

1) Title Slide...note that this method was developed for people with interest in oceanic phenomena

2) Which satellites are used? What are the guidelines that governed the development of this technique?

Map together the high-resolution imagery possible in individual polar swaths. Shift data in time by model winds so you can get global resolution

Why? Analyze environments in tropical oceans to gauge tropical cyclone possibilities. Coastal forecasts for downwind of oceans -- know when moisture is arriving. Knowledge of 'atmospheric rivers.'

3) Outline of Talk

4) TPW values are quasi-conservative in the atmosphere -- values do not change quickly.

Microwave data are used to map TPW -- 22 GHz is at the peak of a water absorption band; 19.35 GHz is off the peak. Subtract the two: that difference is a function of TPW

Caveats: MW emissions/reflections over ice will cause errors...don't use MIMIC TPW if there is ice (it's usually screened out anyway)... excessive cloud water leads to noisier and more biased observations: but in those areas, impact of liquid/solid water on the thermodynamic environment makes any water vapor measurement less useful -- because you know the environment is very very wet.

5) Swath advection -- to shift the observations in time -- requires a global model, and the GFS is the one used. Low-level winds are used because almost all moisture in the atmosphere is near the surface. So the observations are moved by weighted winds -- 1000, 850 and 700 mb. Weights for the levels are constant Equatorward of 25 and Poleward of 50. Between 25 and 50 degrees Latitude, the weights smoothly move from the two sets of values.

6) This is an example of a polar swath from DMSP-16, moving forward in time

7) This is an example of the same polar swath moving backwards in time.

8) Describe how the different swaths are blended. Each polar swath is moved forward and backward in time. You have swaths from different

satellites that are the most recent observation at each point. Construct maps using data from the past stepping forward in time, and from the future stepping backwards in time. You know the delta-t at each point. To get one image, combine the forward and backward maps by time-weighting the two maps. All data expires after 16 h.

- 9) Time gaps between observations do occur. Think of how polar orbiters move around the Earth -- you have far better coverage at the Poles, where swaths overlap, than at the Equator where you might have gaps. However, with 4 satellites, every point on Earth is sampled at least once every 16 hours, and they are sampled much more frequently near the Poles.
- 10) How are data validated? Take two separate swaths, from different satellites at different times, and move them with model winds so a region overlaps. Compare the TPW values in those regions.
- 11) This method yields many many independent observations for one case -- 3 weeks during June of 2009. The mean error is a function of advected time as shown on frame 2, and for most cases is below 2 mm. Bottom line: error is small and manageable -- it's also of the same order of magnitude of the observation errors in the microwave TPW estimates.
- 12) This shows error magnitude as a function of advection time. For example, for data that are advected 3 hours by the models, 99% of the error is less than 5+mm. Advection time is almost always 7 hours or less, so the large values on the right hand side of this image are exceedingly rare. Again, these are errors introduced by this method and are separate from the 1 or 2 mm bias in TPW retrieval from microwave data. Some of the larger absolute errors are telling you about features that are generating TPW. In other words, times when TPW is not quasi-conservative, but it's being actively generated (by convection, for example).
- 13) Note that the loop you see is being updated continuously. At the latest time, there is little (no) data that arises from swaths being advected backwards in time; all the data are advected forward in time by GFS model winds. Consider the last 6 hours of a real-time loop to be preliminary. Still accurate, but it will contain outliers. As

more and more data arrives, the outliers are reduced in importance.
Note also that there can be a delay -- up to 4 or 6 hours -- for some polar scans to arrive and be processed into the product.

- 14) Some examples
- 15) Loop from AWIPS from early November 2010. Note the atmospheric rivers are present from central Atlantic towards Europe and north of Hawaii towards the Pacific NW.
- 16) MIMIC TPW is available on the web as well, with various regions highlighted.
- 17) Use for situational awareness: Look at the moisture-rich plume of air emanating out of the tropical Pacific and flowing due north into south Central US. Result: tremendous flooding in Nashville TN!
- 18) MIMIC compares well with other moisture variables -- the blended TPW product (which also uses MW data over the ocean), the GOES Sounder, and somewhat with water vapor. Keep in mind that the TPW might be at levels below those sensed by the water vapor. In other words, the atmosphere might be very very moist in low levels, but the water vapor signal might be peaking above the moist low levels.
- 19) MIMIC has advantages over other observation methodologies when you are doing a standard loop.
- 20) Specifically, for a timed loop, the staggered time from the Blended TPW can mean that there are individual hours with no observations (further, the TPW product time for each individual pixel is not clear). And there are issues with cloudiness with the GOES sounder product, or with Keep-Out Zones/eclipse times with GOES Imager WV.
- 21) But MIMIC TPW and Blended products usually tell similar stories. The MIMIC TPW does not give data over land. You can find more information about the blended product on-line, and there is a website at CIRA that has different global sectors. The NESDIS website at OSDPD also has blended TPW imagery (just do a google search on 'blended TPW product' -- it's the first match).

- 22) Training is available on the blended product as well through both SHyMet and VISIT.
- 23) Advantages of MIMIC TPW -- treat them as observations. They aren't smoothed, global observations over the ocean, available at hourly resolution. Every 12 hours, around 1200 UTC and 0000 UTC, there is a break as fields are re-processed. So at those times, fields can be up to 4 hours old in AWIPS.
- 24) Biggest strength of this product (or of blended product): Situational awareness. Where are the regions of excess moisture, and how are they moving? Links between tropical moisture and midlatitudes are glaringly obvious.
- 25) How do you get MIMIC into AWIPS? Follow the instructions at this website.