On the 2013 Spring Floods at Chicago

Edwin Campos, Jiali Wang, Scott Collis, Jonathan Helmus and Rao Kotamarthi

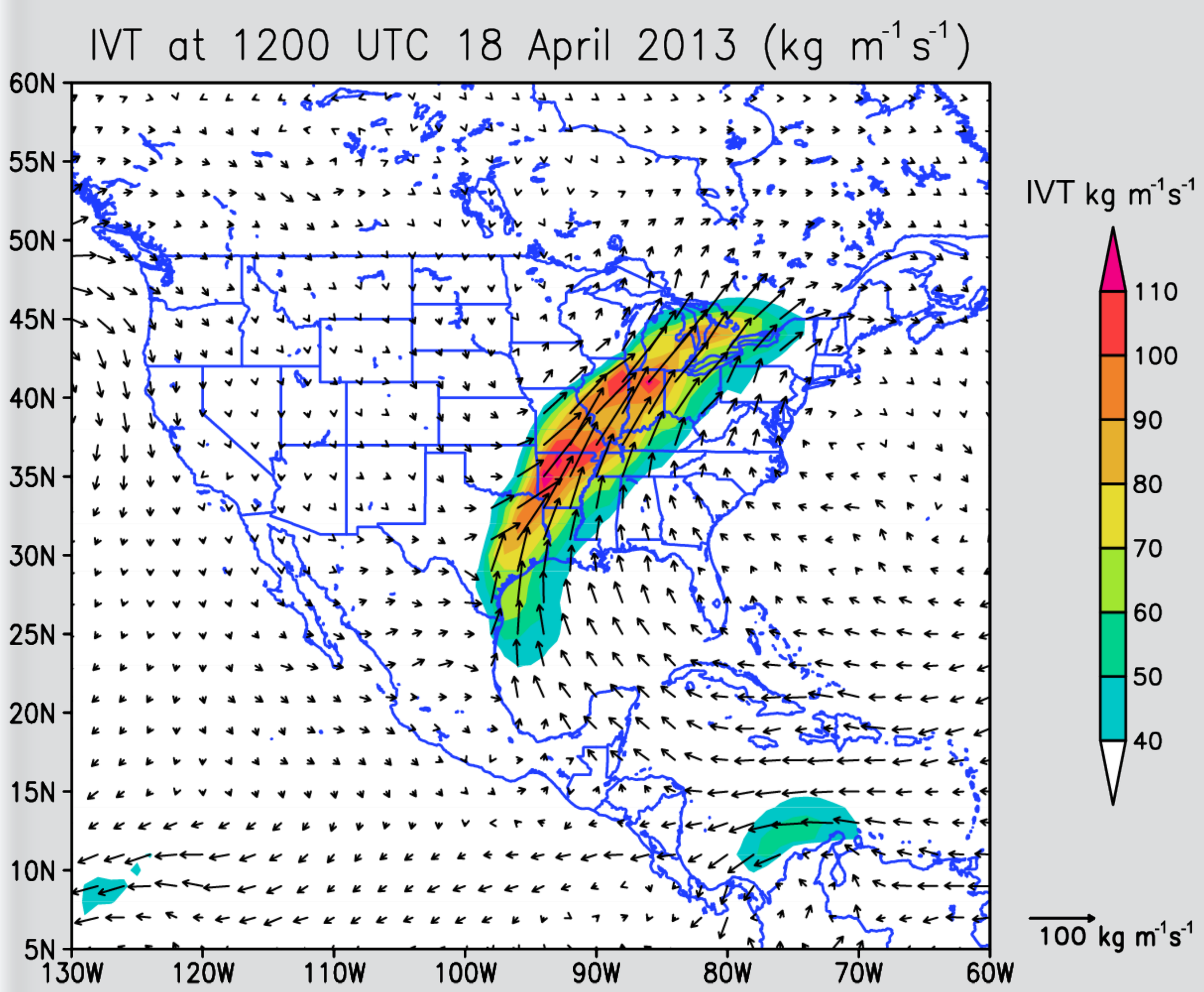
Environmental Science Division, Argonne, IL 60439, USA

The worst floods experienced by Chicago area residents in the last three decades occurred this past spring: On 2013 April 18th, Illinois was declared in a State of Emergency, and by April 21st, forty four of its counties were declared as Disaster Areas.

West branch of DuPage river raised 4.5 m (photos of Riverwalk and City Hall at Naperville)

The weather event set new monthly rainfall accumulation records for April at Argonne and O'Hare International Airport. In terms of water damage, the Wall Street Journal ranked this among the 5 worst floods in Chicago history.

Synoptic scale analysis: The specific humidity, the zonal and meridional wind fields were retrieved from NCEP Final reanalysis (FNL) at a 1.0 degree horizontal resolution on 1200 UTC 18 April, 2013. The vertically integrated horizontal water vapor transport (hereafter, integrated vapor transport, IVT) is calculated from 1000 hPa to 300 hPa, which provides a detailed depiction of an atmospheric river associated to the flood event.

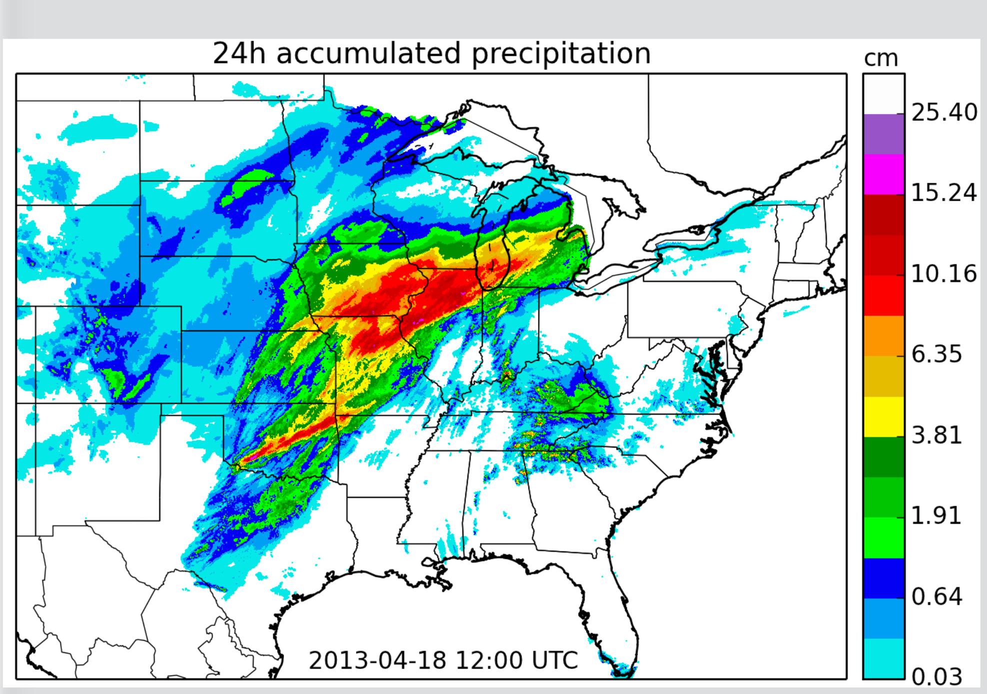


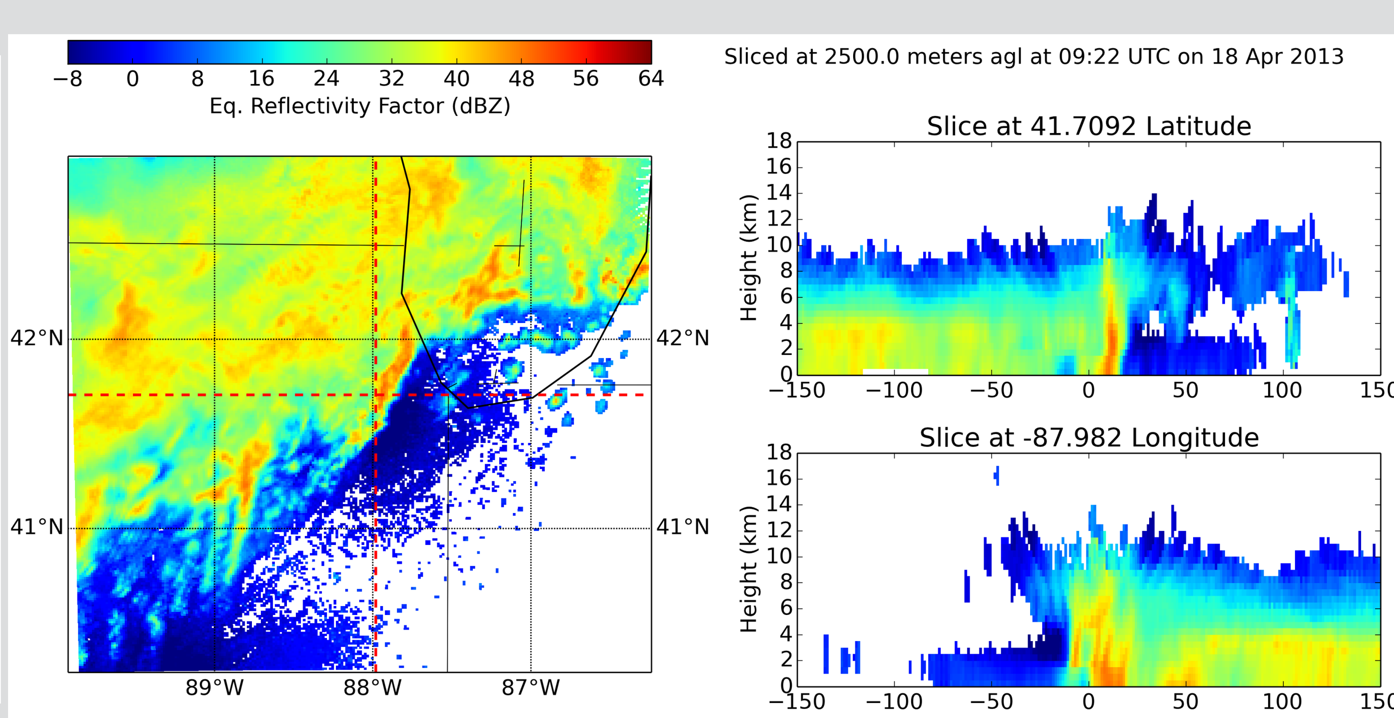
An atmospheric river: The vertically integrated horizontal water vapor transport (hereafter, integrated vapor transport, IVT) is calculated from 1000 hPa to 300 hPa levels (Lavers et al. 2013 GRL):

$$\mathrm{IVT} = \sqrt{\left(\frac{1}{g}\int_{1000}^{300} qu\,dp\right)^2 + \left(\frac{1}{g}\int_{1000}^{300} qv\,dp\right)^2} \qquad (1)$$

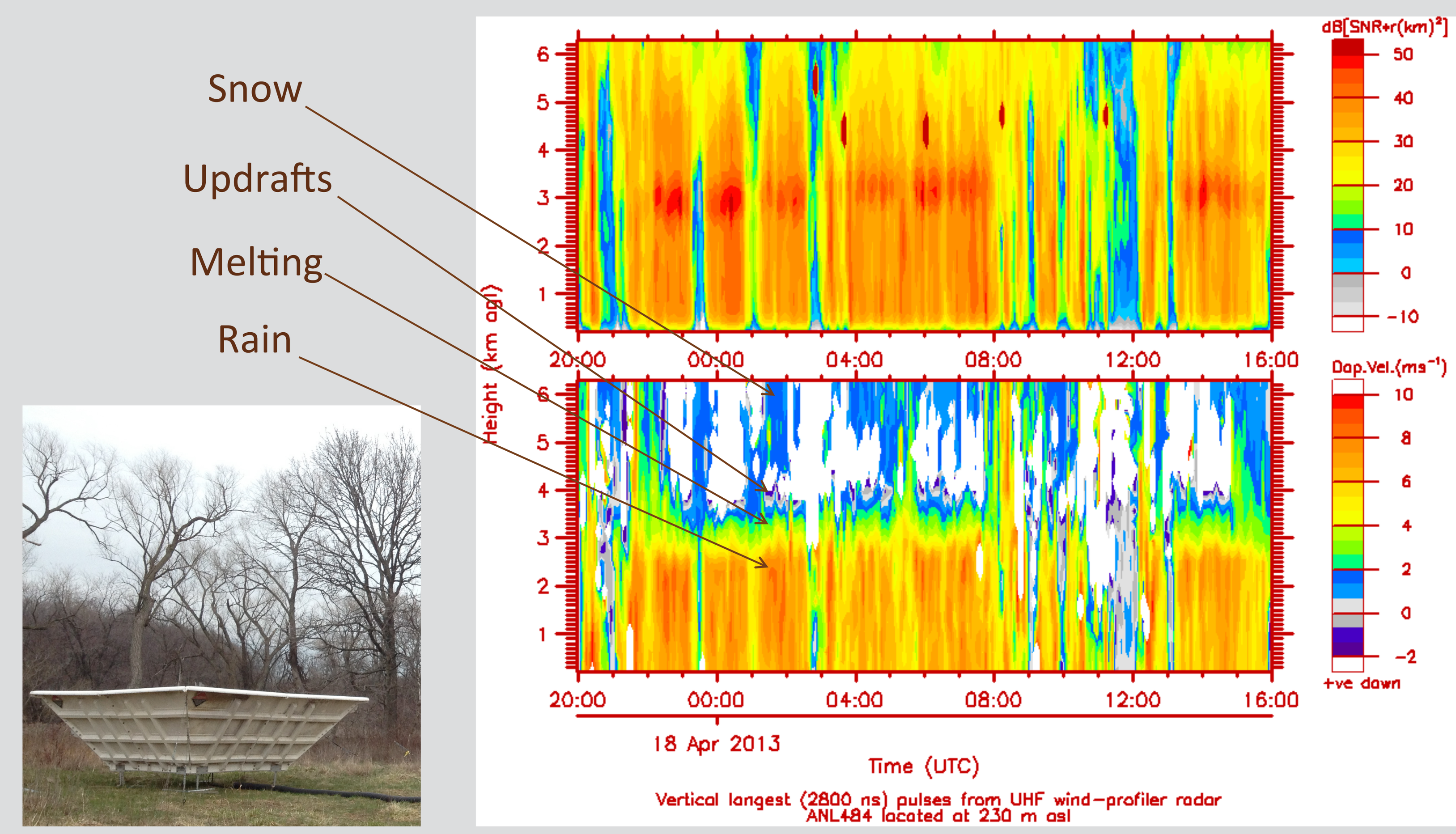
where q is the layer-averaged specific humidity in kg/kg, u and v are the layer-averaged zonal and meridional winds in ms^{-1} respectively, g is the acceleration due to gravity, and dp is the pressure difference between two adjacent pressure levels.

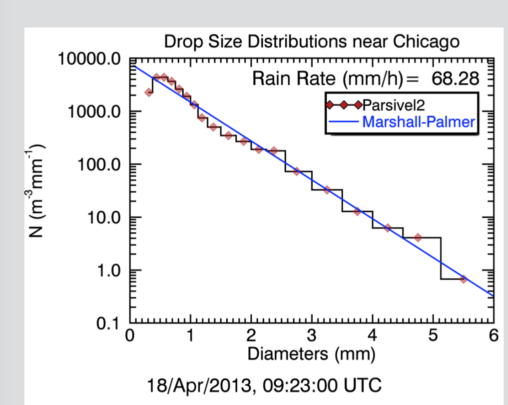
Mesoscale analysis: Left panel shows 24hr cumulative rainfall amount from 17 April 1200 UTC to 18 April 1200 UTC, according to NOAA multisensor product (water.weather.gov). Center panel shows equivalent radar reflectivity factors (in dBZ, for color scale at the top) mapped at 1-km height above the ground, derived from observations by four NEXRAD WSR-88D radars (KLOT, KILX, KDVN, KMKX). The red dashed cross is centered at Argonne. Right panels plot constant-latitude (top) and constant-longitude (bottom) slides centered at Argonne. Here, equivalent radar reflectivity factors (on the same color scale as in the left panel) are mapped as a function of height (in kilometers above the ground) and horizontal distance (in kilometers from the Argonne Weather Observatory).

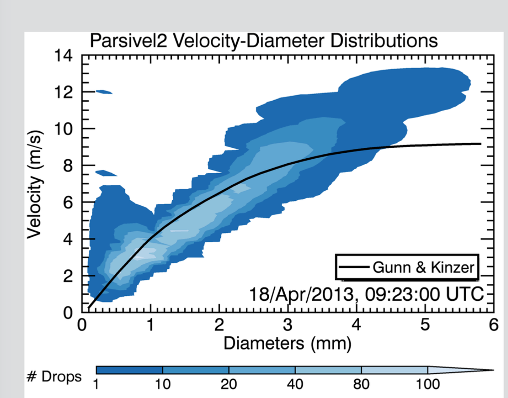




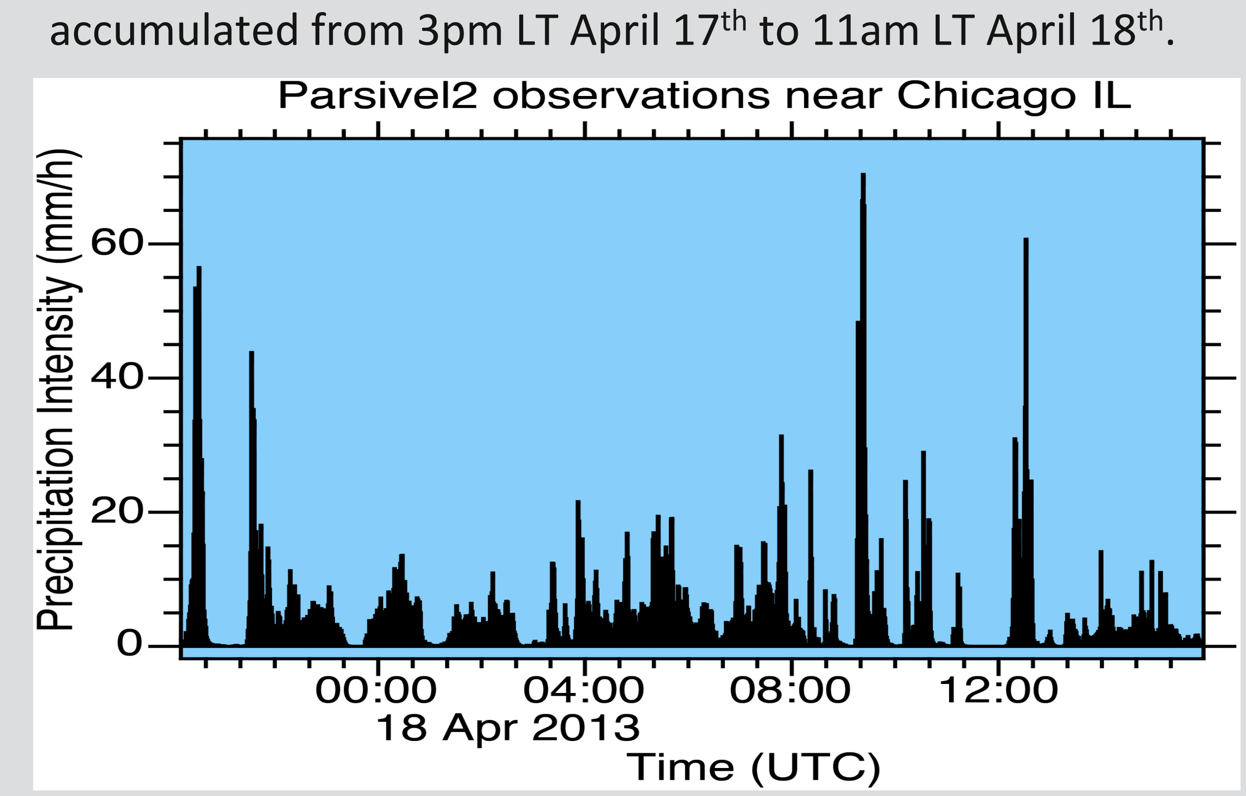
Microphysical analysis: We examined precipitation data collected at Argonne. The monitoring equipment available includes a 915-MHz profiler radar, co-located with a 24-GHz vertically-pointing radar (Micro-Rain-Radar2), a Parsivel2 disdrometer, conventional weather sensors on a 60m tower, and conventional raingauges at the ground. Some examples follow.







Argonne's Parsivel2 registered 91.8 mm (3.6 inches) accumulated from 3pm LT April 17th to 11am LT April 18th.



Summary: The integration of Argonne's radar and simulation platforms near a large city (Chicago) during a high impact weather event is quite remarkable, and it opens new doors for developing useful precipitation and hydrologic applications in the urban context.

Contact the authors:
Argonne Weather Observatory
http://weather.anl.gov
ecampos@anl.gov

U.S. DEPARTMENT OF ENERGY