The Annals of Applied Statistics
2012, Vol. 6, No. 4, 1349–1351
DOI: 10.1214/12-AOAS606

SECTION ON THE SPECIAL YEAR FOR MATHEMATICS OF PLANET EARTH (MPE 2013)

BY TILMANN GNEITING

Universität Heidelberg

Dozens of research centers, foundations, international organizations and scientific societies, including the Institute of Mathematical Statistics, have joined forces to celebrate 2013 as a special year for the Mathematics of Planet Earth. In its five-year history, the *Annals of Applied Statistics* has been publishing cutting edge research in this area, including geophysical, biological and socio-economic aspects of planet Earth, with the special section on statistics in the atmospheric sciences edited by Fuentes, Guttorp and Stein (2008) and the discussion paper by McShane and Wyner (2011) on paleoclimate reconstructions [Stein (2011)] having been highlights.

As a prelude to the special year for the Mathematics of Planet Earth, and welcoming the concurrent International Year of Statistics, the December 2012 issue of the *Annals of Applied Statistics* features a special section dedicated to statistical aspects of the study of planet Earth. The section is comprised of ten papers that span the four themes of the special year, *A Planet to Discover*, *A Planet Supporting Life*, *A Planet Organized by Humans* and *A Planet at Risk*.

Three of the papers in this section relate to the history of planet Earth. Reitan, Schweder and Hendriks (2012) look into the deep past, studying time series of cell size evolution in marine algae, Erästö et al. (2012) merge distinct paleoclimate reconstructions, and Baggaley et al. (2012) consider population dynamics in the late Stone Age. Reich and Shaby (2012), Sigrist, Künsch and Stahel (2012), Cooley, Davis and Naveau (2012) and Jona-Lasinio, Gelfand and Jona-Lasinio (2012) study the atmosphere and the oceans of our planet, looking at output from regional climate models, short term predictions of precipitation, air pollutants and wave direction data, respectively. Biological aspects of planet Earth are addressed by Illian, Sørbye and Rue (2012) who consider rainforest ecosystems and the foraging behavior of a particularly popular inhabitant of our planet, the koala. Finally, Chiou (2012) and Lahiri et al. (2012) set out to solve problems of prediction and estimation, respectively, that arise in transportation engineering.

The challenges posed by a planet at risk have been a major driver in the development of statistical theory and methodology, and the papers in this special section document the use of state of the art techniques in addressing critical real world

Received September 2012.
Key words and phrases. Mathematics of Planet Earth 2013.

problems. Not surprisingly, time series analysis, spatial and spatio-temporal statistics play prominent roles in the special section papers, including the use of point processes, Gaussian random fields, max-stable processes and stochastic differential equations, with functional data methods frequently addressing similar tasks. One current challenge is to develop parsimonious, physically realistic models for multivariate global data that can handle complex nonstationarities in space and time [Jun and Stein (2008), Bolin and Lindgren (2011)]. Reich and Shaby (2012) and Cooley, Davis and Naveau (2012) develop the fast-paced field of extreme value statistics, including its fruitful and important links to spatial statistics, which have recently been reviewed by Davison, Padoan and Ribatet (2012). Another major methodological challenge lies in the marriage of analytic, numerical and statistical techniques in inference or forecasting problems, as discussed or touched upon by Baggaley et al. (2012), Reich and Shaby (2012), Jona-Lasinio, Gelfand and Jona-Lasinio (2012) and Sigrist, Künsch and Stahel (2012).

State of the art applied statistical work is inevitably computational. Developments of note in this context include the advent of the integrated nested Laplace approximation [INLA; Rue, Martino and Chopin (2009)] technique in Bayesian computing, which Illian, Sørbye and Rue (2012) make available for fitting complex spatial point processes, and the ubiquity of massive data sets, which require the adaptation of classical techniques, as explored by Lahiri et al. (2012) in the case of bootstrap resampling.

Undoubtedly, mathematical and statistical techniques play key roles in the multidisciplinary scholarly efforts that address the challenges faced by planet Earth. At the *Annals of Applied Statistics*, it is our continued goal to publish cutting edge research that can help resolve these critical issues. Simultaneously, our sister journal *Statistical Science* is preparing a special issue with invited reviews of probabilistic and statistical facets of the scientific study of our planet.

REFERENCES

BAGGALEY, A. W., BOYS, R. J., GOLIGHTLY, A., SARSON, G. R. and SHUKUROV, A. (2012). Inference for population dynamics in the Neolithic period. *Ann. Appl. Stat.* **6** 1352–1376.

BOLIN, D. and LINDGREN, F. (2011). Spatial models generated by nested stochastic partial differential equations, with an application to global ozone mapping. *Ann. Appl. Stat.* **5** 523–550. MR2810408

CHIOU, J. M. (2012). Dynamical functional prediction and classification, with application to traffic flow prediction. *Ann. Appl. Stat.* **6** 1588–1614.

COOLEY, D., DAVIS, R. A. and NAVEAU, P. (2012). Approximating the conditional density given large observed values via a multivariate extremes framework, with application to environmental data. *Ann. Appl. Stat.* **6** 1406–1429.

DAVISON, A. C., PADOAN, S. A. and RIBATET, M. (2012). Statistical modeling of spatial extremes. *Statist. Sci.* **27** 161–186.

ERÄSTÖ, P., HOLMSTRÖM, L., KORHOLA, A. and WECKSTRÖM, J. (2012). Finding a consensus on credible features among several paleoclimate reconstructions. *Ann. Appl. Stat.* **6** 1377–1405.

FUENTES, M., GUTTORP, P. and STEIN, M. L. (2008). Special section on statistics in the atmospheric sciences. *Ann. Appl. Stat.* **2** 1143–1147. MR2655652

ILLIAN, J. B., SØRBYE, S. H. and RUE, H. (2012). A toolbox for fitting complex spatial point process models using integrated nested Laplace approximation (INLA). *Ann. Appl. Stat.* **6** 1499–1530.

JONA-LASINIO, G., GELFAND, A. E. and JONA-LASINIO, M. (2012). Spatial analysis of wave direction data using wrapped Gaussian processes. *Ann. Appl. Stat.* **6** 1478–1498.

JUN, M. and STEIN, M. L. (2008). Nonstationary covariance models for global data. *Ann. Appl. Stat.* **2** 1271–1289. MR2655659

LAHIRI, S. N., SPIEGELMAN, C., APPIAH, J. and RILETT, H. (2012). Gap bootstrap methods for massive data sets with an application to the OD matrix estimation problem in transportation engineering. *Ann. Appl. Stat.* **6** 1552–1587.

MCSHANE, B. B. and WYNER, A. J. (2011). A statistical analysis of multiple temperature proxies: Are reconstructions of surface temperatures over the last 1000 years reliable? *Ann. Appl. Stat.* **5** 5–44.

REICH, B. J. and SHABY, B. A. (2012). A hierarchical max-stable spatial model for extreme precipitation. *Ann. Appl. Stat.* **6** 1430–1451.

REITAN, T., SCHWEDER, T. and HENDERIKS, J. (2012). Phenotypic evolution studied by layered stochastic differential equations. *Ann. Appl. Stat.* **6** 1531–1551.

RUE, H., MARTINO, S. and CHOPIN, N. (2009). Approximate Bayesian inference for latent Gaussian models by using integrated nested Laplace approximations. *J. R. Stat. Soc. Ser. B Stat. Methodol.* **71** 319–392. MR2649602

SIGRIST, F., KÜNSCH, H. R. and STAHEL, W. A. (2012). A dynamic non-stationary spatio-temporal model for short term prediction of precipitation. *Ann. Appl. Stat.* **6** 1452–1477.

STEIN, M. L. (2011). Editorial. *Ann. Appl. Stat.* **5** 1–4. MR2810376

INSTITUT FÜR ANGEWANDTE MATHEMATIK
UNIVERSITÄT HEIDELBERG
IM NEUENHEIMER FELD 294
69120 HEIDELBERG
GERMANY
E-MAIL: t.gneiting@uni-heidelberg.de
URL: http://www.foo.com