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Soil moisture and hydrological forecasting

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CGEO workshop on soil moisture
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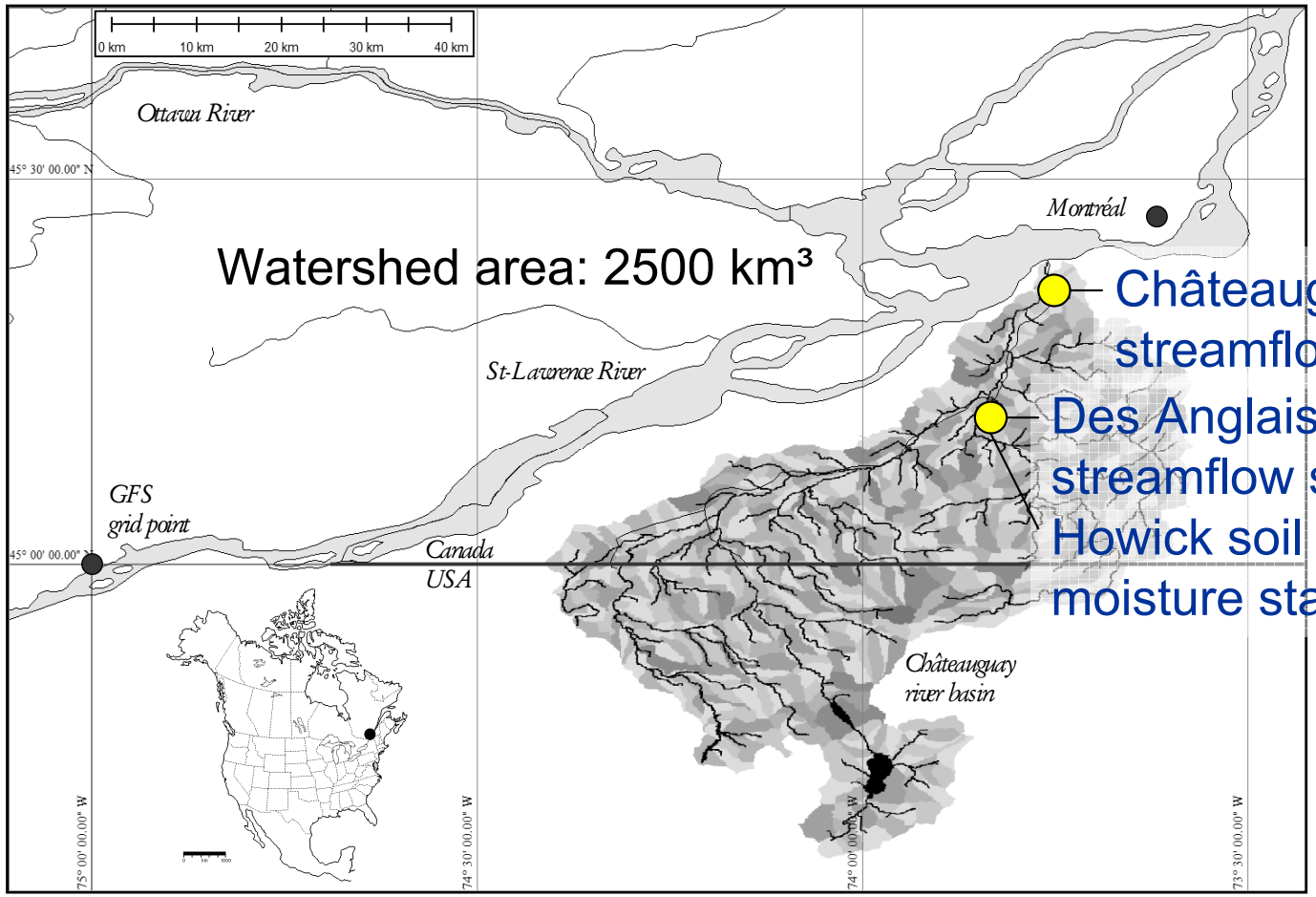
Outline

- A case study showing that soil moisture observations can indeed be useful for hydrological forecasting
  - Châteauguay watershed, summer and fall 2003
- The need for a soil moisture observation network to support flow forecasting in Quebec
  - The viewpoint of a hydrological forecaster

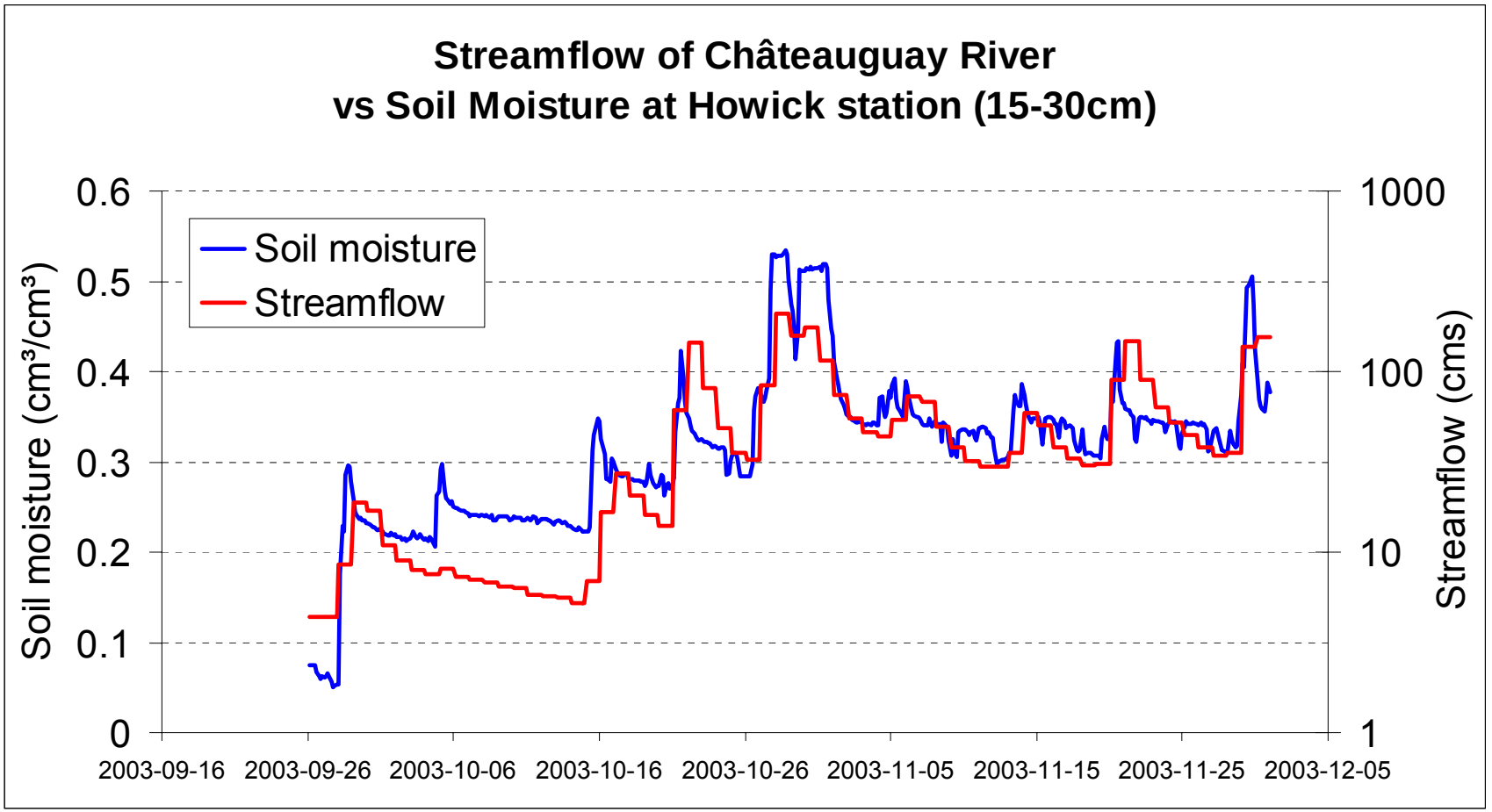
Case study

- Châteauguay watershed



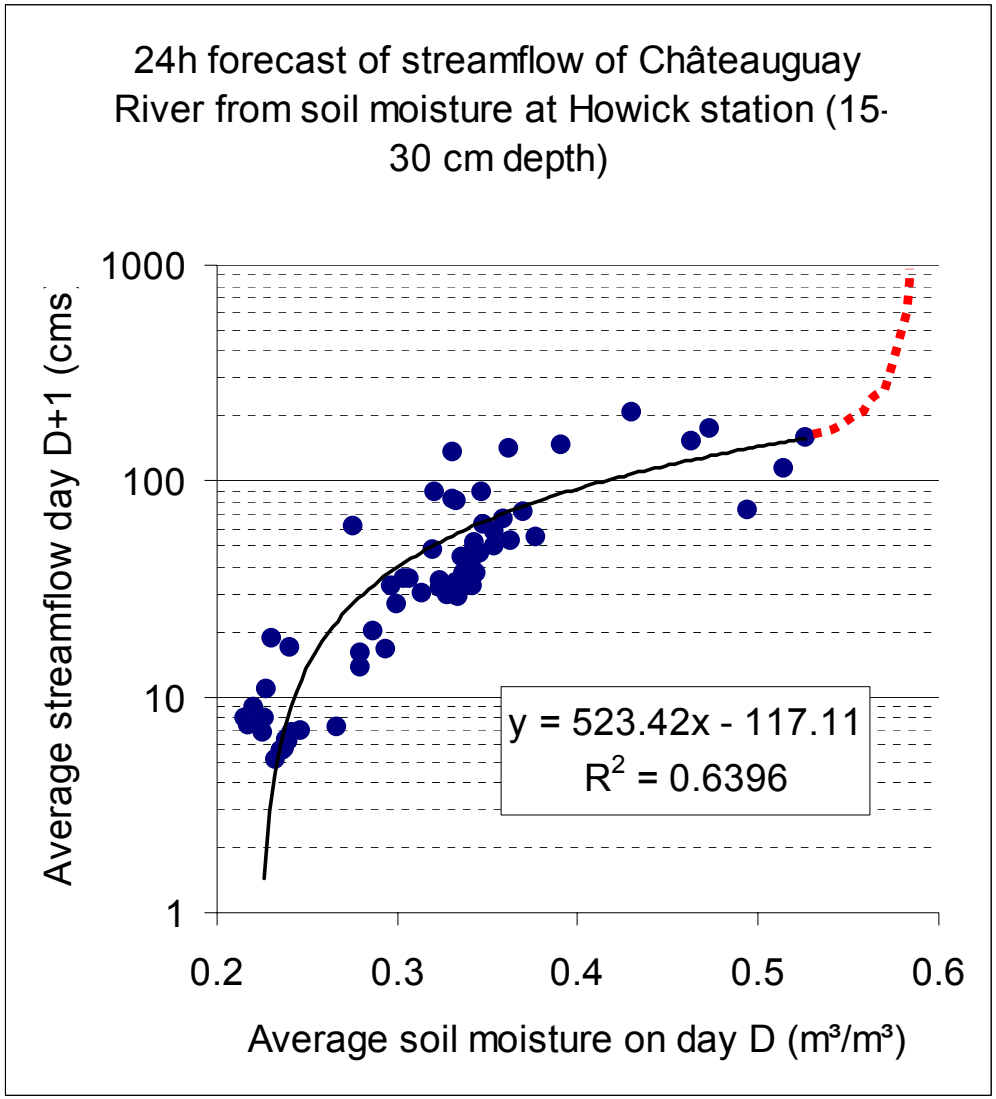
Observed relationship between soil moisture and streamflow

- Soil moisture is a good indicator of streamflow
  - Not so bad for a point measurement!



24h forecast of streamflow from soil moisture observations

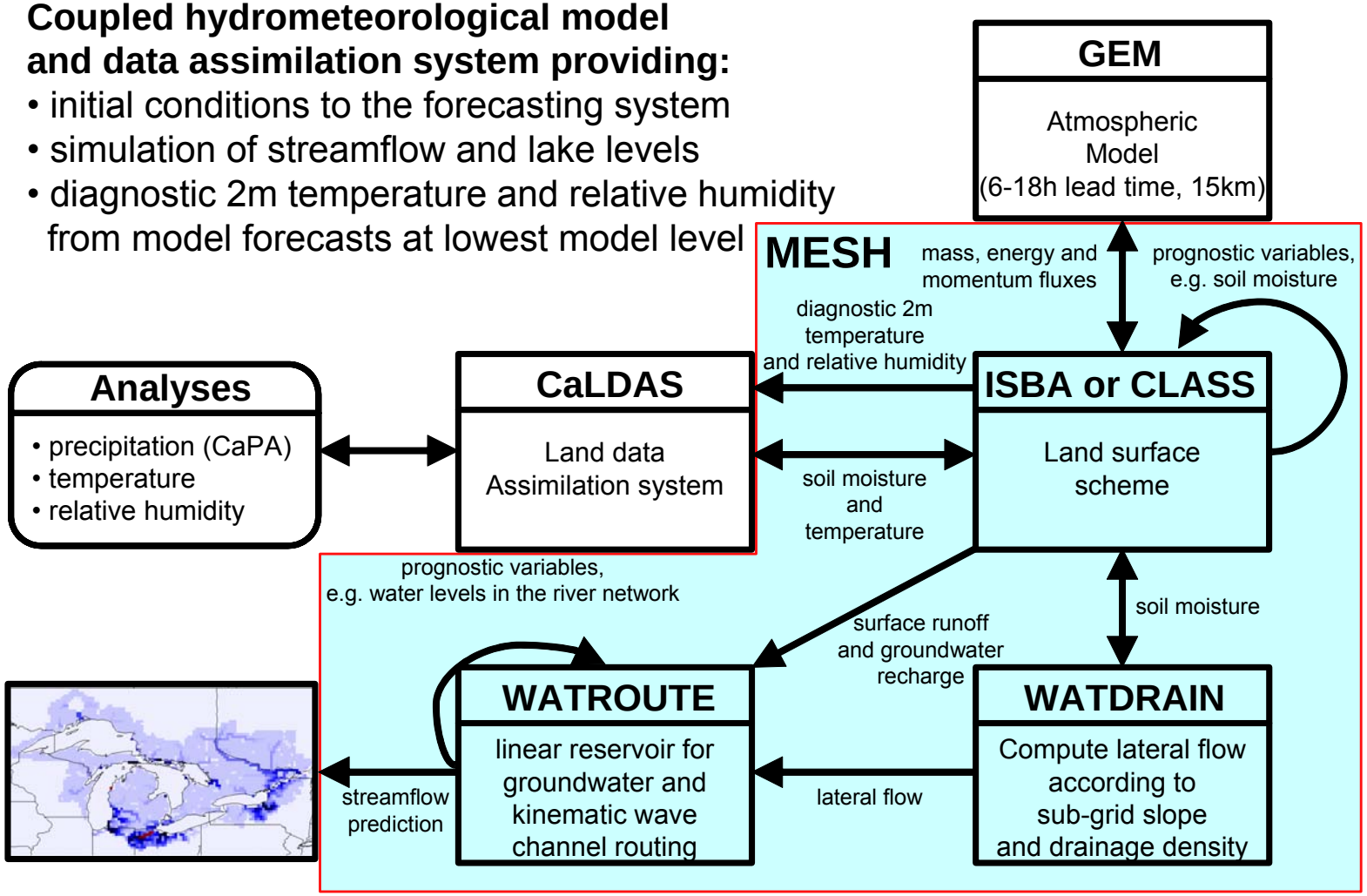
- Great, but still only slightly better than persistence
  - R^2=0.59 for AR(1) model
- We can't discriminate between large events when saturation is reached
  - dashed red line
- We need a more elaborate hydrological model!



MESH coupled modelling system

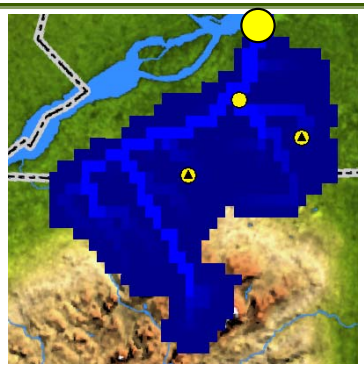
Coupled hydrometeorological model and data assimilation system providing:

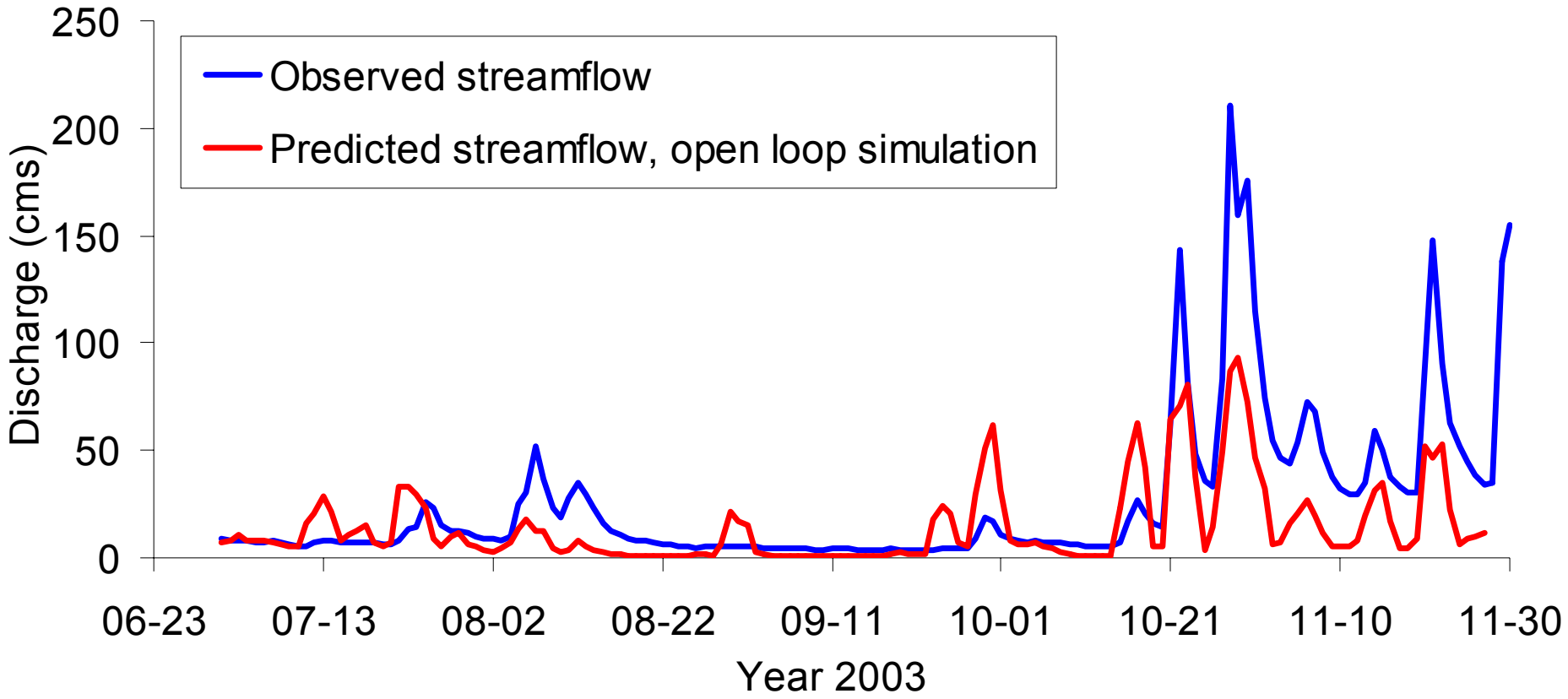
- initial conditions to the forecasting system
- simulation of streamflow and lake levels
- diagnostic 2m temperature and relative humidity from model forecasts at lowest model level



Predicted streamflow, Open loop simulation, no calibration

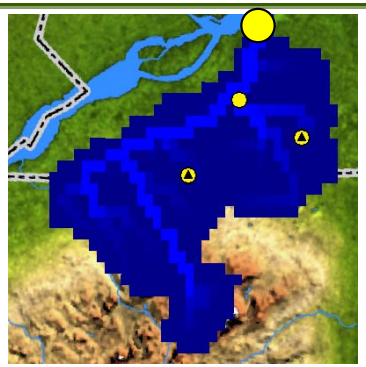
- Châteauguay River
  - Major events captured, peaks too low
  - Underestimation of baseflow: model too dry

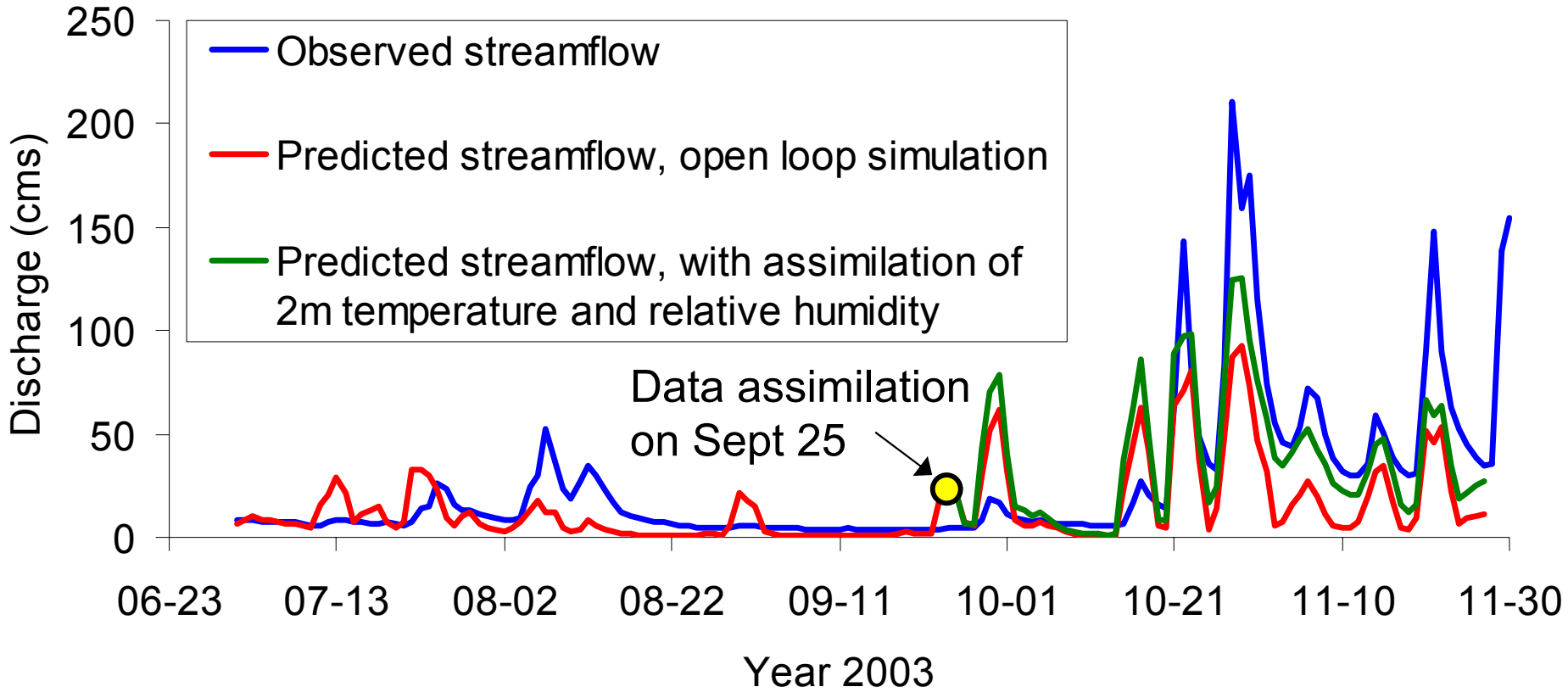




Predicted streamflow, with assimilation of 2m TT and HU

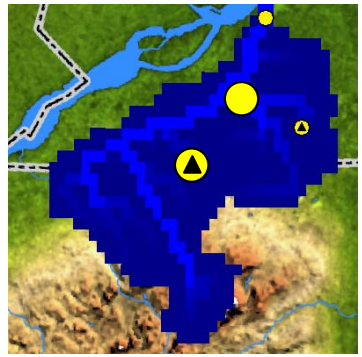
- Châteauguay River
  - Data assimilation improves simulation of base flow
  - Peak flow still underestimated

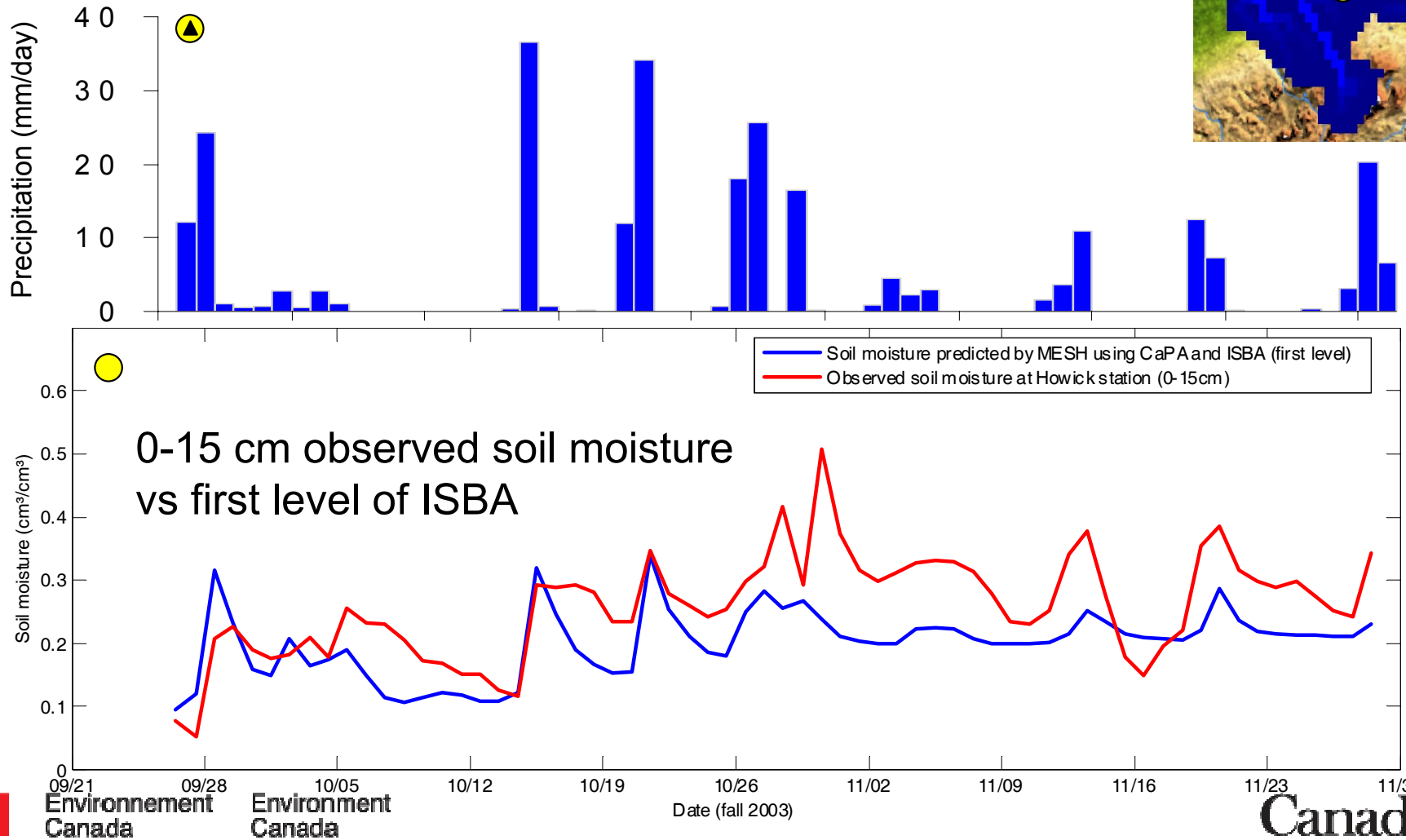




Precipitation and soil moisture predicted at Howick station

- With data assimilation on Sept 25





Conclusions

- Good news: observed soil moisture at one location is actually correlated with discharge of the whole basin!
- We are able to capture this using MESH
- But we need data assimilation
  - currently only near-surface observations are assimilated
  - we should be able to benefit from observations of soil moisture
- We still have work to do to turn this modelling system into an operational hydrological forecasting system
  - calibration and data assimilation of observed streamflow
  - more elaborate land-surface sheme needed
    - we are currently testing the Canadian Land Surface Scheme (CLASS)