SAFL Seminar Series

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St. Anthony Falls Laboratory ~ Auditorium

Beneath the surface: Interpreting remotely sensed coherent structures on the water surface in rivers and estuaries

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Coherent structures such as fronts, eddies, jets and boils are ubiquitous in river and estuarine flows. They are typically created by the interaction of the flow with variations in bathymetry such as bedforms, flow obstructions and channel curvature, and contribute to fluxes of mass, momentum, salt, sediment, contaminants and other material carried in the river or estuary. As embedded features in the flow, coherent structures may also be exploited to gain a better understanding of fundamental flow and transport processes. In this work we use state-of-the-art infrared (IR) remote sensing to image the complex thermal patterns on the water surface of a mesotidal estuary that result from bottom-generated coherent structures. The remote sensing measurements are coupled with detailed co-located water column measurements in order to link observed surface expressions with subsurface structures. The over-arching goal of the work is to evaluate whether remotely sensed surface signatures can be used to determine mean flow speed, turbulence intensity, density stratification, bottom roughness and other water column properties.

In this talk I will present results from two field campaigns in the Snohomish River estuary near Everett WA. In July 2006 we examined the surface expression of an abrupt rocky sill 4 km upstream of the river mouth in a periodically stratified section of the estuary. In this flow configuration, boils are initially suppressed by strong stratification early in the ebb. Later, when the densimetric Froude number is greater than 1, boils form in the mixing layer generated by separated flow over the sill and carry cool salty water to the water surface. We find that a simple vortex model successfully predicts the surfacing location of the boils. In September 2009 we moved upstream to examine the surface characteristics in a series of more typical river sections including a range of bottom roughness scales. I will present preliminary results including measurements of near surface turbulence and their relationship to the remotely sensed IR fields.