# ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

13 – 17 November 2023 | ESA-ESRIN, Frascati (Rome), Italy

## The CERTAINTY project and its interaction with the EarthCARE mission.

CERTAINTY
CLOUD–AEROSOL INTERACTIONS & THEIR IMPACTS IN THE EARTH SYSTEM

# CERTAINTY:

**C**loud-a**ER**osol in**T**eractions
& their imp**A**cts **IN T**he earth s**Y**stem

Jennie Thomas, CNRS/IGE (coordinator)
Harri Kokkola, FMI (scientific coordinator)

# Consortium

18 partners from 10 countries

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# Overarching objective

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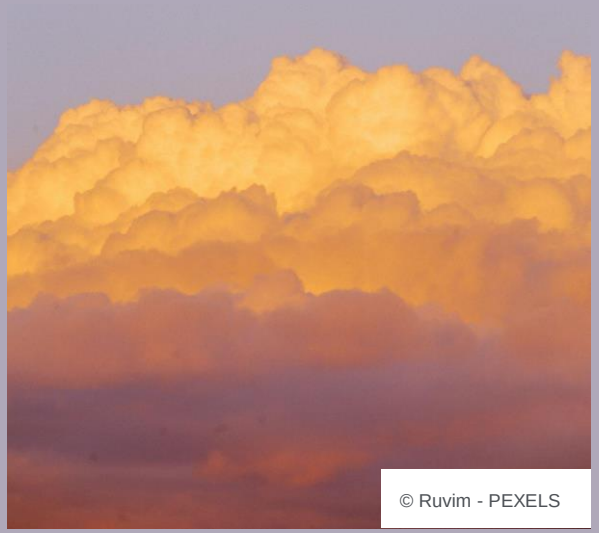
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The overarching objective of CERTAINTY is to

***deliver the knowledge and models that provide improved confidence and representation of the role of cloud–aerosol-radiation interactions in climate and weather.***

This translates to **better understanding and predictions of extreme events** and facilitates planning **climate mitigation/adaptation strategies** for the good of European citizens and global society.

**Total EU budget requested/granted:** 8 million EUR (UK partners are now being moved out of this total)
**Project duration:** 1 January 2024 - 1 January 2028

# Target ACI uncertainties & processes

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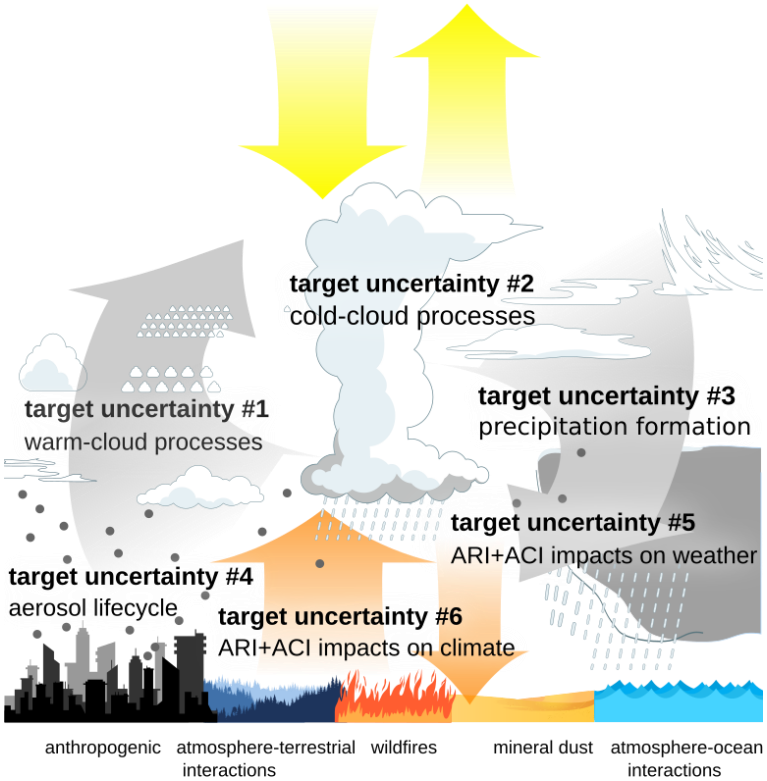
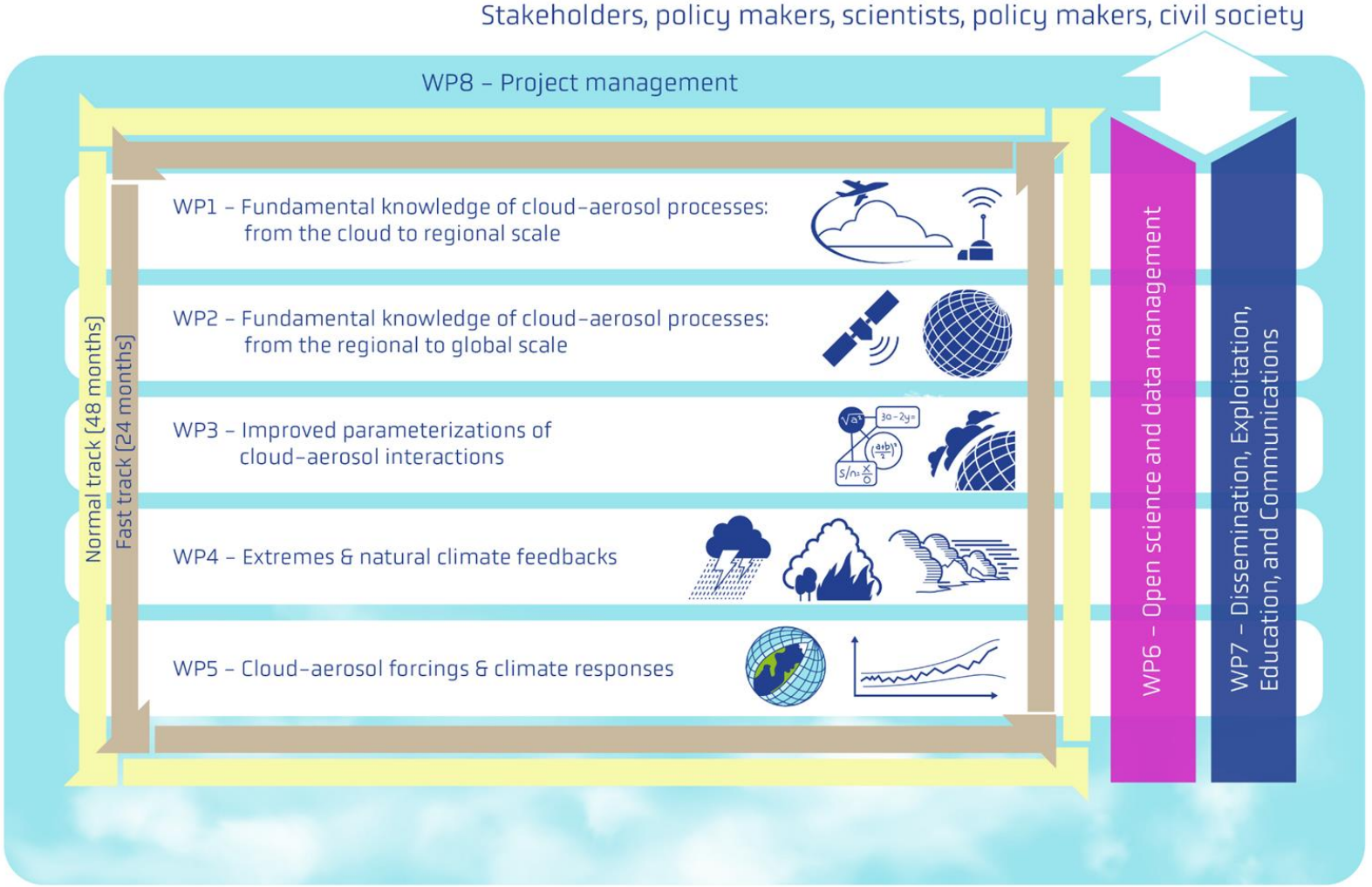



Specific Objectives (SOs)

- SO#1-#6: address the six target uncertainties
- SO#7: Early adoption of EarthCARE and Metop-SG data into ACI science
- SO#8: Train the next generation of multidisciplinary, diverse ACI scientists
- SO#9: Use EU infrastructures to deliver FAIR and open science

# Work Package Structure



# Leadership team

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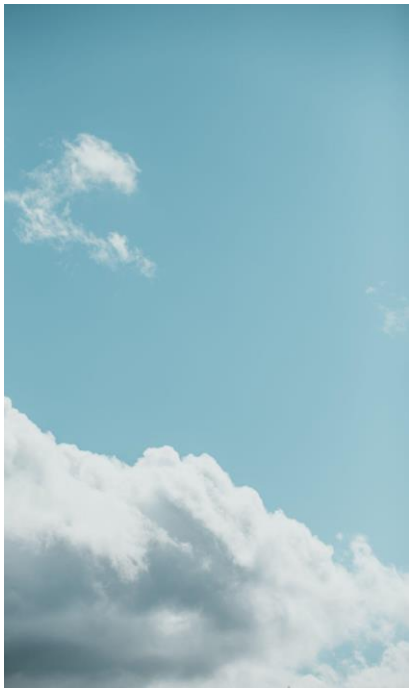
**WP1:** Fundamental knowledge of cloud-aerosol processes: from the cloud to regional scale
**Leads: Hugh Coe (Univ Manchester), Silke Gross (DLR)**
***Link to EarthCARE:*** Constraining the radiative effects of ACI using observational synergies, achieve radiative closure with irradiance observations from ground (e.g. ACTRIS, WMO-GAW, BSRN), air (e.g. HALO) or satellite (e.g. EarthCARE).



**WP2:** Fundamental knowledge of cloud-aerosol processes: from the regional to global scale
**Leads: Angela Benedetti (ECMWF), Ed Gryspeerdt (Imperial College London)**
***Link to EarthCARE***:

- Use of ACTRIS and other ground based Observations to validate and calibrate newly online EarthCARE observations.
- CERTAINTY will assimilate EarthCARE lidar particle backscatter to constrain the vertical distribution of aerosol and clouds simultaneously.

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**WP3:** Improved parameterizations of cloud-aerosol interactions
**Leads: Carlos Perez (BSC), Zamin Kanji (ETH Zürich)**

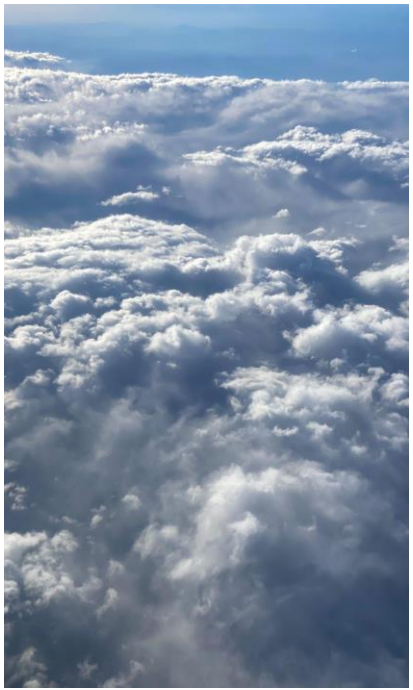
- ***Link to EarthCARE:*** use of observations in evaluating model parameterizations

**WP4:** Extremes and natural climate feedbacks
**Leads: Annele Virtanen (UEF), Ilona Riipinen (Stockholm Univ)**

- ***Link to EarthCARE:*** use of observations together with models to estimate climate feedbacks

**WP5:** Cloud-aerosol forcings and climate responses
**Leads: Twan van Noije (KNMI), Moa Sporre (Lund Univ)**

- ***Link to EarthCARE:*** use of observations to evaluate improved ESMs



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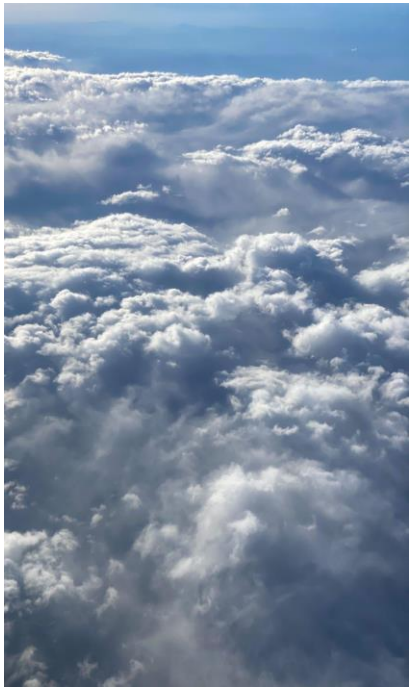
**WP6:** Open science and data management
**Leads: Anca Hienola (FMI), Jennie Thomas (CNRS/IGE)**

- ***Link to EarthCARE:*** Establishing pathways for effective workflow, storage, distribution, and availability of data

**WP7:** Dissemination, Exploitation, Education, and Communications
**Leads: Jennie Thomas (CNRS/IGE), Harri Kokkola (FMI)**
***Link to EarthCARE:*** stakeholder interactions that feedback through the continuous process via implementation of our international advisory committee (IAC). This task also coordinates CERTAINTY activities with the Validation Programmes of EarthCARE/MetOp-SG.



# Consortium expertise

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# Consortium Links with EarthCARE

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ECMWF

Assimilation of EarthCARE cloud radar and lidar observations; EarthCARE JMAG

Lidar data assimilation (new observation operators; backscatter and extinction) & cloud doppler radar data for assimilation within ECMWF's IFS to constrain the vertical distribution of aerosol and clouds *simultaneously.*

Scientific coordinator for the EarthCARE (lidar and aerosol related) Cal/Val & key partner in ground based observations (ACTRIS)

Use of ASKOS/JATAC campaign and the ACROSS Mediterranean experiment for EarthCARE in CERTAINTY. Achieve ACI radiative closure with irradiance observations from ground, air or satellite using observational synergies. Reducing uncertainties in aerosol optical properties to improve aerosol assimilation, focusing on particle depolarization.

DLR

Science and Cal/Val Campaigns; EarthCARE JMAG

Synthesizing aircraft observations to quantify ACI processes & Preparing for the use of EarthCARE
EarthCARE validation using ground-based observations and products from airborne EarthCARE-like instrumentation.
Use of campaign data: Earth Care Validation; Tropical Oceans and Organized Convection (EC-TOOC; 2024)

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

CARDINAL L2 project lead & ATLID L2a and L1b processor development; EarthCARE JMAG

EarthCARE product knowledge for EarthCARE Cal/Val and lidar assimilation
Cloud-aerosol forcings and climate responses

# Key links to EarthCARE

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Provide:
- L1b & L2 Data
- Instrument and product knowledge

Long Term Outcome:
- new products and collections
- Improved predictions of precipitation assessed using satellite observations (EarthCARE) and reanalysis/analysis.
- EarthCARE and Metop-SG data and methods will be an integral part of ACI studies and model evaluation
- Improved quantification and actions that consider the role of ACI in weather/climate new higher-level (combined) products

- Independent evaluation and validation of the EarthCARE products.
- 3 new products for EarthCARE (dust, CCN, IN concentration profiles)
- 5 satellite products validated via Cal/Val activities (EarthCARE and MetOp-SG missions)
- 2 validation studies on EarthCARE
- 1 model on aerosol radiative properties
- 1 new product for data assimilation (particle depolarization for EarthCARE)
- 3 new observation operators (backscatter, extinction and depolarization) for data assimilation

Publish datasets with DOI

# CERTAINTY International Advisory Committee

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| Representing | Organization | Position | IAC member |
|---|---|---|---|
| CMIP7 | WCRP Coupled Model Intercomparison Project (CMIP) International Project Office | Director | Eleanor O'Rourke |
| EarthCARE | European Space Agency (ESA), EO Programme Department | Senior Engineer | Rob Koopman |
| METOP-SG | European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) | Project Scientist | Thierry Marbach |
| ACTRIS | The Aerosol, Clouds and Trace Gases Research Infrastructure | Scientific chair | Paolo Laj |
| C3S | Copernicus Climate Change Service | Senior Scientist | William Bell |
| CAMS | Copernicus Atmosphere Monitoring Service | Principal Scientist | Johannes Flemming |
| WMO | World Meteorological Organization | Scientific Officer | Sara Basart |

# Discussion Points & Questions

- **EarthCARE Cal-Val specialists (e.g. NOA, DLR, UHEL), assimilation (ECMWF) and EarthCARE L2 products (KNMI) are involved on CERTAINTY & EarthCARE. Are any additional steps needed for our interactions?**
- **How should we set up communications between CERTAINTY and EarthCARE team beyond the commissioning phase?**
- **Topics for future focused discussions: EarthCARE Cal/Val activities in CERTAINTY & coordination with ground-based observations (ACTRIS (EARLINET/CLOUDNET), PollyNet , ARM)**
- **CERTAINTY and CleanCloud (upcoming presentation) projects collaborate via the ESA-AIRSENSE project to leverage advancements achieved by both initiatives.**
- **Upcoming events**
  - EarthCARE meetings/conferences: EGU-2024, ILRC-2024 & Launch May 2024!
  - CERTAINTY kick off (2024)
- **The KNMI position, focusing 40% on EarthCARE cal/val and 60% on aerosol model improvements, will be advertised in December. Inform us if you know candidates!!**

# Extra slides

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# Coordination team

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cnrs

IGE
Institut des Géosciences de l'Environnement


Jennie Thomas, CNRS Researcher
+ Adeline Suppo, Communications Officer

FMI


Harri Kokkola, FMI Research Professor

# EU Europe call, duration, and budget

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Selected highlights from the Call: ***Improved knowledge in cloud-aerosol interaction***

Project results are expected to contribute to following outcomes:

- Enhanced large community effort in Europe around ACI
- Improved Earth systems models
- Reduced uncertainties in climate models through a better representation of cloud formation, aerosol-cloud interaction, and their combined radiative properties.

The projects should address this challenge through:

- Enhancing the systematic and coordinated collection and use of ground-based or airborne observing systems from relevant existing networks (e.g. Earlinet, Aeronet, ACTRIS). These datasets will also be critical to enhance satellite retrievals and validation of cloud and aerosols parameters.
- Establishing in the course of the projects wide-open access to the observation data produced within relevant measurement network databases (e.g. ACTRIS).

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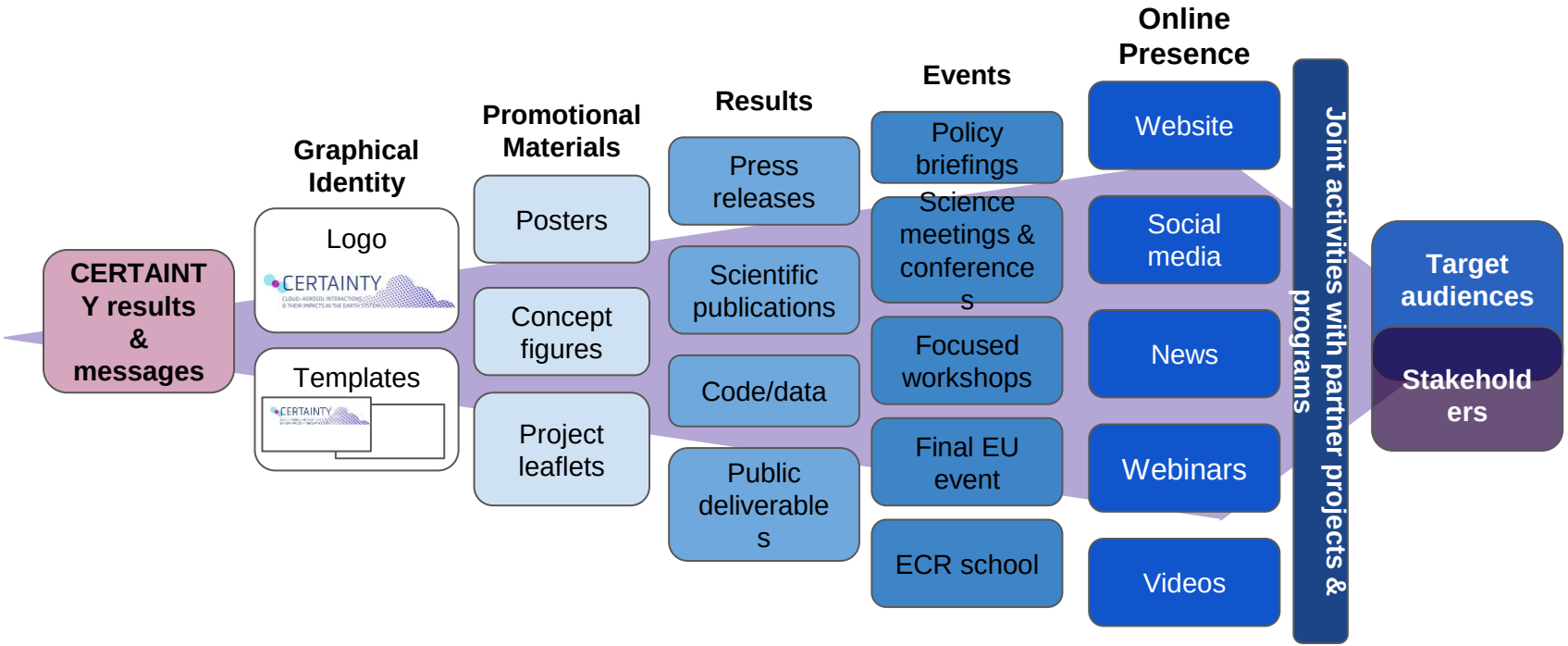
# Methods for reaching audience



# Stages of dissemination