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Technology and human purpose: the problem of solids transport on the earth's surface

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This paper presents a logical, systematic setup of the events and ingredients that must have occurred in the development of "high metabolism technological systems," wherein high accuracy advective transport of solids is essential, and where the consequences of "human purpose" cannot be shunned as part of the analysis and understanding of the dynamics of modern Earth systems. I highlight below several key parts of the paper. This is a thoughtful (and thought provoking) contribution.

The paper seems to have two principal groupings of material. Although the current structure is fine, there nonetheless might be value in organizing the sections into appropriately titled super-headings. The first grouping, sections 1-5, cover locomotion and the necessary ingredients of solids transport over Earth's surface. Section 6 is like bridge (although it could go with 1-5). The second grouping, sections 7-10, cover the development of advection (and its ingredients) within the technological context. In addition, I offer the following comments regarding specific material in the text.

Page 419

Line 12: ...spatially distributed to localized high concentration zones widely dispersed...?

Line 26: Should we include human/animal transport (consistent with page 422)?

Page 420

Line 5: On first read, this looks like the ratio of advective to diffusive rather than the diffusive to advective. Might I suggest wording like: "...if on dimensional grounds we define a diffusivity as the product νl such that the diffusive timescale is $L^2/\nu l$, then the ratio of diffusive to advective time scales....

Page 521

Line 5: localized sources?

Page 423

Line 6: The point is well taken, but does high-friction terrain include surfaces navigable and un-navigable by wheels? Do we include "smooth" roads/rails within "high friction"? (Elaboration, methinks, arrives in the next section. Perhaps a transition sentence/phrase would be useful here.)

The analogy between terrestrial skin and form resistance with the fluid counterparts is compelling.

Line 24: relative size of surface irregularities in contact with the advective flow (that is, over the "wetted perimeter")

Page 424

Line 4: Is this idea necessarily restricted to the steady-state condition? Is it more general to just say something like "in order for transport to persist...?"

Line 14: The gradient involves distance, so might there be value in exploring/elaborating the idea that, once humans/purpose are involved, a “strong” gradient over short distances yields transport, even if inefficient, at least over short distance (i.e. communities nearby a source benefit more than those far away — until development of efficient advective systems)? In turn, therefore, is there something like an “effective” gradient formed as the ratio of concentration to the distance-friction (i.e. required work) product?

Page 425

Line 27: I recommend rewording to something like: “The dynamical problem that “purpose” solves is this: It enables action-at-a-distance dynamics in the absence of a continuous potential gradient between separated source and sink zones capable of inducing transport. Purpose in effect provides a basis for...”

Page 426

Line 13: I’m interpreting this sentence to mean that attributing ultimate causation to purpose skirts the issue..., whereas my reading of the material leading up to this sentence suggested that we might be avoiding attributing causation to purpose, in which case it seems that the lack of attributing causation to purpose skirts the issue... (which, methinks, is consistent with the next paragraph). Am I misinterpreting?

Perhaps reword slightly to something like... “appealing to human purpose risks giving the impression of skirting the issue/challenge of providing valid...”

Line 16: This is one of the most important paragraphs of the paper.

Page 427

Line 24: “information content” is not clear to me. Does this refer to “structure” or “configuration” or “function”? (I see that this is fully explained starting with the first sentence on the next page.) Also perhaps, “during the transport process” or “while being transported”

Page 428

Line 1: “...in transport dynamics, as do fluids.”

Page 429

Line 1: Nice visual to make the point regarding accuracy!

Line 15: Perhaps “...use of energy that leads to no added value of purpose...”

Page 430

Line 4: It is unclear what “such a transport mode” is referring to. Does this mean transport in response to the “potential gradient”?

This is a clear summary paragraph. Might there be value in adding a brief (perhaps parenthetical) example or elaborating phrase regarding “new dynamical principles”?