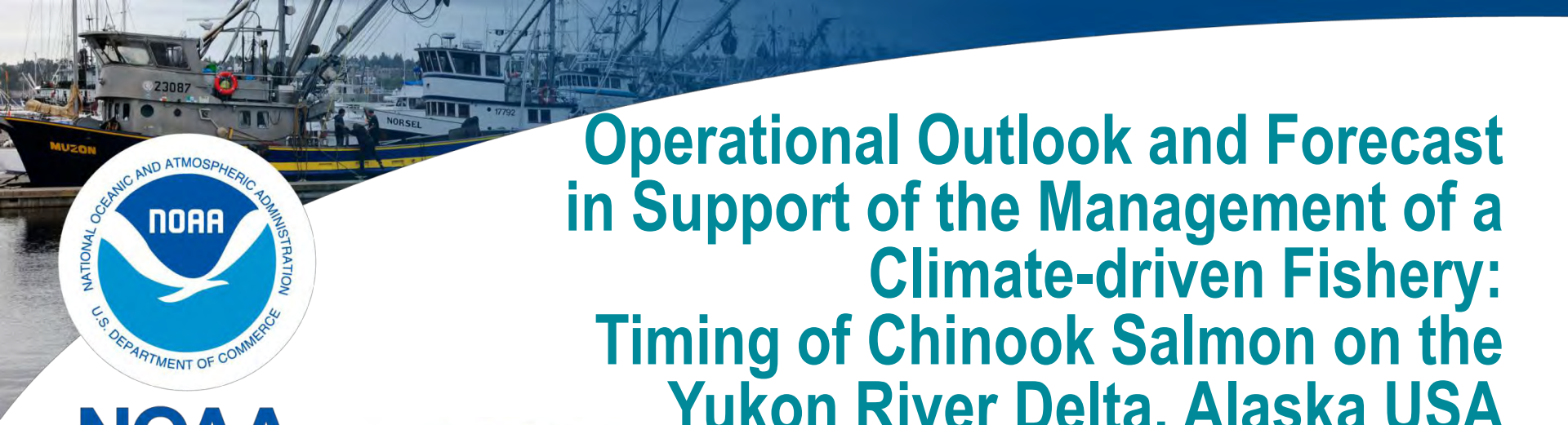

Operational Outlook and Forecast in Support of the Management of a Climate-driven Fishery: Timing of Chinook Salmon on the Yukon River Delta, Alaska USA

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Alaska Fisheries Science Center

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PICES FUTURE Science Program

FUTURE's Big Question

- What is the future of the North Pacific given current and expected pressures of climate change?

FUTURE Advisory Panel on Status, Outlooks Forecasts and Engagement, SOFE AP

- FUTURE aims to engage human societies by providing useful products on ecosystem change.

How can we provide useful products on ecosystem change? Four Steps.

- **Step 1**: Identifying a valued **climate driven ecosystem service** with a **problem in need of solution**
- **Step 2**. Understanding and defining **processes and relationships** between climate, fish behavior and fishery performance
- **Step 3**. Research to **develop products** based on the relationships
- **Step 4**. Operationalizing research; developing **timely reliable communication**

Step 1: Identifying a valued climate driven ecosystem service with a problem in need of solution, the Yukon Chinook Salmon Fishery

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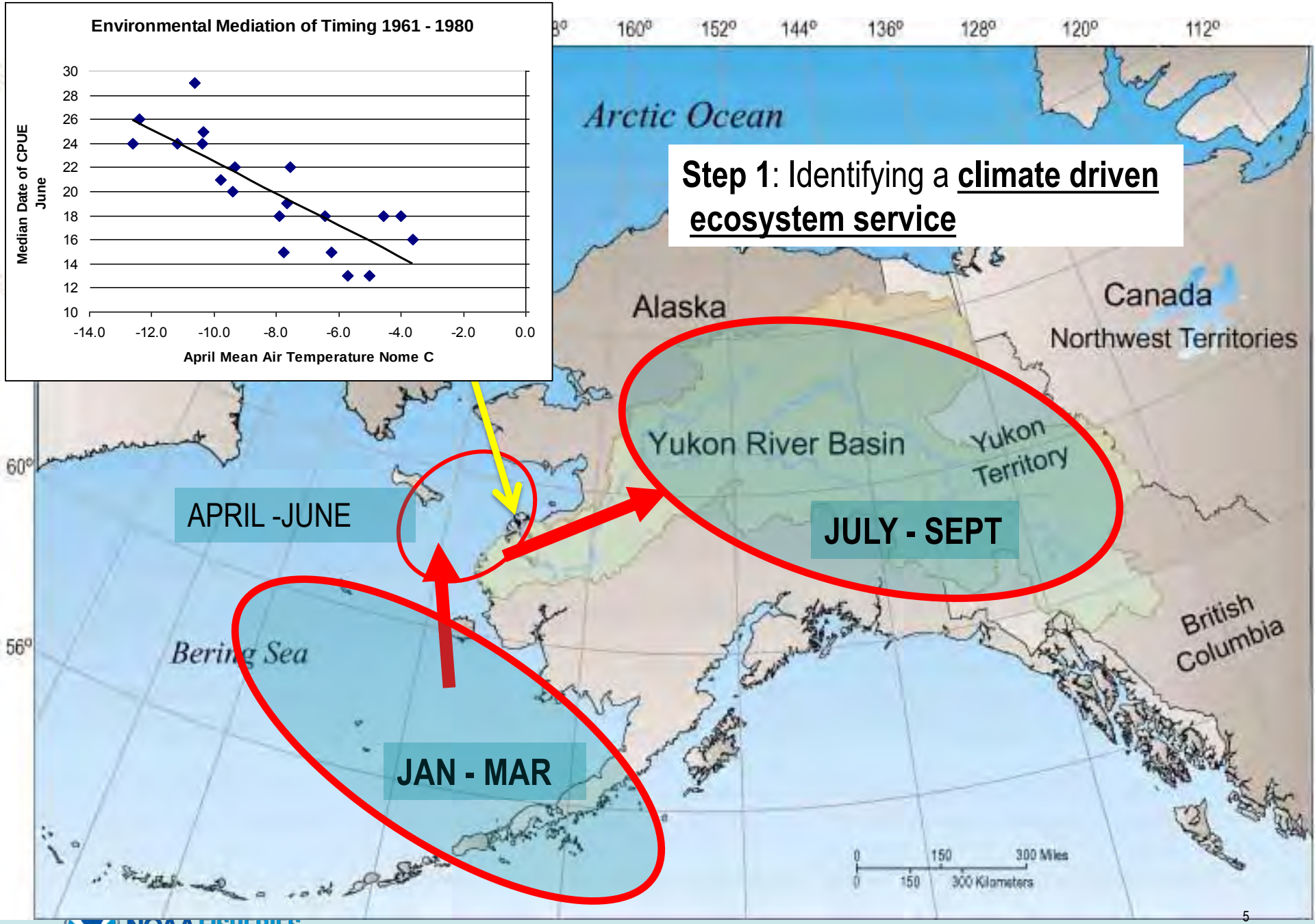

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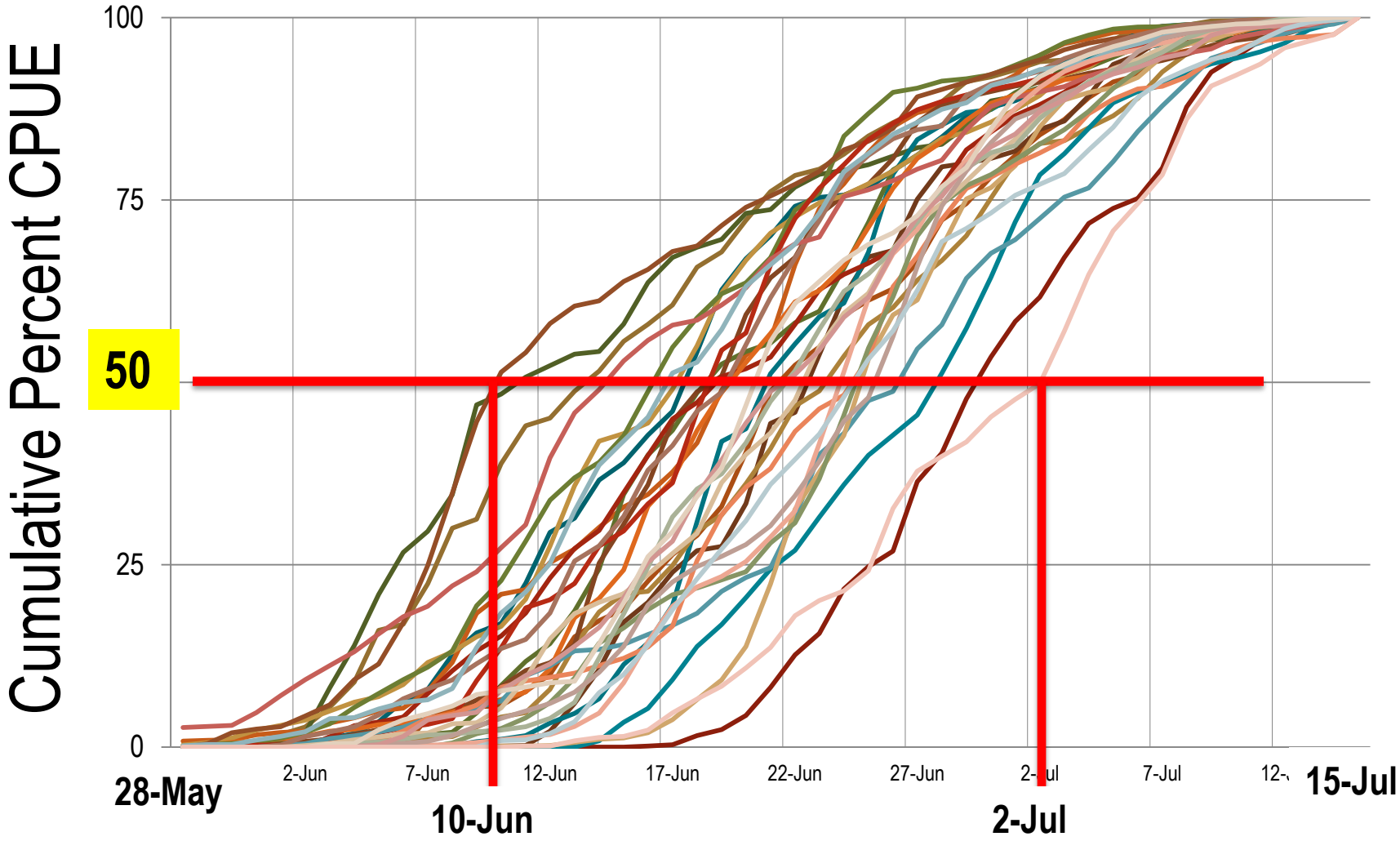
http://water.usgs.gov/nasqan/docs/yukonfact/images/fig1.jpg

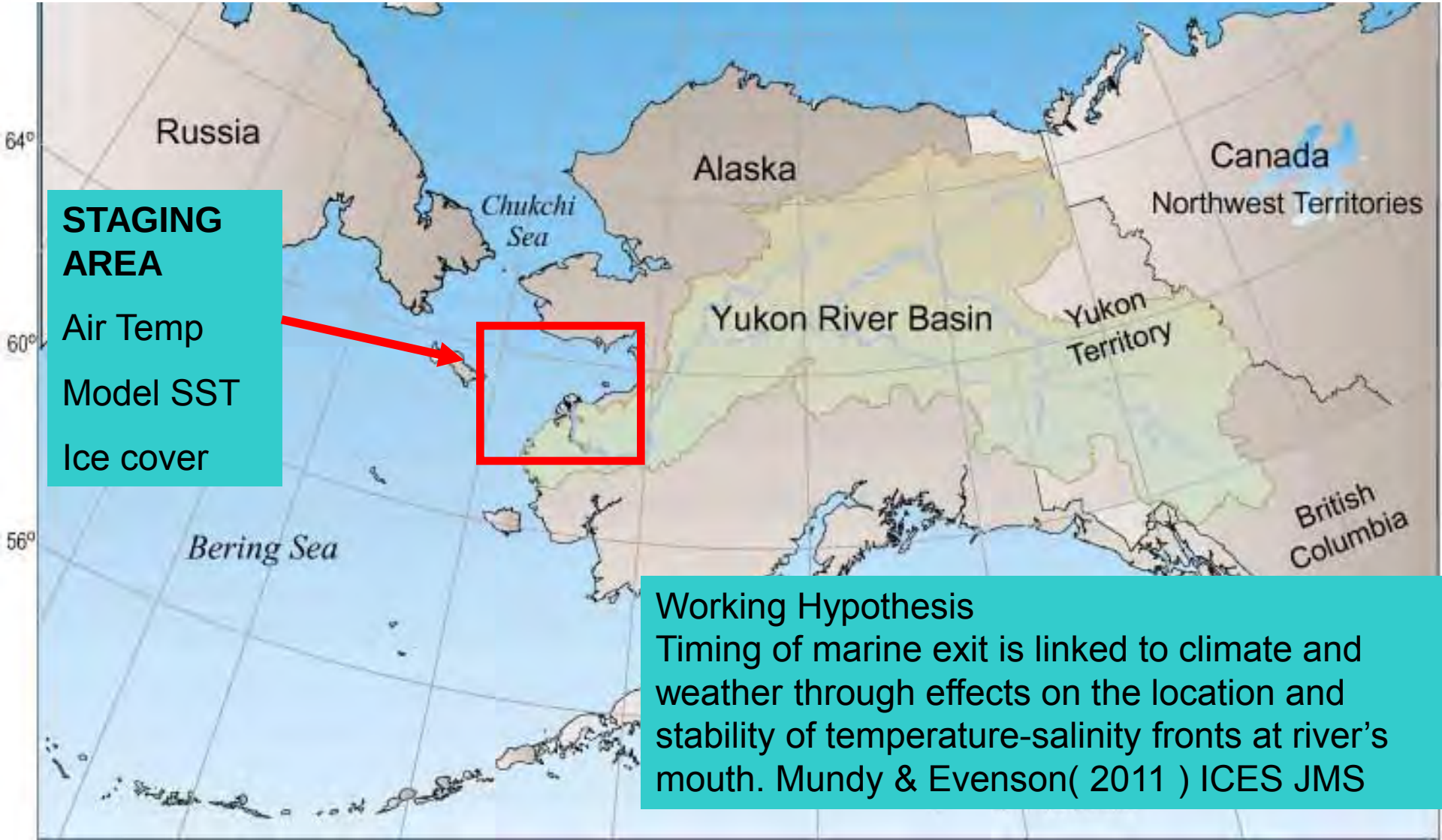
Step 1: The Yukon Chinook Salmon Fishery is highly valued by humans inside and outside the watershed

- International treaty agreement with Canada
- Major subsistence resource for 43 villages; object of commercial, personal use and sports fisheries
- Abundances at historic lows; federal disaster relief
- Chinook salmon bycatch controls billion dollar annual Bering Sea pollock fishery and limits use of other salmon species
- High profile and high value means fishery managers welcome help

Step 1: A problem in need of a solution
Yukon Chinook Timing Observed 1980 - 2013

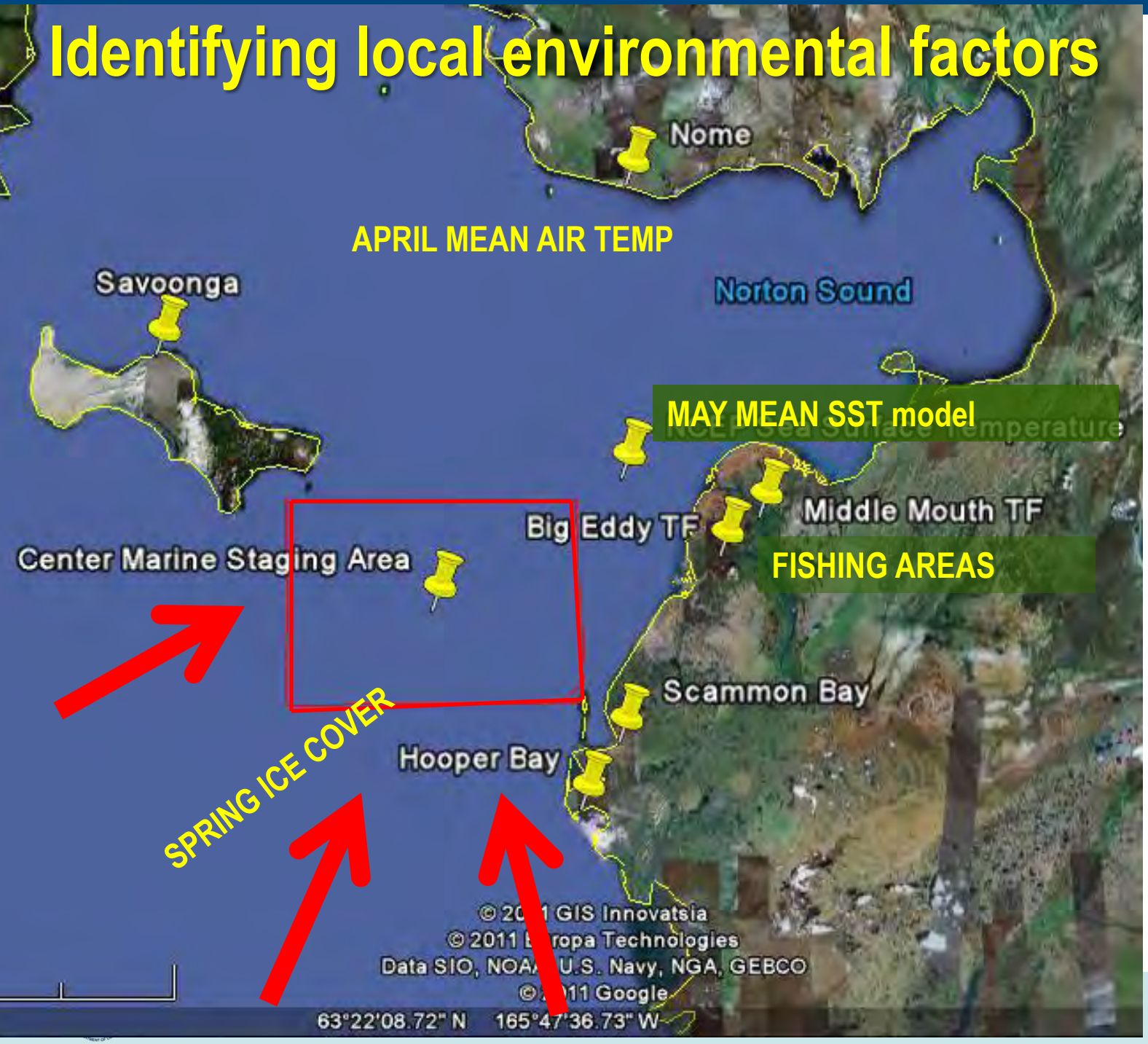


Step 2. Understanding and defining **processes and relationships** between climate, fish behavior and fishery performance



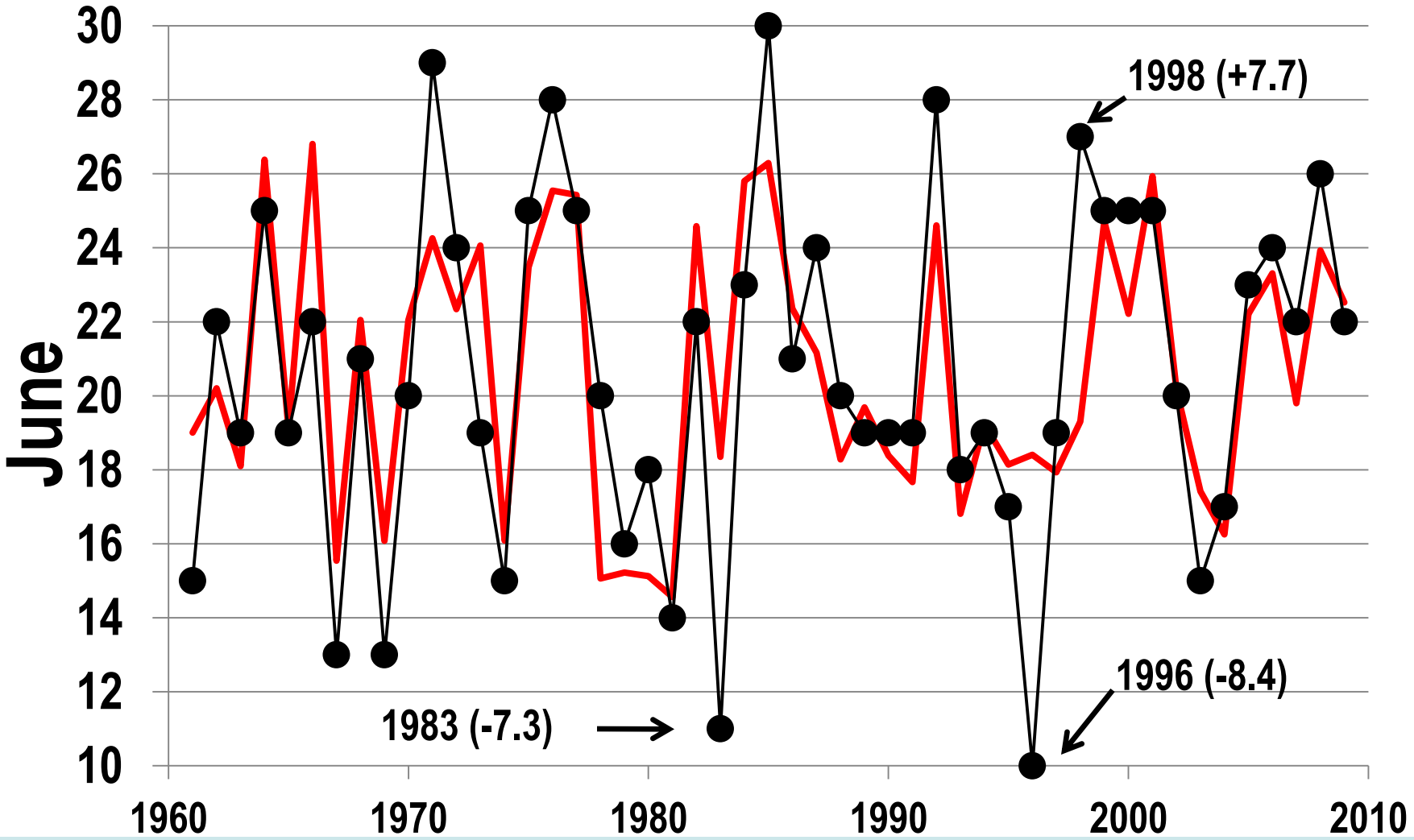
Working Hypothesis
Timing of marine exit is linked to climate and weather through effects on the location and stability of temperature-salinity fronts at river's mouth. Mundy & Evenson(2011) ICES JMS

Identifying local environmental factors



Model Timing = (-0.410)AIRT + (-1.638)SST + 17.357

Observed Timing 1961 - 2009



Step 3. Research to develop products based on the relationships – May 31 Outlook and Forecast

Outlook

- Synopsis of Spring Conditions, ice, air, ocean
- EARLY, AVERAGE, or LATE
- Uncertainty as percent of years early, average and late under similar Spring conditions

Forecast

- Dates of 15th 25th and 50th percentiles
- Model of percentages for all dates updated weekly
- Quantitative uncertainty – linear statistical models

Estimated and observed daily percentages of the 2013 salmon migration

Chart 1 Fit through July 2 2013

Chart 1. Forecast of the cumulative percent of the Chinook run in Y-1 on each date from June 1 through July 15, 2013. Blue bars are forecasts of the 15%, 25% and 50% run percentiles derived from a model that approximates the migration of 1985. The cyan-colored line shows 2013 cumulative CPUE converted to estimated run percentages.

Web posted, updated daily

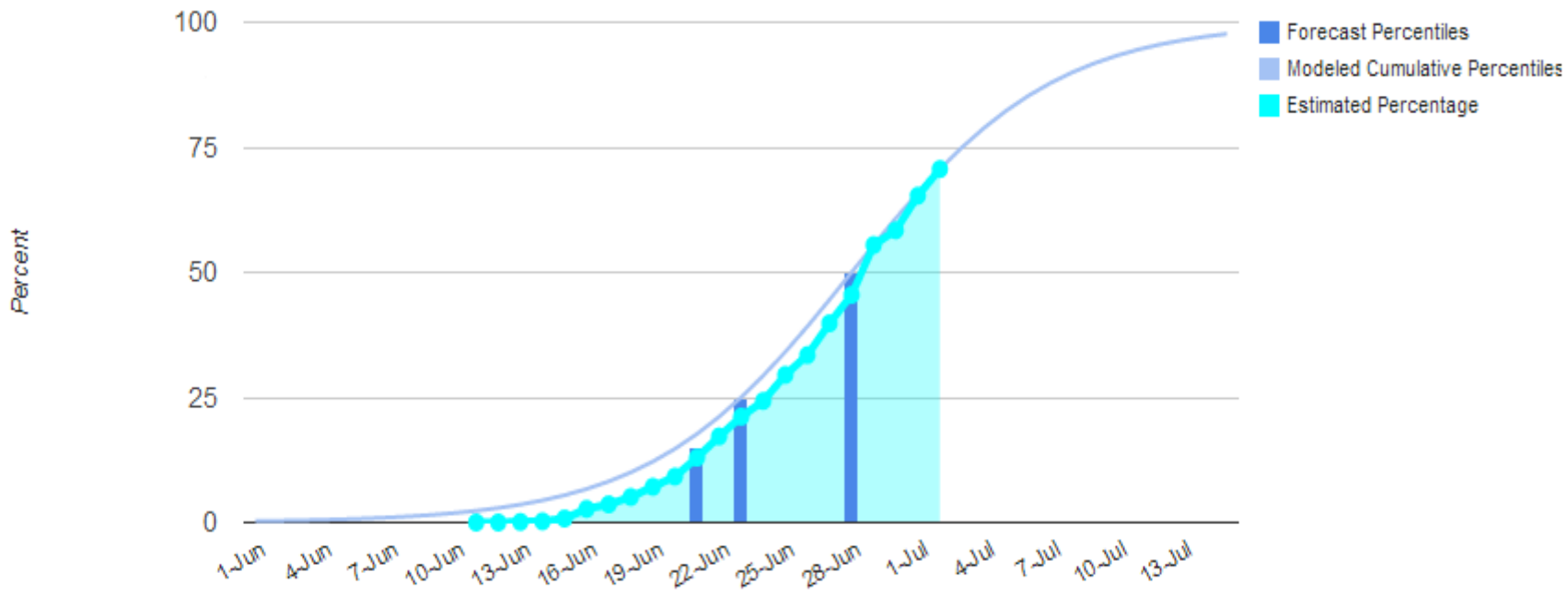


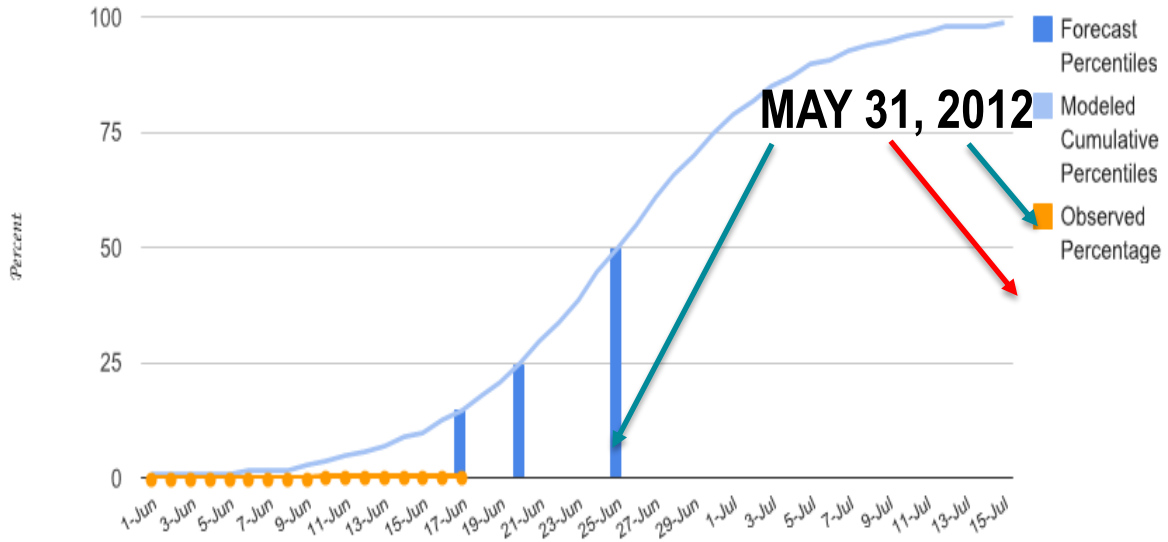
Table. Dates on which 15th and 50th percentiles of chinook test fishery CPUE were observed 2010 – 2013 and the dates forecast on May 31 for these percentiles by the research (2010 – 2011) and operational (2012 – 2013) projects, and the difference between observed and forecast in days.

Year	Percentile	Date Observed	Date Forecast	Obs - Fore
2010	15	June 17	June 17	0
2011	15	June 15	June 16	1
2012*	15	June 22	June 17	5
2013	15	June 21	June 21	0
2010	50	June 25	June 24	1
2011	50	June 21	June 24	3
2012*	50	July 2	June 25	7
2013	50	June 28	June 28	0

***2012 is latest migration in recorded history, 1961 - 2013**

June

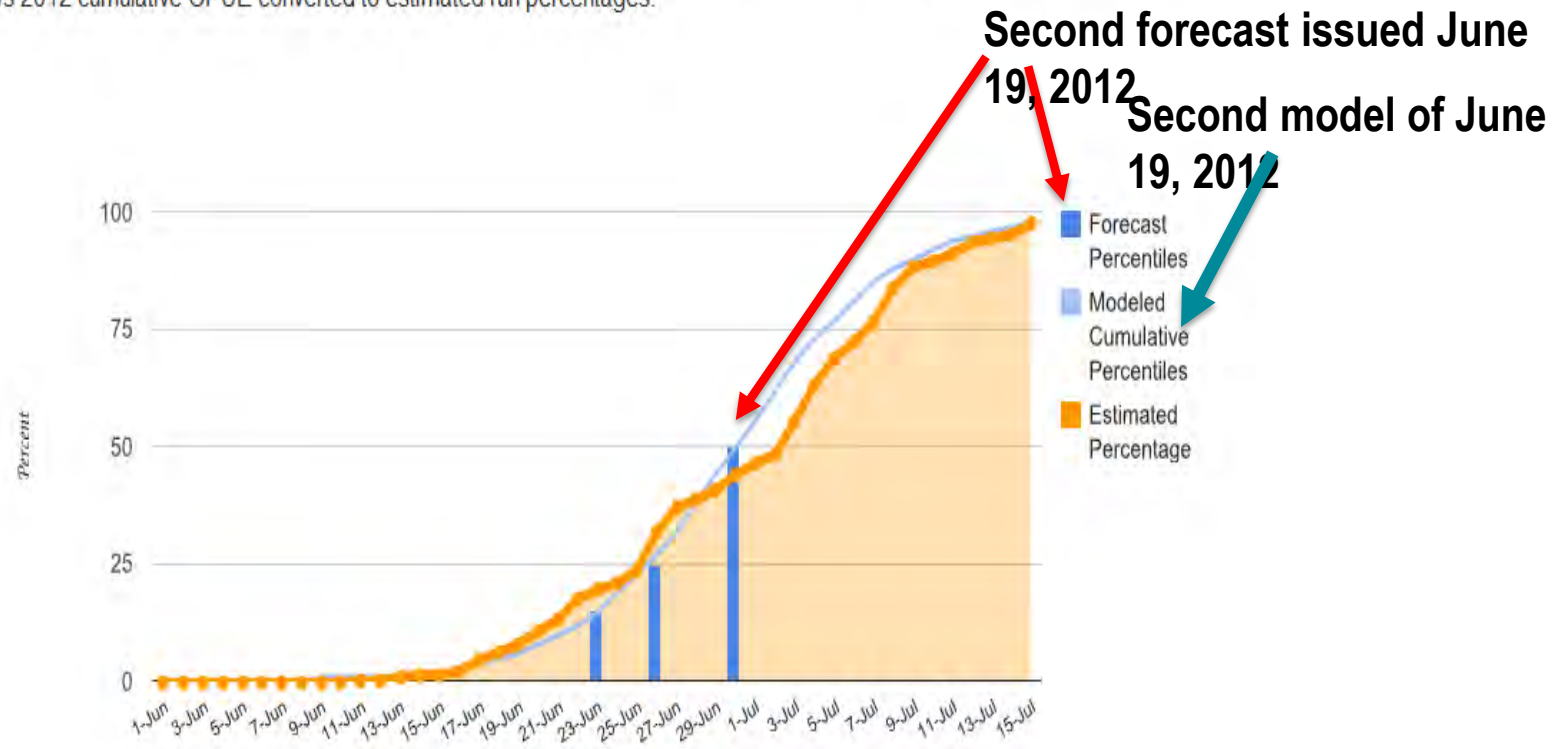
Chart 1. Forecast of the cumulative percent of the Chinook run in Y-1 on each date from June 1 through July 15, 2012. Blue bars are forecasts of the 15%, 25% and 50% run percentiles derived from a model that uses marine environmental variables (April mean air temperature, May mean marine surface temperature, and sea ice concentration). The orange line shows CPUE converted to estimated run percentages and is updated daily.



As of June 18, it is clear that the May 31 model does not fit the observations, so the model is updated on June 19

July 15, 2012 Model and Observation

Chart 1. Forecast of the cumulative percent of the Chinook run in Y-1 on each date from June 1 through July 15, 2012. Blue bars are forecasts of the 15%, 25% and 50% run percentiles derived from a model that approximates the migration of 1985. The orange line shows 2012 cumulative CPUE converted to estimated run percentages.



The updated model forecasts (blue bars) of June 19 missed the observed dates (orange circles) by only 1 – 2 days

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Step 4. Operationalizing research; developing timely reliable communication

- The AOOS web site is the focal point for getting the outlook, forecasts, and daily updates on timing and environmental conditions to public
- It is linked to other web sites providing environmental and fishery data to the project and to the public
- Other web sites point the public to the AOOS web site (ADF&G, NOAA, others)

www.aoos.org

2012 Chinook Forec... | 2012 Chinook Histor... | BOZEMAN DAILY C... | Current North Pacifi... | Deep Sea Research P... | Geospatial Platform ... | Home - AFSC Boa

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ADFG uses AOOS data to predict late Chinook run for Yukon delta

The forecast for 2013 is for a late run similar to that experienced in 2012. Click to read the complete outlook and more about development of the forecast.

1 2 3 4 5 6 7 8 9 10

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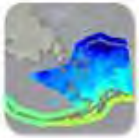
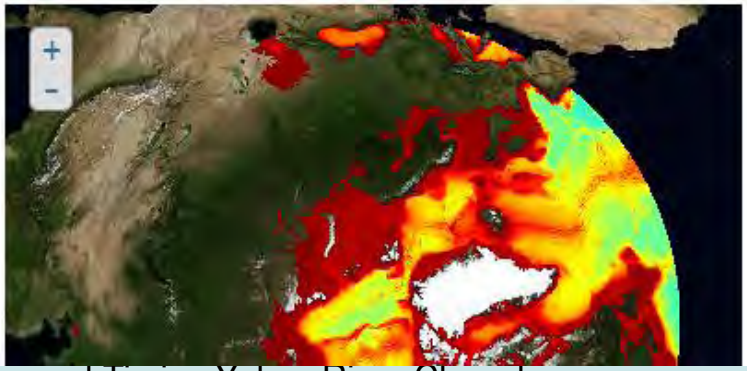


New and improved features!

Now iPad friendly, this updated application includes a searchable catalog for improved model discovery and an improved virtual sensor. Learn more

General Bathymetric Chart of the Oceans (GEBCO)



2013 Outlook and Forecast for Chinook Salmon Timing
Lower Yukon River (Area Y-1), May 31, 2013

Outlook

The 2013 timing outlook is for a Chinook migration that is about a week later than average. In terms of the runs of the last 52 years, a late run is most likely, an average migration is unlikely, and a slightly early migration is highly unlikely but it has occurred in the past under similar environmental conditions. The Spring of 2013 has been much colder than average, based on the three most reliable environmental indicators, ice cover, sea surface temperature and Nome air temperature. The marine area between St.

www.aoos.org/this-years-forecast-chinook-salmon-in-the-yukon-river-delta/

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ADFG uses AOOS data to predict late Chinook run for Yukon delta

Posted on May 31, 2013 by Ellen Tyler

Known for navigating the longest annual freshwater migration route of any salmon to reach their spawning grounds, Chinook salmon can start arriving on the Yukon River delta at almost any point in June. Traditional knowledge on the Yukon holds that spring weather conditions, including ice, temperatures and wind determine when in June the fish enter the river, but each spring brings a different combination of conditions, so pinning down a schedule for the arrival of the first pulse can be tricky. Over the past 50 years the first pulse of Chinook on the Yukon delta has occurred sometime between the 6th and the 26th of June. While 20 days doesn't sound like a long time to wait, it can seem like forever when the size of the winter's salmon supply hangs in the balance.

Click to enlarge

Photograph by Deborah Mercy

What's so important about getting the timing right?

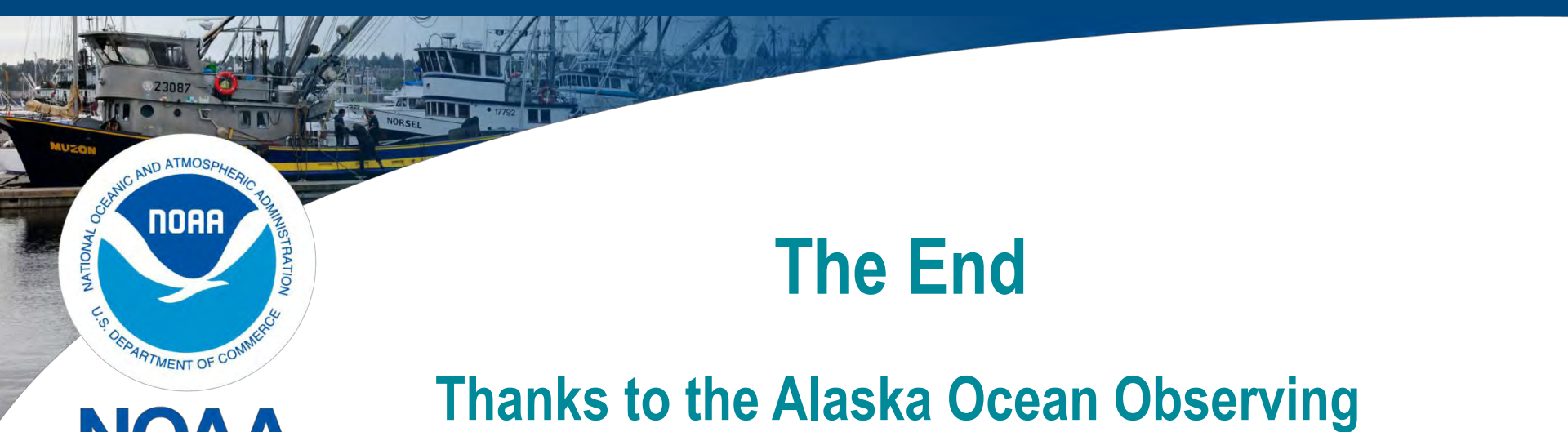
Management of the Chinook salmon fishery is closely linked to expected time of arrival in harvest areas. When the migration begins earlier than expected, it is reasonable for fishery managers to conclude that the run is stronger than it actually

Research on run timing

Peer Reviewed Journal Article

Conclusions

- Timing of the Chinook salmon migration in the Yukon River can be reliably forecast using marine environmental conditions that occur BEFORE the migration begins.
- A successful outlook and forecast of the timing of the Yukon River chinook is presently in place to guide fishery managers and to advise the public.
- The FUTURE premise has been demonstrated. It is indeed possible to deliver useful products on ecosystem change.



The End

Thanks to the Alaska Ocean Observing System, the Alaska Department of Fish and Game and NOAA for financial and material support.

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