

How not to ruin your whitewater kayak season

10th Anniversary HEPEX meeting

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CONTEXT

Kayak au Québec



Accueil > Québec Kayak > Forum de discussion

« Would it be a good idea to go to Lake St-Jean next weekend? »

SUJET: Est-ce une bonne option de monter au Lac St-Jean le week-end prochain?

Outils de navigation

27/09/09 à 21:13

#8879

stevsky



Fresh Boarder



Est-ce une bonne option de monter au Lac St-Jean le week-end prochain?

Pour faire du playboat et disons, le trou de la Fée? J'avais pensé faire une tournée, genre vague Arcand, rouleau Barrette et Cépale... Je parle de ces spots car c'est les seuls que je connaisse... Mais je sais qu'il y a aussi du beau creek par chevous, gang de chanceux!

Devrais-je reporter le projet?

« Should I delay the trip? »

27/09/09 à 21:35

#8881

Re:Est-ce une bonne option de monter au Lac St-Jean le week-end prochain?

Je crois qu'avec la pluie qui débute, ton idée pour le prochain fds est plus qu'excellente ! Selon mes prédictions... sa va être beau partout !

aquabooger



« It is supposed to start raining soon, I predict it will be good everywhere. »

28/09/09 à 14:37

#8906

Katia



Junior Boarder



Re:Est-ce une bonne option de monter au Lac St-Jean le week-end prochain?

Je serais étonnée que Barrette soit la en fin de semaine... La rivière doit être au moins à 80-90 pour qu'il y ait qqch... Et en plus ça dépend du niveau du barrage en aval..

Tu peux regarder à cette adresse pour connaître le débit www.cehq.gouv.qc.ca/Suivihydro/graphique.asp?NoStation=061004

Sinon il devrait y avoir plusieurs rivières à faire en fin de semaine!!

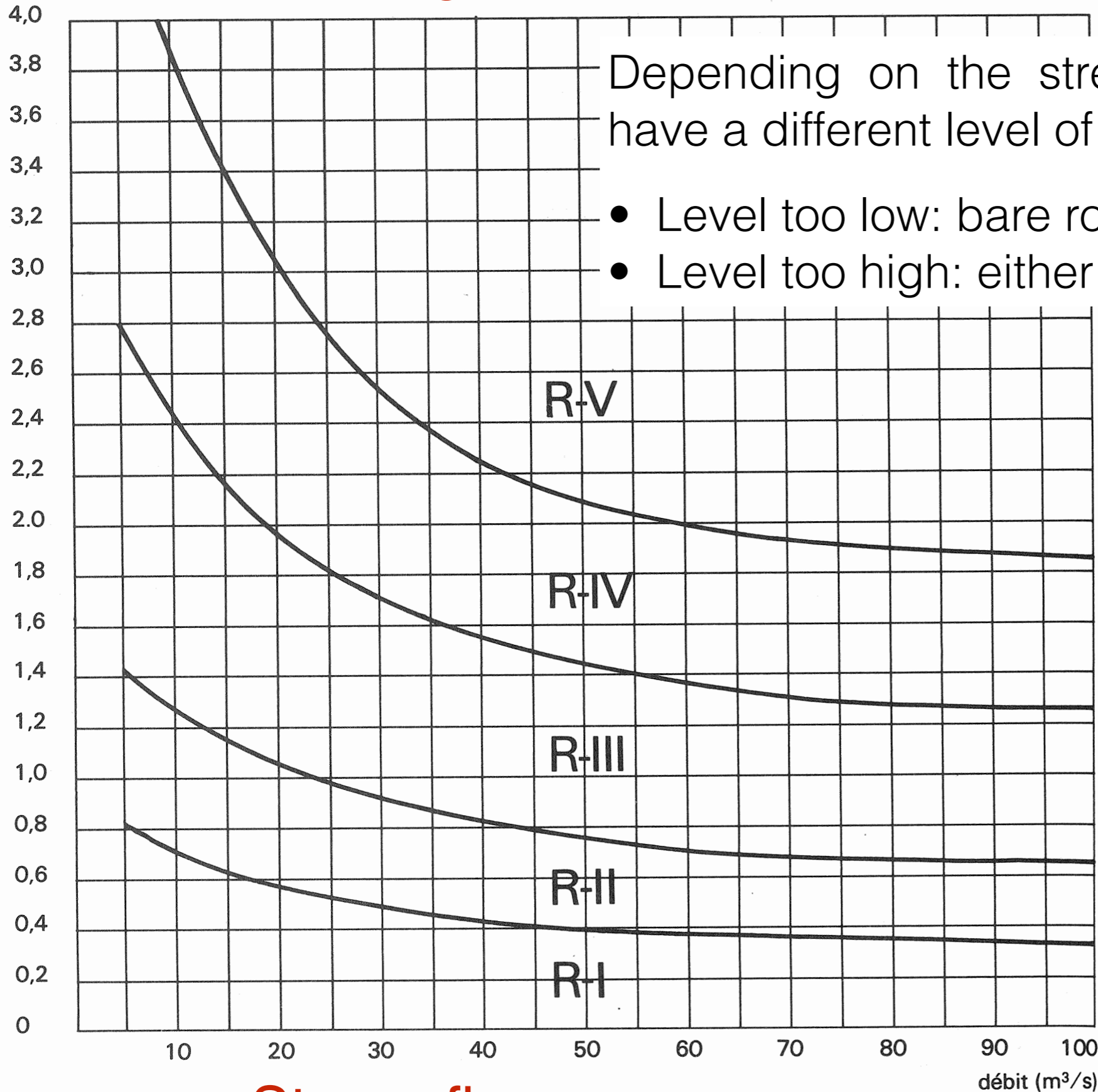
« I don't think the Barrette roll will appear. It needs at least 80-90 m³/s and it depends on the level of the reservoir upstream. You should check « Info débit »

CONTEXT

- Decision problem, different than hydropower production
- Kayakers are usually very enthusiastic and willing to help. Many have an excellent « experience based » hydrological knowledge.
- If they would have access to forecasts, they would probably be avid users.
- Many rivers of high interest for kayak are ungauged and/or difficult to predict because they react to very precise conditions.
- Each kayaker looks for particular streamflow conditions, depending each river, on his/her level of skill and risk taking attitude.
 - Represent a real hydrological challenge

Average channel slope

Pente (%)



Depending on the streamflow, each river will have a different level of difficulty. In addition:

- Level too low: bare rocks...
- Level too high: either dangerous...or boring

Streamflow

METHODOLOGY

- Chose Case studies
 - Rivers that are interesting for kayakers
 - Gauged
 - Uncontrolled
 - Same geographical region (for decision problem)
- Build forecasting model
 - GR4J hydrological model (Perrin et al. 2003) + CemaNeige (Valéry 2010)
 - Model calibration using different combinations of possible meteorological stations (Jakrapun and Jean-Denis)
 - CMC ensemble forecasts retrieved from TIGGE. April-May-June 2011
- Build decision model
 - Decision making for two days later, according to actual observed streamflow
 - Decision making according to two-day ahead ensemble forecasts

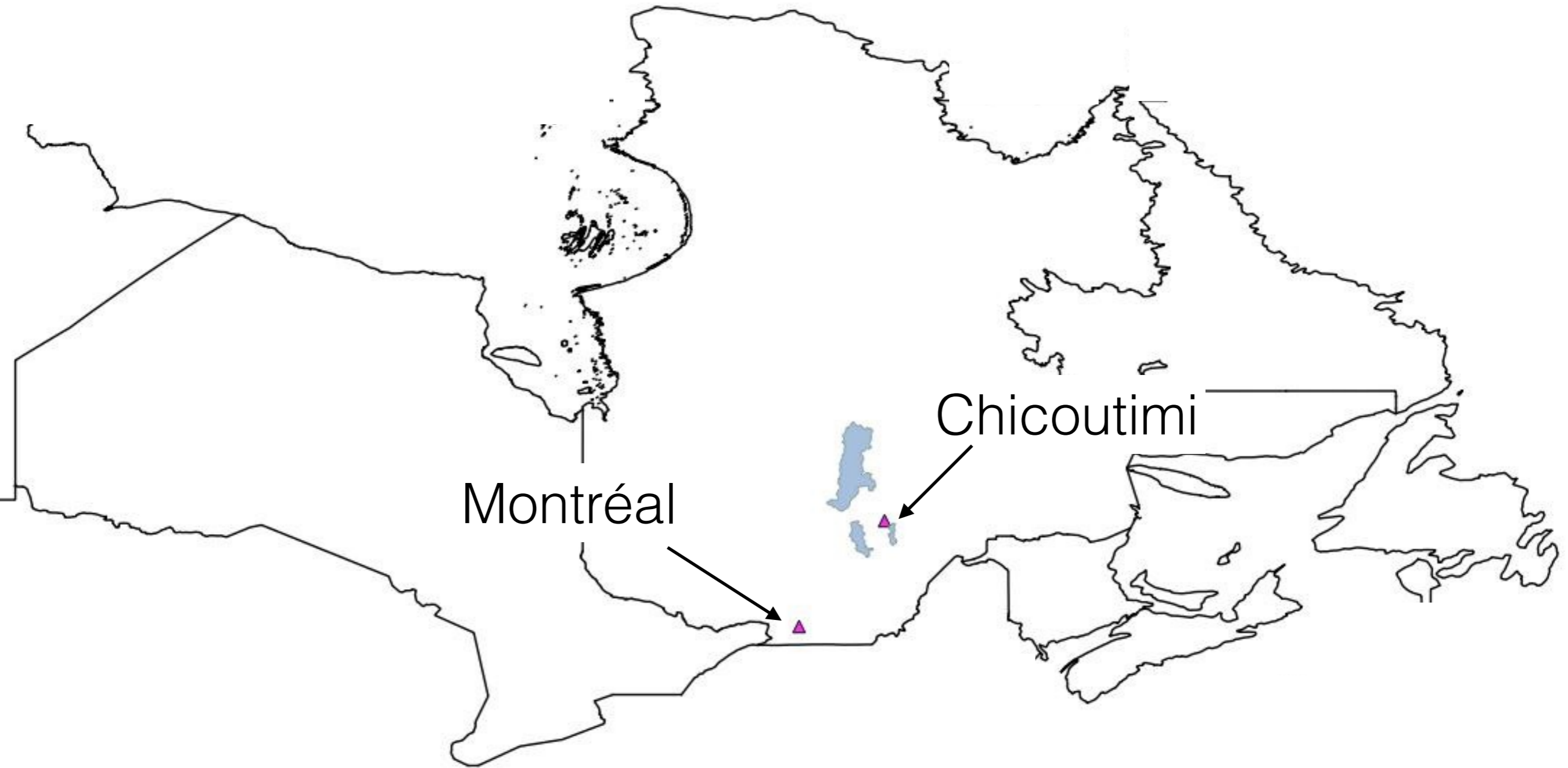
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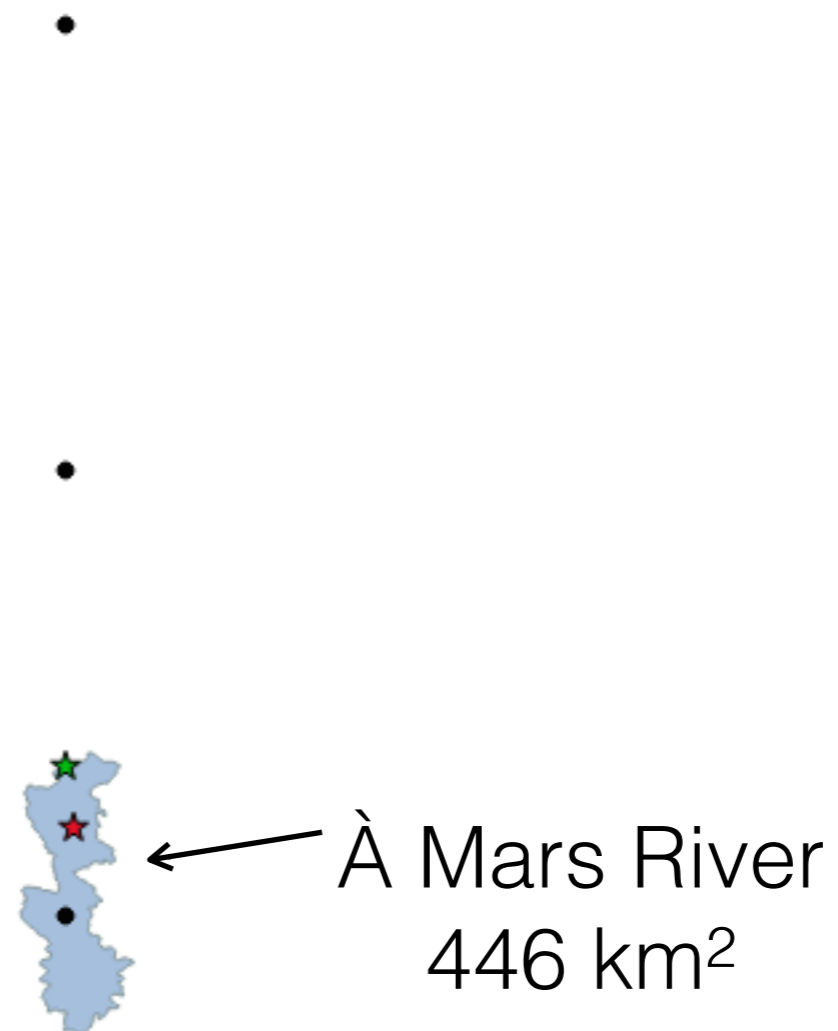
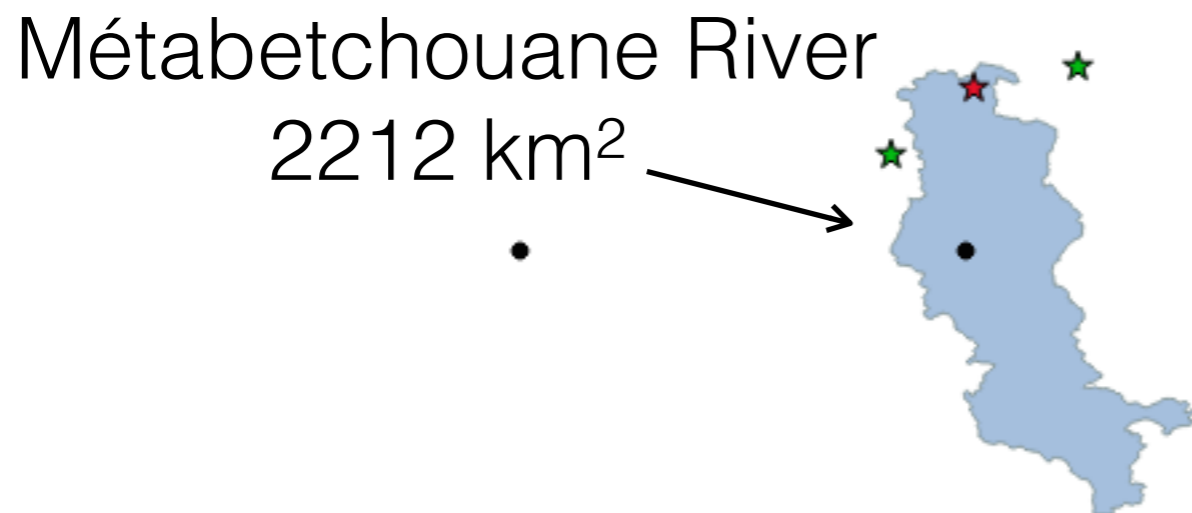
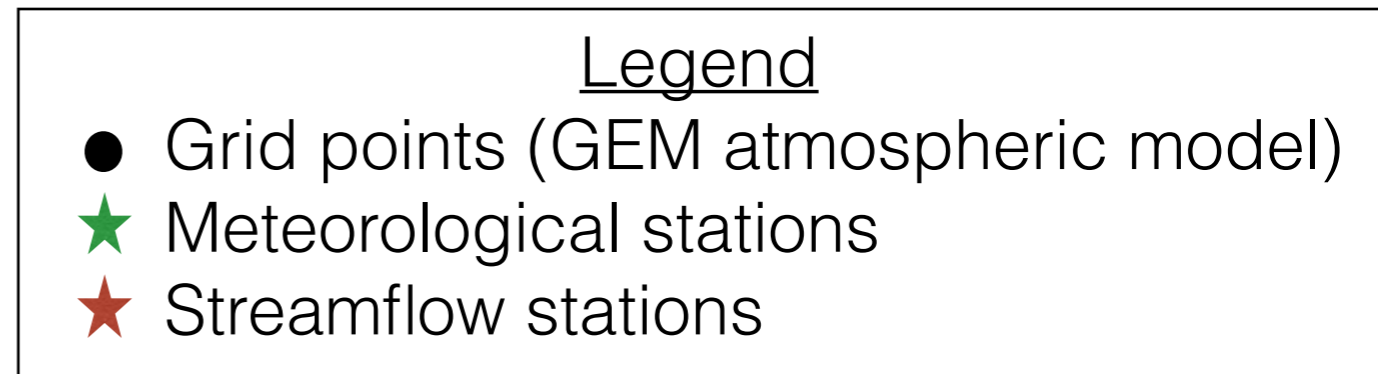
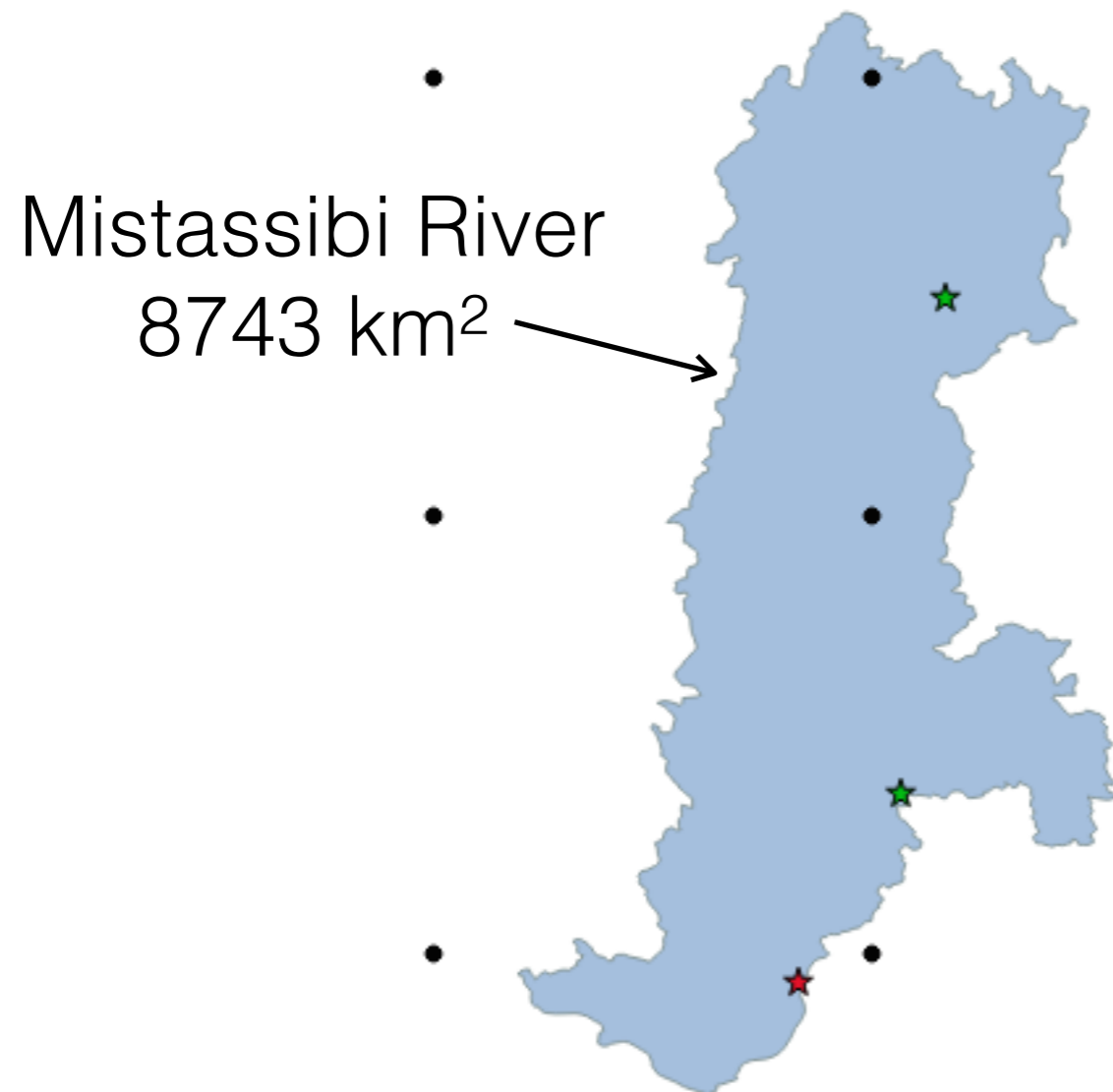
Unexpected problems!!!

 - 1) Precipitation forecasts always much higher than observations
 - 2) Model behaves badly during snowmelt
- Build decision model
 - Decision making for two days later, according to actual observed streamflow
 - Decision making according to two-day ahead ensemble forecasts

CASE STUDY



WATERSHEDS, GEM GRID AND GROUND STATIONS

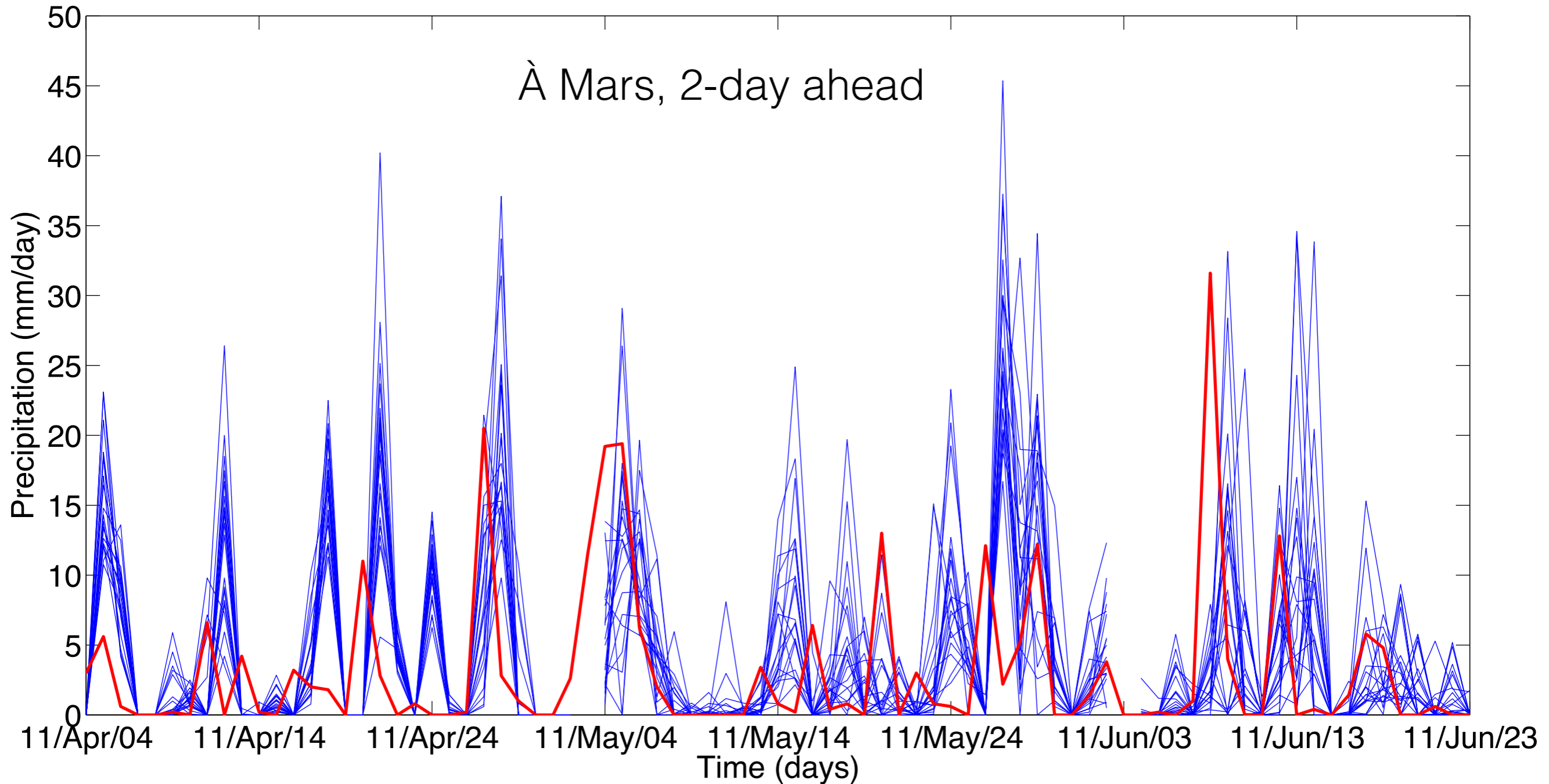


AVAILABLE DATA

| | Data for calibration | Model warmup period | 2-day ahead forecasts | Driving distance from Chicoutimi |
|----------------|------------------------------|---------------------------------|-----------------------|----------------------------------|
| À Mars | Oct. 1st 2008 to Dec 31 2010 | Oct. 7th 2008 to April 1st 2011 | April 2 June 30 | 30 km |
| Métabetchouane | Aug 1st 1964 to June 30 1996 | | | 57 km |
| Mistassibi | Aug 1 Dec 31 | | | 190 km |

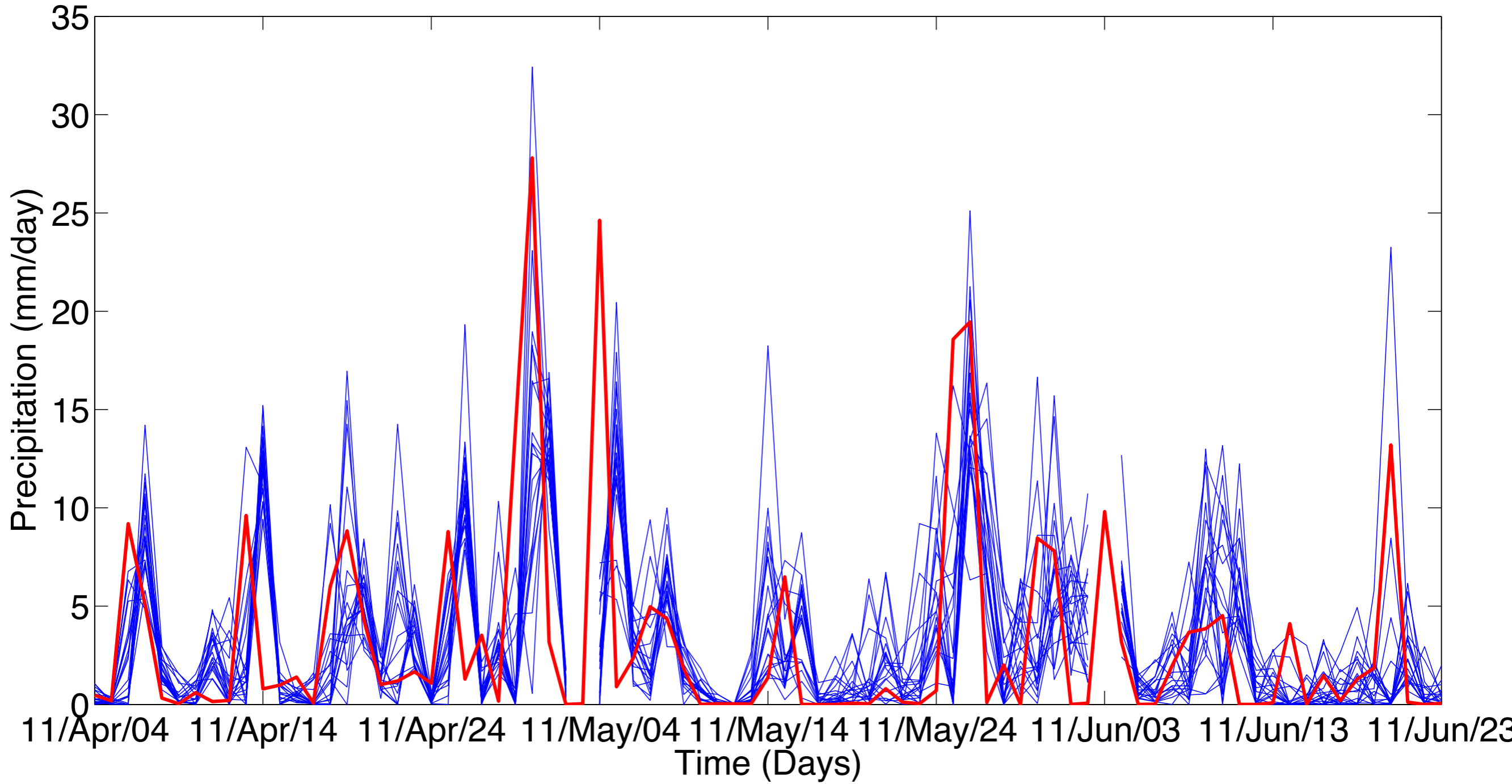
FORECASTING MODEL

Too much precipitation from GEM...



FORECASTING MODEL

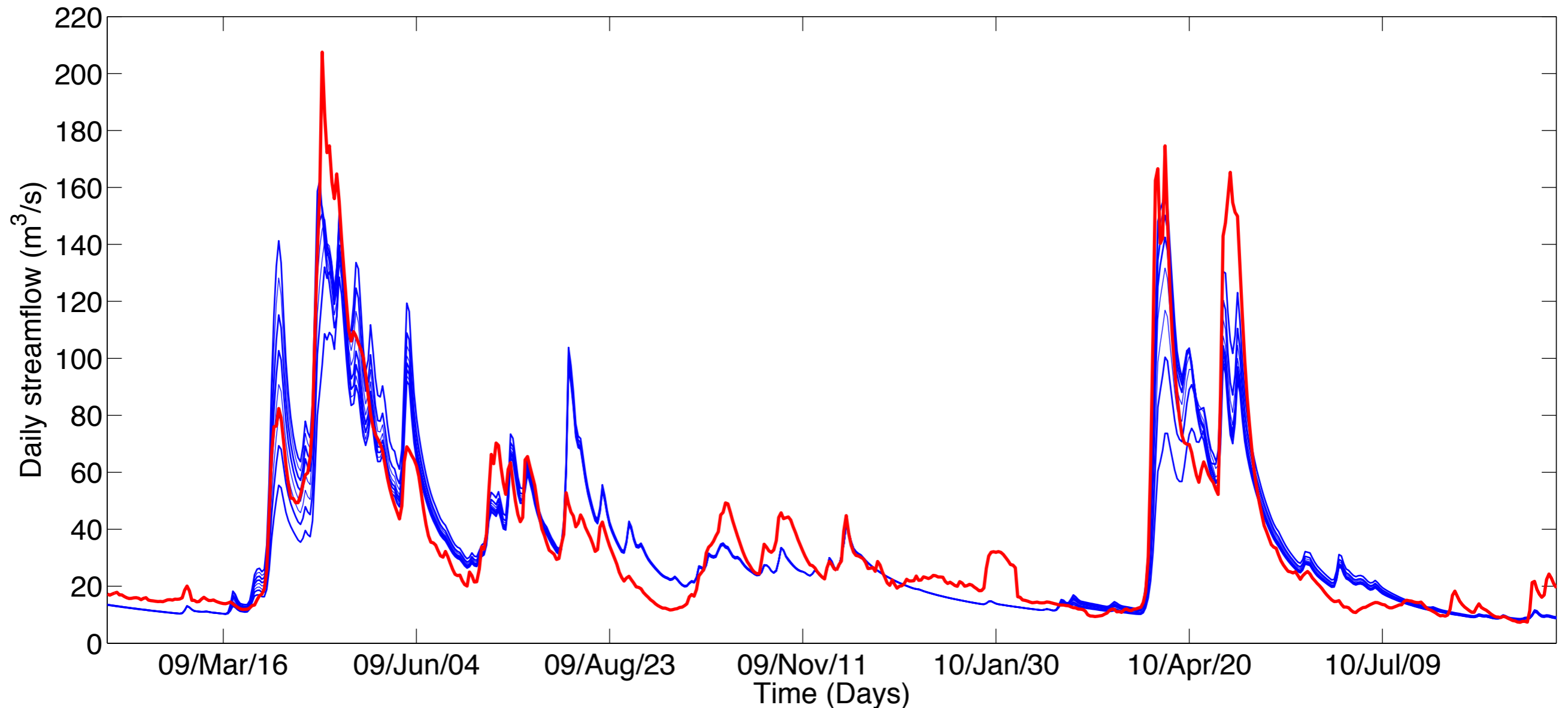
...Except for Mistassibi.



FORECASTING MODEL

- Probably unrealistic to use only one parameter set
- Snow module's parameters should be regionalized
 - Coefficient for the thermal state of the snowpack
 - Melt factor ($\text{mm}/^{\circ}\text{C}$) : highly sensitive

Daily simulation for Métabetchouane



DECISION MODEL

- Hypotheses:
- All four kayakers (Beginner/Inter/Advanced/Expert) live in Chicoutimi
- They can go kayaking everyday
- Rivers other than Métabetchouane, Mistassibi and À Mars are not considered
- For each river, each kayaker have a possible range of « optimal » streamflow values according to his/her preferences
 - For instance, the **Expert** is perfectly able to go kayaking in **Beginners** conditions, but it does not correspond to the best situation for him/her so it is not considered an option.
- On days for which two or more rivers are possible choices for one kayaker he/she chooses to go for the river that is most rarely rideable for him/her.

DECISION MODEL

- Naïve Model
 - Decision based only on observations: it is considered that today's observed streamflow will persist (or stay in the same range) for the next two days.
 - In reality, the decision process is based on the evolution of the last hourly observations + public available deterministic precipitation forecasts

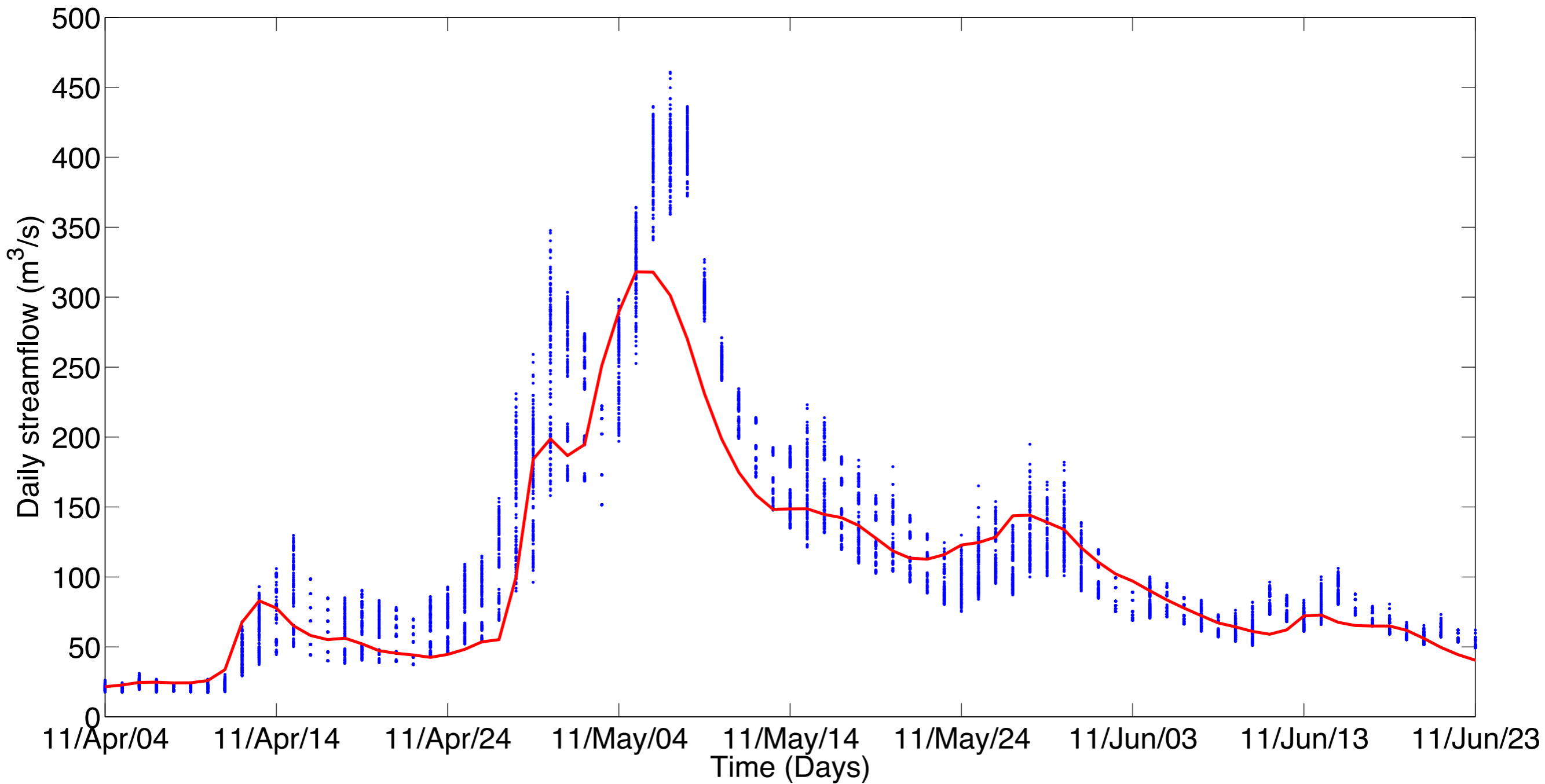
DECISION MODEL

- Threshold values were decided according to:
 - Figure 2 from Fortin (1980)
 - Québec Kayak's Table from their website (Mistassibi only)
 - P. Lévesque from Saguenay's kayak club (personal communication, 2014)

| River \ Kayaker | Beginner (m) | Intermediate (m) | Advanced (m) | Expert (m) |
|-----------------|-----------------|---------------------|-----------------|---------------|
| À Mars | 5 - 15 | 10 - 30 | 20 - 60 | 40 - 70 |
| Métabetchouane | 20 - 35 | 30 - 60 | 50 - 100 | 60 - 120 |
| Mistassibi | N.A. | 140 - 250 | 200 - 350 | 250 - 550 |

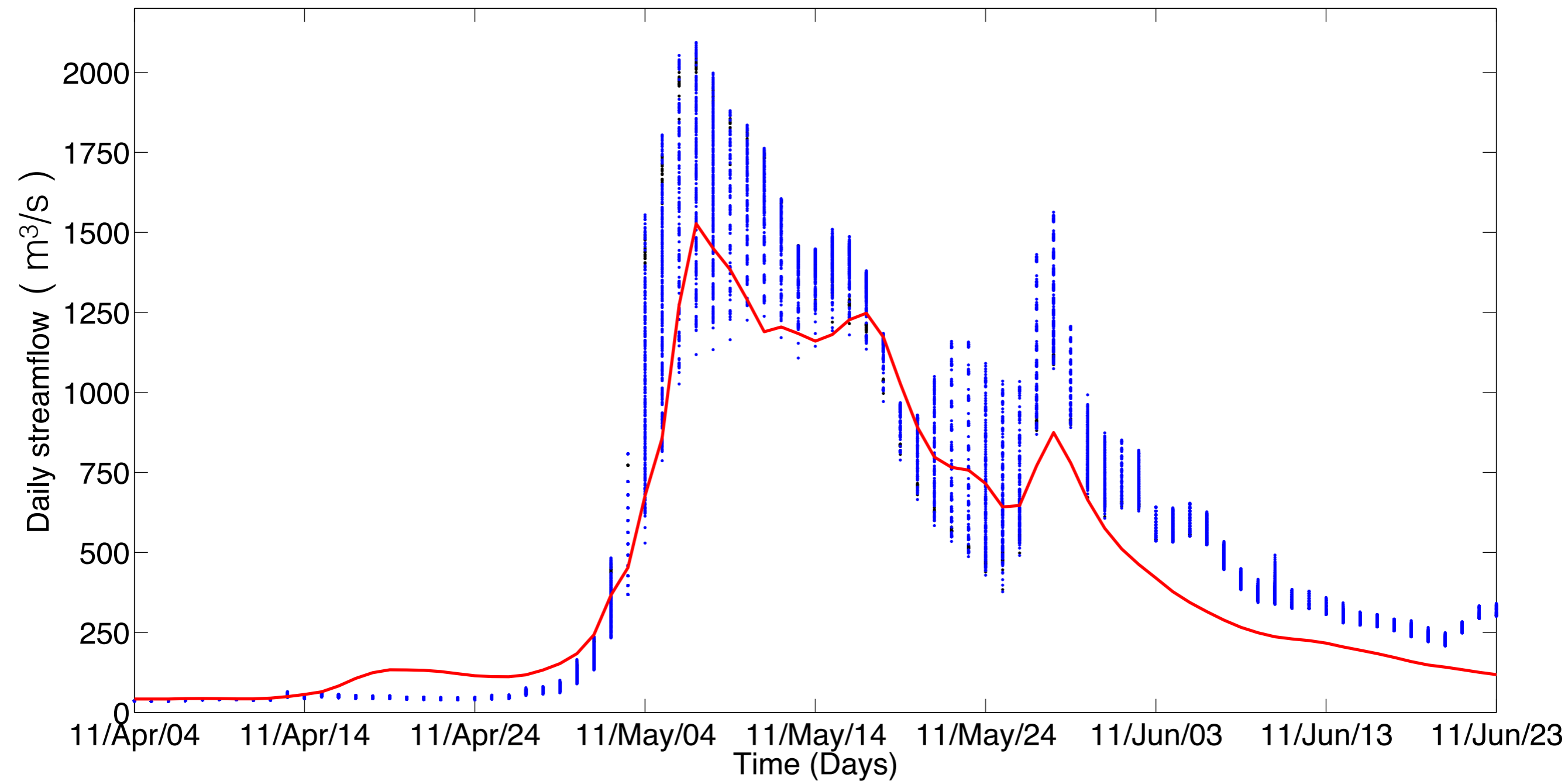
RESULTS

Métabetchouane, 2-day ahead



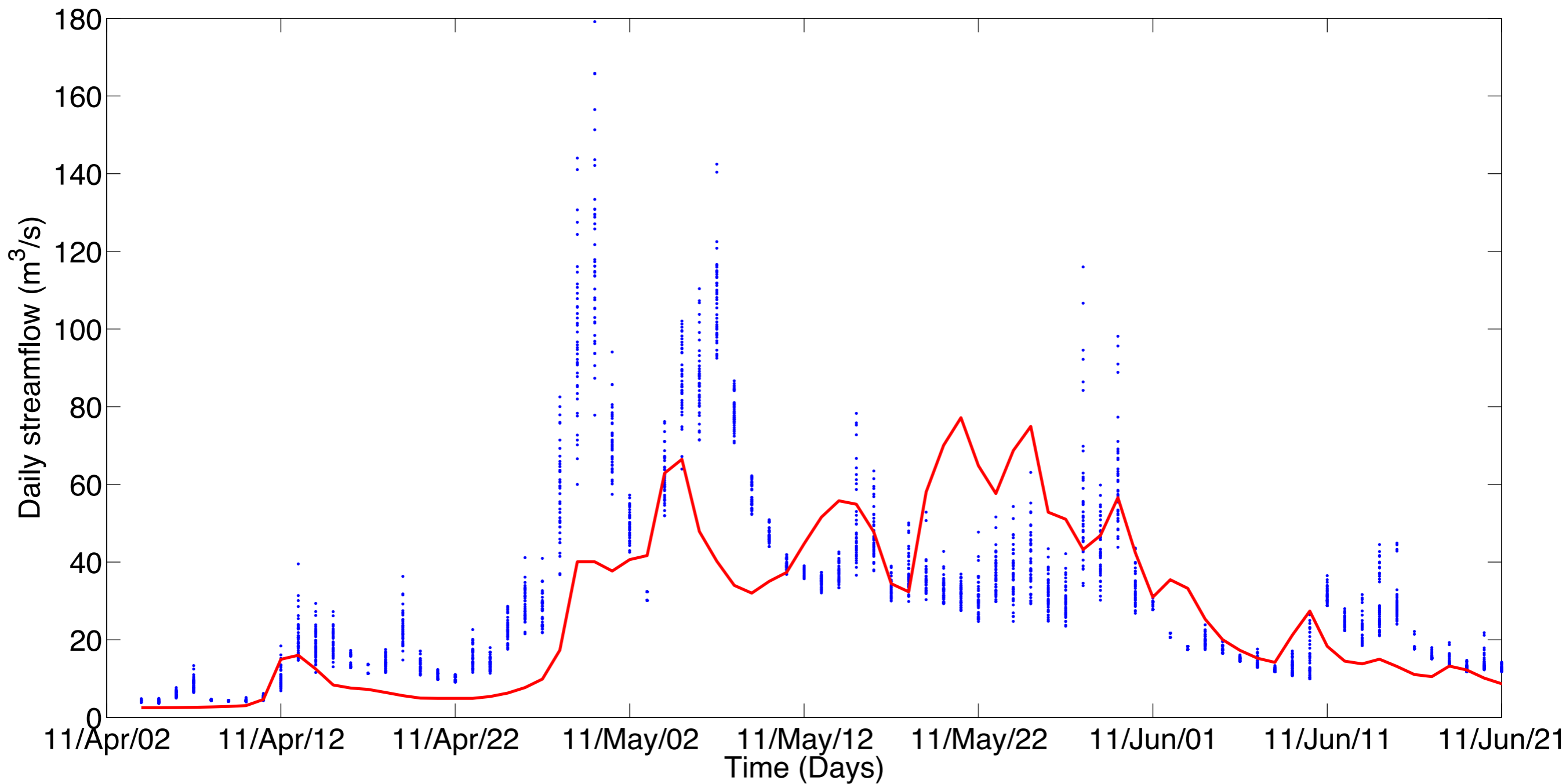
RESULTS

Mistassibi, 2-day ahead



RESULTS

À Mars, 2-day ahead



RESULTS

- Naïve model is hard to beat
- Beginner and Advanced kayakists can benefit from the forecasts
 - Less km wasted
- Less opportunity losses for the Expert, but much more wasted km.

| | | Beginner | Intermediate | Advanced | Expert |
|--------------------|----------|----------|--------------|----------|--------|
| km wasted | Naïve | 380 | 2892 | 1619 | 1272 |
| | Ensemble | 330 | 888 | 1125 | 4981 |
| Opportunity losses | Naïve | 6 | 5 | 10 | 10 |
| | Ensemble | 8 | 6 | 15 | 1 |

CONCLUSIONS

- Model parameter uncertainty is important, especially during snowmelt.
- Parameters for snow model should be regionalized
- A shorter time step should be used
 - Would allow for a more realistic decision-making scheme
 - Better results for À Mars River?
- The naïve forecasts are difficult to beat:
 - Short time step, so the autocorrelation with previous streamflow is important
 - Kayakists look for very precise conditions, not just above or under a certain threshold
 - The optimal streamflow ranges for the Expert correspond to events that are harder to predict

FUTURE WORK

- Change from daily time step to *hourly* time step
 - People don't really decide two days in advance where they are going to go...
 - Improve decision-making model
 - Possible model would be GRP (Tangara (2005) ; Berthet (2010))
- Finish year 2011 and add 2012+2013
 - Study GEM's apparent over prediction in precipitation
 - Change model?
 - TIGGE LAM?
- Include more catchments:
 - Gauged: Du Gouffre, La Malbaie, Petit Saguenay
 - Ungauged: Huit-Chutes, Bras-Louis...

FUTURE WORK

- More extended tests on the model's parameters
 - Regionalization of the snow module parameters
 - Develop relation to obtain possible range of GR4J's (or GRP's) parameters according to catchment's physical characteristics
- Data assimilation
 - Combine existing information (evolution of observed streamflow) with forecasts

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Tangara, M., 2005. Nouvelle méthode de prédiction de crue utilisant un modèle pluie-débit global. Thèse de Doctorat, EPHE, Paris, 374 pp.

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