Short-range NWP for Direct Normal Irradiance by Utilizing Meteosat Second Generation Data

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Current project DNICast

- FP7-project: Direct Normal Irradiance Nowcasting methods for optimized operation of concentrating solar technologies (October 2013 - September 2017)
- WP3 with objective: Develop and combine a variety of complementary methods for the nowcasting of DNI that cover different parts of the window from 1-360 min.



Motivation: Nowcasting



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Based on extrapolation of observations





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HARMONIE/AROME experiment setup

- Cycle 38h1.1 with 2.5 km horizontal grid resolution and 65 vertical levels. 15-minute output up to fc+9h. Period: April 2013
- Control experiment: 3D-Var, conventional obs., AMSU.
- Experiments with:
 - assimilating SEVIRI radiances
 - Initialize clouds with MSG cloud product
 - 4D-Var

DNICAST HARMONIE South European domain.

Exp: Use of SEVIRI radiances



- SEVIRI Spinning Enhanced Visible and Infra-red Imager on-board Meteosat second generation satellites (MSGs)
- ~3-4 km horizontal resolution over DNICAST domain.
- 12 channels, we use 2 (wv062 and wv073)
- Cloud-mask and cloud-top pressure from NWC SAF product to select clear-sky radiances used.
- Spatial thinning (~25 km) and variational bias correction

Positive impact of SEVIRI on relative humidity

FC-error for rel. humidity 13 stations, fc +12 + 24



Kuiper skill score for Cloud Cover 224 stations, fc +6 +18



Exp: Initialisation with MSG-based cloud product SMH

Based on van der Veen, MWR 2012

 Generate 3-D cloud cover from cloud mask, cloud top temperature and cloud base height based on input from MSG based NWP-SAF products and climatological cloud base heights.

init saturated*CCC 10 saturated 20 after MSG Cloud top temperature (K) Vertical level Cloud mask (0-1 Cloud base height (m) 50 60 2. Based on product from step 1 modify model specific humidity and temperature 65 fields preserving buoyancy and keeping T_v 0.002 0.004 0.006 0.008 Λ 0.01 constant. Specific humidity (kg/kg)

(our gratitude to Sibbo van der Veen at KNMI)



Adjustment in specific humidity



Initialisation with MSG based cloud product







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Verification of DNI forecasts at Almeria station



Location of Almeria station



Almeria solar power plant



bias=ob-fg. Hence too little clouds in control and too much with Cloud init.



4D-Var: Impact on forecast quality



4D-Var in Harmonie-AROME developed by Magnus Lindskog and Jan Barkmeijer (KNMI).

Tangent linear and adjoint code from IFS used for adiabatic flow with Buizza simplified physics and vertical diffusion of temperature in boundary layer.

Promising results. KNMI has seen improved humidity forecasts by assimilating more windobservations (Mode-S EHS)

Thanks to Jan Barkmeijer



Spec humidity, 14 stations, fc +12h +24h



Need for wind observations: ESA-Earth explorer Atmospheric Dynamics Mission Aeolus

- Profiles of line-of-sight wind
- Particle backscatter at 355nm
- Global coverage
- Planned launch: 2017
- Lifetime: 3 years
- Wind retrieval by ECMWF



• Aim: To improve DNI forecasts with NWP by assimilating MSG data.

- Assimilation of SEVIRI radiances has a positive impact on short-range humidity forecast.
- Initialisation with MSG-based cloud product is a promising approach for short-range DNI forecast. But some improvements are needed.
- 4D-Var needs work on the use of simple physics model.

More MSG, winds and improved DA methods for better short-range DNI forecasts.

Thank you! Questions?