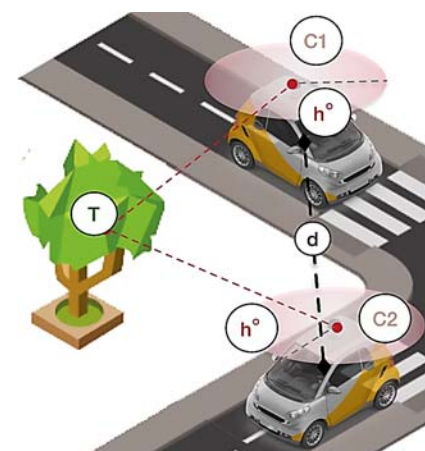
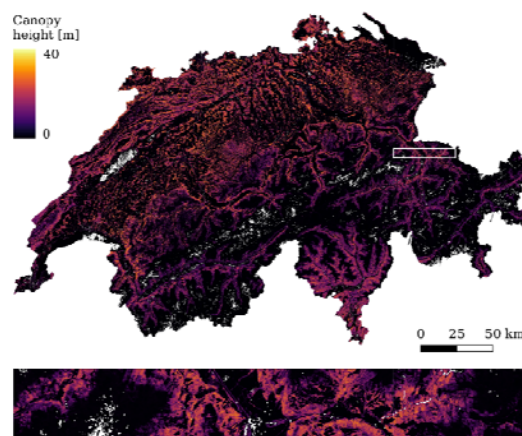


Quo Vadis Photogrammetry?

Jan Dirk Wegner

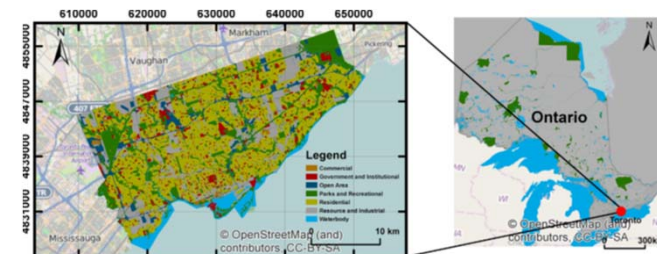
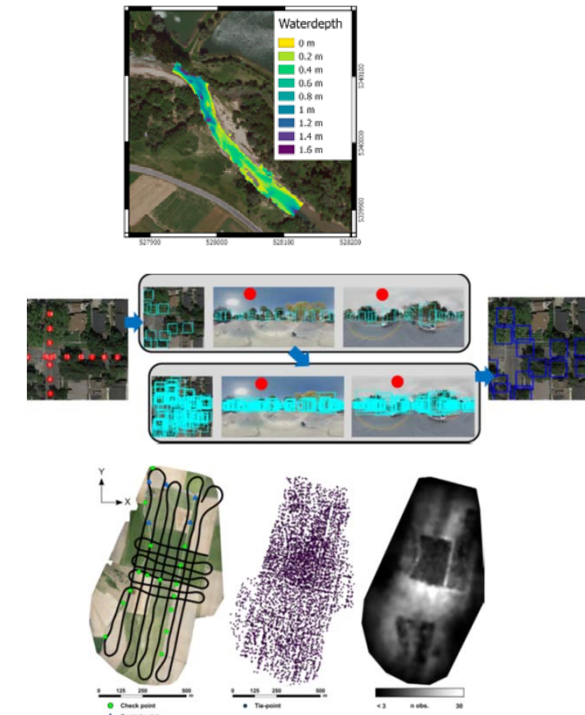
Head of the EcoVision Lab, ETH Zurich



We are good at mapping and measuring accurately

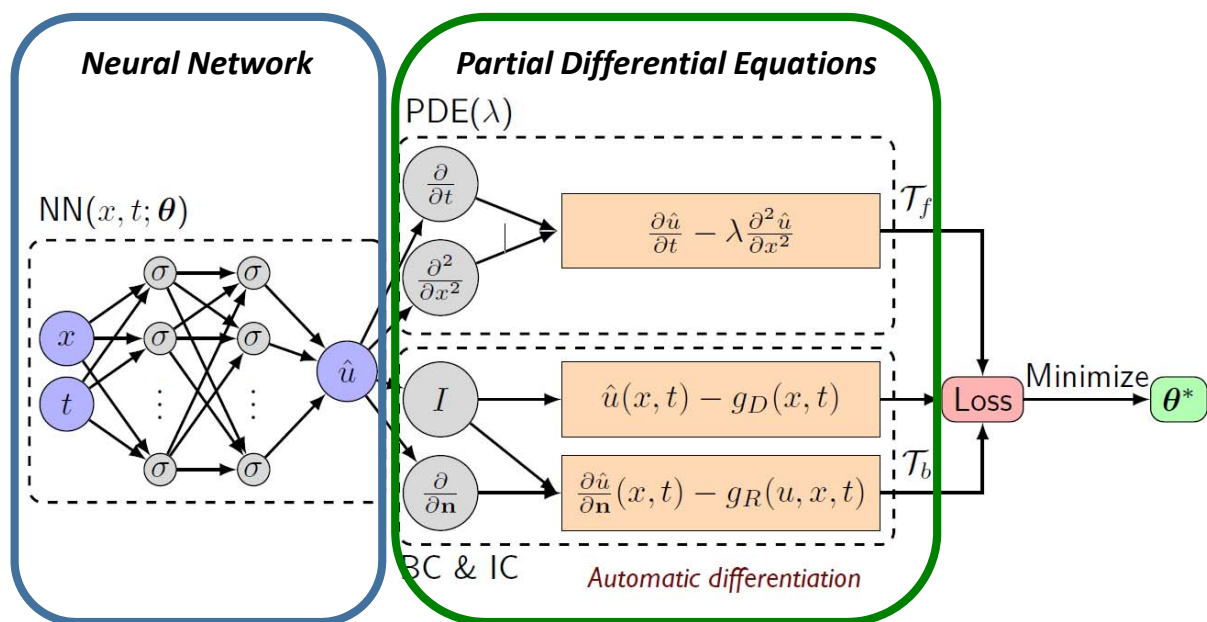
U.V. Helava Award – best paper published in the ISPRS Journal of Photogrammetry and Remote Sensing

- 2019: *Design and evaluation of a full-wave surface and bottom-detection algorithm for LiDAR bathymetry of very shallow waters* (R. Schwarz, G. Mandlbürger, M. Pfennigbauer, N. Pfeiffer)
- 2018: *From Google Maps to a fine-grained catalog of street trees* (S. Branson, J.D. Wegner, D. Hall, N. Lang, K. Schindler, P. Perona)
- 2017: *Bundle adjustment with raw inertial observations in UAV applications* (D.A. Cucci, M. Rehak, J. Skaloud), best paper 2016-2019
- 2016: *Understanding human activity patterns based on space-time-semantics* (W. Huang, S. Li)

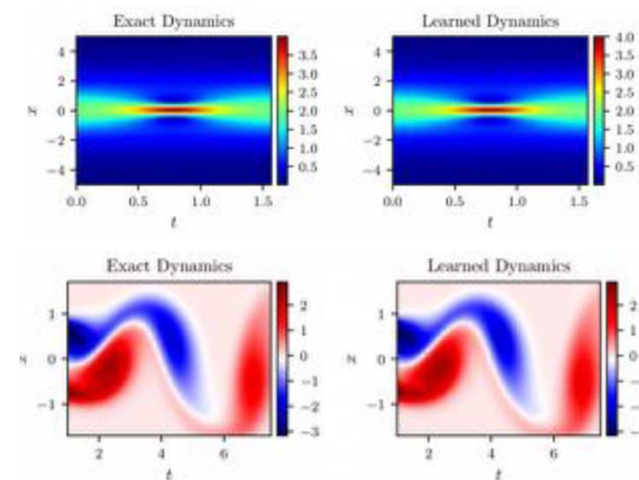


What is the future? ...some thoughts (not exhaustive)

1) Physics-constrained/informed deep learning or more generally: **integration of model-based forward modelling and data-driven approaches**



Example:
Learn Navier Stokes or Schrödinger



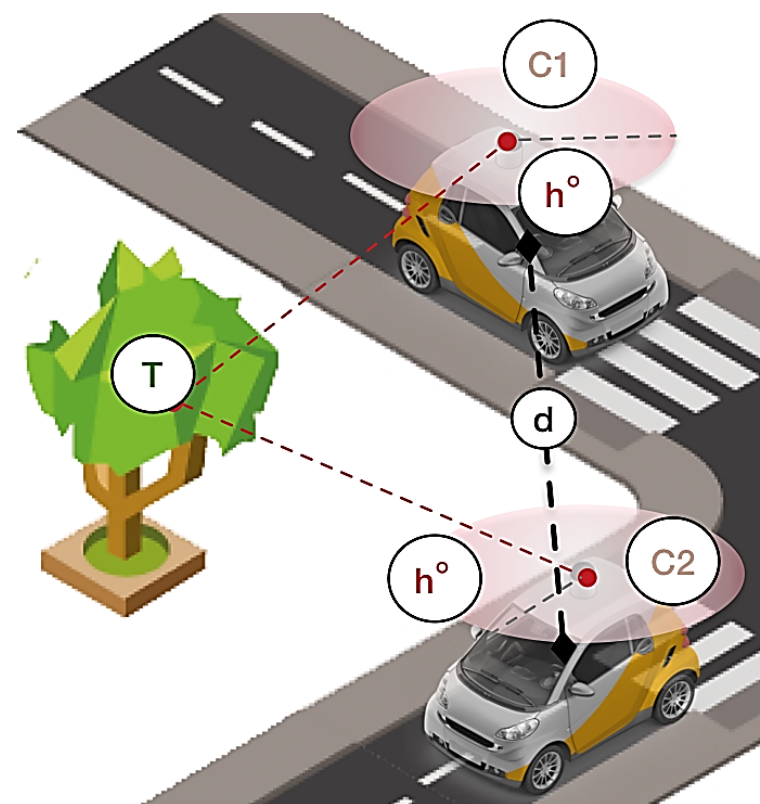
Reichstein, M., Camps-Valls, G., Stevens, B., Jung, M., Denzler, J.: Deep learning and process understanding for data-driven earth system science, *Nature*, vol. 566, 2019, pp. 195–204.
 Raissi, M.: Deep Hidden Physics Models: Deep Learning of Nonlinear Partial Differential Equations, *Journal of Machine Learning Research*, 19, 2018, pp. 1-24.
 Raissi, M., Perdikaris, P., Karniadakis, G.E.: Physics-informed neural networks: A deep learning framework for solving forward and inverse problems involving nonlinear partial differential equations. *Journal of Computational Physics*, 378, 22019, pp. 686-707.
 Stewart, R., Ermon, S.: Label-free supervision of neural networks with physics and domain knowledge, in *Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence*, ser. AAAI'17. AAAI Press, 2017, pp. 2576–2582.

What is the future?

2) Multi-modal, multi-sensor, multi-temporal data interpretation: **combine different data sources, rethink current methods in an unorthodox way**

Example:

Jointly process multi-view geometry and semantics with Graph CNNs



Nassar, A.S., Lefèvre, S., Wegner, J.D.: Simultaneous multi-view instance detection with learned geometric soft-constraints, International Conference on Computer Vision (ICCV), 2019, pp. 6559-6568.

Nassar, A.S., D'Aronco, S., Lefèvre, S., Wegner, J.D.: GeoGraph: Learning graph-based multi-view object detection with detection with geometric cues end-to-end, 2020, arXiv:2003.10151

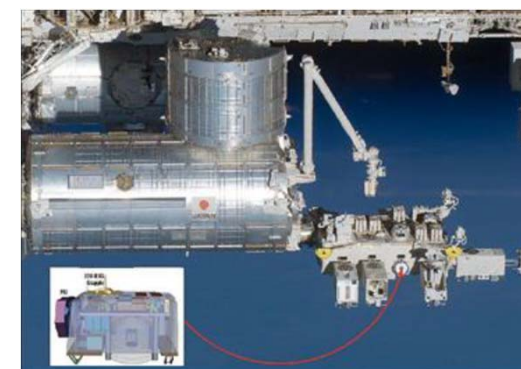
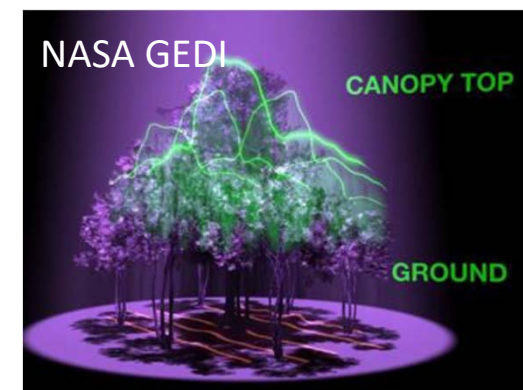
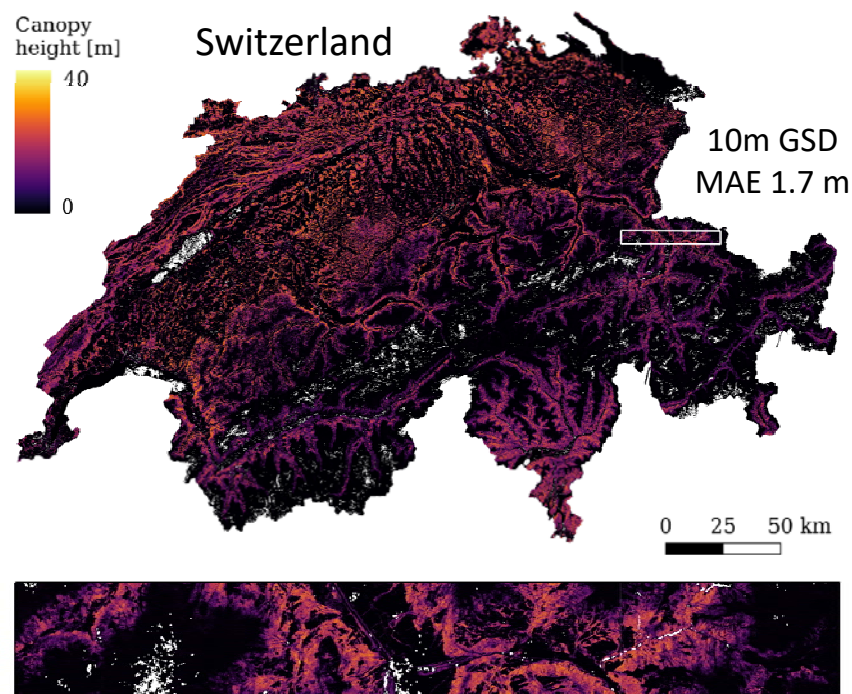
What is the future?

3) Ask a "why" or "how"-question: do not stop after measuring, look for the underlying causal relationships!

Example:

Map vegetation height and biomass globally and connect with biodiversity.

Why is deforestation happening? How does a changing climate impact our planet?



Let us be braver!

- We think across disciplines by education, **let us capitalize more on our strengths**
- How come we never write nature papers? (or at least they do not get accepted...)
- **Tackle problems that are of global societal relevance**



A word on science diplomacy

- [after Clive Fraser]: "what keeps ISPRS together, it is social"
- We are often not only colleagues but friends
- Our events are designed to foster original research (ISPRS Annals) but also **to allow participation and networking for those who cannot compete on that level, yet** (ISPRS Archives) → instead of being an elite club, **we have a participatory philosophy!**
- ISPRS contributes to a **peaceful world by supporting evidence-based decision making informed by science**



So...quo vadis photogrammetry?

✓ *Think across disciplines and **lead** novel efforts that have global environmental and societal impact*



✓ *Give **more responsibilities to younger scientists earlier**, they are the most creative...and our future!*



✓ *Keep investing in sharing scientific progress and expanding our network
→ **more Women, more Africa, more Latin America, more Asia!***



✓ ***Be brave, think big:** how can we improve the state of the world?*

