

## **Suggestions, remarks and comments made by Adriaan de Kraker about Garnier's paper on the risk of floodwaters in the Wash area .....**

The author has looked at a time span of more than three centuries of flood events that have occurred in the Wash area. His information is provided by documentary sources: archival, so primary and contemporary documents and records providing second hand information for the more recent period. The aim of the author is to understand (4.1) the fluctuations, severity and origin, (4.2) the causes and seasonality; (4.3) the socioeconomic impacts in terms of damage, casualties, adaption strategies, etc.

It is a good thing to have more information from multiple areas across Europe about flood events from the past. This could help to have a much more complete and variable picture of weather of the past 3.5 centuries, going back to the pre-instrumental period and for the larger part dealing with the Little Ice Age. In particular information from historical documents is much appreciated.

Those are the main consideration to publish the article, but some major revisions are required, because the paper needs a significant facelift in terms of content, structure and grammar.

The summary does not mention the time span or the area under study and what are the issues?

About the contents:

Garnier studies the Wash area, which is a kind of estuary in which floodwaters are funnelled if there is a springtide along with a north easterly wind blowing. This means that the area has a sea level curve which differs from that of the Norwich coast. As a result tides run lower and higher than they do on the Norwich coast and further south as far as Lowestoft or Dunwich. It thus implies that the Wash area has a bigger tidal amplitude than other areas in its surrounding, which makes the Wash extra vulnerable. This is one aspect which I miss in the description of the study area.

Another vital aspect on a multiple century time scale concerns the changes in the landscape. Some major changes occurred in terms of continuous embankments, so the estuary got smaller and smaller. If this has affected its funnel shape it certainly must have had an impact on the tides, springtides etc. In fact this landscape change is one of the most important noise factors that needs to be taken into consideration comparing events on a multiple time scale.

A third aspect is change in dike building and the drainage network. How did this affect the risk of flooding. As sea walls or any other coastal protection changed in terms of material used or the sheer size and height of sea walls this must have reduced the risk of flooding tremendously, certainly since the mid-nineteenth century. What happened to the River Ouse and others during the period under study. During the 19<sup>th</sup> century rivers everywhere across Europe were straightened, perhaps already at an earlier stage in the industrializing UK?

A fourth aspect is the rainfall pattern in the UK. The Wash area is located in eastern England (East Anglia) which has the lowest annual rainfall in the entire UK and is therefore less vulnerable to river

flooding than for instance Wales and the Lake District. This pattern should be made clear from the start showing how unusual flooding in the Wash area really is.

In short: the geographical setting of the study area and how it has changed over the centuries must be described more systematically in order to know how changes might have affected its vulnerability to flooding. Also the impact of tides and rainfall patterns need to be more explicitly dealt with.

#### About the method

The author uses two different kinds of information. The second type is second hand information. He does not demonstrate, however, that there might be a difference in for instance reliability. He assumes it is as good as any material in particular the first type of information used. In fact the author needs to make clear all the information used is equally reliable, that the series he used are continuous and homogeneous. These are the fundamental requirements of information used, put forward by Leroy Ladurie already decades ago. Also see the additional reading sent separately to the author. Reliability can be checked by using two or more long time series of information about the same area. Homogeneity can be checked by looking at the way information has been recorded and where precisely observations have been made. Homogeneity is under threat when major changes in the landscape, coastal protection, administration, etc. take place. If such changes affect the integrity of the information, this needs to be taken care of.

Terms like homogeneous only appear in the conclusion for the first time, but should already be explained from the start. In the conclusion the author casts doubts about his information 'a relatively reliable series'. Odd? Make sure this doubt is dealt with at the start by being more explicit about the high quality of information used and the method applied

Furthermore the author does not elaborate on the grading system he applies. It would be better to mention a few examples of different categories in order to demonstrate how the grading of events works? It would be helpful too to also study (De Kraker, 1999 and 2013) and to point out how similar or different this grading method is. What about the duration of a flood event?

In short. Chapter 3 should be limited to the material/information studied and a separate ch. 4 should be about the method used, followed by 5: discussion. The discussion should be about the outcome along with all the results in the graphs, which is now most of ch. 4.

#### Other aspects

The discussion of the causes of the flood events needs to distinguish between flooding caused by high tides, storms and storm surges (the sea as major player) and flood events caused by high waters in the rivers and ice blocking (rivers as major players). The combination of the two is a rarely occurring event.

I also notice a bit of a doubling in 4.1 ...origins.... and 4.2. causes..... It would be better to combine these two subsections: for instance Causes and types of floods

In the discussion about flood events throughout the year (winter, spring, summer, autumn) I miss the aspect of evaporation: very low in winter, high in summer. It is therefore no surprise that more than

half of the events occur during winter. Generally flooding by sea water occurs during winter because of the storm season and the very high springtides.

Section 4.3 is about the consequences in terms of damage. That is a clear section, although I miss the impact of sea floods in terms of salinity and generally the impact of erosion both of them being negative. An what about the positive effect of flooding? The positive aspect of river flooding is the depositing of a fresh new layer of silt, which generally fertilizes the meadows. In some areas this last aspect was quite a systematic way of fertilizing land (flood meadows). Was there such a system in the Wash area?

The subsection about mortality is much too speculative. Why not be explicit about the number of people, cattle drowned at each event as facts. And then why not give a few examples of possible death causes and finish the subsection by saying that this is quite an interesting field of study which requires far more research into depth. In the Low Countries there is a similar phenomena with malaria occurring during very hot summers, but it is only after months that people are taken ill, while new born babies mostly die immediately.

In the section socio-economic consequences it would be good to read how strategies were improved in the course of time to prevent flooding. Memory of recent floods could be helpful, flood marks could also help, but profound changes in river systems and dike building or changes in the organisation and administration (even legislation) of water and coastal management are most interesting aspects of the process of continuous learning from the past.

Finally, it would be interesting to have a wider European scale of the events, for instance a comparison with similar events in the North Sea area Netherlands, Flanders and Northern France.

About the figures, tables etc. I would like to see a table with all the flood events with date, place, flooded area and amount of damage (if possible), which would enable us to compare events in the Wash area with similar events elsewhere (Netherlands), because is the same North Sea area and at about the same latitude.

At this stage the paper is in I have not considered other aspects of the paper such as literature/referencing etc. yet.

To conclude.

Garnier has written an interesting paper with a lot of new information on the topic of flood events in the Wash area, 17<sup>th</sup>-19<sup>th</sup> c. which is important enough to be published, but only if after major revisions have been carried out.