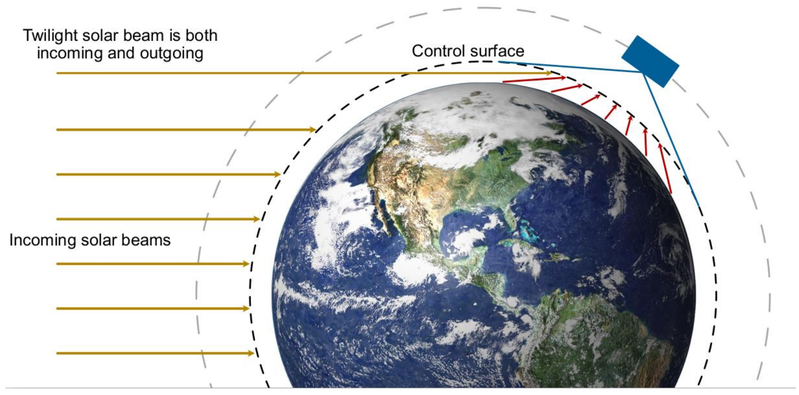
Thomas Hocking, Thorsten Mauritsen, Linda Megner
Department of Meteorology, Stockholm University
Bolin Centre for Climate Research, Stockholm University
thomas.hocking@misu.su.se

Investigating the effect of reflected sunlight on satellite measurements of the Earth's energy imbalance

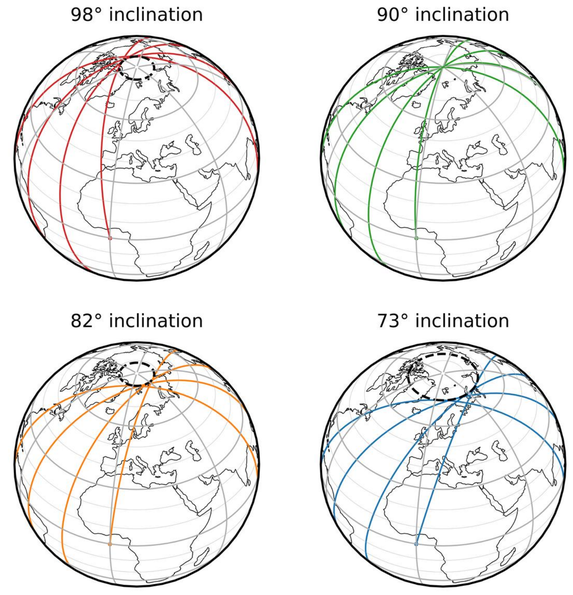
We investigate sampling errors of reflected and emitted radiation at the top of the atmosphere, measured with wide-field-of-view radiometers.

Key points:

- This work is connected to ECO, a proposed satellite mission to measure the Earth's energy imbalance.
- The sampling error depends strongly on the satellite orbit. With certain combinations of satellites, this error is much smaller.
- We find that the direction of reflected sunlight has a limited impact on the annual global mean error.



The Earth Climate Observatory (ECO) is a proposed satellite mission under review by the European Space Agency (ESA).
The aim is to measure the global annual mean energy imbalance, i.e. the difference between incoming and outgoing radiation for the Earth as a whole.



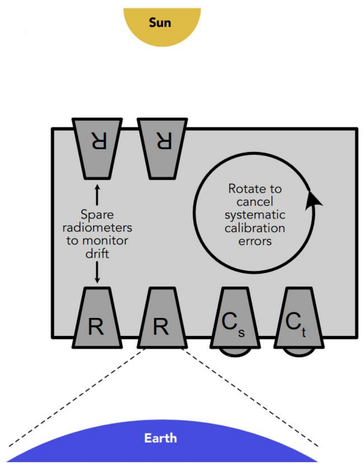
Different satellite orbits result in different sampling of the Earth in space and time. Large sampling errors can be reduced by combining multiple satellites.



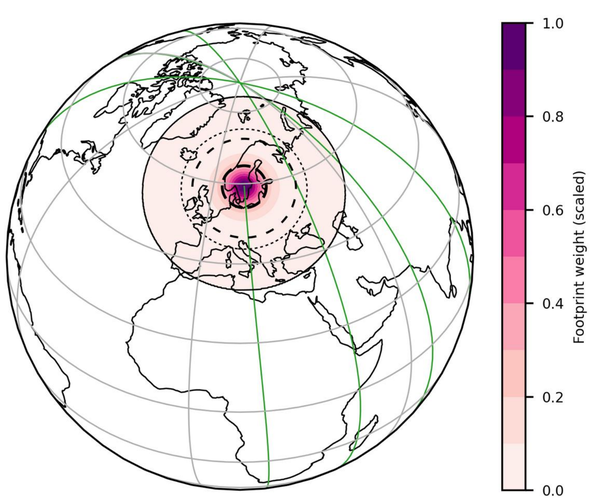
Sunlight can be reflected more strongly in certain directions. We investigate how this affects sampling, compared with if the surface were an ideal diffuse reflector.

Photo: NASA

Simplified satellite design

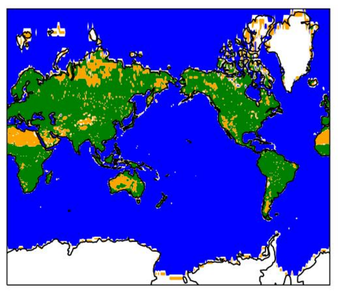


Footprint of wide-field-of-view radiometer

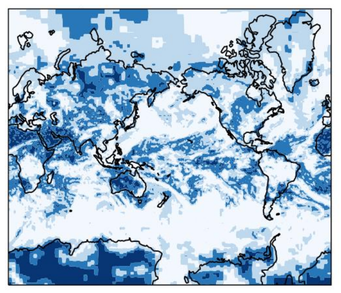


Input for simulated non-diffuse shortwave reflection

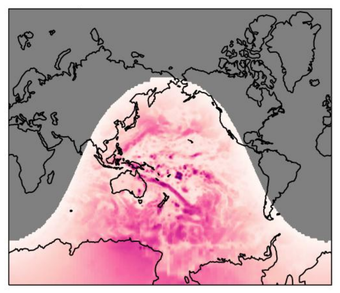
Surface type



Cloud cover

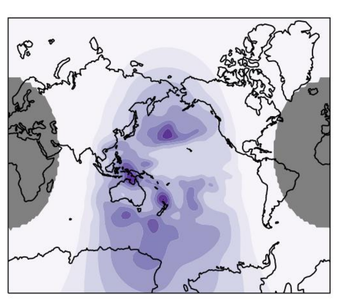


Radiation at top of atmosphere

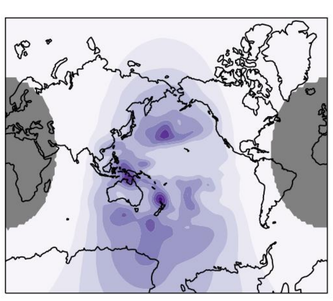


Snapshot of simulated shortwave reflection at satellite altitude

Diffuse reflection



Non-diffuse reflection



Difference (Non-diffuse - Diffuse)

