Enabling science @ ESRL through Distributed Computation

An ESRL Theme “kick-start” meeting

ESRL Theme Reviews – 2007

Date	Points of Contact	Theme
10 May	Chris Fairall, Tanya Smirnova	Surface and Planetary Boundary Layer Processes
07 June	Sara Summers, David Fahey	Observing System Design, Simulation and Demonstration
16 Aug	**Mark Govett, Nick Wilde**	**Enabling Science @ ESRL through a distributed computing infrastructure.**
06 Sep	Ed Dlugokencky, James Burkholder	Radiative Forcing of Climate by Non-CO_2 Atmospheric Gases
04 Oct	John McGinley, Georg Grell	Regional Scale Assimilation and Modeling
01 Nov	Randy Dole, Allen White	The Weather-Climate Connection
06 Dec	Marty Ralph, Christopher Anderson	Hydrometeorology Testbed

ESRL Theme Reviews – 2008

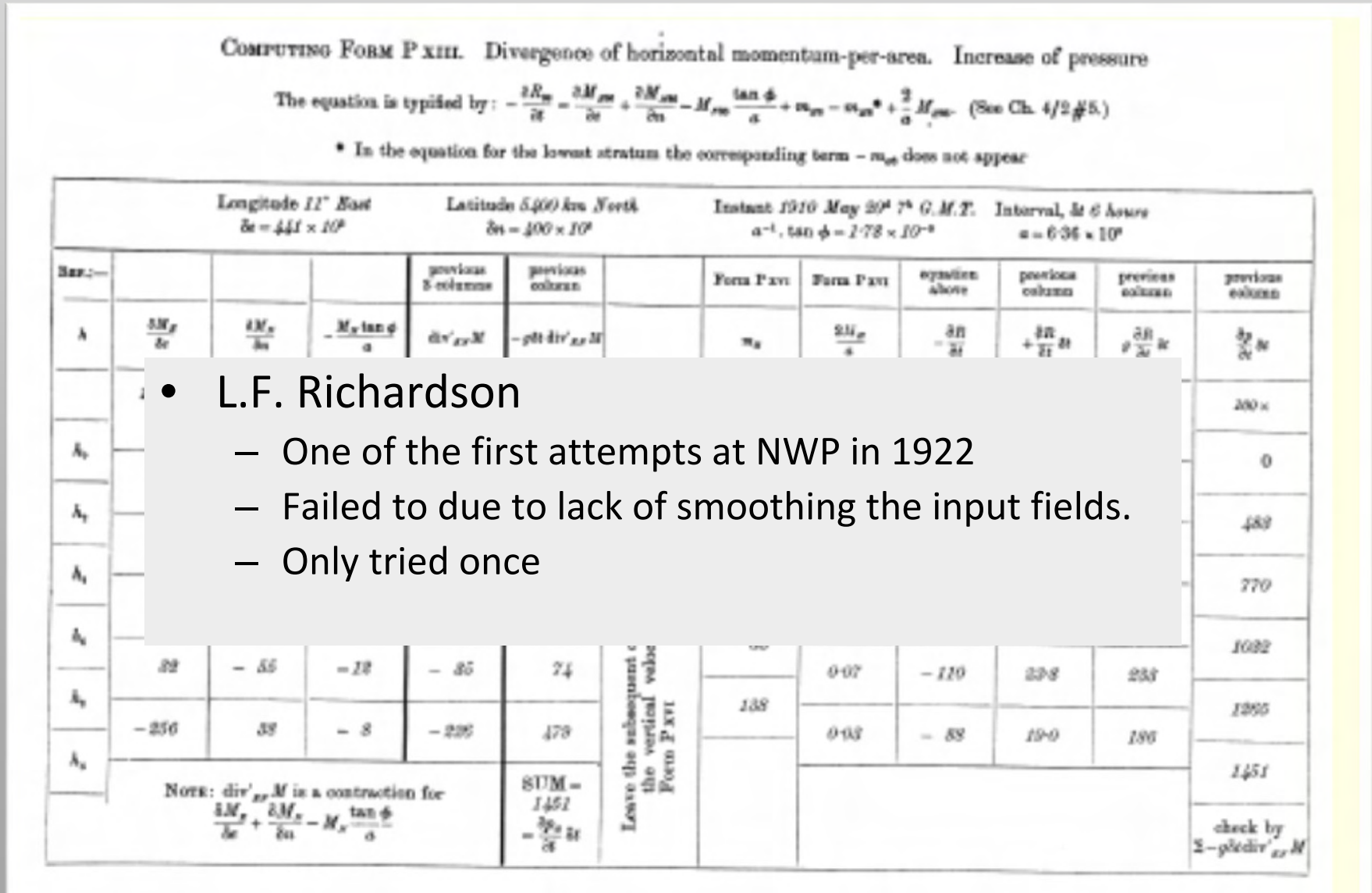
10 Jan	Jim Wilczak, Joost DeGouw	Tropospheric Ozone and Air Quality
07 Feb	Stan Benjamin, Dezso Devenyi	Global Weather Assimilation and Modeling
06 Mar	Steve Montzka, John Daniel	Stratospheric Ozone Layer Recovery
03 April	Carl Bullock, Leslie Hartten	Information Systems
01 May	Arlyn Andrews, John Miller	Carbon Cycle Science
05 Jun	John Ogren, Christoph Senff	Aerosols: Climate and Air Quality
10 Jul	Marty Hoerling, Brad Udall	Climate and Water Systems

Enabling science @ ESRL through Distributed Computation

"When all you have is a hammer, every problem looks like a nail"

– some smart guy

Computing Technology as enabler



COMPUTING FORM P XIII. Divergence of horizontal momentum-per-area. Increase of pressure

The equation is typified by: $-\frac{\partial R_m}{\partial t} = \frac{\partial M_{xm}}{\partial x} + \frac{\partial M_{ym}}{\partial y} - M_{ym}\frac{\tan\phi}{a} + w_{xz} - w_{xz}^{*} + \frac{2}{a}M_{xm}$ (See Ch. 4/2 §5.)

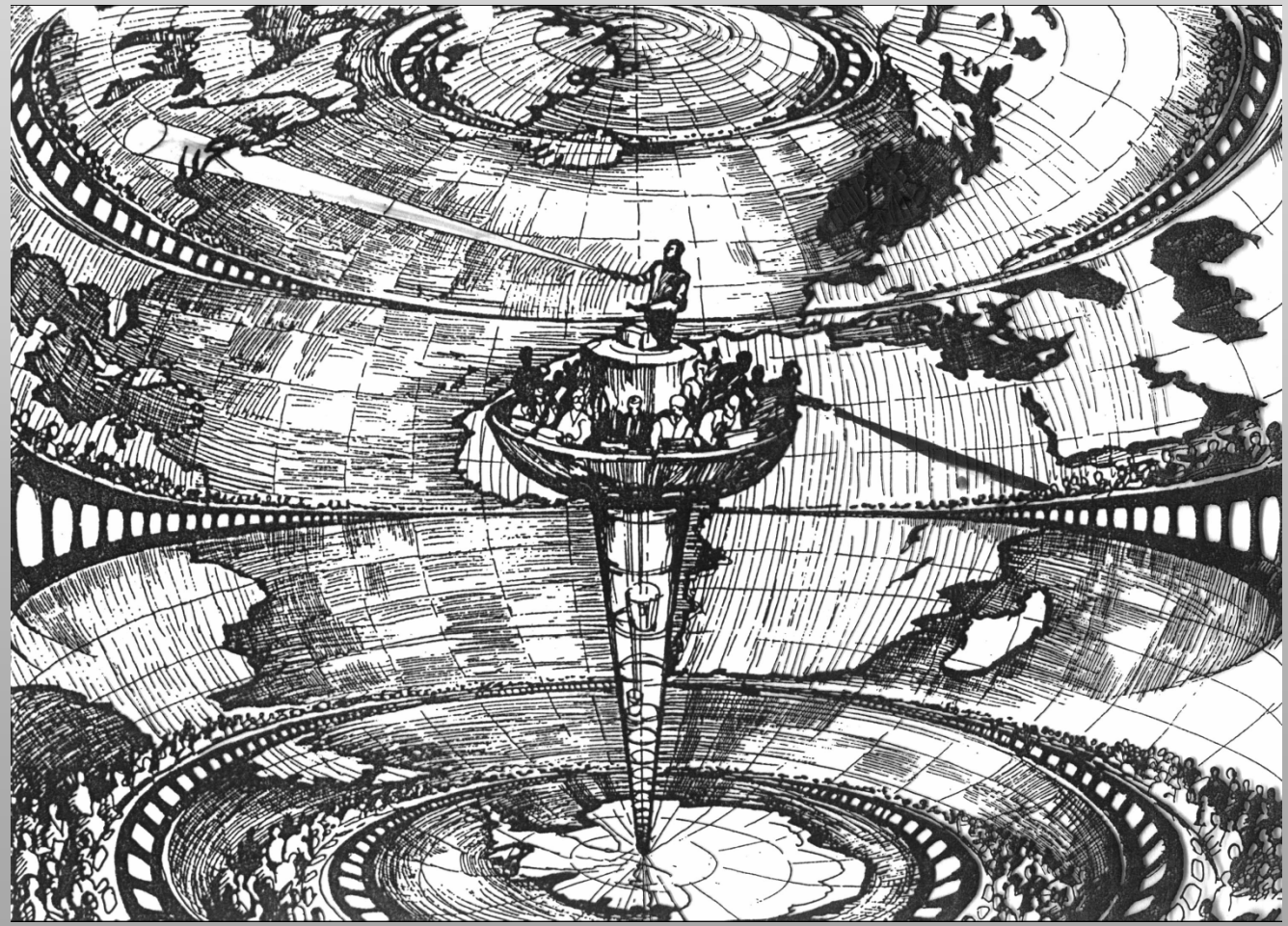
* In the equation for the lowest stratum the corresponding term $-w_{xh}$ does not appear

Longitude 11° East $\delta x = 441 \times 10^3$ | Latitude 5400 km North $\delta y = 400 \times 10^3$ | Instant 1910 May 20d 7h G.M.T. $a^{-1}\tan\phi = 1{\cdot}78 \times 10^{-8}$ | Interval, δt 6 hours $a = 6{\cdot}36 \times 10^6$

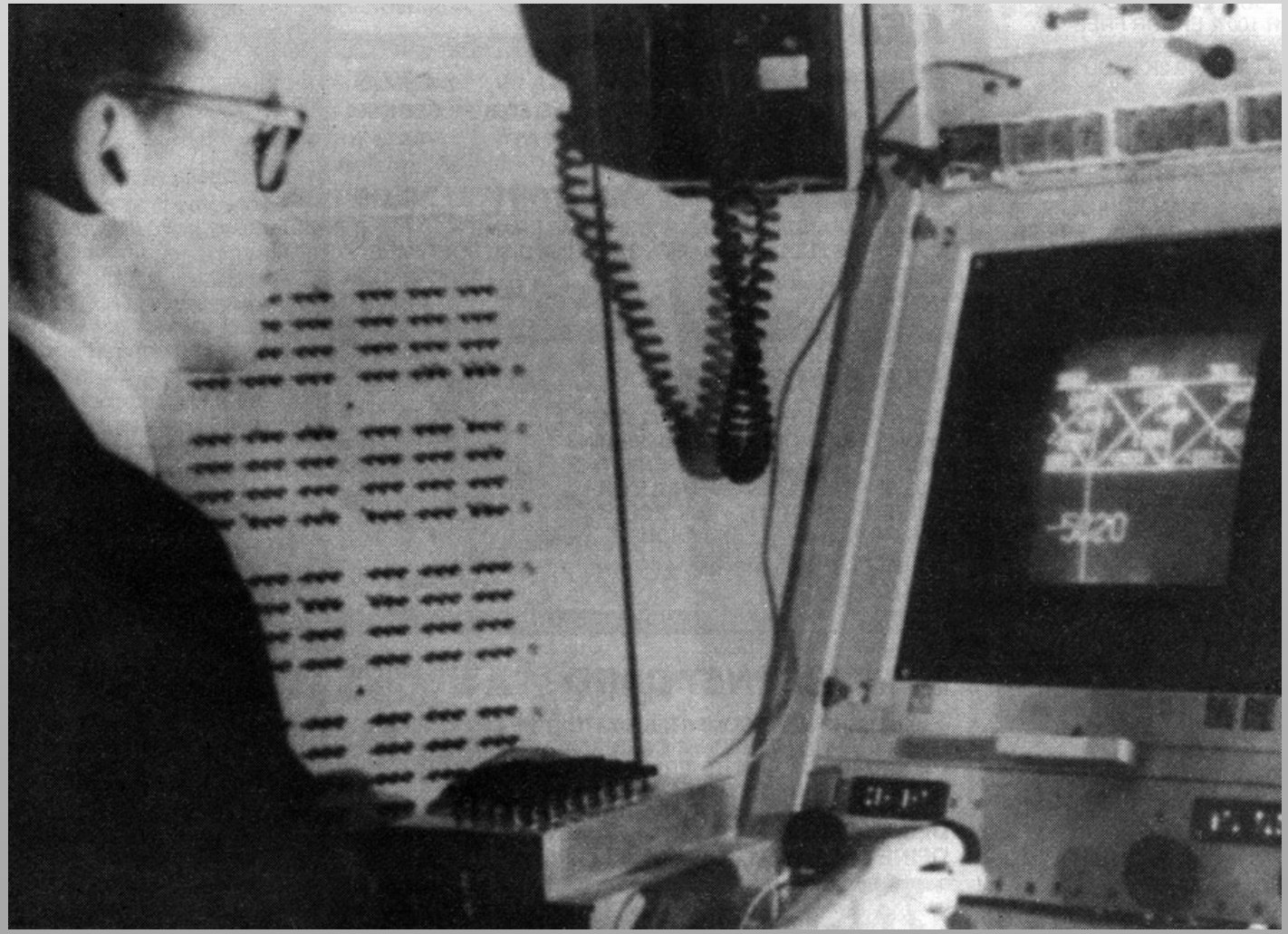
Rem.:—				previous 5 columns	previous column		Form P XVI	Form P XVI	equation above	previous column	previous column	previous column
h	$\frac{\delta M_x}{\delta x}$	$\frac{\delta M_y}{\delta y}$	$-\frac{M_x \tan\phi}{a}$	$\mathrm{div}'_{xy}M$	$-g\delta t\,\mathrm{div}'_{xy}M$		w_h	$\frac{2\Omega_z}{a}$	$-\frac{\delta\Pi}{\delta t}$	$+\frac{\delta\Pi}{\delta t}\delta t$	$\theta\frac{\delta\Pi}{\delta\sigma}\delta\sigma$	$\frac{\delta p}{\delta\sigma}\delta\sigma$
												200 ×
h_5												0
h_7												483
h_8												770
h_9	22	− 55	−12	− 85	74	Leave the subsequent c… the vertical value… Form P XVI		0·07	−110	238	233	1032
h_{10}	−256	39	− 8	−225	479		138	0·03	− 88	19·0	186	1295
h_{11}												1451
	NOTE: $\mathrm{div}'_{xy}M$ is a contraction for $\frac{\delta M_x}{\delta x} + \frac{\delta M_y}{\delta y} - M_x\frac{\tan\phi}{a}$				SUM = 1451 $-\frac{\delta p_s}{\delta t}\delta t$							check by $\Sigma - g\delta\mathrm{div}'_{xy}M$

- L.F. Richardson
  - One of the first attempts at NWP in 1922
  - Failed to due to lack of smoothing the input fields.
  - Only tried once

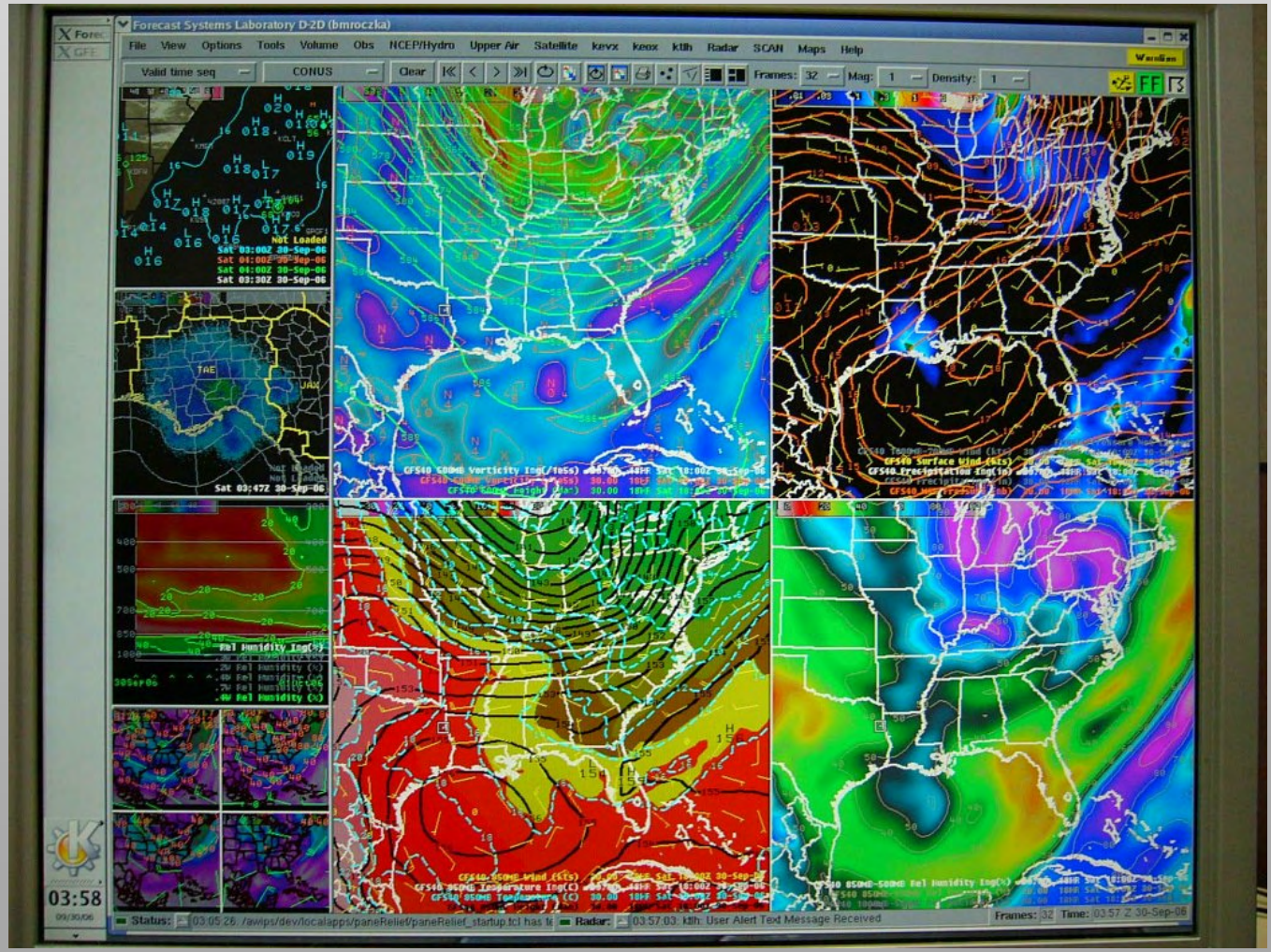
Why did Richardson give up after 1 try?



Technology can also lead..



Sutherland wasn’t thinking about weather forecasting



Major trends in computing technology

1. Interactive Graphics
2. High speed networks
3. “Cheap” cycles and storage
4. The WWW
5. *(RFID? Ubiquitous computing?)*

Distributed & Grid computing

Distributed computing:

2 or more CPU's collaborating over a network

Grid computing:

- A form of distributed computing
- Synergy of high speed networks + idle cycles & storage
- Not Cartesian grid, but electrical "grid"
  i.e. on-demand access to resource(s)
- Demand side computing, as opposed to supply side.

Less a theme, more of a question?

Part 1: Exploring the grid concept

- ***Distributed Computing*** ***Mark Govett, GSD***
- ***The PSD desktop "grid"*** ***Robert Pincus, PSD***
- ***A modeling portal for HPC*** ***Jeff Smith, GSD***

Less a theme, more a conversation

Part II: Is a grid in ESRL's future?

A few unique perspectives.

Jeff Whitaker, Meteorologist, PSD

Rich Beeler, Chief of ESRL IT

Leslie Hart, HPC lead

Stan Benjamin, Meteorologist, GSD

Let’s talk

Part III – your turn

- Are you on the “supply side” or the “demand side” ?
- Does the concept of grid of computing services make sense to you?
- How would this affect your own work?
- What would make you more productive in your job?