hoped that its presence might be used to describe snowcovers at large scales. Accordingly, linear transects of snow depth were analyzed using the method of trace moments. In simple landscapes (no trends in data, a single landform and vegetation type), the fractal portion of the SWE variation appears to be monofractal. Transects across a large valley also show no signs of multifractality, although they do display evidence of deterministic variation at large scales. Some evidence of multifractality at small scales appears to exist for transects where the SWE increases or decreases monotonically or where a single large drift is present on otherwise open ground. It appears that the observed multifractality is due to combining data from distributions that would normally be considered as being separate. Because the maximum scale of multifractality is limited by the fractal cutoff, which is very small (typically less than 100m), snowcovers in complex landscapes can be represented as being composed of adjacent monofractal distributions of SWE.

NG22A-04 1115h INVITED

Scale-Dependent Hydraulic Conductivity in Anisotropic Media: A Dimensional Effect

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As in the case of dispersion in flow through porous media, it is often assumed that the hydraulic conductivity, K, naturally increases with scale of an experiment. The effective value of K has, in general, no relationship with a geometric mean value of K; only the remarkable coincidence that the two-dimensional percolation threshold is 50% could support such a generalization. But since percolation thresholds in 3D are typically much less than 50%, it is possible to find infinite interconnected paths of high conductivity, which only sample the fastest 5-10% of the medium, depending on the system. In small realizations, it is possible to find interconnected paths, which are even more highly conductive, leading to positive corrections on K, which, however, diminish asymptotically with approach to infinite size. Because the effective K can thus be much larger than the geometric mean value of K, introducing additional heterogeneity with increasing scale can easily lead to suites of measured K values with means that increase dramatically with scale. Interpretation of this as a "scale effect" reveals inaccurate theory. More importantly, however, real increases in K with scale can be predicted for anisotropic media, or for strongly non-equidimensional volumes. However, the cause of such increases, as predicted in percolation theory, is traced to a cross-over in the dimensionality of conduction; from 1D at small scales, to 3D at large scales. Results from percolation theory compare favorably with experimental results from Wisconsin carbonate aquifers. Thus it is suggested that apparent increases in K as a function only of scale result also from inability to isolate the scale variable.

NG22A-05 1130h

Nonlinearity of Climate Change in the Past 420,000 Years

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Evidence of past climate variations are stored in polar ice caps and indicate glacial-interglacial cycles of ∼100kyr. Using advanced scaling techniques we study the long-range correlation properties of temperature proxy records of four ice cores from Antarctica and Greenland. These series are long-range correlated in the time scales of 1-100kyr. We show that these time series are nonlinear for time scales of 1-100kyr as expressed by temporal long-range correlations of magnitudes of temperature increments. Our results suggest that temperature increments appear in clusters of big and small increments—a big (positive or negative) climate change is most likely followed by a big (positive or negative) climate change and a small climate change is most likely followed by a small climate change. We then suggest two nonlinear stochastic models for glacial-interglacial dynamics that exhibit similar nonlinear properties as in the data. We conjecture that interaction between fast random fluctuations (representing atmospheric variability) and slowly varying fluctuations (representing oceanic variability) may underlie the observed nonlinearity of time series for glacial-interglacial oscillations.

NG22A-06 1145h

Numerical Tests of Asymptotic Single Scattering Statistics in Universal Multifractal Clouds

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In previous contributions we have presented asymptotic forms for single scattering statistics in thick universal multifractal clouds with parameters $1 < \alpha < 2$ and $H = 0$. An essential feature was that short- and long-photon paths exhibit qualitatively different scaling behaviors. In the near regime the direct transmission is approximately exponential with a renormalized extinction coefficient $\kappa_{eff} < \kappa$, where the transmission behaves as if all scattering were from the most probable singularity in the cloud density field. In the far regime, the transmission falls off much more slowly (on account of "Levy holes"). A study of the moments of the photon pathlengths also supports this idea. The negative moments obey a scaling law algebraic in κ, while the positive moments follow logarithmic scaling according to $(\log \kappa)^{-\alpha}$. We present now the results of numerical simulations (Monte Carlo and discrete angle radiative transfer equations) that address the degree to which the above are relevant to light scattering in real clouds. Three issues are addressed. First, the asymptotic formulas rely on the underlying assumption that the actual multifractal water density field over all but the largest length scales may be replaced by the bare field developed to the same scale. A second issue is that real cloud density fields are not conserved but have $H \approx 1/3$. Finally, we have argued that if density correlations are ignored the multiple scattering should be well-described by an even softer effective extinction coefficient $\kappa_{eff} \approx (\log \kappa)^{\alpha/2}$. We examine the validity of this conjecture and the degree to which correlations require modification.

NG23A CC: 220 C-E Tuesday 1330h

Scaling and Fractals in the Earth, Atmosphere, and Hydrosphere: Resolution Dependence and Nonlinear Variability IV Posters

Presiding: **S Ratti,** Instituto di Physica Nucleare**; F Agterberg,** Canadian Geological Commission

NG23A-01 1330h POSTER

Fractal Aircraft Trajectories, Scaling Stratification, Nonclassical Turbulent Exponents

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The dimension (D) of aircraft trajectories is fundamental in interpretating airborne data. To estimate D, we studied data from 18 trajectories of stratospheric aircraft flights 1600km long taken during a "Mach cruise" (near constant Mach number) autopilot flight mode. Mach cruise implies correlated temperature and wind fluctuations so that $\Delta Z \approx \Delta x^{H_z}$ where Z is the (fluctuating) vertical and x the horizontal coordinate of the aircraft. Over the range ≈ 3 to 300km, we found $H_z \approx 0.58 \pm 0.02$ close to the theoretical 5/9=0.56 and implying $D = 1 + H_z = 14/9$ i.e. the trajectories are fractal. For distances < 3 km aircraft inertia smooths the trajectories, for distances > 300 km, D=1 again because of a rise of 1m/km due to fuel consumption. In the fractal regime, the horizontal velocity and temperature exponents are close to the nonclassical fractal value $H_K = 1/2$ (rather than the Kolmogorov value $H_K = 1/3$). Taking into account (multifractal) intermittency corrections, this implies the corresponding spectral slopes =1.9. We also discuss ESS and cross-ESS estimates of multfractal exponents. We show that there exists a critical average trajectory slope $s = \Delta x/l_s)^{H_z - 1}$; when the aircraft exceeds this, the velocity, temperature fluctuations are dominated by the vertical rather than horizontal statistics; ls is the scale where average horizontal and vertical temperature and velocity fluctuations are equal, we find it to be ≈ 4 cm (although it fluctuates depending on energy and buoyancy force variance fluxes). At this scale, even even small deviations from perfectly flat horizontal trajectories (of the order of 1m/km) will lead to Bolgiano-Obukhov ($H_{BO} = 3/5$) rather than H_F = or H_K. We show that this can explain recently published data from MOZAIC; we also review over a dozen other aircraft and radiosonde experiments showing that they are all compatible with the 23/9 dimensional unified scaling model. Finally we compare this with some direct estimates of H_z from passive scalar surrogates (lidar backscatter of pollution) with shows $H_z = 0.56 \pm 0.02$.

NG23A-02 1330h POSTER

Monte-Carlo and Sparse Matrix Radiative Transfer Calculations on Multifractal Clouds: Flux Tubes and Singularities

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A current challenge of climate modeling is that general circulation model results are extremely sensitive to parameterizations of the poorly understood cloud/radiation interactions. In order to work out some fundamental problems occurring in radiative transfer in the atmosphere, one first needs a physically based model of cloud liquid water density which is able to yield realistic radiance multifractal variability over ranges spanning thousands of kilometers down to less than a meter. Indeed, analysis of nearly 1000 satellite and in situ cloud radiances has shown (in both infrared and visible wavelengths) that the radiances fields are highly multifractal on such huge ranges of scales. After discussing some technical points needed to obtain accurate liquid water density multifractal statistics, we then use both Monte-Carlo techniques as well as new (highly accurate, rapid) sparse matrix methods to simulate the radiative transfer in the cloud and relate scale by scale the resulting radiation fields and the scattering statistics to those of the cloud. Theoretically based on closure techniques, we have predicted that in multifractal clouds, the popular 'independent pixel approximation' (IPA) should work except when applied to radiation flux tubes; and the latter are expected to be fractals. We directly test this hypothesis on the simulations.

NG23A-03 1330h POSTER

Scaling Anisotropy in Cloud Satellite Images at Mid-Latitudes: Directional Structure Function Measurements and Exponents Determination

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Motivation We investigate scaling anisotropy in cloud images. Even if these images look pretty much

the same in all directions, we can observe details at different scales. For instance, small (13 km) bands of clouds tend to be East-West oriented and larger sized (130 km) bands tend to be more North-South. Moreover, bands of clouds can have any orientation, so we have to be able to measure if the scaling anisotropy is aligned with the cardinal directions or not. Data MODIS satellite images are used to measure scaling anisotropy on cloud fields. Two bands available at a resolution of 250 m are used; the image are 1250 by 2000 km (5000 x 8000 pixels) wide. The quantization depth of the pixels is 12 bits. The two bands available at that resolution have been used; they are designed for a primary use in land, cloud and aerosols boundaries. Band 1 (visible) has a bandwidth of 620-670 nm and is sensitive to land cover and vegetation (chlorophyll). Band 2 (near infra-red) has a bandwidth of 841-876 nm and is sensitive to cloud amount, vegetation and, land cover. The selected images were located over the southern Atlantic, mostly in mid-latitude. Islands, continents, and icebergs have been avoided (to lower the effect of topography on cloud statistics) and bad pixels have been ignored. Scaling anisotropy measurement method We propose a simple method to visualize and measure basic exponents of scaling anisotropy in all directions, assuming weak anisotropy. Considering the fact that very few anisotropic analyses have been done to this date it is better to analyse nearly isotropic data first, before going to highly anisotropic cases. This way, isotropic scaling analysis methods can be used for determining the scaling range and anisotropic scaling analysis will show if there is any weak anisotropy. Main results A smooth variation of the structure function exponent with the geographic direction has been observed and the behavior of the function corresponds to what is mathematically expected. There is also a clear difference between the exponents in the North-South and East-West directions. The variation in the value of the exponent between the two axes is one quarter of the exponent, with a higher exponent in the East-West axis. The possible sources for this scaling anisotropy between North-South and East-West directions are the forcing (i.e. the difference in insolation between equatorial area and the poles) and the Coriolis force (which causes the beta effect). Note here that this last effect is not expected to be large because our scaling range (13 km to 130 km) is under the scales where beta effect is typically expected.

NG23A-04 1330h POSTER

Multifractal Analyses of Radar Rainfall Fields - Effects of the Uncertainties

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Multifractal mathematical analysis of spatial rainfall becomes a standard tool to study its physical nature. Most of such analyses are based on the radar rainfall (RR) estimates because it is currently the only way to observe substantial precipitation areas with the desired high spatial resolution. However, very little is known about the effects of the uncertainties in RR on the estimation of the multifractal parameters. We present our preliminary results on this problem. Among the basic systematic factors that can affect the results of multifractal analyses are the selection of the Z-R relationship and the reflectivity threshold, limited spatial resolution of the radar measurements and the necessary polar-cartesian transformation, and the dependence on the range from the radar. The impact of the random errors in RR products might be even more important. We present the results of a preliminary investigation of their possible effects. This study applies our results on the "observation equation" expressing RR as a function of the true rainfall and a random error process. We convolute this simulated error process with the RR fields and estimate the spatial variability parameters proposed by the universal multifractal theory. This investigation indicates that the sensitivity of the results on the RR errors is high and might even dominate the results of the multifractal analyses.

NG23A-05 1330h POSTER

Controls on Variable Fractal Geometry of the Conterminous U.S. Continental Divide

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Relief, dominant surficial process, and bedrock geology stand among the potential controls of drainage divide plan-view geometry. This study addresses correlations among these factors for 65 divide trace segments comprising the Continental Divide in the conterminous U.S. The divider-walk method provides a detailed analysis of Divide plan-view geometry, with resulting fractal dimension (D) values giving an index of the degree of Divide wandering. Within this study's resolution range of 0.5 - 50 km, approximate self-similarity is a common feature of all Divide trace segments. However there are distinct shifts of geometry expressed in part by varying D values, along the Divide trace (from segment to segment) and, in many cases, across the scale ranges of inspection for individual segments. Thirty-nine of the segments display homogeneous fractal character, with a single linear Richardson plot trend identified. The remaining cases are heterogeneous in character, with two distinct linear trends. Fifteen of these display greater wandering (higher D) at relatively fine scales (approx. 0.5 - 2.4 km resolution), while eleven show greater wandering at coarse scales (approx. 3.0 - 18 km). These three categories, along with fine and coarse scale D values quantified for all segments, provide a basis for further analysis. Divide trace fractal dimension values range from 1.01 to 1.16. A mean value of 1.09 applies to each scale range, but coarse scale D displays greater variance than fine scale D. Effects of control factors also relate mainly to variance of fractal dimension values, rather than means of those values. Segments traversing sedimentary bedrock show less variance in D values than those traversing igneous-metamorphic and mixed lithologies. This effect is especially apparent in the coarse scale range. Divide crests dominated by fluvial processes show more coarse scale D variance than those affected by strong alpine glacial sculpting, but this effect entirely disappears at fine scales. Segments dominated by volcanic processes exhibit the greatest degree of variance, as well as somewhat higher mean D value, compared to other types at both fine and coarse scales. Mixes of generic geometric types notably shift among the six physiographic provinces traversed by the Divide. The Basin and Range and Colorado Plateau provinces lack any heterogeneous cases of coarse scale D significantly higher than fine scale D, while the Northern Rocky Mountains province lacks any cases with fine scale D significantly higher. All four segments comprising the Wyoming Basin province have homogeneous geometry. Evaluation of quantitative relief measures confirms that segments displaying significantly greater degrees of wandering at coarse scales are confined to areas of high relief topography.

NG23A-06 1330h POSTER

Incorporating Nonlinear Rules in a Cellular Automata Landform Evolution Model

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This paper presents a landform simulation model that integrates the simplicity of cellular automata (CA) algorithm and the complexity of nonlinear rules of sediment erosion and transportation. In the linear version of the model (http://www.niu.edu/landform), the amount of erosion is linearly proportional to slope and erodibility at any given cell and the precipitons (i.e., rainfall events) are independent of each other. The linear version of the model is implemented as a Java applet, allowing for widest possible accessibility via a standard web browser and interactive user exploration, which is ideal for education purposes. However, the linear rules preclude the simulation of some nonlinear behaviors of the natural systems. Incorporating nonlinear rules into the CA-based Java applet brings the model closer to reality while maintaining its easy accessibility and interactiveness. In the new nonlinear version, the amount of erosion at any given cell is a power function of slope and discharge, which is related to the contributing area (represented by the number of cells flowing into the cell under consideration, i.e., precipitons are no longer independent but interrelated). The linear version becomes a special case of the nonlinear version. Preliminary visual inspection of the simulation results indicates that the nonlinear model generates much more realistic-looking landforms than the linear counterpart. The effect of various factors on landform evolution will be evaluated by changing parameters such as lithology (high vs. low erodibility), climate (wet vs. dry) and tectonic uplift rate. Fractal dimensions and other quantitative morphometric measures of the resultant landforms under different scenarios and between the linear and nonlinear versions will be compared and discussed. This project is supported by the CCLI program of NSF.

URL: http://www.niu.edu/landform

NG23A-07 1330h POSTER

Using Scaling Anisotropy to Statistically Characterize River Networks

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The statistical properties of two drainage networks selected in the China Loess Plateau and Utah Desolation Canyon were investigated using remotely sensed ASTER images. Remotely sensed images provide new insights into the characterization of river networks since they treat rivers as spatial fields rather than reducing them to geometrical networks. Depending of the underlying bedrock and the degree of network development, river structures exhibit a wide range of scales, morphologies and orientations. Investigating the scaling and the anisotropic properties of the associated drainage areas is then important to better understand the geological dynamics of a region.

Initially we performed analyses using isotropic energy spectra. All data sets exhibit (isotropic) scaling behaviour from at least 240 meters to 3800 meters. The scale invariant spectral exponent was found to depend on the drainage density. In order to better discriminate between different drainage areas, we went on to characterize the anisotropic scaling properties. Based on the Generalized Scale Invariance (GSI) framework we developed a statistical method, which estimates parameters that determine the degree of differential anisotropy i.e. the variation of the orientation and stretching of structures as a function of scale. We combined these anisotropic parameters with the isotropic spectral exponents to statistically distinguish networks, which develop as densely dendritic in loess, dendritic in hard rocks, mature river in loess and mature river in hard rocks showing structurally-controlled development.

NG23A-08 1330h POSTER

The Relationship Between Mass Factal Dimensions of Solid Matrix and Pore Space in Porous Media

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Measuring fractal dimensions by image analyzing techniques has become a common practice to describe structural properties of porous media. Depending on the object of interest, different features of the structure can be measured: solid matrix, pores, and the interface between them. In many cases the fractal dimension of one of these features has been determined and taken to describe the entire system. The question arises whether these dimensions are independent from each other or whether they can be related to an underlying property of the structure or image, respectively. For a variety of porous media we measured the fractal dimension of the matrix, the pore space, and the interface between them simultaneously using the box counting method. The images were obtained from soil thin sections, a void system in a clayey soil, and a moss agate, which is a dendrite structure within a calcite matrix. Measured fractal dimensions were compared with fractal dimensions estimated by the pore-solid fractal (PSF) model, which derives the fractal properties of the matrix and the pore space completely as a function of the porosity, the size of the initiator and the fractal dimension of the interface. Measured results agree well with values obtained from the PSF model. A clear relationship between the mass fractal dimensions of the two phases (solid matrix and pore space) of a porous media was observed. For all images the smallest fractal dimensions were found for the interface between matrix and pores. Values for the fractal dimension of the two phases were between those for the interface and the Euclidian space with the phase with the lower mass fraction always having the smaller dimension. Model results also predict a dependency of the dimension of the phases on the spatial resolution of the analyzed image.

NG23A-09 1330h POSTER

Spatio-Temporal Complexity of Geospace Disturbances

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Earth's magnetosphere is a key region of geospace involving a broad range of interacting scales, a complex geometry and many physical processes with overlapping space and time scales. The observational time series data from the ground and space based observatories have been used extensively to develop data-derived models of the magnetospheric dynamics. The coherence in the magnetosphere on the global scale, obtained in terms of low dimensionality of its dynamics, and the consequent predictability of its dynamics, has been used to develop space weather tools for forecasting geomagnetic indices. The multi-scale properties, on the other hand, can not be predicted dynamically and the methods of nonlinear dynamics and statistical physics have been combined to develop comprehensive models that yield deterministic predictions of the global component of the dynamics and probabilistic predictions of its multi-scale features. The next challenge lies in the understanding of spatio-temporal complexity of the geospace disturbances. These disturbances consist of magnetic storms and magnetospheric substorms and are monitored by more than 100 ground magnetometer stations and many spacecraft in the magnetosphere. The solar wind variables, which drive these disturbances, are monitored by spacecraft such as ACE at the Lagrange point and others at different locations in geospace. The data from these ground and space-borne platforms are used to develop an integrated spatio-temporal model of geospace disturbances during storms and substorms.

NG23A-10 1330h POSTER

Pattern Scaling in Quasihexagonal Fracture

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Quasihexagonal fracture processes in nature produce such interesting geophysical phenomena as columnar jointing and ice-wedge polygons. The Giant's Causeway is an example of the former, while surface polygons on Mars may be an example of the latter. This pattern has been observed across eight orders of magnitute in scale, prompting the obvious question as to what sets the absolute scale of quasihexagonal fracture. We have sudied columnar jointing in desiccated corn starch, a lab-friendly medium which sustains joints on the mm to cm scale. Columnar joints form as fractures advance into a shrinking body, and it is known qualitatively that the joint spacing increases with decreasing rate of fracture advance. Our research quantifies this observation by correlating the drying power with the fracture scale, and by using feedback control to maintain constant fracture advance conditions. The feedback experiments also model the hydrothermal convection thought to dominate the cooling of deep basaltic columnar joints. Our results may be compared to recent theoretical models (E. A. Jagla, xxx.lanl.gov/abs/cond-mat/0311481), based on energy minimization schemes.

URL: http://www.physics.utoronto.ca/~goehring/research1.htm

NG23A-11 1330h POSTER

Kinking Nonlinear Elastic Solids, Nanoindentations and Geology

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Many materials near Earth's surface are believed to be nonlinear mesoscopic elastic (NME) solids that exhibit nonlinear elastic behavior, hysteresis and discrete memory. Currently, these solids are modeled phenomenologically (e.g. P-M space model) and the underlying physical mechanism of hysteresis remains elusive. On the other hand, it has long been established that kink bands (KBs) play an important role in the deformation of geologic materials. However, because the response of NME solids is fully reversible, the two were never linked. Herein we report on the response of mica single crystals - loaded parallel to their c axis - to a 13.5 micrometer radius spherical diamond nanoindenter. Up to loads of 5mN, corresponding to stresses of 0.5 GPa, fully reversible hysteresis loops are observed. At stresses less than 0.5 GPa, the first loops are slightly open; subsequent loops, in the same location, are fully reversible and harder than the first. Simple compression experiments on polycrystalline cylinders yielded qualitatively similar results. Our results, together with much of the literature on the mechanical properties of mica, can be explained by invoking the formation of incipient kink bands, IKB's, that give way to mobile dislocation walls that, in turn, coalesce into kink boundaries with increasing stress. The IKB's are by definition fully reversible; the dislocation walls result in plastic deformation, and the kink boundaries explain the hardening. Since the dislocations are confined to the basal planes, they cannot entangle and can thus move reversibly over relatively large distances resulting in the dissipation of substantial amounts of energy during each cycle. Examination of the craters formed provided direct evidence for kink bands and the formation of a multitude of subgrains under the indenter. Based on this work, there is little doubt that the IKBs and KBs are the hysteretic mesoscopic units invoked to explain the behavior of NME's. We further claim that regardless of their type of bonding, solids with high c/a ratios - which per force are plastically anisotropic - will deform by kinking. These kinking nonlinear elastic (KNE) solids - include layered silicates and minerals such as mica, ternary carbides and nitrides, layered oxides, graphite, high Tc oxides, BN and the active elements in NME solids. The implications of this work on geology are obvious and will be discussed.

NG23B CC: 220 C-E Tuesday 1330h

Nonlinear Phenomena in Fluid Dynamics With Implications for Climate II Posters

Presiding: **M Stastna,** University of Toronto**; F Poulin,** Scripps Institution of Oceanography

NG23B-01 1330h POSTER

Wave Disturbances Spectral Characteristics Changes due to Interaction of Solar Radiation Field and Atmospheric Gas

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The structure and dynamics of atmosphere is obtained by non-linear interaction of solar radiation and atmospheric gas. With the aim to study the character of this non-linear interaction of solar radiation and atmosphere the spectral characteristics of acoustic-gravitational wave's disturbance in a two-component medium consisting of gas and radiation are studied in this work. One of the sources of disturbances in atmosphere, including the ionosphere, is the spatial and temporal difference of flux of solar radiation in the atmosphere. By characteristics, the disturbances generated by those sources, are naturally attributed as radiating class, as the primary factor determining structures and scale of disturbances generated by them, are characterized by the transformation of the solar radiation in various forms into the atmosphere, including energy of atmospheric waves generated by them. That is why for such sources, it is important to consider both the processes of transformation and the transport of solar radiation into the atmospheric gas. For studying influence of atmospheric energy transport processes in spatial and temporal structure of disturbances generated by radiating class sources, we constructed the equation of energy taken into account the heat conductivity of gas, heat radiation and heating of gas by solar radiation. Besides the above system of the equations additional equation of transport of the solar radiation with atmospheric gas is used. The dispersion equation of atmospheric waves is obtained.The numerical calculations of obtained dispersion equation and analysis of comparison these spectra with corresponding spectra for equilibrium atmosphere were made. The heights and character wave scales where non-equilibrium effects are stronger are determined.

NG23B-02 1330h POSTER

Signs of Life Below the GCM Gridscale

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In this talk we will discuss several climate simulations performed with the NCAR CSM in our laboratory at the University of Toronto. We will focus primarily on two equilibrium climates, namely a Modern climate and a climate with the model parameters chosen in accord with what is believed to be appropriate for the Last Glacial Maximum (approx. 18,000 years ago). By focusing on the North Atlantic region we will contrast the thermohaline circulation of the two climates, and this will in turn allow us to speculate on the role of processes below the grid scale in determining the thermohaline circulation. In particular we will comment on convective processes, mixing, and sea-ice interactions. In each case we will outline what we feel are the issues that cannot, for the forseeable future, be handled by GCMs. Time permitting we will show some results from a small-scale, nonhydrostatic model. These simulations show rather poignantly that on the scale of kilometers nonlinearity can have surprising consequences.

NG23B-03 1330h POSTER

Simulating the climate system through an interglacial-glacial transition

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Physical phenomena are sometimes characterized in terms of self-organized criticality theory (e.g. phase transitions) and require passing a threshold to initiate an instability, which in turn drives the physical process. Major changes in northern hemisphere glaciation are thought to involve changes from one climate state to another by a series of concurrent feedback mechanisms that initiate the instability. In particular, the transition from a non-glaciated or interglacial state to a glaciated state may involve such a rapid transition on the millennial time scale. Most current climate simulations of past geological epochs require global modelling at relatively low resolutions and therefore neglect subgrid scale behaviour that may be instrumental in driving these feedbacks. Some examples of how sub grid scale phenomena may impact the initiation of glaciation in global climate models will be presented. In particular, the influence of spectrally decomposed topography and low resolution primitive vegetation modelling on glacial inception climate will be discussed.

NG23B-04 1330h POSTER

Greenland tip jets and implications for climate

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Greenland lies in close proximity to the northern branch of the North Atlantic storm track, and as such can be a point of strong orographic interaction with atmospheric flow. The major climatological consequence of this is the location of the Icelandic Low in the lee of Greenland. However, the tip of Greenland is also frequently the source of high wind speed events called tip jets. These events can occur in a situation of westerly synoptic flow in the normal case, or they can be observed in easterly synoptic flow situations that produce a reverse tip jet event. The tip jet generally has a zonal extent of about 1000 km, but has a meridional extent of 100–200 km. The air-sea interaction associated with tip jet event has been proposed to be of importance to the thermohaline circulation because of the potential for deep ocean convection connected with the high wind speeds that characterize the tip jet. Because of their mesoscale nature, tip jets are not well resolved, or even at all resolved by most GCMs. In