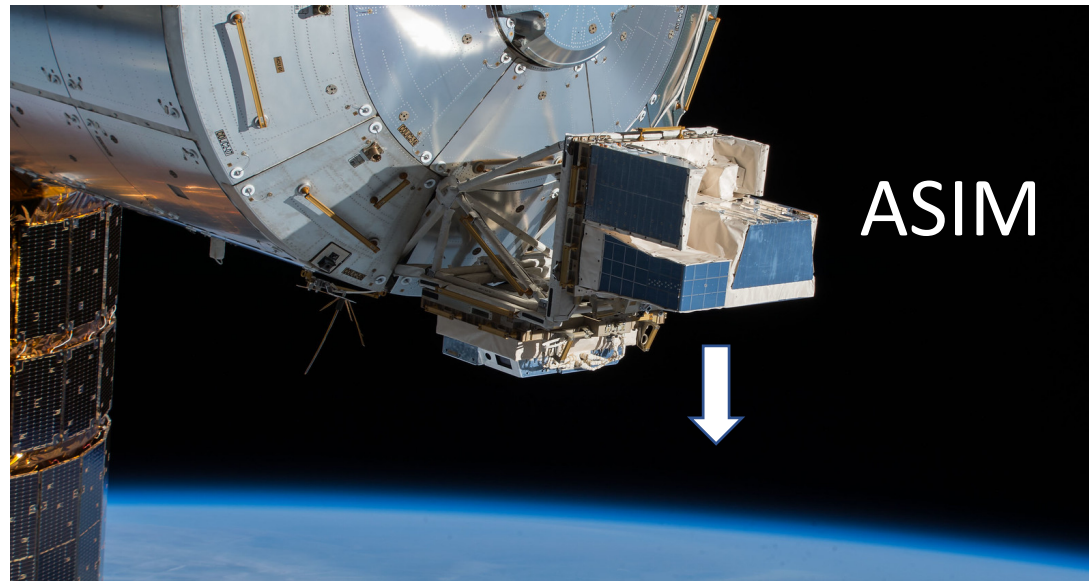


Cloud and lightning observations with ASIM and TOTEM on the ISS

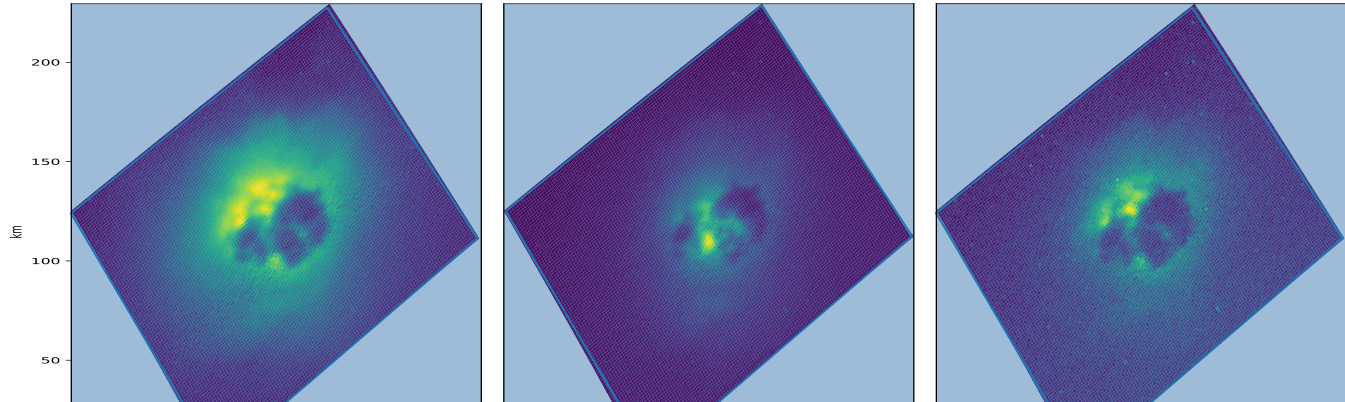
Torsten Neubert and Krystallia Dimitriadou,
Technical University of Denmark, Kongens Lyngby, Denmark (DTU Space) neubert@space.dtu.dk



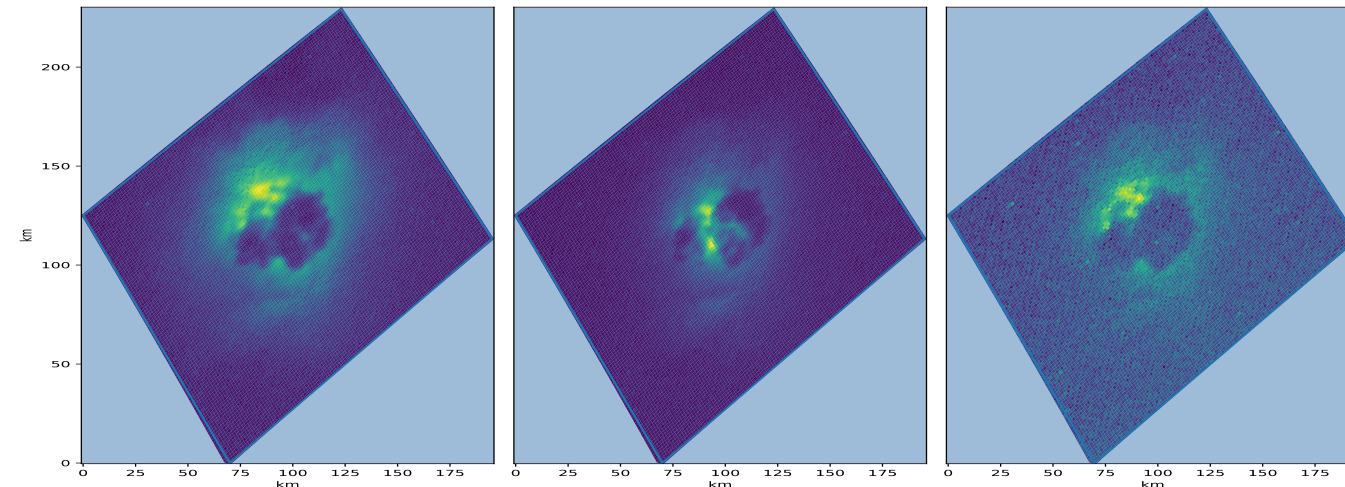
Typical ASIM Clouds and Lightning

3 consecutive frames; colour scale adjusted to max/min values

337 nm
83 ms exposures



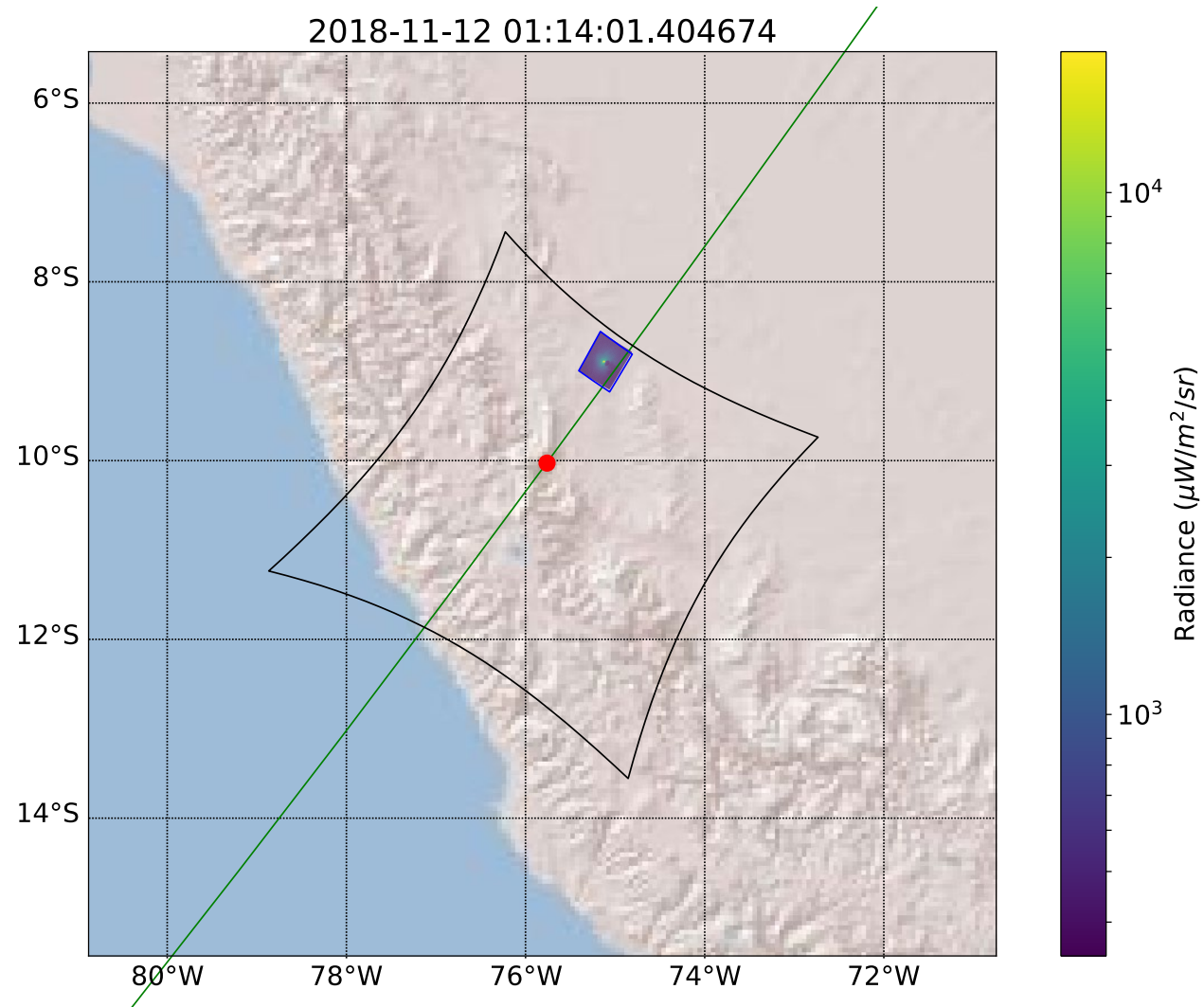
777.4 nm
83 ms exposures



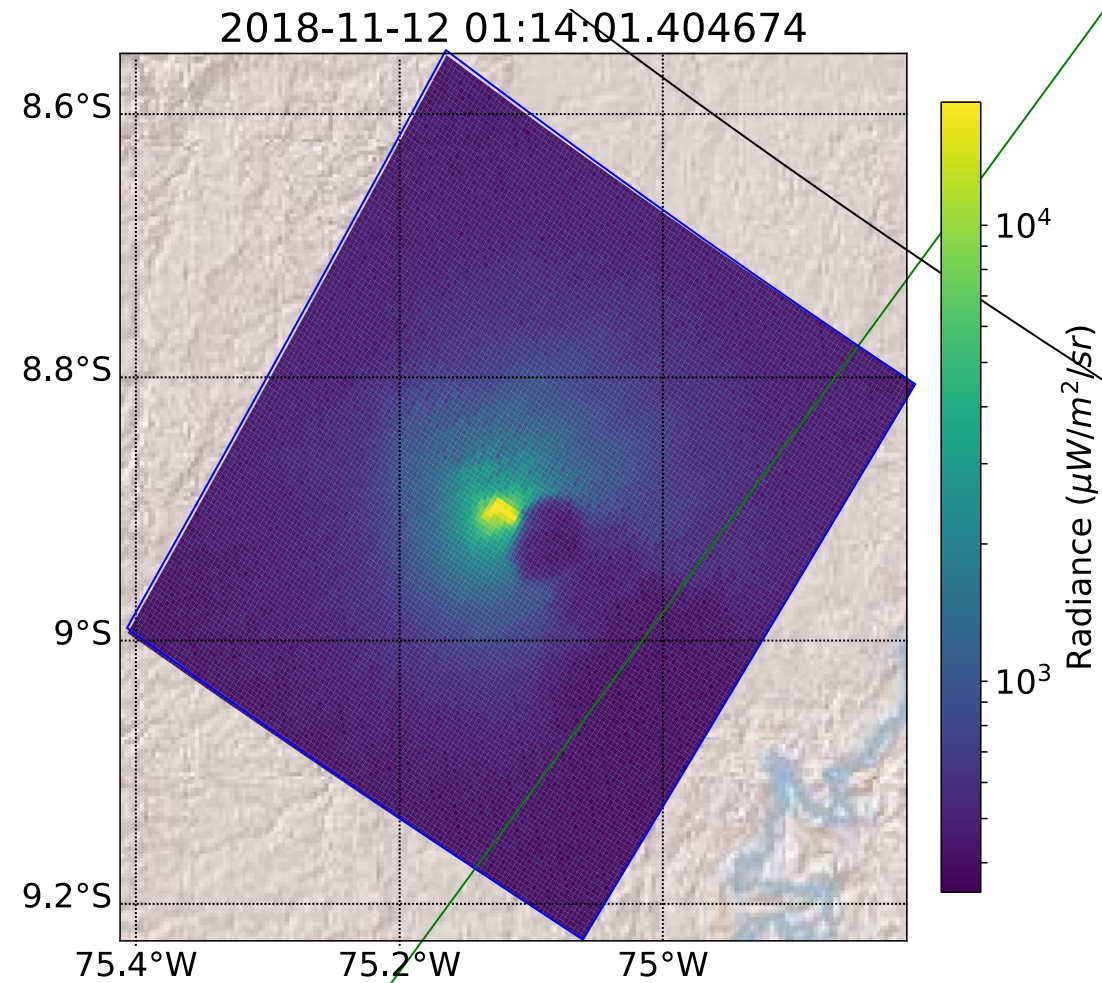
Outline

- Discuss issues with observations of clouds and lightning towards nadir based on ASIM data
 - Reflections in lower clouds
 - Clouds tend to block the view and displace the lightning location
 - Clouds may complicate the identification of a leader relative to a cloud edge
- The TOTEM project idea
 - To observe at 45 deg from Nadir to resolve the 3-D structure of clouds
 - TOTEM relative to present and coming lightning space missions
 - Status of TOTEM
 - Invitation to join the TOTEM investigations

Cloud reflections

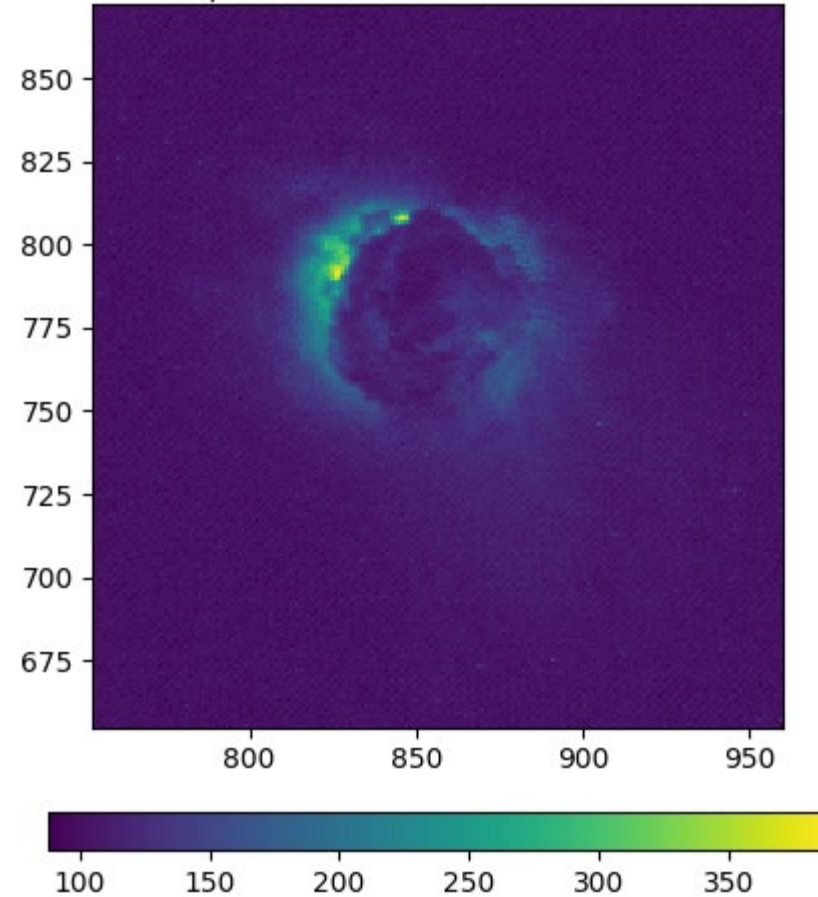


Cloud reflections



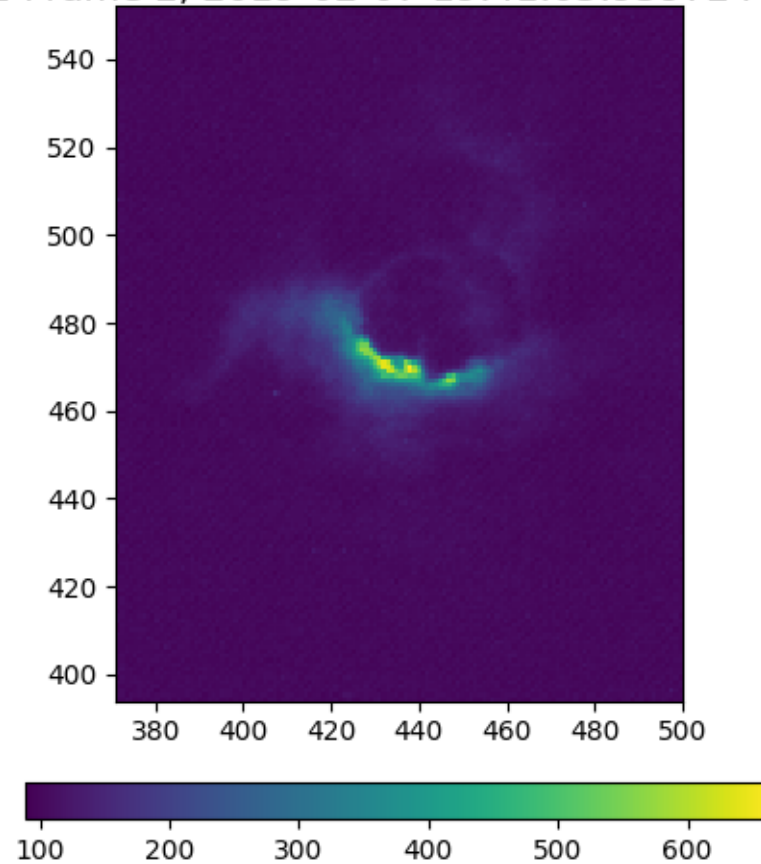
Clouds blocking the view

CHU2 Frame 2, 2019-04-21 08:58:15.058468+00:00



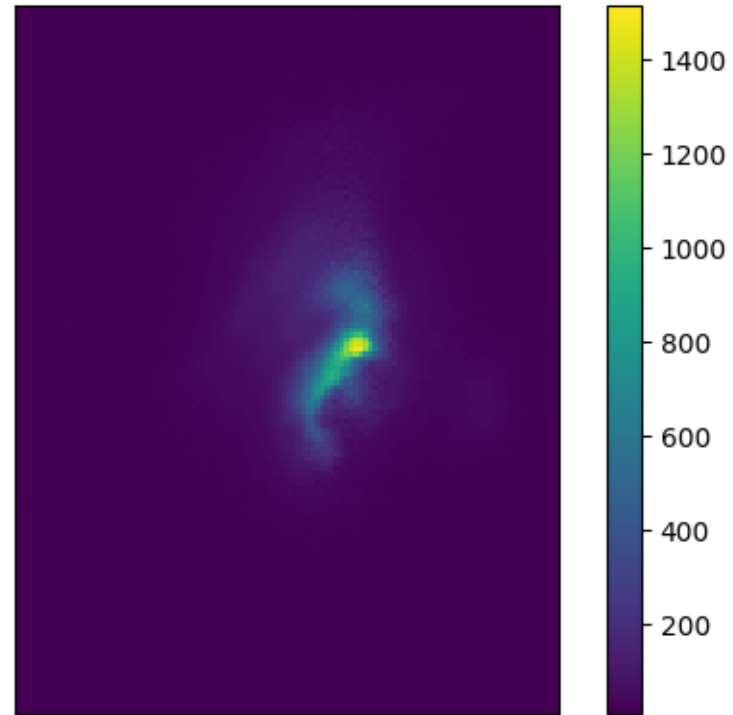
Cloud edge or lightning leader?

CHU2 Frame 2, 2019-02-07 19:41:05.959724+00:00



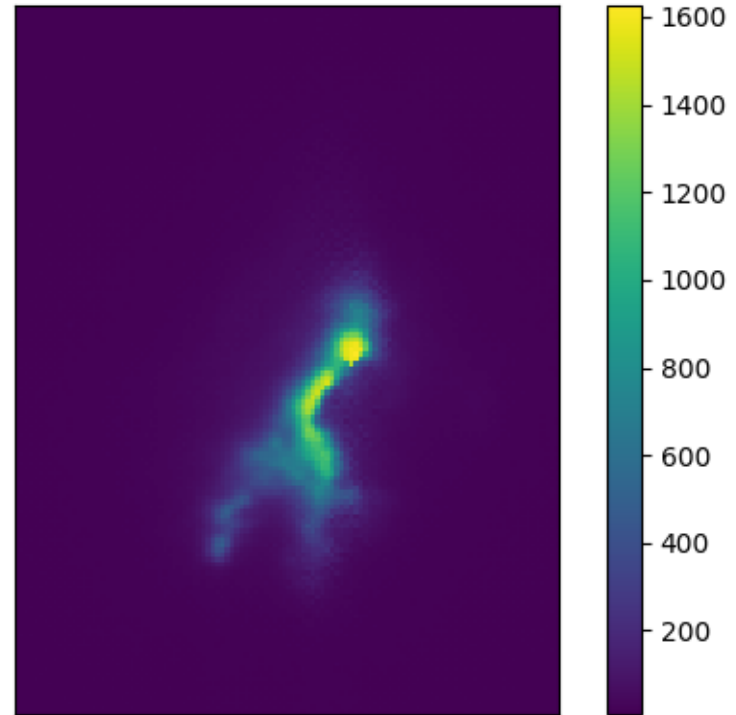
Cloud edge or lightning leader?

CHU1 Frame 1



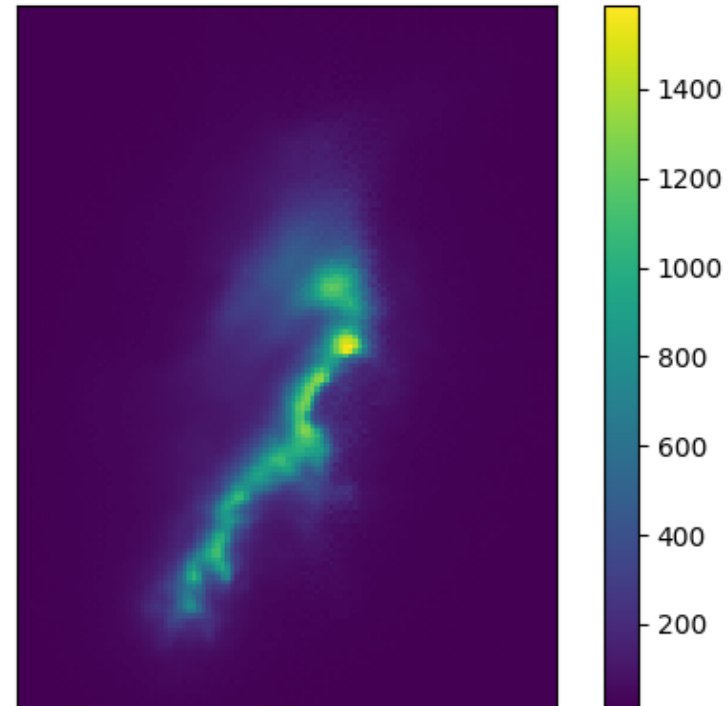
Cloud edge or lightning leader?

CHU1 Frame 2



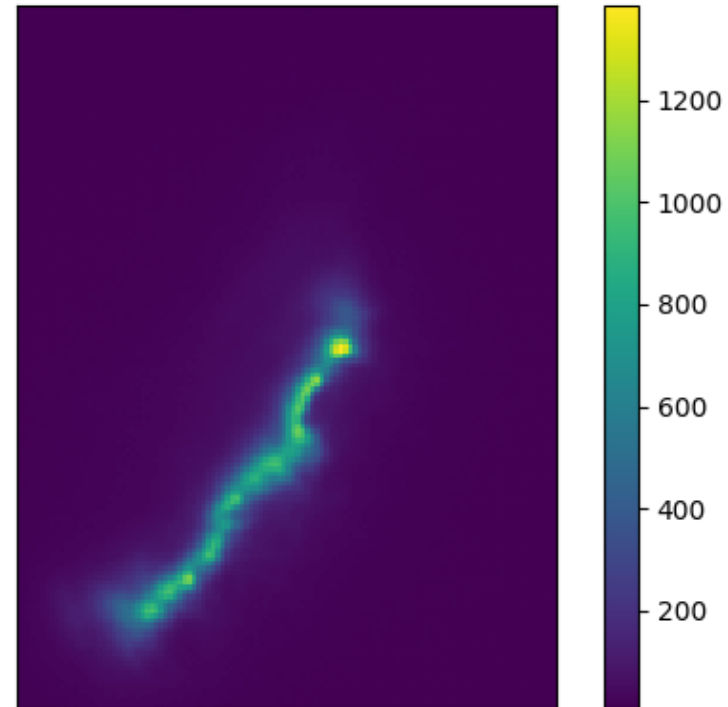
Cloud edge or lightning leader?

CHU1 Frame 3



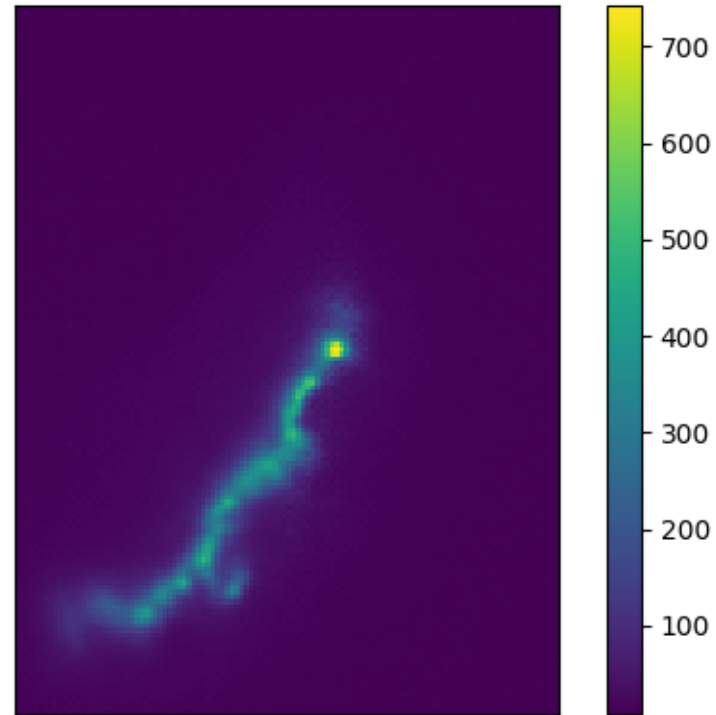
Cloud edge or lightning leader?

CHU1 Frame 4



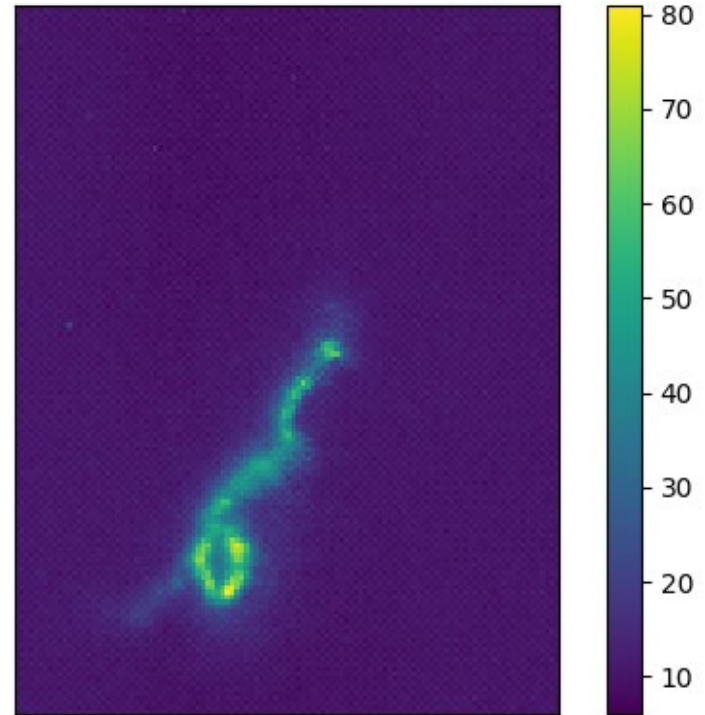
Cloud edge or lightning leader?

CHU1 Frame 5

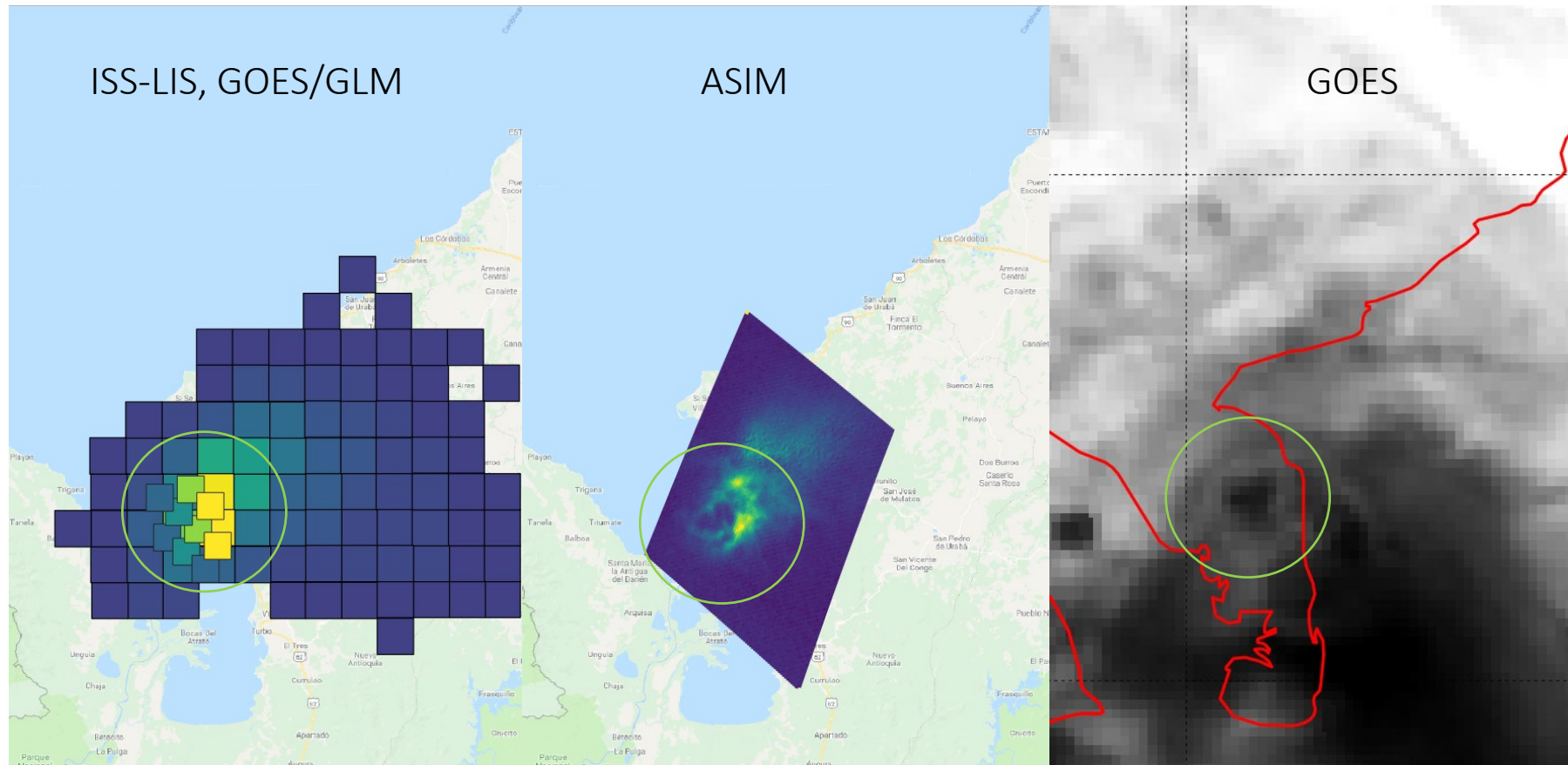


Cloud edge or lightning leader?

CHU1 Frame 6



Lightning observations with ISS-LIS and GOES/GLM



Van der Velde et al., jgr 2020; ASIM-LIS –GLM : Columbia 181113-02:02

Summary of nadir observations

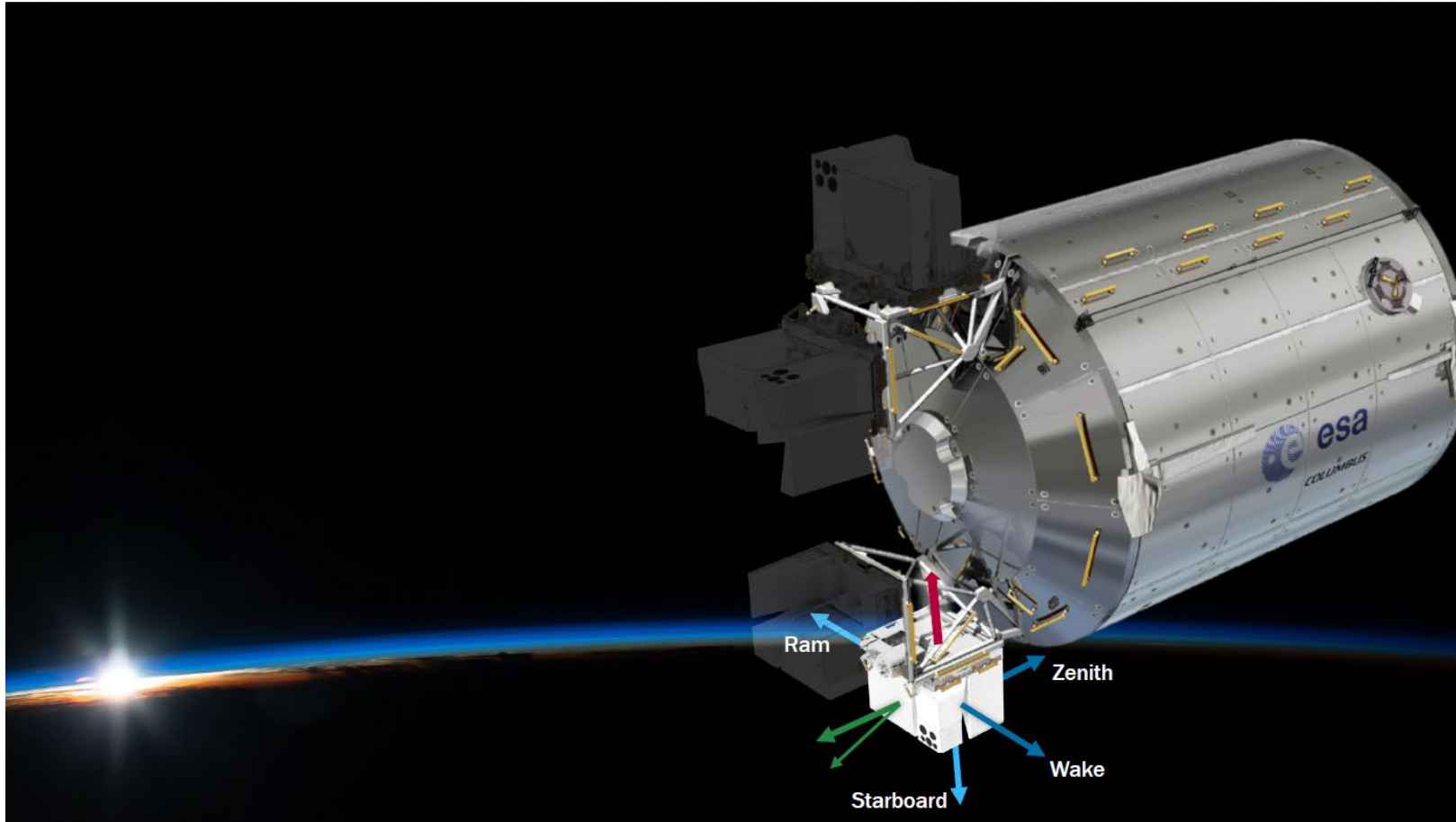
- We suggest that:
 - Clouds tend to bias the location assigned to events, caused by cloud reflections and blocking of light ... or to completely block emissions when viewed at large angles.
 - if one considers, for instance, the MTG or GOES, some information is available to help quantify the problem, in the cloud imager data, as these identify high cloud structures.
 - Perhaps imaging in a different viewing geometry would help to quantify the data quality ...

Slanted view

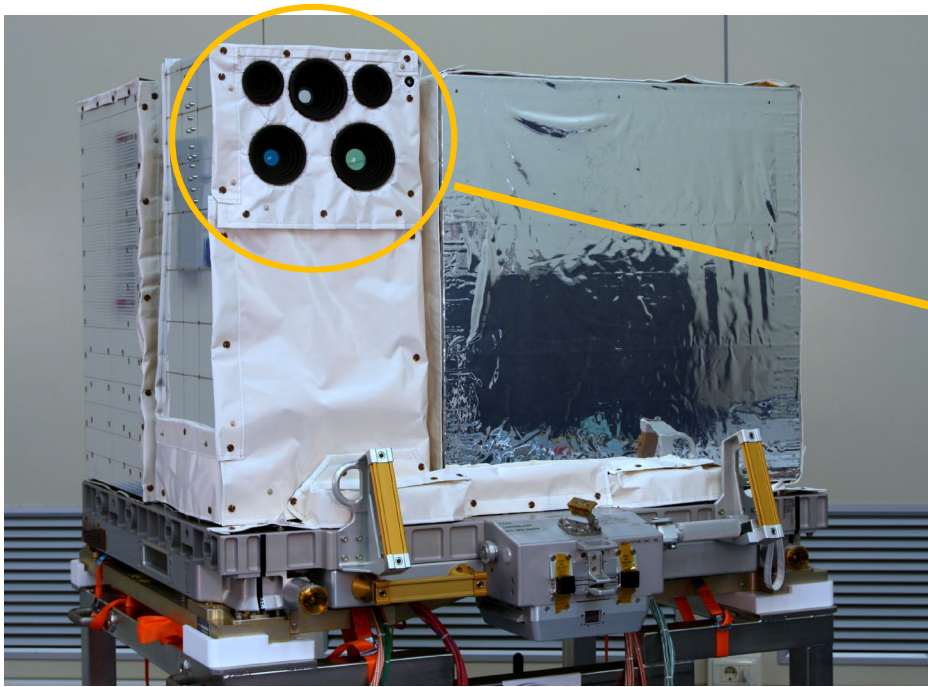
Thunderstorm clouds from the ISS, Andreas Mogensen.



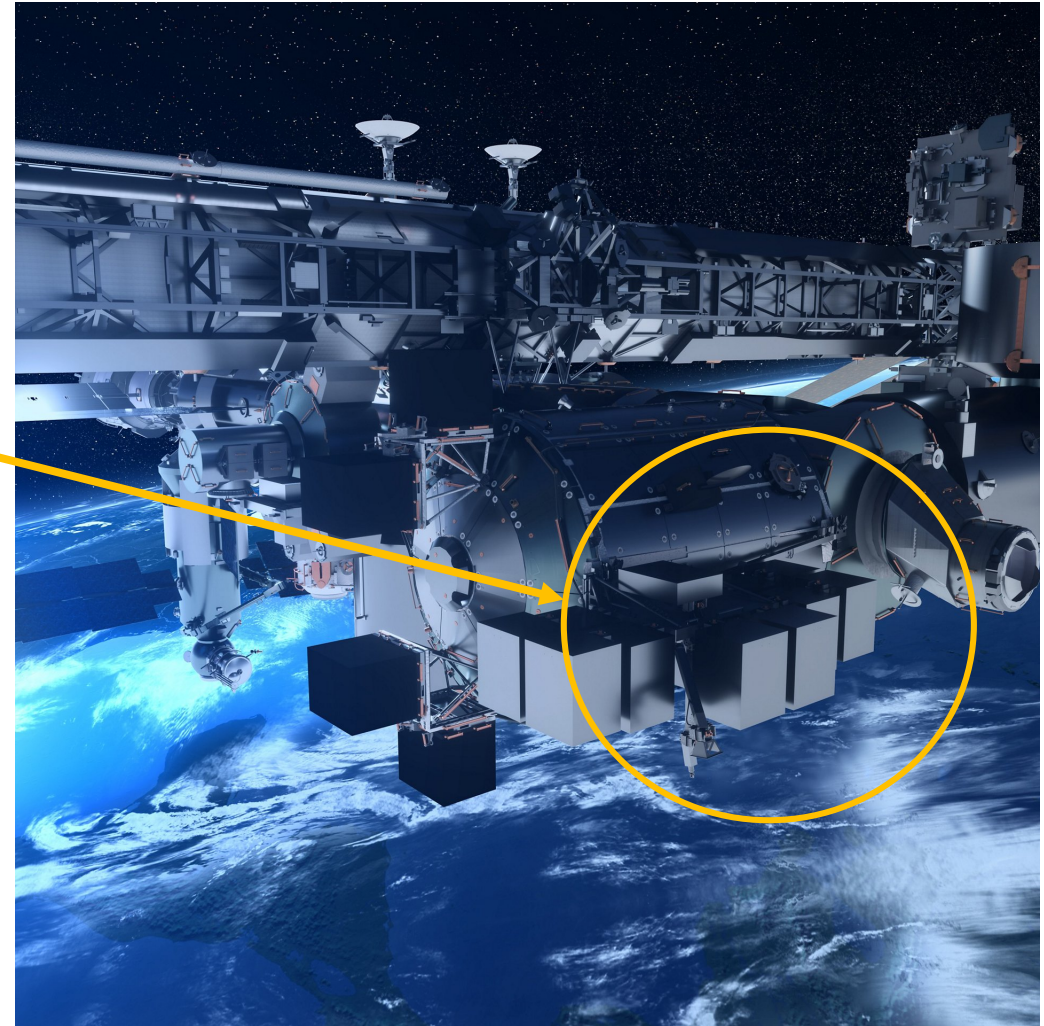
ASIM Limb on the ISS



TOTEM for Bartolomeo on the ISS



2 cameras (337, 777 nm; 300 m resolution) 12 fps
3 photometers (180-235; 337, 777 nm; 10 μ s resolution)





- ASIM Limb gives better than ~ 1 km spatial resolution (TBD)
 - The move to the limb position is currently scheduled to no later than 22 January 2022
- TOTEM resolution gives better than ~ 300 m (TBD) from ??
- The imagers may be the only in space that gives altitude resolution of clouds and electrical activity.
- We suggest it could be useful for validation and scientific use of MTG/LI and GOES/GLM and other EO instruments directed towards the nadir.

TOTEMs main goal is anchored in thunderstorms and climate research.

TOTEM is in a feasibility study at ESA

You are invited to join the TOTEM science team. Write me at:

neubert@space.dtu.dk