



Diffusione degli inquinanti nell'atmosfera

Massimo D'Isidoro
UTVALAMB-AIR

Col contributo dei colleghi:

Mario Adani

Gino Briganti

Andrea Cappelletti

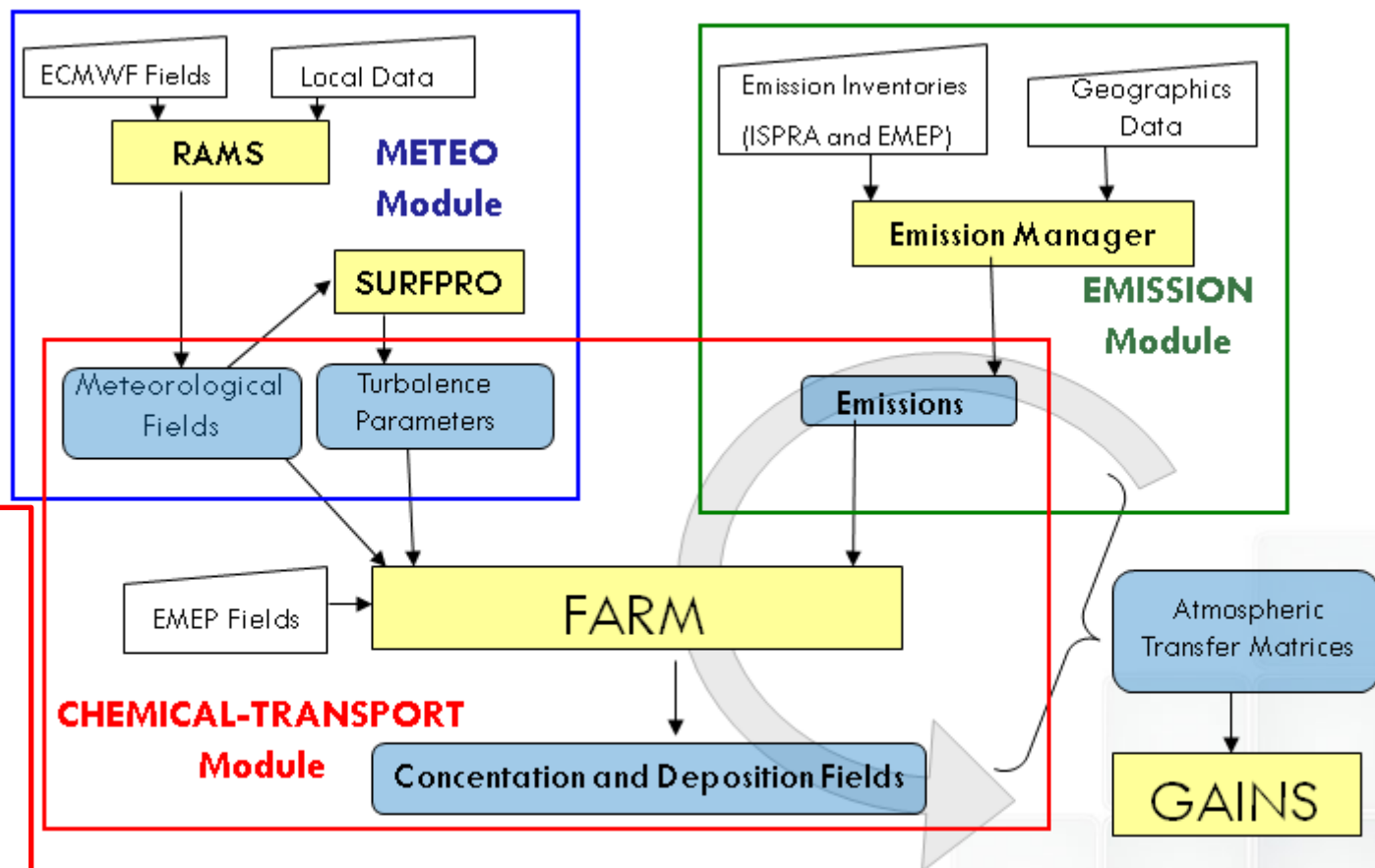
Lina Vitali

RAMS (METEOROLOGICAL MODEL)

- prognostic non-hydrostatic
- open source <http://www.atmet.com/index.shtml>
- compiled in its parallel version
- implemented in MVAPICH environment

EMISSION MANAGER (EMISSION PRE-PROCESSOR)

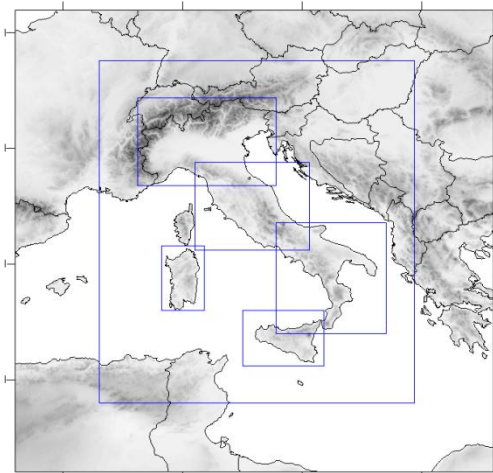
- Modular pre-processing system for model-ready emissions input (Spray, Chimere FARM)
- different geometries treatment (point, area, line)
- different speciation schemes (SAPRC90/99)



FARM (CHEMICAL TRANSPORT MODEL)

- 3D Eulerian grid dispersion model
- K-closure turbulence
- SAPRC90/99 chemical mechanisms
- AERO3 aerosol model
- OpenMP compiler directives

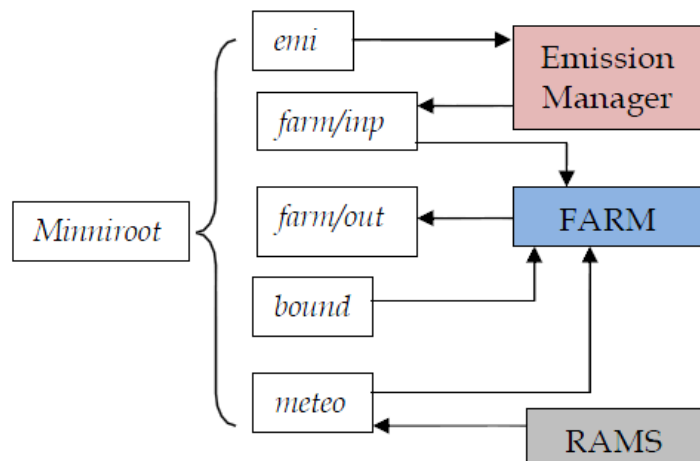
COMPUTATIONAL DOMAINS



MINNI SIMULATIONS

Atmospheric Modelling System is applied to produce *annual simulations* of meteorological and air quality fields with *hourly time step* and a *spatial resolution* of both $20 \times 20 \text{ km}^2$ (over a domain covering the whole Italy) and $4 \times 4 \text{ km}^2$ (over five sub-domains covering North of Italy, Centre of Italy, South of Italy, Sardinia and Sicily islands). Vertically, the computing domain comes up to 10 km AMSL.

DATA STRUCTURE



STORAGE AND CPU REQUIREMENT

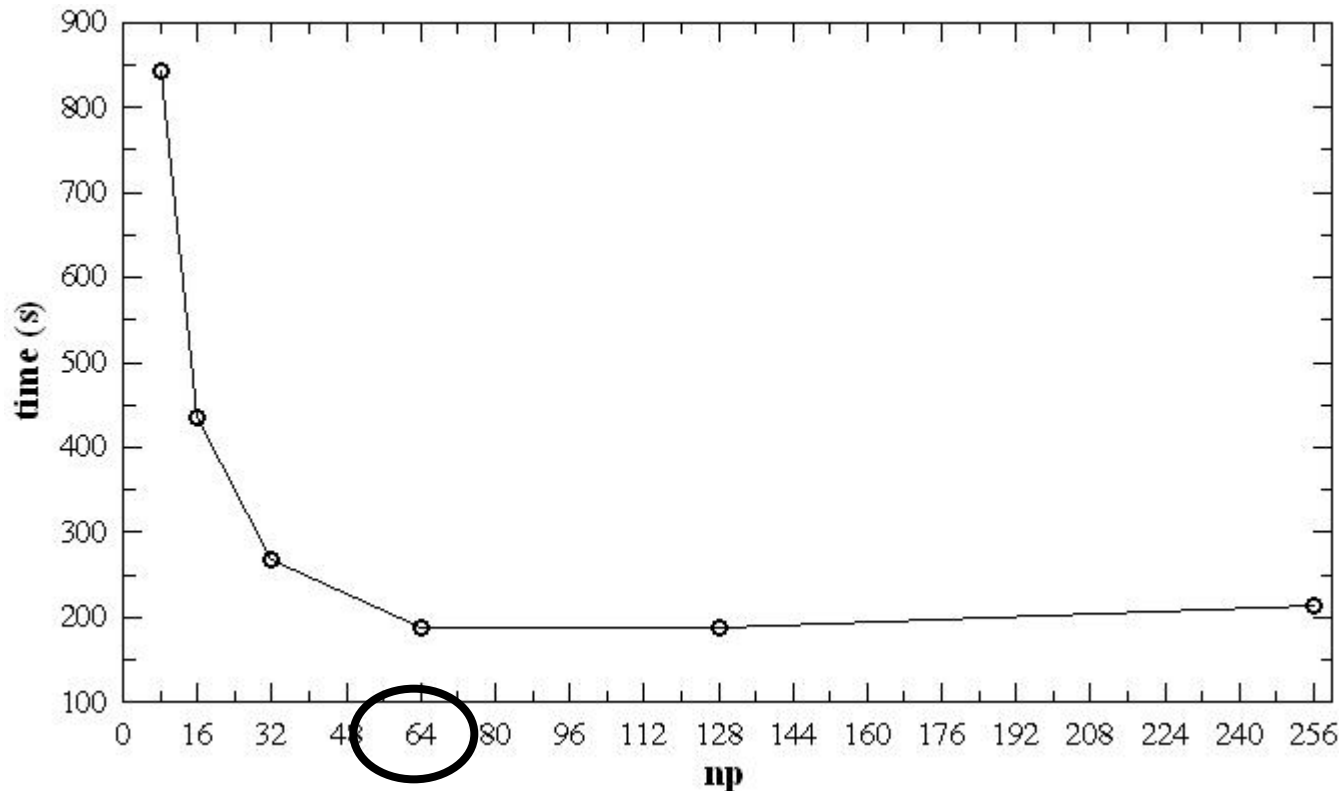
(FOR AN ANNUAL SIMULATION)

Scenario	Cpu time hours x cores	Space (GB)
Meteo	90000	250
Emissions	100	500
Concentrations/ depositions	15000	4000

Schema delle simulazioni meteorologiche annuali

- Fino ad oggi 64 processori su cresco 1-2.
Tests e prime prove su cresco3...
- 37x3 jobs concatenati (run di 10 giorni ognuno):
 - 1) Italia a 20km (2 griglie annidate)
 - 2) Nord, e sud a 4km(4 griglie annidate)
 - 3) Centro, Sicilia e Sardegna a 4km (4 griglie annidate)

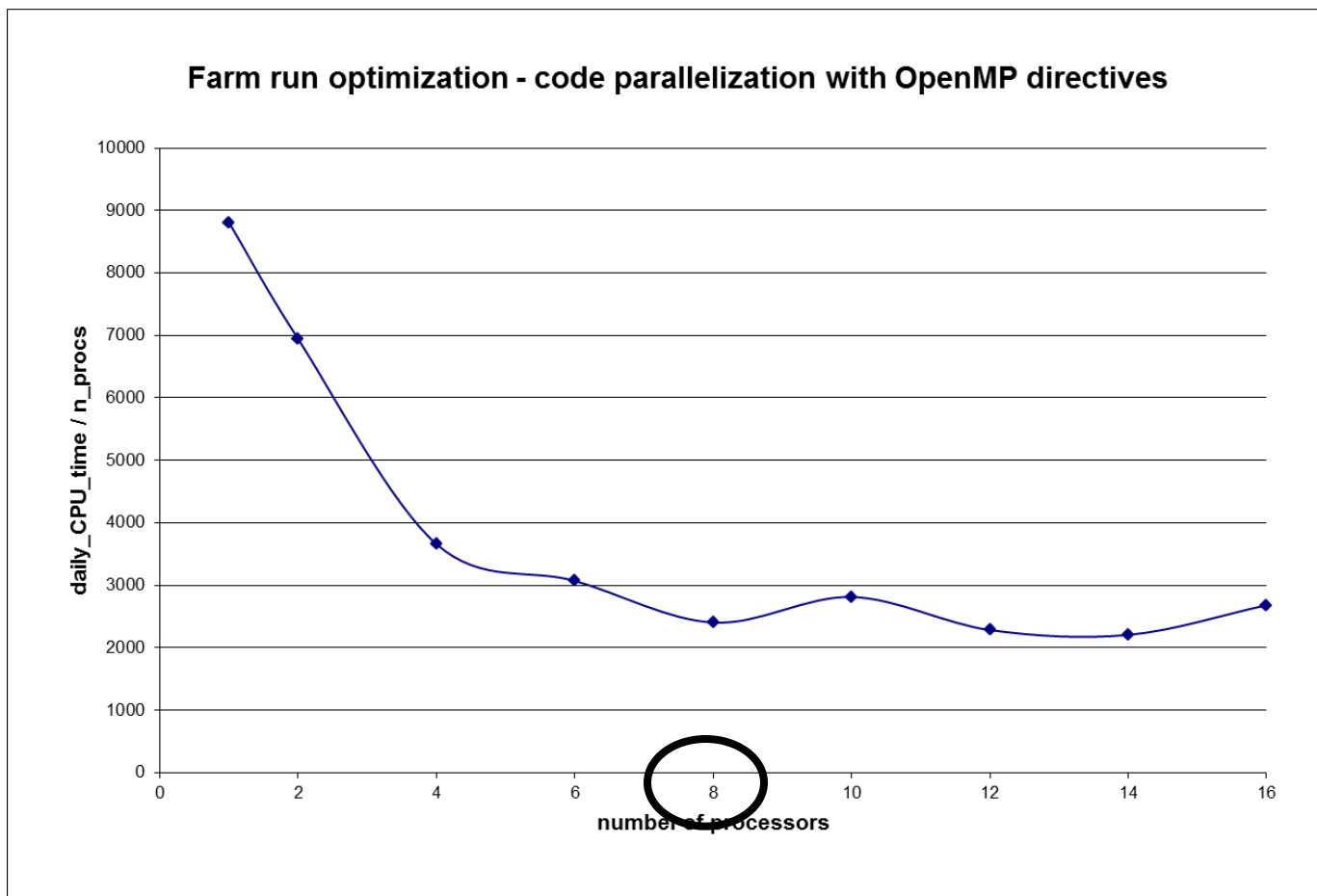
Numero ottimale di processori per le simulazioni meteo (cresco1-2)



Schema delle simulazioni annuali di qualità dell'aria

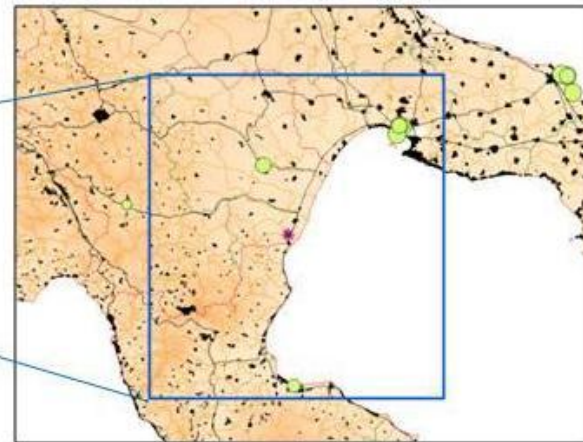
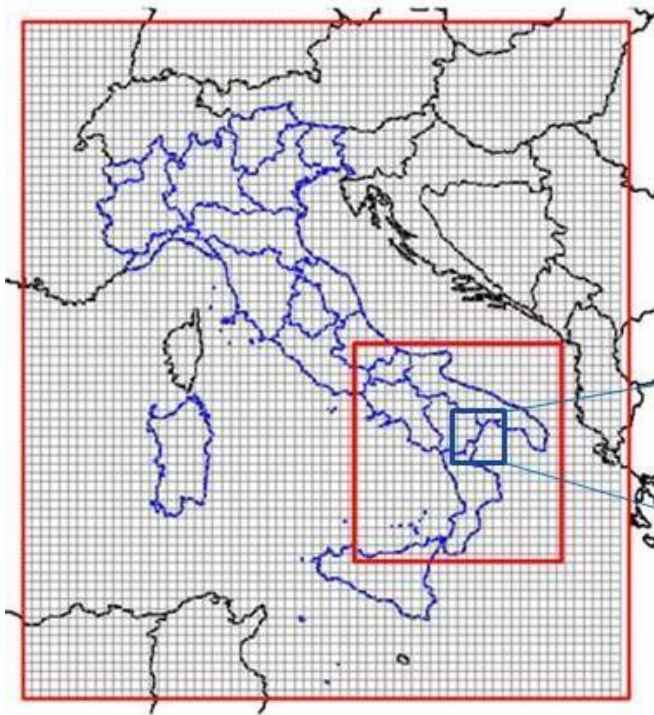
- 8 processori su cresco 1-2 (OpenMP).
- Modello parallelizzato MPI pronto (da testare) ;
- 12 jobs indipendenti (1 per mese) organizzati in 4 jobs concatenati (decadi);
 - 1) Italia a 20km;
 - 2) Nord, centro, sud, Sicilia e Sardegna a 4km (annidati su Italia a 20km).

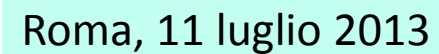
Numero ottimale di processori per le simulazioni di qualità dell'aria



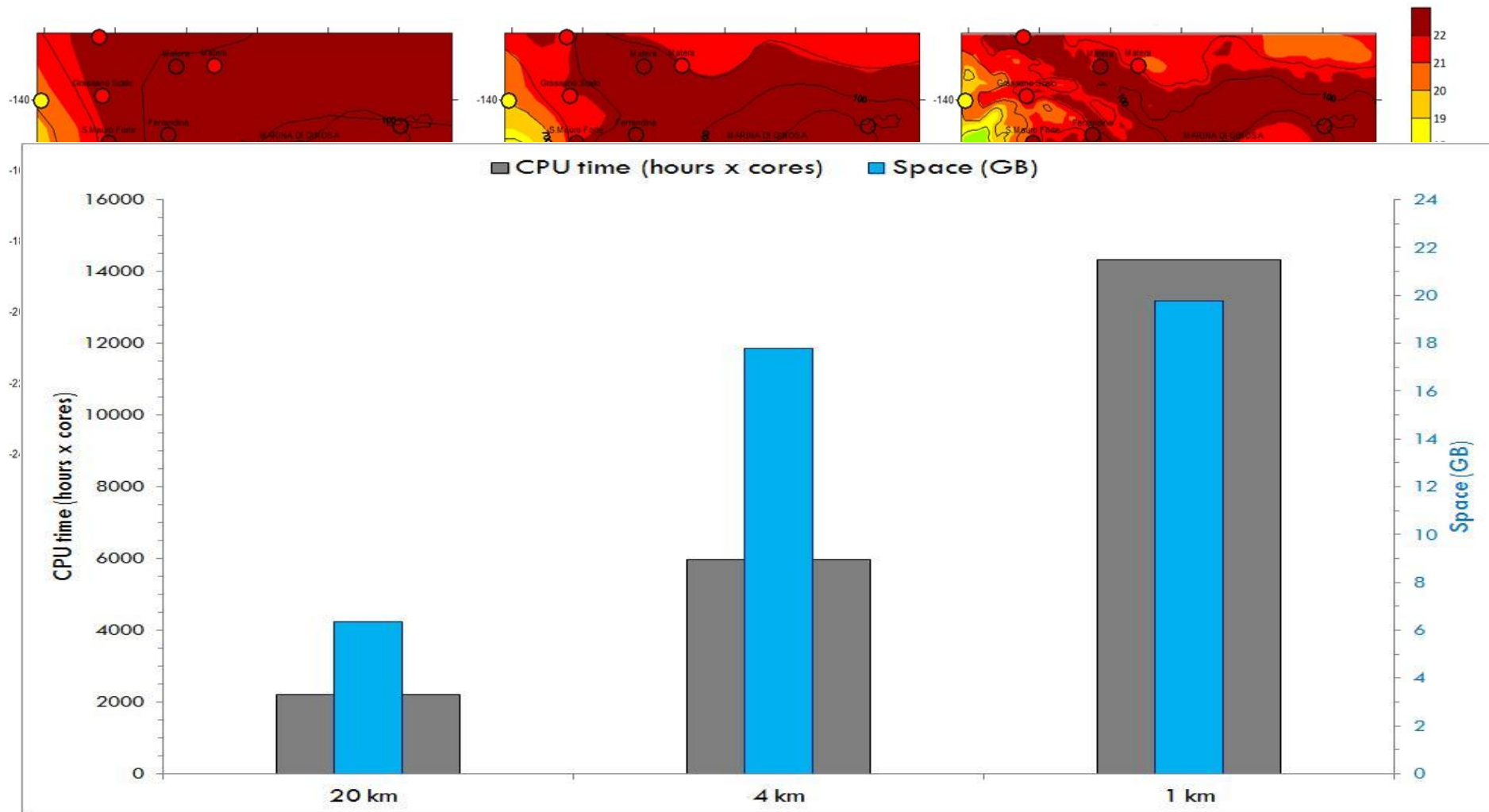
Esempio: Passaggio a 1km di risoluzione

	20 km	4 km	1 km
N _x	67	116	119
N _y	75	121	131
N _z	16	16	16
N _x · N _y · N _z	80400	224576	249424

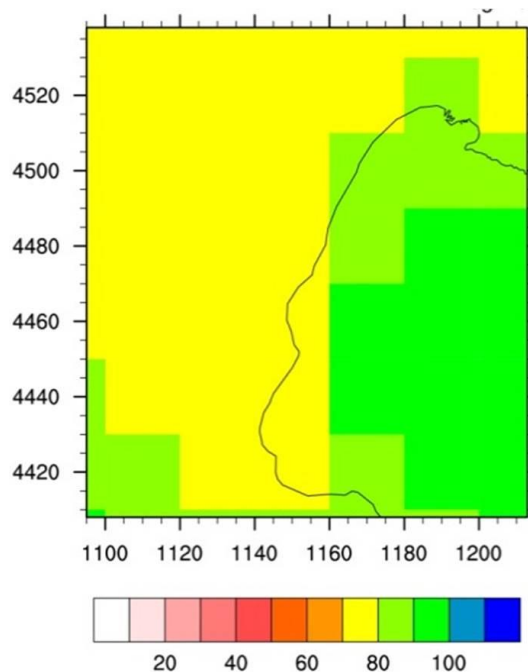




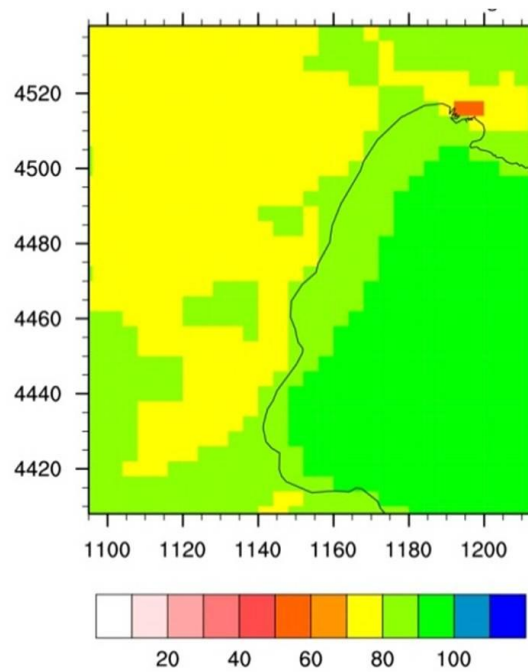
Temperatura media giugno 2010



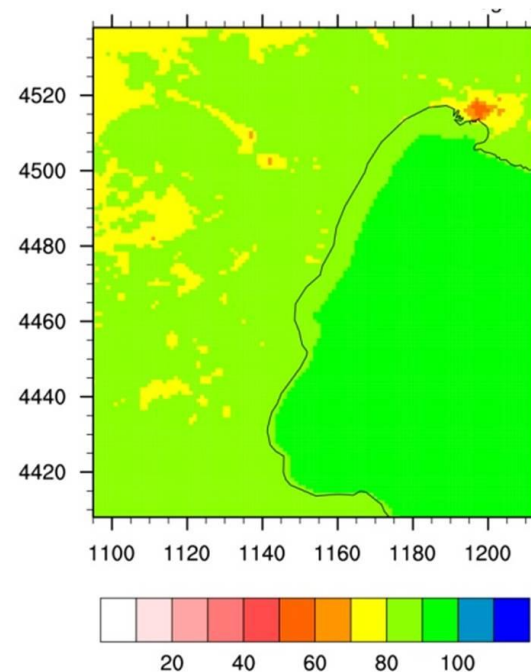
Ozono medio giugno 2010



20km

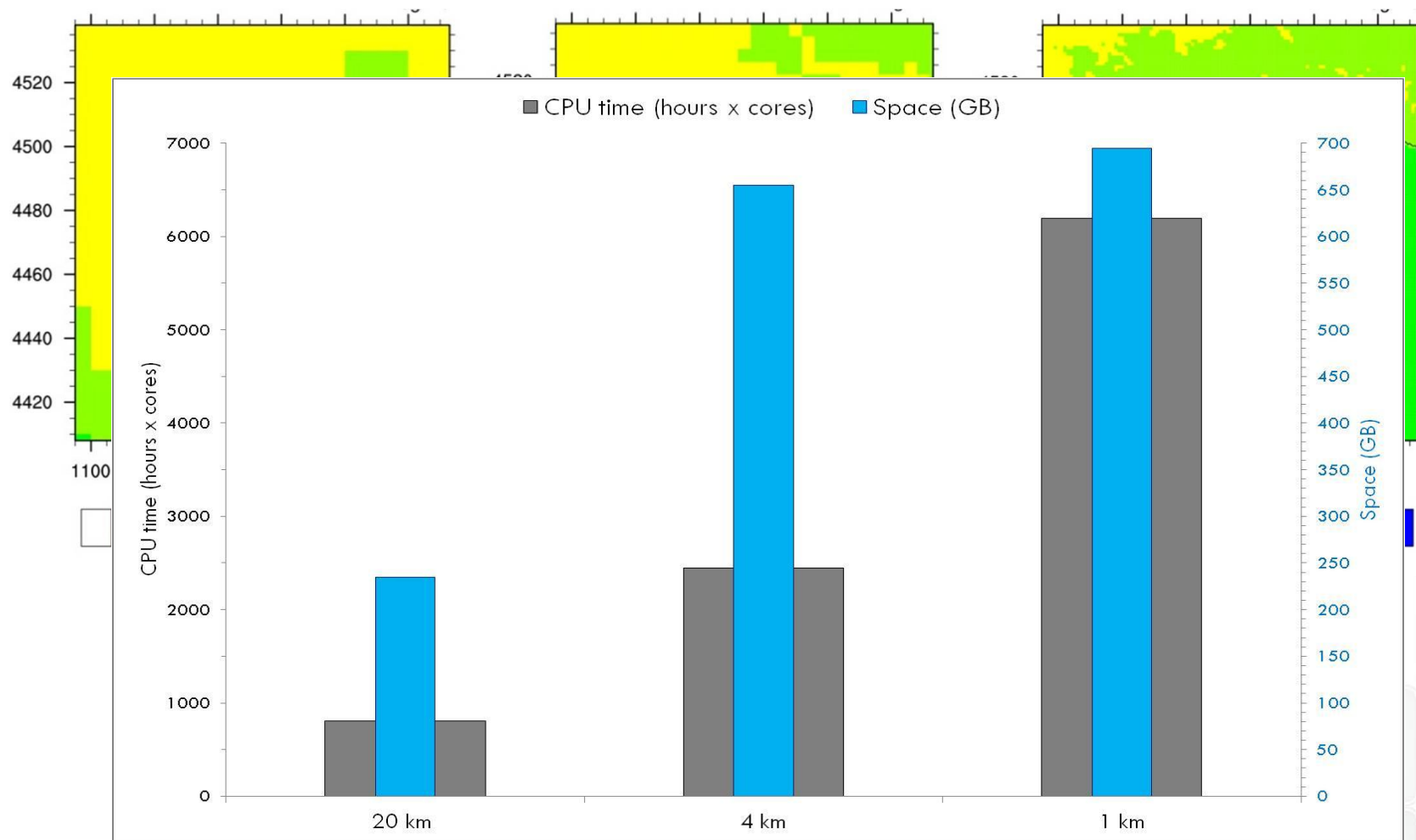


4km



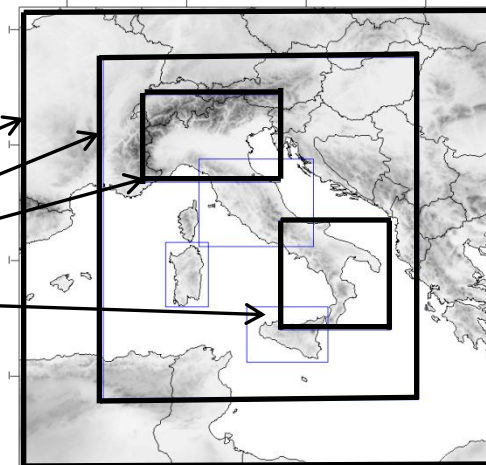
1km

Ozono medio giugno 2010



Test meteo su cresco 3: 10 giorni di simulazione

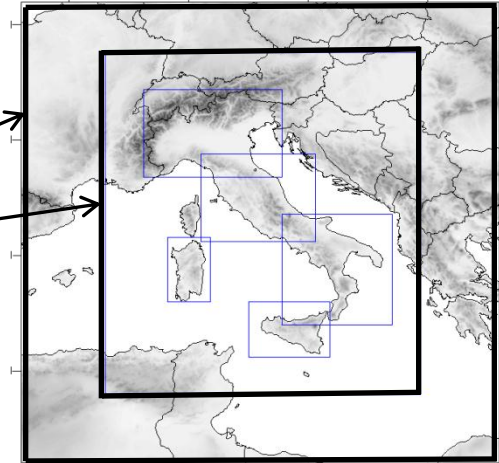
4 Griglie annidate: 48-12-4km



CRESCO 1-2	CRESCO 3
64 processori: 21.5h	64 processori: 16h
	144 processori: 10h
	216 processori: 8.5h

Test meteo su cresco 3: 10 giorni di simulazione

2 Griglie annidate: 48-12km



CRESCO 1-2	CRESCO 3
64 processori: 3h 20m	216 processori: 1h 40m

Riassumendo

- Per noi fondamentale cresco sia come **cpu** che come **storage**.
- Oltre al calcolo parallelo nella nostra catena ci sono processi **seriali** (emissioni, pre e post-processamenti) che talvolta possono presentare criticità (virtualmente risolte da quando si è aggiunta la coda cresco_serh24)
- Promettenti i test su cresco3 -> con 216 processori tempi ridotti di circa 60% per il modello meteo.

Problemi riscontrati talvolta alla partenza dei jobs con le allocazioni MPI (network fail...) già segnalati col ticketing