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IMPROVED RETRIEVAL OF ALTIMETRY HEIGHTS IN COASTAL AND SEA ICE-COVERED REGION VIA WAVEFORM MODIFICATION AND RETRACKING

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GEODETIC SCIENCE
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Outline

- **Background**

    Objectives and altimetry data products

- **Improved data processing techniques**

    Waveform modification

    – Subwaveform Filtering (SF)

- **Application of SF waveforms at coastal and polar region**

- **Conclusions and future works**

    Application of novel waveform retracking techniques

Background:

- **Objectives:**

  ✓ Modifying contaminated waveforms before retracking

  ✓ To retain more samples and extend closer to the shoreline

  ✓ Applying developed technique to other "un-retrackable" area

- **Data products and retracker:**

  ✓ Envisat and Jason-2 altimetry
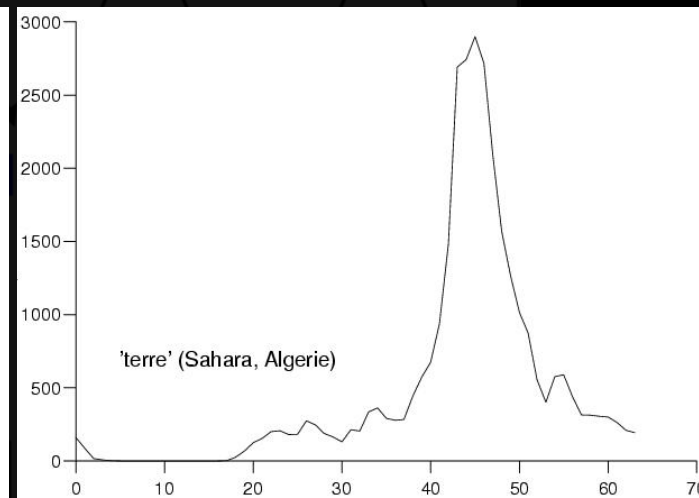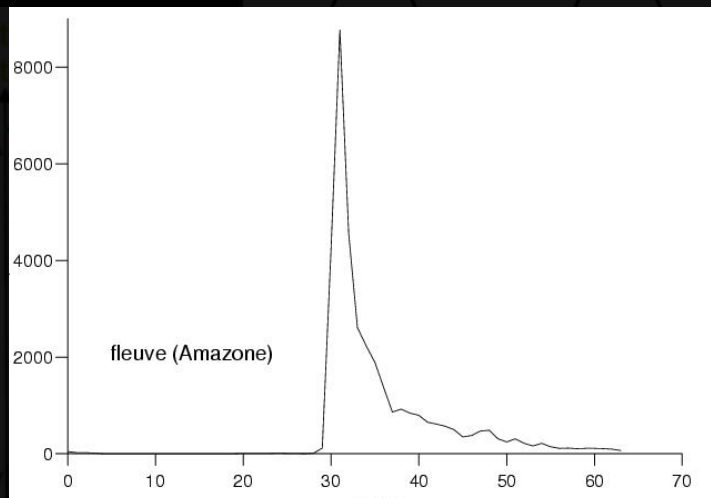
  ✓ 20% Threshold retracker (TR)

- **Error sources:**

  ? Insufficient information about sea surface condition

Waveform retracking: conventional methods

• Retrackers: OCEAN, ICE, OCOG, Threshold

ice, lake, river,…   land, mixed, …

Resource: AVISO (http://www.aviso.oceanobs.com/)

Waveform retracking: improved technique

Subwaveform Filtering (SF) method

- Coastal waveform peak migration

  Envisat ascending pass 305, cycle 91, near Freshwater Canal Locks gauge station, Louisiana
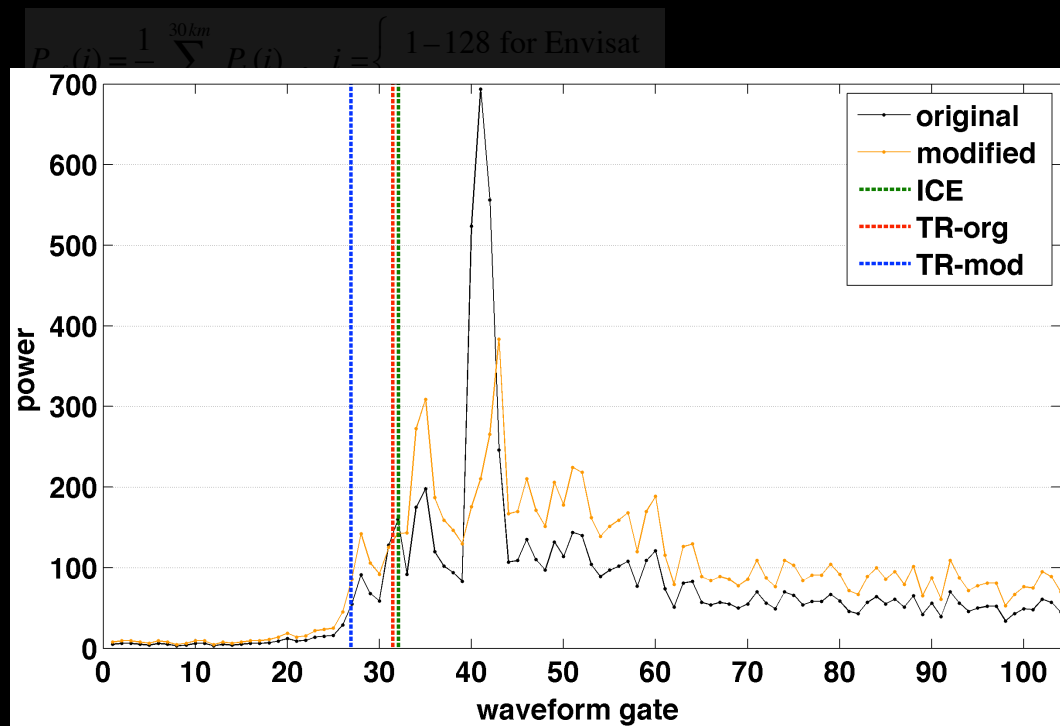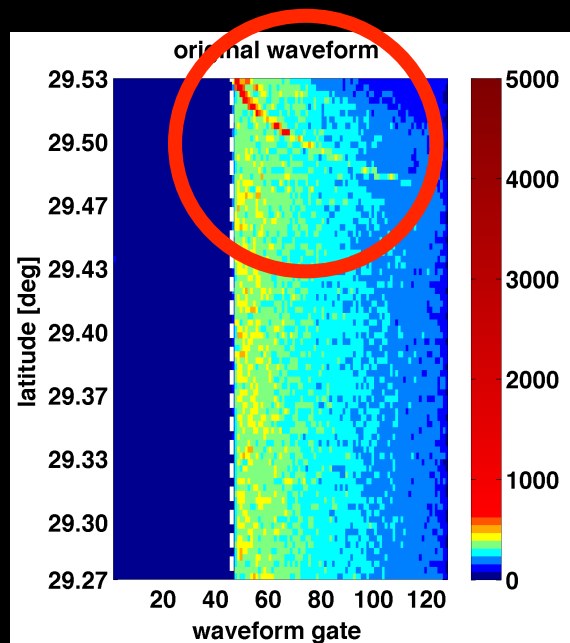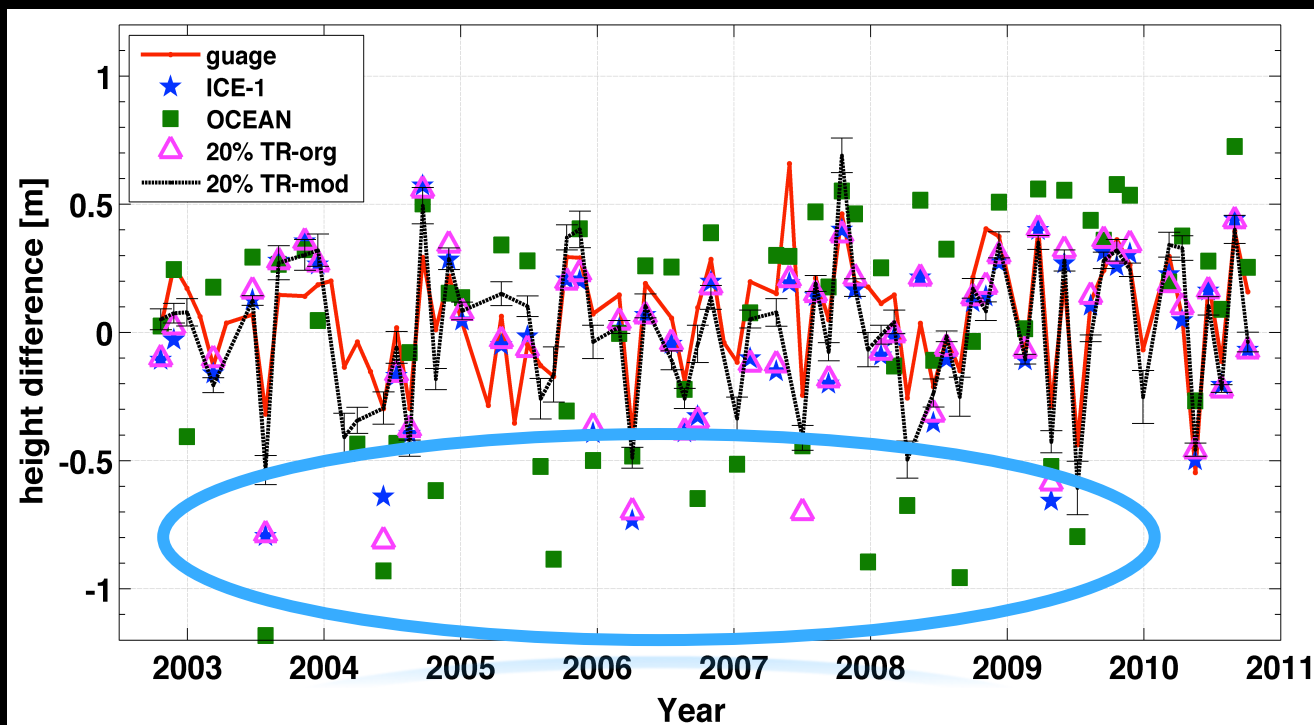
Waveform retracking: improved technique

Case study near Louisiana

• Example of improved result using SF method

Application

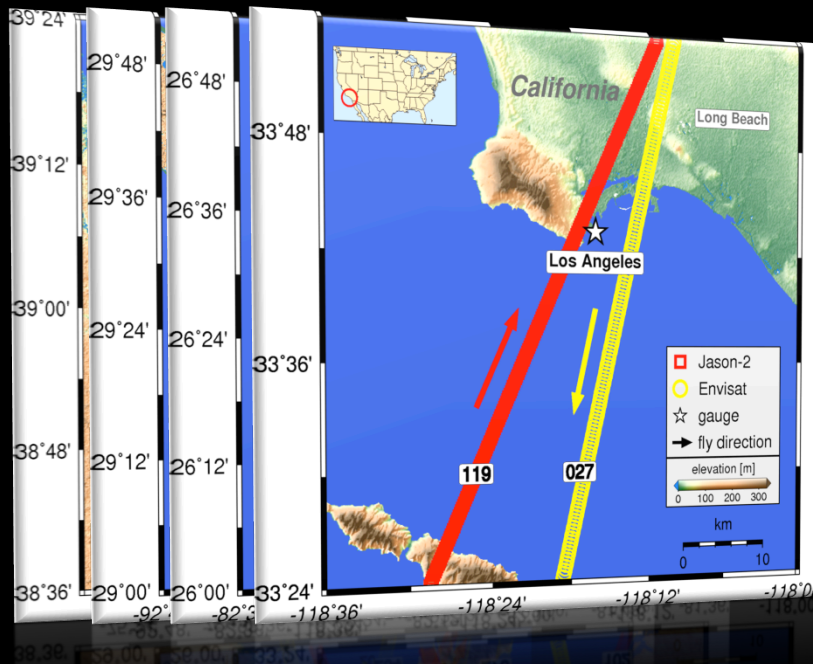# Waveform Retracking at Coastal Region

Subwaveform Filtering (SF) method

to eliminate spurious peak in coastal waveforms

Application of the **SF** method – coastal region

- **Study region**

- **Location selection criteria**

o Envisat, Jason-2 passes and nearby tide gauge stations

o Gauge station (NOAA) provides 6-min high resolution measurement

o The distance to the shoreline is roughly determined by the AVISO pass locator

o Occasional orbit drift up to ±1 km is ignored

Application of the **SF** method – coastal region

Averaged improvement of the four study regions

- Statistical comparison

| Satellite and Retracker	1km-7km		0.5km-1km	
	RMSE [cm]	invalid cyc in ts	RMSE [cm]	invalid cyc in ts
ICE/ICE-1	25±39	8.7	50±16	9.3
OCEAN	56±76	8.8	44±12	30.7
Threshold (original)	29±47	9.3	50±16	8.8
Threshold (SF)	22±31	9.3	54±15	9.1
Mod. Threshold (original)	47±155	16.4	193±66	15.5
Mod. Threshold (SF)	42±111	12.7	224±71	11.7

Applications

Waveform Retracking near Polar Region

Applying Subwaveform Filtering (SF) method

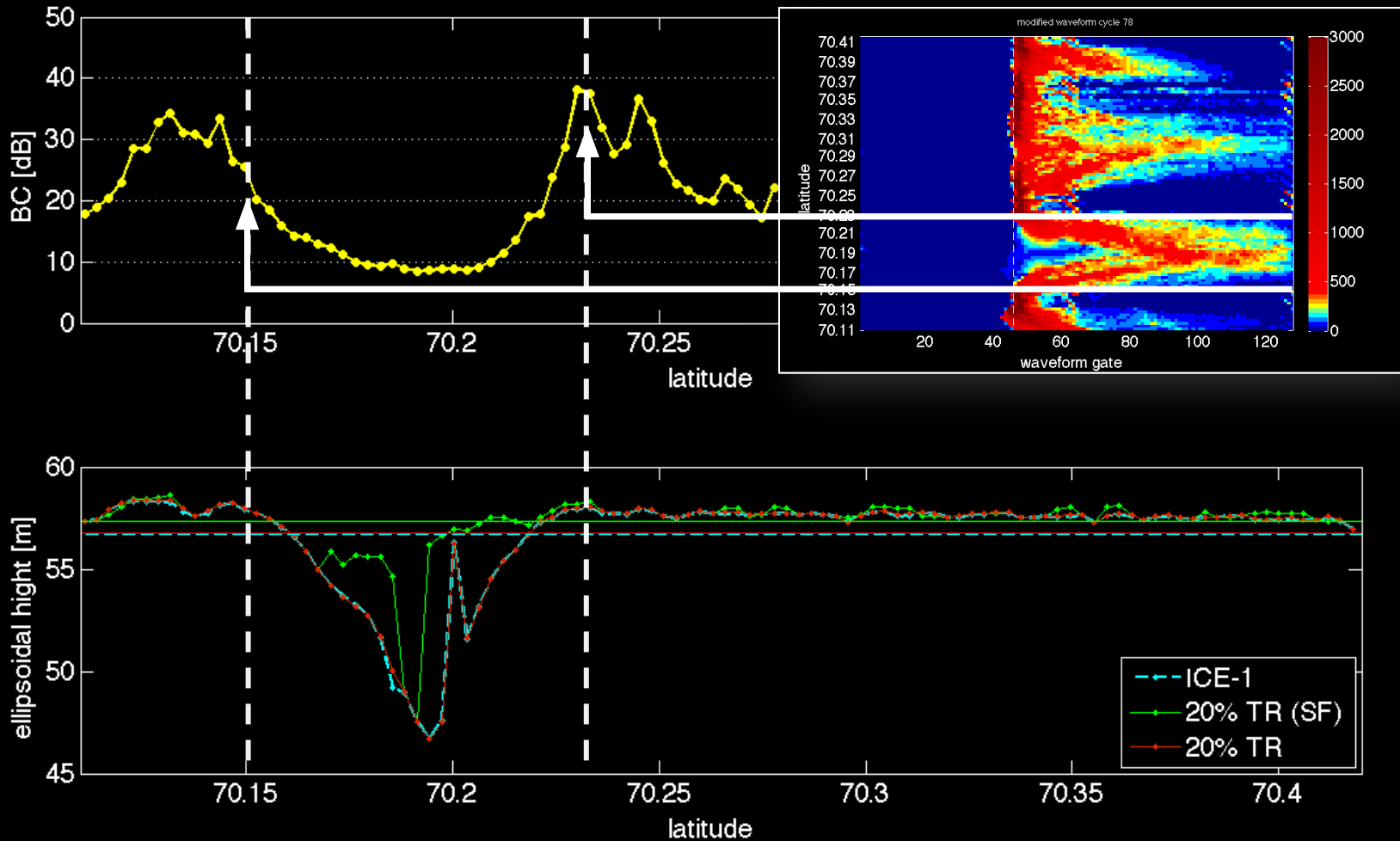### to eliminate spurious peak over sea ice floes
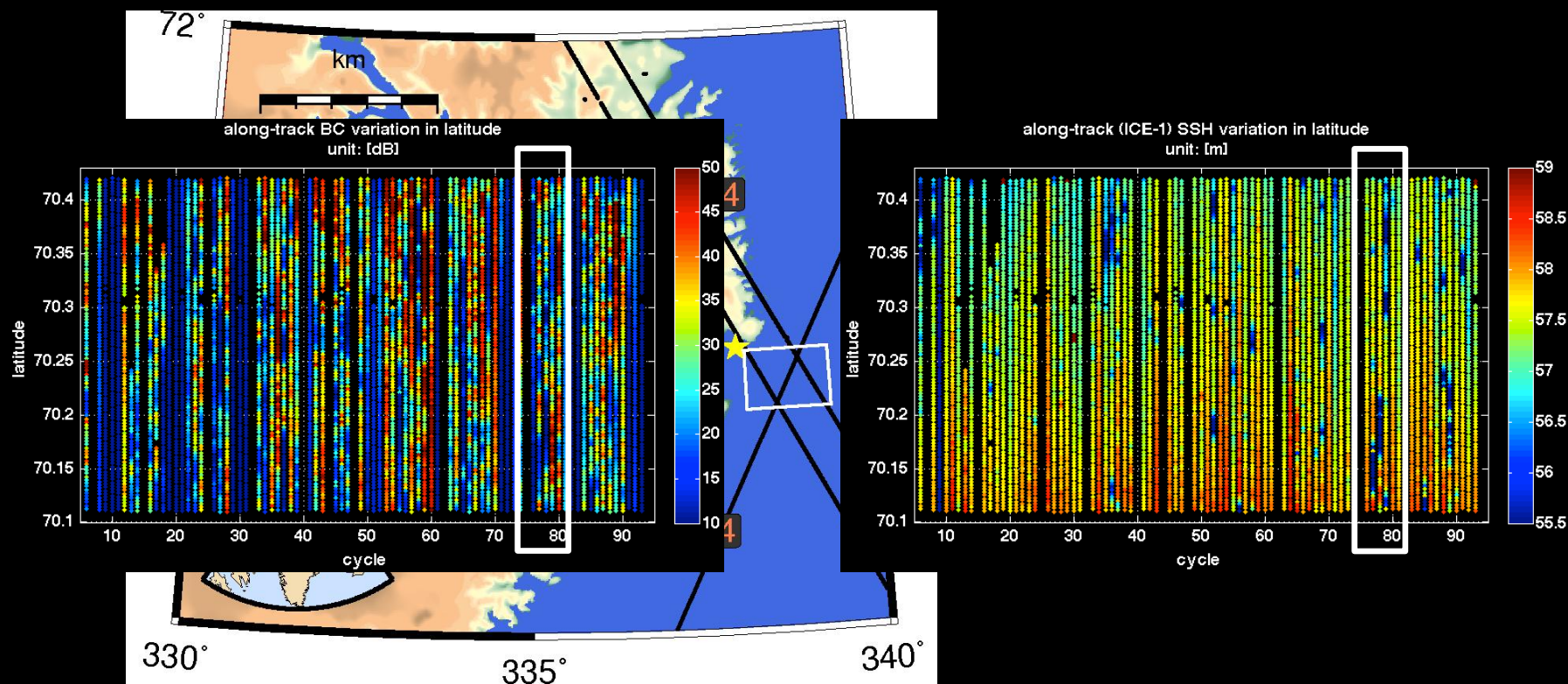
Application of the SF method – sea ice region

Application of the SF method – sea ice region

Application of the SF method – sea ice region

Improved measurements at East Greenland

- Statistical comparison of three passes
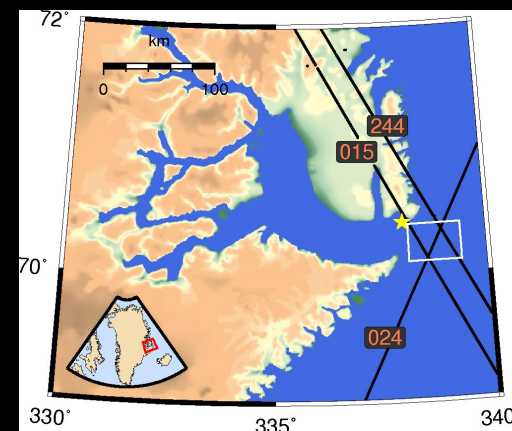
Pass		ICE-1	OCEAN	SEAICE	20% TR	20%TR mod
224	RMSE [cm]	21	41	42	22	17
	Correlation	0.77	0.5	0.42	0.76	0.87
	Cycle gap	0	4	0	0	0
24	RMSE [cm]	14	61	34	15	14
	Correlation	0.88	0.25	0.43	0.86	0.88
	Cycle gap	0	0	0	0	0
15	RMSE [cm]	30	72	62	30	23
	Correlation	0.58	0.43	0.42	0.58	0.71
	Cycle gap	0	0	0	0	0

19~23 % RMSE improvement percentage (IMP) to ICE-1

Conclusions

- Subwaveform Filtering (SF) method extends altimetry measurements toward 1-7km offshore

- Accuracy of measurement maintains around 14–23 cm

- Leading/trailing edge is distorted during modification

- SF can be potentially applied to other topographical interface

Thank you!