choice. The generic multifractal process is a multiplicative cascade. From the point of view of multifractals, there is an enormous difference between low but finite rain rates and exactly zero rates. This leads to a fundamental modeling question: is a single rain process adequate to model rain (perhaps with a very low rate cut-off to zero) or does one require separate processes for determining where and when it rains and another for the rates in the raining regions? In more mathematical terms, is the support of the rain process a fractal subset of space-time? On the other hand, the low and zero rain rates are particularly difficult to measure; for example, a tipping-bucket type rain gauge does not have a fixed temporal resolution, but rather a fixed depth resolution so that at the low rain rate limit, the temporal resolution becomes infinite. We show that this problem leads to spurious breaks in the scaling at scales which can be of the order of an hour even though the depth resolution can be very small (0.1 mm). In order to overcome these problems an alternative is explored, which analyses the rain as a function of total rain-depth rather than time. This method is particularly suitable for tipping-bucket rain data, because it uses the raw data rather than reconstructed time-series. By comparing results from two climatological regions we show that whereas the statistics from reconstructed series are very different, those with the new depth based series are almost identical (since they are insensitive to the low/zero rain rate problem). In addition, it eliminates the scale breaks so that rain is clearly seen to be scaling from the smallest resolvable scales to the synoptic maximum (roughly 2 weeks).

NG41E MCC: 3010 Thursday 1120h

Funding Agency Perspectives on Nonlinear Approaches in Data Analysis and Simulations: Public Forum

Presiding: **D L Turcotte,** University of California, Davis**; C C Barton,** U.S. Geological Survey

NG41E-01 1125h

Funding Agency Perspectives on Nonlinear Approaches in Data Analysis and Simulations: Public Forum

Stephen Meacham[1] (smeacham@nsf.gov)

John LaBrecque[2] (jlabrecq@hq.nasa.gov)

Michael Shlesinger[3] (shlesinger@onr.gov)

[1]National Science Foundation, Geosciences, Falmouth, MA 00000, United States

[2]NASA, Solid Earth and Natural Hazards Program, Greenbelt, MD 11111, United States

[3]Office of Naval Research, Physical Science Division, Washington, DC 20007, United States

This session will be a panel discussion.

NG51A MCC: Level 2 Friday 0830h

Scaling in Our Fluid Earth: Chaos and Multifractals in the Atmosphere, Oceans, Hydrology, and Climate III Posters *(joint with A, B, GP, H, OS, PP, SA, AE, C, GC)*

Presiding: **S Lovejoy,** McGill University**; D Schertzer,** Laboratoire de Modélisation en Mécanique, Université Pierre et Marie Curie

NG51A-0822 0830h POSTER

Study of the Space-Time Variability of the Precipitations in the semi Arid Tropics Areas like African Sahel

Philippe Ladoy

ACMAD, BP 13184, Niamey Niger, Niger

One of the difficulty of decision making in the matter of climate in semi arid tropics areas like African Sahel, is to manage the high time space variability of the atmospheric fields. For example, the high time space variability of the rain fields (intermittency) is explained by the multiplicity of time space scales which involves. A multifractal approach of the field is assumed. Some aspects of the study are related to : o Down scaling adaptations of the outputs of global climate models to regional and local scales; o Prediction of extremes events : floods, droughts or "dry spells"... Studies are developed by the African Centre for Meteorological Application for Development (ACMAD) This Centre, located in Niamey, Niger, acts as an African institution for weather and climate. Its long term goals are to : - reduce the dryness effects or any other catastrophe related to the climatic conditions such as the tropical cyclone, the floods and the storms; - to develop methodologies and techniques for weather and climate application at the national and sub-regional level; The basic activities to realize this objectives are: - the collection and analysis of hydrometeorological data; - the dissemination of climatic information for the early alarm in the fields related to the agriculture or the management of resources in water and energy; - the dissemination in due time of useful information on the weather and climate; - the connected of the variability and of the climatic change, and such as their impact upon the economy, - the development of strategies of appropriate responses to the impact of the desertification, floods, tropical cyclones,

URL: http://www.acmad.ne

NG51A-0823 0830h POSTER

Multifractal Large particle limit in rain: implications for radar rain measurements

Nicolas Desaulniers-Sou[1] (514-398-6480; Desaulniers-Soucy.N@ems-t.ca)

Marc Lilley[1] (514-398-6480; lilleym@physics.mcgill.ca)

Shaun Lovejoy[1] (514-398-6537; lovejoy@physics.mcgill.ca)

Daniel Schertzer[2] (33.1.64.15.36.33; Daniel.Schertzer@cereve.enpc.fr)

[1]Physics, McGill University, 3600 University st., Montreal, Que H3A 2T8, Canada

[2]CEREVE Ecole Nationale des Ponts et Chaussées, 6-8, avenue Blaise Pascal,Cité Descartes, MARNE-LA-VALLEE 77455, France

Raindrop size and position data - from eighteen scenes of a = 8 m**3 region each containing 5,000 to 15,000 rain drops - obtained for 5 different storms in the HYDROP (HYdrometeor Detection and Ranging using stereO-Photography) experiment - was systematically statistically analyzed in spheres ranging from 10 cm to 2m in diameter. In four of the five storms, we found convincing evidence for the convergence to a multifractal scaling large N limit; the observed scaling exponents were quite close to those reported in the rain literature at much larger scales. By randomizing the positions of the drops, we could compare directly the true fluctuation statistics with those of the classical theory; the latter were significantly smaller. By carefully considering the meteorological conditions, in particular the turbulence intensity and the drop size distributions, we could explain the observed variations in the inner scale. In the multifractal large N limit, the drop size distribution is of secondary importance, it is the drop number, liquid water content, and other densities which tend to universal multifractal scaling limits. These results are related to the often invoked log-normal behavior of rain, but with important differences. We also show that if the densities are multifractal with the same universal multifractal index a, that we recover power law relations between their statistics, for example mean(R)=a*Mean(Z)**b (c.f. the usual deterministic relations R=a*Z**b where R, Z are random variables).

NG51A-0824 0830h POSTER

Multifractal downscaling of a GCM rainfield

Angelbert Biaou[1] (33 (0) 1 44 27 23 73; Angelbert.Biaou@ensmp.fr)

Pierre Hubert[1] (33 (0) 1 44 27 23 73; Angelbert.Biaou@ensmp.fr)

Daniel Schertzer[2,3] (Daniel.Schertzer@cereve.enpc.fr)

Frédéric Hendrickx[4] (Frederic.Hendrickx@edf.fr)

Iouia Tchiguirinskaia[5] (Tchiguir@ccr.jussieu.fr)

[1]Ecole des Mines de Paris, 35 rue Saint Honoré, Fontainebleau 77305, France

[2]CEREVE Ecole Nationale des Ponts et Chaussées, 6-8, avenue Blaise Pascal Cité Descartes, Marne-la-vallée 77455Cedex, France

[3]Météo-France, 1 Quai Branly, Paris 75007, France

[4]EDF Division Recherche et Developpement, 6 Quai Watier, Chatou 78041Cedex, France

[5]UMR Sysiphe,Laboratoire de Géologie Appliquée Université Pierre et Marie Curie, 4 place Jussieu, Paris 75252Cedex, France

In order to get a more efficient production management of reservoirs, it would be helpful to apply long-term meteorological forecasts to hydrological models. Unfortunately, the explicit scales of present GCM's are quite larger (e.g. 243kmx243kmx32 days) than those of hydrological models (e.g. 1 kmx1kmx1day). Therefore it is indispensable to proceed to a downscaling of the output of the former in order to obtain an input for the latter. In this paper, we present a multifractal downscaling procedure. The site of the study is the area of Doubs river, with the help of a dense local hydrological network, but in order to get a larger spatial scale ratio we extend our multifractal analysis to France, with the help of Météo-France PRECIP data base. We first argue that it is indispensable to consider a multifractal downscaling procedure in order to respect the scaling properties of the hydro-meteorological fields. We performed time, scale and time-space multifractal analysis of the available data and evaluate the corresponding universal exponents, as well as the anisotropy/dynamical exponent of the time-space generalized scale. We show that these exponents are quite robust. We compare our analysis to similar works, but restricted to the use of Log-Poison cascade and space-time isotropy. We show both theoretically and empirically that these restrictions are untenable, in particular with respect to the extremes. We also show simulations should be done with the help of continuous (in scale) and causal cascade models, not with ad-hoc time-space cascades, and present the corresponding numerical simulations. of space-time downscaling of (meso-scale) GCM data down to (micro-scale) hydrological scales. We greatly acknowledge the financial support from Electricité de France, as well as Météo-France for providing access to its PRECIP data base.

URL: http://www.multifractal.jussieu.fr

NG51A-0825 0830h INVITED POSTER

Potential of Multifractals for Water Resources Planners

Ioulia Tchiguirinskaia[1] (tchiguir@ccr.jussieu.fr)

Daniel Schertzer[2,3] (Daniel.Schertzer@cereve.enpc.fr)

Pierre Hubert[4] (hubert@cig.ensmp.fr)

Hocine Bendjoudi[1] (Hocine.Bendjoudi@ccr.jussieu.fr)

Shaun Lovejoy[5] (lovejoy@physics.mcgill.ca)

[1]UMR Sysiphe,Laboratoire de Géologie Appliquée Université Pierre et Marie Curie, 5 Pl. Jussieu, Paris 75005, France

[2]CEREVE Ecole Nationale des Ponts et Chaussées , 6-8, avenue Blaise Pascal Cité Descartes, Marne-la-vallée 77455Cedex, France

[3]Meteo-France, 1 Quai Branly, Paris 75007, France

[4]Ecole des Mines de Paris, 35 rue Saint Honore, Fontainebleau 77305, France

[5]Physics dept. McGill University, 3600 University st., Montreal Que H3A 2T8, Canada

The natural variability of water resources and the augmenting demand for water leads mankind to strongly interfere with the hydrologic cycle in attempts too ensure that water will be available in adequate quantity and quality, with a proper distribution in space and time. So, engineers will be often concerned with ambitious plans of flood control. Runoff predictions, such as the estimates of peak flows that are associated with a particular exceedence probability, form the basis for the design of most civil engineering works. Since river runoff phenomena reflect many complex interactions at different scales between diverse basin factors as well as meteorological and climatic fluctuations, that strongly modify the precipitation input, the prediction of a maximum expected water flow remain a rather unsolved issue. Indeed, as hydrologists often observed it, the probabilistic distribution of runoff is skew; however its mathematical form is far from being known, in particular its tails. As a consequence, the insufficient spillway capacity remains worldwide the second commonest cause of dam failure (after the foundation failure). Present communication demonstrates how the multifractal framework overcomes some present difficulties in the flood predictions within space and time domains. Moreover, our multifractal results reflect crucial changes in river regimes after dam construction, that may have drastic consequences for the spillway capacity. To consolidate our results, we use few millions of flow measurements at very different hydrological locations all over the World. The time-scale of the data ranges from a day to several centuries.

URL: http://www.multifractal.jussieu.fr