Challenges and issues of meso-scale data assimilation for Sochi-2014 Winter Olympics

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Sochi-2014: WWRP FDP/RDP

Decision 3.3.7: . . . The JSC strongly encouraged a WWRP project be developed in association with the Sochi 2014 Games. . . .

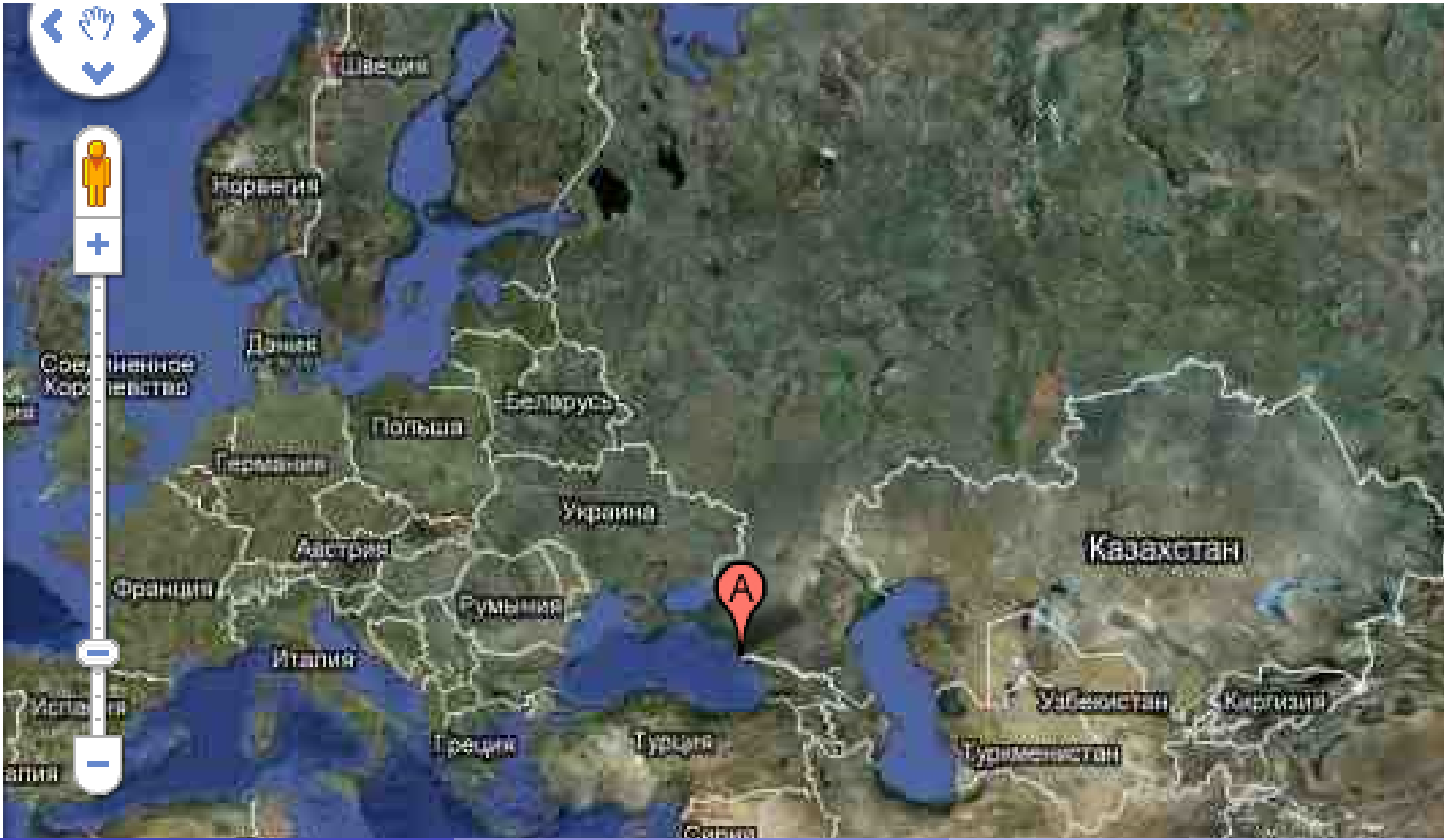
Action: As the project develops the project leaders are encouraged to work with the THORPEX Data Assimilation Working Group and that EUMETNET and EUMETSAT organizations are asked to play a role in this effort.

The kick-off meeting to be held in Sochi, 1-3 March 2011.

Sochi-2014 Winter Olympics

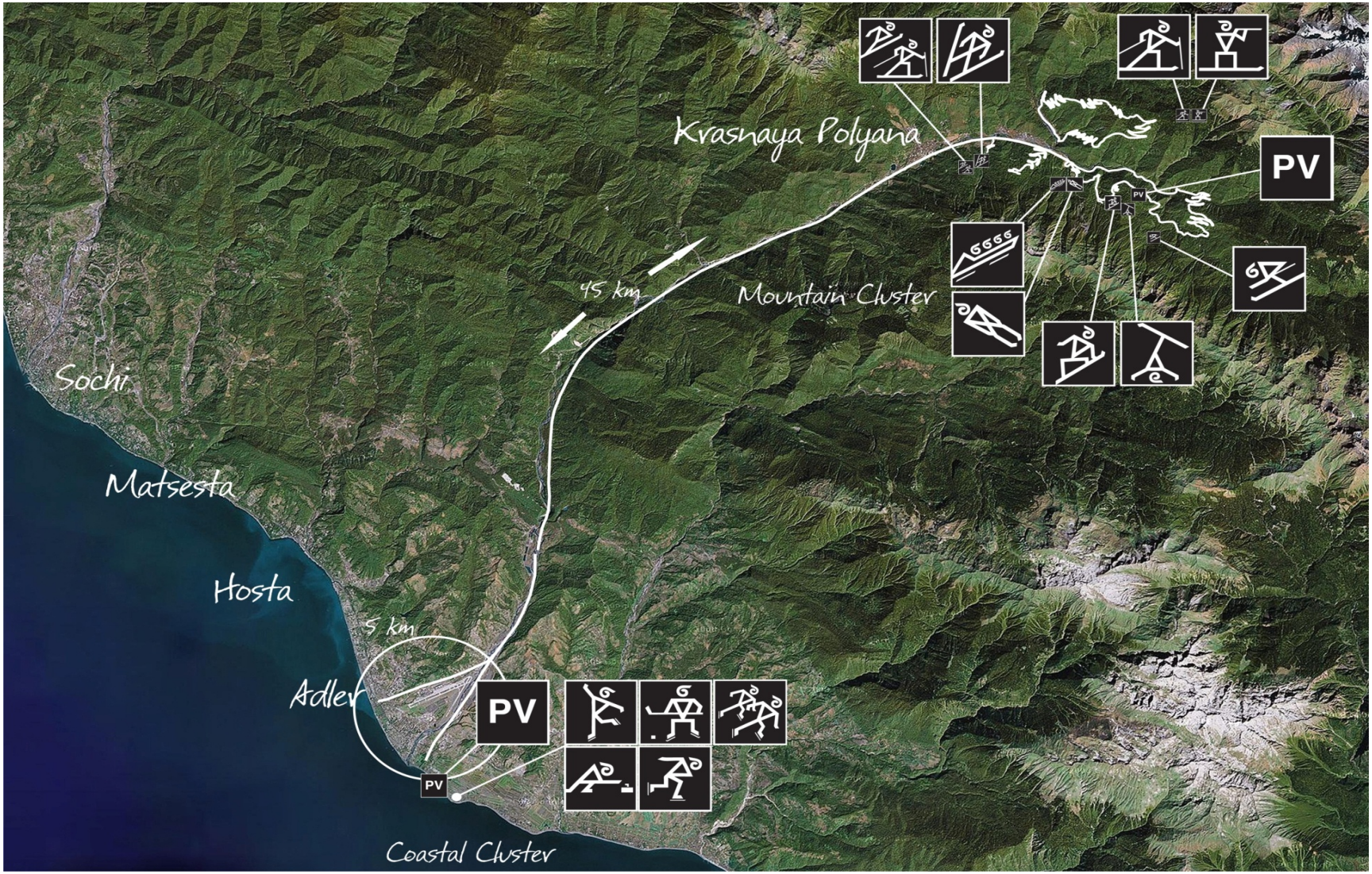
Dates: Feb 8-23.

Place: 44°N, 40°E. On the Black sea coast.



Sochi-2014 Winter Olympics

The mountain cluster: 50 km on-shore, 2 km above the sea level



Data assimilation: strategy

COSMO model will be used for both data assimilation and forecast.

For the COSMO model: currently nudging, LETKF being developed.

In Russia: 3D-VAR to be extended from the global analysis (using stretched geometry).

Ensemble flow-dependent covariances will be used within 3D-Var.

Resolution: 1km planned.

Global 3D-VAR on the basis of 3-D filters

Spatial ARMA (SARMA)

In the most general terms:

$$S\xi = V\alpha$$

Auto-regression in the vertical:

$$\xi_0 = U_0\alpha_0$$

$$\xi_k = \sum_{j=k-q}^{k-1} F_{kj}\xi_j + U_k\alpha_k$$

$$B = WW^T, \qquad W = S^{-1}V$$

The 3D-VAR is designed to work with flow-dependent covariances.

Global observations: in use, tbd in 2010-1012

- *In-situ observations*
- *Satellite observations*
  1. Winds (AMV): Geostationary, Polar winds
  2. Radiances: AMSU-A, AMSU-B, IASI
  3. Radio-occultation: COSMIC, GRAS, GRACE
  4. Scatterometers: ASCAT
  5. Others: Snow (VIIRS?), cloud fields (SSMIS?), soil moisture (SMOS?) ...?
- *Radars*

Local observations

Additional in-situ: little of them (a few mobile radiosonde systems and several tens of automatic ground stations and buoys).

Radars: new Russian radars are expected to be deployed closer to the event, so we are not sure about them. Two Vaisala radars near Sochi.

Wind profilers: a couple of them near Sochi.

Challenges

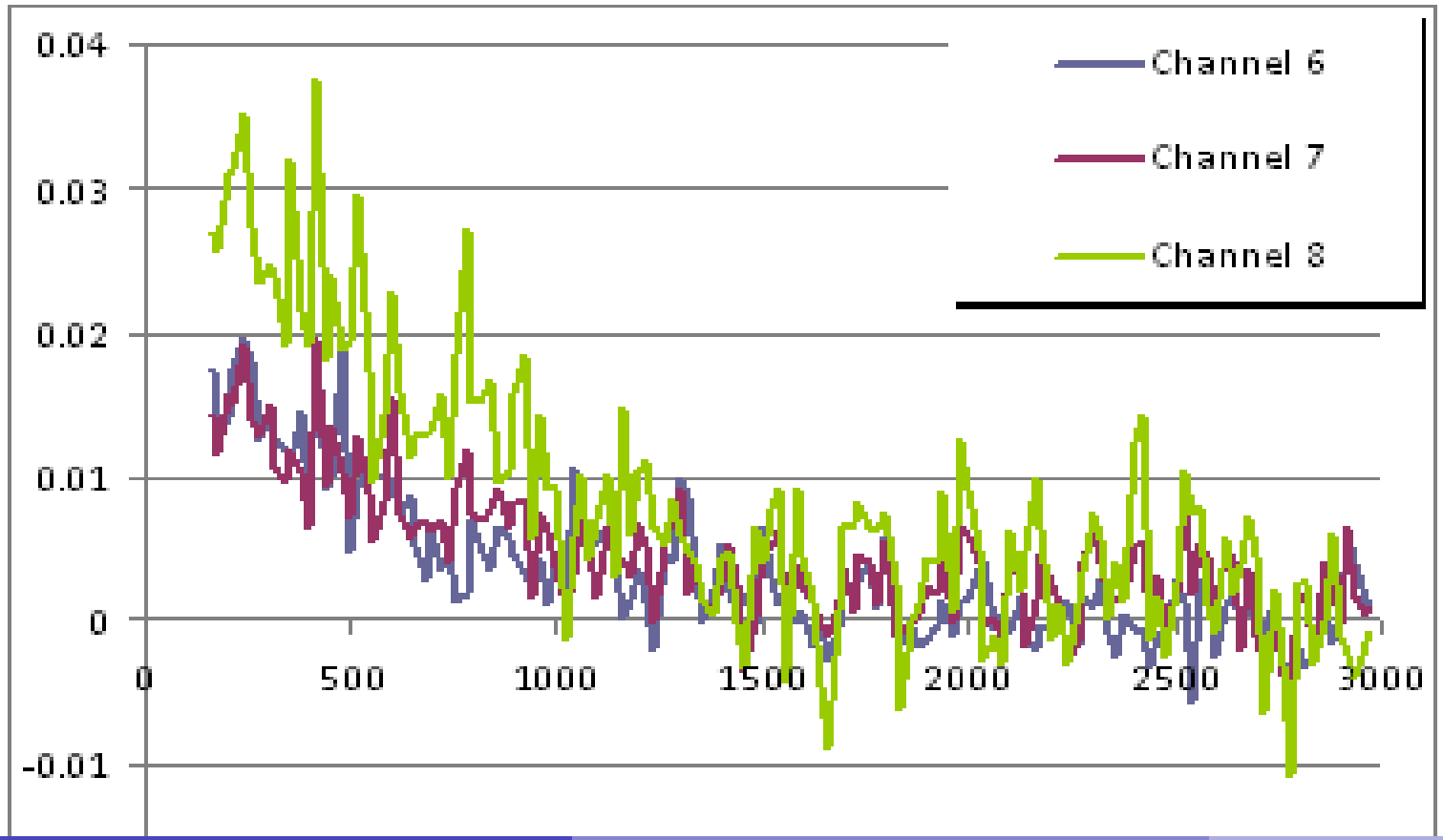
- (1) Can we succeed with a 1-km data assimilation having, virtually, only satellite data?
- (2) For *high-resolution* analysis we need *high-resolution* satellite data. So, thinning satellite data is not appropriate.
  But without thinning, satellite error correlations become important and are to be accounted for in data assimilation:

Satellite error correlations

AMSU-A observations were compared with radiosondes; significant error correlations were found (horizontal, temporal, inter-channel, and cross-correlations with forecast errors)

(Gorin and Tsyrulnikov 2010, MWR, under review).

Horizontal auto-covariances:



Challenges

- (3) Are radars critically needed or satellite observations can be used instead?
- (4) How critical is the addition of an ensemble assimilation component?
- (5) How to properly *modulate* the 3D-Var covariances using the ensemble statistics?

Issues

- Should the meso-scale data assimilation scheme assimilate only meso scales or all scales?
- Which satellite data should be added to the list?
- How frequent should be the analysis updates?

Conclusions

- We have: the Global 3D-Var and global satellite and in-situ data.
- TBD:
  1. A meso 3D-Var on the basis of the global scheme
  2. 3D-Var with obs-err correlations
  3. An ensemble assimilation system based on the 3D-Var with ensemble flow-dependent background-error covariances