

Balancing the Radiation Budget

A Jigsaw Exploration of the Global Climate System

Name: _____

Introduction

Up to this point we have largely treated Earth as a uniform object. In this activity, we will begin to explore spatial variations in Earth's energy balance. These variations play a critical role in driving the global climate system and creating regional climate variations.

This activity employs a "jigsaw" approach where you will be assigned to a specialty group to study a single map in depth (Day 1) and then a synthesis group where you will present a summary of your specialty group's analysis and then work as a team to synthesize the data sets to generate map and cross section concept sketches of Earth's radiation balance (Day 2).

All of the data sets we will be analyzing come from NASA's Earth Radiation Budget Experiment (ERBE - <http://science.larc.nasa.gov/erbe/>). The instruments for this mission were launched on three satellites from 1984-1986 and data were collected until 1990. The data sets we will be analyzing represent the January monthly average (climatology) over this period. All data can be viewed and downloaded from the International Research Institute for Climate and Society at Columbia University's Earth Institute (<http://iridl.ldeo.columbia.edu/SOURCES/.NASA/.ERBE/>). Although the mission is no longer active, ERBE-like measurements continue to be made by NASA's Clouds and the Earth's Radiant Energy System mission (CERES - <http://ceres.larc.nasa.gov/>).

Group Assignments

Specialty Group (circle your assigned group):

Short Wave In Short Wave Out Long Wave Out

Synthesis Group (circle/complete assignment below):

Hemisphere: Northern Southern

Longitude: _____ East West

Specialty Group Work (Day 1)

Learning Goals

By the end of this unit you should be able to:

- Explain the physical causes for spatial variation of each of the major components of Earth's radiation balance.
- Interpret maps of radiation data to identify patterns and hypothesize their physical causes.
- Create concept sketches to effectively communicate observations and interpretations.
-

Task 1: With your specialty group (assigned by radiation component), inspect your assigned map and identify major radiation patterns and infer their possible causes. *Be prepared to share your findings with the whole class.*

A few questions to get you started:

1. What data does your map present? How were they collected?
2. Where are the highest and lowest values located (note latitude/longitude)?
3. Do you see patterns related to:
 - a. Latitude?
 - b. Landcover (water, bare earth, vegetation, snow/ice)?
 - c. Other factors?
4. What physical processes introduced in the first three units might explain your observations?

Task 2: Continue working with your specialty group to create a concept sketch on the *specialty group base map* you have been provided that illustrates the patterns you observe in your data and the underlying processes that you hypothesize are responsible for creating these patterns. Your map should include a title, author's names, an explanation, and graphic and text annotations that highlight key features and interpretations. Examples of features you might choose to annotate include high and low values, general patterns, and exceptions to these patterns. *You will use this map to explain your data, observations, and inferences to your synthesis group in the next task.*

Task 2b: (Time permitting) Plot a profile of your specialty group data along your assigned synthesis group longitude line.

Take Home

How would you express the radiation balance in a simple equation using the three components from the specialty groups?

Map-based concept sketch rubric

| Level of achievement | Content/Comprehension | Communication/Presentation |
|-----------------------------|---|---|
| Exemplary | <ul style="list-style-type: none"> - Map thoroughly illustrates the patterns in the data while not simply copying the original presentation - Map labels and symbols provide clear and correct explanation of underlying physical process(es) <p style="text-align: center;">(8 points)</p> | <ul style="list-style-type: none"> - Map clearly labeled with title, primary author's name and group member's names - Map elements clearly and accurately drawn and labeled directly or explained in legend <p style="text-align: center;">(2 points)</p> |
| Adequate | <ul style="list-style-type: none"> - Map illustrates primary patterns in data, but may miss secondary details - Labels and symbols capture main process(es), but may miss some details or contain some minor errors <p style="text-align: center;">(6-7 points)</p> | <ul style="list-style-type: none"> - Some basic map information missing - Map elements lack some detail or are not clearly drawn or labeled <p style="text-align: center;">(1 point)</p> |
| Needs improvement | <ul style="list-style-type: none"> - Map misses important patterns in data - Important processes are ignored or incorrectly explained <p style="text-align: center;">(5-0 points)</p> | <ul style="list-style-type: none"> - Map lacks detail or is uninterpretable <p style="text-align: center;">(0 points)</p> |