The hydrological forecasting platform GEM-Hydro within the GWF project

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# Outline

- GEM-Hydro: a forecasting system based on coupled numerical models for water cycle prediction

- Example: Great Lakes and St. Lawrence watershed
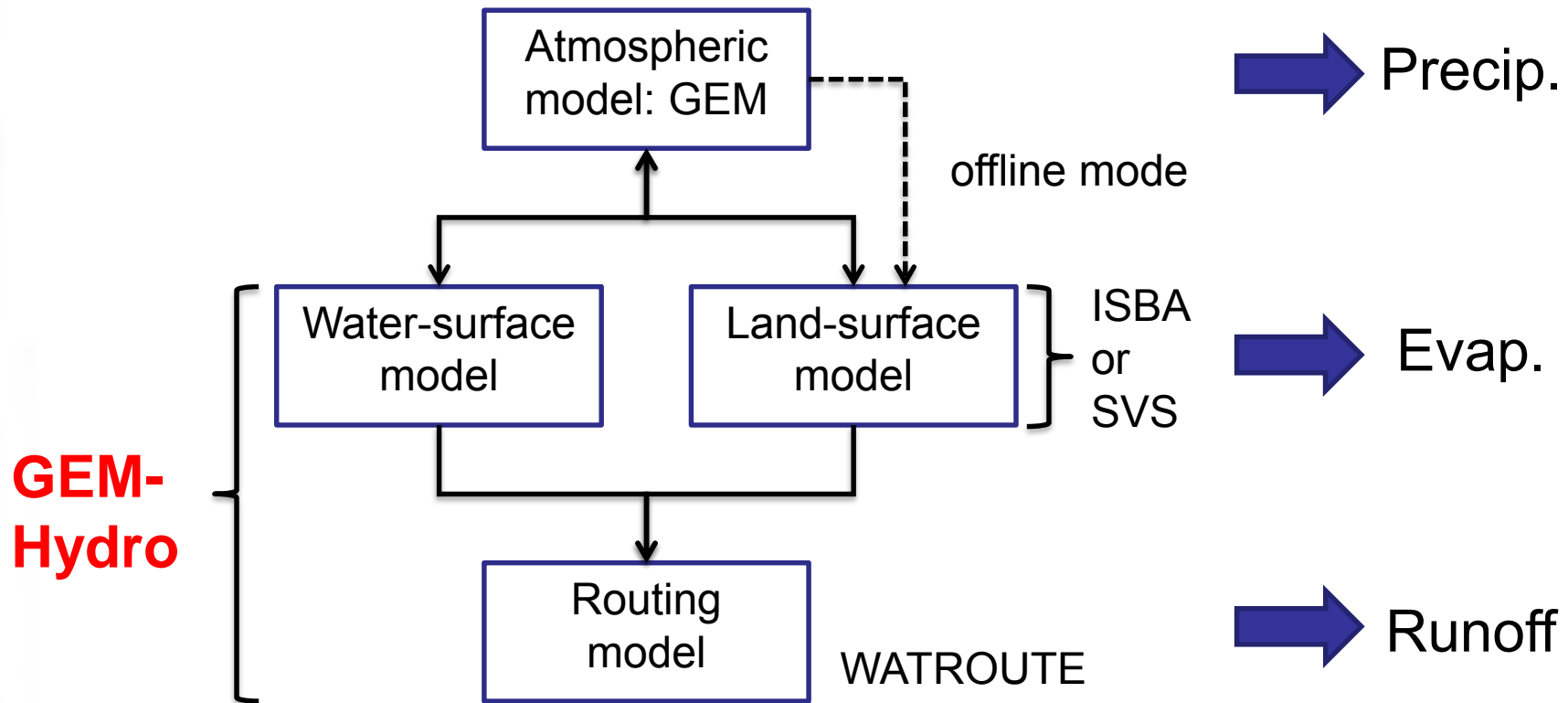
- GEM-Hydro for GWF

GEM NWP system

- Global 25-km

  240-h forecasting system

- North American 10-km

  48-h forecasting system

- Canadian 2.5-km

  48-h forecasting system

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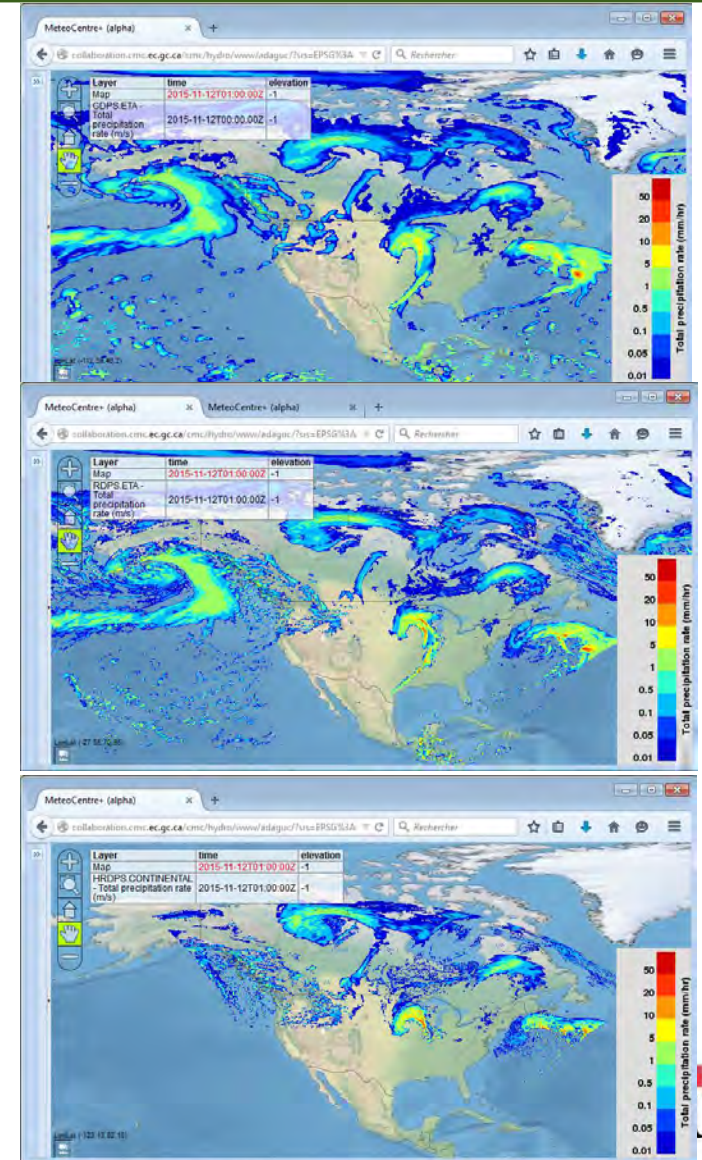
GEM-based surface prediction system
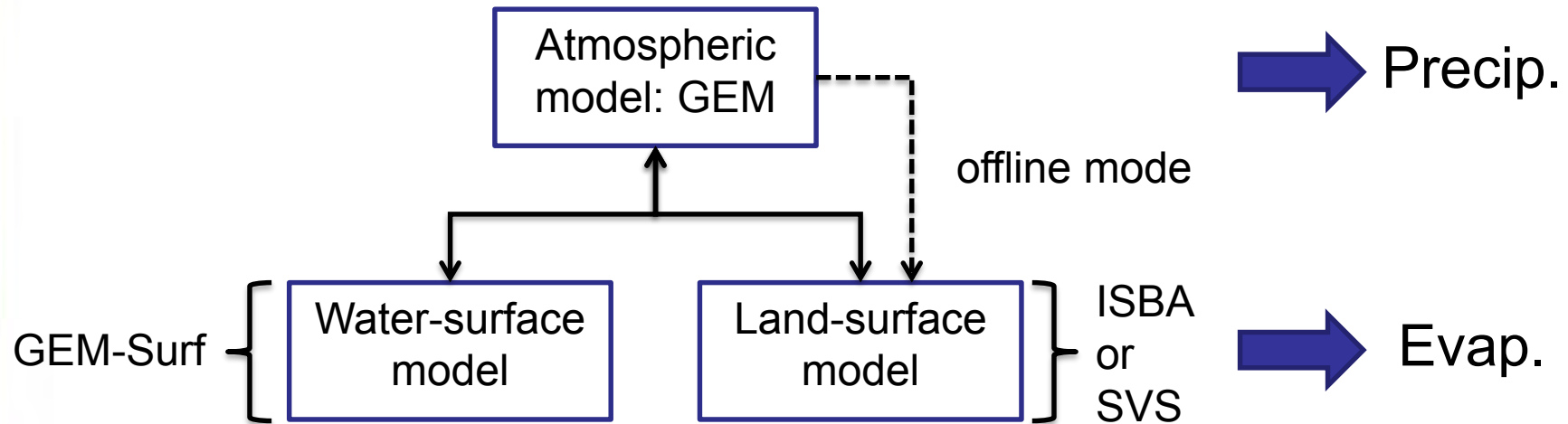
GEM-based hydrological prediction system

Gaborit et al. (2017, HESS, Accepted); Durnford et al. (2017, BAMS, Accepted)

Advantages of using coupled environmental models

- **Accuracy and consistency gains:**
  - Effects of interactions between the atmosphere and the surface (lakes, land, …)
  - Evaporation and evapotranspiration are the same in the atmosphere, hydrology and lake models

- **Efficiency gains:**
  - Latency: environmental predictions are available at the same time as the weather forecast
  - Robustness: 24/7 support at almost no additional cost
  - Maintenance: a single land-surface model to maintain

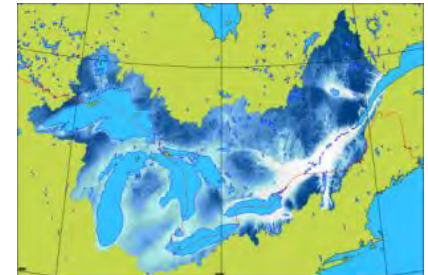# Water Cycle Prediction System for the Great Lakes and St. Lawrence

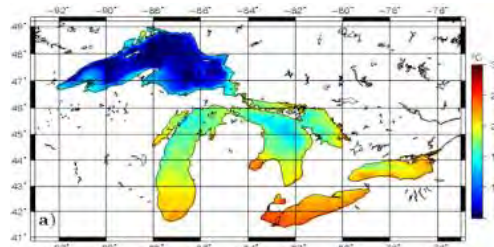**GEM RDPS (10 km) atmospheric model**
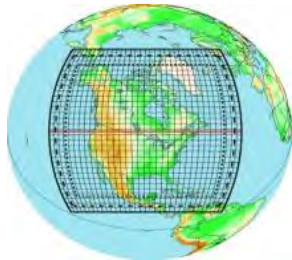
GEM LAM (10 km) atmospheric model (ISBA land-surface scheme)

WATROUTE routing model (1km)

Data assimilation system (EnVAR)

NEMO+CICE (2 km) ocean-ice model over the Great Lakes

Water Cycle Prediction System for the Great Lakes and St. Lawrence

**GEM LAM (10 km)
atmospheric model
(ISBA land-surface scheme)**

**WATROUTE
routing model (1km)**

**In production since
June 2016:**

- 2 runs per day

- 3.5 day forecasts
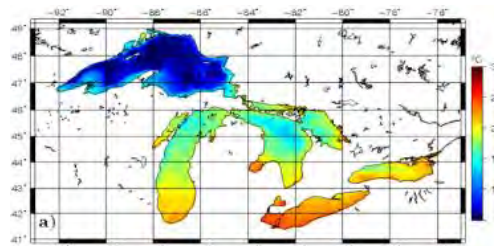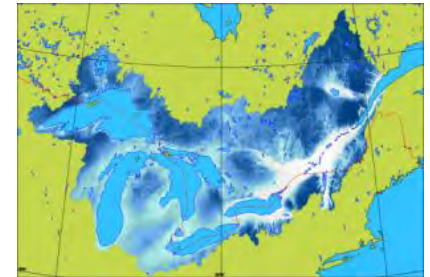
**NEMO+CICE (2 km)
ocean-ice model
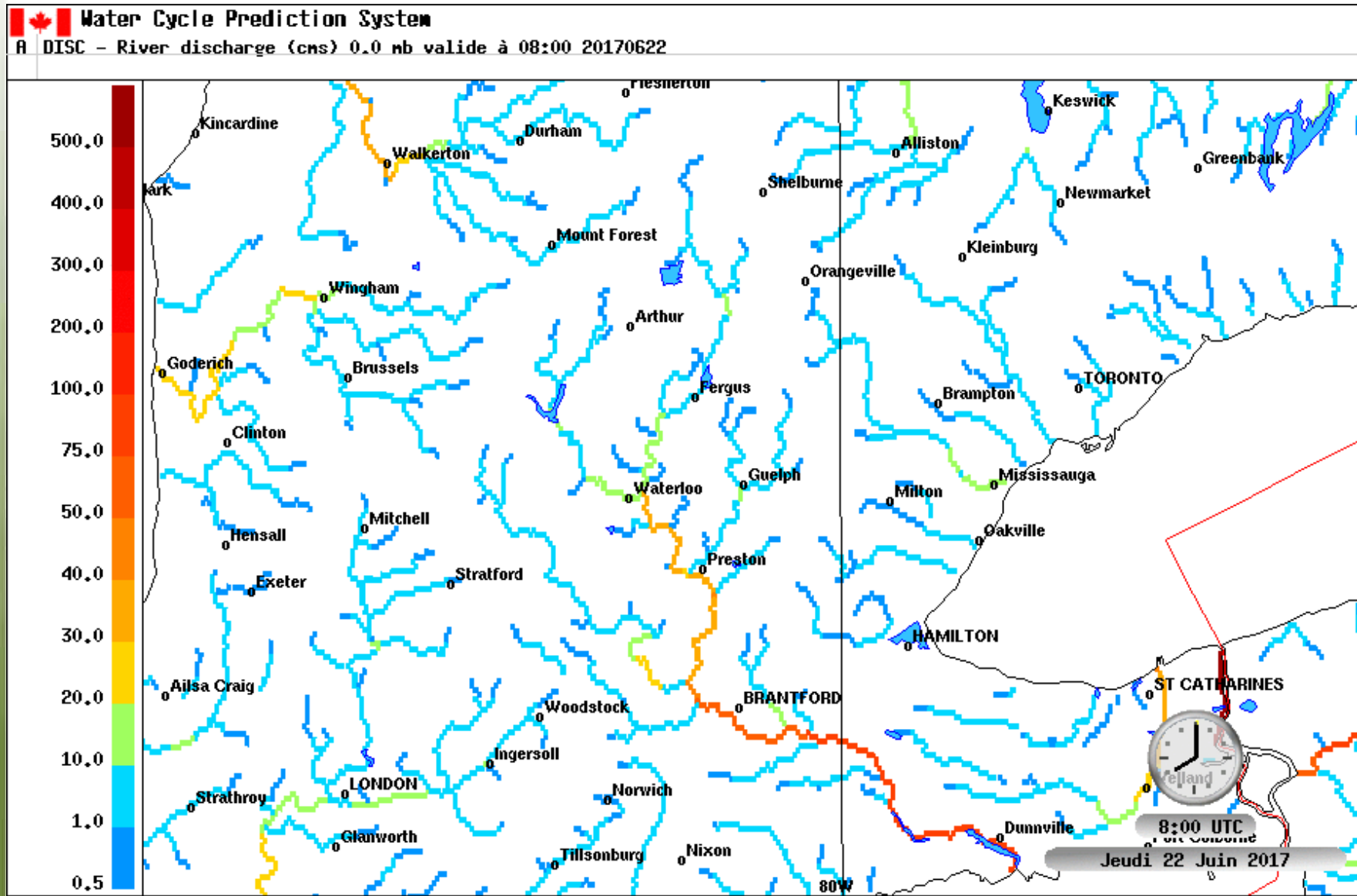over the Great Lakes**

Streamflow analysis cycle
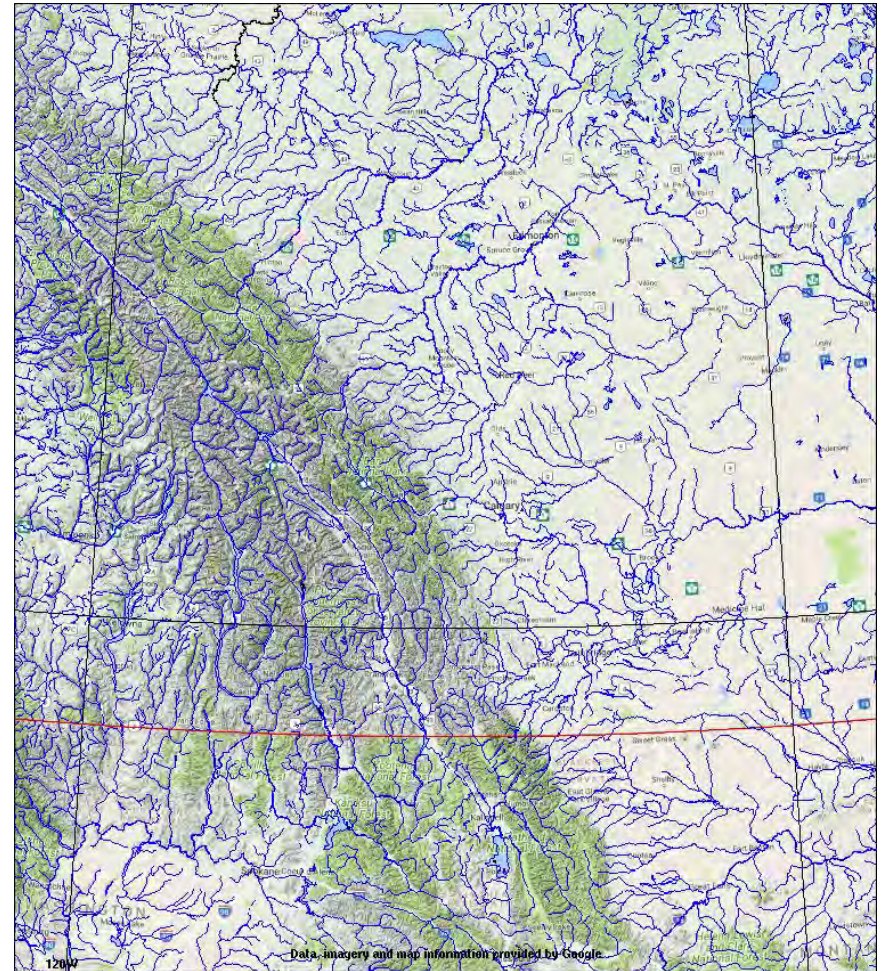## 2017-06-22 06Z - 2017-06-24 06Z
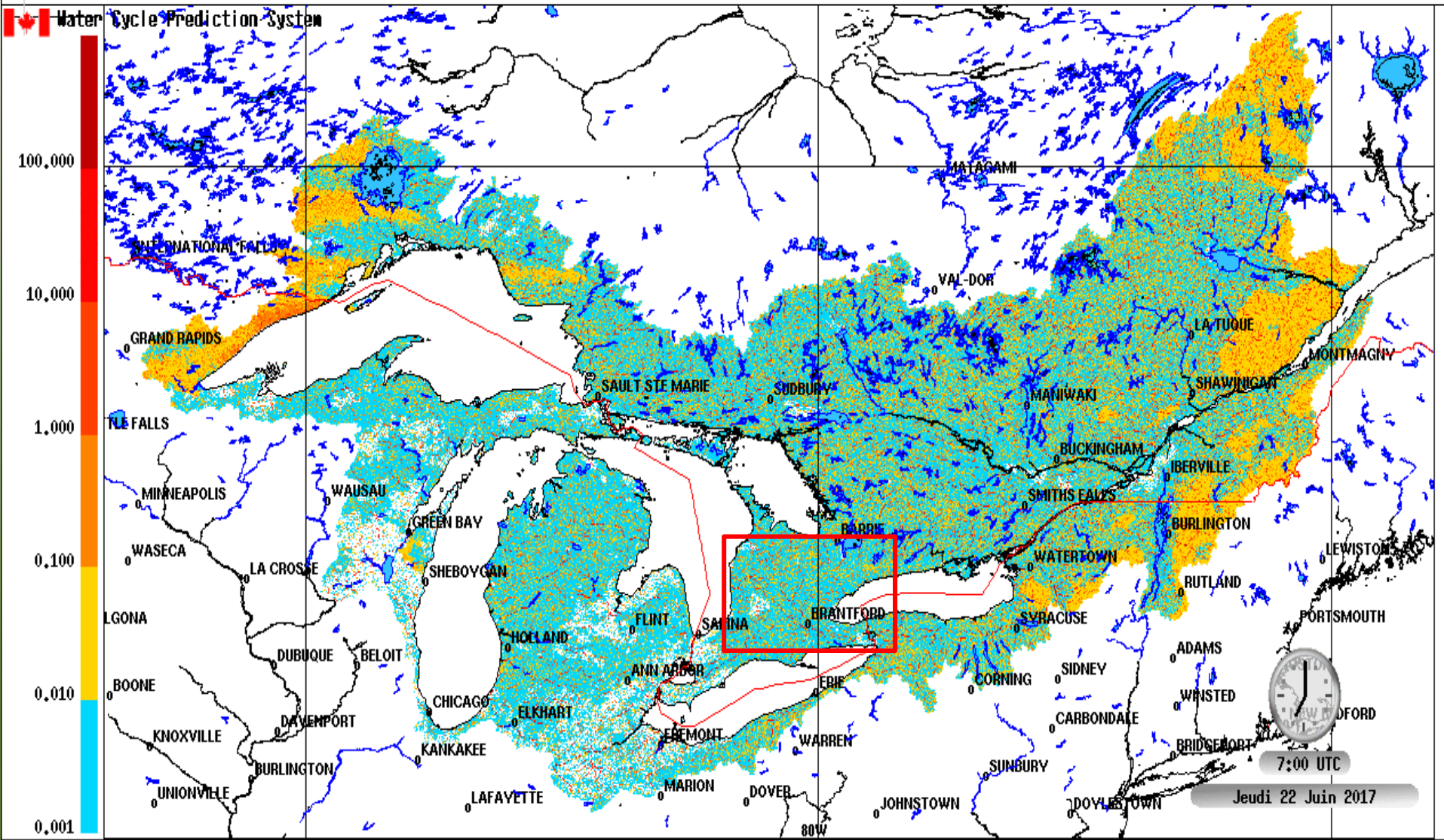
Streamflow analysis cycle
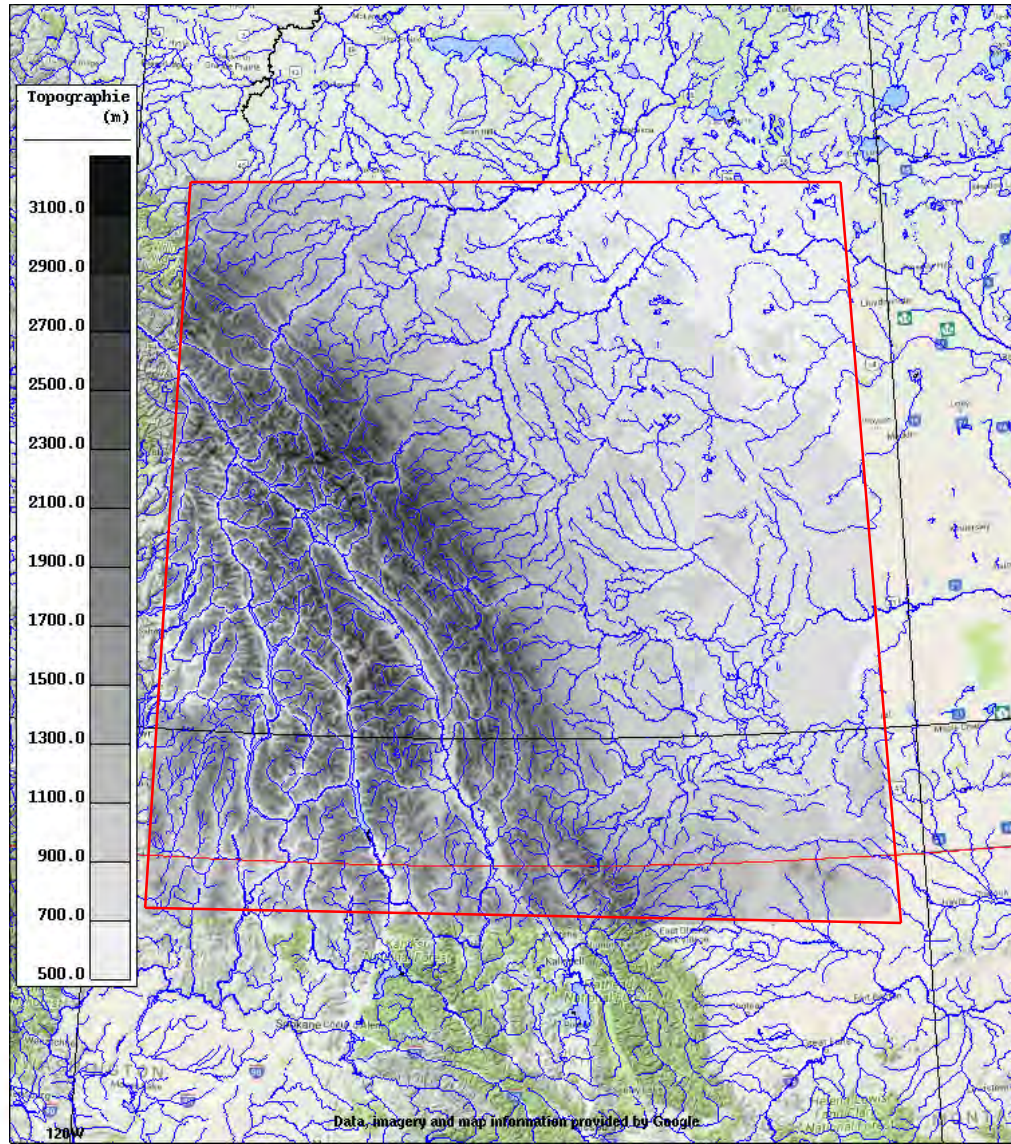## 2017-06-22 06Z - 2017-06-26 06Z

GEM-Hydro within GWF

- GEM-Hydro over **Southern Alberta**

- Region strongly impacted by the June 2013 flood

- Many challenges for hydrology including upstream mountainous region

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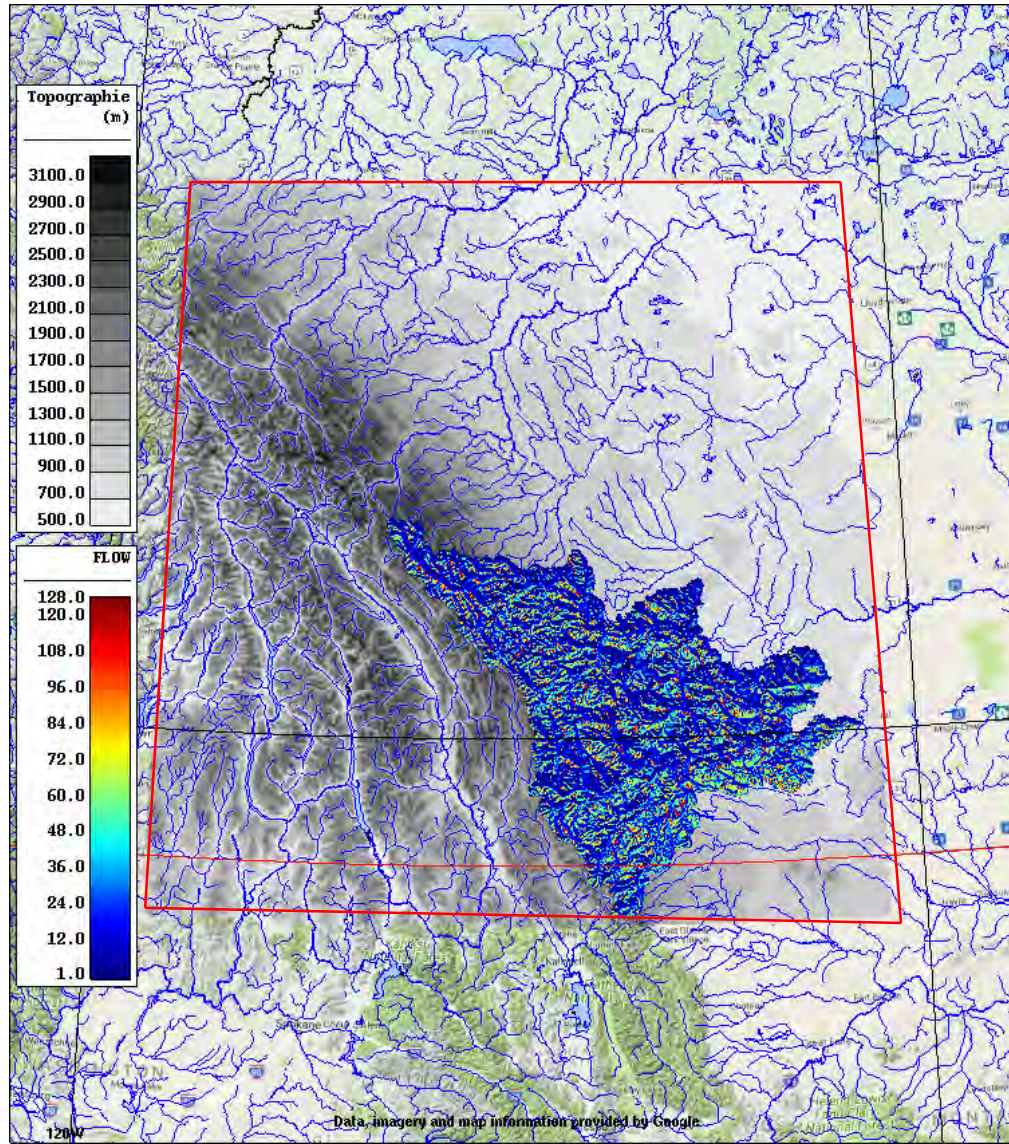Environment and Climate Change Canada

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Operational configuration

- 1-km grid spacing domain covering South Alberta
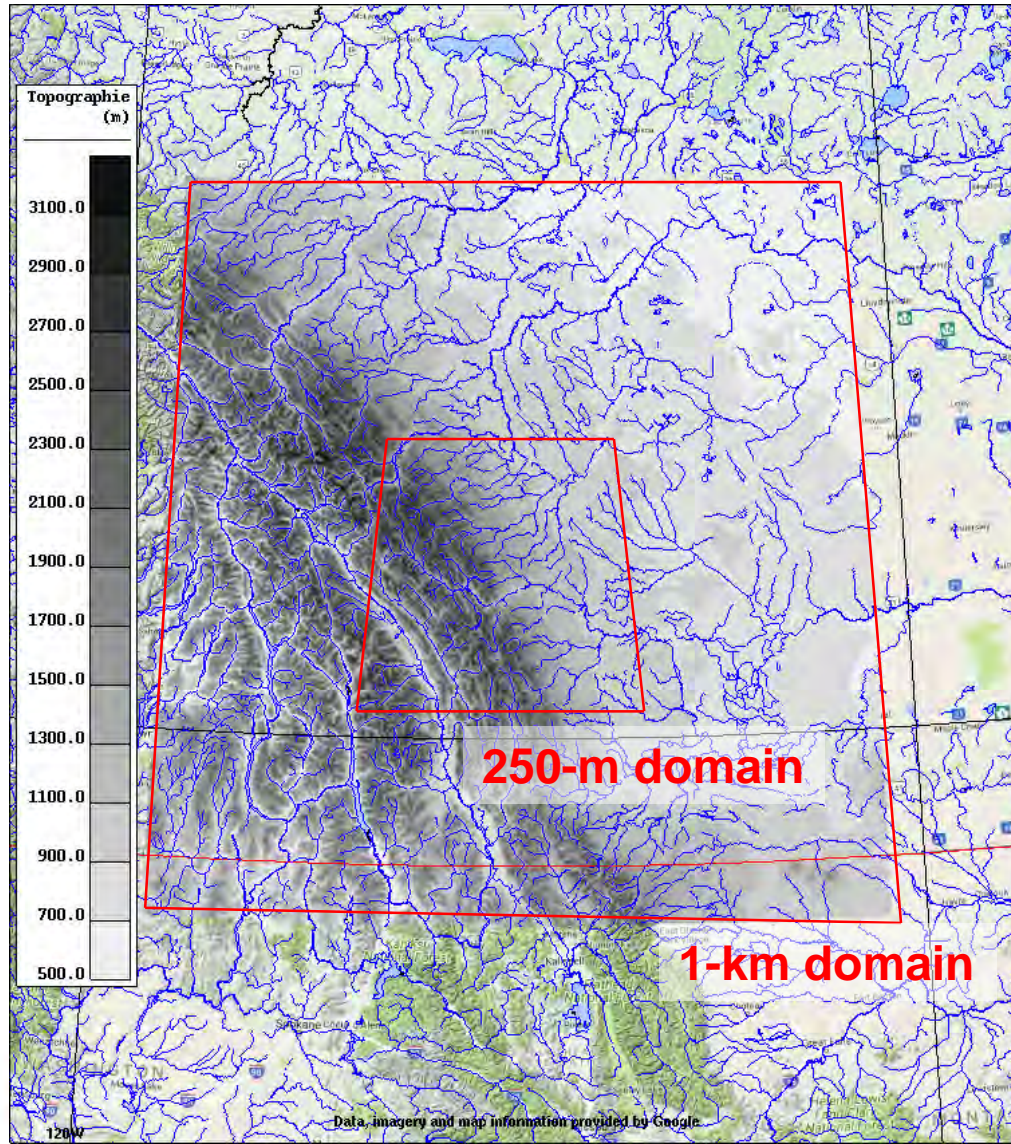
Operational configuration

- 1-km grid spacing domain covering South Alberta

- Includes South-Saskatchewan river watershed

- Runs:
  - **Coupled:** GEM 1km (-> 48h)
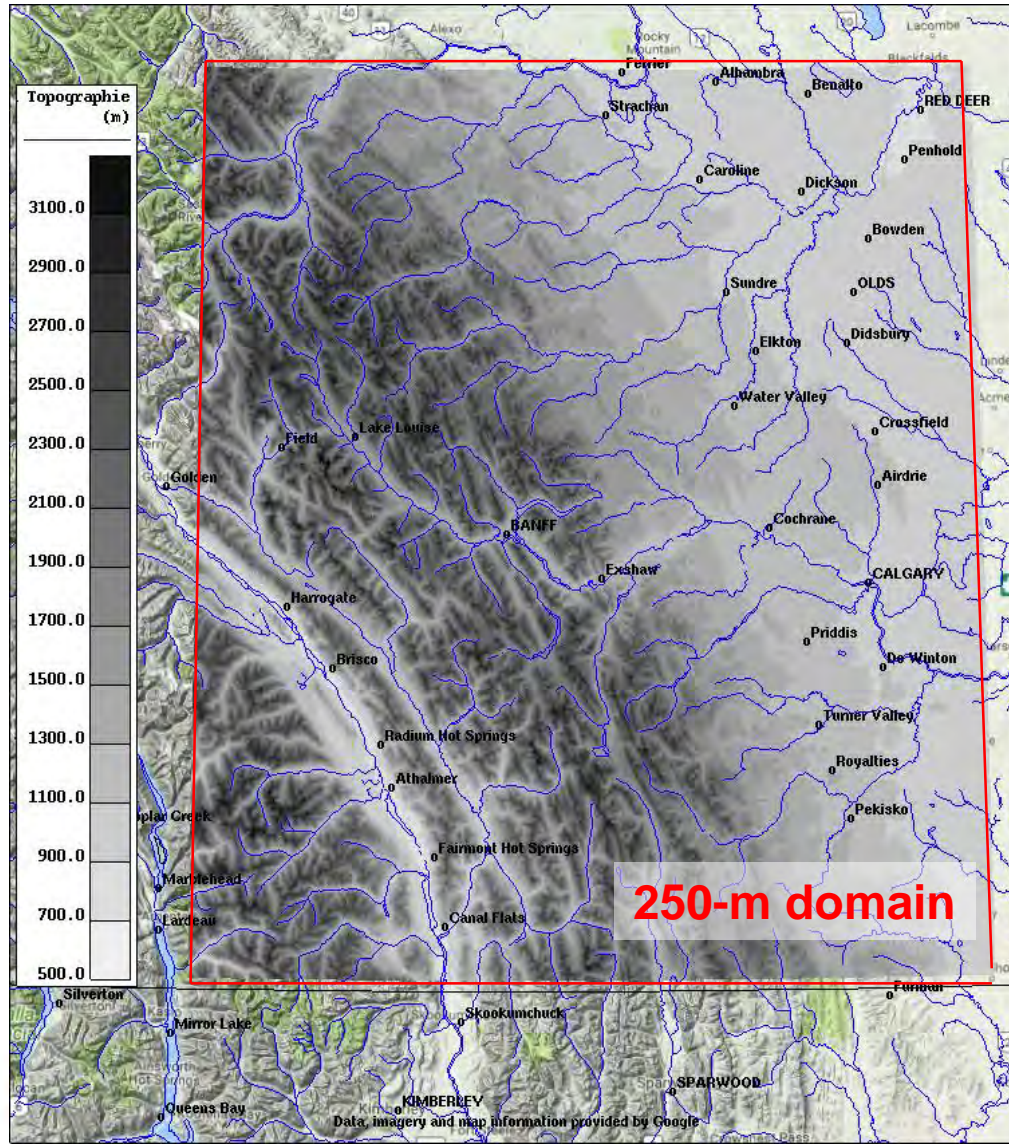 - **Offline:** Ensemble (REPS) 10->1 km (-> 96h)

Experimental configuration

- **1-km grid** spacing domain covering **South Alberta**

- **250-m grid** spacing domain covering the **Bow river** watershed

- Focus on **mountain hydrology**

Experimental configuration

250-m domain

- **1-km grid** spacing domain covering **South Alberta**

- **250-m grid** spacing domain covering the **Bow river** watershed

- Runs:
  - **Coupled**: GEM 250 m (-> 24h)
  - **Offline**: GEM 1-> 0.25 km (-> 48h)

Experimental configuration

A configuration to tackle major challenges in mountain hydrology:

- Precipitation:
  - Spatial variability and phase change: GEM 1km, 250 m
  - Precipitation analysis in mountainous terrain: CaPA 1km

- Snowpack:
  - Model complexity (single- and multi-layer schemes in SVS)
  - Subgrid spatial variability (coll. Coldwater Lab.)
  - Data assimilation (SWE, SCA, …)

- 1st test : Rain on Snow Event during the June 2013 flood

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Thank you for your attention!
Questions?