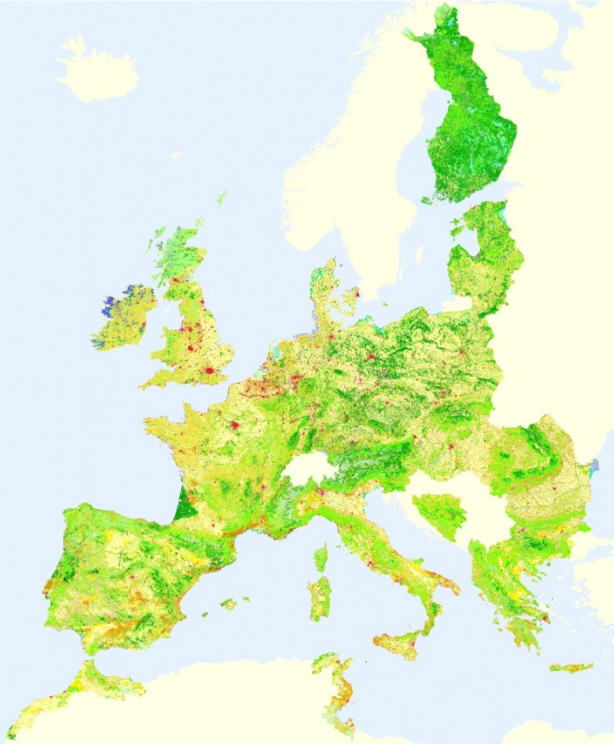
A series of lectures (outlines are given on next 2 pages) will be delivered during the research training week

by Alexander Mahura on:
“Treatment of Land-Cover/ Use and Urbanization in Modelling”

and

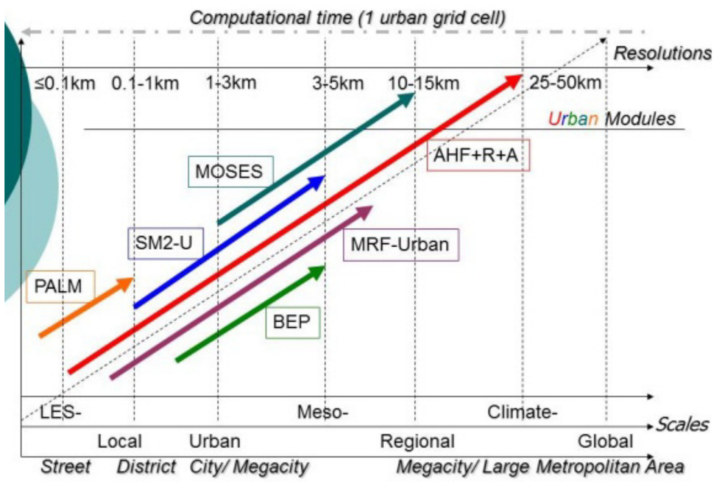
by Anders Persson on:
“From Counter-Intuitive Dynamics and Statistics to "Self-Learning Equations"

Treatment of Land-Cover/Use and Urbanization in Modelling

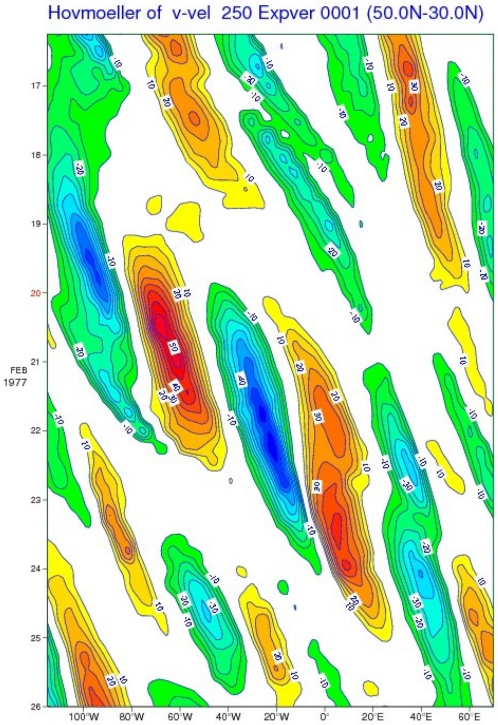


Outline:

- **Land-cover and land-use**: classification; importance for meteorological modelling and land surface schemes; datasets (CORINE - Coordination of Information on the Environment (Fig. left), ECOCLIMAP, USGS, PELCOM, etc.).
- **Urban lands**: urban lands – some available statistics on development, uptake by origin, by countries, by metropolitan areas.
- **Urbanized areas**: urban boundary layer (UBL); specific features for urban areas; controls on urban climate effects (including Urban Heat Island); approaches for treatment of UBL features; methodologies for urbanization of meteorological models (Increased grid resolution and nesting of models; Urban land-use classification & algorithms for roughness parameters; Urban fluxes and sublayer parameterization; Approach based on improved urban roughness and fluxes; Effect of urban canopy roughness; Effective roughness over inhomogeneous terrain; Surface energy budget in urban areas).
- **Urbanization of models**: urban modules; land surface scheme, tiles and urban areas, modelling domains, and focus; estimation of anthropogenic heat fluxes in urban areas; Building Effect Parameterization (BEP); urban districts classification (extraction of districts related characteristics (statistics); Soil Model for Sub-Meso scales Urbanized version (SM2-U): thermal and water budgets; revised land-use classification.
- **Urban modules results:** as impact of urban areas on simulated meteorological fields through changes in air and surface temperatures, wind characteristics, storage and sensible heat fluxes for different types of urban surfaces (artificial, buildings/roofs, vegetation over artificial surfaces) and urban districts (city center, industrial commercial, high buildings, and residential) on a diurnal cycle and month-to-month variability - for selected case studies and long-term verification.
- **Applicability of results**: Testing and verification of numerical weather prediction and climatological models performance over high resolution model domains, and especially, over the urbanized areas; Investigation of temporal and spatial variability of various meteorological and derived variables over urbanized areas; Improvements in land use classification and climate generation properties; Distinguishing and selection of types of urban districts and their properties; Urbanization of climate regional and global models.
- **Hierarchy of urban parameterizations** - Simple modification of land surface schemes (AHF+R+A); Medium-Range Forecast Urban Scheme (MRF-Urban); Building Effect Parameterization (BEP); Soil Model for Sub-Meso scales Urbanised version (SM2-U); UM Surface Exchange Scheme (MOSES); Urbanized Large-Eddy Simulation Model (PALM) (Fig. right) & examples from research projects.



From Counter-Intuitive Dynamics and Statistics to "Self-Learning Equations"



Outline:

- **Monitoring of NWP:** Every automatic system needs a constant supervision. At ECMWF it consists of three parts, a) daily monitoring of the current forecast and forecasts verifying on the current day, missing observations, unusual large forecasts jumps or bad forecasts; b) Monthly, quarterly and annual statistics of forecast performance and observation quality; c) presentations for the scientific staff every three months with a focus of the last months.
- **Statistical verification and validation** are not the same. The former relates to the accuracy or skill (not the same thing either!), the latter to the realism of the model. The interpretation of this statistics is not trivial, improved models may display increase of errors.
- **Bayesian statistics** has its name after a 18th century English vicar, but should rather be associated with Siméon de Laplace who studied it extensively around 1800. The mathematics is straight-forward, what has caused controversy over 200 years with the dominating *frequentist school*, is the interpretations of the subjective elements in "Bayesianism". But since they address questions which are common and important in weather forecasting, both numerical and subjective, it is worthwhile for the meteorological community to have a fair grasp of its philosophy.
- **Misinterpretations in dynamical meteorology** are common because of the non-intuitive behaviour of rotating gases (and fluids). Examples will be given involving explanations of Trade winds, Rossby waves, the Subtropical Jet (angular momentum conservation), simple geostrophic adjustment, winds passing over mountains, the slowing down of jet stream winds and the interpretation of "metric terms".
- **The Coriolis effect** was fairly well understood in the mid 1800s by the American William Ferrel, the German Adolph Sprung and the French Charles Delaunay. But in the 1890 all kinds of misleading geometrical explanations replaced the prevailing physical. 100 years of confusions began to be rectified only in 1993 with an article by Prof. Dale Durran at University of Washington, Seattle, US.
- **Group velocity and "downstream development"** deals with the interaction of one atmospheric (baroclinic) circulation system with another, often downstream (see upper left figure). This process is not only important when designing limited area models, but also when trying to trace the "cause" behind a poor or "jumpy" forecast. Although the quasi-geostrophic formalism to understand atmospheric motions has served the community well it is not, due to its kinematic nature, designed to include this interaction. For this purpose "group velocity thinking" is superior to "PV-thinking". A distinction must also be made between the common mathematical description of group velocity (superimposed sine waves) with the physical mechanism which is different for different media (solids, liquid and gases).
- **"Self-leaning equations" to modify NWP output** is an alternative to the dominating frequentist approach, which aims at establishing statistical relations between forecasts and reality (often through linear regression) using historical data. This Bayesian approach, using a simple Kalman filter, borrowed from Control Theory, applies an adaptive, day-by-day routine, very similar to human intelligence. The Kalman filter, which is in a "Joseph form", is slightly different to the ones used in data-assimilation.