Post–Calipso perspective:

EarthCare and MESCAL

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What we want to know: how clouds change when climate warms?
To predict future climate we need to know how the clouds change and why?

Clouds remain the main source of uncertainty for future climate prediction (IPCC AR5, WCRP Grand Challenge).

Models predict that cloud changes enhance the greenhouse warming.

Models predict that cloud changes weaken the greenhouse warming.

Illingworth et al. 2015, BAMS
Thank's to Calipso and the A-train, we know where the clouds are.

Detailed vertical distribution of clouds

Chepfer et al. 2008
Cesana et al. 2012

Latitude (°)

Altitude (km)
To quantify how the clouds change and why, we need a long term lidar record.

Models prediction of high cloud altitude change seen by lidar:
- High clouds enhance significantly the Earth warming
- High clouds enhance slightly the Earth warming

Models prediction of low cloud volume change seen by lidar:
- Low clouds weaken the Earth warming
- Low clouds enhance the Earth warming

Need for 25+ years spaceborne lidar record - CALIPSO/EarthCare
To quantify how clouds change and why, we also need to understand the role of aerosols and ocean ecosystems.

Aerosols observed by High Spectral Resolution Lidar.
To know how the clouds change and why, we need an innovative lidar with new technology.
To know how the clouds change and why, we need the lidar to fly with radar and radiometers.
To know how the clouds change and why, we must implement the **MESCAL mission**

**MESCAL:**
- A lidar mission co-proposed by the French–EU/EECLAT and the US/ACE science communities.
- Will fly in formation with radar and radiometers, building on the demonstrated synergies of CALIPSO + CloudSat + A–train and EarthCARE.
Back up
To quantify how clouds change and why, we also need to understand the impacts of aerosols on clouds. For this we need to build on the advances of EarthCARE to deploy a multi-wavelength high spectral resolution lidar.
To quantify how clouds change and why, we also need to understand the role of aerosols and ocean ecosystems. Airborne High Spectral Resolution Lidar (HSRL) demonstration provides insight on linkage between clouds, aerosols, and ocean biology.