Analysis of potential flood damage on crops at global scale

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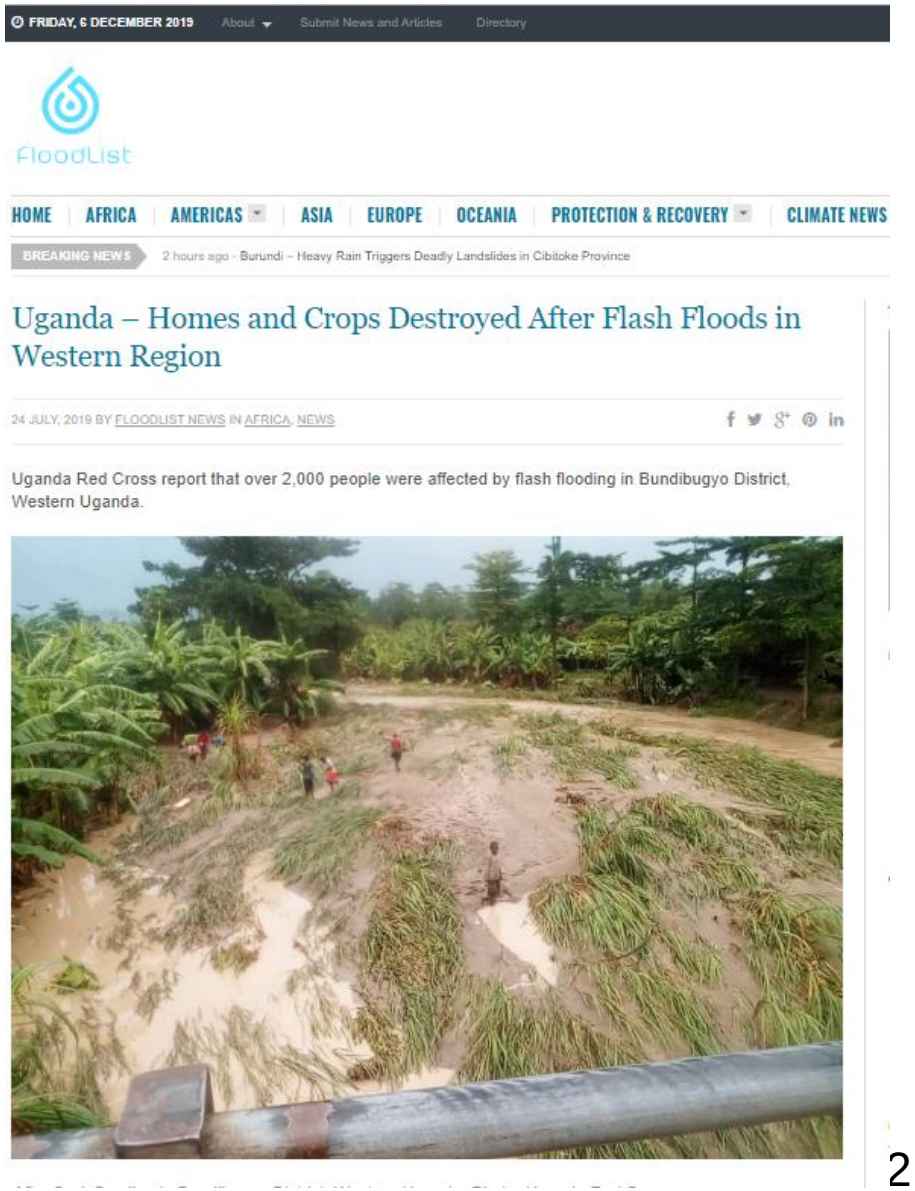
Foreword

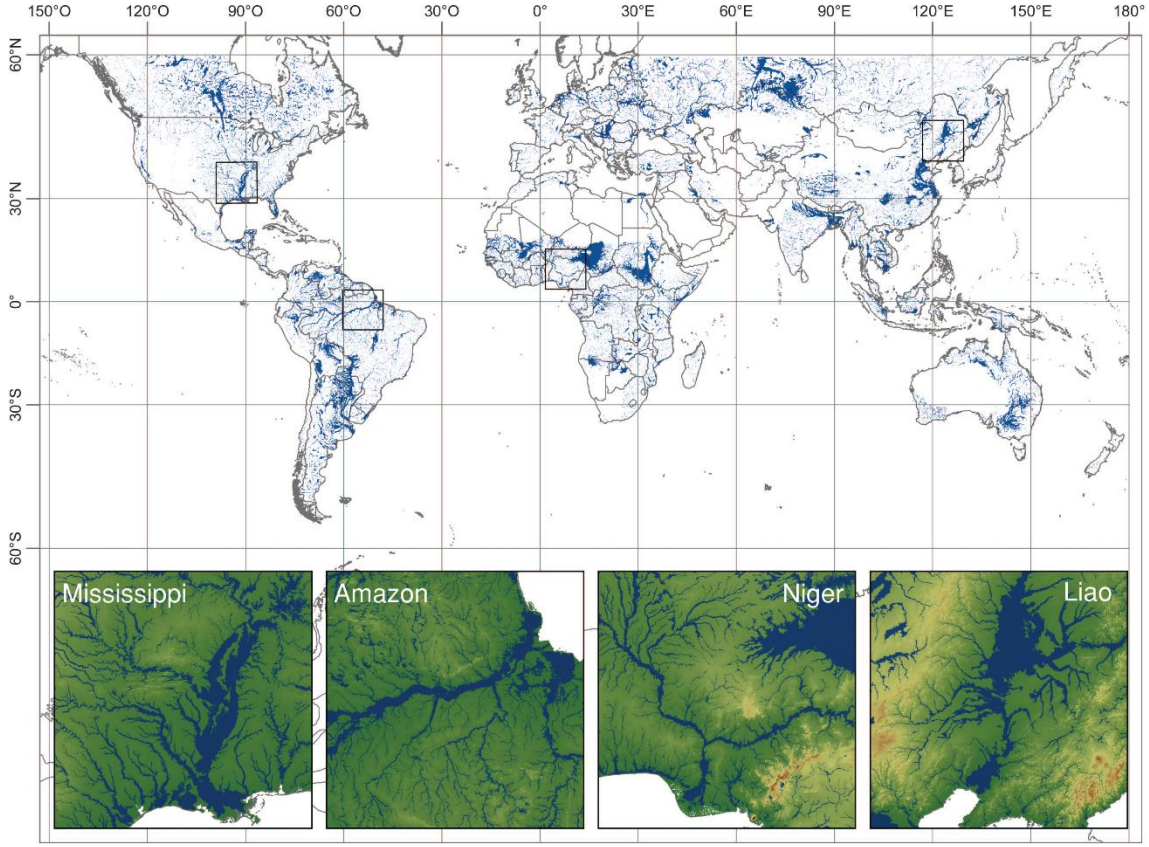
- Most of the food production connected to agricultural production is located in fluvial corridors because of their suitable morphology and fertile soils.

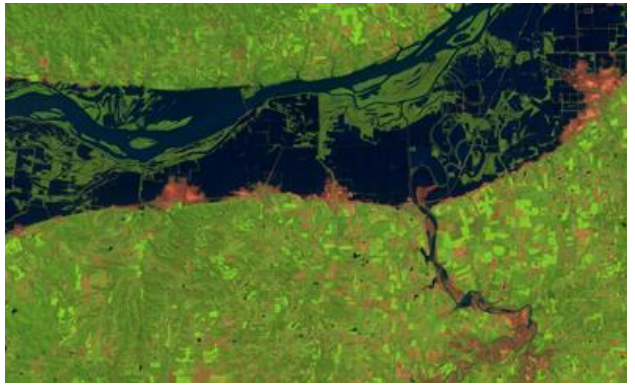
- What if those areas are flooded?



Floodplains

A floodplain is an area of land adjacent to a stream or river which stretches from the banks of its channel to the base of the enclosing valley walls, and which experiences flooding during periods of high discharge.

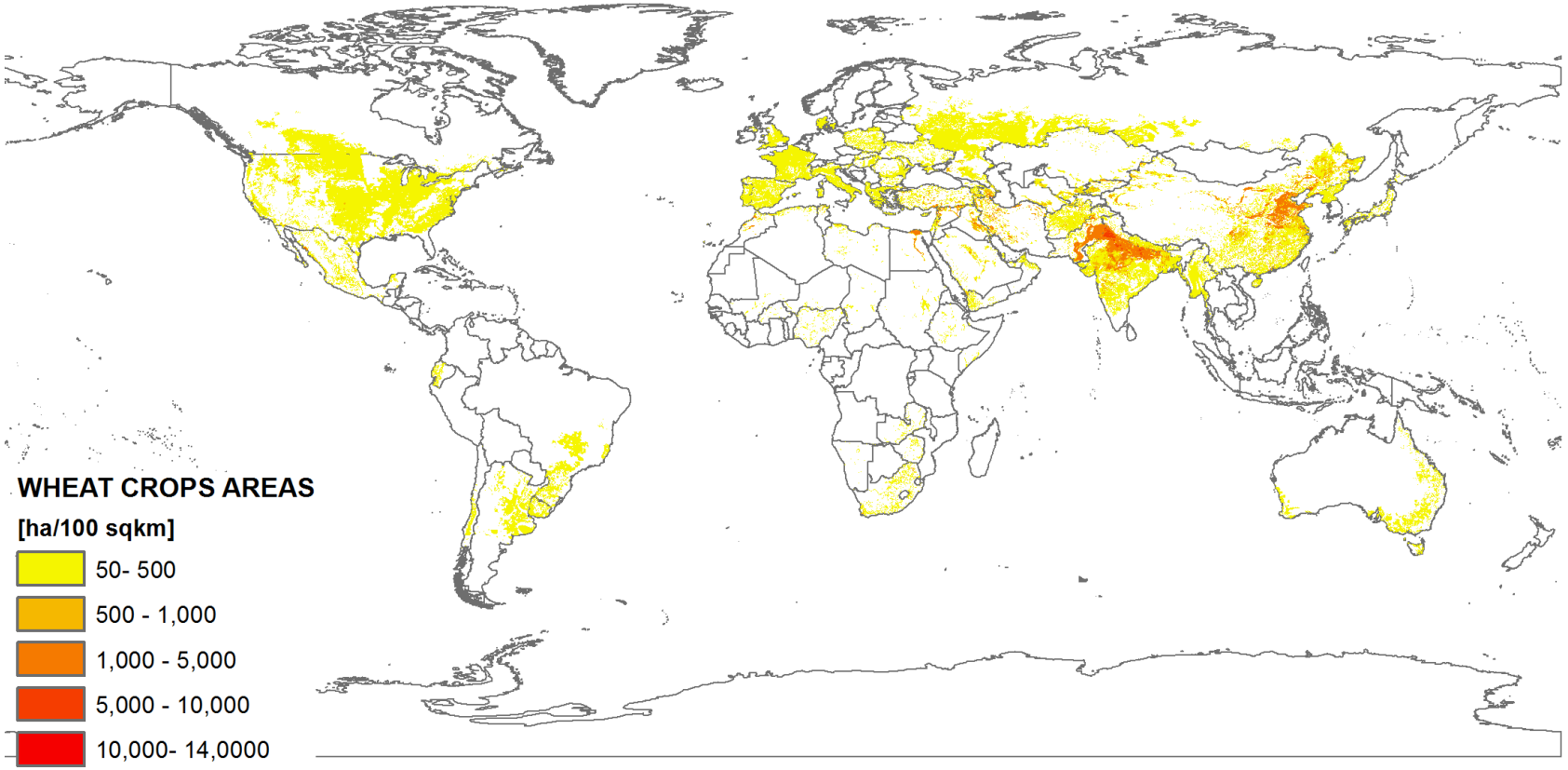




Nardi et al., *Scientific Data*, 2019 https://www.nature.com/articles/sdata2018309

Agricultural harvested area

Agricultural harvested area indicates the area that is harvested in any given year. Crop production, both for staple and cash crops is strictly dependent to the harvested area and the climatic characteristic of each growing period of each crop.



Global Cropland Area Database (GCAD)

Teluguntla et al., 2014

Research questions

- Where agricultural harvested area is located?
  - Most of the food production connected to crops is located in fluvial corridors because of their suitable morphology and fertile soils.
- An opportunity or a risk?
  - The knowledge and large scale quantification of the agricultural resources at flood risk has a crucial importance for improving urban and regional planning.

Research goal

- A global assessment of cropland at flood risk in terms of extension, productivity and the related calories is presented

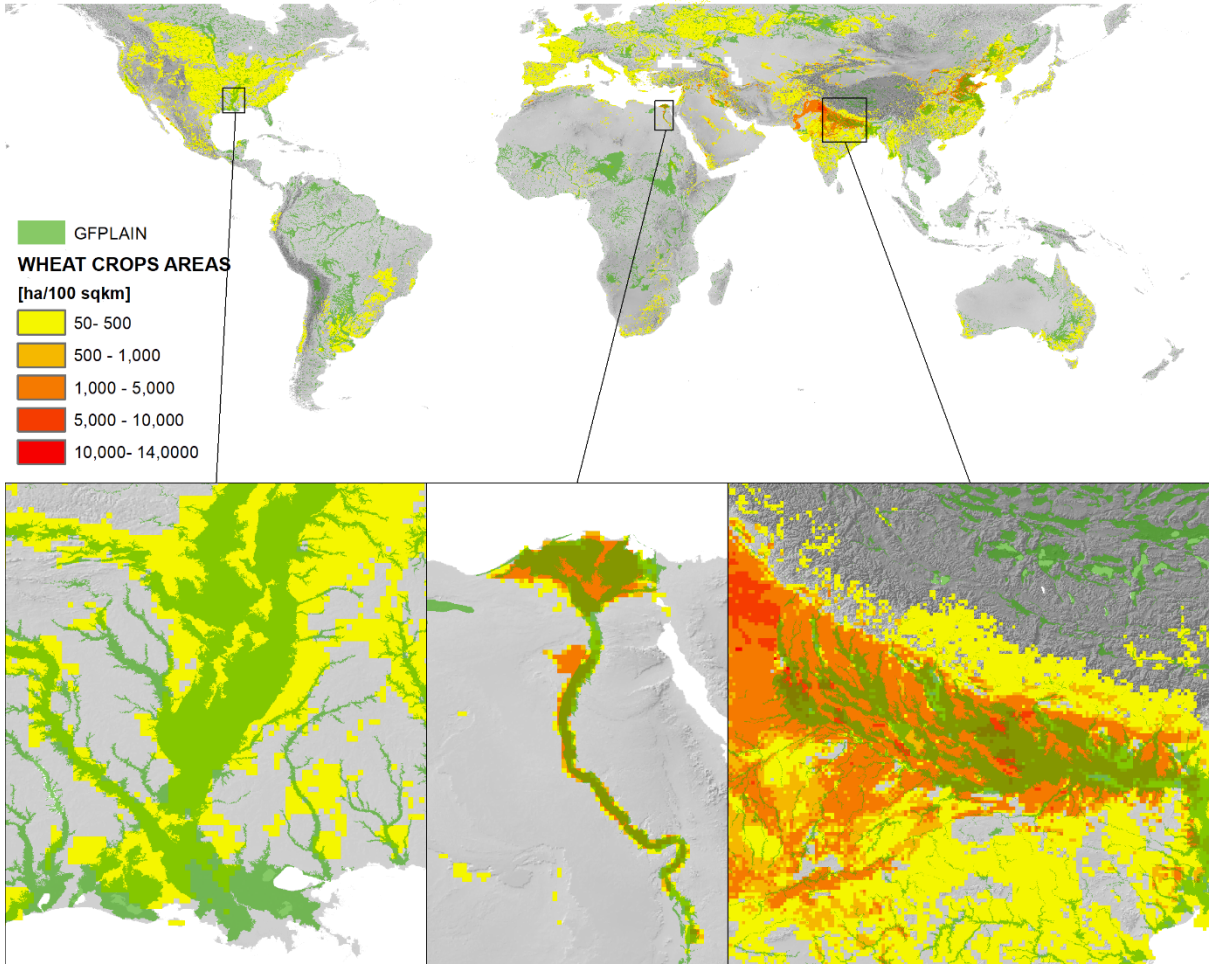
Methodology

- Two different types of floodplain datasets:
  - The GFPLAIN (250m resolution, Nardi et al., 2019)
  - The JRC flood hazard maps at different return period (1km resolution, Dottori et al., 2016)

- 16 main staple and cash crops covering about 75% of total crop production (10km resolution, Portmann et al., 2010)

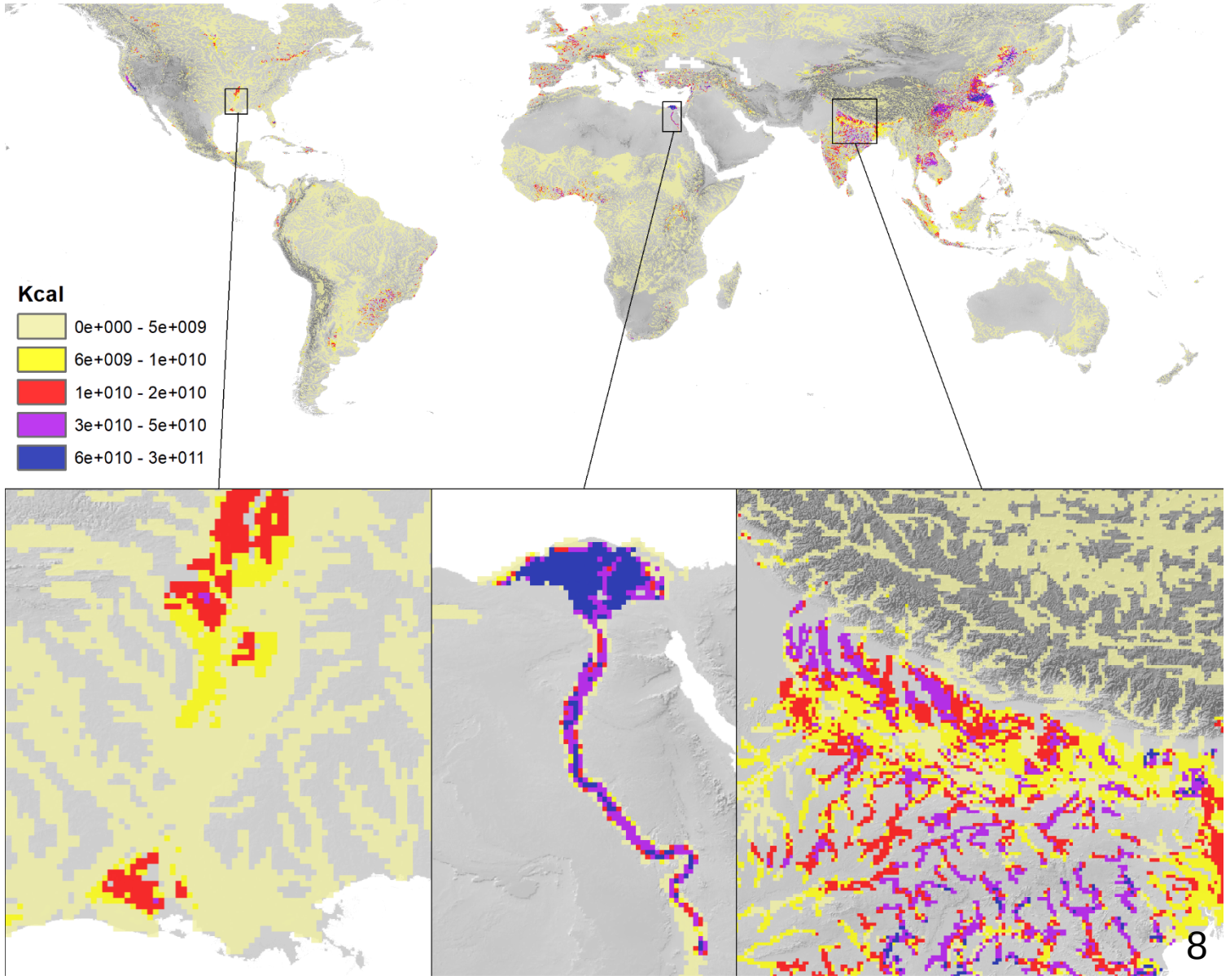
Methodology

- We calculate spatially distributed and crop specific percentage of floodplain and flood hazards maps considering the minimum value between crop area and floodplain in same cell.
- The crop yield and calories contents of each crop is assigned according to D'Odorico et al. (2014)



Results

- Potential loss of Kcal in the hypothesis that the maximum extension of the global floodplain is flooded



Results

- Potential loss of Kcal in the hypothesis that the 19 river basins are completely interested by related to specific return periods (10, 50, 100, 200 years)

River basin	*Population*	*Population in floodplain area*		*Area potentially flooded [Mha]*				*Kcal produced in flooded area [10^{12}]*			
	[Mln]	*[Mln]*	*% of the total*	*10y*	*50y*	*100y*	*200y*	*10y*	*50y*	*100y*	*200y*
Ganges-Brahmaputra	753.9	353.4	47%	33.6	36	37	37.7	45.1	47.6	48.6	49.3
Yangtze	379.8	167	44%	15.9	16.3	16.5	16.6	47.3	48.5	49	49.4
Hwang Ho	170.1	58.3	34%	9.7	10.2	10.3	10.4	24.7	25.9	26.3	26.6
Amur	67.7	24.3	36%	3.7	4	4.1	4.2	21	22.3	22.7	23.1
Parana	68.2	9	13%	6.8	7.3	7.4	7.6	16.5	17.4	17.7	18
Nile	216.9	70.8	33%	7.4	7.8	8	8.1	16.5	17.1	17.4	17.6
Indus	227.6	4.4	2%	14.6	15.6	15.9	16	15.3	16.2	16.4	16.6
Mekong	63.2	29.4	46%	5.9	6	6.1	6.1	15.1	15.7	16	16.2
Mississippi	81.5	14.8	18%	16.8	17.3	17.5	17.7	10.8	11.2	11.3	11.4
Godavari	82.6	10.4	13%	3.6	3.9	4	4	9.4	10	10.2	10.2
Volga	59.8	12.2	20%	4.2	4.4	4.4	4.4	9.3	9.7	9.7	9.8
Danube	77.1	20.8	27%	7.4	7.8	7.9	8	9	9.5	9.6	9.7
Liao	44.6	11.1	25%	2.6	2.7	2.7	2.8	9	9.5	9.6	9.8
Si	125.6	48.9	39%	2.9	3	3	3.1	8.2	8.6	8.7	8.8
Sacramento	6.3	2	31%	0.9	0.9	0.9	0.9	8.3	8.6	8.6	8.7
Mahanadi	42.5	7.8	18%	1.9	1.9	2	2	7.8	7.9	8	8.2
Chao Phraya	29	20.3	70%	3.6	3.6	3.7	3.7	7.2	7.5	7.5	7.5
Ob	26.4	7	27%	4.4	4.6	4.6	4.7	7	7.2	7.3	7.3
Tigris-Euphrates	51.8	7.3	14%	2.9	3	3	3.1	6.5	6.6	6.7	6.7

Discussion

- The research is aimed to support protection and intervention strategies at different geographic, climatic and socio-economic scales for food security management

- Outcomes of this research at large scale highlight the pivotal role of efficient and safe floodplain management for sustainable food security.

- Note that the potential lost calories are calculated considering the total distruction of the crops and the maximum extention of the floodplains and the flood hazard maps related to specific return periods for the entire globe.

THANK YOU!

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