The COMET Operational NWP system

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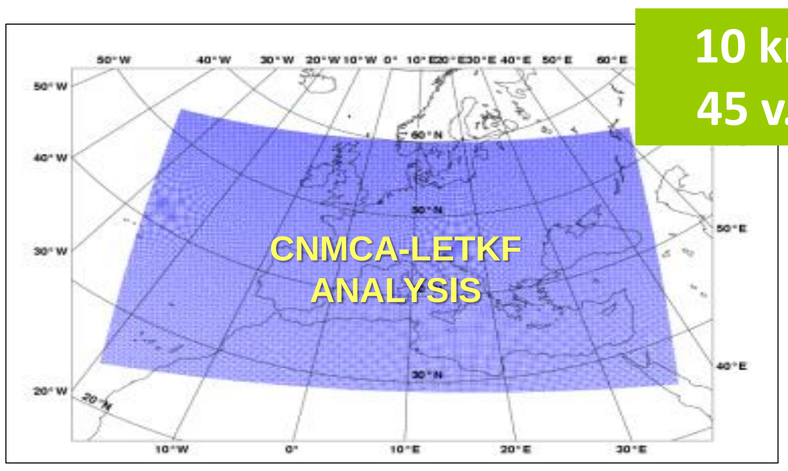
Ensemble Data Assimilation

CNMCA – LETKF (*Bonavita, Torrisi and Marcucci, Q.J.R.M.S.,2008,2010)*

- ***OPERATIONAL SINCE 1 JUNE 2011*** *CNMCA/COMET is the first meteorological centre which uses operationally a pure EnKF DA to initialize a deterministic NWP model*
- ***LETKF Formulation*** *(Hunt et al,2007)*



- 6-hourly assimilation cycle
- 40 ensemble members + deterministic run with 0.09° (~10Km) grid spacing (COSMO model), 45 hybrid z-sigma vertical levels (top at ~27km)
- (T,u,v,pseudoRH,ps) set of control variables
- Observations: using RAOB (also 4D), PILOT, SYNOP, SHIP, BUOY, Wind Profilers, AMDAR-ACAR-AIREP, MSG3-MET7 AMV, MetopA-B scatt. winds, NOAA/MetopA-B AMSUA/MHS and NPP ATMS radiances + LandSAF snowmask.
- "Relaxation-to-Prior Spread" Multiplicative Inflaction according to Whitaker et al (2010)

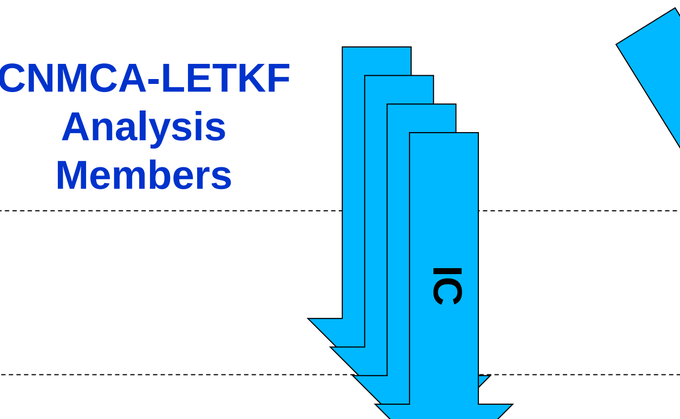
an. pert. $\mathbf{x}'_a = \mathbf{x}'_a \sqrt{\alpha \frac{\sigma_b^2 - \sigma_a^2}{\sigma_a^2} + 1}$ α = 0.95, σ^2 = variance

- Additive noise from EPS
- Lateral Boundary Condition from deterministic IFS perturbed with ECMWF-EPS
- Climatological Perturbed SST
- Adaptive selection radius using a fixed number of effective observations (sum of obs weights)

CNMCA-LETKF Analysis Members

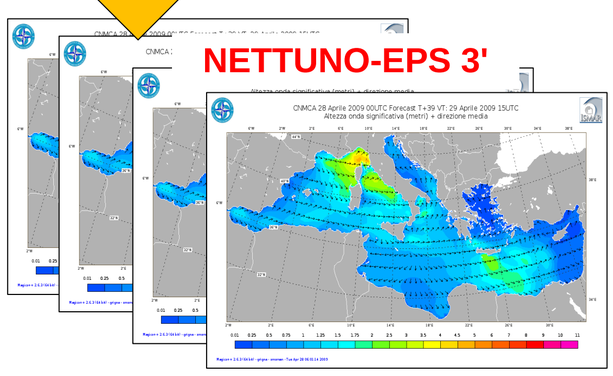
DeterministicAnalysis
computed using the standard LETKF-Kalman gain and the deterministic short-range forecast

Ensemble Prediction System



-Stochastic Perturbed Physics Tendency (SPPT)
- 40+1 members
integrated up to 72h

atm forcing



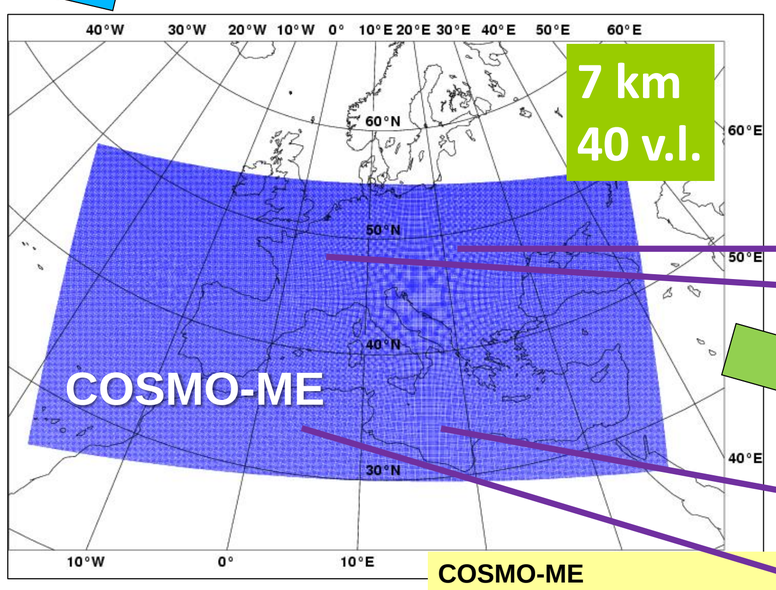
The sea state probabilistic forecast is obtained driving the **WAM** wave model using the hourly **COSMO-ME EPS** wind forecast members

The **NETTUNO-EPS** consists of 40+1 members, that are integrated at 00 UTC up to 48 hour forecast in the Mediterranean basin

IC

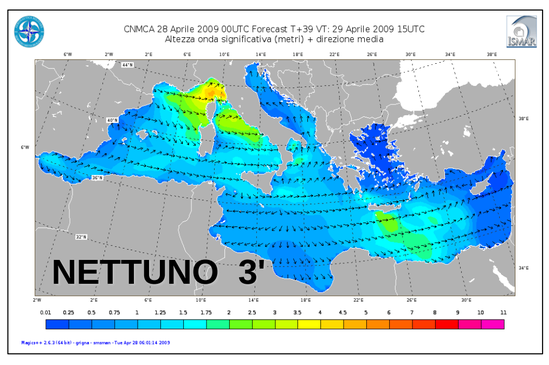
IC

Local Area Modeling



COSMO-ME
- IC from CNMCA-LETKF
- compressible equations
- parameterized convection
integrated up to 72 h

atm forcing



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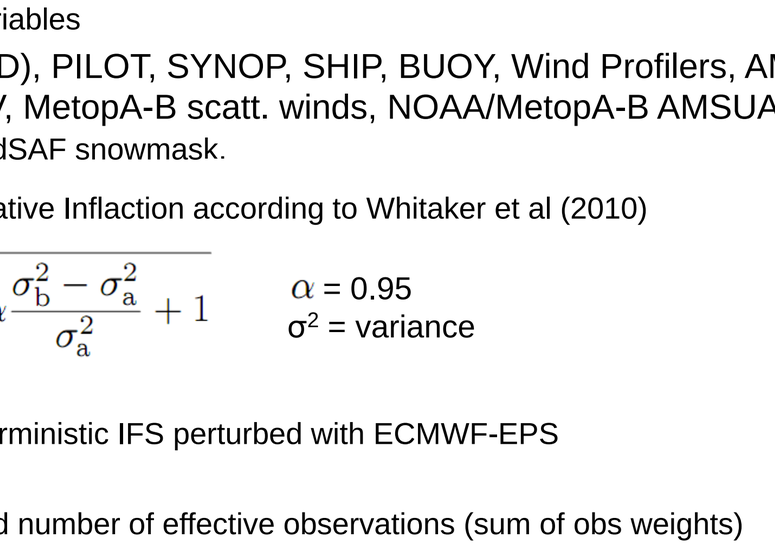
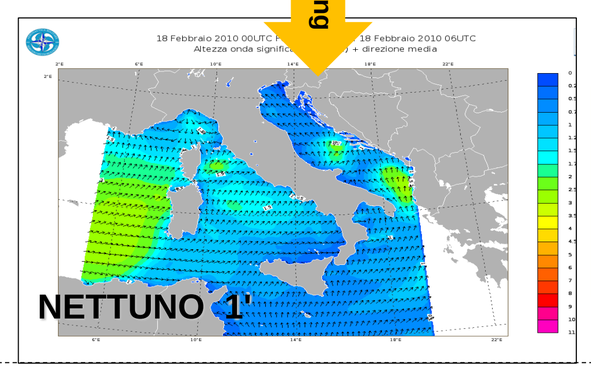
COSMO-IT
- IC through 6h **NUDGING** of obs
- compressible equations
- explicit convection
- integrated up to 30 h



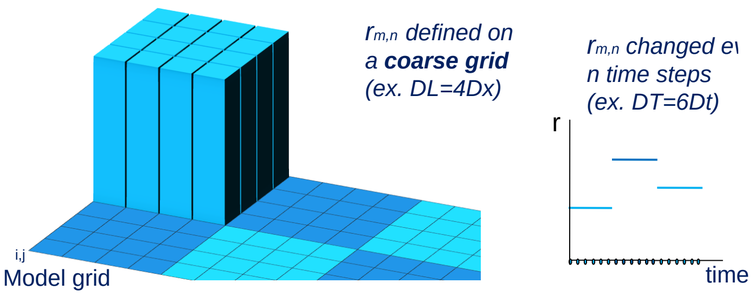
atm forcing



NETTUNO is the high resolution wave forecast system operational over the Mediterranean Sea, based on the **COSMO** and **WAM** models
(In cooperation with ISMAR-CNR of Venice)

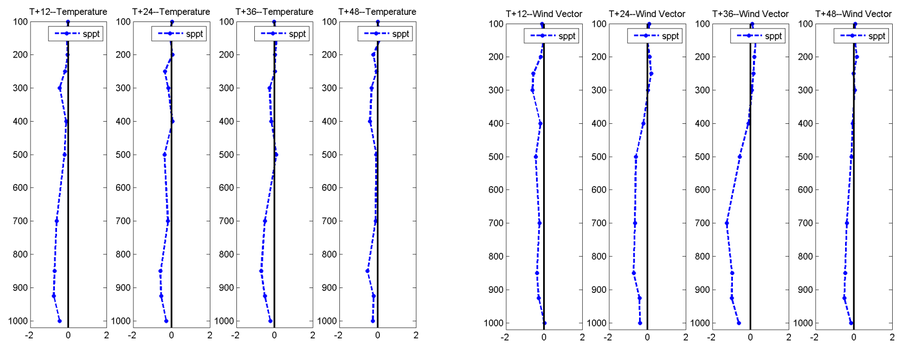
Stochastic Perturbed Physics Tendency (SPPT) in COSMO model

- Model uncertainty could be represented also with a stochastic physics scheme (Buizza et al, 1999; Palmer et al, 2009) implemented in the prognostic model
- This scheme perturbs model physics tendencies by adding perturbations, which are proportional in amplitude to the unperturbed tendencies Xc: **Xp=(1+r μ)Xc**



Same random pattern in the whole column and for u,v,t,qv variables.

Evaluation of the SPPT (used in assimilation cycle) impact on forecast:



Relative difference (%) in RMSE, computed against IFS analysis, with respect to reference run without SPPT for 00 UTC COSMO forecasts from 11-nov 2014 to 10 dec 2014 *(negative value = positive impact)*

CURRENT AND FUTURE DEVELOPMENTS

- Assimilation of GPS ground stations and MODES is under investigation.
- Monitoring of local automatic stations and satellite derived soil moisture (H-SAF)
- Improvementent of radiance vertical localization
- Self-evolving additive inflaction/SPPT
- ASCAT (H-SAF) surface soil moisture data assimilation allowing the influence of the near surface atmospheric fields