Koninklijk Meteorologisch Instituut
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“Who needs ensemble nowcasts anyway?” Lessons from Belgium

Lesley De Cruz

ERAD 2022 Short Course

Who are our users?

What do users want?

Running (py)steps in real time: the software

Running (py)steps in real time: the hardware

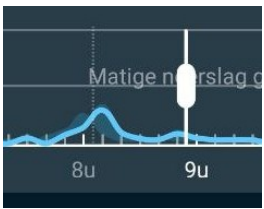
Bottom line

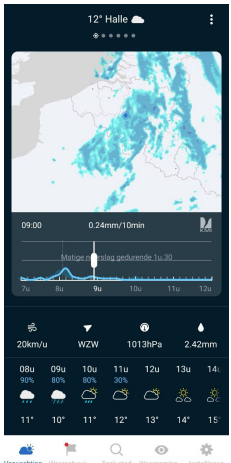
First reaction of our product development group

“Users can’t deal with ensemble forecasts, let alone ensemble nowcasts!”

But clearly, this is not true

Both forecasters and our smartphone app users are getting more familiar with ensemble forecasts.





Downstream modellers need ensembles

- However, just providing probabilities or mean + quantiles is not sufficient for many users
- This alone does not allow to **propagate forecast errors** through the highly nonlinear hydrological models
- For these applications, **ensemble forecasts** with the right spatiotemporal correlations are essential!

But do they need ensemble NOWCASTS?

- Hydrological models typically require a temporal resolution of 1-6 hours: no need for nowcasts?
- In fact, there are other kinds of users!
- One of our test users: Aquafin

Who uses ensemble nowcasts? Example: Aquafin

- Control of stormwater drainage pumps in order to:
  - Reduce stormwater pollution of waterways (light/moderate rainfall)
  - Avoid floods (extreme rainfall)
- Real time control of collectors
  - Goal: minimize overflow
- Other daring innovations
  - e.g. management of (private) rainwater tanks (Aqtiput)

Who else uses ensemble nowcasts?

- Hydraulic modellers: systems react at much shorter timescales, so nowcasts and high spatiotemporal resolutions are needed
- Local authorities and emergency services:
  - probabilities and quantiles are generally sufficient
  - specific needs, e.g. “probability of T10 / T20 in this bunch of pixels in the next hours?”
  - potential new development: pysteps-IDF
- Developers of smart green roof technology (Antwerp)
- Other water infrastructure managers

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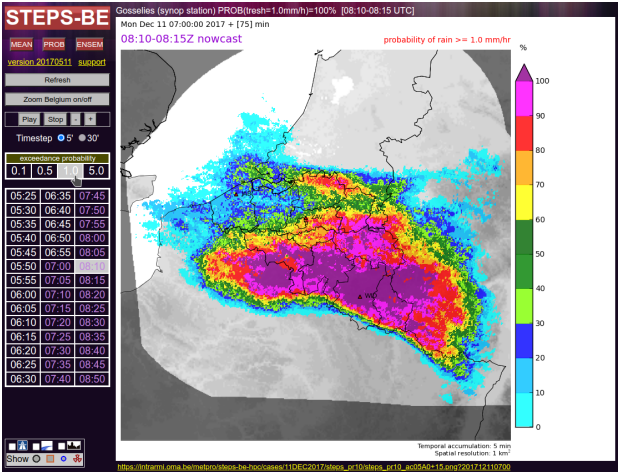
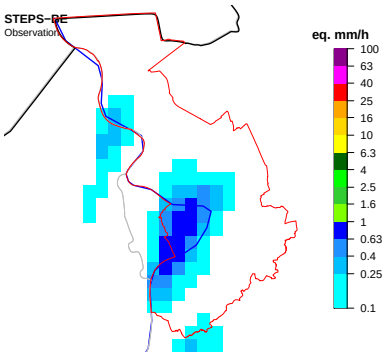
An intuitive graphical interface + trainings

created by Loris Foresti and Maarten Reyniers:



Data they can use

Us: “Here are 48 ensemble members for 6 hours!”
City of Antwerp: “Can you please just give us the output in this shp?”



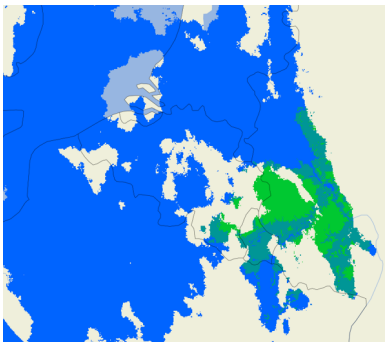
Test data, early!

Sharing test output early:

- helps users prepare their systems for the expected data formats and volumes
- allows them to give feedback at an early stage
- drives innovation (e.g. encourage a move towards hydrological ensembles)
- even if the product is not operational, and validation is still ongoing!

Additional variables

For example, the app requires the **precipitation type** as well.
Work in progress: combine pysteps-be with INCA-BE temperature profiles!



courtesy of Esteban Montadon

- light green: snow
- dark green: melting snow
- blue: rain

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STEPS-BE

- Belgian version of STEPS 1 (BOM & MetOffice) set up and further developed by Loris (Foresti et al., 2016)
- Currently running in real time on hardware with a 24/7 SLA almost uninterruptedly since 2017
- Regular users include the weather office and the meteo wing: mainly forecasters
- Occasional users include local authorities (city of Ghent, Antwerp) and water managers (Farys)

STEPS-BE: Operator's manual

STEPS-BE @ HPC operator's manual

Lesley De Cruz - Version of 25-10-2017

Introduction 1

Scripts on HPC 2

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Troubleshooting

Below, we list the possible causes of commonly encountered problems.

No nowcasts are produced

The lockdir is (on the node for steps, see `cat /home/steps_op/config/node`): `/home/steps_op/scratch/steps_realtime/tmp/check_files_trigger_steps-steps_op.lock`

Lockdir is absent or very recent (last couple of minutes)

- `AFD` is not working properly (no new radar data files are arriving); for a quick status check, run this command on the hpc:

```
ls /mnt-meteo/afd_shelf/observations/radar/composite/`date -d "15 minutes ago" +%Y%m%d`*.hjbwbzfa.image.rate.hl500as1_comp_sri.hdf | tail
```

- `/mnt-meteo/afd_shelf/` is not mounted at the node
- `/home/steps_op/config/node` does not contain the name of the node that is split off for STEPS
- the split-off node is not accessible by steps_op through ssh (e.g. ssh access of the node was not configured correctly after moving to another node or side)
- `chronos` is offline
- quota of steps_op is full

STEPS-BE: current status: pre-operational

- Eternal question of research to operations: who gets the phonecall at 1:00 am when there's a crash?
- Operators don't have time to read a 10 p manual for every product they are guarding

Management of operational products

Currently, two types of operational runs (both on hardware with 24/7 operational support)

- Run inside a docker with well-defined required inputs and provided outputs, on a VM with redundant hardware
- Run on the HPC with ecFlow (operational numerical weather predictions)

RMI

What is ecFlow?

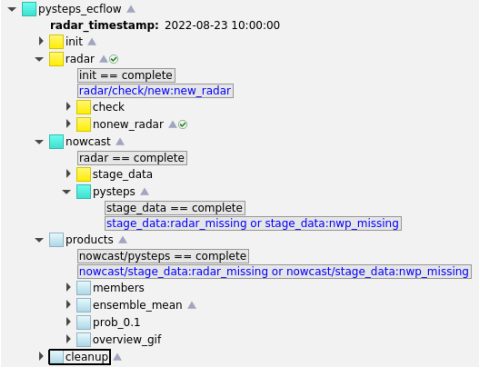
“ecFlow is a client/server workflow package that enables users to run a large number of programs (with dependencies on each other and on time) in a controlled environment. It provides reasonable tolerance for hardware and software failures, combined with restart capabilities. It is used at ECMWF to run all our operational suites across a range of platforms.”

See: `https://confluence.ecmwf.int/display/ECFLOW`

RMI's new NWP ecFlow set-up: NodeRunner

courtesy of Alex Deckmyn

pysteps-be ecFlow set-up



courtesy of Michiel Van Ginderachter

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STEPS-BE on HPC

Needs to run on hardware with 24/7 operational support:

- Problem: STEPS-BE is too heavy to run on our operational VMs
- Solution: “squat” one node of the operational HPC (24-core blade)
- New problem: HPC will retire soon, operational NWP will move to Bologna (ECMWF) and STEPS-BE will be EOL.

pysteps-be

Current situation:

- VMs for other products run on 72-core production machine
- Redundant master-slave set-up
- Not enough capacity for pysteps-be

Solution:

- Buy a new machine for pysteps, run in VM
- 1 master and 2 slaves: if one of the machine fails, we will still have 1 master and 1 slave
- Ideally add a staging machine to add redundancy
- ... if budget allows!

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Our experience

- Actively try to find and contact potential users
- Share data early, even if it's still work in progress
- Talk to users and listen to their requests and feedback
- Think about the transfer of research to operations: it's hard!
  Where/how will it run and who will manage it?
- Solutions exist, so no need to reinvent the wheel (e.g. ecFlow)