STSM report

Introduction

This is a report for a Short Term Scientific Mission (STSM) for the COST Action ES1305: *European Network for the Radar surveillance of Animal Movement (ENRAM)* under working group 3: *Visualizing spatio-temporal patterns of animal movement*.

- **STSM title**: Next generation bird migration flow visualization: software development
- **Host institution**: Research Group of Computational Geo-Ecology at the University of Amsterdam in the Netherlands under the coordination of Dr. Judy Shamoun-Baranes.
- **Grantee**: Bart Aelterman from the LifeWatch team at the Research Institute for Nature and Forest (INBO) in Belgium.
- **Dates**: June 8 to 12, 2015

Work of on this STSM was done in close collaboration with Peter Desmet (INBO, Belgium).

Purpose

The goals set out for this STSM were:

1. To develop new features for the bird migration flow visualization developed last year (http://enram.github.io/bird-migration-flow-visualization/viz/) and move the visualization from prototype to production.
2. To analyze forward trajectory model data and to migrate these data to the backend for a new bird migration visualization.
3. To conceptualize a unified visualization for animal migration using weather radars.

In parallel with this STSM, the University of Amsterdam hosted an ENRAM Working Group 3 meeting, titled “Visualizations: from show cases to production” (overview, agenda and minutes of that meeting are available here). This allowed for interaction with a wider user group and another visualization team, but also added more goals to this STSM, such as applying the flow visualization to data from the United States.

Description of the work carried out

Monday 8 June 2015

- Meetings:
    - STSM kick-off: discuss the current state of the visualization and define goals for the week
    - Detailed discussion of features for a unified visualization for animal migration and their priorities.
- Refactor the flow visualization code:
    - Replace the asynchronous tasks by synchronous ones. This makes the initial startup a bit slower, but is easier to maintain.
    - Replace the CartoDB backend with a static file containing the case study data. The file is loaded in memory entirely which makes it easy to use the visualization for other data.
    - Split up the code in logical parts and remove redundancy.
- Documentation:
    - Describe new tasks as issues on GitHub

Tuesday 9 June 2015

- Meetings:
    - Working group 3 kick-off with other participants. This included presentations of the different visualization efforts so far and aims for the coming days.
    - Discussion with KNMI to examine the technical feasibility to deploy the flow visualization in production on real time data.
- Refactor the flow visualization code:
    - Create separate configurable application settings (required for other case studies, such as the US).
    - Find base layer data for the US.
    - Load radar locations separately from base layer (for easier plug and play)

Wednesday 10 June 2015

- Meetings:
    - Discussion on future perspective for work group 3
    - Discussion on case study aggregation query
    - Demonstrate working visualization on US data
- Develop a forward trajectory model visualization:
    - Obtain the data in the correct format and load in CartoDB
    - Update the SQL and CartoCSS to create three visualizations
- Develop prototypes of new features for the flow visualization:

    - Clip the animation at 50 pixels around the radars to reduce excessive interpolation.
    - Investigate ways to display density as a heatmap.
    - Display a small timechart below the visualization to provide more context.
- Documentation:
    - Document the aggregation query

Thursday 11 June 2015

- Meetings:
    - Present the developments on the flow visualization
- Develop prototypes of new features for the flow visualization:
    - Finish the timechart and add interactivity to it.
    - Alternative to visualize density: pulsating circles around radars.
    - Update the colours of the visualization for better display in presentations.
- Documentation:
    - Create a shapefile that can be used for all visualizations and document the process to crop it to a certain area.
    - Implement versioning of the visualization. This allows us to keep older versions of the visualization stable while allowing new versions to be added and discovered by users.

Friday 12 June 2015

- Closing presentations:
    - Results of the STSM
    - Plans for writing a publication

Personal contribution

This STSM was done in parallel with the STSM of Peter Desmet and a Working Group 3 meeting. I participated as main JavaScript developer for the flow visualization. During the first days of the STSM I put a lot of effort in refactoring the code to come up with a clean, stable yet flexible and maintainable code base that is ready for a production environment. I've been able to implement some new features however none of these reached production state. The main aim of these rapid developments were to give the users a better idea of what is achievable and how it could look like to spark discussions for future plans. I also actively participated in these discussions from a technical point of view.

Results

Move bird migration flow visualization from prototype to production

In order to move from prototype to production, the code base of the flow visualization required some serious refactorings. The main optimizations made were:

- Keep previously released versions of the visualization accessible by using a stable url.
- Restructure code to obtain a clean and maintainable code base.
- Extract configurable parameters, base layer, and radar data from the code, which makes it easy to plug in a different data set.
- Provide basemap data which can be used for any use case

As a result of our efforts, we were able to apply our visualization on a US case study. This was done in collaboration with researchers of the University of Massachusetts and Cornell University who were attending the parallel working group 3 meeting.

Develop new features for the bird migration flow visualization

The following features were developed:

- New colours, allowing better display in presentations.
- Basemap with more precise borders and neighbouring countries.
- Clip the animation around the radars to avoid too much interpolation over marine areas.
- Display a timechart that allows the user to quickly navigate to interesting intervals.
- Show bird density on the map as an animated heatmap.
- Show bird density around radars as pulsating circles.

Except for the first two, these features are not production ready. We chose to develop prototypes of several features to spark further discussion, rather than focusing on one feature and getting that to production level.

Develop a prototype of a new bird migration visualization using forward trajectory model data

Requirements for the data were discussed with and provided by Hans Van Gasteren. We developed three visualizations using the CartoDB software, showing how birds are predicted to migrate through the night. These visualizations and background information were published as a

blog post on June 18 at http://lifewatch.inbo.be/blog/posts/forward-trajectory-visualizations.html. SQL and CSS code have been published as a GitHub gist. The prototype proofs that CartoDB is a valuable platform for these types of visualizations.

Conceptualize a unified visualization for animal migration using weather radars

Requirements for a unified visualization were discussed with the researchers. These requirements are prioritized as short, medium or long-term term and will be written out in a document that can then serve as a roadmap for further visualization development. This document should allow others to work on visualization features as contained projects (e.g. as an STSM), while keeping a unified vision.

Future collaborations/opportunities

Further actions for the flow visualization include:

- Incorporate refactorings, versioning, and new base map and colours in the main online flow visualization to support the planned publication (see next section about outreach / foreseen publications)
- Decide on which prototype features should be implemented in a next version of the flow visualization.

Furthermore, thanks to the parallel working group 3 meeting, some joint initiatives started during our STSM that will continue during the next months.

- Together with the US researchers (Cornell University / University of Massachusetts) we developed a second use case for the flow visualization using US data. This work will be continued as we will add this case study to the flow visualization website.
- Together with the TIMAMP development team, we discussed possibilities to integrate both visualizations in a unified website where users can toggle between visualizations and case studies. We will discuss the requirements for this website in detail later this month.

Outreach / foreseen publications

- A scientific publication will be drafted by Judy Shamoun-Baranes and Andrew Farnsworth in the next weeks. The publication will be sent to an open access, peer reviewed journal.
- A second publication will be drafted for a more general audience. For this, we would develop a unified website that features the TIMAMP and flow visualizations for both case

studies and release the website together with the publication.
- A blogpost was published on the LifeWatch INBO blog about the forward trajectory model visualization. This post was also shared on Twitter and got a lot of feedback

Confirmation letter by host institution

Attached.

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June 29, 2015

ENRAM STSM coordinator
Dr. Silke Bauer

Dear Dr. Bauer,

The Research Group of Computational Geo-Ecology at the University of Amsterdam hosted a Short Term Scientific Mission (STSM) in the context of ENRAM between June 8 and 12, 2015. The goals of this STSM were to develop (1) new features for the bird migration flow visualization developed during the previous STSM (http://enram.github.io/bird-migration-flow-visualization/viz/); (2) a prototype of a web-based visualization of forward trajectory model output for bird migration; (3) a conceptual design of a unified visualization for animal migration using weather radars.

Within five days, Peter Desmet and Bart Aelterman from the LifeWatch team at the Research Institute for Nature and Forest (INBO) reached all milestones that were defined at the very start of the STSM. Furthermore they contributed to the working group 3 meeting that occurred in parallel and provided support for the extension of their visualizations for a US case study, an activity which was very successful and not part of the original planning. The outcome of this STSM has been well documented, in the report and published online on github.

In short, we are truly pleased with the results of this STSM, the functioning of the team that visited us and the process itself . We hope to continue this collaboration throughout the course of ENRAM.

Sincerely,
Judy Shamoun-Baranes
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