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Name of University Researcher Preparing Report: Todd Sikora

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Partners or Cooperative Project: Partners Project

Project Title: Verification of SAR [Synthetic Aperture Radar] Winds in the Inner Channels of Southeast Alaska

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SECTION 1: SUMMARY OF PROJECT OBJECTIVES

1.1 Summary of progress during the past year in terms of project objectives:

1.1.1 Increase the usefulness of SAR wind products, by determining the accuracy of SAR-derived wind speed data for channel wind events (gap flows) and employing the results for more general use in protected coastal waters.

To meet objective 1.1.1, we conducted field studies during fall 2006 and spring 2007. *In situ* marine surface observations were collected by volunteer and contracted marine operators at three study areas coinciding with synthetic aperture radar (SAR) satellite passes. Those study areas are shown in Figure 1, which also includes an overview of the project.

The goal of the field studies was to compare *in-situ* wind observations with SAR-derived wind speed data for the channels within each study area. The three areas were selected because they: (1) show a tendency for channel wind events under specific synoptic conditions; (2) are within quick sailing range of a nearby harbor; and (3) potentially provide new insight into complex channel wind events.

1.1.2 Increase the understanding of channel-directed flow in complex terrain.

This will be a product of the more detailed analysis portion of the research, which is planned to continue through the fall of 2007.

1.1.3 Improve graphical marine forecast and warning products for Southeast Alaska.

This will be a product of the more detailed analysis portion of the research that is planned to continue through the fall of 2007. The expected increased understanding of channel-directed flow in complex terrain will lead to improved interpretations of numerical weather prediction (NWP) models and enhanced accuracy of forecaster input for the Graphic Forecast Editor (GFE).

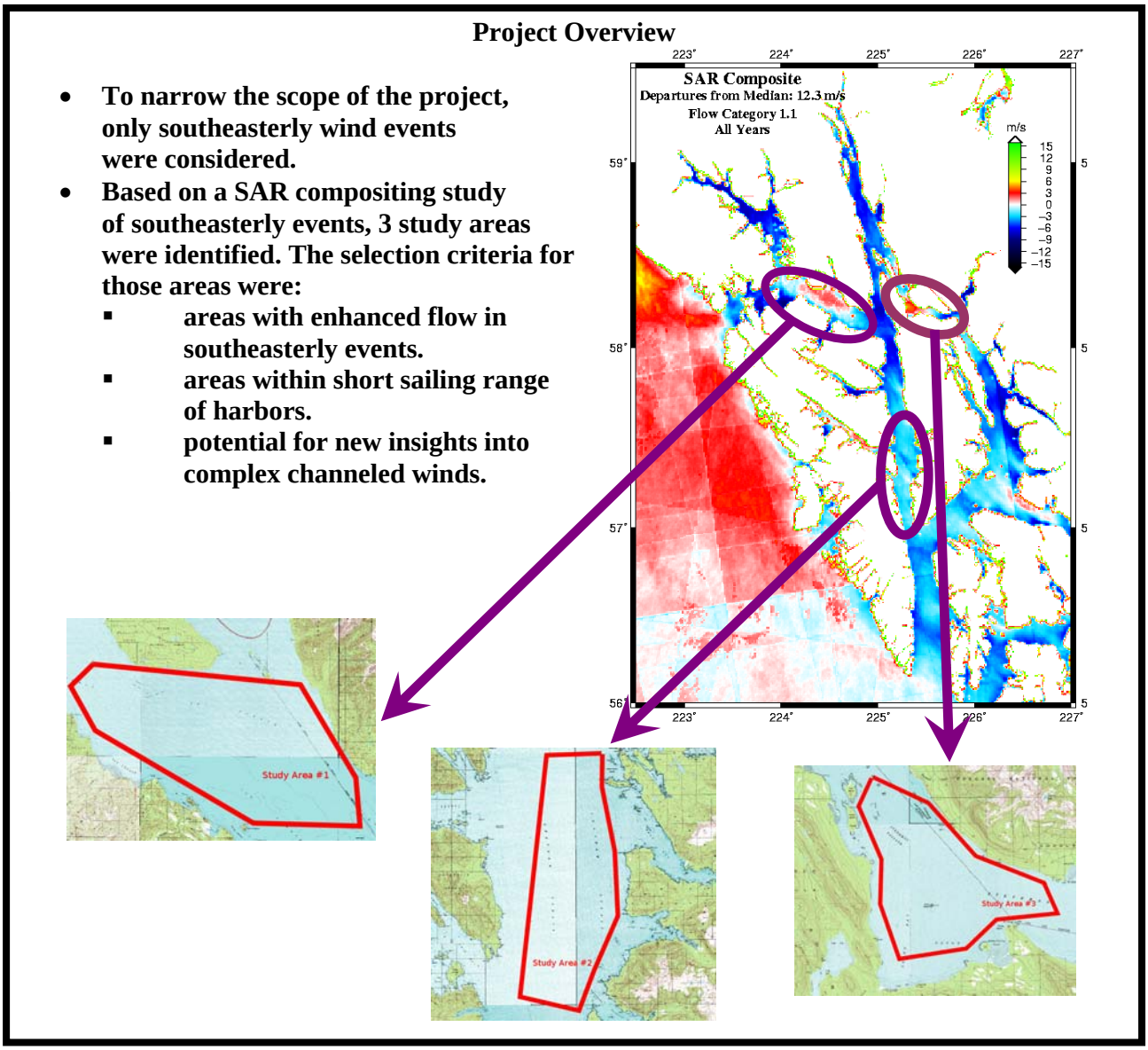

Figure 1. The project overview, including locations of the three study areas.

1.1.4 Conduct a workshop to inform WFO Juneau staff and others on the effective use of SAR data.

The *North Pacific Environmental Satellite Workshop for Coastal and Marine Applications* was held 29-30 May 2007 at the University of Alaska Southeast. The agenda and abstracts can be viewed at the workshop website, http://pajk.arh.noaa.gov/training/sat/workshop.html. The goal of the workshop was to provide a forum for presentation and discussion of research and development regarding the application of SAR and other environmental satellite data to a variety of coastal and marine issues. Additional workshop sponsors were University of Alaska Southeast (UAS), National Environmental Satellite Data and Information Service (NESDIS) and Johns Hopkins University Applied Physics Laboratory (JHUAPL). The Workshop was attended by 37 participants from government (federal, state, and local), private, and educational institutions across the United States and Canada. Participants represented a variety of disciplines, including meteorology, hydrology, fisheries, hazards response, and law enforcement

and included participants from academic, research, government and private sectors. A detailed workshop report is under review for publication in *National Weather Digest.*

1.1.5 Involve the local marine community as contributors to a project designed for their benefit.

Charter boat captains were recruited and trained to collect the *in situ* marine observations. Thus, they have been, and will continue to be, an integral part of the research. In the process, these individuals were briefed on the purpose of the study and the capabilities of SAR for determining wind speed.

Marine community outreach was a major focus of the workshop. For example, there were two panel discussions affording the local marine community an opportunity to express their environmental satellite data user needs and questions.

SECTION 2: PROJECT ACCOMPLISHMENTS AND FINDINGS

2.1 During the project, there were seven successful case studies, with the best event occurring 4 October 2006. Given the synoptic setting on that date, surface wind speeds for the northwest-southeast oriented channels were expected to be enhanced beyond that predicted by coarse NWP models or that sampled by the coarse operational coastal observation network. The 4 October 2006 field study was very productive, with excellent ship observations and SAR data obtained during an extreme channel wind event. A sample of results for that field study can be found within Figure 2.

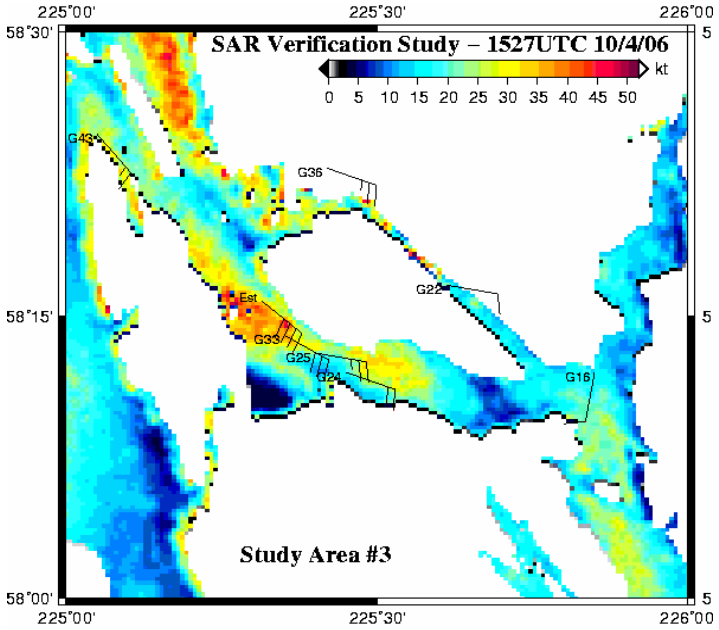

Figure 2. Sample set of observations from 4 October 2006. Colored pixels are SAR-derived wind speeds. White pixels denote land. Staff (pointing towards wind direction) and barbs (one barb equals 10 knots) are in situ observations. "G" refers to in situ gust observation in knots.

Although a detailed analysis has not yet been completed, preliminary results show significant correlation between SAR-obtained wind speeds and observed wind speeds in the Southeast

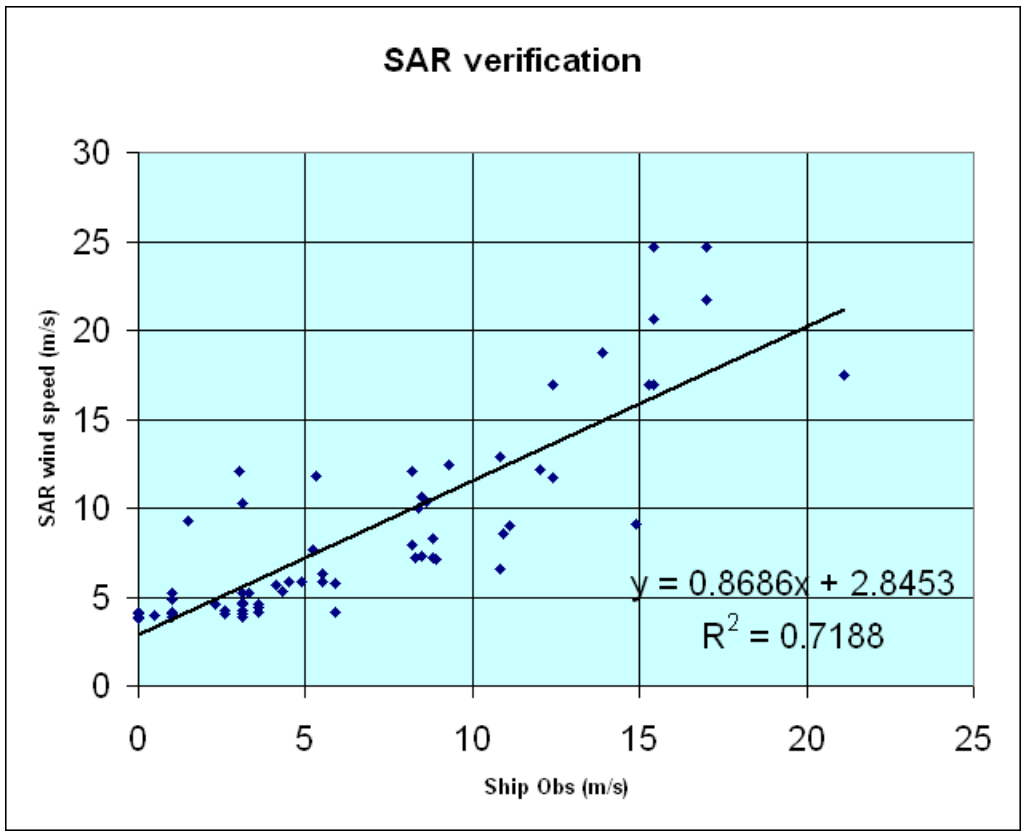

Figure 3: SAR winds versus in-situ observations taken during the 2006-07 field study.

Alaska inner channels. Figure 3 shows a scatter plot with good correlation between SAR winds and *in situ* observations taken during the field study. Despite the promising findings, there are still concerns related to the ambiguity of the SAR wind algorithm that need to be investigated more thoroughly.

The status of this study, along with its preliminary results, has been reported to WFO staff. In mid-March, reports from this and other SAR studies were presented at the Vancouver office of Environment Canada. Attendees at this workshop, which included representatives from WFO Seattle, WFO Anchorage, WFO Fairbanks, and MSC/PSPC Vancouver Canada, were updated on the status of the project. Finally, a poster on the study was presented at the American Meteorological Society's *15th Conference on Air-Sea Interaction*, held 20-23 August 2007 in Portland, OR.

SECTION 3: BENEFITS AND LESSONS LEARNED: OPERATIONAL PARTNER PERSPECTIVE

3.1 The goal of this project is to determine the accuracy of SAR-derived channel wind speeds under various synoptic scale situations and to develop a corresponding error climatology based on the determination of wind directions at critical locations. It is expected that the results may be applied in a more general way to other marine areas affected by channeled flow. The expected increased understanding of channel-directed flow in complex terrain will lead to improved interpretations of NWP models and enhanced accuracy of forecaster input for the GFE.

3.2 Logistical issues between our supplier of SAR wind speed data (Nathaniel Winstead) and the operators of the SAR prevented the acquisition of SAR data over the study areas until late in the fall 2006 season. In short, careful planning and preparations for each data collection event were based on a SAR acquisition schedule that could be superseded, without notice to us, by *high priority* SAR users. These *high priority* users often selected SAR beam modes which did not sample our study areas. As a result, excellent *in situ* surface observations were collected for two early fall 2006 events for which no SAR wind data were available for comparison.

In order to compensate for the missed opportunities of fall 2006, an additional field study period was conducted in the spring of 2007. We endeavored to elevate the priority of our satellite data requests, but still were not able to acquire a few SAR passes that would have been optimal. An accommodation was finally arranged with one *high priority* user which allowed for the sharing of the satellite. Moreover, we were provided with access to the final SAR acquisition schedule so that we could abort planned observation collections, if necessary.

3.3 Communication was a problem at the most remote of the study areas that resulted in missed observation collection opportunities from one of the charter boat captains. Land and cellular phone service was intermittent throughout the field study periods and the site was too remote for visits from WFO staff. This was mitigated somewhat by applying a greater focus on the other two study areas during the event.

SECTION 4: BENEFITS AND LESSONS LEARNED: UNIVERSITY PARTNER PERSPECTIVE

4.1 This project focused in part on the transition of research to operations. Thus, it provided Todd Sikora with valuable insight into how his funded research can be applied at coastal WFOs. The experience and knowledge gained by Todd Sikora will be integrated into future sections of Forecasting Practicum and Satellite Meteorology taught by him at Millersville University. In addition, that experience and knowledge will feed into his future journal articles written to operational audiences, including those described in Section 5 below. Finally, the community service aspect of this project is viewed very highly by Millersville University.

Undergraduate research is a valued component of the Millersville University curriculum. In that vain, Todd Sikora has recruited a Millersville University meteorology undergraduate student into this project. That student is currently a senior and is working with Todd Sikora and Carl Dierking to develop a coastal *in situ* wind – SAR wind climatology within the study areas. The student will also participate in the marine *in situ* wind – SAR analysis portion of this research.

This research complements an Office of Naval Research funded grant of Todd Sikora which is aimed at examining the marine meteorology of the north Pacific Ocean using SAR.

4.2 Last-minute scheduling changes in the SAR acquisition schedule caused us to lose expected SAR data coincident with several dedicated field study periods. In order to overcome this problem, we developed a system for obtaining the final SAR pass schedule so that planned observation collections could be halted, if necessary. In addition, we made arrangements with a high priority SAR user to share the use of the satellite such that more data was made available to us.

SECTION 5: PUBLICATIONS AND PRESENTATIONS

5.1 We presented a poster at the *15th Conference on Air-Sea Interaction* (20-23 August 2007, Portland, OR). The full reference is:

Sikora, T. D., C. F. Dierking, N. S. Winstead, J. C. Curtis, T. A. Ress, B. M. Crowthers, and D. B. Fitzgerald, 2007: An investigation of channeled wind events in Southeast Alaska using synthetic aperture radar. *Fifteenth Conference on Air-Sea Interaction*, AMS, Portland, OR, 20-23 August 2007.

The summary of the *North Pacific Environmental Satellite Workshop for Coastal and Marine Applications* is in review at *National Weather Digest.* At least one presentation is planned at the *16th Conference on Air-Sea Interaction* (early 2009, Phoenix, AZ). Moreover, we plan to submit at least two manuscripts to the *Journal of Applied Meteorology and Climatology*.

SECTION 6: SUMMARY OF UNIVERSITY/OPERATIONAL PARTNER INTERACTIONS AND ROLES

6.1 Division of labor between the academic and forecaster partners

Todd Sikora managed and distributed funds. Todd Sikora aided in determining proper field study tactics and the planning of future field studies. Nathaniel Winstead was responsible for the submission of SAR data requests. Todd Sikora and Nathaniel Winstead provided scientific advice on data interpretation and comparison methods. Todd Sikora participated in the planning of the workshop. Todd Sikora recruited a Millersville University undergraduate student to participate in project research and supervises the student's tasks.

WFO personnel were responsible for recruitment and training of charter boat captains, the assembly meteorological equipment on board the charter boats (see Figure 4), the forecasting of

Figure 4. A WFO Juneau forecaster installs an anemometer on one of the vessels used to collect in situ data.

field study periods, the compiling of *in situ* field study data, and workshop logistics.

WFO and academic partners will continue to collaborate on data analysis and all subsequent publications.