

Arabian Sea and the Gulf of Oman

Overview

The Arabian Sea is located in the northwest Indian Ocean. It is bounded by India (to the east), Iran (to the north) and the Arabian Peninsula (in the west)(Figure 1). The Gulf of Oman is located in the northwest corner of the Arabian Sea. The continental shelf in the region is widest off the northwest coast of India, which also experiences wind-induced upwelling. [LME, 2004]. The circulation in the Arabian Sea is affected by the Northeast (March-April) and Southwest (September -October) Monsoon seasons [Tomczak et al. 2003].

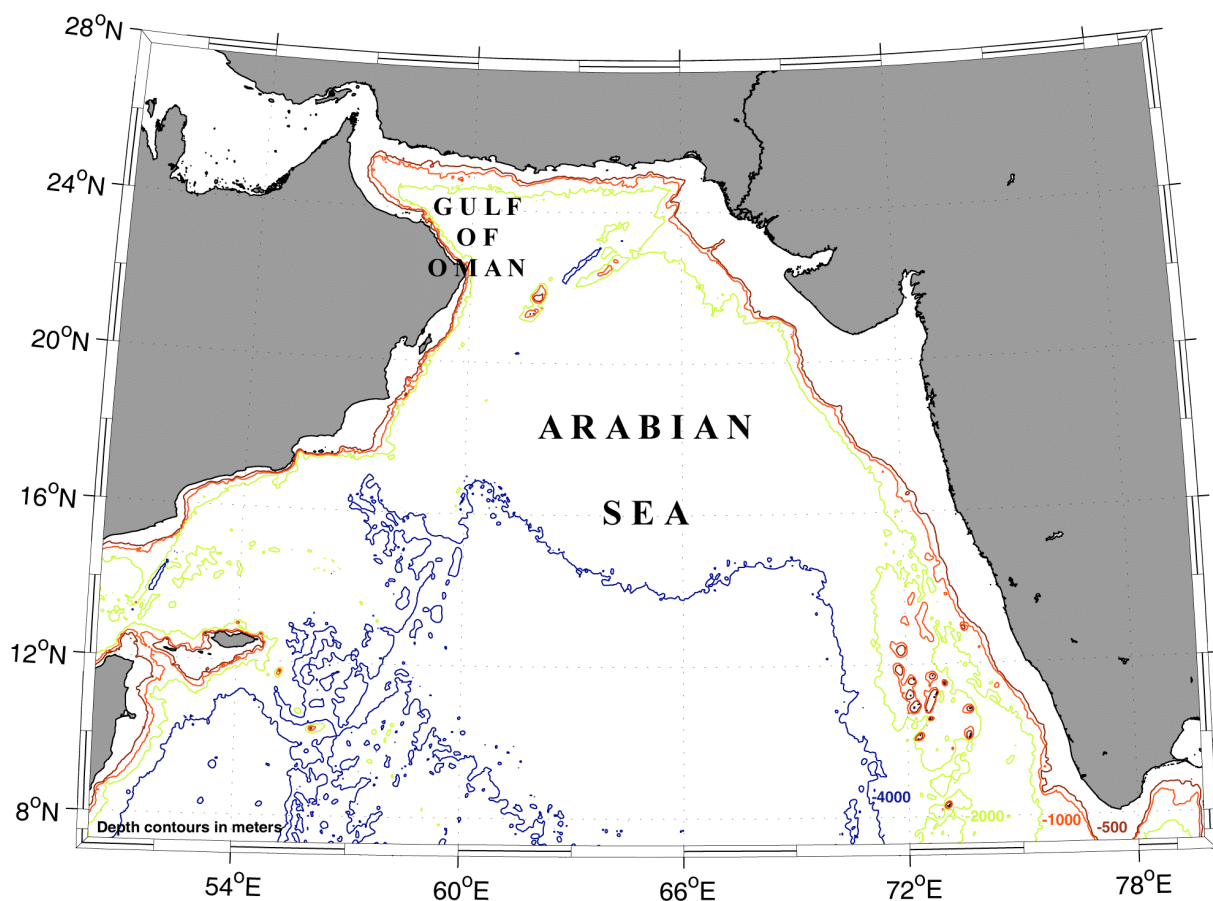


Figure 1. Bathymetry of Arabian Sea [Smith and Sandwell, 1997].

Observations

There has been some scientific study of internal waves in the Arabian Sea and Gulf of Oman through the use of satellite imagery [Zheng et al., 1998; Small and Martin, 2002]. The imagery shows evidence of fine scale internal wave signatures along the continental shelf around the entire region.

Table 1 shows the months of the year when internal wave observations have been made.

Table 1 - Months when internal waves have been observed in the Arabian Sea and Gulf of Oman
 (Numbers indicate unique dates in that month when waves have been noted)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	2		5	5	2		1	2	5	1	

Small and Martin [2002] reported on internal wave signatures observed in ERS SAR images of the Gulf of Oman. The imagery showed internal wave packets propagating towards the Musandam Peninsula from the shelf-edge on the eastern edge of the Gulf. The signatures had the classic appearance of rank ordered non-linear waves that depress the pycnocline. The images suggest a tidal generation mechanism, yielding a phase speed estimate from 0.5 m/s near the coast to 0.7 m/s on the shelf. Table 2 presents the environmental coefficients and KdV parameters.

Table 2 – KdV Parameters – Gulf of Oman (October Profile) [After Small and Martin 2002]

Environmental		KdV Model	
$h_1 = 40 \text{ m}$	$\rho_1 = 1024.3 \text{ kg m}^{-3}$	$\alpha = -0.01 \text{ s}^{-1}$	$c = 0.82 \text{ m/s}$
$h_2 = 60 \text{ m}$	$\rho_2 = 1027.2 \text{ kg m}^{-3}$	$\gamma = 328 \text{ m}^3 \text{ s}^{-1}$	$V_{\max} = 0.94 \text{ m/s}$

References

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<http://na.nefsc.noaa.gov/lme/text/lme32.htm>
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- Tomczak, Matthias & J Stuart Godfrey, 2003 Regional Oceanography: an Introduction 2nd edn (2003), Pdf version 1.2. Chapter 11 The Indian Ocean
<http://www.es.flinders.edu.au/~mattom/regoc/pdfversion.html>
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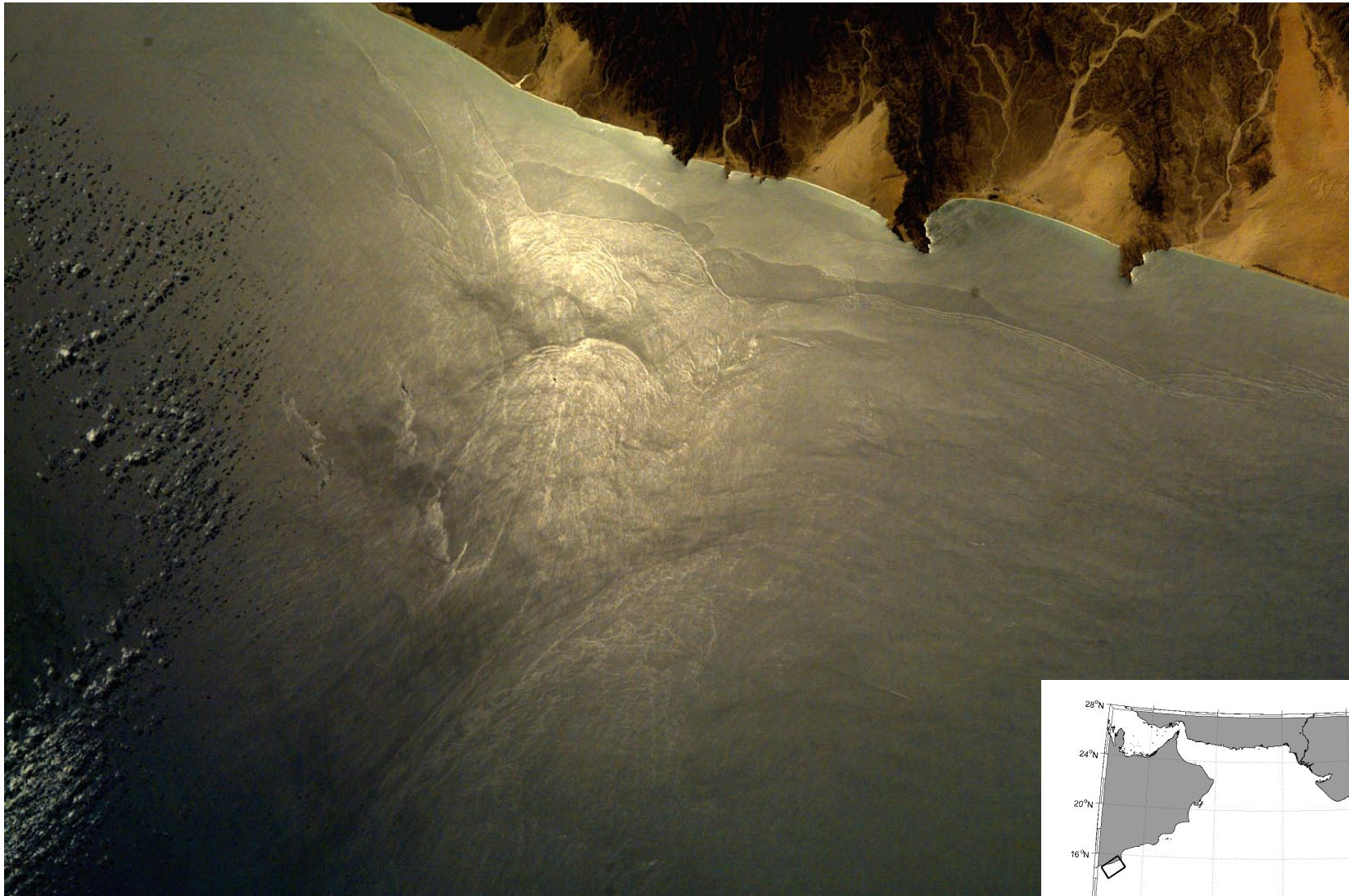


Figure 2. Astronaut Photograph (ISS002-E-5453) acquired on 13 April 2001 at 1126 UTC. The image shows internal waves in the Arabian Sea along the coast of Yemen. Imaged area is approximately 150 km x 100 km. [Image Courtesy of Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center (<http://eol.jsc.nasa.gov>)]

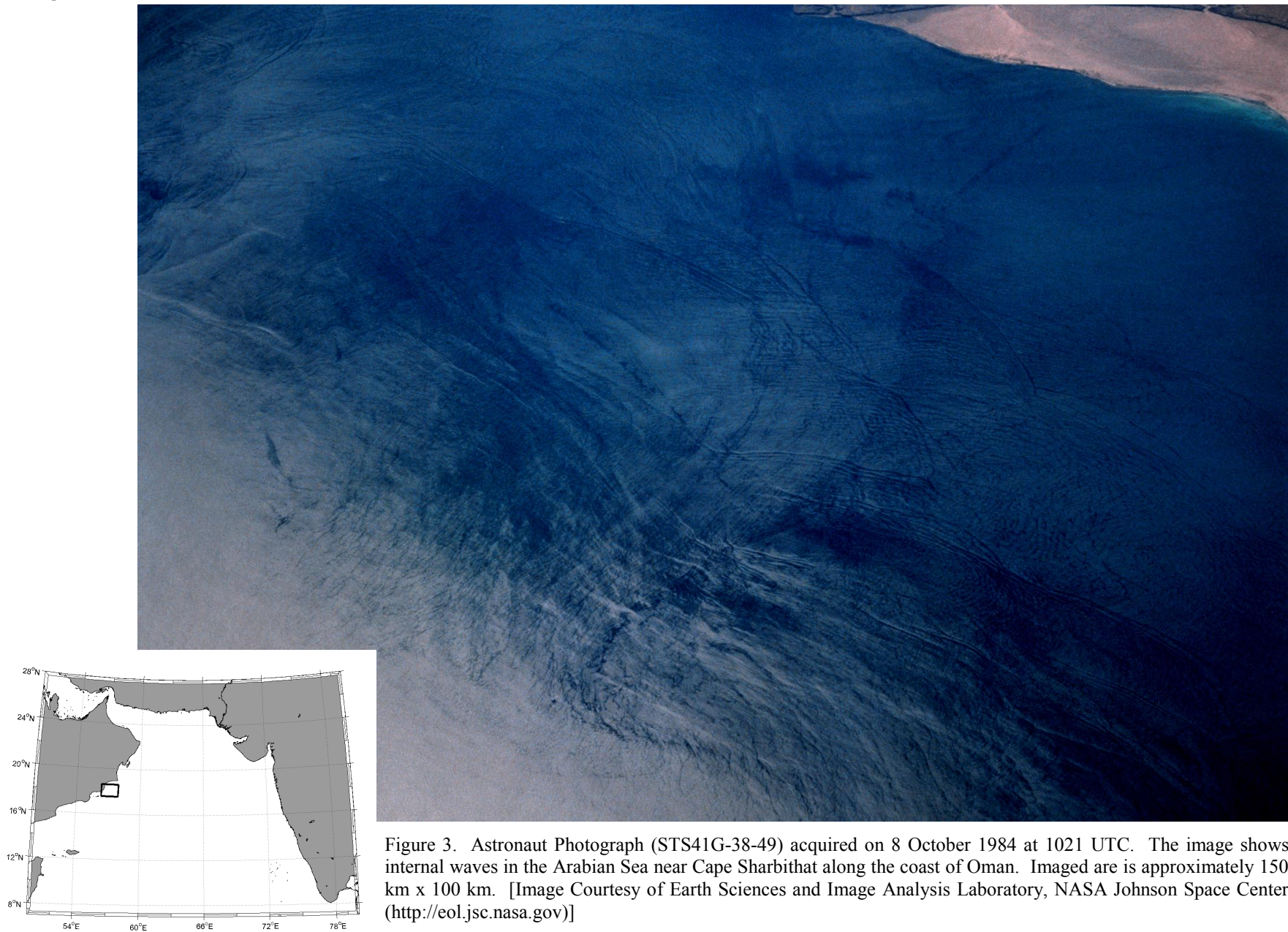


Figure 3. Astronaut Photograph (STS41G-38-49) acquired on 8 October 1984 at 1021 UTC. The image shows internal waves in the Arabian Sea near Cape Sharbithat along the coast of Oman. Imaged area is approximately 150 km x 100 km. [Image Courtesy of Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center (<http://eol.jsc.nasa.gov>)]

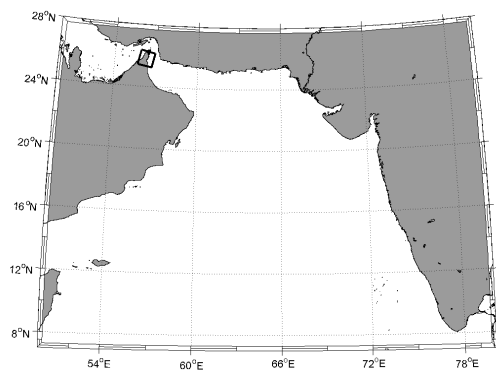
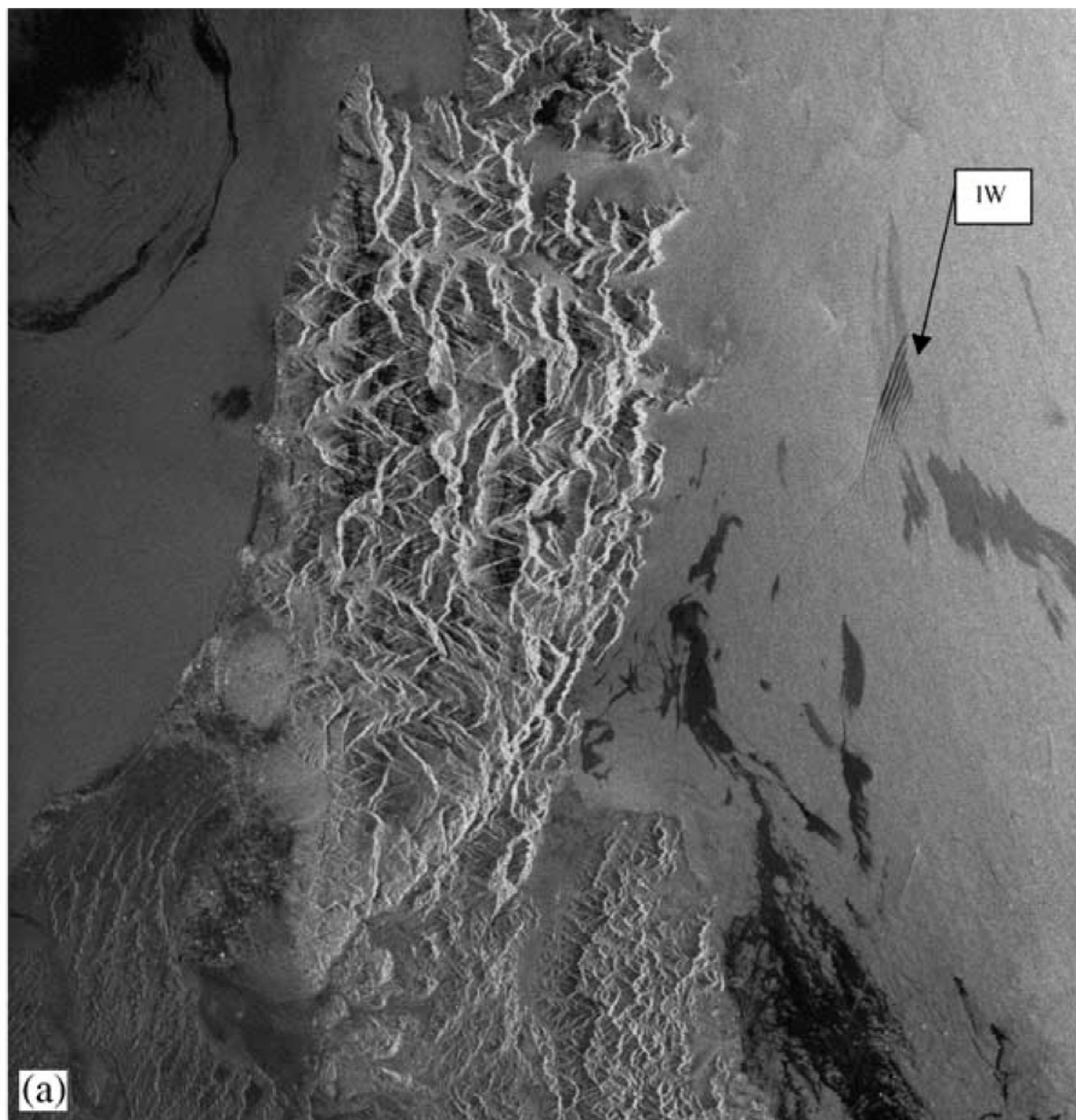


Figure 4. ERS-1 (C-band, VV) SAR image over the Musandam Peninsula in the Gulf of Oman acquired on 3 October 1998 at 0649 UTC (orbit 18053, frame 3087). The image shows a single internal wave packet propagating to the northwest. Imaged area is 100 km x 100 km. ©ESA 1998 [After Small and Martin, 2002].



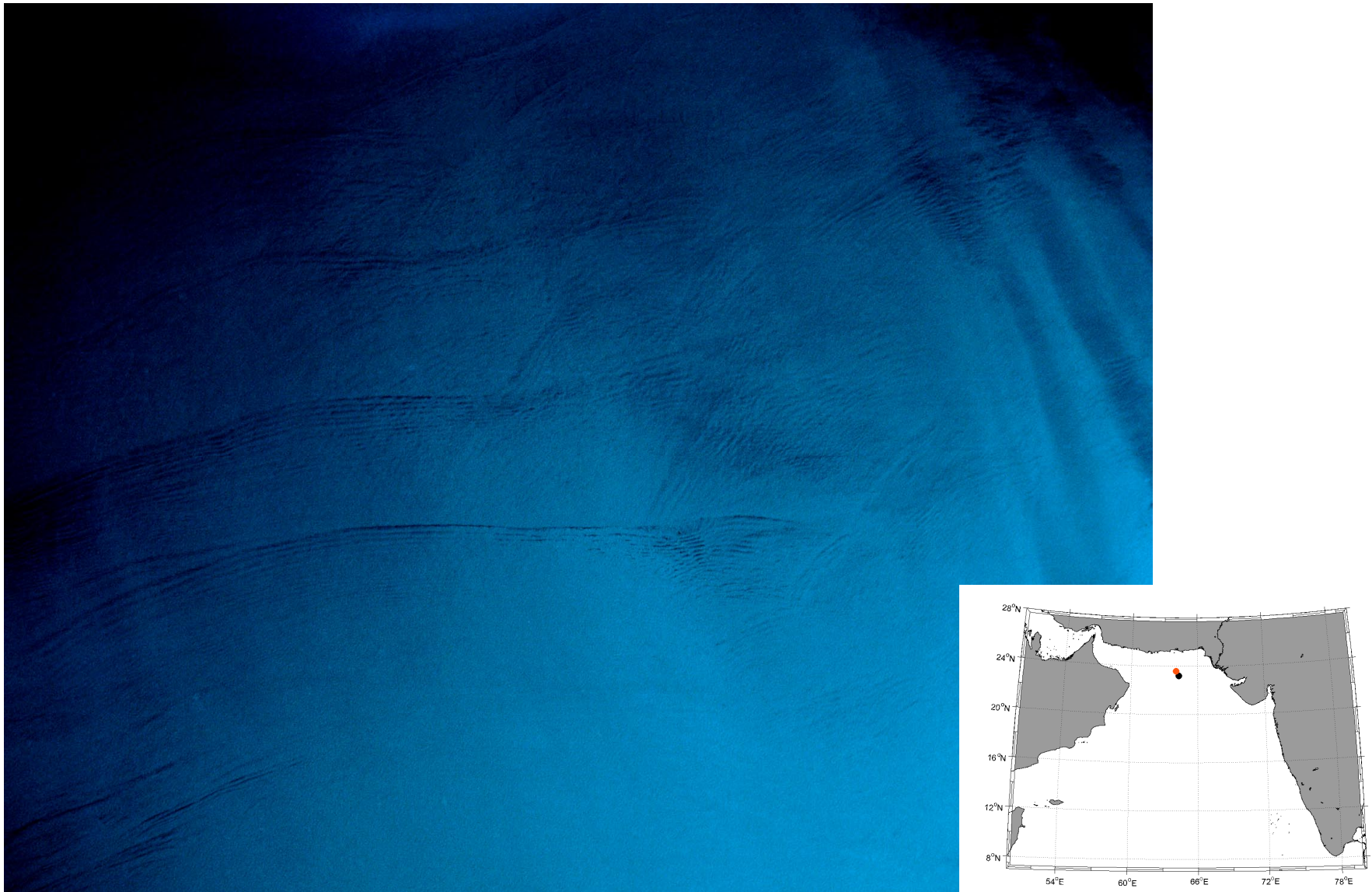


Figure 6. Astronaut Photograph (STS30-95-113) over the Arabian Sea acquired on 7 May 1989 at 0537 UTC. The image shows the signature of several well-structured internal wave packets. Imaged area is unknown. Position estimate based on spacecraft nadir (black dot) and sun specular location (red dot). [Image Courtesy of Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center (<http://eol.jsc.nasa.gov>)]

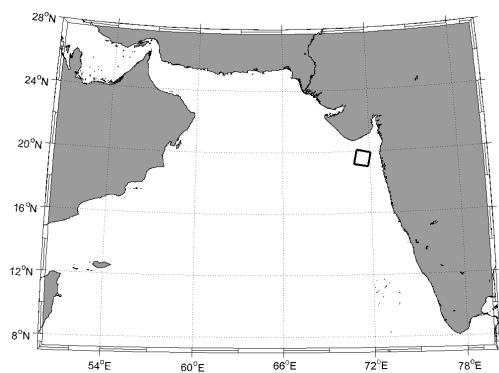
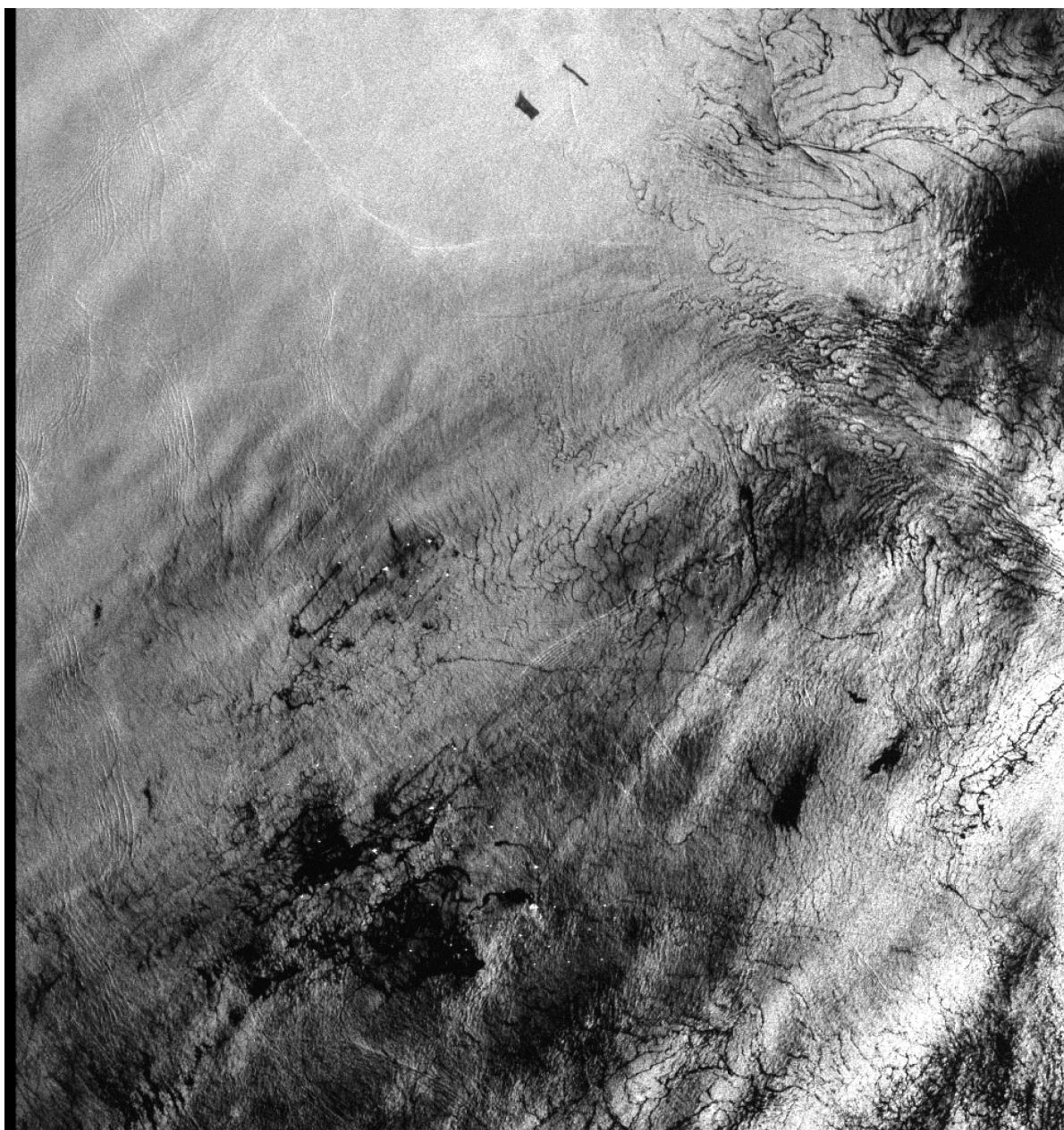


Figure 7. ERS-1 (C-band, VV) SAR image over the Gulf of Kambhat acquired on 8 October 1994 at 0545 UTC (orbit 16892, frame 3213). The image shows internal waves on the continental shelf propagating both toward and along the coast. The clusters of bright dots (center and bottom center) are oil drilling platforms. Imaged area is 100 km x 100 km. ©ESA 1994 [Image courtesy of Werner Alpers University of Hamburg.]



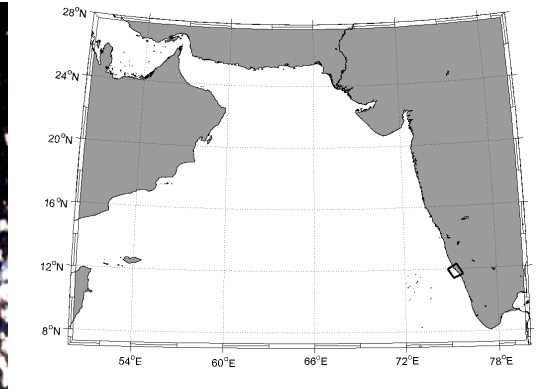


Figure 8. Astronaut Photograph (STS077-743-33) along the southwest coast of India acquired on 26 May 1996 at 0508 UTC. The image shows the signature of internal wave packets propagating shoreward. Imaged area is approximately 40 km x 60 km. [Image Courtesy of Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center (<http://eol.jsc.nasa.gov>)]