Global monitoring of light pollution and night sky brightness from satellite measurements

global evaluation of atmospheric scattering of manmade light

Italian Space Agency (ASI) - Contract 2001

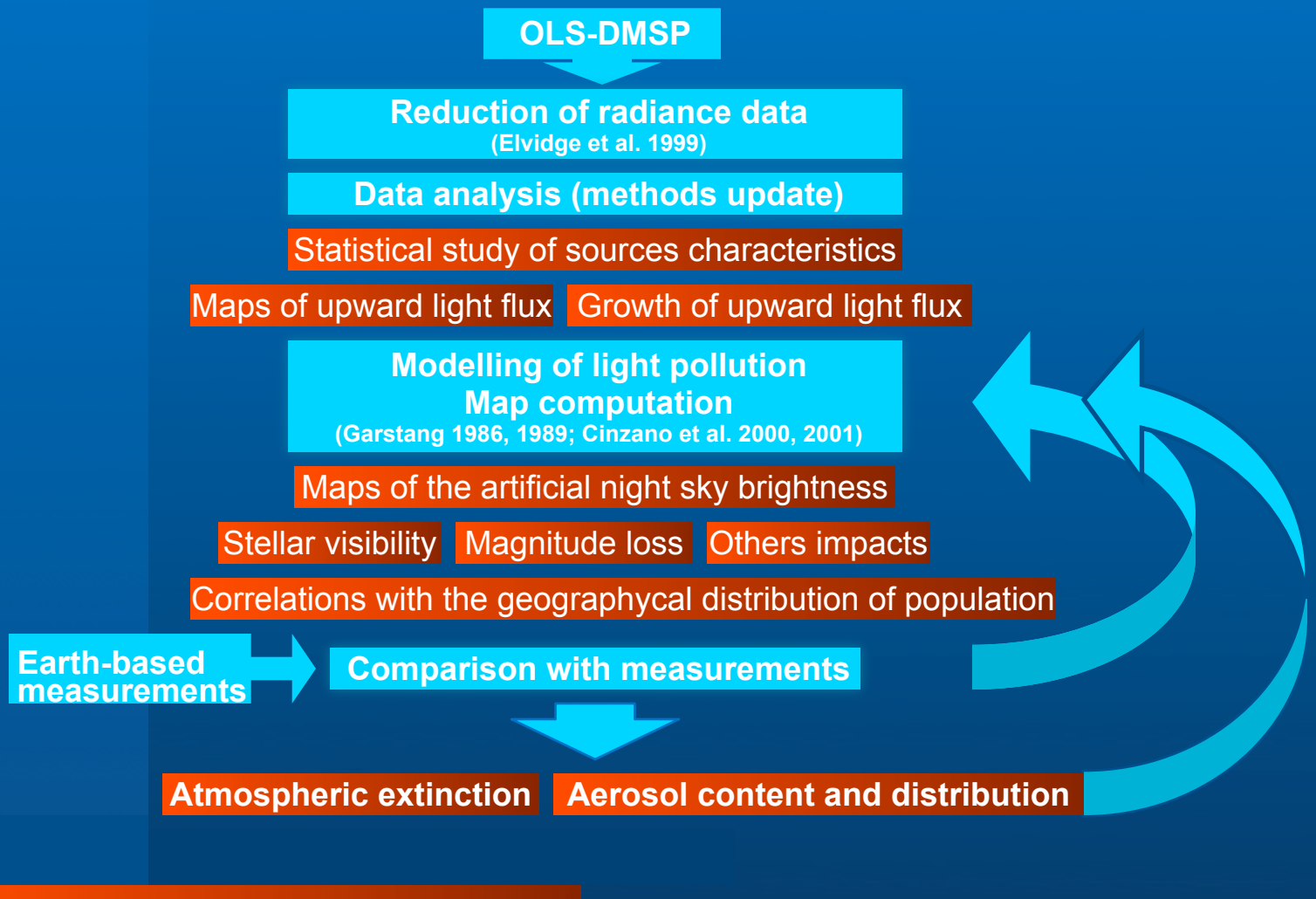
Pierantonio Cinzano[1], Fabio Falchi[1], Christopher Elvidge[2]

[1]Istituto di Scienza e Tecnologia dell'Inquinamento Luminoso (ISTIL), Thiene, Italy

[2]National Geophysical Data Center, Boulder, USA

email:cinzano@lightpollution.it

Main steps


OLS-DMSP
Reduction of radiance data
(Elvidge et al. 1999)
Data analysis (methods update)
Statistical study of sources characteristics
Maps of upward light flux
Growth of upward light flux
Modelling of light pollution
Map computation
(Garstang 1986, 1989; Cinzano et al. 2000, 2001)
Maps of the artificial night sky brightness
Stellar visibility
Magnitude loss
Others impacts
Correlations with the geographycal distribution of population
Earth-based measurements
Comparison with measurements
Atmospheric extinction
Aerosol content and distribution

Applications

GLOBAL SCALE

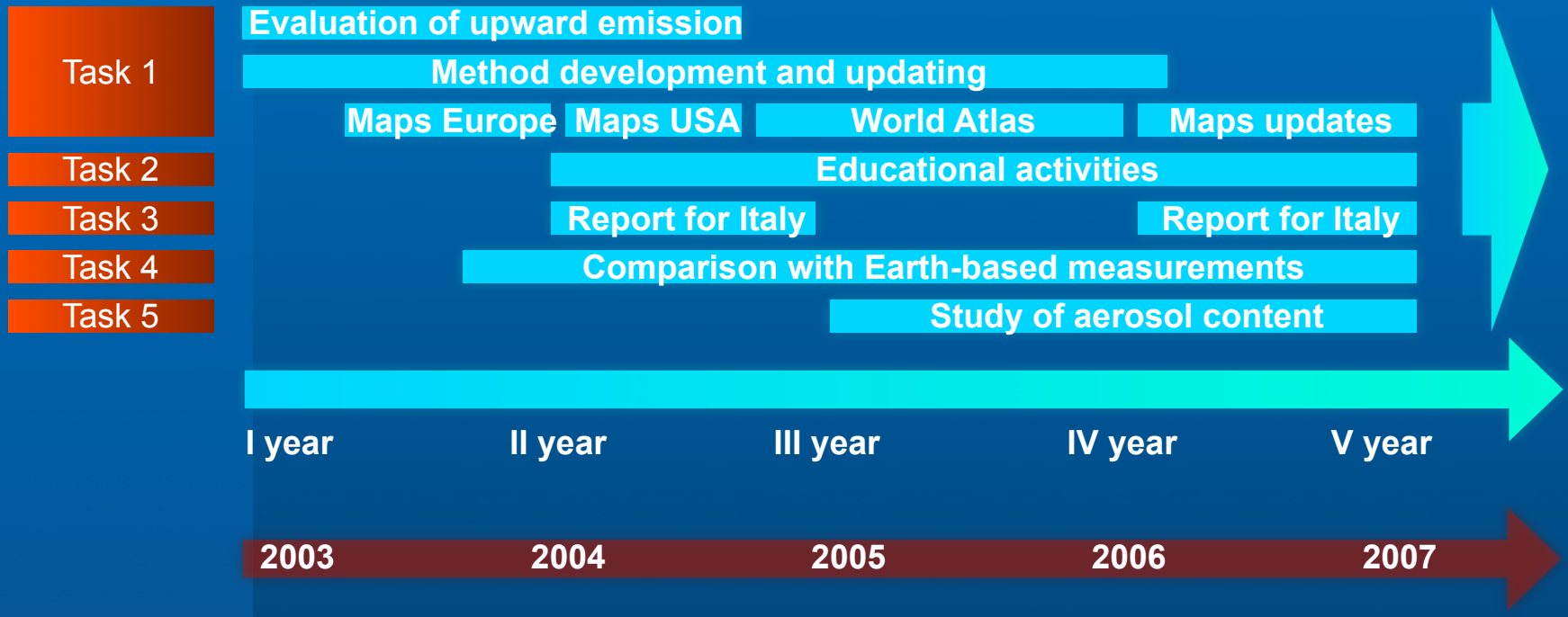
- **Aerosols**
  - Vertical extinction ⇒ geographical distribution of aerosols
  - Light scattering and stellar extinction ⇒ constraint/testing of models of 3D aerosol distribution, validation of other sources
- **Light Pollution**
  - Informations on processes and polluting sources
  - Maps of the upward light emission and its growth ⇒ geographical distribution of sources, energy saving, evolution
  - Maps of the artificial night sky brightness ⇒ site testing and land monitoring (astronomy), index of environmental impact of artificial lighting (ecology and environmental sciences)
  - Maps of the loss of limiting magnitude and stellar visibility ⇒ impact of artificial lighting (human sciences and governments)
  - Other environmental impacts of light pollution (natural sci.)
- **Remote Sensing**
  - Validation and calibration of OLS-DMSP radiance data
- **Fires**
  - Study of scattered light from ephemeral sources (fires)

Interest of light pollution

Rapidly growing

- Night sky brightness adopted as Index of environmental impact of the energy sector (ANPA, ARPA)
- Laws in 9 Italian regions, covering more than half of the Italian population and main cities (Milan, Rome, Venice, Florence, Naples)
- 3 national UNI standard rules
- 5 Bills in Parliament (XIV legislature)
- Didactic activities by MIUR (3rd year) and EU
- Conferences UNESCO (Paris '92), ONU (Wien '99)

Schedule

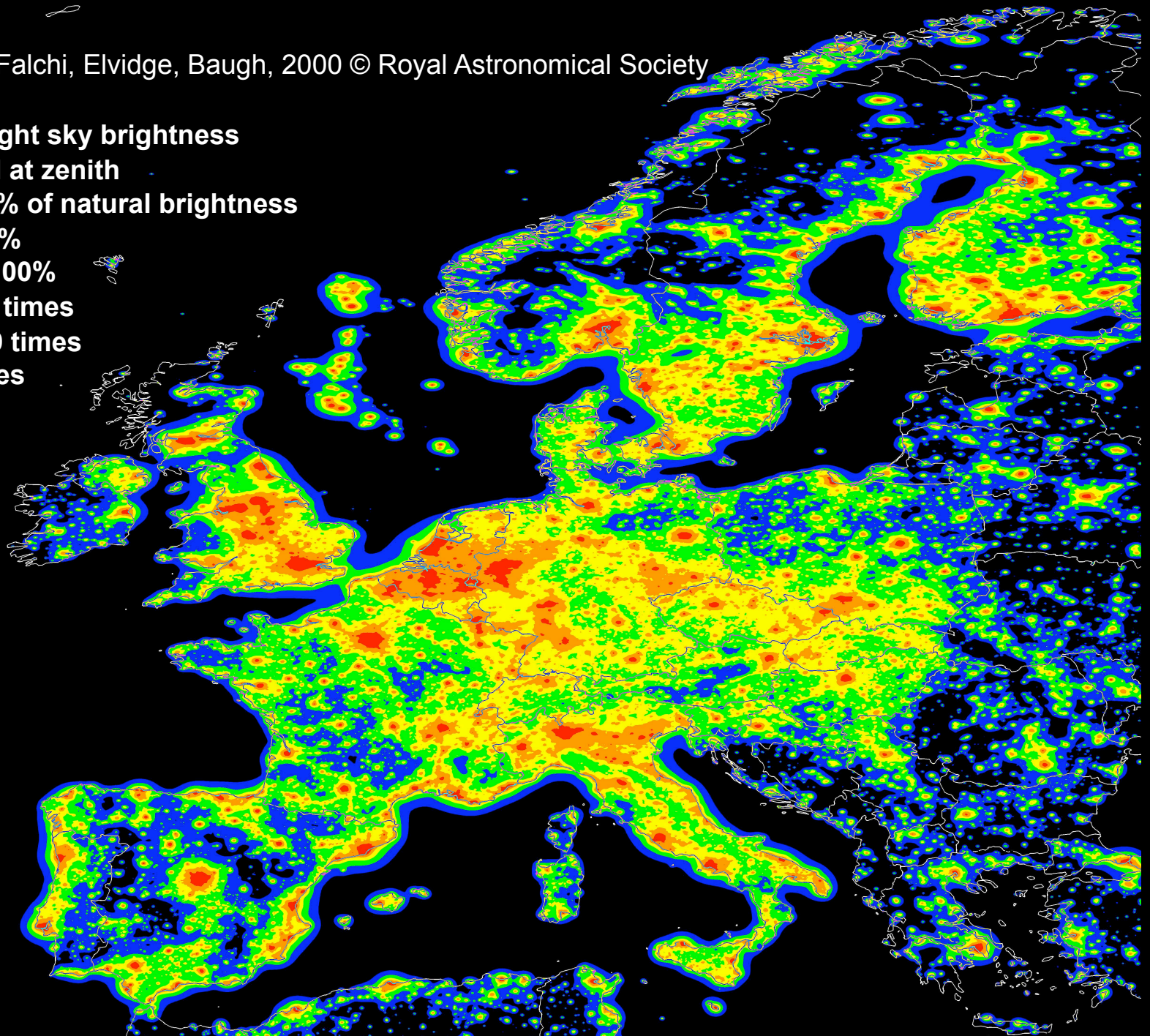

Task 1
Task 2
Task 3
Task 4
Task 5
Evaluation of upward emission
Method development and updating
Maps Europe
Maps USA
World Atlas
Maps updates
Educational activities
Report for Italy
Report for Italy
Comparison with Earth-based measurements
Study of aerosol content
I year
II year
III year
IV year
V year
2003
2004
2005
2006
2007

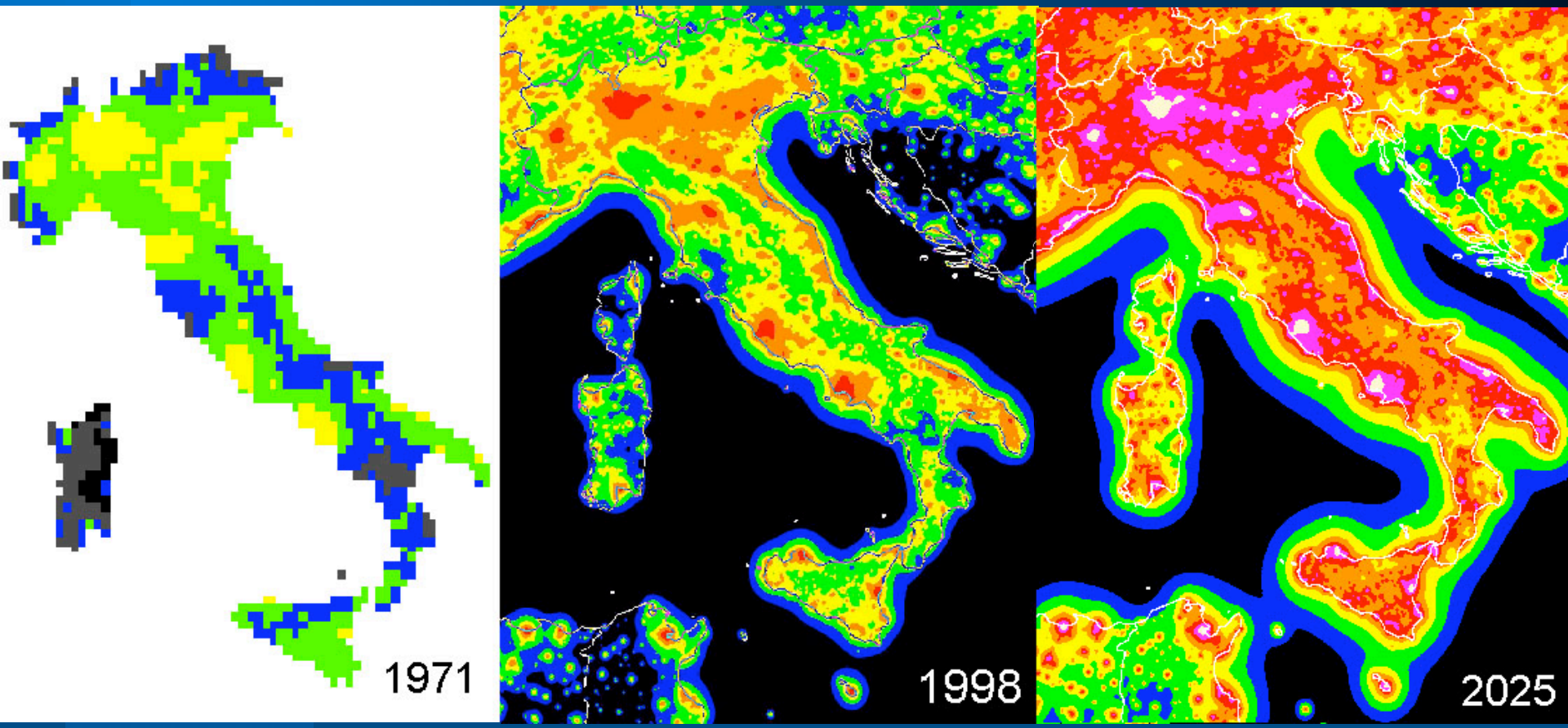
Collaborations

- University of Padua, Dep. of Astronomy (Global monitoring of the situation of the night sky in astronomical sites)
- Astronomical Observatories (IAC/OTPC, NOAA/CTIO, VAT, Lowell, etc.)
- National and regional agencies for environmental protection (ANPA and ARPA)
- International Dark-Sky Association, Tucson


© 2001 ISTIL

Artificial night sky brightness
at sea level at zenith
black: <11% of natural brightness
blue: 11-33%
green: 33-100%
yellow: 1-3 times
orange: 3-9 times
red: >9 times





© Cinzano, Falchi, Elvidge, Rapporto ISTIL 2001

Validation and further calibration by comparison with fotometrical data taken from the Earth surface