Review by Thomas Bruns, Deutscher Wetterdienst, Hamburg

of the manuscript "Global ship accidents and ocean swell-related sea states"

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1. General comments

It is an interesting paper investigating the correlation between ship accidents and certain sea states, co-occurrence of wind sea and swell, in particular. It is well known that ships are endangered in high seas, depending on their size. Therefore, the IMO recommends ship owners to take advantage of ship routing services. However, accidents also occur unexpectedly at moderate sea states and thus it makes sense to dig deeper in the available data base. From this point of view, I find this paper is worth being published.

However, I have some major concerns and proposals of improvement:

- The wave model data set ERA-20c used is not suitable for this study, therefore acquire a high resolution data set
- Discuss the typical cases in terms of time series in addition to the 2-dim-representation
- Include interpretation of wave spectral partitioning
- Include some discussion on ship behavior in rough seas

Under these conditions , the paper will be acceptable , otherwise, I would have to reject the paper.

My comments in detail:

2. Numerical Wave Model Data :

Page 3, line 24-25:
The Ocean Wave Daily data in the ERA-20C dataset are available from 1900–2010 every 3 hours at a grid size of **0.125**°ERROR → The spatial resolution is actually **1.5**° !! The coarseness is obvious in figures 4 and 5. Near coastal wave heights tend to be underestimated. Referring to section 4, most of the ship accidents occurred near coasts!

3. Overview of Ship Accidents

The section describes the large variety of ship types and accidents. It is clear that each case would deserve a distinct study taking into account the ship's properties. Since this will hardly be possible, some discussion on ship's behavior in heavy seas would be helpful at this point. The authors already mention parameteric rolling, but a lot other dangerous incidents may occur, like extreme slamming, bending and torsional stresses, green water on deck and emerging propellers (both reducing ship's stability).

4. Analysis of the Sea State during Ship Accidents

With the statistical evaluation in this section the authors attempt to find evidence of a relation between ship accidents and crossing seas (wind sea and swell), characterized by small $\Delta T<2s$, directional spread of 30-40°.

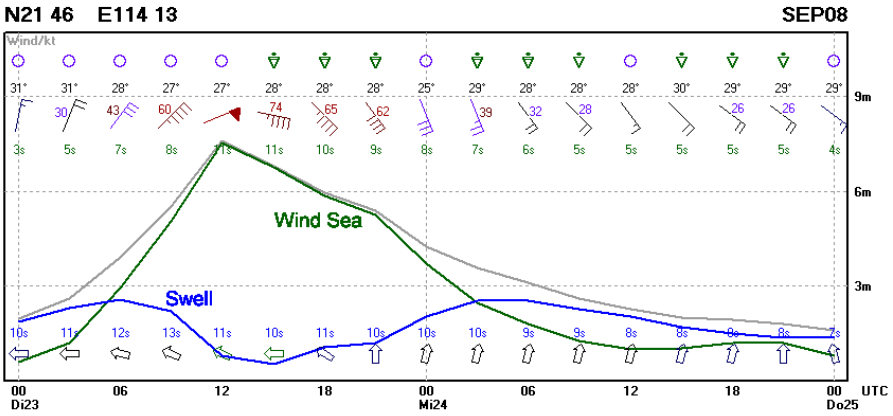
Indeed, a tendency in this direction can be recognized, but there is a lot of noise in the data, which remains unexplained. Some portion of this noise is probably due to the coarse data grid. The rest should be explainable by the large variety of ships and different kinds of causes for accidents (see **3.**). Human errors may also cause accidents, even in moderate sea states. A discussion of this issue should be included here.

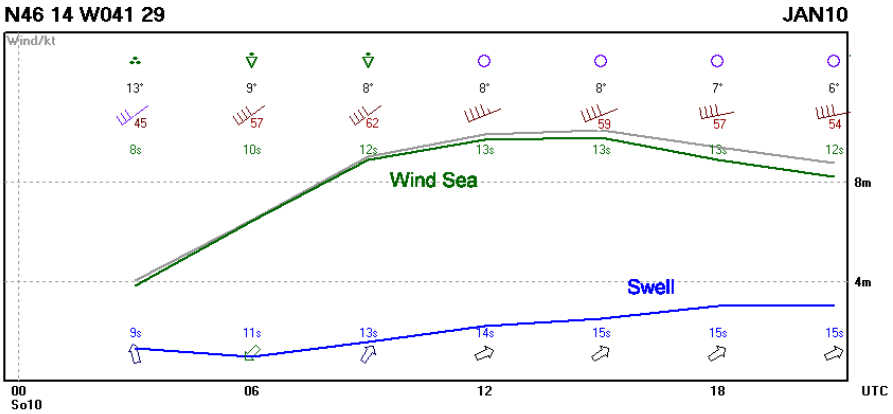
Wave steepness values between 0.03 and 0.04 are surely not hazardous for ships at all, but steepness of individual waves will probably increase the average steepness. The positive correlation between steepness and the spread between sea and swell propagation is interesting: Is there some theoretical explanation for this phenomenon?

5. Sea States of Typical Cases

It should be mentioned that the distinction between wind sea and swell is an artificial construction. Mariners usually think of swell as a wave system originating from a distant storm, travelling into the local wind field. Crossing seas of this type are not very frequent but very hazardous. The sea states discussed in this section and presumably most of the other 753 cases do not involve a “classical” swell. Crossing seas with angles of 30-40° between directions of wind sea and swell are typically generated by rapidly moving low pressure systems, particularly in the vicinity of cold fronts with sudden changes in wind direction. Consider a storm with high wind sea : If the wind changes direction, a new wind sea is generated and the “old” wind sea is transformed to “swell”. This partitioning of wave systems is done by the wave model post processing.

Figures 4 and 5 are difficult to interpret, I could hardly follow the arguments in the text. The coarse 1.5° model grid creates strange rectangular wiggles of contours. Furthermore, I miss date and time in the legend. In order to thoroughly investigate the cause of accidents I suggest a local description in terms of time series like the ones I include here, based on the operational ECMWF Global WAM. Note that in case 1 waves are twice as high as in ERA-20c! Obviously, this is not a “low sea state” case.





6. Minor revisions

Page 2, line 5 :
A high wave height is ~~no doubt~~ undoubtedly a threat 5 for ships, yet some ships wreck at relatively low wave heights ~~and~~ but high wave steepness sea states (Toffoli et al., 2005).

Page 2, line 28-29 :
The detailed information discussed above ~~are~~ is presented in section 2.
Page 3, line 22:
"ERA-Interim" has not been described so far.

Page 5, line 1:
The number of ship accidents ~~that fell within~~ inside each region was summed …

Page 6, line 2:
As discussed in the Introduction ~~section~~, the co-occurrence of wind sea and swell conditions is considered a potential causal.

Page 8, line 4:
a small ΔD area in the northerly direction and a large ΔD area in the southerly direction. → seen from the ship's position? This is hardly recognizable on the map of fig 4!