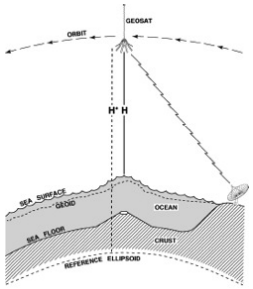
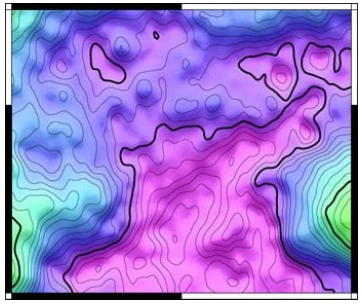


NEW MARINE GRAVITY FROM JASON-1 AND CRYOSAT-2 REVEALS TECTONICS, SEAMOUNTS, AND ABYSSAL FABRIC



David Sandwell, Emmanuel Garcia (SIO), Walter H.F. Smith (NOAA),
Khalid Soofi (ConocoPhillips Co.), Paul Wessel,
Michael Chandler (U. of Hawaii), Karen Marks (NOAA)

- motivation:

  much of the deep ocean floor is uncharted by ships

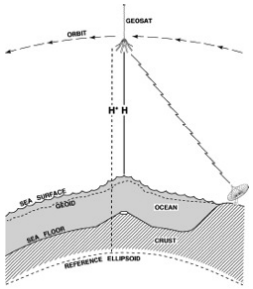
  high spatial resolution gravity can reveal tectonic fabric, uncharted seamounts, and seafloor roughness

- objectives:

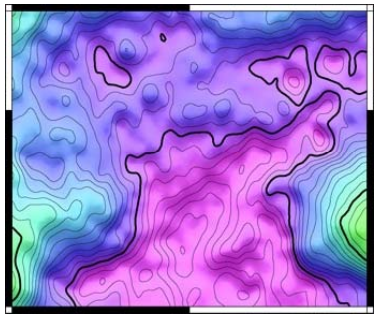
  spatial resolution < 6 km (1/2 wavelength)

  accuracy < 2 mGal

(material published in: *The Leading Edge,* August, 2013)

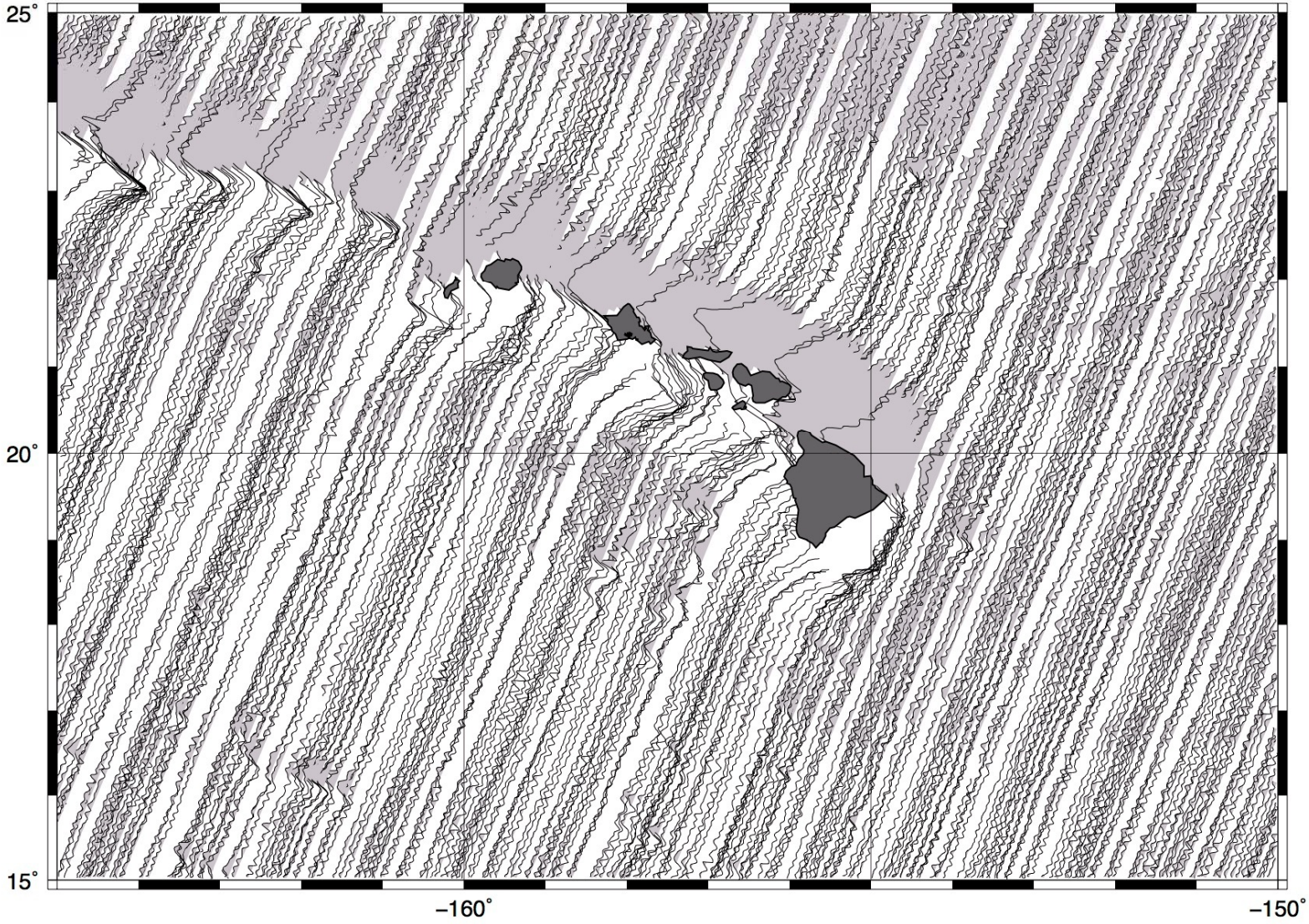


NEW MARINE GRAVITY FROM JASON-1 AND CRYOSAT-2 REVEALS TECTONICS, SEAMOUNTS, AND ABYSSAL FABRIC



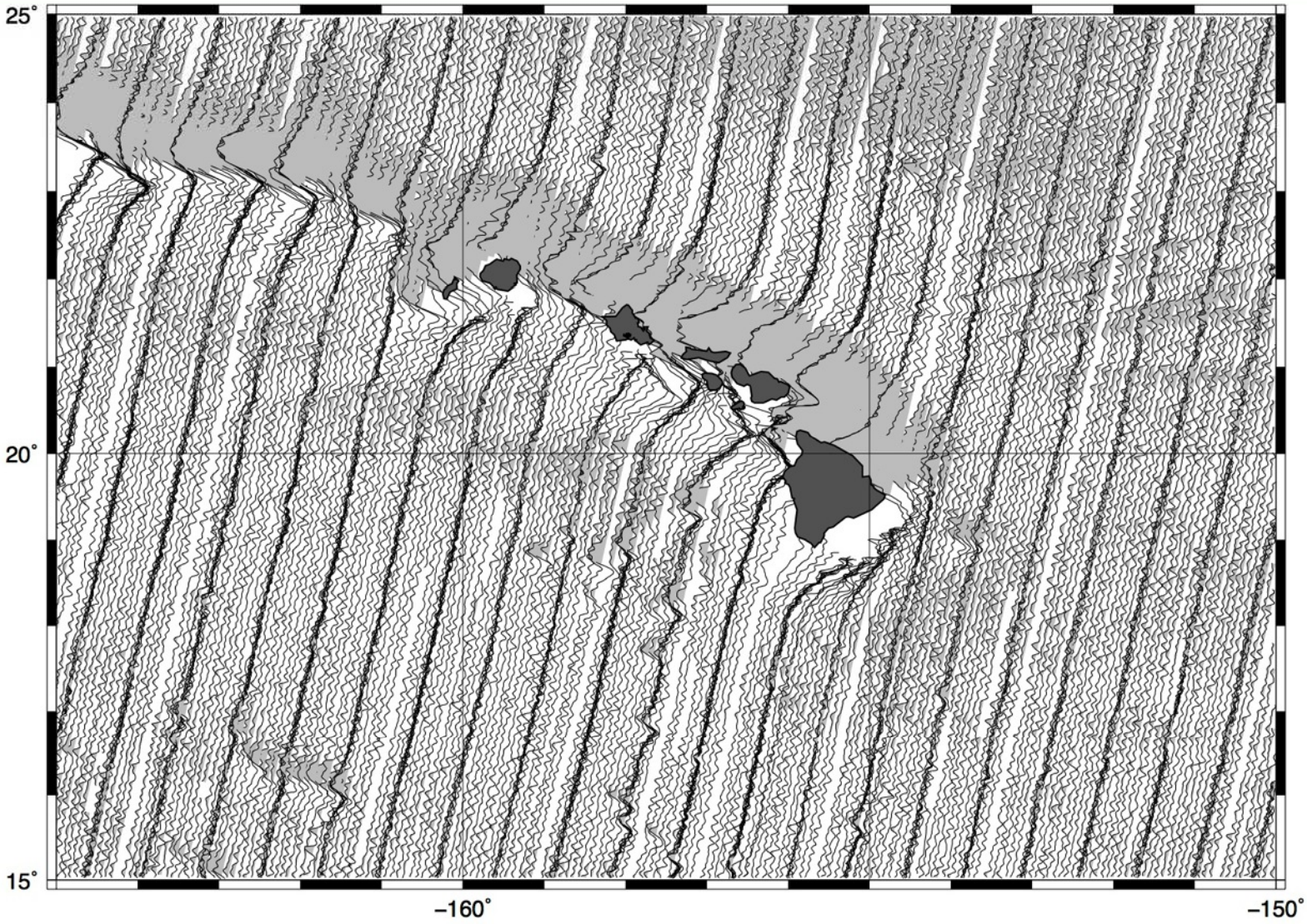
- higher accuracy = improved range precision + improved coverage
- why retracking is essential for optimal gravity accuracy
- retracking improves range precision by 1.5 times
- current gravity accuracy (V22.1 grid)
- some tectonic examples

TRACK COVERAGE OVER HAWAII: GEOSAT



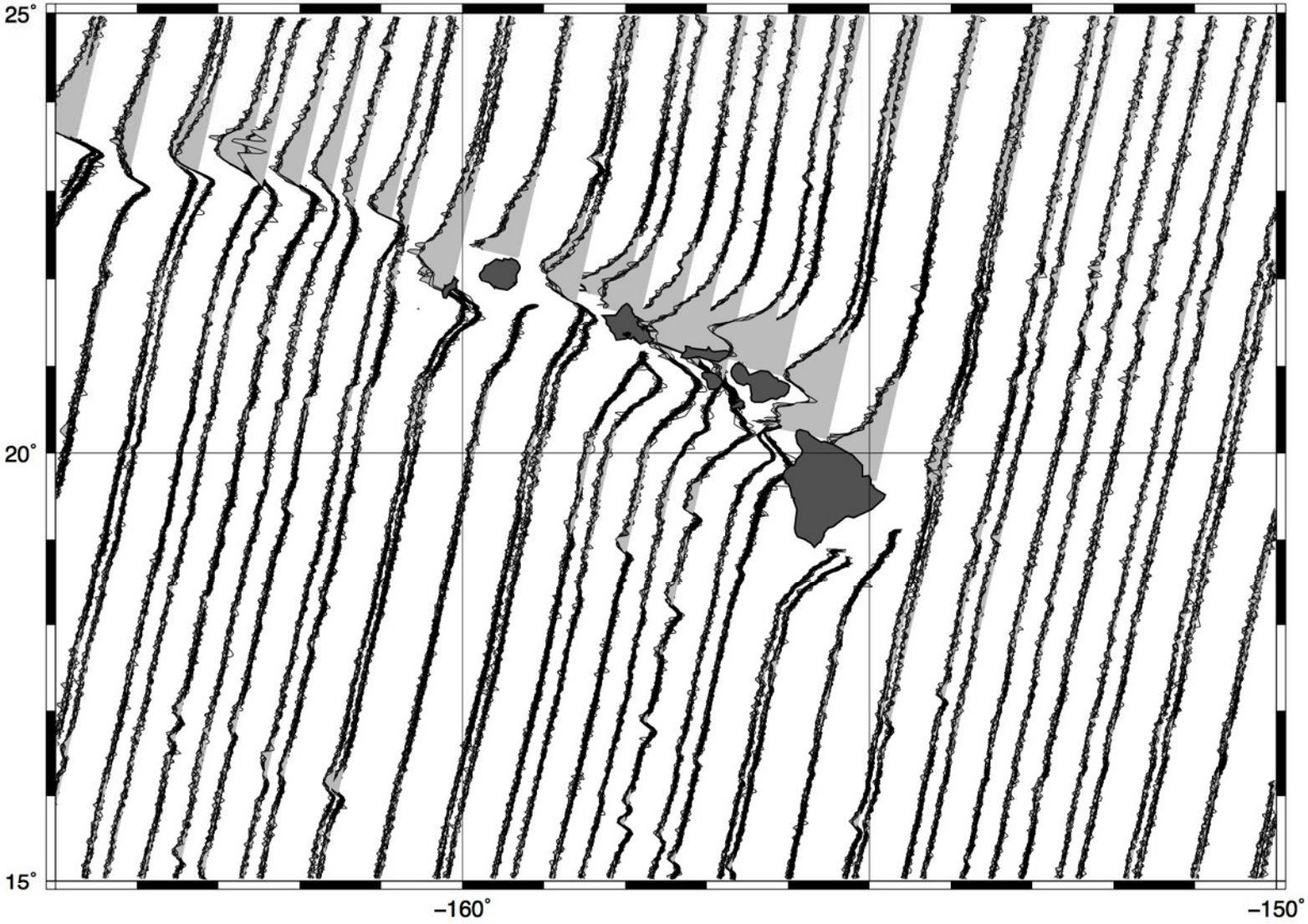
descending passes, 18 months worth of data (previously included)

TRACK COVERAGE OVER HAWAII: ERS-1



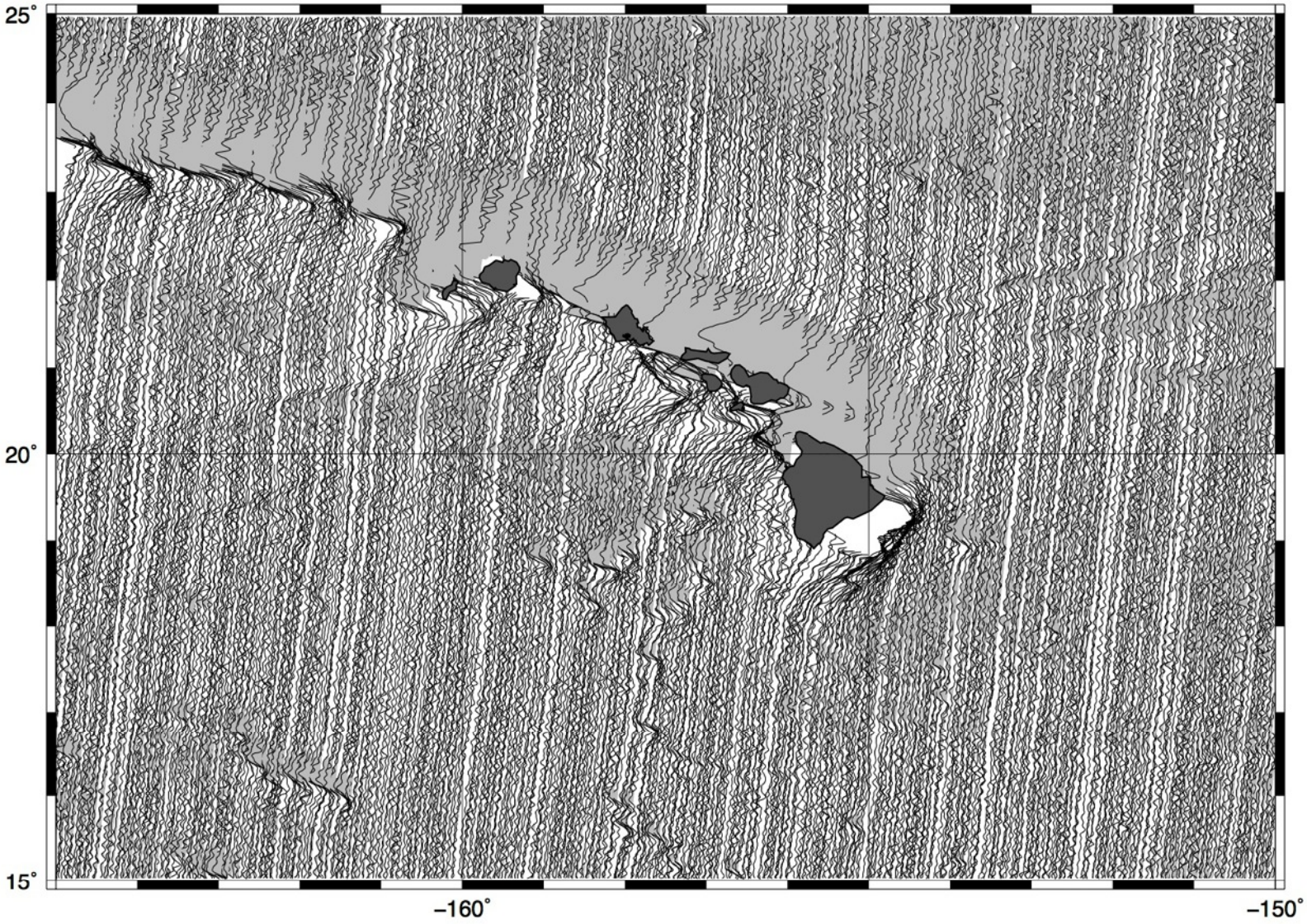
descending passes, 12 months worth of data (previously included)

TRACK COVERAGE OVER HAWAII: ENVISAT



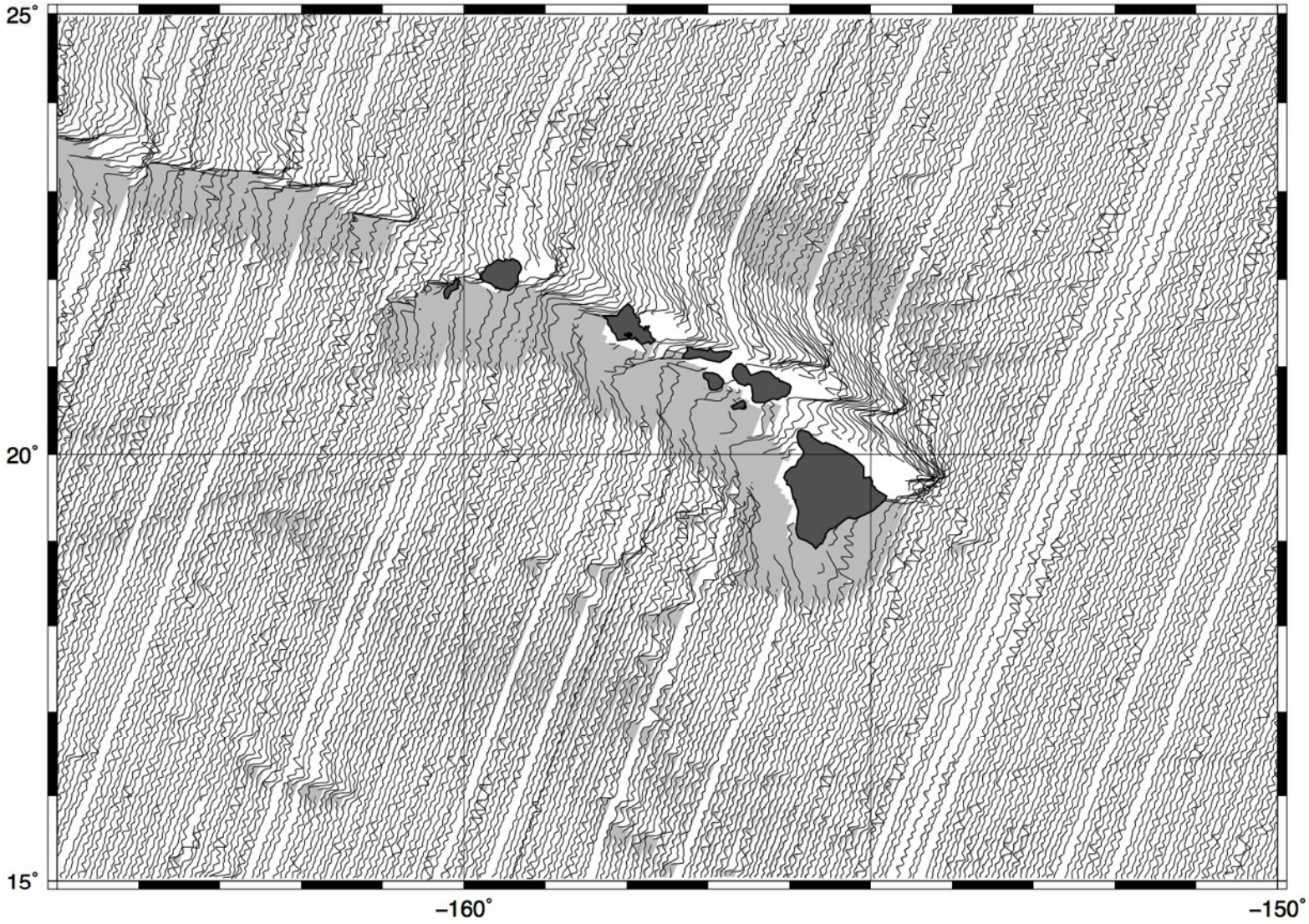
descending passes, 18 months worth of data (NEW)

TRACK COVERAGE OVER HAWAII: CRYOSAT-2

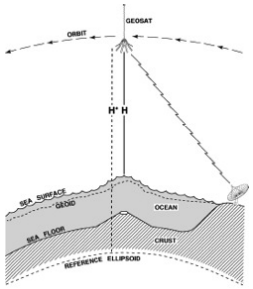


descending passes, 34 months worth of data (NEW)

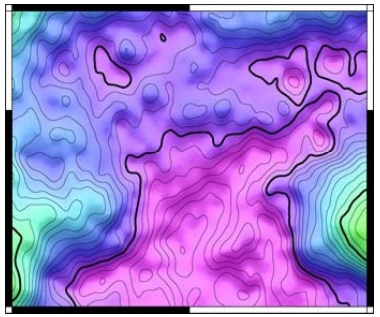
TRACK COVERAGE OVER HAWAII: JASON-1



descending passes, 14 months worth of data (NEW)



NEW MARINE GRAVITY FROM JASON-1 AND CRYOSAT-2 REVEALS TECTONICS, SEAMOUNTS, AND ABYSSAL FABRIC



•higher accuracy = improved range precision + improved coverage

•why retracking is essential for optimal gravity accuracy

•retracking improves range precision by ~1.4 times

•current gravity accuracy (V22.1 grid)

•some tectonic examples

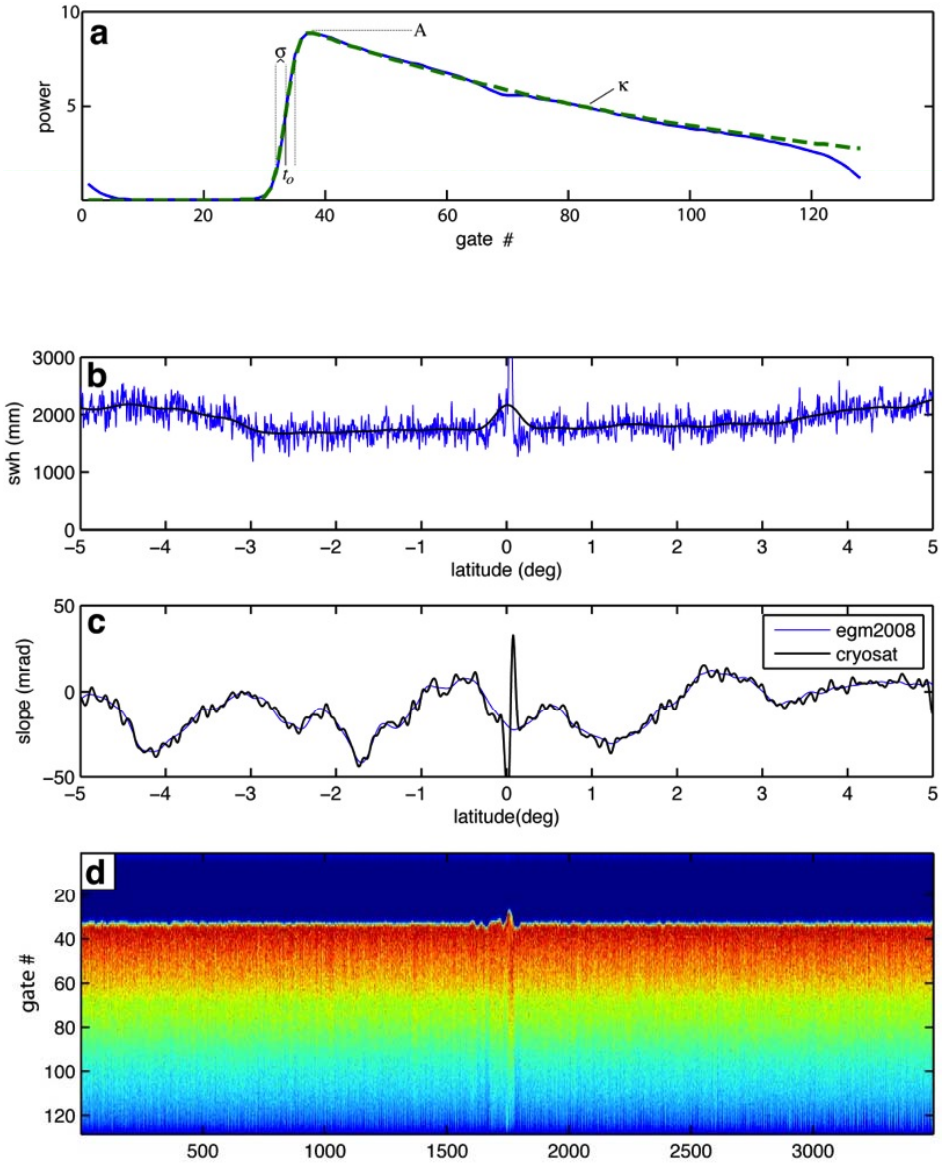
DOUBLE RETRACKING TO IMPROVE PRECISION

1) retrack waveforms with standard 3-parameter model

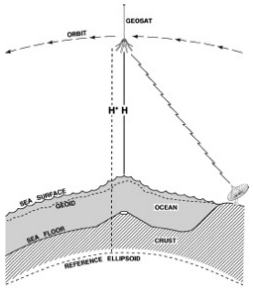
2) smooth wave height over 40-km

1) retrack waveforms with 2-parameter model

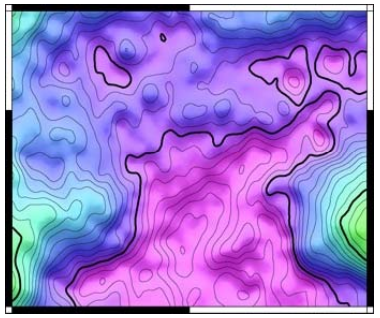
Note: this assumes wave height varies smoothly along track.



[Sandwell and Smith, GJI, 2005]



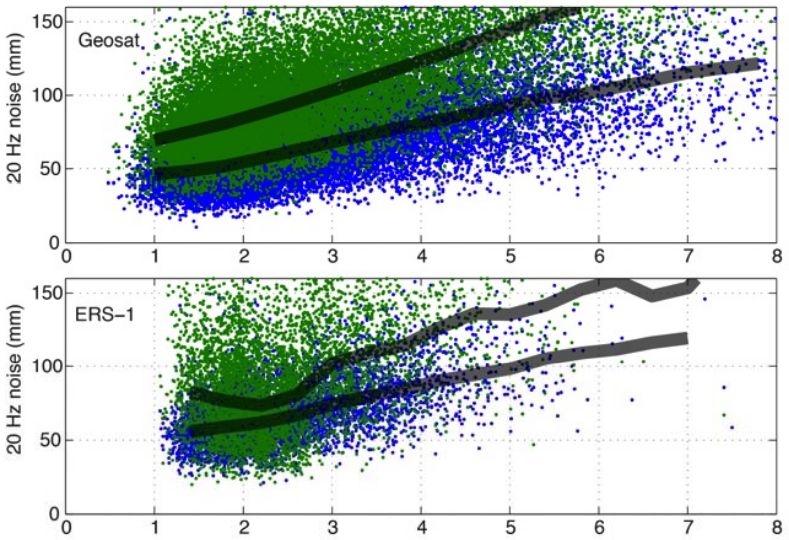
NEW MARINE GRAVITY FROM JASON-1 AND CRYOSAT-2 REVEALS TECTONICS, SEAMOUNTS, AND ABYSSAL FABRIC



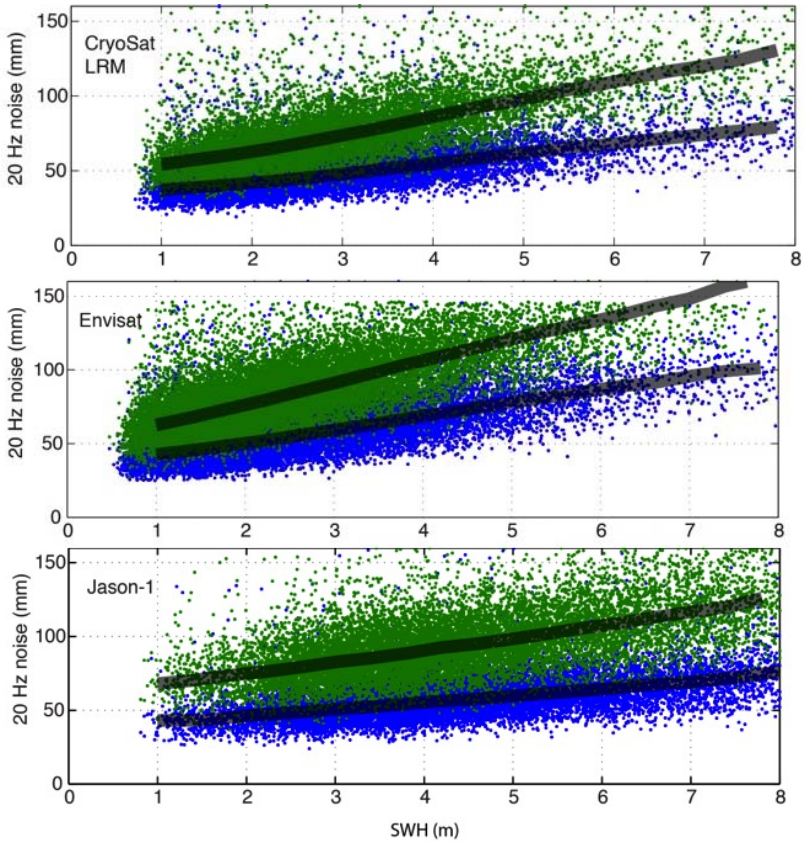
- *higher accuracy = improved range precision + improved coverage*
- *why retracking is essential for optimal gravity accuracy*
- **retracking improves range precision by 1.5 times**
- current gravity accuracy (V22.1 grid)
- some tectonic examples

20 HZ RANGE PRECISION COMPARISONS

- 3-parameter
- 2-parameter

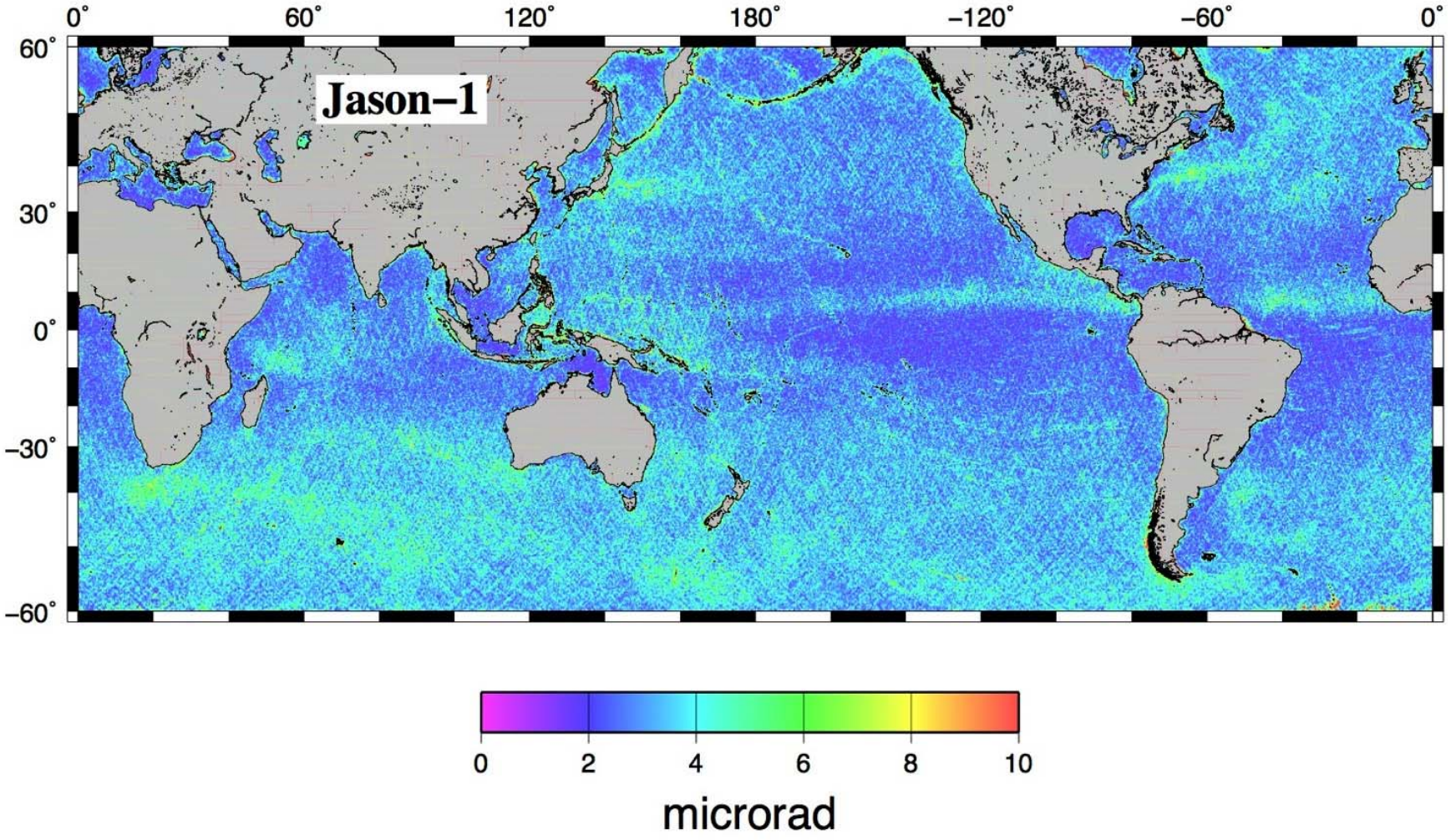


Altimeter	2-PAR @ 2 m
Geosat	57.0
ERS-1	61.8
Envisat	51.8
Jason-1	46.4
CryoSat LRM	42.7



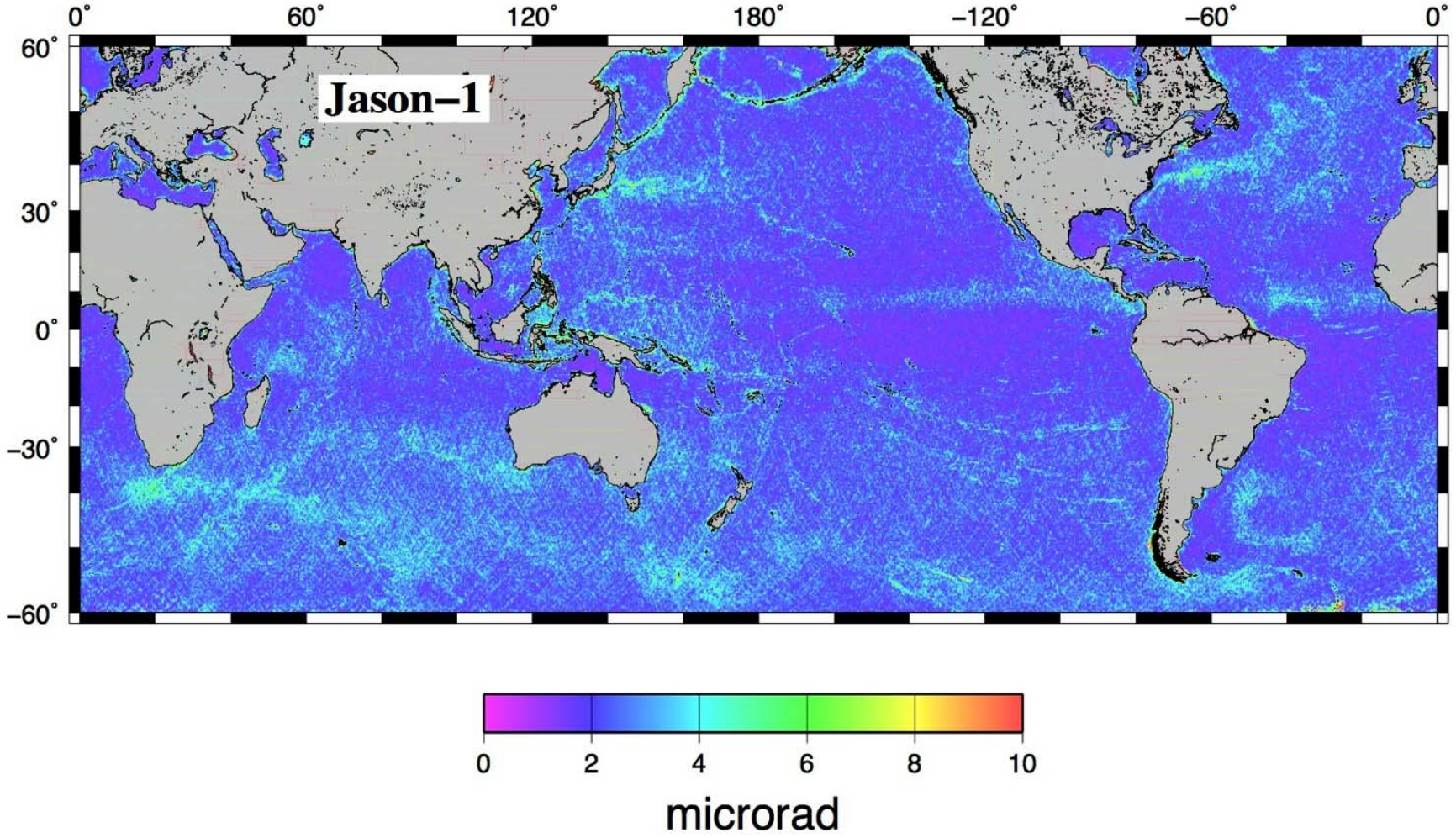
RESIDUAL SLOPES: RETRACKING ONCE

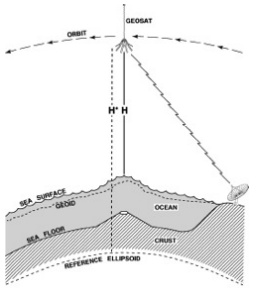
Jason-1 along-track sea surface slopes from 3-parameter retracking,
with slopes from the latest marine gravity anomaly grid (v. 22.1) subtracted



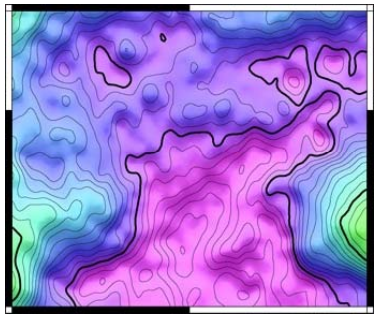
RESIDUAL SLOPES: AFTER DOUBLE RETRACKING

Jason-1 along-track sea surface slopes from 2-parameter retracking,
with slopes from the latest marine gravity anomaly grid (v. 22.1) subtracted



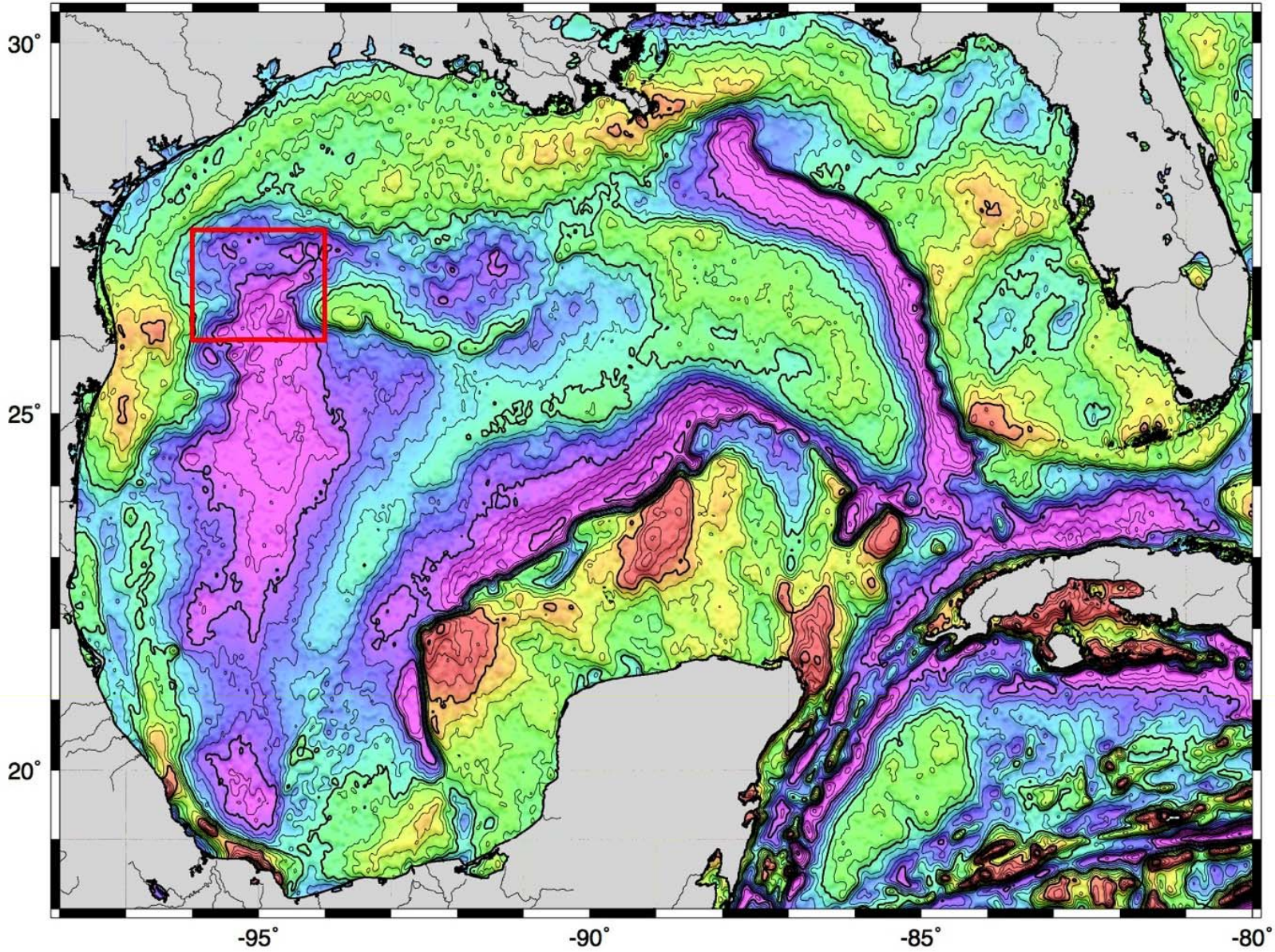


NEW MARINE GRAVITY FROM JASON-1 AND CRYOSAT-2 REVEALS TECTONICS, SEAMOUNTS, AND ABYSSAL FABRIC



- *higher accuracy = improved range precision + improved coverage*
- *why retracking is essential for optimal gravity accuracy*
- *retracking improves range precision by 1.5 times*
- **current gravity accuracy (V22.1 grid)**
- some tectonic examples

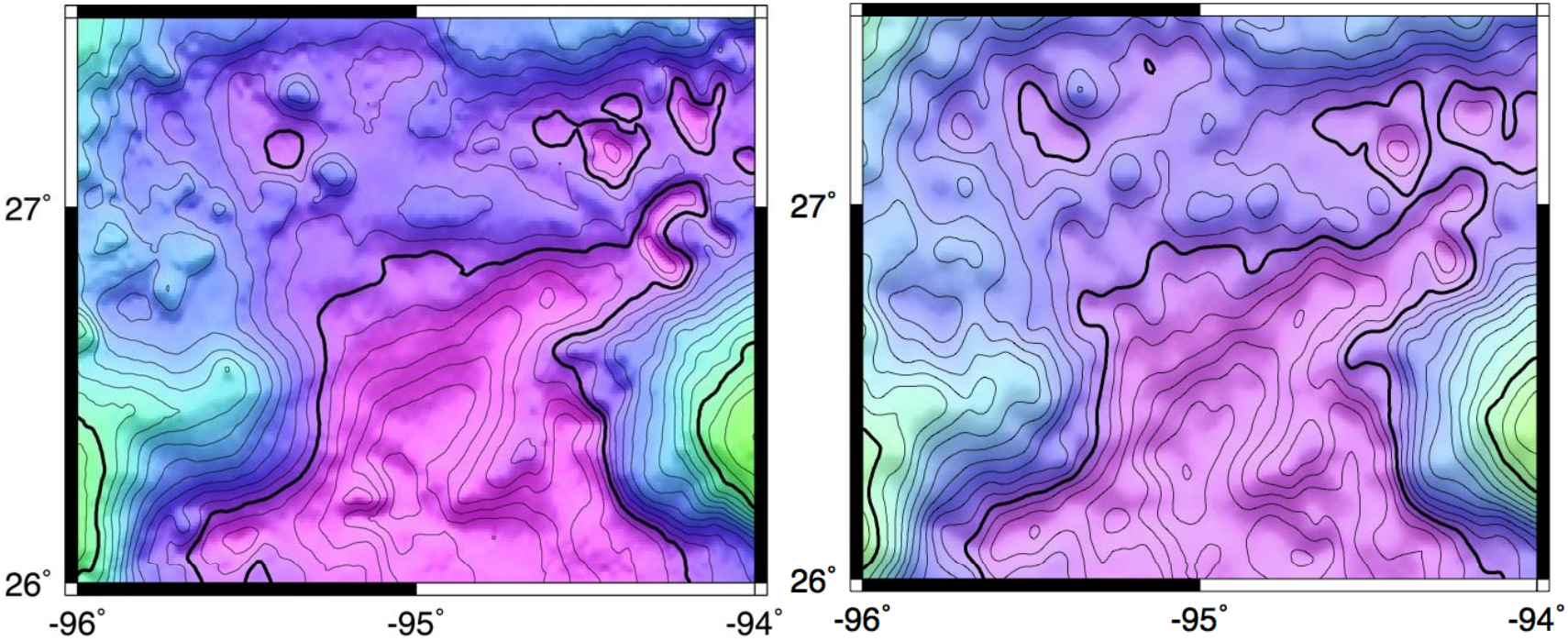
MARINE GRAVITY ANOMALY V22.1



COMPARISONS WITH SHIP DATA IN GULF OF MEXICO

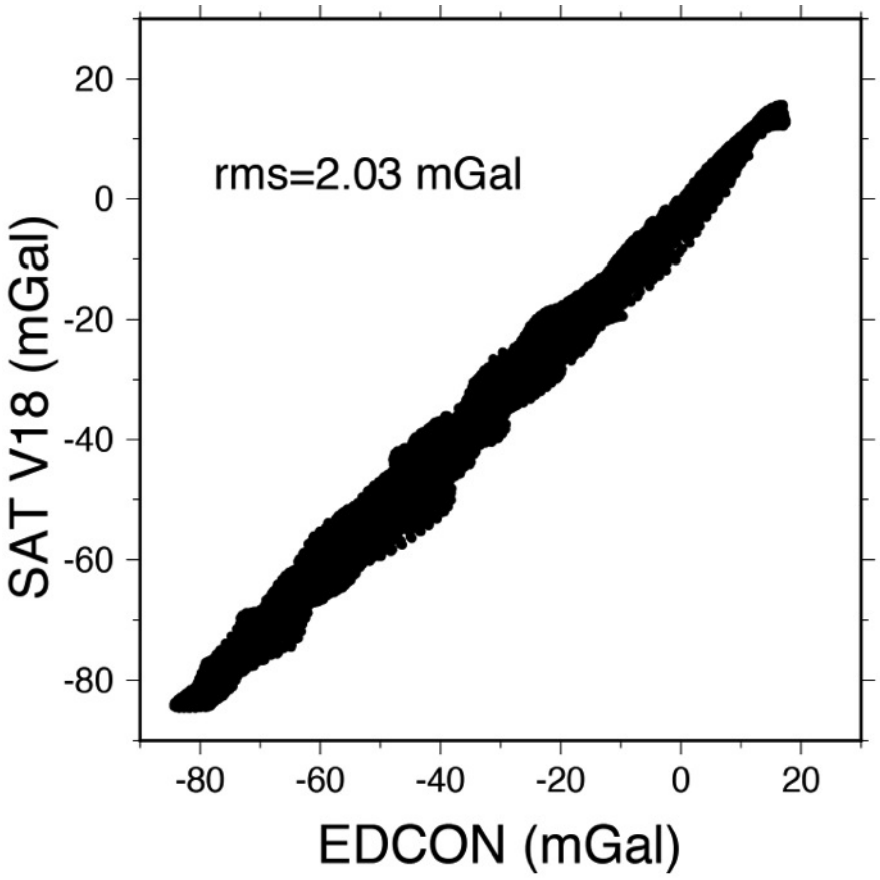
ship gravity
from EDCON

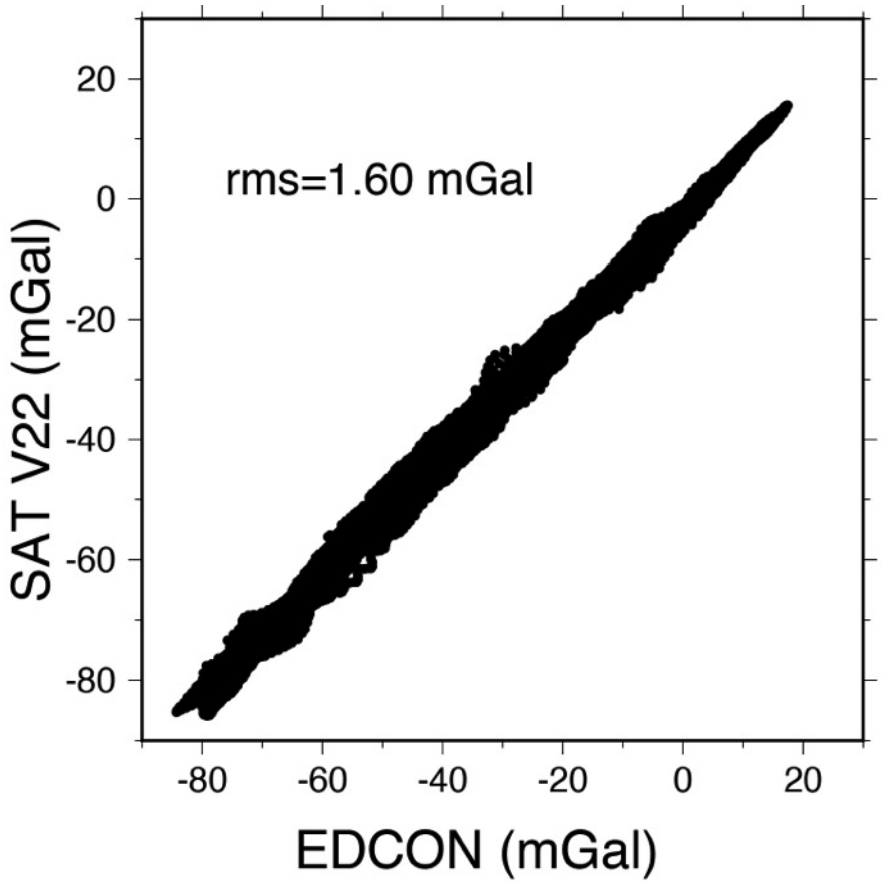
satellite gravity with Geosat, ERS-1, CryoSat LRM, Envisat and Jason-1



5 mGal contour interval

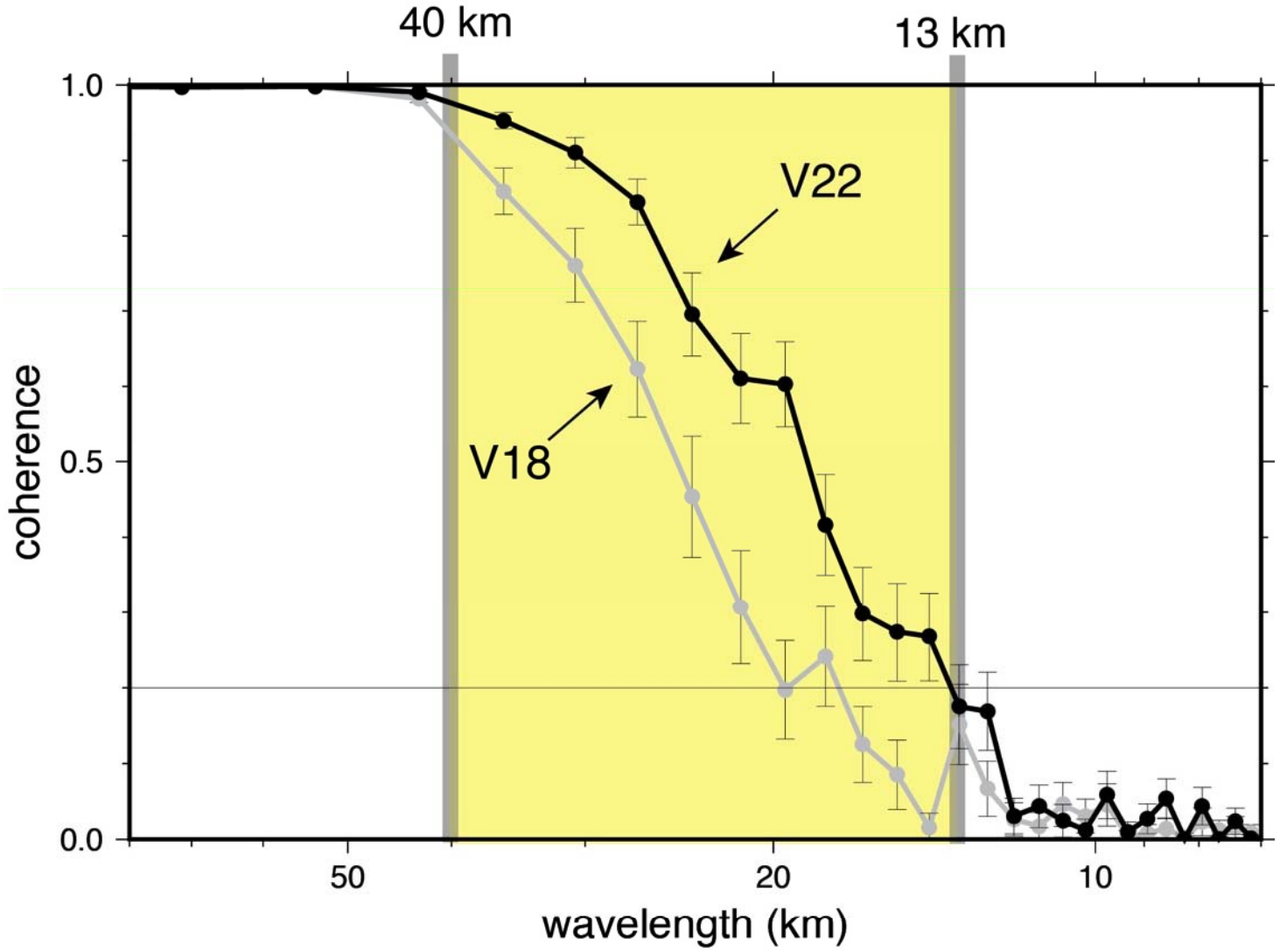
SPATIAL COMPARISONS IN THE GULF OF MEXICO



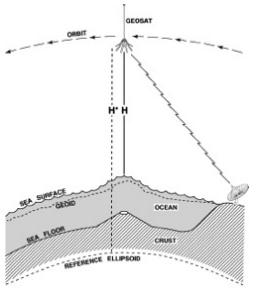


Noise contribution from the EDCON data is 0.51 mGal.

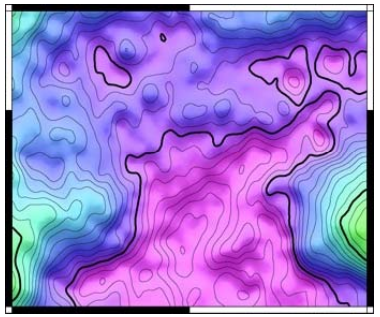
SPECTRAL COMPARISONS IN THE GULF OF MEXICO



coherence between shipboard and satellite-based gravity

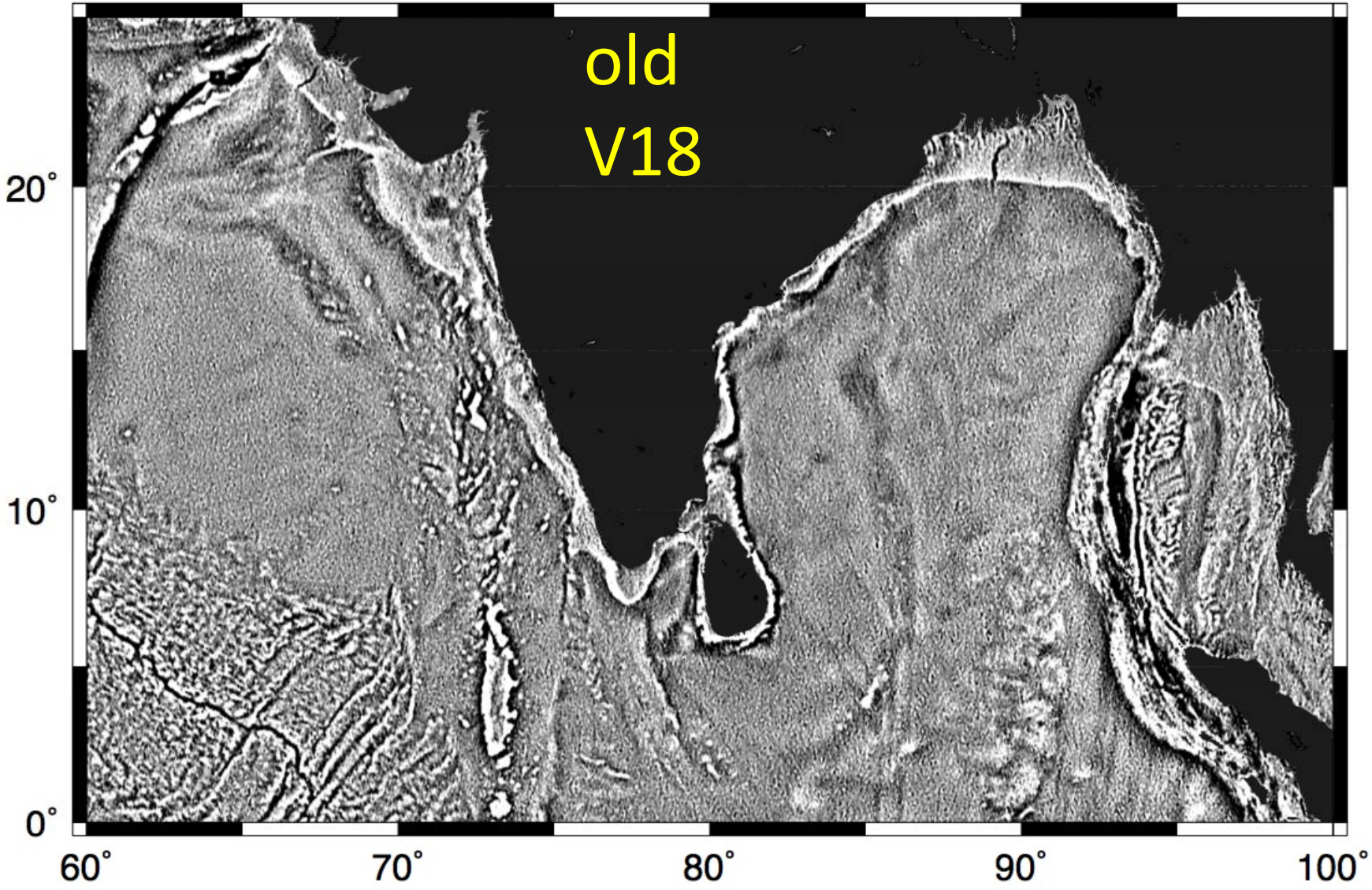


NEW MARINE GRAVITY FROM JASON-1 AND CRYOSAT-2 REVEALS TECTONICS, SEAMOUNTS, AND ABYSSAL FABRIC

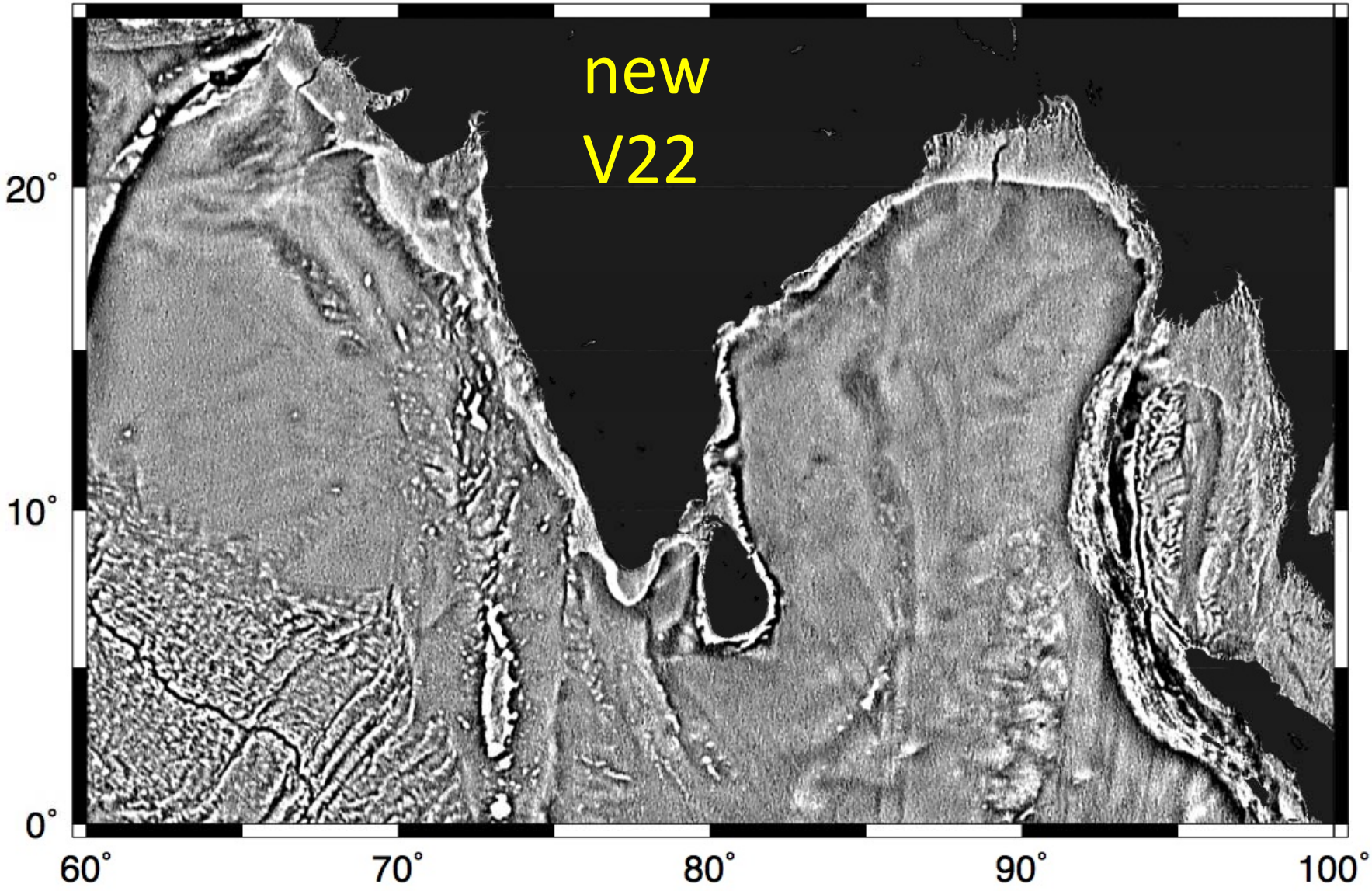


- *higher accuracy = improved range precision + improved coverage*
- *why retracking is essential for optimal gravity accuracy*
- *retracking improves range precision by 1.5 times*
- *current gravity accuracy (V22.1 grid)*
- **some tectonic examples**

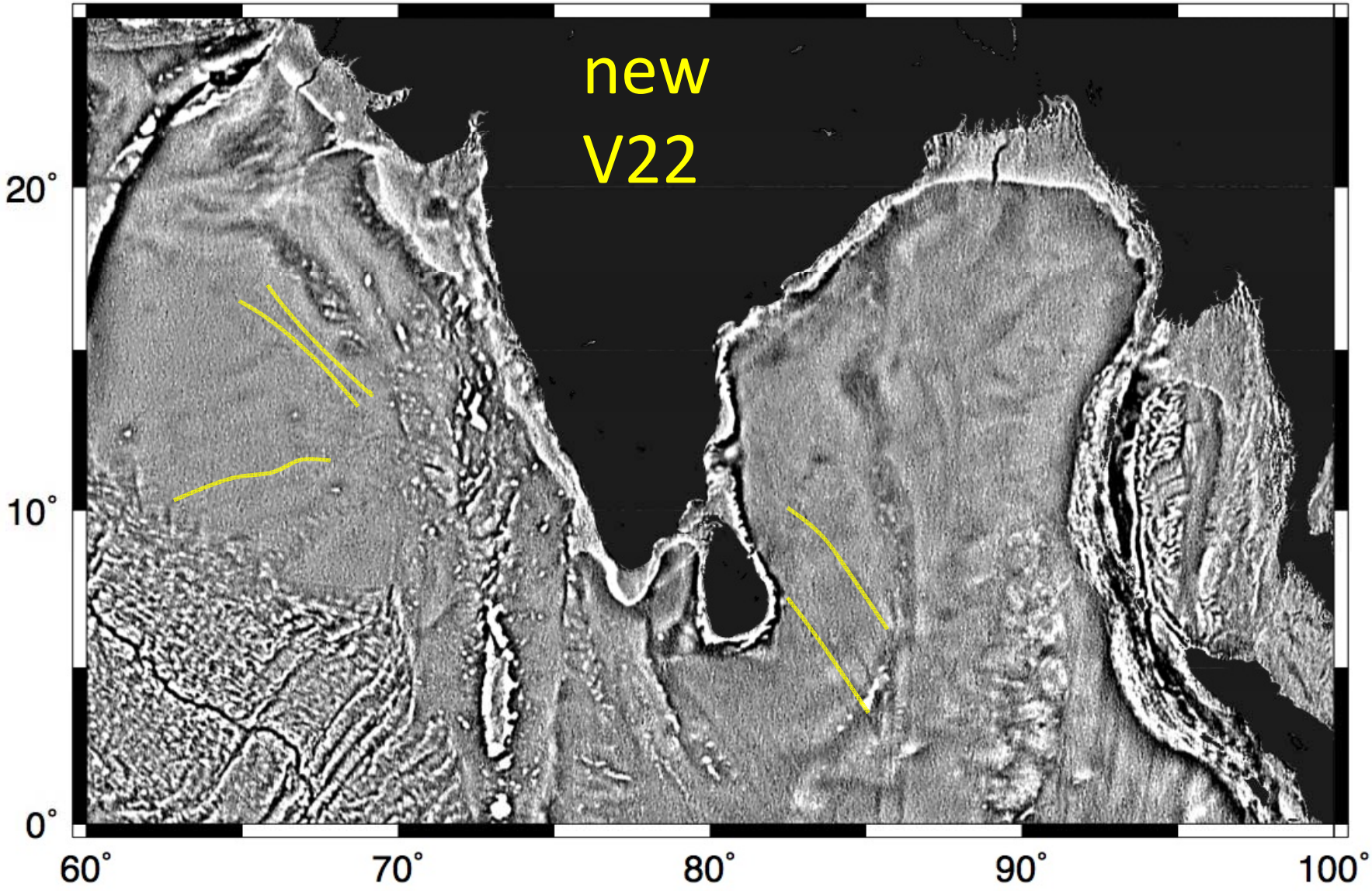
TECTONIC STRUCTURES UNDERNEATH SEDIMENTS



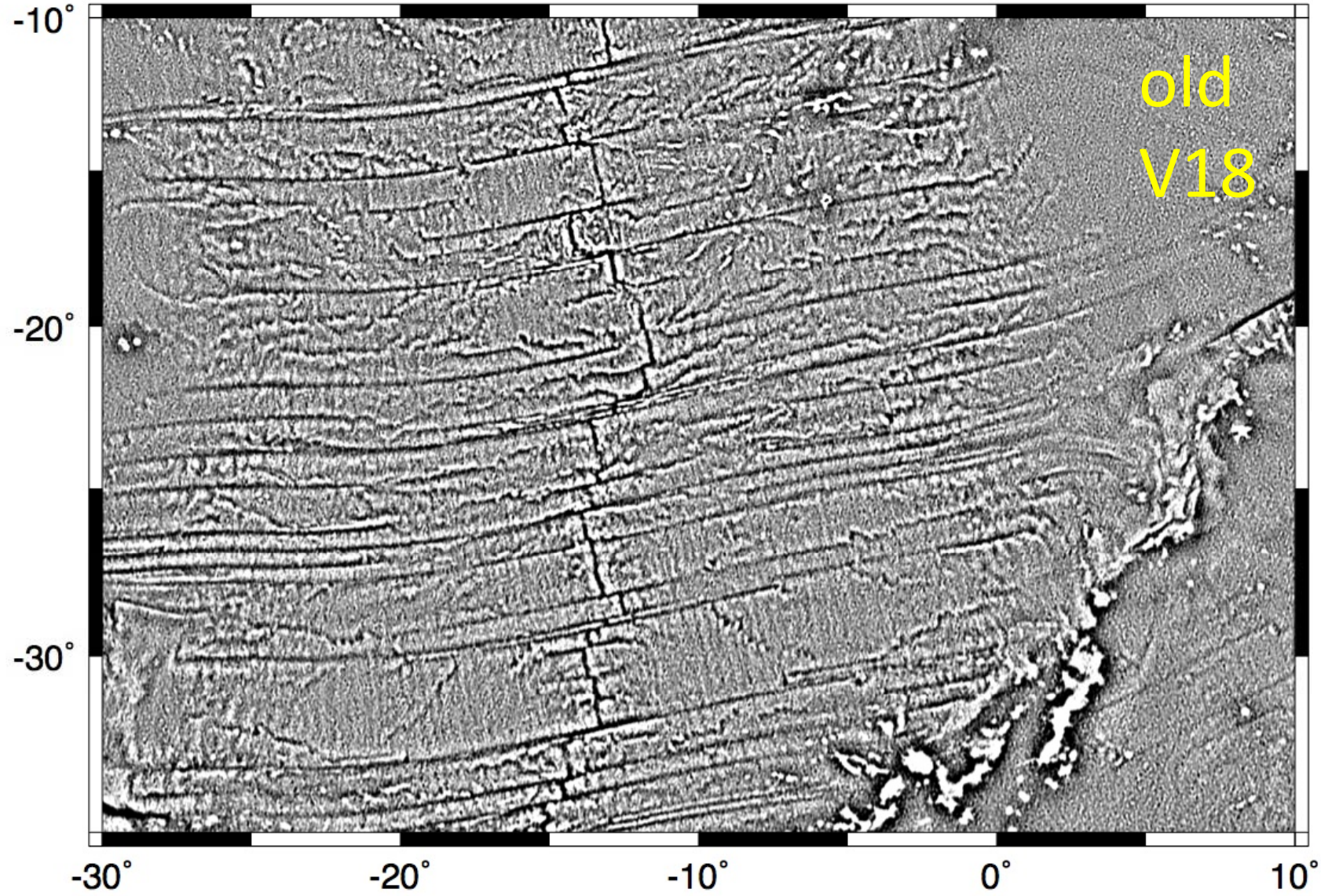
TECTONIC STRUCTURES UNDERNEATH SEDIMENTS



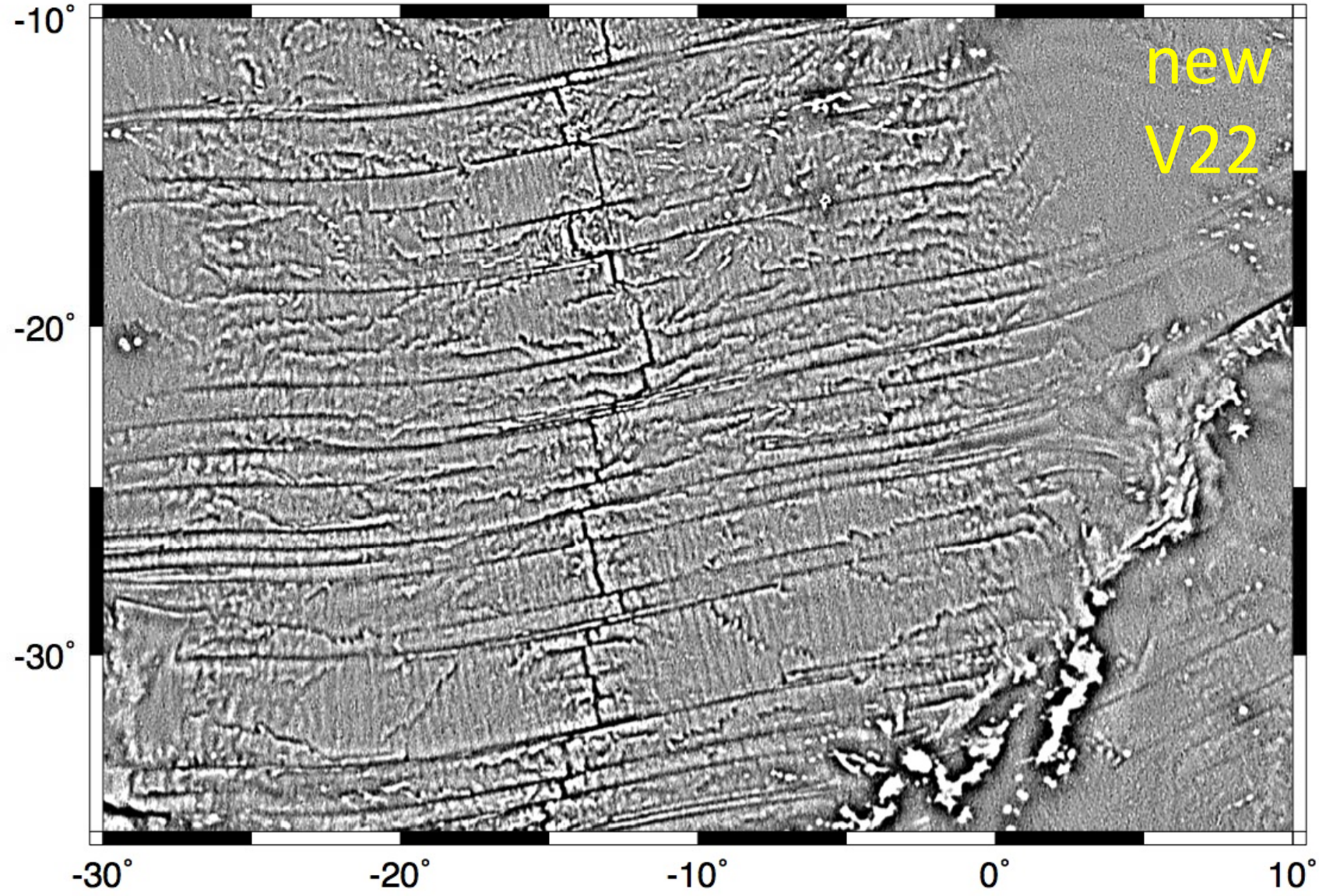
TECTONIC STRUCTURES UNDERNEATH SEDIMENTS



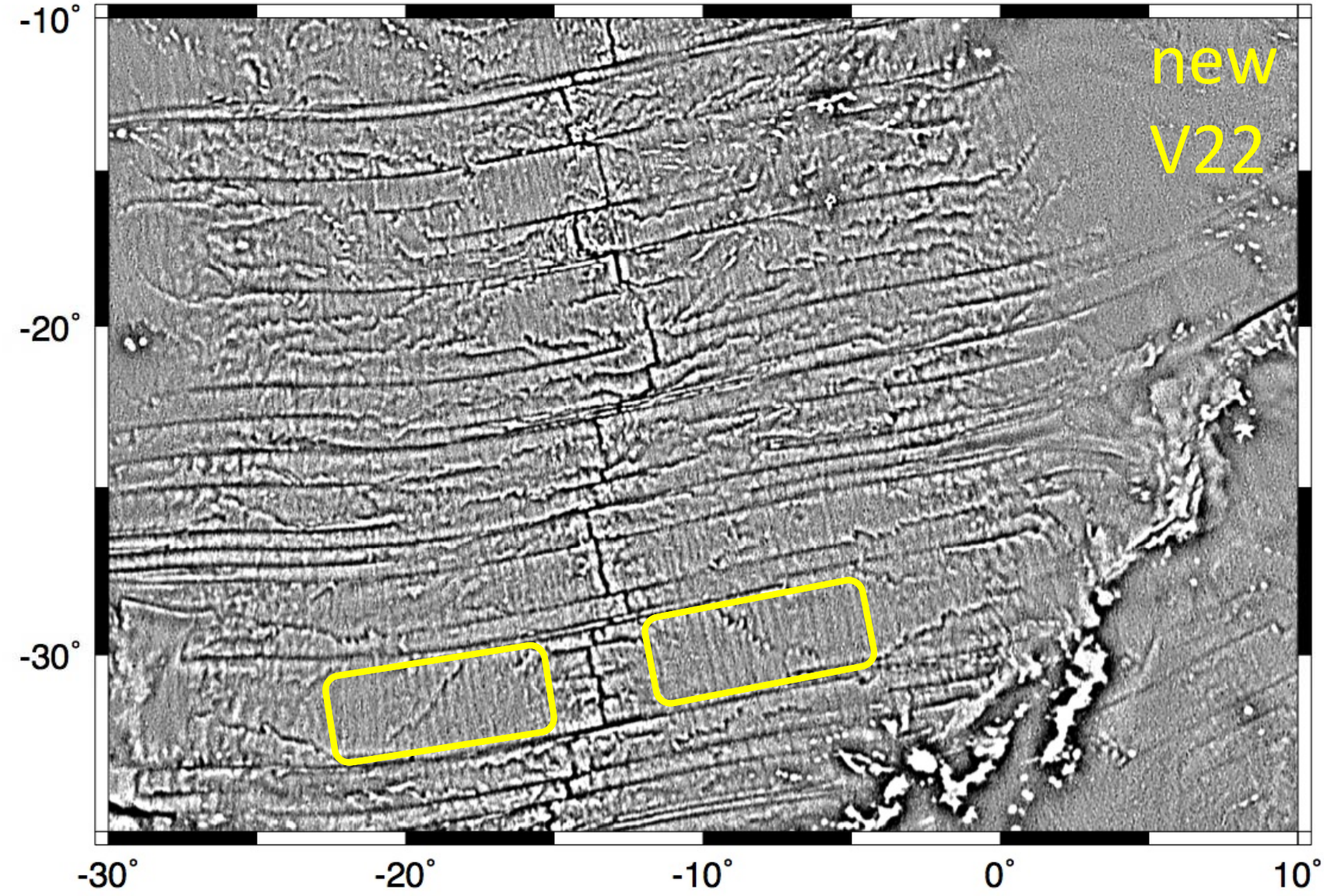
ABYSSAL HILLS

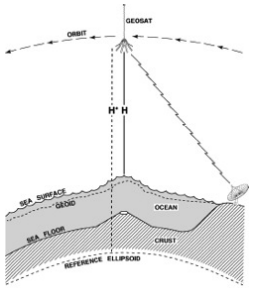


ABYSSAL HILLS

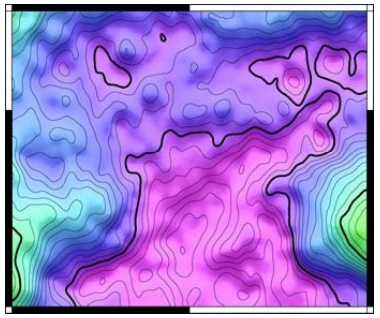


ABYSSAL HILLS





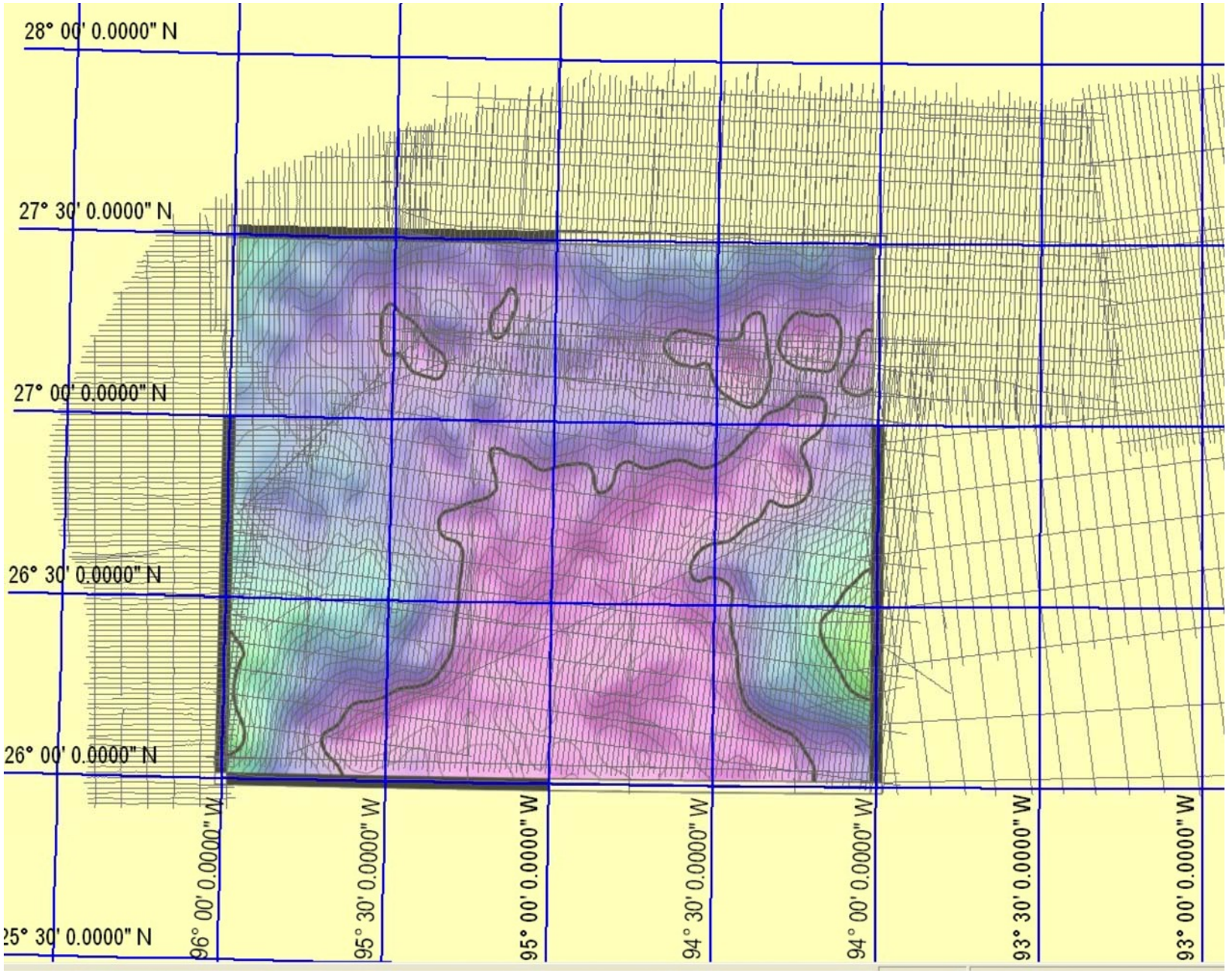
NEW MARINE GRAVITY FROM JASON-1 AND CRYOSAT-2 REVEALS TECTONICS, SEAMOUNTS, AND ABYSSAL FABRIC



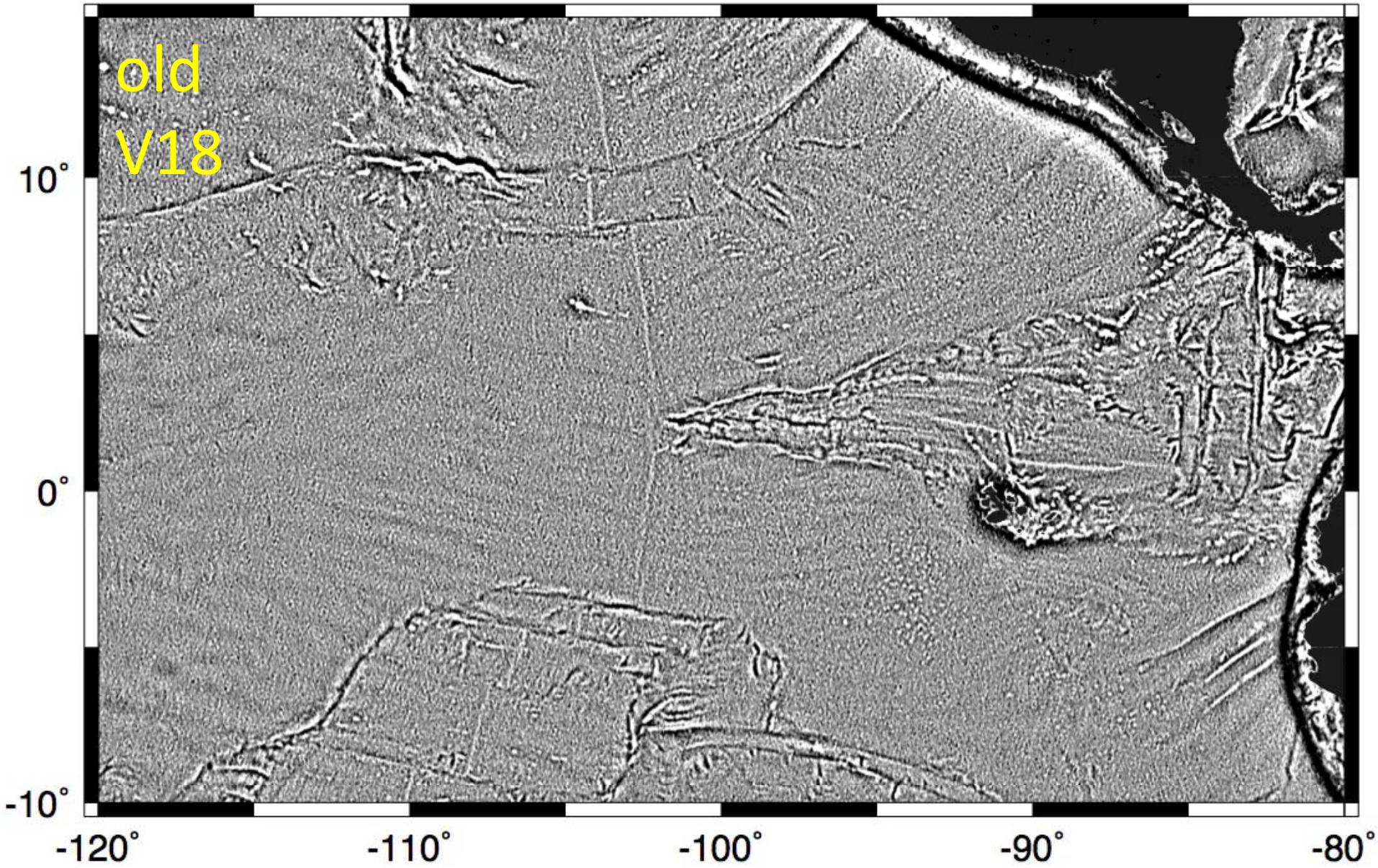
- “newer” altimeters have 1.4 times better range precision and 2 times better coverage.
- double retracking provides 1.5 times range precision
- marine gravity accuracy is currently 1.6 – 3.5 mGal with most improvement in the 13 – 40 km wavelength band.
- the new V22 gravity has less filtering but lower noise so subtle tectonic features are now apparent.

GPS Navigated Gravity survey of Alaminos Canyon

(Alan Herring, personal communication, Dec. 2011.)



small seamounts



small seamounts