Inventory of models, tools and input parameters for GIS/RS assisted slope hazard zonation using LiDAR data

supervisor: Harry Seijmonsbergen

Over the last decade or so LiDAR (Laser altimetry) models are available at (sub) meter resolution. This means that Land Surface Parameters (LSPs) can be extracted at high detail. This would suggest that input for (GIS-supported) slope stability models should lead to reliable hazard zonation maps. Goal of this essay is to get an overview of models, tools used in GIS software and the input parameters necessary to come to a reliable output. Scale is therefore an important issue and the parameters necessary at various scales. This literature study may lead to a prototype GIS model which used LiDAR data as a basis for slope hazard zonation in mountain areas at semi-detailed scales.

Literature to get started:

- M. Rossi, F. Guzzetti, P. Reichenbach, A.C. Mondini, S. Peruccacci (2009) Optimal landslide susceptibility zonation based on multiple forecasts. *Geomorphology*, In Press, Corrected Proof, Available online 8 July 2009.
- G. Metternicht, L. Hurni, R. Gogu (2005) Remote sensing of landslides: An analysis of the potential contribution to geo-spatial systems for hazard assessment in mountainous environments. *Remote Sensing of Environment* 98, 284-303.
- N.F. Glenn, D.R. Streutker, D.J. Chadwick, G.D. Thackray, S.J. Dorsch (2006) Analysis of LiDAR-derived topographic information for characterizing and differentiating landslide morphology and activity. *Geomorphology* 73, 131-148.

Review of change detection using multi-temporal LiDAR data

supervisor: Harry Seijmonsbergen

LiDAR data provide detailed surface and terrain information in landscapes. Especially in inaccessible areas – such as in mountains – new possibilities and therefore new techniques for analyzing temporal changes in land cover and landform. Raw data handling, statistical interpolation, smoothing and other pre-analysis is necessary before actual change analysis can be made. In what way does this type of analysis differ from existing techniques of land cover change? What applications have been used already? What software and hardware is necessary to handle the large datasets?

Literature to get started:

- O. Dewitte, J.-C. Jasselette, Y. Cornet, M. Van Den Eeckhaut, A. Collignon, J. Poesen, A. Demoulin (2008) Tracking landslide displacements by multi-temporal DTMs: A combined aerial stereophotogrammetric and LIDAR approach in western Belgium. *Engineering Geology* 99, 11-22.
- M. Baldo, C. Bicocchi, U. Chiocchini, D. Giordan, G. Lollino (2009) LIDAR monitoring of mass wasting processes: The Radicofani landslide, Province of Siena, Central Italy. *Geomorphology* 105, 193-201.
- C. Scheidl, D. Rickenmann, M. Chiari (2008) The use of airborne LiDAR data for the analysis of debris flow events in Switzerland. *Natural Hazards and Earth System Sciences* 8, 1113-1127.

How are activity sensors being used to classify animal behaviour?

supervisor: Judy Shamoun-Baranes

Numerous types of activity sensors can be attached to animals, GPS loggers, heart rate monitors, dive depth recorders, pressure sensors, accelerometers etc. Sensors can be used to monitor movement and specific activities. The aim of this essay is to review what techniques are available to monitor behaviour in free ranging animals and what methods are used to classify different behaviours. The findings of this essay may help us find the right tools to classify different aspects of behaviour during our research.

Literature to get started:

- Miller, P. J. O., Johnson, M. P., Tyack, P. L. and Terray, E. A. (2004). Swimming gaits, passive drag and buoyancy of diving sperm whales Physeter macrocephalus. *J Exp Biol* 207, 1953-1967.
- Ropert-Coudert, Y. and Wilson, R. P. (2005). Trends and perspectives in animal-attached remote sensing. *Frontiers in Ecology and the Environment* 3, 437-444.

Town or city: How do urban ecosystems differ from the rural surroundings?

supervisor: Judy Shamoun-Baranes

Urban ecosystems differ in many respects from rural areas, e.g. through climate, noise levels, presence of predators, extent and fragmentation of suitable habitat. These differences are however not equally important for every species. Some bird species, for instance, dwell succesfully in urban environments, while other (sometimes seemingly quite similar) species are more succesfull in rural areas. There are also examples of changing patterns over time. This study should focus on a limited group of bird species and, with respect to these, provide an overview of the key aspects of the urban environment which makes it suitable for reproduction and/or foraging.

Literature to get started:

- M.L. McKinney (2002) Urbanization, Biodiversity, and Conservation. *Bioscience* 52, 883-890.
- A. Møller (2008) Flight distance of urban birds, predation, and selection for urban life. *Behavioral Ecology and Sociobiology* 63, 63-75.
- C. Rutz (2008) The establishment of an urban bird population. *Joural of Animal Ecology* 77, 1008-1019.

Key ecological questions addressed in the last decade using telemetry (radio, satellite, GPS)

supervisor: Judy Shamoun-Baranes

Via telemetry the movements of individual animals can be recorded in detail. However, it is not trivial to generalize these movement data and link them to applied ecological questions, behavioural or physiological theory. This study should find studies that did succeed in establishing this link and make an overview of important ecological questions and theories that have investigated successfully by using telemetry data. The essential features of the telemetry data for the respective questions (like observation frequency, global reception) could also be addressed in this study.

Literature to get started:

- T. Alerstam (2006) Conflicting Evidence About Long-Distance Animal Navigation. *Science* 313, 791-794.
- P. Berthold, M. Kaatz, U. Querner (2004) Long-term satellite tracking of white stork (Ciconia ciconia) migration: constancy versus variability. *Journal of Ornithology* 145, 356-359.
- M. Mauritzen, A.E. Derocher, O. Wiig, S.E. Belikov, A.N. Boltunov, E. Hansen, G.W. Garner (2002) Using satellite telemetry to define spatial population structure in polar bears in the Norwegian and western Russian Arctic. *Journal of Applied Ecology* 39, 79-90.

An inventory of explanatory variables in species distribution models

supervisor: Emiel van Loon

In macro-ecology the use of so-called Species Distribution Models (SDMs) has become very popular. SDMs are usually static and data driven models that predict the occurrence of a species by a set of explanatory varialbes. A critique which applies to many SDM-studies is that the correlative models don't lead to any new ecological insights. An aspect which is of large importance to the interpretation of SDMs is the prior selection of the environmental variables to be considered as explanatory variables. If just easily available variables (e.g. climate, soil, vegetation from satellite images) are included while there is no ecological reason to do so, chances to learn anything from the result are obviously quite low. This essay investigates whether the application of this so-called lazy variable selection is widespread in the current SDM studies. It also establishes which environmental variables are most frequently included in SDMs. The essay focuses on a consistent species group, like birds, higher plants or butterflies.

Literature to get started:

- M. Austin (2007) Species distribution models and ecological theory: A critical assessment and some possible new approaches. *Ecological Modelling* 200, 1–19. pdf
- M.B. Araujo, A. Guisan (2006) Five (or so) challenges for species distribution modelling. *Journal of Biogeography* 33, 1677–1688. pdf
- A. Guisan, W.Thuiller (2005) Predicting species distribution: offering more than simple habitat models. *Ecology Letters* 8, 993–1009 pdf

Measuring specialisation of birds

supervisor: Emiel van Loon

In behavioural or community ecology, species are often characterized as specialists or generalists on the basis of their food choice or habitats in which they live. The purpose of this essay is to find out how the degree of specialisation is usually measured for bird species.

Literature to get started:

- R. Julliard, J. Clavel, V. Devictor, F. Jiguet, D. Couvet (2006) Spatial segregation of specialists and generalists in bird communities. *Ecology Letters* 9, 1237–1244. pdf
- S.N. Scott, S.M. Clegg, S.P. Blomberg, J.Kikkawa, I.P.F. Owens (2003) Morphological shifts in island-dwelling birds: the roles of generalist foraging and niche expansion. *Evolution* 57, 2147–2156. pdf
- S. Tebbich, B. Fess, D. Blomqvist (2009) Exploration and ecology in Darwin's finches *Journal of Evolutionary Ecology* 23, 591-605. pdf

Water availability at continental scale

supervisor: Willem Bouten

In the past, a lot of hydrological research is carried out at field scale or catchment scale to assess components of the water balance. Measurements are carried out to determine the properties of the system and to validate the model. However, as a result of globalization, often questions are nowadays asked at the scale of continents. Therefore, models are run on the basis of existing data. The essay can focus on different aspects: the complexity of the models used, data availability or data quality, the type of conclusions that can be drawn, model validation or model accuracy at the continental scale. It would also be possible to take a specific continent and specific question and to evaluate the methodologies to answer this question, such as: quantify the spatio-temporal dynamics of fresh water in Africa.

Literature to get started:

- Lehner B, Doll P, Alcamo J, Henrichs T, Kaspar F, 2006, Estimating the impact of global change on flood and drought risks in europe: A continental, integrated analysis, Climate Change 75(3): 273:299
- Milly PCD, Dunne KA, Vecchia AV, 2005, Global pattern of trends in streamflow and water availability in a changing climate, Nature 238(7066): 347-350
- Oki T, Kanae S, 2006, Global hydrological cycles and world water resources. Science 313(5790):1068-1072

Spatio-temporal dynamics of thermal convection

supervisor: Willem Bouten

Large birds such as raptors of storks use thermal convection to stay in the air without flapping their wings. They use the rising airs both for local (hinting) flights and for migration over long distances. To be able to understand the behavior of these birds we first have to better understand the occurrence of thermals and convection in relation to the landscape properties and meteorological conditions. In short, on a sunny day, the sun heats the earth surface and the absorbed energy is either returned as latent or sensible heat flux to the atmosphere. The sensible heat warms up the air thus causing thermals. The essay can focus on measurement techniques to assess thermal convection or on models that are used to describe or predict convection. It can focus on the local scale or at the migration scale, depending on the interest of the student.

Literature to get started:

- Nathan R, Sapir N, Trakhtenbrot A, Katul GG, Bohrer G, Otte M, Avissar R, Soons MB, Horn HS, Wikelski M, Levin SA, 2005, Long-distance biological transport processes through the air: can nature's complexity be unfolded in silico?, Diversity & Distributions 11(2): 131-137.
- Lin CL, Glendening JW, 2002, Large eddy simulation of an inhomogeneous atmospheric boundary layer under neutral conditions, J. Atm. Sci. 59(16): 2479-2497 http://www.drjack.info/RASP/index.html
- Siqueira M, Katul G, Porporato A, 2009, Soil Moisture Feedbacks on Convection Triggers: The Role of Soil-Plant Hydrodynamics, J Hydrometeorology 10(1):96-112
- Shamoun-Baranes, J., Leshem, Y., Yom-Tov, Y. and O. Liechti. 2003. Differential use of thermal convection by soaring birds over central Israel. Condor 105:208-218. pdf

Environmental conditions that apparently impede soaring bird migration

supervisor: Willem Bouten

In 2008 and 2009 we have studied the migration of Honey Buzzards. These birds breed in the Netherlands and migrate to their wintering grounds in tropical rainforest in Africa. During migration they are dependent on atmospheric convection (thermal activity). While crossing the Sahara birds always seem to fly along the shortest route to their destiny. They only show a slight drift, probably due to side winds. Only rarely a very distinct change of behavior has been registered. A bird can suddenly turn 180 degrees and go back while passing the Sahara. This behavior is not understood. We hypothesize that this may have to do with sand or dust storms, but we still don't know.
This literature review identifies the possibilities to assess the occurrence of sand or dust storms. The review can focus on the use of remote sensing, and the availability of images but it could also focus on models that have been developed to predict sandstorms at the scale of our interest.

Literature to get started:

- Washington R, Todd M, Middleton NJ, Goudie AS, 2003, Dust-storm source areas determined by the total ozone monitoring spectrometer and surface observations, ANNALS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS Vol 93(2): 297-313
- Shao Y, Dong CH, 2006, A review on East Asian dust storm climate, modelling and monitoring. GLOBAL AND PLANETARY CHANGE, Vol 52(1-4): 1-22
- Miller SD, Kuciauskas AP, Liu M, Ji Q, Reid JS, Breed DW, Walker AL, Al Mandoos A, 2008, Haboob dust storms of the southern Arabian Peninsula. JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES, Vol.113(D1) D01202

Evaluation of model differences by intercomparison studies

supervisor: Willem Bouten

The Project for Intercomparison of Land-surface Parameterization Schemes (PILPS) is a project designed to improve the parameterization of the continental surface, especially the hydrological, energy, momentum, and carbon exchanges with the atmosphere. It concerns the intercomparison and validation of different models. After 15 years of research it is worth it to evaluate what we have learned from such an extensive programme on which unmerous scientists have worked together. The essay can focus of the differences between the models, on the type and value of measurements that are used to assess the quality of the models or on the methodology of model comparison, possibly in relation to other model comparison activities.

Literature to get started:

- Henderson-Sellers A, Yang ZL, Dickinson RE, 1993, The Project for Intercomparison of Land-Surface Parametrization Schemes. Bulletin of the American Meteorological Society 74(7):1335-1349
- Pitman AJ, Henderson-Sellers A, Desborough CE, Yang ZL, Abramopoulos F, Boone A, Dickinson RE, Gedney N, Koster R, Kowalczyk E, Lettenmaier D, Liang X, Mahfouf JF, Noilhan J, Polcher J, Qu W, Robock A, Rosenzweig C, Schlosser CA, Shmakin AB, Smith J, Suarez M, Verseghy D, Wetzel P, Wood E, Xue Y, 1999, Key results and implications from phase 1(c) of the Project for Intercomparison of Land-Surface Parametrization Schemes, Climate Dynamics 15(9):673-384