

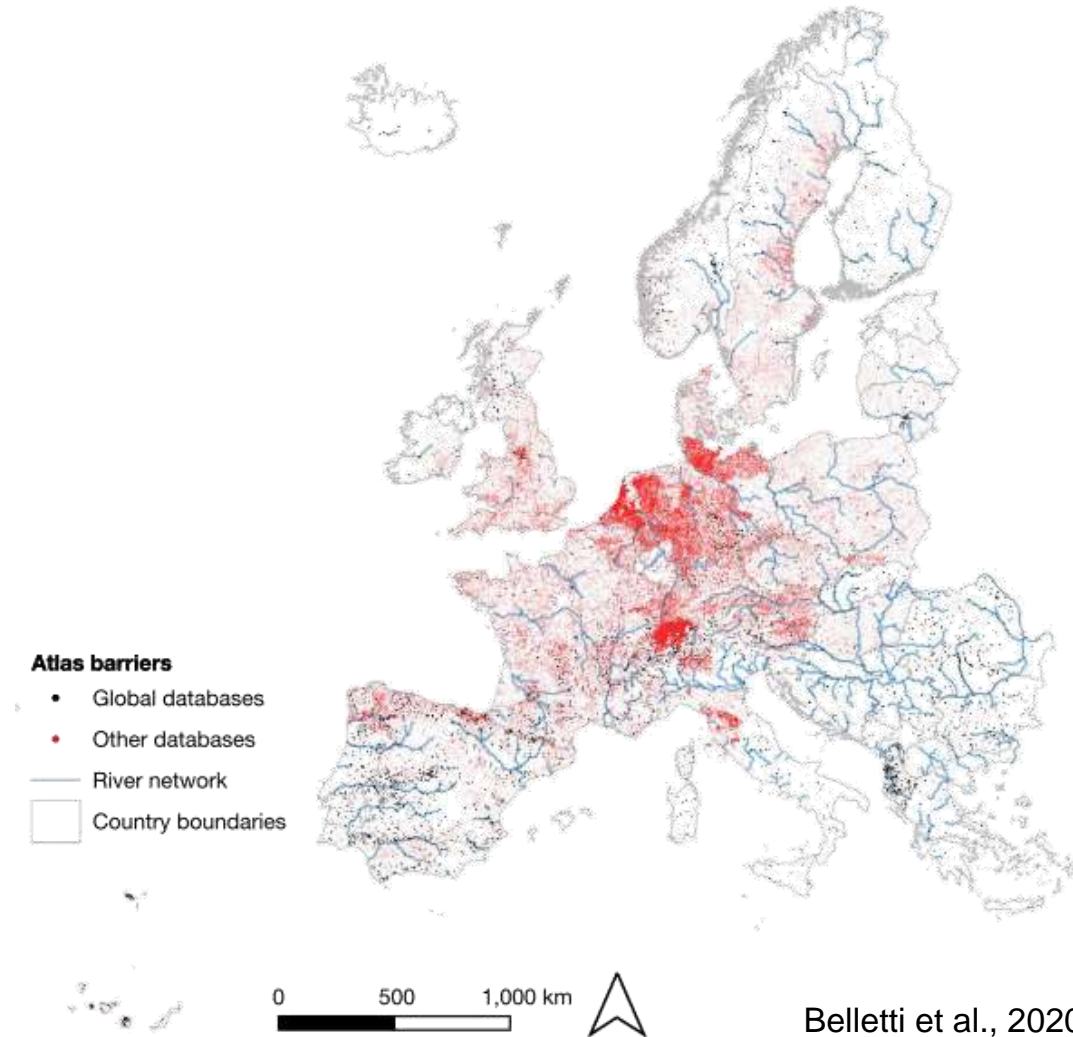
Applying hidden Markov modelling to fine-scale fish telemetry data

Jelger Elings

R. Mawer, S. Bruneel, I. Pauwels, M. Schneider, J. Coeck, I. Kopecki, P. Goethals

Why?

- High density of migration barriers
 - Increase in hydropower development
- Blocks fish migration
- Fish navigation key to success in fishway efficiency
 - By improving attraction efficiency



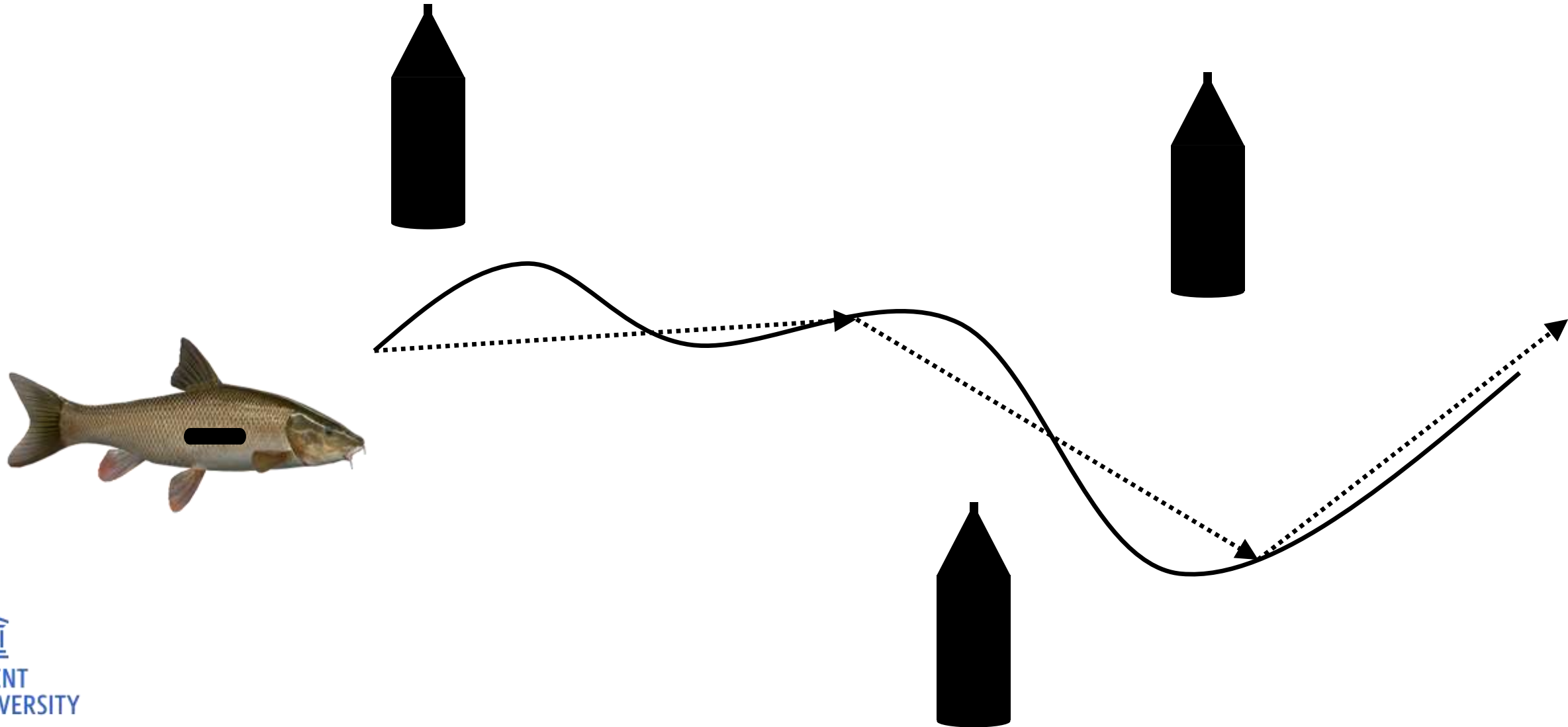
Belletti et al., 2020

Fish navigation

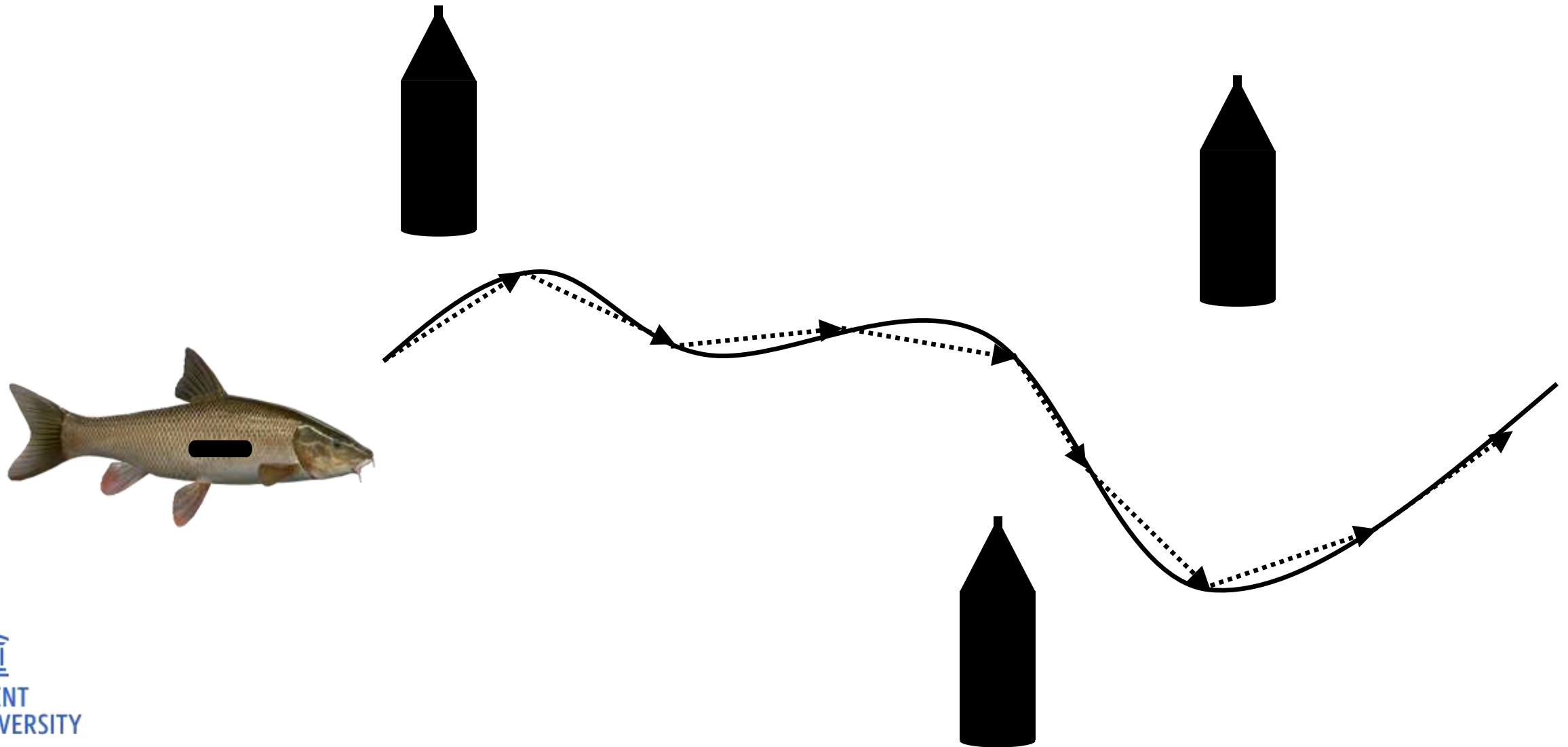
- Fish navigation mainly depending on ecohydraulic cues
 - Flow velocity
 - Spatial velocity gradient
- How do fish react to ecohydraulic cues around fishway entrances?
 - Fine-scale telemetry allows to investigate fine-scale decisions



Acoustic Telemetry – How does it work?

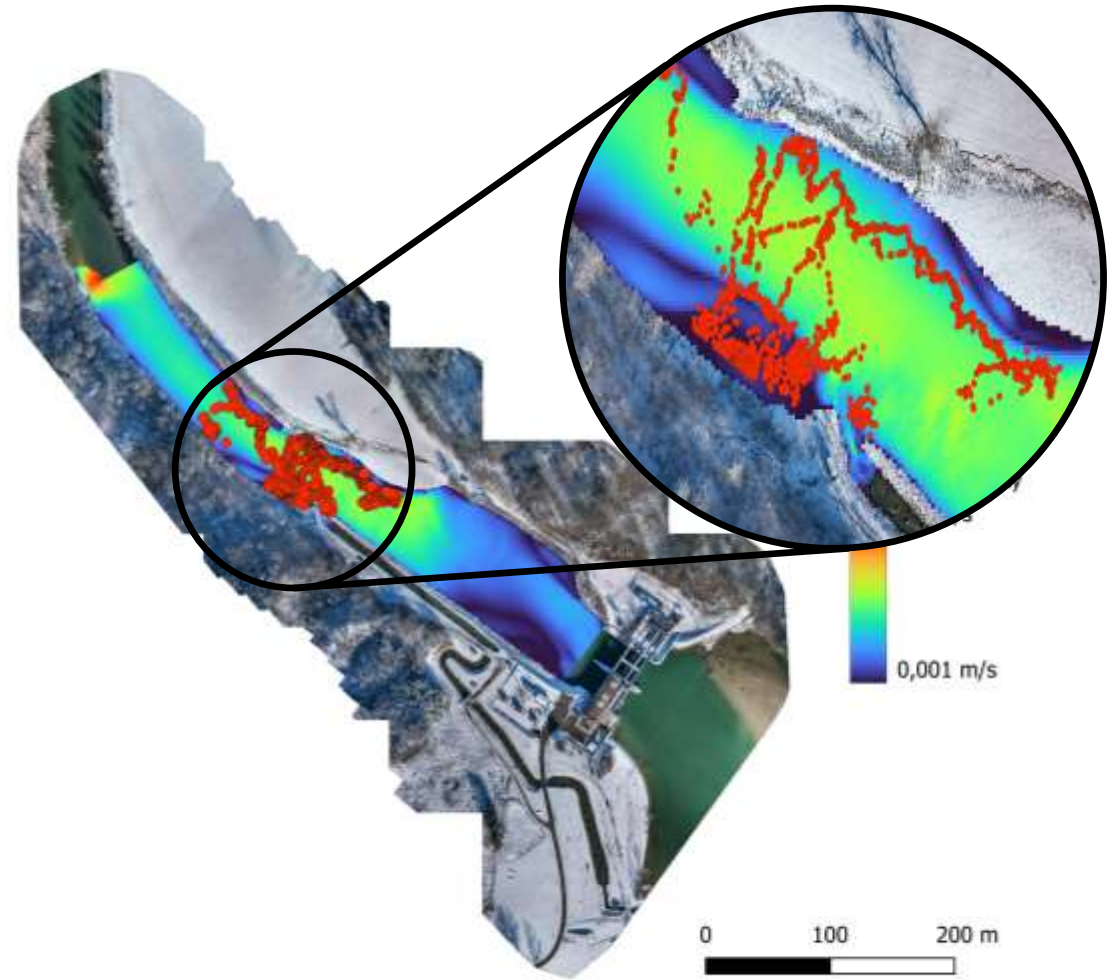


Acoustic Telemetry – How does it work?



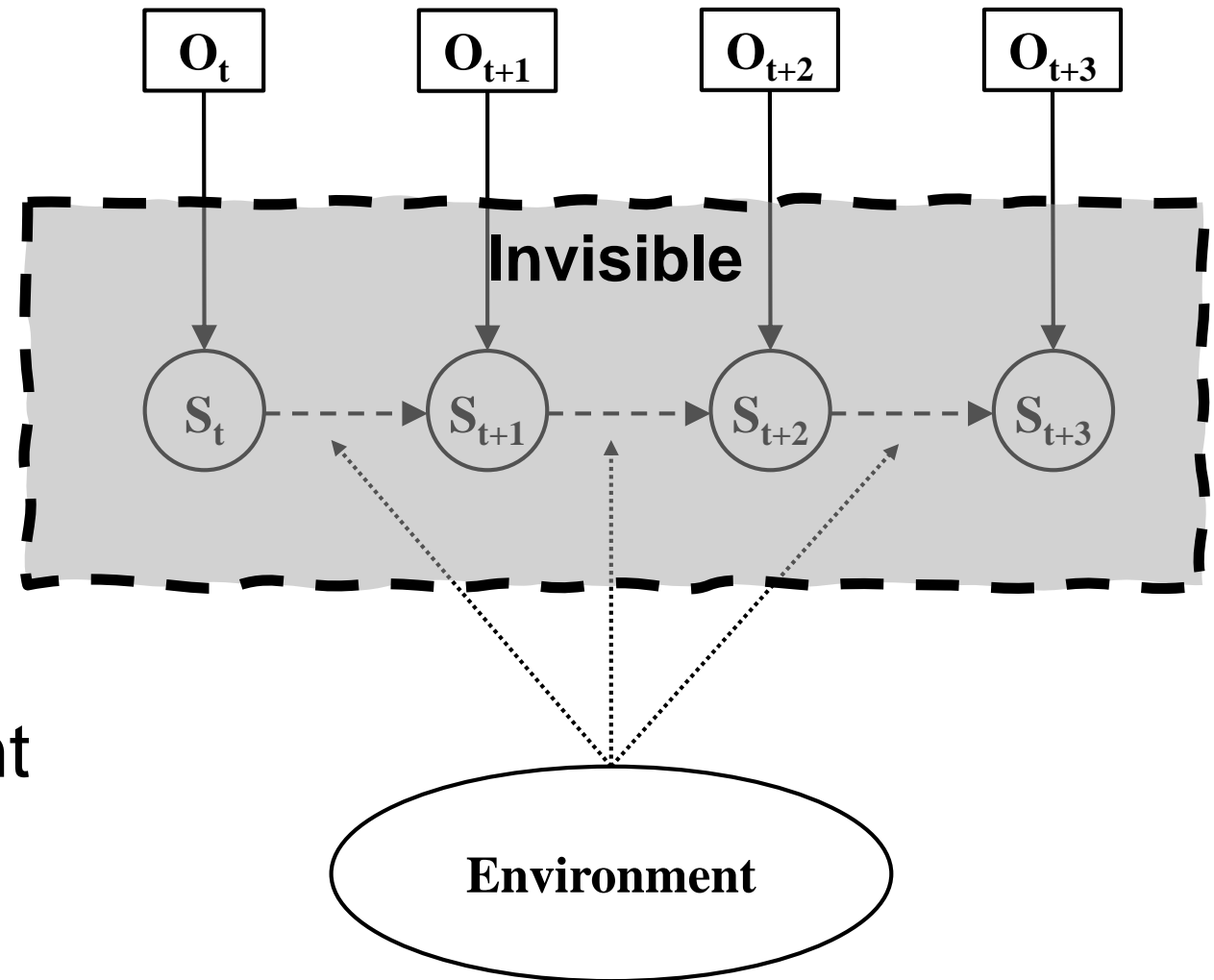
Acoustic Telemetry – fine-scale tracking

- Fish position every ~1 second
- Fish is utilizing different habitats
 - Swimming throughout
 - Resting in low-velocity area

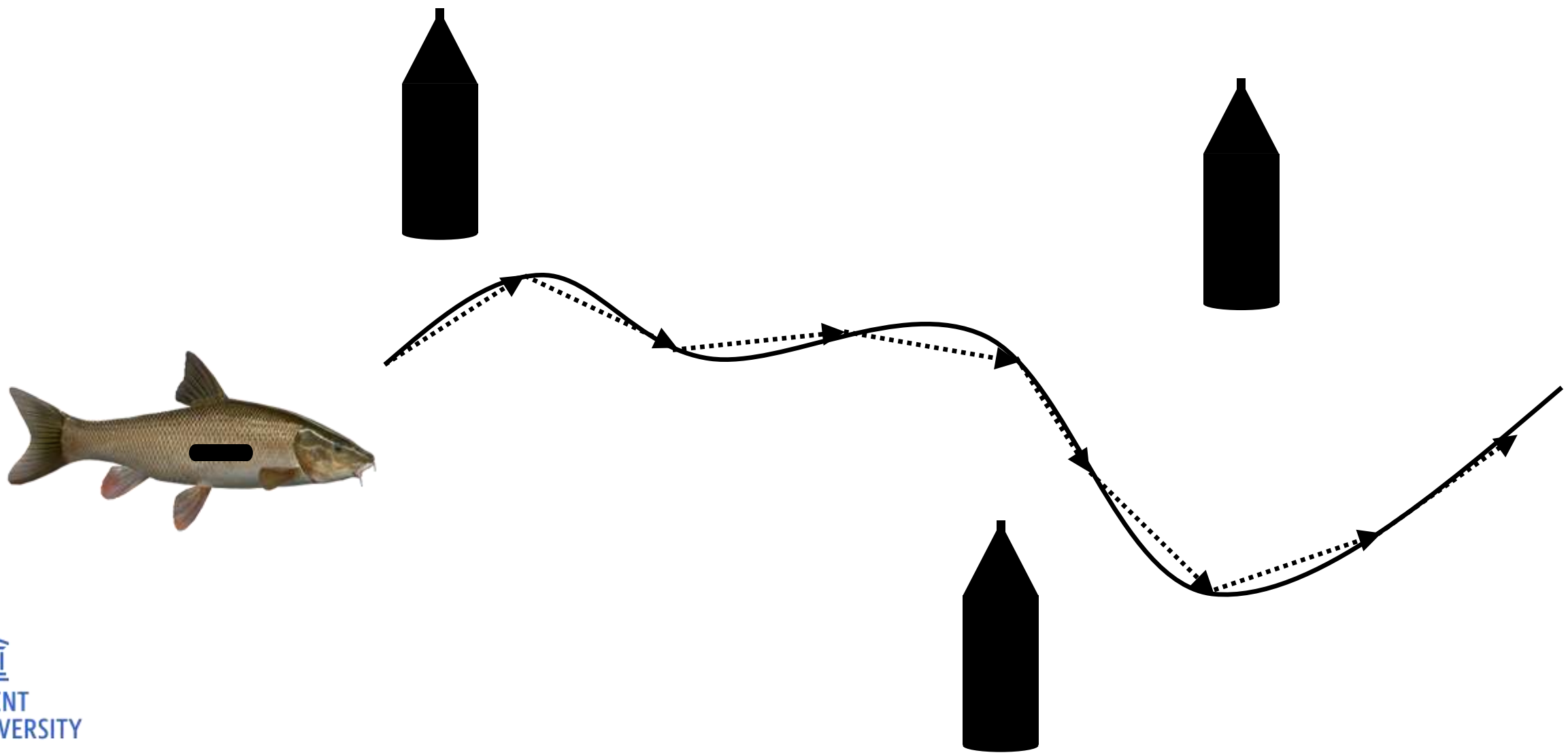


Hidden Markov Models

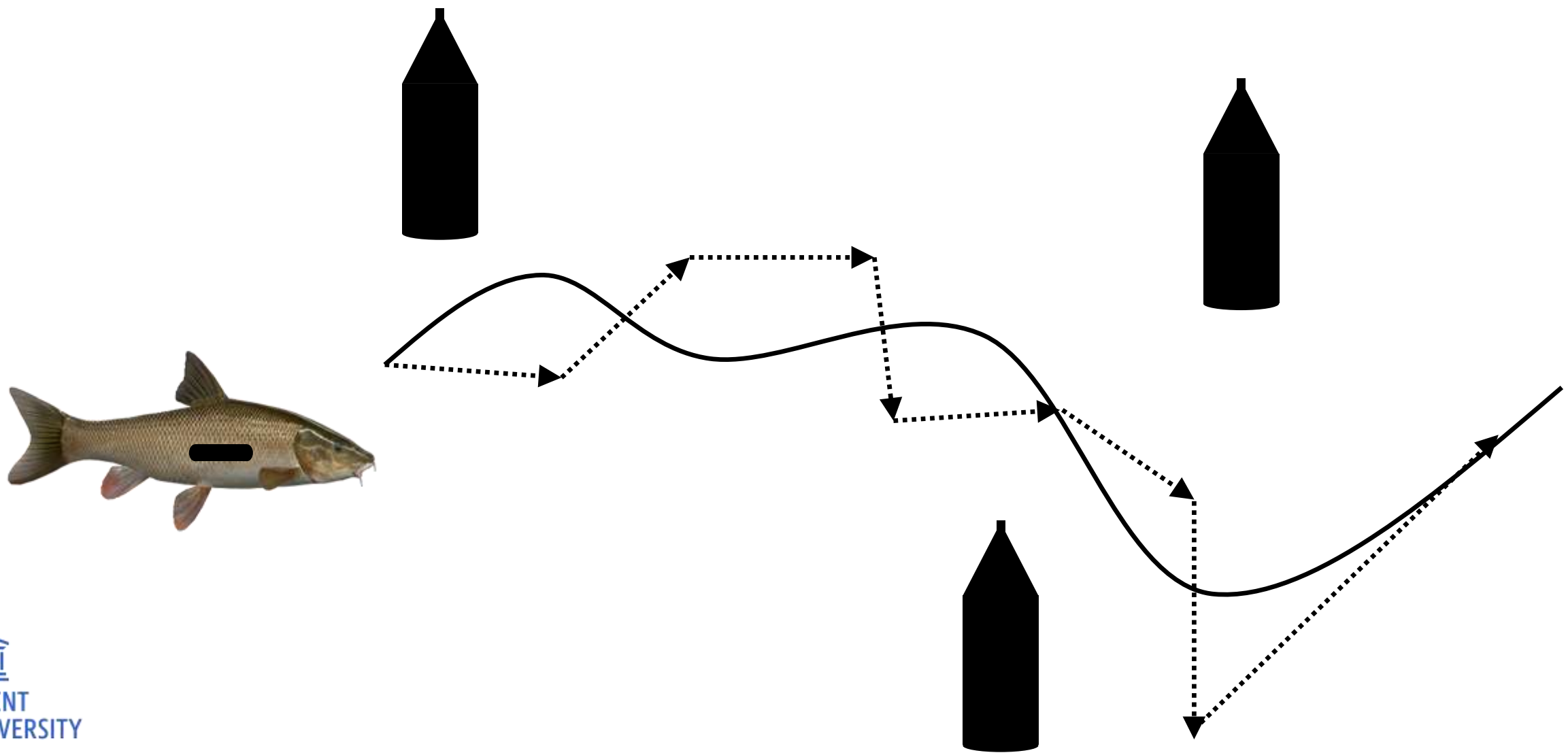
- We know where.
But why?
- Certain assumptions to be met:
 - Regular timesteps
 - Negligible measurement errors



HMM – measurement errors

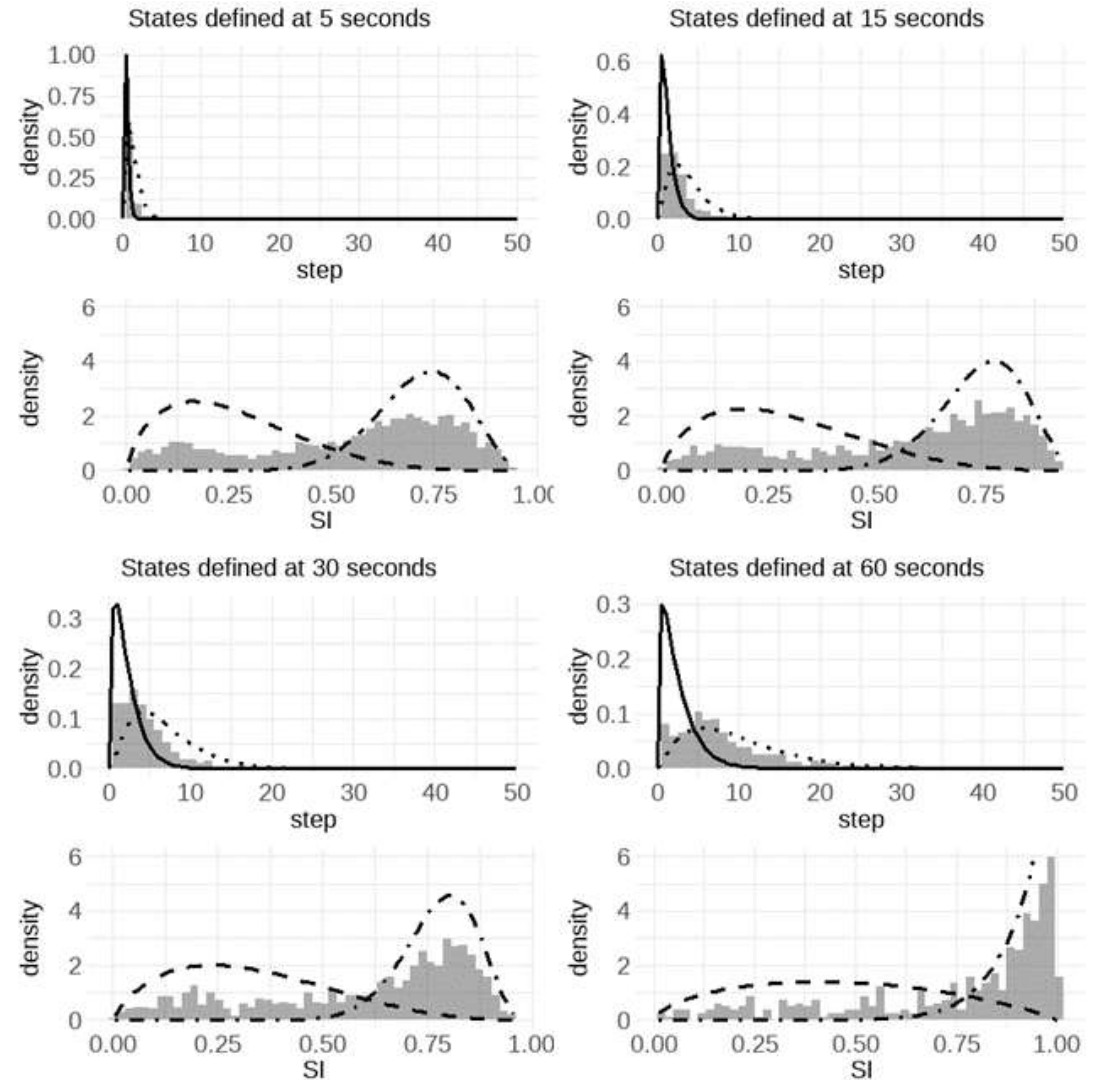


HMM – measurement errors



HMM – Effect of regularization

- HMM developed for several tracks (1 fish)
- Choosing timestep affects state definition
- After state definition links to ecohydraulic parameters can be made



Thank you for listening

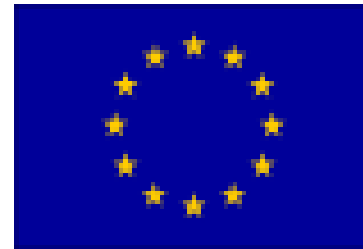


jelger.elings@ugent.be



@JelgerE

RIBES



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