Application and development of air quality models in Chile

by

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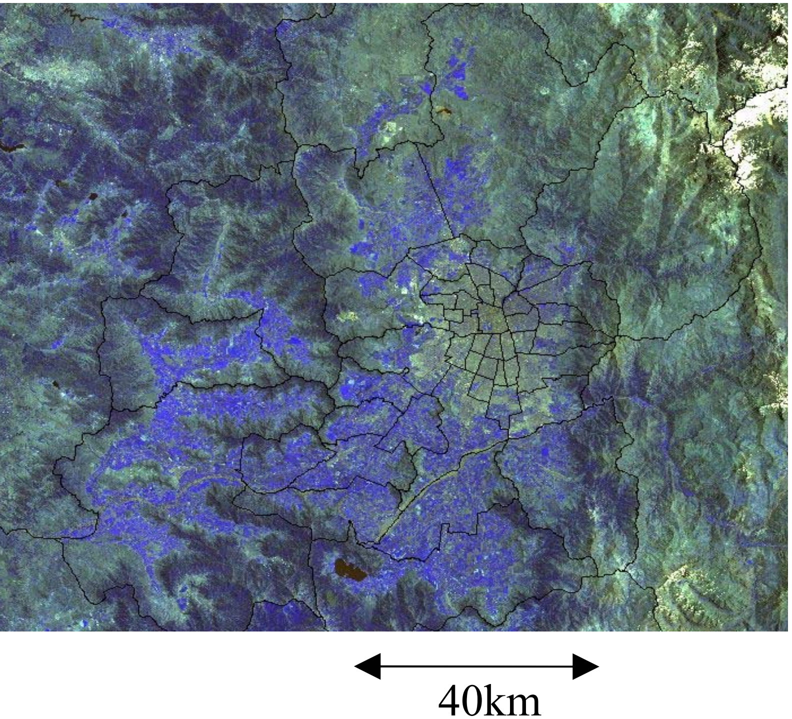

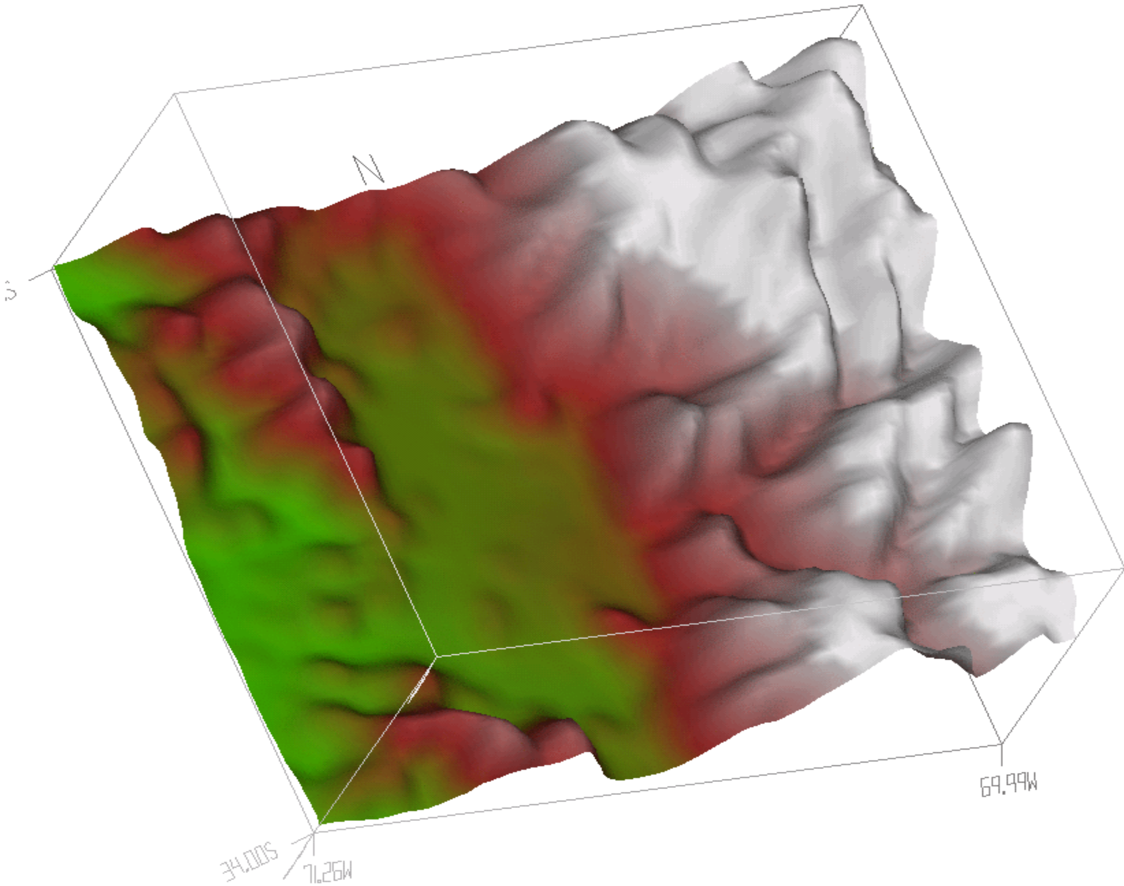

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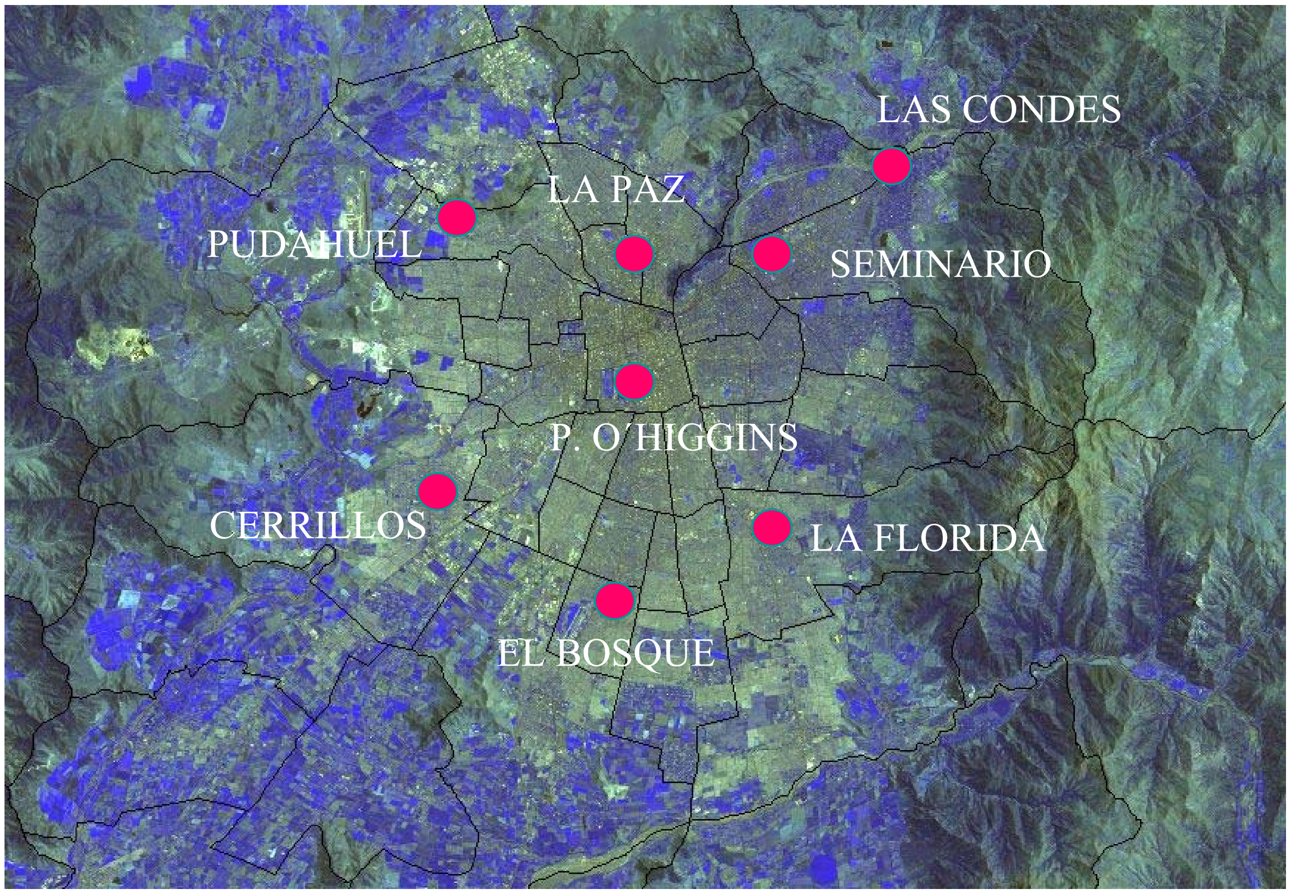
Monitoring Network

Variables:
NOx, SO2, O3,
CO, PM10, NMH



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Air quality

	Norms	Observed maximum (at one of the monitoring sites)	# of days per year above norm
PM10	24-hour average **150** µg/m3	~**330** µg/m3	~60
CO	8-hour average **10** mg/m3	~**15** mg/m3	~60
Ozone	1-hour average **150** µg/m3	~**350** µg/m3	~140

Air quality forecast for Santiago

orecast for PM10 (24-hour average one day in advance for every station

ype of model: **Multiple linear regression analysis**
62 Meteorological predictor variables
16 Short-term PM10 trend indicators

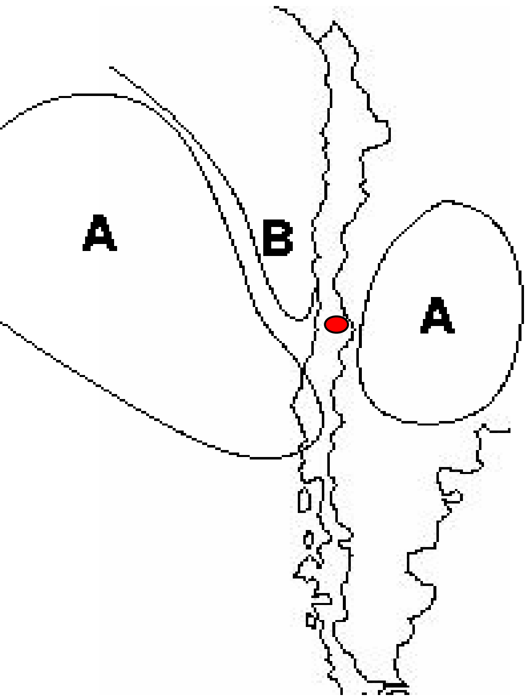
xample:

PM1024H = -21.7 + 39.4*MI1 + 0.33*OPM10 + 2.06*T925 + 0.21*DH500

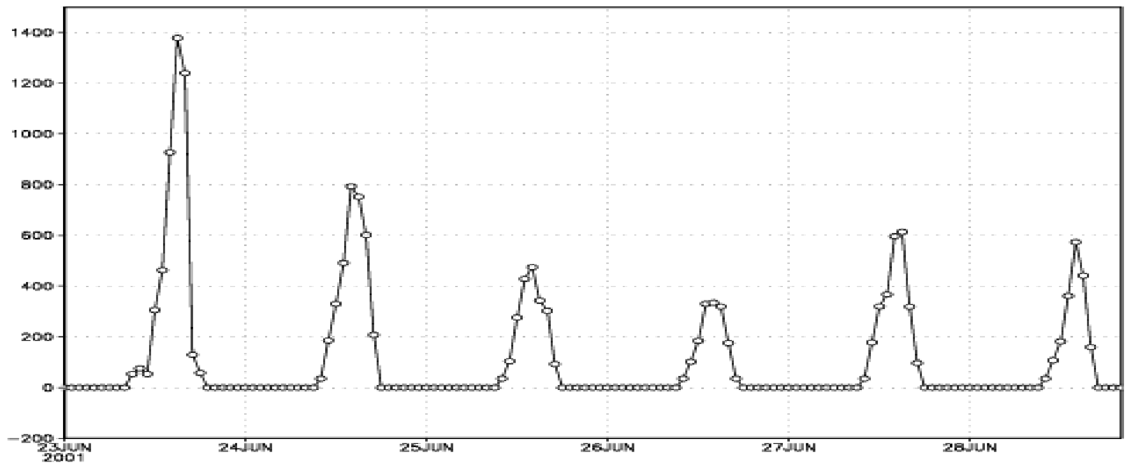
PM1024H	24-hrs average PM10 concentration for next day
MI1	Index of meteorological potential of atmospheric contamination
OPM10	observed 24 hrs PM10 average
T925	Temperature at 925 mb observed at the nearest radio sounding
DH500	24-hrs change of the geopotential height observed at the nearest radio sounding

Model development

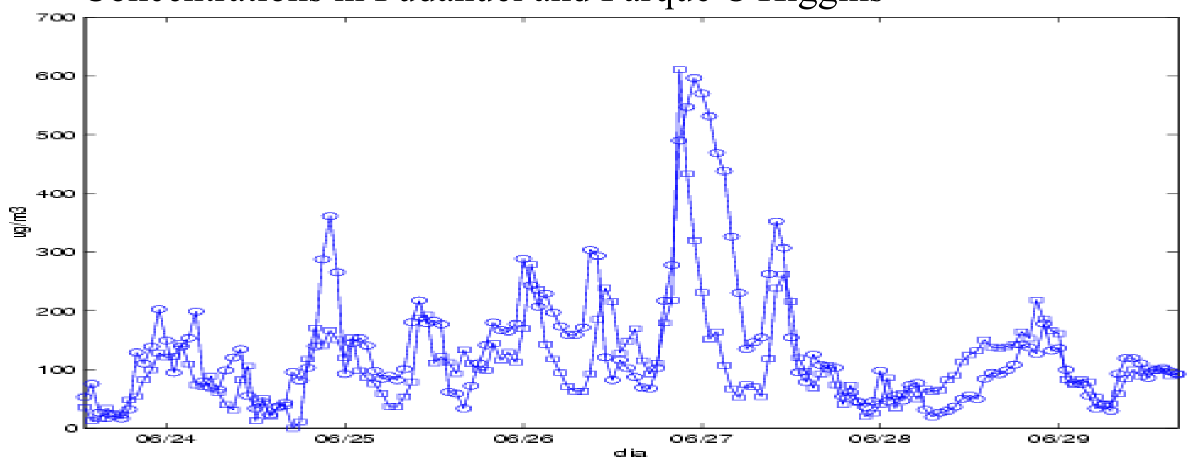
PM10



Mixing layer height



Concentrations in Pudahuel and Parque O'Higgins



Model development

PM10

Change from:

Statistical model

PM1024H = -21.7 + 39.4*MI1 + 0.33*OPM10 + 2.06*T925 + 0.21*DH500

To:

Combination of dynamic and statistical model

PM1024H = a*OPM10 + b*MLH

OPM10: observed

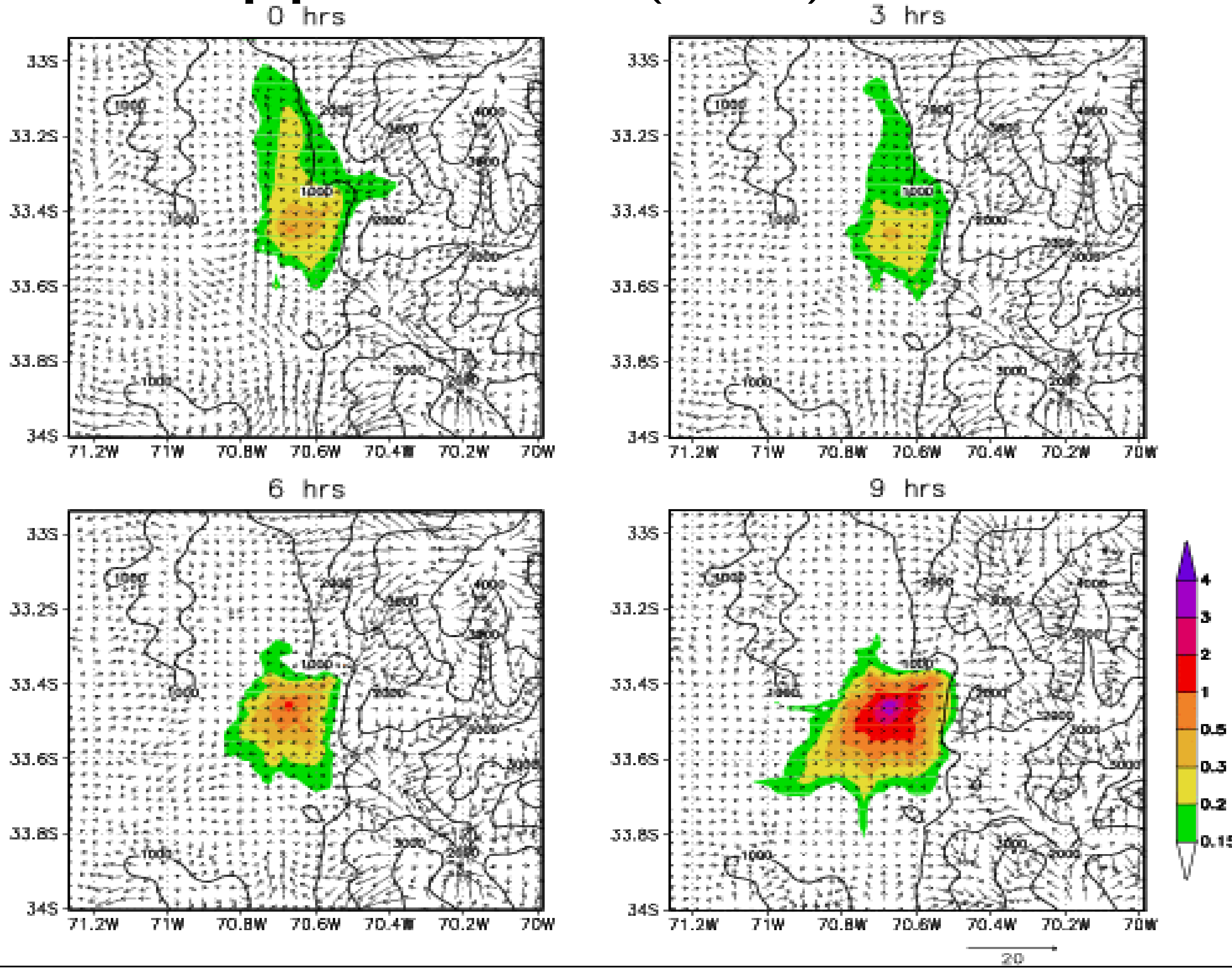
MLH: forecasted by MM5

CADM (**C**hilean **A**ir Quality **D**ispersion **M**odel)

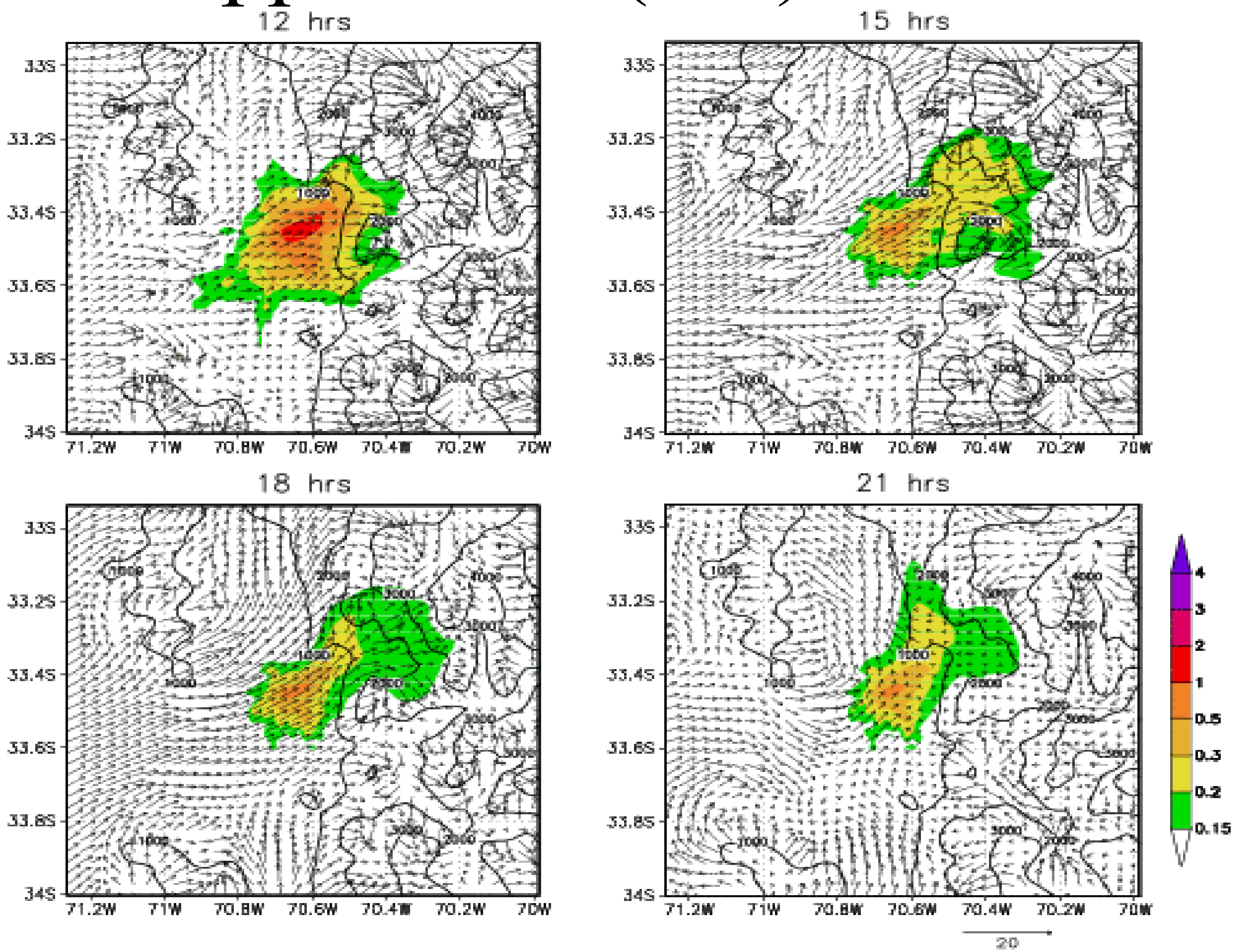
METEOROLOGY	MM5
TRANSPORT	
•Advection:	Smolarkievic (1984) Bott (1988)
•Diffusion:	Crank-Nicolson scheme (Thomas, 1995) Mixing length scheme (Dyer, 1974) TKE (Gayno *et al.*, 1994, Shafran *et al.*, 2000, Ballard *et al.*, 1991)
•Dry deposition:	Resistence model (e.g. Chang *et al.*,1987)
CHEMISTRY	
•Mechanism:	RADM2 (Stockwell *et al.*, 1990)
•Solver:	PSSA

Model documentation: www.dgf.uchile.cl/~schmitzr

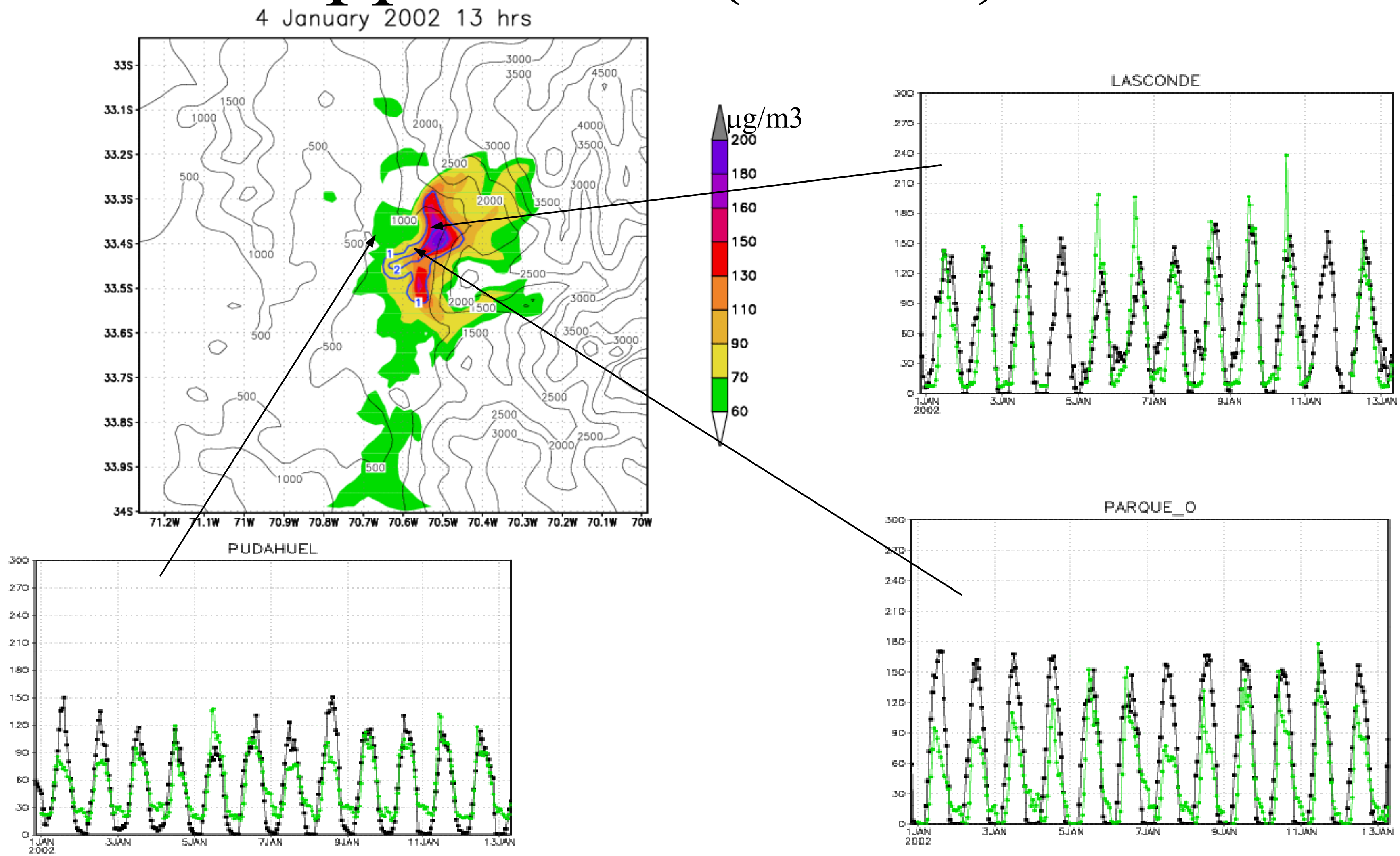
ADM application (CO)



ADM application (CO)

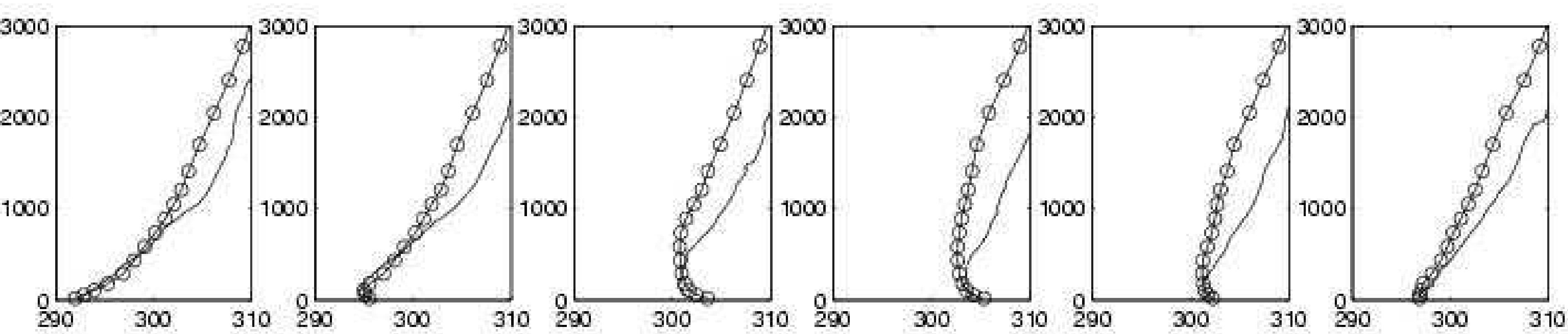


ADM application (Ozone)



Meteorological performance

0700 0900 1200 1600 1900 2200



Potential temperature

Future work

- One dimensional meteorological simulations
- Meteorological field experiments
- Improvement of emission inventories
- Chemical field experiments

Use of air quality models in Chile

Institutions and their respective models:

- CENMA (Joseph Casmassi)
- University of Santiago (Neural Networks)
- Chilean Weather Office (MM5)
- CONAMA/CENMA (AIRVIRO, HIRLAM/MATCH)
- Catholic University (UAM, CAMx, CALMET)
- University of Chile

    Department of Geophysics (CADM)
    Center for Mathematical Modelling (MATCH)

- Others (KAMM/DRAIS)

Chilean experience

- Universities have to be involved.
- Young people (with doctorate degree) have to be integrated.
- Support from governmental bodies is necessary.
- Communication between different institutions is essential.

- The choice of the right model (also) depends on local expertise, requirements, and infrastructure.

Santiago de Chile

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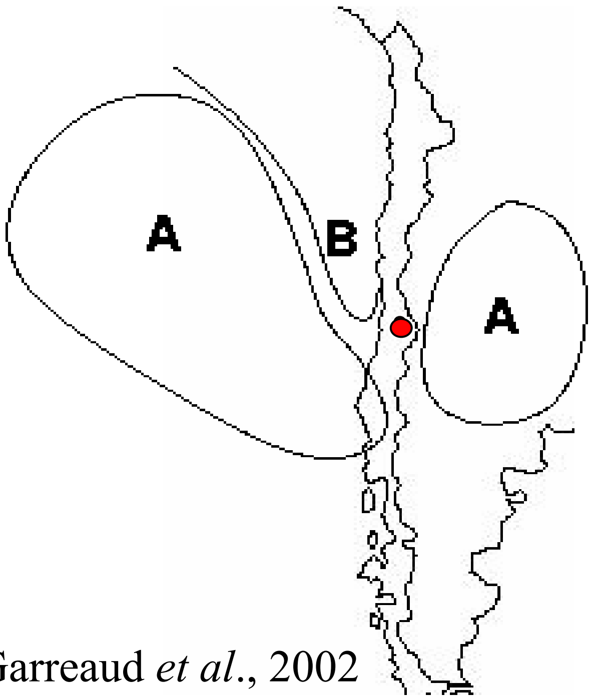
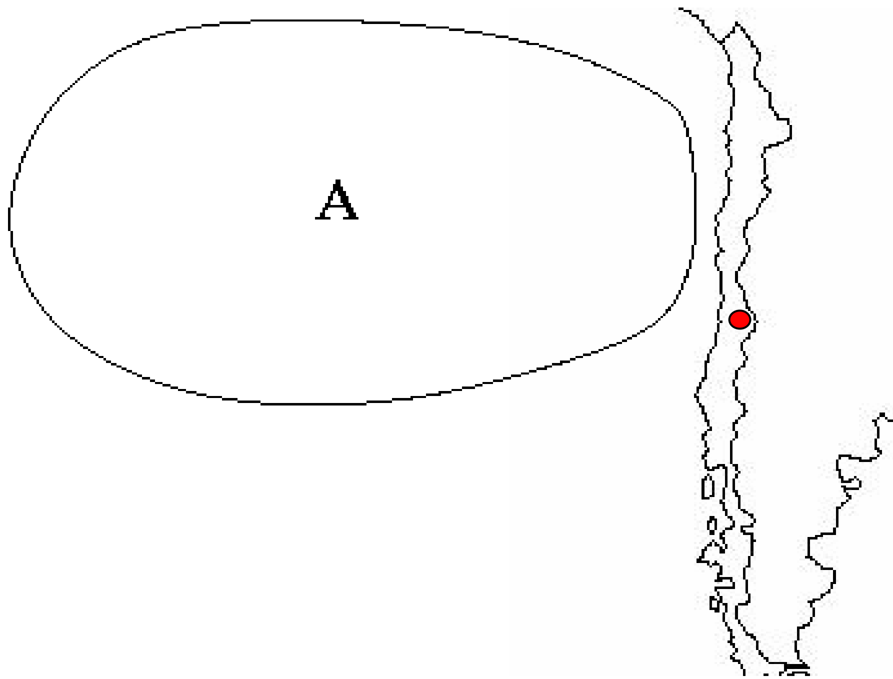
Typical synoptic situations

Winter



Garreaud *et al.*, 2002

Summer



20° S

50° S