2 June 2013

Response to Reviewers' Comments (OS-2012-78)

Reviewer 1

Ocean Sci. Discuss. 9, 2885 – 2914, 2012, Soloviev et al., Fine-scale features on the sea surface in SAR satellite imagery – Part 1: Simultaneous in-situ measurements

It was a pleasure for the reviewer to read this manuscript. The basic ideas pursued earlier work carried out at the University of Hamburg by Feindt and Gade who tentatively suggested an approach for distinguishing between natural and artificial features in SAR images that is based on polarization phase differences. However, the authors of the present paper correctly conclude from these earlier investigations that "the technology of the nineties of the last century did not allow conclusions that were on a sufficiently reliable statistical base. Obvious "tendencies" were observed; however, higher resolutions had been necessary to form a solid base for Gade's "tentative conclusions". In the present work, a state-of-the art CPD filter was applied to SAR images of artificial fish oil slicks, natural slicks, ship wakes, an atmospheric frontal line, and rain signatures collected in the Straits of Florida. Thus results were obtained that were in line with Gade's conjectures thus forming a considerably safer basis for this approach.

The manuscript is written in an exceptionally excellent English style, the conclusions a well supported by data. Therefore, the manuscript can be warmly recommended for publication. A few minor suggestions should be considered by the authors as follows:

1.) In Chapter 5, third section, a definitely wrong statement is given:

"In contrast, a natural surfactant monolayer covering the sea surface produces relatively weak damping. The HH-VV correlation in the case of a surfactant monolayer is relatively high and almost the same as for the clean surface (Migliaccio et al., 2009)."

This observation by Migliaccio et al. cannot be generalized. Some cautionary statements are due! The present authors should refer to the wealth of observations published by the Hamburg group about airborne radar data over biogenic and artificial surface films. Many examples were published clearly showing that in the presence of some plankton species (for example, *phaeocystis globosa* or red tide forming species) natural sea slicks maybe formed exhibiting comparable wave damping characteristics as artificial sea slicks and stronger wave damping effects than crude oil spills! A convincing example for this fact can be found in

Hühnerfuss, H., W. Alpers, H. Dannhauer. M. Gade, P.A. Lange, V. Neumann, and V.Wismann (1996). Natural and man-made sea slicks in the North Sea investigated by a helicopter-borne 5-frequency radar scatterometer. Int. J. Remote Sensing, 17, 1567 - 1582.

Response: A cautionary note has been added in Section 5 to address this important comment.

The reason for this observation is the fact that the morphology of both natural and anthropogenic sea slicks may become comparable. Details can be found in:

Hühnerfuss, H., F. Hoffmann, J. Simon-Kutscher, W. Alpers and M. Gade (2006) New chemical insights into the structure and morphology of sea slicks and their geophysical implications. In: Gade, M. ; Hühnerfuss, H.; Korenowski, G. (eds.) Marine Surface Films: Chemical Characteristics, Influence on Air-Sea Interactions, and Remote Sensing, Springer Verlag, Heidelberg, 2006, 37-44.

Response: We completely agree with this comment. In the future, it is important to test the CPD filter approach in the known environment for different types of biogenic and artificial slicks in order to determine the range of the CPD filter applicability.

2.) The quality of some Figures should be improved: in Figure 1 the letters indicating the locations are hardly readable; Figure 3: what is the meaning of PE; bold letters may improve readability in Figure 4 and 10a.

Response: We will work with technical editors to provide a proper quality of figures.

3.) Some misprints in the references: please, check the name of Hühnerfuss (not Huhnerfuss)

Response: Typos corrected.

In conclusion, the present paper represents a considerable step forward with regard to the approach of using a CPD filter for discriminating natural and artificial features on the sea surface. The final step would include application of well-defined artificial sea slicks that are known to simulate natural sea slicks of different morphology. But this will be new story that could be carried out in a joint experiment with the Hamburg group.

Response: We will look forward to the possibility of a joint experiment with the University of Hamburg group.

Reviewer 2

General comments

The paper is addressed to an important issue. Interpretation of atmospheric and oceanic phenomena seen in SAR imagery is still a challengeable task. Nevertheless the results presented

are quite disappointing. There is nothing really just discovered among them. The discussion undertaken is very weak. Proposed interpretation of phenomena detected in SAR imagery is wrong at places. I've got an impression that the authors had not been dealing much with SAR imagery in their career and not always knew what they were talking about. I'm afraid this manuscript should not be published in a peer-viewed journal.

Response: We agree with the reviewer that "Interpretation of atmospheric and oceanic phenomena seen in SAR imagery is still a challengeable task." This task, however, cannot be completed without simultaneous satellite and in situ observations. The experiment described in our paper is aimed at obtaining such data. The data set analyzed here includes examples of several phenomena related to SAR imaging of fine feature on the sea surface. In this work, we test the CPD filter, which is potentially a powerful but not yet completely understood tool. This tool may have wide practical application.

Specific comments

Introduction is too romantic and general.

Page 2, line 4 "radar… penetrating through clouds…" – radar doesn't penetrate through clouds; it is its pulses that do

Response: corrected.

Page 2, line 10 "The fine-scale features observable in SAR include surface signatures of ship wakes, sharp frontal interfaces, freshwater plumes, and internal waves." Is that all? How about circulation features, e.g. eddies?

Response: corrected

Page 2, line 11 "The visibility of these features can be enhanced or masked due to the presence of natural or anthropogenic surfactants." How about the role of wind speed???

Response: the wind speed range is of course an important parameter (which is actually demonstrated in Fig. 9). Additional comment is added in Section 1.

Page 2, line 26 "coherent structures" – what is that?

Response: clarified and an additional reference is provided (Khalsa and Greenhut, 1985).

Page 2, line 26 stratification is not a process

Response: yes – corrected.

Page 2, line 27 “surfactants or oil spills” – so oil is not a surfactant?

Response: “surfactants or oil spills” replaced with “slicks and oil spills”.

Page 3, line 7 – “internal wave solitons” – only solitons?

Response: Internal waves but mostly internal wave solitons – clarified.

Page 3, line 7 – “spreading freshwater lenses” – only spreading ones?

Response: of course not only spreading freshwater lenses– clarified.

Page 3, line 17 – “influences of atmospheric process” – what kind of process?

Response: influences of different atmospheric processes are discussed throughout the paper (and specifically listed in Section1.

Page 3, line 32 – (Maingot, 2011) – what kind of information is given in this paper? A user guide of SeaKeeper SK1000?

Response: detail of the experiment are given in Maingot (2011) – clarified.

Page 4, line 14 – “during very low wind speed conditions” – when?

Response: time of the experiment is now given (15 June 2010, around 7 am EST)

Page 4, line 15 – “core of the Gulf Stream” – does Gulf Stream have a core?

Response: “core of” removed

Section 3.1

The frontal structure seen in the image can be frequently observed in SAR imagery obtained in different parts of the World Ocean. Apparently they are caused by differences in wind speed and have nothing to do with the Deepwater Horizon dispersants. Elongated slicks seen in the coastal area reflect the surface currents and have nothing in common with internal waves.

Their very origin is still unknown.

Response: This is just a hypothesis. We don't have any direct confirmation since virtually no measurements of possible oil spill signature were done by anyone in the Straits of Florida during the Deepwater Horizon oil spill.

Section 3.2

As it was mentioned above, the frontal structure was more likely of atmospheric origin. So it is useless to search correspondence with ocean interior.

Response: Simultaneous SAR and in situ measurements suggest that this frontal structure most probable is of ocean origin. Though, one cannot completely exclude that it is of atmospheric origin or a coupled ocean-atmosphere origin.

Section 3.3

The structures being under discussion are atmospheric gravity waves, not oceanic.

No need to present here what you could NOT investigate. Of course there are oceanic internal waves in that region. It is very naïve to give such an example as a confirmation of oceanic origin of features seen in figure 5.

Response: Many of the "wave-like" signatures in SAR imagery, but not all, are induced either by atmospheric rolls or atmospheric internal waves. In some places of the World Ocean, signatures of internal waves in SAR are, nevertheless, quite pronounced. Since the time of writing the discussion version of our paper, we have retrieved the ADCP mooring deployed in the SAR image area in the Straits of Florida. The data suggest presence of intense soliton activity with internal waves reaching 50 m height around the time of the satellite overpass shown in Figure 5. Figure 6 is now providing these new ADCP data.

Page 7, line 6 slick is not a natural phenomenon, it is an area without ripples.

Response: clarified

Page 8, line 29 “frontal eddies and meanders” – what is that? Nothing was mentioned about them before.

Response: “frontal eddies and meanders” are actually mentioned in the caption to Figure 4.

Figure 2 – is there a need in such a figure for Ocean Science readers?

Response: Data in Figure 4 are obtained with the system shown in Figure 2. We have decided to show its photo, because this is not a conventional system. For more details, we refer the reader to Maingot (2011).

Figure 3 – where were the photos taken? What is the correspondence between the SAR image and photos?

Response: clarified in the caption to this figure.

Technical comments

“fine scale” or “fine-scale”? Need to use one version throughout the paper.

Response: Only one version is now used throughout the paper,

Some commas are missing after “et al.”, “e.g.”.

Response: corrected

Some abbreviations are not clarified (e.g., CTD).

Response: clarified

Figures should be of bigger size.

Response: we will work with the technical editor on the optimum size of figures.

Reference list is not alphabetically ordered.

Response: references are now alphabetically ordered.

Caption of figure 13 – “bot” instead of “but”.

Response: typo corrected.

I would recommend mentioning spatial resolution and swath width for every SAR image being discussed.

Response: We have included a new table in the revised manuscript, which is providing this information for all SAR images included in the analysis.

We thank both reviewers for constructive comments!