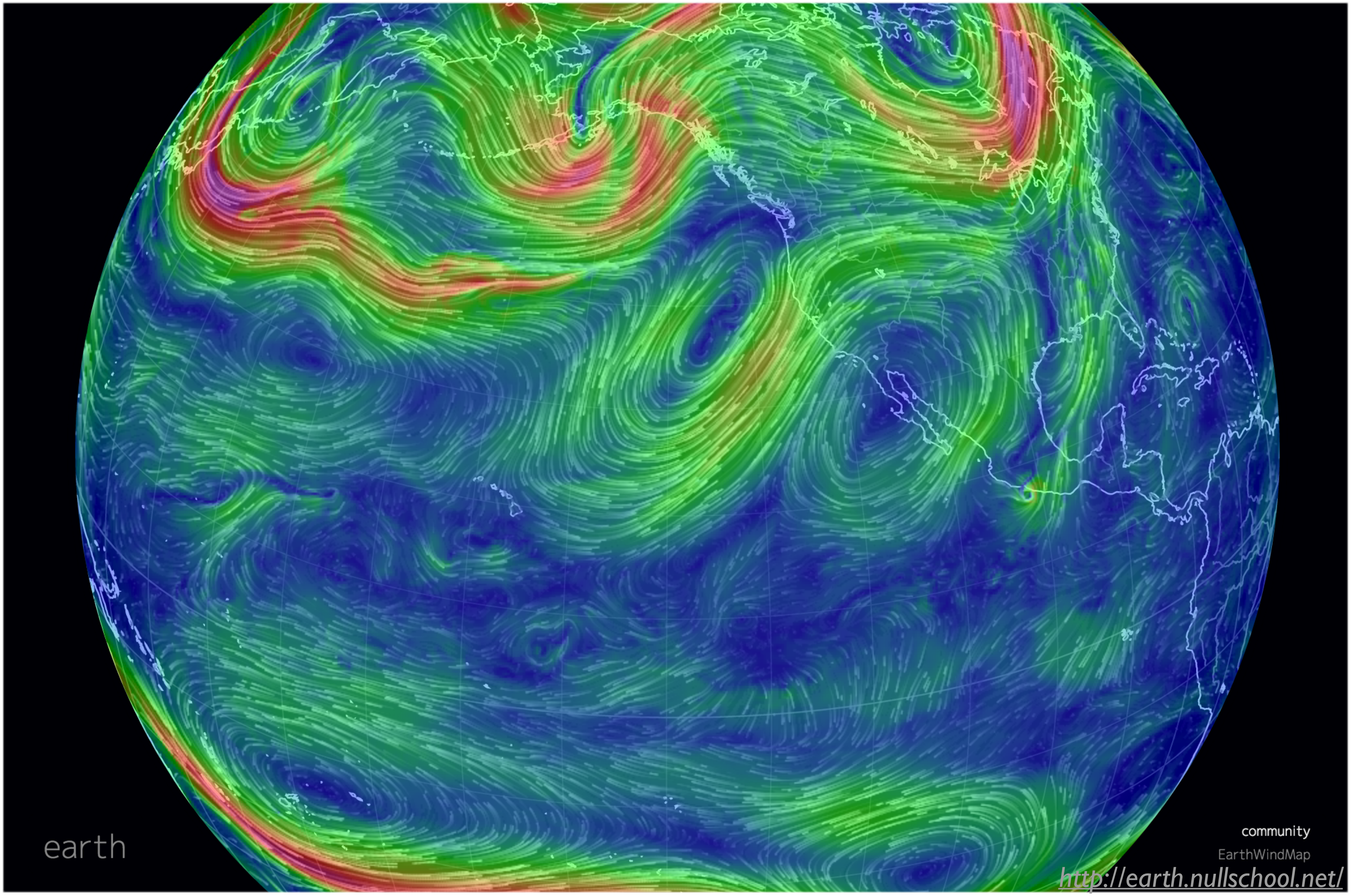


ATMOSPHERIC MOTION I (ATM S 441/503)

INSTRUCTOR

- Daehyun Kim

  Born in 1980 | B.S. 2003 Ph.D. 2010 | 2010-2013 | 2014-

  - Assistant Professor at Dept. of Atmospheric Sciences
  - Office: ATG 608
  - E-mail: daehyun@uw.edu
  - Office hours: Mon/Tue 11:30~12:20 or by appointments

CLASS MEETS

- MWF 10:30-11:20am
- @ ATG 310

TEXTBOOK

- Holton, J.R., and G. J. Hakim, 2013: Introduction to Dynamic Meteorology, 5th Edition. Elsevier.

COURSE OUTLINE (SUBJECT TO CHANGE)

I. Introduction: Fundamental forces, rotating coordinates, Coriolis force, atmospheric statics.

II. Basic conservation laws: Momentum equation, continuity equation, thermodynamic energy equation, scale analysis.

III. Elementary applications of the basic equations: Isobaric coordinates, geostrophic flow, intertial flow, cyclostrophic flow, gradient wind, thermal wind, vertical motion.

IV. Circulation, vorticity, and potential vorticity: Circulation theorem, vorticity, potential vorticity, barotropic vorticity equation.

V. Atmospheric oscillations: Linear perturbation theory, basic properties of waves, linear waves.

PURPOSE OF THE COURSE

- To develop understanding of why large-scale (synoptic scale) midlatitude weather systems behave as they do

ATMOSPHERIC MOTION IN REALTIME (AND FORECAST)

- http://earth.nullschool.net/
- https://www.windyty.com

YOU'LL HAVE ANSWERS TO THESE QUESTIONS AT THE END OF THE CLASS..

- What information/knowledge do we need to fully describe the behavior of the atmosphere?
- What are the forces that move the air parcel around? Among them, what are of primary importance in the midlatitude synoptic scale motion?
- Why does the wind blow almost parallel to the height contours on a 500-mb map?
- Why is there the jet stream in the mid-latitude?
- Why do we need math to answer these questions?

GENERAL CIRCULATION MODEL

WHAT IS THE GCM?

COMPUTER CODE THAT NUMERICALLY SOLVES EQUATIONS

THAT GOVERN THE STATE OF THE ATMOSPHERE, OCEAN, LAND SURFACE AND SEA ICE

- EX) ATMOSPHERIC STATE: WIND, TEMPERATURE, HUMIDITY, PRESSURE
- RULES THAT THE ATMOSPHERIC STATES FOLLOW
  - NEWTON'S SECOND LAW OF MOTION
  - FIRST LAW OF THERMODYNAMICS
  - MASS CONSERVATION

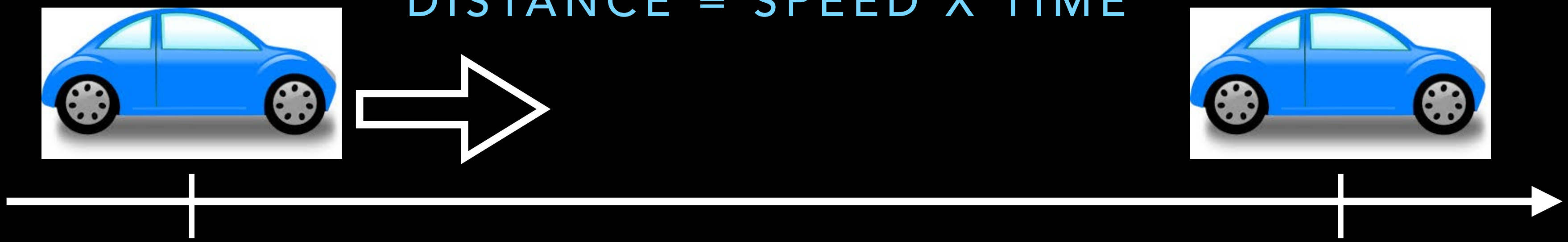
WHAT IS THE GCM?

COMPUTER CODE THAT NUMERICALLY SOLVES EQUATIONS

"SOLVING EQUATIONS"

LAW THAT GOVERNS THE MOTION OF THE CAR

DISTANCE = SPEED X TIME



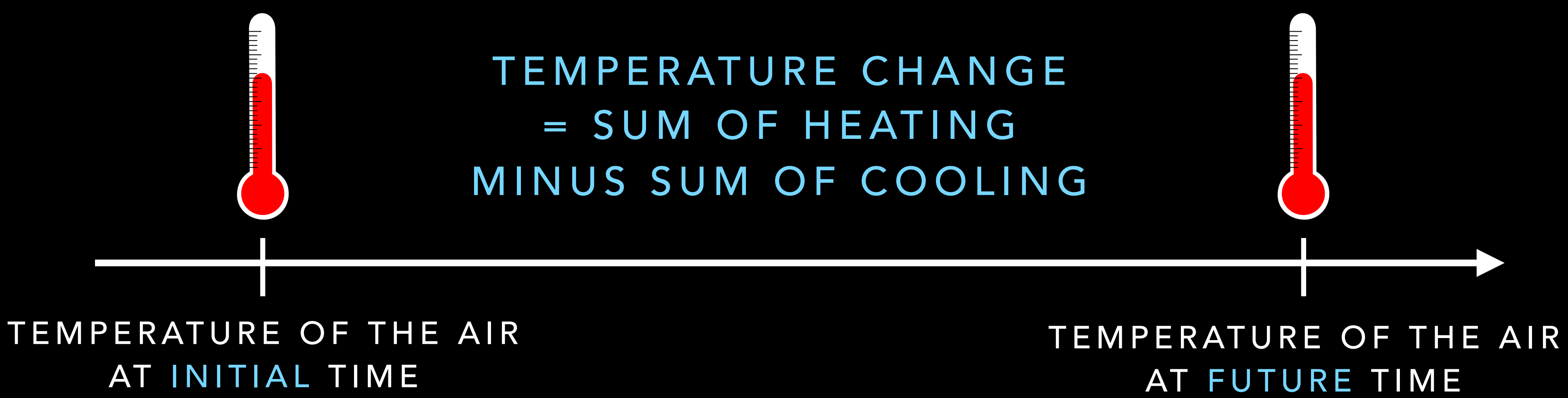
POSITION OF THE CAR AT INITIAL TIME

POSITION OF THE CAR AT FUTURE TIME

COMPUTER CODE THAT NUMERICALLY SOLVES EQUATIONS

“SOLVING EQUATIONS”
=CALCULATING EVOLUTION OF STATES
=CLIMATE SIMULATION

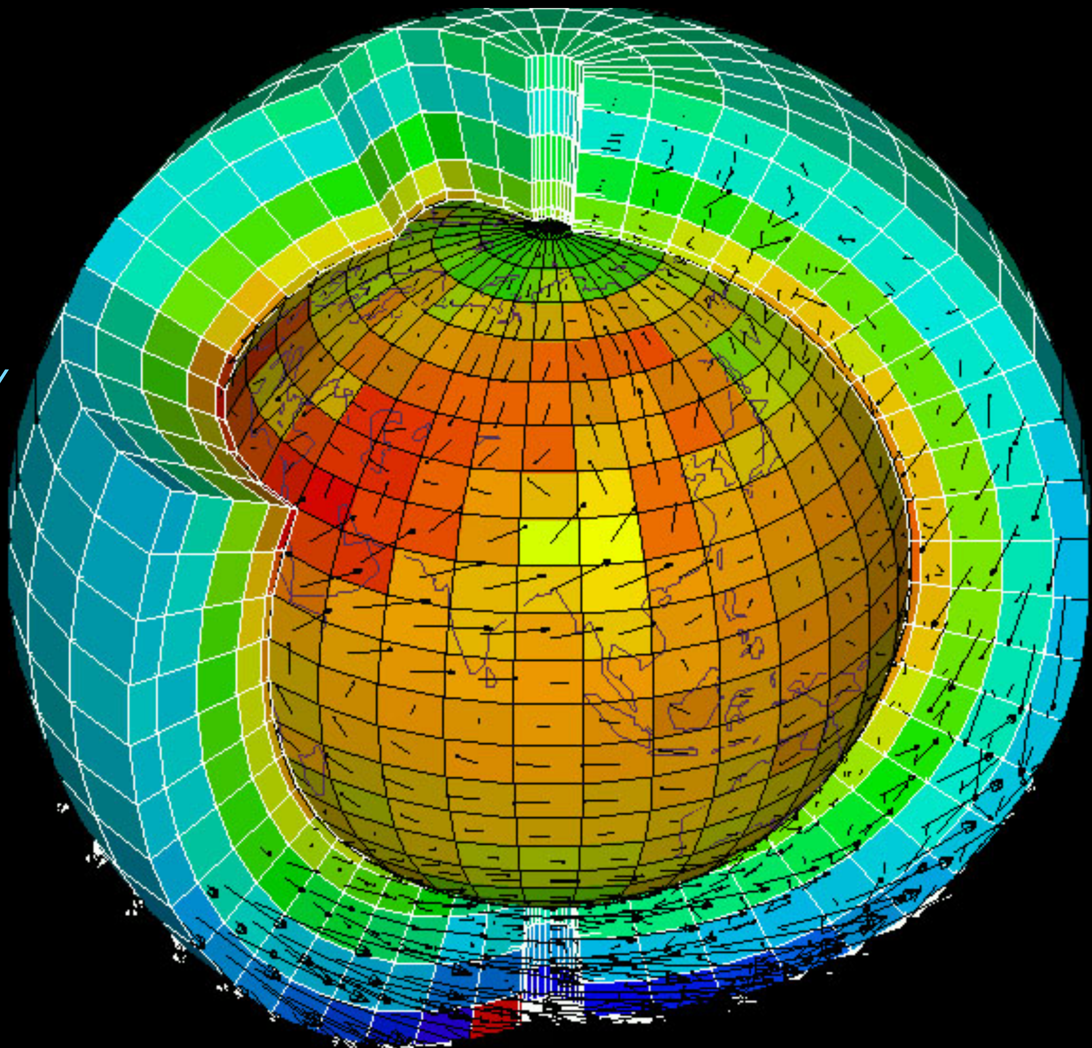
LAW THAT GOVERNS TEMPERATURE OF THE ATMOSPHERE



WHAT IS THE GCM?

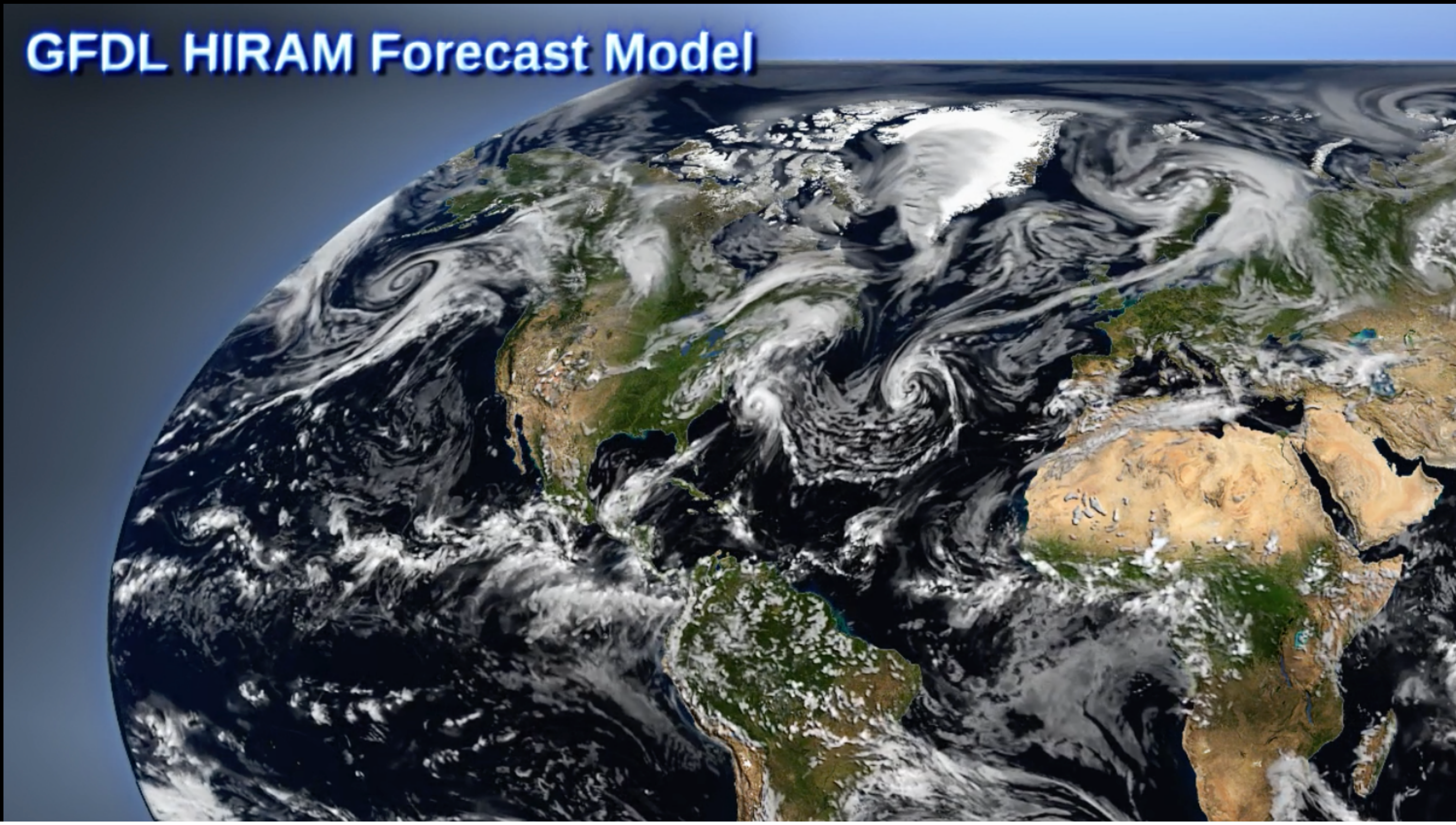
COMPUTER CODE THAT NUMERICALLY SOLVES EQUATIONS IN THE GLOBAL DOMAIN

- SHOULD SOLVE THE EQUATIONS IN EVERY "BOX"
- THERE IS NO WALL - EVERY BOX AFFECT ADJACENT BOXES AND THE EFFECTS QUICKLY SPREAD OUT
- BY SOLVING A SAME EQUATION SET IN EVERY BOX INTERACTING WITH OTHERS, WE GET..



BY SOLVING EQUATIONS IN EVERY BOX, WE GET..

THE EMERGING PATTERNS (WEATHER/ CLIMATE) AND THEIR EVOLUTION



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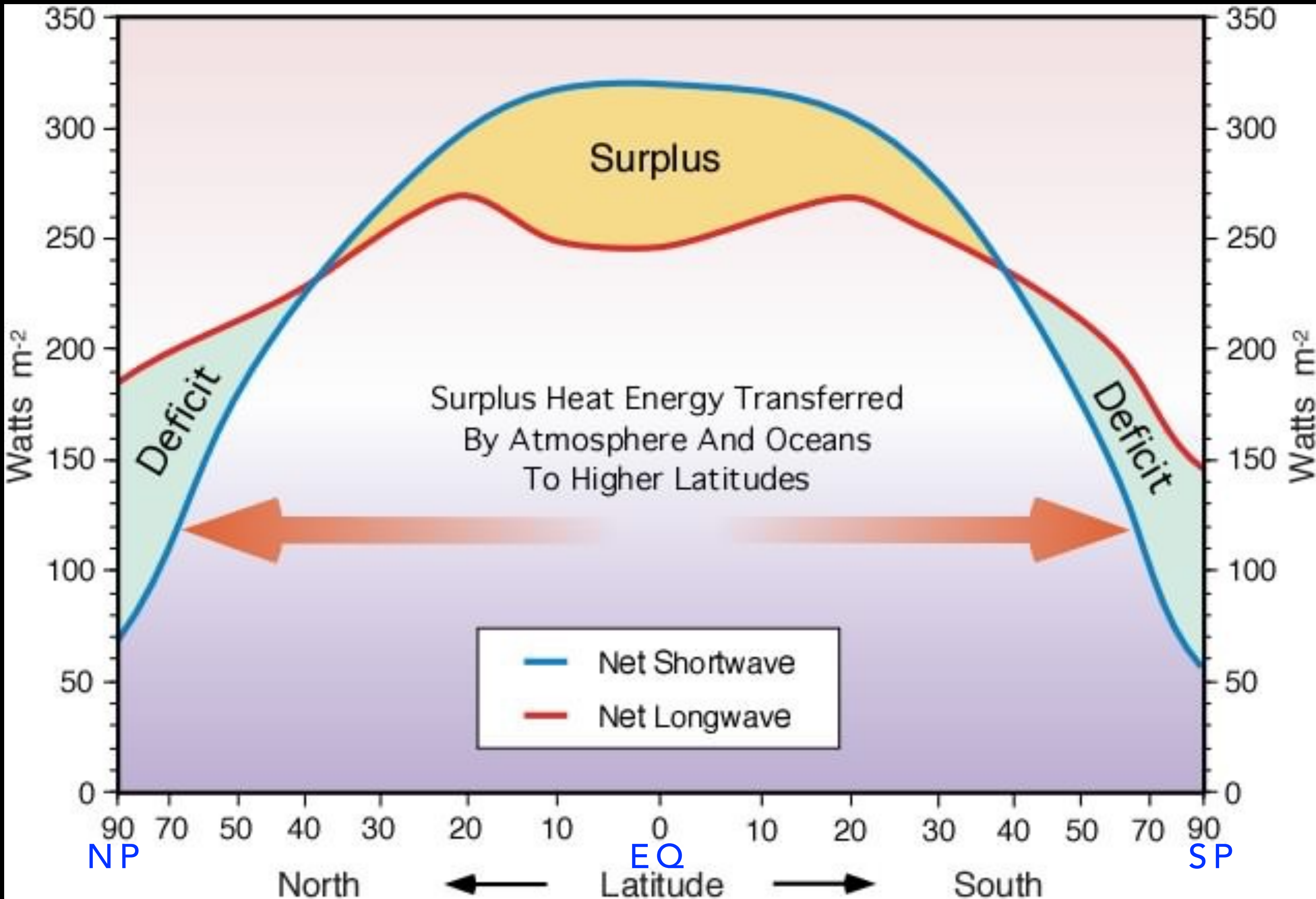
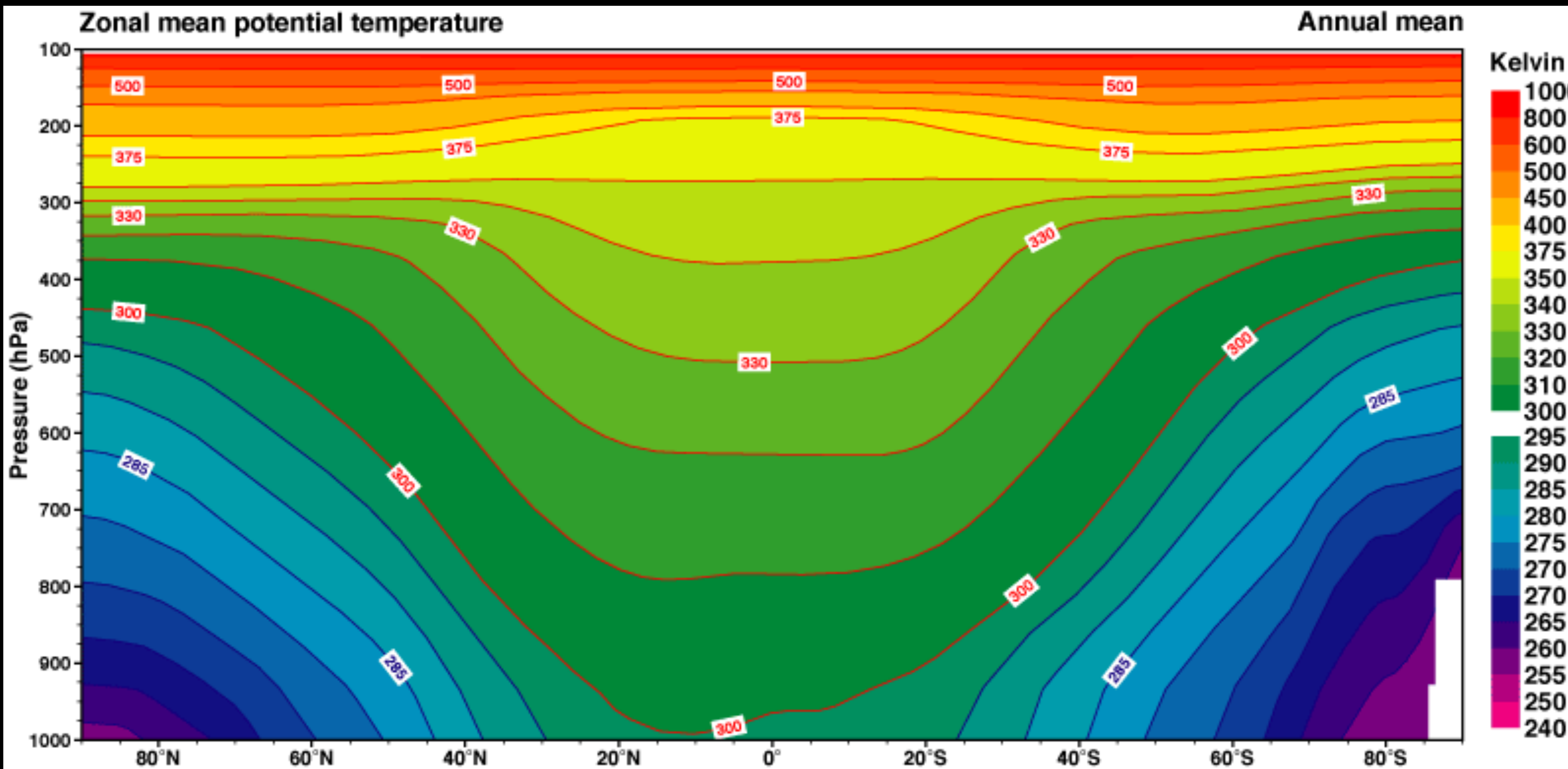
ZONAL MEAN RADIATION BALANCE



SOURCE: HTTP://WWW.PHYSICALGEOGRAPHY.NET/FUNDAMENTALS/7J.HTML

ERA40 (ZONAL MEAN FIELD)

POTENTIAL TEMPERATURE (ANN)

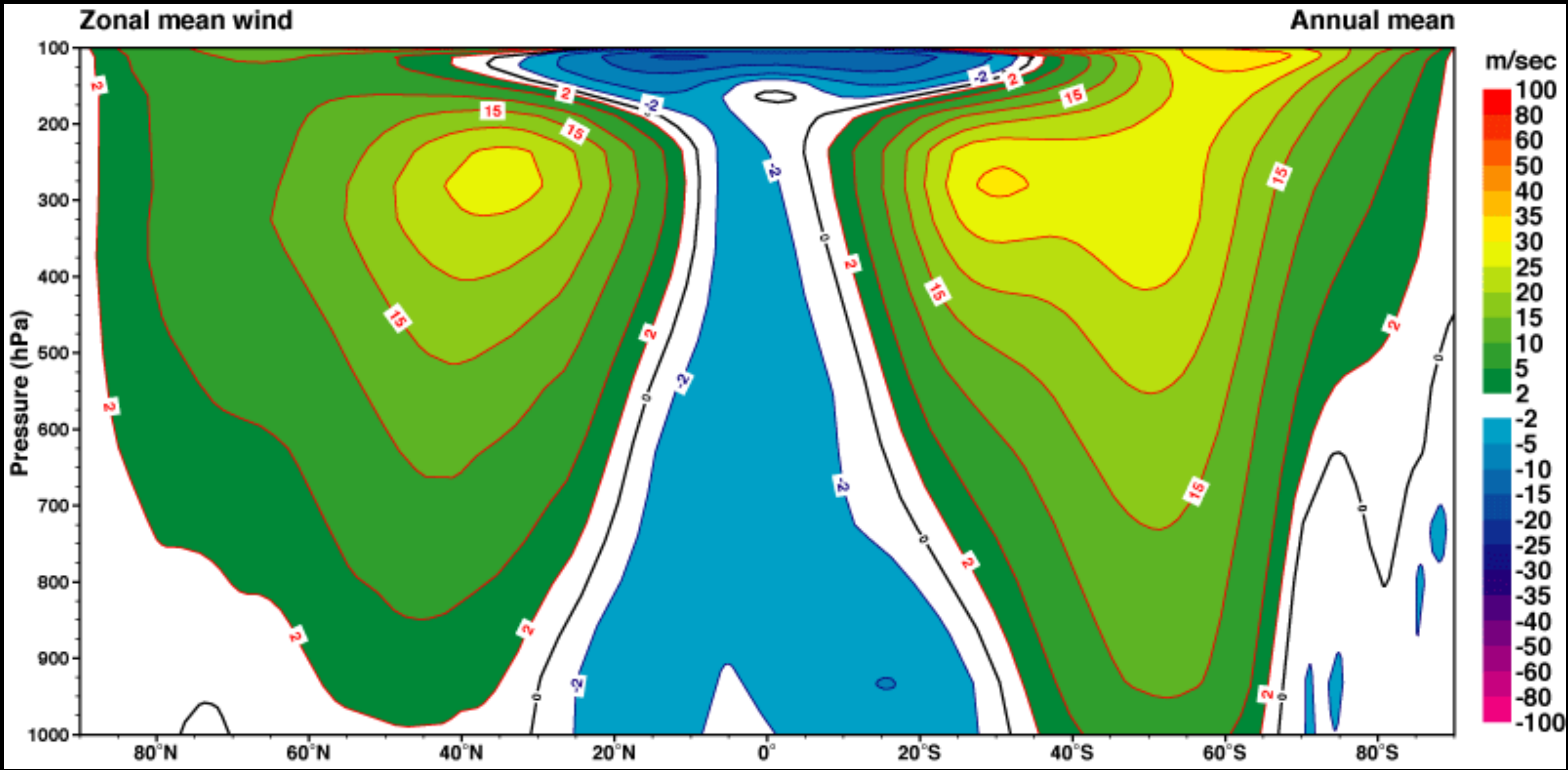


NP EQ SP

SOURCE: HTTP://193.63.95.1/RESEARCH/ERA/ERA-40_ATLAS/

ERA40 (ZONAL MEAN FIELD)

ZONAL WIND (ANN)



NP EQ SP

SOURCE: HTTP://193.63.95.1/RESEARCH/ERA/ERA-40_ATLAS/

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u	Wind speed in east-west direction
$\frac{\partial T}{\partial x}$	Temperature change (°C) per unit distance (m) in east-west direction
$u\frac{\partial T}{\partial x}$	?

GRADING

- Homework: 30%
- Quiz: 30%
- Final exam: 30%
- Participation: 10%

LECTURES

- **Handouts will be used in most lectures**
  - Handouts will make it easy to follow the derivations, and will enable us to take more time understanding the equations
  - You should pay attention to keep the handouts in an organized fashion
  - You need to write what you learned on it (otherwise, you will likely forget..)

HOW TO SUCCEED

- Lectures
  - Read the text book ahead and try to fill in the blanks in the handout
  - Bring questions to the class
  - Follow the lectures and ask question (make sure your brain wakes up before the class :))
  - Check your handout after the class (I'll upload the filled-in version)
- Get familiar with the mathematical concepts and use of math symbols as early as possible (I'll be happy to help)
- Talk (even argue) with peers about the materials

COURSE WEBSITE

- https://canvas.uw.edu/courses/1218607