A Draft TOA and Surface Radiative Flux Assessment Plan: Results from Workshop 1 held in Zurich, Switzerland from Oct. 4-6, 2004

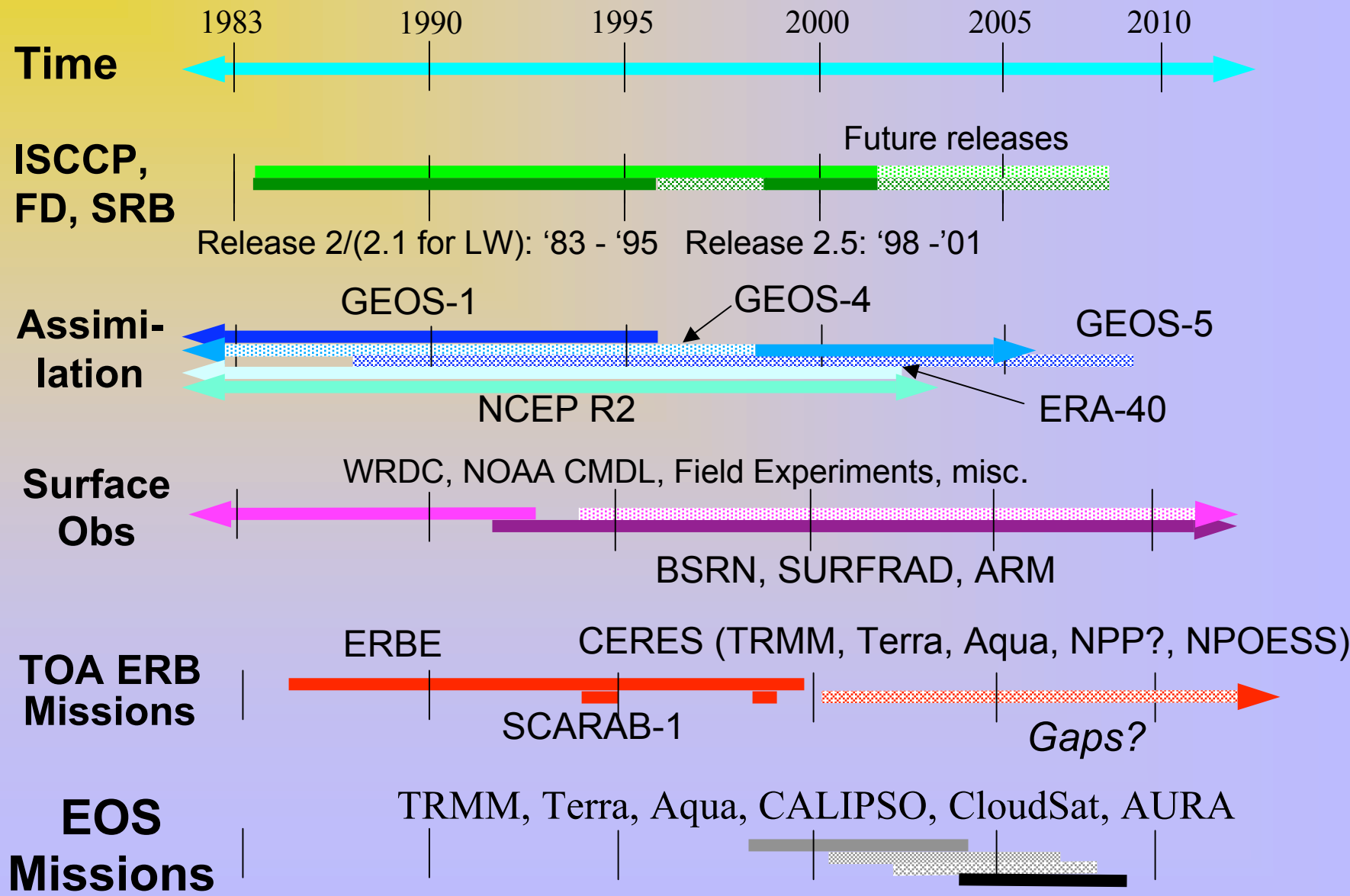
2nd GEWEX Working Group on Data Management and Analysis

and

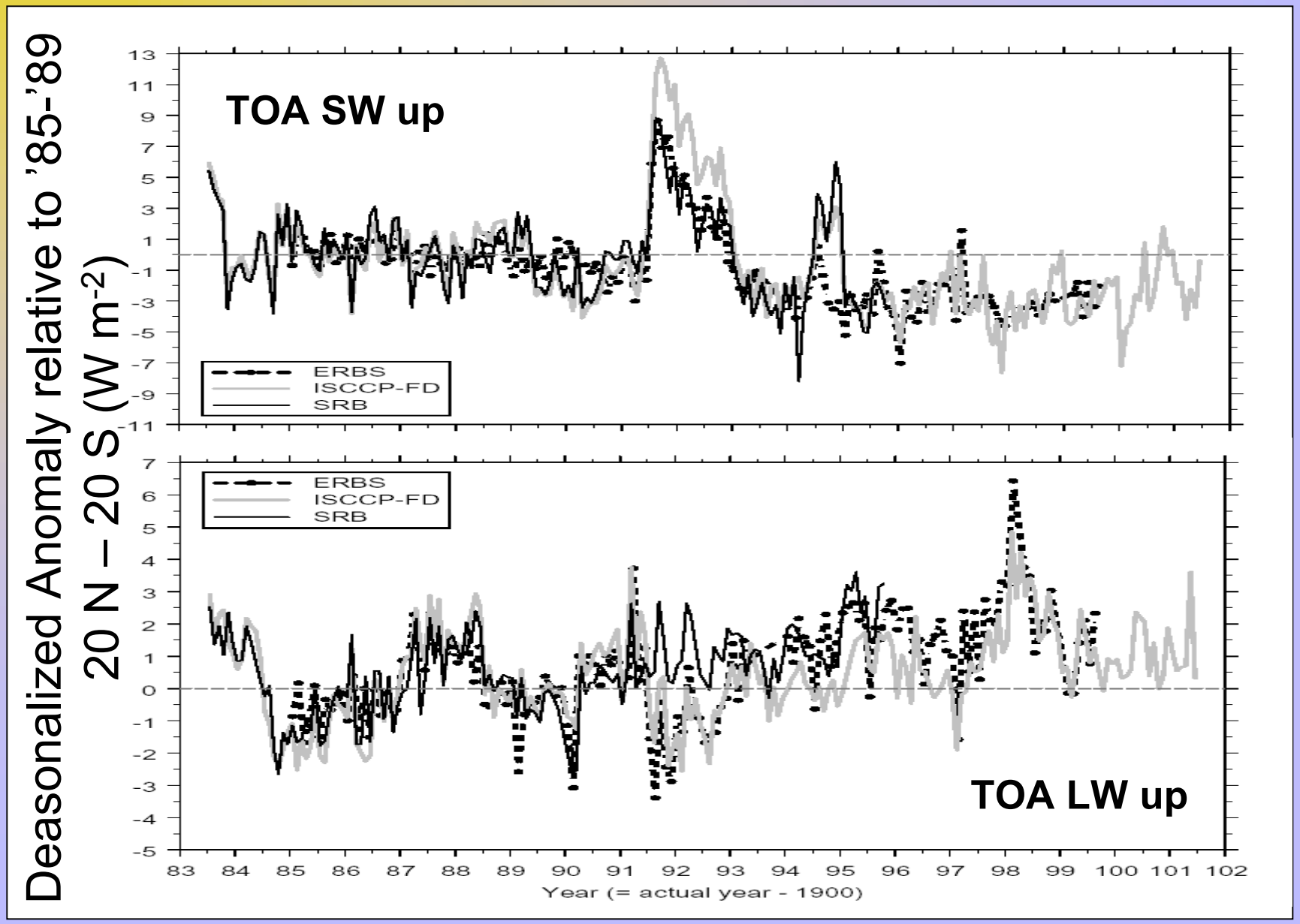
15th GEWEX Radiation Panel Meeting

October 18 - 22, 2004

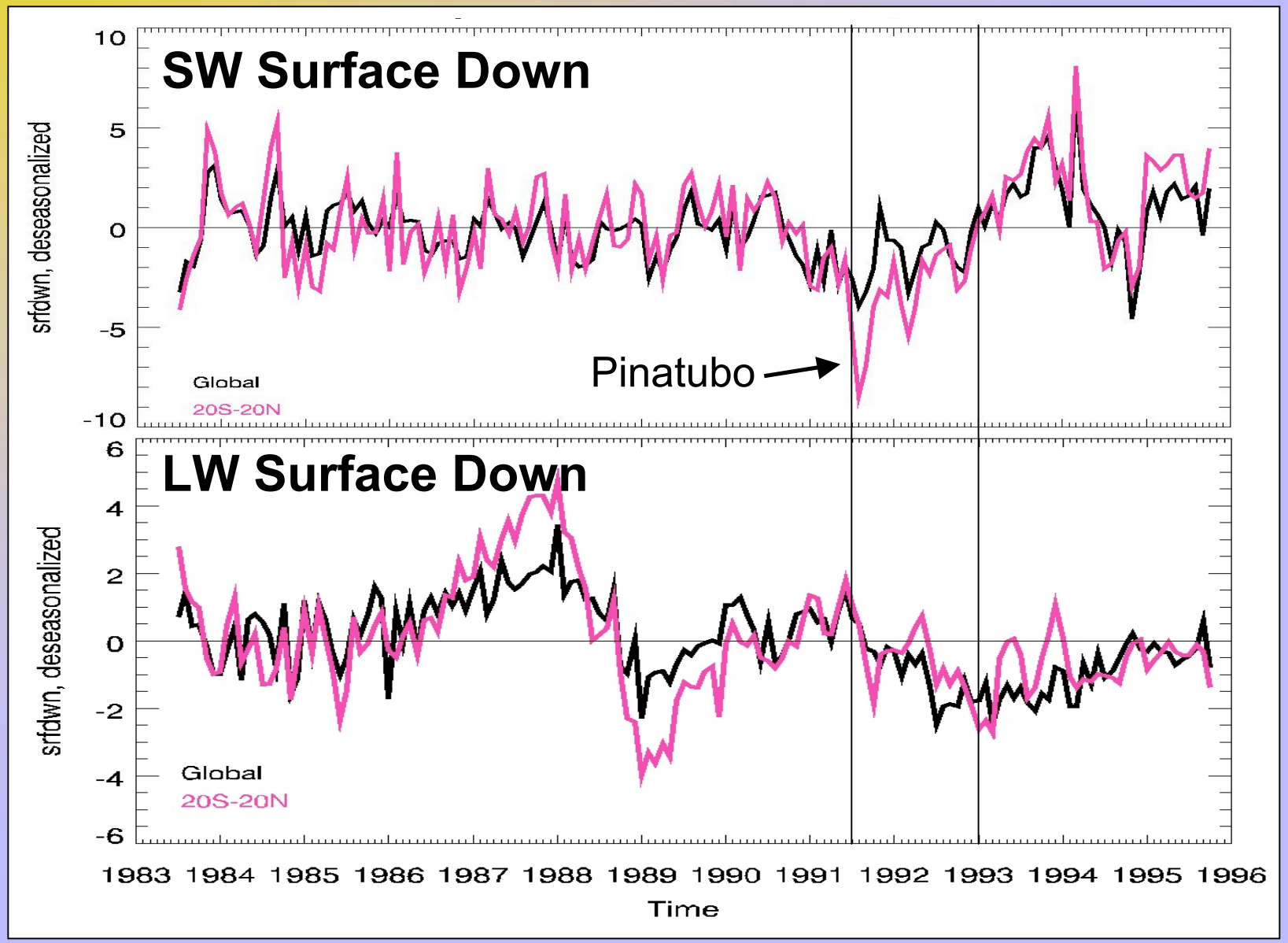
Radiation Dataset Timeline



Example Long-term TOA Fluxes



Example Long-Term Surface Flux



Global Annual Surface Fluxes

Para-meter	Ohmura & Gilgen (1993) *GEBA Surf. Obs.*		Kiehl and Trenberth (1997) ERBE/ CCM3		Zhang & Rossow (latest) *5 yr Mean ('85-'89)*		NASA/GEWEX SRB Rel. 2* (NASA LaRC) *12 yr Mean (July '83 – June '95)*			
							SW, LW		SW, LW QC	
	Flux	% Fo	Flux	% Fo	Flux	% Fo	Flux	% Fo	Flux	% Fo
SW Down	169.0	49.4	198	57.9	185.0	54.1	186.2	54.5	184.2	53.9
SW Net	142.0	41.6	168	49.2	161.1	47.1	164.6	48.0	160.9	47.1
LW Down	345	100.9	324	94.8	347.8	101.8	342.6	100.6	345.2	101.0
LW Net	-40.0	-11.7	-66	-19.3	-47.9	-14.0	-50.8	-14.9	-47.2	-13.8
Total Net	102.0	29.8	102	29.8	113.0	33.1	113.8	34.2	113.7	33.3
SW CRF	--	--	--	--	-55.1	-16.1	-56.9	-16.6	-58.5	-17.1
LW CRF	--	--	46	13.5	34.2	10.0	36.5	10.4	35.6	10.4
Total CRF	--	--	--	--	-20.9	-6.1	-20.4	-6.2	-22.9	-6.7

** Normalized to F_o = 1367 W m^{-2}*

Radiative Flux Assessment Overview

- **Purposes:**
  - To provide a comprehensive overview of our current understanding and capability to derive TOA and Surface radiative fluxes from analysis of satellite observations .
  - To provide information of the uncertainties and outstanding issues of the flux estimation at various time and space scales, particularly the long-term variability, by:
    - *providing uncertainty information from sources ranging from satellite calibration, input data sources, and assumptions*
    - *comparison of surface fluxes to surface based measurements*
    - *intercomparison of various existing data products*
    - *Identify largest uncertainties and needs*
  - To develop climate system observation requirements for radiative fluxes and compare to current product accuracies.
  - To detail methods and uncertainties in such a way as to be useful for the next IPCC report on long-term data uncertainty.
  - To develop a test bed of current satellite radiative budget products and surface measurements and assess current GCM and reanalysis products.

Priority: emphasis on GEWEX products first

Workshop Purposes

- Develop a draft flux assessment document outline to facilitate the flux assessment task.
- Use the outline to:
  - focus comparison tasks
  - clarify and set writing assignments
  - clarify and set schedule
  - clarify crosscutting and overview writing assignments
  - look for missing items in the approach
- Outline should be logically “complete”
  - some sections may be only minimally covered in this assessment and call out for future needs
- Outline to be finalized via interaction of participants after incorporating results of the meeting

Workshop Results

- **Workshop Total Participants: 29**
  - **Organizers: Raschke and Ohmura**
  - **Flux Assessment Committee Members: Ohmura, Raschke, and Rossow, Stackhouse (co-chair) and Wielicki (co-chair)**
- **Two subgroups formed:**
  - **TOA Fluxes: Wielicki, chair**
  - **Surface Fluxes: Stackhouse, chair**
- **Agenda:**
  - **Overview talks (Rossow, Wielicki)**
  - **Flux Accuracy Needs**
    - ***Jakob – process scale; transmittance by cloud regime***
    - ***Slingo – monthly averaged needs 5 W m^{-2},***
    - ***Wielicki – decadal accuracies, order 0.3 – 0.6 W m^{-2}; ocean storage as constraint to TOA net radiative flux***
    - ***Raschke – atmospheric flux divergence profiles***
    - ***Ohmura – surface radiometer decrease through early 90's; increase after on order 5 – 10 W m^{-2}***
  - **Data product overview talks (many talks)**
  - **Data analysis talks (several)**
  - **Plenary and subgroup discussions**

Flux Assessment Draft Plan:
Summary and Introduction

- Executive Summary

- Introduction
  - Assessment Objectives
    - Decadal variability
    - Defining accuracy of TOA and Surface data
    - Long term goal is merged TOA, Atmosphere, Sfc Data
  - Observation System Requirements
    - Climate model natural variability: defining the limits of observing system accuracy.
    - Observing requirements driven by climate radiative forcing, cloud feedback, aerosol indirect effect issues.
    - Long term goal is climate prediction uncertainty driven requirements (climate prediction.net example)

Flux Assessment Draft Plan: TOA

- **Provide overview of current TOA flux estimation products including: ERBE (Scanner/Nonscanner), CERES, SCARAB, ISCCP FD, GEWEX SRB, NOAA Pathfinder and Reanalysis**
- **Intercompare SWup, Lwup, Net; all-sky and clear-sky:**
  - **Monthly gridded product maps**
  - **Monthly time series (global and zonal; land and ocean; Hovmeuller)**
  - **Seasonal gridded maps of diurnal cycle**
  - **Characterize variability at various time and space scales**
    - ***Observation products***
    - ***Model products***
  - **Compare Meteorological Regimes and Cloud Systems**
    - ***Classify 250 km/daily meteorological regime using ISCCP for 2 bands (tropics and middle latitudes)***
    - ***Use CERES cloud object classifier for individual cloud systems***
  - **Time Series at selected surface sites (collaborate w/ surface)**
  - **High Space and Time Intercomparison: GERB area, for June – July 2004**
  - **Error budget intercomparison**
- **Provide Web based data portal for data producers and users**

Flux Assessment Draft Plan: Surface

- Provide overview of surface measurements networks
  - Poll existing data sets: spatial and temporal extent; calibration
  - Select long and short-term datasets
  - Summarize surface measurement needs and issues
- Provide overview of current Surface flux estimation products including:
  - Global: GEWEX SRB, ISCCP FD, ESRB, CERES SARB and SOFA, UMD ISCCP and MODIS based (Pinker), SWnet (Li), ERA 40, NCEP R2, GEOS-4
  - Regional: GEWEX CSE's, Tropical Pacific (Chou), MSG (2-3), Polar Fluxes (Key), Brazilian products, UMD GOES and ISCCP DX, SUNY-Albany
- Satellite-Surface Intercomparisons for: SW down (total, direct, diffuse), LW down; all-sky and clear-sky
  - Statistical Intercomparisons: various space and time scales
  - Time series intercomparisons: variability, systematic
  - Summarized satellite-surface issues

Example Uncertainty Matrix:
BSRN Operational Measurement Quality

RMS Uncertainties for Radiative Measurements (Ohmura et al, 1998, BAMS; Michalsky et al., 1998; Shi and Long, 2002, Dutton et al., 2001; Ells Dutton personal comm.)

Quantity (Instrument)	1 Minute Avg. (1 Hz sampling) ($W\ m^{-2}$)	1 Hour ($W\ m^{-2}$)	1 Day ($W\ m^{-2}$)	1 Month ($W\ m^{-2}$)	1 Year ($W\ m^{-2}$)	10 Years	Thermal Offset
LW Broadband (pyrgeometer)	5 - 7 (2%)	5	3 -- 5	3 -- 5	3 -- 5	??	---
SW Broadband Global (direct+diffuse, pyranometer)	25+ (4-5%)	8 -- 20	5 -- 15	5 -- 15	5 -- 15	??	up to -3%
SW Broadband Direct (NIP)	5 - 15 (1.5%)	1% or 2	1% or 2	1% or 2	1% or 2	??	---
SW Broadband Diffuse (shaded pyranometer)	5 -- 7 (3-4%)	5 -- 15	5 -- 15	5 -- 12	5 -- 12	??	up to -10
SW Broadband Total (shaded pyranometer + NIP)	10 -- 15 (3.0%)	5 -- 15	5 -- 15	5 -- 12	5 -- 12	??	up to -10

Challenge: Derive similar tables for each network; survey and classify measurements (i.e., land, ocean)

Surface Data Product Time and Space Scale Matrix

Space Scale Averaging	Instantaneous	15 min	1 hour	3 hour	daily	pentad	month	seasonal	annual	decade
Global	A				A	A	A	A	A	A
Zonal	A				A	A	A	A	A	A
1000 km	A	A	A	A	A	A	A	A	A	A
280 km		A	A	X	A	A	A	A	A	A
100 - 120 km	X	X	A	X	A	A	A	A	A	A
40 - 60 km	X	X	A	A	A	A	A	A	A	
20 - 40 km	X		A	A	A	A	A	A	A	A
5 - 10 km	X		X	A	A	A	A	A	A	
< 2 km	X									

Time Scale Averaging

X - Native space and time averaging
A - Existing or derivable by averaging existing data products

Cloud object
Synoptic
Intermediate
Climate

Flux Assessment Draft Plan: Surface

- **Satellite-based Surface Flux Product Intercomparisons for: SW down (total, direct, diffuse), SW up, albedo, LW down, LW up, emissivity; all-sky and clear-sky (for fluxes)**
  - **Monthly gridded product maps**
  - **Monthly time series (global and zonal; land and ocean)**
  - **Seasonal gridded maps of diurnal cycle**
  - **Characterize variability at various time and space scales**
    - ***Observation products***
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Flux Assessment Draft Plan

- Contributed Chapters
- Lessons Learned
  - Data Management
    - *Data Access and Delivery (GEBA example)*
    - *Data Analysis Tools (Live Access Server)*
    - *Data Archive: long-term archive issues*
  - Data gap issues for Satellite and Surface measurements
- Observation vs. Climate Model Incomparisons in nonparallel world
  - Twilight issues
  - Reference altitude
- Final Assessments and Recommendations
  - Assessment of TOA fluxes
  - Assessment of Surface fluxes
  - Assessment of Atmospheric Divergence
- Identification of Key issues
- Appendix (contains more highly detailed information related to issues from calibration to radiative transfer, etc.)

Flux Assessment Next Steps

- Finalize draft outline and document through participant review - prioritize
- Begin polling of surface measurement and additional data producers
- Establish a web site location and selection of graphical and data distribution tools
- Begin submittal of data products from participants
- Make selection of and begin collection of surface measurement datasets
- Begin to derive statistics of own datasets for submission including comparisons against surface site data (participants or collaborators?)
- Collaboration of analysis towards draft assessment document approximately 1 year from now.