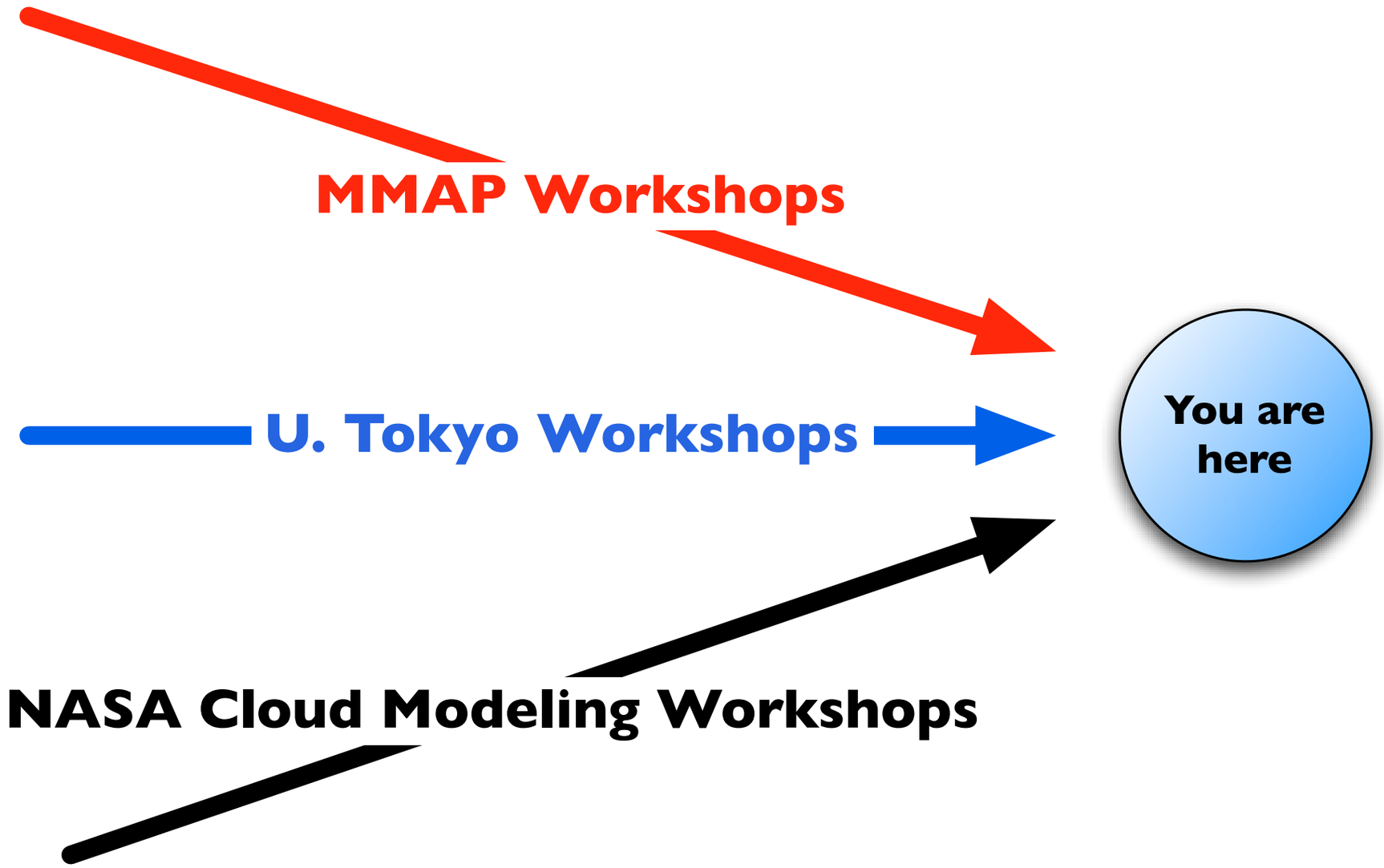
Cloud Modeling 2005:
Count the Clouds.


MMAP Workshops
U. Tokyo Workshops
NASA Cloud Modeling Workshops
You are here

Thanks to:

- NSF, NASA, and DOE/ARM for supporting a lot of the work to be presented here
  - NSF for sponsoring this workshop
  - NASA for its cloud-modeling initiative
  - DOE/ARM for its forward-looking approach to the cloud-climate problem
- Cindy Carrick and Lisa Casuto for making the arrangements for the Workshop

Logistics

- **The Program for the Workshop is available as a handout.**
- **Morning and afternoon breaks will be half an hour long. Snacks and beverages will be provided.**
- **Lunch breaks will last 1.5 hours. A list of restaurant suggestions is available as a handout.**
- **The poster session runs this evening from 6 to 8 p.m. The room is available all day today for poster set-up. Posters will have to be removed by 9 a.m. on Thursday.**
- **On Thursday evening, I am hosting a party at my house, starting at 6 p.m. Driving directions are available on a handout.**

Status of MMAP

MMAP was one of 164 Pre-Proposals in June 2003.

MMAP was one of 37 invited Full Proposals in February 2004.

MMAP was site-visited in October 2004 -- one of twelve.

Six of the twelve were declined in January 2005 -- but not MMAP.

Two of the remaining six were funded in April 2005 -- but not MMAP.

The remaining four, including MMAP, are in limbo, pending 2006 NSF budget.

“Signs are positive” but no guarantees.

We should hear by the end of the year.

Sitting in limbo

"Due to budgetary constraints the NSF Leadership has decided to initiate funding in FY 2005 for the two top proposals on the list recommended by the STC Advisory Committee. An announcement regarding those two formative centers will be forthcoming.

NSF Leadership also has decided to defer the determination on funding the four remaining, highly recommended Centers until the FY 2006 budget is more transparent."

There are two dictionary definitions of "Limbo." One is "...a place where souls remain that cannot enter heaven." That's us, alright. We are not in heaven, but (look on the bright side) we are not in hell either.

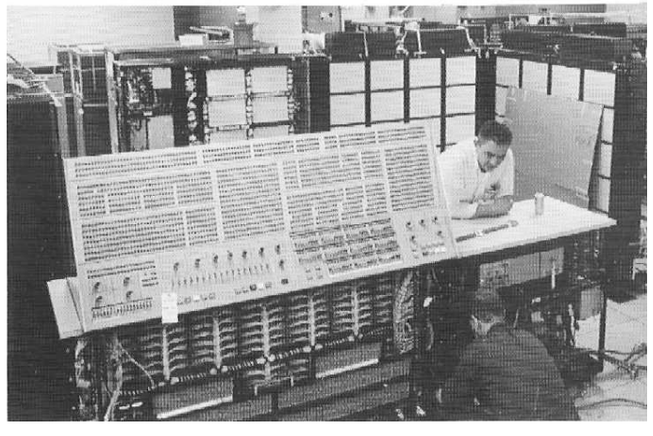
The second definition is "A West Indian dance in which the dancers keep bending over backward and passing under a pole that is lowered slightly each time."

We have indeed passed under successively lower poles: Preproposal, Full Proposal, Site Visit, Blue Ribbon Panel. How low can we go? There is one pole left.

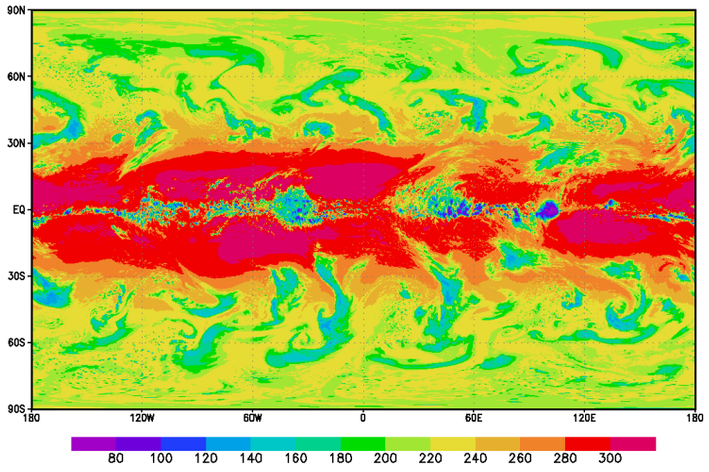
Let’s talk about computers.

IBM 7094

Exponential growth

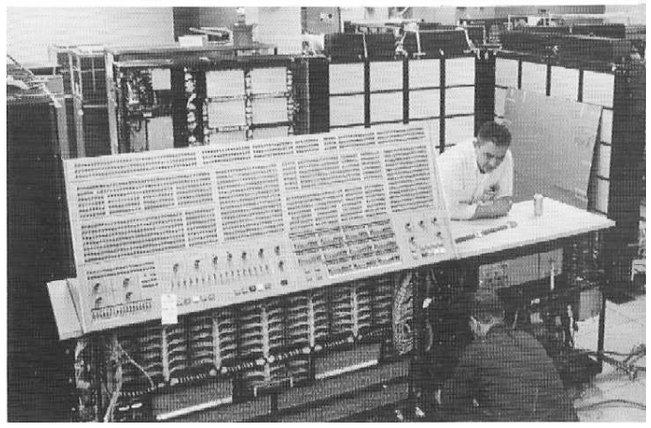


When I was doing my dissertation during the 1970s, a global atmospheric model delivered about 10 simulated days per day, on an IBM 360/91 -- about 1 MF-year per simulated year. I analyzed a 10-day simulation in my thesis.



During this Workshop, we will hear about 10-day simulations that run at the rate of 1 TF-year per simulated year.

Over the past 30 years, computing power has increased by a factor of 10^6.



In the climate modeling arena, almost all of this increased power has been used to make longer simulations, and more simulations.

Very little of it has been used to improve the way models are built.

What have we accomplished over the past 30 years?

Then	Now
Clouds predicted in some AGCMs	Clouds predicted in all AGCMs
ERB unexplored	ERB well observed and thoroughly tuned
Precipitation observations very poor	Precipitation observations getting better
Hydrologic cycle and radiatively active clouds modeled independently	Hydrologic cycle and radiatively active clouds linked in some models
Coupled models being born	Coupled models in routine use
CSRMs being born	CSRMs in widespread use
Cloud parameterizations untested	Cloud parameterizations tested against field data -- GCSS and ARM
Models simulate cloud feedbacks on climate change, but nobody knows whether or not they are realistic.	No change.

How have parameterizations changed over the past 30 years?

Then	Now
Convective mass fluxes	Same
Moisture convergence closure and buoyancy closure	Buoyancy closures of various types
Equilibrium closure	Non-equilibrium being explored
Prognostic cloud water proposed by Sundqvist	Now widely implemented, and updated in some models
Emissivity	Correlated k
Random overlap	Maximum-random overlap
Prescribed cloud optical properties	Interactive cloud optical properties
Crude convective momentum transport in some models	Same
Crude coupling of convection to the PBL	Same
No mesoscale organization	Same

Getting it right takes time.

The current generation of global models was born in the 1960s, and has reached maturity only recently.

- **Operational global weather forecasting did not begin until the late 1970s.**
- **Until the 1980s, most "climate" simulations consisted of just a few hundred simulated days, run with atmosphere-only models.**
- **Coupling with ocean models did not become widespread until the late 1980s.**
- **Systematic testing of parameterizations did not begin until the 1990s.**

If we plan to do something new, we'd better get started.

Cloud Processes

Radiation

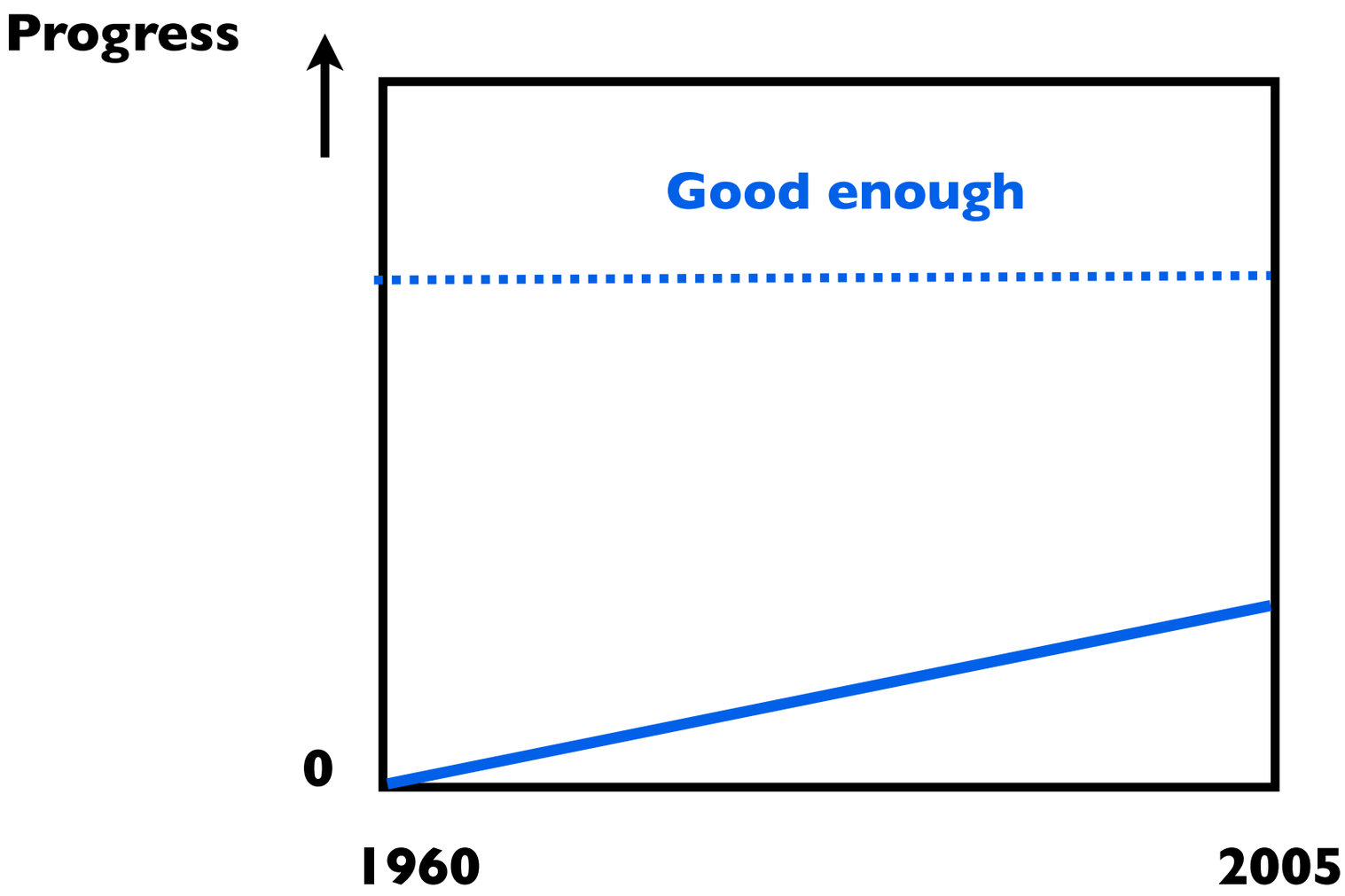
Cloud-scale motions

Turbulence

Microphysics

These processes interact strongly on the cloud scale.

Are we doing OK?



The clouds are winning.

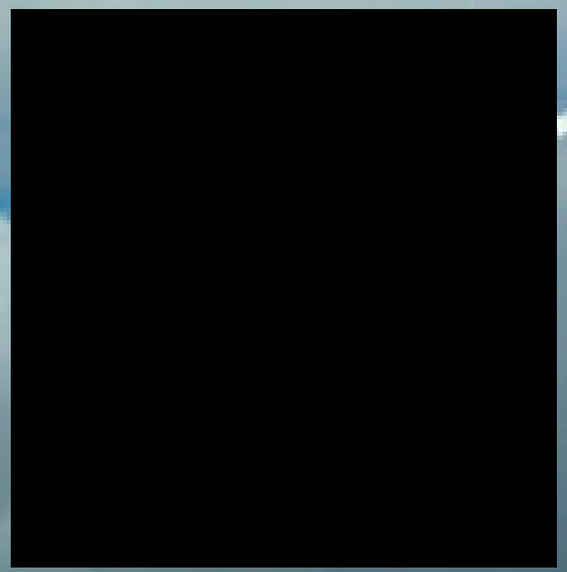

Randall is a pessimist.


Randall is an optimist.

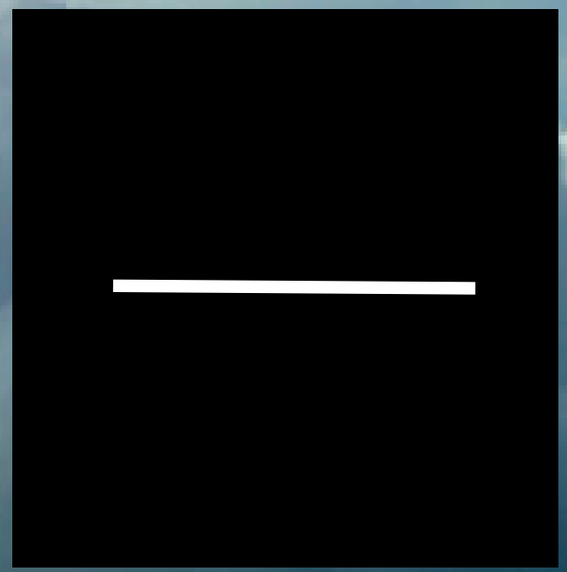
Models simulate cloud feedbacks on climate change, but nobody knows whether or not they are realistic.

- We will, eventually, find out whether or not they are realistic.
  - Simulated cloud feedbacks *are* subject to observational tests.
  - We have to wait for that.
- In the mean time, how can we get better results?
  - Computational power
  - Better parameterizations
  - Better parameterizations through computational power

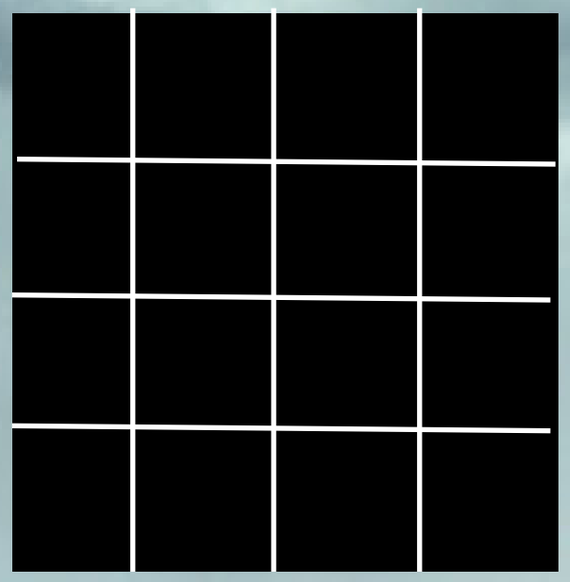
Fantastic Four



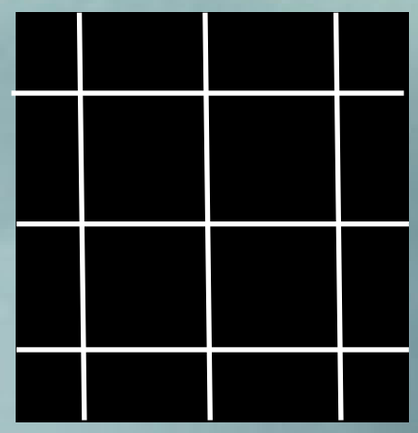
GCMs With "Classical" Parameterizations



MMF



Global CSRM

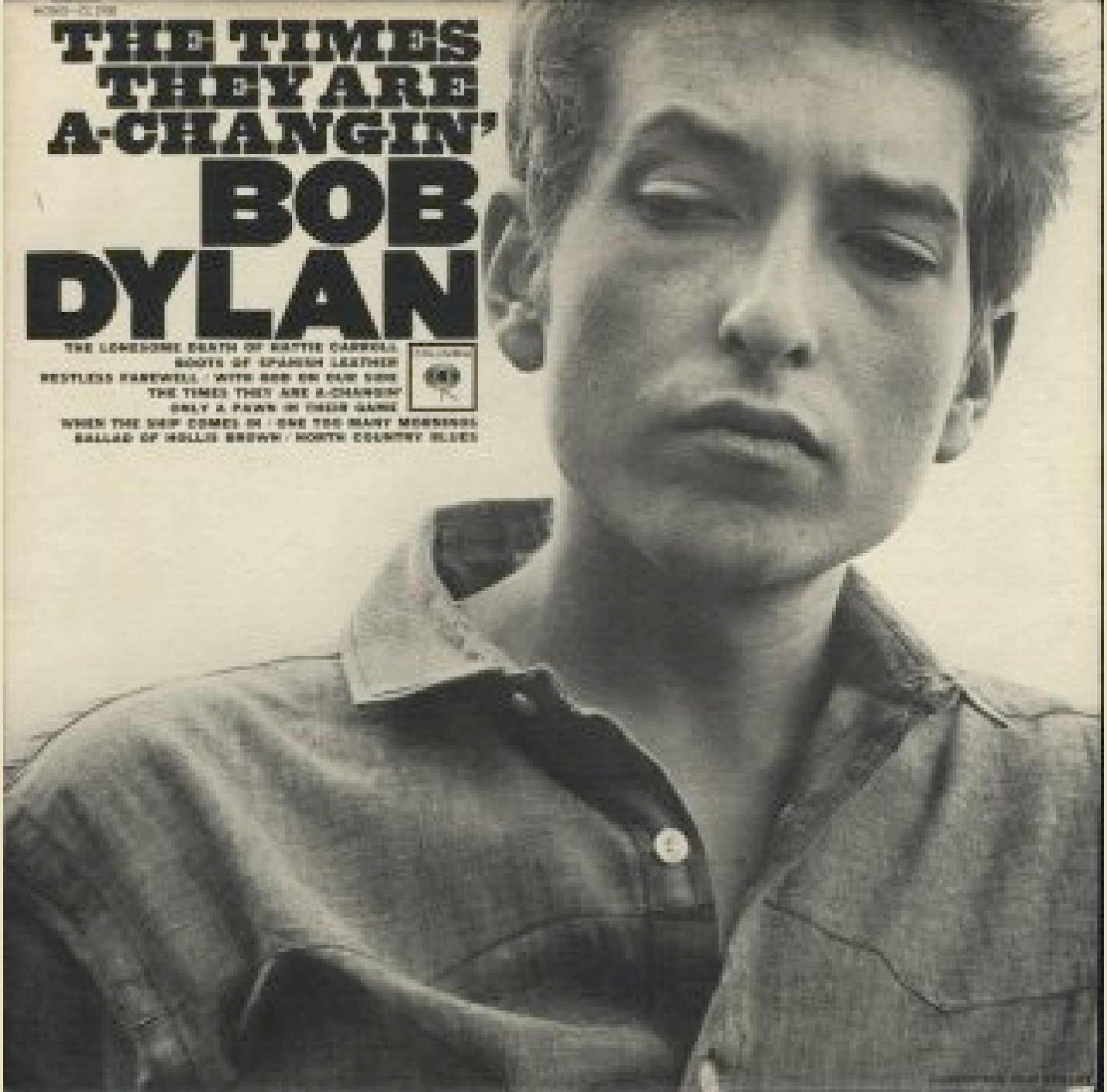


DARE

THE TIMES THEY ARE A-CHANGIN'

BOB DYLAN

THE LONESOME DEATH OF HATTIE CARROLL
BOOTS OF SPANISH LEATHER
RESTLESS FAREWELL / WITH GOD ON OUR SIDE
THE TIMES THEY ARE A-CHANGIN'
ONLY A PAWN IN THEIR GAME
WHEN THE SHIP COMES IN / ONE TOO MANY MORNINGS
BALLAD OF HOLLIS BROWN / NORTH COUNTRY BLUES



Where will we be in 30 years?

- Progress in computation
  - Moore's Law will give us a factor of about 10^6, we hope.
  - Global cloud-resolving models will be used in true climate simulations.
- Progress in understanding: Future parameterizations
  - A new focus on microphysical processes
  - How many clouds?

Count the clouds.