Surface Energy Budget Process Relationships
for Evaluating Model Performance in Central Greenland

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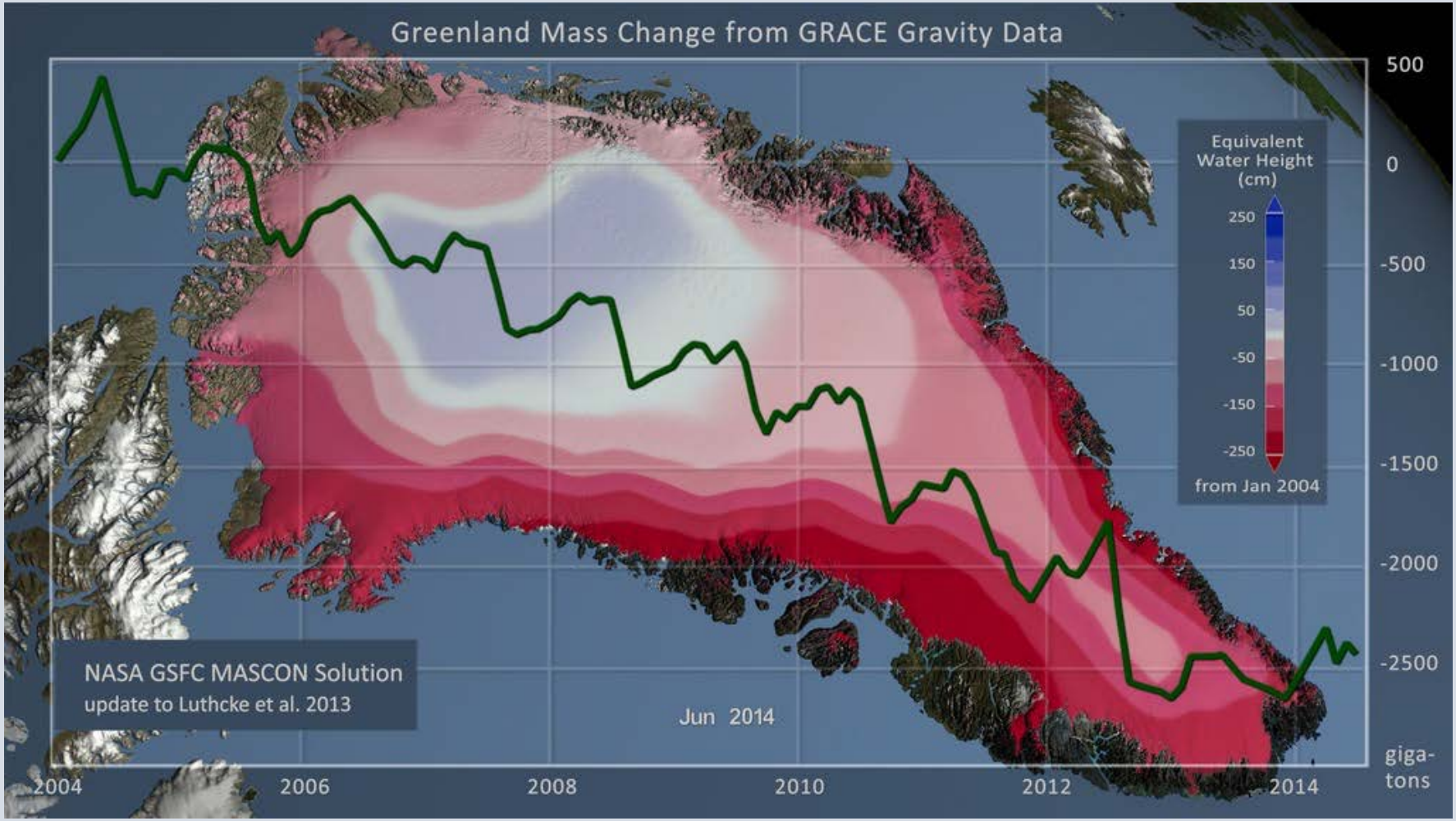
Importance of Greenland



1) Sea Level Rise: Losing 287 Gt/year = 0.8mm of sea level rise / year
2) Impacts on Thermohaline Circulation
3) Role in regional atmospheric circulation

Surface Energy Budget and Drivers
at Summit Station

3255 m
72°35’ N
38°25’ W

Measurements

- Clouds (ICECAPS)
- Radiation (NOAA GMD, Swiss WSL)
- Near-surface Met (NOAA GMD, Noone)
- Subsurface temperatures (Noone)

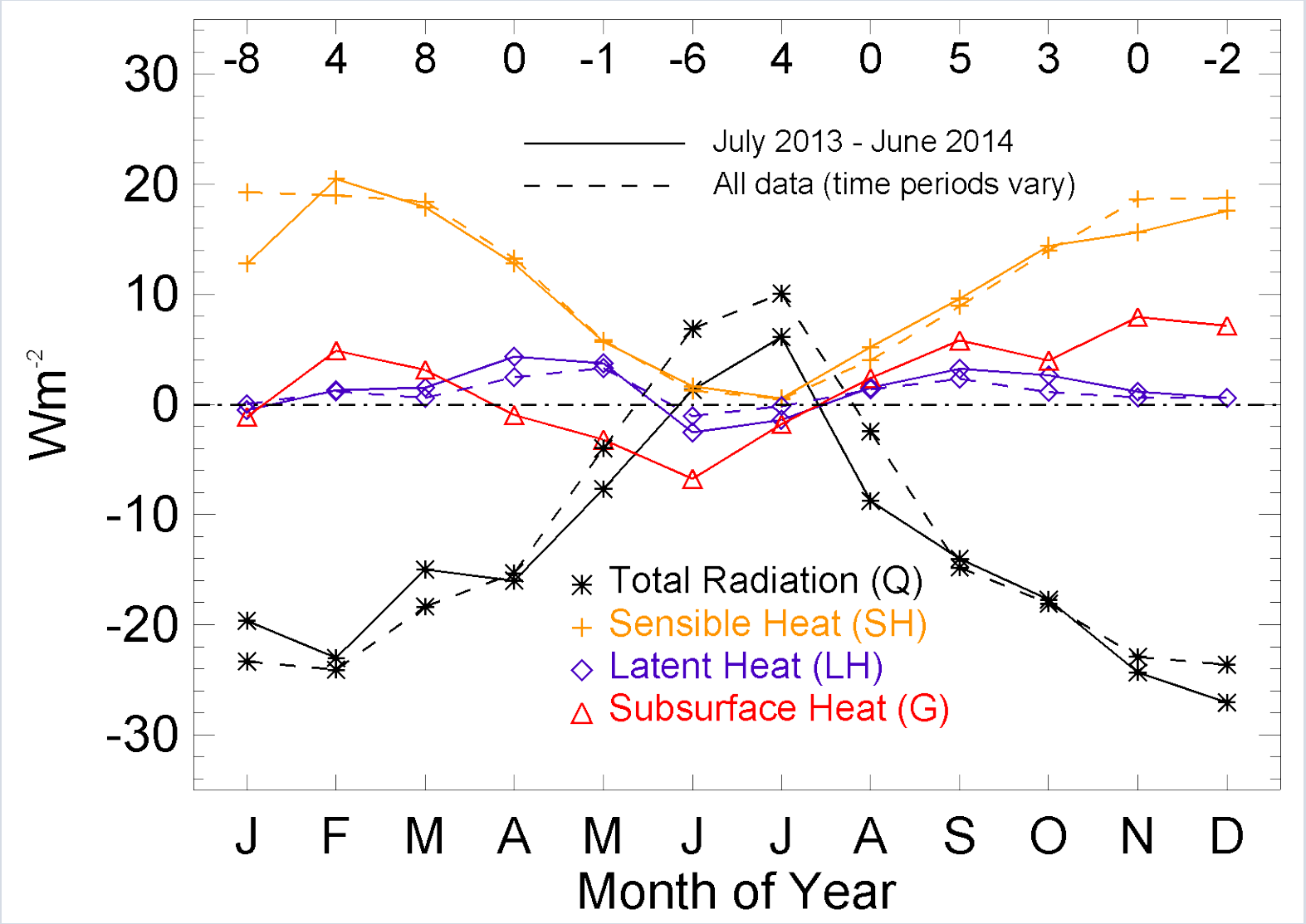
Surface Energy Budget (positive flux = surface warming)

$$SW_{down} - SW_{up} + LW_{down} - LW_{up} + SH + LH + G - \cancel{Melt} = 0$$

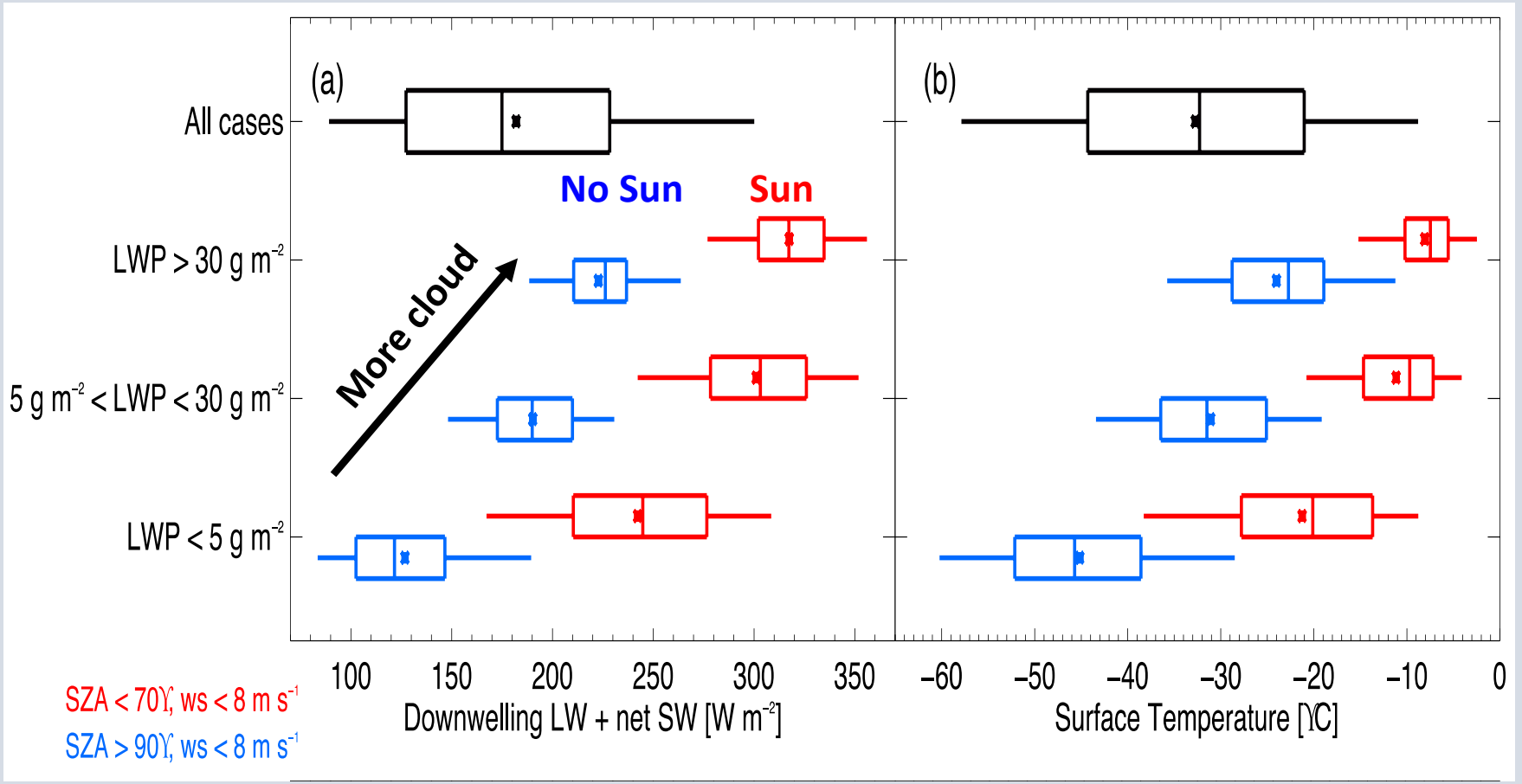
Forcers

Responders

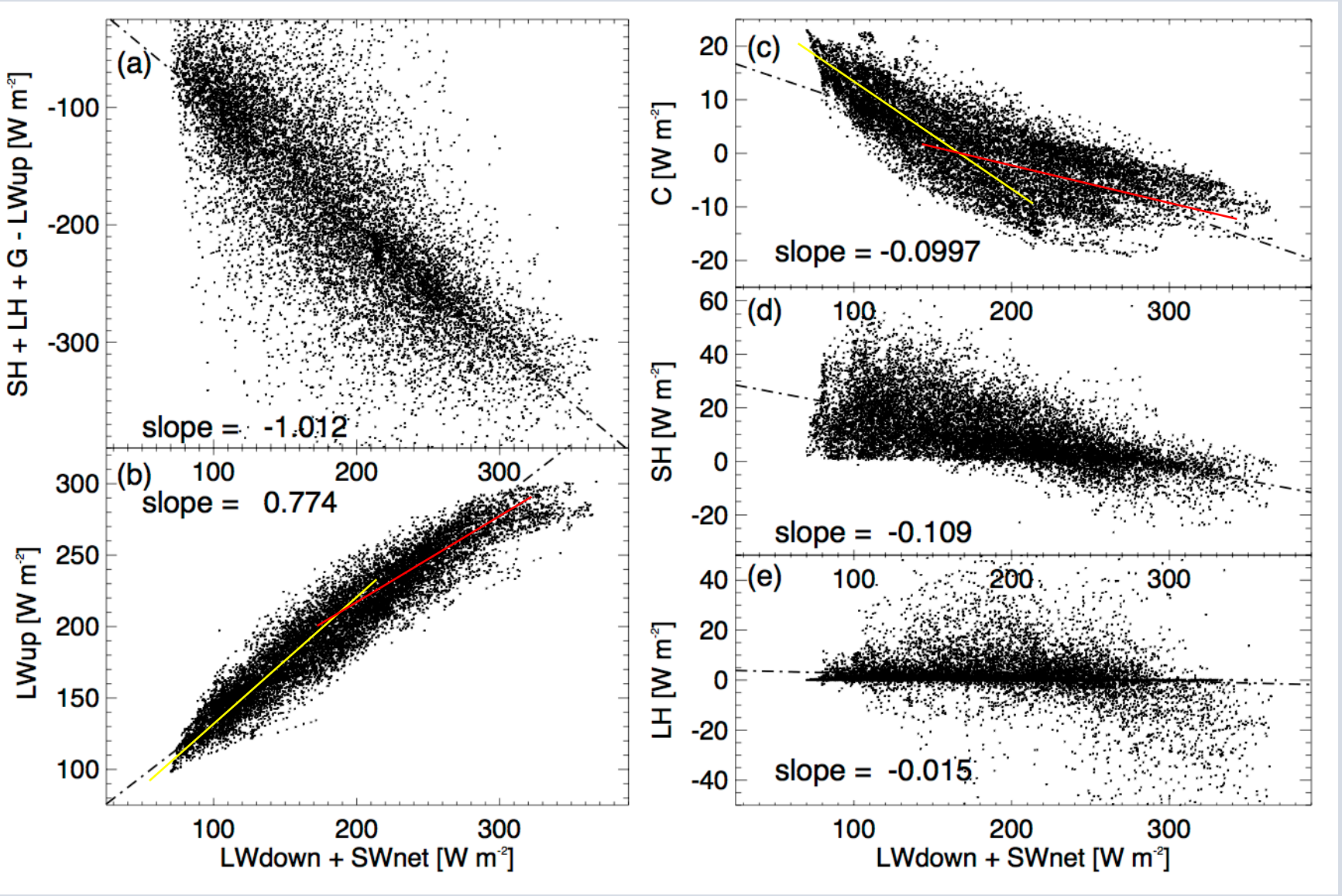
Surface Energy Budget



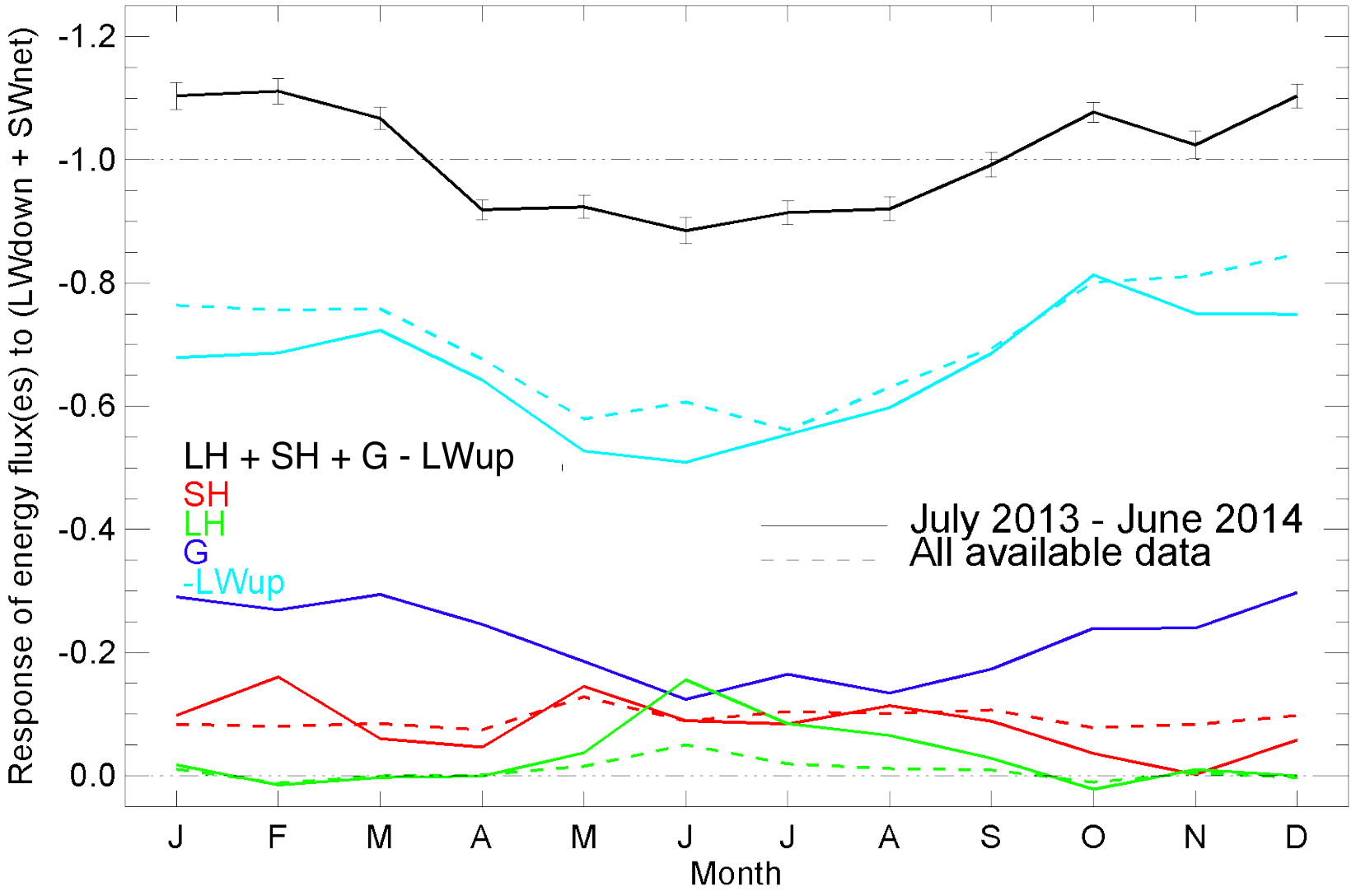
Impact of Liquid-bearing Clouds & Insolation



Response to Forcing terms



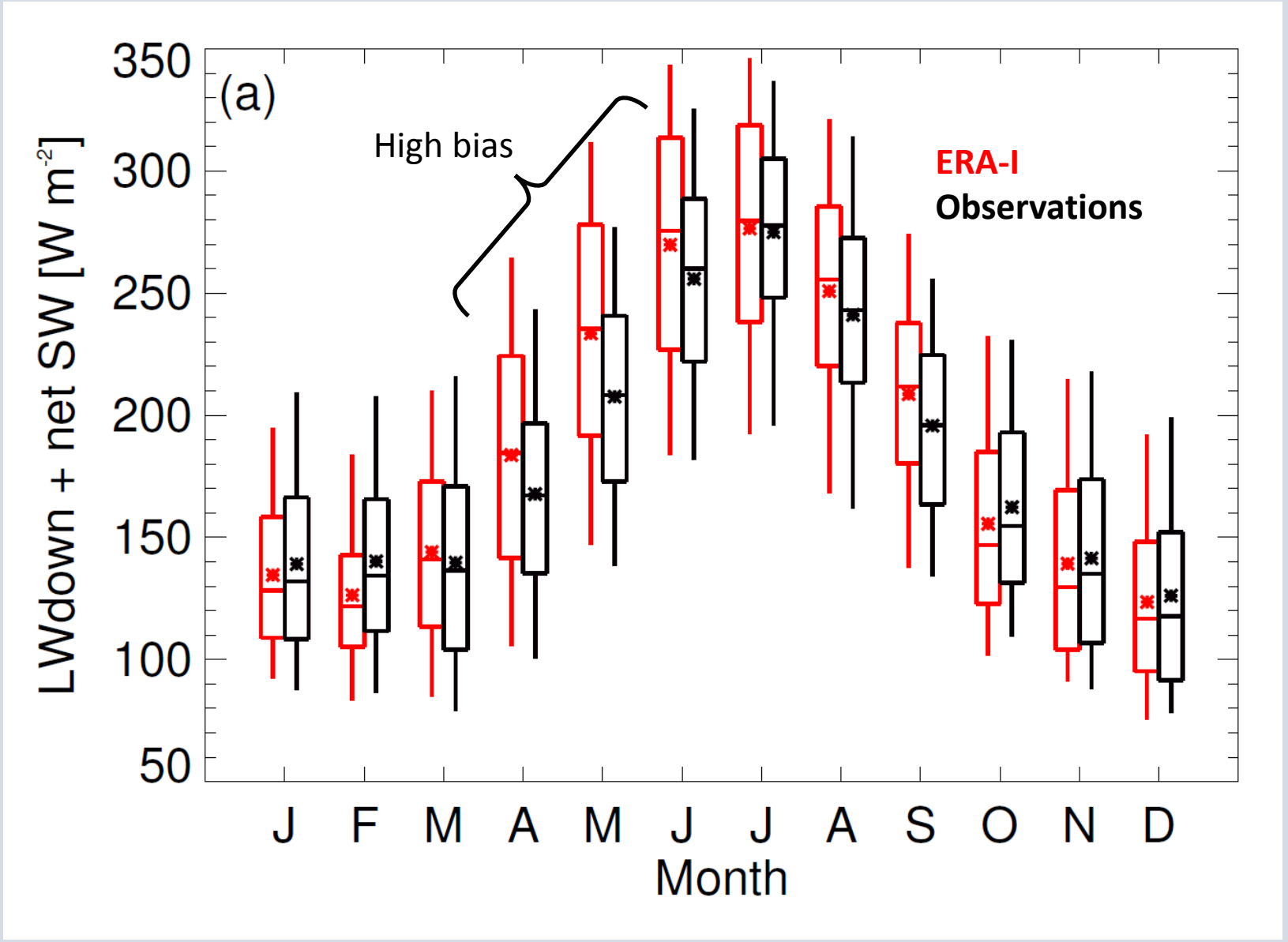
Annual Cycle of Responses



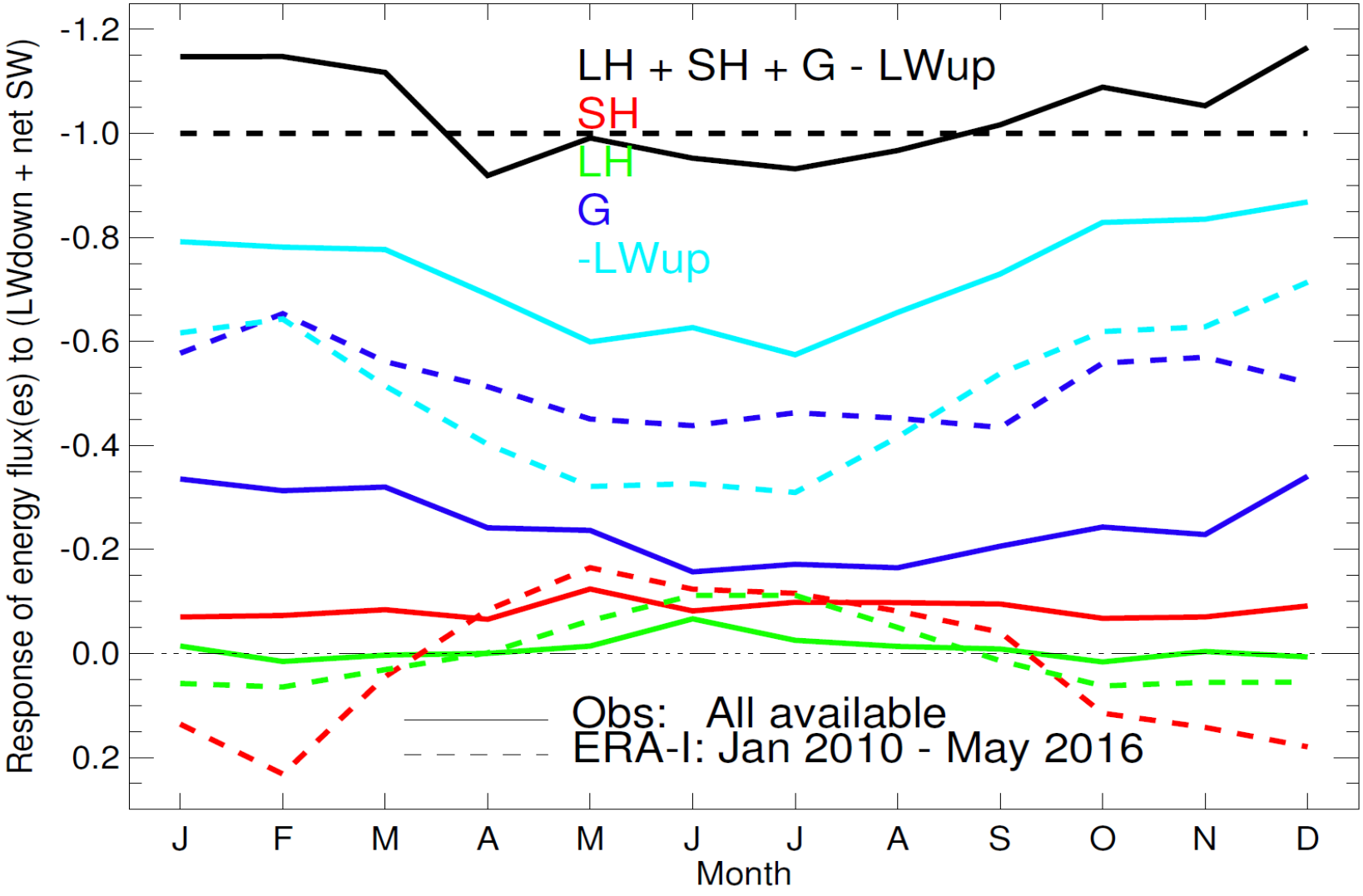
Models

- ERA-Interim (ERA-I)
  - Reanalysis product from the European Centre for Medium-Range Weather Forecasts
  - 3-hourly, 2010 – 2016
- Climate Forecast System version 2 (CFSv2)
  - Operational forecast model from the National Centers for Environmental Prediction
  - 6-hourly, 2011 – 2016
- Community Earth System Model (CESM)
  - Free running climate model maintained by the Climate and Global Dynamics Laboratory
  - 1-year data representative of current climate, 30-min
  - Beta version 7, candidate for CESM2, CAM6, CLM5

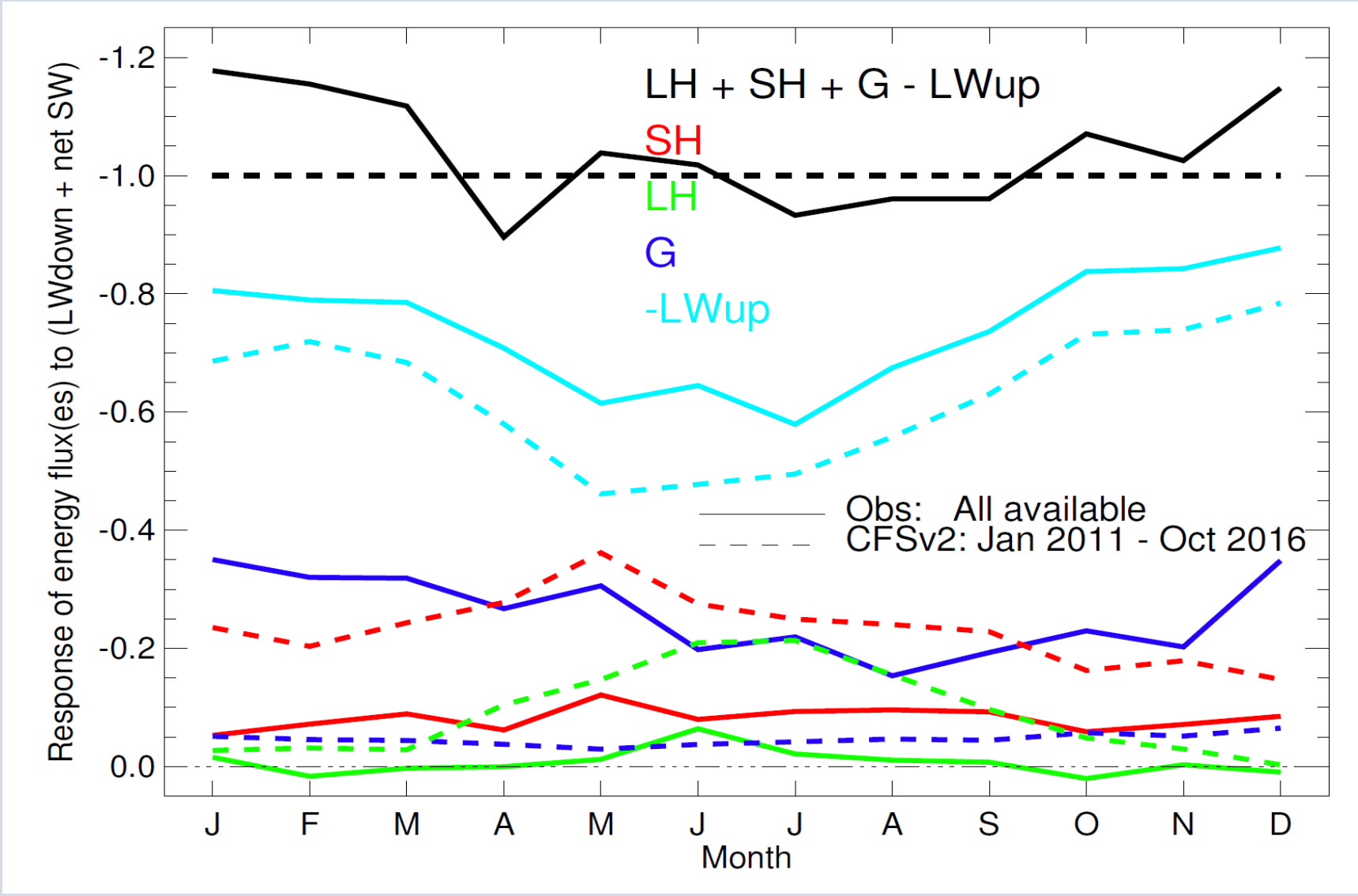
ERA-I Forcing



ERA-I Responses



CFSv2 Responses



Conclusions

- Multi-year SEB and cloud data set at Summit
- Achieved near closure in SEB calculations
- Model assessment of individual parameters AND process relationships
- Revealed important model deficiencies related to surface albedo, snow density, ABL processes