OSRI-LONG-TERM OBSERVATIONS (LTOs)/INTENSIVE OBSERVNG PERIODS (IOPs) WORKSHOP REPORT(DRAFT)

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LIST OF ACRONYMS

ACC – Alaska Coastal Current
ADCP – acoustic Doppler current profiler
ASI – air-sea interaction
AUV- autonomous underwater vehicle
BC – boundary condition
CI – Cook Inlet
EEZ – Exclusive Economic Zone (from shoreline to 200NM offshore)
ENSO –el Nino/Southern Oscillation
EPWS – Extended PWS; i.e., PWS plus NGOA
GPS – Global Positioning System
HE – Hinchinbrook Entrance
HF – high frequency
IC – initial condition
IMS – Information Management System
MS – Montague Strait
NFS – nowcast/forecast system
NGOA – Northern Gulf of Alaska
NOS – National Ocean Service
NWP – Numerical Weather Prediction
NWS – National Weather Service
POM – Princeton Ocean Model
PWS – Prince William Sound
QSCAT – QUICKSCAT (radar scatterometer)
RAMS – Regional Atmospheric Modeling System
ROMS – Regional Ocean Modeling System
RPV – Remotely Piloted Vehicle
SAR – Synthetic Aperture Radar
SSS – sea surface salinity

SCIENCE PLAN

EXECUTIVE SUMMARY

The general aim, over the next five years, is to improve the sustained observing system in PWS and its offings; expand the knowledge of physical processes controlling the environment and ecology of PWS, including physical transports of materials; and validate and verify the corresponding enhanced predictive modeling. A combined approach of more extensive long – term (i.e., continual) observing systems and short-term (ca. 3mo.) intense observing periods with additional focused observations is required for critical process studies and model skill assessment, as well as evolution of the nowcast/forecast system for the extended PWS domain. Here, the observing element options are enumerated and the intense observing period themes are identified. While a continuing effort is made to upgrade the observing system and modeling system (i.e., the nowcast/forecast system), and to assist in the design of an upgraded observing system through the IOPs, approximately one IOP would be conducted per year, sometimes combining two or more of the IOP themes. To leverage sufficient resources for the execution of the recommended program of studies, it will be necessary for OSRI to coordinate with other programs; e.g., GLOBEC, EVOS/GEM, North Pacific Research Board, Coastal Alaska Observing System (CAOS), and Stellar Sea Lion Study, and with other entities such as NWS, NOS, PMEL and UA. This Science Plan should be followed by development of a well-coordinated Implementation Plan.

FIVE-YEAR GOAL AND OBJECTIVES

GOAL. Design and assess complementary observing and modeling systems that can be used for real-time, predictive environmental and ecological management, emergency response, assessment of the coastal physical and ecological response to climate change, etc.

OBJECTIVES.

Scientific: Improve knowledge of

- air-sea exchanges (momentum, heat, and moisture), including those due to gap winds and barrier jets
- freshwater runoff
- influence of meso-topography (e.g., submarine canyons, submarine ridges, capes, embayments, islands, basins) on ACC and mixing
- impact of mesoscale eddies in NGOA on shelfbreak exchange (horizontal and vertical)
- upstream and downstream BCs (velocity, temperature, and salinity)
- Lagrangian transport and dispersion
- seasonal cycle of circulation (flow and stratification), including volume, heat, and salt budgets for PWS
- interannual variability; e.g., ENSO, and decadal variability; e.g., North Pacific "regime shift"
- critical submesoscale processes; e.g., winter ventilation (free convection, subduction, etc.) related to neocalanus (copepod) wintertime diapause, etc.; springtime restratification related to "neocalanus fountains" and patchiness (1 to 10 km diameters); vertical shears (due to near-inertial motions, baroclinic tides, etc.) for mixing parameterizations; and tidal bottom mixing
- "choke points" in space and time for monitoring focus
- critical seasonal, etc. scenarios for linked physical and ecological processes

Technical: Assessment of new and alternative technologies; e.g., glider (AUV) hydro-surveys; spaceborne SAR and scatterometer winds; coastal HF radars for near-real-time surface current maps; horizontal scanning ADCPs for current transects; and RPV atmospheric profiling, transect, and mapping surveys.

Programmatic: Develop a cohesive community of scientists and engineers with common interests in operational environmental information systems and related analysis for the NGOA coastal ocean, including the evolving NWS and NOS partners.

ELEMENTS OF LONG-TERM OBSERVATIONS (LTOs)

RATIONALE: needed for model ICs, BCs, validation, verification, and assimilation, AND for retrospective analyses.

Focal domain: (to encompass PWS, Copper River Delta, Kayak Is., Hinchinbrook Canyon, Montague Canyon, Chiswell Ridge)

Yakutat Bay (or Cape Suckling) to Kodiak Is. (or Gore Point)
northern PWS to NGOA-EEZ seaward limit (i.e., 200 nautical mile zone)
year-round (continual, real-time operation)

Observational elements:

Coastal stations:

tide gauges (NOS, OSRI, etc.)
meteorological (NWS, OSRI, etc.)

Telemetering moorings:

ADCP, conductivity/temperature, etc. profilers
ASI and meteorological (NDBC) surface buoys
bio-sensors (fluoresence, nitrate, ammonia, etc.)

Coastal HF radars:

surface currents
surface waves (possibly)
surface winds (possibly)

Periodic hydro-surveys:

ships, aircraft, gliders
upstream – PWS – downstream

Enhanced meteorological observing systems:

soundings (e.g., radiosondes, GPS-sondes, radar profilers, acoustic sounders)
RPVs (remotely piloted vehicles)

Periodic Lagrangian deployments:

surface as well as 15, 40, etc. m depths

THEMES FOR INTENSE OBSERVING-PERIODS (IOPs)

PWS-NGOA (ACC, etc.) exchange (all seasons):

Hinchinbrook Entrance & Canyon
Montague Strait & Canyon

PWS mesoscale dynamics (spring/summer):

Central Basin and Black Hole, top to bottom
near-inertial motions
baroclinic tides
"patchiness"

Barrier (alongshore) jets and gap (cross-shore) winds (winter):

mesoscale NWP assessment
coastal ocean response (including Lagrangian transports)

Wind-driven events (summer):

coastal upwelling
coastal downwelling

Buoyancy-driven events (autumn):

marine boundary layer characterizations
seasonal rains and runoff

Ventilation in PWS (winter):

Black Hole
Central Basin

Role of mesoscale eddies in NGOA (spring/summer):

shelfbreak exchange
ecological response

PRESENTATION EXTRACTS

David Musgrave, UAF. Introduced the new NASA-sponsored SALMON (Sea-Air Land Modeling) Program at UA, which extends from Kayak Island to Shelikov Strait and consists of information service, education & outreach, and research components. Present thoughts include purchase of a few coastal HF radars (type & vendor yet to be determined) to be deployed in CI for familiarization purposes, then re-deployed in PWS for a short test, return to CI for an over-winter test, and then return to PWS on a long-term basis, possibly on Naked Is. and Goose Is. The aim is to be "operational" by the summer of 2003. It is also planned to purchase a few bottom-mounted ADCPs (possibly the new horizontally profiling ADCPs) for installation in HE; with more funds, MS would be so instrumented, too. An IMS under development at the UA Geophysical Institute will be utilized for a graphics interface. In consonance with the national trend toward "operational coastal oceanography" and ICOOS, it is assumed that the SALMON observations will be made publicly available in real-time.

Terry Whitledge, UAF. Described the GLOBEC effort at UAF, which is in its fifth year and is focused on several seasonal, cross-shore transects and moorings that observe basic physical and ecological variables, most notably time series from moored fluorometers and nitrate sensors. Some effort has also been invested in examining zooplankton in the Black Hole. Preliminary results indicate a lot of (unresolved) alongshore variability, mesoscale variability, and inter-annual variability. Juvenile salmon follow their prey (neocalanus) from PWS to the shelf. There are unresolved issues of upstream (Alaska Shelf) influences, though there are a few transects at Cape Suckling southeast of Kayak Island.

Nick Bond, JISAO/UW & PMEL. Explained that SAR and QSCAT wind fields support the notion that (alongshore) barrier winds are formed along steep coastal orography and are trapped within ca.100 km offshore. They occur ca. one-third of the time between OCT and MAY, are induced by land-falling weather systems, and persist for ca. one day. The orographically controlled (cross-shore) gap winds are also detected in SAR and QSCAT wind fields. They occur intermittently between NOV and MAR. The barrier and gap wind phenomena are of common interest to OSRI and several PMEL programs in progress or planned for the coming decades, including NWP assessments. For example, PMEL is deploying Lagrangian drifters (drogued at 40 m) and is also operating telemetering physical (SEACAT and ADCP) and biophysical (nitrate) moorings (*ala* "tau-array north") in the NGOA for GLOBEC, Stellar Sea Lion, and Bering Sea studies. The proposed effort for the Co-OP Buoyancy-Driven Regime Program will probably have some emphasis upstream of PWS. The extensive experience with the NOAA P-3 aircraft in coastal studies was summarized, which includes results from several remote sensors and numerous expendable profilers. For example, synoptic maps of ocean color made form below the cloud base are particularly promising in the coastal waters of NGOA, and SSS mapping may be feasible in the NGOA. The P-3 has been requested for MAY 03, and OSRI needs to relate to this possible opportunity, which may be postponed to another month or year. It was noted that the prospects for RPVs on such airborne missions are brilliant in the next few years.

Craig Lee, UW. Introduced emerging technologies of gliders (AUVs that extract thermal energy from the ocean, allowing long-duration missions) and Triaxus (a towed profiler that offers better control than SeaSoar). The glider can operate in either the virtual mooring mode or the transect mode; it can presently sample to 1,500 m; by the end of 2003, the depth range will be extended to 6,000 m. It weighs 52 kg, is 1.8 m long, has a wing span of 1 m, and a speed of ¼ m/s. Its purchase cost is $65 to 100K; the mission cost is ca. $6K. A deep mission is ca. 1 yr.; a shallow mission is ca. 2 mos. In recent years, it has been tested in Monterey Bay and Puget Sound. It will soon begin sampling for GLOBEC off Seward for 4 yrs.

Shari Vaughan, OSRI/PWSSC. Summarized the ongoing OSRI observational program that consists of seasonal hydrographic (XBT, XCTD, and towed ADCP) cruises in PWS and HE using a SERVS vessel, which is supplemented by a bottom-mounted ADCP moored in HE (sponsored by EVOS). Periodic deployments of WOCE drifters will resume under OSRI sponsorship.

Chris Mooers and Inkweon Bang, RSMAS/OSRI. Summarized the present status of the quasi-operational, first-generation PWS/NFS, including model (1-km POM) validation and nowcast/forecast verification results and issues. The model is forced by synoptic winds; eight tidal constituents; and climatological heat flux, runoff, and HE inflow. Outlined the process issues (e.g., PWS – ACC exchange and seasonal heating) and operational motivation (e.g., Lagrangian links between PWS & NGOA and forecast winds) that are guiding the implementation of the second-generation EPWS/NFS (for the NGOA as well as PWS *per se).* EPWS/NFS will be nested in a quasi-operational Navy model for the North Pacific and a NOAA model for the global ocean.

Kate Hedstrom, UAF. Explained strategy of model nesting (using ROMS) with PMEL & Rutgers U. The North Pacific model has 20 km resolution; the Gulf of Alaska & Bering Sea model has 10km resolution; the NGOA model has 3 km resolution; and the PWS model will have 1 km resolution. The ROMS modeling in the NGOA is in support of SALMON, GLOBEC, and Stellar Sea Lion research. Hence, the next priority is to add an ecosystem component.

Peter Olsson, UAA/OSRI. Introduced the new effort to provide the PWS region with an atmospheric mesoscale nowcast/forecast modeling system (RAMS) that will be used to drive the OSRI PWS/NFS. The model is implemented with a local polar-stereographic coordinate system and 36 vertical levels to 25 km altitude. Triple nesting is used: a 50 x 50 grid with 64 km grid-spacing and 80s time step; a 70 x 58 grid with 16 km grid-spacing and 40s time step; and a 102 x 78 grid with 4 km grid-spacing and 20s time step. Orography has been smoothed to ca. 40 km. The NCEP Eta model is used for ICs, lateral BCs, and top BC. Uses a cluster of 12 workstations for parallel computation: runs 24 hr in 2 hr of clock time. Demonstrated a PWS gap wind case for JAN02 in comparison with SAR wind field.