Replies to reviewer 1

The authors thoroughly responded to reviewer comments. Thank you. I only have a few minor additional comments:

(1) The term 'river channel rips' is misleading. Rip currents are driven by the action of wave breaking (Bowen, 1969). In this case, the rips described are breaking patterns over bathymetric features formed by the estuarine processes. Thus, a more appropriate term would be 'river-channel bathymetric rip' or something along the lines of this rip current type being a sub-category of a bathymetric rip.

Thank you for this suggestion, I agree it is clearer to use that wording. I have amended this in the abstract, conclusions, and Section 6.3:

These 'river-channel bathymetric rips' fit with the concept (McCarroll *et al.*, 2018) that intense rip flows occur in shore-normal channels with high alongshore non-uniformity (i.e., deep and narrow), regardless of whether the channels were formed by estuarine or wave processes.

(2) The new findings suggest that mean direction is important. This should be reflected in the conclusion.

Good suggestion. I have now amended the first paragraph of the conclusions as follows:

'Surfzone currents at an embayed estuary mouth beach were both measured and modelled, revealing complex surfzone circulation patterns, including circulating, alongshore, and exiting flow regimes. The river channel morphology is a key driver of the circulation above mid-tide. The river channels act to constrain both estuarine and wave-driven currents, directing the flows alongshore and offshore, often connecting with boundary and channel rip currents lower on the beach face. Flow velocities through the river channels were enhanced by increasing estuary discharge, increasing wave power, and decreasing water depth. Wave direction was also found to alter bathing hazards, hindering seaward estuary flows during shore-normal waves and exacerbating shadow boundary rips during obliquely arriving waves. Overall, tidal stage exerted the greatest control on surfzone exits and seaward flows at this embayed, estuary mouth beach.'

(3) Perhaps I missed this, but how is an incident defined? A lifeguard rescue attempt?

This is defined on line 567 'Only flow-related incidents (n = 648) were considered where a lifeguard was required to rescue or assist a water-user back to shore (**Error! Reference source not found.**).'

(4) L571: How are the threshold values defined? Are these simply chosen as the best hazard agreement with observations by manual tuning? Please explain. Why are there only a low and high threshold for the exits?

I've now slightly re-worded this paragraph to make it clearer:

'The thresholds in Table 2 were optimised by analysing past bathing incidents at Crantock Beach over the years 2016–2021. Only flow-related incidents (n = 648) were considered where a lifeguard was required to rescue or assist a water-user back to shore (Figure 13). The lifeguard data were discretised into 2-hour time bins and the number of Incidents were divided by the bather head count made by the lifeguards during each 2-hour period (representing an estimate of the average Exposure over that period), resulting in an 'observed' Hazard level from Eq. 1 for each timestep. The Hazard timeseries was then used to compute bin-averaged Hazard values across a number of discrete Uoff and E bins. The distribution of Hazard over these bins suggests that sharp increases in Hazard occur

when Uoff reaches 0.2 m/s and 0.4 m/s. The lower threshold is corroborated by Moulton et al. (2017a), who identified that rip current speeds greater than 0.2 m/s may be hazardous to swimmers. For E we find a single threshold of 0.2 (20% likelihood of a drifter exiting the surfzone), which distinguishes between lower and higher levels of Hazard. An obvious second increase in Hazard with E was not visible from the distribution. Using these thresholds, two scores are obtained from Table 2 which are added together and rounded to achieve a final Hazard Score, following the approach of Austin et al. (2013).'

(5) Fig 13: The caption is not updated per the new section. For example, 'Risk' is still included.

Thankyou, this is now amended:

Performance summary of the developed bathing hazard forecast over the hindcast period (2016–2022). Proportion of forecasted Hazard Scores (HS1, HS2, HS3; upper left), relative average water-user exposure (upper right), proportion of total incidents (lower left), and probability of an individual water user being in a flow-related incident (Hazard, lower right).

(6) L718: Do we actually know that bathymetric and topographically controlled rips are far more common here? This study did not use a phase-resolved model, so the authors can't prove anything about transient rips with these findings. Is there clear evidence in the literature that transient rip processes would not be important here?

I agree, that was a stretch too far. I've now re-worded that bullet point to better reflect our understanding of their importance here:

'The surfbeat mode of XBeach was employed in this study, which captures the wave variations and associated wave-driven flows at the wave group (infragravity) timescale (Roelvink *et al.*, 2010) expected to drive the bathymetric and topographically controlled rips at Crantock (Austin *et al.*, 2010; Austin *et al.*, 2014; Scott *et al.*, 2014). However, transient flows driven at the incident wave timescale such as flash rips (Castelle *et al.*, 2016) are not captured by the model, which may occur over the planar lower beach morphology (Castelle *et al.*, 2014) away from the headlands.'

Replies to reviewer 2

This is the revised version of an interesting observational and modeling study exploring swimmer hazards in an understudied environment where estuary mouth flows encounter surfzone currents in an embayment. The authors addressed all of the minor line-by-line suggestions. My earlier concerns were (1) the framing of the paper, (2) the forecasting hazards analysis, and (3) the clarity of the text and figures.

For (1), I appreciate the mention of boundary rip currents in the intro and the added comment about cellular circulation is great. I still think the abstract (and possibly the title) should mention the embayed setting and boundary rip currents to accurately represent the paper and to highlight the unique setting that contributes to the paper's interest and novelty. This system has an estuary entering a beach within an embayment, which has modified wave conditions and boundary rip currents not present on an open-coast. The authors note this in the Discussion: "The embaymentisation […] elicit[s] specific flow behaviours (shadow rips, for example) that won't necessarily occur in the same way at other estuarine surf beaches." In addition to many mentions of

boundary rips in the results, the authors note in the hazard section that other forecasts have not "yet included dynamics from channel rips, boundary rips, and estuary flow," in the Discussion there is a section titled "Embayment, estuary, and wave controls on surfzone exits," and the Conclusions state that "The river channels act to constrain both estuarine and wave-driven currents, […] often connecting with boundary and channel rip currents lower on the beach face." To me, the embayment setting and boundary rips are a significant part of the story of this paper, but if I'm misunderstanding, maybe the text needs to be revised some to reflect this.

On reflection, I agree that this has become (especially since the first round of revisions) a significant part of the paper. Therefore, I have amended the title as per your original suggestion to:

'New insights into combined surfzone, embayment, and estuarine bathing hazards'

And I've slightly revised the abstract to also reflect this:

'Rip currents are the single largest cause of beach safety incidents globally, but where an estuary mouth intersects a beach, additional flows are created that can exceed the speed of a typical rip current, significantly increasing the hazard level for bathers. However, there is a paucity of observations of surfzone currents at estuary mouth beaches, and our understanding and ability to predict how the bathing hazard varies under different wave and tide conditions is therefore limited. Using field observations and process-based XBeach modelling at an embayed, estuary mouth beach, we demonstrate how surfzone currents can be driven by combinations of estuary discharge and wave-driven bathymetric and boundary rip currents under various combinations of wave and tide forcing. While previous studies have demonstrated the high hazard that rip currents pose, typically during lower stages of the tide, here we demonstrate that an estuary mouth beach can exhibit flows reaching 1.5 m/s – up to 50% stronger than typical rip current flows – with a high proportion (>60%) of simulated bathers exiting the surfzone during the upper half of the tidal cycle. The three-dimensional ebb shoal delta was found to strongly control surfzone currents by (1) providing a conduit for estuary flows that connects to boundary headland rips, and (2) acting as a nearshore bar system to generate wave-driven 'river-channel bathymetric rips'. Despite significant spatio-temporal variability in the position of the river channels on the beach face, it was found to be possible to hindcast the timing and severity of past bathing incidents from model simulations, providing a means to forewarn bathers of hazardous flows.'

For (2), the revised and expanded forecasting section is much more detailed and clear.

Thankyou, your suggestions have definitely helped to improve this section.

For (3), the authors improved the clarity of the figures and discussion of the study limitations. I like the added time series in Figure 10 and the change to Figure 12 showing the signed cross-shore velocity in color is an improvement over the quivers. In Figure 8, the zoom regions could be shown with boxes in a, d.

Thankyou for this additional figure suggestion. I have now added zoom regions to in Figure 8, which I agree clarifies the zoomed panels.

I have no further comments.

Thankyou for taking the time to review our paper again.