GOBIERNO DE ESPAÑA
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

AEMet
Agencia Estatal de Meteorología

Remote Sensing Technology to improve the Early Warning Systems: Case studies

Dr. Fernando Belda Esplugues
AEMET

Satellite-based Services for Disaster Risk Management, Barcelona, Spain. 26th Feb 2025

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Architecture for Climate Monitoring from Space

Coordinated Satellite-based Observation and Exploitation of Climate Data Records

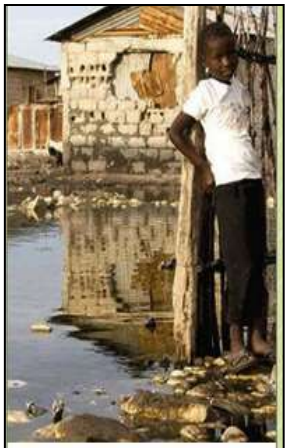
Satellite-based Services for Disaster Risk Management, Barcelona, Spain. 26th Feb 2025

GFCS
GLOBAL FRAMEWORK FOR CLIMATE SERVICES

Vision

Enable better management of the risks of climate variability and change and adaptation to climate change, through the development and incorporation of science-based climate information and prediction into planning, policy and practice on the global, regional and national scale

Agriculture and food security



Disaster risk reduction

Water

Health

Energy

GFCS
GLOBAL FRAMEWORK FOR CLIMATE SERVICES

Early Warning for All

EW4ALL: Pillars

Pillar 1: Disaster Risk Awareness

- Systematic data collection and start risk assessment.
  - Are vulnerabilities and hazards well known?
  - What are the patterns and trends of these factors?
  - Are risk maps widely available?

Pillar 2: Detection, observation, monitoring, analysis and prediction of risks?

- Develop early warning and hazard monitoring systems.
  - Are the right parameters being monitored?
  - Is there a robust scientific basis for making predictions?
  - Can timely and accurate warnings be generated?

EW4ALL: Pillars

Pillar 3: Dissemination and communication of warnings

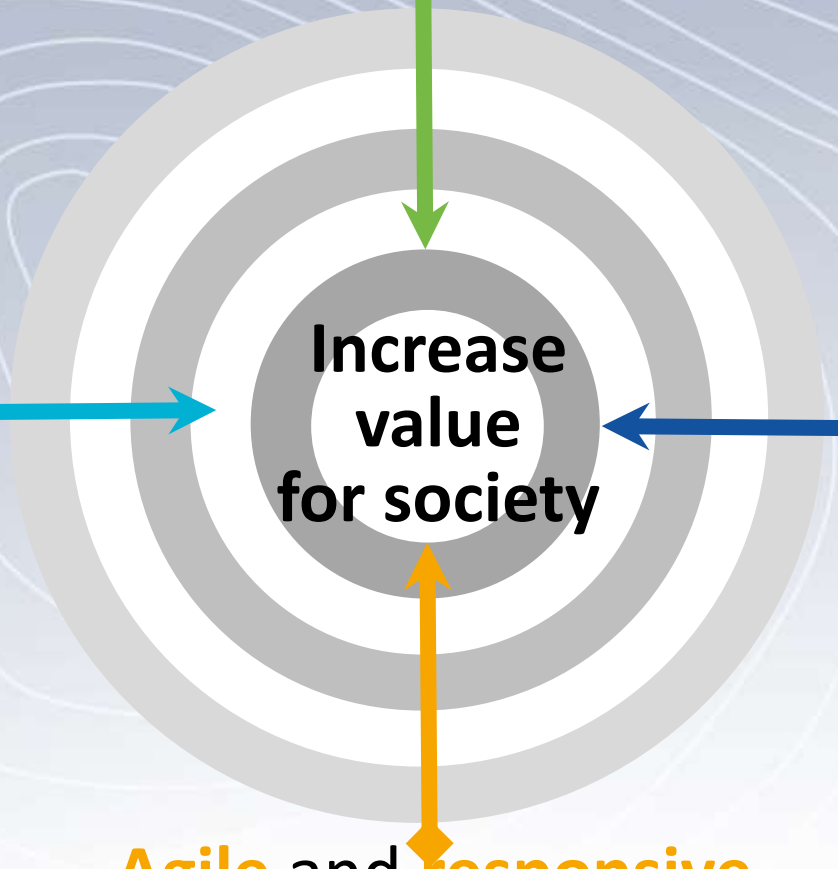
- Communicate risk information and warning systems.
  - do warnings reach all those affected?
  - are warnings and risks understood?
  - are warnings clear and usable?

Pillar 4: Preparedness and response capacity

- Build national and local response capacities.
  - Are plans up to date and tested?
  - are local skills and knowledge being harnessed?
  - are people prepared and ready to react to warnings?

Effectiveness and **efficiency**

Seamless and **integrated** approach



Engagement of Partners

Agile and **responsive** to **new challenges**

Space Support: 4 Activity Areas

supporting weather, water, climate, and space weather

Coordinate satellite observing systems, orbits, instruments, for WIGOS

Develop the Architecture for Climate Monitoring from Space

Set standards on quality and consistency of satellite-based products

Promote readiness of Members to new generation satellites (2025-2030)

Maintain resources and national projects; provide advice and guidance

Coordinate rapid, integrated global dissemination of satellite data, consistent with WIS

Enhancing satellite data utilization

National user mechanisms

Through:

- Stakeholders Cooperation
- Governance mechanism
  - Coordination Group
  - Expert group on Satellite Utilization

- Membership:
  - Operational users
  - Satellite providers
  - Training centres (Academy)
  - Scientific users
  - Others

Advantages for User:

- Effective user-provider dialogue
- Defined format for expressing requirements
- Coordination of data distribution
- Identification of training needs
- Implementation of WIGOS/WIS

Enhancing satellite data utilization

<u>WMO Guidelines formally published:</u>

- Guidelines on Best Practices for Achieving User Readiness for New Meteorological Satellites:

Arabic version: https://library.wmo.int/opac/index.php?lvl=notice_display&id=19931
Chinese version: https://library.wmo.int/opac/index.php?lvl=notice_display&id=19930
English version: https://library.wmo.int/opac/doc_num.php?explnum_id=3553
Russian version: https://library.wmo.int/opac/index.php?lvl=notice_display&id=19929

- Guideline on Satellite Skills and Knowledge for Operational Meteorologists, providing guidance to design and implement satellite-related training programmes to support WMO competencies:

Arabic version: https://library.wmo.int/opac/index.php?lvl=notice_display&id=19890
Chinese version: https://library.wmo.int/opac/doc_num.php?explnum_id=3585
English version: https://library.wmo.int/opac/doc_num.php?explnum_id=3439
Russian version: https://library.wmo.int/opac/index.php?lvl=notice_display&id=19870

Global Climate Observing System (GCOS): Global climate monitoring requirements baseline

Essential Climate Variables (ECVs)

Atmospheric

Surface

Air temperature, Wind speed and direction, Water vapour, Pressure, Precipitation, Surface radiation budget.

Upper-air

Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget, Lightning

Composition

Carbon Dioxide (CO2), Methane (CH4), Other long-lived greenhouse gases (GHGs), Ozone, Aerosol, Precursors for aerosol and ozone.

Oceanic

Physics

Subsurface temperature, subsurface salinity, Subsurface currents, Ocean surface stress, ocean-surface heat flux, sea-surface temperature, surface currents, sea-surface salinity, sea level, sea state, sea ice

Biogeochemistry

Inorganic carbon, oxygen, nutrients, transient tracers, nitrous oxide (N_2O), ocean colour

Biology/ecosystems

Plankton, marine habitat properties

Terrestrial

Hydrology

River discharge, groundwater, soil moisture, lakes

Cryosphere

Snow, glaciers, ice sheets and ice shelves, Permafrost

Biosphere:

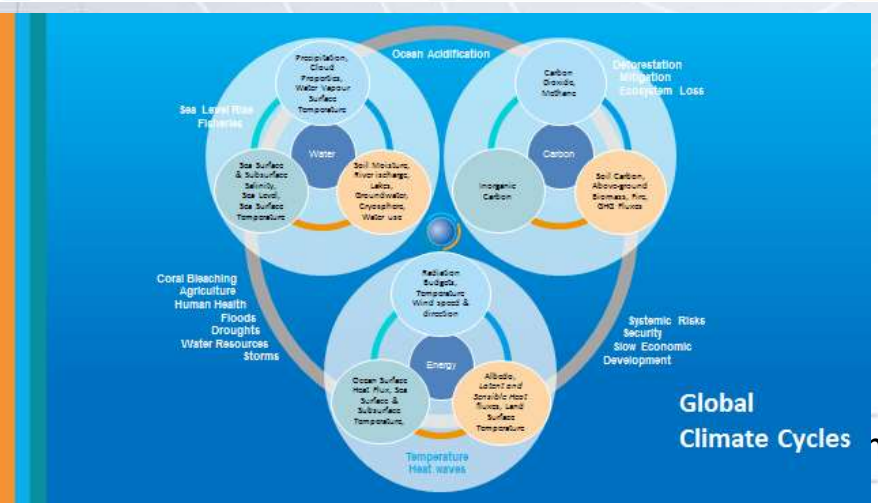
Albedo, land cover, fraction of absorbed photosynthetically active radiation, leaf area index, above-ground biomass, fire, land-surface temperature, soil carbon

Human use of natural resources:

Water use, Anthropogenic Greenhouse Gas fluxes

55 ECVs in total
Satellites provide a major contribution

(The Global Observing System for Climate: Implementation Needs 2016 (GCOS-200))



ment,

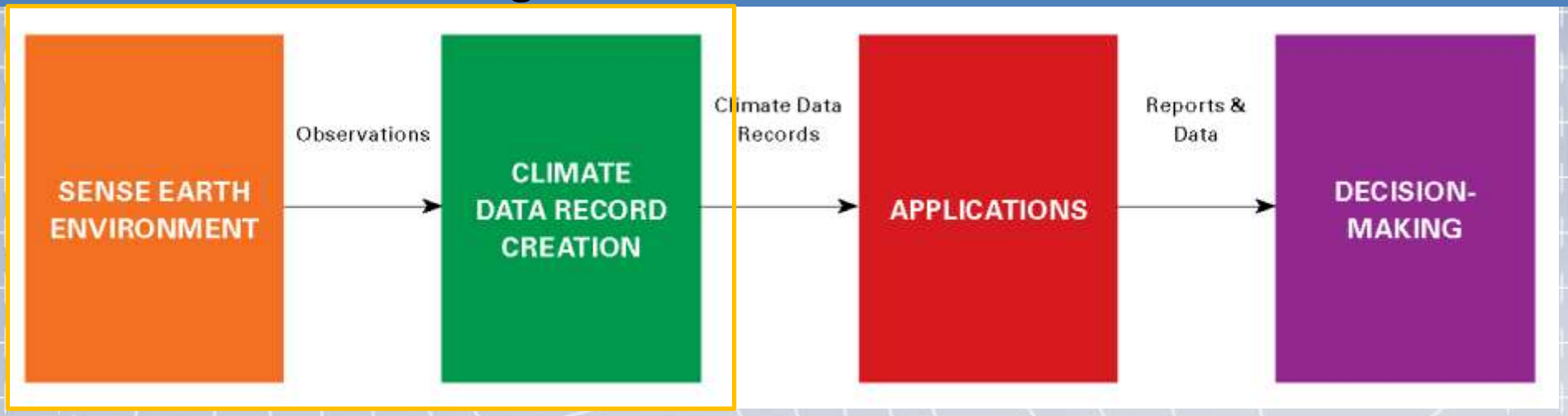
Architecture for Climate Monitoring from Space

- Prerequisites for implementation:

1. Validating the logical flow (through Case studies)

2. Knowing existing and planned ECV climate data records (through ECV Inventory)

1. Case studies for validating the Architecture: Starting from climate service end users



Needs?

Needs?

Needs?

Needs?

- Information flow
- Dependencies
- Requirements
- Intermediate / End users

Monitoring

Short-term forecasting

Seasonal forecasting / outlook

Impact / Risk Assessment

Adaptation

Mitigation

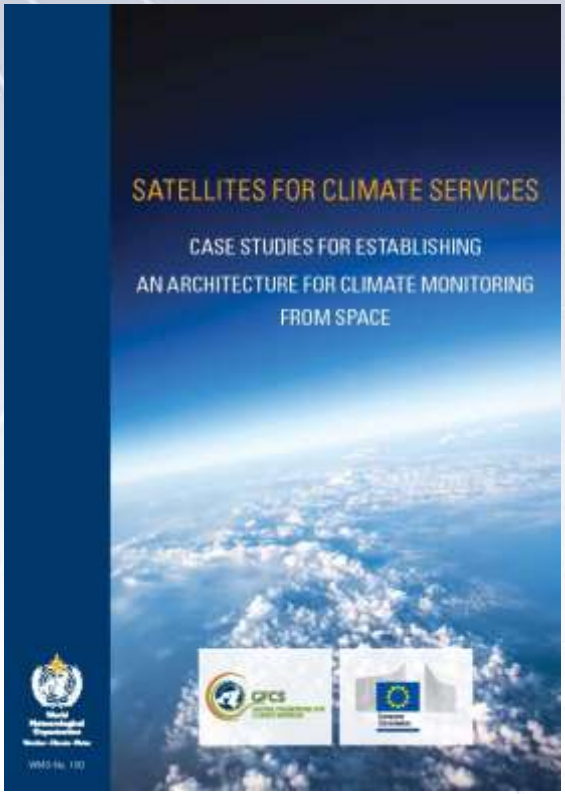
Case studies:

Service needs by end users in climate-sensitive sectors

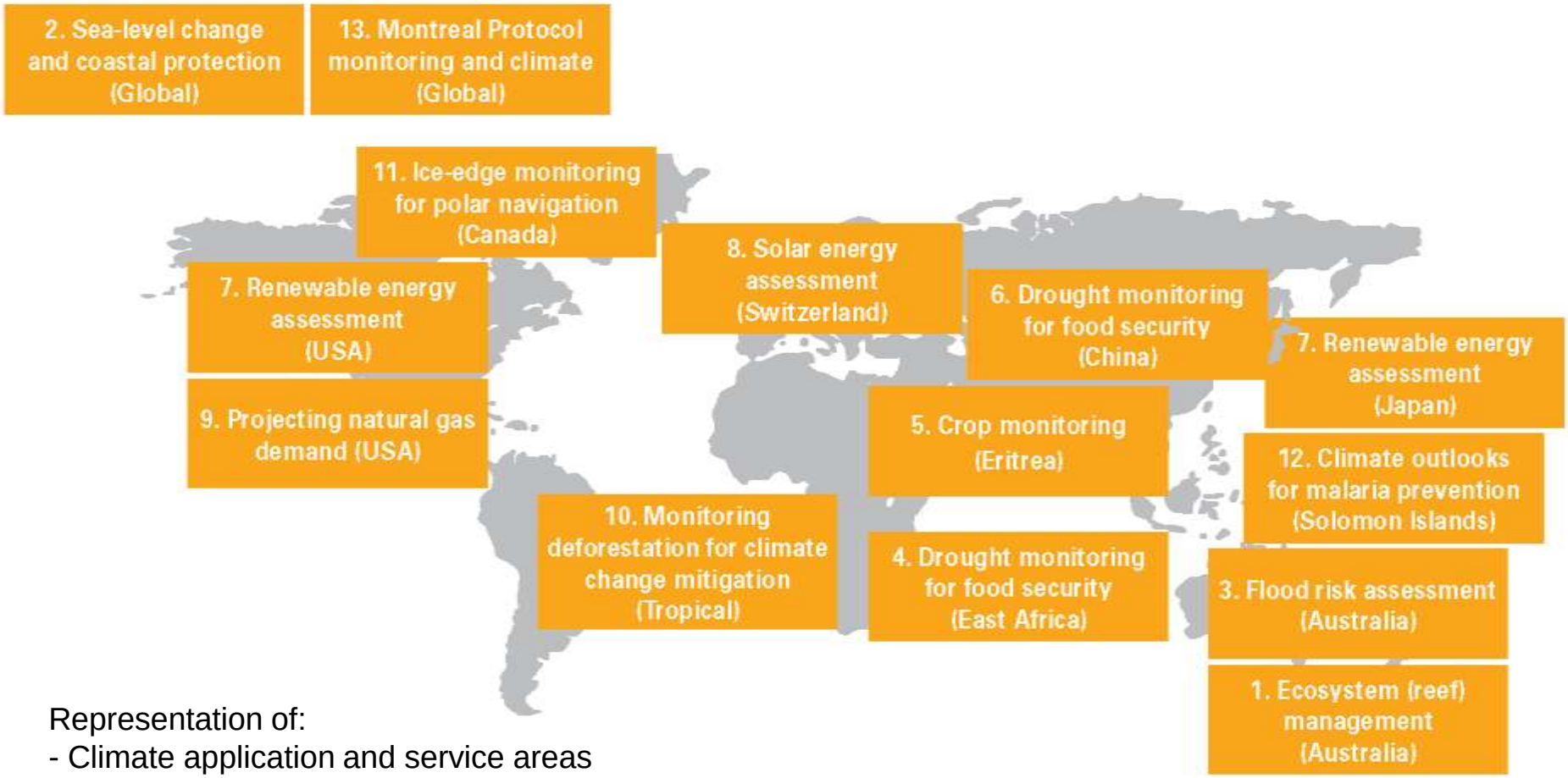
Needs?

Case studies for validating the Architecture:

- Objectives:
  - Validate the Architecture logic starting from the end user, and demonstrate its benefits
  - Investigate how satellite data are used in climate services
  - Better understand information flows, dependencies, requirements
  - Formulate recommendations



Case Studies Overview



Representation of:
- Climate application and service areas
- Geographical contexts
- Developing and developed countries, and economies in transition
- Global, regional, and local scales

NWC SAF products and services for MTG

- ✓ NWC SAF provides software.
- ✓ NWC-SAF products generated locally by users => No bandwidth constraints.
- ✓ NWC-SAF is the SAF nearest to users. It works in the users side of the EUMETCast

User tools

User 4D Weather data cube in NWC SAF region of interest

L1 processing → L2 processing

EUMETSAT headquarters

MTG L1

MTG L2

EUMETCast

IRS L2 → sSHAI_ES service → ES IRS L2

IRS L1 PC → qIRS service → IRS L1 BT

qIRS service → sSHAI → NWCSAF IRS L2

FCI L1

L I

NWC SAF GEO → NWC SAF MTG-I L2

NWP

Obs(radar, synop)

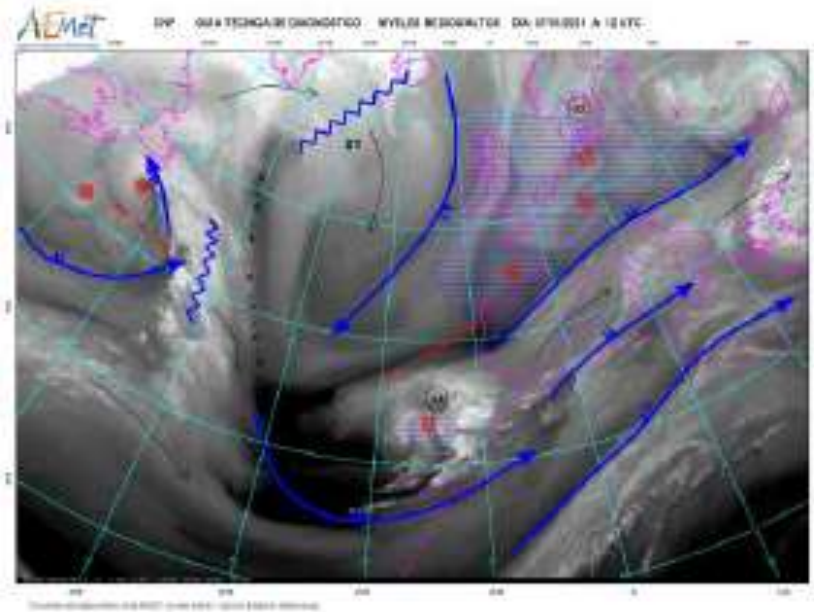
EWC

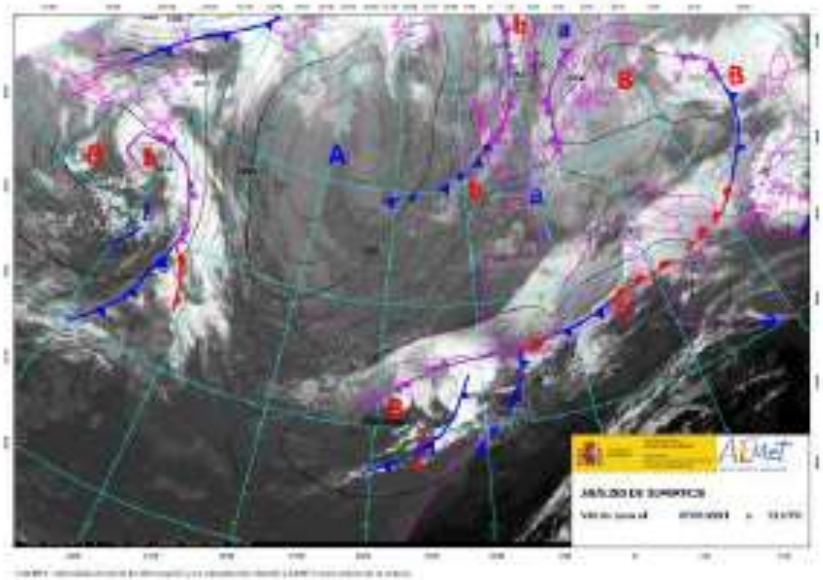
European Weather Cloud

Filomena Squall

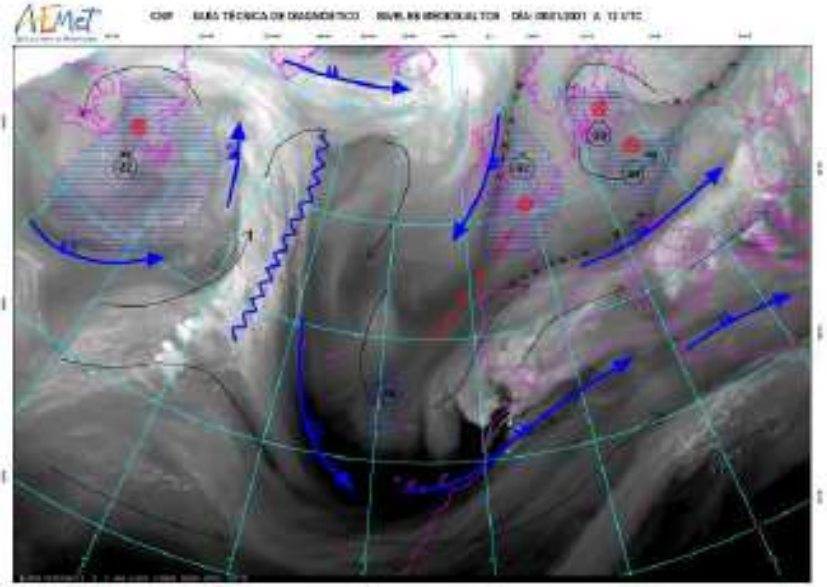
- Meteorological Episode of heavy snowfall and precipitation and subsequent cold spell.
- Period 6 - 10 (8 and 9) January 2021

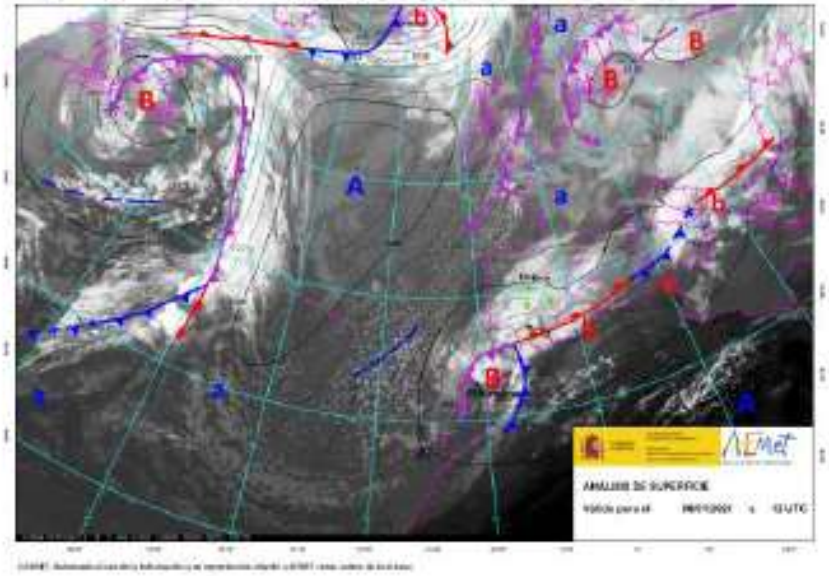
Day 7



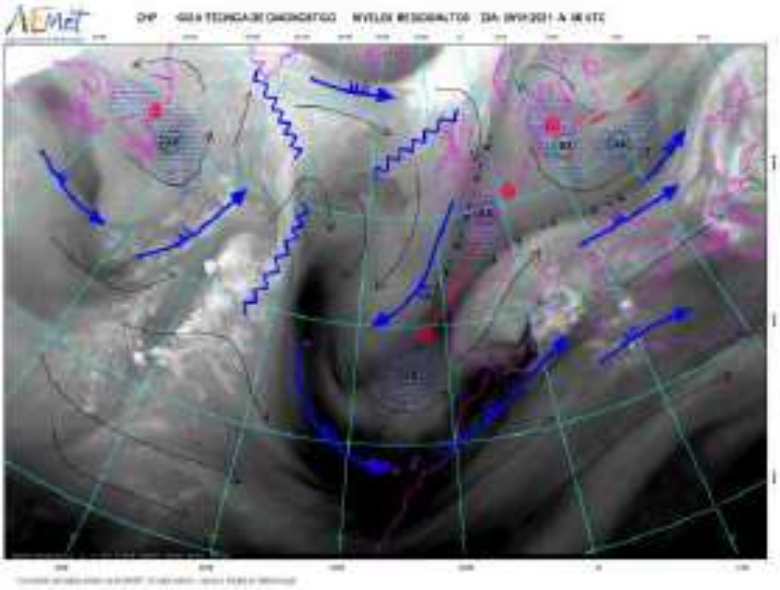


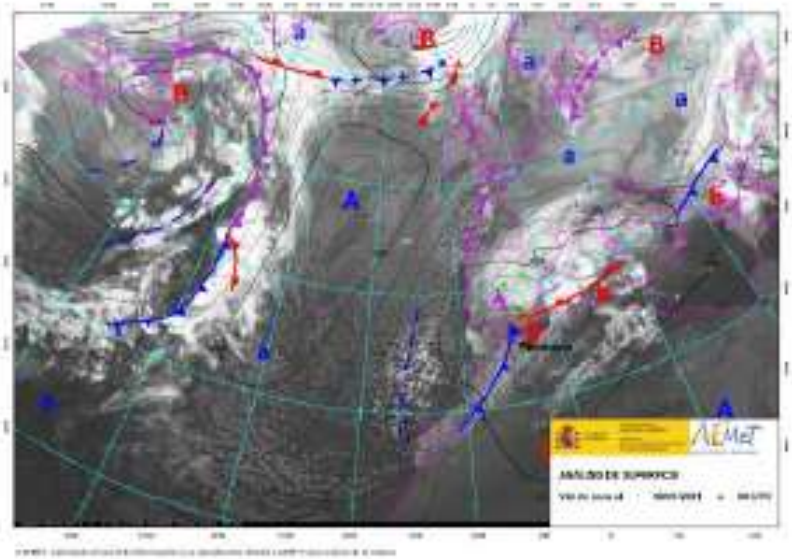
Day 8



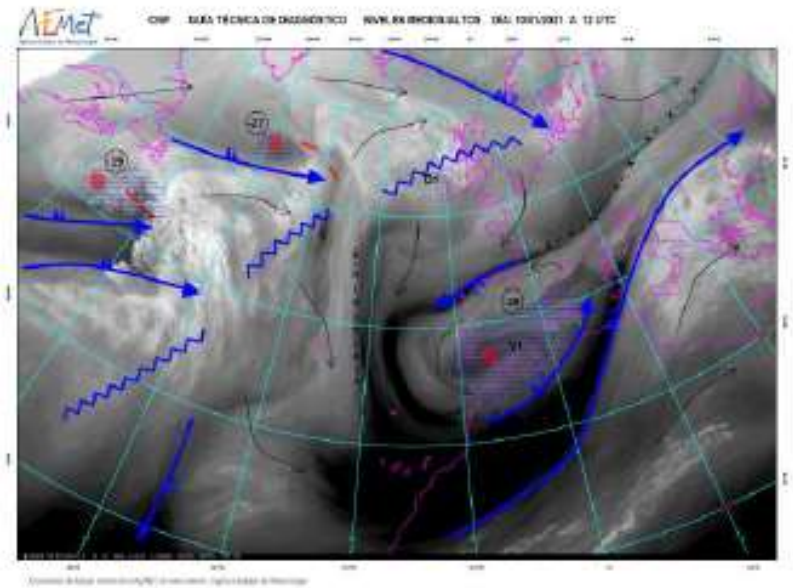


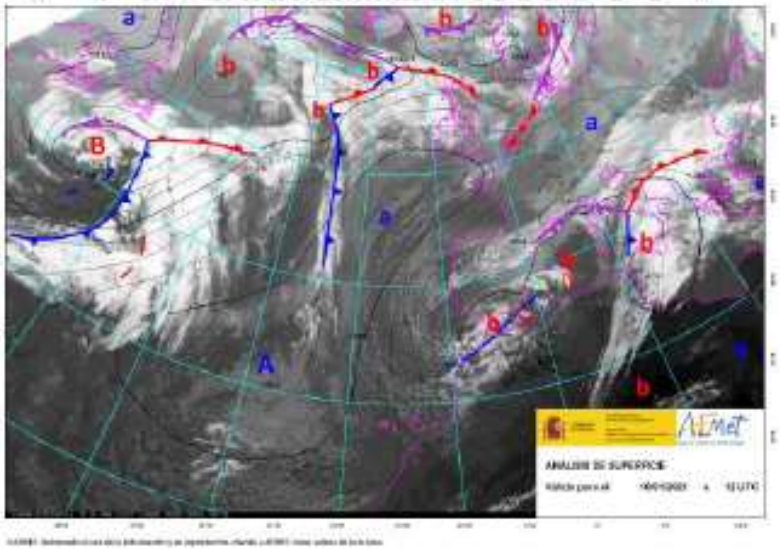
Day 9

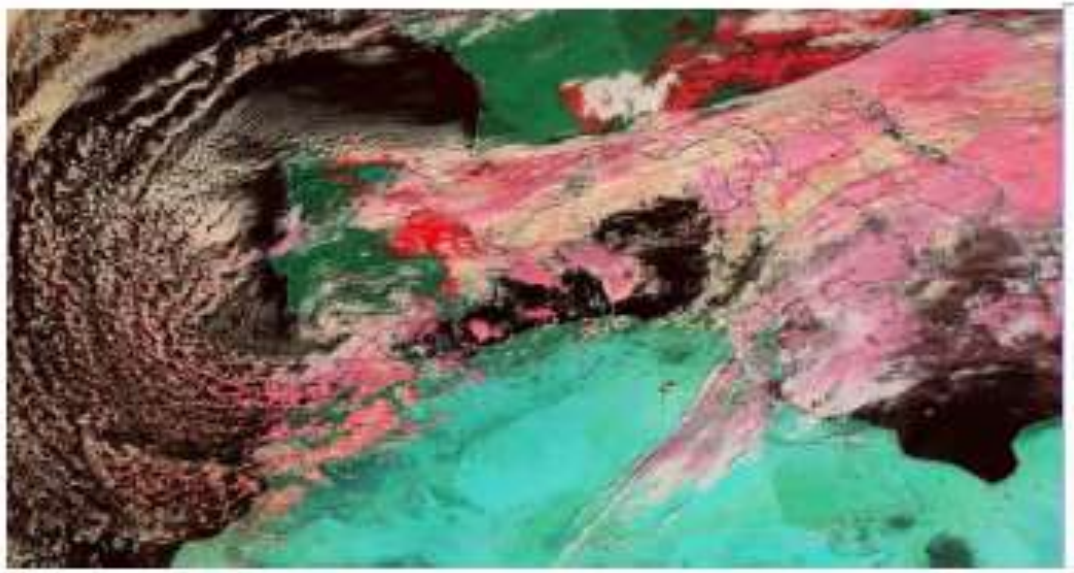


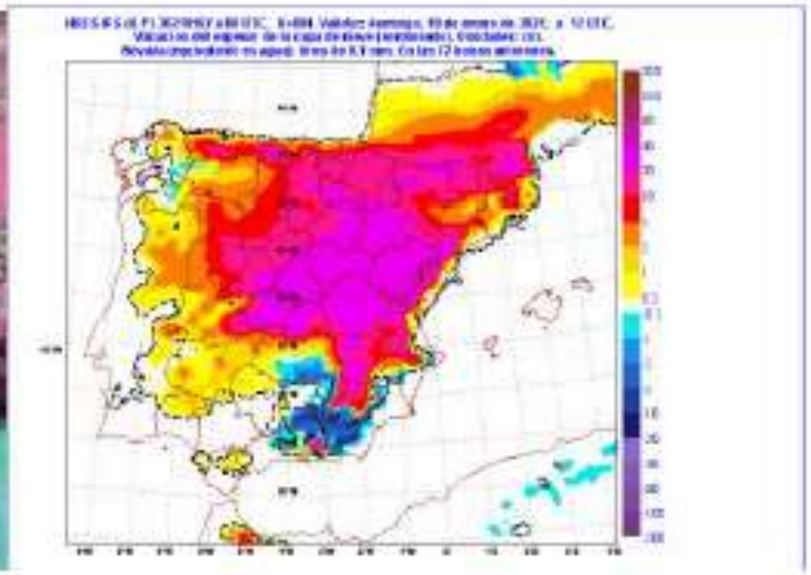


Day 10









Suomi-NPP satellite image with coloured enhancement (snow in red) of day 10 at noon (left) and variation of snow cover thickness according to the HRES-IFS model between day 7 at 12 o'clock U

DANA

- Weather episode of torrential and persistent rainfall
- Isolated High-Level Depression (Cut-off Low) 29 October 2024

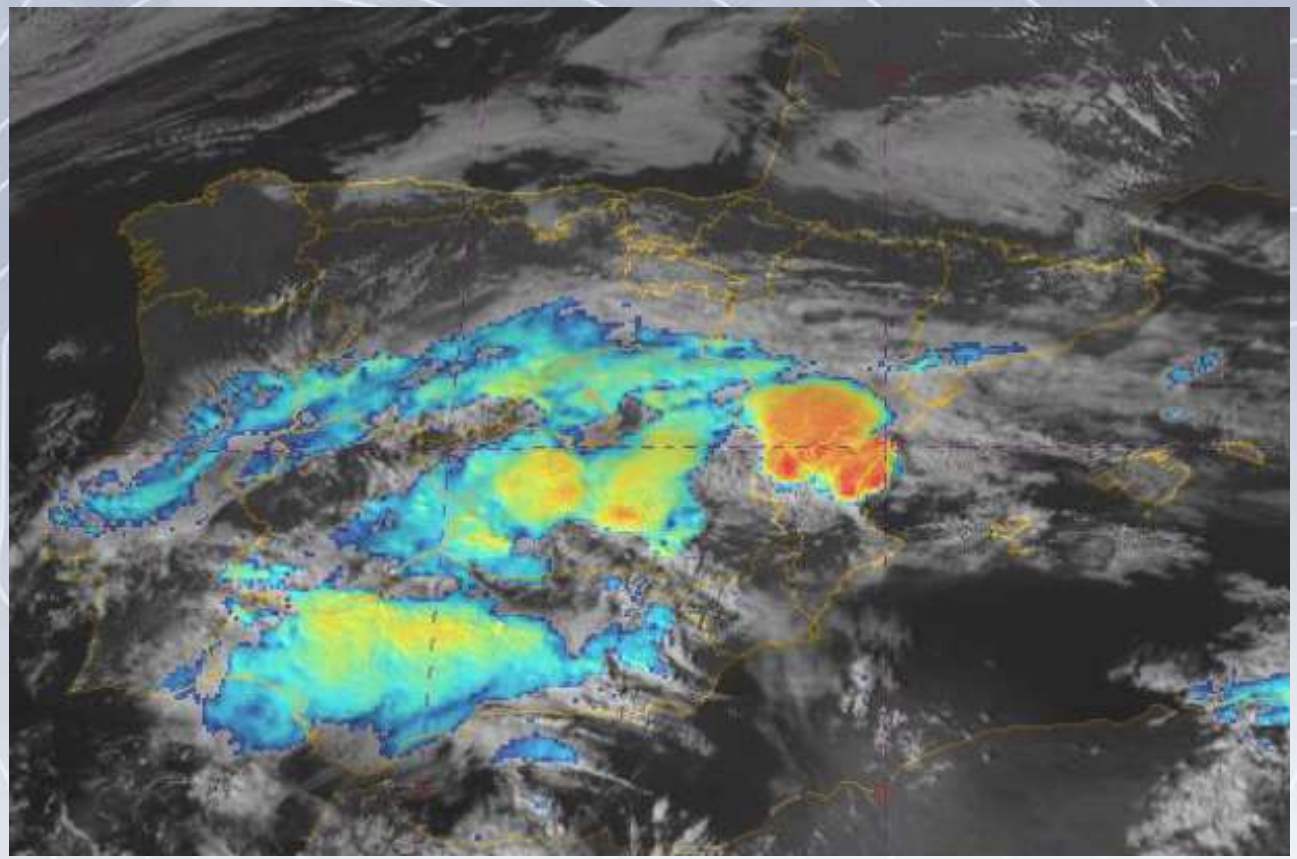
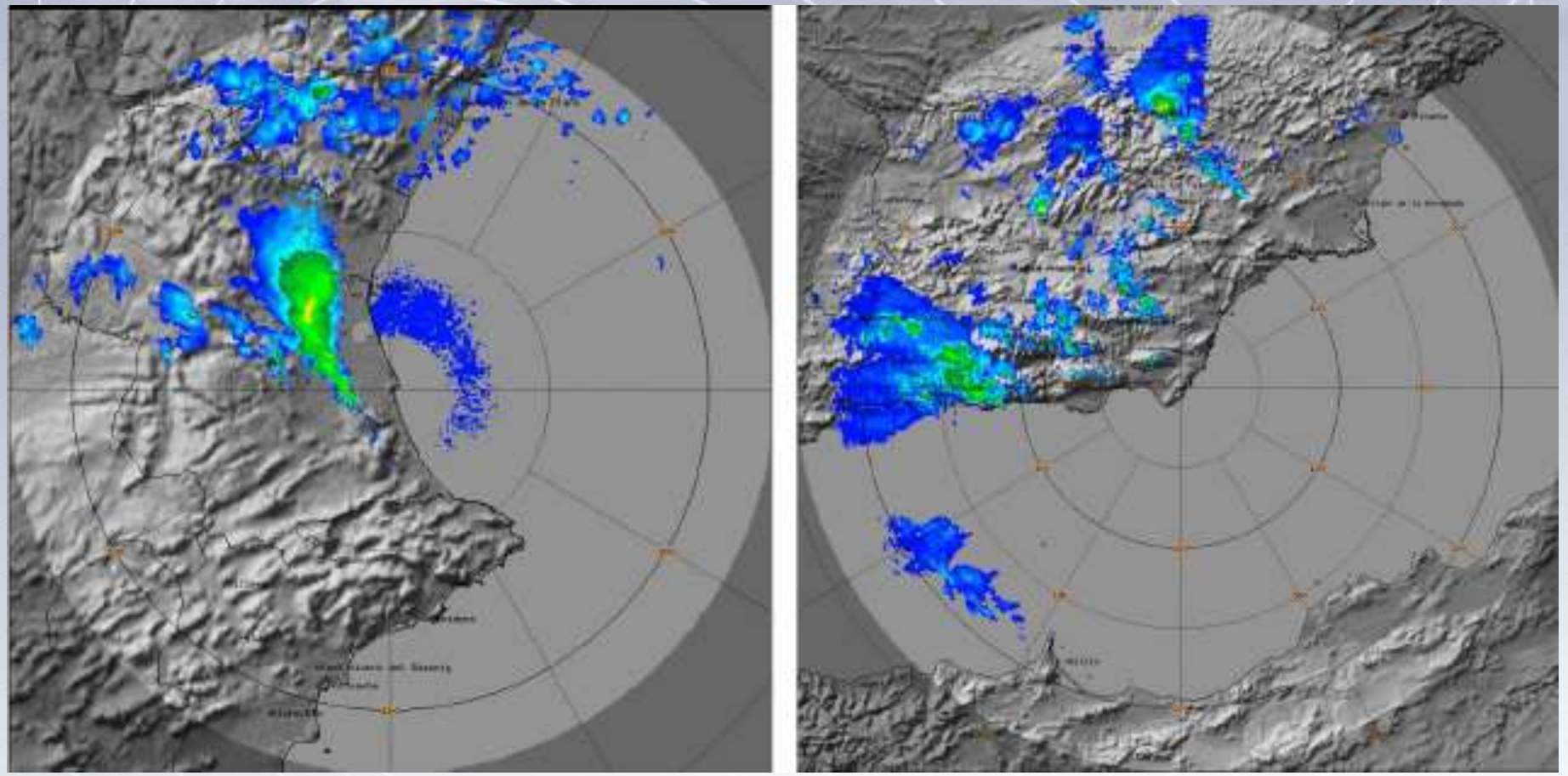
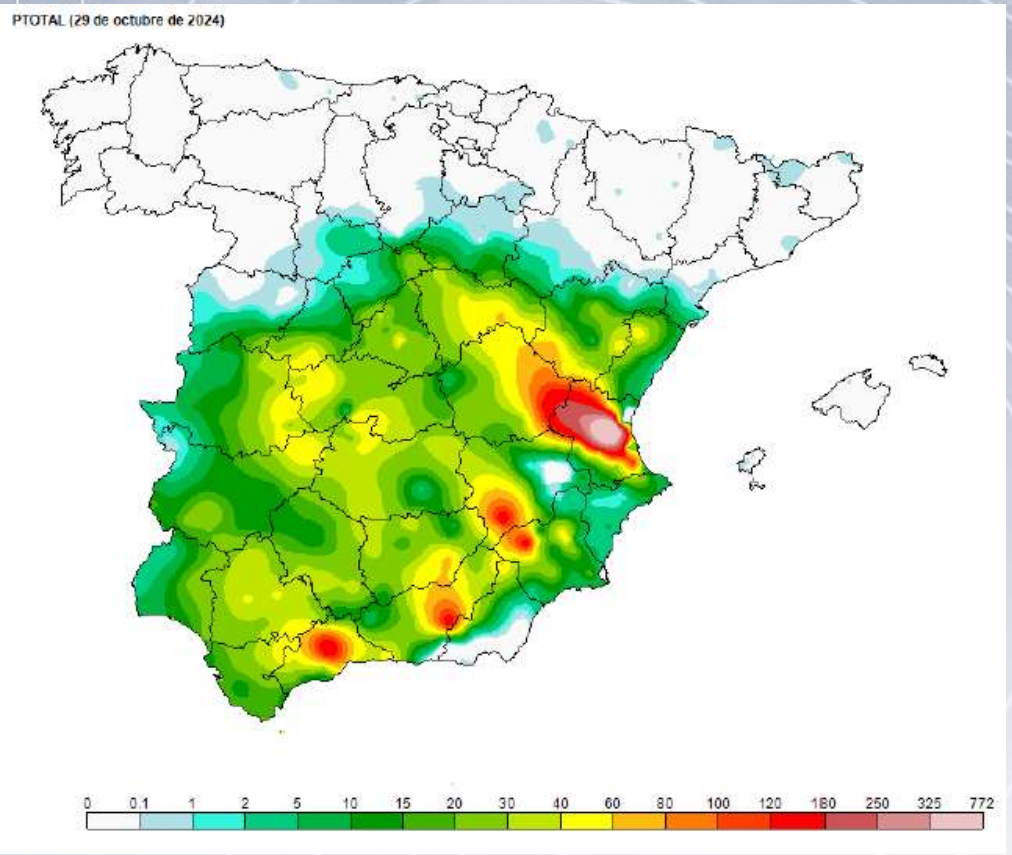
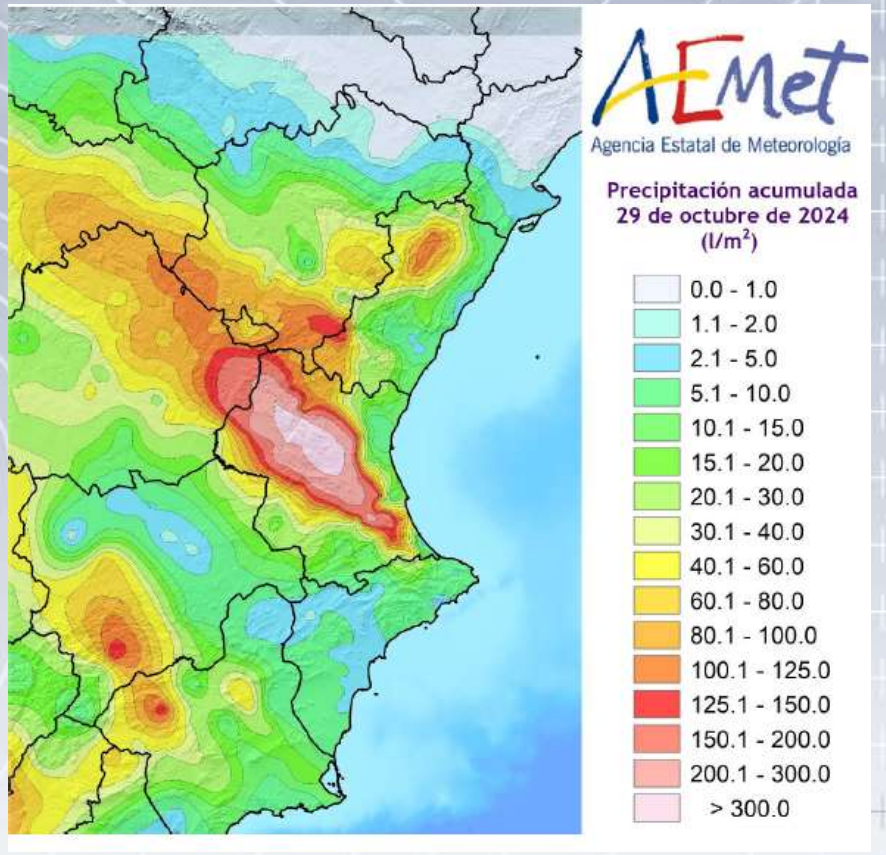


Image of 15:00 hours. From the MSG-11 satellite, combination of its HRVIS and IR10.8 channels, in which the main convective structures affecting our country are highlighted in warm colours. Different structures can be seen, with the most intense one over the Valencian Community.



Images from the Valencia (left) and Almería (right) weather radars at 16:00 and 13:30 hours, respectively. The train-type convective structures stand out, one of them affecting the interior of the province of Valencia and the other the western interior of the province of Murcia and southeast of Albacete.





Accumulated precipitation on 29 October 2024
Source: AEMET, CHJ, AVAMET

Sentinel-1 radar images from 19 and 31 October illustrate the severe flooding of the Albufera National Park due to the discharge of the Magro, Turia and Poyo rivers. This park borders the Mediterranean Sea to the east and encroaches on densely populated neighbourhoods to the west.(Courtesy, AEE)

Concluding Remarks

- Satellite agencies provide a critical contribution to global, regional and national systematic climate/land monitoring and climate data record. (Important or critical to monitor >75% of the ECVs)
- ECV Inventory published by CEOS-CGMS http://climatemonitoring.info/
- Gap analysis report including recommendations/ actions to be completed regulary.

Concluding Remarks

- Best practices on use of satellite-based CDRs and ECV Products must be planned to guide operational centres,
- More case studies is needed
- The Architecture will coordinate and fully leverage these contributions, for the benefit of climate services

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THANK YOU

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