# Single Column Model of Ocean and Atmosphere

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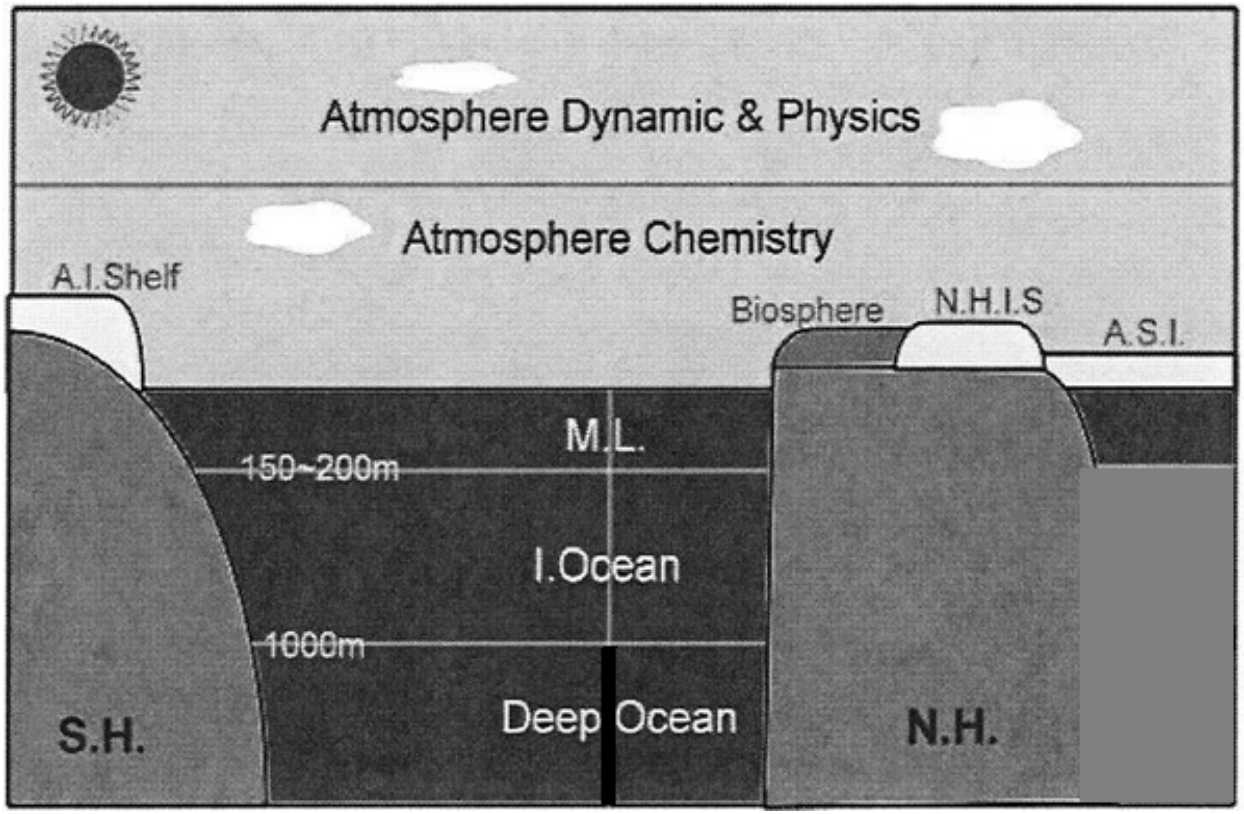
# 11-Box Climate System

- A simplified Earth's climate system
- Use to verify some global climatic changes




**N.H.I.S.**
Northern Hemispheric Ice Sheet

**A.S.I.**
Arctic Sea Ice

# Contents

- Single Column Model
- Energies
- Results

# Single Column Model

- A prototype of 11-box climate system
- An 1 dimensional representative energy (temperature) model consisting of N. H. ocean and the atmosphere above.
- Includes energy communication between ocean and atmosphere.

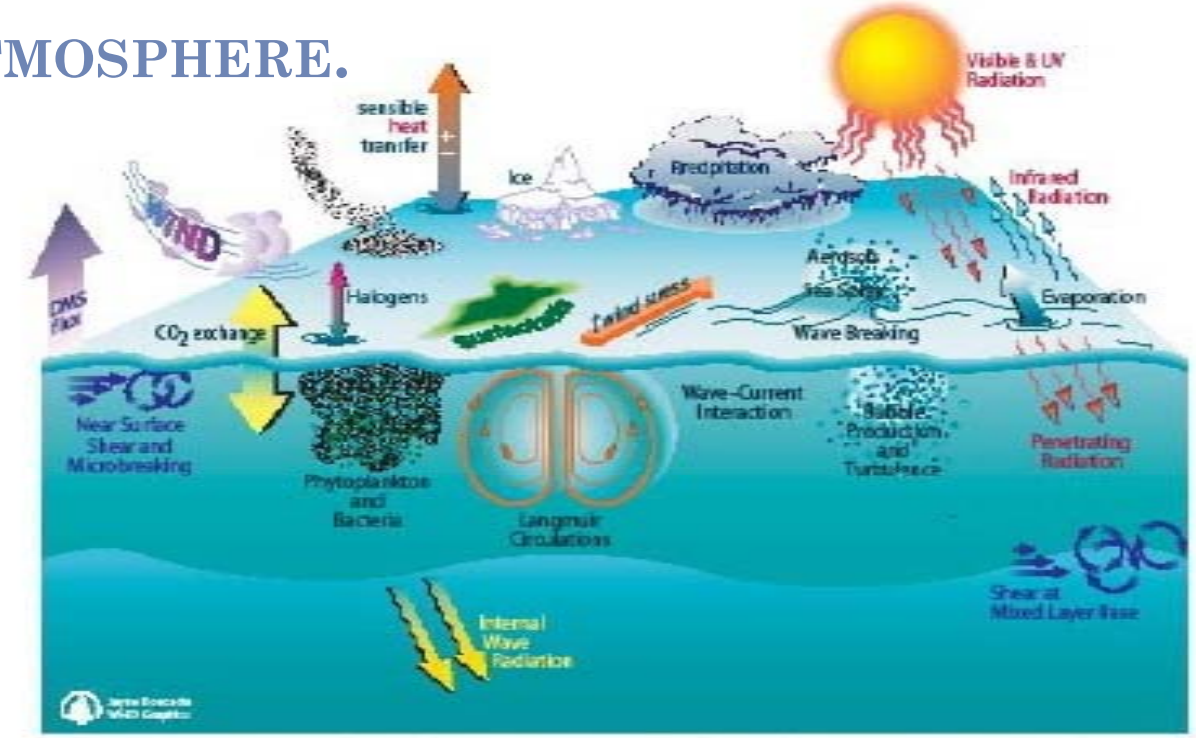



Figure H-1: Schematic of the air-sea interface with dominant processes and fluxes. ORION aims to significantly improve parameterization of air-sea exchange processes, thus allowing more accurate estimations of regional and global flux fields, and their spatial and temporal variability.

# STRUCTURE

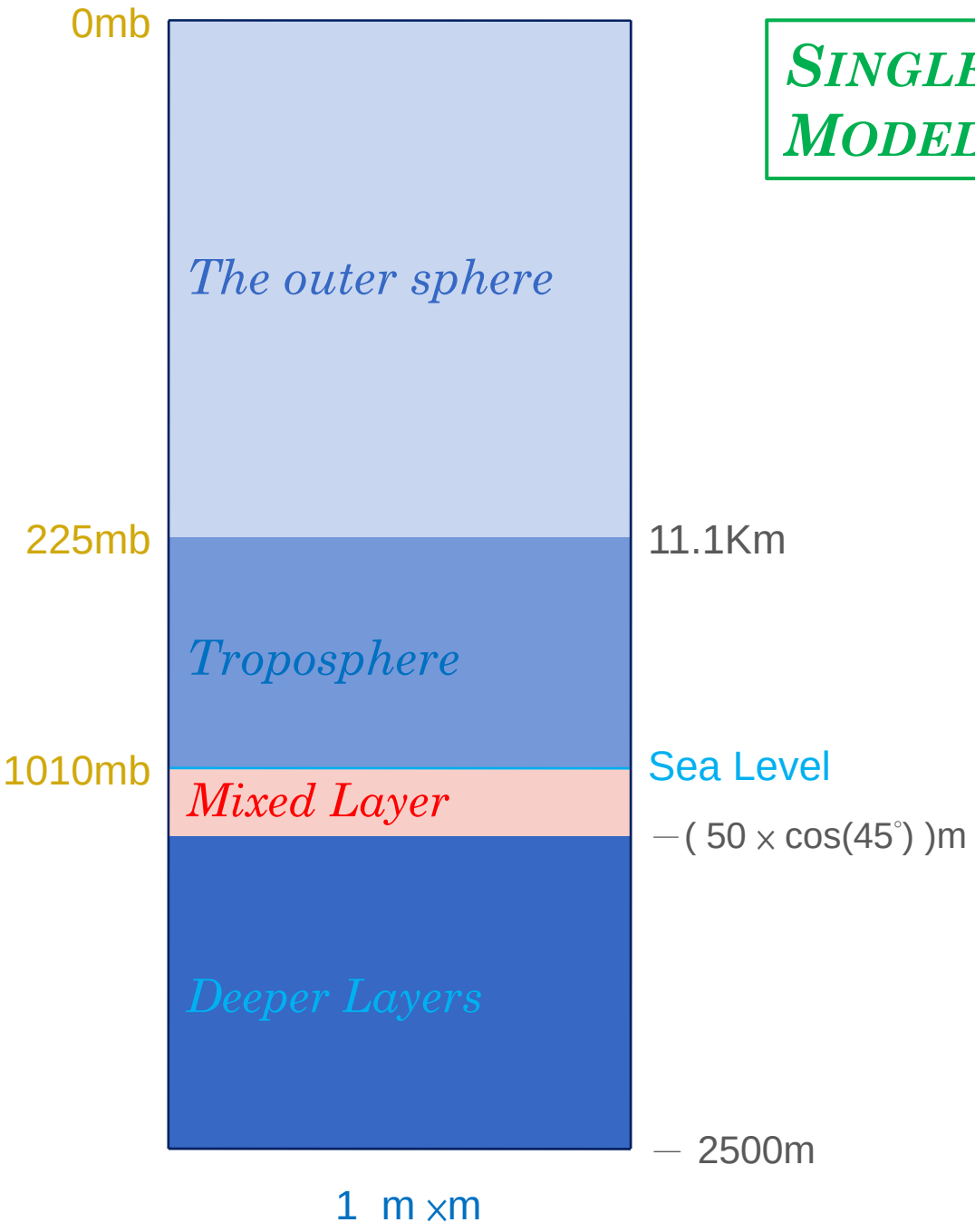
## *1. Atmosphere*

- Troposphere 1010mb~225mb ( 0~11.1 km )
- The outer sphere 225mb~0mb ( 11.1~ km )

## *2. Ocean*

- Mixed Layer 0~ 50 × cos(45°) m
- Deeper Layers thickness: 20 m

# SINGLE COLUMN MODEL



# Initial State of Atm.

- Temperature of troposphere :

  bottom (1010mb): 14.5°C

  top (225mb): − 56.5°C

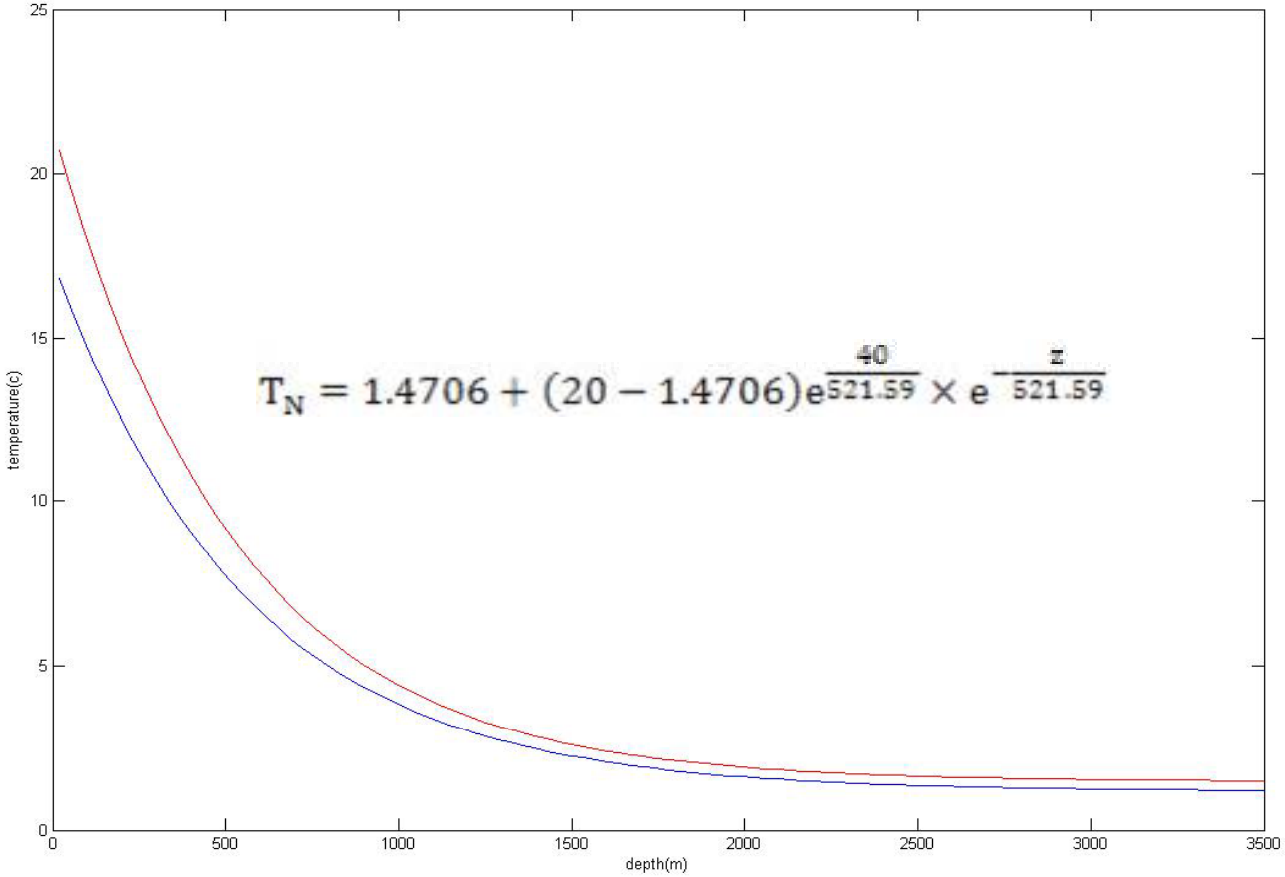
  Ps: −6.3964 °C/Km

- Temperature of the outer sphere :

  − 56.5°C ( fixed )

°C

# INITIAL STATE OF OCEAN




| Depth(m) | 40 | 300 | 500 | 1000 | 2000 | 3000 | 3500 |
|---|---|---|---|---|---|---|---|
| Model() | 20 | 12.7264 | 9.1415 | 4.4118 | 1.9030 | 1.5342 | 1.4706 |

# ENERGIES

## 1. Atmosphere & Mixed Layer

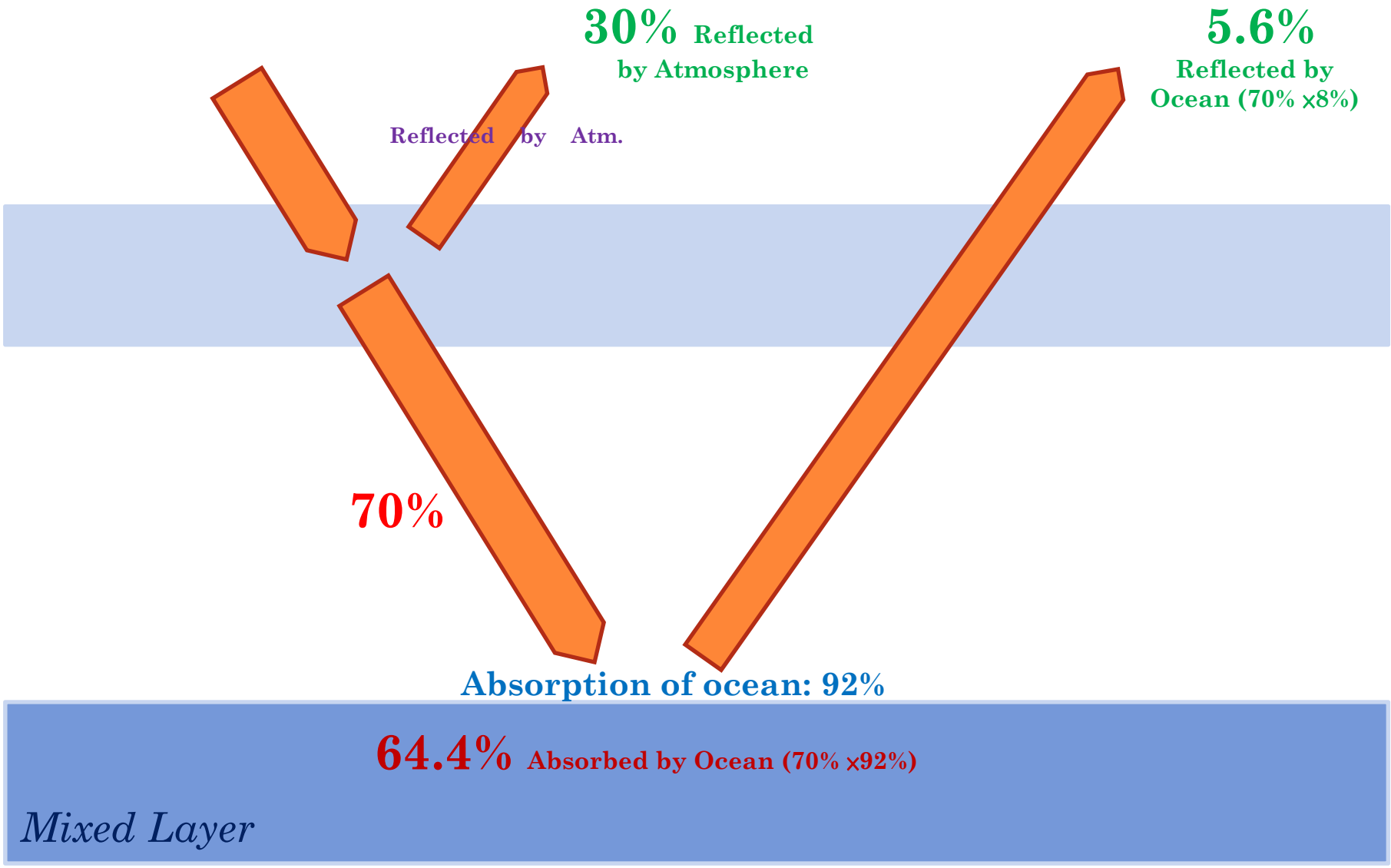
- Solar energy
- Blackbody Radiation
  ( ocean and greenhouse gas )
- Latent Heat
- Sensible Heat

## 2.Mixed layer & Deeper Layers

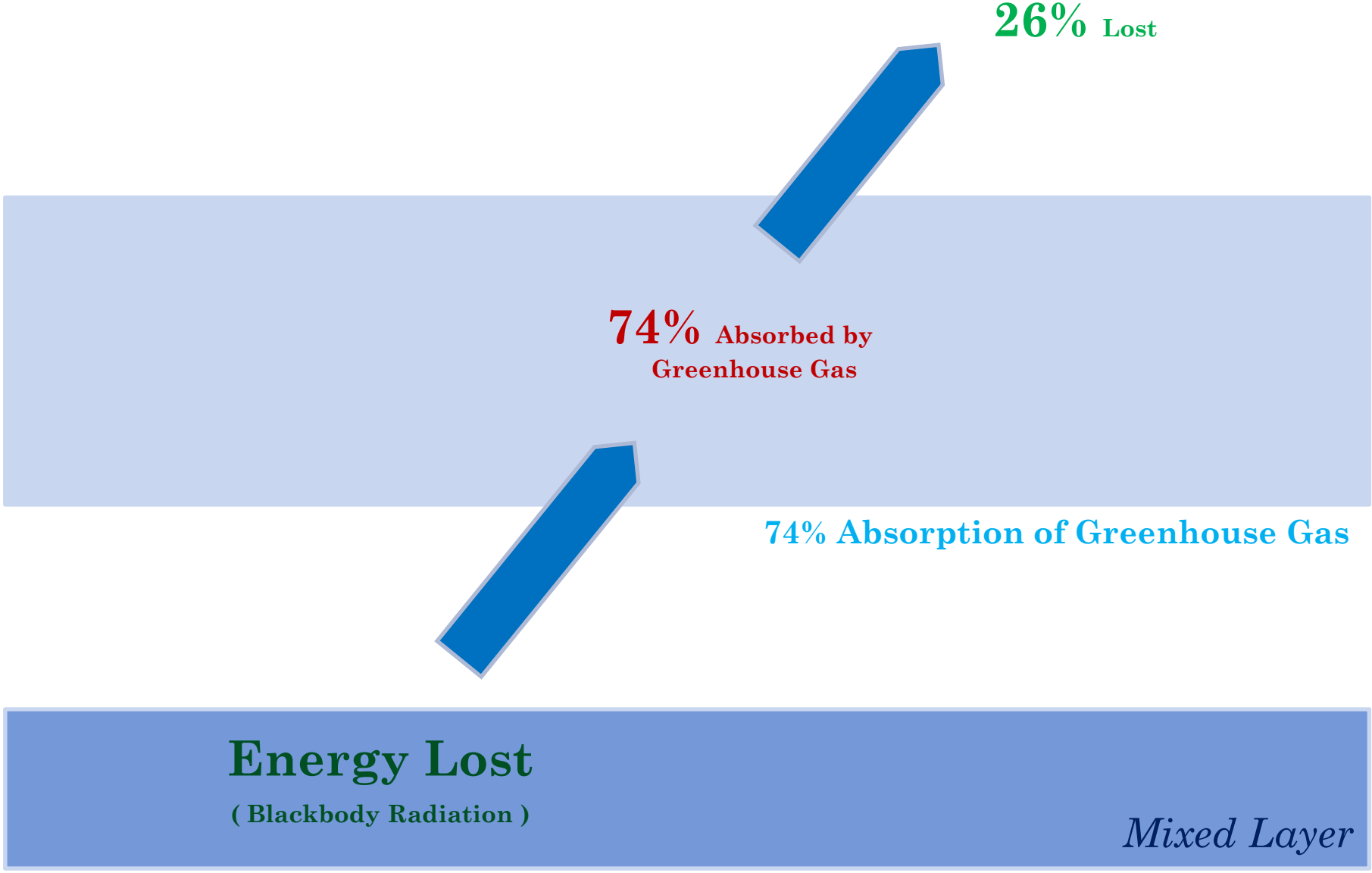
- Diffusion

# SOLAR ENERGY

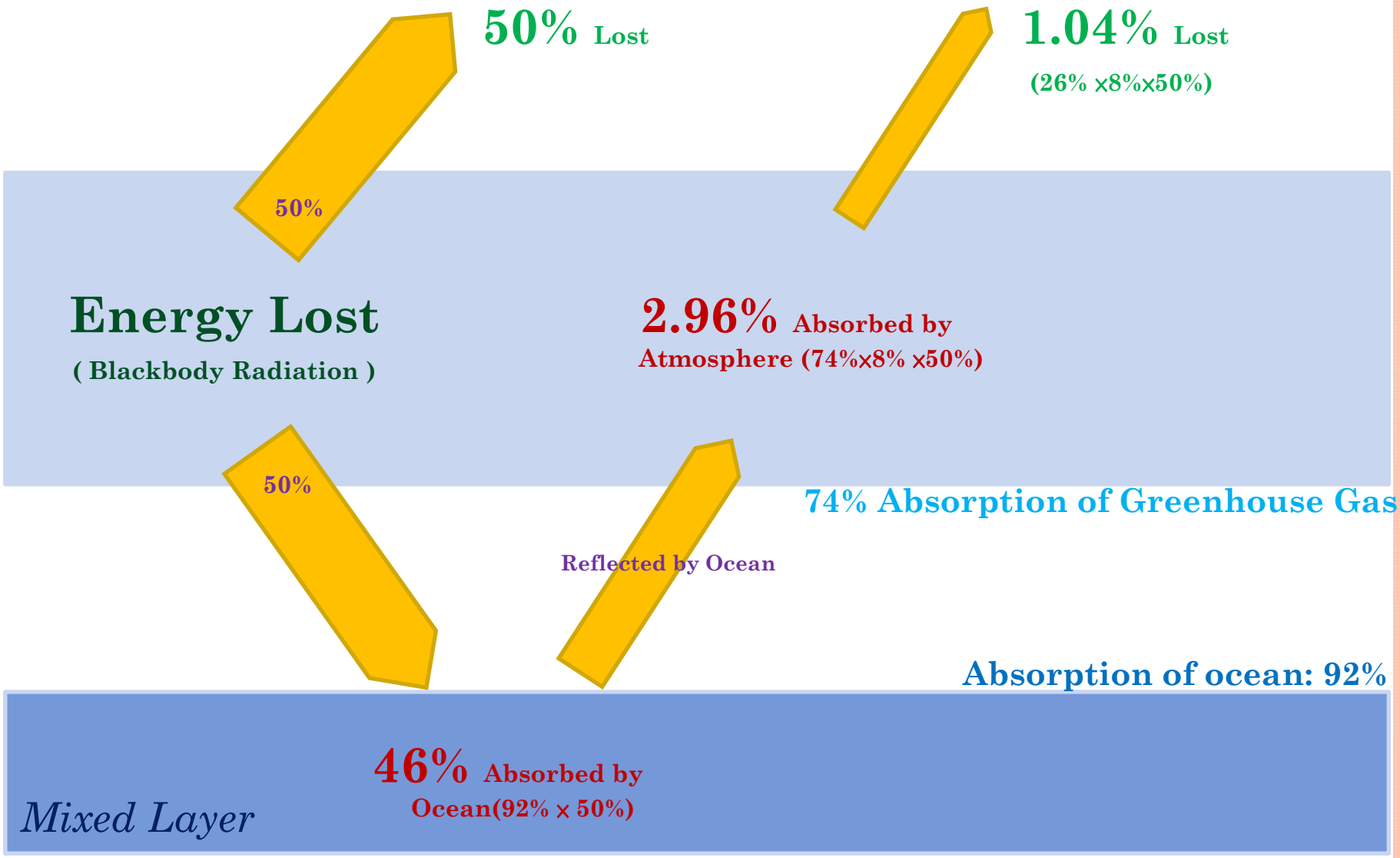
(BASED ON BERGER'S PAPER)



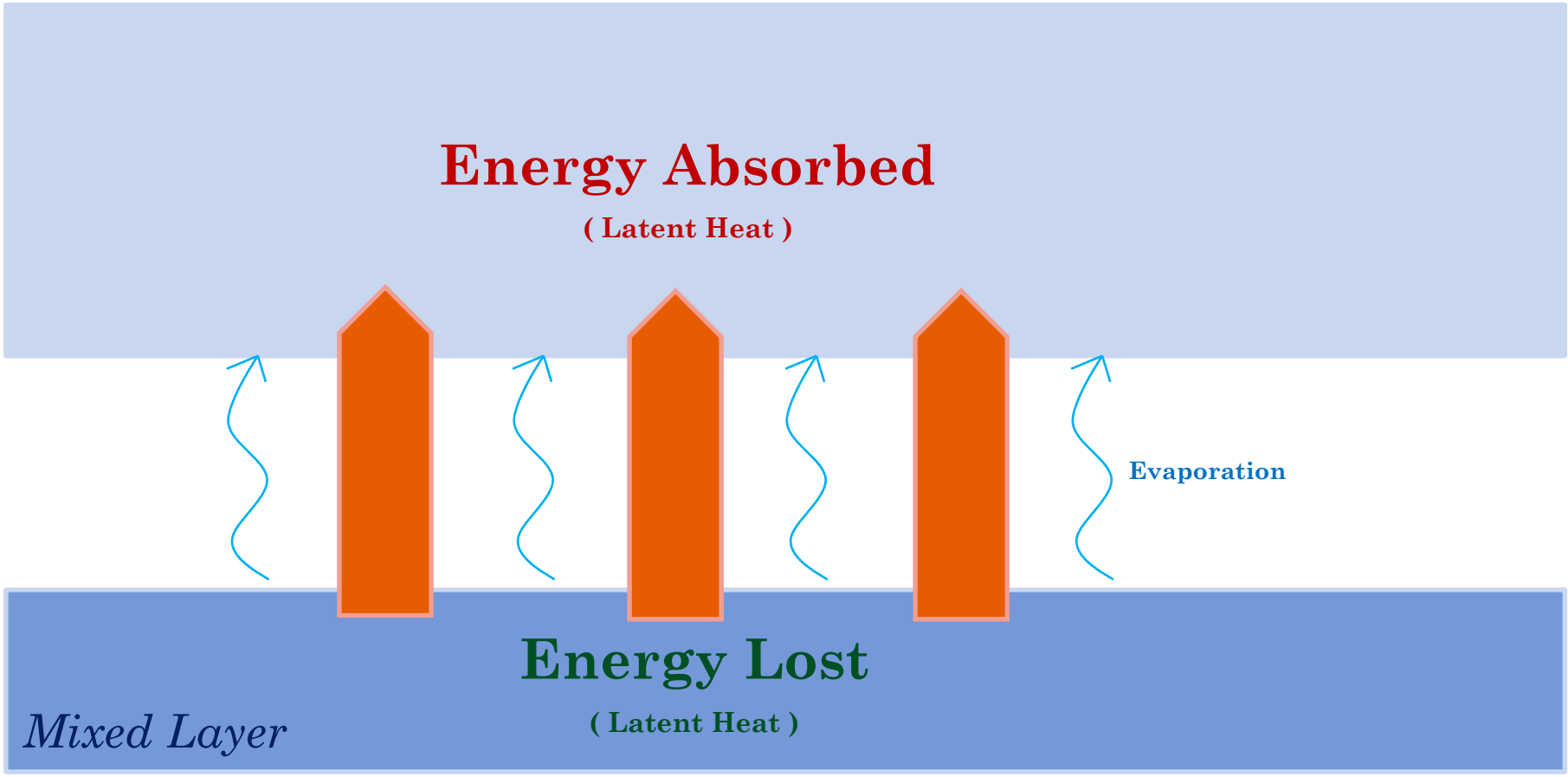
# Blackbody Radiation of Ocean



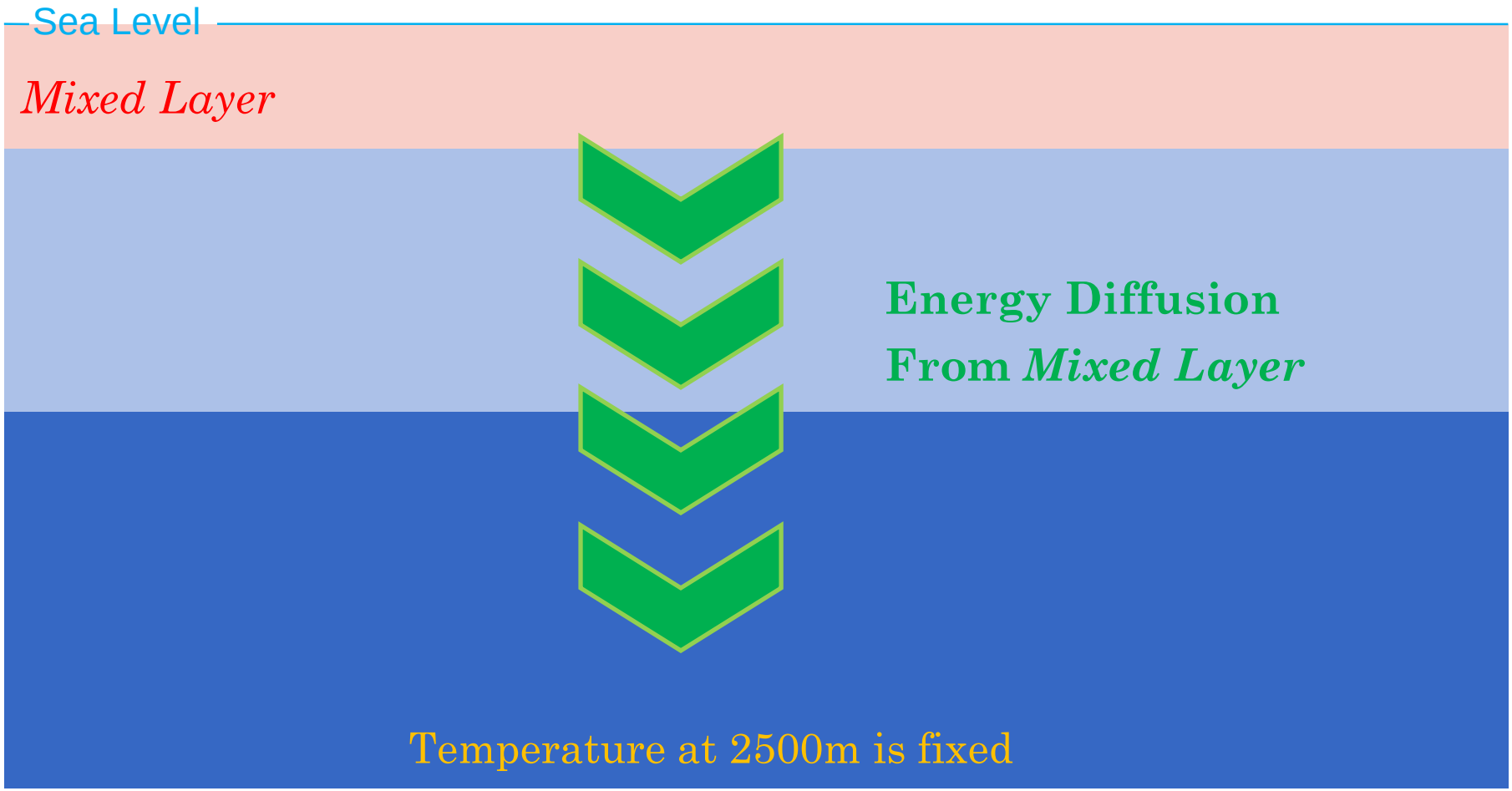
# Blackbody Radiation of Greenhouse Gas



# Latent Heat

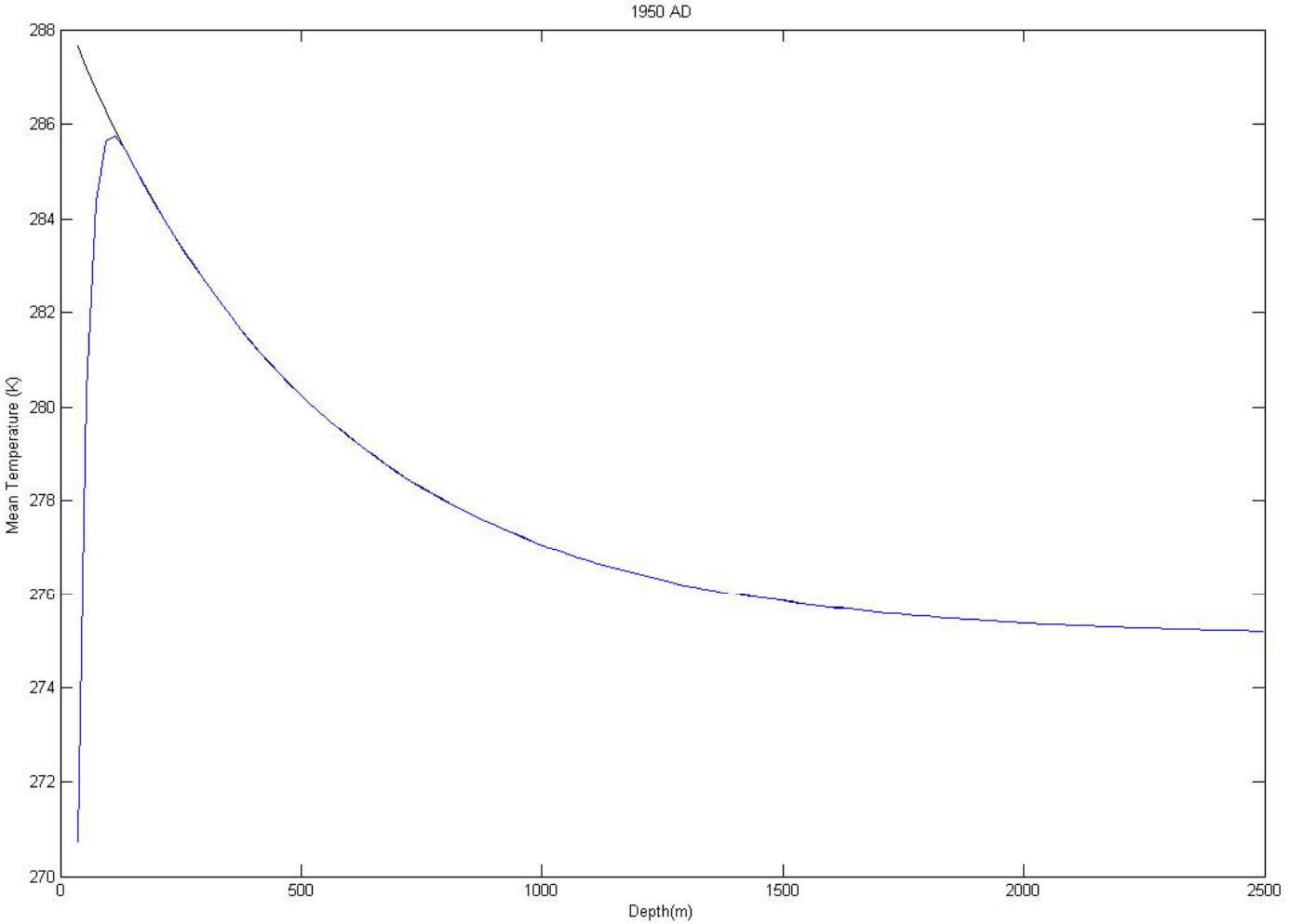

Energy Absorbed
( Latent Heat )
Evaporation
Energy Lost
( Latent Heat )
Mixed Layer

# DIFFUSION


Sea Level
Mixed Layer
Energy Diffusion
From Mixed Layer
Temperature at 2500m is fixed

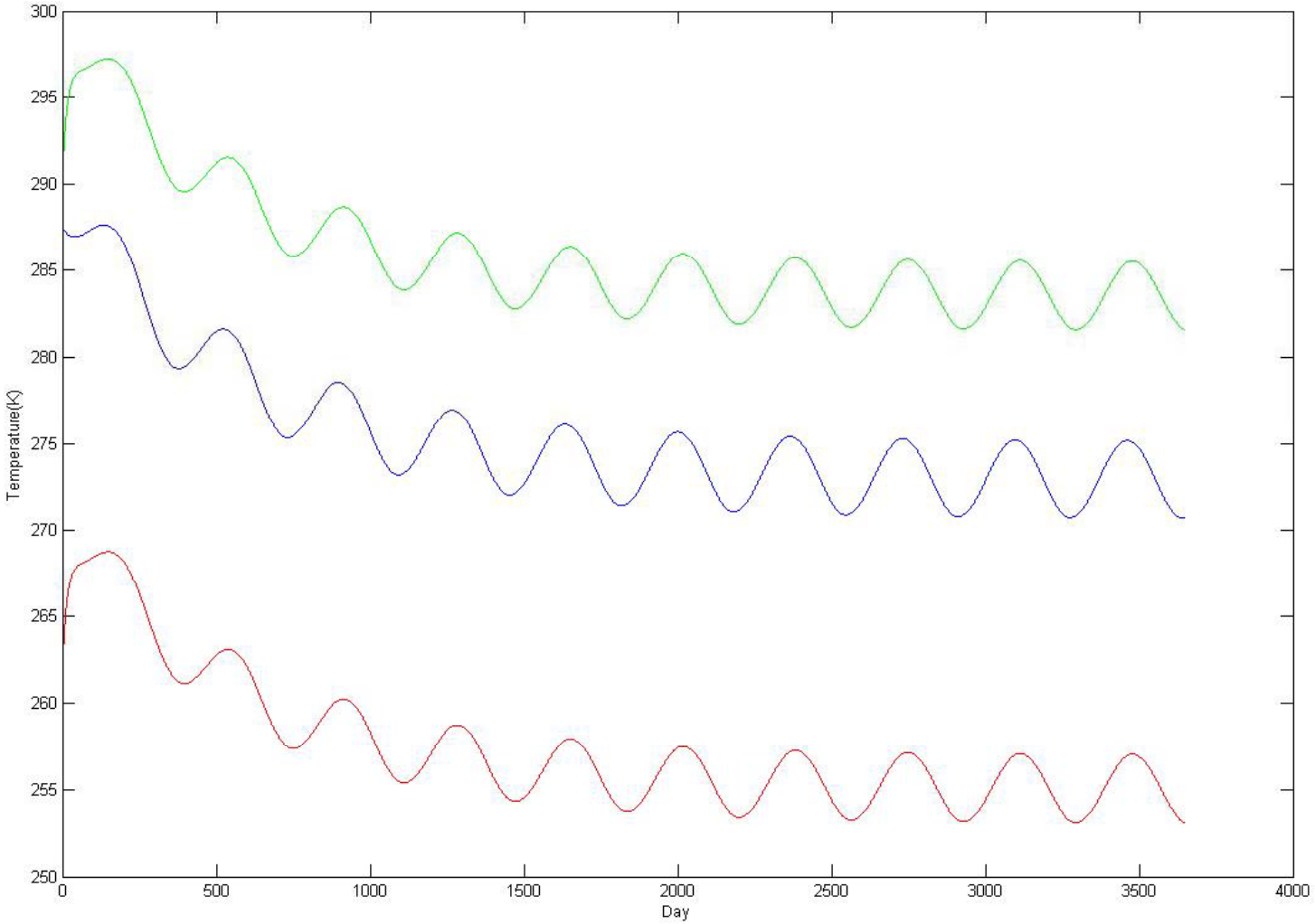
# RESULTS VER. 0325

## TEMPERATURE OF OCEAN




Black curve initial condition

Blue curve after 10 years




Red curve Temperature of Troposphere center (4.54Km)

Green curve Temperature of Troposphere bottom

Blue curve Temperature of Mixed Layer

# COMPARISON

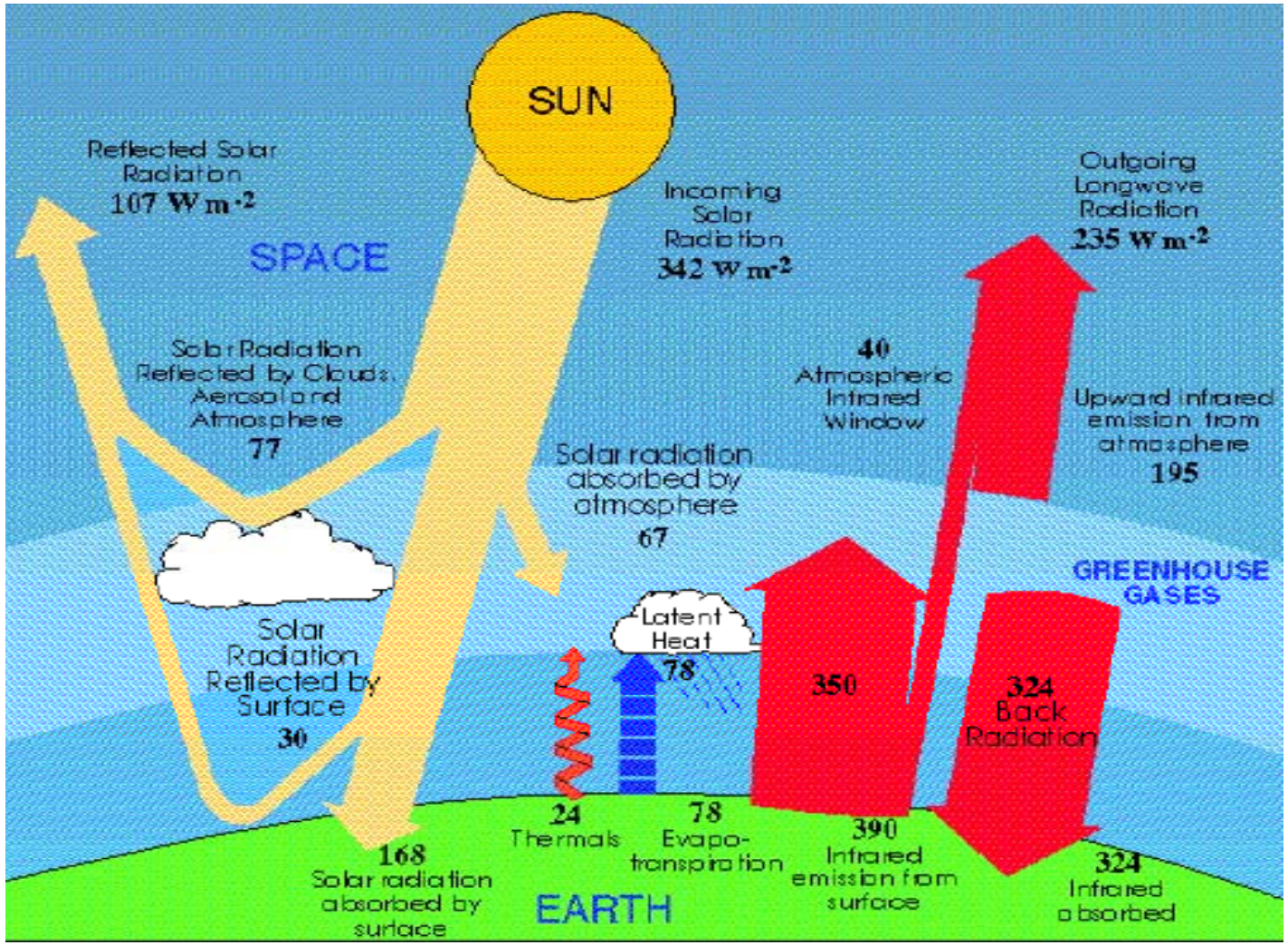



Fig. 1

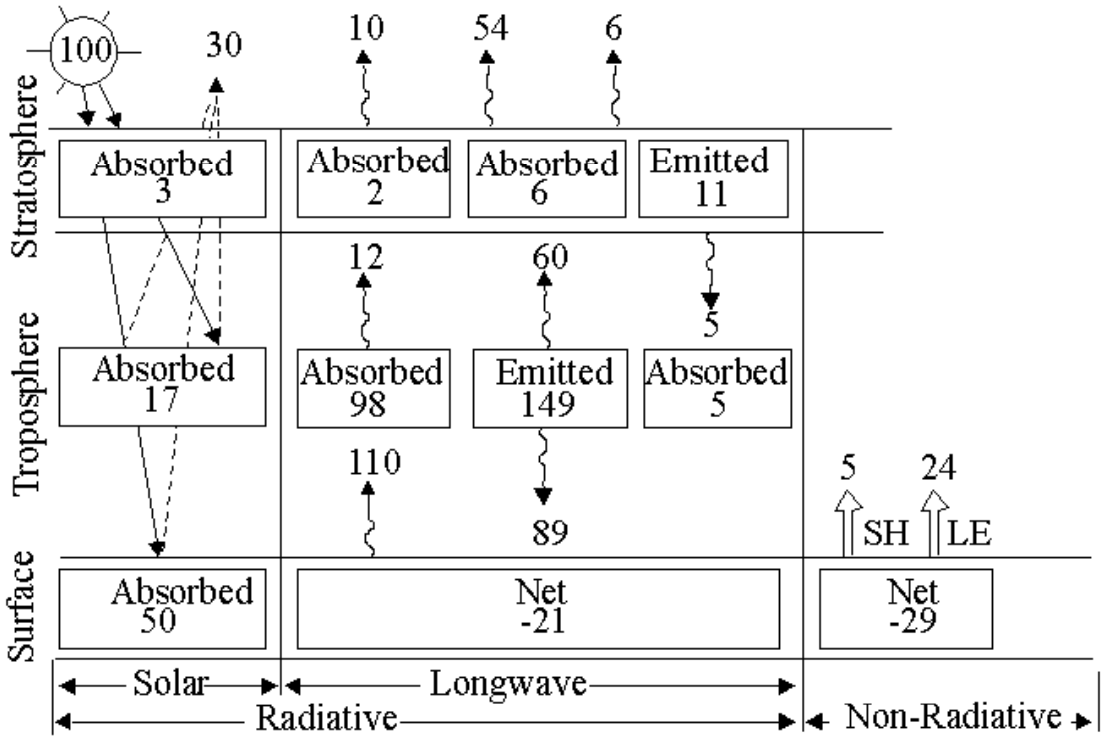



圖4-1：全球平均之大氣及地表的能量收支圖。100單位等於342Wm$^{-2}$
（來源：Hartmann, 1994）

**Fig. 2**

Solar energy from above figures

$$ES_F = 342\ {}^{W}/_{M^2} = 1.0785 \times 10^7\ {}^{Kj}/_{Year \times M^2}$$

Solar energy from model

$$ES_M = 6.4411 \times 10^6\ {}^{Kj}/_{Year \times M^2}$$

| *Energy* | *Figure 1* $(\times 1/ES_F)$ | *Figure 2* $(\times 1/ES_F)$ | *Model* $(\times 1/ES_M)$ |
|---|---|---|---|
| Solar Radiation | 1 | 1 | 1 |
| Blackbody Radiation of Mixed Layer | 1.1404 | 1.49 | 1.5414 |
| Blackbody Radiation of Atmosphere | 1.5176 | 1.1 | 1.1755 |
| Tot. Energy Absorbed by Mixed Layer | 1.4386 | 1.39 | 1.5407 |
| Tot. Energy Absorbed by Atmosphere | 1.2193 | 1.2 | 1.1754 |

Thank you for your listening.

END