Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Tumorigenesis and Greenhouse-Effect System Dynamics: Phenomenally Diverse, but Noumenally Similar? SAI PRAKASH, Johns Hopkins University — We present a physicochemical model of tumorigenesis leading to cancer invasion and metastasis. The continuum-theoretic model, congruent with recent experiments, analyzes the plausibility of oncogenic neoplasia-induced cavitation or tensile yielding (plasticity) of the tumoral basement membrane (BM) to activate stromal invasion. The model abstracts a spheroid of normal and cancer cells that grows radially via water and nutrient influx while constrained by a stiffer BM and cell adhesion molecules. It is based on coupled fluid-solid mechanics and ATP-fueled mechano-damped cell kinetics, and uses empirical data alone as parameters. The model predicts the dynamic force and exergy (ATP) fields, and tumor size among other variables, and generates the sigmoidal dynamics of far-from-equilibrium biota. Simulations show that the tumor-membrane system, on neoplastic perturbation, evolves from one homeostatic steady state to another over time. Integrated with system dynamics theory, the model renders a key, emergent tissue-level feedback control perspective of malignancy: neoplastic tumors coupled with pathologically-softened BMs appear to participate in altered autoregulatory behavior, and likely undergo BM cavitation and stress-localized ruptures to their adhesome, with or without invadopoiesis, thereby, initiating invasion. Serendipitously, the results also reveal a noumenal similarity of the tumor-membrane to the earth-atmosphere open reactive system as concerns self-regulation.

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Date submitted: 05 Nov 2015 Electronic form version 1.4