Convection and high impact weather studies by aircraft measurements and operation of the KITCube in the "CORSICA" observatory

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PANDOWAE

NEPTUN
Cyclogenesis in the Western Mediterranean causing High-Impact Weather (HIW)

HALO
High Altitude and Long Range Research Aircraft

KIT-CUBE

T-NAWDEX:
North Atlantic Waveguide and Downstream Impact Experiment

THORPEX
A World Weather Research Programme

HALO-THORPEX

Helmholtz Dead Sea Project

Deutsche Forschungsgemeinschaft
DFG

Focus: The dynamics and predictability of Mediterranean cyclones leading to high impact weather (HIW)

Observations:

Contribution to HyMeX SOP/LOP

WG1, 2, 4

→ HALO- NEPTUN

→ KIT-CUBE

→ CORSICA observatory

Modelling:

Short-term prediction

→ PANDOWAE German contrib to THORPEX

Aerosol-precipitation modelling

Regional climate modelling/ Budget diagnostics

→ New German/Ital. initiative: COSMO-NEMO coupling

Goals (in cooperation with many HyMeX-partners)

Dynamics and predictability of Mediterranean cyclones. Focus on influence of

- **upper-level forcing**
- **moist processes**
- **surface fluxes and orography**

on the development of high impact weather.

Influence of convection of different scales on HIW generation

- **small-scale boundary layer turbulence**
- **development of cumulonimbus**
- **their organisation into mesoscale systems**
- **impact on the synoptic scale flow**

Priorities

- **model investigations and data analyses of previous HIW in the Mediterranean**
- **preparation of theHALO demo-mission NEPTUN in 2010/11.**
- **NEPTUN data will be utilised to study the predictability of Mediterranean cyclones with new modelling techniques from phase 1,**
- **develop adaptive observing and forecasting strategies for the Mediterranean**
- **HyMeX participation in 2012.**

Hemispheric/synoptic scale: the links

HyMeX

THORPEX
A World Weather Research Programme

T-NAWDEX:
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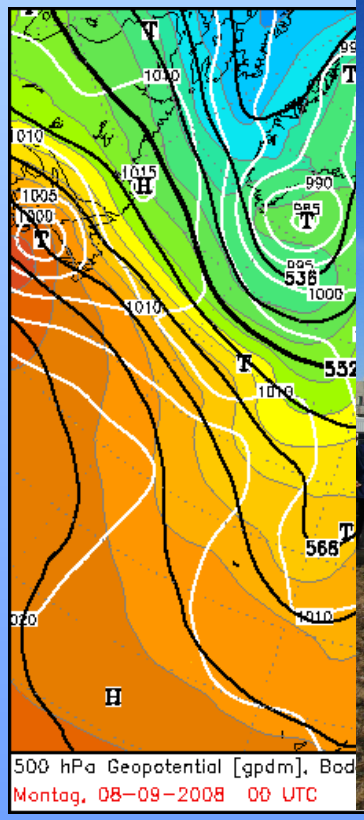


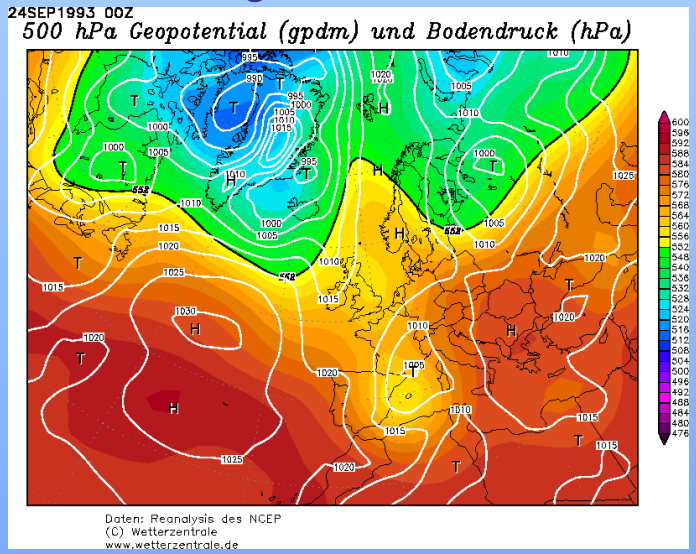
HALO arriving at DLR Oberpfaffenhofen, 2009

Synoptic scale/ Flight plans

Proposed flight pattern for HALO
Previous day: T-NAWDEX mission

HALO

- Turbulence probing system at nose boom (DLR)
- Multi-Sensor dropsonde system (KIT)
- 2µm scanning wind LIDAR (DLR)
- Water vapour DIAL (DLR)
- Scanning rotational Raman LIDAR (U Hohenheim ?)



Brig Flash Flood cyclone, Sept. 23/24, 1993. Surface pressure (white) and height of the 500 hPa topography (colour code)

DO 128

- Turbulence probing system at nose
- Radiation fluxes: up, down, SW, LW
- IR thermometer
- Gas phase chemistry
- Dropsondes

HALO
2010/11 probable
partly funded
2012 claimed

Do128
2010/11 very probable
2012 probable, partly funded

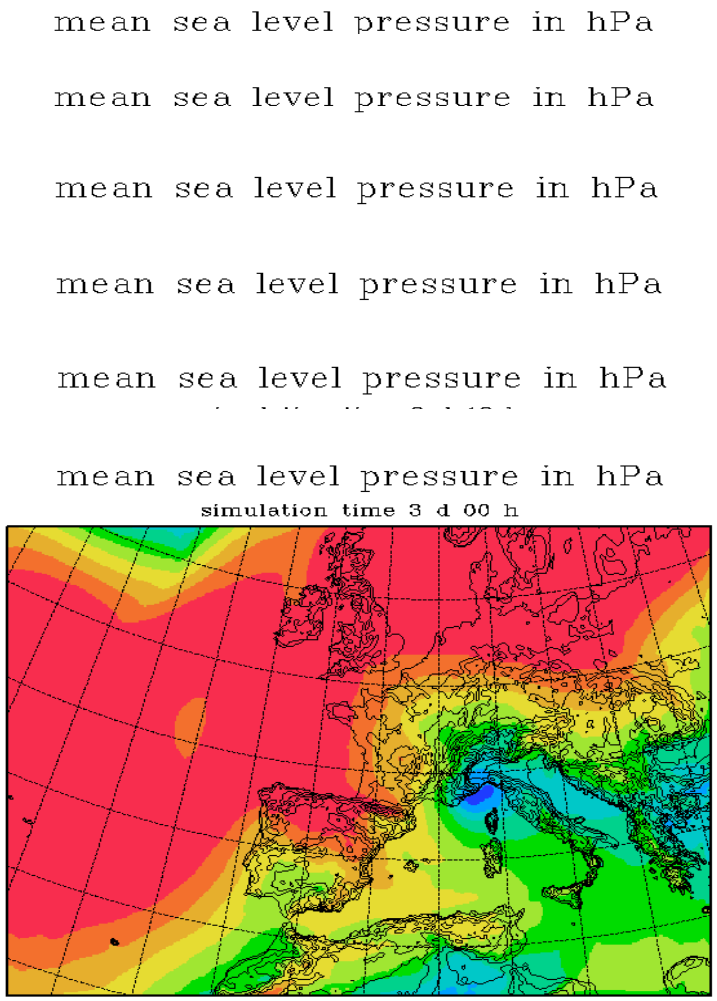
COSMO

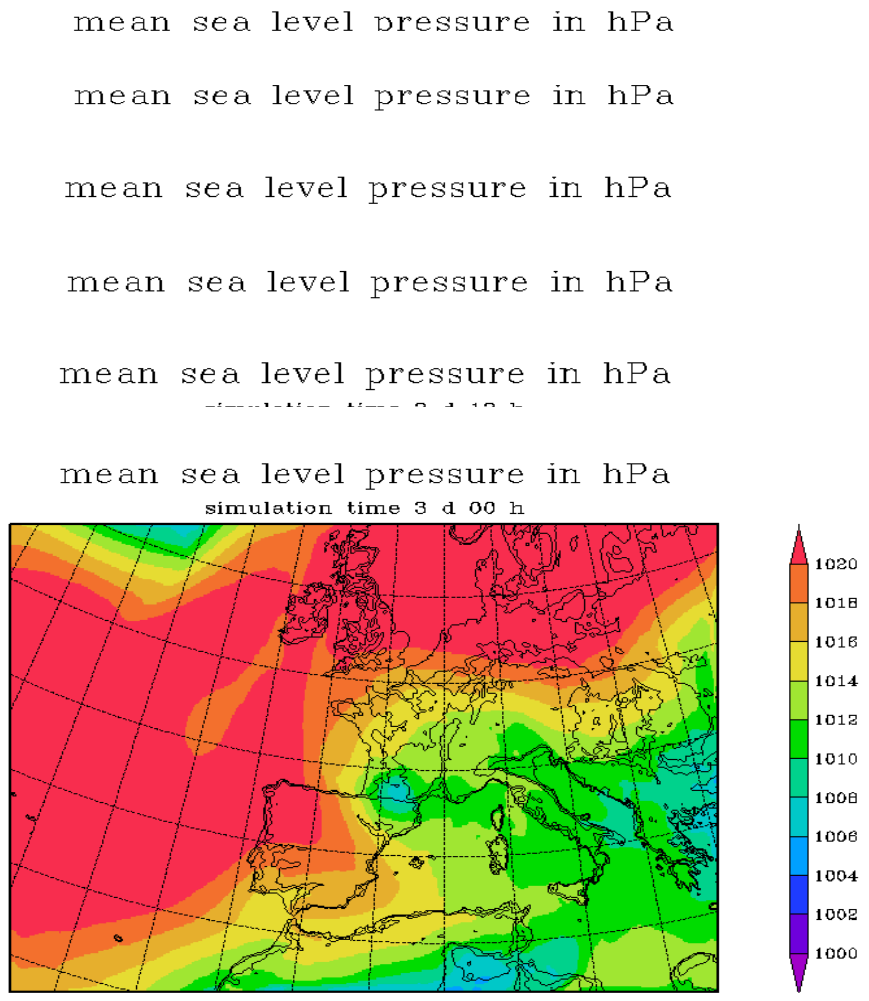
Non-hydrostatic, compressible, numerical limited-area model developed by the COSMO community (http://www.cosmo-model.org)

COSMO-EU, COSMO-DE (DWD)	**LAM weather forecast**
COSMO-CLM (COSMO consortium)	**LAM regional climate**
COSMO-ART (KIT, B.+H. Vogel)	**aerosols/trace gases**

- prognostic variables: wind vector, pressure, temperature, specific humidity, cloud water & cloud ice content (optionally rain water, snow, graupel content)
- time-independent, hydrostatic, resting, horizontally homogeneous basic state
- rotated horizontal coordinates, terrain-following coordinates in vertical directionwith user-defined grid stretching
- grid structure: Arakawa-C/Lorenz grid
- time integration: 3 time-level, time-splitting Leapfrog scheme (optional 2 time-level time-splitting Runge-Kutta scheme or 3-d semi-implicit integration)
- parameterizations:
  - radiation: 2-stream method (Ritter & Geleyn, 1992)
  - large scale precipitation: bulk formulation (Kessler type)
  - moist convection (Tiedtke, 1989; optional Kain-Fritsch, 1992)
  - partial cloud cover in grid cell
  - subgrid scale turbulence (prognostic TKE, closure Mellor-Yamada level 2.5)
  - soil model (multi-layer model, optional force-restore method)

An orographic truncation experiment

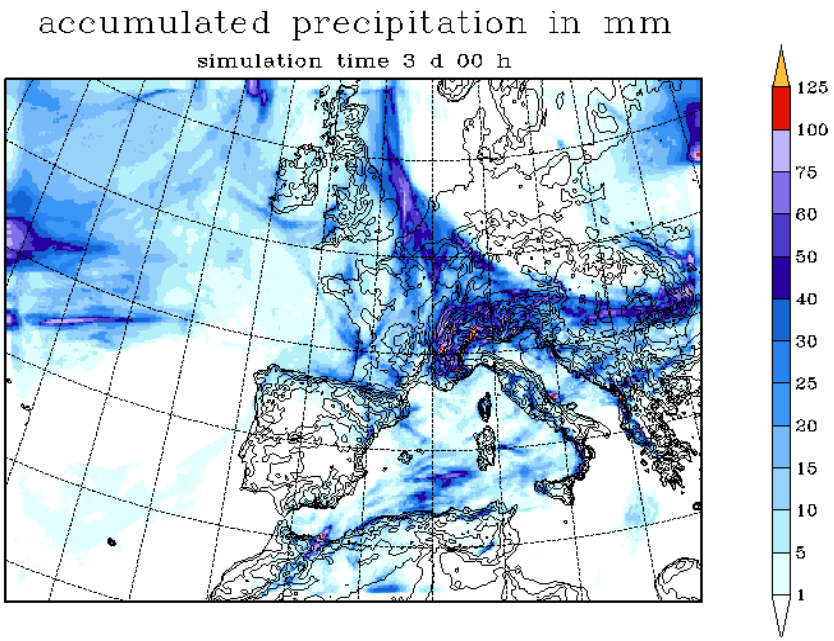


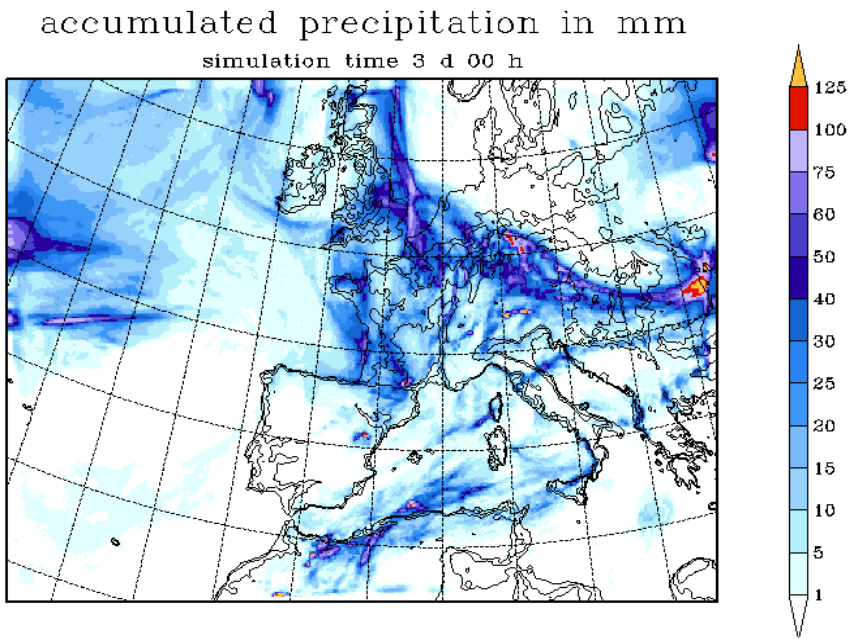


reference run with „real“ model orography

run with „eroded“ orography

Synoptic scale/ COSMO modelling





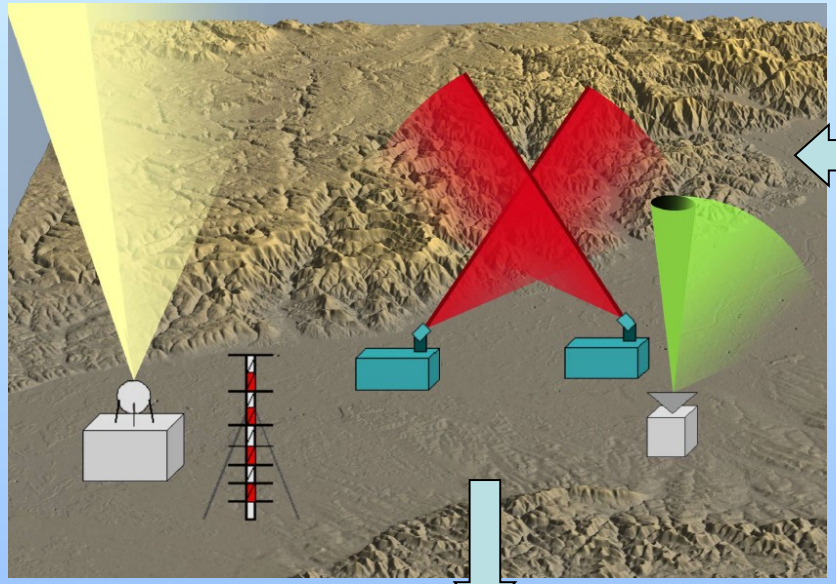
reference run with „real“ model orography **run with „eroded“ orography**

Maybe a rather useless experiment …

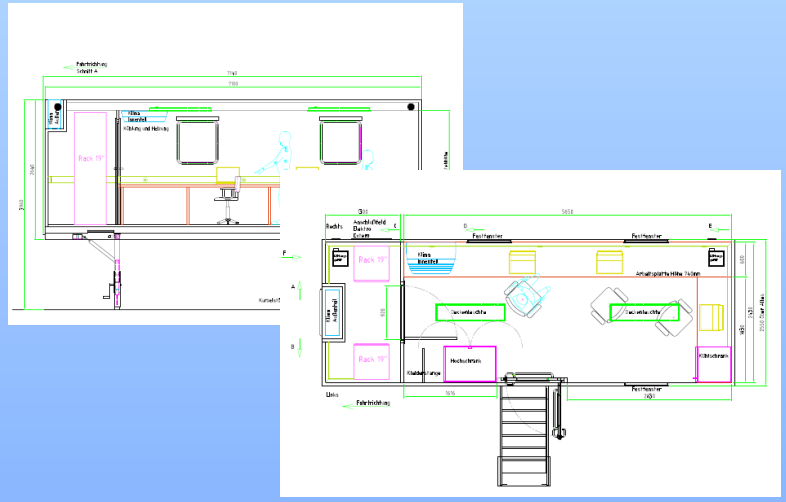
….but nevertheless instructive about orographic effects on cyclogenesis

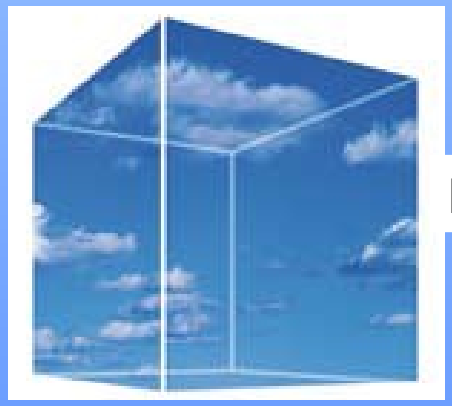
… will be expanded to study various process interactions leading to HIW

Meso scale/local scale/ KITCube

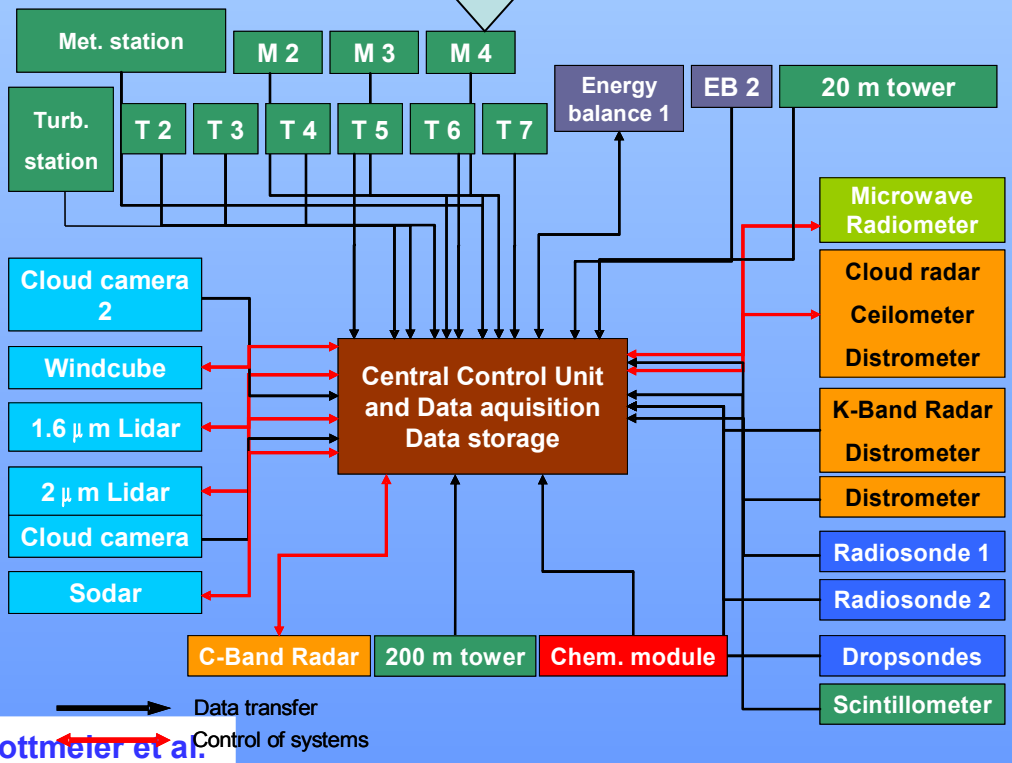


- Numerous measurement systems?
- Mostly mobile?
- Lack of personell?
- Synchronisation, coordinated scans, safe data acquisition, high flexibility needed?





KIT-CUBE



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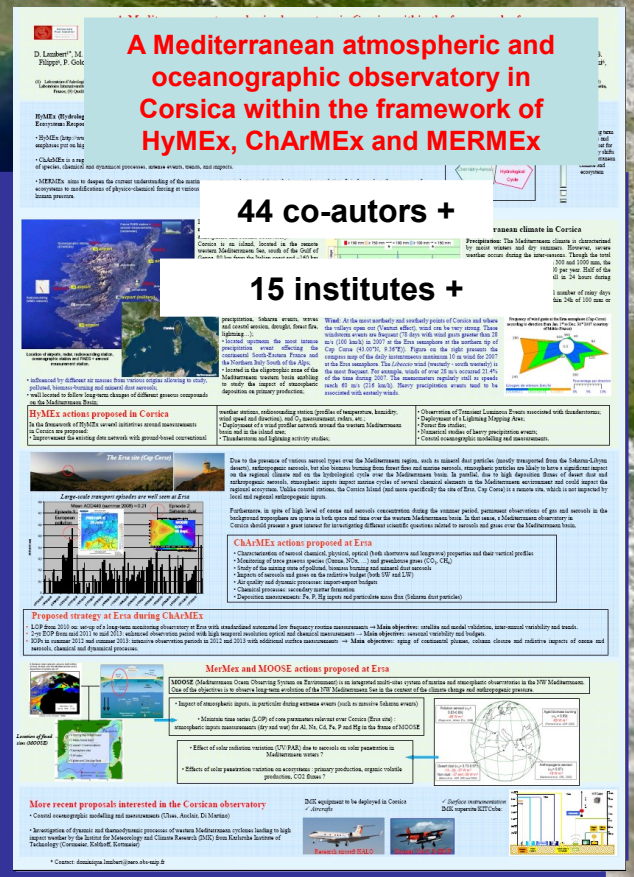
Meso scale/local scale/ CORSiCA

Corsica: located ~80 km from the Italian coast and ~160 km from the French Riviera, maximum altitude 2710m :

- **South of the Genoa Gulf (most cyclogenetic area in western Mediterranean)**
- **Regularly affected by intense meteorological events: windstorms, heavy precipitation, Saharan dust events, waves and coastal erosion, drought, forest fires, lightning…**

- **Located upstream of the most intense precipitation event affecting the continental South-Eastern France and the Northern Italy South of the Alps;**
- **Located in the oligotrophic zone of the Mediterranean western basin enabling to study the impact of atmospheric deposition on primary production;**
- **Influenced by different air masses from various origins allowing us to study polluted, biomass-burning and mineral dust aerosols;**
- **Well located to follow long-term changes of different**



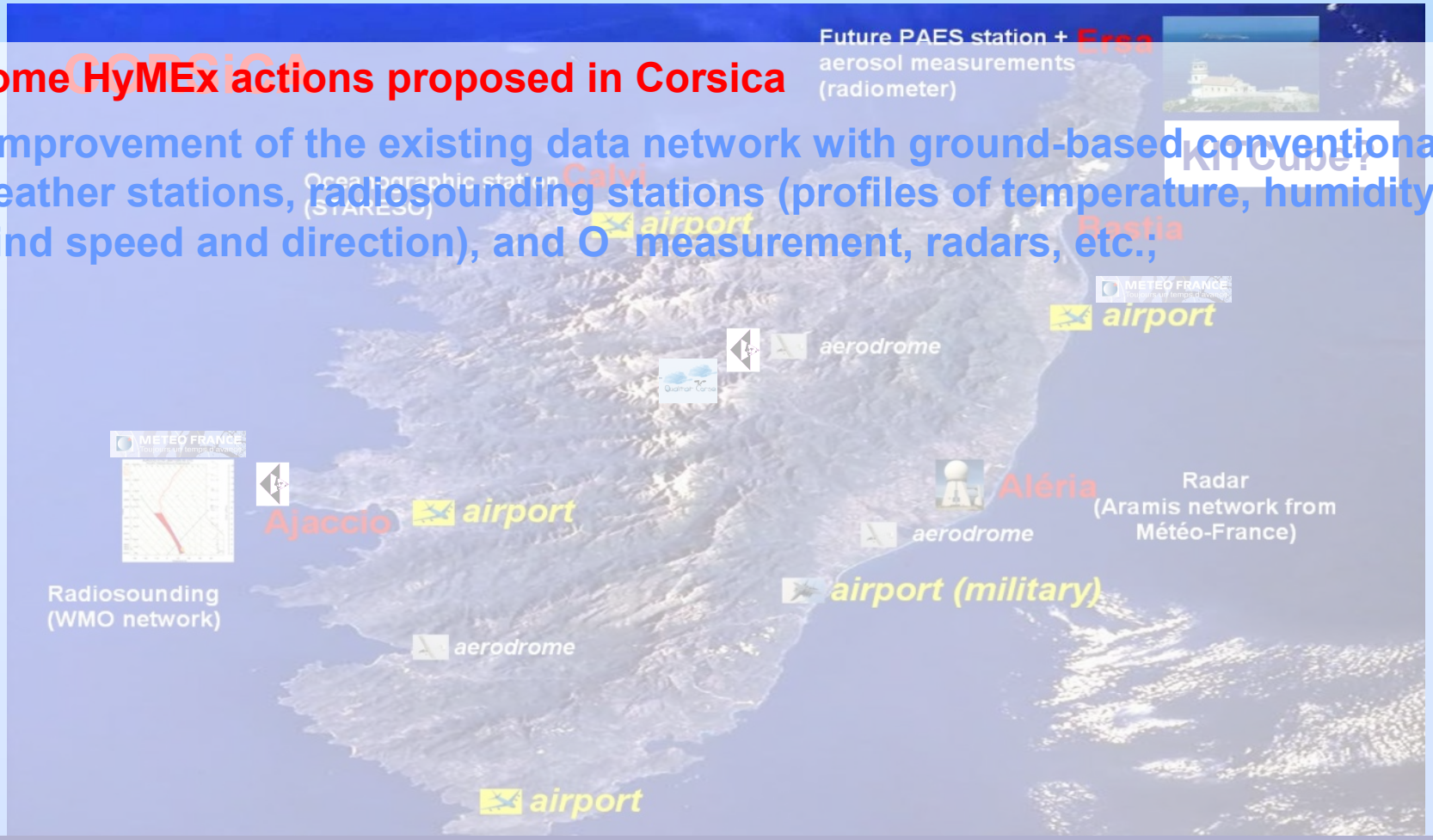
It is proposed to combine measurements from HyMEx, ChArMEx and MERMEx programs in an atmospheric and oceanographic observatory in Corsica

Atmospheric and oceanographic observatory in Corsica :

Corsican **O**bservatory for **R**esearch and **S**tud**i**es **C**oncerning the **A**tmosphere and the ocean

Some HyMEx actions proposed in Corsica

- Improvement of the existing data network with ground-based conventional weather stations, radiosounding stations (profiles of temperature, humidity, wind speed and direction), and O_3 measurement, radars, etc.;

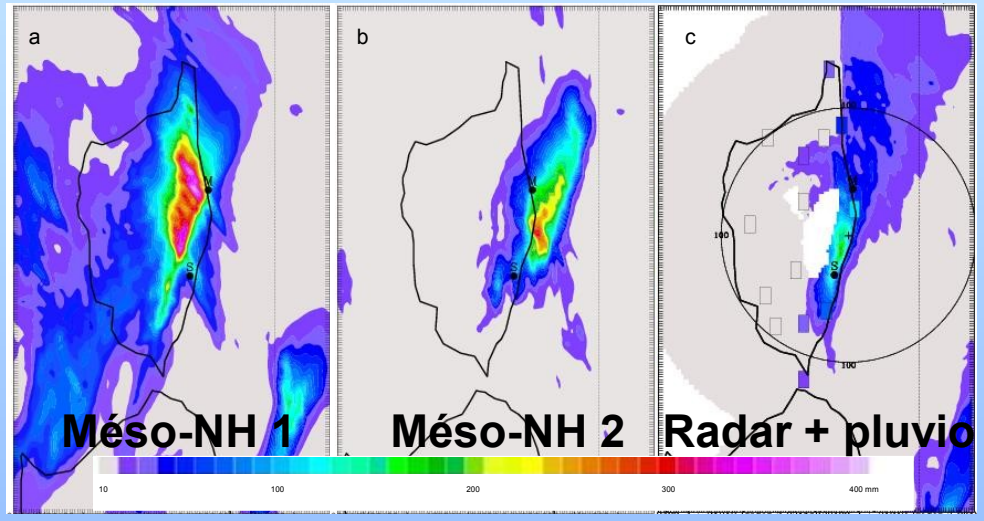


Contact: D. Lambert (Laboratoire d'Aérologie, Toulouse)

Email: dominique.lambert@aero.obs-mip.fr - Web site: http://www.aero.obs-mip.fr/spip.php?article658

Preliminary study of an intense rainfall episode in Corsica, 14th September 2006 (Lambert and Argence, 2008)

Accumulated precipitation (mm) from 14th Sept. 06UTC to 12UTC from Meso-NH simulations (a, b) & (c) for radar (Météo France / DSO / CMR) and rain-gauge data (small squares).



(a,b) are for the simulation coupled and initialised with ECMWF and ARPEGE analyses, respectively.

2 different analysis sets used in the same configuration can lead to very different simulations of precipitation

How to improve precipitation forecasts?

Some ideas:

- Need to analyses improvement → reinforcement of the observing data network in area with little instrumentation like islands
- Measurements in Corsica → improvement of data sets used to validate numerical simulations → resolution, initial conditions, parametrization, size of the domains, validation of precipitation and stratospheric intrusions → model-to-satellite approach

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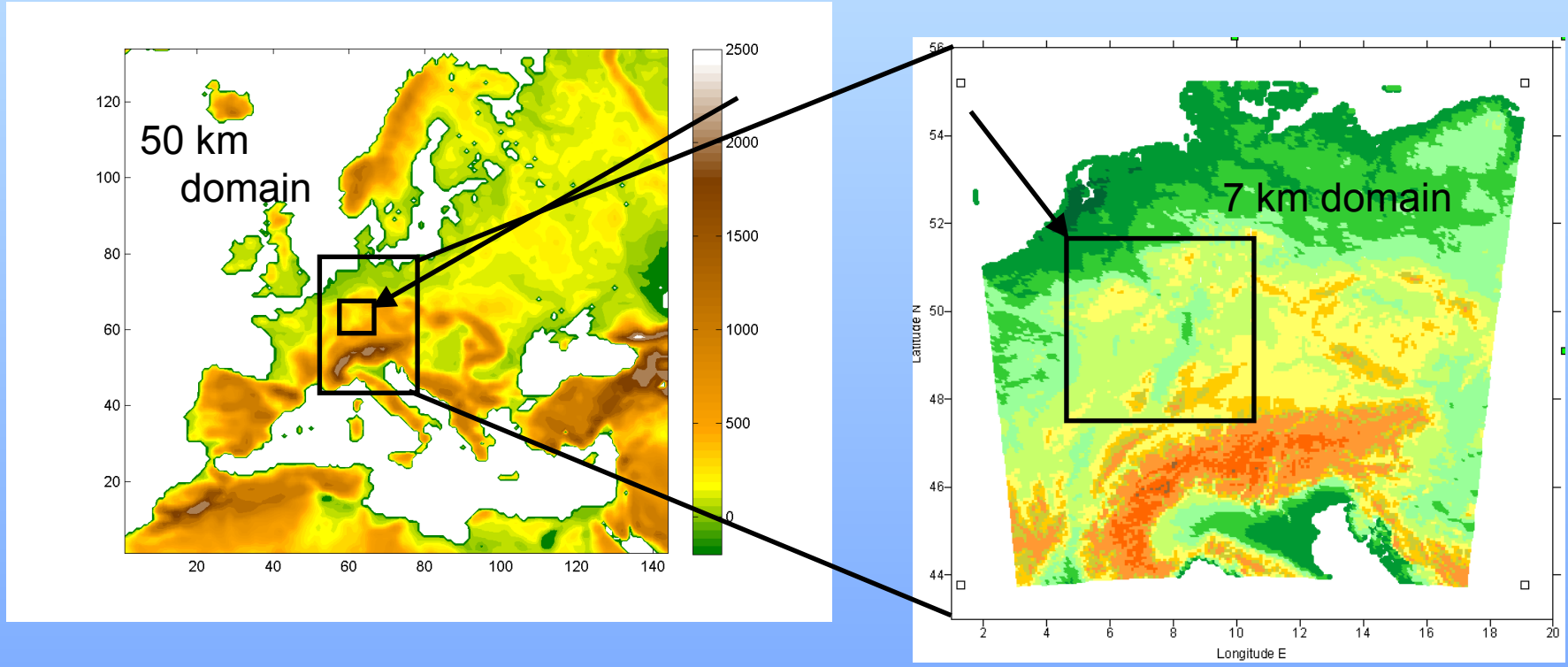
Regional climate modelling, with a focus on cyclones/extremes

Potential Contributions of KIT (IMK-TRO) to HyMeX

- Reanalyses of the recent past (ca. 1971-2000) with COSMO-CLM at resolutions of about 7 km
- Climate change signal between present (1971-2000) vs. near future (2011-2040 or 2021-2050)
- Ensemble simulations (different GCMs and realisations) and statistical analysis
- Water balances, extremes
- Assessment of added value of high resolution, coupled simulations (COSMO-CLM – OASIS – NEMO)
- Scenarios in agreement with the new IPCC-AR5 framework (CORDEX)

7 km COSMO-CLM Simulations at KIT

- double nesting
- driving data:: ERA, ECHAM5_20C, ECHAM5_A1B (2 realisations each), HadCM3



Current analysis domain

- 50 km resolution for Mediterranean different forcing available
- 7 km resolution for e.g.- Western Mediterranean feasible
- Considerable efforts needed for validation and statistical analysis!

7 km COSMO-CLM Simulations at KIT

on NEC SX8/SX9 HLRS Stuttgart, SCC Karlsruhe

Global Data	Period	Wall-Clock Time (d)	No of CPUs
ERA40	1968-2001	9.5	16
		31	16
ECHAM5_20C3M all, Realization 1	1968-2000	9	16
		20	24
ECHAM5_20C3M all, Realization 3	1968-2000	9	16
		20	24
ECHAM5_A1B Realization 1	2007-2041	9	16
		20	24
ECHAM5_A1B Realization 3	2007-2041	9	16
		20	24

Thanks for your attention