# NMR safeguarding plan in case of major flooding of the Seine river

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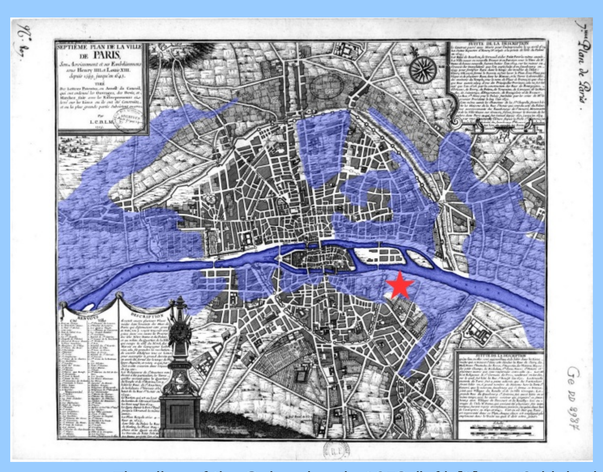
## 1 – Introduction

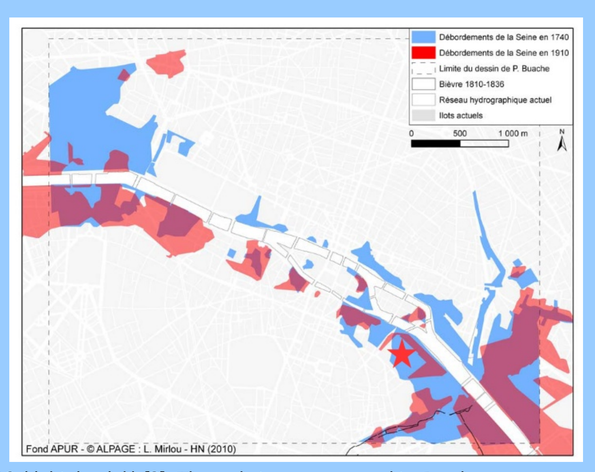
- Jussieu site is located in Paris on the banks of the Seine river.
- 14 NMR spectrometers are ranging from 300 MHz to 700 MHz.
- 9 NMR are on the ground floor, 5 NMR are on higher floors.
- Their total cost is 7 M€.
- A quench will cost 40 k€ per spectrometer.
- Flooding of electronics is estimated to 200 k€ per spectrometer.

## References

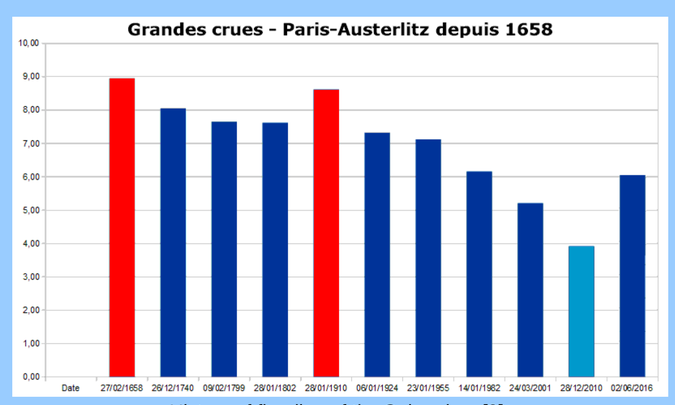
[1] ‘La crue de la Seine, Plans, Photographies, Films’, *Netfis*, 2016. [Online]. Available: http://www.neftis.eu/NeftisWeb/Documents.htm. [Accessed: 12-Mar-2017].
[2] H. Noizet, S. Robert, and L. Mirlou, ‘Cartographie des crues centennales à Paris (1740, 1910)’, *Rev. Nord*, vol. 26, pp. 91–104, 2011.
[3] ‘Vigicrues – historique crue 4 juin 2016’, *Les Riverains de la rue Saint-Georges Maisons-Alfort*, 06-Jun-2016. [Online]. Available: http://rsg.fleurons.fr/vigilance-crue-maisons-alfort/vigicrues/. [Accessed: 12-Mar-2017].
[4] ‘La Grande Inondation’, *Water-Words*. [Online]. Available: http://www.water-words.net/la-grande-inondation. [Accessed: 12-Mar-2017].
[5] ‘Synthèse de la crue de janvier 1910 sur le bassin de la Seine’, DRIEE Île-de-France - Service de prévision des crues Seine moyenne / Yonne / Loing, Sep. 2010.
[6] P. Breteau and A. Sénécat, ‘Les drôles de mesures de crues sur le zouave du pont de l’Alma’, *Le Monde.fr*, 03-Jun-2016.
[7] ‘Inondations: pourquoi le niveau de la Seine a-t-il été sous-estimé à Paris?’, *LExpress.fr*, 04-Jun-2016. [Online]. Available: http://www.lexpress.fr/actualite/societe/meteo/inondations-pourquoi-le-niveau-de-la-seine-a-t-il-ete-sous-estime-a-paris_1798981.html. [Accessed: 12-Mar-2017].
[8] ‘Épisodes de crue de mai-juin 2016 sur le bassin de la Seine’, DRIEE Île-de-France - Service de la prévention des risques et des nuisances - Pôle hydrologie et prévision des crues, Oct. 2016.
[9] ‘Bilan de la Crue de juin 2016’, EPTB Seine Grands Lacs, Jul. 2016.

## 2 – History



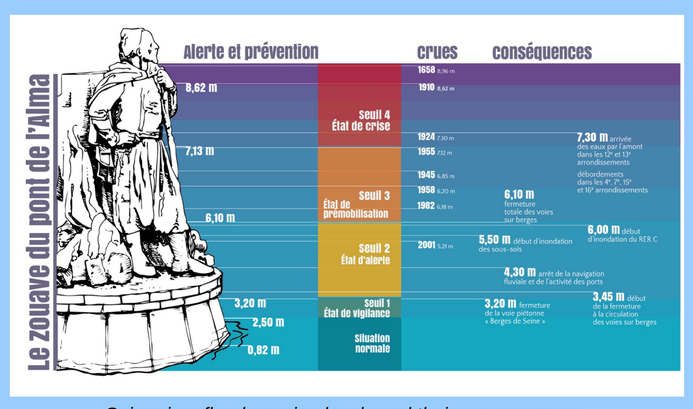

*Flooding of the Seine river in 1658 (left) [1], 1740 (right, in blue) and 1910 (right, in pink) [2]. The red stars correspond to Jussieu.*



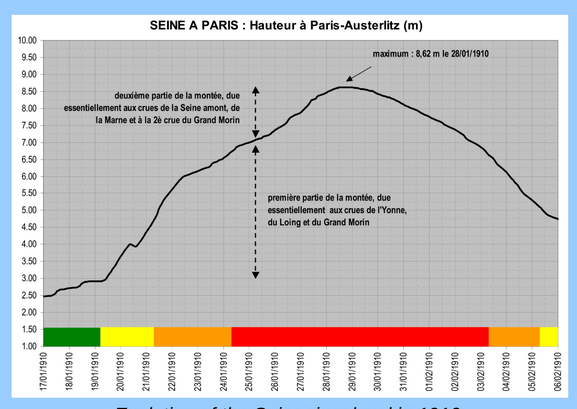

*History of flooding of the Seine river [3].*

In 2016 the regional train lines were perturbed.

## 3 – Measurements




*Seine river flood warning levels and their consequences, measured on the Zouave of the Alma Bridge [4].*




*Evolution of the Seine river level in 1910, Measured at the Austerlitz station [5].*

- The Seine river level is difficult to measure and forecast:
  - The Zouave of the Alma bridge has been lowered by 30-40 cm in 1970 [6],
  - Automatic probes can give incorrect results [7],
  - Predictive models reach their limit [8].
- The Seine retention lakes can only partly compensate [9].
- Basements will be flooded above 5.50 m.
- Transports will be affected above 6.00 m.
- Roads and transports in the entire region will be strongly degraded during 10 days above 6.75 m.
- There could be 80 cm of water in the NMR rooms during 6 days.

## 4 – Triggers and actions

**Green level**
- No action is required.

**Yellow level**
- Check *vigicrues* reports twice a day.

**Orange level**
- Preventively fill up all the spectrometers with liquid He.
- Fill up all the 3000 L-tanks on campus with liquid $N_2$.
- Daily fill up all the spectrometers with liquid $N_2$, as long as possible.
- Check the presence of water in freight elevator shafts.

**6.50 m**
- Stop and caulk the uninterruptible power supply and the air compressor on the basement floor.
- Stop and disconnect the electronic cabinets of the NMR on the ground floor.
- Evacuate the electronic cabinets and the shims coils tubes to a higher floor.
- Fill up all the 100 L-dewars available with liquid $N_2$ and store them near the NMR rooms on higher floors.

**Red level**
- Avoid floating objects in the NMR rooms.
- Wait and see.

**Recovery**
- Fill up all the magnets, starting with the smallest ones.
- Clean the NMR rooms and restart the spectrometers.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## 5 – Conclusion

- Major flooding of the Seine river is a highly probable risk.
- The NMR platform could be strongly affected.
- The electronic cabinets need to be evacuated to higher floors.
- A good coordination is needed between NMR technical staff, campus cryogenics staff and campus technical staff.
- NMR staff comings and goings will get considerably more complicated.

## Acknowledgements

- NMR technical staff
- Campus cryogenics staff
- Campus technical staff