

AIRBORNE MICROWAVE AND INFRARED REMOTE SENSING



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Compact Airborne System for Imaging the Environment (CASIE): Specifications

Synthetic Aperture Radar

- Along-track and cross-track interferometric
- L- and C-band
- 3 km imaging area

Thermal Infrared Cameras

- Dual uncooled thermal cameras
- 640 × 480 pixel resolution
- 25° and 40° fields-of-view
- External temperature reference

Lidar

- 690 nm wavelength ('eye safe')
- 3000 Hz sampling
- 6.4 cm resolution
- 1000 m range

Also have fixed visible wavelength cameras, a gimballed camera system, and radiometers.

Compact Airborne System for Imaging the Environment (CASIE): Applications

Synthetic Aperture Radar

- Ocean currents
- River flow
- Ocean waves
- Ocean fronts
- Internal waves
- Topographic mapping

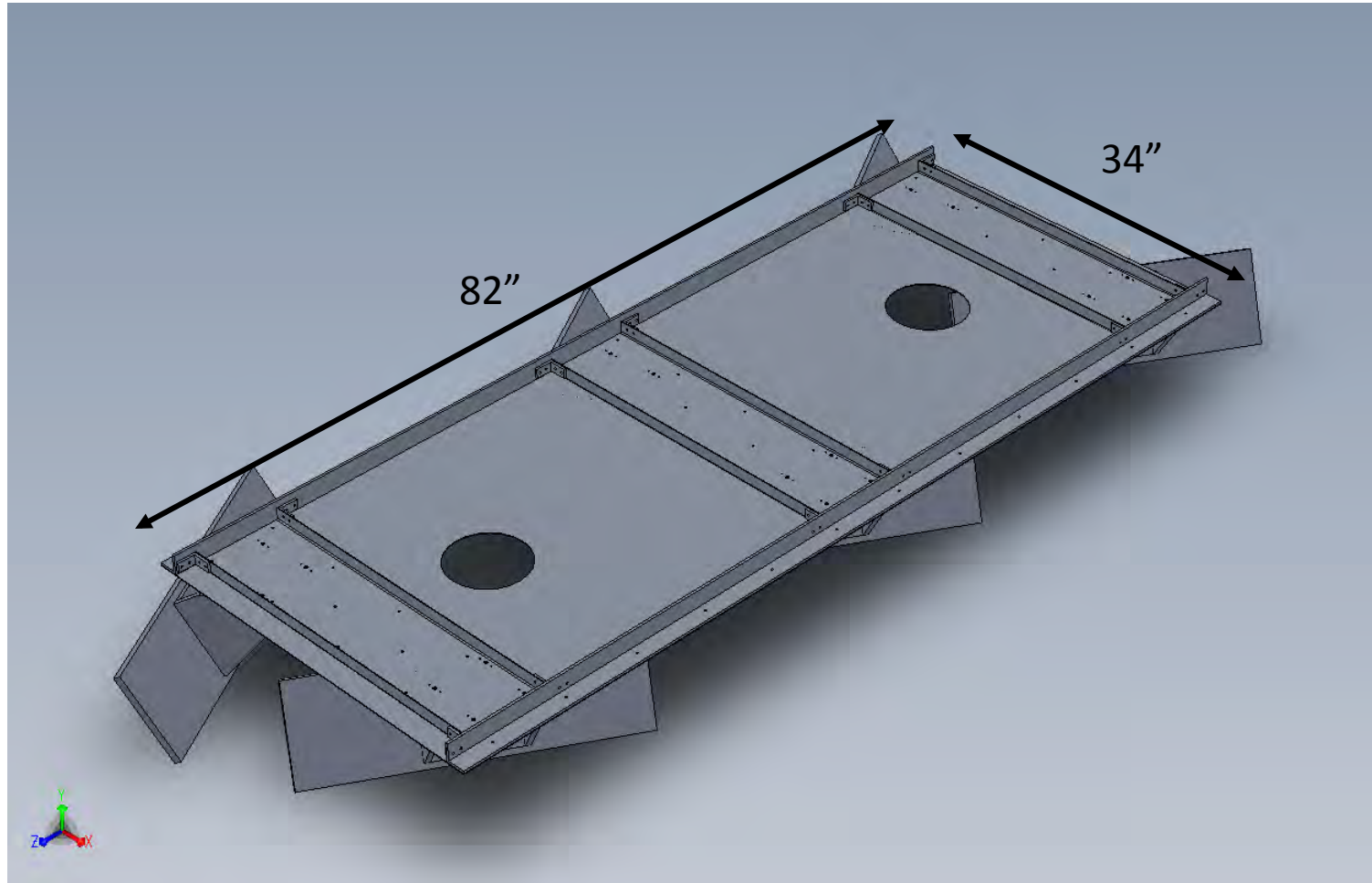
Thermal Infrared Cameras

- River temperature
- Water body mapping
- Ocean waves
- Ocean fronts
- Internal waves

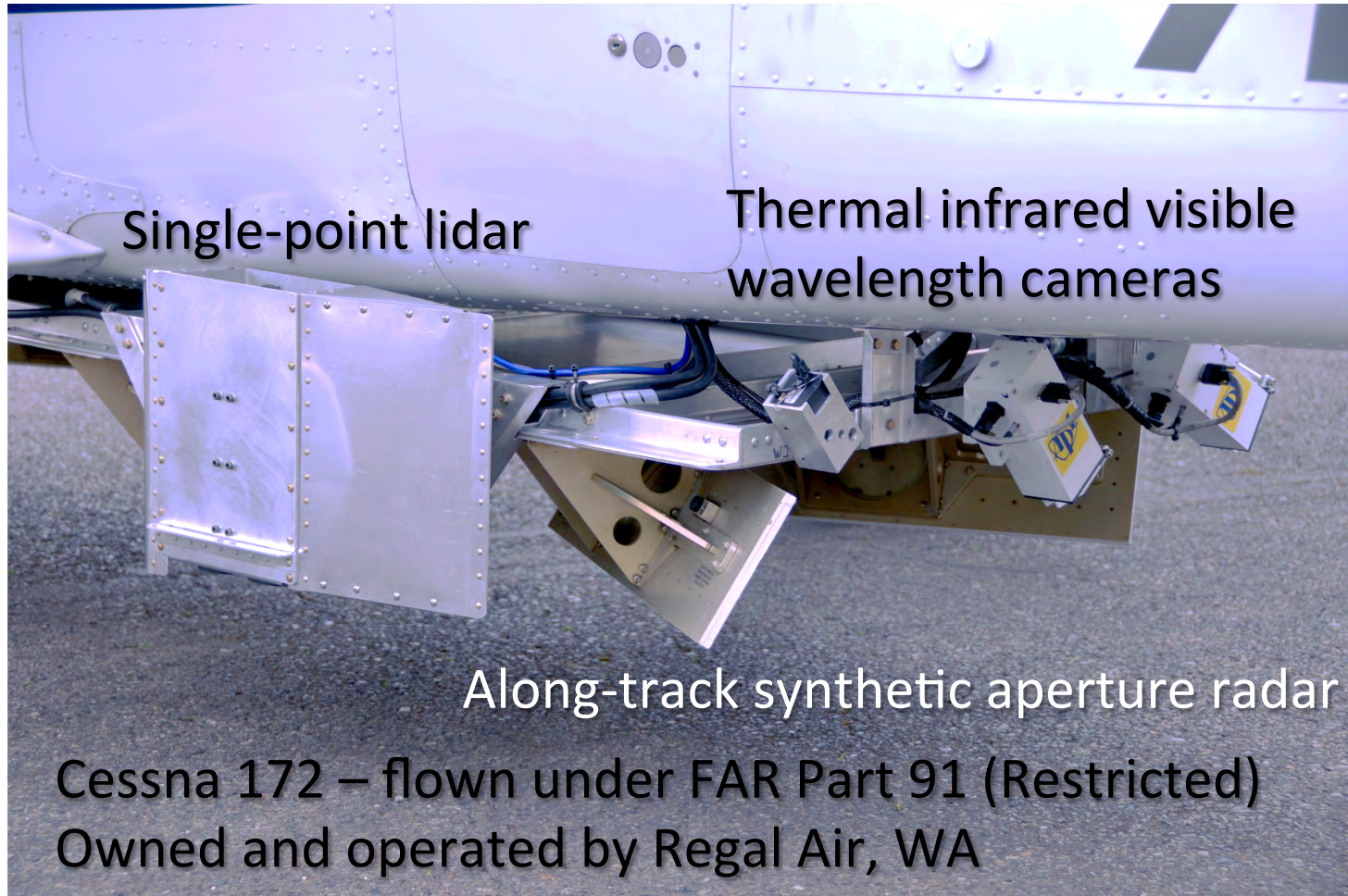
Lidar

- Ocean wave height
- Topographic mapping

Radar Antenna Mount (RAM)



Compact Airborne System for Imaging the Environment (CASIE)

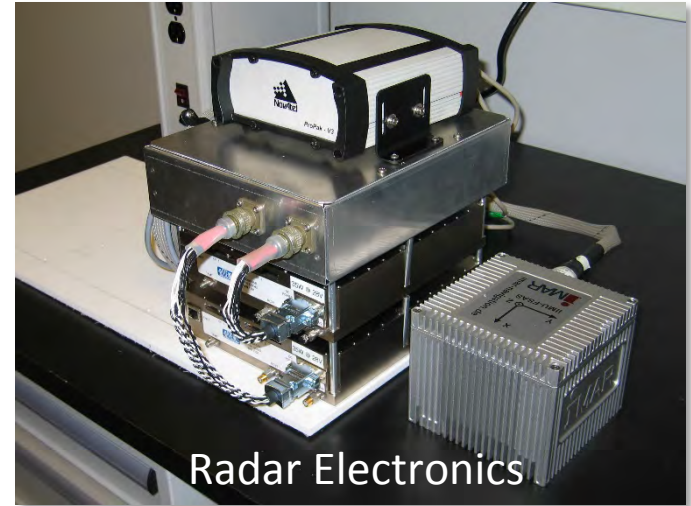


Past and Present Projects

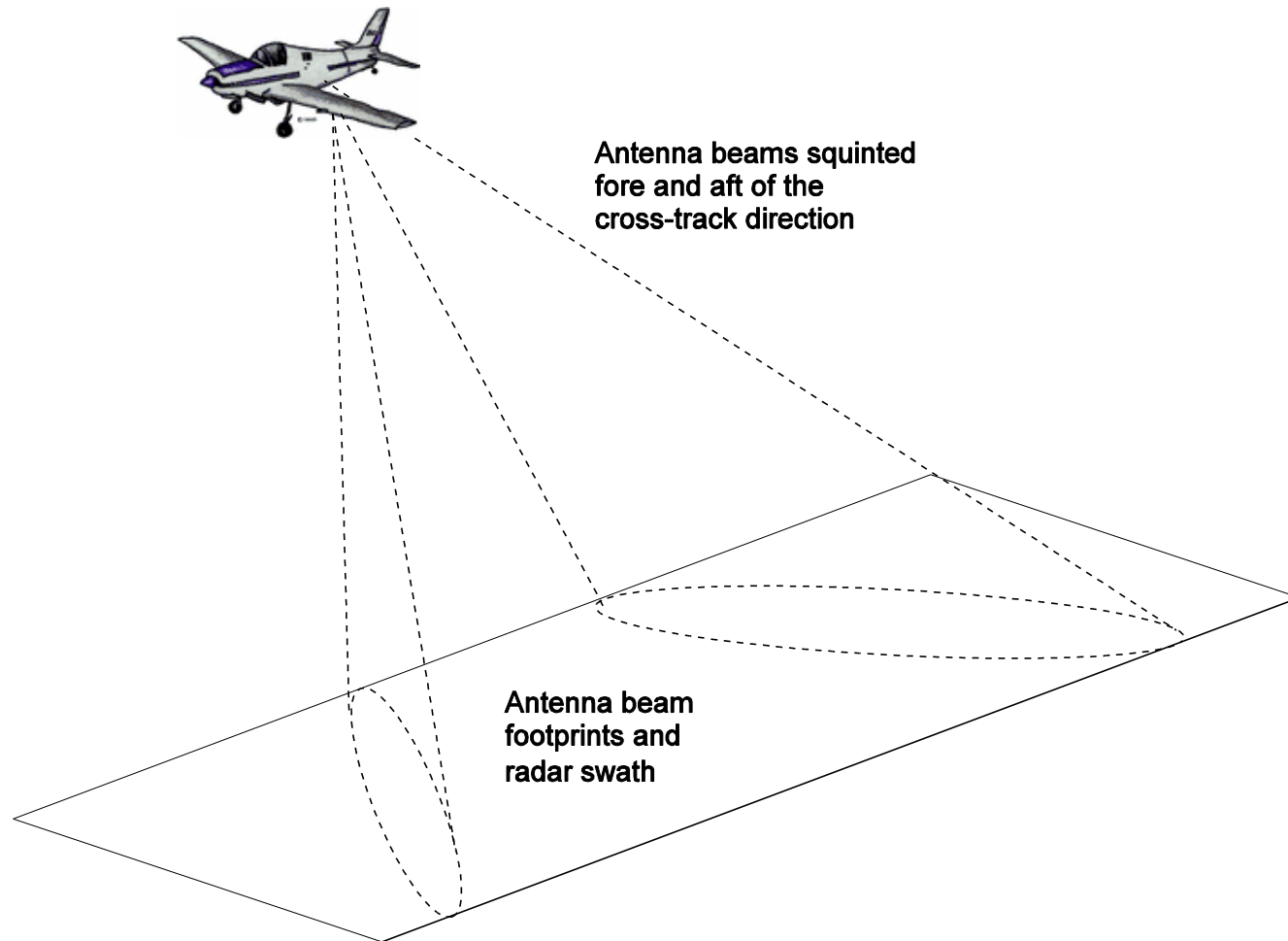
Year	Project	Location	Science Hours	Agency
2012	RIVET	NC	50	ONR
2012	CMOP	OR	20	NSF
2012	SWASH	WA / ID	30	DARPA
2013	AirSWOT	CA	20	APL/UW
2013	RIVET II	OR	80	ONR
2013	CMOP	OR	20	NSF
2014	Oso Landslide	WA	6	APL/UW
2014	DopplerScatt	WA	6	NASA/JPL
2014	Snow Temperature	CA	20	NASA
2015	Inner Shelf	CA	20	ONR
2016	Small Boat Detection	WA	20	NATO
2016	DopplerScatt	CA	30	NASA/JPL
2016	Multi-freq. ATI SAR	WA	20	ONR
2016	Snow Temperature	CA	20	NASA
2017	Inner Shelf	CA	50	ONR

ATI SAR

- The system consists of two C-band dual-channel transceivers built by Artemis Inc., an inertial navigation system, and six antennas
- The radar electronics are mounted in the baggage area of the Cessna 172
- Typically fly at around 3000 ft AGL, 90 knots
- Single-pass swath is around 3 km
- SAR data processed with GPUs



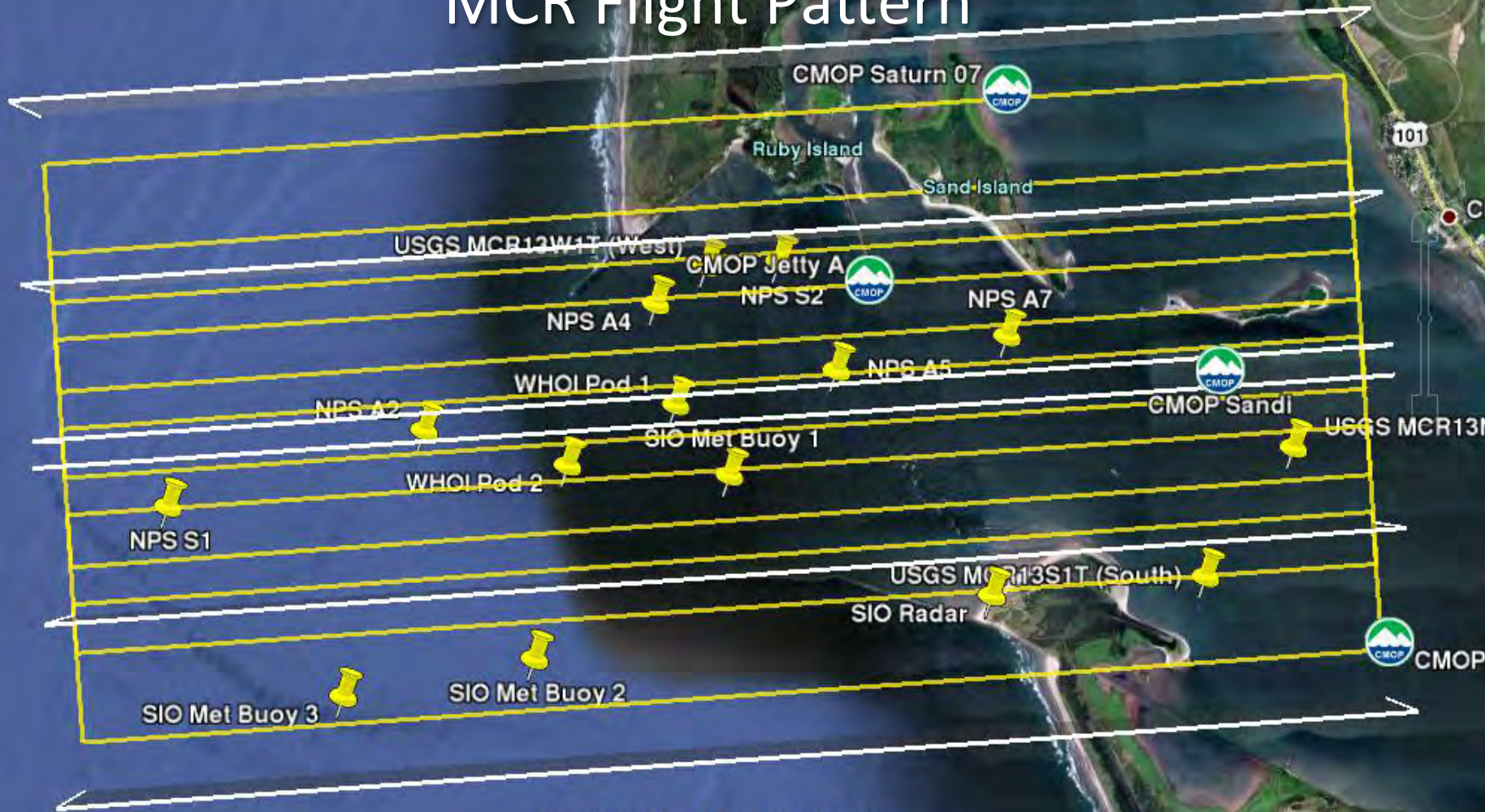
Dual-Beam ATI SAR



Mouth of the Columbia River



MCR Flight Pattern



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2013 Google

3.87 km

©2010 Google

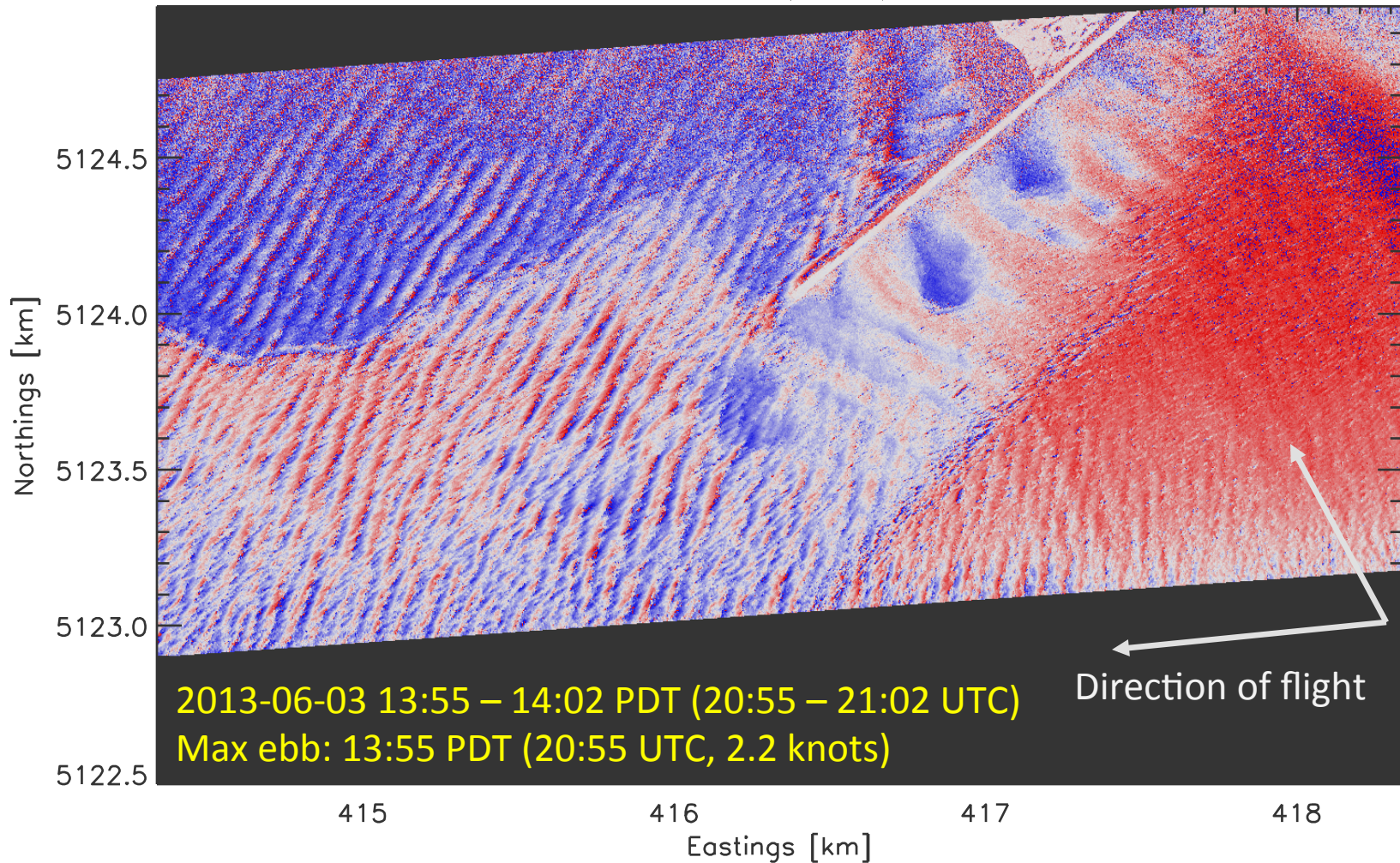
Imagery Date: 7/7/2012

lat 46.249986° lon -124.063550° elev -8 m

Eye alt 16.62 km

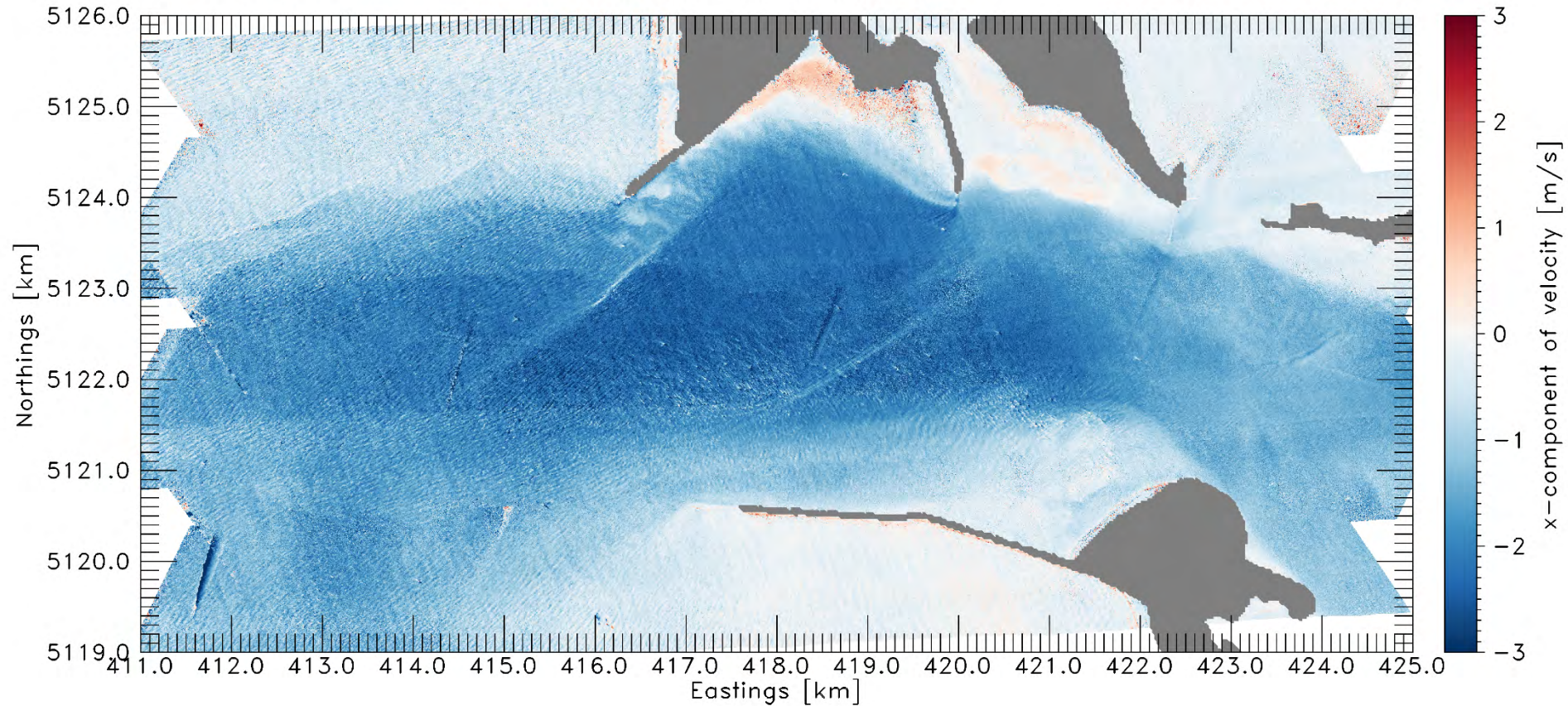
ATI SAR Interferograms

Phase $(-\pi, \pi)$



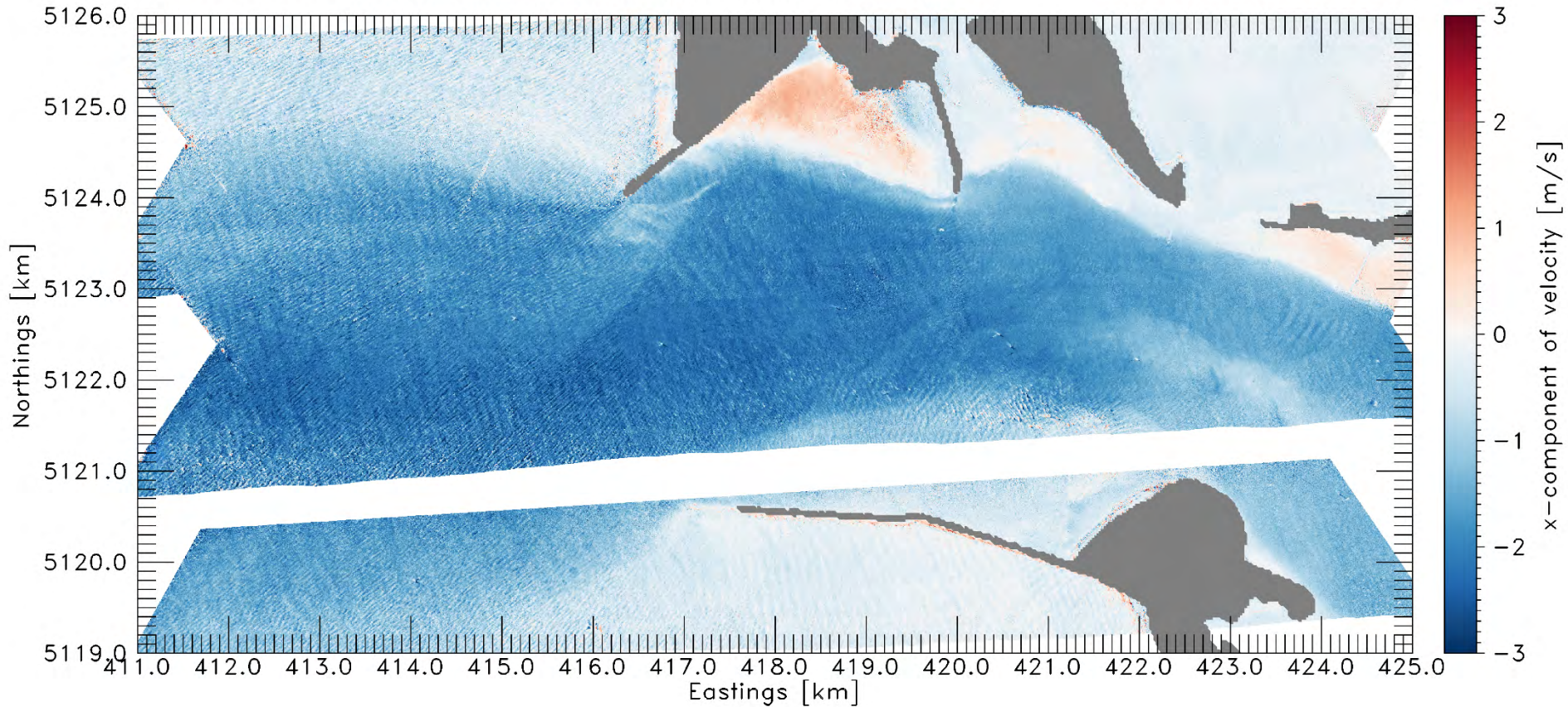
MCR Ebb Flow

Tue Jun 4 21:58:24 2013



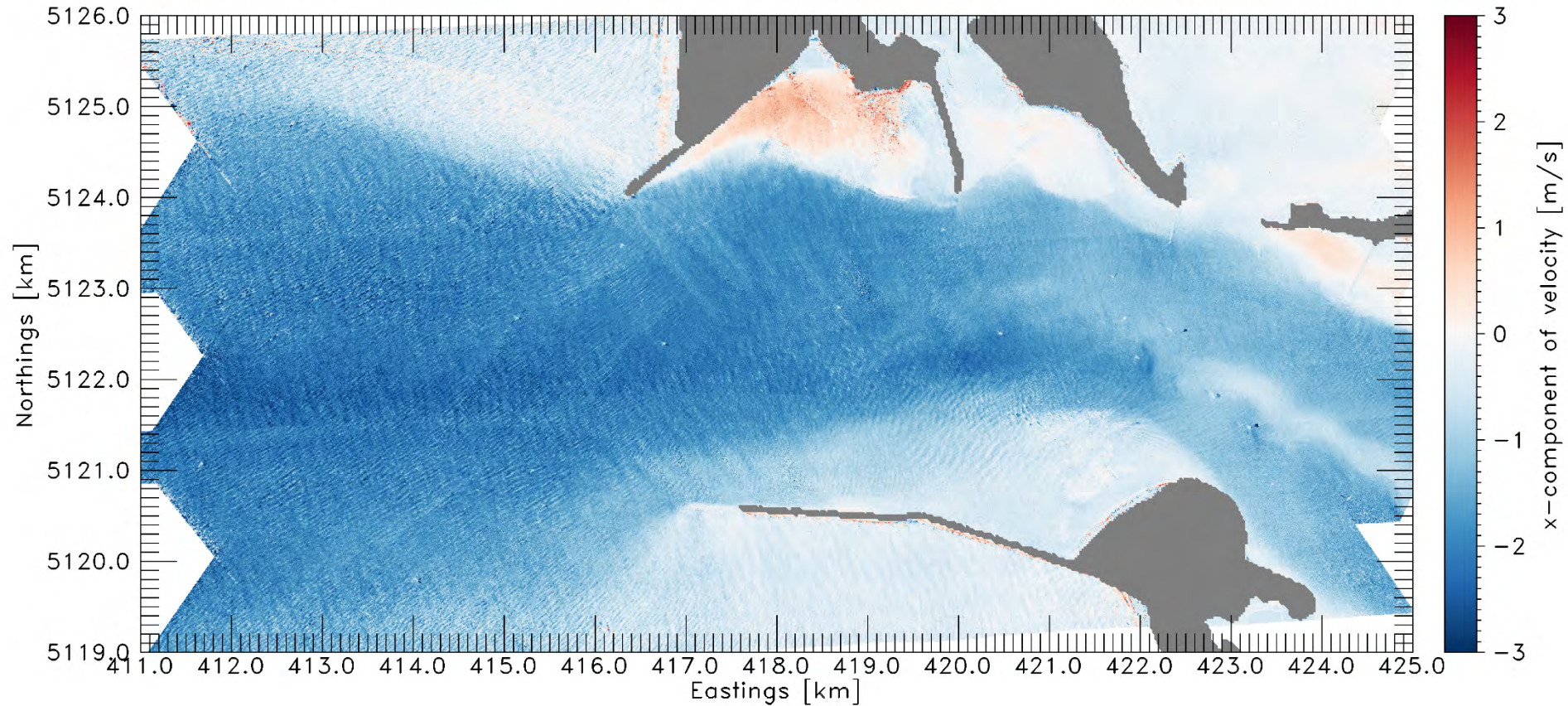
MCR Ebb Flow

Tue Jun 4 22:49:36 2013



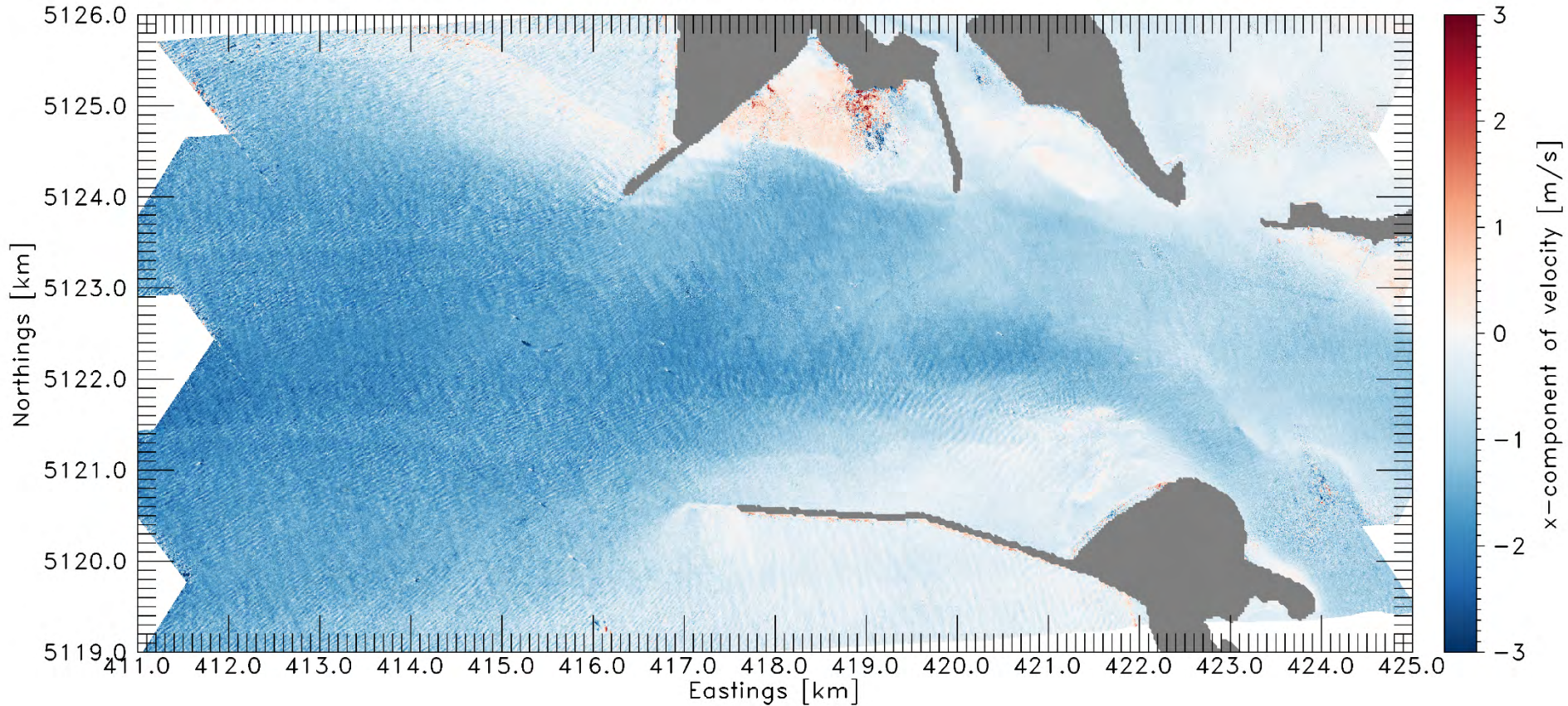
MCR Ebb Flow

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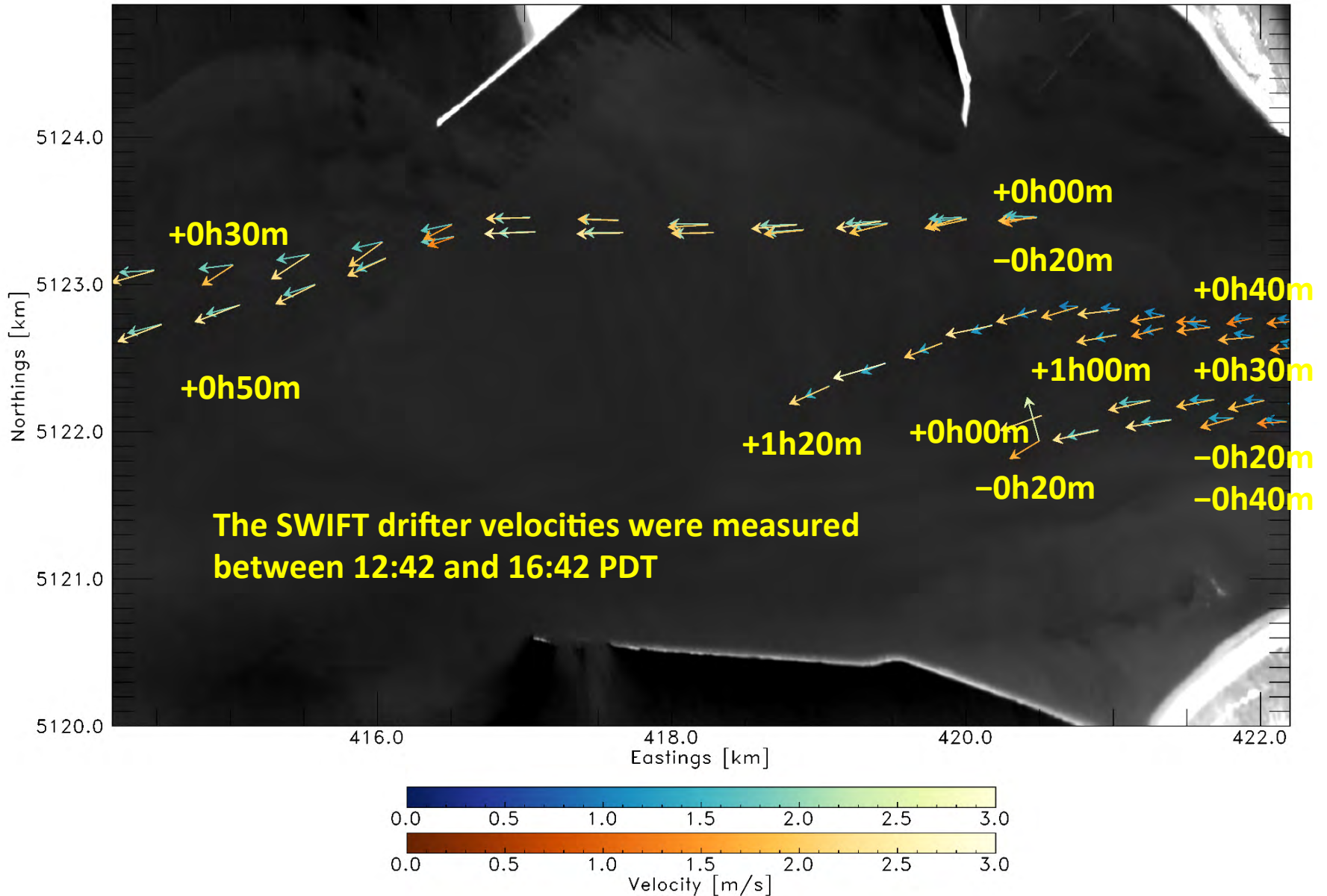


MCR Ebb Flow

Wed Jun 5 00:32:00 2013



Data collected from 14:42 to 15:12 PDT on June 4, 2013 (max. ebb flow around 14:50 PDT)

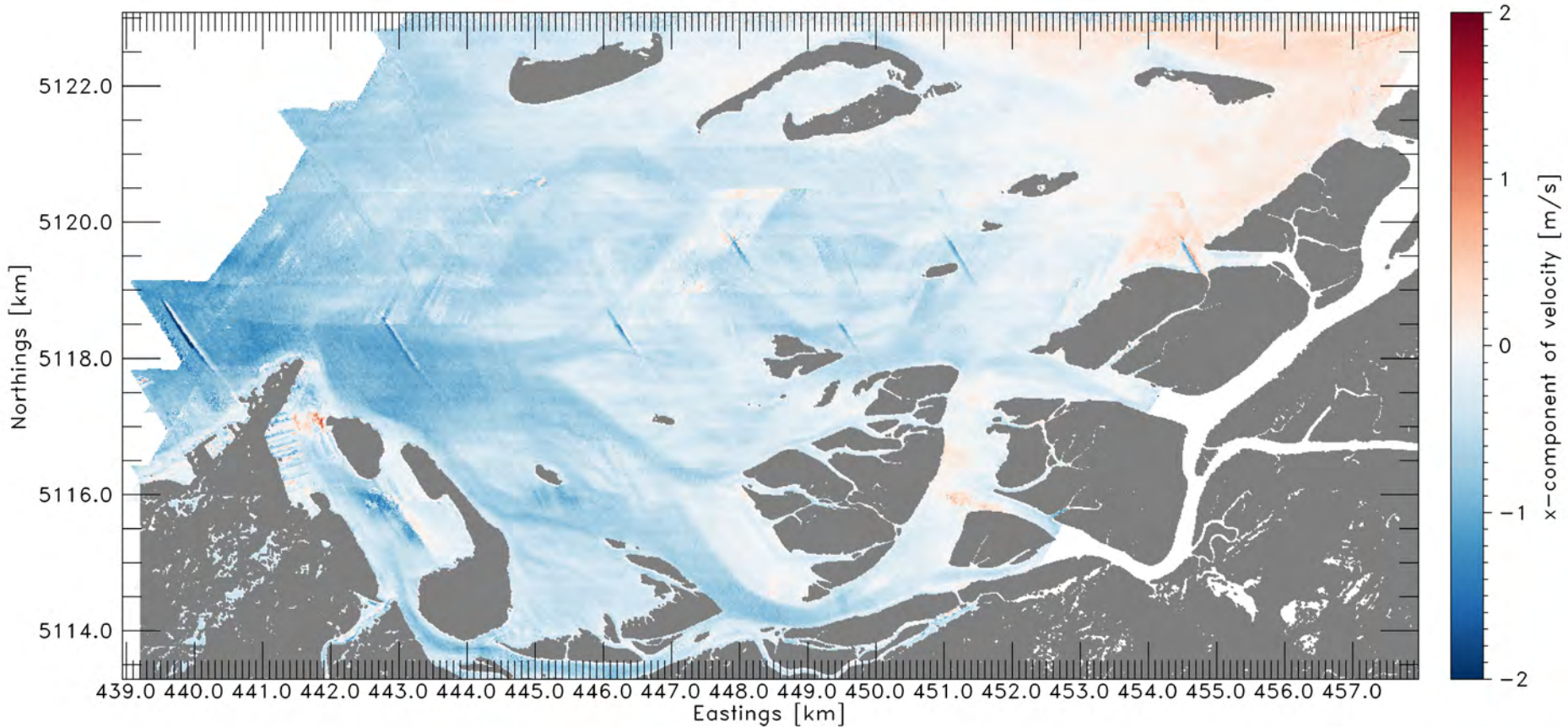


Cathlamet Bay



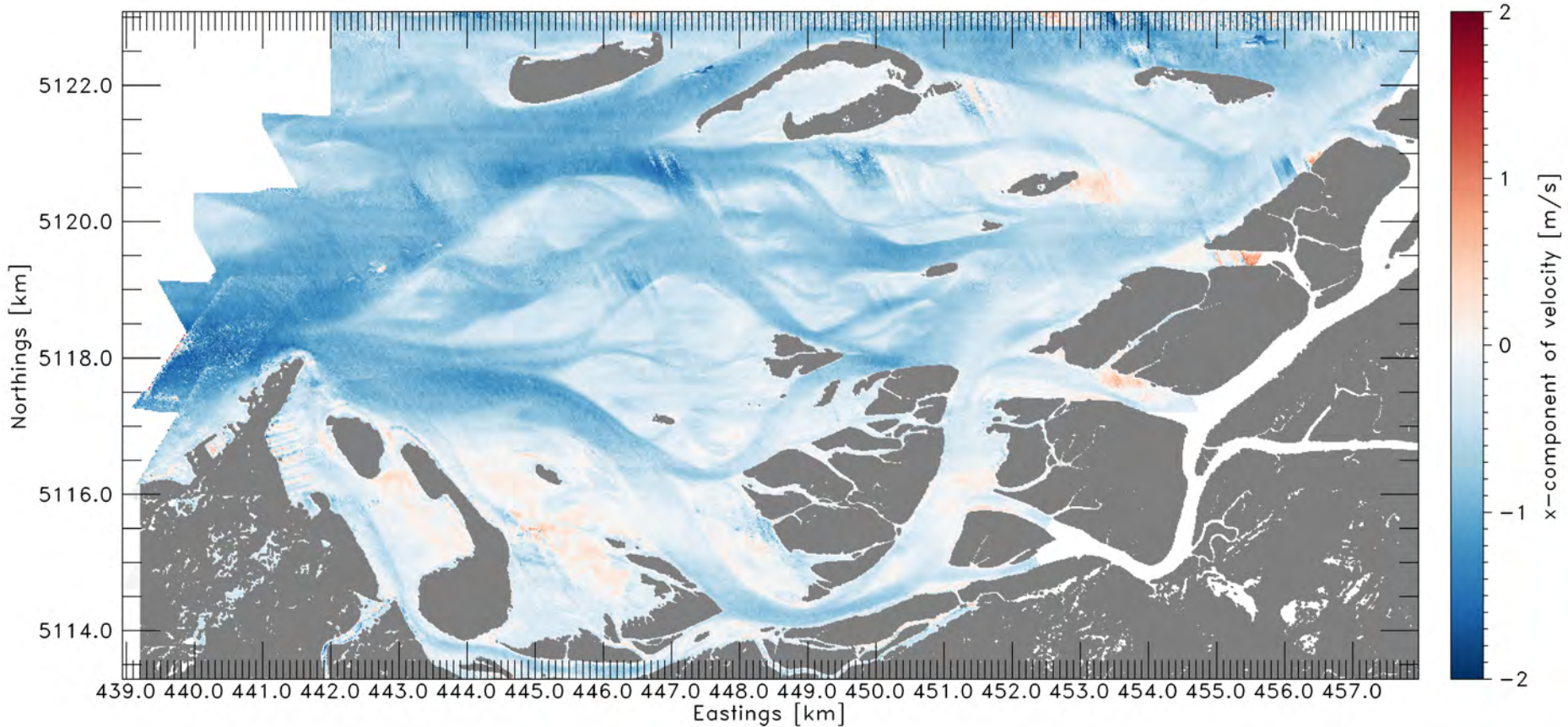
Cathlamet Bay

Tue Aug 20 23:04:32 2013



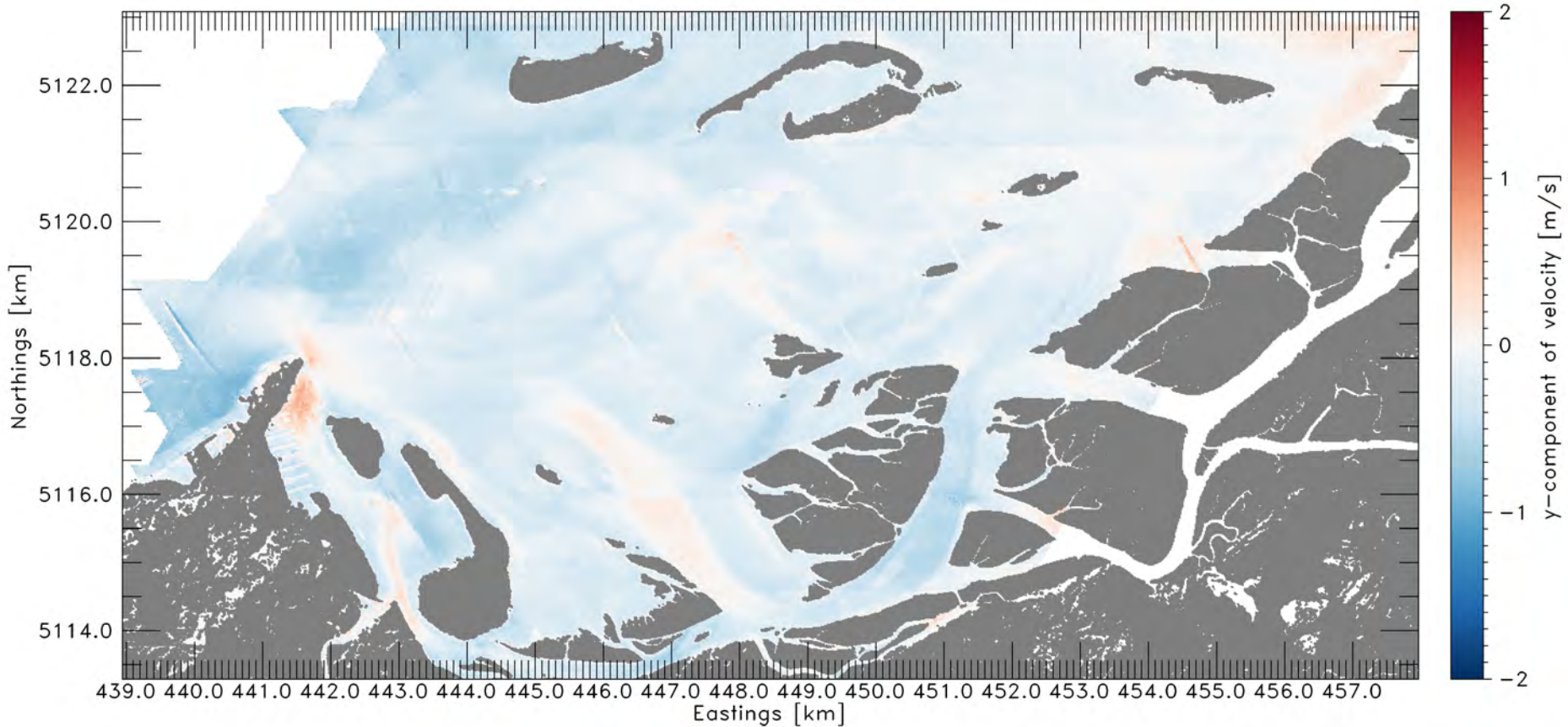
Cathlamet Bay

Wed Aug 21 00:59:44 2013



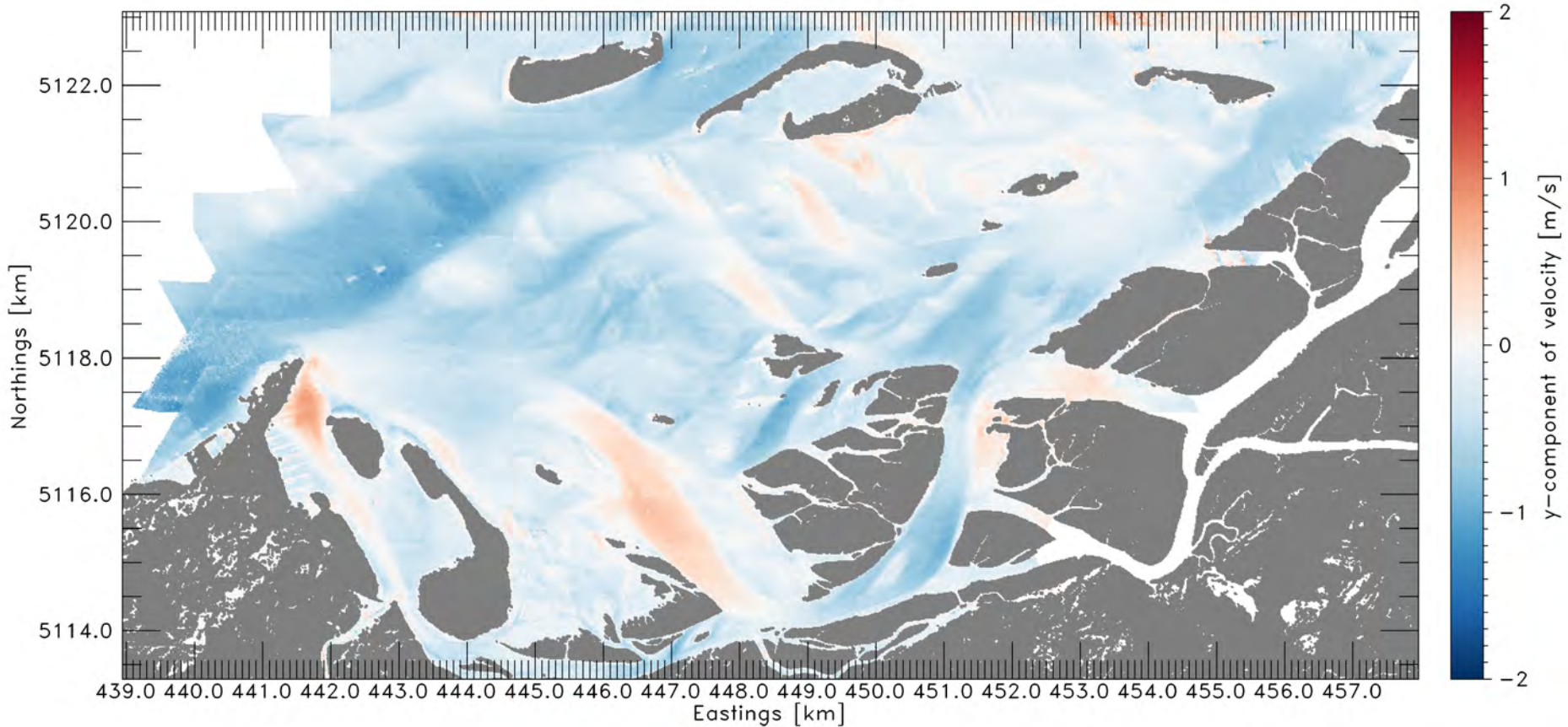
Cathlamet Bay

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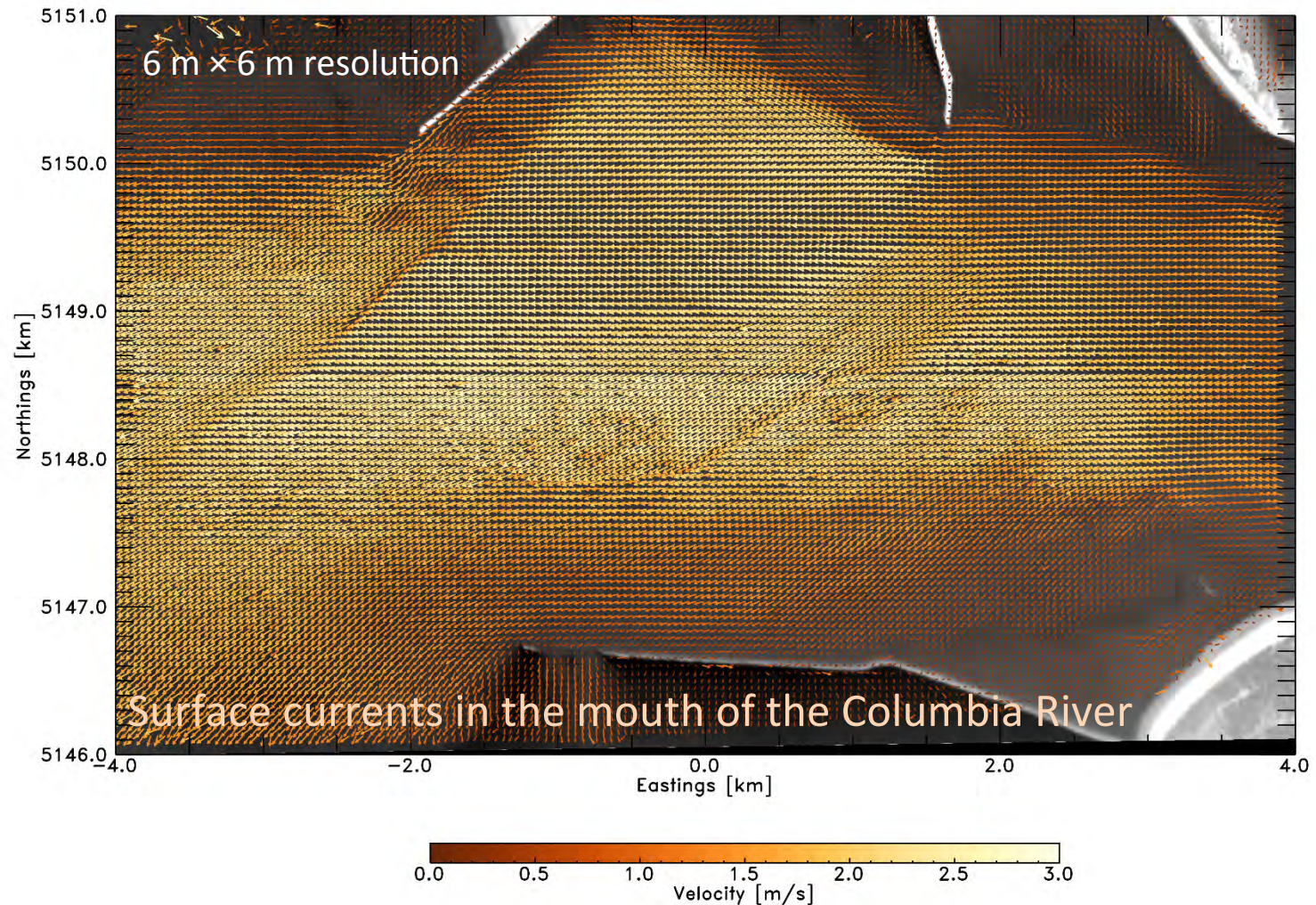


Cathlamet Bay

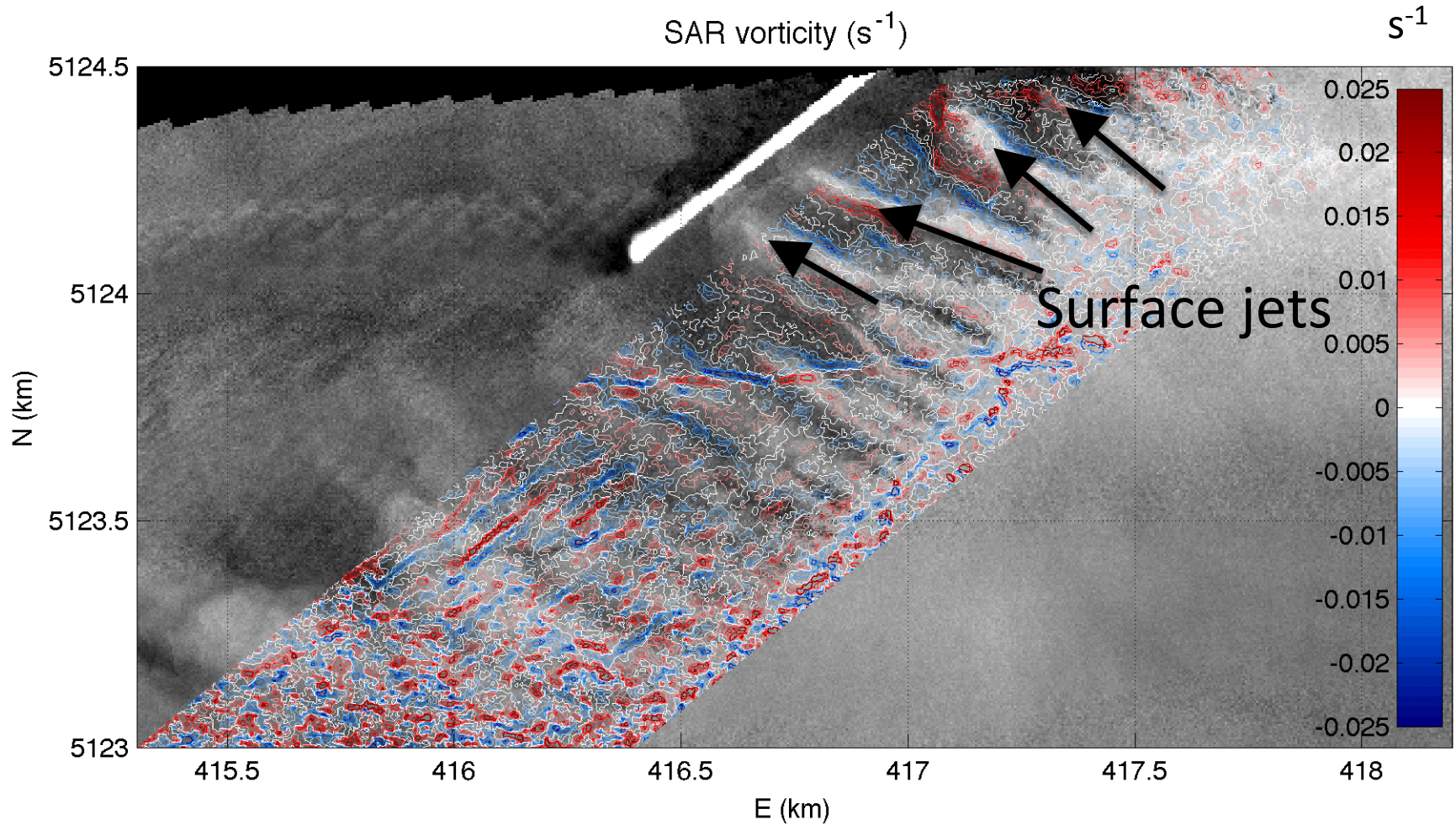
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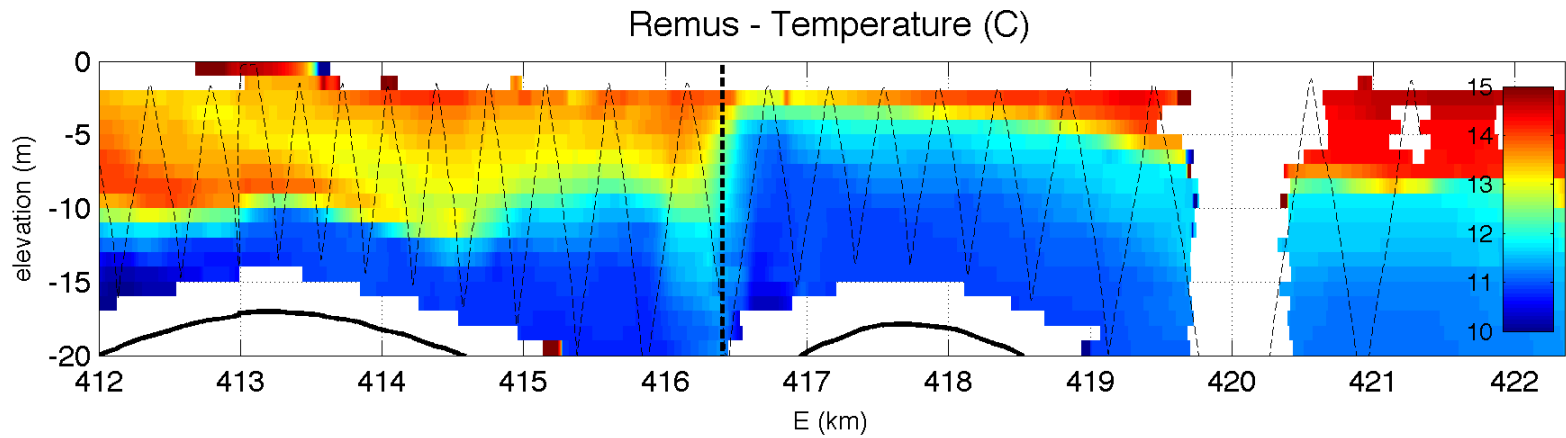
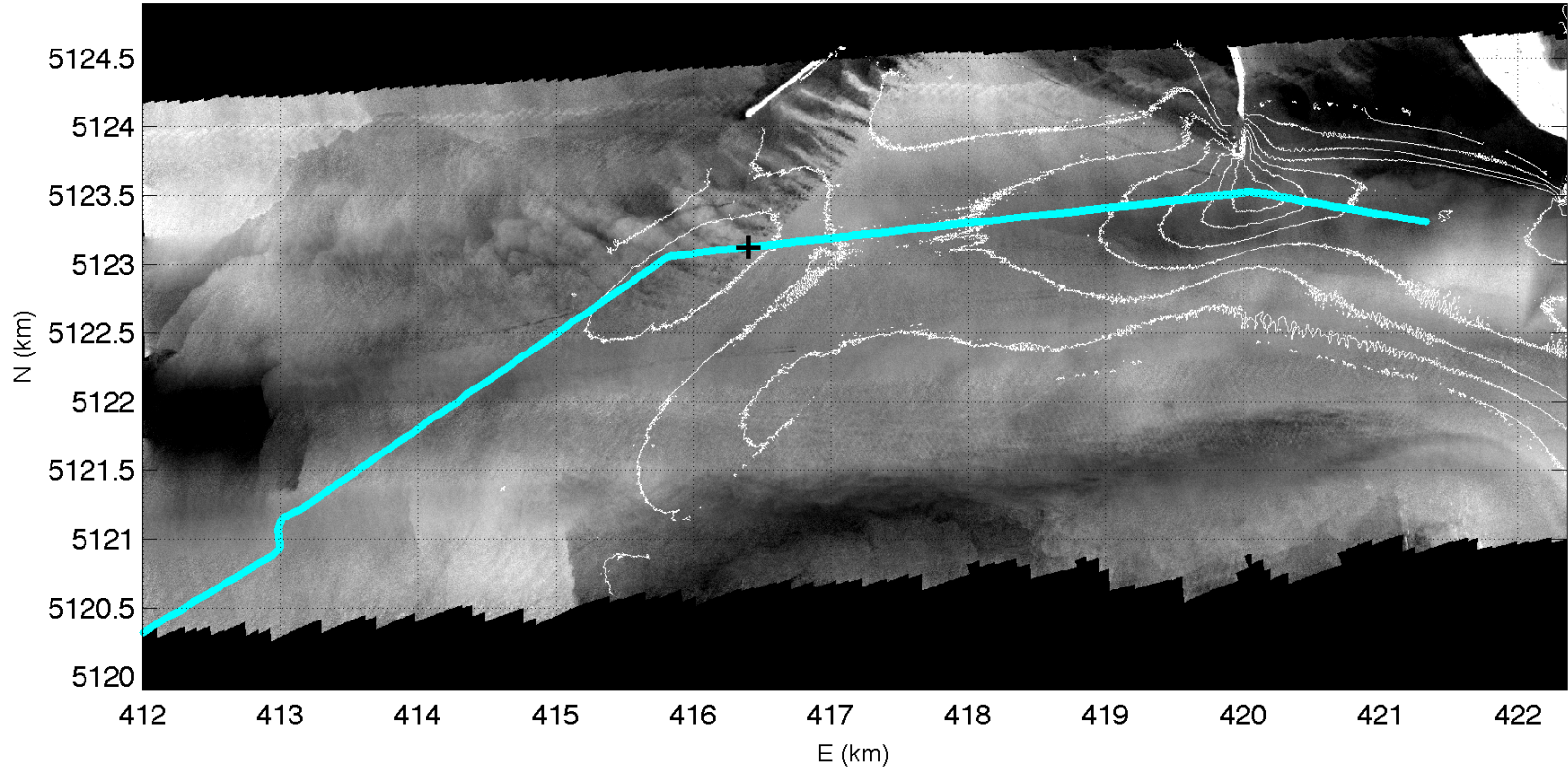
Mouth of the Columbia River – Internal Hydraulic Jump



Vorticity



2013-06-03 1343 PDT

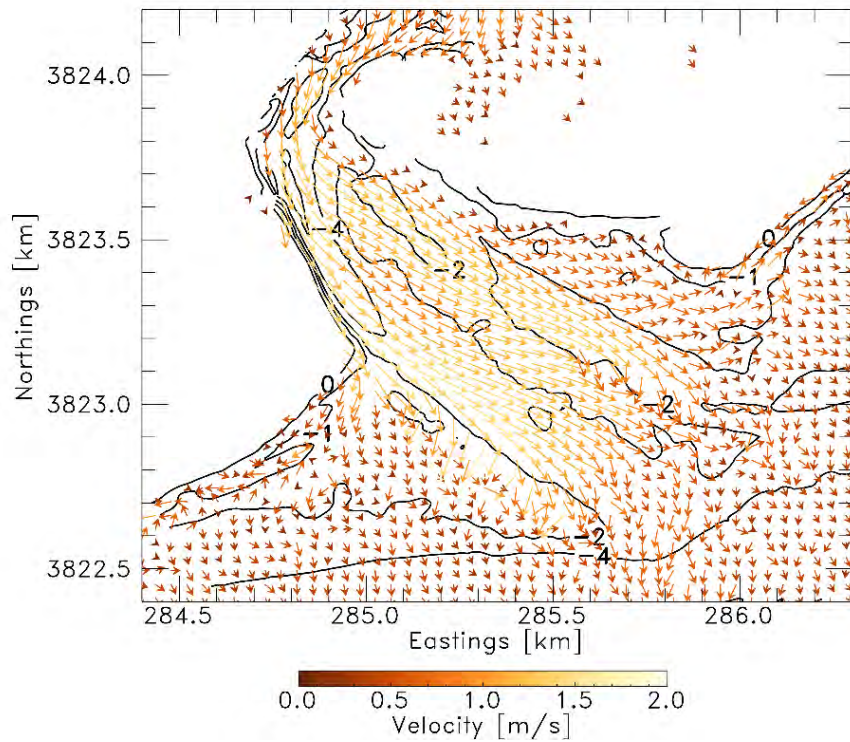


New River Inlet

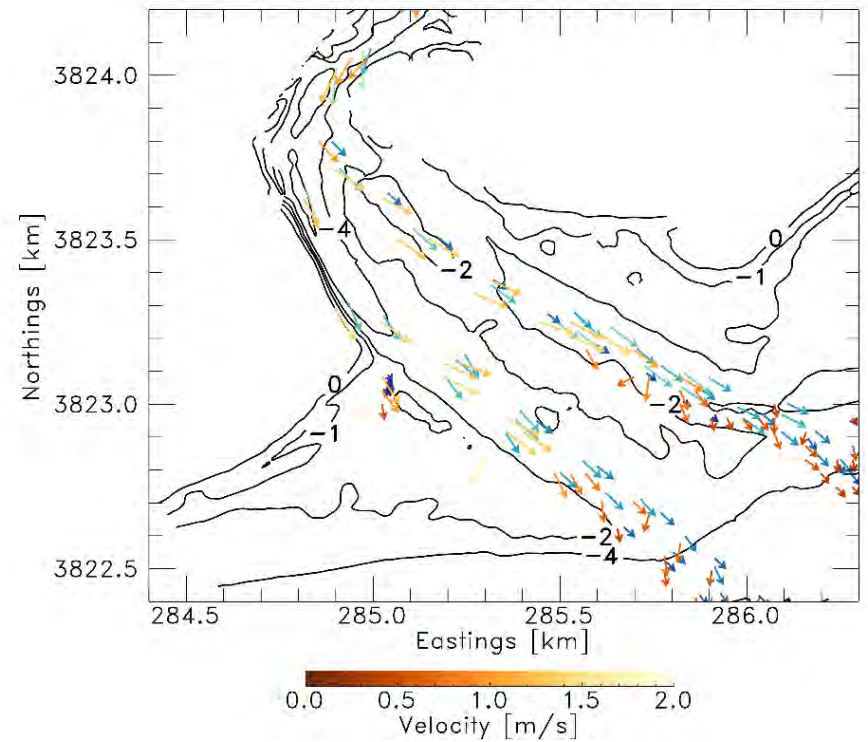


Comparison with SWIFT Drifter Measurements

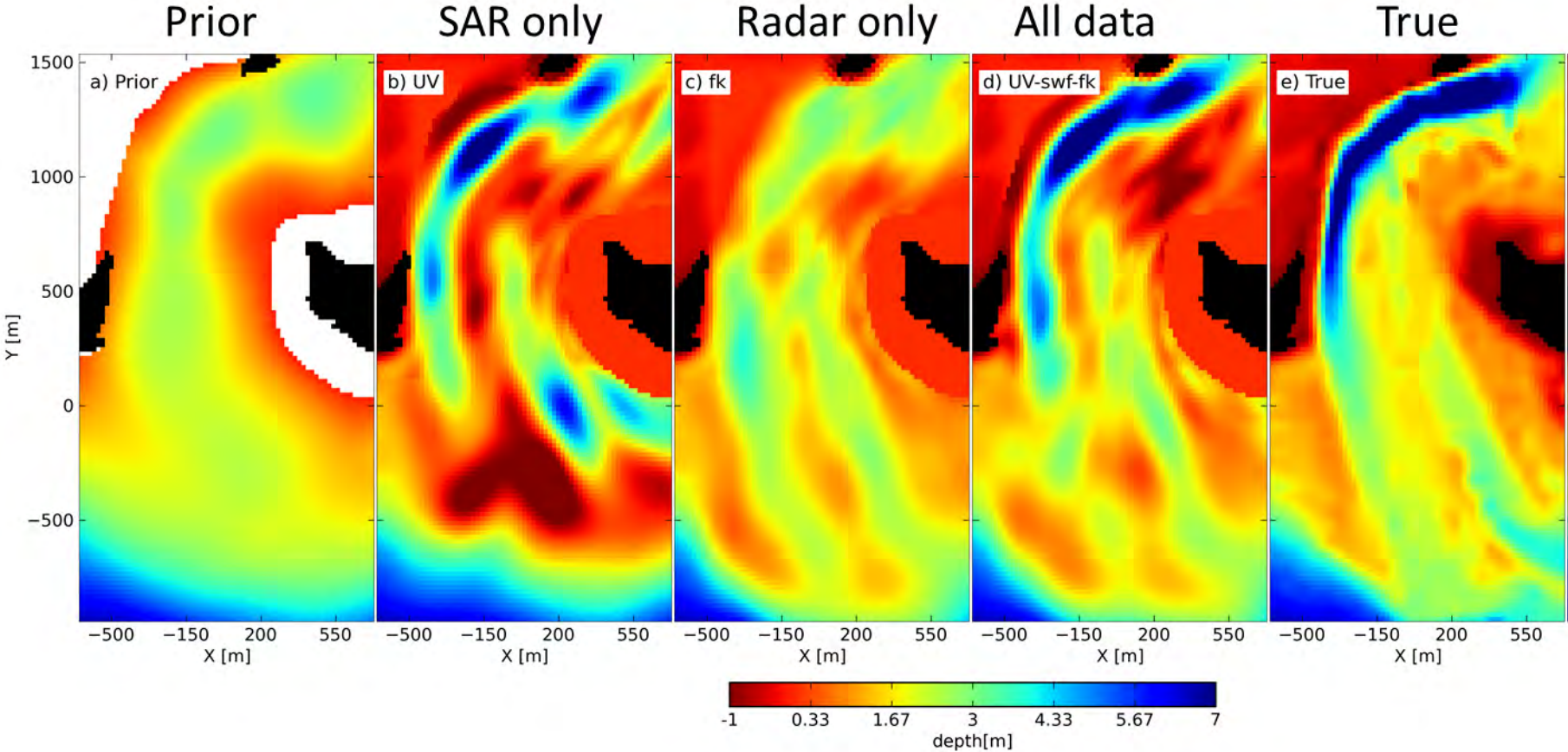
Radar



Radar and SWIFT



Bathymetric Retrieval

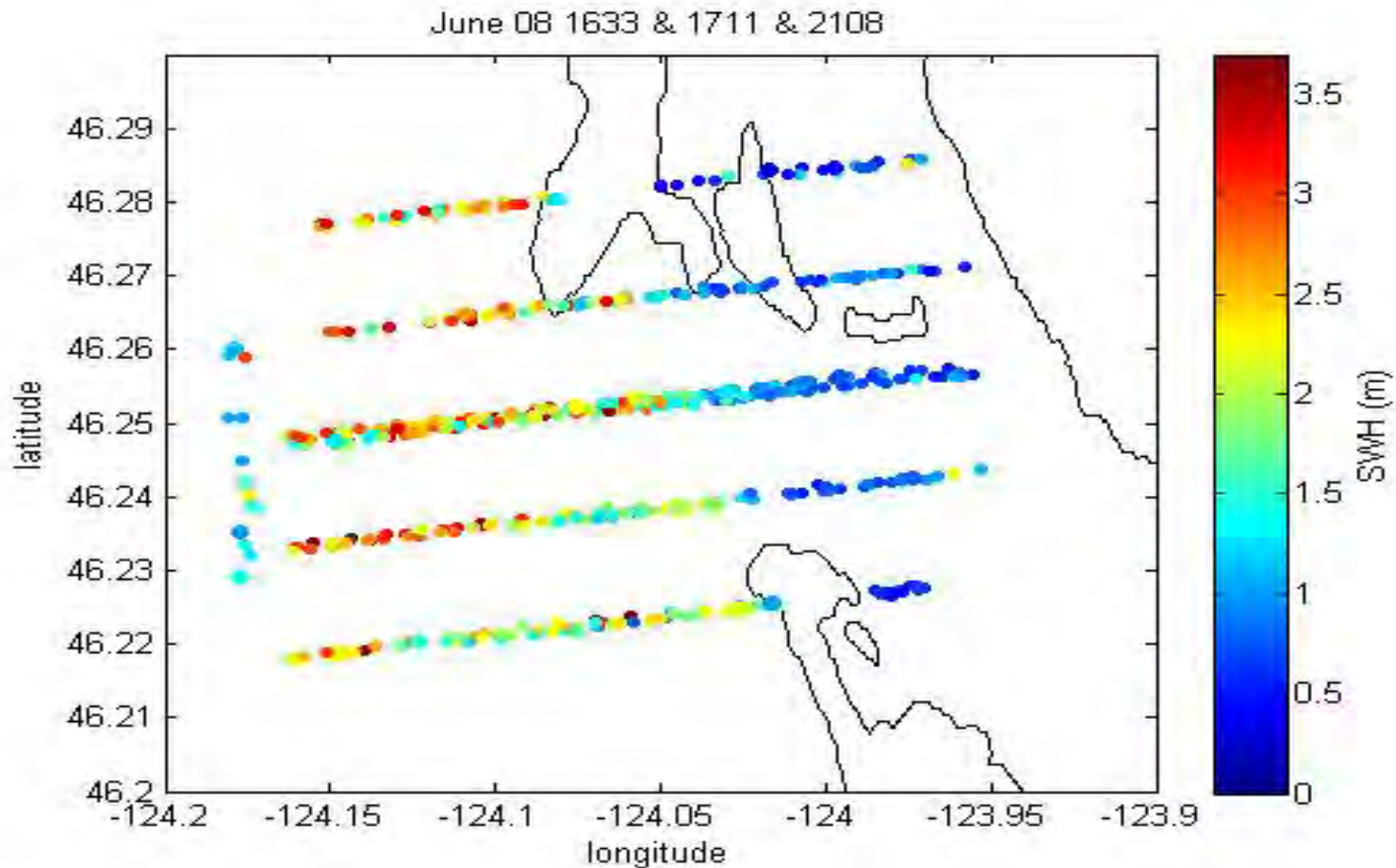


Other Instruments / Applications



Ocean Waves

Lidar wave height map of the mouth of the Columbia River

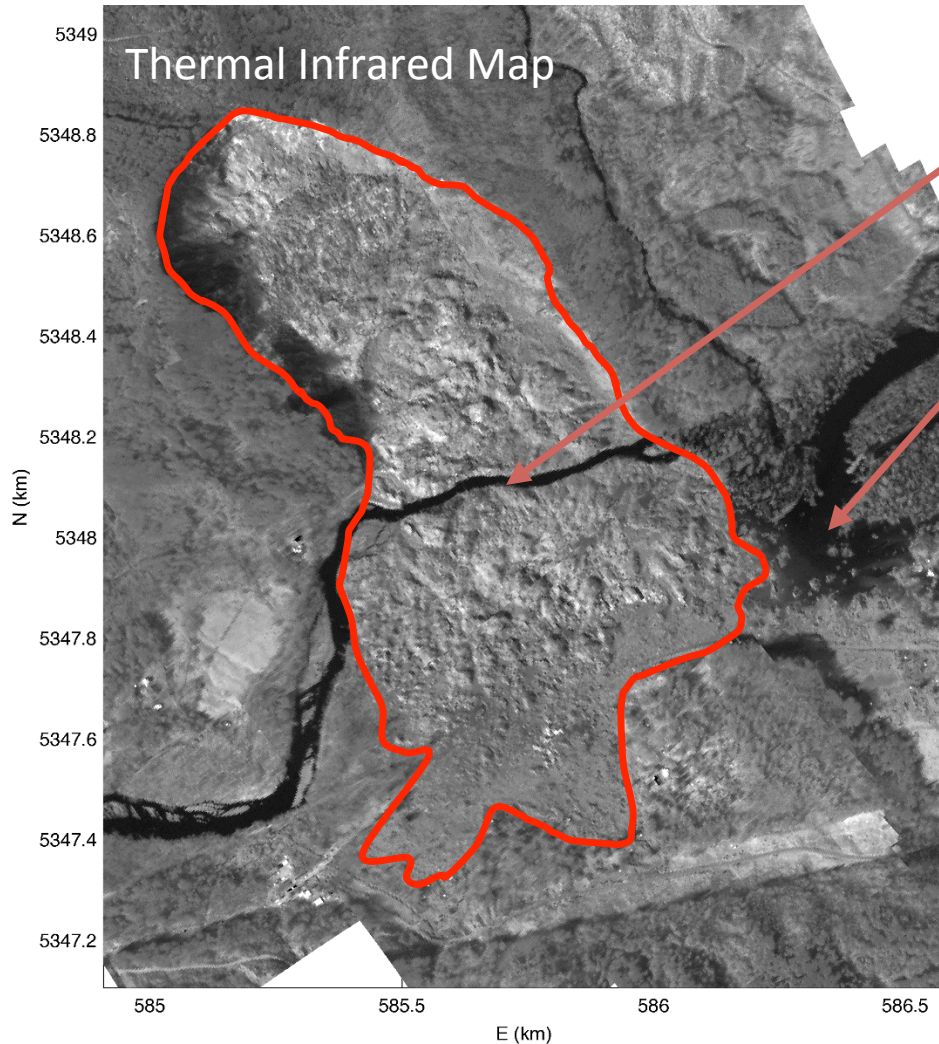


Ground Water Seepage



Hood Canal near Belfair, WA

Oso Landslide Extent



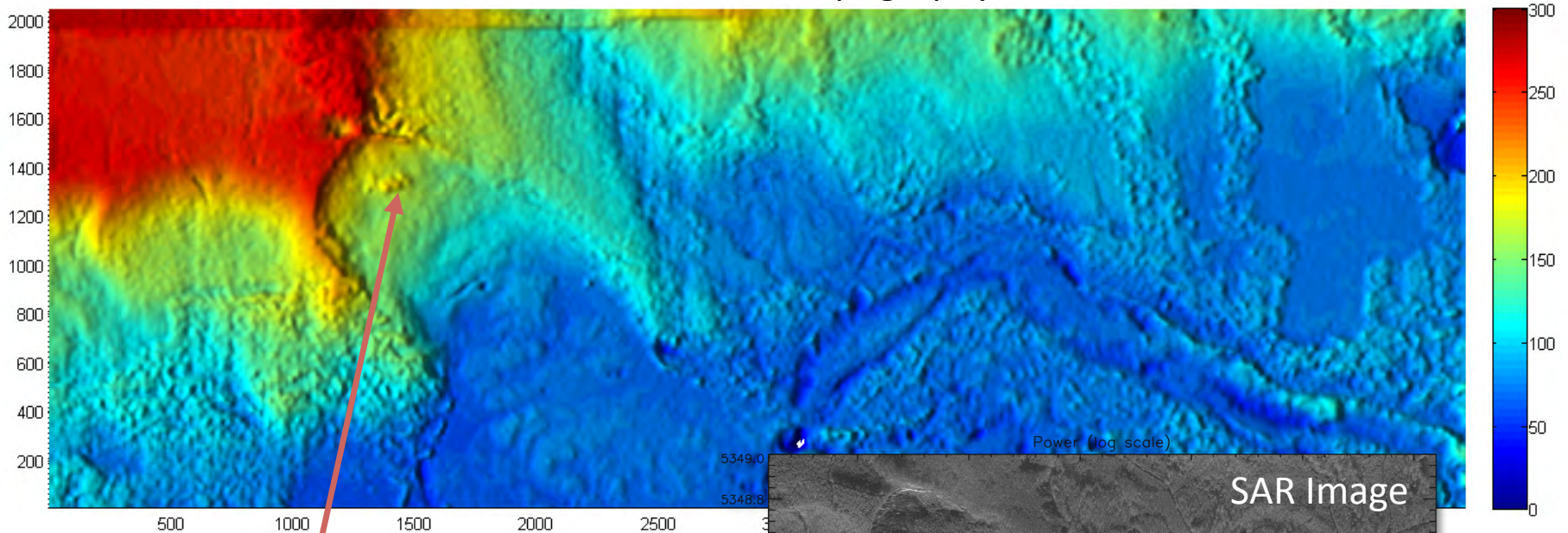
New river channel well established
9 days after the slide

Water inundated areas distinctly
imaged in infrared imagery

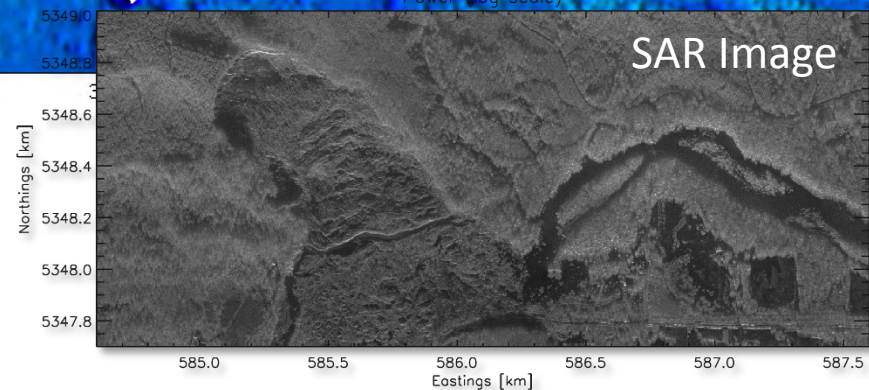


Terrestrial Mapping: Oso Landslide Topography

SAR-derived Topography

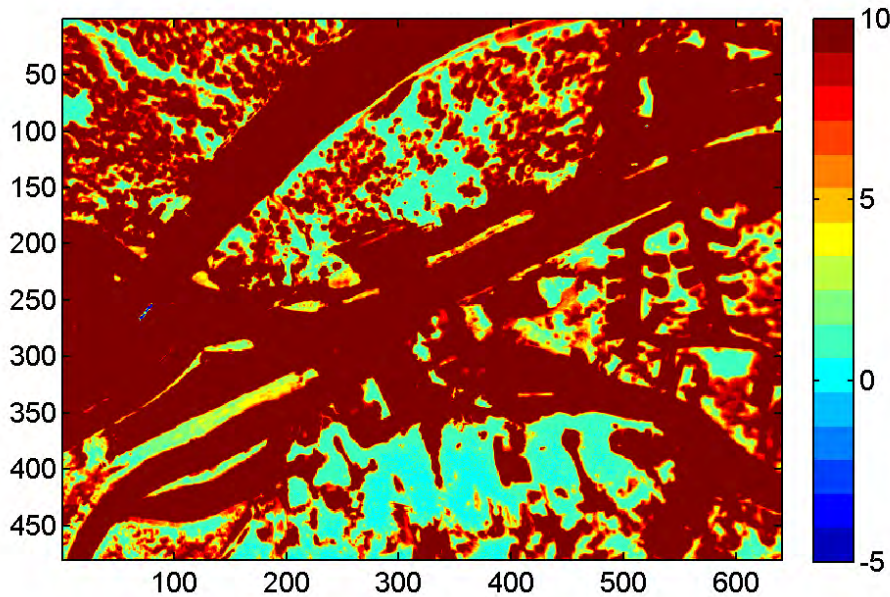


Oso landslide topography
measured with
interferometric SAR



Snow Temperature

Thermal Infrared



Visual Image



Snow coverage. Snow is around 0° C.

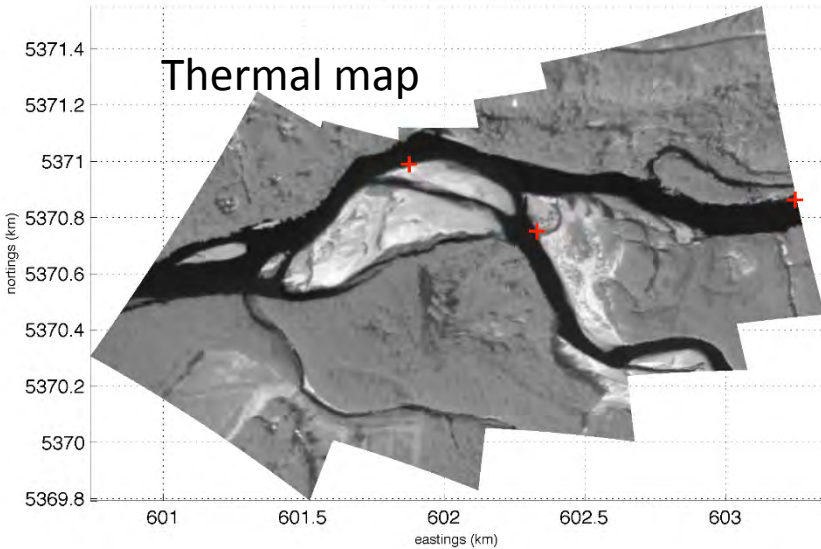
Snoqualmie Summit, WA

River Temperature

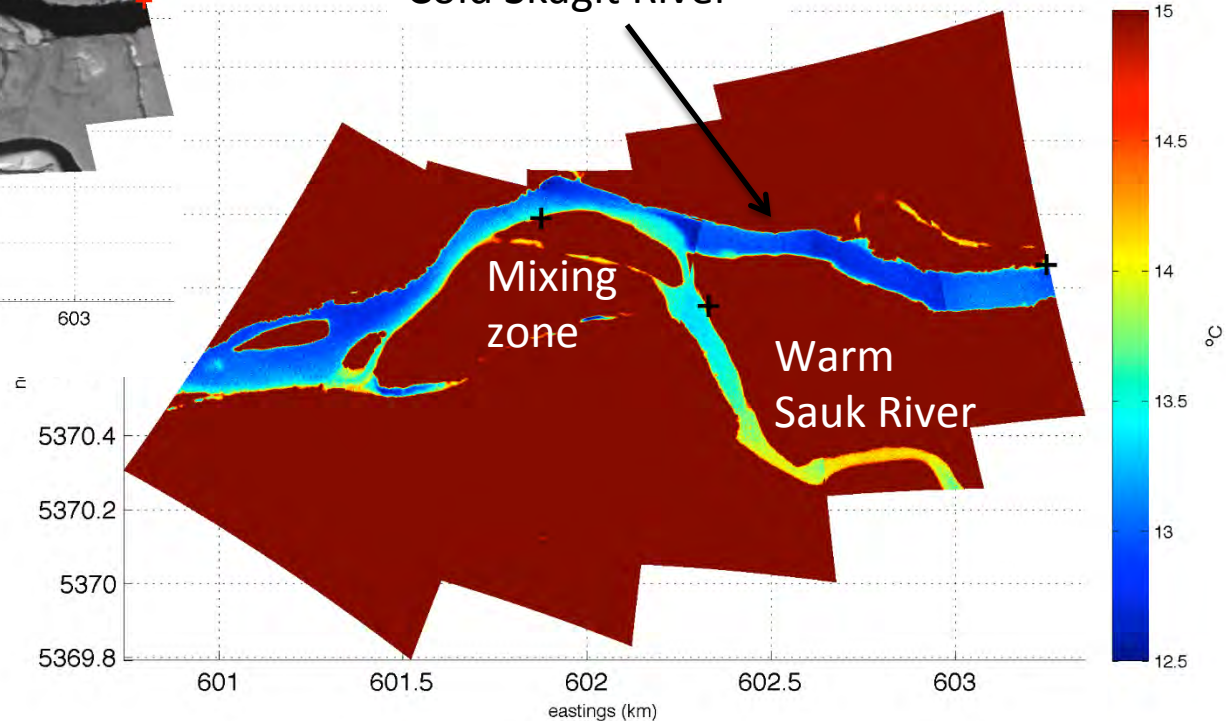
Skagit River, WA thermal characterization

Sauk-Skagit Confluence

Thermal map

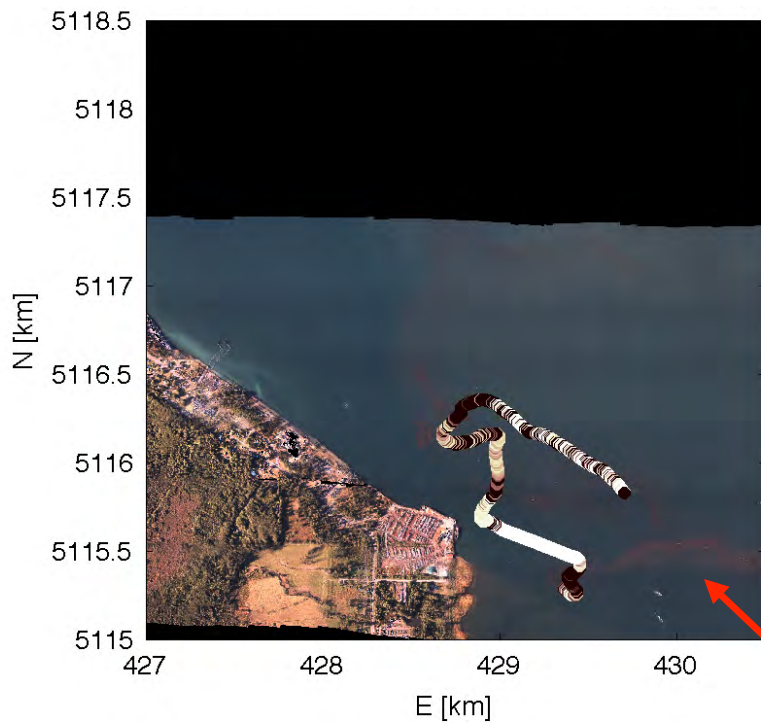


Cold Skagit River

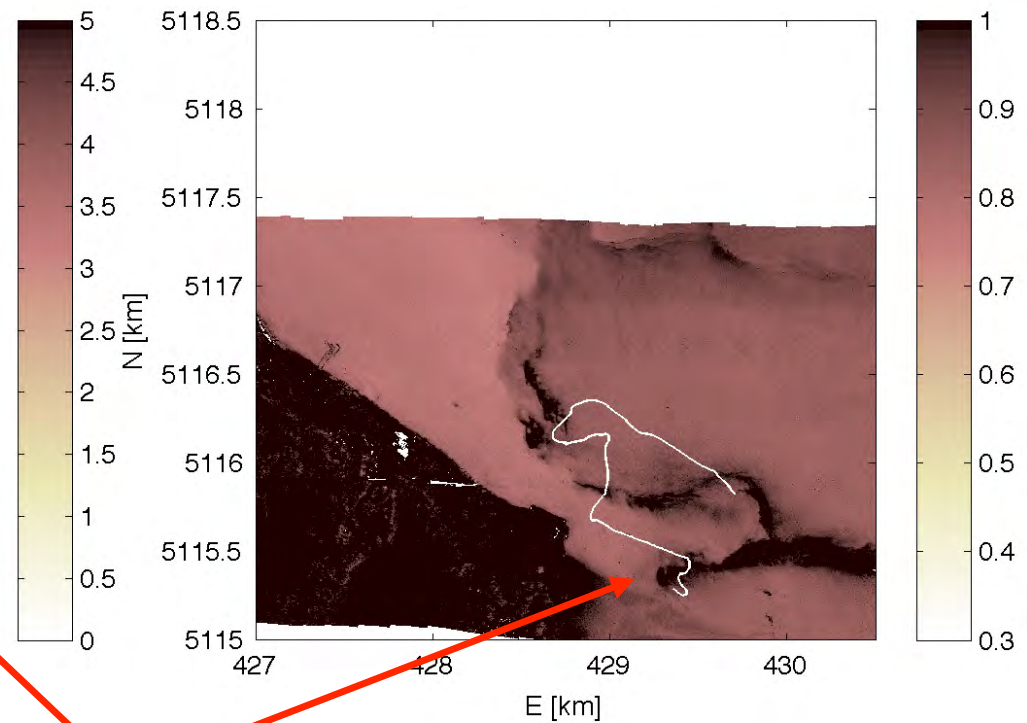


Algal Blooms

Visual Image



Bloom Concentration



M. rubra bloom mat in the south channel of the Columbia River

Current Work

- Small ship detection project in July at the MCR
- Dual-frequency (L- and C-band) ATI SAR experiment in Fall to test the idea of estimating the Bragg-wave phase velocity contribution to the mean Doppler shift
- Inner Shelf field experiment in September/October next year
- Continue to improve surface current estimation by using a more detailed microwave scattering model to correct for wave contribution to the mean Doppler shift
- Work underway to calibrate the ATI SAR to estimate radar cross section to apply scatterometry techniques to estimate near surface wind speed and direction (project with JPL)

Summary

- Flexible platform for airborne remote sensing
- Limited to inland and coastal areas