



Committee on Earth Observation Satellites

CEOS – Working Group on Disasters

GEO/LEO/SAR Flood Pilot Projects

Marcelo Uriburu Quirno (CONAE) - Presenter

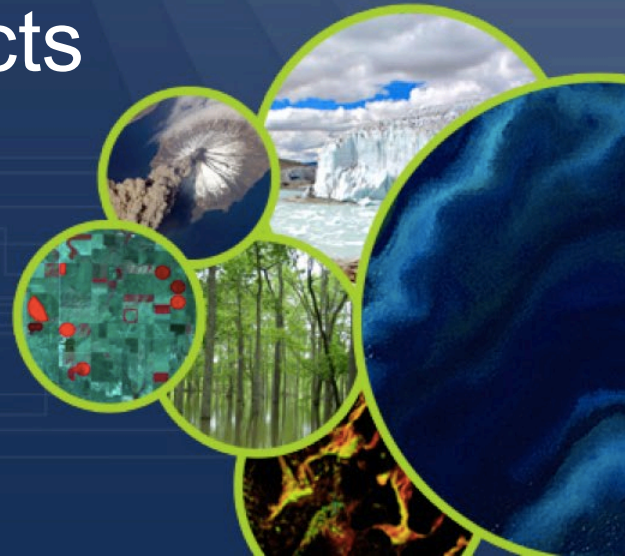
Guy Schumann (RSS Hydro)

Mitch Goldberg (NOAA)

WGDisasters-19 Meeting

Córdoba, Argentina

18 – 21 April 2023



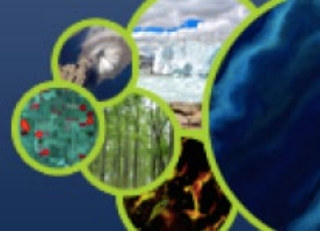


Objective

Flood Pilot Projects would explore and demonstrate best practices for combining diverse optical and SAR data to map floods.

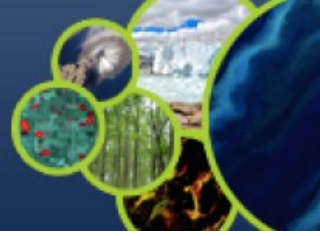
Report on best practices developed through integration of LEO, GEO and SAR.

Flood Pilot Projects are **gradually** broadening their scope to include exploring the use of satellite EO for **other aspects** of Flood Risk Assessment and Management, in closer contact with disaster management agencies and end users.



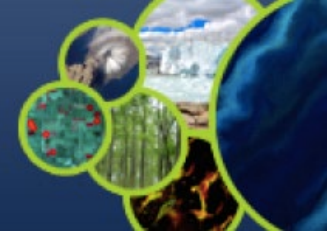
Since October 2022

- 3 monthly meetings with members of the “Sub-groups”
- 1 coordination meeting
- Permanent e-mail exchange among the co-leads, for project coordination



“Understanding Flood Risk from Space” (DIS - 22 - 01): Deliverable for Q4 2024

- Given the maturity achieved in applying flood mapping techniques with optical, SAR or their combination, next steps will include different aspects of flood risk (not just hazard but also exposure and vulnerability) to support flood risk management
- Report on best practices developed through integration of LEO-GEO and SAR
- Learn from organizations that use satellites for flood response/management (National Disaster Management Agencies, i.e., the FEMA equivalent from different countries)
- Format TBD



SG1: Red River of the North

Vince Decker, Natural Resources Canada

SG2: Bermejo and Pilcomayo Basins

Marcelo Uriburu Quirno, CONAE

SG3: Brahmaputra River and Mahanadi Delta

G S Rao, ISRO

SG4: Pearl River Basin

Weiyuan Yao, CAS

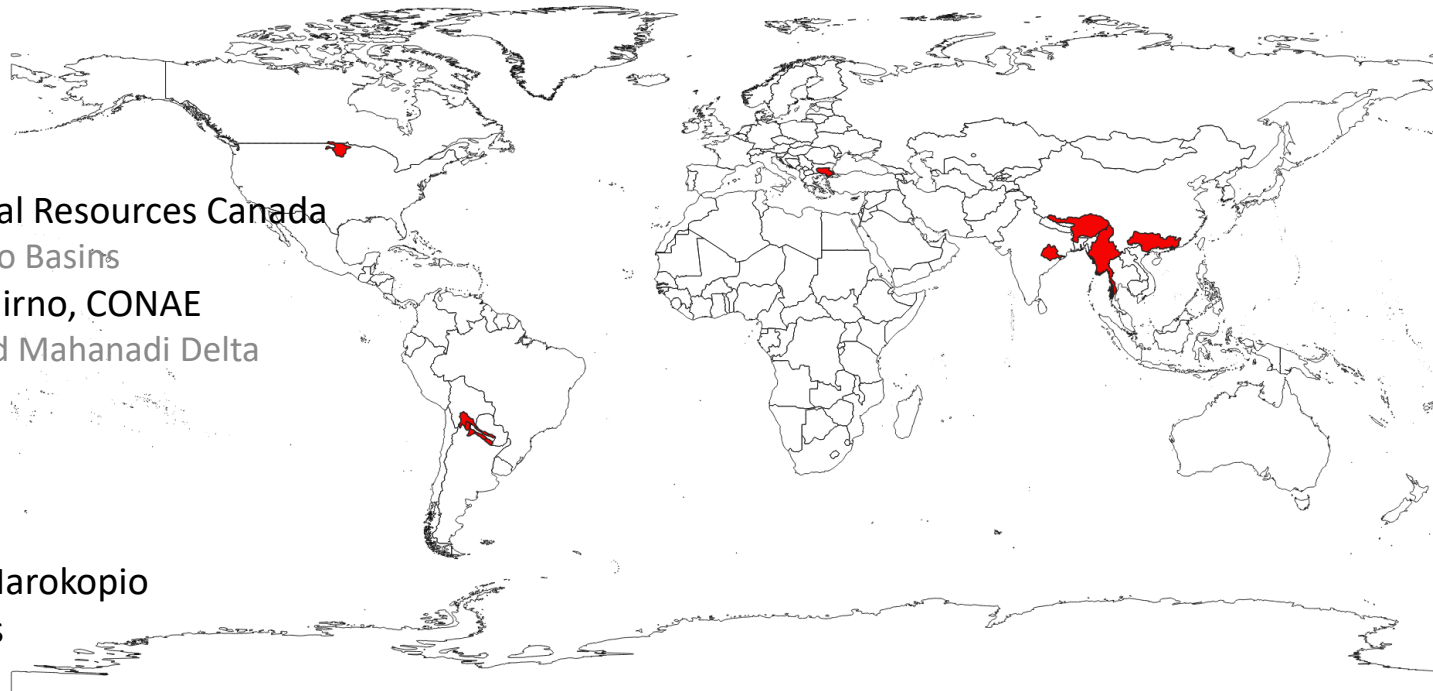
SG5: Balkans

Issaak Parcharidis, Harokopio

University of Athens

SG6: Myanmar

Patrick Matgen, LIST



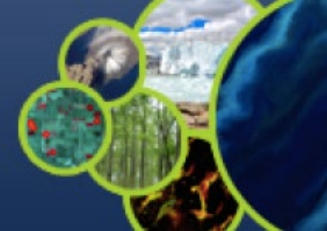


SG5, led by Issaak Parcharidis, Harokopio of University of Athens, on Balkans area.

Two new members joined the team, thus broadening the scope of their project, potentially incorporating two transboundary rivers.

- 1- the Evros river (Greece-Turkey and Bulgaria)
- 2- the Aaos/Vjosa river (between Greece and Albania)





Evros is a transboundary river between Greece-Turkey and Bulgaria. It flows into the Aegean Sea, forming a delta.

The proposal → using EO data for mapping of islets and monitoring the fluvial dynamics and the impact of floods on their formation



The proposal is relevant for the Flood Pilots





The Vjosa /Aaos → transboundary river (upper basin in Greece, lower basin in Albania)

The basin is in a pristine state, river flows aren't regulated.

One of the longest (272km) transboundary rivers in the Balkan area

EO data → essential for environmental mapping and river basin monitoring over the past decades.

In terms of climate change and terrain susceptibility to multi-hazards, reliable and recent EO data can provide useful information for continuous monitoring of changes within the river basin.



The thematic relevance wrt Flood Pilots is yet to be discussed.

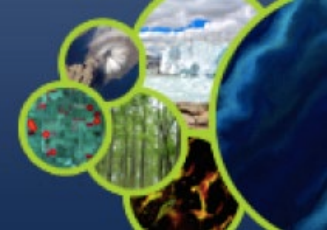


A broad variety of aspects have been covered, including:

- ML techniques for merging water fraction products,
- Downscaling flood mapping to a finer detail with the use of DEMs ,
- Merging GEO-LEO and SAR sources,
- Monitoring antecedent moisture conditions at basin level with satellite rainfall estimates,
- The infusion of satellite data to flood monitoring and warning systems, automated flood extent mapping systems.



- Probabilistic inundation maps, combining the results of hydrologic modelling with the inundation statistics based on a library of SAR imagery of events.
- SAR-based flood mapping methodology for flood extent, flood frequency, evolution, etc.
- Other effects that share the same forcing as floods have been covered: erosion and soil loss, landslide risks, etc.



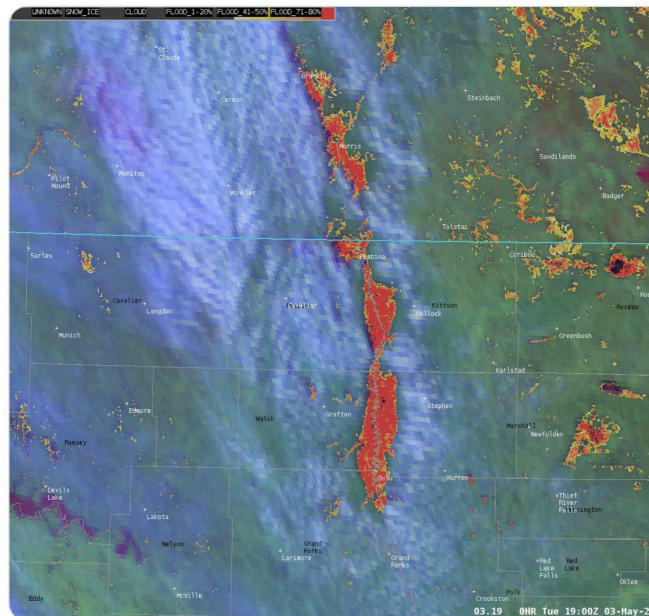
Lessons learned and interagency collaboration fostered by the Flood Pilots are benefiting services.

US National Weather Service used NOAA VIIRS flood maps to inform emergency managers

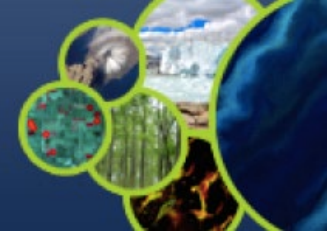


NWS Grand Forks ✓
@NWSGrandForks

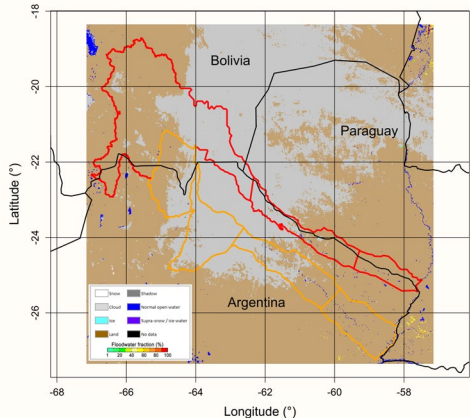
The yellow/orange coloring in this image denotes flood water detected by the VIIRS satellite instrument, in some locations around 8 miles wide!



Examples of recent uses of GEO/LEO/SAR



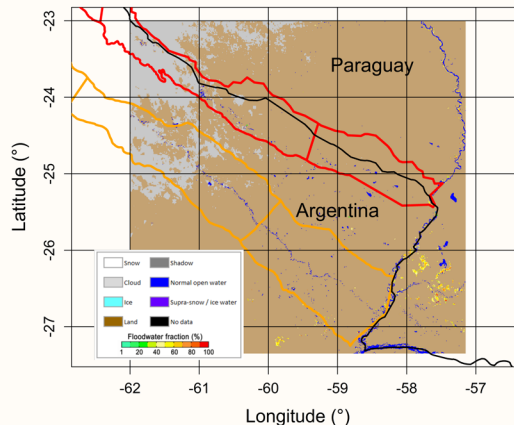
Joint ABI/VIIRS flood product. Pilcomayo & Bermejo Basins. 2023-04-18



CONAE - GOT - SGaYP

NOAA

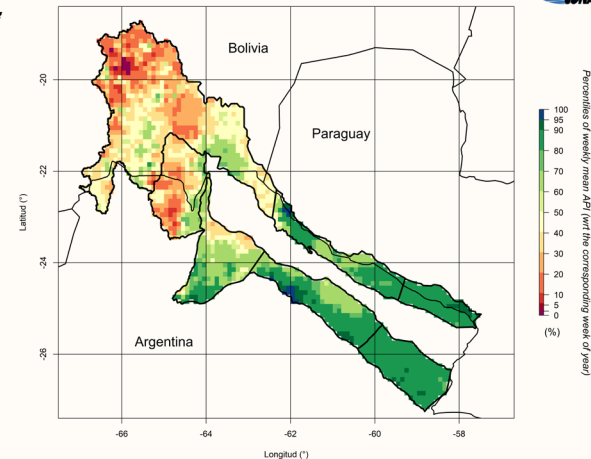
Joint ABI/VIIRS flood product. Pilcomayo & Bermejo Lower Basins. 2023-04-18



CONAE - GOT - SGaYP

NOAA

Hydrological Status. Pilcomayo & Bermejo Basins. Week through 2023-04-18
Comparison with the most recent 20-year record



copyright CONAE, 2023

Non-Validated Product

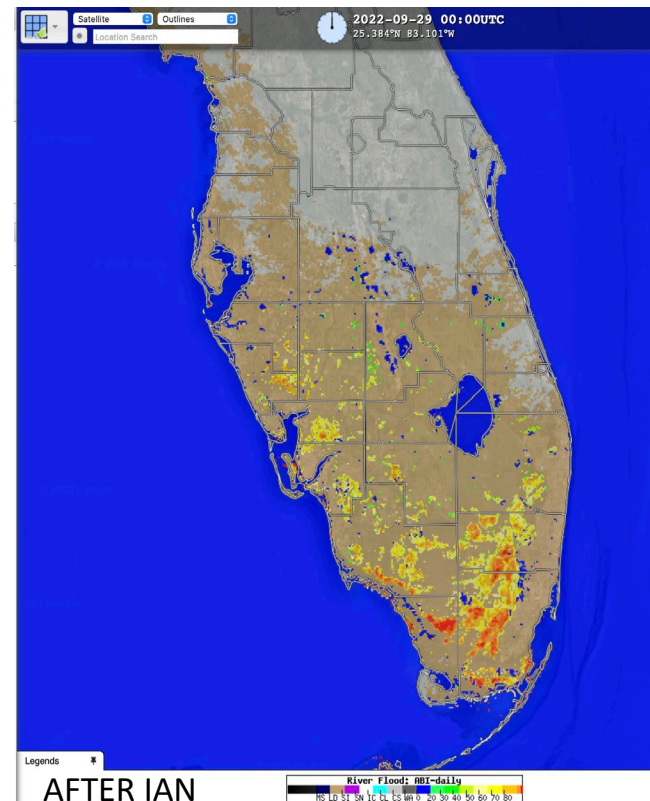
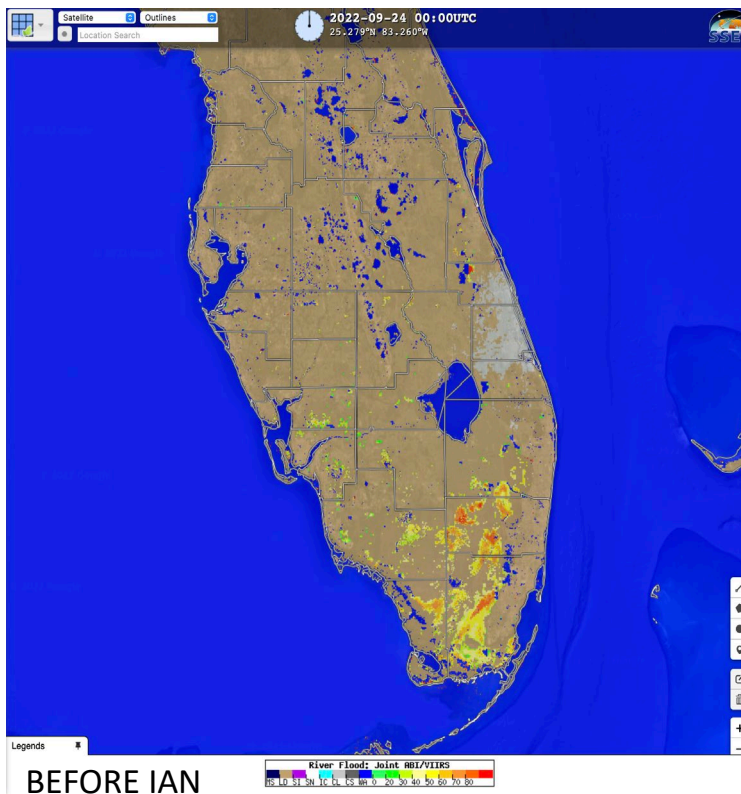
Joint ABI/VIIRS flood product. Apr 18, 2023

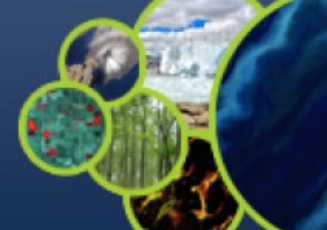
GPM-based API percentiles.
Apr 12-18, 2023

Examples of recent uses of GEO/LEO/SAR



Geostationary (ABI)
flood mapping for Ian,
Advantage –
information available in
morning and wide
coverage for situational
awareness

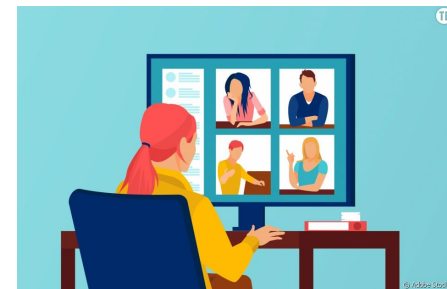




Modify the dynamics of our future meetings, by inviting experts in the use of RS for floods and experienced end-users, in a workshop-type format.

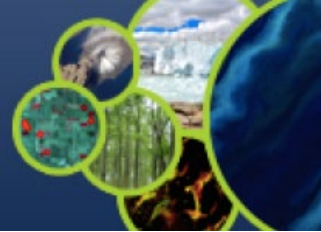
Discussions are currently taking place among the co-leads to define the workshops' modality in terms of

- structure,
- duration,
- frequency (one every 3 months?).



Brainstormed initial candidates: GFP, Copernicus, FEMA, EOTEC DevNet

As co-leads, we need to foster the subgroup members' participation in the workshops and the application of the acquired knowledge to their projects



CEOS Earth Analytics Interoperability Lab

Working Group on Information Systems and Services and Systems Engineering Office

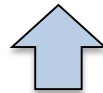
20 April 2020

Robert Woodcock, CSIRO, WGISS Chair

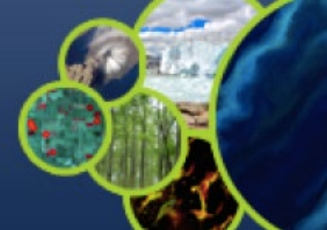
Brian Killough, NASA, SEO Director



Required training on Analytics tools for integrated analysis using Jupyter Notebooks 



As informed yesterday by Dave Borges, SEO & CSIRO Chile are discussing possibilities



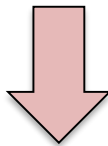
- Continue the consolidation of flood mapping techniques with LEO-GEO-SAR integrated sources
- Gradually incorporate all aspects of flood risk into the analyses, in line with the DIS-22-01 deliverable
- Increase the knowledge of the use of satellite data for flood response/management made by disaster managers
- Increase the impact of the Pilots on the decision making of disaster managers
- Increase interaction and synergies among sub-groups and other CEOS WGs

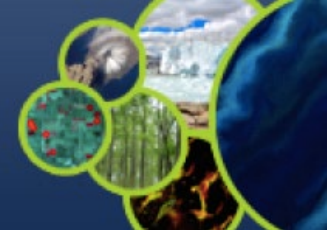


- Use of AI/ML for EO Analysis for flood extent and flood depth mapping.

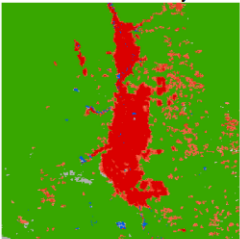


Some of our NOAA experts are applying ML techniques for flood detection:
Rapid & UNET





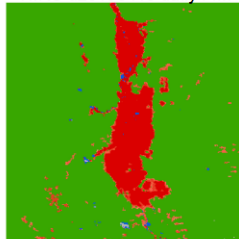
VIIRS d20190416 daily FIM



VIIRS d20190417 daily FIM



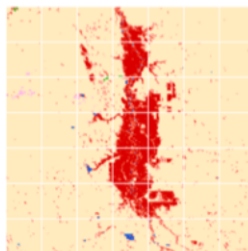
VIIRS d20190418 daily FIM



S1 d20190417 RAPID FIM



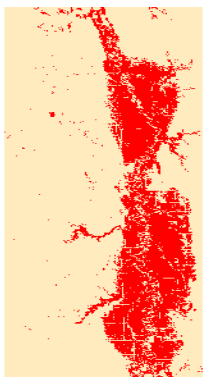
Merged VIIRS/RAPID FIM



VIIRS and SAR FIM



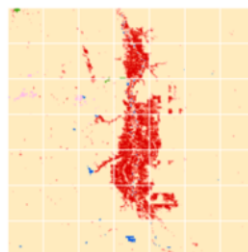
Landsat d20190422 FIM



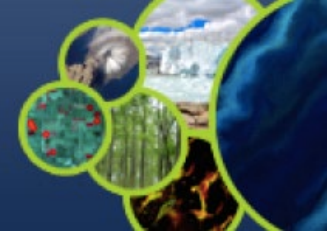
S1 d20190417 UNET FIM



Merged VIIRS/UNET FIM



- NOAA is testing performance of 2 Machine Learning algorithms (Liu et al UNET, Shen et al RAPID) for flood detection in the Red River.
- UNET excludes “permanent” water from the flood prediction, while RAPID includes “permanent” water.
- The Sentinel 1b overpass on April 17 was cloudy preventing VIIRS observations, but VIIRS flood observations on April 16 & 18 were collected allowing for a general comparison. VIIRS is 375m resolution, while the SAR products are 30m resolution.
- The 30m Landsat observation on April 22, is the closest date to the SAR overpass. Conditions by that date show the migration of the water downstream (north) and may not be suitable for direct validation, but can be applied to understand ML algorithm differences.
- **More testing is needed, but for April 17, the RAPID algorithm appears better aligned with VIIRS and LandSat.**

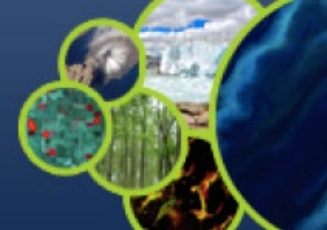


Some linkages to be developed or strengthened, particularly with JRC and the Global Flood Partnership, and Copernicus: To be invited as speakers to our workshops

Links between operational models as GEOGloWS and GloFAS of deterministic and ensemble hydrologic forecasts and flood pilot projects: Initial conversations with Rui Kotani (GEO Secretariat) for the use of GEOGloWS in relation with UN EW4ALL initiative.



Linkages with other CEOS and non-CEOS WGs (Ongoing)



- CEOS WGISS, CSIRO & SEO: EAIL Focal points: Jonathan Hodge and Dave Borges.
- CEOS COAST Ad-hoc team: training on EAIL. Focal point: Merrie Beth Neely
- CEOS WGCapD & EOTEC DevNet, Flood tracker. Focal point: Nancy D. Searby



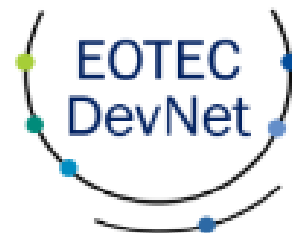
EOTEC DevNet Community of Practice
Americas Region - Floods Working Group Meeting

Provisional Agenda

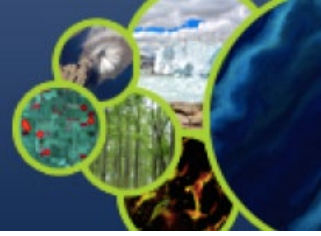
19 April 2023, 16:00 -17:15 **UTC**

Meeting leaders:

- *Adrián Guzmán González, Agencia Espacial Mexicana*
- *William Straka, SSEC/CIMSS (US)*



Guy Schumann, Marcelo Uriburu Quirno and William Straka are members of the Community of Practice



Thank you for your attention