Situation with the routing !

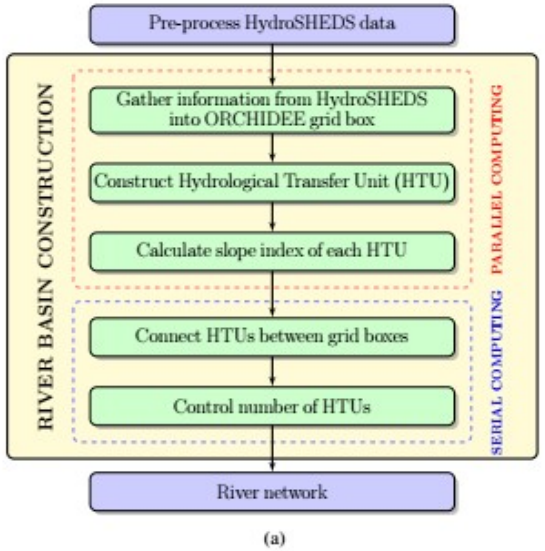
J. Polcher, Xudong Wang and Thomas Dubos
Laboratoire de Météorologie Dynamique/IPSL

- Situation left by Trung Nguyen
- The work of Xudong
- Ideas on how to evolve toward a more general parallelisation of the routing scheme

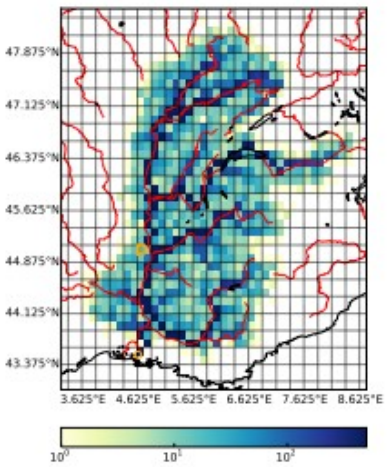
LMD

Institut Pierre Simon Laplace

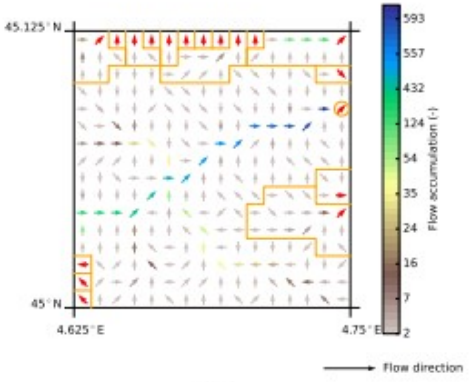
Routing as left by Trung



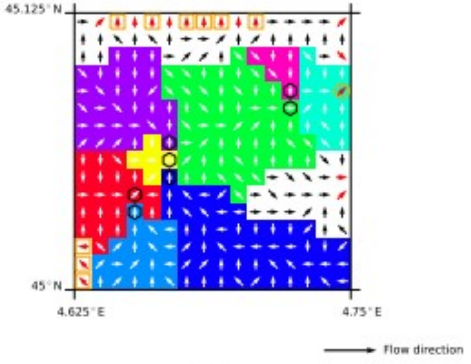
(a)



(b)



(c)



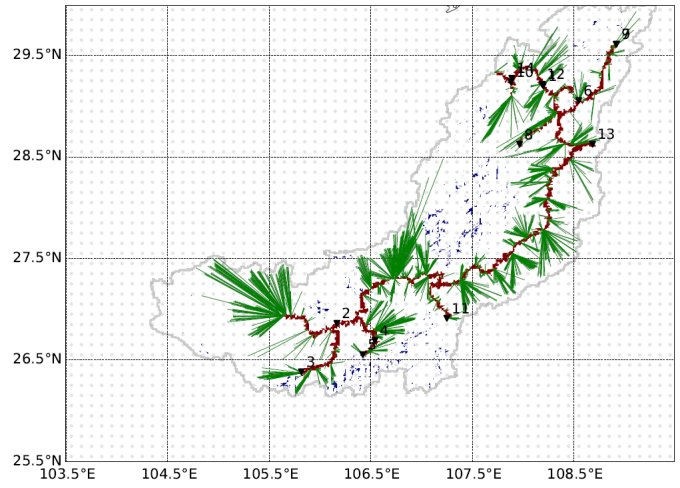
(d)

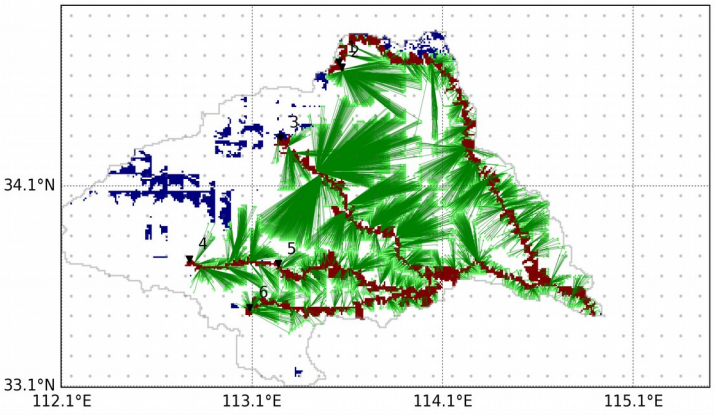
- HydroSHED is still not global.
- The supermeshing methodology which preserves the river graph, works on curvilinear grids.
- The value of the high resolution routing this allows has been demonstrated.
- The code is in a bad state :
  - Generation of the supermesh is not parallel.
  - The parallelisation of the routing is not optimal.

LMD

Institut Pierre Simon Laplace

The work performed by Xudong



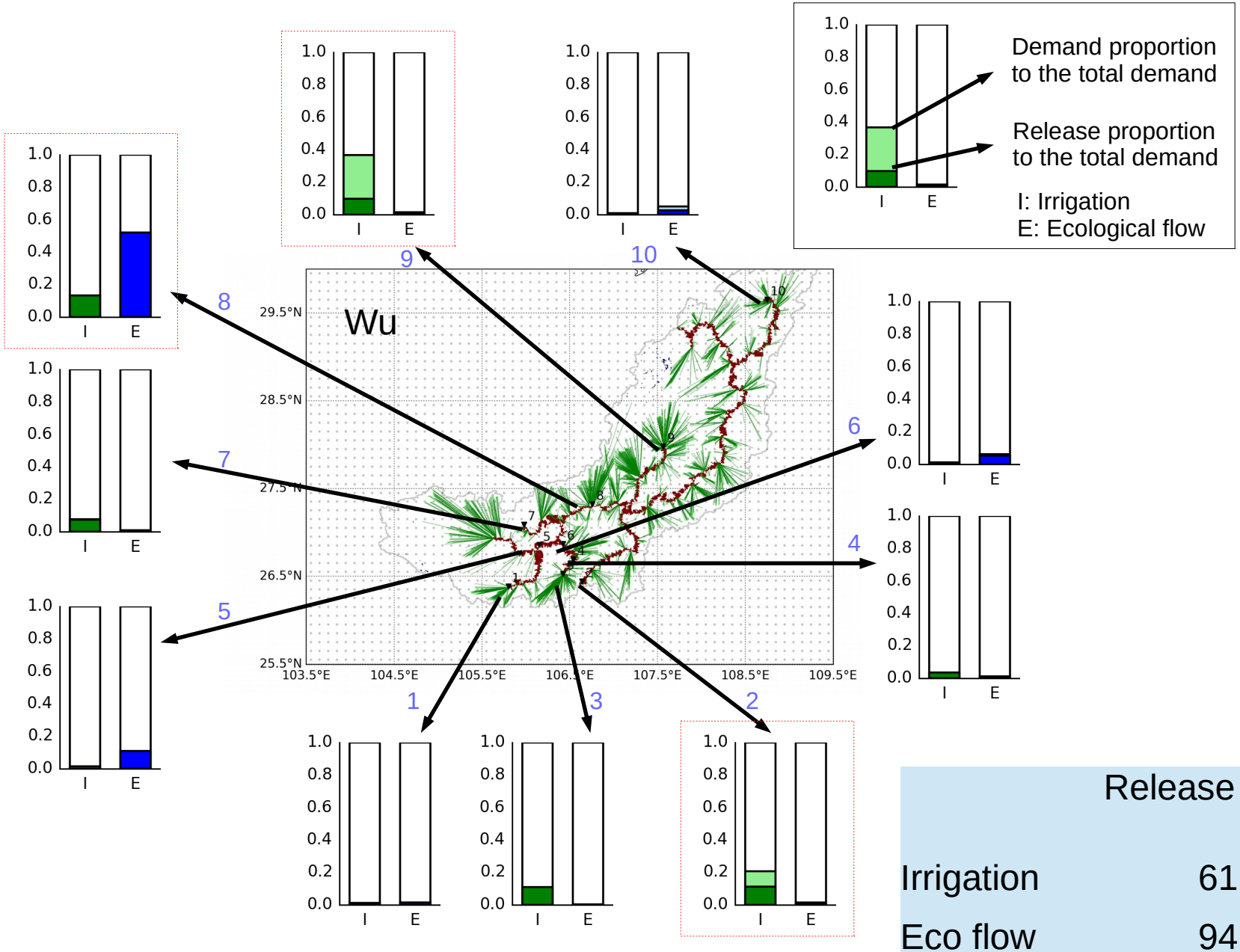


- To add water management (dams, adduction network) Xudong wrote a prototype in Python.
- It uses a combination of Python and FORTRAN.
- It generates the supermesh and does the routing.
- It is not parallel and thus works only on small basins.

LMD

Institut Pierre Simon Laplace

Demand and release at dams location



	Release / demand
Irrigation	61.6%
Eco flow	94.4%

Evolutions being tested

- Better treatment of small HTUs :
  - The small HTU may impose a limit on the time step.
  - Celerity map of Allen et al. (2018) is used to impose the following condition :

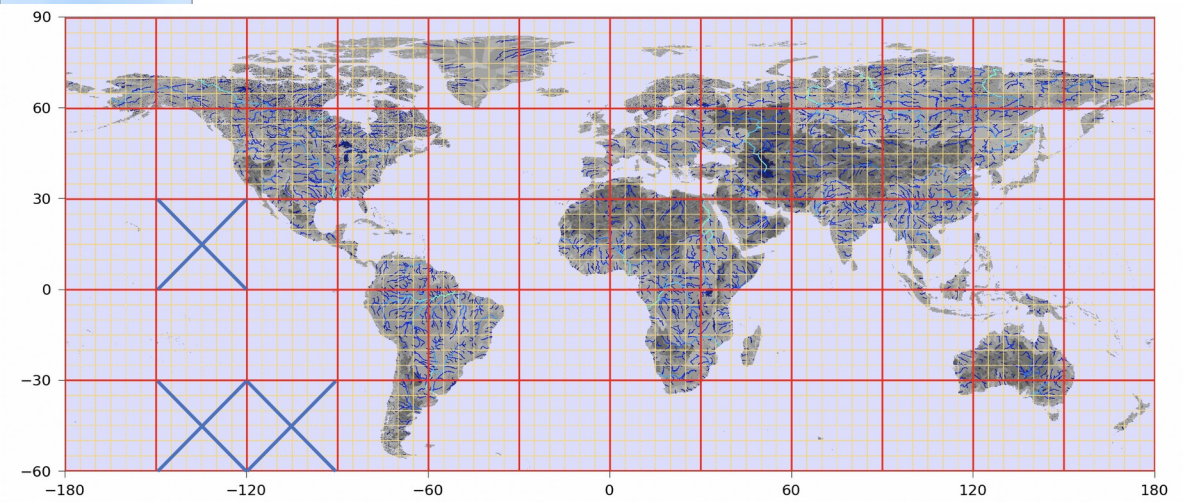
$$dt_{routing} \approx \sum_{i \in HTU} t_i = \sum_{i \in HTU} Length_i / celerity_i$$

  - It has to be combined with the conditions on preserving flow direction and basin integrity.

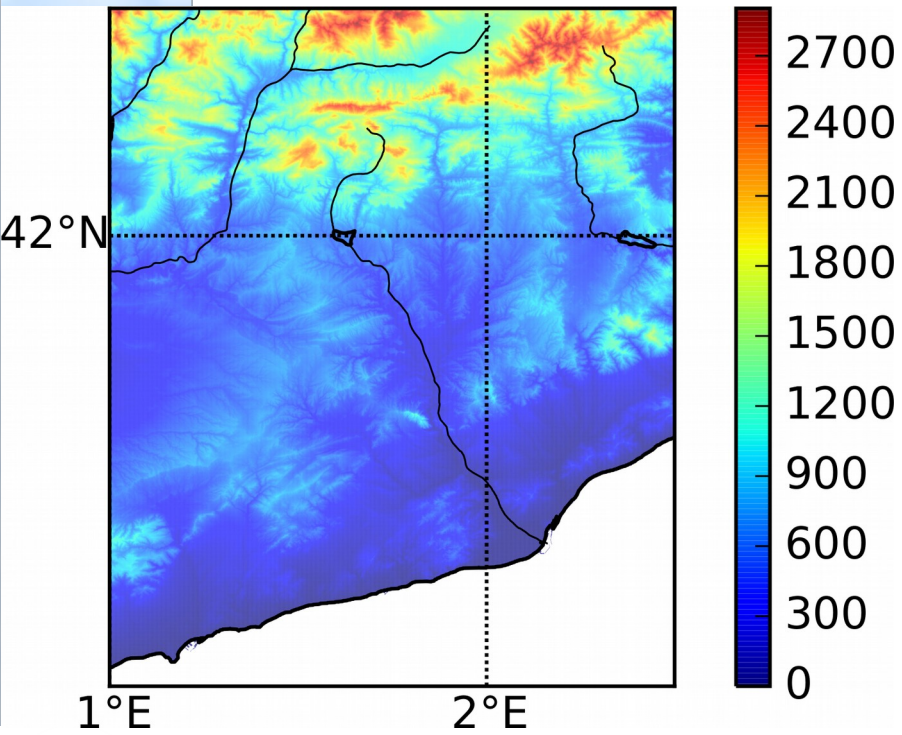
- Moving Xudongs scripts to unstructured grids using the spherical polygon package of Python.

LMD

Institut Pierre Simon Laplace



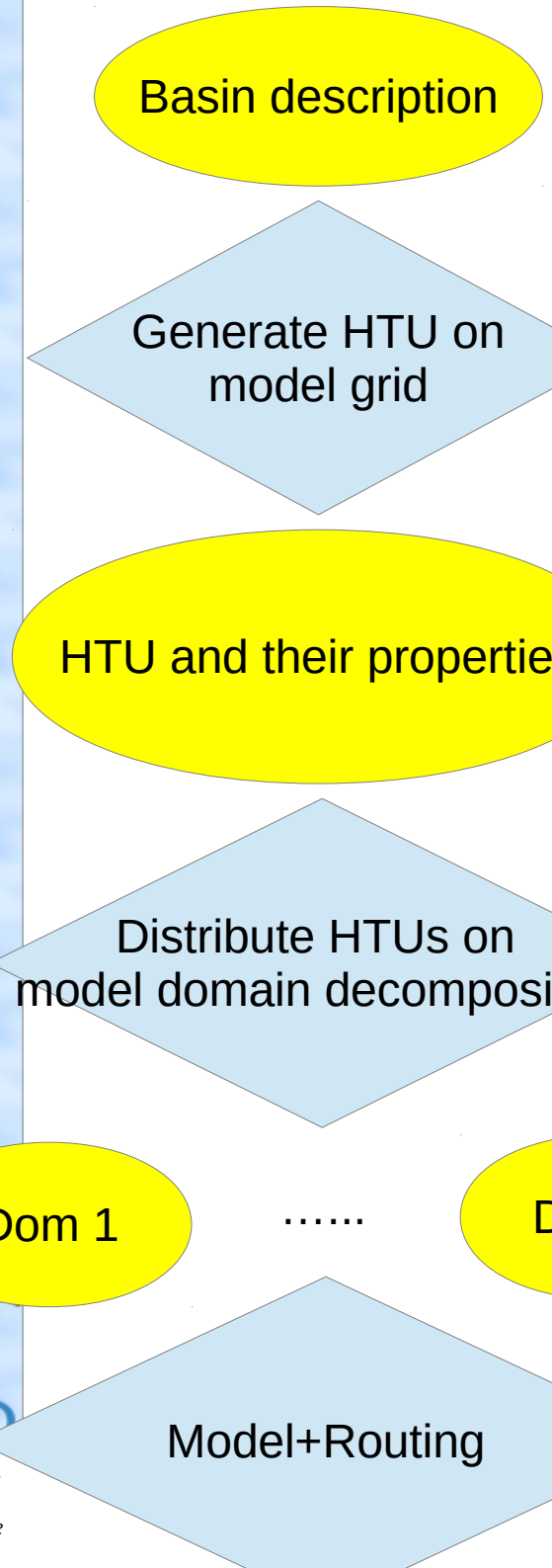
A New Global Hydrography Map



- Dai Yamazaki developed a hydrography database based on the MERIT DEM.
- It is global and on top of HydroSHED it includes river width.
- Resolution is arc-sec (~ 90m)
- GeoTif format but usable in Python.
- Kotaro Hamada is in Paris to implement this map in Xudong's prototype

Institut Pierre Simon Laplace

Proposed new structure



- Python/Fortran
- Parallel because of large data sets.

- A netCDF file with all HTUs

- Could be Python or Fortran
- Before runtime because nb of cores needed

- Any format as this is internal.

- Model simplified
- If domain decomposition can be done by XIOS simplifications are possible

Possible content of HTU file

- As it is a supermesh it needs the original grid
- For each HTU we need the following information
  - *Grid to which it belongs*
  - *Up-stream HTUs (more than one)*
  - *Up-stream area*
  - *Downstream HTU (could be more than 1 in floodplains)*
  - *Distance to ocean*
  - *Properties of HTU : sloap, river length, celerity, …*
  - *River ID*
  - *Number of HydroSHED grid boxes.*
  - *River, lake or dam ?*
  - *HTU to which there is an adduction link*
  - *GRDC station*

LMD

Institut Pierre Simon Laplace

Discussion of the new solution

- Advantages :
  - *The supermesh is constructed off-line with a different parallelisation algorithm (more oriented toward memory optimisation)*
  - *The HTU decompositions can be more easily verified and enhanced.*
  - *More information on the surface flows can be provided to the model.*
  - *The parallelisation of the routing in the time loop of ORCHIDEE will be simpler to implement.*
- Disadvantages
  - *A new code needs to be managed and documented.*
  - *For each atmospheric model grid and supermesh truncation an HTU file has to be created.*