Foreword

On reading this wonderful text on Geophysical Fluid Dynamics (GFD) by Benoit Cushman-Roisin and Jean-Marie Beckers, Antoine de Saint-Exupéry's memorable quote regarding artful simplification seems very appropriate:

In anything at all, perfection is finally attained not when there is no longer anything to add, but when there is no longer anything to take away.

Any scientific endeavor, particularly one that addresses a system as important and complex as the fluid earth, demands a hierarchy of approaches. One must not only strip away extraneous detail to expose what lies beneath, but also study the emergent behavior that results from the interaction of myriad components. Today, sophisticated computer models simulate virtual earths so comprehensively that even the effect of a cloud's shadow cast on the ocean can be represented. Such models are used to synthesize observations, make projections about the vagaries of the weather or the likely future evolution of earth's atmosphere and ocean under anthropogenic forcing.

But, as Jorge Luis Borges' one-paragraph parable on "Exactitude in Science" warns us, we should be wary of the danger of plunging headlong into complexity:

In that Empire the art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a city, and the map of the Empire the entirety of a Province...In time it was realized that the vast Map was Useless.

Like the Empire's perfect cartography, our virtual earths, although far from useless!, are often not the most appropriate tools to figure out where we are, or build understanding and intuition about what matters and what does not. In short, complex models are rather poor pedagogical tools, yet that pedagogy is vital if we are to make wise inferences from them.

In their updated GFD text, the art of intelligent simplification and clear exposition is used by Cushman-Roisin and Beckers. Carefully chosen models are presented and tailored to the phenomenon at hand so that the reader learns by being taken up and down the modeling hierarchy. Moreover, the parallel development of physical and numerical aspects of GFD, both reinforcing and echoing the other, succeeds in breaking down artificial barriers between analytical and numerical approaches.

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