ISCCP

cloud effects on radiative fluxes

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Outline

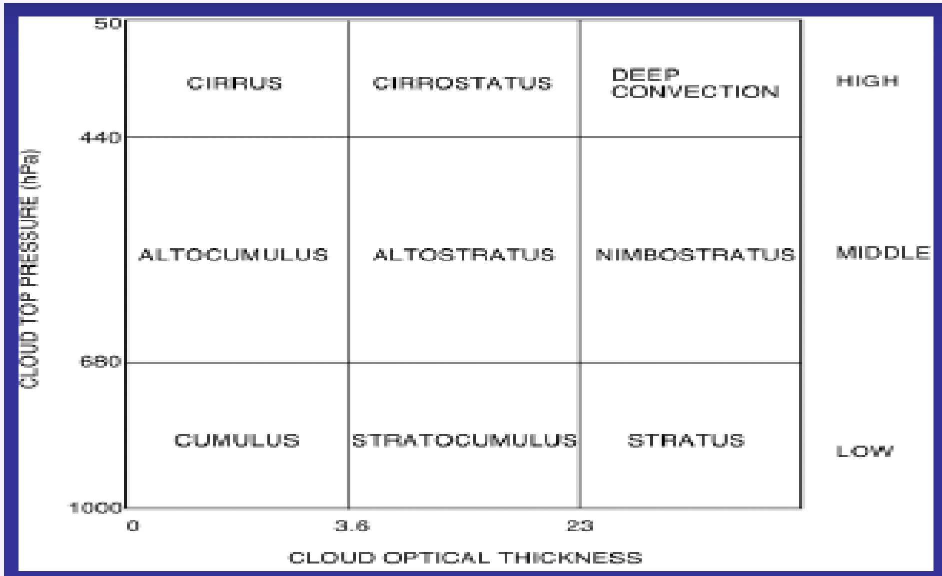
- ISCCP cloud statistics
    - comparison of maps to other data
- ISCCP flux data
    - comparisons to other cloud climatologies
    - comparisons to IPCC simulations
  - weaknesses
    - energy only approximately balanced
    - solar trace gas absorption and aerosol representations require updates.

I. ISCCP cloud statistics

- **stratification of** ***(3hourly)*** **cloud properties**
  - **by cloud altitude (high *440hPa* mid *680hPa* low)**
  - **by cloud optical depth (0 --- 3.6 --- 23 ---)**

- **products** ***(combining cloud-data at the same level)***
  - **cloud cover**
  - **cloud opt.depth**

- **comparison**
  - **to other data**



Rossow et al. 1996, ISCCP Documentation of New Cloud Dataset

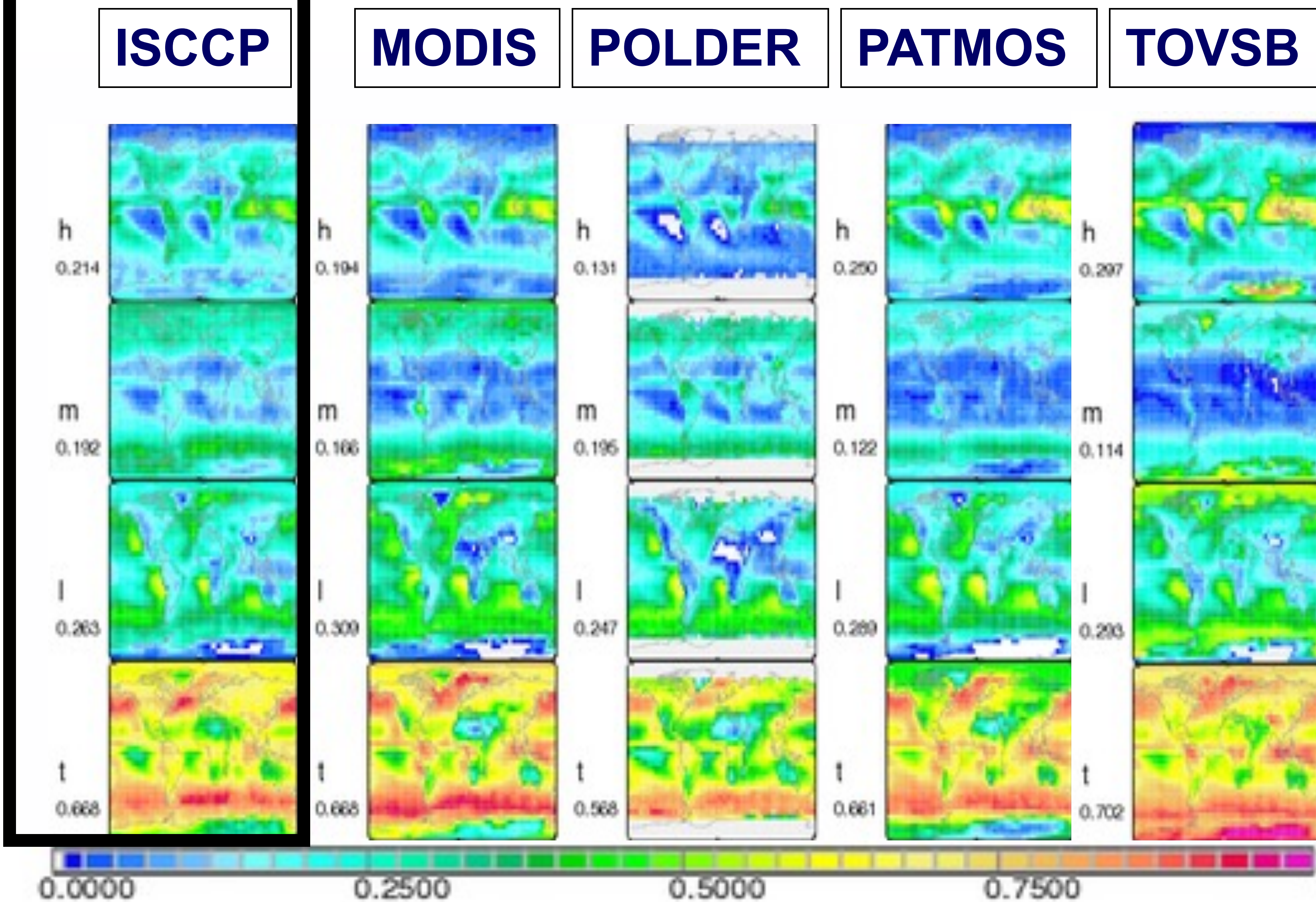
cloud-cover – annual maps

high
.21 ⇨

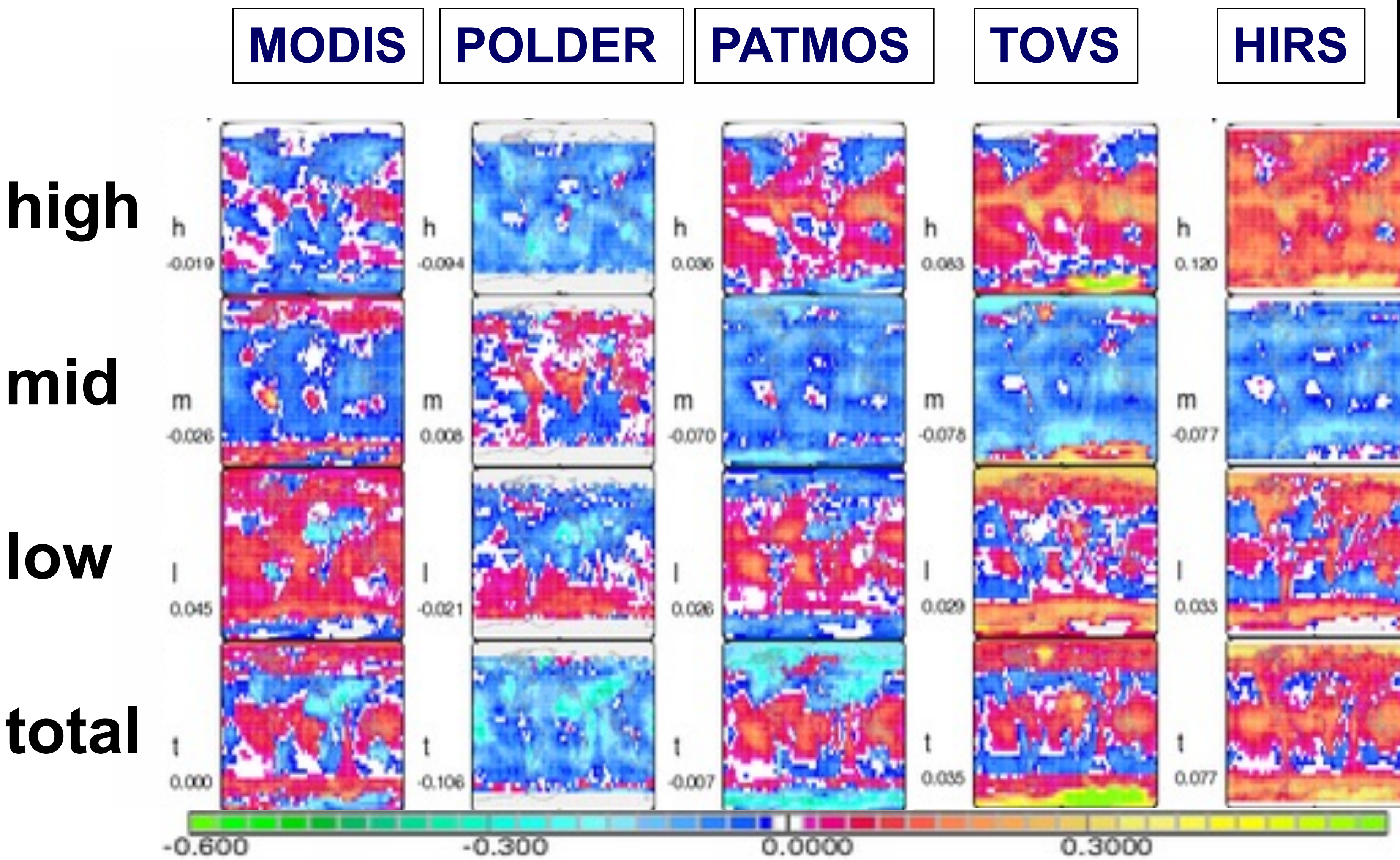
mid
.19 ⇨

low
.26 ⇨

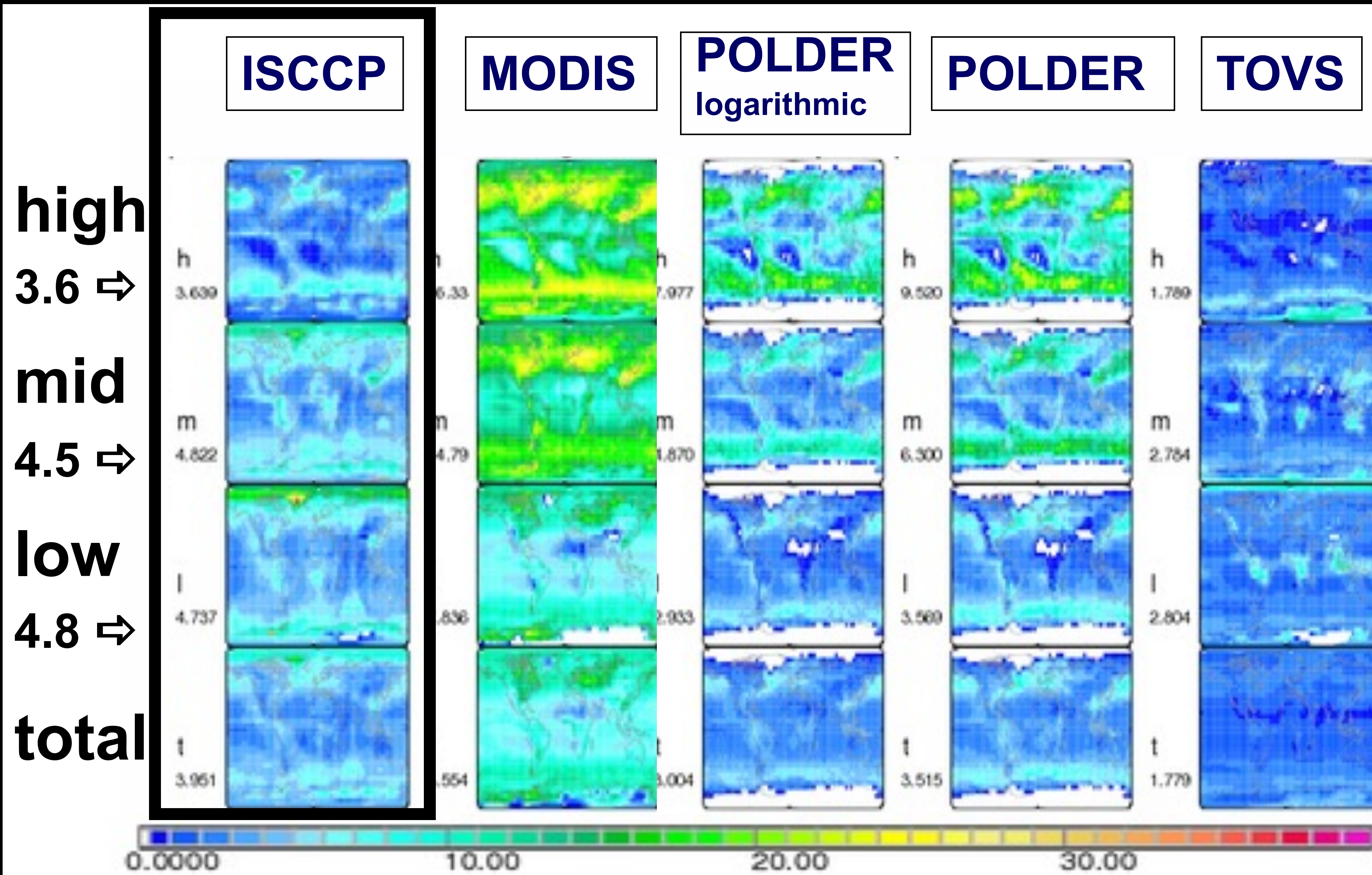
total
.66 ⇨



Δ cloud-cover – diff to ISCCP



cloud opt.depth – annual maps



summary 1

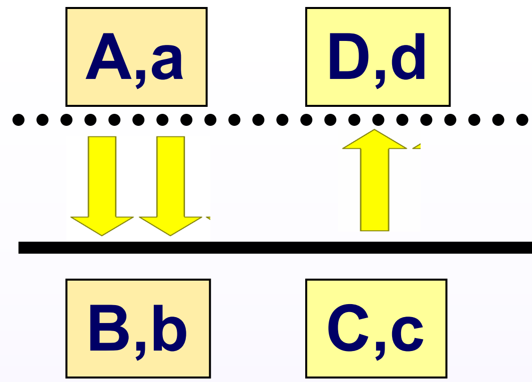
- ISCCP is probably the most applied cloud-climatology
  - reference to new climatologies and in modeling
- differences to other cloud-climatologies need to be understood *(e.g. GEWEX- effort)*
  - community demands certainty – not diversity
- uncertain aspects can be revisited as independent data are becoming available
  - cloud over-lap assumptions with CALIPSO data
  - microphysical detail by MODIS, POLDER or SEVIRI
  - missed thin clouds (τ <0.3) with CALIPSO, TOVS ..

II. flux fields

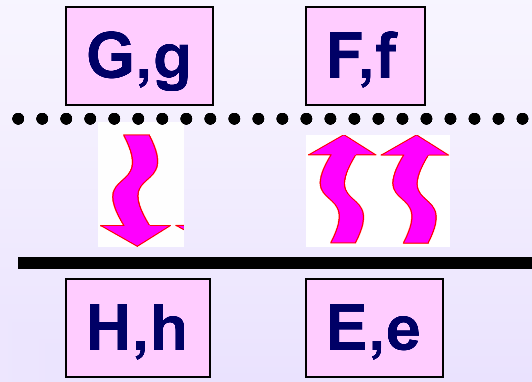
- cloud data modify clear-sky fluxes
  - 'CLOUD EFFECTS' (CE)
    - reduce downward solar fluxes to the surface
    - increase planetary albedo (solar fluxes to sapce)
    - reduce IR losses to space (greenhouse effect)
    - Increase downward IR fluxes to the surface
- multi-annual averages are compared
  - ISCCP (1984-1995)
  - SRB (1984-1995) *… uses ISCCP clouds*
  - CERES (2000-2003)
  - IPCC 4AR (1984-1995) *… 20 different models*

radiative fluxes - labeling

- **solar** *(maps)*
  - A/a all/clear-sky solar DN at ToA
  - B/b all/clear-sky solar DN at surf
  - C/c all/clear-sky solar UP at surf
  - D/d all/clear-sky solar UP at ToA
  - X,x (C/B, c/b) solar albedo at surf

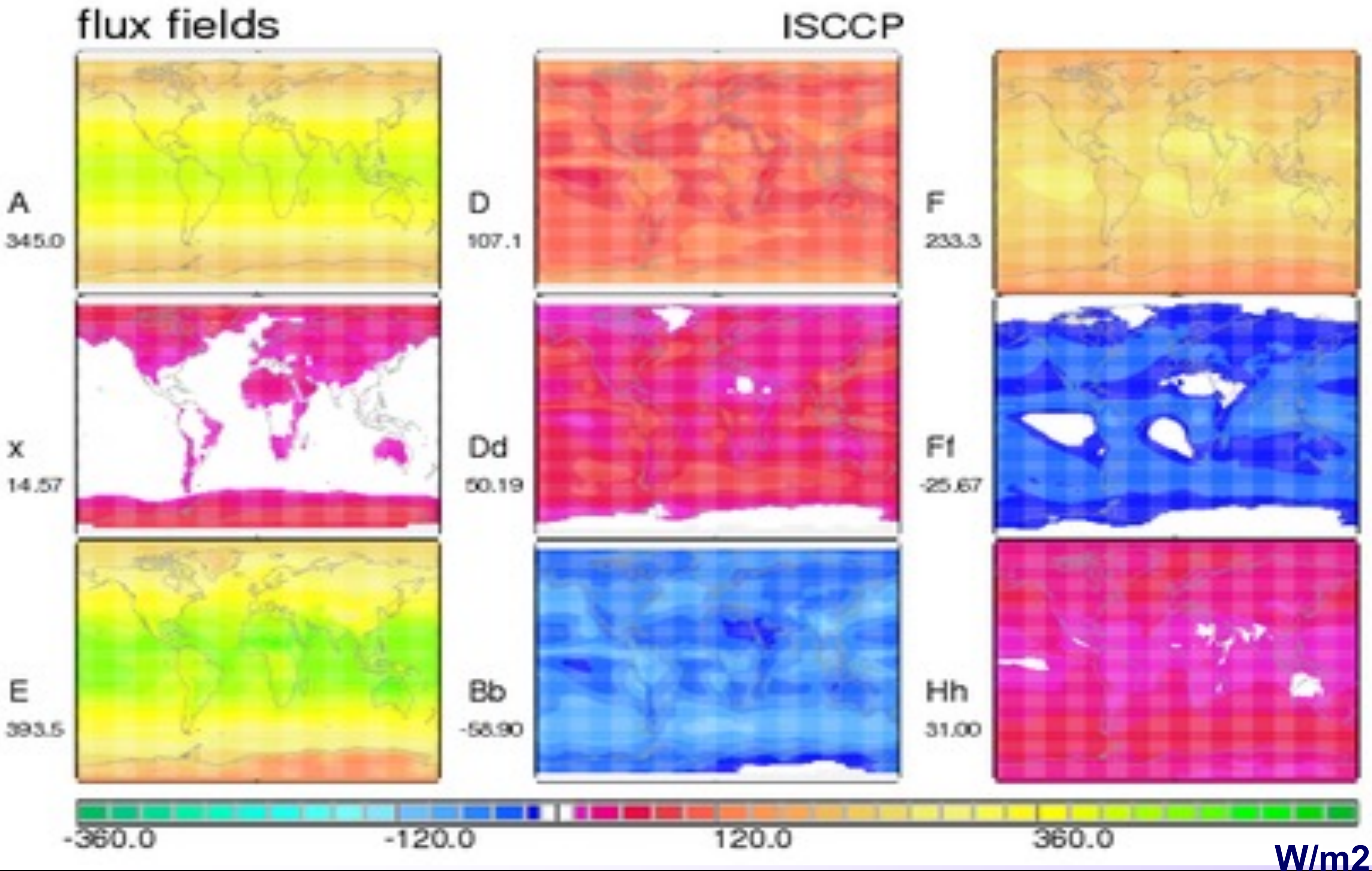


- **infrared** *(maps)*
  - E/e all/clear-sky IR UP at surf
  - F/f all/clear-sky IR UP at ToA
  - H/h all/clear-sky IR DN at surf

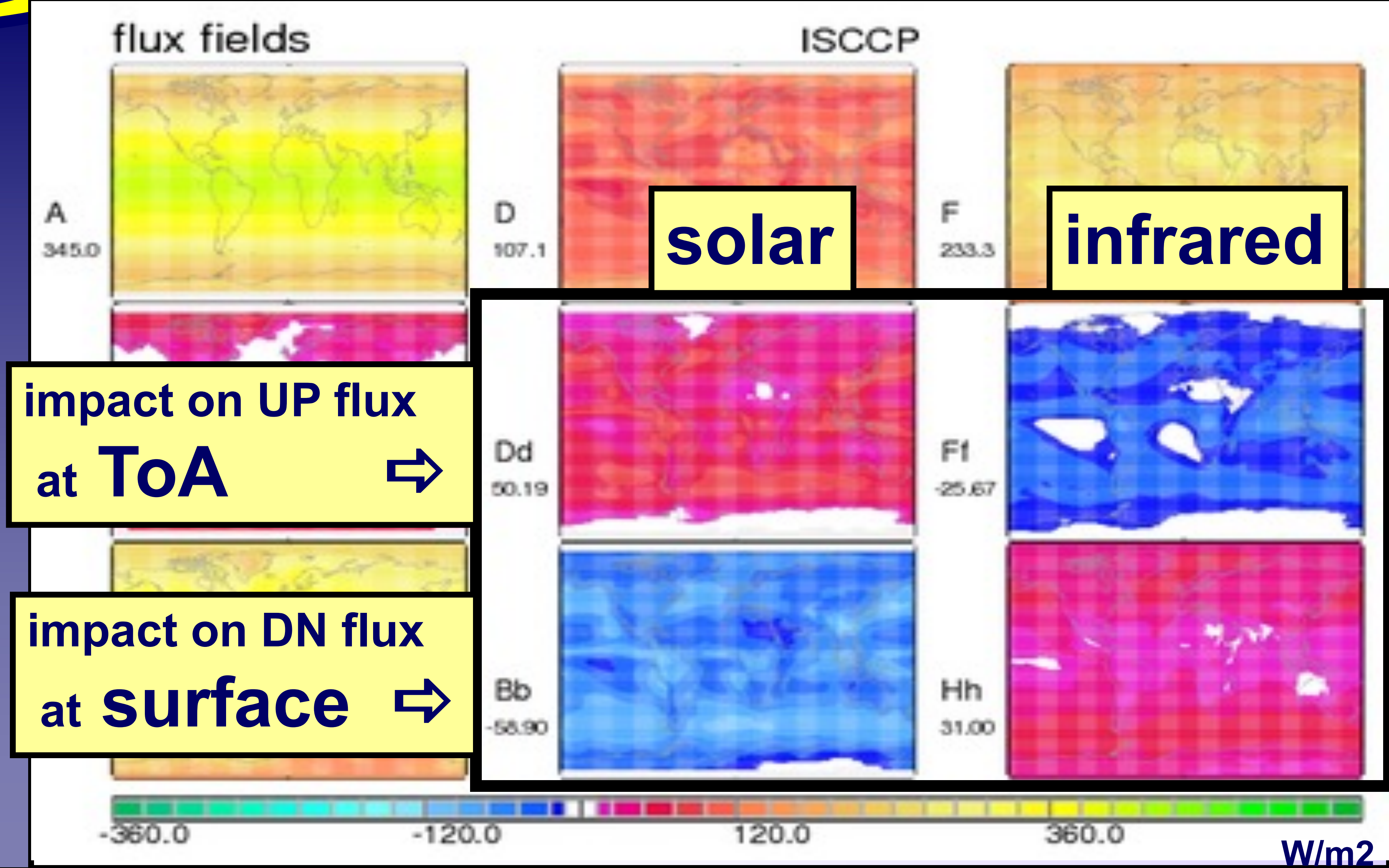


- **cloud effects** *(all-sky minus clear-sky)*
  - solar cloud effects: Bb (= B minus b), Dd (= D minus d)
  - IR cloud effects: Ff (= F minus f), Hh (= H minus h)

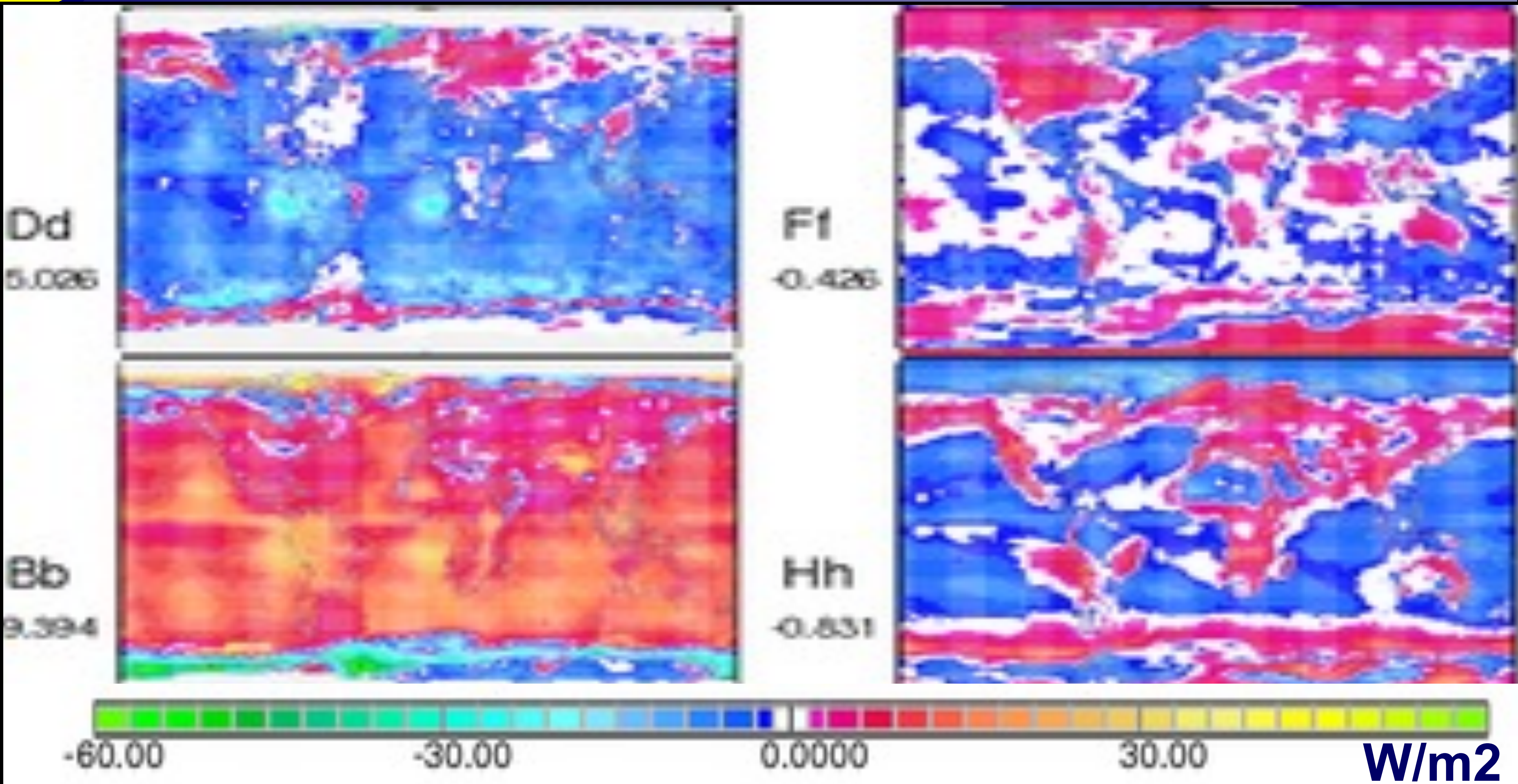
ISCCP 1984-1995 avg



ISCCP CE 1984-1995 avg

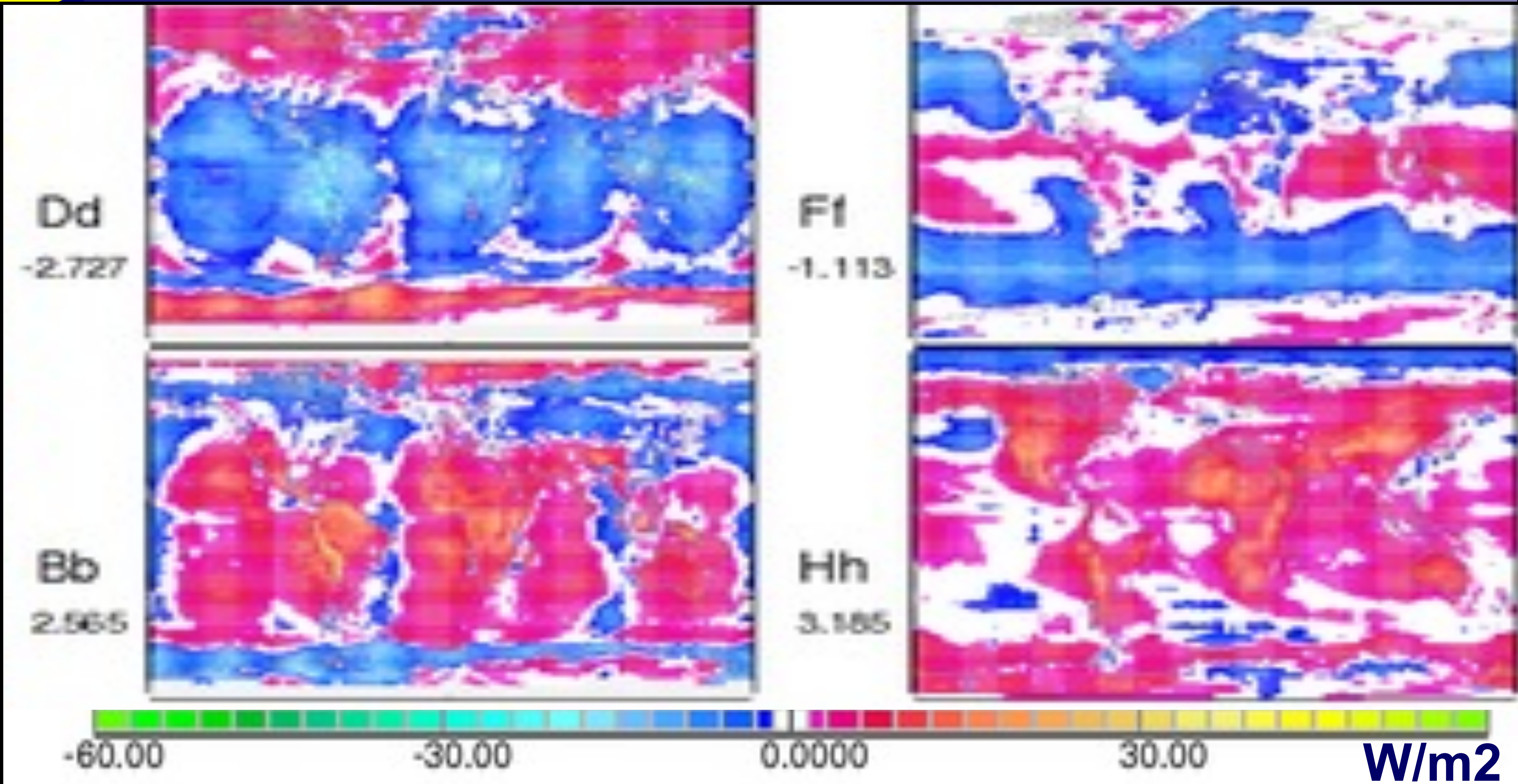


CE diff. – CERES *minus* ISCCP



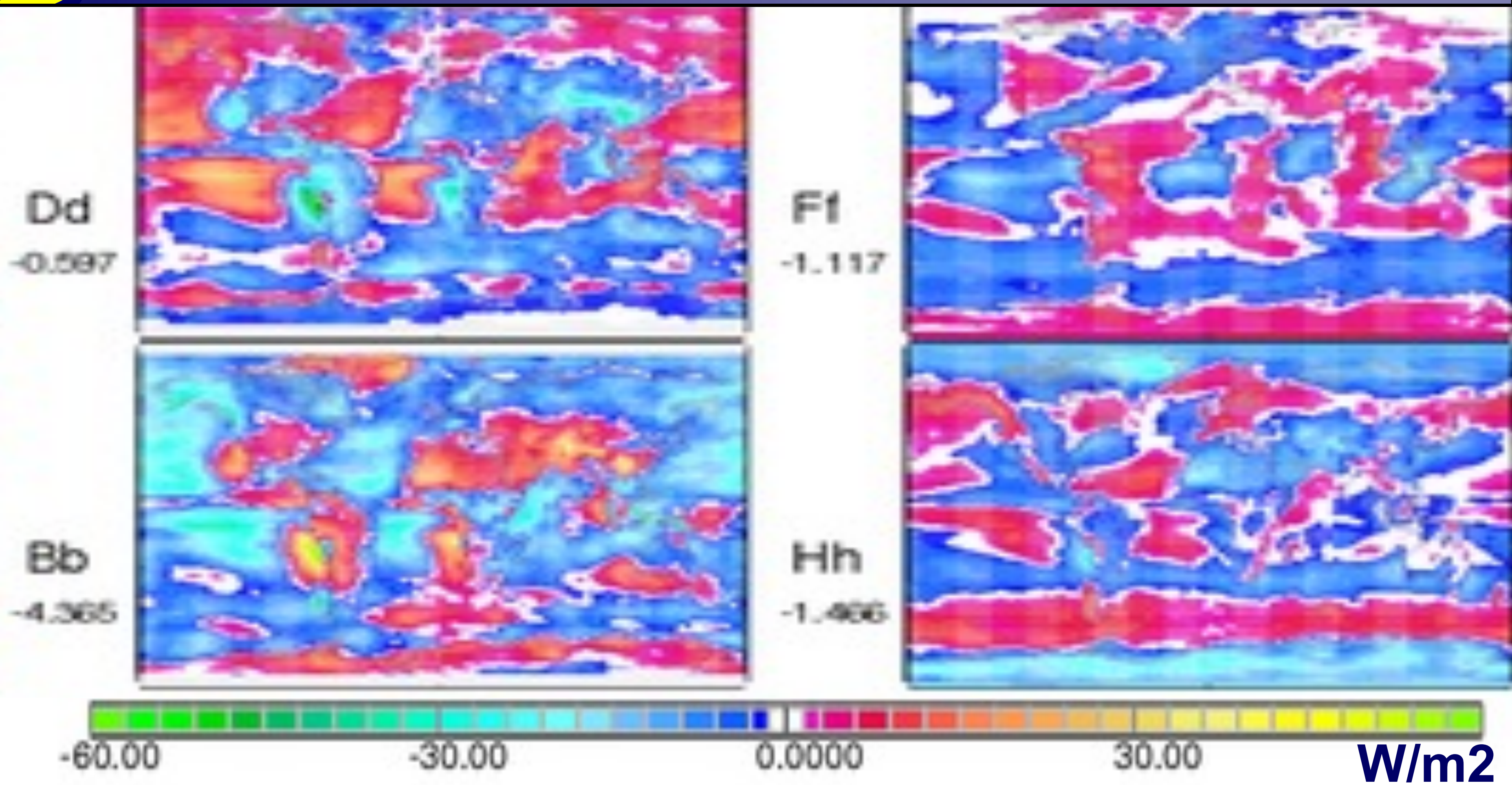
- **ISCCP solar CEs are larger (15% sur, 8% ToA)**
- **larger differences for coastal stratus fields**

CE diff. – SRB *minus* ISCCP



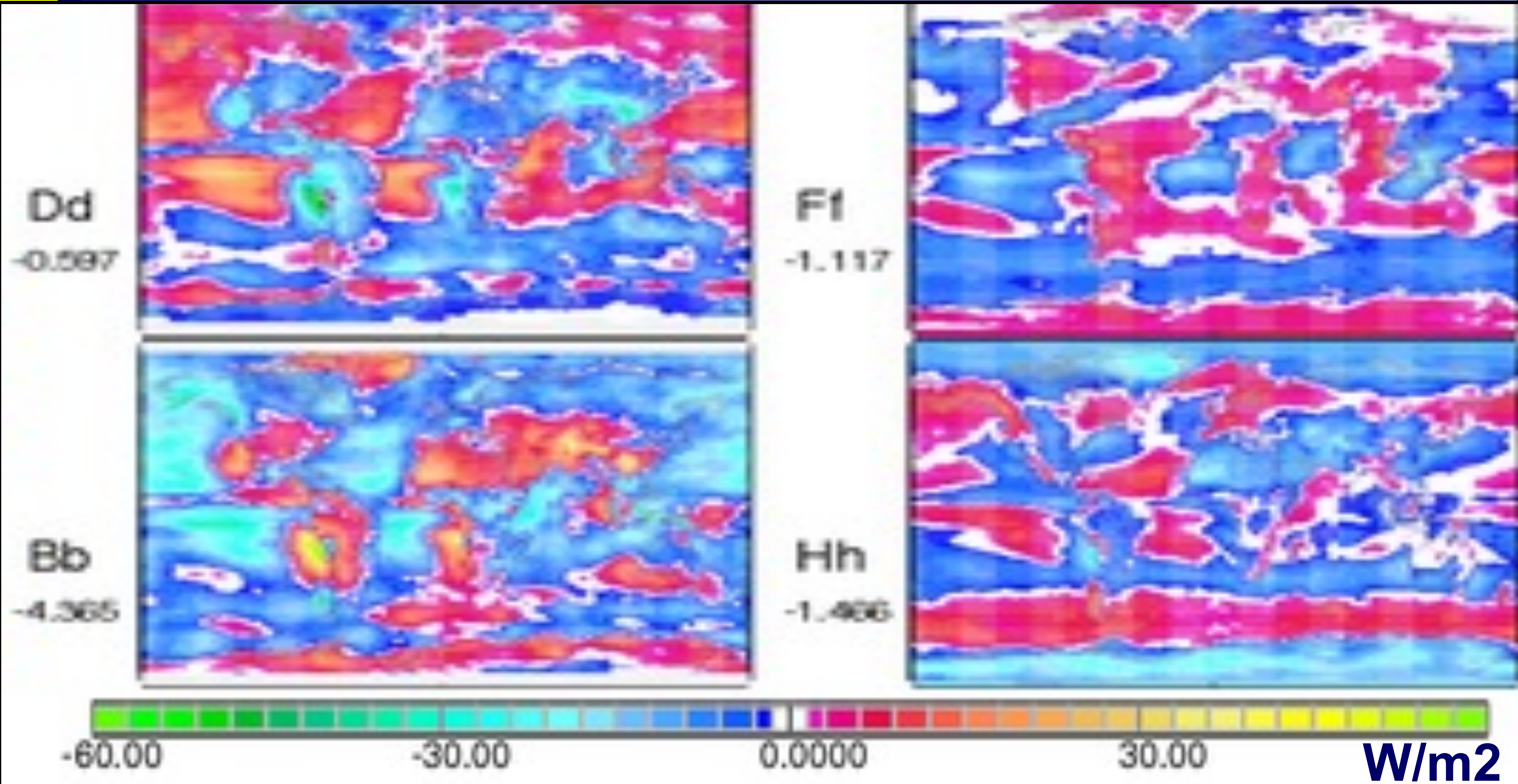
- SRB uses ISCCP ot and cover, but differs !
- SRB clouds are at lower over 'mountains'

CE diff. – IPCC median *minus* ISCCP



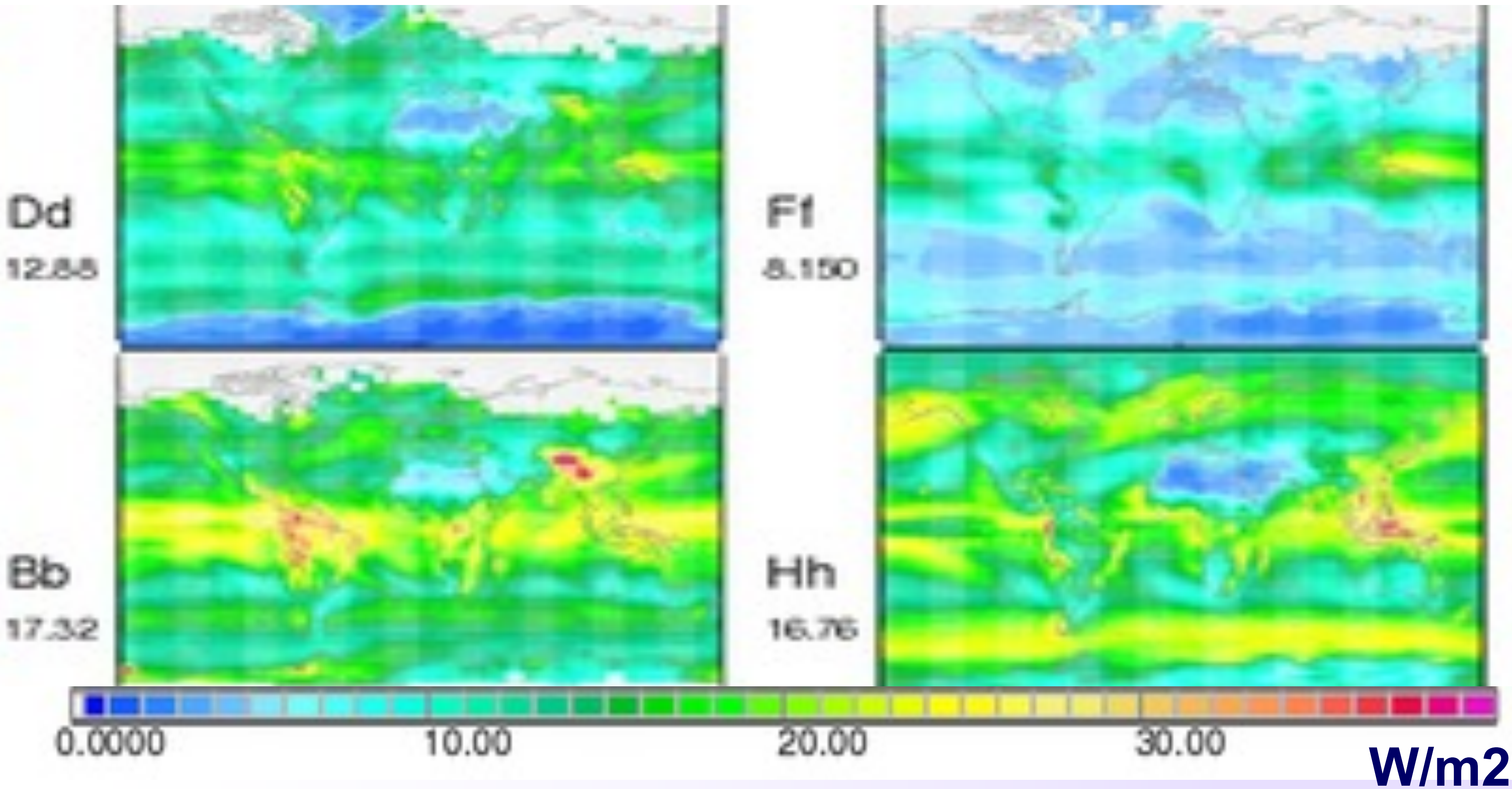
- modeling has more Bb (-4.4) and less Dd (-.6) ⇨ ISSCP: smaller drops + weaker solar absorption

CE diff. – IPCC median *minus* ISCCP



- … not so coastal stratus and land convection ⇨ ISCCP suggests larger opt.d (model deficiency !)

CE std dev – 20 IPCC models



- ToA CE values are tuned, surf CE reveal ⇨ diverse: OT in tropics, mid-lat low cld alti.

CE uncertainty

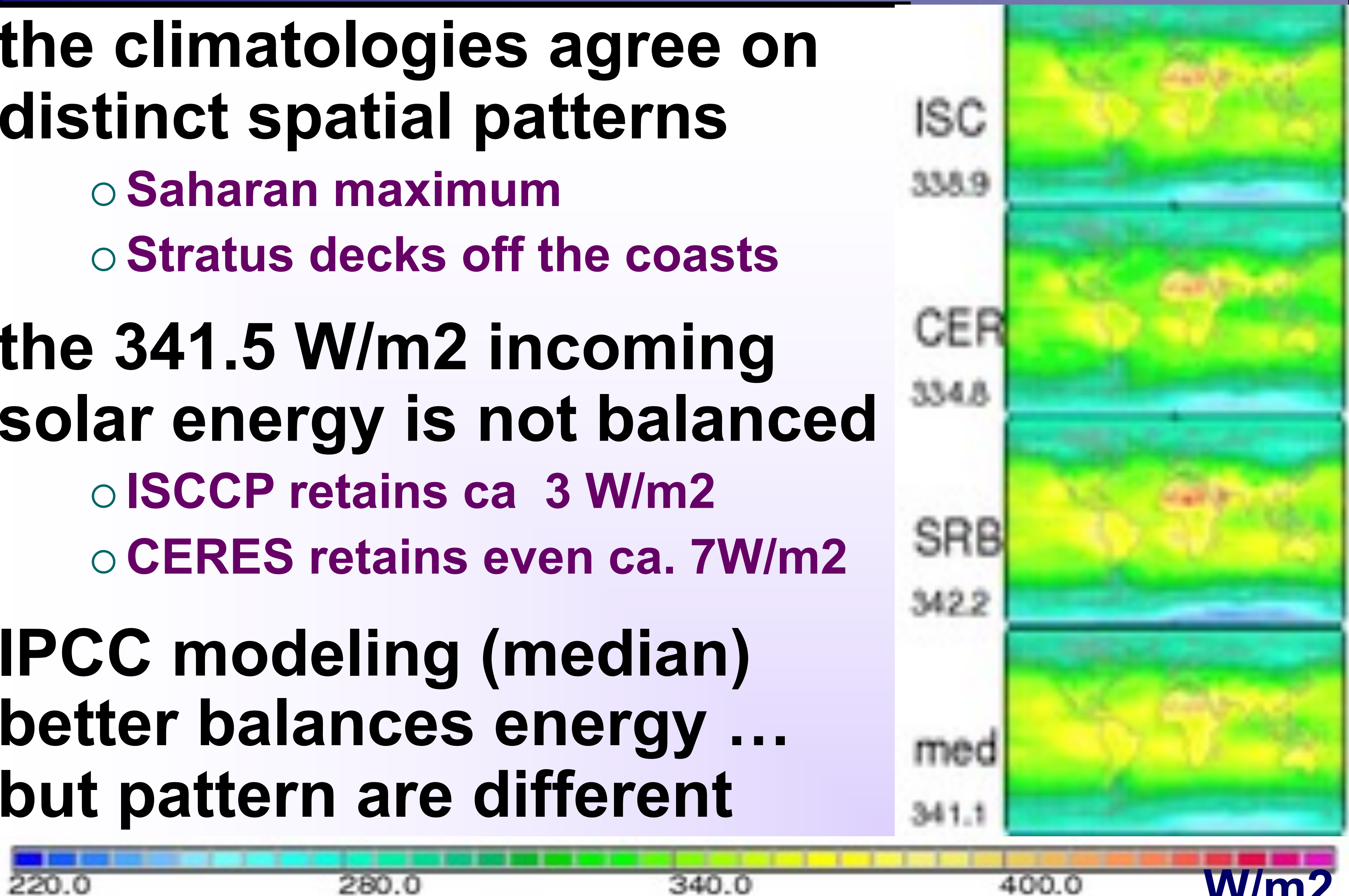
although the climatologies do NOT agree …
… their range is much smaller than in IPCC
(even the IPCC standard deviation is larger)

in W/m2	up flux	ToA	dn flux	surf
	solar	IR	solar	IR
range ISCCP,SRB,CERES	4.5	2.5	7.8	4.6
std.dev (IPCC models)	12.6	8.2	17.3	16.8

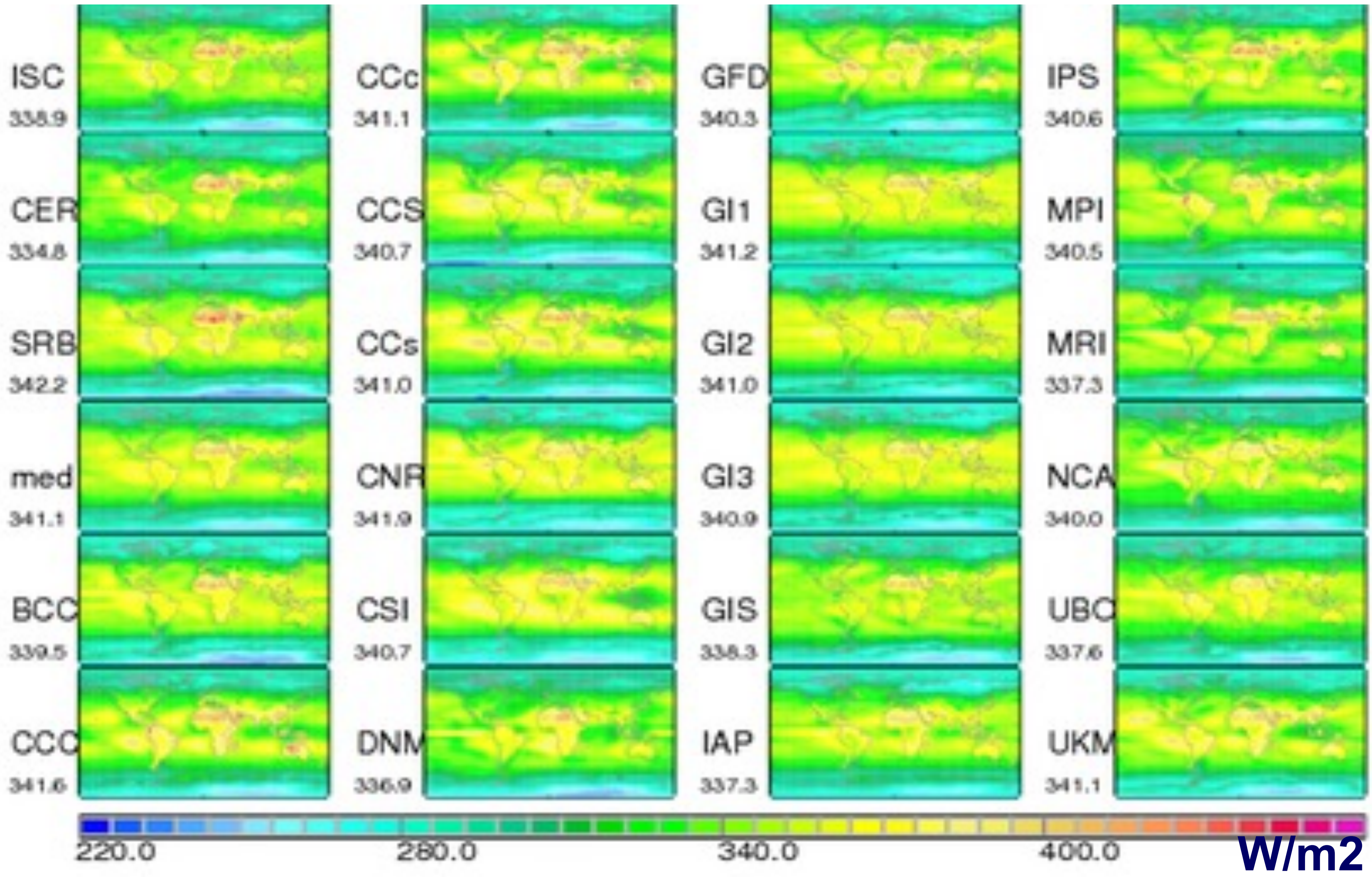
climatologies like ISCCP are useful testbeds
… especially on how clouds are distributed:

solar+IR losses - at ToA to space

- the climatologies agree on distinct spatial patterns
  - Saharan maximum
  - Stratus decks off the coasts
- the 341.5 W/m2 incoming solar energy is not balanced
  - ISCCP retains ca 3 W/m2
  - CERES retains even ca. 7W/m2
- IPCC modeling (median) better balances energy … but pattern are different

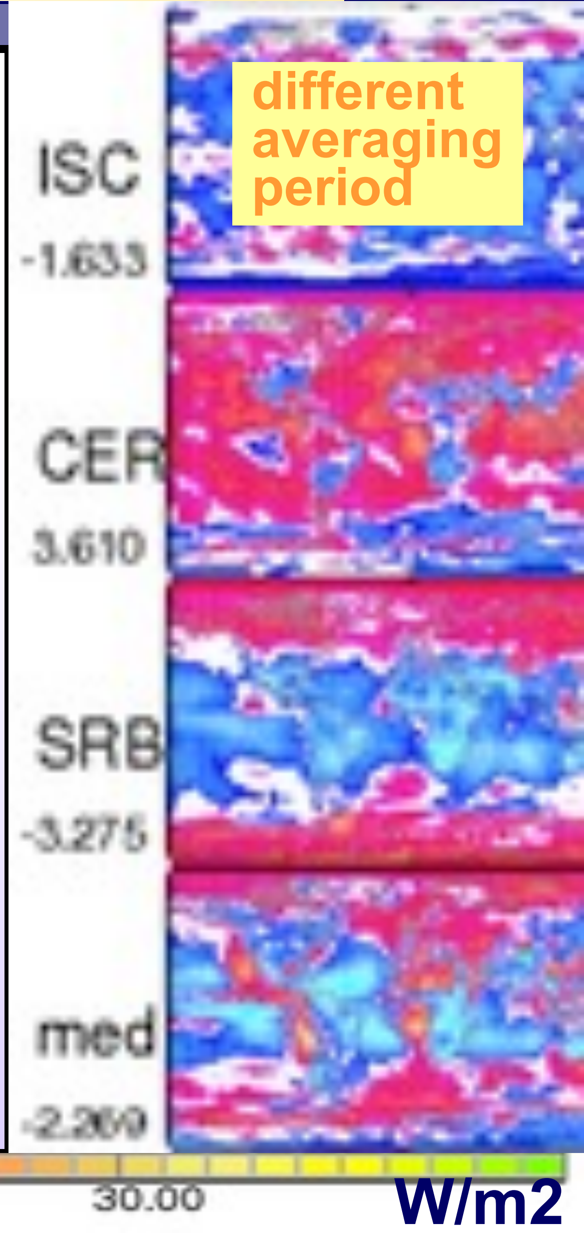


solar+IR ToA losses – all data

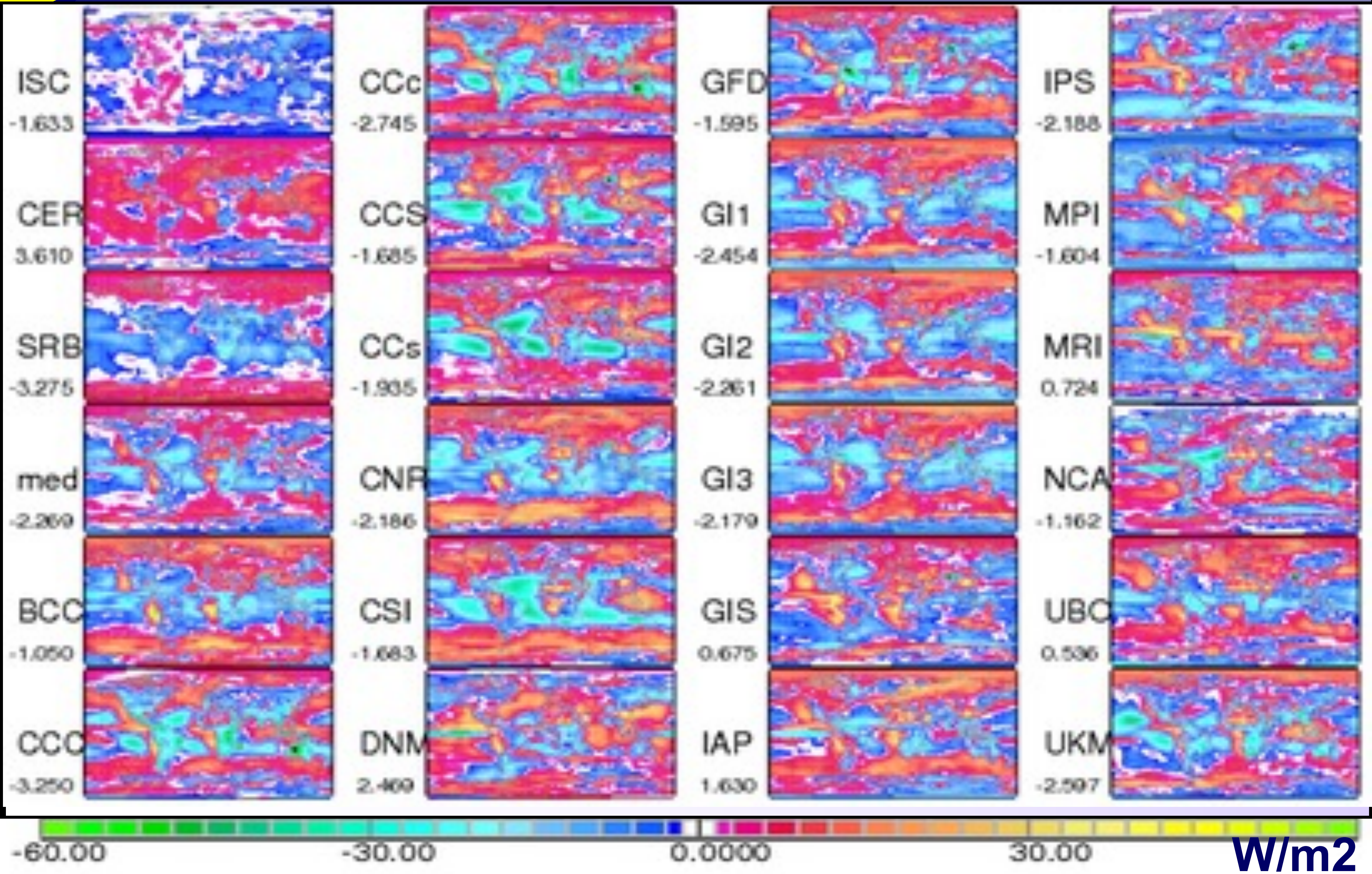


ToA gain/loss – diff to ISCCP

- the climatologies tend differ more in an absolute sense
  - ISCCP retains less than CERES
  - ISCCP retains more than SRB
- differences to modeling reveal distinct features
  - assuming ISCCP is correct
    - modeling loses too much energy over oceans and
    - modeling retains too much energy over stratus, continental regions and roaring 50ies



ToA gain/loss – diff to ISCCP

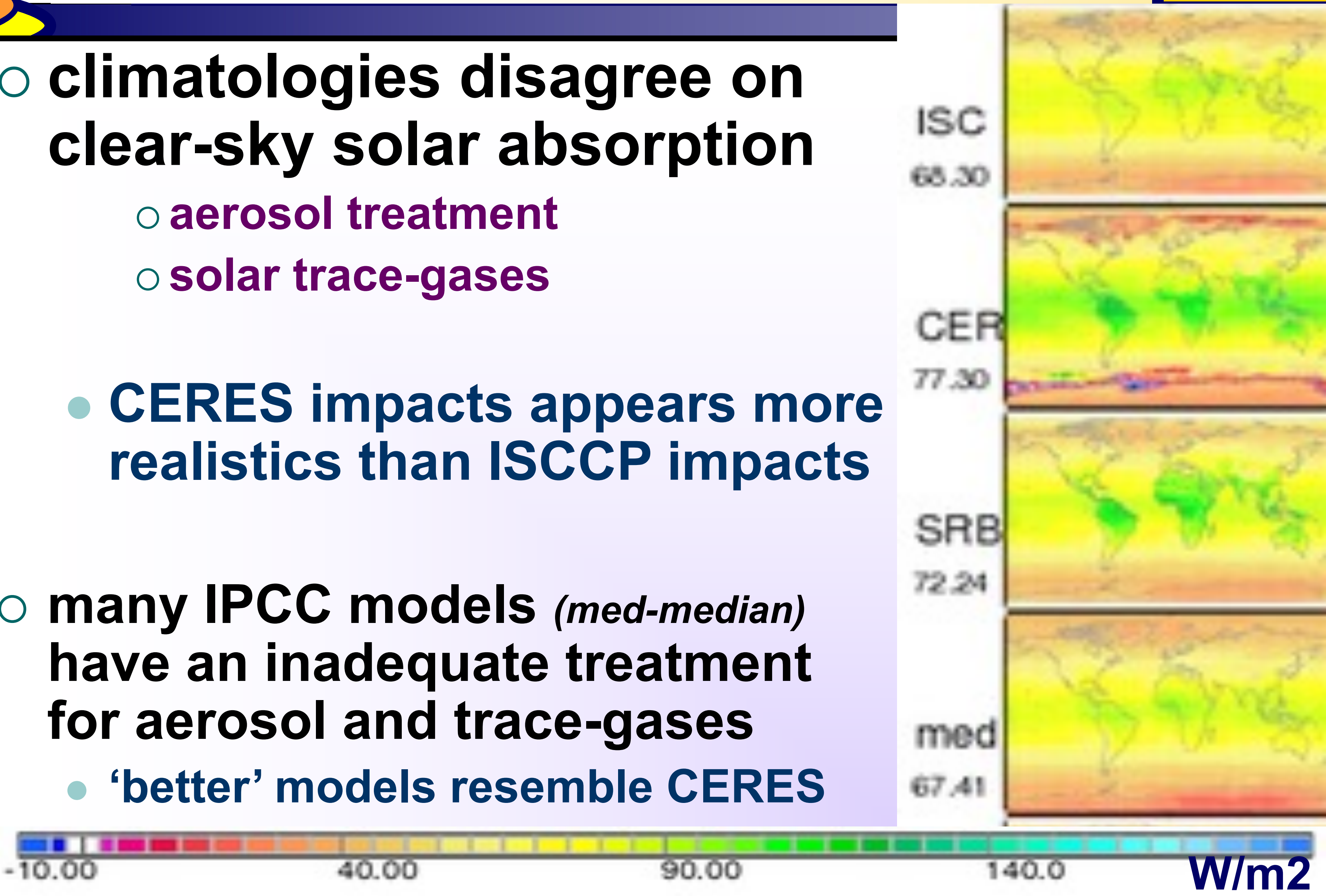


clear-sky solar absorption

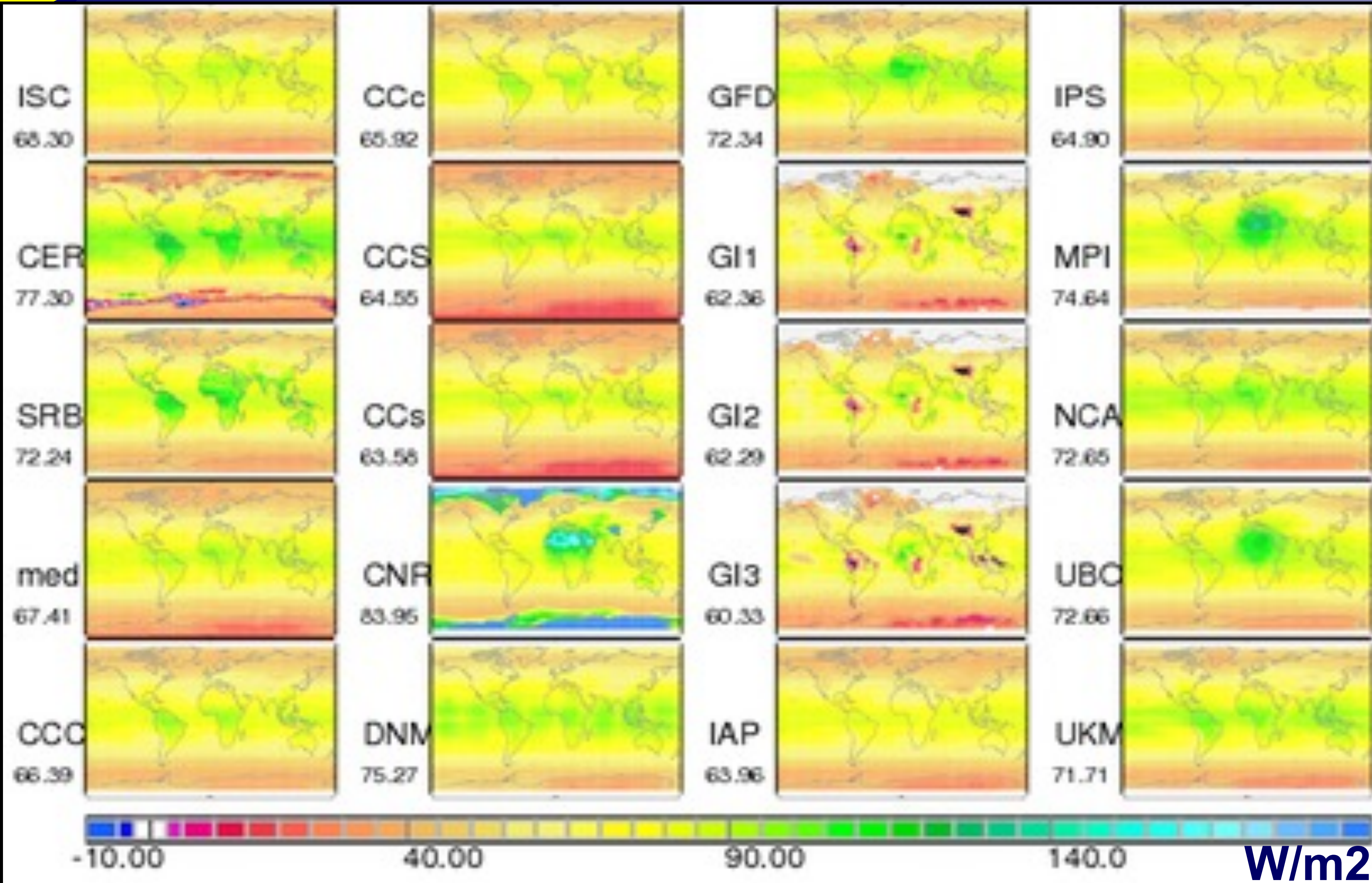
- climatologies disagree on clear-sky solar absorption
  - aerosol treatment
  - solar trace-gases

- CERES impacts appears more realistics than ISCCP impacts

- many IPCC models *(med-median)* have an inadequate treatment for aerosol and trace-gases
  - 'better' models resemble CERES



clear-sky solar abs. – all data



summary (2)

- ToA planetary albedo differences (5W/m2) between ISCCP and CERES surprise
  - TOA data are a tuning parameter to modeling
- despite unexpected diversity among three different cloud climatologies ...
  - the diversity in modeling is much larger
  - there is agreement on distinct patterns
  - modeling can learn from climatologies !
- in future ISCCP processing (10km) it would be nice to update
  - solar trace-gas absorption
  - aerosol properties (GACP type algorithm ?)

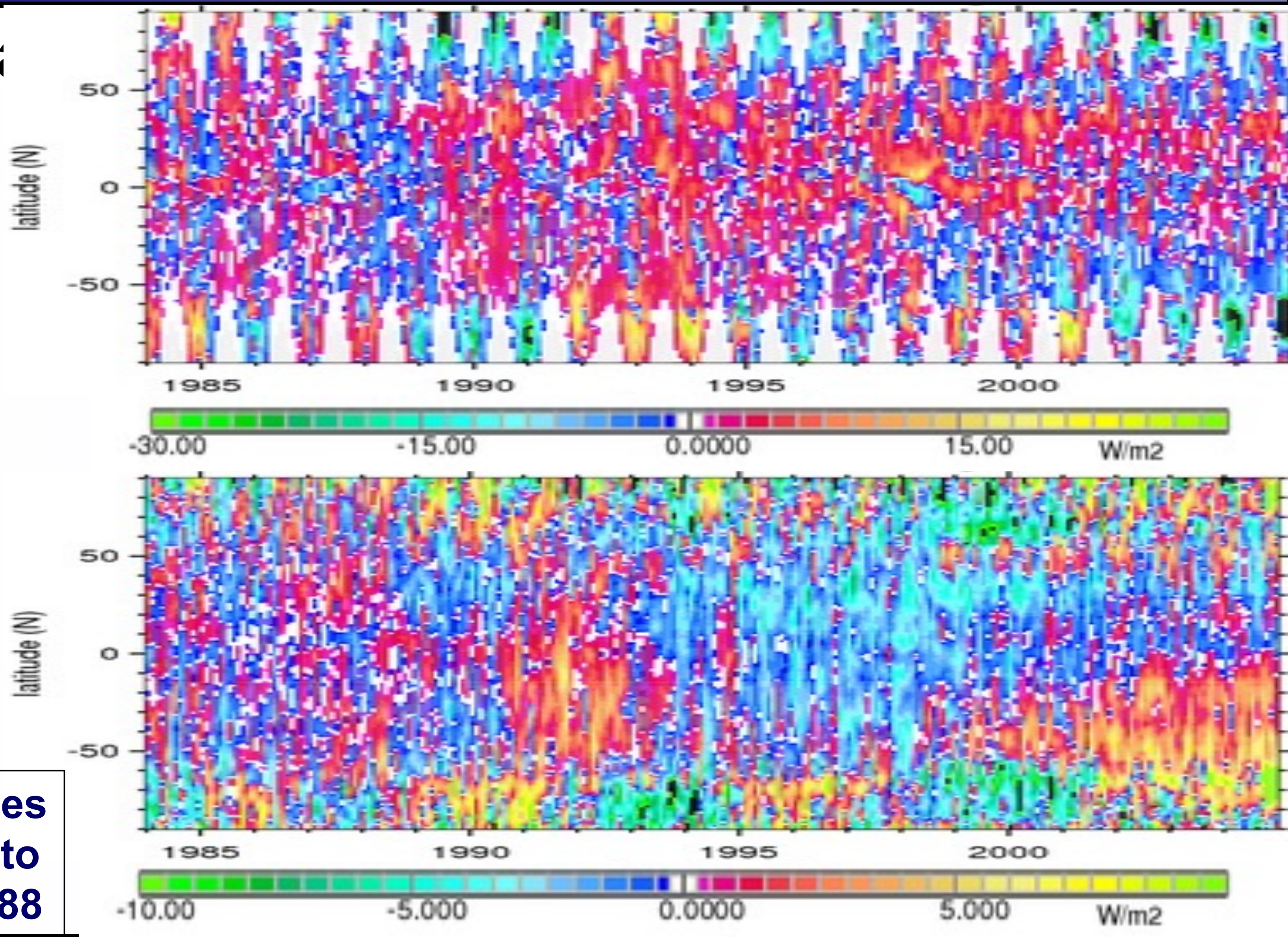
extras

CE trends ?

- are there temporal trends is ISCCP CEs ?

cloud effect trends at surface?

- sol

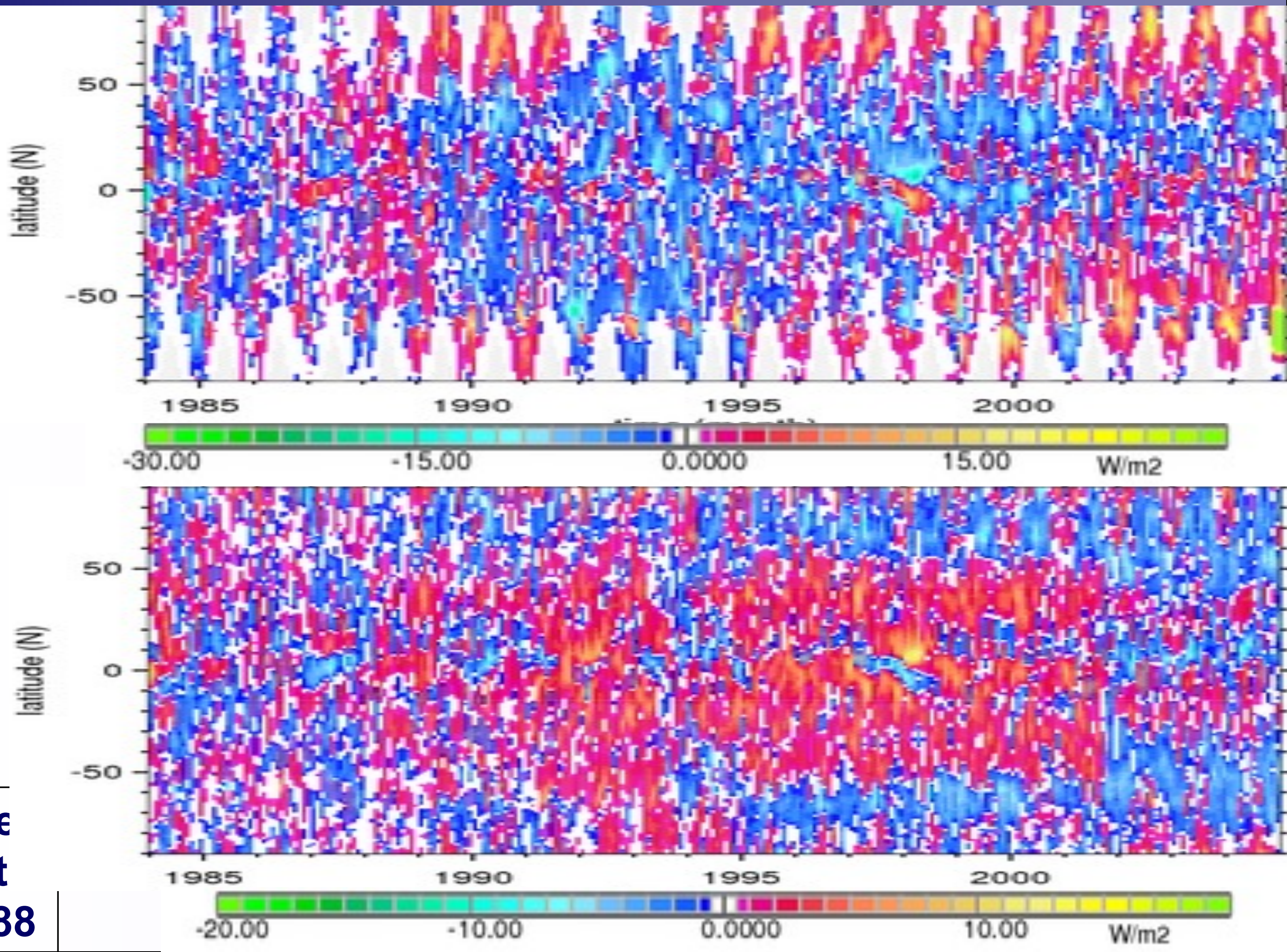


- IR

anomalies relative to 1985-1988

cloud effect trends at TOA ?

- sol
- IR



anomalie relative t 1985-1988