

Integrated Cook Inlet Environmental Monitoring and Assessment Program (ICIEMAP): A Collaboration Of Four Inlet Contaminant Studies

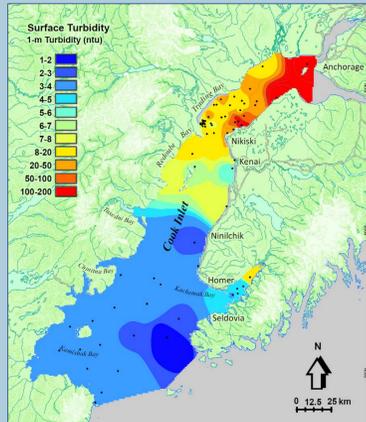
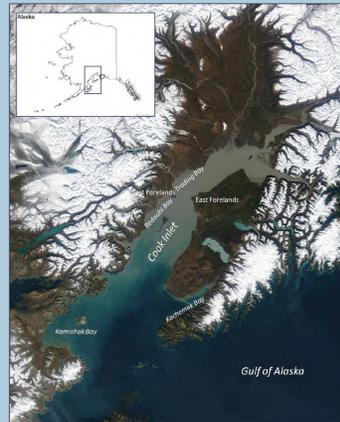
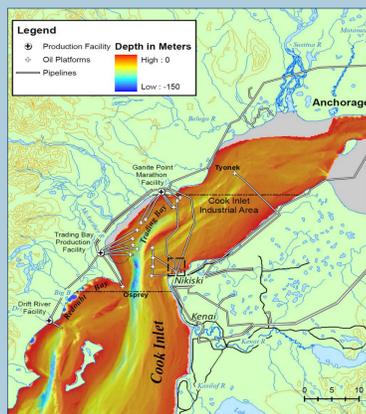
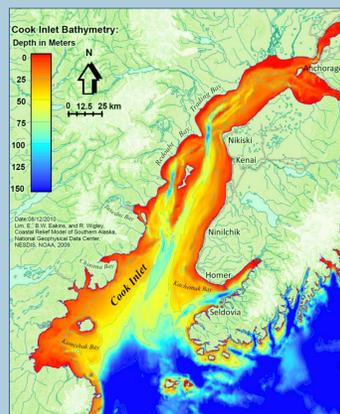
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ICIEMAP: Introduction to Coordinated Studies

• This poster provides an overview of ICIEMAP – an example of cooperation, coordination and leveraging resources to survey chemical, biological, and physical parameters in Cook Inlet. A merged study plan was initiated by Cook Inlet Regional Citizens Advisory Council (CIRCAC) in 2007, and in 2008 and 2009 a field program filled the sampling needs of four studies, each with independent goals but overlapping data needs:

- A **Cook Inlet Environmental Monitoring and Assessment Program (EMAP)** with a probabilistic survey design to assess ecosystem health in Cook Inlet and specific oil industry operation areas.
- **Produced water discharge fate and transport study** designed to fulfill EPA requirements for the General Cook Inlet Oil and Gas National Pollutant Discharge Elimination System (NPDES) permit.
- A component of a NOAA, **National Status & Trends (NS&T) Bioeffects Program** study to assess water column and benthic health in the deep waters of Kachemak Bay.
- A **River Background Source study** to measure contaminant loads (metals and hydrocarbons) entering Cook Inlet from the larger rivers draining watersheds in the Inlet.



Cook Inlet bathymetry showing several deeper channels along the axis of the Inlet (left). Oil industry infrastructure (pipelines, platforms, shore facilities) are concentrated in the upper Inlet north of the constriction at the Forelands (upper right). For most platforms on the west side, produced water is shipped via pipeline to the Trading Bay Treatment Facility where it is treated and discharged to the Inlet just offshore. This discharge accounts for more than 96% of the total produced water discharged to Cook Inlet. The mixing zone associated with this discharge is the focus of a component of ICIEMAP.

Cook Inlet watershed drains ~10,000 km², dumping large quantities of glacial flour into Cook Inlet, especially the upper Inlet (lower left, Orbimage satellite image). Total sediment loads have measured > 2 g/L in upper Inlet marine waters. This suspended sediment is transported by net currents along the west side to settle out in lower energy areas nearshore or when swept south and deposited in deep areas outside of the Inlet. Turbidity data from ICIEMAP reflects what is shown by satellite imagery (lower right).

Cook Inlet

• The shape and bathymetry of Cook Inlet basin is such that M2 tides resonate and create extreme tidal amplitudes and subsequent tidal currents (especially in the upper Inlet).

• Net circulation is from the upper Inlet to the southwest, driven by density currents from the larger volumes of freshwater entering the upper Inlet.

• Net currents sweep particulates from the upper Inlet to areas of lower energy downstream or in shallow waters nearby.

• A portion of the sediments are swept out the Inlet and deposited in the deep benthic environment of Shelikof Strait.

1. Cook Inlet EMAP National Coastal Assessment

- The basis of ICIEMAP was a plan to look at a suite of contaminants and indicators of ecosystem health in Cook Inlet benthic sediments.
- The Cook Inlet study plans included a probabilistic study design by EPA that allows “scaling up” from a suite of 50 sampling sites.
- CIRCAC led a previous EMAP sampling program in the western Gulf of Alaska in 2002 for the State of Alaska as part of their component of the EPA’s National Coastal Assessment.
- The earlier EMAP effort covered coastal areas from Unimak Pass in the southwest to the Copper River Delta in the northeast, and included Cook Inlet (See map below). However, the study was not designed so that the data statistically represented Cook Inlet.
- The Cook Inlet EMAP plans formed the basis for ICIEMAP.
- Funding for this component of ICIEMAP was provided to CIRCAC through NOAA’s Office of Restoration and Response.

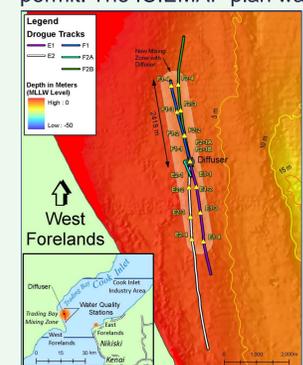


Earlier sampling was done in the western Gulf of Alaska using EPA’s National Coastal Assessment statistical design for coastal waters. The study was based on a modified sediment-quality-triad that focused on benthic metals and organic contaminants in sediments and fish, sediment toxicity, and benthic infaunal assemblages. Cook Inlet RCAC led the program for the State of Alaska.

Those data provide a context in which the Cook Inlet EMAP data can be interpreted. Data from this western Gulf of Alaska coastal assessment led to additional studies and also helped guide decisions when developing a Cook Inlet assessment.

3. Produced Water Fate and Transport Study

- A produced water discharge study was required by EPA’s Cook Inlet Oil and Gas National Pollutant Discharge Elimination System (NPDES) Permit AKG-31-5000 when it went into effect in July 2007.
- The permit required the largest-volume dischargers of produced water in the Inlet to assess the fate and transport of pollutants in the water column and sediments. Over 96% of all produced water discharged to Cook Inlet is treated at the Trading Bay Treatment Facility on the west side of Cook Inlet and discharged just offshore.
- Portions of this study were nested within the sampling frame for the Cook Inlet EMAP, and included water column sampling for contaminants in addition to the benthic sediments.
- A n additional transport study included drogued-drifter releases at the discharge location during flood and ebb tides. Water column samples were collected periodically along the drifter track.
- Funding for this component was by Chevron and XTO Energy as required by their permit. The ICIEMAP plan was approved by EPA



Drogued-drifter tracks for drifters released at the produced water discharge location for the Trading Bay Treatment Facility (left). The strong tidal currents carry the drifters north and south transported by flood and ebb tides, respectively. Map above shows location of Trading Bay facility on the west side of Cook Inlet relative to specific platform locations.

2. Background River Source Sampling

- Hydrocarbons and metals occur naturally in the environment, complicating the interpretation of potential anthropogenic impacts.
- Natural sources vary depending on many factors, such as the source ore bodies and watershed characteristics.
- The river background source study was incorporated into ICIEMAP to assess hydrocarbons and heavy metals from a range of Cook Inlet rivers. These data provide a context in which to interpret Cook Inlet marine data.
- Funding for this portion of the study was provided by Cook Inlet RCAC.
- The following rivers were included in this component of the study:

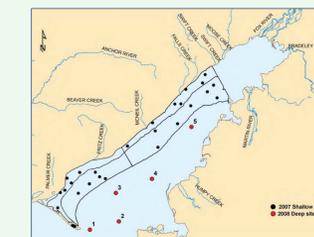
- Kenai River
- Kasilof River
- Fox River
- Bradley River
- Grewingk River
- Douglas River
- Kamishak River
- McNeil River
- Glacier Creek
- Tuxedni River
- Chinitna River
- Drift River
- Big River
- McArthur River
- Beluga River
- Susitna River
- Matanuska River
- Knik River



Note the contribution of suspended sediment loads from river systems into Cook Inlet. Notable on this satellite image are contributions from major rivers in upper Cook Inlet that settle in areas of low energy and are swept out of the inlet where currents are stronger. Contributions from Kamishak Bay rivers in the southwest corner of Cook Inlet can also be seen contributing sediments to the area as does the Fox River at the head of Kachemak Bay on the lower east side of Cook Inlet. These sediments contain metals at various concentrations, depending on their source. They also can adsorb hydrocarbons to their surface and fine sediments are known to have higher concentrations due to their increased surface to volume ratio.

4. Kachemak Bay Bioeffects Study

- National Status and Trends conducted a bioeffects study in Kachemak Bay in 2007 for shallow depths (<20m).
- Funding was lost prior to the > 20m depth stratum being sampled.
- Not a single site landed within Kachemak Bay in the sampling frame for ICIEMAP. The opportunity to incorporate Kachemak Bay led to integration of the Kachemak Bay sites into ICIEMAP.
- A separate poster on the Kachemak Bay work is presented here by Ian Hartwell of NS&T.



Map of Kachemak Bay showing strata and site locations from the 2007 and 2008 components of NOAA’s National Status & Trends bioeffects study. The 2008 sampling was integrated into ICIEMAP in 2008 when funding for the assessment was lost after the 2007 sampling.

A series of accompanying ICIEMAP posters are also presented here. These posters do not present data specifically for separate studies (except for the Kachemak Bay bioeffects study). Instead, they summarize components of the ICIEMAP, for example organic compounds or metals or benthic infaunal communities interpreted for all the integrated studies