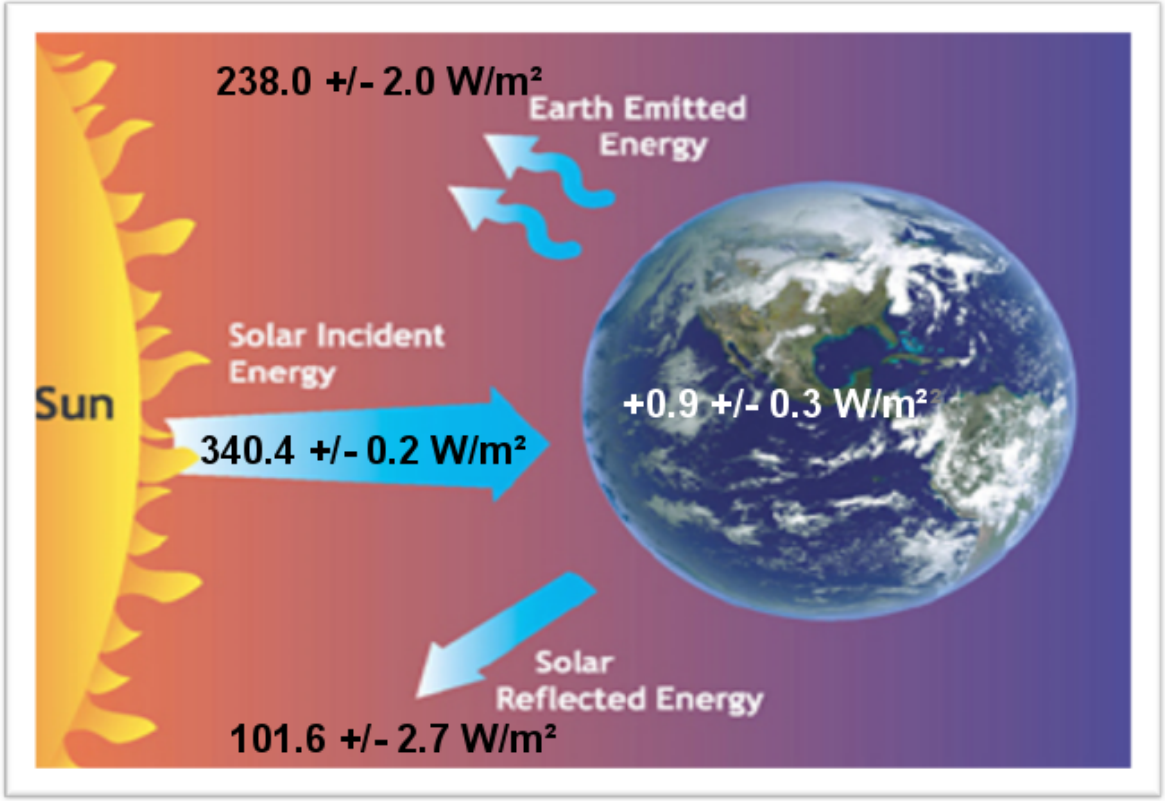
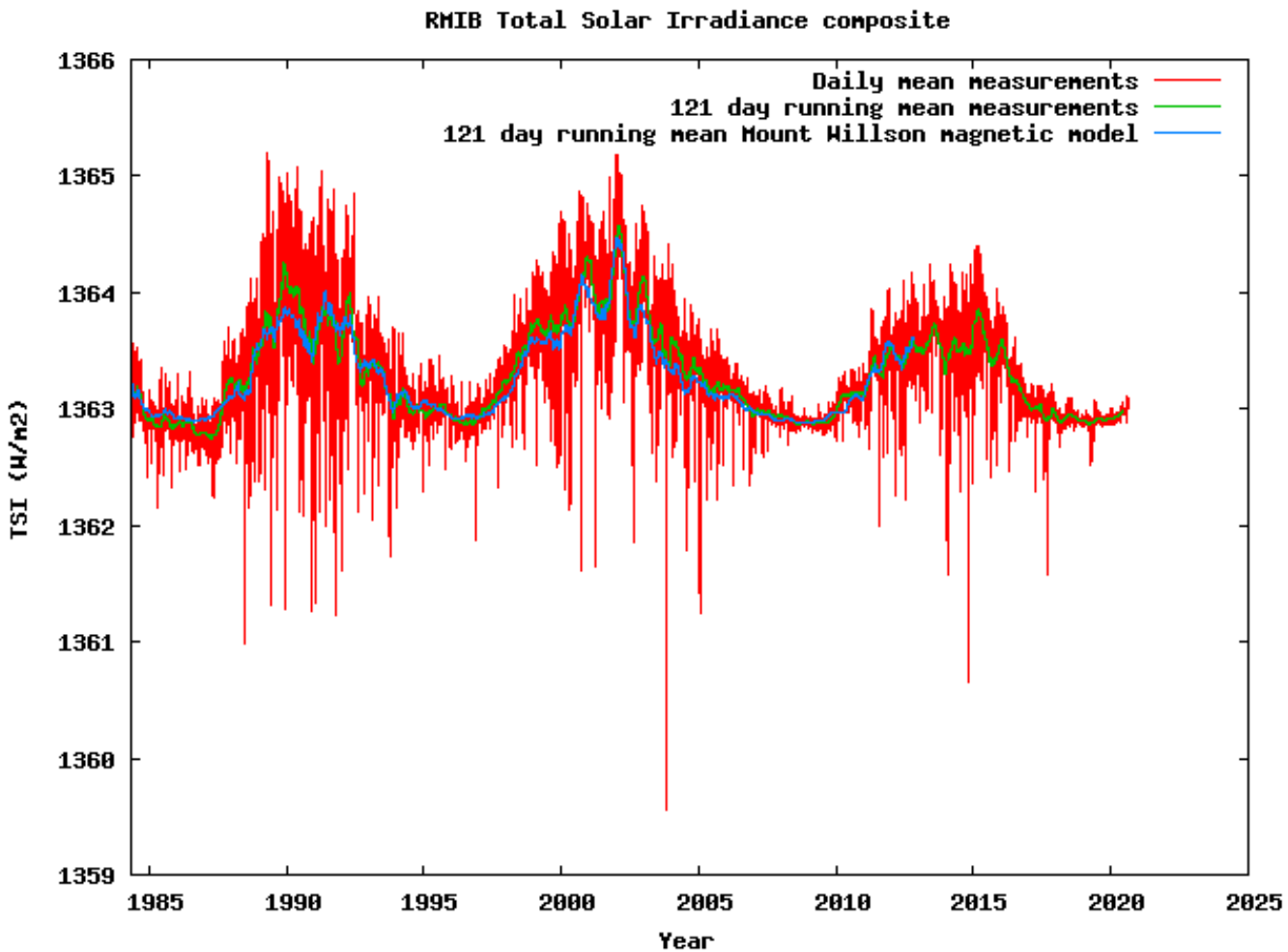
Decadal changes of the Earth Radiation Budget components: status of our knowledge and future perspectives



Steven Dewitte, RMIB, Virtual Ceres meeting, 17/9/2020

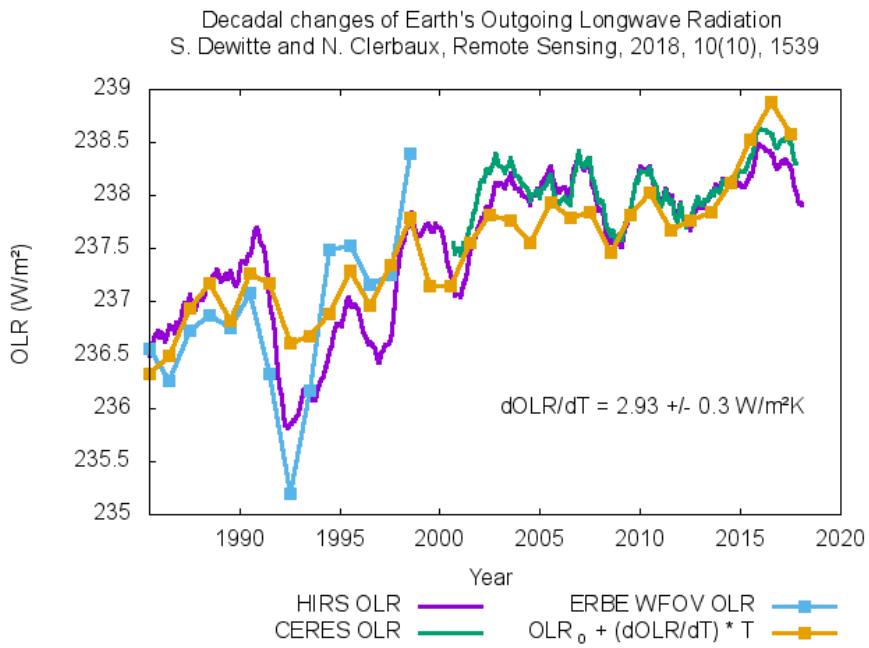
Incoming solar radiation

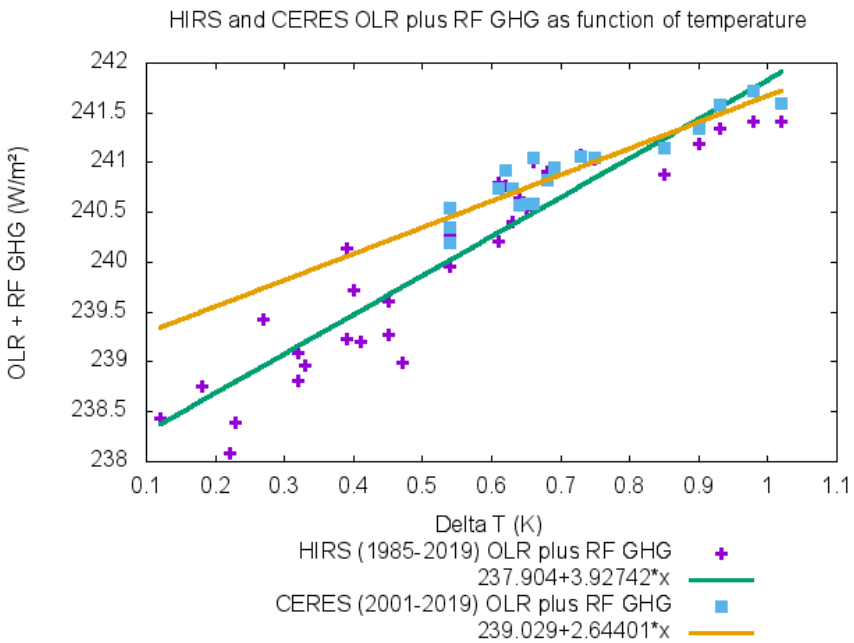


2000-2018 trend Incoming Solar Radiation = -0.07 W/m²dec

Outgoing Longwave Radiation

Expectation: $\Delta OLR = -\Delta RF_{GHG} + k_{LW} * \Delta T$
Planck response: $k_{LW} = 3.3\ W/m^2K$



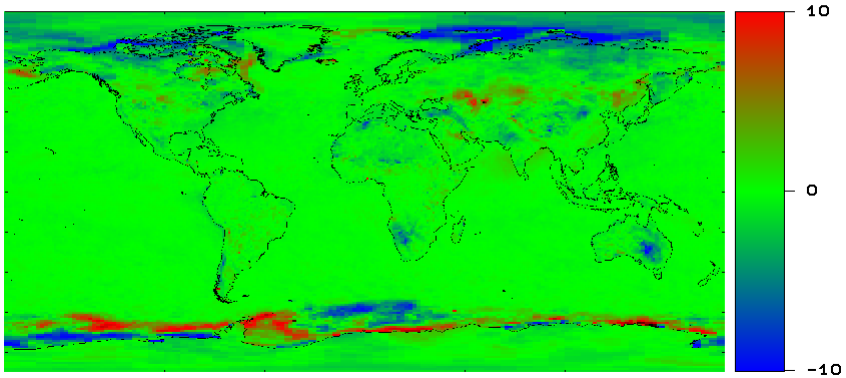


CERES: $k_{LW} = 2.6\ W/m^2K < 3.3\ W/m^2K$

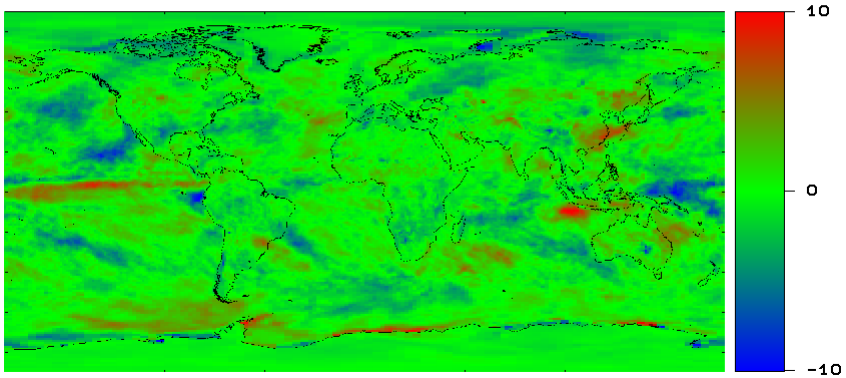
HIRS: $k_{LW} = 3.9\ W/m^2K > 3.3\ W/m^2K$

Reflected Solar Radiation

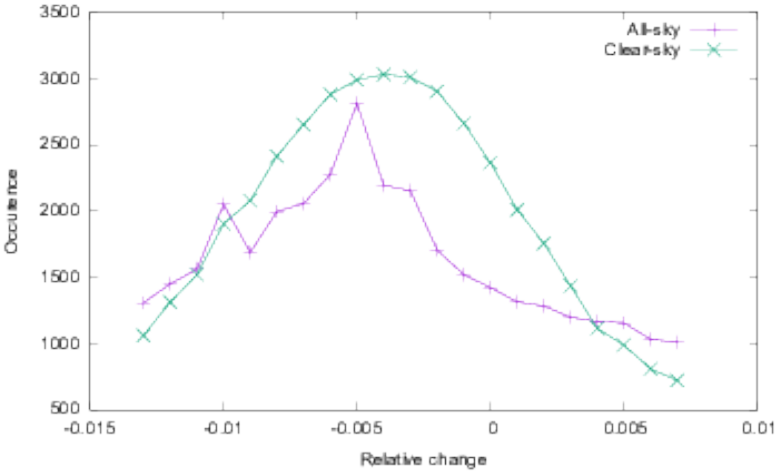
Clear-sky change
2000-2009 -> 2009-2018



All-sky change
2000-2009 -> 2009-2018



W/m²



Mode of clear-sky and of all-sky changes both close to -0.5%/dec

Most likely explanation: instrument drift

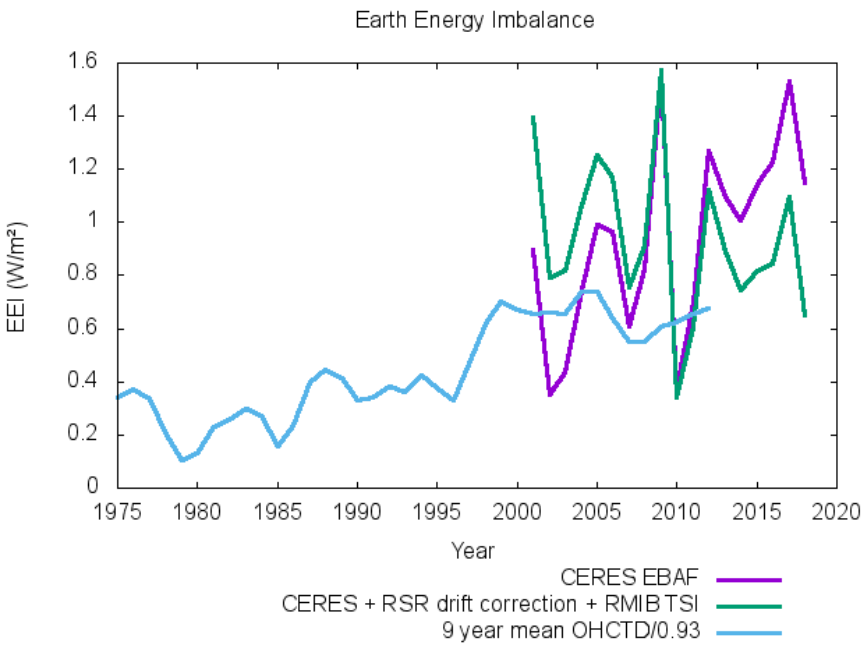
Earth Energy Imbalance

2000-2018 EEI trends:

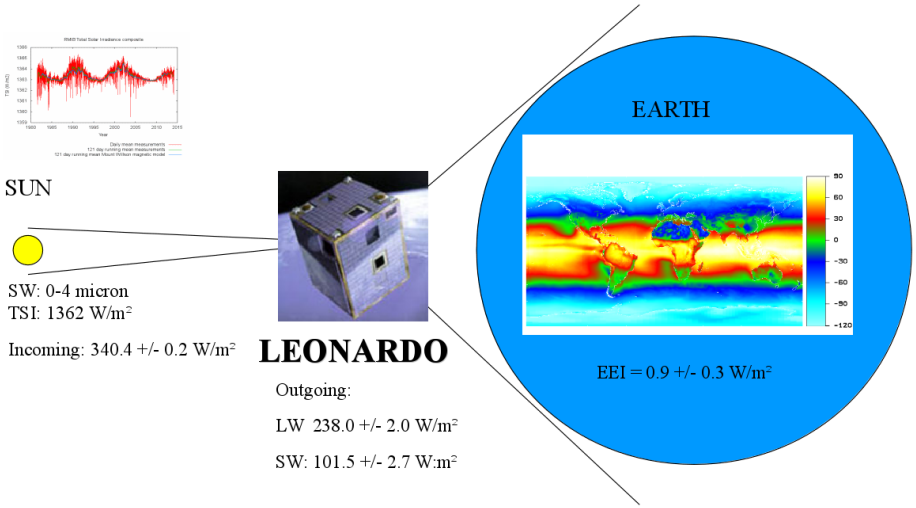
CERES EBAF:
+0.43 W/m²dec

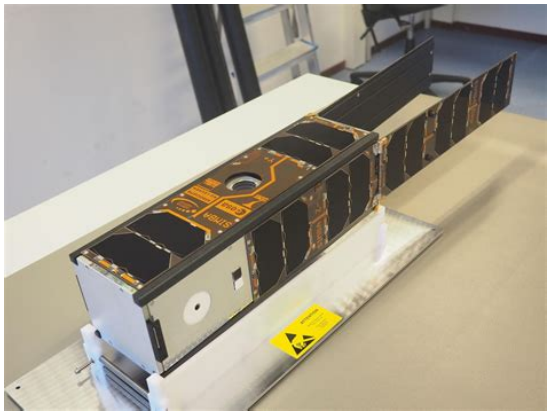
CERES+RSR drift correction+RMIB TSI:
-0.16 W/m²dec

1975-2012 EEI trend based on OHC:
+0.14 W/m²dec

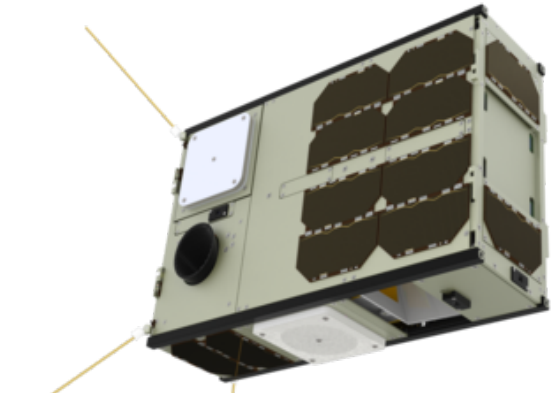


A new challenge: measuring the Earth Energy Imbalance



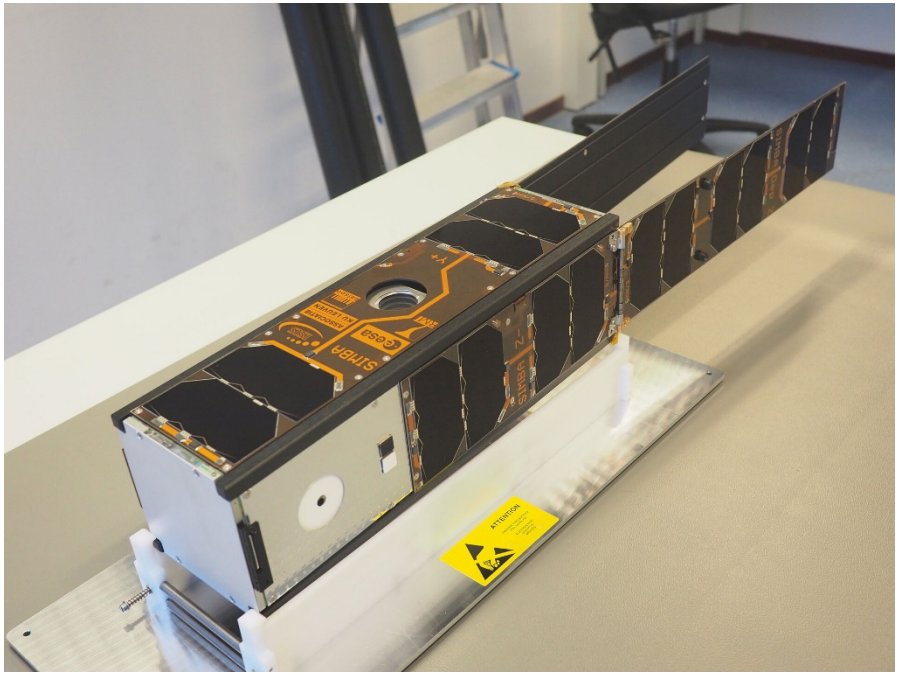


SIMBA: 3U tech demo



ASTERIX: 6U precursor for operational monitoring from morning orbit

Launch Sun-earth IMBAlance (SIMBA) cubesat on 3 Sep 2020



Summary

Downward trend Incoming Solar Irradiance

Increase Outgoing Longwave Radiation with temperature primarily due to Planck response

Decrease Reflected Solar Radiation primarily due to melting Arctic

High uncertainty on Earth Energy Imbalance trend due to uncertainty Reflected Solar Radiation trend

SIMBA 3U cubesat launched

ASTERIX 6U cubesat in development

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