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19-08 Focus: Radiative Fluxes

1) What (if anything) makes radiative fluxes at high latitudes different from radiative fluxes in the tropics or mid latitudes?

- The extent of the ice is critical.
    - Currently not taken into account in satellite radiative products
    - Impact of this problem is unknown
- Bidirectionality of snow is a big issue we are now understanding
    - CERES – applies to total solar
    - Suspected for IR, but not yet confirmed
- Cloud detection is a big issue in determining SW fluxes
    - example from slide 1
    - Probably need more channels to resolve this problem
- Spatial sampling problems
    - high lats sampled by polar satellites, which reduces the sampling at the poles compared to geosynchronos observations
    - need much more samples per day (MODIS is better)
    - See fig. 2

A) From an observational perspective

i) Lack of sufficient ground truth

Need to compile inventory of ground observations: long term (e.g., Barrow, Alaska; South Pole station); short term: (various experiments (e.g. SHEBA).

ii) Quality of ground observations

iii) Cloud detection over bright surfaces

Figure 1 - as evident, the first two products are similar even at the poles. The reason - both use the ISCCP cloud info. MODIS shows less radiation in polar vregions, most likely, due to better cloud detection over snow.

iv) Low sun angles

v) Limitation of observations from geostationary satellites that represent diurnal cycle

Figure 2

vi) Less accurate auxiliary information

B) From a modeling perspective

I) ADD summary of comparisons between models (reanalyses) and other data sets.

Will explain basic differences between models.

2) Are all flux parameterization similar in their estimates of fluxes? (No)

A) Why not?

i) Basic methodology

a) TAO is very similar (even where there are no data

b) Changes in time integration can be quite important

- Slide 4 shows difference between analytic solution and 20m interpolation

ii) Radiative transfer scheme

a) Differences in angular models are rather substantial

b) Trouble distinquishing between cloud or heavy aerosol

c) Polar problems are also distinquishing the difference between cloud and snow

d) MODIS has about 36 useful channels to help with this, compared to the four useful channels for older satellite

iii) Cloud parameterization

a) Cloud distribution (in space) is a problem for algorithms and for comparison data

iv) Other issues

MODIS sampling is space and time is not sufficient to full sampling at the 5km resolution.

- 5km cells sampled every 30km
- Sampling in time is very scattered to reduce biases
- MODIS samples many crucial variables at the same time, whereas previous approaches had to combine data from many satellites

v) Validation: note that BSRN comparisons are much worse for the high latitude sites.

For "other issues" see:

Figures 3. and 4

Will explain.

B) What additional physical processes do we need to consider (over ice and over water)?

Figures 5 and 6.

i) Glint over water: is there snow over ice?; melting ice?

a. Melt ponds are not considered

b. Differences between ice and snow are small compared to either and water

c. The assumption of a constant extent causes some big problems

ii) How much would it change the absorbed heat if albedo wrong?

a) Do leads have a different albedo?

At issue: Figures 7, 8, 9 – non of these changes are currently accounted for in satellite methods for SRB

iii) Other

C) What accuracy are we likely to be able to achieve with current algorithms? Are there issues in addition to those mentioned in (2)

Did some preliminary comparisons: Table 1.

i) Need more ground truth to have a good error estimate over large areas

ii) The spatial/temporal sampling.

- 5km product shows a lot of high resolution features
- Temporal sampling is currently twice per day (from TERRA and AQUA)
  - daytime only!
- Sampling is better at high latitudes
- Overlapping satellite swaths helps give more times

iii) Can we separate these issues?

Figures 10, 11, 12, 3, 14 can be done over polar regions at 5 km resolution.

3) What do people think it will take to do better?

i) From an observational perspective

a) high latitude reference sites

b) BSRN quality sites on OceanSites and oil platforms

c) Inventory of available

ii) From a modeling perspective

- cloud base height is a problem for the IR fluxes
  - could cause a bias between land and sea for LW
  - SW is not likely to be as big a problem
- water vapor is a big difference between models and satellites
- Vertical structure is questionable from both model and satellite
- IR methods are more problematic at high latitudes

Chris – comments

- at sea Instruments and techniques have improved at lot since TOGA COARE
- Accuracy seems to be better than satellite
- Satellite products are probably much better than reanalyses (almost useless)
  - Errors in solar radiative fluxes are possibly less than for surface turbulent fluxes
- At high latitudes, LW flux errors roughly cancel SW errors

Action items:

i) Ship locations with radiation data (from Smith)

ii) Summary of radiative flux data from ship data

a. Include Russian data and from fixed platforms
    1) Include TAO/TRITION and PIRATA
b. What is the quality of these types of data
c. Sampling at high latitudes?
d. IPY

iii) Rachel – repeat comparison for ocean site

iv) Consider putting on oil platforms
a. Some extra logistics
b. Will recommends a high latitude group
c. GofM towers?