Implementation of a regional model for climate prediction en Chile

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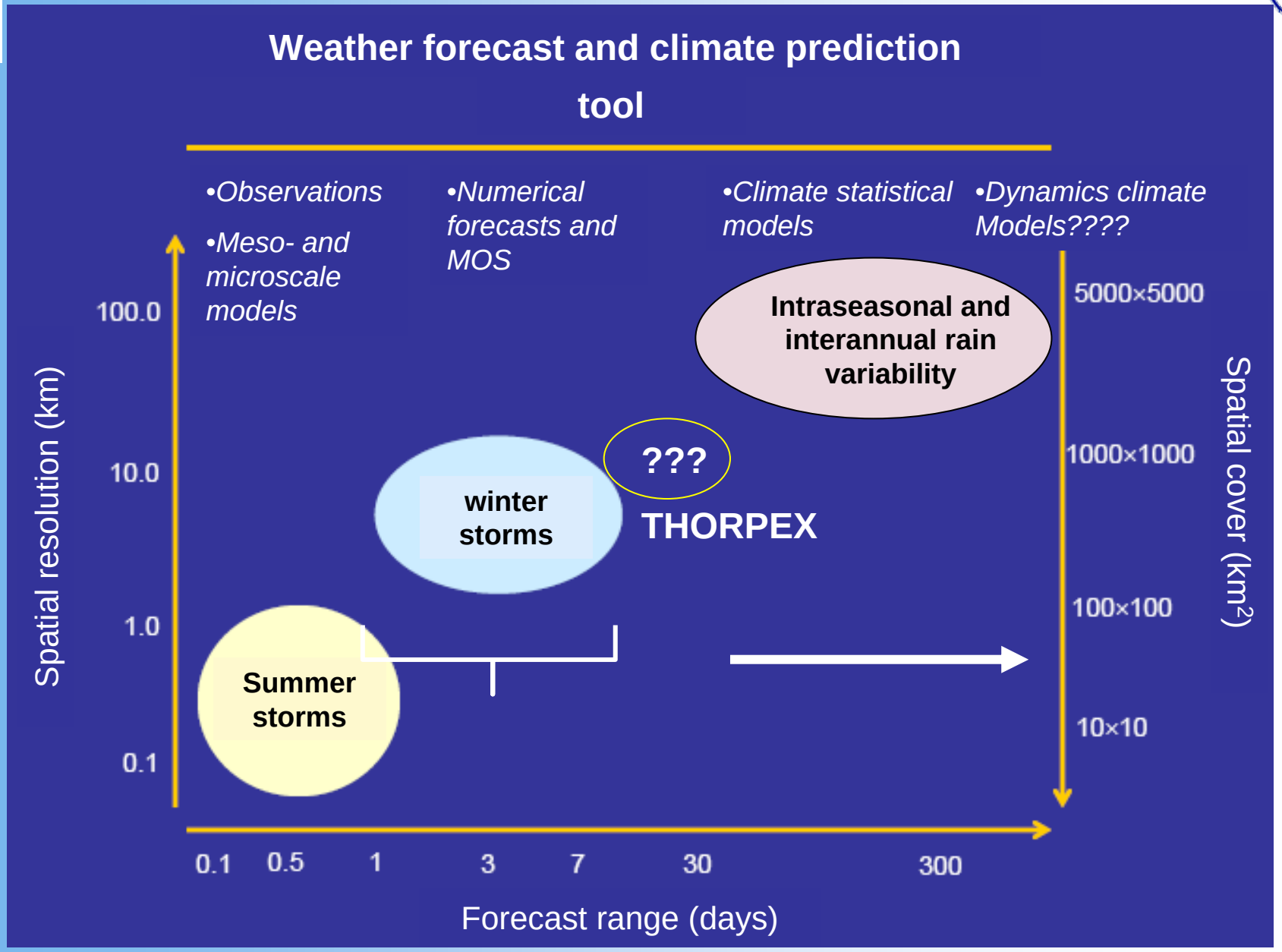
Some **preliminary** important thoughts

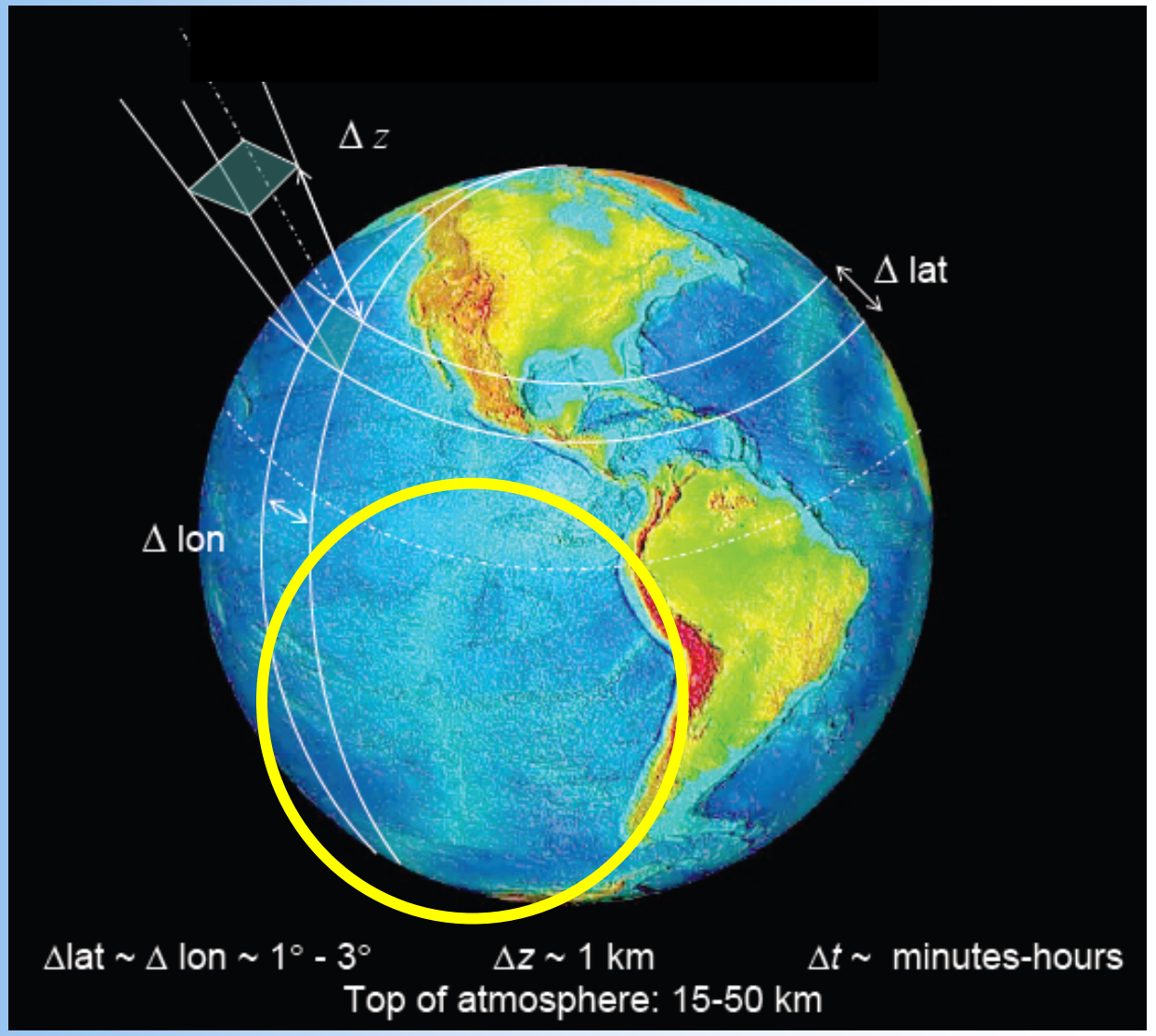
First **there is a large range of meteorological events that we would like to forecast, but we only concentrate our effort on:**

- **Operational synoptic and mesoscale weather including pollution, and**
- **Regional climate model, seasonal and climate change**


Weather forecast and climate prediction tool
•Observations
•Meso- and microscale models
•Numerical forecasts and MOS
•Climate statistical models
•Dynamics climate Models????
Intraseasonal and interannual rain variability
???
THORPEX
winter storms
Summer storms
Spatial resolution (km)
100.0
10.0
1.0
0.1
5000×5000
1000×1000
100×100
10×10
Spatial cover (km²)
0.1
0.5
1
3
7
30
300
Forecast range (days)

Second,

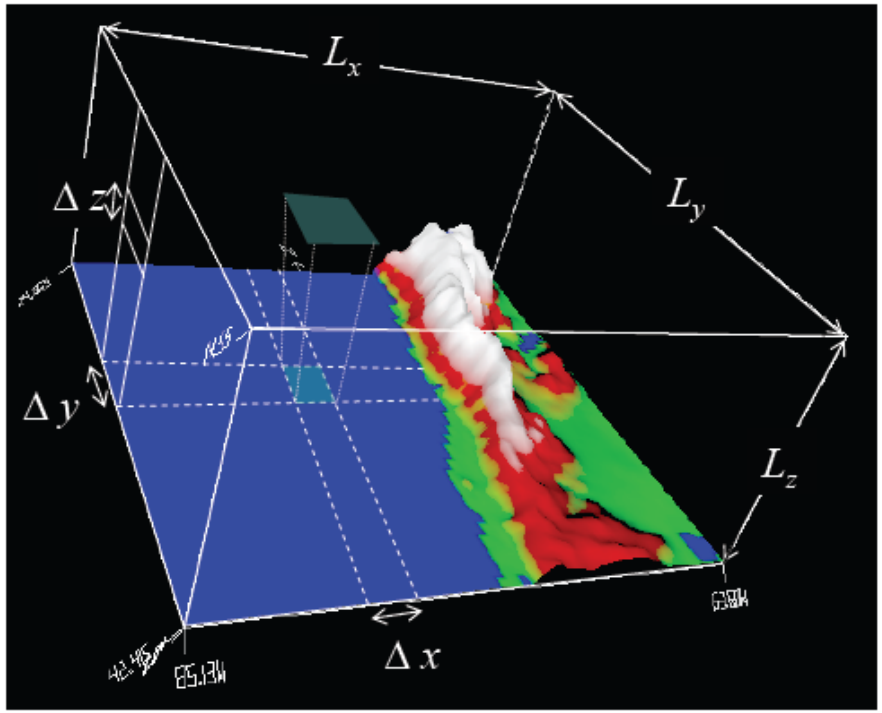
Chile faces the large Pacific Ocean, where real data is scarce so numerical models become very important



And third

The Andes mountains introduce a big challenge to the models, and that is important issue for us; so that, the goodness of the numerical forecast will depend on how good the model is able to resolve the influence of the simulated mountains.

Regional Models (LAM, Mesoscale Models)



$\Delta x \sim \Delta y \sim$ 1-50 km $\Delta z \sim$ 50-200 m $\Delta t \sim$ seconds

$L_x \sim L_y \sim$ 100-5000 km $L_z \sim$ 15 km LBC from GCMs

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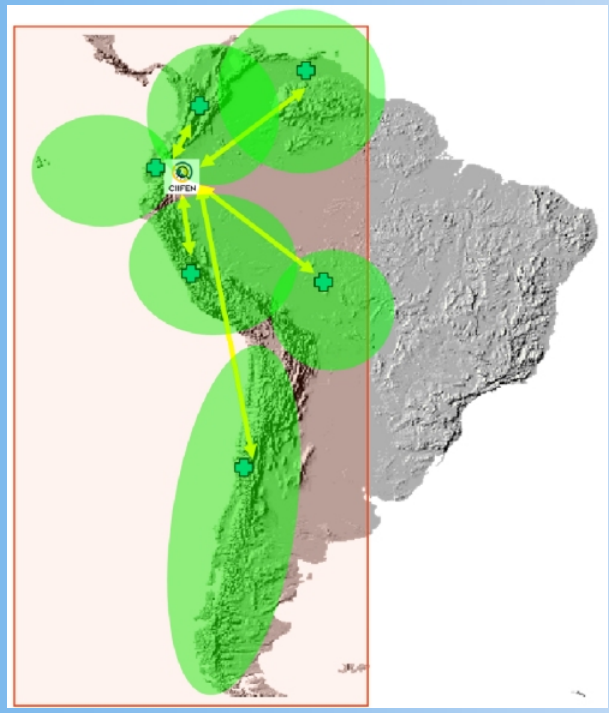
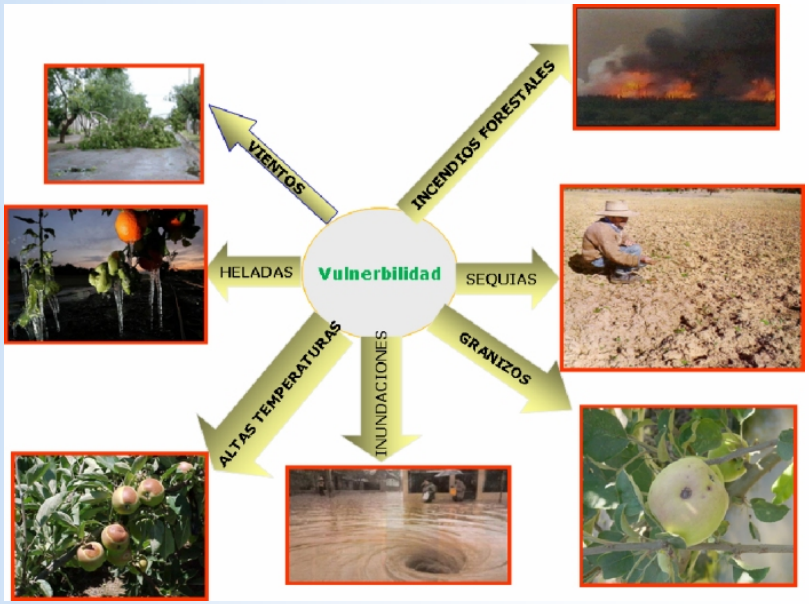
BID project : ANT/OC-10064-RG
“Apply Climate Information for Risk Manegement in the Andes countries”

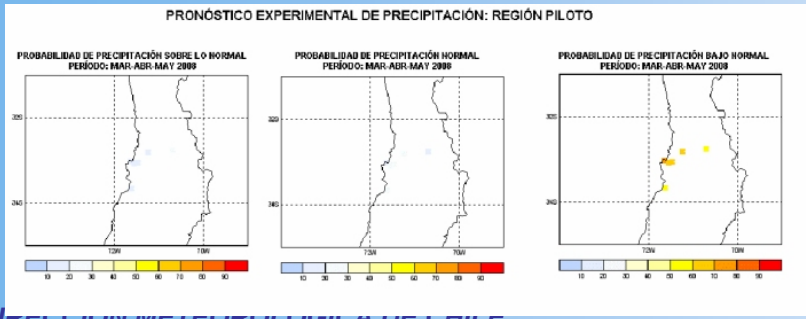
Validation of the dynamic numerical model MM5-WRF for climate forecast application

Proyecto ATN/OC-10064-RG BID
"Información Climática Aplicada a la Gestión de riesgo agricola en los países andinos"



CIIFEN: Proyecto: ATN/OC-10064-RG





Banco Interamericano de Desarrollo
FOMIN - CII

Interamerican Development Bank

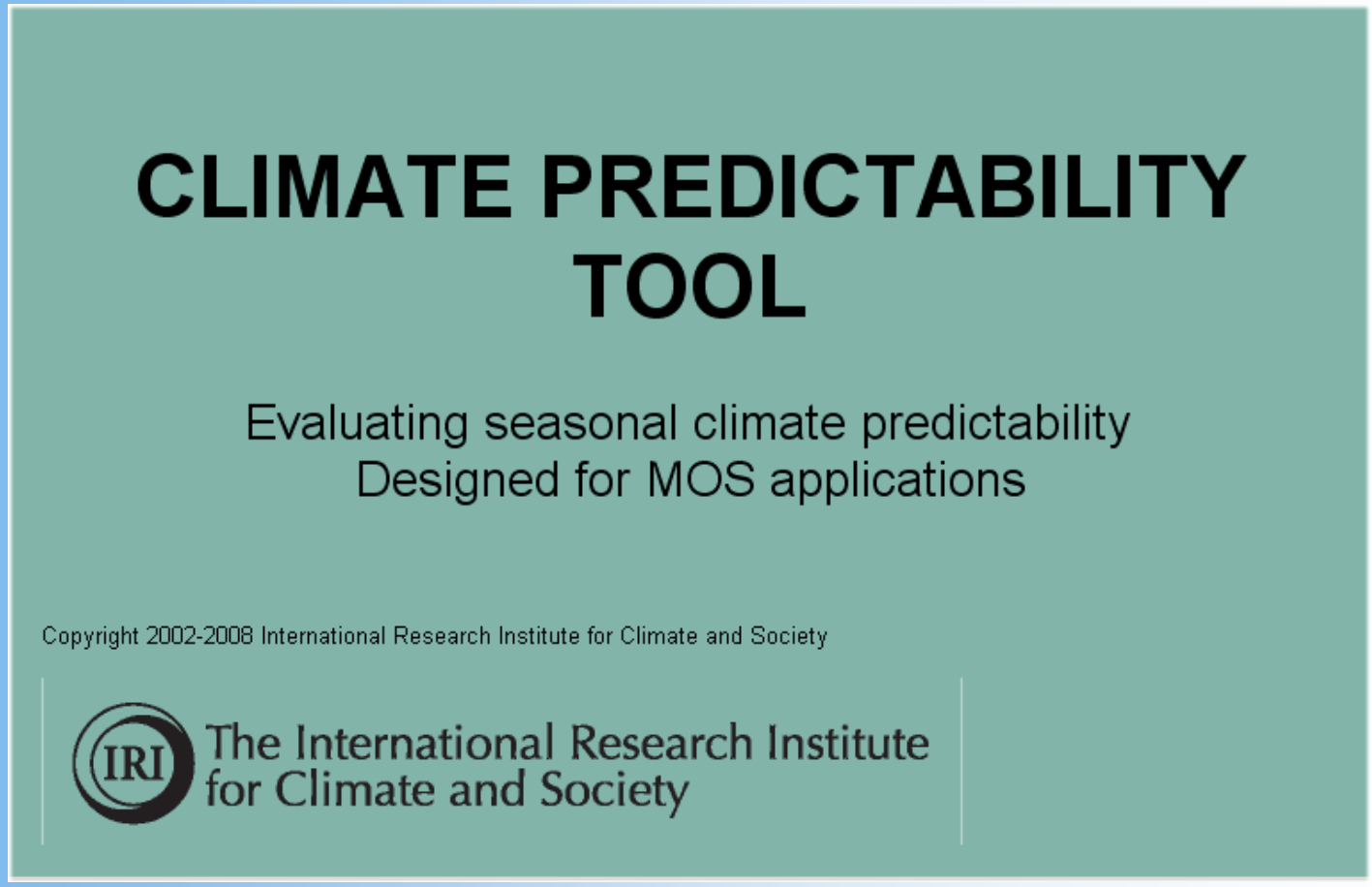
Background (why?)

- The importance of the climate model:
  To be used for decision-makers for application in hydroelectricity, agriculture, construction, etc.

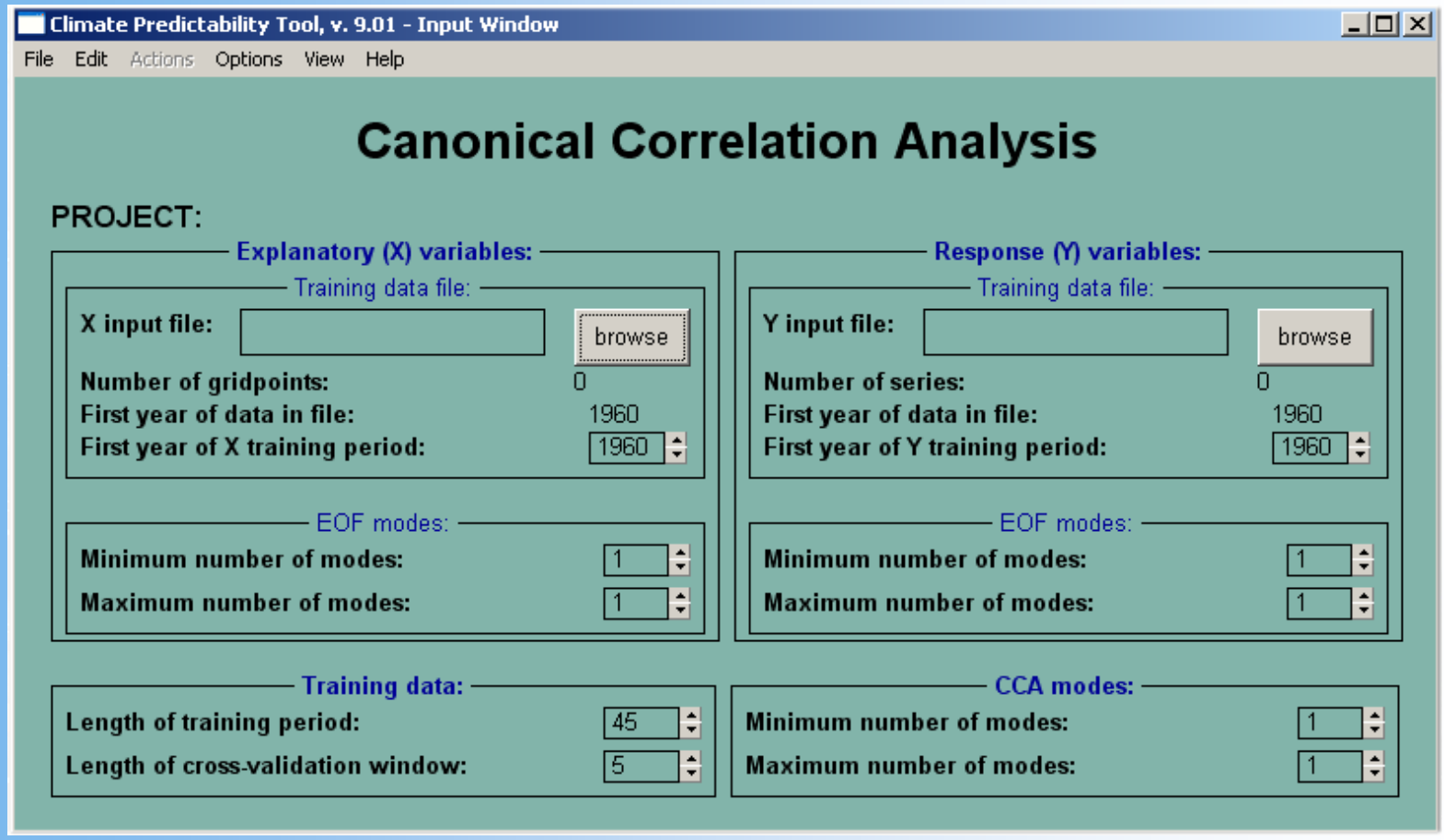
- Currently, the DMC uses the statistical model called Climate Predictability Tool for carrying out seasonal forecast (3-months period), with good results since 2006.

- However, new tools are needed to decrease the uncertainty of the seasonal forecast and to carry out areal forecast using a dynamical numerical model rather than local forecast.

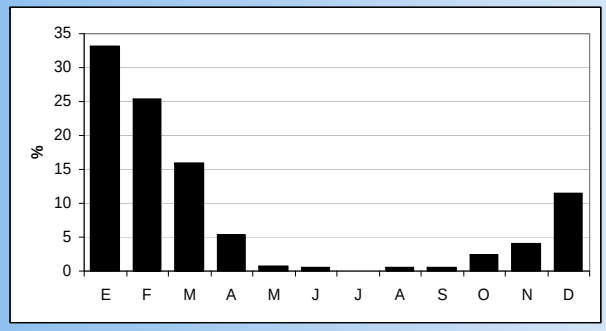
Statistical Model
Climate Predictability Tool (CPT)

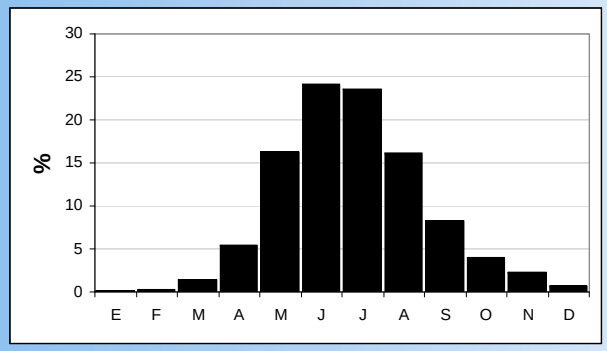


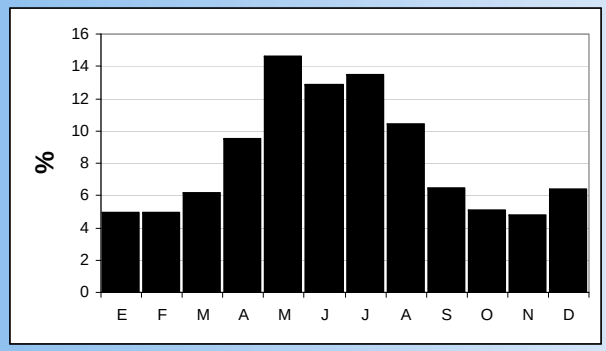
http://portal.iri.columbia.edu/portal/server.pt (ingresar a IRI Tools)

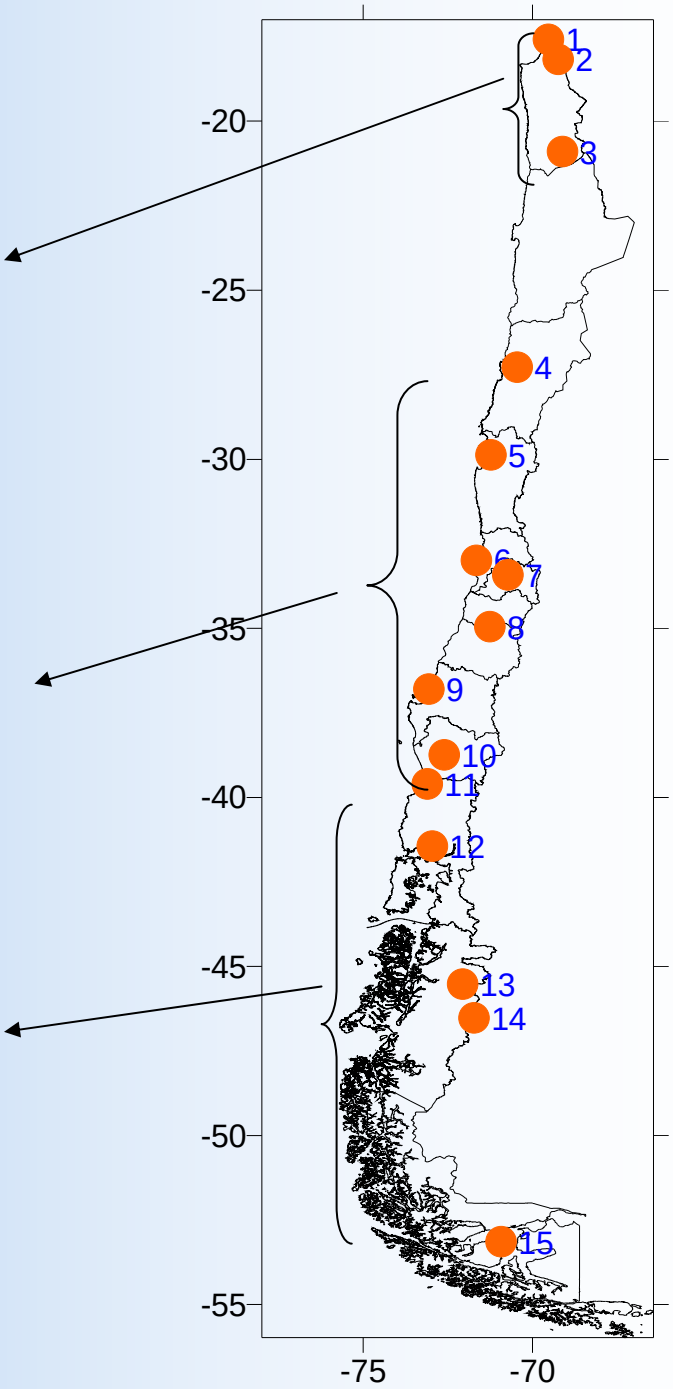

Climate Predictability Tool, v. 9.01 - Input Window
File Edit Actions Options View Help
Canonical Correlation Analysis
PROJECT:
Explanatory (X) variables:
Training data file:
X input file:
browse
Number of gridpoints: 0
First year of data in file: 1960
First year of X training period: 1960
EOF modes:
Minimum number of modes: 1
Maximum number of modes: 1
Response (Y) variables:
Training data file:
Y input file:
browse
Number of series: 0
First year of data in file: 1960
First year of Y training period: 1960
EOF modes:
Minimum number of modes: 1
Maximum number of modes: 1
Training data:
Length of training period: 45
Length of cross-validation window: 5
CCA modes:
Minimum number of modes: 1
Maximum number of modes: 1

Selected pluviometric stations







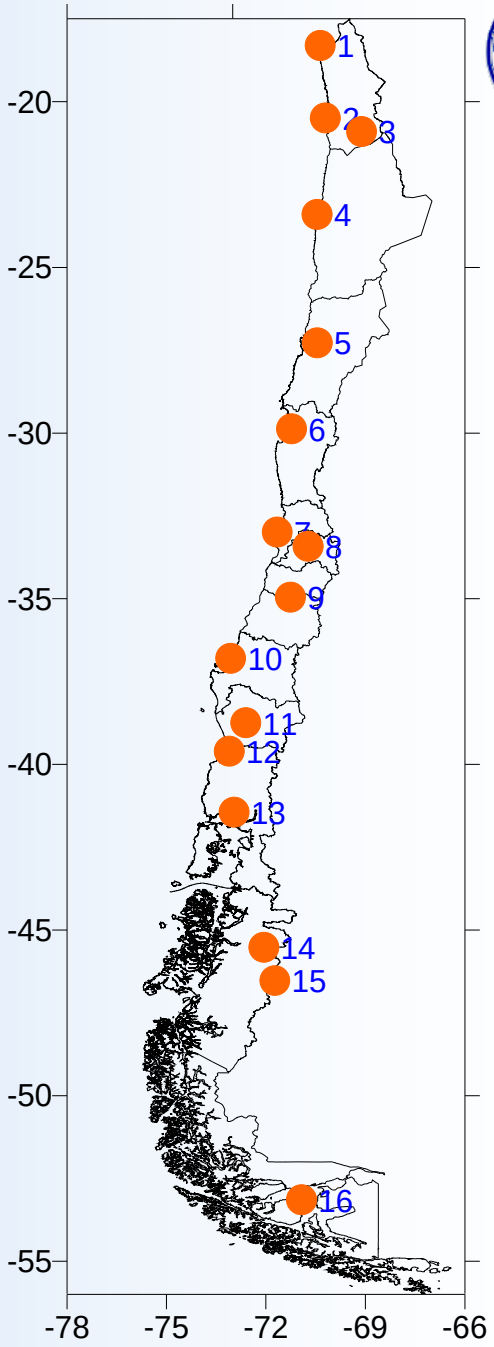


Total: 15 stations

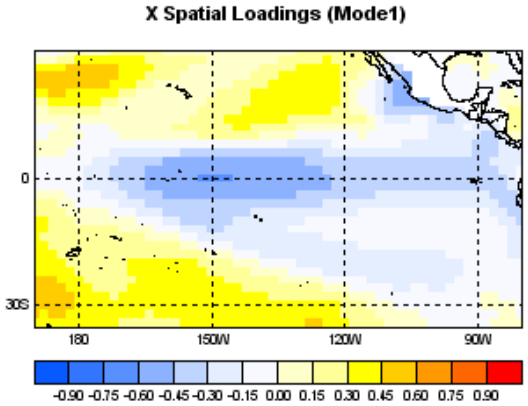
Selected stations for Tº Max and Tº Min

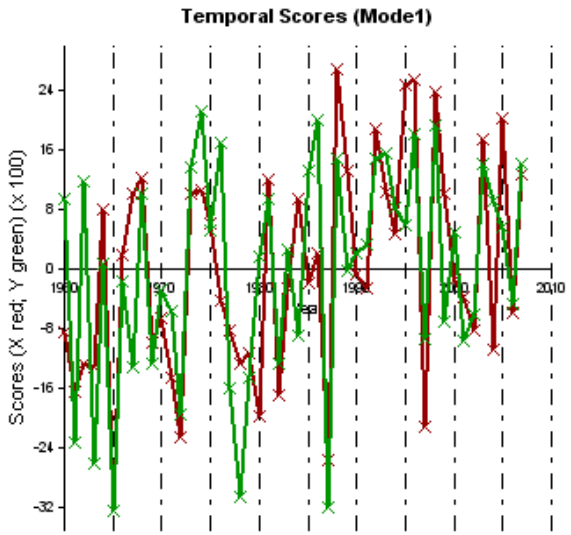
Estación	Lat.	Long.	Elev. (m)	Período
Arica (1)	-18.33	-70.33	58	1961-2004
Iquique (2)	-20.52	-70.18	52	1961-2004
Huatacondo (3)	-20.93	-69.08	2450	1970-2004
Antofagasta (4)	-23.43	-70.43	135	1961-2004
Copiapo (5)	-27.30	-70.42	291	1961-2004
La Serena (6)	-29.90	-71.20	142	1961-2004
Valparaíso (7)	-33.02	-71.63	41	1961-2004
Santiago (8)	-33.45	-70.70	520	1961-2004
Curicó (9)	-34.98	-71.23	228	1961-2004
Concepción (10)	-36.83	-73.03	12	1961-2004
Temuco (11)	-38.77	-72.58	114	1961-2004
Valdivia (12)	-39.63	-73.08	19	1961-2004
Pto. Montt (13)	-41.47	-72.93	90	1961-2004
Coyahique (14)	-45.55	-72.03	310	1961-2004
Chile Chico (15)	-46.55	-71.70	327	1965-2004
Punta Arenas (16)	-53.17	-70.90	37	1964-2004

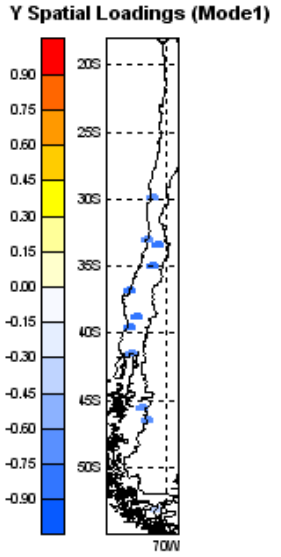
Total: 16 stations



CCA mode: 1 Canonical correlation: 0.6873







PRECIPITACIÓN
Trimestre: Jul-Ago-Sep 2008

Ciudades	Seco	Normal	Lluvioso
La Serena	10	54	36
Valparaiso	15	48	36
Santiago	14	51	35
Curicó	16	51	33
Concepción	14	51	34
Temuco	9	51	40
Valdivia	8	48	44
Pto. Montt	16	47	37
Coyhaique	16	47	37
Chile Chico	21	40	39
Pta Arenas	13	47	40

SECO
NORMAL
LLUVIOSO
INCIERTO

Pronost. Tº Máxima Jul-Ago-Sep 2008

Estación	Bajo Lo Normal	Normal	Sobre Lo Normal
Arica	52	21	27
Iquique	57	19	24
Antofagasta	52	14	34
Copiapo	39	20	41
La Serena	47	11	42
Valparaíso	37	12	51
Santiago	27	20	54
Curicó	31	19	50
Concepción	37	17	46
Temuco	27	24	49
Valdivia	30	22	48
Pto. Montt	30	18	52
Coyahique	25	17	58
Chile Chico	23	20	57
Punta Arenas	26	9	64

Cálido
Normal
Frío
Pronóstico Incierto

Background (why?)

- The importance of the climate model:
  To be used for decision-makers for application in hydroelectricity, agriculture, construction, etc.

- Currently, the DMC uses the statistical model called Climate Predictability Tool for carrying out seasonal forecast (3-months period), with good results since 2006.

- However, new tools are needed to decrease the uncertainty of the seasonal forecast and to carry out areal forecast using a dynamical numerical model rather than local forecast.

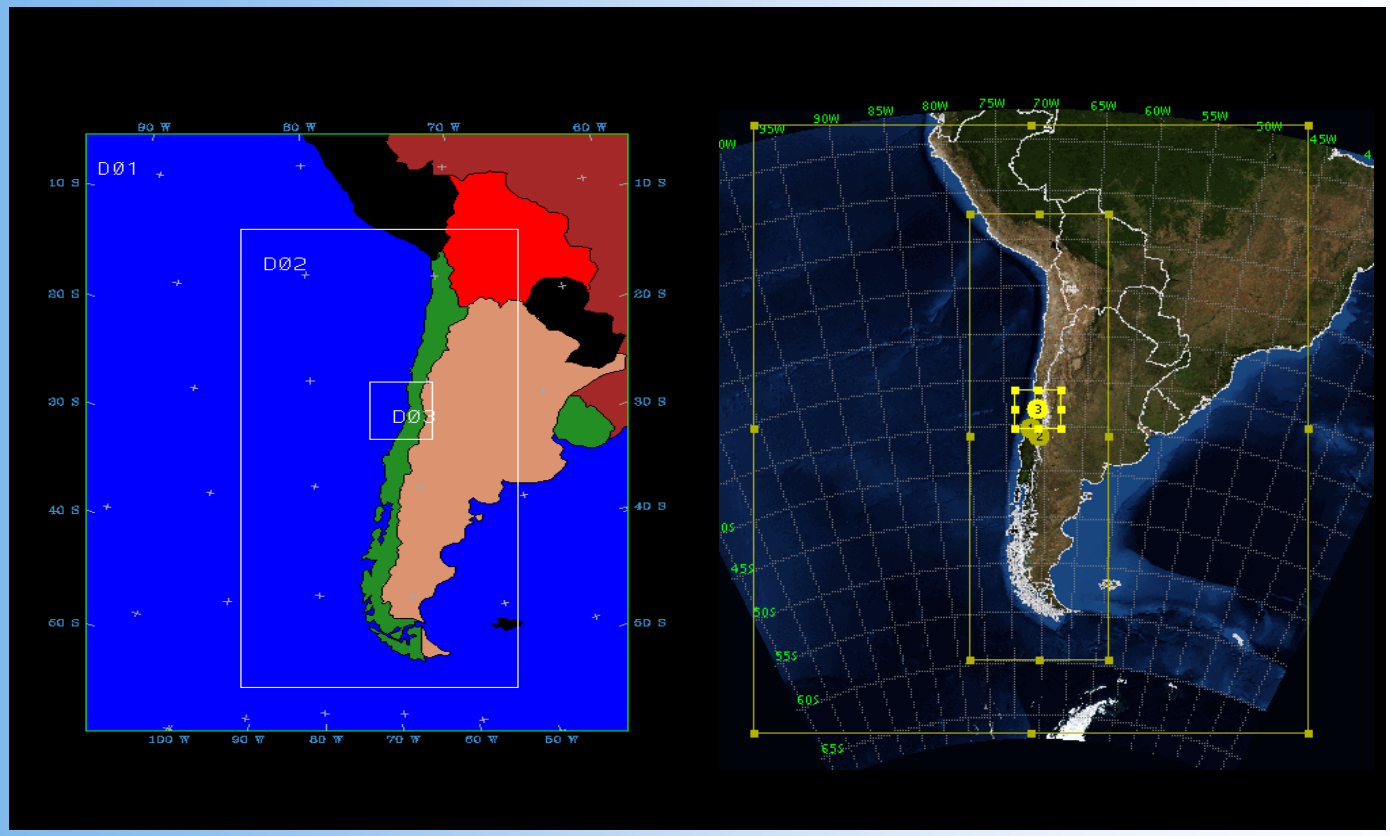
OBJETIVE:

To implement a dynamical numerical regional scale model for seasonal climate prediction, to resolve local and regional problems.

We need to choose predictors.

SST induces changes in the circulation pattern.

The interaction atmosphere-ocean



DEVELOPMENT OF THE CMM5-WRF

Phase 1: Implementation MM5-WRF: ok

Phase 2 : Validation MM5: currently

i) Compare model accumulation of monthly and 3-month precipitation with observations

ii) Compare mean maximum and minimum temperature.

iii) Compare simulated 1971-200 climate means forced by NCEP/NCAR Reanalysis with actual climate.

Phase 3: Carry out 3-month seasonal forecast every month.

Characteristic of the workstation

Componente	Descripcion
Procesador	Doble nucleo 2.33 GHz (Dell Precision 690)
Motherboard	Workstation advanced Borrad
Memoria	4 Gb 667 MHz, 2 DIMM
Disco Duro	250 Gb SATA 3.0 Gb/s, 7200 RPM 8 MB DataBurst Cache
Floppy Drive	1.44 MB 3.5 inch
Tarjeta grafica	nVidia, Quadro FX 4600, 798 MB dual VGA/DVI
Flat Panel	Dell UltraSharp 2208FP, 22inch

Software	Descripcion
Sistema Operativo	Linux Scientific
Sistema Operativo 2	Microsoft Windows XP Professional

* Near future only linux

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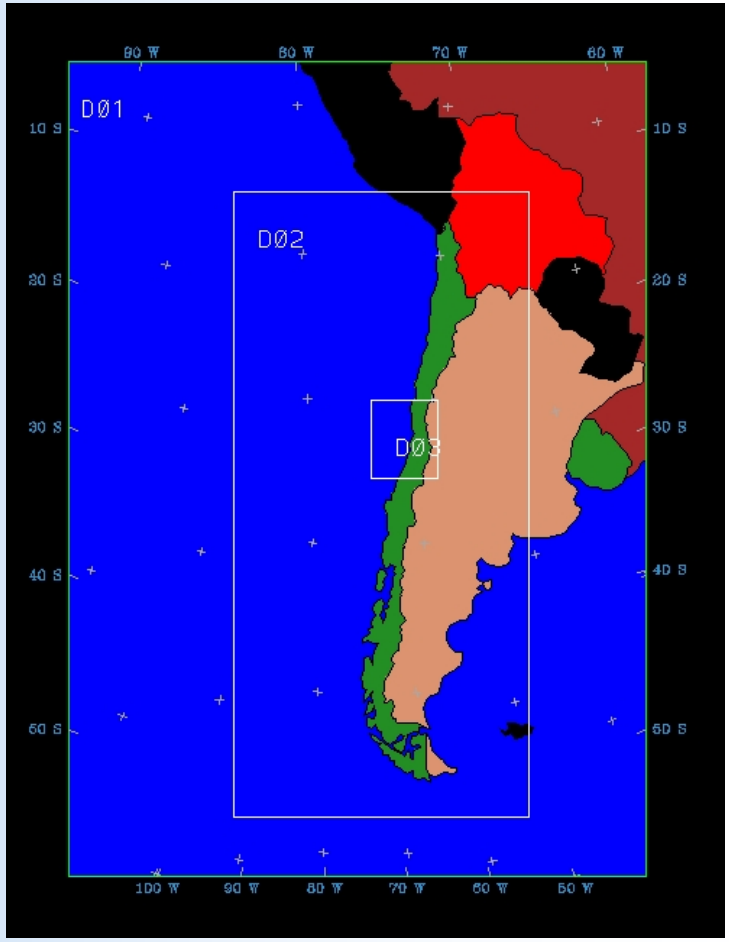
Experiment

2. DOMAINS

Domain 1: res 90 km, boundary condition for the I downscaling, allows visualize circulation patterns

Domain 2: res 30 km, oriented to support climate dynamic forecast

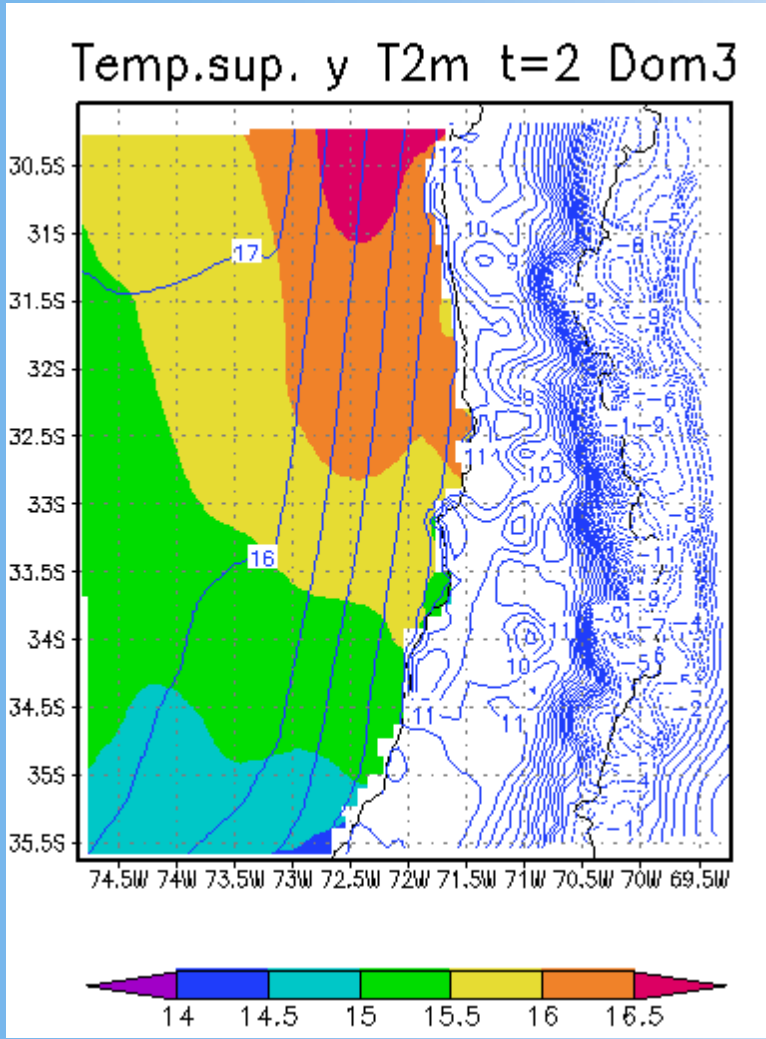
Domain 3: res 15 km pilot area of the project for agriculture purposes



Some results

TEMPERATURES

Temperatures fallow the torographic with a higher resolution.

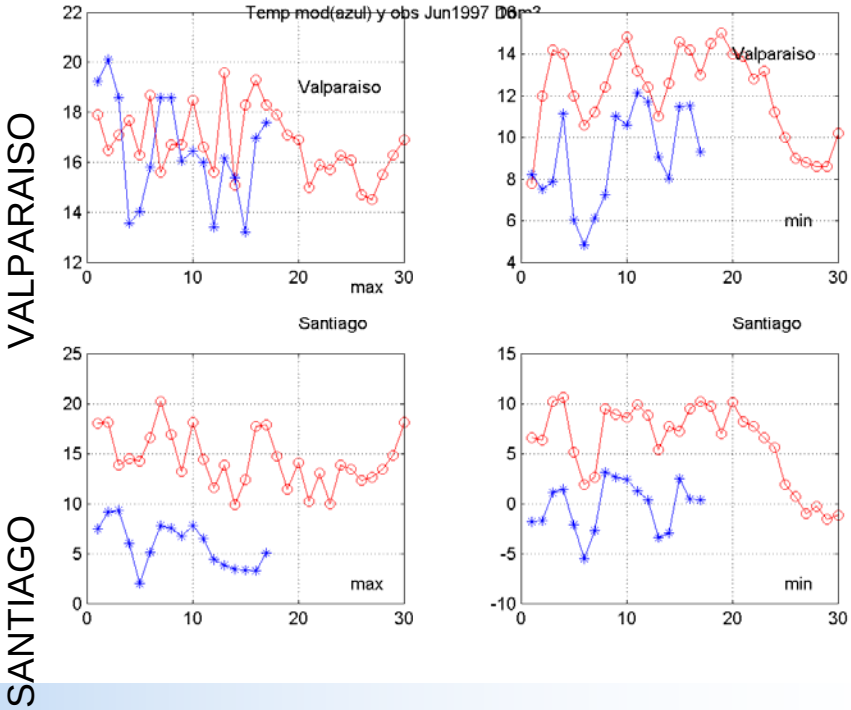


- In general the model simulated the variability of the temperature (min).
- But, it under estimates the temperatures by 2 ºC (need correction by altitude?)

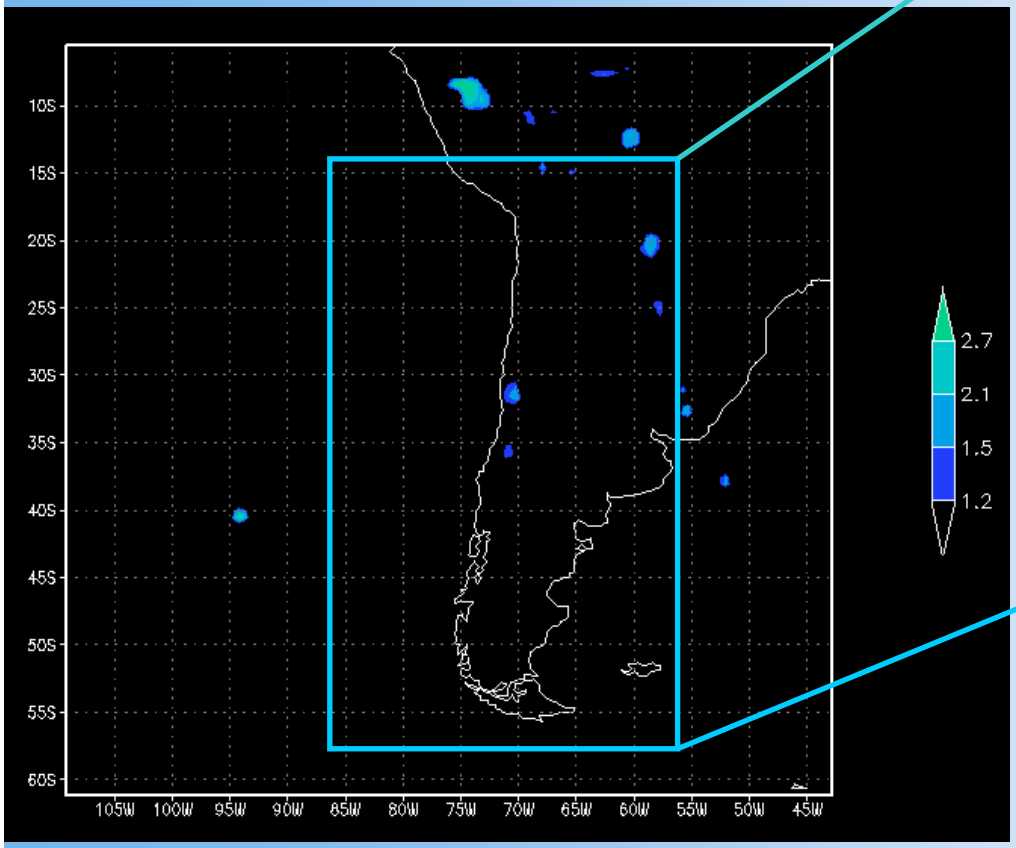
T ºMAX T ºMIN

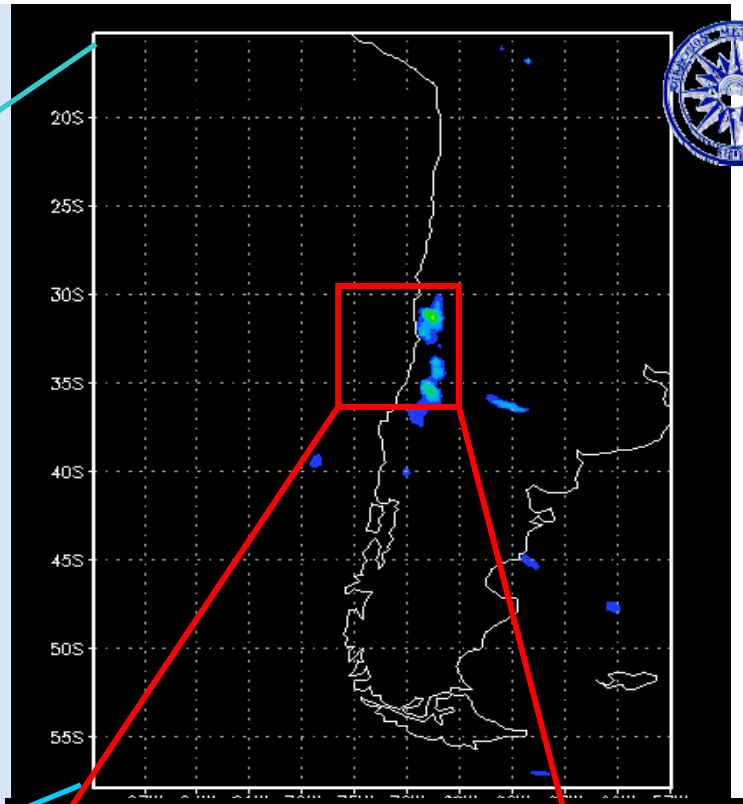
VALPARAISO

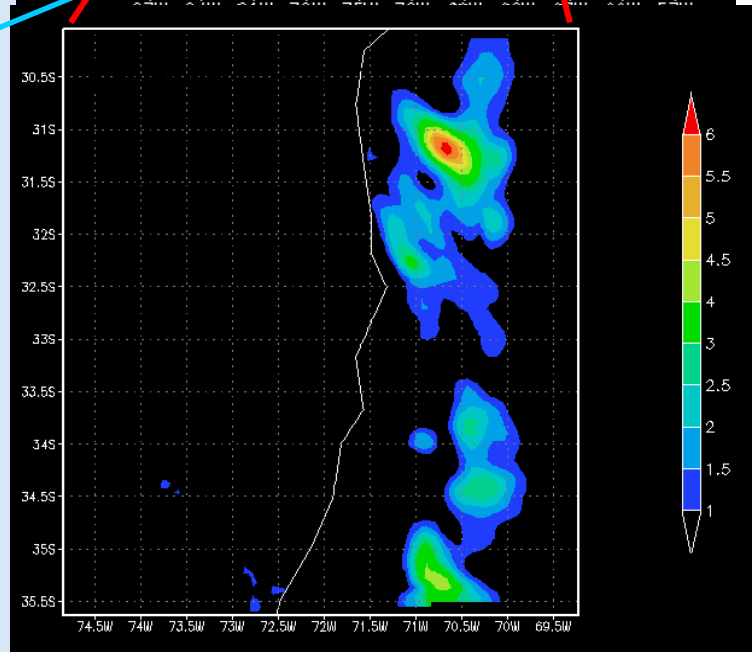
SANTIAGO



Outputs



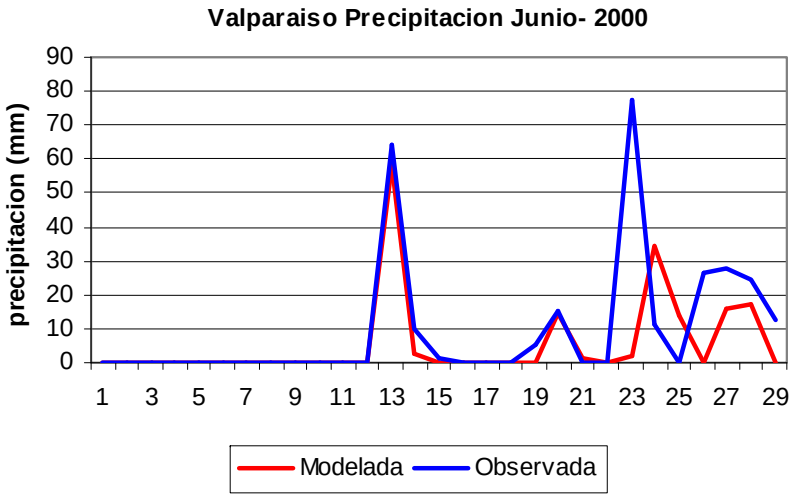


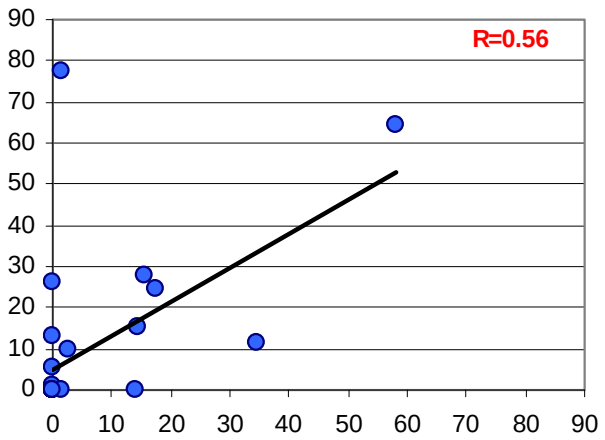


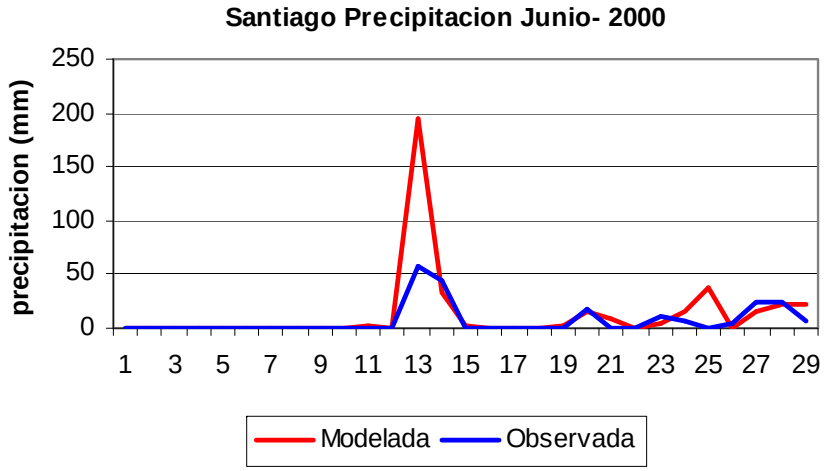
14 June 2000

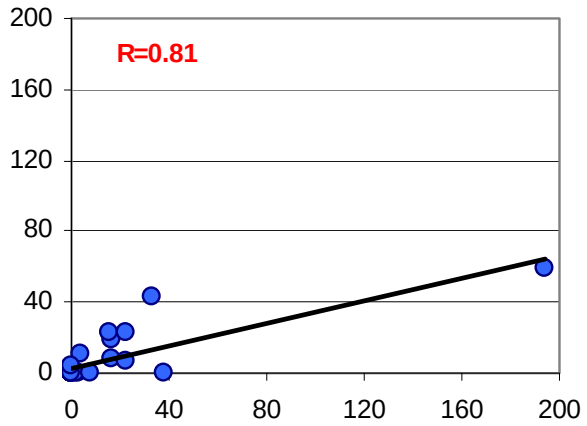
MM5-DMC

Domain 3: June 2000









Conclusions

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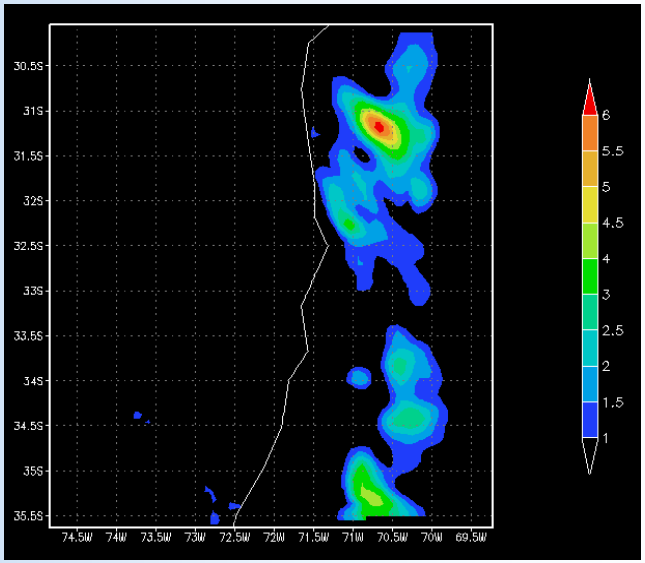

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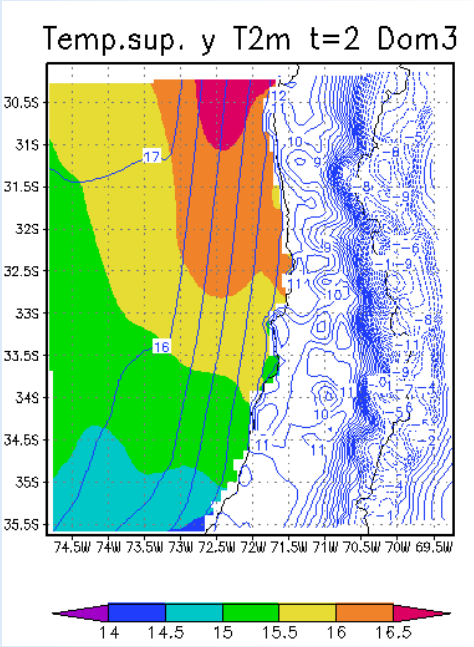


Conclusions

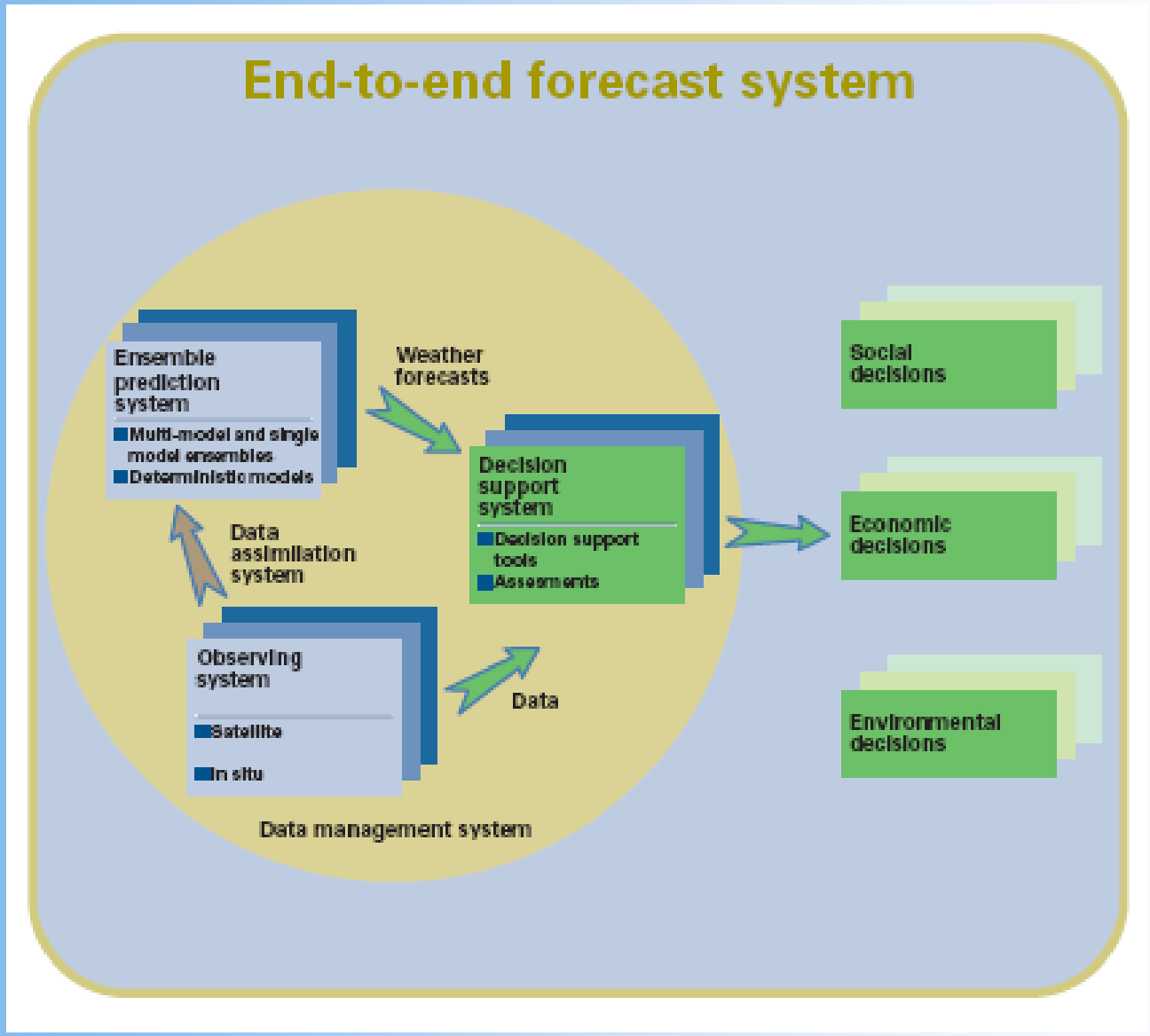
Preliminary results suggest that the model is able to reproduced precipitation events and the behavior of the temperature, although some correction are needed

Need to validate the monthly and 3-month precipitation accumulation as well as its performance for seasonal prediction

The CPT statistical model has been very good since it started and it will be still used in the future along with the dynamical model

The regional model will allow new application in the mesoscale (local) level.

With this implemantation we want to fallow the THORPEX scheme, in the sense of:



Gracias