ecological benefit, or whether additional actions might be required to achieve restoration goals.
- Achieving large increases in habitat capacity and fish abundance through habitat restoration will likely require substantial restoration effort.

River restoration plans often propose numerous rehabilitation actions to address key habitat impairments for salmonids. However, restoration plans rarely attempt to quantify the potential benefits of alternative sets of actions for targeted biota. In this paper, the Authors used geomorphic and biological analyses to estimate restoration potential under three restoration scenarios for a 64-km section of Trinity River, California from the North Fork Trinity River to



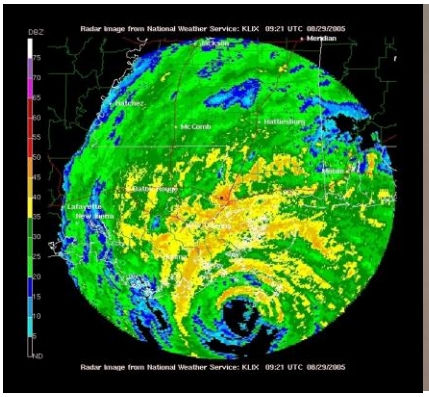


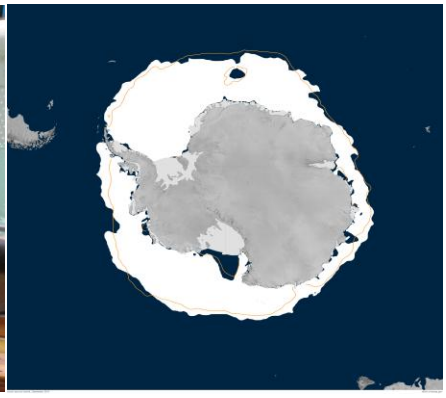
Lewiston Dam (the focus of habitat rehabilitation efforts under the Trinity River Restoration Program). For each scenario, the Authors used existing stream habitat and juvenile salmonid data from previous studies to estimate improvement in fry or pre-smolt production potential. The potential increase in Chinook and steelhead fry rearing capacity was 62% and 67% %, respectively, for Scenario 1 (a relatively realistic estimate of increasing low velocity areas with cover), and 36% and 44% for Scenario 2 (increasing rearing capacity by increasing sinuosity and side-channel length). Only the most optimistic Scenario 3 (combining Scenarios 1 and 2 to increase both habitat quality and rearing capacity) more than doubles potential juvenile salmonid production (112% increase). These quantitative predictions provide a frame of reference for evaluating alternative restoration options, and for setting measurable restoration goals.
Expected Publication Date: Fall 2014

*The use of satellite tags to redefine movement patterns of spiny dogfish (*Squalus acanthias*) along the U.S. east coast: Implications for fisheries management*
PLOS One
A. E. Carlson, **E. R. Hoffmayer (NMFS/SEFSC)**, **C. A. Tribuzio (NOAA/AFSC)**, and J. A. Sulikowski

- Spiny dogfish migratory patterns in the western North Atlantic Ocean were redefined using popup satellite archival tags.
- Seasonal migration patterns were local in nature with sharks remaining relatively close to the two tag deployment locations.
- The sharks exhibited distinct diel patterns in vertical utilization suggesting that this species may not utilize the benthos as previously thought, potentially decreasing availability to benthic gear.

Spiny dogfish *(Squalus acanthias)* are assumed to be a highly migratory species, making habitual north-south migrations throughout their northwestern Atlantic United States (U.S.) range. Also

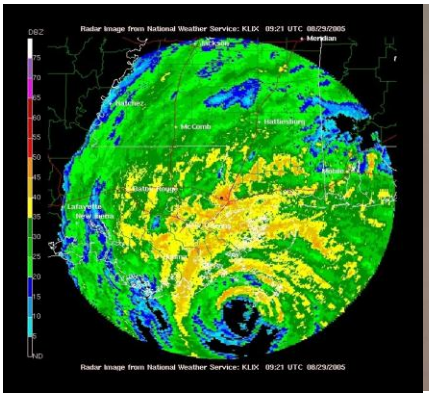


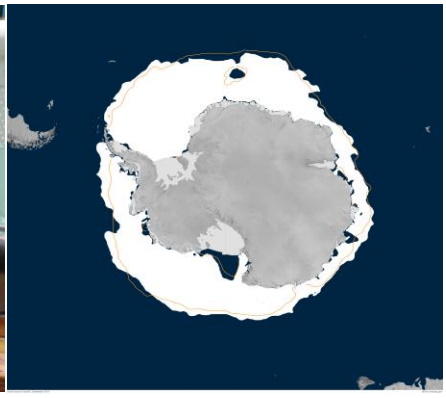


assumed to be a benthic species, spiny dogfish stock structure is estimated through Northeast Fisheries Science Center (NEFSC) bottom-trawl surveys. Recent anomalies in population trends, including a recent four-fold increase in estimated spawning stock biomass, suggest alternative movement patterns could exist for this shark species. To obtain a better understanding of the horizontal and vertical movement dynamics of this species, Microwave Telemetry pop-up satellite archival X-Tags were attached to forty adult spiny dogfish at the northern (Gulf of Maine) and southern (North Carolina) extents of their central U.S. geographic range. Reconstructed geolocation tracks ranging in lengths from two to 12 months suggest that the seasonal migration patterns appear to be local in nature to each respective northern and southern deployment site, differing from previously published migration paradigms. Differences in distance and direction traveled between seasonal geolocations possibly indicate separate migratory patterns between groups. Kernel utilization distribution models also suggest strong separate core home ranges. Significant differences in seasonal temperature and depths between the two regions further substantiate the possibility of separate regional movement patterns between the two groups. Vertical utilization also suggests distinct diel patterns and that this species may not utilize the benthos as previously thought, potentially decreasing availability to benthic gear.
Expected Publication Date: Not Known

Landscape factors affect the genetic population structure of Oncorhynchus mykiss *populations in Hood Canal, Washington*
Environmental Biology of Fishes
D. M. Van Doornik and **B. A. Berejikian (NMFS/NWFSC)**

- This paper describes the genetic population structure of *Oncorhynchus mykiss* populations in Hood Canal and the factors responsible for the observed population structure.



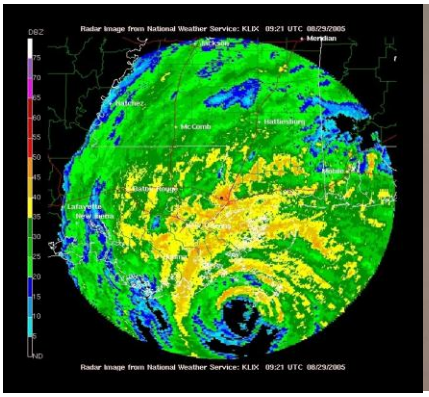


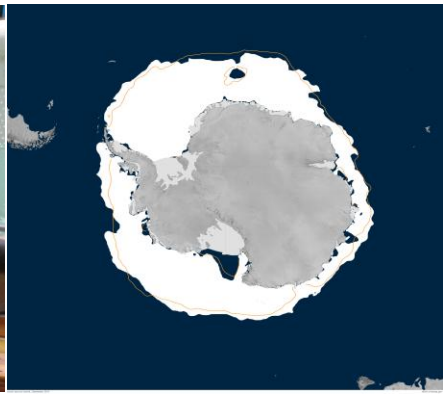
- Population structure and local adaptation were influenced more by location on one of two peninsulas, river flow rate and hydrologic characteristics than by geographic distance, river gradient, or mean annual river temperature.

Among salmonids, local adaptation can reduce gene flow among populations, which can then lead to population sub-division. As such, it is important to understand what landscape variables affect local adaptation, especially for populations for which conservation concerns exist. By examining allele frequencies at 15 microsatellite DNA loci from anadromous (steelhead) and freshwater resident (rainbow trout) *Oncorhynchus mykiss* collected from 7 Hood Canal, Washington rivers, the authors of this study surveyed the genetic population structure within and among populations, and examined the landscape factors that could be affecting their genetic population structure. They found that samples from within a river system were more genetically similar to each other regardless of life history type or sampling location than they were to similar types from other rivers. Rainbow trout samples had lower genetic diversity than steelhead samples. The authors identified two main population groups among the steelhead samples. Genetic distance among populations was most strongly influenced by the populations' locations on one of two peninsulas, and to a lesser extent, river flow rate and hydrological characteristics. These factors influence genetic population structure and local adaptation more than geographic distance, river gradient, or mean annual river temperature.
Expected Publication Date: Fall 2014

Using aerogravity to produce a refined vertical datum
FIG Congress 2014 Proceedings
D. Roman and **X. Li (NOS/NGS)**

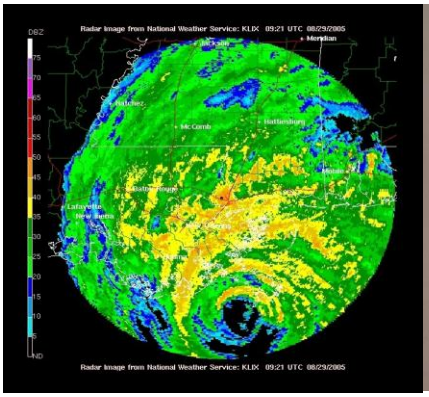
- Existing gravity data used to make global and regional datum models for physical height determination have systematic errors that contribute to meters of uncertainty.
- Reducing these systematic errors will greatly aid in making comparisons between oceanographic and terrestrial datums.

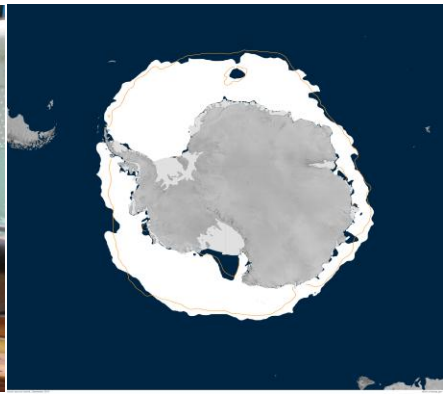




- The aerogravity collected as a part of the GRAV-D project directly aid in detecting and, eventually, removing these systematic effects.
- Follow-on studies, such as the Geoid Slope Validation Study of 2011 and 2014, provide an outside metric for calibration/validation.

The National Geodetic Survey (NGS) instituted the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) Project in 2008, with a goal of developing a seamless, accurate gravity field model for production of a centimeter-level accurate geoid height model. This geoid model will serve as the realization of a new vertical height system in the United States, replacing the North American Vertical Datum of 1988 (NAVD 88). Collaboration with Canada, Mexico, and other countries in North America, Central America, and the Caribbean will ensure this model can serve as a regional vertical datum and be readily linked to a future world height system. To produce such a model, significant (3-8 mGal) biases existing in many of the 1400 different terrestrial gravity surveys across the United States must be detected and mitigated. Furthermore, 10-100 km wide near-shore gaps in oceanic gravity surveys needed to be surveyed. Satellite models do not have sufficient resolution to do either of these tasks. Consequently, aerogravity profiles were collected to enhance the satellite gravity field model for such uses. A simplified approach was taken to determine and remove trackwise biases in the aerogravity profiles using a reference model determined by blending EGM2008 with GOCO03S. A comparison between aerogravity and the modified reference model off the coast of the northeastern United States highlighted areas of systematic difference at the +/- 3 mGal level, with lateral extents of about 100 km. These features would translate into an equivalent 5-10 cm of systematic error in a geoid model and indicate possible errors in the surface gravity data used in EGM2008. A similar analysis over the Great Lakes region demonstrated +/- 10 mGal biases with the NGS surface gravity data and clearly marked which surface gravity profiles need to be addressed. More sophisticated techniques will need to be developed to detect and mitigate the NGS surface survey data, which largely lack metadata that might otherwise eliminate these errors. In this manner, the



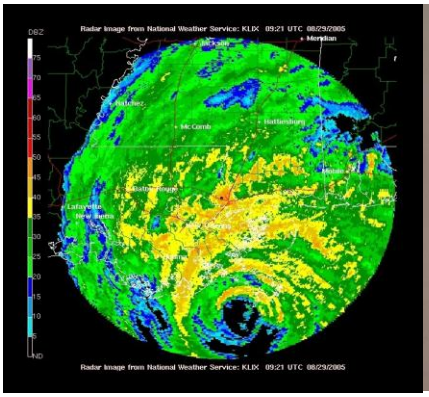


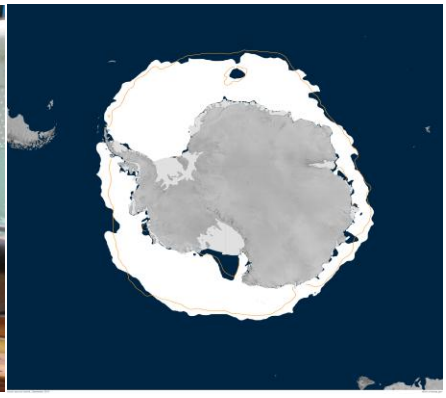
satellite, airborne, and terrestrial data will be made consistent, so as to produce a seamless gravity field model for accurate and precise vertical control.
Expected Publication Date: Summer 2014

Standardizing compositional data for stock assessment
ICES Journal of Marine Science
J. T. Thorson (NMFS/NWFSC)

- The author develops a new method for analyzing sampling data that are routinely collected for marine fishes.
- The new method can estimate the information content ("effective sample size") of resulting estimates, and the effective sample size can then be input into stock assessment models.

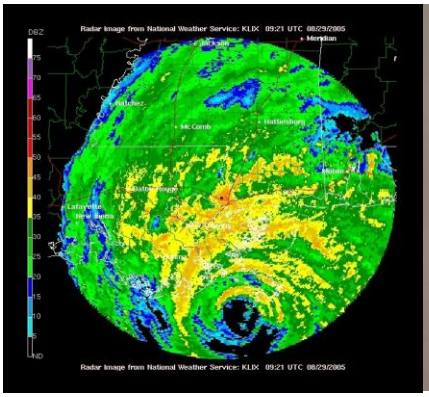
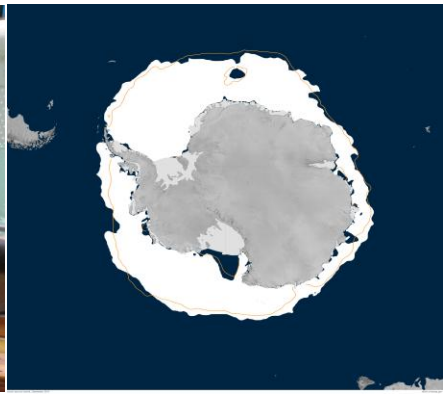
Population dynamics and stock assessment models frequently integrate abundance index and compositional (e.g., age, length, sex) data. Abundance indices are generally estimated from survey data using index standardization models, which provides estimates of standard errors for the abundance index while dealing with three confounding factors: (1) differences in sampling intensity spatially or over time; (2) non-independence of available data; and (3) the effect of covariates. However, compositional data are not generally processed using a standardization model, so effective sample size is not routinely estimated and these three issues are unresolved. To rectify this absence, I propose a computationally simple 'normal approximation' method for standardizing compositional data, and compare this with design-based and Dirichel-multinomial methods for analyzing compositional data. Using simulated data from a population with multiple strata, heterogeneity within strata, differences in sampling intensity, and additional overdispersion, I show that the normal-approximation method provides unbiased estimates of abundance at age as well as estimates of effective sample size that are consistent with the imprecision of these estimates. The Dirichet-multinomial, by contrast, fails to account for known differences in sampling intensity, and hence provides biased estimates when sampling intensity is





correlated with variation in abundance-at-age data. We end by discussing uses for 'composition-standardization models' and propose that future research develop methods to impute compositional data in strata with missing data.
Expected Publication Date: Summer 2014

Energy content of pacific salmon as prey of northern and southern resident killer whales
Endangered Species Research
S. M. O'Neill, **G. M. Ylitalo**, and J. E. West **(NMFS/NWFSC)**

- The data on salmon energetics in this paper will provide better precision and estimates on the caloric value of prey to southern resident and northern resident killer whales which will help to refine estimates of the numbers of Chinook salmon needed to support the prey base for killer whales.

Recovery of depleted species is difficult but it can be especially complex when they interact strongly with other depleted species. Such is the case for northern and southern resident killer whales, *Orcinus orca*, listed as Endangered under the U.S. Endangered Species Act (ESA) and Canada's Species at Risk Act. These resident killer whale populations prey heavily on Pacific salmon, *Oncorhynchus spp.*, including several Evolutionarily Significant Units also listed under the ESA. In response to concerns that a depleted prey base may affect killer whale recovery, we analyzed proximate composition and calculated caloric content of Pacific salmon to evaluate the importance of salmon species, population, body-size, and lipid levels in determining their energy content as prey for killer whales. We sampled all five species of Pacific salmon but emphasized Chinook salmon, a preferred prey of killer whales. Energy density (Kcal· kg-1) was highly correlated with lipid content whereas total energy value (Kcal· fish-1) was determined primarily by fish mass and secondarily by lipid content. To facilitate application of these results to the co-management of salmon and killer whales, we produced a simple relationship that uses fish length to predict total energy of Chinook salmon as prey where population-specific energy densities and fish masses are lacking. Benefits to killer whales from possible salmon fishery closures, or other activities that affect prey availability, will depend on the salmon species and populations involved.
Expected Publication Date: Fall 2014